COURSE SYLLABUS

GEOS 434/634 - Remote Sensing of the Cryosphere

SPRING 2006

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Class meets at: 10:00 a.m. – 12:00 p.m. (Wednesday) and
9:00 a.m. – 12:00 p.m. (Friday) in 101 WRRB.

Office Hours: I am generally available for student consultation whenever I am in my office with the door open. You can also call me or send me an e-mail if you would like to meet at a specific time/day.

COURSE RATIONALE AND OBJECTIVES

The cryosphere can be defined as the portion of the Earth consisting of ice masses and snow deposits. It includes ice sheets, ice caps and glaciers, sea ice, snow cover, lake and river ice, as well as seasonally frozen ground and permafrost. The cryosphere is an integral part of the global climate system with important linkages and feedbacks operating through its influence on energy, moisture and gas fluxes. Large areas of the cryosphere exist at temperatures close to melting and, as a result, are very sensitive to changes in temperature. This is a significant fact since much of the global cryosphere is located in high latitudes where enhanced warming is projected by climate models.

The cryosphere is among the most important features of the physical and biological environment of Alaska, with most of the territory experiencing several months of snow as well as freshwater and sea ice covers each winter. Also, with nearly 80% of its landmass underlain by permafrost, monitoring and understanding the cryosphere of Alaska is required for operational decision making, and for understanding its response to warming and the impacts on our ecosystems and economy. The later is particularly pertinent since a wide range of Alaskan activities are sensitive to variations in cryospheric elements (e.g. transportation, construction, mining, offshore oil exploration, recreation). Given the size of Alaska, satellite remote sensing is the most promising means for routine monitoring of the cryosphere over large areas of the State.

This course will provide a survey of the most recent advances on the application of remote sensing for mapping/monitoring the cryosphere. Emphasis will be placed on the description of the latest algorithms/methods for the determination of geophysical quantities related to snow, freshwater ice, and frozen ground. The course is designed to provide students with a study of the foundation of the remote sensing algorithms as well as measurement methods and techniques to obtain the relevant geophysical quantities in the field.

Prerequisite

GEOS 422 (Geoscience Applications of Remote Sensing) or equivalent.

Grading

Grading system:

A: 85% and above B: 75-84% C: 65-74% D: 50-64% F: Below 50%

Item:		Due date:
Class presentation: **10%**		March 24
Term project: **40 %**		
Proposal abstract (200 to 250 words)		February 8
15-min. oral presentation: 15%		May 5
Written report: 25%		May 5
(12-15 pages double-spaced, excluding figures and tables)		
Term paper (literature review): **25 %**	Draft:	March 24
	Final:	April 21
Final take-home exam: **25 %**		May 10

Class presentation: Each student will research and prepare a 30-min lecture on a topic related to the course and approved by the instructor. You will be graded by other class members and the instructor. Please negotiate your presentation date with the instructor.

Term project: Each class member will select one of several possible remote sensing data sets to analyze in detail. Class members will write a proposal abstract (includes a tentative title, rationale for topic selected, objectives as well as data and methods to be used), give an oral presentation, and write a report presenting their findings. The report will take the form of a journal paper being submitted to *Remote Sensing of Environment* (see Guide for Authors at http://authors.elsevier.com/GuideForAuthors.html?PubID=505733 for details).

Term paper: Each student will research and prepare a 10-15 page (double-spaced, excluding figures and tables) research paper on a topic related to the course and approved by the instructor. The same topic may be used for both the *class presentation* and *term paper* with the instructor's permission. The paper should be tutorial in nature with other class members as the audience. The first draft of the report will be edited by class members. Members of the class will review and edit the report, make comments, and return the report to the author within 2 weeks of receipt (i.e. April 7). The final version of the report (the one graded by the instructor) will be due on April 21. Only the final version of the report will be graded. The term paper will also take the form of a journal paper being submitted to *Remote Sensing of Environment*

Final exam: This will be a comprehensive take-home exam. You will pick-up the questions at the end of class on Friday, May 5, and return your answers before noon on Monday, May 8.

TEACHING PHILOSOPHY

I feel the instructor's role is to expand on the reading material and lab assignments and to provide additional examples and explanations as needed. As a student it is your responsibility to read the assigned material (book chapters and papers) prior to coming to class, to actively participate in the class by listening and asking questions, and to complete the lab assignments. All of these are designed to help you understand and apply the material. The final exam is designed to evaluate your ability to apply what you have learned. Lab assignments are designed to reinforce what you have learned and provide practice using “real world” data.

ACADEMIC INTEGRITY

Each student in this course is expected to abide by the UAF Student Code of Conduct (2005-2006 Catalog, pp. 73-74).

ACCOMODATION FOR STUDENTS WITH DISABILITIES

Students who anticipate needing accommodations should contact as early as possible, ideally before the beginning of classes, the coordinator of Disability Services at (907)474-7043.

