NRM 641 Natural Resource Applications of Remote Sensing

Spring 2024, Credits: 3, CRN: 35236, 35239

Prerequisite: NRM 338 or NRM 435 or Instructor's Permission

Location: WRRB 004 Computer Lab and Synchronously Online (Zoom)
Meeting Time: MW 9:30 – 11:00 am

Instructor: Dr. Santosh Panda (email: skpanda@alaska.edu; phone: 907 474 7539)
Office: Room: O'Neill 368
Office Hours: MW 11:00 – 11:45 am (face-to-face, phone, Zoom)

Course Description: This course is primarily focused on remote sensing applications in natural resource management (including land, forest and freshwater) and geo-hazards using a variety of datasets. Students will work on several arctic focus remote sensing application projects (e.g. arctic greening, browning of boreal forest, wildfire detection and burn severity, lake change, coastal erosion, glacier recession, and landscape analysis).

Course Goals:

1. To learn basic image processing methods using ArcGIS Pro including panchromatic, pseudocolor, and color image display, image georeferencing, change detection methods, supervised and unsupervised classification, and accuracy assessment methods.
2. To learn about sensors especially applicable to vegetation applications in Alaska including hyperspectral data, LIDAR, IFSAR, Landsat, MODIS, and AVHRR sensors and data products.
3. To use ArcGIS Pro to explore changes associated with climate warming in Alaska including greening of the arctic, browning of the boreal forest, mapping wildfire severity and hotspots, mapping shrinking lakes, receding glaciers, and coastal erosion, etc.

Student Learning Outcomes:

After successfully completing this course you will be able to:

- understand what spectral bands are most appropriate for a variety of remote sensing applications
- effectively display panchromatic, color, color infrared and false color imagery
- merge panchromatic and multispectral bands and create fly-in and fly-by animations
- use unsupervised and supervised classification methods to create land cover maps
- co-register and use historic remotely sensed imagery for change detection applications
- use ground truth locations to quantitatively assess the accuracy of remote sensing classifications
- process global AVHRR NDVI data to assess the greening of Arctic Alaska and the browning of boreal Alaska
- use MODIS NDVI data to assess NDVI response following the 2004 drought in interior Alaska
- work with MODIS snow cover data in Alaska
- map and assess fire severity using Landsat sensor Normalized Burn Ratio indices
- derive weekly hotspot density rasters and wildfire polygons based on MODIS hotspot thermal anomaly product
- produce a lightning density map from a lightning strike dataset
- assess the accuracy and precision of LIDAR elevation estimates
- use LIDAR to map tall tree locations and to map canopy closure distributions by forest type
- prepare and give a seminar on remote sensing applications
- lead discussion on a peer-reviewed publication in the area of remote sensing

- effectively communicate image processing tasks and results through report writing and oral presentation

Course Materials:

It's a NoLo (No Cost or Low Cost) course. There is no required textbook for this class. I'll provide all lecture, lab, assignment and reading materials.

Online reference including ArcGIS Pro help for image processing tools, websites specific to sensors.

Technology requirements: The course uses ESRI ArcGIS Pro software which is a Windows-only software. All students will be provided with an ArcGIS Pro account and installation file. Students will have three different options to access the software (1: installation on their personal computers, 2: access through OIT virtual lab space, and 3: access to computers in WRRB 004 computer lab.

Check the computer system requirements for ArcGIS Pro 3.1

Technology requirements for Remote section: The course uses ESRI ArcGIS Pro software which is a Windows-only software. All students will be provided with an ArcGIS Pro account and installation file. Students with Mac computers will need to use a Virtual Windows environment to access ArcGIS Pro on their computer (Run ArcGIS Pro on a Mac computer). Alternatively, students may access ArcGIS Pro software through OIT virtual lab space which requires stable internet connection and familiarity working on a remote Windows computer.

Confirm that your computer can run ArcGIS Pro: You will run a test to confirm that your computer can support ArcGIS Pro. Even if you have ArcGIS Pro installed, you should confirm that it can support ArcGIS Pro 3.1.

