

Geography curriculum revision and new major proposal:
Breakdown of distribution of quarter credit hours by major and specialization

Major and specialization	Core (all majors)	Core (specialization)	Major electives	Total major	Non-Geog prereq	Total major + prereq	GEC	GEC double counts	Free electives	Total
Geography BA										
Urban, Regional, and Global Studies Specialization	NA	15	40	55	0	55	90	0	36	181
Environment and Society Specialization	NA	10	40	50	0	50	90	0	41	181
Geography BS										
Spatial Analysis Specialization	NA	30	18-20	48-50	9	57-59	90	0	32-34	181
Climate and Physical Geography Specialization: Climatic Studies Path	NA	28	25	53	30	83	90	25	33	181
Climate and Physical Geography Specialization: Physical Geography Path	NA	30	23-25	53-55	20	73-75	90	15	31-33	181
Atmospheric Sciences BS	43	NA	8-10	51-53	50	101-103	90	35	23-25	181
Geographic Information Sciences BS	45	NA	6-10	51-55	9	60-64	90	0	27-31	181

Notes

1. The actual GEC is 80-100 hours because of the language requirement variation of 0 to 20 hours. The 90 hours used in the table assumes a typical student would be taking 10 hours of foreign language.
2. GEC double counts: Because of requirements in math, physics, and chemistry, the Climate and Physical Geography (CPG) specialization and the Atmospheric Sciences BS offer significant double counts between the required prerequisites and the GEC, in the areas of Quantitative and Logical Skills, Natural Science Breadth, and Additional Breadth.



Arts and Sciences

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June 19, 2009

W. Randy Smith, Vice Provost
Office of Academic Affairs
203 Bricker Hall, 190 N. Oval Mall
CAMPUS

Dear Randy:

On May 29, 2009, the Arts and Sciences Committee on Curriculum and Instruction (CCI) unanimously approved a series of significant changes to the Geography undergraduate curriculum which includes:

1. Revisions to the structure and names of 4 existing tracks within the current Geography major

- Revision to the BS in Analytical Cartography and Geographical Information Systems
 - proposed new name: *Spatial Analysis*
- Revision to the BS in Atmospheric and Climatic Studies
 - proposed new name: *Climatology and Physical Geography*
- Revision to the BA in Urban and Regional Studies
 - proposed new name: *Urban, Regional and Global Studies*
- Revision to the BA in People, Society and Environment
 - proposed new name: *Environment and Society*

2. Establishment of two new Bachelor of Science Majors

- New BS in *Geographic Information Science*
- New BS in *Atmospheric Sciences*

Please see the accompanying cover letter from Associate Dean Gene Mumy (p 2-7) which provides a detailed summary of the proposal including credit hour changes. The transmittal history provided includes detailed minutes from meetings of the SBS College Curriculum Committee, the CCI Sciences Subcommittee, and the A&S CCI over the past year which may also prove helpful in vetting this proposal at the CAA level (p 114-130). The numerous syllabi and course requests associated with these proposals are in the ECA system pending the approval of the program proposals by CAA. Below is a list of the course requests in ECA associated with this proposal.

The crucial issue of concurrence from the School of Earth Science was resolved before the proposal was approved by CCI. This packet includes original documentation of key correspondence between Earth Science and Geography (p 131-135) in order to provide background information to the committee. The final official concurrence from Earth Science is included on page 113. A related issue that arose at the CCI discussion concerned the status of the Major in Mapping and Land Information Systems, housed in the School of Earth Sciences, which currently has no majors. On May 29, representatives from Geography indicated that they would have no objections to Earth Sciences reviving this major in principle and would want to work with them to ensure that the major is distinctive from any Geography majors or tracks.

Please let me know if I can be of further assistance as CAA considers this proposal.

Sincerely,

Kathleen M. Hallihan
Director, Curriculum and Assessment

c: Randy Smith
Melissa Soave
Terry Gustafson

New courses:

Geog 205
Geog 420
Geog 455
Geog 470
Geog 480
Geog 505
Geog 600
Geog 684
Geog 688
Atmospheric Sci 689
Atmospheric Sci 699
Atmospheric Sci H783

Course changes:

Geog 200
Geog 240
Geog 400
Geog 430
Geog 445
Geog 460
Geog 490
Geog 510
Geog 605
Geog 630
Geog 640
Geog 642
Geog 650
Geog 652
Geog 655
Geog 680
Geog 683
Geog 686
Geog 687
Geog 695
Atmospheric Sci 637

Geography Major Revision Summary for CCI

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- 6) BS/BA- Geography Tracks Proposal
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Summary of Motions for CCI to act upon

1. New Bachelor of Science in Geographic Information Science
 2. New Bachelor of Science in Atmospheric Sciences
- Geography Major- 4 revised tracks*
3. Revised Bachelor of Science in Spatial Analysis
 4. Revised Bachelor of Science in Climatology and Physical Geography
 5. Revised Bachelor of Arts in Urban, Regional, and Global Studies
- Revised Bachelor of Arts in Environment and Society:*
6. Approval of curricular changes
 7. Approval of track name change

May 22, 2009

From January 26, 2009 to April 7, 2009 the CCI Sciences Subcommittee spent a considerable amount of time evaluating a package of proposals to alter specializations in the Geography major and establish two new majors in the areas of Atmospheric Sciences and Geographical Information Science. The current Geography major requires students to complete at least one of four specialization areas. The proposed revisions to the Geography major include name changes for all of the specializations and at least some changes to the content of all of the specializations. The proposed revisions to two of the specializations are linked to the creation of the two new majors. Issues concerning the specializations will be considered first and then those concerning the new majors.

I. Urban and Regional Studies (a BA specialization)

A. Change Name to Urban, Regional, and Global Studies

Rationale is that the new name better reflects the levels of scale and integration required for appropriate analysis. The addition of global also reflects faculty research and teaching strengths, which is reflected in course content and design.

B. Repackage requirements and add new courses.

The repackaging presents a more coherent path through the specialization and aligns requirements and electives with current pedagogical practice in the discipline. A new Human Geography course (205) provides a basic foundation; a new capstone course, Geographic Inquiry (600), gives historical perspective to the specialization; and a Research and Professionalization Seminar (695) develops applications of specialization content. The three new courses add 15 credit hours to the Specialization, which is partially offset by eliminating a methods requirement and a physical Geography course.

The revised specialization has 55 credit hours, which is 5 more than in the current specialization

II. People, Society, and Environment (a BA specialization)

A. Change name to Environment and Society.

Rationale is that Environment-Society Relations has been a core area of Geography since its inception as a discipline, and the new name better identifies this content to students than the somewhat cumbersome current name. The proposed new name has also become a disciplinary norm.

- B. Restructure the required areas in the specialization and replace some current courses with geography courses that have been developed recently.

Because of the specific expertise of new faculty and changing faculty interests in general, there are now many courses in Geography that can usefully be separated into Physical Geography (the environment side) and Human Geography (the society side) and packaged as such to provide a particularly geographical perspective on Environment and Society. Therefore it seems useful to package courses into these two areas along with a Methods requirement.

There is some concern about eliminating all non-geography courses in the specialization. However, analysis of outside-geography enrollments of students in the specialization since its inception in 2002 has been very small. The most taken outside course has been EEOB 413.01, which has averaged three of these students a year (see appendix L).

Because of variation in course credit hours **the current specialization requires 50-60 credit hours and the proposed revised specialization standardizes credit hours at 55.**

Revisions to the two BS specializations in the Geography major are linked to proposals to create two new majors in Atmospheric Sciences (AS) and Geographical Information Science (GIS). Some of the content of the new majors will be withdrawn from or altered in the setup of the Geography specializations.

III. Analytical Cartography and Geographical Information Systems (BS specialization)

A. Becomes Spatial Analysis

The revised specialization is meant to provide a general geography education along with technical expertise in spatial analysis. The revised specialization should be attractive to students thinking of pursuing graduate education in Geography and related fields, or professional careers requiring the use and planning for spatial data. By way of contrast, GIS is focused on technical expertise in spatial data management, analysis, and visualization. The specialization name reflects its distinctness from GIS.

B. Curriculum Revision

The proposed curriculum revision gets rid of the rigid GIS and Analytical Cartography sub specializations but keeps some content of both content in its own core and much more of both as possible electives. So while gaining some core knowledge, the revised curriculum is much more flexible in allowing a student choice in particular additions to technical expertise and applications. This additional flexibility is also a feature of the proposed new major in GIS, which raised one issue.

Under the proposed curricula for the two majors, it would be possible to satisfy the requirements of both with only a one course difference, raising the question of how are the two degrees distinct. Geography's position is that this possibility arises only because

of a desire not to limit areas of additional expertise or application in either degree, but most emphasis in Spatial Analysis electives would differ from emphasized areas in GIS electives because of what students in each are trying to achieve. So, it would be very rare for course work in the two majors to vary by only one course. The subcommittee found this explanation to be convincing.

Credit Hours increase from 44/45 to 50

If approved, implementation of the revision is contingent on approval of the proposed GIS major (see below)

IV. Atmospheric and Climatic Studies

A. Becomes Climatology and Physical Geography

This name reflects now mainstream recognition of the interconnection between the Earth's surface and the atmosphere and provides the connection between climatology and physical geography. Deeper analysis of atmospheric phenomena is moved to the proposed AS major. Coupling existing strengths in climatology with physical geography also provides a coherent platform for undergraduate teaching by new faculty with specialties in or related to physical geography, e.g. in biogeography and hydrology.

B. Curriculum Revision

The specialization is designed to provide *general geographic education* alongside *technical expertise in climate and physical geography*. Students in this specialization will be introduced to a broader array of methods and applications courses from which they will be able to select. Further, a specialization with emphasis on broad physical geography education is more common in the discipline than the current specialization, which focuses almost exclusively on atmospheric sciences.

The new curriculum includes two different paths, in Climatic Studies (CS) and in Physical Geography (PG). These paths reflect both student demand and current faculty expertise. Each path has math, physics, and statistics prerequisites (30 hours for CS, 20 for PG), distinctive core requirements (28–30 for both paths), and electives (25 hours for both paths), which allow considerable exploration into the other path.

Prerequisite credit hours for CS have increased by 5. Compared to the current CS path, core requirement and elective credit hours in both revised paths have increase from 43 to 53-55.

If approved, implementation of the revision is contingent on approval of the proposed AS major (see below)

OVERALL APPRAISAL OF GEOGRAPHY MAJOR REVISION

The Sciences Subcommittee recognized that a tremendous amount of thought and work went into the revisions. Some relatively minor changes were made during the process and the committee was more than satisfied with the content of the specialization changes. With the exception of the proposed change to Environment and Society, the name changes were uncontroversial. The proposal also contained an appropriate description of learning outcomes and assessment plan. As a result, the proposed names and curricular content of the following specializations were each **Unanimously Approved**:

Urban, Regional, and Global Studies
Spatial Analysis
Climatology and Physical Geography

Because of some unresolved concerns of Earth Sciences about the name of the Environment and Society specialization (now resolved), the subcommittee voted separately on the curricular content of the revision and the name change.

Curricular revision -- **Unanimously Approved**
Name change -- **Unanimously Approved**

At this point the name change and curricular content of this specialization can be treated as a single item.

THE PROPOSED NEW MAJORS

The proposals to create BS majors in GIS and AS have already been on in relation to revisions of the Geography major specializations in which they now exist. Coherent programs in these two areas are being lifted out of the current specializations in order to allow stand-alone development and to create distinctive and clearly identifiable majors in these areas.

I. The proposed GIS major (BS)

A. Rationale

1. There is extensive and growing demand for GIS skills (managing, analyzing, and communicating geospatial information) and the highly-ranked Geography Department has world class expertise in the area.
2. A common set of expertise and skills for being a GIS professional is crystallizing and it requires more breadth and depth than is easily achieved as a track in a geography major.
3. Students looking for essentially a professional degree generating these skills and expertise have difficulty identifying programs that produce them. The new degree

will identify the existence of exactly this kind of program in a highly ranked geography department.

4. Employers looking for people with GIS training can clearly identify a GIS major in a transcript.

B. Proposed Curriculum.

The proposed curriculum is grounded in the GIS path of the current Analytical Cartography and GIS specialization. The required prerequisites are essentially unchanged (10 hours) but additional breadth and depth (more sharply focused) are apparent in the proposed core requirements and electives. The proposed core contains two more courses (for 45 hours) than the current core: this is accomplished by moving the choice of one of two CSE courses to a more focused electives list, while adding two newly developed courses and requiring both of what is currently a choice of one out of two courses. The number of electives does not change (2 courses) but the choice set in the proposal is a list of specific courses as opposed to, e.g., the current requirement that one elective be any human geography course at the 600 level.

Credit hours in the proposed major are 53-55, as compared to 43-45 in the current specialization path (there are 10 credit hours of prerequisites in both).

C. Assessment plan.

There are well specified goals for the major and an appropriate assessment plan based on the assessment plan for the Geography major.

OVERALL APPRAISAL

The subcommittee found the rationale to be compelling and the proposed curriculum appropriate to the rationale and **Unanimously Approved** the proposed GIS major

II. The proposed AS major (BS)

A. Rationale

1. The Geography Department is the home of strong Ph.D. program is AS with the required faculty expertise and facilities to offer full menu of degrees in AS
2. Although no university in Ohio currently offers a BS degree in AS, several peer institutions with strong Ph.D. programs do.
3. Undergraduate students have indicated a desire to have a major that accurately identifies their interests.

4. The distinct major designation helps employers identify qualified job candidates.
5. A stand-alone AS major is easier to tailor to the standards of the American Meteorological Society's Policy Statement on *Bachelor's Degree in Atmospheric Science*.

B. Proposed Curriculum

As compared to the current AS specialization path, the proposed major adds 10 additional hours of science preparation with an additional physics course and a general chemistry course, bringing total prerequisite credit hours to 50, 35 of which can overlap with the BS GEC. The proposed core requirements are identical to the current AS path core requirements (43 hours). The current AS path has no electives requirement but the proposed major gives some flexibility in acquiring additional depth or application breadth by requiring two elective courses from a limited list. The proposed curriculum seems to provide substantial math and science preparation for a focused set of major courses, which clearly satisfies professional standards for an AS Bachelor's degree.

C. Assessment plan.

There are well specified goals for the major and an appropriate assessment plan based on the assessment plan for the Geography major.

OVERALL APPRAISAL

The subcommittee found the rationale to be compelling and the proposed curriculum appropriate to the rationale and **Unanimously Approved** the proposed AS major

Respectfully Submitted,

Gene E. Mumy
Chair (at the time of approval)
CCI Sciences Subcommittee



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30 September 2008

Dr. Kate Hallihan
ASC Curriculum and Assessment Office
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Dear Kate,

The Department of Geography recently undertook a comprehensive evaluation of our entire undergraduate curriculum. Drawing on outcomes of our assessment activities, discussions during faculty meetings, and work by ad-hoc faculty committees, the Undergraduate Studies Committee has put together a proposal to overhaul the existing Geography major. Additionally, we are proposing two new majors to be housed within the department: Geographic Information Science and Atmospheric Sciences. We designed these majors following standards of excellence provided by academic and industry bodies in these fields.

Our proposal is designed with three central goals in mind. The first is to update our curriculum in light of changes in the discipline and in the composition of our faculty. Secondly, the revised curriculum will better prepare our students while providing them more flexibility. Third, these revisions will attract new students to the department, college, and University.

The proposal is packaged as five separate documents:

1. A set of proposals for five new courses, including one GEC course.
2. A set of course change requests for 23 courses.
3. A proposal to revise the existing Geography major. This proposal maintains the four specializations within the major (two of which lead to a BA, and two to a BS). We propose substantial revisions to the curriculum for each of the four specializations, each of which is structured very differently.
4. A proposal for a new Bachelor of Science in Geographic Information Science

5. A proposal for a new Bachelor of Science in Atmospheric Sciences

We look forward to working with the Curriculum Office this year to improve these proposals and see them through the approval process. We are confident that the proposals will lead to a much stronger and more attractive Department of Geography at Ohio State.

Sincerely,
Becky Mansfield
Chair, Undergraduate Studies
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247-7264

Proposal: Bachelor of Science in Geographic Information Science

I. GENERAL INFORMATION

1. Give the name of the proposed major.

Geographic Information Science

2. State what degree students competing the major will receive.

Bachelor of Science in Geographic Information Science

3. State the proposed implementation date.

Autumn 2009

4. Identify the academic units (e.g. department, college, etc.) responsible for administrating the major program.

Department of Geography, College of Social and Behavioral Sciences, Colleges of the Arts and Sciences

II. RATIONALE

5. Describe the rational/purpose of the major.

Maps have long served as a means for presenting location-based information. However, since the advent of computerized geographic information systems (GIS) in the 1960s, as well as the subsequent development of software and computing power, maps have become a much more widespread means for managing, analyzing, and communicating geospatial information.

The extensive demand for GIS skills has entailed a significant role for Geography. Indeed, although GIS is a multi-disciplinary endeavor, geographers have produced the bulk of what now comprise the core knowledge areas of the field. The Geography department at Ohio State in particular has been at the forefront of developments in GIS over the past 40 years. The department is ranked in the top 5 departments nationally, and is recognized globally as a leader in cartographic, spatial analytic and GIS-related teaching and research.

There are currently two GIS-related specializations offered in the department: Analytical Cartography and Geographic Information Systems (See Appendix B). These specializations reflect a division of labor between faculty in the department dating back several decades. Due to a significant turnover in faculty appointments over the past decade, as well as to changing pedagogical norms, we currently offer only the GIS specialization. The GIS specialization is popular among students: we enroll on average about 40 students per year, representing approximately 20% of our departmental majors.

Our department's commitment to revising the GIS curriculum dates to the late 1990s. In 1998, Professor Duane Marble (now emeritus), was appointed chair of the national Model Curricula Task Force commissioned by the University Consortium for Geographic Information Science (UCGIS). The UCGIS task force was convened in order to address worries by GIS departments across the country that undergraduate curricula in GIS were dated, and that as a result

students were inadequately prepared for the demands of the workplace. The task force deliberations were recently published as the *Geographic Information Science and Technology Body of Knowledge 2006* (DiBiase et al., 2006). The report reflects the insights of more than 70 educators, researchers, and practitioners. Its goals are to a) foster greater coherence and effectiveness within the GIS education community, and b) to outline what core knowledge, skills, and applications areas should be covered in a rigorous geographic information science education (see Appendix A).

During the 2007-2008 academic year, GIS-related faculty in the department undertook an extensive and collaborative review of course content based on the external standards of excellence suggested in the 2006 report. We also solicited detailed feedback from current geography majors specializing in GIS. Our goal was to identify significant overlaps and/or shortcomings in our curriculum. Our review indicated that while we cover a significant amount of the material suggested in the 2006 UCGIS document, our curriculum could do more to cover some fundamental knowledge areas. Faculty and students also agreed that while students are generally well-prepared for post-graduation employment, more could be done to enhance our graduates' readiness for the job market, including ensuring enough depth and breadth of coursework in the core areas of GIScience and emphasizing application oriented training.

Based on the importance of geotechnologies in society, the strength of the Department of Geography at OSU, the existence of the Body of Knowledge 2006 document, and the recent review by the department, the department is proposing a new major in Geographic Information Sciences (Appendix C). There are three main rationales for proposing a new major:

1. The new major will allow students to gain unprecedented breadth and depth in GIS. Students in the proposed major will receive comprehensive and progressive training from the top scholars in the field. Students not only learn to use software, but also the underlying theories for data structures, geographic analysis, as well as its application to a variety of real world issues. The comprehensive nature of this training not only exceeds that offered by GIS certification programs (which mainly focus on learning software), but also that offered in the current GIS specialization in the OSU Department of Geography.
2. The new major will benefit not only from the expertise of current faculty, but from the long history of research, teaching, and application of GIS in the OSU Department of Geography. Students in this major will profit from the depth of experience this department has in research and teaching on geotechnologies.
3. The major will increase the visibility of GIS at the Ohio State University and in the State of Ohio. Although geospatial technology is among the most important emerging fields today (Gewin 2004), it is not as visible as it should be. This seems to be because GIS is embedded in the discipline of geography, which is unfamiliar to most undergraduates in the United States. Having a stand-alone major will help overcome this problem; at the same time, having that major associated with a top-ranked geography department will ensure that the major continue to benefit from its disciplinary home.

6. Identify any unique characteristics or resources that make it particularly appropriate for Ohio State to offer the proposed major.

A. Department resources.

The proposed major will continue to be housed in Geography, where it will benefit from the department's world-class faculty and depth of experience in GIS education. The major also benefits because the courses and facilities are not only in place, but already well-tested.

Faculty: The department of Geography has seven full-time tenure track faculty in the area of GIS and related sciences (out of a full faculty of 25) (see Appendix F and Appendix G). These leaders in the field are internationally known for their innovative research. Many have ongoing collaborations and formal affiliations with other departments and colleges on campus, which will broaden the resources available to students in the proposed major.

Teaching resources: The department already offers almost all courses that are required in the proposed major. Included among these is an interdisciplinary course in the Fundamentals of GIS (Geog 607) that is co-taught by faculty in Geography, Civil Engineering, City and Regional Planning, and Geodetic Science.

Computer facilities: The department has extensive computer labs with necessary software and instrumentation for teaching and research in the many aspects of GIScience. See Section 30 for a full description.

Student space and facilities: The department also has an active Geography Club, in which GIS majors will be encouraged to participate; this Club will soon have its own academic resource center with computer facilities, academic journals, and publications of current faculty.

Advising staff: The department maintains its own undergraduate advising program, that will also serve the students in the GIS major. Rick McClish is the fulltime undergraduate advisor, and Assoc. Prof. Becky Mansfield serves as the honors advisor.

Relations with local government and business: Through ongoing research projects, alumni, and an active internship program, geography has existing linkages with a variety of state and local government agencies (e.g. Ohio EPA) and local businesses (e.g. Nationwide Insurance). These linkages are especially valuable for students seeking internship positions. Current Geography students with a GIS specialization have obtained valuable experience through such internships, many of which are paid positions.

B. University resources.

Centers for research and outreach: The university has a variety of centers for interdisciplinary research and outreach that help inform and enhance course content, provide points of contact for students, and provide potential for other forms of interaction beyond the university (e.g. internships, hourly positions, undergraduate research). Primary among these is the Center for Mapping, whose mission focuses on GIS and related technologies. Others include the Center for Human Resource Research, the Criminal Justice Research Center, the Center for Urban and Regional Analysis, John Glenn Institute for Public Service and Public Policy, the Kirwan Institute for Race and Ethnicity, and the Initiative on Population Research.

Library resources: Another important university resource unique to Ohio State is the Libraries Map Room collection, which includes a wide array of map collections of regional and global significance. The libraries has a dedicated librarian for Maps, Steve Rogers, who has many years of experience with the collection and with helping undergraduate students.

7. Cite the benefits for students, the institution, and the region or state.

The primary benefit for students is that the proposed new major is tailored specifically to fit the needs of students who want to pursue careers or higher education in geospatial technologies. Students will develop a substantive knowledge base that answers to specific job market demands in a growing industry. It also clearly identifies the students' major as Geographic Information Sciences, which is a degree that is clearly recognized by potential employers. A bachelor's degree in GIS is today the preferred entry level degree for a beginning career as a GIS professional (see item 10 below). The proposed major is organized to provide the foundation and skills necessary with a clear path to graduation. It also includes sufficient flexibility that the professional undergraduate advisor in Geography can help students choose the courses to satisfy the requirements of the General Education Curriculum (GEC) and their electives to match their specific goals. Students who complete the proposed major will be well positioned to take the next step after they graduate.

The principal benefit to the university is that the proposed new major will attract some high quality students that would otherwise attend other universities. Having a prominent GIS major will attract driven and goal-oriented students from across Ohio, and beyond. In addition to adding to the intellectual vitality of the university, some of the best students may also choose to continue at Ohio State and do their graduate work in the Geography department. Another benefit of the proposed major to the University is that it will provide the opportunity for students in other majors to double-major or minor in GIS. This will provide these students with both substantive knowledge and technical skills that will enhance their position in the job market. A GIS major will also make an important contribution to the University's outreach mission by means of the many application and service learning-oriented courses in the curriculum. Several courses require students to engage directly with clients, both within and outside of the university, in various forms of projects ranging from spatial database development, to integrated spatial analyses, to map design.

The principal benefit to the state of Ohio is that the proposed new major would keep more bright motivated undergraduate students in the state, as there are currently few universities in Ohio that currently offer an undergraduate major in GIS. The proposed new major would also provide a source of potential employees for the wide range of businesses that require people who can manipulate, analyze, and visualize spatial data. Major employers such as Nationwide Insurance, American Electric Power, city and regional governments all need employees with expertise in designing and using GIS.

8. List similar majors offered in both public and private institutions in Ohio and the U.S. Explain how these majors compare to the one proposed.

Valid data on GIS oriented degrees are difficult to obtain since the field does not have an unambiguous Classification by Instructional Program (CIP) code in the U.S. Department of Education data bases. It is clear, however, that very few higher education institutions offer baccalaureate degree programs in GIS. Many offer specializations in GIS *as part of* a degree in geography, which is the current situation here at Ohio State. While these provide intermediate and advanced training in GIS, they do not offer the comprehensive and progressive training of the proposed BS in GIS.

Within Ohio, only one other university (Ohio University) offers a four-year major in GIS. As with the current proposal, this major is housed in a Geography department. However, unlike our proposed major, students at Ohio University complete the requirements for a general Geography major rather than focusing extensively on GIS related knowledge and skills. Six universities and colleges offer a GIS certificate program and/or a 2-year degree, one offers only a GIS minor, and three (other than OSU) offer GIS as a specialization within the Geography major.

GIS Education in Ohio

Bowling Green State University	Bowling Green, OH	Geography & Geology major
Cleveland State University	Cleveland, OH	Graduate and undergraduate GIS certificate programs
Columbus State Community College	Columbus, OH	GIS Certificate and 2-yr degree programs
Hocking College	Nelsonville, OH	GI/GPS Certificate and 2-year degree program
James A. Rhodes State College	Lima, OH	GIS Certificate and 2-year degree program
Kent State University	Kent, OH	Geography major
Miami University	Oxford, OH	GIS Certificate
Ohio Northern University	Ada, OH	GIS minor
Ohio State University	Columbus, OH	Geography major
Ohio University	Athens, OH	GIS Analyst major
Ohio Wesleyan University	Delaware, OH	Geography major
University of Cincinnati	Cincinnati, OH	BS Geography
University of Akron	Akron, OH	BS Geography and Certificate in GISci

9. Cite enrollment patterns of similar majors in Ohio or in the United States.

We conducted a survey of GIS programs at four-year institutions in Ohio, and other university of similar size, including peer Big 10 institutions. Of these contacts, we received a few responses.

Departments with GIS majors: Ohio University currently has 18 students enrolled in the GIS major, with yearly enrollments averaging between 15-20 students since inception of the program seven years ago. Michigan State University has had on average 12 students since the major's inception in 2005. (Their specialization averages 20 students per year).

Departments with GIS specializations within the Geography major: University of Cincinnati has a modest number of students in the GIS specialization of the Geography major (3-4 students per year). University of Minnesota has a specialization in GIS, with about 27 students per year. The department just began a minor in GIS, to begin Fall 2008.

10. Describe career opportunities and/or opportunities for graduate or professional study available to persons who complete the major.

Students graduating from OSU with a major in GIS will be well positioned to find gainful employment. In 2004 the U.S. Department of Labor identified geotechnology as one of the three most important emerging and evolving fields, along with nanotechnology and biotechnology. Traditionally, the public sector has been the main employer of GIS professionals. There are also growing opportunities within the private sector. An informal study of current jobs listed on the website "gisjobs.com" included positions with the federal government (USEPA, USDA), state and local government (city, county), industry (e.g., software companies, consulting firms, location-based service providers), and academia (providing research support to interdisciplinary centers). Within these current employment opportunities, applications include resource management, spatial database development and management, environmental planning, transportation planning, software development, cartography, conservation, urban planning, and spatial decision support services.

