To: Prof. William Green, Chairperson Graduate Committee

From: L. Gregory Huey, Chairperson Grad. Studies Comm. EAS

Re: New Course Petition EAS 6120

We request approval for a new graduate course, EAS 6120 – Environmental Field Methods. The graduate course will be taught concurrently with the senior undergraduate class EAS 4420. The graduate students will be assigned more difficult problem sets, take different exams and be required to complete a more involved field project. The primary motivation for this course is to provide a viable option for CEE graduate students who can use the course as one of the required electives for the Hydrogeology certificate. The course was taught in this manner as a special problems course in the fall of 2001 with a graduate enrollment of five students. Please let me know if I can be of any assistance in your evaluation of this proposal.

____________________ date_______________
Judith Curry
Chairperson, School of Earth and Atmospheric Sciences

____________________ date_______________
Gary B. Schuster
Dean, College of Sciences

____________________ date_______________
Jean-Lou Chameau
Provost
NEW COURSE PROPOSAL

GRADUATE  Level I  XX  Level II  _____  UNDERGRADUATE  ________

SCHOOL, DEPARTMENT, COLLEGE  Earth and Atmospheric Sciences, College of Sciences  DATE  9/28/02

1. Course Number  EAS 6120  (Verify with Registrar's Office)

2. Hours:  

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<th>Mode</th>
<th>% of Course</th>
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<tr>
<td>Lecture</td>
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<td>Discussion</td>
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<td>Seminar</td>
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<td>Independent Study</td>
<td>20</td>
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<tr>
<td>Library Work</td>
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<td>Demonstration</td>
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<td>Other (Specify)</td>
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3. Descriptive Title:  Environmental Field Methods

4. Recommended Abbreviation for Transcript – (24 characters including spaces):

5. Catalog Description – (25 words or less)

Environmental site characterization through a field-based project that advances student's research. Theory, field data acquisition, and data fusion using geochemical, geophysical, hydrologic, and related methods.

6. Basis:  L/G  X  P/F  Audit

7. Prerequisites:

Prerequisites with concurrency:

Corequisites:

8. Has the course been taught as a special topic?  YES  If YES,  When  Fall 2001  Enrollment 5 grad students

9. Is this course equivalent to a no course taught at Ga. Tech? (graduate or undergraduate) This will be the graduate version of EAS 4420

10. Are you requesting that this course satisfy:  Humanities  Social Science

11. Expected Mode of Presentation:

12. Planned Frequency of Offering:

<table>
<thead>
<tr>
<th>Term to be Offered</th>
<th>Expected Enrollment</th>
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<tr>
<td>Fall</td>
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<td>Spring</td>
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<tr>
<td>Summer</td>
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</table>

13. Probable Instructor(s) – Please mark with an asterisk any non-tenure track individuals.

C. Ruppel

14. Purpose of Course:  Relation to other courses, programs and curricula:

To expose students to state of the art environmental field methods and the opportunity to participate in a real environmental project. The course also emphasizes formulating a proposal for a field project, designing and completing a field project at our existing sites, and professional report writing and presentation.

15. Required  Elective  X  THIS COURSE HAS BEEN LISTED AS ONE OF THE OPTIONS FOR STUDENTS PURSUING THE HYDROGEOLOGY CERTIFICATE PROGRAM IN CEE. This is a graduate certificate program administered by Prof. Mustafa Aral. To comply with the requirement, we must have a graduate version of this course.

16. Please attach a topical outline of the course
EAS 6120 - Environmental Field Methods
This is a project-based course that is one component of Georgia Tech’s Hydrogeology Certificate program administered by Civil and Environmental Engineering. For graduate students, the centerpiece of the course is a self-defined project implemented at a field site. The students formally propose a project (including cost analysis), acquire and process the data, and complete a professional scientific report (with interim feedback on how to rewrite) that synthesizes their own results with those obtained by the rest of the class. Graduate students are expected to pursue an original project that pushes the limits of their own knowledge. Note that 3 of the 5 graduate projects completed in Fall 2001 will lead to either a contribution to the peer-reviewed literature or a major change in the research methods implemented in the student’s research. During the pilot year for graduate participation, a student designed and analyzed the first slug test ever completed at the field site, devised a new method for implementing and interpreting Wenner DC resistivity data in high conductivity terrains, and logged sediment cores/interpreted GPR data to constrain the evolution of lithofacies on the island.