In a web browser, go to Can You Run It?

Click the Run Tech Check button.

Follow the steps to open and run the test.

The site generates a report that lists the minimum requirements and identifies whether your machine meets these requirements.

If your computer does not meet the requirements, check the Common Questions to find links to complete the recommended updates, and then run the test again.

Note: If your computer does not meet the requirements, you may need to use a different computer or update your graphics card. For more information, go to ArcGIS Pro Help: Graphics adapter resources.

Course schedule:

Week: Dates	Topics
1: 1/17	Introduction - Course introduction - Remote sensing fundamentals - Introduction to ArcGIS Pro
2: 1/22, 24	Raster Display in ArcGIS Pro

	- Raster surprises in ArcGIS - Querying and clipping Raster data - One bit binary and psuedocolor images - 8-bit panchromatic images - True color image display
3: 1/29, 31	Image-based pdf posters and animations in ArcGIS Pro - Hillshade Raster - Hillshade sharpening - Drop-down animations - Fly-by animations - Temporal animations
4: 2/5, 7	Exploring spectral regions using ArcGIS Pro - Visible spectral regions - Near-Infrared spectral region - SWIR spectral region - Thermal spectral region - Hyperspectral remote sensing - Analysis of spectral responses
5: 2/12, 14	Georeferencing with ArcGIS Pro - Linear georeferencing model - ArcGIS Pro georeferencing toolbar - Co-registration of historic imagery - Georeferencing photographs - Artificial change due to co-registration error
6: 2/19, 21	Supervised classification - Maximum likelihood classifier - Supervised classification in ArcGIS - Image segmentation - Point-based classification accuracy assessment
7: 2/26, 28	Unsupervised classification - Spectral clustering - Spectral clustering in ArcGIS - Using ArcGIS to fix mixed spectral classes - Raster-based classification accuracy assessment
8: 3/4, 6	AVHRR sensor applications - The Advanced Very High Resolution Radiometer (AVHRR) - Processing GIMMS-NDVI raster data - 20-year change in peak summer NDVI by ecoregion - Working with 1-km AVHRR Alaska products
9:	Spring Break (Mar. 11 - 15)
10: 3/18, 20	MODIS sensor applications - MODIS land products - Assessing MODIS NDVI reliability

	- Assessing eMODIS NDVI reliability - Working with 250-m NDVI tiles in Alaska - 500-m snow product in Alaska
11: 3/25, 27	Landsat sensor applications - Landsat sensors - Mapping burned areas - Mapping Arctic greening - Mapping Aspen defoliation - Mapping radiant temperature
12: 4/1, 3	IFSAR and LIDAR applications - Guest lecture (4/6/22: mapping water extent, fire scar, and deforestation using microwave data) - Working with IFSAR data - Assessing LIDAR precision and accuracy - Using LIDAR to locate tall trees - Using LIDAR to map percent forest canopy closure
13: 4/8, 10	Point sensor applications - Creating density maps from point locations - Mapping hotspot polygons - Interpolating depth points - Lightning detections and weather station data
14 - 16: 4/15, 17, 22, 24, 29	Climate Change Applications 1. Mapping lake area change in a warming boreal climate 2. 25-year trend in annual maximum NDVI 3. 35-years of declining sea ice extent 4. Mapping glacier recession in the Alaska Range 5. Mapping coastal erosion in a warming Arctic 6. Decadal Arctic NDVI and summer warmth index
5/1	Final project report due by 5/1 midnight

Course Policies:

Participation: You will use ArcGIS Pro and follow along as I teach you new concepts each week (through lectures).

Late Work Policy: Late assignments will be accepted with a 5% penalty per day late (if not approved in advance by the instructor).