Graduates of the proposed GIS major will be well-prepared for positions beyond routine use of geospatial technologies, and able to apply spatial analysis techniques to address sophisticated problems in a variety of fields. In addition, graduates of the proposed program will have begun to develop the business and communication competencies required for advancement in government agencies and private businesses.

Graduates of the proposed GIS major will also be very competitive for continued academic study, at OSU or other universities. Current trends in the discipline (as evidenced the "Jobs in Geography" website maintained by the Association of American Geographers [AAG]) are that graduates of doctoral programs in geography and cognate disciplines with GIS skills, expertise, and research interests are highly in demand.

11. Describe any licensure or certification for which this major will prepare students.

Given the relatively short history of GIS, certification of GIS programs is still a new phenomenon. The UCGIS Body of Knowledge (DiBiase et al. 2006) has clearly defined core competencies, which are the basis for a new certification system for GIS professionals by the GIS Certification Institute. This certification includes three components: educational achievement, professional experience, and contribution to the profession. Students in the new GIS major will be able to document and complete the educational attainment component of a GIS professional certificate.

III. GOALS/OBJECTIVES/EVALUATION**12. Provide a learning outcomes assessment plan for the major program.****A. State the general and specific educational goals and objectives for the major.**

The general educational goals for the major are that students will:

1. learn how to operationalize fundamental concepts in Geographic Information Sciences.
2. achieve proficiency with methods of Geographic Information Sciences.
3. be provided with a strong foundation for seeking employment or graduate or professional training.

The specific educational goals for the major are:

1. **Technical:** Students will acquire an ability to assess relationships among geospatial technologies, GIS theory and applications, technical writing, and technological literacy.
2. **Analytical:** Students will become creative thinkers, acquire problem-solving skills, and demonstrate an ability to situate GIScience in a larger societal context.
3. **Communication:** Students will be able to represent complex technical information orally, visually, and in writing.

B. Indicate the methods that will be used to assess whether the educational goals and learning objectives are being met.

The Department of Geography currently has an assessment plan that includes a suite of outcome monitoring methods that allows us to gauge whether or not we are meeting pedagogical goals and to make necessary corrections. The plan is reviewed annually by the College of Social and Behavioral Sciences, and is overseen by our undergraduate advisor. The current plan consists of two indirect assessment methods and one direct method. Geography's assessment methods include:

- Embedded questions in one regularly offered and popular upper division course
- Informal focus groups with students in the major. In the 2007-2008 school year we conducted four such groups, one for each specialization.
- An exit survey of graduating seniors, which includes questions about the major regarding overall educational experience, classroom experience, research and internship participation, and placement in jobs and graduate school.

As part of the proposed overhaul of the Geography major, we have engineered an improved assessment strategy. As we gain experience with assessment and as the needs of the department change, we will refine our methods of assessment. We expect the result to be geography majors who are better prepared for graduate studies and the job market. Our plan includes continued use of focus groups and exit surveys with graduating seniors. We also include expanded use of embedded testing to reach 100% of our undergraduate majors.

Because the proposed GIS major will remain within the department of Geography, assessment for the GIS major will use the same techniques as assessment of the Geography major. We will include focus groups, exit surveys, and embedded testing techniques. Embedded testing will take place in the GIS Applications in Social Science and Business (686), and GIS Design and Implementation (687) courses. These classes are ideal for embedded testing because they not only teach methods and skills, but require students to express their general knowledge about concepts and methods in GIS and integrate these skills in an applied project. A group of faculty who specialize in GIS is currently developing a set of embedded questions for this class that will assess the department's success in teaching students technical, analytic, and communication skills.

C. Provide the time over which the assessment plan will be implemented.

Because the GIS major will remain within the Department of Geography, the above plan will be implemented immediately. We will continue to revisit our assessment methods, deciding which methods and techniques yield the most useful information. We currently produce an annual assessment report for the College of Social and Behavioral Sciences. For the new major, in Year 4 we will do an extensive additional report which looks at the educational experience of our first full cohort of GIS majors.

D. Describe how outcomes information will be used to improve student learning and program effectiveness.

1. The Undergraduate Studies Committee, in consultation with the undergraduate advisor, will review annual assessment data for GIS majors. These data will be used to make suggestions to faculty regarding content and pedagogical practice for existing courses in the GIS major.
2. The Undergraduate Studies Committee and the undergraduate advisor, along with an advisory committee of GIS-related faculty, will convene at the end of the third year to design a special assessment mechanism for the first graduating cohort. The group will meet again at the end of the fourth year to collate and analyze the data. These results will be used to consider more substantive changes of the GIS curriculum, including suggestions for any necessary new courses, course sequencing, and professionalization experiences such as internships and undergraduate research.

IV. RELATIONSHIP TO OTHER PROGRAMS

13. Describe current major and minor programs in the department(s) and how they relate to the proposed major.

Currently the Department of Geography offers BA and BS degrees in Geography, as well as a minor in Geography. A proposal for revision of the major is currently under review; the description here is of the current structure, with indication of important changes we are proposing.

Students majoring in geography choose one of four specializations: Analytical Cartography/Geographic Information Systems (BS), Urban and Regional Studies (BA), People-Society-Environment (BA), and Atmospheric and Climatic Studies (BS). These divisions represent long-standing core areas of knowledge in the geography discipline, and are mirrored at many of our peer institutions. The four specializations have unique, though overlapping, curricula that convey core geographical concepts and methods while allowing students to develop expertise in a particular area. The proposed structure retains these four tracks, renames them, and changes some of the requirements in them. Like the major, the minor in Geography has the same four specializations. Students are required to take five courses from a list of courses specific to each specialization.

As discussed in point 6, above, the proposed major in GIS relies extensively on the resources and structure of the Geography department. The courses for the new major already exist in the Geography department, current Geography professors comprise the faculty, and the department has a variety of resources (e.g. computer facilities) that will be available to students in the proposed major.

Approval of the current proposal for a major in GIS will allow for a separation of GIS training into two complementary levels. Within the geography major, the current Analytical Cartography/Geographic Information Systems specialization will become "Spatial Analysis" and will focus on geographical analysis methods in broader terms and provide a more general geographic education. (This Spatial Analysis specialization would be similar to the GIS major offered at Ohio University, which requires students to fulfill the requirements of the Geography major.) The proposed GIS major at OSU will provide full coverage of core knowledge areas in the GISciences, training students to become highly trained experts in their fields. We designed the two programs to attract and train different types of students. Students in the GIS major will be trained for professional careers specializing in spatial data, prepared to fill roles related to data acquisition and management, application development, training, data analysis, interpretation, and visualization. Students choosing the Spatial Analysis specialization will be prepared either for graduate school in Geography, or for careers that require them to use and plan for spatial information, for example in roles related to project management, systems analysis, coordination, training, and marketing. There is substantial overlap in the courses available to students in the two programs, which serves two purposes. First, students in both programs need to achieve adequate technical proficiency. Second, we want to provide maximum flexibility for students to design their programs around their specific interests and career paths. All students will be encouraged to design courses of study that take full advantage of the range of courses available.

An additional advantage of offering a GIS major is that it will allow students to pursue double majors. The GIS profession is highly interdisciplinary, as geospatial information is increasingly becoming a driving force for decision making across the local to global continuum. The GIS degree will likely be a popular complement to a degree in Geography, with focus in one of the other, substantive areas of specialization. This will allow students to combine sophisticated technical knowledge with in-depth knowledge in a substantive area (e.g. environmental issues, urban planning). The GIS degree will also be a popular complement to degrees in, *inter alia*, landscape architecture, city and regional and planning, computer science, natural resources, political science, and business. In addition many seeking a complement to their major will also benefit from a minor in GIS that will provide students with a general knowledge of geographical analysis methods.

14. Identify any overlaps with other programs or departments within the University. Append letters of concurrence or objection from related units.

Geodetic Science	603 Remote Sensing
	607 Fundamentals of Geographic Information Systems
	640 Decision-Making with GIS
	774 Spectral Methods and Raster Geometry in Digital Mapping
Civil Engineering	608 Spatial Analysis Techniques in Civil Engineering
City and Regional Planning	608 geographic Information Systems in Professional Planning Practice
Environment and Natural Resources	324 Natural Resources Photointerpretation

Concurrence letters are attached in Appendix D.

15. Indicate any cooperative arrangements with others institutions and organizations that will be used to offer this major.

None

16. Specify any articulation arrangements (direct transfer opportunities) with other institutions that will be in effect for the major.

None

17. Provide information on the use of consultants or advisory committees in the development of the major. Describe any continuing consultation.

This proposed major was developed by the Undergraduate Studies Committee, chaired by Professor Becky Mansfield, in consultation with an ad-hoc committee within the current Analytic Cartography/GIS specialization, headed up by Professor Ola Ahlqvist. Our evaluation of the specializations was inaugurated in WI07, with recommendations brought before the faculty in SP08. Faculty support for the changes was unanimous.

18. Indicate whether this major or a similar major was submitted for approval previously.

Neither this nor a similar major has been submitted previously.

19. Indicate where students will be drawn from, e.g. existing academic programs, outside of the University, etc. Estimate the mix of students entering the major internally and externally

Although it is extremely difficult to predict enrollment in our proposed GIS major, based on our current enrollment of approximately 35 majors per year in the GIS specialization, we estimate that the number of students enrolled in the GIS major will double by year four (see question 20, below).

Internal transfers: Our proposed major in GIS will, for the most part, draw students from the Geography major (current specialization in GIS). We are currently conducting a survey with our Geography majors as well as alumni in the GIS specialization, gauging their interest/opinion of a GIS major. At this point we expect most if not all of our current GIS students to transfer in the event that the GIS major is approved.

External entry: We expect that the new GIS major will attract a significant number of *new* students to OSU, both regionally and nationally. Faculty affiliated with the proposed GIS major will lead a major national-scale recruitment drive in the event that the major is approved. Given the high visibility of our faculty, we expect to draw a significant amount of interest.

Double major/minor: Given the multi-disciplinary nature of GIS it is likely that some students see the value of a double major or a minor in GIS as a way to augment their job placement or graduate studies opportunities.

Student mix: We anticipate very little disturbance to existing programs at OSU due to our proposed GIS major. Although some students will change to the GIS major from others such as Civil Engineering or Computer Sciences, we also expect that most new majors will be incoming freshman.

V. STUDENT ENROLLMENT

20. Indicate the number of students you anticipate will be admitted to the major each year

Regular Academic Year	Year 1	Year 2	Year 3	Year 4
Full-time (new entering)	35	8	10	12
Full-time (cumulative)	35	43	53	65
Part-time (new entering)	1	2	3	4
Part-time (cumulative)	1	3	6	10
Estimated Summer Enrollments	Year 1	Year 2	Year 3	Year 4
Full-time	NA	NA	NA	NA
Part-time	NA	NA	NA	NA

Our estimated enrollment in full-time studies during the first four regular academic years is based on current enrollment figures for the GIS specialization in Geography. Since AU03 we have averaged 35 new majors per year in the GIS specialization.

VI. REQUIREMENTS

21. List the courses (Department, title, credit hours, description) which constitute the requirements and other components of the major. Indicate which courses are currently offered and which will be new. Append a quarter-by-quarter sample program and all New Course, Course Change, and Course Withdrawal forms necessitated by the implementation of the proposed major.

There are three components to the proposed GIS major: required prerequisites or supplements to the major, core requirements, and electives. (See Appendix C for schematic version and Appendix H for course syllabi)

The 9 hours of required prerequisites and supplements to the major include a choice of introductory computer programming classes (CSE 201 or 202), and Introduction to Statistical Analysis (STAT 245). These courses provide a computing and mathematical basis for further training in the major and are also in line with OSU requirements for a BS degree.

The core requirements component of the major consists of 45 credit hours, representing depth and breadth in the major subfields of GIS. The GIS sequence including Fundamentals of Geographic Information Systems (607), Intermediate GIS (685), GIS Applications in Social Science and Business (686), and GIS Design and Implementation (687). A sequence in the

subfield of cartography and geovisualization includes Map Reading and Interpretation (480), Elements of Cartography (580) and Computer Cartography and Geographical Visualization (680). These sequences in GIS and cartography are rounded out by the course Quantitative Geographical Methods (683) and Geographic Applications in Remote Sensing (684).

Finally, the third component of the proposed major is 8-10 hours of elective courses across Geography and Computer Science & Engineering. Two courses can be chosen from the following, depending on the student's interests and career goals: Geography of Transportation (645), Locational Analysis (647), Land Use Geography (655), Emerging Topics in GIS (688), Seminar in GIS (787), Undergraduate Seminar in Research and Professionalization (695), Earth Systems Data Collection and Analysis (Earth Sci 310), Data Structure for Information Systems (CS&E 214), Introduction to C++ Programming (CS&E 230), Object-Oriented Programming for Engineers and Scientists (CS&E 502), and Introduction to Database Systems I (CS&E 670). We note that those students wanting to take CS&E 214 should choose 201 as a prerequisite, while those wanting to take CS&E 230 or 502 should take 202; we also note that 502 is the prerequisite for 670.

22. State the minimum number of credits required for completion of the major.

53

23. State the average number of credits expected for a student at completion of the major.

We expect most students to have 54 major credit hours when they graduate, based on the average number of credits in the elective courses.

24. Give the average number of credits taken per quarter by a typical student. Estimate the average for each year.

The average number of credit hours is 15 per quarter, for a total of 45 per year. Credit hours vary depending on quarters and the time the GIS major is declared. Sample curricula with quarter by quarter credit hour estimates are shown in Appendix E.

25. Give the number of credits students are required to take in other departments.

The major requires 53-55 credit hours in Geography. The core consists of 45 credit hours (nine courses), all in Geography. Students are also required to take 8-10 credit hours (two courses) of electives. The elective list includes five courses from Geography and four from Computer Science & Engineering. All GEC requirements are taken outside Geography; these amount to 80-100 hours (depending on test placement). This leaves 26-46 free elective credit hours, which can be taken both inside and outside Geography.

26. Give the number of credits a typical student might take as electives in other departments.

20-40 credit hours

27. Describe other major requirements in addition to course requirements, e.g., examinations, internships, final projects.

None

28. Identify from which specialized professional association(s) accreditation will be sought. List any additional resources that will be necessary to gain such accreditation.

No such accreditation currently exists for GIS education.

29. Describe the number and qualifications of full-time and part-time faculty. List current faculty and areas of expertise. Describe the number and type of additional faculty needed

The Department of Geography currently has 24 full- or part-time tenure track faculty; seven of these are associated with GIS-related fields. For a list of faculty and specializations see Appendix F and Appendix G. We expect to hire one additional faculty member in this area in the 2008-2009 year, to replace a faculty member who recently resigned. Based on current enrollment patterns and projections, we do not expect to hire additional faculty in the next three years. However, we will consider making hires if justified by additional credit hours generated, in line with Social and Behavioral Sciences and OSU's budget model.

30. Describe existing facilities, equipment, and off-campus field experience and clinical sites to be used. Indicate how the use of these will impact other existing programs.

Computing requirement and lab space: GIS is a computer-intensive field, and Geography has significant computer facilities and space at its disposal. Our major undergraduate-only instructional computer lab (Derby 0140) comprises 50 state-of-the-art-work stations, with a full suite of GIS-relevant software. A sampling of the software loaded on all computers includes, but is not limited to: ArcGIS 9.2, ArcView 3.2 w/ 3D, Encarta, spatial statistics software, Geoda 0.95i, Google Earth, Google Sketchup, IDL 5.5.2 Student version, Illustrator, Mapobjects 2, Maptitude, .Net 1.1, Office 2003, PC GIS 3.2, R, SPSS, VB 6.0 as well as VB .NET.

DB0140 is managed by two full-time technical staff as well as a graduate student. The department is confident that our existing staff will be able to manage the increased traffic through our labs as a result of the GIS major.

Currently, on average, DB0140 is used for seven to ten courses per quarter, with peak hours of usage occurring between 9am and 5pm. This means that careful management of the lab will be required in order to accommodate the growth in GIS majors that we are predicting (see section 20). However, we are fully confident that our predicted enrollment numbers for Year 4 can be comfortably accommodated in the department, for the following reasons:

- There is currently little to no usage of DB0140 in the 7:30-9am slot, and no usage after 5pm. Geography is prepared to expand its use of early morning and late afternoon classes in order to adjust to more lab users as a result of the GIS major.
- Currently, utilization rates (i.e. the number of workstations used) in DB0140 seldom exceeds 50%. This means that we can easily accommodate a doubling of students in DB0140 in any given lab slot.

- There is sufficient physical space in DB0140 to expand the number of workstations by up to 30%, depending on demand as well as resources. We are currently updating the lab with 50 new computers. Although as of yet this will not result in any additional workstations in DB0140, we will be rebuilding the existing computers into 25 workstations to be allocated throughout the department as we see fit, including in the lab as required.
- We are currently moving ahead with a new spacious undergraduate resource center. This will be completed by the end of SU08. A portion of the older computers from DB0140 will be installed in the center so as to expand the number of computers available for use outside scheduled lab hours. We expect our future GIS majors to make substantial use of these machines.
- The department is also prepared to develop an additional undergraduate-only instructional lab should we require the space as a result of the proposed GIS major.

Regular classroom space: Of the nine core courses in our proposed GIS major, all have lecture as well as lab components. Approximately 30% of these courses involve simultaneous lectures and labs in DB0140. The other 70% of the classes require rooms for the lecture portion of the class, in addition to lab time and space. The only course which we do not teach exclusively in departmental classrooms is Geog 607, which is shared with Civil Engineering, City and Regional Planning, and Geodetic Science with lectures currently taught in Dreese 113. The rest of our classes are taught in DB1116, DB1080 and DB0155. Due to the ample size of these rooms, as well as departmental flexibility in allocating classroom usage, we foresee no classroom space restrictions based in the proposed GIS major. Additionally, the department regularly teaches courses in Paige Hall.

In sum, we expect little to no impact on other departments in terms of space use as a result of this proposal.

31. Describe additional University resources, including libraries, that will be required for the new major.

None

32. Describe the major as it would appear in the appropriate college bulletin.

The undergraduate Geographic Information Science (GIS) program concerns the nature of geographic information and the many applications of geospatial technologies, such as Geographic Information Systems. These include applications dealing with basic scientific questions as well as practical solutions for the workplace and everyday life activities. The science and technologies surrounding GIS are multi-disciplinary and range from conceptual geographic foundations, spatial data acquisition, modeling, analysis, and visualization, to societal, organizational, and ethical aspects of GIS.

The program is intended to prepare students for careers in the diverse areas of geospatial

applications. Because technology changes so rapidly, the program emphasizes general principles which will serve graduates throughout their careers, while giving students significant exposure and training in state-of-the-art software and technology. By design, students in the new GIS major will also be able to document and complete the educational attainment component of a GIS professional certificate.

Students graduating from OSU with a major in GIS will be well positioned to find gainful employment, both in the public and private sector. Graduates will be well-prepared for positions beyond routine use of geospatial technologies, and able to apply spatial analysis techniques to address sophisticated problems in a variety of fields. In addition, graduates will have begun to develop the business and communication competencies required for advancement in government agencies and private businesses. Graduates will also be very competitive for continued academic study, at OSU or other universities.

Students pursuing a major in geographic information science must complete 53-55 hours of approved courses.

References

DiBiase D W, DeMers, M N, Johnson A J, Kemp K K, Taylor-Luck A, Plewe B S, and Wentz E A (2006). *Geographic Information Science and Technology Body of Knowledge (First Edition)*. Washington DC, Association of American Geographers

Gewin, Virginia (2004). Mapping opportunities. *Nature* 427: 376-377.

Appendix A

UCGIS Geographic Information Science and Technology Body of Knowledge 2006 (DiBiase et al. 2006)

Knowledge areas (underlined) are clusters of knowledge, skills, and applications that span the breadth of GIScience. Units are coherent sets of topics that embody representative concepts, methodologies, and applications, designed as either core (**bold face**) or elective (normal face).

Knowledge Area AM. Analytical Methods

Unit AM1 Academic and analytical origins
Unit AM2 Query operations and query languages
Unit AM3 Geometric measures
Unit AM4 Basic analytical operations
Unit AM5 Basic analytical methods
Unit AM6 Analysis of surfaces
Unit AM7 Spatial statistics
Unit AM8 Geostatistics
Unit AM9 Spatial regression and econometrics
Unit AM10 Data mining
Unit AM11 Network analysis
Unit AM12 Optimization and location-allocation modeling

Knowledge Area CF. Conceptual Foundations

Unit CF1 Philosophical foundations
Unit CF2 Cognitive and social foundations
Unit CF3 Domains of geographic information
Unit CF4 Elements of geographic information
Unit CF5 Relationships
Unit CF6 Imperfections in geographic information

Knowledge Area CV. Cartography and Visualization

Unit CV1 History and trends
Unit CV2 Data considerations
Unit CV3 Principles of map design
Unit CV4 Graphic representation techniques
Unit CV5 Map production
Unit CV6 Map use and evaluation

Knowledge Area DA. Design Aspects

Unit DA1 The scope of GI S&T system design
Unit DA2 Project definition
Unit DA3 Resource planning
Unit DA4 Database design
Unit DA5 Analysis design
Unit DA6 Application design
Unit DA7 System implementation

Knowledge Area DM. Data Modeling

Unit DM1 Basic storage and retrieval structures
Unit DM2 Database management systems
Unit DM3 Tessellation data models
Unit DM4 Vector and object data models
Unit DM5 Modeling 3D, temporal, and uncertain phenomena

Knowledge Area DN. Data Manipulation

Unit DN1 Representation transformation
Unit DN2 Generalization and aggregation
Unit DN3 Transaction management of geospatial data

Knowledge Area GC. Geocomputation

Unit GC1 Emergence of geocomputation
Unit GC2 Computational aspects and neurocomputing
Unit GC3 Cellular Automata (CA) models
Unit GC4 Heuristics
Unit GC5 Genetic algorithms (GA)
Unit GC6 Agent-based models
Unit GC7 Simulation modeling
Unit GC8 Uncertainty
Unit GC9 Fuzzy sets

Knowledge Area GD. Geospatial Data

Unit GD1 Earth geometry
Unit GD2 Land partitioning systems
Unit GD3 Georeferencing systems
Unit GD4 Datums
Unit GD5 Map projections
Unit GD6 Data quality
Unit GD7 Land surveying and GPS
Unit GD8 Digitizing
Unit GD9 Field data collection
Unit GD10 Aerial imaging and photogrammetry
Unit GD11 Satellite and shipboard remote sensing
Unit GD12 Metadata, standards, and infrastructures

Knowledge Area GS. GI S&T and Society

Unit GS1 Legal aspects
Unit GS2 Economic aspects
Unit GS3 Use of geospatial information in the public sector
Unit GS4 Geospatial information as property
Unit GS5 Dissemination of geospatial information
Unit GS6 Ethical aspects of geospatial information and technology
Unit GS7 Critical GIS

Knowledge Area OI. Organizational and Institutional Aspects

Unit OI1 Origins of GI S&T
Unit OI2 Managing the GI system operations and infrastructure
Unit OI3 Organizational structures and procedures
Unit OI4 GI S&T workforce themes
Unit OI5 Institutional and inter-institutional aspects
Unit OI6 Coordinating organizations (national and international)

Appendix B

Current Geographic Information Sciences (GIS) Curriculum

Part A. Required Prerequisites or Supplements to the Major (Credits count towards the major)

1. CS&E 201
2. Statistics 245

Part B. Core Requirements

1. Elements of Cartography 580
2. Fundamentals in Geographic Information Systems 607
3. Numerical Cartography 680
4. Introduction to Geographic Analysis 683
5. Intermediate Geographic Information Systems 685
6. GIS in Social Science and Business Research 686 or Design and Implementation of Geographic Information 687
7. CS&E 214 or CS&E 230

Part C. Electives within the Major

1. Choice of human geography course at the 600 level
2. Choice of one physical geography course from:
 - Physical Geography and Environmental Issues 210
 - Climatology 520
 - Integrated Earth Systems: Confronting Global Change 597.02
3. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix C

Proposed Geographic Information Science (GIS) major

Part A. Required Prerequisites or Supplements to the Major. (Do not count toward the 53-55 hour major)

1. CS&E 201 (Elementary Computer Programming; Java is taught) or 202 (Introduction to Programming and Algorithms for Engineers and Scientists; C++ is taught)
2. Statistics 245

Part B. Core Requirements (45 credit hours)

1. Map Reading and Interpretation 480
2. Elements of Cartography 580
3. Fundamentals in Geographic Information Systems 607
4. Computer Cartography and Geographic Visualization 680
5. Quantitative Geographical Methods 683
6. Geographic Applications of Remote Sensing 684
7. Intermediate Geographic Information Systems 685
8. GIS Applications in Social Science and Business 686
9. GIS Design and Implementation 687

Part C. Electives (6-10 credit hours)

1. Choose two of the following courses:
 - Geography of Transportation 645
 - Locational Analysis 647
 - Land Use Geography 655
 - Emerging topics in GIS 688
 - Seminar in GIS 787
 - Undergraduate Research and Professionalization Seminar 695
 - CS&E Data Structures for Information Systems 214 (4 credits)
 - CS&E Introduction to C++ Programming 230 (4 credits)
 - CS&E Object-Oriented Programming for Engineers and Scientists 502 (3 credits)
 - CS&E Introduction to Database Systems I 670 (3 credits)
 - For the above courses, CS&E suggests that students who have taken 201 for their prerequisite take 214, while those who have taken 202 should choose 230 or 502. The prerequisite for 670 is 502.
 - Earth Sci 310 Earth Systems Data Collection and Analysis
2. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix D
Concurrence

We will be attaching concurrence letters as they are received.