Approximate Syllabus
(Example case for field site on a Georgia Bight barrier island)

- Introduction and social context of environmental problems, key environmental regulations affecting groundwater/surface water quality and the coastal environment
- Geological evolution and structure (deposition processes, mineralogy, dynamic components)
- Porous media hydrology applied to coastal phreatic aquifers
- Practical aspects (field methods) for groundwater hydrology: well design and installation, long-term monitoring
- Practical aspects for other hydrologic studies: quantifying components of the water cycle
- Determining aquifer parameters (grain size distributions, slug and pumping tests)
- Complexities of coastal aquifers (variable density flow), important off-the-shelf groundwater models
- Soil science in site characterization (soil chemistry, soil physics, basic soil parameters, soil origin, applications of Archie’s law)
- Geophysical remote sensing techniques for hydrofacies/lithofacies analysis & site characterization
  1. Ground penetrating radar and relationship to seismic techniques
  2. DC Resistivity
  3. Inductive EM
  4. Borehole geophysics
- Ground water geochemistry
  1. Cation/anion analyses: techniques, calculated conductivities, etc.
  2. Redox species: measurement, redox zonation, interpretation
  3. Nutrients: measurement, interpretation
  4. Mixing calculations
- Use of monitoring station information (e.g., sondes, met stations, gages) for short- and long-term records
- Review of GIS and use of aerial/satellite remote sensing data
- Links to ecosystem studies
- Data fusion
  1. Statistical methods
  2. Interpreting competing data sets

3-day field trip to coastal Georgia field site annually scheduled for first week of October
To: Prof. William Green, Chairperson Graduate Committee

From: L. Gregory Huey, Chairperson Grad. Studies Comm. EAS

Re: New Course Petition EAS 6130

We request approval for a new graduate course, EAS 6130 – Earth System Modeling. The graduate course will be taught concurrently with the senior undergraduate class EAS 4610. The graduate students will be assigned more difficult problem sets, take different exams and be required to complete a more involved modeling project. This course is currently being taught as a special problem class and has an enrollment of 10 graduate students primarily from CEE and EAS. The class has proven very valuable as an introduction to standard numerical techniques and provides training in how to analyze experimental data. Please let me know if I can be of any assistance in your evaluation of this proposal.

____________________ date_______________
Judith Curry
Chairperson, School of Earth and Atmospheric Sciences

____________________ date_______________
Gary B. Schuster
Dean, College of Sciences

____________________ date_______________
Jean-Lou Chameau
Provost
# NEW COURSE PROPOSAL

**GRADUATE  Level I  X  Level II  ____  UNDERGRADUATE  ____  **

**SCHOOL, DEPARTMENT, COLLEGE**  Earth and Atmospheric Sciences, COS  **DATE**  September 28, 2002

| 1. Course Number – **EAS 6130** (Verify with Registrar's Office) |
| 2. Hours: **LECTURE 3  LAB 0  RECITATION 0  TOTAL SEMESTER CREDIT 3** |
| 3. Descriptive Title: **Earth System Modeling** |
| 5. Catalog Description – (25 words or less) **An introduction to computer modeling in Earth System Science.** |
| 6. Basis: L/G  X  P/F  Audit |
| 7. Prerequisites: |
| Prerequisites with concurrency: |
| Corequisites: |
| 8. Has the course been taught as a special topic? **Yes** if YES, When **Past 3 years**  Enrollment **The enrollment is currently 10 graduate students.** |
| 9. Are you requesting that this course satisfy: **Humanities** **Social Science** |
| 10. Expected Mode of Presentation: **MODE**  **% of COURSE** |
| Lecture  70 |
| Laboratory  Supervised  10 |
| Unsupervised  |
| Discussion  10 |
| Seminar  |
| Independent Study  |
| Library Work  |
| Demonstration  |
| Other (Specify) Student Presentation  10 |
| 11. Planned Frequency of Offering: **TERM TO BE OFFERED**  **EXPECTED ENROLLMENT** |
| Fall  |
| Spring  X  6-10 graduate students |
| Summer  |

