DRAFT – To be finalized

Course information:

Title: Field techniques in interdisciplinary sea-ice research
GEOS/MSL 695 (2 CR)

Duration and location: 8-18 May 2013 at UIC-NARL in Barrow, Alaska (student contact hours based on 8 hours of lectures and 56 hours of lab plus additional reading and writing assignments. meets requirements for two credits of intensive, summer-session course).

Prerequisites:
Recommended for GEOS section: GEOS 615 Sea Ice or equivalent
Recommended for MSL section: MSL 650 biological oceanography

Open to UAF graduate students (in earth, environmental, marine and biological sciences and engineering); open to outside students on an unsubsidized, space-available basis; max. number of spaces: 20

Course fee & tuition: Participation in the course will require a course fee of $400 in addition to costs for 2 full UAF credits ($383 per credit). The course fee and tuition cover all the logistics expenses while in the field, accommodation and a substantial portion of the food consumed while in Barrow. Students are responsible for travel to and from Barrow. There may be an opportunity to apply for supplemental travel support (if interested, please contact one of the instructors).

Instructors
Hajo Eicken, hajo.eicken@gi.alaska.edu, 907-474-7280, WRRB 104E, Fr 9-noon
Rolf Gradinger, rrgradinger@alaska.edu, 907-474-7407, O Neill 252, We 1-2pm
Eric Collins, rec3141@gmail.com, room, telefone TBD – new faculty hire

Required textbook/material: The textbook for the course is Eicken et al. (2009) Field Techniques for Sea Ice Research, University of Alaska Press.
Additional reading will be provided in the description of the various modules (see below).
Students need to provide field clothing adequate to work in Arctic winter conditions.

Brief course description and rationale

This is a course for graduate-level students that offers a practical introduction to the principal field techniques employed in sea-ice studies of an interdisciplinary (geophysical-biogeochemical) nature. The course focuses on sea ice as an instructive example of the close intertwining between ocean, ice and biosphere processes in the polar regions and the transdisciplinary importance of the ice cover in the climate system.

The course is organized in such a way as to encourage interdisciplinary approaches to the problems posed, addressing in particular the themes of temporal and spatial variability of geophysical and biogeochemical variables at different scales. An effort will be made to entrain students from Ilisagvik College in the course activities and include a Native Alaskan ice-knowledge component.

Student Learning Outcomes:
The goal of this course is to introduce graduate students to the methodological approaches for interdisciplinary sea ice research. These approaches will include biology, ecology, sea ice physics and chemistry, oceanography, remote sensing and statistics. Discussions and lectures during the field course will broaden the scope into understanding of the complete scope of sea ice services to the ecosystem and humans in ice-covered waters. This course will enhance the awareness of

challenges related to conduct research in the Arctic and the implications of Arctic warming in Alaskan waters. Students taking this course will receive training in applying modern state-of-the art tools in the Arctic and will also improve their writing and oral skills based on assignments given during the class.

Registration: Prior to registration at the UAF summer sessions website (www.uaf.edu/summer/), students are asked to send their CV and a 1-page statement indicating how this field course will fit into their research and career plans to hajo.eicken@gi.alaska.edu. The instructors will evaluate these documents to decide about participation if the course is oversubscribed. Deadline for submission of these documents is Friday, March 15, 2013. Students will then be notified by April 1 at the latest about their inclusion in the course.

Instructional methods

All students will complete 9 different teaching modules that involve a wide range of field work, sample processing in the lab, presentations and lectures.

All students will complete Module 1 individually before the onset of the field course.

For the field course, the students will form 4 interdisciplinary teams composed of between 3 and 5 students (depending on enrollment). Each team will complete all of the field-course modules (module 2 to 9). Data analysis and module reports will be completed such that each student is part of a small group that is responsible for 2 of the reports for modules 2-9.

During the field course, each group completing fieldwork will be accompanied by an instructor (and/or bear guard depending on weather, location and course progress). Laboratory work will be organized accordingly.

All students will participate in the following nine modules. Detailed descriptions of the modules will be posted on the class specific website and be made available to the students latest one month prior to the class.