Appendix E

Sample 4-year plan for the GIS major (on the next page)

Sample four year plan B.S. Geographic Information Science			
Year 1			
Autumn	Winter	Spring	Summer
English 110	Math 151	Math 152	
Math 150	First GEC Natural Science course	Second Foreign Language course	
Geography 200 or 240 (GEC Social Science course)	First Foreign Language course	Visual/Performing Arts	
University Survey course (1hour)			
Year 2			
Autumn	Winter	Spring	Summer
Geography 480	Geography 580	Geography 607	
CS&E 201	GEC Second Writing course (367's)	Statistics 245	
Third GEC Foreign Language	Fourth GEC Foreign Language	First GEC Historical Study course	
Year 3			
Autumn	Winter	Spring	Summer
Geography 683	Geography 680	Geography 686	
Second GEC Historical Study	Geography 685	Third GEC Natural Science course	
Second GEC Natural Science	Literature	Minor or General Elective course	
Year 4			
Autumn	Winter	Spring	Summer
Geography 687	GIS Major Elective	Fourth GEC Natural Science	
Geography 684	First Additional Breadth course	GIS Major Elective	
Second GEC Social Science	Second Additional Breadth course	Minor or General Elective course	

Appendix F

List of GIS Geography Faculty, with Area of Expertise

Name	Area of expertise	Faculty Status	Percent of Time
Ola Ahlqvist	uncertainty and semantics, visualization, land-use & land-cover change	Core Faculty (Assistant Professor)	100%
Marie Cieri	Qualitative and critical GIS, GIS and society, representation	Core Faculty (Assistant Professor)	100%
Mei-Po Kwan	3-D GIS, qualitative and critical GIS, travel behavior and accessibility	Core Faculty (Professor)	100%
Desheng Liu	spatial statistics, land-use & land-cover change, remote sensing of the environment	Core Faculty (Assistant Professor)	75%
Darla Munroe	Environmental modeling , urban, regional, and natural resource planning and development, environmental valuation	Core Faculty (Assistant Professor)	100%
Morton O'Kelly	spatial interaction, spatial optimization, service location models	Core Faculty (Professor)	100%
Ningchuan Xiao	geocomputation, information and communication technologies	Core Faculty (Assistant Professor)	100%

Appendix G
List of Other Geography Faculty

Name	Faculty Status	Percent of Time
Jason E. Box	Core Faculty (Associate Professor)	100%
David H. Bromwich	Core Faculty (Professor)	100%
Mathew Coleman	Core Faculty (Assistant Professor)	100%
Kevin R. Cox	Core Faculty (Professor)	100%
Nancy Ettlinger	Core Faculty (Associate Professor)	100%
Jay S. Hobgood	Core Faculty (Associate Professor)	100%
Jialin Lin	Core Faculty (Assistant Professor)	100%
Ed Malecki	Core Faculty (Professor)	100%
Becky Mansfield	Core Faculty (Associate Professor)	100%
Bryan Mark	Core Faculty (Assistant Professor)	100%
Kendra McSweeney	Core Faculty (Associate Professor)	100%
Yuri V. Medvedkov	Core Faculty (Professor)	100%
Ellen Mosley-Thompson	Core Faculty (Professor)	100%
David Porinchu	Core Faculty (Assistant Professor)	100%
Jeff Rogers	Core Faculty (Professor)	100%
Mary Thomas	Core Faculty (Assistant Professor)	50%
Joel Wainwright	Core Faculty (Assistant Professor)	100%
John Arnfield	Emeritus Faculty	
Larry Brown	Emeritus Faculty	

S. Earl Brown	Emeritus Faculty	
Emilio Casetti	Emeritus Faculty	
Howard Gauthier	Emeritus Faculty	
Henry Hunker	Emeritus Faculty	
Duane Marble	Emeritus Faculty	
Harold Moellering	Emeritus Faculty	
Joel Morrison	Emeritus Faculty	
John Rayner	Emeritus Faculty	

Proposal: Bachelor of Science in Atmospheric Sciences

I. GENERAL INFORMATION

1. Give the name of the proposed major.

Atmospheric Sciences

2. State what degree students completing the major will receive.

Bachelor of Science in Atmospheric Sciences

3. State the proposed implementation date.

Autumn 2009

4. Identify the academic units (e.g. department, college, etc.) responsible for administering the major program.

Department of Geography, College of Social and Behavioral Sciences, Colleges of the Arts and Sciences

II. RATIONALE

5. Describe the rational/purpose of the major.

The atmosphere affects Ohio in a number of ways. Blizzards snarl transportation and affect utilities. Floods threaten life and infrastructure. Droughts reduce agricultural production and heat waves cause the demand for electricity to spike. Hail and high winds damage property and increase insurance rates. Even sunshine can increase the formation of haze and smog. In addition, climate change may alter the severity and location of all these events.

Other states and universities understand the importance of the atmospheric sciences and offer comprehensive degrees in this area. Regionally, Penn State, the University of Michigan, Purdue University, and the University of Illinois offer B.S. degrees with majors in meteorology/atmospheric sciences. Some schools are in the process of revising their atmospheric sciences offerings in order to cope with increased demand. For instance, Purdue University recently revised and enhanced its major in Atmospheric Science. The University of Illinois likewise approved a new undergraduate major in Atmospheric Sciences during the 2007-2008 academic year. In contrast, no university in Ohio currently offers a B.S. with a major in meteorology/atmospheric sciences. Students at Ohio State who want to focus on atmospheric sciences currently pursue a B.S. degree with a major in Geography and complete the requirements of the Atmospheric and Climatic Studies (ACS) track.

Our ACS graduates are successful when they apply to top graduate programs as well as to jobs in the public or private sector. However, many current students, alumni and

prospective students (and their parents) have indicated strongly that they would prefer to major in atmospheric sciences if they had that option. In particular, our undergraduates tell us that they find it difficult to understand why graduate students may choose either Geography or Atmospheric Sciences given that they do not have the same option. Their feeling is that students with a specialized B.S. in Atmospheric Sciences will be in a much better position to market themselves upon graduation. Our faculty are agreed, and also believe that a stand alone B.S. in Atmospheric Sciences in the Department of Geography is required in order to keep up with our peer institutions as well as fill state, regional and national demand for undergraduate education in the atmospheric sciences.

Geography at Ohio State has an almost ninety year tradition of research and teaching in the atmospheric sciences. Following a 1920 address to the American Meteorological Society, Eugene Van Cleef was invited to establish a climatology program at the Ohio State University in 1921. Van Cleef became a member of the Department of Geography when it was formed and served as a faculty member here until 1973. As a result of this longstanding focus on climatology and physical geography, the department is recognized internationally as top-ranked in atmospheric sciences-based research and teaching. At the undergraduate level the climatology program has evolved into the ACS track, leading to a B.S. in Geography. The Atmospheric Sciences was established as a Graduate Program at Ohio State in 1971, offering both M.S. and Ph.D. degrees. The Atmospheric Sciences Program was co-located with the Department of Geography in 1986.

The topics of study in the atmospheric sciences have expanded considerably since the inauguration of atmospheric sciences in Geography at the Ohio State University. Climatology is now just one important component in a much broader landscape of research and teaching. Current faculty in the Department of Geography offer a wide range of courses, touching on topics such as global warming, climate change, El Niño, hurricanes, floods and other aspects of severe weather.

Our proposed B.S. in Atmospheric Sciences complements the existing B.S. degree in Geography which is undergoing concurrent revisions. It also potentially feeds into our existing M.S. and Ph.D. programs in Geography and in Atmospheric Sciences and it will provide benefits to students in the Department of Geography and the university. The primary reasons for this proposal are that it

- 1) responds to an existing demand at the undergraduate level for a major in Atmospheric Sciences;
- 2) fills a need that exists at Ohio State and in the state of Ohio;
- 3) takes full advantage of the expanded expertise of recent faculty hires; and
- 4) accurately reflects the broadened nature of the atmospheric sciences. The proposed new major is designed to be consistent with the American

Meteorological Society's Policy Statement on *Bachelor's Degree in Atmospheric Science*.

6. Identify any unique characteristics or resources that make it particularly appropriate for Ohio State to offer the proposed major.

The Ohio State University has a number of unique resources that make it the perfect place for a major in Atmospheric Sciences. The Department of Geography has eight full-time tenure track faculty who teach courses in the atmospheric and related sciences. These faculty and their specializations are listed in Appendix A. One of the faculty, Dr. Jeff Rogers, is the State Climatologist for Ohio. The cluster of faculty at Ohio State and the range of their expertise in the atmospheric sciences exceeds those at any other university in Ohio. In addition the department has another cluster of faculty with expertise in Geographic Information Science (GIS) and remote sensing, which are topics central to the analysis and forecasting of atmospheric conditions. The Department of Geography already offers the courses that are required in the proposed major. The department has computer labs for teaching and research in the atmospheric sciences. Derby Hall 1066 serves as the Synoptic Meteorology Laboratory and home to the Meteorology Club. The department maintains a collection of instruments for field research and teaching that offers students "hands-on" experience with data collection and analysis. The department hosts Twister, the Ohio State University Weather Server, which provides real-time meteorological data for educational and informational uses. Twister is highly visible and many official meteorological web sites, including the National Hurricane Center, maintain links to it.

The Meteorology Club supported by the Department of Geography and the Office Student Activities organizes and hosts an Ohio Severe Weather Symposium (OSWS) every April. The OSWS brings in experts from around the U.S. and the state of Ohio to discuss the causes and effects of severe weather. It provides students an excellent opportunity to interact with professionals in the field and to develop their communication and personal skills.

The university has other unique resources that make it particularly appropriate to offer a major in atmospheric sciences. The university is a member of the University Corporation for Atmospheric Research (UCAR), which consists of approximately 60 universities in the U.S. and Canada that offer Ph.D. degrees in the atmospheric and related sciences. The recently completed review of Doctoral Programs at Ohio State rated the program in Atmospheric Sciences as "Strong". The university is the home of the Byrd Polar Research Center (BPRC), which is a world class facility for research and education in polar meteorology and climate change. The excellent people and extensive facilities at the BPRC provide students with a wide range of opportunities for mentoring and research. The proposed new major also complements the Climate Water Carbon Targeted Investment in Excellence. The Great Lakes Forecasting System (GLFS) was developed as a result of a collaboration between members of the Department of Civil

and Environmental Engineering and Geodetic Sciences and the Atmospheric Sciences Program.

The central location of the university is also a valuable asset for the new major. Students have opportunities for internships at the National Weather Service Forecast Office in Wilmington, at some state agencies, in the private sector with companies like NetJets, and at local media outlets.

7. Cite the benefits for students, the institution, and the region or state.

The purpose of the proposed major is to provide students with the education and experience necessary for them to be successful upon graduation. The specific benefits for the students include

- 1) an excellent liberal arts education preparing them for career paths in the atmospheric sciences and other fields;
- 2) a foundation in atmospheric and related sciences necessary for success in a range of career paths;
- 3) enhanced opportunities for involvement in research, internships and other learning activities; and
- 4) a major that clearly identifies the nature of their education and interest.

However, by far the biggest benefit for students is that the proposed new major is tailored specifically to fit the needs of students who want to pursue careers in the atmospheric sciences. It is organized to provide the foundation and skills necessary with a clear path to graduation. The major includes sufficient flexibility that the professional undergraduate advisor in Geography can help students choose the courses to satisfy the requirements of the General Education Curriculum (GEC) and their electives to match their specific goals. Students who complete the proposed major will be well positioned to take the next step after they graduate. An additional benefit is that the students' major will be clearly identified as Atmospheric Sciences, which is something that students and alumni have been requesting for a long time.

The benefits of the proposed major to the Department of Geography are

- 1) it expands and enhances the existing undergraduate major, which is being modified in a concurrent proposal;
- 2) it aligns the departmental offerings with the interests of the field and current faculty; and
- 3) it responds affirmatively to the requests of undergraduates and alumni.

The benefits of the proposed major to the university are

- 1) it clearly establishes Ohio State as the center for undergraduate education in atmospheric sciences in Ohio;

- 2) it will help recruit high quality students who would have gone out of state to major in meteorology/atmospheric sciences;; and
- 3) it complements other university activities such as the Carbon, Water, Climate (CWC) Targeted Investment in Excellence (TIE).

The principle benefit to the university is that the proposed new major will attract some high quality students that would otherwise attend other universities, particularly the regional universities identified above. Prospective students who insist on pursuing a major called Meteorology/Atmospheric Sciences currently do not choose Ohio State, because the university does not offer that major. In addition to adding to the intellectual vitality of the university some of the best students may also choose to continue at Ohio State and do their graduate work in the Atmospheric Sciences Program. The University of Illinois recently recognized the benefits of a similar proposal and approved a new undergraduate major in Atmospheric Sciences. Another benefit for both students and the university is that it would make it easier for students in related disciplines to do double majors.

The principle benefit to the state of Ohio is that the proposed new major would keep more bright and motivated undergraduate students in the state. There is no university in Ohio that currently offers an undergraduate major in meteorology/atmospheric sciences. Thus, any students who insist on a major with that title leave Ohio to go to a university that offers such a major. The proposed new major would also provide a source of potential employees for businesses that require people who can forecast weather or analyze the risk posed by severe and major events. Major insurers like Nationwide Insurance need people who can analyze the potential risk from severe weather and estimate losses after it occurs. Major utilities like American Electric Power need expert forecasters to help predict load demand and to anticipate the need for repair crews when severe weather threatens their service areas. Transportation companies like NetJets employ meteorologists because they require accurate forecasts for route planning, logistical and safety considerations.

8. List similar majors offered in both public and private institutions in Ohio and the U.S. Explain how these majors compare to the one proposed.

No similar majors are offered by any institution within the state of Ohio. Based on information available on the American Meteorological Society's web site, approximately 29 public and private institutions offer B.S. majors in either Atmospheric Sciences or Meteorology. Penn State and Michigan offer B.S. majors in Meteorology, and Purdue and Illinois offer B.S. majors in Atmospheric Sciences. A list of the universities that offer similar majors is contained in Appendix B. A few of the majors are offered at institutions that only have undergraduate programs. Many of the majors are offered by programs that also offer M.S. and Ph.D. degrees in Meteorology/Atmospheric Sciences. That will be the situation at Ohio State, if the proposed major is approved.

The American Meteorological Society Council adopted a policy statement on the *Bachelor's Degree in Atmospheric Science* on 29 April 2005. The policy statement, which is contained in Appendix G, describes the attributes that should characterize such a degree program. The 29 degree programs listed in Appendix B conform to the policy statement and the attributes listed in it were followed in the design of the proposed major. The proposed major is very similar to a major in Atmospheric Sciences recently approved at the University of Illinois. The primary differences between the proposed major and the similar majors at other institutions are found in the electives available to students. No institution attempts to cover all of the specializations in the atmospheric sciences. Institutions tend to cluster faculty in a few specializations that represent their areas of emphasis. The electives in the proposed major reflect the expertise and areas of emphasis of the faculty at Ohio State.

9. Cite the enrollment patterns of similar majors in Ohio or in the United States.

Periodic surveys conducted by the American Meteorological Society and the University Corporation for Atmospheric Research reveal that approximately 1000 undergraduates in the U.S. are pursuing a B.S. in Meteorology/Atmospheric Sciences at any given time. This number has remained relatively steady over the past 10-15 years. The specific enrollment data cited in this proposal were gathered from the American Meteorological Society's web site and from requests to specific well-regarded programs in the Big Ten and the U.S. The available data are contained in Appendix B.

As can be seen in Appendix B, the enrollments range from 20-30 students in the smaller programs to approximately 300 students at Penn State and the University of Oklahoma. Typical programs have roughly 50-150 undergraduates in their majors. The programs with the fewest number of majors tend to be at private institutions or in programs that only offer B.S. degrees. The programs with the larger number of major tend to be at public institutions and offer M.S. and Ph.D. degrees as well as a B.S.

10. Describe career opportunities and/or opportunities for graduate or professional study available to persons who complete the major.

Undergraduates who complete the proposed major will have the foundation to apply successfully to highly regarded graduate programs in meteorology/atmospheric sciences. The requirements of the proposed major exceed the entrance requirements of those graduate programs. Students who indicate an interest in graduate study will be advised to maximize their opportunities through involvement in internships and summer programs, and will be strongly encouraged to participate in research projects.

The proposed major contains the courses necessary for undergraduates who are interested in a career as a weather forecaster. Students who complete the major will fulfill all of the Federal Civil Service Requirements for Meteorologist Positions (GS 1340). This will qualify the students for meteorology positions in the National Weather Service,

the Federal Aviation Administration or any other Federal agency. Students in ROTC will be qualified for meteorology positions in their respective branch of the Armed Services. Students will also be qualified for weather forecasting positions in the private sector, since most private companies base their expectations on the Federal GS 1340 requirements. Students who indicate interest in careers in weather forecasting will be strongly advised to participate in internships at the National Weather Service Forecast Office in Wilmington or at private companies in order to acquire additional practical experience. Students currently prepare a daily local forecast that appears on the front page of The Ohio State University Weather Server – Twister. The nature of the rotating shifts worked by forecasters in both the public and private sector and the need to forecast the weather 24 hours a day, seven days a week ensures a constant turnover and job opportunities. Organizations like the American Meteorological Society and the National Weather Association regularly post new announcements of openings for weather forecasters on their web sites.

Undergraduates who are interested in a career as an on-air meteorologist will receive an excellent background in the fundamentals of meteorology and in the techniques used to analyze and display meteorological information. Students who indicate an interest in becoming an on-air meteorologist will be advised to take Communications and other courses to supplement their meteorological training. They will also be strongly encouraged to participate in internships with local media in order to get valuable practical experience and make necessary professional contacts. Persons entering the field of on-air meteorology generally begin in smaller markets at modest salaries. Individuals with talent, skill and motivation can quickly progress to larger markets with much higher salaries.

The proposed major contains sufficient flexibility for undergraduates who are interested in careers in environmental monitoring, consulting, applications development or some aspect of the atmospheric sciences besides weather forecasting and on-air meteorology.

The American Meteorological Society, the University Corporation for Atmospheric Research and other organizations periodically conduct surveys of starting salaries for atmospheric scientist. Estimated starting salaries based on a compilation of those data for three career paths are presented in Table 1.

Table1
Estimated Starting Salaries for Atmospheric Scientists

Degree	B.S.	M.S.	Ph.D.
Private Sector	\$18,000.- \$30,000.	\$30,000.- \$40,000.	\$40,000.- \$60,000.
Government	\$28,000. - \$34,500.	\$42,000. – \$54,000.	\$70,000. -
Academic			\$45,000. - \$80,000.

11. Describe any licensure or certification for which this major will prepare students.

The American Meteorological Society (AMS) has programs that certify the credentials of meteorologists/atmospheric scientists in two career paths. The Certified Broadcast Meteorologist Program awards the AMS Seal of Approval to those individuals who fulfill the requirements of that program. Completion of the proposed major will fulfill one of the requirements for the Seal of Approval. The AMS Certified Consulting Meteorologist Program is available for meteorologists who work as consultants in the private sector. Completion of the proposed major will fulfill one of the requirements for that certification and will prepare students for the written and oral exams they will have to pass to become certified.

III. GOALS/OBJECTIVES/EVALUATION**12. Provide a learning outcomes assessment plan for the major program.****A. State the general and specific educational goals and objective for the major.**

The goal of the proposed major is to provide students with a foundation in basic atmospheric and related sciences, mathematics and statistics, while providing sufficient flexibility and breadth so students can pursue a number of different career paths. It is designed to allow students to acquire an appropriate combination of fundamental knowledge, core competencies and skills for their chosen goals. The courses required for the major are chosen to provide students opportunities to develop critical thinking and communication skills including problem solving, reasoning, analytical and other relevant professional skills.

Students who want to major in atmospheric sciences typically have the following goals:

- 1) to pursue graduate education in the atmospheric sciences and become research scientists;
- 2) to become weather forecasters in either the public or private sector;
- 3) to become on-air meteorologists; or
- 4) to acquire a more broadly based liberal arts education focused on their interest in the atmospheric sciences.

This proposed major is designed to provide the rigor and foundation for students who want to do research and to provide the flexibility, knowledge and skills for those students who want pursue other opportunities.

The general educational goals of the proposed major are:

- 1) to provide students with a core foundation of knowledge in the atmospheric and related sciences;

- 2) to prepare students for graduate study in atmospheric science or a closely related field through advanced education with a focus on critical thinking and problem solving; and
- 3) to prepare students for a successful career through advanced education and training in the relevant professional skills.

The specific educational goals for the proposed major are:

- 1) to provide students with the theoretical basis for fundamental atmospheric processes and systems;
- 2) to develop students' ability to solve problems faced by atmospheric scientists;
- 3) to introduce students to computational and other forms of technology used in the atmospheric sciences.

B. Indicate the methods that will be used to assess whether the educational goals and objectives are being met.

The Department of Geography currently has an assessment plan that includes suite of outcome monitoring methods that allows us to gauge whether or not it is meeting pedagogical goals and to make necessary corrections. The plan is reviewed annually by the College of Social and Behavioral Sciences, and it is managed by the department's professional undergraduate advisor. The plan consists of two indirect assessment methods and one direct method. The assessment methods include:

- 1) embedded questions in the exams given in one regularly offered and popular upper division undergraduate course;
- 2) informal focus groups with students in the major (e.g. In the 2007-2008 academic year there were four focus groups representing each of the specializations within the major); and
- 3) an exit survey of graduating seniors, which includes questions about the major regarding their overall educational experience, classroom experience, research and internship participation, and placement in jobs and in graduate schools.

The Department of Geography is conducting a concurrent revision to its undergraduate major and is developing an improved assessment strategy. The department is in the process of refining the methods it uses for assessment. The intention is to take the information gained during the assessment process to date and to improve the preparation of students for graduate studies and the job market. In addition the department is gaining experience with the methods of assessment and an ongoing evaluation of those methods will lead to better assessment of the major.

Because the proposed major will be within the Department of Geography it will be able to take advantage of the experience the department has with assessment. The initial

assessment plan consists of similar elements to those already used by Geography. They include:

- 1) the use of existing questions in Atmospheric Sciences 638;
- 2) informal focus groups with undergraduate majors and members of the Meteorology Club; and
- 3) exit interviews with graduating seniors.

Atmospheric Sciences 638 (Dynamic Meteorology II) is a course that many students will take as one of the last courses required for their major. Most students will have already taken courses dealing with synoptic meteorology and boundary layer processes. Some of the topics covered in Atmospheric Sciences 638 include the derivations of the theoretical bases for many important concepts in synoptic meteorology. There are also discussions of the assumptions made during the derivations and the limitations imposed by those assumptions on the applications of the resulting concepts. In addition some of the material covered in Atmospheric Sciences 638 links the processes in the boundary layer to the processes operating in the rest of the large scale atmosphere. Thus, some of the questions on examinations in Atmospheric Sciences 638 provide an opportunity to assess students' acquisition of a core foundation of knowledge in the atmospheric sciences. The performance of the students on specific questions will be reviewed by faculty who teach courses in the proposed major and curriculum changes will be discussed and implemented as necessary. Those faculty already meet both formally and informally to discuss curriculum issues.

Focus groups will be conducted without faculty present in order to encourage students to feel free to be open with their opinions. Students' opinions on individual courses required for the proposed major and on the structure and requirements of the major will be solicited. The results of the focus groups will be conveyed to the faculty and changes to the major will be considered as appropriate.

Exit interviews will include questions about the future plans of graduating seniors. In addition to providing additional opinions on the structure and requirements of the proposed major, the exit interviews will provide data in the ability of graduating seniors to get into graduate programs and to find employment. This information will enable the department to assess if the proposed major is meeting its goal of preparing students for those options. The information gathered during the exit interviews will be reviewed and discussed by the faculty and changes to the major will be considered as appropriate.

C. Provide the time over which the assessment plan will be implemented.

Because this will be a new major, the implementation of the assessment methods will be introduced gradually.

Year 1 – Focus groups

Year 2 – Focus groups, assess questions in Atmospheric Sciences 638

Year 3 – Focus groups, assess questions in Atmospheric Sciences 638, exit interviews,

Year 4 – Focus groups, assess questions in Atmospheric Sciences 638, exit interviews, review assessment plan.

IV. RELATIONSHIP TO OTHER PROGRAMS

13. Describe current major and minor programs in the department(s) and how they relate to the proposed major.

The current major in Geography contains an Atmospheric and Climatic Studies (ACS) track. The details of the current major are contained in Appendix C. The current structure of the ACS track contains two paths in Atmospheric Sciences and in Climatic Studies. The Climatic Studies path represents an evolution of the Geography's original specialization in climatology and it is a path typically found in many Geography departments around the U.S. Students in the Climatic Studies path are provided with the foundation necessary to analyze climate and climate change and are exposed to a broader geographical education. The Atmospheric Sciences path was developed in attempt to address the needs and requests of students who wanted to pursue graduate education or other career opportunities in the atmospheric sciences. The Atmospheric Sciences path requires students to complete three additional Mathematics courses (i.e. through differential equations), and requires students to complete courses providing a thorough theoretical foundation in atmospheric sciences. The Atmospheric Sciences path was designed using all of the relevant courses offered by the Department of Geography at the time it was created.

The Department of Geography has subsequently hired additional faculty in the atmospheric sciences and has expanded both the range and level of the courses it offers in that area. The department is undertaking a thorough re-examination and modification of all of the undergraduate tracks in a separate proposal being developed concurrently with this proposal. The existing Atmospheric and Climatic Studies (ACS) track in Geography is being completely revamped and will become the Climatology and Physical Geography (CPG) track. The details of proposed CPG track are contained in a separate proposal and are listed in Appendix D. The Atmospheric Sciences path is being eliminated in the proposed revisions to the Geography major, contingent upon approval of this proposal.

The requirements of the proposed new major in Atmospheric Sciences are more rigorous than those for the current Atmospheric Sciences path. Students will be

required to take an additional physics course (Physics 133), a Chemistry course (Chemistry 121), and two additional courses in their major (chosen from a list of electives in the major). These additional requirements will make the proposed major consistent with the attributes listed in the American Meteorological Society's Policy Statement on *Bachelor's Degree in Atmospheric Science* and will make students who complete the major competitive with graduates of other universities around the U.S.

The proposed major differs from the existing M.S. in Atmospheric Sciences in both the required level knowledge and skills. Students pursuing a M.S. degree must take graduate- only seminars in addition to their other coursework. Students who successfully complete a M.S. degree must demonstrate a higher level of knowledge in specific areas in comprehensive written and oral examinations and demonstrate research competency by writing a Thesis

14. Identify any overlaps with other programs or departments within the University. Append letters of concurrence or objection form related units.

There is no overlap with other majors or programs within the university.

15. Indicate any cooperative arrangement with other institutions and organizations that will be used to offer this major.

None.

16. Specify any articulations arrangements (direct transfer opportunities) with other universities that will be in effect for the major.

None.

17. Provide information on the use of consultants or advisory committees in the development of the major. Describe any continuing consultation.

Initial consultations were held with all members of the Department of Geography who teach courses in the current Atmospheric and Climatic Studies (ACS) track. Ideas about the content and structure of the proposed major were discussed. The opinions of some alumni were solicited. Consultations continued with the faculty and a consensus was achieved about the content and structure of the major. A focus group of undergraduates in the current ACS track or in the Meteorology Club was convened in Spring Quarter of 2007. The focus group strongly favored the proposed major and responded positively to its content and structure. The proposed major was discussed by the Undergraduate Curriculum Committee in Geography and at a subsequent departmental faculty meeting. Minor modifications to the proposal were made and unanimously endorsed by the faculty in the ACS track. If substantial modifications to

the structure and content of the proposed major are required, the faculty will be consulted and their endorsement will be sought.

18. Indicate whether this major or a similar major was submitted for approval previously. Explain at what stage and why that proposal was not approved or was withdrawn.

This proposed major has never been submitted previously for approval.

19. Indicate where students will be drawn from, e.g. existing academic programs, outside the university, etc. Estimate the mix of students entering the major internally and externally.

The projections in this section are based on discussions with current undergraduate students in the Atmospheric and Climatic Studies (ACS) track and the professional undergraduate adviser in the Department of Geography. It is projected that a large percentage of undergraduates currently in the ACS track will switch to the proposed major. The projection is that 51 students will switch from the ACS track to the proposed major. In addition we project 5 new students will choose the proposed major. As the proposed major becomes more widely known, it is anticipated that the number of new students choosing the major will increase, as indicated by the projections in the answer to Question 20. Most of the increase in entering students who choose the proposed major will be comprised of students who will not attend Ohio State, if the proposed major is not available. There will likely be 1-3 students each year who change majors and choose the proposed major, but most of the new majors will arrive from outside Ohio State. Many students who choose to major in the meteorology/atmospheric sciences at other universities declare that major as incoming freshman. It is anticipated that a similar pattern will occur at Ohio State. It is anticipated that the number of undergraduates in the proposed major will level off at between 90-120 students. This projection is consistent with the enrollment in similar majors at other universities and would be an appropriate size for the proposed major.

V. STUDENT ENROLLMENT

20. Indicate the number of students you anticipate will be admitted to the major each year.

Student type	Year 1	Year 2	Year 3	Year 4
Full time (new entering)	56	9	11	15
Full time (cumulative)	56	65	76	91
Summer enrollment	4	4	5	5

VI. REQUIREMENTS

21. List the courses (department, title, credit hours, description) which constitute the requirements and other components of the major. Indicate which courses are currently offered and which will be new. Append a quarter-by-quarter sample program and all New Course, Course Change, and Course Withdrawal forms necessitated by the implementation of the proposed major.

The requirements for the major are contained in Appendix E. A quarter-by-quarter sample program is contained in Appendix F. The curriculum consists of 181 credit hours including the required one credit hour university survey course. The Required Prerequisites and Supplements to the major consist of 50 credit hours, but 35 of those hours may also be applied to the General Education Curriculum (GEC) requirements for B.S. degrees in the Colleges of the Arts and Sciences. The Core Courses in the major consist of 43 credit hours. The Major Electives consist of 8-10 credit hours depending on which courses students choose. Thus, there are 51-53 total credit hours required in the proposed major. The GEC for B.S. students consists of 100 credit hours, but 35 of those credit hours overlap with the Required Prerequisites and Supplements to the major. Therefore, a student will have 12-14 credit hours of Free Electives unencumbered by the other requirements for graduation. Students will be advised about which GEC courses and Free Electives are most appropriate for their interests and career aspirations.