13. Probable Instructor(s) – **Please mark with an asterisk any non-tenure track individuals.**

**C. Ruppel and M. Bergin**

**Purpose of Course:** Relation to other courses, programs and curricula: **Introduces the discretization and programming of mathematical physics that govern chemical, biological, and physical processes in the Earth System, through exercises and an original, independent modeling project related to the graduate students research.**

15. Required  Elective  X

16. Please attach a topical outline of the course
EAS 6130 – Earth System Modeling

Formal Lecture Topics

1. Philosophy of modeling
2. Terminology, calibration, validation, goodness of fit statistics
3. Discrete Math I: From analytical solutions to finite differencing
4. Discrete Math II: Indicial notation, higher order (accurate) solutions
5. Machine epsilon, truncation error, instability
6. Discrete Math III: Grid formulation
7. Review of matrix algebra and links to implementation of discrete math on computers
8. Box models (0 dimensional)
9. 1D models: steady-state
10. 1D models: transient
11. 2D models: steady-state and transient
12. Advection-dispersion problems
13. Boundary and initial conditions
14. Coupled Models
15. Advanced numerical methods (implicit, higher-order accuracy)
16. Nonlinear systems and chaos
17. Inverse models: Generalized inverse, tomographic problems
18. Stochastic Models / Monte Carlo methods
19. Finite Element Models
20. Spectral Models

This course is taught simultaneously with the undergraduate version. Graduate students are assigned additional problem sets and are given more challenging exams. The graduate students are graded on a different scale and required to complete more complex modeling projects. Graduate students are also strongly encouraged to use matrix-based methods for their projects as a means of providing them with access to a broad range of advanced topics in numerical computation.

Project

The centerpiece of this course is the numerical model developed by the student for an atmospheric, geochemical, geophysical, hydrological or biogeochemical process or system. Non-EAS students may use examples from their own fields of study. Graduate students are very strongly encouraged to develop a model directly related to their own research, and many students have used their model as the basis for a comprehensive exam or Ph.D. research.

A key lesson emphasized in this course is that modeling must be motivated by the need to gain fundamental physical insight into a process or system. Thus, students are strongly encouraged to develop a model for a system for which data are available. The projects typically focus on solving fundamental equations of mathematical physics numerically in space and/or time. On occasion, the instructor permits projects that do not rely on the solution of a system of differential equations. Such projects typically are more sophisticated and may focus on chaotic systems, Monte Carlo methods, inverse models, etc.

Most of the exercises in the course focus on implementation of modeling concepts in Matlab, but independent/advanced students are welcome to build their models and do course exercises in any mathematical or compiled language (e.g., Fortran, C). Spreadsheet-based programs are not acceptable.

Examples of past graduate student projects

- 2D advection-dispersion (including reactive transport) in a saturated aquifer with spatially heterogeneous hydraulic conductivity field
- Diffusion-based model for sedimentary facies development in a river delta
- Exchange of mass and energy between benthic chambers and the shallow seafloor
- Monte Carlo model of stalagmite growth
- Two-dimensional plane wave propagation
- Soil liquefaction and stress dissipation in response to earthquake loading
- Stratosphere-troposphere exchange of ozone
- 2D transport of water vapor within the troposphere
To: Prof. William Green, Chairperson Graduate Committee

From: L. Gregory Huey, Chairperson Grad. Studies Comm. EAS

Re: New Course Petition to replace EAS 6511

We request approval for a new graduate course, EAS 6502 – Introduction to Fluid Dynamics and Synoptic Meteorology. This course will replace EAS 6511 “Introductory Fluid Dynamics and Synoptic Laboratory” which is comprised of 2 hours of lecture and 3 hours of synoptic laboratory. The new course will be taught as a 3 hour lecture. The primary motivation for this is that, in the past 15 years, traditional manual analyses of synoptic meteorology maps have been gradually supplanted by more objective, computer-based analyses. Consequently, we believe it is more effective to provide students with a weekly one hour synoptic-oriented lecture that provides the background for take home exercise than a three hour monitored laboratory focused on the details of manual synoptic analyses. The primary point is to more strongly emphasize the results and interpretation of synoptic analyses as opposed to the mechanics of how they are produced. Please let me know if I can be of any assistance in your evaluation of this proposal.