Module 1, Introduction to field program design, including use of remote sensing of sea ice properties and processes
Seasonal cycle of sea-ice reflectance (albedo) and surface temperature based on AVHRR data analysis; synthetic aperture radar (SAR) backscatter signatures of sea ice; use of remote-sensing data in designing field measurement programs; regional upscaling from field measurements through remote sensing

Module 2, Sea ice and snow thickness and morphology
Direct measurements of ice thickness; electromagnetic induction measurements of apparent conductivity and derivation of sea-ice thickness; ice morphology (level, rafted, ridged); snow depth and snow property measurements

Module 3, Ice-core and in-situ measurements of basic sea-ice physical properties
Ice core drilling and sampling; in-situ measurements of ice temperature, ice electrical conductivity, measurement of ice strength in-situ with borehole jack strength tests and ice engineering properties

Module 4, Ice transport properties and mathematical modeling
Mathematical modeling of the brine microstructure and transport properties,

including an introduction to percolation theory and homogenization techniques; theory of field measurements of fluid permeability and DC electrical conductivity

Module 5, Ice dielectric properties
Dielectric ice properties and relations to resistivity, dc and multi-frequency ac surface soundings, impedance measurements on ice cores

Module 6, Sea ice (bio)optical properties and radiative transfer
Measurements of all-wave total albedo and above-/in- and below-ice spectral irradiance; attenuation of shortwave radiation as a function of snow and ice properties; impact of biological and sedimentary inclusions on radiative transfer in the sea-ice system (incl. modeling)

Module 7, Sea ice microbial communities and biogeochemistry
Collection of ice and water samples, determination of macronutrient concentrations within the ice and in the brine channels, measurements of bacterial and viral abundance and diversity, impact of particles and sediment inclusions on diversity and productivity of microbial communities, entrainment of microbes into sea ice, spatial heterogeneity of bacterial and algal communities (vertical and areal), microbial alterations of sea ice microstructural properties

Module 8, Sea ice primary production and food webs
Collection of ice and water samples, determining PAR light intensities available for algal growth, measurements of biomass and composition of algae in the water column and sea ice (chlorophyll a, flow cytometry), estimating primary productivity rates using optical techniques (PAM), relate productivity values to sea ice specific microstructural properties, measurements of abundance and diversity of sea-ice meiofauna (metazoans: polychaetes, turbellaria, nematodes, crustaceans), calculation of potential role in ice-based food web (using allometric equations)

Module 9, Traditional and local knowledge of sea ice
Introduction to Iñupiaq sea-ice science (including field trip)

Course calendar
Course preparation: Work through web module on field safety; complete reading assignments; complete remote-sensing data analysis project

Day 1: Travel day, arrival in Barrow, Alaska
Day 2: Orientation (introduction, field safety, general course overview, remote-sensing project discussion, introduction to modeling)
Day 3 to Day 9: Field experiments and laboratory work by individual groups. Detailed descriptions of the assigned tasks will be handed out to all students prior to the field trip.
Day 10: Completion of experimental work and data analysis; clean-up; evening summary symposium with presentation of preliminary results
Day 11: Departure
Course completion: Complete final report by June 30; final grade by July 31

Evaluation
Project reports (Module 1 and two of Modules 2-9): 90 %
Presentation: 10 %
Grades will be determined jointly by the instructor team based on student performance. The following letter grade system will be used: A+ for better than 95% performance (number of total possible points) summed over all categories, A >90 to 95%, A- >85 to

90%, B+ >80 to 85%, B >75 to 80%, B- >70 to 75%, C+ >67 to 70%, C >63 to 67%, C- >60 to 63%, D 50 to 60%, F <50%.

Course policies. Those enrolled in this class are subject to the Student Code of Conduct as outlined in University Regents' Policy on Student Rights and Responsibilities.Students should be familiar with the UAF Honor Code. Neither cheating, plagiarism nor fabrication will be tolerated. Any student found to have plagiarized or fabricated statements (including passages from web pages) will receive an automatic 'F' for the class. Any student found turning in a paper that has been used in another class will also receive an automatic 'F' grade for the class. Students are expected to participate in all modules outlined above, be on time, and be active members of their working groups.

Special needs: Students with learning or other disabilities who may need special course accommodations are encouraged to visit the Disabilities website and make an appointment with the Office of Disability Services (474-5655). Please meet with the instructors (not later than April 1, 2013) so that the appropriate accommodations and supports to assist in meeting the goals of the course can be made in collaboration with the Office of Disability Services. Note that the ability to conduct field work in harsh environments and transportation by snow machine will be essential to successfully complete the class.