Three new courses are being proposed as part of the new major. Atmospheric Sciences 689 (Student Internship in Atmospheric Sciences), Atmospheric Sciences 699 (Undergraduate Research in Atmospheric Sciences) and Atmospheric Sciences H783 (Honors Research) are being proposed as a result of input from students and alumni that indicated they wanted something on their transcripts that clearly indicated their internships or research were in atmospheric sciences. Copies of the proposals for these new courses are attached to this proposal. The major also includes a new course, Geography 684 (Geographic Applications of Remote Sensing), that is being proposed by the Department of Geography as a part of the revision to the B.S. major in Geography.

22. State the minimum number of credit required for completion of the major.

The minimum number of credit hours required for the major is 51.

23. State the average number of credits expected for a student at completion of their major.

We expect most students to have 53 major credit hours when they graduate, based on the average number of credits in the elective courses.

24. Give the average number of credits taken per quarter by a typical student. Estimate the average for each year.

A typical student takes an average of 15 credit hours per quarter. A typical student takes an average of 45 credit hours per year.

25. Given the number of credits a student is required to take in other departments.

Students are not required to take any credit hours in their major in other departments. Students may choose to take 5 credit hours in Geological Sciences or 4-8 hours in Civil Engineering if they choose those courses for their Major Electives. Students are required to take 25 credit hours in Mathematics, 15 credit hours in Physics, 5 credit hours in Chemistry and 5 credit hours in Statistics as part of their Required Prerequisites and Supplements to the Major.

26. Give the number of credits a typical student might take as electives in other departments.

The typical student might take 12-30 credit hours as electives in other departments. The number of credit hours and specific courses taken by an individual student will depend the student's career goals and area of interest within the atmospheric sciences.

27. Describe other major requirements in addition to course requirements, e.g., examinations, internships, final projects.

None.

28. Identify from which specialized professional association(s) accreditations will be sought. List additional resources that will be necessary to gain such accreditation.

No accreditation will be sought form professional associations. Although the American Meteorological Society has discussed the possibility of developing an accreditation program from time to time, it has always decided against doing so.

29. Describe the number and qualifications of full-time or part-time faculty. List current faculty and areas of expertise. Describe the number and type of additional faculty needed.

There are eight full time tenure track faculty who will teach courses in the proposed major. The list of the faculty and their areas of expertise are listed in Appendix A. In addition to the specializations listed in Appendix A Dr. Rogers is the State Climatologist for Ohio. Dr. Mosley-Thompson has received numerous awards for her distinguished work in paleoclimatology and climate change and Dr. Hobgood received an Alumni Distinguished Teaching Award in 1996. So, the faculty who will be teaching courses and

mentoring students in the proposed major are extremely well-qualified to do so. No new faculty are required for the establishment of this major. If opportunities arise to hire additional faculty who can contribute to this proposed major, the major will be revised appropriately.

30. Describe existing facilities, equipment, and off-campus field experiences to be used. Indicate how the use of these facilities, equipment, etc. will impact other existing programs.

The Department of Geography has computer labs for teaching and research in the atmospheric sciences. There are sufficient resources in the labs to handle any additional students in courses taught in those labs generated by the proposed new major. Derby Hall 1066 already serves as the Synoptic Meteorology Laboratory and home to the Meteorology Club. There is sufficient space in that room to accommodate the increased number of students projected for the new major. The Department of Geography maintains a collection of instruments for field research and teaching that offers students “hands-on” experience with data collection and analysis. The department has sufficient resources to acquire additional instruments if the number of students in the new major exceeds expectations. Thus, the additional students generated by the proposed major should not have a major impact on existing facilities and equipment.

Specifically, the Department of Geography uses Derby 0140 as its primary instructional computer laboratory. Several of the courses required in the proposed major are already being taught in that lab. There are open seats available when those courses are taught. Derby 0140 contains 50 state-of-the-art workstations and each is equipped with a full complement of relevant software. The lab is managed by two full-time technical staff and a graduate student. The department is confident that its existing staff will be able to manage the increased usage of the lab. There is sufficient space in the lab to expand the number of workstations by 30%, if the number of majors increases beyond the projections. Undergraduates are free to use the workstations in Derby 0140 for class assignments and research projects when no classes are being taught in the lab. This generally means that students have access to those machines at most times between 5:00 p.m. and 9:00 a.m.

The Department is preparing a spacious new undergraduate student resource center. The designation of this space specifically for undergraduates will give students in the proposed major a dedicated space, when they need to work in Derby. Computers will be installed in the center, which will further increase the number of machines available to undergraduates working on class assignments or research projects. The resource center will supplement the space in the Synoptic Meteorology Laboratory in Derby 1066 for the Meteorology Club. Undergraduates in the proposed major will have multiple places in Derby Hall where they can work.

31. Describe additional University resources, including libraries that will be required for the new major.

None.

32. Describe the major as it would appear in the appropriate college bulleting.

The undergraduate Atmospheric Sciences major examines atmospheric processes and systems that occur at many spatial and temporal scales. A fundamental understanding of the theoretical basis of atmospheric transfers of matter and energy provides the foundation necessary to analyze systems of varying sizes and intensities. These theories provide the framework used to analyze current patterns of weather and climate and to predict future changes of weather and climate. Numerical models of the atmosphere solve equations based on these theories and are used to provide forecasts at many scales.

The major is designed to prepare students for a variety of career paths. The major emphasizes a strong fundamental background to prepare students for a lifetime of learning as knowledge about weather and climate advances. The strong background will serve students who desire a career in research and those who are more interested in operational meteorology well. Applications of computers and other technology in the atmospheric sciences continue to expand. Students are introduced to technology used by atmospheric scientists and are encouraged to develop their computational skills. The requirements for the major and the available electives provide sufficient flexibility for students to be able to tailor a program of study for their particular interests.

Students graduating with a major in Atmospheric Sciences will be well prepared to compete for admission to graduate programs in meteorology or atmospheric sciences and to find gainful employment in the public and private sector. Students who desire advanced training at the graduate level will have the foundation necessary to contribute to research projects and be successful. Students who are interested in jobs in operational or broadcast meteorology will have the knowledge and training to be able to negotiate successfully the challenges of those professions. Graduates will have the background to enable them to add value and make positive contributions to their chosen endeavors.

**Appendix A
Faculty**

Box, Jason (Assistant Professor), Global Energy and Mass Balances, Climate Change.

Bromwich, David (Professor), Polar Meteorology and Climatology, Climate Theory: Modeling and Diagnostics, Cryosphere, Mesoscale Meteorology and Modeling, Precipitation, Operational Weather Prediction.

Hobgood, Jay (Associate Professor), Hurricanes, Tropical Cyclones, Atmospheric Thermodynamics, Dynamic Meteorology.

Lin, Jialin (Assistant Professor), Global Climate Modeling, Tropical Dynamics, Tropical Convection and Clouds.

Mark, Bryan (Assistant Professor), Climatology, Paleoclimatology, Mountain Climate, Tropical Glaciers, Glacier-Climate Dynamics, Climate-Change Impacts.

Mosley-Thompson, Ellen (Professor), Paleoclimatology, Ice Cores, Climate variability and Change, Abrupt Climate Change, Volcanic Aerosols, Polar Climatology.

Porinchu, David (Assistant Professor), Global Change, Paleoclimatology, Paleoecology, Biogeography, Climate Change.

Rogers, Jeffery (Professor), Climatology, Climatic Change, Synoptic Meteorology.

Appendix B
Similar Majors at Other Universities in the U.S.

University	Degree Offered	Estimated Enrollment
Univ. of California at Davis	B.S. Atm. Sc.	25
UCLA	B.S. Atm. Sc.	35
Creighton Univ.	B.S. Atm. Sc.	20
Florida St. Univ.	B.S. Meteor.	160
Georgia Tech.	B.S. Earth and Atm. Sc.	60
Univ. of Hawaii at Manoa	B.S. Meteor.	20
Univ. of Illinois	B.S. Atm. Sc.	New major
Iowa State Univ.	B.S. Meteor.	NA
Lyndon St. Col.	B.S. Meteor.	55
Univ. of Missouri-Columbia	B.S. Atm. Sc.	70
Univ. of Michigan	B.S. Meteor.	NA
Univ. of Nebraska-Lincoln	B.S. Meteor.	65
North Carolina St. Univ.	B.S. Meteor.	125
University of Nevada-Reno	B.S. Atm. Sc.	NA
Univ. of North Carolina-Asheville	B.S. Atm. Sc.	100
Northern Illinois Univ.	B.S. Meteor.	NA
SUNY at Albany	B.S. Atm. Sc.	NA
Oklahoma Univ.	B.S. Meteor.	310
Penn. St. Univ.	B.S. Meteor.	300
Purdue Univ.	B.S. Atm. Sc.	60
San Jose St. Univ.	B.S. Meteor.	NA
S. Dakota School of Mines and Tech.	B.S. Atm. Sc.	NA
Texas A&M Univ.	B.S. Atm. Sc.	150
Texas Tech. Univ.	B.S. Atm. Sc.	NA
Univ. of Utah	B.S. Meteor.	90
Univ. of Wisconsin-Madison	B.S. Atm. Sc.	120
Univ. of Washington	B.S. Atm. Sc.	NA
Univ. of North Dakota	B.S. Atm. Sc.	75
Rutgers	B.S. Atm. Sc.	50

NA – The estimated enrollment was Not Available.

Appendix C. Current Atmospheric and Climatic Studies Curriculum

Part A. Required Prerequisites or Supplements to the Major

1. Atmospheric Sciences path
 - Math 151, 152, 153, 254, 415
 - Physics 131, 132
 - Statistics 245
2. Climatic Studies path
 - Math 151, 152
 - Physics 131, 132
 - Statistics 245

Part B. Core Requirements

1. For both Atmospheric Science and Climatic Studies paths
 - Basic Meteorology AS 230 OR Climatology Geog 520
 - Synoptic Meteorology Laboratory AS/Geog 620
 - Boundary Layer Climatology Geog 622.01
 - Microclimatological Measurements Geog 622.02
 - Synoptic Analysis and Forecasting Geog 623.01
 - Severe Storm Forecasting 623.02
2. Additional for the Atmospheric Science path
 - Atmospheric Thermodynamics AS 631
 - Dynamic Meteorology I AS 637
 - Dynamic Meteorology II AS 638
3. Additional for the Climatic Studies path
 - Introduction to Cartography Geog 580
 - Undergraduate Seminar in Applied Geography Geog 695 OR Seminar in Geography Geog 795
 - Any Human Geography course 600-level or higher

Part C. Electives within the Major

- NA

Appendix D. Proposed Climatology and Physical Geography Curriculum

Part A. Required Prerequisites or Supplements to the Major

1. For Climatic Studies path
 - Math 151, 152, 153
 - Physics 131, 132
 - Statistics 245
2. For the Physical Geography path
 - Math 151, 152
 - Physics 131
 - Statistics 245

Part B. Core Requirements

1. For Climatic Studies path
 - Basic Meteorology AS 230 OR Climatology Geog 520
 - Synoptic Meteorology Laboratory AS/Geog 620
 - Boundary Layer Climatology Geog 622.01
 - Microclimatological Measurements Geog 622.02
 - Synoptic Analysis and Forecasting Geog 623.01
 - Severe Storm Forecasting 623.02
2. For Physical Geography path
 - Introduction to Physical Geography Geog 220
 - Global Climate Change: Causes and Consequences Geog 420
 - Biogeography: An Introduction to Life on Earth Geog 490
 - Basic Meteorology AS 230 OR Climatology Geog 520
 - Integrated Earth Systems: Confronting Global Change Geog 597.02
 - Geomorphology Earth Sci 550

Part C. Electives within the Major

1. For Climatic Studies path. Choose five of the following courses:
 - Climate System Modeling: Basics and Applications AS 629
 - Atmospheric Thermodynamics AS 631
 - Dynamic Meteorology I AS 637
 - Dynamic Meteorology II AS 638
 - Physical Geography and Environmental Issues Geog 210
 - Global Climate Change: Causes and Consequences Geog 420
 - Biogeography: An Introduction to Life on Earth Geog 490
 - Introduction to Cartography Geog 580
 - Integrated Earth Systems: Confronting Global Change Geog 597.02
 - Fundamentals of Geographic Information Systems Geog 607
 - Undergraduate Research and Professionalization Seminar Geog 695 OR Seminar in Geography Geog 795

2. For Physical Geography path. Choose five of the following courses (at most one may be from Earth Sciences):
 - Physical Geography and Environmental Issues Geog 210
 - Introduction to Cartography Geog 580
 - Computer Cartography and Geographic Visualization 680
 - Fundamentals of Geographic Information Systems Geog 607
 - Intermediate Geographic Information Systems Geog 685
 - Undergraduate Research and Professionalization Seminar Geog 695 OR Seminar in Geography Geog 795
 - One Human Geography course 600-level or higher
 - Synoptic Meteorology Laboratory AS/Geog 620
 - Boundary Layer Climatology Geog 622.01 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Microclimatological Measurements Geog 622.02 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Synoptic Analysis and Forecasting Geog 623.01 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Severe Storm Forecasting 623.02 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Climate System Modeling: Basics and Applications AS 629
 - Atmospheric Thermodynamics AS 631 (note: has a prerequisite of Math 153)
 - Dynamic Meteorology I AS 637 (note: has prerequisite of Math 255)
 - Dynamic Meteorology II AS 638
 - Principles of Oceanography Earth Sci 206
 - Water in the Basin Hydrologic Cycle Earth Sci 410
 - Glaciers and Landscapes Earth Sci 650

Part D. Internship

1. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix E. Proposed Atmospheric Sciences Major**Atmospheric Sciences Major**

The Atmospheric Sciences major provides core foundation of knowledge in the atmospheric sciences with emphases on theoretical concepts and techniques of analysis and problem solving.

Part A. Required Prerequisites or Supplements to the Major. (Do not count toward the credit hours required in the major)

Courses	Credit Hours
Math 151 – Calculus and Analytic Geometry I	5
Math 152 – Calculus and Analytic Geometry II	5
Math 153 – Calculus and Analytic Geometry III	5
Math 254 – Calculus and Analytic Geometry IV	5
Math 255 – Differential Equations and Their Applications	5
Physics 131 – Introductory Physics: Particles and Motion	5
Physics 132 – Introductory Physics: Electricity and Magnetism	5
Physics 133 – Introductory Physics: Thermal Physics, Waves and Quantum Physics	5
Chemistry 121 – General Chemistry	5
Statistics 245 – Introduction to Statistical Analysis	5

Part B. Core Requirements. (43 hours)

Courses	Credit Hours
Atmospheric Sciences 230 – Basic Meteorology	5
<i>Or</i>	
Geography 520 – Climatology	5
Atmospheric Sciences/Geography 620 – Synoptic Meteorology Laboratory	3
Geography 622.01 – Boundary Layer Climatology	5
Geography 622.02 – Microclimatological Measurements	5
Geography 623.01 – Synoptic Analysis and Forecasting	5
Geography 623.02 – Severe Storm Forecasting	5
Atmospheric Sciences 631 – Atmospheric Thermodynamics	5
Atmospheric Sciences 637 – Dynamic Meteorology I	5
Atmospheric Sciences 638 – Dynamic Meteorology II	5

Part C. Major Electives (Choose two courses from the list below)

Courses	Credit Hours
Atmospheric Sciences 629 – Climate System Modeling: Basics and Applications	5
Geography H410 – Global Climate and Environmental Change	5
<i>Or</i>	
Geography 420 Global Climate Change: Causes and Consequences	5
Geography 597.02 – Integrated earth Systems: Confronting Global Change	5
Geography 607 – Fundamentals of Geographic Information Systems	5
Geography 684 – Geographic Applications of Remote Sensing	5
Geological Sciences 206 – Principles of Oceanography	5
Civil Engineering 603 – Remote Sensing	4
Civil Engineering 613 – Principles of Applied Hydrology	4

Appendix F. Sample Four Year Plan

Sample four year plan B.S. Atmospheric Sciences			
Year 1			
Autumn	Winter	Spring	Summer
English 110	Math 151(Pre-major and GEC)	Math 152(Pre-major and GEC)	
Math 150	First Foreign Language course	Physics 131 (Pre-major and GEC)	
First GEC Social Science course	Visual/Performing Arts	Second Foreign Language course	
University Survey course (1 hour)			
Year 2			
Autumn	Winter	Spring	Summer
Math 153	Math 254	Math 255	
Physics 132 (Pre-major and GEC)	Physics 133 (Pre-major)	Atmospheric Sciences 230 (or	
Third Foreign Language course	Fourth Foreign Language course	Geography 520)	
		GEC Second Writing course	
Year 3			
Autumn	Winter	Spring	Summer
Atmospheric Sciences 631	Geography 622.01	Geography 623.01	
Geography 620	Geography 623.01	Chemistry 121 (Pre-major and GEC)	
Statistics 245	Second GEC Social Science course	Literature	
Year 4			
Autumn	Winter	Spring	Summer
Geography 622.02	Atmospheric Sciences 637	Atmospheric Sciences 638	
Civil Engineering 206(M.Elective)	Earth Sciences 206 (M.Elective)	Fourth GEC Science course(must	
First GEC Historical Study	Second GEC Historical Study	be a Biological Science)	
First Additional Breadth course		Elective	
		Second Additional Breadth course	

Appendix G. AMS Policy Statement on Bachelor of Science in Atmospheric Science**Bachelor's Degree in Atmospheric Science**

(Adopted by AMS Council on 29 April 2005) *Bull. Amer. Met. Soc.*, 86

1. Introduction
2. Attributes of bachelor's degree programs
3. Appendix A: Preparation for selected careers in atmospheric science
4. Appendix B: Federal civil service requirements for meteorologist positions (GS 1340, effective 1 March 1998)

1. Introduction

The primary purpose of this statement is to provide guidance to university faculty and administrators who are seeking to establish and maintain undergraduate programs in atmospheric science. This statement describes the minimum curricular composition, faculty size, and facility requirements recommended by the American Meteorological Society for an undergraduate degree program in atmospheric science¹. It also provides information that may be helpful to prospective students who are exploring educational alternatives in atmospheric science. Although the focus of this statement is deliberately on curricular composition and course offerings, it must be recognized that the content, format, and methods used for teaching those courses are important factors in student outcomes and their preparedness for future careers. For example, courses with more hands-on experiences can have a considerable impact on student learning.

A contemporary academic program in atmospheric science must provide students with a fundamental background in basic atmospheric and related sciences, mathematics, and statistics. It must also provide flexibility and breadth so that students can prepare to pursue a variety of professional career paths. Along the way to their graduation, students must acquire an appropriate mix of fundamental knowledge, core competencies, and skills needed to compete and succeed in a variety of atmospheric science-related careers. While emphasizing fundamental knowledge in atmospheric science, the curriculum should also consider the fact that many of the significant problems facing the world today deal with the interaction of processes that span multiple domains in natural, physical, and mathematical sciences. Atmospheric science courses must also provide students ample opportunity for developing communication and critical thinking skills, including problem solving, reasoning, analytic and other relevant professional skills.

Computers and information technologies are now playing a central role in this

complex and ever-changing world in which we live and work, with the Internet reshaping almost every aspect of life, including education and commerce. More than ever, educators, students and their future employers recognize the importance of computer literacy and information technology (IT) skills. To meet those expectations, atmospheric science programs must help students build a seamless pathway from the classroom to productive careers in atmospheric and related fields and prepare them for today's increasingly IT-driven and global society. Specifically, computer programming and other computer-related skills should be integrated, as appropriate, into as many atmospheric science courses as feasible.

Also due to the rapid advances in computer and communication technologies, students will encounter frequent and inevitable changes in the types and forms of technologies with which they will interact and the ways in which they will use them when they join the workforce. Undergraduate atmospheric science education, therefore, should also be designed to develop student talents that provide them the necessary versatility for long-term success in an evolving profession.

The program attributes listed in [section 2](#) are those common to any career in atmospheric science. Additional coursework may be helpful for gaining entry to some specific career paths; suggestions are given in Appendix A for a few selected careers.

While many similarities exist, the curricular program described in [section 2](#) differs from that required for employment as a meteorologist by the federal government ([see Appendix B](#) for current federal civil service requirements). Although the federal requirements provide excellent guidelines for preparation for a career in operational weather forecasting, university academic requirements are designed to support a broader spectrum of career options.

2. Attributes of bachelor's degree programs

a. General objectives

The objectives of a bachelor's degree program in atmospheric science should include strong preparation for:

- 1) a successful career in atmospheric science or a closely related field through a combination of in-depth education and the development of a range of relevant professional skills; *or*
- 2) graduate study in atmospheric and related sciences through in-depth education

and focus on critical thinking, problem solving, reasoning, and analytic and other scientific skills.

b. Course offerings

A curriculum leading to a Bachelor of Science or Bachelor of Arts degree in atmospheric science should contain

1) at least 24 semester hours² of credit in atmospheric science courses that include the following:

- 12 semester hours of lecture and laboratory courses, with calculus as a prerequisite or corequisite 3, in atmospheric thermodynamics and dynamic, synoptic, and mesoscale meteorology that collectively provide a broad treatment of atmospheric processes at all scales;
- 3 semester hours of atmospheric physics, with emphasis on cloud/precipitation physics and solar and terrestrial radiation³;
- 3 semester hours of atmospheric measurements, instrumentation, or remote sensing, including both lecture and laboratory components;
- at least 3 semester hours in applied/specialty meteorology topics such as:
 - advanced dynamics, agricultural meteorology, air pollution meteorology, applied climatology, aviation meteorology, broadcast meteorology, hydrology or hydrometeorology, physical oceanography, tropical meteorology, and weather forecasting;
- up to 3 semester hours of a synthesizing experience⁴ such as
 - an undergraduate research project
 - a capstone course;
 - an internship focused on a career in atmospheric science or a closely related field; or
 - work experience closely related to the atmospheric sciences;

2) a minimum of a three-semester sequence of calculus that includes vector calculus and ordinary differential equations, in courses designed for majors in either mathematics, physical sciences or engineering;

3) a one-year sequence in physics lecture and laboratory courses, with calculus as a prerequisite or corequisite;

4) at least one course (3 semester hours) in chemistry appropriate for physical science majors;

5) a course with a multi-disciplinary and/or integrative approach to an environmental topic, such as a course on climate change;

6) an appropriate level of coursework or demonstrated competency in the following areas:

- computer science or information technology appropriate for physical science majors, including a course that teaches scientific, structured programming skills;
- statistics appropriate for physical science majors;
- technical, scientific, and professional writing, and oral communication;

Whenever possible and where appropriate, course requirements should include components that utilize modern computer and instrumentation labs and facilities.

As in any science curriculum, students should have the opportunity and be encouraged to supplement minimum requirements with additional course work in the major and supporting areas. This supplemental course work may include courses designed to broaden the student's perspective on the earth as a system, the environmental sciences, science administration, ethics, history of science, and policy making, as well as additional courses in the basic sciences, mathematics, statistics, and engineering. Also, students should be strongly urged to supplement their atmospheric science course work with additional courses or other activities designed to develop effective communication skills, both written and oral.

The use of computers and numerical models in the atmospheric sciences has increased dramatically in recent years. Students should be strongly encouraged to build skills in computer programming, graphic and web design, data manipulation, statistics, and numerical modeling. Students with strong backgrounds in statistics and computer science will be especially well-positioned to contribute to the advancement of the atmospheric sciences within most specialty areas.

Finally, as noted in the introduction, the curriculum described above differs from federal civil service requirements (see [Appendix B](#)). However, it is recommended that courses required to fulfill federal employment requirements-even if not required for the curriculum-be made available. Further, if the offering of such courses is not consistent with the educational objectives of the program, then the institution has an obligation to inform prospective students that the completion of their undergraduate degree will not fully qualify them for entry-level employment in federal agencies.

c. Faculty

There should be a minimum of three full-time regular faculty with expertise sufficiently broad to address the subject areas identified in item 1 in section 2b. This recommendation assumes a regular faculty teaching load of three or more courses per semester. For those departments where atmospheric science faculty are expected to carry out an active research program, it is recommended that the minimum number of departmental faculty be increased concomitant with the university's research expectations. University administrators should also bear in mind when considering the desired number of atmospheric faculty at their institution the integral role of atmospheric science in the physical and environmental sciences and the considerable potential for extramural support in the atmospheric sciences.

The faculty role should extend beyond teaching and research to include mentoring of students with diverse educational and cultural backgrounds. Departments and programs are also encouraged to emphasize increasing the diversity of their faculty, as an important and visible component of an overall commitment to diversity.

d. Facilities

There should be sufficient and coherent space for the atmospheric science program and its students. Contained within this space should be instructional labs and facilities to foster excellence in teaching and learning and to accommodate the changing needs of today's student population. Atmospheric science programs should maintain labs where real-time and archived meteorological data can be accessed through computer-based data acquisition and display systems, along with indoor and outdoor facilities suitable for teaching meteorological observation, instrumentation, and measurement techniques.

- Whenever possible, faculty should make use of modern instructional facilities, either within their department or elsewhere within the institution, that contain computerized instructional aids, internet connectivity, and appropriate projection equipment for teaching their courses. Such facilities allow faculty to use the rapidly expanding suite of multi-media offerings now available either on the World Wide Web or on CD-ROMs for teaching atmospheric science courses.

To support the courses in section 2b, the atmospheric science program should

provide students with appropriate tools, applications software, and simple or idealized computer models suitable for learning about dynamical and physical processes in the atmosphere.

e. Student recruitment and retention

The number of students from traditionally underrepresented groups in the atmospheric sciences continues to be alarmingly low. Ideally, atmospheric science programs should reflect the full diversity of the general population. To that end, atmospheric science programs should work with their institutions, community colleges, and secondary schools to develop resources and procedures that support recruitment and retention of diverse students. Programs should nurture and promote an academic culture that is deeply supportive of and committed to diversity. Efforts aimed at increasing the participation of traditionally underrepresented students in the atmospheric sciences, such as identification and implementation of best practices and procedures that most successfully result in achieving the diversity goals, should become a continuing priority.

Appendix A: Preparation for selected careers in atmospheric science

This section provides advice about additional courses that could be useful for those students who wish to pursue a specific career path in atmospheric science. The careers listed cover only a small fraction of the professional employment opportunities in atmospheric science. Since this statement is concerned with the bachelor's degree and students already have many course requirements, only a few additional courses are listed per career. It is not intended to be an exhaustive list of all courses that could be useful for a particular career.

Students should keep in mind that many of the suggested courses may have prerequisites that are not listed here and that may vary from institution to institution.