____________________ date_______________
Judith Curry
Chairperson, School of Earth and Atmospheric Sciences

____________________ date_______________
Gary B. Schuster
Dean, College of Sciences

____________________ date_______________
Jean-Lou Chameau
Provost
NEW COURSE PROPOSAL

GRADUATE  Level I  X  Level II  UNDERGRADUATE

SCHOOL, DEPARTMENT, COLLEGE  EAS/COS  DATE  9/28/02

1. Course Number
(Verify with Registrar's Office)  6502

2. Hours:
LECTURE  3
LAB  0
RECITATION  0
TOTAL SEMESTER CREDIT  3

3. Descriptive Title:
INTRODUCTORY FLUID DYNAMICS AND SYNOPTIC METEOROLOGY

4. Recommended Abbreviation for Transcript – (24 characters including spaces):
INT  FLU  DYN & SYN  M E T

5. Catalog Description – (25 words or less)
Fundamental principles of atmospheric fluid dynamics, analysis of meteorological codes, weather data, and patterns, and numerical weather prediction.

6. Basis:  L/G  X  P/F  X  Audit  X

7. Prerequisites:
MATH 2403 or MATH 2413

Prerequisites with concurrency:

Corequisites:

8. Has the course been taught as a special topic?  If YES, When  Enrollment

9. Is this course equivalent to a no course taught at Ga. Tech?  (graduate or undergraduate)  yes this course is designed to replace EAS 6511

10. Are you requesting that this course satisfy:  Humanities  Social Science

11. Expected Mode of Presentation:

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<thead>
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<th>MODE</th>
<th>% of COURSE</th>
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12. Planned Frequency of Offering:

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<tbody>
<tr>
<td>Fall</td>
<td>10-15</td>
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13. Probable Instructor(s) – Please mark with an asterisk any non-tenure track individuals.
Robert Black

14. Purpose of Course:  Relation to other courses, programs and curricula:
Part of the graduate core curriculum in atmospheric sciences (replacement for EAS 6511)

15. Required  X  Elective

16. Please attach a topical outline of the course
**Topical Outline (Fluid Dynamics):**

Week:
1. **Fundamentals**
   - Fluid properties and fluid forces, equation of state
2. **Statics**
   - Hydrostatic balance, geopotential height, hypsometric equation, pressure as a vertical coordinate
3-4. **Kinematics**
   - Flow characterization, vorticity and circulation, divergence and deformation
5-6. **Dynamics in an inertial reference frame**
   - Conservation of mass, momentum and energy; reference frames; momentum; thermodynamic and continuity equations
7-8. **Dynamics in a rotating reference frame**
   - Spherical coordinates, Centrifugal and Coriolis accelerations, effective gravity, equations of motion
9. **Balanced flows**
   - Scale analysis; geostrophic approximation; natural coordinates; inertial, gradient, and cyclostrophic flow; thermal wind
10-11. **Circulation and vorticity (revisited)**
   - Circulation theorem, vorticity equation, potential vorticity conservation
12-15. **Introduction to atmospheric waves**
   - Linear theory and perturbation methods, wave properties, gravity waves, Rossby waves, forced waves

**Topical Outline (Synoptic Meteorology)**

Week:
1. **Introduction:** Atmospheric composition and structure, weather, and climate
2. **Meteorological data:** Observation types, METAR codes, station model plotting
3-5. **Objective analysis methods:** Plotting and analysis of upper air and surface charts
6. Plotting and analysis of atmospheric soundings; vertical stability analysis
7. **Overview of large-scale weather systems**
8-9. **Structure and evolution of midlatitude cyclones and anticyclones**
10. Upper troposphere waves
11. **Introduction to numerical weather prediction**
12-13. **Overview and application of diagnostic tools for synoptic meteorology**
14-15. **Case study:** Diagnosis and numerical prediction