READING SCHEDULE

Week	To read by:	References (see full citation on last page)
3	02/01	**Snow:** Dozier and Painter (2004), Scherer *et al.* (2005)
7	03/01	**Freshwater ice:** Jeffries *et al.* (2005)
11	03/29	**Sea ice:** TBD
13	04/12	**Glaciers and ice sheets:** Winther *et al.* (2005)

WEDNESDAY'S SCHEDULE

Week	Date	Topic
2	01/25	**Snow**: importance, properties, and in situ measurements
3	02/01	Overview of spectral signatures of snow, ice and water
4	02/08	Remote sensing of snow cover area *Proposal abstract due today*
5	02/15	Remote sensing of snow water equivalent and depth
6	02/22	Remote sensing of other snow parameters (no class - reading material) *Claude away from the office (CRYSYS Meeting)*
7	03/01	**Freshwater ice:** importance, properties, and in situ measurements
8	03/08	Remote sensing of lake ice cover: from freeze-up to break-up
9	03/15	*Spring recess*
10	03/22	Remote sensing of other lake ice parameters and river ice
11	03/29	**Sea ice:** importance, properties and in situ measurements
12	04/05*	Remote sensing of sea ice
13	04/12*	**Glaciers and ice sheets:** importance, properties, and in situ measurements
14	04/19*	Remote sensing of glaciers and ice sheets
15	04/26*	**Seasonally frozen ground and permafrost:** importance, properties, and in situ measurements
16	05/03	Remote sensing of permafrost and seasonally frozen ground

* Claude may be away for 1-2 weeks in April (field work or IGOS-Cryosphere Meeting)

FRIDAY'S SCHEDULE

Week	Date	Topic
1	01/20	Presentation of course syllabus
2	01/27	Discussion of term project, data sets available, software issues, etc.
3	02/03	Snow reflectance and albedo algorithms
4	02/10	Snow cover area algorithms
5	02/17	Snow water equivalent and depth algorithms
6	02/24	*Claude away from the office (CRYSYS Meeting)*
7	03/03	Algorithms for other snow parameters (e.g. grain size, wetness)
8	03/10	Algorithms for the determination of freeze-up and break-up
9	03/17	*Spring recess (no classes)*
10	03/24	*Class presentations* *Draft version of term paper due today*
11	03/31	Algorithms for other freshwater ice parameters (e.g. ice type, thickness)
12	04/07*	Algorithms for sea ice parameters (e.g. ice concentration, melt pond fraction)
13	04/14*	Discussion of issues related to term projects
14	04/21*	Algorithms for glacier/ice sheet parameters (e.g. zones, velocity) *Final version of term paper due today*
15	04/28*	*UAF SpringFest* Algorithms for mapping/monitoring permafrost and frozen ground (no class - reading material)
16	05/05	*Oral presentations of term projects* *Project report due today*

* Claude may be away for 1-2 weeks in April (field work or IGOS-Cryosphere Meeting)

References

Books/journal publications:

Dozier, J. and T.H. Painter, 2004. Multispectral and hyperspectral remote sensing of alpine snow properties, *Annu. Rev. Earth Planet. Sci.*, *32*, 465-494.

Duguay, C.R., T. Zhang, D.W. Leverington, and V.E. Romanovsky, 2005. Remote sensing of permafrost and seasonally frozen ground. In *Remote Sensing in Northern Hydrology: Measuring Environmental Change*, Edited by Duguay, C.R. and A. Pietroniro, Geophysical Monograph 163, American Geophysical Union, Washington, DC, pp. 91-118.

Jeffries, M.O., K. Morris, and N. Kozlenko, 2005. Ice characteristics and processes, and remote sensing of frozen rivers and lakes. In *Remote Sensing in Northern Hydrology: Measuring Environmental Change*, Edited by Duguay, C.R. and A. Pietroniro, Geophysical Monograph 163, American Geophysical Union, Washington, DC, pp. 63-90.

Scherer, D., D.K. Hall, V. Hochschild, M. König, J.-G. Winther, C.R. Duguay, F. Pivot, C. Mätzler, F. Rau, K. Seidel, R. Solberg, and A.E. Walker, 2005. Remote sensing of snow cover. In *Remote Sensing in Northern Hydrology: Measuring Environmental Change*, Edited by Duguay, C.R. and A. Pietroniro, Geophysical Monograph 163, American Geophysical Union, Washington, DC, pp. 7-38.

Winther, J.-G., R. Bindschadler, M. König, and D. Scherer, 2005. Remote sensing of glaciers and ice sheets. In *Remote Sensing in Northern Hydrology: Measuring Environmental Change*, Edited by Duguay, C.R. and A. Pietroniro, Geophysical Monograph 163, American Geophysical Union, Washington, DC, pp. 39-61.

Other references that are pertinent to the subjects covered in lectures will be given on a regular basis throughout the semester.

Resources on the web:

The best starting point is ColdLinks from NSIDC (National Snow and Ice Data Center). This will provide you with an impressive list of links to web sites dealing with one aspect or another of the cryosphere. Follow the link http://nsidc.org/links/