As a general rule, performing an internship in the area of interest and/or completion of an undergraduate research project on a topic in the area are excellent complements to the additional courses listed here and fulfill the recommended synthesizing experience listed under item 2b.

a. Weather forecasting careers

Students intending to enter this career field should consider including the following course work or types of experiences in their program of study:

- 1) three courses in synoptic and mesoscale meteorology, to include an introduction to numerical weather prediction (these courses would include courses recommended in basic requirements under item 1 of [section 2b](#));
- 2) a course in operational weather analysis and forecasting techniques that includes a laboratory component; and
- 3) a remote sensing course in either satellite or radar meteorology that includes a laboratory component (such a course would also meet the basic requirements under item 1 of [section 2b](#)).

b. Media careers, including those in Broadcast Meteorology

Students intending to enter this career field should consider including the following course work or types of experiences in their program of study:

- 1) a course in operational weather analysis and forecasting techniques;
 - 2) one or more courses in communication, journalism, writing, and speech; and
 - 3) one or more courses in publishing or broadcast media and broadcasting.
- In addition, students pursuing a Broadcast Meteorology career track should become familiar with the requirements and procedures for gaining certification, such as the American Meteorology Society's Certified Broadcast Meteorologist program.

c. Hydrometeorology careers

Students intending to enter this career field should consider including the following course work or types of experiences in their program of study:

- 1) a course in hydrology, fluid mechanics or fluid dynamics;
- 2) a course in hydrometeorology or precipitation processes;
- 3) a course in radar meteorology that includes radar observations of meteorological phenomena; and
- 4) a course in Geographic Information Systems.

d. Environmental monitoring careers

Students intending to enter this career field should consider including a select

subset of the following course work or types of experiences in their program of study:

- 1) an additional chemistry course (in most schools this course would be a continuation of the course used to meet the requirement for a chemistry course in item 4 of section 2b);
- 2) a course in atmospheric or environmental chemistry;
- 3) a course in atmospheric turbulence, micrometeorology, or boundary layer meteorology;
- 4) an air pollution meteorology course having courses such as items 2 and 3 above as prerequisites;
- 5) a course involving dispersion analysis and the use of air quality models;
- 6) a course in climate change or climatology; and/or
- 7) a course in earth-system science, biometeorology, or oceanography.

e. Careers in Support of Transportation, including Aviation Meteorology

Students intending to enter this career field should consider including the following course work or types of experiences in their program of study:

- 1) a course in fluid mechanics;
- 2) a course in aviation meteorology, including a basic understanding of turbulence and aircraft icing;
- 3) a course in weather analysis and forecasting;
- 4) a course in weather information systems or aircraft systems and instruments; and
- 5) an additional course in advanced thermodynamics or physical meteorology.

f. Business-related careers

Students intending to have a career in private sector or commercial meteorology should consider the following coursework:

- a course in economics;

- a course in marketing;
- a course in organization principles and management;
- a course in information systems;
- either a course in organizational behavior and human behavior, or one in entrepreneurship or small business management; and
- a course in strategic planning, program evaluation, or budget formulation and execution.

g. Preparation for graduate studies and research positions

Students intending to continue their academic careers with a graduate degree (MS or PhD) before pursuing a career should consider including the following course work or types of experiences in their program of study:

- 1) additional mathematics courses, such as advanced calculus, partial differential equations, and linear algebra;
- 2) additional atmospheric science courses in dynamics, physical meteorology, mesoscale and synoptic meteorology, climate change, or remote sensing;
- 3) a course in numerical methods or computational fluid dynamics;
- 4) a course in statistics and probability theory; and
- 5) additional scientific computer programming courses. It should be noted that FORTRAN continues to be the preferred programming language for developing many atmospheric science applications, including numerical modeling and data assimilation.

h. K-12 teaching careers

Students intending to enter the teaching profession should consider elective coursework related to their chosen area of specialization, which might include earth science, physical science, general science, or mathematics. Students may pursue provisional middle- or high-school teaching certification with the BS degree in Atmospheric Sciences, as determined by state education rules. Students could include the following coursework or types of experiences in their program of study:

- Educational foundations, theory, and practice; educational psychology

(appropriate for level, following state guidelines)

- General Science: coursework in Biology and expanded coursework in Chemistry, Geoscience, and/or Physics
- Earth Science: additional coursework in geology, hydrology, oceanography, and astronomy
- Physical Science: additional coursework in chemistry, physics, and astronomy
- Mathematics: additional coursework in mathematics such as geometry, logic, linear algebra

i. Military Weather Officer careers

Military Weather Officers initially work in forecast intensive assignments, then enter a graduate school MS program and work in more management and leadership roles in the later stages of their military career. Students intending to enter the military, as an Air Force Weather Officer or Navy Meteorology and Oceanography (METOC) Officer, should consider including some of the course work outlined in section a. (Weather forecasting careers) and section i. (Preparation for graduate studies and research positions) in their program of study. A course in Physical Oceanography would be helpful for those students most interested in the Navy METOC program.

Appendix B: Federal civil service requirements for meteorologist positions (GS

1340, effective 1 March 1998)

The requirements for federal employment as a meteorologist are given below. To meet these requirements, students should ensure that the 12 credits of course work in atmospheric thermodynamics and dynamics and weather analysis and forecasting recommended in section 2 of this statement include six semester hours of dynamic meteorology and six semester hours of weather analysis and forecasting.

A. A degree in meteorology, atmospheric science, or other natural science major that includes the following:

- 1) At least 24 semester hours (36 quarter hours) of credit in meteorology/atmospheric science, including a minimum of
 - a) 6 semester hours in atmospheric dynamics and thermodynamics⁵,
 - b) 6 semester hours in analysis and prediction of weather systems (synoptic/mesoscale),
 - c) 3 semester hours of physical meteorology, and
 - d) 2 semester hours of remote sensing of the atmosphere and/or instrumentation;
- 2) 6 semester hours of physics, with at least one course that includes laboratory session⁵;
- 3) 3 semester hours of ordinary differential equations⁵; and
- 4) at least 9 semester hours of course work for a physical science major in any combination of three or more of the following: physical hydrology, chemistry, physical oceanography, physical climatology, radiative transfer, aeronomy, advanced thermodynamics, advanced electricity and magnetism, statistics, light and optics, and computer science.

Or

B. A combination of education and experience-course work shown in A above, plus appropriate experience or additional education.

1 For the purposes of this document, the terms "atmospheric science" and "meteorology" are taken to be equivalent.

2 Some institutions use a quarter system rather than the semester system.

Normally, two semester hours equates to three quarter hours. In some cases, the recommended credits in section 2b may convert to noninteger numbers of quarter hours. In such cases, the institutions may combine a course with an appropriate portion of another course to meet the recommendation.

3 There is a prerequisite or corequisite of calculus for course work in atmospheric dynamics and thermodynamics, physics, and differential equations. Calculus courses must be appropriate for a physical science major. The preferred sequence of courses is for students to enroll in atmospheric thermodynamics and dynamics courses after completing at least two semesters of calculus.

4 This requirement is assigned a range of credit hours (i.e., 0-3 credits) in acknowledgement that many cooperative and internship experiences, such as the NWS Student Career or Temporary Employment Programs that offer participants work experience directly related to their academic field of study, are salaried and consequently at most colleges and universities students cannot earn credit hours for these synthesizing and capstone work experiences.

5 There is a prerequisite or corequisite of calculus for course work in atmospheric dynamics and thermodynamics, physics, and differential equations. Calculus courses must be appropriate for a physical science major.

Proposal to Revise the Existing Geography Major

Name of Major: Geography

Degrees: Bachelor of Science and Bachelor of Arts

Target Implementation Date: Autumn 2009

Rationale:

Established almost 100 years ago, the Department of Geography at Ohio State is one of the top-ranked departments in the discipline. Students majoring in Geography choose from among four specializations, two of which lead to a Bachelor of Arts and two to a Bachelor of Science. The BA specializations are "Urban and Regional Studies" and "People, Society and Environment;" the BS specializations are "Analytical Cartography and Geographic Information Systems" and "Climatic and Atmospheric Sciences" (for faculty associated with each of these, see Appendix O).

Between WI07 and SP08 the department's Undergraduate Studies Committee undertook an extensive review of student curricula across the entire department. As part of this review, we solicited feedback from faculty, advising staff and current geography majors. The goal was to evaluate what we teach and how we teach it, in light of significant changes in our faculty, the discipline, and the job market for undergraduate majors. Our findings can be summarized as follows:

1. Due to a large number of hires, the composition of our faculty has changed dramatically over the past decade. Since 2001 we have hired 15 professors, out of a total faculty of 25. Most of these hires have been at the assistant level. Although this demographic shift allows us to teach material that is more in keeping with new directions in the discipline, the existing curricular structure limits our ability to take advantage of this strength.
2. Interdisciplinarity and the pace of real-world events have made Geography a much more dynamic discipline than it was twenty years ago. Geographers now regularly engage with scholars in a wide-range of fields (as diverse as Political Science, Geology, and Computer Science) and deal with a broad array of constantly changing subject matter, such as global warming and globalization. Our current curricular structure does not reflect the topical or conceptual complexity and dynamism of our discipline.
3. Students in Geography have a variety of career paths. Some go on to graduate school in the social and natural sciences. Many others go directly into the job market, in fields as diverse as regional planning, weather forecasting, international development, and retail location analysis. To remain competitive in both academic and non-academic fields, as well as to be effective citizens, our graduates must be conversant in always-changing technical and content-driven fields. Our current curricular structure requires both more flexibility and more cohesion to meet these challenges.

4. Departmental assessment of learning of outcomes (focus groups, exit surveys) and discussion with faculty indicate a need to address the overall cohesiveness of the curriculum. Students and faculty agree that we need to update content, reduce redundancy, and align more introductory with more advanced courses. At the same time, we need to streamline progress through the program by creating structure while retaining maximum flexibility and allowing for timely completion of the degree. Faculty also indicate that such changes will bring us in line with best teaching practices at peer institutions.
5. The names of our specializations need to be updated, as do the titles and descriptions of many individual courses. Updating names and descriptions will better reflect and communicate content, and will make them more similar to the terms used at peer institutions. Our proposals for name and description changes result from intensive faculty consultation.

In sum, Geography is currently a very dynamic and diverse discipline, and our department is also in the midst of a personnel shift that parallels the dynamism and diversity of the discipline. Our proposal updates the curriculum to better represent state of the art in each specialization, take advantage of expertise of current faculty, and provide a clear and comprehensive education to students with a range of interests and career plans.

Revised Major:

Based on our evaluation, we are proposing a substantial revision of the curriculum of all four specializations in the Geography major, as well as a suite of changes to individual courses. Together, these changes better represents what we do, and make it clearer to students how different parts of the curriculum fit together.

We are including course change proposals for 24 courses (see Appendix A for summary). The proposed changes include 17 new names, 21 new descriptions, two number changes, and several small changes in things such as distribution of contact time.

We are proposing seven new courses (see Appendix B for summary). Because the new courses are designed to fill explicit gaps in the curriculum for each specialization, justifications for these new courses are included within our descriptions of revisions for each specialization.

We are proposing to increase and/or standardize the number of credit hours for the major (changes for each specialization are detailed below, in the description for each). Currently, each specialization requires a different number of credit hours, ranging from 43 to 60. Our proposal provides consistency across our specializations by requiring 50-55 credit hours. Recent graduates receiving a BA are already taking this number of credit hours within the major, while those receiving a BS are taking somewhat fewer (44-48). The proposed number of required credit hours will provide greater rigor within the major. The proposal is also consistent with the requirements of peer institutions, which vary widely. Of the ten universities from which we gathered information, three require fewer credit hours than we are proposing,

four require more, two are the same, and one (Univ. of Colorado) has a wide range that is both slightly less and significantly more than we are proposing. See Appendix N for these data.

What follows below are narrative descriptions of the proposed revisions to each of the specializations. Outlines of old and new curricula are provided in Appendices C-J. Sample four-year course plans for each specialization are provided in Appendix K. Note that all required courses, for all specializations, are taught at least once per year; some of the elective courses are occasionally taught every other year.

Urban and Regional Studies (to become “Urban, Regional, and Global Studies”)

Students in this specialization focus on the spatial differentiation and organization of political, social, cultural and economic activity. The proposed changes respond primarily to student demand for a more integrated and up-to-date curriculum. They also derive from broad support among faculty for course sequences and content which better reflect the state of teaching and research in Human Geography. Students enrolled in the specialization will become familiar with an array of geographical theories and theoretical controversies, develop strong quantitative and qualitative research skills, and engage with a wide range of up-to-date case studies. Upon completion of the degree, students will be able to link urban and regional politics and development to larger, global scale forces and trends. We propose four main revisions.

1. *Change the name to “Urban, Regional, and Global Studies.”* This name change builds on long-term strengths of OSU Geography while signaling the growing importance of the global-scale scholarship in Geography more generally. It also better represents the diversity of faculty strengths in this area.
2. *Repackaging and simplifying requirements.* Currently our courses are duplicated across a broad array of “Methods”, “Systematic”, “Regional” and “Elective” courses. This makes requirements for graduation difficult to follow, it allows little flexibility in some areas, and the progression of courses is unclear.
 - a. The existing structure has a) three required Methods courses, b) a choice of four Systematic courses from a given list, c) a choice of one Physical Geography course from a given list, d) one required Regional Geography course from a given list, and e) one elective course from a given list. See Appendix C.
 - b. The new curriculum streamlines this structure and provides more choices for the student. The proposed structure includes: a) a Methods sequence, with one required course and two electives, b) a new required introductory course in Human Geography (see below), c) choice of three more introductory courses (200/400-level), including a new 400-level course in Urban Geography (see below), d) choice of three advanced courses (500/600/700-level), and e) a new required Geographic Inquiry course (see below). See Appendix D.
3. *Addition of three new courses.* See Appendix B

- a. Geog 205: Human Geography. Coming at the beginning of the curriculum, this course is designed to provide a coherent platform for students' future studies in URGs. Our peer institutions across the country have a course similar to this one. This course will be required of all students in the specialization.
 - b. Geog 455: Cities and Their Global Spaces. This course is designed to fill a 400-level gap in our current course offerings. We already teach a variety of 600-level courses on urban topics. This course would be included in the list of introductory courses from which students will choose three.
 - c. Geog 600: Geographic Inquiry. This course is intended to give students a theoretical retrospective at the end of their undergraduate career. Students have explicitly requested this sort of capstone course. Moreover, as with the proposed Geog 205, our peer institutions have courses similar to this one. This course will be required of all students in the specialization.
4. *Increase the total number of credit hours from 50 to 55.* In the current structure, students take 50 credit hours. We have added two new required courses (205 and 600), yet our revision of the rest of the curriculum means only five more credit hours of coursework.

People-Society-Environment (to become "Environment & Society")

Students in this specialization focus on understanding the relationship between people and nature. Although this is a relatively new specialization in the department (started in 2002), so-called "human-environment interactions" or "nature-society relations" have been at the core of geographical thought since its inception as a discipline. Drawing on this history of geographic thought, the proposed curriculum better emphasizes the reciprocal relationship between social and environmental processes. It introduces relevant theories in human and physical geography, appropriate methods of inquiry, and case studies of environmental challenges. We propose three main revisions.

1. *Change the name to "Environment & Society."* This name change better reflects disciplinary terminology and signals the diversity of faculty strengths in this area.
2. *Alter the main divisions within the curriculum and change which course count in each area..*
 - a. The current structure has a required core, and then provides options in three areas: synthetic and methodological electives, environmental electives, and social electives. See Appendix E.
 - b. The new curriculum replaces this structure with three substantive areas, each of which has a set of required courses and electives. These areas are: Human Geography, Physical Geography, and Methods. The courses formerly in the required core have been integrated into these three areas. See Appendix F.
 - c. In light of new courses that have been added over the past several years due to an influx of new faculty, the new curriculum also changes which courses count in each of these areas. Despite growing faculty expertise and student demand when this

specialization was proposed in 2002, at that time the department offered a limited number of courses in these areas. Now, our faculty offers a full-complement of courses in these areas. These courses offer us the ability to teach disciplinary specific material that introduces key geographical concepts, provides continuity across courses, and allows us to alter the content of courses as disciplinary foci change. The course lists we propose reflect this major change in our ability to provide explicitly geographical course content to our students. Compare Appendix E and F.

3. *Standardize the total number of credit hours at 55.* In the current structure, students take a variable number of credit hours, ranging from 50-60. The new structure requires a consistent number of credit hours, while still maintaining student flexibility.

Analytical Cartography and Geographic Information Systems (to become "Spatial Analysis")

Students in this specialization focus on learning tools and methods for the management and analysis of geographic information while also receiving broad training in geographical principles. The geography department at Ohio State was among the pioneering institutions in the development of geospatial technologies, and has been a leader in the fields of cartography, spatial analysis, and geographic information technology. The proposed curriculum draws on these strengths by providing integrative training in geovisualization, spatial analysis, and geographic information systems, while also providing extensive training in technical skills. Further, the proposed curriculum allows students to develop expertise in non-technical substantive areas of human and/or physical geography. We propose four main revisions.

1. *Split the current specialization into two: a separate major, called Geographic Information Science (GIS; see separate new major proposal), and a remaining specialization within the Geography major, called "Spatial Analysis".*
 - a. The Spatial Analysis specialization has been designed to provide general geography education alongside technical expertise in spatial analysis, whereas the focus of the GIS major is technical expertise in spatial data management, analysis, and visualization.
 - b. The Spatial Analysis specialization is targeted to students wishing to proceed to graduate school in Geography or related fields, and those wishing to enter professional fields in analysis and managerial roles that would require using and planning for spatial information. The GIS major is targeted to students wishing to enter professional fields focused on spatial data acquisition and analysis, in positions such as GIS analyst or spatial database manager.
 - c. The course lists for the two programs have been chosen to maximize individual flexibility while assuring necessary competencies (see below for details).
 - i. The Spatial Analysis specialization and GIS major have a similar set of core courses, to ensure adequate technical proficiency. Reflecting the different

focus of the two programs, the required core of the GIS major is more extensive.

- ii. There is still substantial overlap in the list of electives; this is to provide individuals with maximum flexibility to design a course plan that meets specific needs. The main difference between the programs is that the Spatial Analysis specialization includes a broader array of applications courses from which students will be able to select. Given this list of electives, it would be possible for a student majoring in Geography to design a course sequence that differs from the GIS major by only one course. However, because the intent of the Spatial Analysis specialization is to gain training in substantive areas of human or physical geography, there would be little advantage in choosing this option. All students choosing the Spatial Analysis specialization will be encouraged to take full advantage of the range of Geography courses available to them, while allowing them to tailor the program to their interests and career plans.
 - d. The proposal for this specialization is contingent on approval of the separate GIS major. If that proposal is not approved by the Board of Regents, this specialization will need to be revisited.
2. *Alter the main divisions within the curriculum, and which courses count in each area.*
- a. The specialization currently consists of two fairly rigid paths, in Analytical Cartography and Geographic Information Systems (see Appendix G).
 - b. The new curriculum eliminates these paths, and also eliminates a separate human and/or physical geography elective. It maintains a required core and proposes a larger set of combined electives that a) include a greater set of methods courses from which students can choose, thus offering greater flexibility, and b) allow students to choose a greater number of electives in human and/or physical geography. The proposed structure allows students with a variety of backgrounds and career aspirations to tailor the specialization to their specific needs, while assuring core competency in geographical methods. See Appendix H.
 - c. The number of credit hours in the required core is increased by 10 by adding Intermediate GIS (685) and Undergraduate Research and Professionalization Seminar (695).
 - d. Students choose four elective courses: one methods, one human or physical geography, and two of the students' choosing (i.e. these may include methods and human and physical geography courses).
3. *Addition of two new courses.* Both courses are included in the list of electives for the specialization. See Appendix B.
- a. Geog 684: Geographic Applications in Remote Sensing. This course is intended to cover a core knowledge area that is recommended by the University Consortium for

GIS Body of Knowledge (UCGIS 2006). A course in this area has been requested by students, and also draws on the expertise of new faculty in the department.

- b. Geog 688: Emerging Topics in GIS. Given the rapidly changing nature of GIS, this course is designed to keep students abreast of innovations and new technologies in the field. The course has been requested by students to provide additional training for undergraduates planning to work in GIS-related fields.
4. *Increase the total credit hours from 44/45 to 50.* Increasing the required credit hours is necessary to provide students with sufficient technical training while also providing them a broad-based geographical education. It also aligns the requirements of this specialization with the rest of the major.

Atmospheric and Climatic Studies (to become "Climatology and Physical Geography")

Students in this area focus on the interactions between the Earth's surface, at local and global scales, and the atmosphere. Geography at Ohio State has well-established expertise in climatology, which is one aspect of physical geography more broadly. Recent hires strengthen this emphasis and add expertise in other aspects of physical geography, such as biogeography and hydrology. The revised curriculum takes advantage of these strengths by allowing students to emphasize either climatology or physical geography. At the same time, the proposed curriculum provides an overarching framework for understanding connections between land and atmosphere. We propose four main revisions.

1. *Split the current specialization into two: a separate major, called Atmospheric Sciences (AS; see separate new major proposal), and a remaining specialization within the Geography major.*
 - a. The following proposal for this specialization is contingent on approval of the separate AS major. If that proposal is not approved by the Board of Regents, this specialization will need to be revisited.
 - b. This specialization within the Geography major has been designed to complement the proposed Atmospheric Sciences, and is intended for students wishing to gain knowledge substantive areas of Geography. The specialization is designed to provide *general geographic education* alongside *technical expertise in climate and physical geography*. Students in this specialization will be introduced to a broader array of methods and applications courses from which they will be able to select. Further, a specialization with emphasis on broad physical geography education is more common in the discipline than our current specialization, which focuses almost exclusively on atmospheric sciences.
2. *Change the name to "Climatology and Physical Geography (CPG)."* This name reflects now-mainstream recognition of the interconnection between the Earth's surface and the atmosphere. It also reflects the expertise of new faculty in physical geography.

3. *Alter the main divisions within the curriculum.*
 - a. The current structure includes two paths, in Atmospheric Sciences and in Climatic Studies. The prerequisite courses are the same, except that the Atmospheric Sciences path include an additional 15 credit hours of Math. The core 28 credit hours are the same for both paths. Each path has a different set of electives, though both are 15 credit hours. See Appendix I.
 - b. The new curriculum includes two different paths, in Climatic Studies (CS) and in Physical Geography (PG). These paths reflect both student demand and current faculty expertise. Each path has a distinct set of prerequisite courses (30 hours for CS, 20 for PG), core requirements (28-30 for both paths), and electives (25 hours for both paths). The PG path includes the option of taking one Human Geography course. See Appendix J.
4. *Increase the total credit hours from 43 to 53-55.* The additional credit hours represent an increase in the number of electives. This adds both rigor and flexibility to the specialization, while also aligning the credit hour requirement of this specialization with the rest of the major.

General and specific educational goals and objectives for the major:

The general learning objectives for the Geography major are as follows:

1. Students acquire fundamental concepts of geography, taking into account that the substantive expression of these concepts will vary across major specializations
2. Students will achieve familiarity with methods used in geography.
3. Students are provided with a strong foundation for seeking employment or graduate or professional training.

There are specific learning objectives for each of the following specializations.

Specific educational goals for Urban, Regional, and Global Studies are to:

1. help students become familiar with fundamental geographical concepts for understanding human processes and systems, including their social, political, cultural, and/or economic dimensions
2. develop students' ability to represent and analyze fundamental theoretical debates and empirical studies in human geography in written, oral and visual forms
3. introduce students to the range of analytical and methodological tools for producing geographical knowledge regarding human processes and systems

Specific educational goals for Environment and Society are to:

1. help students become familiar with fundamental geographical concepts for understanding the relationship between environment and society

2. develop students' ability to represent and analyze fundamental theoretical debates and empirical studies in environment-society geography in written, oral and visual forms
3. introduce students to the range of analytical and methodological tools, from both physical and human geography, for producing geographical knowledge regarding environment-society relationships

Specific educational goals for Spatial Analysis are to:

1. help students become familiar with fundamental concepts in geographic theory, spatial analytic methods, and geospatial technologies,
2. develop students' ability to represent analysis of geographic phenomena in written, oral, and visual forms,
3. develop students' ability to apply GIS and other quantitative techniques to a substantive area of geography of interest to the student.

Specific educational goals for Climatology and Physical Geography are to:

1. provide students with a core foundation of knowledge in climatology and physical geography that includes the importance of processes which occur on different spatial scales;
2. prepare students for graduate study in geography or a closely related field through advanced education with a focus on critical thinking and problem solving;
3. prepare students for a successful career through advanced education and training in relevant professional skills, including computational and other forms of technology used in climatology and physical geography.

Assessment Plan:

Current Assessment Plan The Department of Geography has an assessment plan that includes a suite of outcome monitoring methods that allows us to gauge whether or not we are meeting pedagogical goals, and then to make necessary corrections. The plan is reviewed annually by the College of Social and Behavioral Sciences, and is overseen by our undergraduate advisor. The current plan consists of two indirect assessment methods and one direct method. The feedback we received from these forms of assessment was important in our development of the current proposal, including both new courses and the overall curricular structure. Our current assessment methods include:

- Embedded questions in one regularly offered and popular upper division course
- Informal focus groups with students in the major. In the 2007-2008 school year we conducted four such groups, one for each specialization.
- An exit survey of graduating seniors, which includes questions about the major regarding their overall educational experience, classroom experience, research and internship participation, and placement in jobs and graduate school.

Future Assessment Plan Our assessment will be multidimensional and ongoing. We will refine our methods of assessment as we gain more experience with them and as the needs of the

department change. We expect our assessment strategy to result in geography majors who are better prepared for graduate studies, the job market, and as citizens. Our future assessment plan consists of:

- Continued use of focus groups with students and exit surveys with graduating seniors.
- Expanded use of embedded testing.
 1. There is no one class that all majors in geography are required to take. However, with this revision the Undergraduate Research and Professionalization Seminar (Geog 695) will be required of all majors in the Urban, Regional, and Global Studies; Environment and Society; and Spatial Analysis specializations. It also will be an elective for majors in the Climate and Physical Geography specialization. We expect that 80% or more of our majors will be taking this class, largely in their junior and senior years. This class is ideal for embedded testing because it not only teaches methods and skills, but requires students to express their general knowledge about geographic concepts and methods. The Undergraduate Studies Committee, which represents all four specializations, is currently developing a set of embedded questions for this class that will assess the department's success in teaching students core concepts, methods, and professional skills.
 2. To assess knowledge of those students in the CPG specialization who do not take Geog 695, we are developing embedded questions in Climatology (Geog 520), which is required of all students in the specialization, regardless of their path (either Climatology or Physical Geography). The Undergraduate Studies Committee is overseeing this process.
- The data gathered through this variety of assessment methods will be reviewed and discussed by the faculty and changes to the major will be considered as appropriate.

Relationship to other programs:

We expect our relationship to other programs to be only modestly altered.

We expect no disturbance in terms of the ways in which our existing courses are used by other departments and programs (e.g. some of our courses are required for students enrolled in the International Studies major). Likewise, none of the changes proposed in this document will affect courses currently categorized as GECs. In general, the proposed curricular changes seek only to formalize or extend existing course content, and do not represent any substantive shifts in terms of material covered.

In terms of changes in enrollment in other programs and departments at OSU, we predict a minimal impact. The proposed changes to the *Urban, Regional, and Global Studies* specialization do not alter the distribution of required credit hours between geography and other departments. Likewise, the proposed changes to the *Spatial Analysis* specialization are internal changes, with little impact on outside credit hours. We continue to include Computer Science and Engineering as well as Statistics courses as an important component of the curriculum.

The proposed changes to the *Climatology and Physical Geography* specialization may increase the number of our students taking courses other departments. Not only do we continue to include courses from the School of Earth Sciences in the curriculum, but we are now including one such course in the required core. Earth Sciences 550 (Geomorphology) is part of the *required core* for the physical geography path, and Earth Sci 410 (Water in the Basin Hydrologic Cycle) and 650 (Glaciers and Landscapes) are electives for this path.

The curricular changes made to the proposed *Environment & Society* specialization might be expected to have the most impact on enrollment numbers outside the department. This is because under the existing curriculum, students majoring in the specialization have the option of taking courses from a wide-variety of other departments and colleges. With this revision, we have removed this option for this specialization. However, we expect the impact of this change to be negligible for two reasons (see Appendix L). First, we have had an annual average of only 16 majors in this specialization since SP02, when it began. As a result, there are a very limited number of credit hours to be shared with other departments and colleges in the first place. Second, our data suggest that very few of our students have taken advantage of courses outside the department. The course with the highest enrollment of E&S students is Ecology (EEOB 413). Since 2002, the lecture portion of this course has enrolled an annual average of approximately three students; the lab portion has enrolled an annual average of two students. Similarly, an annual average of just over one E&S student has enrolled in Soil Science (taking both lecture and lab) (ENR 300) since 2002. Even more strikingly, since 2002 only ten E&S students have enrolled in the History courses in our curriculum (366.01 Environmental Issues in Historical Perspective and 366.02 (formerly 567) American Environmental History). Four have enrolled in the social science courses in ENR (367 Making and Meaning of the American Landscape and 400 Natural Resources Policy), while only one student has enrolled in Geomorphology (Earth Sci 550), and that was in 2005.

We also expect positive synergies between the existing Geography major and the proposed majors in Atmospheric Sciences and in Geographic Information Sciences. In particular, we anticipate that some students will elect to double major in Geography and either Atmospheric Sciences or GIS, or major in Geography and minor in the latter. This is an especially exciting aspect of our proposed curriculum overhaul. Students who take advantage of this opportunity will receive a particularly well-rounded education that combines substantive knowledge in geographic concepts with an extensive quantitative and qualitative job-ready skills set.

Student enrollment:

As of Autumn 2008, the Geography undergraduate program consists of approximately 200 majors. Geography majors tend to declare the major very late in their undergraduate career; we estimate that at least half of our students declare Geography as a major sometime during their third year. We expect that updating the major to reflect current disciplinary trends, with more recognizable and relevant titles and course descriptions, will increase visibility and attraction to the Geography major. Revising the major for greater strength and relevance should have several effects on enrollment of majors. First, it will help students find their way to Geography sooner in their time at OSU. Second, we expect that retention of students in

Geography will be improved. Third, we expect some growth in the number of majors by attracting students to OSU who might otherwise enroll elsewhere. In addition to effects on majors, we expect to enroll more students in Geography courses from across the college and the university. For example, the revision of the GIS specialization will better represent the suite of tools, applications and techniques that are of broad utility to many students across the university, while the revision of the Environment and Society specialization will better represent the contribution of geography to anyone interested in environmental topics.

Administration:

The Geography major will continue to be housed in the Department of Geography, within the College of Social and Behavioral Sciences (SBS).

Advising:

We do not expect our reorganization of the Geography undergraduate curriculum to result in any major changes to advising. Our primary advising contact for students will continue to be Rick McClish, our Undergraduate Advisor, who reports to our departmental chair, Professor Morton O'Kelly. Honors students will continue to be advised by our designated Undergraduate Studies Committee chair, currently Professor Becky Mansfield.

Appendix A Course Change Proposals

Summary of proposed changes to courses. Formal course change request forms, with syllabi, are being submitted separately.

Course number	Current Name	Name change	Description change	Number change	Other
200	World Regional Geography		✓		
240	Economic and Social Geography		✓		
280	Map Reading and Interpretation		✓	✓	
400	Geography of the United States and Canada	✓	✓		
430	Geographical Perspectives on Environment and Society		✓		✓
445	The Geography of Transportation Security	✓			
460	Political Geography	✓	✓		
490	Introduction to Biogeography	✓			
505	South America	✓	✓		✓
510	Geography of Western Europe	✓	✓		✓
605	Special Problems in the Geography of Latin America	✓	✓		✓
630	Conservation of Natural Resources	✓	✓		
640	Economies, Space, and Society		✓		
642	Geography of Development		✓		
650	Urban Geography	✓	✓		
652	Cities, Cultures, and the Political Geography of Difference	✓	✓		
655	Theories and Methods of Regional Geography	✓	✓		✓
670	Population Geography	✓	✓	✓	✓
680	Numerical Cartography	✓	✓		
683	Introduction to Geographic Analysis	✓	✓		
686	GIS in Social Science and Business Research	✓	✓		
687	Design and Implementation in Geographic Information	✓	✓		
695	Undergraduate Seminar in Applied Geography	✓	✓		
ASP 637	Dynamic Meteorology I				✓
TOTAL		18	21	2	7

Appendix B
New course proposals

Summary of new course proposals. Individual course proposal forms with syllabi are being submitted separately.

Course number	Name
Geog 205	Human Geography
Geog 455	Cities and their Global Spaces
Geog 600	Geographic Inquiry
Geog 684	Geographic Applications in Remote Sensing
Geog 688	Emerging Topics In GIS
ASP 689	Internship in Atmospheric Sciences
ASP 699	Undergraduate Research in Atmospheric Sciences
ASP H783	Honors Research

Appendix C
Current Urban and Regional Studies Specialization Curriculum

Part A. Required Prerequisites or Supplements to the Major

- NA

Part B. Core Requirements

1. Three required methods courses:
 - Elements of Cartography 580
 - Fundamentals in Geographic Information Systems 607
 - Introduction to Geographic Analysis 683
2. Choice of four required systematic courses:
 - Making the Modern World 450
 - Political Geography 460
 - Conservation of Natural Resources 630 or Globalization and the Environment 635
 - Economic Geography 640 or Geography and Development 642
 - Geography of Transportation 645
 - Urban Geography 650 or Urban Political Geography 660
 - Locational Analysis 647 or Theory and Methods of Regional Analysis 655
 - Population Geography 670
3. Choice of one required physical geography course:
 - Physical Geography and Environmental Issues 210
 - Climatology 520
 - Integrated Earth Systems: Confronting Global Change 597.02
4. Choice of one required regional geography course:
 - Geography of the US and Canada 400
 - Geography of Western Europe 510
 - Geography of Eastern Europe 511
 - Geography of the Soviet Union 512
 - South Asia: Ecology, Economy and Polity 513
 - Special Problems in the Geography of Latin America 605
 - South Africa: Society and Space 608
 - Special Problems in the Geography of the Former USSR 612
 - Globalization and the Environment 635

Part C. Electives within the Major

1. Any Geography course 400-799 not already used in the major (excludes 520 and 597.02)

Appendix D
Proposed Urban, Regional and Global Studies Specialization Curriculum

Part A. Required Prerequisites or Supplements to the Major

- NA

Part B. Core Requirements

1. Human Geography 205
2. Undergraduate Research and Professionalization Seminar 695
3. Choice of two of the following methods courses:
 - Map Reading and Interpretation 480
 - Elements of Cartography 580
 - Fundamentals of Geographic Information Systems 607
 - Computer Cartography and Geographical Visualization 680
 - Quantitative Geographical Methods 683
 - Intermediate Geographic Information Systems 685
4. Choice of three more introductory courses:
 - Economic and Social 240
 - Geography of North America 400
 - Geography of Ohio 401
 - Transportation Security 445
 - Making the Modern World 450
 - Cities and their Global Spaces 455
 - Space, Power, and Political Geography 460
 - Modern Geopolitical Imagination 465
 - Life and Death Geographies: Global Population Dynamics 470
 - Water Security in the 21st Century Earth Sciences 411
5. Choice of three advanced courses:
 - Geography of Latin America 505
 - Geography of the European Union 510
 - Geography of Eastern Europe 511
 - Geography of the Former Soviet Union 512
 - South Asia: Ecology, Economy, Polity 513
 - World Urbanization 597.01
 - New Worlds of Latin America 605
 - South Africa: Society and Space 608
 - Economies, Space and Society 640
 - Geographies of Governmentalities 643
 - Geography of Transportation 645
 - Urban Spaces in the Global Economy 650

- Social Cities 652
- Land Use Geography 655
- Conflict, Power, and Politics in the City 660

6. Geographic Inquiry 600

Part C. Electives within the Major

- NA

Part D. Internship

1. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix E
Current People, Society and Environment Specialization Curriculum

Part A. Required Prerequisites or Supplements to the Major

- NA

Part B. Core Requirements (Five Courses)

1. Physical Geography and Environmental Issues 210
2. Geographic Perspectives on the Environment and Society 430
3. Fundamentals of Geographic Information Systems 607
4. Undergraduate Seminar in Applied Geography 695
5. Introduction to Geographic Analysis 683

Part C. Electives within the Major

1. Synthetic and Methodological Electives (Choose one course)
 - Map Reading and Interpretation Geog 280
 - Elements of Cartography Geog 580
 - Numerical Cartography Geog 680
 - Intermediate Geographic Information Systems Geog 685
 - Demographic Analysis Soc 754
 - Remote Sensing CEE 603
 - Terrain Analysis CEE 604
 - Natural Resources Photo Interpretation ENR 324
 - Magazine Writing J 602
2. Environmental Electives (Choose one *group*)
 - Synoptic Meteorology Laboratory Geog 620 AND Integrated Earth Systems: Confronting Global Change Geog 597.02
 - Ecology EEOB 413.01 (lecture) AND 413.02 (lab)
 - Field Botany EEOB 510 AND Plants and People EEOB 502
 - Soil Science ENR 300.01 (lecture) AND 300.02 (lab)
 - Geomorphology Earth Sci 550 OR Hydrogeology Earth Sci 651
 - Applied Hydrology CE 613
3. Social Electives (Choose three courses, at least one must be in Geography)
 - South Asia: Ecology, Economy, and Polity Geog 513
 - Latin America Geog 605
 - Conservation of Natural Resources Geog 630
 - Globalization and Environment Geog 635
 - Geography of Development Geog 642
 - Population Geography Geog 670
 - Energy, Mineral Resources, and Society Earth Sci 210
 - Environmental Archaeology Anth 602.03
 - Ethnobotany Anth 610
 - Cultural Ecology Anth 620.05

- Women in Rural Society Rur Soc 678
- Environment and Natural Resources Ag Econ 531
- Economics of Growth/Sprawl in America's Countryside Ag Econ 680
- The Making and Meaning of the American Landscape ENR 367
- Natural Resources Policy ENR 400
- Environmental Issues in Historical Perspective Hist 366
- American Environmental History Hist 567
- Science and Society Comp St. 272
- Gender and Science Comp St. 535

Appendix F
Proposed Environment & Society Specialization Curriculum

Part A. Required Prerequisites or Supplements to the Major

- NA

Part B. Core Requirements (Students have to fulfill requirements of all three areas: human, physical, methods)

1. Human Geography (Four courses)
 - Geographical Perspectives on Environment and Society 430
 - Choose three of the following courses:
 - Life and Death Geographies: Global Population Dynamics 470
 - Geography of Latin America 505
 - New Worlds of Latin America 605
 - Environmental Conservation 630
 - Globalization and Environment 635
 - Geography of Development 642
 - Land Use Geography 655
2. Physical Geography (Three courses):
 - Physical Geography and Environmental Issues 210 OR Introduction to Physical Geography 220
 - Biogeography: An Introduction to Life on Earth 490
 - Global Climate and Environmental Change H410 OR Global Climate Change: Causes and Consequences 420 OR Climatology 520 OR Integrated Earth Systems: Confronting Global Change 597.02
3. Methods (Three courses)
 - Undergraduate Research and Professionalization Seminar 695
 - Choose two of the following courses:
 - Map Reading and Interpretation 480
 - Elements of Cartography 580
 - Fundamentals of Geographic Information Systems 607
 - Computer Cartography and Geographical Visualization 680
 - Quantitative Geographical Methods 683
 - Intermediate Geographic Information Systems 685

Part C. Electives within the Major

- NA

Part D. Internship

- After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix G
Current Analytical Cartography (AC)/Geographic Information Sciences (GIS) Specialization
Curriculum

Part A. Required Prerequisites or Supplements to the Major

1. CS&E 201
2. Statistics 245

Part B. Core Requirements

1. Required core for both paths:
 - Elements of Cartography 580
 - Fundamentals in Geographic Information Systems 607
 - Numerical Cartography 680
 - Introduction to Geographic Analysis 683
2. Analytical Cartography required core:
 - Undergraduate Seminar in Applied Geography 695
 - Analytical Cartography 780
 - Seminar in Geography 795
3. Geographic Information Sciences required core:
 - Intermediate Geographic Information Systems 685
 - GIS in Social Science and Business Research 686 OR Design and Implementation of Geographic Information 687
 - CS&E 214 OR CS&E 230

Part C. Electives within the Major

1. Any human geography course at the 600 level
2. Physical Geography and Environmental Issues 210 OR Climatology 520 OR Integrated Earth Systems: Confronting Global Change 597.02

Appendix H Proposed Spatial Analysis Specialization Curriculum

Part A. Required Prerequisites or Supplements to the Major

1. CS&E 201 (Elementary Computer Programming; Java is taught) or 202 (Introduction to Programming and Algorithms for Engineers and Scientists; C++ is taught)
2. Statistics 245

Part B. Core Requirements

1. Elements of Cartography 580
2. Fundamentals in Geographic Information Systems 607
3. Computer Cartography and Geographic Visualization 680
4. Quantitative Geographical Methods 683
5. Intermediate Geographic Information Systems 685
6. Undergraduate Research and Professionalization Seminar 695

Part C. Electives within the Major. Choose four of the following courses. At least one must be a methods course (items 1-11), one must be a physical OR human geography course (items 12-13; marked with a *), and the other two are of the students choosing.

1. Map Reading and Interpretation 480
2. Geographic Applications in Remote Sensing 684
3. GIS Applications in Social Science and Business 686
4. GIS Design and Implementation 687
5. Emerging Topics in GIS 688
6. Advanced Applications in Geographic Information Systems 787
7. Geography of Transportation 645
8. Locational Analysis 647
9. Land Use Geography 655
10. CS&E Data Structures for Information Systems 214 (4 credits) or CS&E Introduction to C++ Programming 230 (4 credits) or CS&E Object-Oriented Programming for Engineers and Scientists 502 (3 credits) or CS&E Introduction to Database Systems I 670 (3 credits)
(Note that CS&E suggests that students taking 214 choose 201 as their prerequisite course, while those taking 230 or 502 choose 202. The prerequisite for 670 is 502)
11. Earth Sci 310 Earth Systems Data Collection and Analysis
12. Any 400, 500 or 600 –level human geography course *
13. Any 400, 500 or 600 –level physical geography course *

Part D. Internship

1. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix I
Current Atmospheric and Climatic Studies Specialization Curriculum

Part A. Required Prerequisites or Supplements to the Major

1. Atmospheric Sciences path
 - Math 151, 152, 153, 254, 415
 - Physics 131, 132
 - Statistics 245
2. Climatic Studies path
 - Math 151, 152
 - Physics 131, 132
 - Statistics 245

Part B. Core Requirements

1. For both Atmospheric Science and Climatic Studies paths
 - Basic Meteorology AS 230 OR Climatology Geog 520
 - Synoptic Meteorology Laboratory AS/Geog 620
 - Boundary Layer Climatology Geog 622.01
 - Microclimatological Measurements Geog 622.02
 - Synoptic Analysis and Forecasting Geog 623.01
 - Severe Storm Forecasting 623.02
2. Additional for the Atmospheric Science path
 - Atmospheric Thermodynamics AS 631
 - Dynamic Meteorology I AS 637
 - Dynamic Meteorology II AS 638
3. Additional for the Climatic Studies path
 - Introduction to Cartography Geog 580
 - Undergraduate Seminar in Applied Geography Geog 695 OR Seminar in Geography Geog 795
 - Any Human Geography course 600-level or higher

Part C. Electives within the Major

- NA

Appendix J
Proposed Climatology and Physical Geography Specialization Curriculum

Part A. Required Prerequisites or Supplements to the Major

1. For Climatic Studies path
 - Math 151, 152, 153
 - Physics 131, 132
 - Statistics 245
2. For the Physical Geography path
 - Math 151, 152
 - Physics 131
 - Statistics 245

Part B. Core Requirements

1. For Climatic Studies path
 - Basic Meteorology AS 230 OR Climatology Geog 520
 - Synoptic Meteorology Laboratory AS/Geog 620
 - Boundary Layer Climatology Geog 622.01
 - Microclimatological Measurements Geog 622.02
 - Synoptic Analysis and Forecasting Geog 623.01
 - Severe Storm Forecasting 623.02
2. For Physical Geography path
 - Introduction to Physical Geography Geog 220
 - Global Climate Change: Causes and Consequences Geog 420
 - Biogeography: An Introduction to Life on Earth Geog 490
 - Basic Meteorology AS 230 OR Climatology Geog 520
 - Integrated Earth Systems: Confronting Global Change Geog 597.02
 - Geomorphology Earth Sci 550

Part C. Electives within the Major

1. For Climatic Studies path. Choose five of the following courses:
 - Climate System Modeling: Basics and Applications AS 629
 - Atmospheric Thermodynamics AS 631
 - Dynamic Meteorology I AS 637
 - Dynamic Meteorology II AS 638
 - Physical Geography and Environmental Issues Geog 210
 - Global Climate Change: Causes and Consequences Geog 420
 - Biogeography: An Introduction to Life on Earth Geog 490
 - Introduction to Cartography Geog 580
 - Integrated Earth Systems: Confronting Global Change Geog 597.02
 - Fundamentals of Geographic Information Systems Geog 607

- Undergraduate Research and Professionalization Seminar Geog 695 OR Seminar in Geography Geog 795
 - Principles of Oceanography Earth Sci 206
 - The Cryosphere Earth Sci 450 or Glaciers and Landscapes Earth Sci 650
2. For Physical Geography path. Choose five of the following courses (at least three must be from Geography or Atmospheric Sciences):
- Physical Geography and Environmental Issues Geog 210
 - Introduction to Cartography Geog 580
 - Computer Cartography and Geographic Visualization 680
 - Fundamentals of Geographic Information Systems Geog 607
 - Intermediate Geographic Information Systems Geog 685
 - Undergraduate Research and Professionalization Seminar Geog 695 OR Seminar in Geography Geog 795
 - One Human Geography course 600-level or higher
 - Synoptic Meteorology Laboratory AS/Geog 620
 - Boundary Layer Climatology Geog 622.01 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Microclimatological Measurements Geog 622.02 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Synoptic Analysis and Forecasting Geog 623.01 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Severe Storm Forecasting 623.02 (note: has prerequisite of Physics 132, which has a prerequisite of Math 153)
 - Climate System Modeling: Basics and Applications AS 629
 - Atmospheric Thermodynamics AS 631 (note: has a prerequisite of Math 153)
 - Dynamic Meteorology I AS 637 (note: has prerequisite of Math 255)
 - Dynamic Meteorology II AS 638
 - Principles of Oceanography Earth Sci 206
 - Water in the Basin Hydrologic Cycle Earth Sci 410
 - The Cryosphere Earth Sci 450
 - Glaciers and Landscapes Earth Sci 650

Part D. Internship

1. After students have completed 20 hours of coursework in Geography, they are eligible for an internship and receive credit for it through the department.

Appendix K
Four-year course plans for each specialization
(charts starting on the following page)

Sample four year plan B.A. Geography - Urban, Regional, and Global Studies Specialization			
Year 1			
Autumn	Winter	Spring	Summer
English 110	Math (Dependent on placement)	First Natural Science	
First Foreign Language	Second Foreign Language	Third Foreign Language	
Geography 200 (GEC)	Geography 205 (Major)	Visual/Performing Arts	
Year 2			
Autumn	Winter	Spring	Summer
Fourth Foreign Language	Geography 450	Stats 145	
Geography 580	Second Writing	Second Natural Science	
First Historical Study	Second Historical Study	Geography 460	
Year 3			
Autumn	Winter	Spring	Summer
Geography 470	Geography 645	Geography 695	
Literature	Geography 655	Second Social Science	
Minor or General Elective	Third Natural Science	Minor or General Elective	
Year 4			
Autumn	Winter	Spring	Summer
First Additional Breadth course	Geography 660	Geography 607	
Issues of the Contemporary World	Internship Credit	Minor or General Elective	
Minor or General Elective	Second Additional Breadth course	Internship Credit	

Sample four year plan B.A. Geography - Environment and Society Specialization			
Year 1			
Autumn	Winter	Spring	Summer
English 110	Math (Dependent on placement)	First Natural Science	
First Foreign Language	Second Foreign Language	Third Foreign Language	
Geography 200 or 240 (GEC)	Geography 210 (Major)	Visual/Performing Arts	
Year 2			
Autumn	Winter	Spring	Summer
Fourth Foreign Language	Geography 580	Stats 145	
Geography 430	Second Writing	Second Natural Science	
First Historical Study	Second Historical Study	Geography 420	
Year 3			
Autumn	Winter	Spring	Summer
Geography 490	Geography 605	Geography 695	
Literature	Geography 635	Second Social Science	
Minor or General Elective	Third Natural Science	Minor or General Elective	
Year 4			
Autumn	Winter	Spring	Summer
First Additional Breadth course	Geography 642	Geography 607	
Issues of the Contemporary World	Second Additional Breadth course	Minor or General Elective	
Minor or General Elective	Minor or General Elective	Internship Credit	

Sample four year plan B.S. Geography - Spatial Analysis Specialization			
Year 1			
Autumn	Winter	Spring	Summer
English 110	Math 151	Math 152	
Math 150	First GEC Natural Science course	Second Foreign Language course	
Geography 200 or 240 (GEC Social Science course)	First Foreign Language course	Visual/Performing Arts	
University Survey course (1hour)			
Year 2			
Autumn	Winter	Spring	Summer
Geography 605	Geography 580	Geography 607	
Geography 460	GEC Second Writing course (367's)	Statistics 245	
Third GEC Foreign Language	Fourth GEC Foreign Language	First GEC Historical Study course	
Year 3			
Autumn	Winter	Spring	Summer
Geography 683	Geography 680	Geography 695	
Second GEC Historical Study	Geography 685	Third GEC Natural Science course	
Second GEC Natural Science	Literature	Minor or General Elective course	
Year 4			
Autumn	Winter	Spring	Summer
Geography 640	Geography 520	Fourth GEC Natural Science	
Minor or General Elective course	First Additional Breadth course	Second Additional Breadth course	
Second GEC Social Science	Minor or General Elective course	Minor or General Elective course	

Sample four year plan B.S. Geography - Climatology & Physical Geography Specialization - Climatic Studies Path			
Year 1			
Autumn	Winter	Spring	Summer
English 110	Visual/Performing Arts	Physics 131(GEC and m. prereq)	
Math 150	Math 151	Math 152	
Geography 200 (First Social Sci)	First Natural Science	Literature	
Year 2			
Autumn	Winter	Spring	Summer
Physics 132 (GEC and m. prereq)	Second Writing Course	Atmospheric Sciences 230 (m.core)	
Math 153 (major prereq)	Statistics 245 (major prereq)	Geography 210 (major elective)	
Second Social Science	First Foreign Language	Second Foreign Language	
Year 3			
Autumn	Winter	Spring	Summer
Geography 620 (major core)	Geography 622.01 (major core)	Geography 695 (major elective)	
Geography 420 (major elective)	Geography 623.01 (major core)	Geography 623.02 (major core)	
Third Foreign Language	Fourth Foreign Language	First Additional Breadth course	
Year 4			
Autumn	Winter	Spring	Summer
Geography 622.02 (major core)	Fourth Natural Science	Geography 607 (major elective)	
Geography 490 (major elective)	First Historical Study	Second Historical Study	
Internship Credit	Second Additional Breadth course	Minor or General Elective	

Sample four year plan B.S. Geography - Climatology & Physical Geography Specialization - Physical Geography Path			
Year 1			
Autumn	Winter	Spring	Summer
English 110	Visual/Performing Arts	Physics 131(GEC and m. prereq)	
Math 150	Math 151	Math 152	
Geography 200 (First Social Sci)	First Natural Science	Literature	
Year 2			
Autumn	Winter	Spring	Summer
Third Natural Science	Second Writing Course	Second Foreign Language	
Geography 220 (major core)	Statistics 245 (major prereq)	Geography 210 (major elective)	
Second Social Science	First Foreign Language	First Additional Breadth course	
Year 3			
Autumn	Winter	Spring	Summer
Geography 580 (major elective)	Geography 520 (major core)	Geography 695 (major elective)	
Geography 420 (major core)	Earth Sciences 550 (major core)	Earth Sciences 650 (major elective)	
Third Foreign Language	Fourth Foreign Language	First Historical Study	
Year 4			
Autumn	Winter	Spring	Summer
Second Historical Studay	Fourth Natural Science	Geography 607 (major elective)	
Geography 490 (major core)	Minor or General Elective	Individual Study (693)	
Internship Credit	Second Additional Breadth course	Minor or General Elective	

Appendix L
Geography - People, Society, and Environment (PSE) majors
and Enrollment of PSE specialization Majors in Courses Outside Geography

	2002	2003	2004	2005	2006	2007	(Wi-Sp) 2008	Total	Average
Geography majors with PSE specialization (spring term count)	0	1	13	14	26	20	22	NA	16
PSE enrollments in outside courses									
EARTHSCI 550 Geomorphology				1				1	0.1
EEOB 413.01 Ecology			4		8	6	3	21	3.0
EEOB 413.02 Ecology Lab			4		5	4	2	15	2.1
ENR 300.01 Soil Science	1		2		3	1	1	8	1.1
ENR 300.02 Soil Science Lab	1		2		3	2	1	9	1.3
ENR 367 Making and Meaning of the American Landscape						2	1	3	0.4
ENR 400 Natural Resources Policy						1		1	0.1
HIST 366.01 Global Environmental History		1		2		1	2	6	0.9
HIST 366.02 (formerly 567) American Environmental History			1		3			4	0.6

Appendix M Concurrences

The proposal has been sent (with the course requests and new major proposals) to the following schools/departments:

City and Regional Planning
Civil & Environmental Engineering & Geodetic Sciences
Computer Science and Engineering
Evolution, Ecology, and Organismal Biology
School of Earth Sciences
School of Environment and Natural Resources

Appendix N
Credit hours in Geography at OSU and at peer institutions

Actual credit hours in the major taken by OSU Geography graduates in 2006-2008 (based on a random sample, n= 46)		
Specialization	Average number of hours taken	Notes
Atmospheric Science (BS)	44	Varies depending on choices of course options within specialization.
Geographic Information Systems (BS)	48	
People, Society and Environment (BA)	53	Varies depending on choices of course options within specialization.
Urban and Regional Studies (BA)	50	

Sample of peer institution Geography departments detailing major and overall degree credit hour requirements			
University	Degree	Credit Hours—Quarter Equivalent	
		Major	Total
Michigan State - semesters	BA and BS	47	180
Penn State - semesters	BA	72	180
	BS	90	180
University of Arizona - semesters	BA	53	180
UC Berkeley - semesters	BA	66	180
UCLA - quarters	BA	48	180
University of Colorado - semesters	BA	48-68	180
University of Florida - semesters	BA	51-53	180
University of Illinois - semesters	BA	60-63	180
Wisconsin - semesters	BA and BS	45	180

Appendix O
Specializations with which Geography faculty are associated

Note that all faculty listed are full-time and tenure-track. The department also hires lecturers as needed.

Name	Urban, Regional, and Global Studies	Environment and Society	Spatial Analysis	Climatology and Physical Geography
Ahlquist, Ola		X	X	
Box, Jason				X
Bromwich, David				X
Coleman, Mathew	X			
Cox, Kevin	X			
Ettlinger, Nancy	X			
Hobgood, Jay				X
Kwan, Mei-Po	X		X	
Lin, Jialin				X
Liu, Desheng		X	X	
Malecki, Edward	X			
Mansfield, Becky	X	X		
Mark, Bryan		X		X
McSweeney, Kendra		X		
Medvedkov, Yuri	X			
Mosley-Thompson, Ellen		X		X
Munroe, Darla	X	X	X	
O'Kelly, Morton	X		X	
Porinchu, David		X		X
Rogers, Jeffrey				X
Thomas, Mary	X			
Wainwright, Joel	X	X		
Xiao, Ningchuan	X	X	X	

From: **Jennifer Evans-Cowley** <cowley.11@osu.edu>
Date: Wed, Jan 21, 2009 at 9:21 AM
Subject: Geography Degree Proposals
To: mansfield.32@osu.edu

Dear Becky,

We appreciate your sending us for review your proposals for overhauling the existing Geography major, including (1) renaming and reorganizing existing specializations, (2) existing course changes, (3) creation of five new courses, and (4) two new majors, Geographic Information Science and Atmospheric Sciences.

Overall, we are supportive of these changes. However, we believe that one of the proposed new courses, Geo 455 – Cities in a Globalizing World, has significant overlap with one of the courses that CRP has been teaching for many years, CRP 597 City Planning in the Contemporary World (the syllabus is attached). We ask that the title of Geo 455 be changed to minimize confusion among students. In addition, we believe that our course could serve as a substitute for Geo 455 and ask that this course be put on a substitution list.

In addition, with the addition of the new major in Geographic Information Science we want to make sure that there will be support from Geography for the continued offering of GIS courses in City and Regional Planning (CRP 607 and CRP 608) and the addition of new courses in GIS in City and Regional Planning. For example, last year we offered a new GIS course under a 694 number. This course will be offered again this spring and we anticipate a new course request (under number CRP 609). The course topic is GIS and Decision Support Systems. This course focuses on visualization and decision support plugins for GIS that allow for enhanced decision making. We would strongly encourage Geography to count advanced GIS courses offered in City and Regional Planning to be applied towards the Geographic Information Science degree.

Sincerely,
Jennifer Evans-Cowley, PhD, AICP
Section Head City and Regional Planning

From: Bruce W. Weide [<mailto:weide@cse.ohio-state.edu>]
Sent: Wednesday, January 21, 2009 10:53 AM
Subject: Geography majors

Sorry, my dept chair, Xiaodong Zhang, just forwarded to me the Geography and GIS major proposals and supporting documentation. I don't recall seeing it in October. So, I've given it a look just now and see a few things (below) that the Geography folks proposing it might investigate further; I invite them to get back with me. If you can forward this e-mail to the appropriate parties in Geography, I'd appreciate it. If the person(s) responsible could contact me by e-mail or by phone (2-1517), I'd be happy to discuss these items. Thanks.

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Cheers,
-Bruce

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Bruce W. Weide
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2015 Neil Ave.
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PRELIMINARY COMMENTS

Document: Proposal to Revise the Existing Geography Major

Top of p 6: "CS&E 201 (Elementary Computer Programming) is moved from the pre?major required courses into the Electives, where students may choose this course, or other CS&E programming courses (214 or 240)." Whether CSE 201 and perhaps 214 are the "right" courses here might be open to debate; see below for details. CSE does not have a course numbered 240, nor have we ever had one to my knowledge, so this must be a typo. (This is repeated on p 19, App G.)

Document: Proposal: Bachelor of Science in Geographic Information Science

Sec IV, p 12 and App C, p 18: Students who start in CSE 201 should, if they want to learn elementary data structures, continue into CSE 214; both these courses use Java as the programming language and a context of business-oriented problems in the labs. An alternative path would be CSE 202 followed by CSE 230, a similar intro sequence up through elementary data structures that uses C++ as the programming language and a context of engineering/science problems in the labs. (While it is permissible to go from CSE 201 to CSE 230, there is little reason for anyone to do so when planning is involved. :-) If the programming language is important in the rest of the proposed curriculum, then

this probably should be used as the criterion for which of these courses to list. Related notes:

* CSE 215 is not offered regularly and should not be listed.

* We do not recommend that students start CSE 221 unless they plan on continuing through the CSE 221, 222, 321 sequence, which is taken by CSE and CIS majors and minors and focuses on software development concepts and practices that are not part of the "intro programming in context X using language Y" type courses such as CSE 201 and CSE 202. In fact, it might be worth informing students in this major of the availability of a CIS minor:

<http://www.cse.ohio-state.edu/ugrad/minor.shtml>

and it might be interesting to allow students to count a course or two of this minor (e.g., CSE 201 or CSE 202) in place of the same GIS requirements. (I don't know whether ASC allows this, but limited substitutions like this are allowed for Eng majors and this has led to many more students taking minors.)

* There are two other intro CS courses that parallel CSE 201 and CSE 202.

CSE 203 is "Computational Thinking in Context: Interactive Animations and Games", and CSE 204 is "Computational Thinking in Context: Digital Images and Sound". Both teach intro programming in contexts that might of interest to some students, but both use programming languages that appropriate but not so popular commercially -- and there are no second courses in CSE covering elementary data structures in these contexts or languages. It is not clear that either is appropriate for the proposed GIS major, but that's not our decision!

* CSE will be piloting another intro course this year, CSE 294P "Computational Thinking in Context: Science and Engineering", that uses MATLAB as the language. While it is inappropriate to list a pilot course in a major program, the proposers should be aware of this development and might wish to keep an eye on it as another alternative to CSE 201 in the future, depending on their needs.

* Details of all these courses and others are at:

<http://www.cse.ohio-state.edu/cgi-bin/syllabus-view.cgi>

Document: Department of Geography Course Change Requests

GEOG 680: The informal course description in the syllabus says, "We take a deeper look into data structures and data transformations as a basis for different analytical techniques and visual representations." This does not sound like using off-the-shelf GIS tools, but rather understanding how they work or perhaps even programming with some of them. I don't see how this can succeed with no CSE prerequisites; students are unlikely even to know what a data structure is without CSE 214 or CSE 230. If there is a transitive chain that leads back to one of these courses, I missed it.

In fact, it would expedite my further review and concurrence if the proposers could list (just for me, not in the proposal) the courses in each curriculum that have any CSE course as a prerequisite. As our smorgasbord of intro course offerings should make clear, we are delighted to teach intro programming to anyone on campus! We are, at the same time, unwilling to accept intro programming being taught elsewhere on campus as part of some other course. Our advice on this front, as above, will always be available and (we hope :-) welcome. Our concurrence, however, will always be based on our being convinced that no proposed course involves teaching intro programming or intro data structures concepts already taught in CSE courses -- and concurrence for such comprehensive proposals is quicker when we can see where these concepts are used later in the curriculum and where the prerequisite CSE courses come into the bigger picture. I hope someone with knowledge of this issue could point me in the right direction so my review can be conducted most expeditiously.

FROM: Thomas E. Hetherington [hetherington.1@osu.edu]
SENT: Mon 1/26/2009 5:25 PM
RE: Dept of Geography changes

26 January 2009

Dear Dr. Severtis,

The EEOB curriculum committee has evaluated the proposed changes and additions to the curriculum and undergraduate major programs within the Department of Geography and is fully supportive of the proposals. While we recognize that the impact of these changes on our undergraduate program will be minimal, we are confident that they will significantly improve undergraduate education in the Department of Geography.

Sincerely,

Thomas E, Hetherington, Chair
EEOB Curriculum Committee



School of Environment and Natural Resources

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February 3, 2009

Terry L. Gustafson
Associate Dean, Arts and Sciences
Professor of Chemistry

Dear Prof. Gustafson,

The School of Environment and Natural Resources Academic Affairs Committee met several times to discuss the proposed new Geography major during the fall quarter. After soliciting input from our broader environment and natural resource faculty who work in areas of mutual interest, we are in accord with the general direction of the changes to the major. At the same time, our faculty have expressed a concern related to one course, Geog 430.

Based on the material provided, it appears that Geog 430 covers content that is more closely aligned with the existing title, "Geographical Perspectives on Environment and Society," than with the proposed new title, "Environment and Society." The syllabus indicates the course will focus on how geographers have understood human-nature relations, and the proposed catalog course description also emphasizes "geographical understanding." To the extent that geographical perspectives are emphasized, the course reduces the potential overlap with material currently taught in our course ENR 203, "Society and Natural Resources."

While course titles are a relatively minor part of a curriculum, we think they are worth noting because they play an important role in guiding students in course choice, and they help to distinguish new courses from existing courses.

Our concern about Geog 430 notwithstanding, we are in support of the revisions to the Geography major. We look forward to working together with Geography to promote the understanding of important issues related to the environment and human use of it through our respective curricula and courses.

Sincerely,

Tom Koontz, chair
Academic Affairs Committee
School of Environment and Natural Resources

From: Frank Schwartz [<mailto:schwartz.11@osu.edu>]
Sent: Sunday, May 17, 2009 9:14 AM
To: Gustafson, Terry
Cc: andereck@mps.ohio-state.edu; platz@chemistry.ohio-state.edu;
Leitzel, Joan; krissek.1@osu.edu; Frank Schwartz; Smith, Randy
Subject: RE: FW: Request for Assistance: Geography Major Revisions

Hi All:

Thanks for your e-mails regarding the proposed Geology. As Matt and Terry have indicated the School of Earth Sciences could concur with renaming and revising of a track within the Geography major as "Environment and Society". We would not agree with "Environment and Society" as a stand-alone BA major, for the reasons expressed in previous correspondence.

Thanks

Frank

Transmittal History for Revision to Geography Major

College of Social and Behavioral Sciences Curriculum Committee

Excerpt from Approved Minutes: 10/20/08

7. Geography Revision Discussion

- a. Rationale: Physical Geography area has expanded dramatically since 2002
- b. Number of hours for majors have increased or decreased in varying amounts, min 50, max 60. Tried to make all 4 tracks average 53-55, including cross-major equivalents (i.e. Atmospheric and Climatology). Increases are due to increased faculty and options for offerings, all still have 20-30 hours of free electives. Also benchmark institutions justify increase. Becky Mansfield to provide appendix with elaboration on credit levels of benchmark institutions.
- c. Undergraduate Studies cmte. organized student focus groups within major run by faculty from specific areas. Students responded very positively to proposed changes.
- d. Q: How will students who declare the major later in their careers be affected by core classes? Students will be grandfathered if this is the case. Core courses will not be required strictly sequentially if students declare later in their program.
- e. Atmospheric and Climactic Studies represent largest changes in curriculum.
- f. Physical Geography path is newest addition to curriculum due to new hires and dept. has tried to make it very distinct from other tracks.
- g. Transfer credit will be applied on a case by case basis as appropriate in conjunction with university rules on transfer credit.
- h. Have not heard back from consulted units yet but Geography is meeting with Engineering soon and will have an update at next meeting. ASC Curriculum and Assessment offered to follow up on letters of support if needed.
- i. Q: GIS: What is difference between GIS and Spatial Analysis? In GIS major, one learns more about how GIS are constructed (design and application, more emphasis on design and system itself) whereas Spatial Analysis track is broader and focused more on use of GIS as tools for analysis.
 - i. GIS more focused on programming and quantitative courses (including Computer Science & Engineering courses), both have cartography courses.
 - ii. SA through courses such as 787, 645, 647, 655 focuses more on human geography and application of GIS after core skills courses are completed.
 - iii. Differences become evident in electives as core requirements are very similar. GIS faculty carefully deliberated what would be the minimum for a GIS core, enabling student proficiency and the track and major depart from that point.
- j. Proposal represents a different focus from EEOB (biogeography) after extended communication with EEOB instructor.
- k. Suggestion to incorporate "From..to..." when discussing titles of tracks and majors.

- l. Q: Internships: Dept. did not want to restrict choices by requiring an internship because of late declarations. Students are however encouraged to complete internships. If number of students rise, can current internship opportunities accommodate increased demand? Availability depends largely on track, but there is room for expansion. Advisors and undergraduate studies chair guide students to resources. Suggestion to track placement related to internships.
- m. Committee decided to bundle discussion of GIS and Atmospheric sciences major discussion at next meeting.
- n. Suggestion: to make argument for increased credit hour requirements in certain tracks more robust, include an appendix listing percentage of students already taking certain number of relevant credit as well as expanded rationales for each track.

College of Social and Behavioral Sciences Curriculum Committee
Excerpt from Approved Minutes: 11/3/08

4. Geographic Information Science New B.S. Proposal
 - a. Context: (Ola Ahlqvist) Demand: Students currently specialize in GIS but without the title on the major. There is a professional demand for this type of graduate, which has triggered the evaluation of the availability of such educational programs to fit demand in the field.
 - i. Students and employers have trouble locating GIS programs and specializations and this new major would make the specialization very visible for the public.
 - ii. The UC-GIS consortium, consisting of approximately 80 universities, was formed to steer the development of this growing field. Consortium worked for many years to identify what a workforce in the GISciences would need to know. They identified a list of core requirements with specializations published in 2006. To date no program has made a concerted effort of this size to accommodate these recommendations and competencies as a complete curriculum for a major.
 - iii. The Geography Department has a specialized faculty that can cover these topics and is large enough to accommodate this demand.
 - iv. Q: Are there any other GIS majors in Ohio? A: There is one program at Ohio University (see p.5 of B.S. GIS proposal) but the curriculum of this major has gaps (as defined by the consortium) that the proposed program at Ohio State would not have. A number of universities have GIS majors, but they are not modeled after these recommendations and are embedded in the current curriculum. Certificate programs exist but these are not as robust as this program would be.
 - b. Q: What is difference between the proposed B.S. in Spatial Analysis (SA) and the GIS? A: SA would be a regular Geography major with an emphasis in SA, which would still be grounded in the curriculum as a Geography degree, whereas the GIS major is focused on a more professional specialization where a student could go directly into the workforce as an GIS analyst or technician.

In that sense the degree is narrower and deeper and some of the Geographic substance matter in a curricular sense. The GIS specialization would be a geographic education with emphasis in the methods and techniques areas of the larger GIScience field.

- i. Proposed SA core curriculum is same as GIS major and electives are very similar. On SA specialization a student could not replicate GIS major using electives. Student would need at least one Geography course and could have up to as many as three. Potentially this could be a one-course difference, but there would be little impetus for students to do this because if they choose the GIS, they are choosing the degree for professional purposes.
- c. Role of advising: There are approximately 200 majors and dept. is projecting that majors will increase over time, about one third of which will be GIS majors.
 - i. If a student wished to pursue a graduate career, they would be advised to choose the SA track in order to get a broader Geographic background.
- d. **Request for C&A Office to encourage feedback letters from other departments. Becky Mansfield to send original requests to Kate Hallihan to be forwarded under Terry Gustafson's name.**

5. Atmospheric Science New B.S. Proposal

- a. Context (Hobgood) : Driven by student demand who want B.S. in Atmospheric Science (graduate degrees currently offered have this focus)
- b. Q: Why is this called "Atmospheric Science" instead of "Meteorology"?
Within the scientific community, the latter is often considered a subset of the former. Also, "AS" matches up with current nomenclature at this institution and more accurately describes the broader specializations of the faculty here. The names to differ nationally and are sometimes used interchangeably.
- c. Q: How many majors are anticipated? A: estimated 91 cumulative after 4 years, which would be larger than the estimated 65 cumulative in the GIS program. Anticipate 10-15 new freshmen. Incremental growth is anticipated early on, which will level off later. Some programs (Penn State) are very large but most across country are in 50-100 range. This estimate also takes into account faculty support. The program also, however, currently loses some potential students who want a degree with the AS name on it rather than just "Geography" so this could help with recruitment.
- d. Q: How would total Geography majors grow? From 200 to maybe 250, which would be sustainable using current resources.
- e. Math 151-255 course requirements: if students do not take these until later in their careers, would that impede their progress to the AS degree? No, 255 is only a pre-req only for advanced climate courses and students would have other Geography course options to take earlier while they were completing their higher-level Math requirements. Students know entering the program are aware that they have to know differential equations in order to attain such a degree.

- f. For someone interested in physical geography, the Math requirements are much lower. Climatology track provides this option whereas AS track is for advanced work in Math and Physics.
- g. The slightly anticipated increase in students would not have an affect on the MPS course loads, because many of these students are already taking advanced courses in other majors and later change major to Geography.
- h. Motion to begin working through course proposals in next meeting, breaking them out by specialization as much as possible. (Wait on considering of "Geog 684 Geographic Applications of Remote Sensing" because that course is being revised after consultation with Civil Engineering program.)

College of Social and Behavioral Sciences Curriculum Committee

Excerpt from Approved Minutes: 12/1/08

7. Final vote on Geography major revisions and new majors and accompanying course requests

Unanimous Approval of all major revisions and new majors

CCI Social, Behavioral, Biological, Mathematical and Physical Sciences Subcommittee

Excerpt from Approved Minutes: 1/12/09

3. Geography major revision
 - Justifications for major change: it makes sense (vs. separate tracks within geography major- the tracks lead to different degrees) with greater specialization; perhaps the model to use here is to start with the geography major revision, then the atmospheric science then the GIS, then the courses
 - Justified as they make large efforts to reconstitute the majors, good explanations of their changes; credentialing and tagging on the degree (types of jobs these majors are qualified for), similar to other universities' degree types, narrowing a broad synthetic field to a more specialized faculty pool; can increase the number of majors & early majors with these changes
 - **List of faculty with matrix as to their specialization, who can teach what specialty**
 - **Learning outcomes for the geography majors as a whole and for each track individually**
 - **Spatial analysis curriculum (App H) Part C: which of these are methods courses (probably all but 1 & 2); specify so students can make sure they choose a methods course**
 - **No CS&E 240—clarify what this course should be- perhaps 204?**
 - Urban, regional and global: very stand alone, not much to do with new atmospheric sciences or GIS majors; just redefining, restructuring the courses; adds the number of credits from 50 to 55
 - **How often will these courses especially the required courses be offered for students? Especially if offered only every other year.**

- **ALL 4-year plans: elective hours for the students (on BA)- looks more like 20 hours on some of the plans- where on the plans would students take their additional breaths? True elective work is small (this should be reflected on all the 4 yr plans). There can be minor work there if they wish; Also add Survey 100 for all four year plans**
- **FOR NEXT MEETING: Division of labor breakdown:**
 - Rigor, course fit, prerequisite structure (Are they justified having the new major? Why are required courses now electives? What happens to the students when they are in these majors? Same rigor and structure? If not, why not? Why are hours going up?)
 - before and after comparison: 1)urban, regional and global (Mumy, Goodman) & 2) environment (Fredal, Bitters) (what are the courses, what are the changes)
 - compare the old & new climatology with the new major (Pride, Breitenberger); and compare the old and new spatial analysis and GIS (Harder, Soundarajan)
- **FOR NEXT MEETING: Invite Geography representative for 10-11 AM to answer questions**
- 4. Atmospheric Sciences program proposal
 - Already a graduate degree in the department
- 5. GIS program proposal
 - Overlap with spatial analysis

CCI Social, Behavioral, Biological, Mathematical and Physical Sciences Subcommittee

Excerpt from Approved Minutes: 1/26/09

3. Geography major revision
 - **URBAN, REGIONAL & GLOBAL**
 - **OLD→new major track: 50→55 hrs**
 - i. (part D, App B) new course Human Geog 205, a very sensible move as a foundation course
 - ii. 5 more credit hrs because: Add 695 (undergrad research)
 - The requirements are allowing students more choice
 - 3 new courses go along with this
 - i. City & Reg planning has some issue with 1 of the courses
 - ii. the 2 other courses are new courses and required parts of the major; Geog 600 is a great historical perspective capstone course
 - Co-reqs: Choice of 2 methods courses, replacing the 3 previous ones
 - i. **Choice of 3 more intro courses- 3 courses at the 200-400 level, a little heavy on the bottom of the core, rather than more advanced courses, 500 and above- could have made them new numbers at a higher level**
 - ii. The advanced courses are similar to the regional geography courses

iii. **Dropped physical geography requirement which kept the major from going to 60 credits**

- ENVIRONMENT AND SOCIETY
 - **On the new major, they have 3 “substantive areas”- they have the new human geography course (205) but is not on their proposal; this is a GEC and could advise students to take it as their GEC requirement**
 - Changed which courses count where and added some courses on the areas, so their methods course is still in that area; a quantitative methods course is now in methods- many name changes; **are they changing course content or were they in the wrong category to begin with?**
 - SPATIAL ANALYSIS
 - Computing is gone from requirements, which seems strange (though it is in the elective); so much is built into other tools so programming from scratch is no longer necessary
 - Narrow in focus
 - **Specific courses in the GIS major are not in the spatial analysis major**
 - **1 course listed (240) is not a course**
4. GIS program proposal (none discussed prior to guest)
 5. Atmospheric Sciences program proposal
 - General questions regarding the formatting on the course presentations
 - **637- has a prereq (631) that is not part of the program setup**
 - Cannot teach Earth Sci courses without teaching global change; there should be some sort of concurrence from Earth Science, a meeting of which is scheduled
 - Consistency and evaluation is in the program, but the wording could be changed a little bit, and syllabi could be cleaned up quite a bit
 - **Not clear where the math is required for the more advanced courses (though it is a prereq)**
 6. Geography courses (new and changes) (not discussed prior to guest)
 7. (2nd hour)- Geography representative (Becky Mansfield- guest)

URB, REG & GLB

Q: Comparing the current (APPX C) & proposed (APPX D): addition of 5 cr hours.

What goes on in 695?

A: required as part of Environment & Society undergrad curriculum, now including it in 3 of the 4 specializations; a combo of research design, practicing research & presenting professionally. Taught by an award-winning teacher (McKendry). Data set hunting, interviewing, quantitative vs. qualitative data analysis, CVs- very hands-on course. Prefer students in Junior year to use as launching point to use in senior year; but most take it in senior yr.

Q: Addition of Human Geo 205

A: Not a formal prerequisite because of the lateness of which students come to Geog; unless they come through it in the GEC. Want to make it possible for them to take 400 & 600 level courses.

Q: Why isn't this course required in Environment & Society as basic human geog

A: 210 & 220, especially 210, is a well-established course; its intro to physical geog & environmental issues; 430 is an intro to some of the history of geog thought & human environment

Q: Previously 3 required methods courses, now a choice of 2 methods courses, giving more flexibility?

A: more student choice, moved towards it in Grad curriculum as well, recognizing broader diversity of geog methods that might be of interest to them and providing them the opportunity for more depth. 3 potential cartography courses, 2 GIS courses, 1 geog analysis class (3 areas of choice, going more in-depth rather than an intro to everything). Recognizing different student interests. Advising them to do 507, 580 & 607, 683 & maybe 1 more, but depends on who they are even in this track. Some will take this and still do jobs in GIS, so they would be encouraged to do more rather than minimum, some encouraged to be GIS major, depending on their interests and career aspirations. Get them skills to get the jobs

Q: Now choice of 3 more introductory courses. Why encourage them to do the intro courses in 200-400 level? What about 500 level courses?

A: Students have had very few 200 level courses to take, almost no 400 levels and a lot of 600 level classes. The 500 level classes haven't been taught in yrs. The feeling was the 600 classes are scary for undergrads because they have grad students in there; also 600 level class has a diversity from freshmen to PhD students. Wanted more of a stepping stone through the curriculum; 205 then 405 then 600 level classes. The dept rarely gets students coming in as Freshmen, especially as Atmospheric Sci. Trying to fill in the 400 level classes as a sweet spot in the curriculum not as in-depth as the 600 level but providing broad overviews of the sub-disciplines/systematic areas. 600 level classes get into more in-depth discussions. 500 level courses in the past have been regional courses so the ones already on the books (450, 460) have been around for a long time so they added 455 & 465. Changing some of the European classes. Combining some courses into 1 course (Latin America)- 505 & 605; overview vs. specific issues.

Q: Dropped an elective and added choice. Dropped any physical geography in this track.

A: Given the choices students already have in terms of specialization (human or physical), and phys geog courses offered have been specialized (climate), the intro 210 could be a possibility, but we want to allow students to get training in methods and sub-disciplines, making it more focused.

Q: Any place to put in physical geog as an elective choice?

A: Probably. Maybe choice of 1 of 3 more intro courses.

ENVIRONMENT & SOCIETY

Q: Nature of the courses. Have the courses changed or is it a matter of redefining the categories

A: We decided to focus on the categories; what we used to include was a broad range of courses from other depts. Now we can offer more and focus more on geography. We are offering a good deal of courses, so the courses really have changed, really emphasizing the geog perspective in society.

Q: 4 courses used to be social electives. Now the changes like 605; 635 has not changed

A: More name changes than anything. 630 gets a new name, 635 hasn't changed.... Not including South Asia, because that faculty member is gone. Some 600 level courses were really being taught at the 400 level

Q: Regional courses?

A: Regional courses have to do with who is teaching them and who will be in the future. They have an environmental focus. Students could petition for certain courses. Students were not taking many courses outside the dept, typically 2-3 students per year. That is a potential impact (EEOB- 503) but students will still be encouraged to take other courses outside the dept.

Q: Is that an essential goal to get majors earlier?

A: That would be ideal; some of the name changes and specialization changes is to make the courses more recognizable to students and more important. Visibility is certainly a goal, interdisciplinary endeavors.

Q: With the new major, is it essential that they come early?

A: Probably not; the prerequisites aren't in place; it is more streamlined, and the choices are more clear. 25 faculty members (23 now)

Q: Are there too many courses?

A: Courses are mostly offered once a year, which makes up for the fact that there are quite a lot. Everybody has a set of courses to teach each year

Q: 1st course?

A: Depends on the student interest and specialization. 205 in social issues; 210 or 430 in human environment; 480 in spatial analysis/mapping.

Q: What grabs the student in Geography? What gets them into the major?

A: 200 which is a large GEC, wide range of interests. Usually early on, though there is a full range.

GIS new major/SPATIAL ANALYSIS TRACK

Q: 240?

A: Meant 230. We understand the CS&E sequencing better

Q: 202-502? 502 is serious programming but also maturity and interest in specific areas; might be good as an elective for GIS. 215 is not offered often and not recently. The other set of courses: 203-204, neither may be appropriate for Geog students, but if enough interest they can look at Geog applications. Teach programming in particular applications. Still programming but context more "applicationary".

A: OK.

Q: Spatial analysis leaves out computing; it would be good to have the current one retained

A: Contingent on spatial analysis major. Will put that back in.

Q: 680. Serious programming goals seem apparent.

A: No, the syllabus (schedule) is not programming heavy, so it was misrepresented in the language of the syllabus. This is about using an array of computer tools, more focused on visualization end rather than programming. Some mash-ups with Google Earth

Q: Any MatLab?

A: Not sure.

Q: Looking at current GIS specialization, spatial analysis; is this revision of the major going to take any students more heavily into programming and using GIS for research

and modeling, requiring more programming skills? Spatial analysis now drops 201 to an elective, and GIS has no increase in programming. Is programming less essential due to software? What about the research element, and going to graduate school?

A: The idea of making it an elective is that students should all have high quality advising, with our full time advisor, there would be some students who need more programming and some less. Focus on here, and working with Grad curriculum less formally, is to provide 4 separate curriculum but within that to allow students to tailor that to their interests and career goals. That explains the range of courses under the elective. Some students would need more programming and would be urged to do so; some less.

Q: If they need less would they be in another specialization? With all these majors, then 1 ought to stand out in this programming area, to be creative.

A: If we could add another 10 units to the major, it could be programming to both of these, and in spatial analysis add more human and phys geography. Some of this GIS skill is more statistical rather than programming. Cartographic methods would require more programming. GIS is strong in programming, a professional degree. Some elective courses might attract students with specific focus areas.

Q: Body of knowledge/reports: database design and mgmt systems as core topics, but neither is elective. If go back to 502, students take them then they can take 670 (database mgmt). Add to elective?

A: Yes, we'll add that in. Body of knowledge: no one school can provide 1 core.

Q: If a student chooses between GIS or spatial analysis track, which is grad track?

A: Spatial analysis is grad track; GIS is terminal degree for Geographers.

Q: This allows students to self-select into these tracks?

A: Yes, we would encourage it.

Q: Appendix H: Electives within the major are methods courses- which is methods?

A: methods courses are 3-8 & 12. We will add that in and make it clear.

Q: New GIS major requires 1 new course?

A: Requires remote sensing course (a piece long would have liked to have been offered but haven't, now we have a junior faculty member who has designed the course), elective is 688. Only atmospheric sci students were taking remote sensings, but GIS students were not able to take it; this new course is able to take a broader range of students with differing backgrounds.

Q: How many in GIS major?

A: Currently 40 majors in GIC, we would expect a majority of them to move over into GIS major, and attract a variety of incoming students who perhaps start elsewhere or choose because they are more visible

Q: Spatial analysis?

A: Would shrink down to about 10. Both GIS & Climat/Phys geog specializations will become small but we want to retain them for those students for whom it makes sense.

Q: How many in the Atmos Sci?

A: We currently have 50-some but we anticipate enrollment by year 4 about 90, really from students who don't go to OSU or go to Purdue or Penn State.

Q: 631?

A: A prerequisite for 637- Atmos Sciences; there was a separate grad program for a long time. On the proposed Atmos Sci major on core requirements. Had Atmos Sci Grad program housed but now allow undergrad track for that.

ATMOS SCI

Q: Potential overlap in Earth Sciences with application thereof: climate change, global change.

A: Will be discussed with ESC. Certainly the case- we have had Atmo Sci grad program, not adding any new courses to undergrad course; we offered a BA in Geog with a specialization in Atmos Sci. Meeting forthcoming. No formal response yet.

Q: p.22- phys geog path- choose 5 courses- 3 Earth Sci courses, choose 1 from ESC

A: maybe we can change the wording; there should be a reason for doing so; part of it is wanting them to have geographical perspectives. Core requirements include Earth Sci 550.

Q: Additional Math & Physics & Chemistry prerequisites in Atmos Sci major now no longer in proposed Climate

A: The climate had math prerequisites- now increasing amount of math in new climatology proposed prerequisites. Used to be 151-152, now 151-152 & 153.

Q: In what courses do they serve as prerequisites?

A: On p.23 of Atmos Sci proposal

CCI Social, Behavioral, Biological, Mathematical and Physical Sciences Subcommittee

Excerpt from Approved Minutes: 2/9/09

3. Geography major revision (returning)

- Geography and Earth Sciences had a meeting last week to discuss their differences; ESC has concerns regarding the revisions but no specifics for this committee yet
- On hold until the differences are explicated- what concerns does this committee have regarding this?
- There might be coursework that students should be able to take in other departments and this committee would like to hear those suggestions
- **ASC Curr Office to create a list of the GEC courses, new courses to the major; basically provide a focusing document on what the committee “has” to approve and what “else” is in the package to speed along the process next meeting**

TABLED- plan on moving on the package next meeting

CCI Social, Behavioral, Biological, Mathematical and Physical Sciences Subcommittee

Excerpt from Approved Minutes: 3/16/09

2. Geography Major revision + GIS + Atmospheric Science (Guests: Becky Mansfield, Terry Gustafson, Dave Andereck, Larry Krissek)

- Earth Science- made suggestions regarding courses to be involved in proposals; most were accepted by Geography; Primary issue: Society & Environment; **CONCERNS:**
 - In the letter sent by SES, 3-fold: 1) in ES, there are many who do things related to the environment, half of which do things related to environ and society, impacts of society/environment; 2) & 3) somewhat related- lack of consultation & SES

has in the past put forward a BA in Earth Systems with an environmental component which ran into resistance w/other units; now interested in an A&S-wide program incorporating all of the areas

- Q: Is lack of consultation still an issue?
 - A: in SES, this contributed towards a separation or thought to multiple programs, more college-wide/interdisciplinary
- Geography- response
 - Reason for lack of consultation: the proposal was sent out last Fall in October, the response was first rec'd in January; the reason not consulted broadly around the issue is because Geog determined their pedagogical goals; we don't see this as a major expansion, and we don't understand why calling it Environ and Society has become a big deal, establishing the first environmental major, why perceived as a dramatic shift? We don't perceive it as a dramatic shift; we are interested in the interdisc major and minor; we are not trying to stake a claim in environ and social issues. On the comment of new faculty as being interdisc, every Geog faculty member is interdisc and could teach in any A&S college on campus, engineering, educ, FAES, etc because of Geog's nature in general
 - Handout- 1997 report on rediscovering Geog- graphic representation- 3 domains of synthesis, viewed as ways of looking at the world; Environment and Society is a core part of Geography and has been since the 1990's as this shows; the dept has a desire to design curriculum based on their history, present and future; this is a growing issue in the discipline; fully in support of other on campus efforts to develop environ and society curriculum
- SES response-
 - Geog & SES have worked on the interdisc minor in environmental citizenship, and it has been a great partnership
- Q: If there was an Interdisc-wide major on Environmental Sciences, how would the Geog major coincide with it?
 - A: We had a minor already in the environmental sciences, are supportive of it, have many courses on the physical and bio-physical science sides, but we feel we offer a Geog perspective on environmental issues, as well as with global systems, etc
- SES response-
 - If Geog is now supportive of other programs, SES sees this as a change from how the former proposal was handled. Geog had 'significant interest in this area'
 - Q: What is the history with the depts.?
 - A: a draft proposal in the Earth Systems BA proposal
 - (DA): Proposal was presented, circulated and the Geog response was that they had significant interest but had no details
- Q (BM): Is the name a part of the problem? It is simply a specialization not a major, just within the majors (GIS & Atmospheric Sci)
- Q (GM): Track changes: take people out of the title; changes in courses and elective courses- what is noticeable about those changes that would signal a more aggressive attitude by Geog?
 - A(LK): going to Environment and Society elevates the Environ side at least in the title; now first in the list of 2 rather than 3rd in the list of 3; the old PSE did

- have a number of Earth Sci courses as electives, now the Environ and Society has no SES courses represented;
 - A (BM): those were moved in the climatic Phys Geog track, Geog courses are offered in here, and multiple climate change classes (Environment and Society track), offering the Geog perspective on the issue (p.19, App F of the proposal)
- Q (GM): Does the old or new track have more or less Physical? (Appendix E)
 - A (BM): Similar amount; an analysis was done of what students have taken in the past 6-7 yrs for this specialization and we found 1 student had taken Geomorphology at that time, quite a few had taken Ecology, by far the most of any of these classes; the practical impact seems minimum (App L on p.31)
- Q (DP): BS in Atmos Sci, under goals and objectives and evaluations; are there requirements outside of Geog? (p.15 of Atmos Sci says they are not required to take anything in other depts)
 - A (BM): True for Atmos Sci, GIS has some CSE prereqs; the required course outside of dept is in Climate Phys Geog track, Geomorphology (SES class 550), the only one required of students. There are multiple electives outside of the dept
- Q (DA): Phys Geog courses are being changed from 1 to 2 SES courses (outside the major)
 - A (LK): On proposal for Atmos Sci, was listing 550 as an elective—
 - A (BM): Phys Geog track requires Earth Sci 550.
- Q (GM): In SES, say “water security issue”, what constitutes Societal impacts in environmental issues for Social Sciences? Are they physically oriented?
 - A (LK): SES has faculty worrying about that from the physical side to potential impacts on society; not just building structures, but finding, using and maintaining water supplies for cities, agricultural, economic resources, probably not politics. As an indication, the water security course is accepted within Intl Studies, showing an extension beyond just the physical/chemical aspects of water.
 - A (BM): Would be interested in including water security class in curriculum.
- Q (GM): What did SES think about the response that Geog didn’t want the course in their curriculum
 - A (LK): If there was a different place Geog thinks it works better that would be fine.
- Q (GM): 1 missing piece- environment and society change in track, SES still has some concern over in terms of building an interdisc A&S-wide major- 1 resolution, is Geog goes back to its old track; the further question is if they changed it to Society and Environment?
 - A (LK): Concern would be the same
- Q (GM): If this committee approved the majors, what would happen? With SES objecting (would it go to CCI with a lack of concurrence)
 - A (LK): SES would express the same concerns with the 1 concentration; the others look resolved
- (BM): Geog would like to have Env & Soc as the name of the track, since the nomenclature has changed over the years.
- (DP): Soc & Env means something different than Env & Soc; Env & Soc means Env drives what society does;

- (BM): Geog views it as a reciprocal relationship. Env holds the specialization together because we have other foci; this is human and physical perspectives on environ
- (DP): Climate change focus?
 - (BM): Geog dept focused on atmos & climatic aspects of phys geog; now we have new faculty who can branch out to a broader phys geog at this point; climate studies does include climate change (past, current, reconstruction)
- (JH): What is the response from Geog to the proposal from SES regarding Enviorn and Soc program interdisc?
 - (BM): Haven't sat down to talk about it but generally supportive of a variety of efforts; would not have an impact on Geog's own major because it is core Geog perspective; we want to offer students opportunity to become Geographers with this specialty. We believe Geographers can study the environment/social processes relationship
- (DA): Geog specialization is on human side? Where does phys geog end and non-classical geology end?
 - (BM): Geogs talk about it as understanding the patterns and processes on the earth's surface, more interested in the uplift of mountains and the physical landscape; basically interested in the historical elements and current
 - (LK): Some Geogs could be in SES depts., as well as SES could be in a broad range of depts.
- (DA): In some joint way, Geographers should be part of SES; Atmospheric Science is physics and chemistry;
 - (BM): Geog bridge across physical and social and human sciences
- (DA): If we are in the midst of how we will be organized, should we hold off on something that could be cross-college; should we hang on and see what happens? Environmental Sciences task force is on the horizon
- (BM): Geog already has a people/environmental specialization, and the students take approx the same courses
- (DA): looking at it from the perspective of 'now is an opportunity to do something bigger', rather than repackaging; raise visibility and develop a larger program
 - (BM): We would still want to offer something in this core aspect of Geog in environment and society, rather than in a track within an Interdisc major, we want to offer a Geog perspective. For some students it offers a unique perspective, offers a home for students who can't find it elsewhere
- Guests Becky Mansfield, Larry Krissek & David Andereck leave
- (TG): Would appreciate being able to stay and listen [no objections from Cmte]
- Overnight letter from SES: does not add anything to Larry's case, just a further reiteration of the Env Society issue
- Env/Soc has been a core part of Geog for awhile
- In many ways there is a bigger issue between these 2 depts/schools- symptomatic at hiring where disciplines are not as relevant as once; a strength and a cause of friction, hiring on the cusp which has often been seen as a strength
- The budget model is and has changed; enrollment is now 20% of budget for A&S, so not in that enrollment controls money mode right now; you do have to fund instruction but there seems to be less emphasis on enrollment; people still need courses to teach

- New hires in Geog for climate change- there was no consultation; but there will be overlap; can both groups accommodate that?
- Env/Soc word ordering- seems important to Geog, but not to SES.
- **GIS MAJOR-** Soundarajan, Harder- **UNANIMOUSLY APPROVED contingent upon SPATIAL ANALYSIS TRACK passing**
- **SPATIAL ANALYSIS TRACK-** Pride, Harder- **UNANIMOUSLY APPROVED; therefore the GIS Major passed**
- **ATMOSPHERIC SCIENCES MAJOR & CLIMATOLOGY/PHYSICAL GEOG TRACK-** Harder, Soundarajan- **UNANIMOUSLY APPROVED**
- **URBAN, REGIONAL & GLOBAL STUDIES & suggested course list change (SES 411 added to options in B.4)-** Harder, Soundarajan- **UNANIMOUSLY APPROVED**
- **ENVIRONMENT AND SOCIETY- TABLED-** wait for full Subcommittee; send back to Geography about some course changes or tweaking; this does not affect other tracks or majors; committee felt it worthwhile to have B Mansfield & L Krissek here today but need not bring back visitors; informal recommendation to further consider a change to Society and Environment track change name

CCI Social, Behavioral, Biological, Mathematical and Physical Sciences Subcommittee

Excerpt from Approved Minutes: 4/7/09

2. Geography major revision- Environment and Society track
 - On the horizon is an Interdisciplinary major in Environmental Sciences/Studies
 - Possible options for the Subcommittee today:
 - Ignore this track/no vote (Geog would still have their original track in People and Society)
 - Approve this track
 - SES has not concurred with the Env & Soc track, primarily based on name change
 - The track itself has changed names, and a change in structure
 - *Substantive changes in curricular track:* looks a little more restrictive in terms of student choice but actually there is more flexibility in this new track but it is a more structured flexibility; the change seems oriented to guaranteeing a breadth of knowledge; under Phys Geog, for instance, there is a choice between 2 or 3 choices, and the dept went to some effort to look at the contents of each course to fit into these categories

MOTION TO APPROVE **CURRICULAR** TRACK CHANGE AS PROPOSED- Harder, Soundarajan- **UNANIMOUSLY APPROVED**

MOTION TO APPROVE **NAME** TRACK CHANGE AS PROPOSED- Harder, Fredal- **UNANIMOUSLY APPROVED**

CCI Approved Minutes excerpt 5/27/09

1. Geography Majors Revision (guests: Jay Hobgood, Becky Mansfield)
 - a. Introduction (Mumy): Taken old Geog major with 4 tracks, refined and updated tracks, and developed from 2 of the existing tracks, 2 new additional majors
 - i. Revision to Urban and Regional Studies Specialization (BA): change name to “**Urban, Regional and Global Studies**” to reflect current practices in field. This specialization has 5 more credit hours required than currently
 - ii. This core area in Geography has been restructured due to new expertise and changes in faculty as well as to follow disciplinary norms. There were concerns about eliminating Geography courses in this track from other units, but Geography now has more faculty to fill this specialization from a Geographical perspective. Was 50-60 credit hours. Now, because of changes in course content, this major requires 55 hours.
 - iii. See p. 4 of Mumy cover letter: All name and content changes to existing tracks were approved by subcommittee. Was some concern for overreach in name change of (the newly titled) **Environment and Society** (BA) track from the School of Earth Sciences, but consensus/concerns have been resolved.
 - iv. Next two specialization revisions are tied to the two new majors
 1. **Revision to BA in Geography with a specialization in “Spatial Analysis”** From the current BS in, “Analytical Geog and GIS” there is a revised specialization in “Spatial Analysis” for students looking for graduate school training.
 2. Students in Spatial Analysis major may still want Geographical Information Systems (GIS) application courses (see discussion of new GIS major below), so concern was raised that students could take very similar curriculum. While this could possibly occur, the subcommittee was satisfied with Geography Department’s explanation of how students would take courses to differentiate their needs.
 3. **New BS in GIS:** Part of content taken from Analytical Cartography portion Analytical Geog and GIS major. Main reason to separate this into a new major is to give GIS students specialization and to give a specific name and tag on transcripts to students. Will help students identify this highly sought-after degree and position by employers. Will require specific technical skills in this field.
 4. **Revision to BA in Geography with a specialization in “Climatology and Physical Geography”:** had added math requirements (+5 pre-req hours) and elective hours have increased from 43-53 to 55, thus adding 10 more hours to this track

5. **New BS in Atmospheric Sciences (BS)** There is more Physical Geography now within the department, adding courses in Physical Geography, allowing the creation of a new BS in Atmospheric Sciences that was formerly contained within the BA in Geography with a specialization in “Climatology and Physical Geography.” Also, the creation of the major in Atmospheric Sciences (BS) was based the current strong Ph.D. program in the same field and undergraduates wanted a similar degree. Naming will also help students and employers identify degree. No similar program in Ohio. Easy to tailor this degree to the requirements of professional organization guidelines for BS degrees in field. This program has the most math in SBS and pre-reqs have been made more rigorous accordingly, including 50 pre-req hours (Math, Physics, Chemistry), 35 of which can overlap with GEC. Requires two targeted electives.
- v. Q: What are total credit hours of new proposed curriculum for A.S. and GIS? about 165 total (pre-reqs, plus GEC, plus major) leaving room for free electives to total 181.
 - vi. Q: What is the general difference between a BA and a BS degree? BS generally connotes more math and science. If student is looking for job with government or as a forecaster, they are looking for more science. BA is more liberal arts-oriented and students could not get a job with National Weather Service with a BA. GIS major has fewer overall credits (2 pre-req courses). Atmospheric Sciences has 10 pre reqs
 - vii. Q: Is there any kind of governing body for GIS? No, but there is a GIS University Consortium that has suggested body of knowledge to define basic necessary grounds. The Department used these suggestions to craft major.
 - viii. Requirements for broadcast meteorology career does require BS, although university requirements differ nationally. Now the Meteorological Society requires a BS in Atmospheric Science to get the CVM.
 - ix. How many students are anticipated? Most Climatology and Physical Geography undergrad majors will likely switch over to Atmospheric Sciences (50-60 students) and the program anticipates doubling that number in the next 10 years based on peer institutions with similar student body and faculty size. Over 120 students would not be desirable given faculty size. 60-65 are likely to be GIS majors by year 4 (based on the current number of students specializing in GIS and projected new majors).
 - x. There is an existing program in Mapping and Land Information Systems housed within the School of Earth Science, but it has no current majors. What is the distinction between GIS and Geodetic Science and that major’s existing focus? GIS grew out of Geography practices in 1960’s of mapping spatial data into GIS. Both students and

employers have been demanding some way to certify that students doing GIS have sufficient technical training. Some schools have gone to certification, others have followed UCGIS suggestion to develop a major in GIS. Geodetic Sciences seems to have come more from surveying field, but details of parallelism between Geography information versus Land Information are unclear at present. GIS applications and add-on spatial statistical science information would likely be different. If Earth Science is interested in reviving major, there should be distinction and Geography would not have objections if this major was revived.

Subcommittee approval stands as motion to approve all proposed revisions and new majors. 2nd Hubin

UNANIMOUSLY APPROVED



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11 March 2009

Prof. Terry Gustafson
Associate Executive Dean
Colleges of the Arts and Sciences
Ohio State University
CAMPUS

Dear Terry,

As discussed in several previous meetings, the School of Earth Sciences (SES) has concerns about the revisions to its B.A. and B.S. programs proposed by the Department of Geography. These concerns arise from three basic points:

- 1) overlaps between the areas included in these revisions and the strong interests and major activities by the School of Earth Sciences in the areas of environmental issues (including societal effects and responses), remote sensing, spatial analysis, surficial processes, and climate/paleoclimatology;
- 2) the development of the proposed revisions without significant consultation with Earth Sciences about these areas of overlap; and
- 3) the potential for campus-wide modification of efforts in the field of the "environment" as a result of recommendations from the task force presently reviewing the various "environmental" programs on campus.

To address these concerns, Earth Sciences provides recommendations here for modifications to Geography's proposals; we view the recommended modifications for several components as relatively minor, and are willing to concur with pieces of Geography's proposal contingent on satisfactory resolution of issues raised in our letter. As indicated in 2 below, SES does not concur with the proposed BA program in Environment and Society because it is an aggressive expansion into a multidisciplinary academic area of the environment that has represented a major area of interest for our unit and others in the Arts and Sciences. We, however, present constructive ideas for how the Department of Geography proposal can be modified.

Specific recommendations follow:

- 1) For the B.A. in Urban, Regional, and Global Studies – we recommend that Earth Sci 411 (Water Security in the 21st Century) be added to the list of options in Part B. 4 ("Choice of three

more introductory courses”). We make this recommendation because Earth Sci 411 parallels Geog 445 (Transportation Security) in both title and description. In addition, Earth Sci 411 considers the issues surrounding a major resource of local (including urban), regional, and global importance.

2) For the B.A. in Environment and Society – we have heard the argument that the proposed program is really just an extension of what the Department of Geography already does. In the respect that the proposed program is constituted almost entirely of Geography courses this is the case. However, development of a broad environmentally-oriented B.A. major to our mind cannot come about without a vigorous discussion of the organization of environmentally-oriented degree programs in the Arts and Sciences more generally. We can’t understand the total absence of discussion of this proposal as it was being developed. Beyond the broader issues, just mentioned, we never learned why SES courses that were included in the predecessor program (People, Society, and Environment) were simply dropped from the new program without explanation.

The School of Earth Sciences already has a very large effort in environmental sciences with about 20 faculty members that work on physical and certain societal aspects. We have a large and extremely successful graduate program in many aspects of Environmental Sciences, a minor called Environmental Studies, and a relatively large number of GEC courses teaching hundreds of students various aspects of environmental sciences every quarter. It is a reasonable expectation for SES to play an important role in environmentally-oriented degree programs in the Arts and Sciences

About a year and half ago, we completed a draft proposal for a B.A. major called Earth System Science that presented environmental sciences from an Earth science perspective. We asked for reactions from units on the draft proposal for this new program. The Department of Geography response was to the effect that they expected to have a substantial ‘interest’ in such a program. This is our identical conclusion concerning their present proposal. We think that substantial participation by our unit in such a program would enrich its diversity, quality and interest, and to that end would offer the following suggestion.

We would propose that Environment and Society degree program be developed more broadly in an interdisciplinary way within the Arts and Sciences. Students within a unit like ours might perhaps emphasize environment science more and policy less. Students at home in other departments of the Arts and Science might develop other niches. We would pledge to work cooperatively to develop such a proposal.

3) For the B.A. in Spatial Analysis – we recommend that Earth Sci 310 (Earth Systems Data Collection and Analysis) be added to Part C (Electives within the Major). A variety of other courses dealing with Spatial Analysis are offered in Earth Sciences, including Earth Sci 641 and 642 and several 600-level Geodetic Science courses. However, the presence of additional prerequisites for those courses precludes us from recommending that any of those courses be included here.

4) For the new B.S. in Geographic Information Science – we realize that much of this major is guided by the national model curriculum for GIS programs; however, we again recommend that Earth Sci 310 (Earth Systems Data Collection and Analysis) be added to Part C (Electives), because Earth Sci 310 focuses on spatial analysis, including GIS.

5) For the B.A. in Climatology and Physical Geography – we recommend that Earth Sci 206 (Principles of Oceanography), and Earth Sci 450 (The Cryosphere) OR Earth Sci 650 (Glaciers and Landscapes) be added to Part C. 1 (Electives within the Major for the Climatic Studies path). We argue that these additions are justified because of the important roles of the ocean and the cryosphere in the earth's climate system. We also recommend that Earth Sci 450 be added to the list of courses in Part C. 2 (Electives within the Major for the Physical Geography path), and request that a student in the Physical Geography path be allowed to take up to two Earth Science courses from the list of electives.

6) For the new B.S. in Atmospheric Sciences – we realize that much of this major is configured to meet guidelines established by the American Meteorological Society, and have no recommendations for additions or changes.

The modifications recommended here incorporate additional expertise from Earth Sciences into the respective programs in Geography, thereby strengthening the preparation of students in those programs. We appreciate your assistance in furthering this collaboration, and look forward to mutually beneficial interactions with the Department of Geography in the future.

Please contact me with any questions, or to discuss these recommendations further.

Yours truly,

A handwritten signature in black ink that reads "Frank W. Schwartz". The signature is written in a cursive style with a large, stylized "F" and "S".

Frank W. Schwartz
Director and Ohio Eminent Scholar

Geography Response to SES (Becky Mansfield & Morton O'Kelly)

13 March 2009

We wish to thank our colleagues in SES for a clear articulation of several areas of concern they have regarding our proposals to revise the Geography curriculum. We hope to continue to an open dialogue about these issues, and it is with the goal of open dialogue that this letter outlines our response.

We appreciate the many good courses that are offered and pledge to work with SES to include appropriate courses as electives where suited.

- We are happy to include SES 310 in our Spatial Analysis and GIS area, and to list courses on oceanography, the cryosphere, and glaciers for both paths of the CPG specialization. We also gladly agree to allow students in CPG to take 2 SES courses.
- We suggest that the Water Security course (though potentially useful in our urban specialization (URGS), especially as it impacts fragile cities like Phoenix and Las Vegas) would likely make more sense in the E&S area. SES might see this more favorably upon consideration and acceptance of the goals of the E&S track, which are restated in the following paragraph.

We want to respond to some of the concerns expressed about the proposed specialization in Environment and Society. We emphasize that this proposal is a repackaging of our existing "People-Society-Environment" specialization, which was approved by the University in 2002. We wish to be very clear that we are not expanding in new areas (for example, we are proposing no new courses in this area). Nor are we trying to stake an exclusive claim to the study of social dimensions of environmental issues. We note that the environment is a shared topic and is likely in the future to be the subject of some very creative curricular ideas. We recognize that other units on campus (including SES and SENR) already offer courses and curricula in related areas, and we expect that they will continue to do so. (And SENR has offered its concurrence for our curriculum proposals.) We also support ongoing efforts to create interdisciplinary programs in related areas, such as the interdisciplinary Environmental Citizenship minor that is currently being proposed. We have been actively involved in creating that minor from the beginning, and look forward to ongoing participation in it. In a related vein we have had a history of supporting City and Regional Planning even though their program has overlap with ours; they too have concurred with our proposal.

Rather than an effort to stake a claim to the exclusive study of environment and society, our proposed curriculum is an organic outgrowth of scholarship in Geography as a discipline. There is a long-standing tradition in Geography of studying environment-society relationships—in fact this was the focus of the discipline at its inception. Therefore, geographers offer unique perspectives on these issues. Our faculty has expertise specifically in this area, even as all of our faculty also draw from and contribute to other areas of geography (physical geography, human geography, and geographical methods). The study of environment and society

relationships is a vital component of our intellectual writings and endeavors. Our curriculum is specifically designed to showcase faculty expertise and teach students geographical knowledge, approaches, and methods regarding the intersection of environment and society. The position of this specialization within the Geography major (rather than as a stand-alone major, as we are proposing for GIS and Atmospheric Sciences) indicates that our aim is to provide this geographical perspective on environment and society.

Regarding the structure of the proposed Environment and Society curriculum, we took a number of factors into account when deciding on which courses to include. (See pages 4-5 of the original "Proposal to Revise the Existing Geography Major"). Certainly one consideration is our desire to provide a geographical perspective on the relationship between environment and society, as outlined above. Thus it seemed important that we emphasize courses taught by geographers; so doing also allows us to provide continuity, reduce overlap across courses, and alter the content of courses as disciplinary foci change. Beyond this, there were two primary considerations:

- The composition of our faculty has changed over the past several years, due to multiple new hires (seven faculty members hired since 2002 are associated with the specialization). Several of these faculty members are able to offer additional courses related to the Environment and Society specialization, especially in physical geography (e.g. Geography 490, on biogeography). The proposed curriculum reflects the expertise of the new hires in the department.
- Enrollment patterns of PSE students since the inception of the specialization in 2002 suggest that the effects of these changes will be minimal. As is outlined on page nine and in Appendix L of the original "Proposal to Revise the Existing Geography Major," very few PSE students took courses offered by other departments, even with these courses formally listed as part of the curriculum. The course with the greatest enrollment was EEOB 413 (Ecology), which had 21 students total during these years, or an average of 3 a year; please note that EEOB has concurred with our proposal. Only one student total took Earth Sciences 550, Geomorphology.

In sum, our curriculum proposal is based on over a year of self-study, in which we carefully evaluated our pedagogical goals and worked to align our curriculum with these goals. All in all, we feel we are not a threat: we are not asserting a first claim on these topics, and do not plan to exclude others from the broad environmental debate. We think we have a great program to offer, we plan to collaborate, and we are more than willing to adapt aspects of our program to gain wider support. We also reaffirm our early and sincere expression of interest in seeing SES's revised proposal.

At the end of the day, we feel like we are in the right position at the right time to propose these changes, and we ask for the committee's support in allowing us to move to further rounds of review. The curriculum overhaul that our department has undertaken is an important aspect of our strategic plan and we believe we have a very high level of support for our ideas.

Geography curriculum revision and new major proposal:
Breakdown of distribution of quarter credit hours by major and specialization

Major and specialization	Core (all majors)	Core (specialization)	Major electives	Total major	Non-Geog prereq	Total major + prereq	GEC	GEC double counts	Free electives	Total
Geography BA										
Urban, Regional, and Global Studies Specialization	NA	15	40	55	0	55	90	0	36	181
Environment and Society Specialization	NA	10	40	50	0	50	90	0	41	181
Geography BS										
Spatial Analysis Specialization	NA	30	18-20	48-50	9	57-59	90	0	32-34	181
Climate and Physical Geography Specialization: Climatic Studies Path	NA	28	25	53	30	83	90	25	33	181
Climate and Physical Geography Specialization: Physical Geography Path	NA	30	23-25	53-55	20	73-75	90	15	31-33	181
Atmospheric Sciences BS	43	NA	8-10	51-53	50	101-103	90	35	23-25	181
Geographic Information Sciences BS	45	NA	6-10	51-55	9	60-64	90	0	27-31	181

Notes

1. The actual GEC is 80-100 hours because of the language requirement variation of 0 to 20 hours. The 90 hours used in the table assumes a typical student would be taking 10 hours of foreign language.
2. GEC double counts: Because of requirements in math, physics, and chemistry, the Climate and Physical Geography (CPG) specialization and the Atmospheric Sciences BS offer significant double counts between the required prerequisites and the GEC, in the areas of Quantitative and Logical Skills, Natural Science Breadth, and Additional Breadth.