Evaluation Policies:

Grades are based on the points (and point percentage) that are attributed as follows:

Four assignments, 20 points each
One seminar, 20 points
One peer-reviewed paper discussion, 20 points
One midterm exam, 30 points

Class project, 70 points
Active participation in lectures (bonus 2%)

Grading criteria:
A (A+: > 94%, A-: > 90%)
B (B+: > 80%, B-: > 70%)
C (C+: > 60%, C-: > 50%)
D (D+: > 45%, D-: > 40%)

Each Student will work on a class project. Students are encouraged to pick a project that is in line with their thesis/graduate research. I'll also help students in identifying a topic for their class project.

Paper discussion (Time: 30 minutes; Points: 20):

In the beginning of the semester, the class will be divided into groups of 2-3 students. Each group will pick a peer-reviewed journal article in the area of remote sensing applications for paper discussion. Instructor will help the groups find a suitable paper. All students will be required to read all papers selected for discussion. The group leading the discussion will introduce the paper and highlight the key findings along with methodology used. Every student will have an opportunity to share their take on the paper. Students will critique the paper, ask questions, and discuss the methods used in the paper.

Seminar scoring rubric (Time: 15 minutes; Points: 20)

Category	Scoring Criteria	Total Points
Content (10 points)	Introduction is attention-grabbing, lays out the seminar's purpose well, and establishes a framework for the rest of the talk.	4
	Material included is relevant to the overall message/purpose.	2
	Appropriate amount of material is prepared, and points made reflect well their relative importance.	4
	There is a conclusion or final remarks summarizing the seminar.	2
Presentation (5 points)	Speaker maintains good eye contact with the audience and is appropriately animated (clear and audible voice).	1
	Visual aids or materials used are well prepared, informative, and effective.	2
	Length of presentation is within the assigned time limits.	1
	Presenter answered all questions fairly.	3
Score	**Total Points**	**20**

Guideline for research project report (Points: 70):

Formatting: Use Times New Roman 11 or 12 font size; single – 1.5-line spacing; 1" margin on all sides

Page Limit: 5 pages (excluding references)

- Project Title
- Project abstract (120 words or less) [10 points]

- Goal Statement or Project objectives [5 points]
- Introduction/ Background work (provide some literature background relevant to your project goal) [10 points]
- Data and Tools (provide some details about the data: source, mode of acquisition, resolution, etc.; a brief info on tool(s)) [10 points]
- METHOD(S) [30 points]:
    o What did you do with your data in order to achieve your project goal (image processing method (or chain) or algorithm; use flowchart or graphics to show your data processing flow; also explain the data processing steps)
- RESULT(s) [30 points]:
    o Results (use figures and tables; interpret and explain the results)
    o Provide quantitative or qualitative evaluation of your results
    o If your results are not what you hoped for in beginning provide justification
    o Discuss any data or method limitations
- Closing statement [5 points]: Conclusion/ final remark on the project (future direction)

Explanation of NB/I/W Grades: This course adheres to the UAF guidelines regarding the granting of NB Grades. The NB grade is for use only in situations in which the instructor has No Basis upon which to assign a grade. In general, the NB grade will not be granted.

Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy:
"The letter "I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student's control, such as sickness, he/she has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an "I" grade."

Successful, timely completion of this course depends on committing yourself early and maintaining your effort. To this end, this course adheres to the following UAF Learning Procedures:

1. The first assignment is due one week after the first day of instruction. Failure to submit this quiz within the first two weeks of the course could result in withdrawal from the course.
2. Failure to submit the first three assignments by the deadline for faculty-initiated withdrawals (the ninth Friday after the first day of classes) could result in instructor initiated withdrawal from the course (W).

How to check your grade: To check your grades in https://canvas.alaska.edu, click on the **Grades** link in the sidebar menu.

Expectation of student effort: Students should expect to spend 10-12 hours per week on this class. Students need to complete all assignments by their due dates.

Academic Integrity: As described by UAF, scholastic dishonesty constitutes a violation of the university rules and regulations and is punishable according to the procedures outlined by UAF. Scholastic dishonesty includes, but is not limited to, cheating on an exam, plagiarism, and collusion. Cheating includes providing answers to or taking answers from another student. Plagiarism includes use of another author's words or arguments without attribution. Collusion includes unauthorized collaboration with another person in preparing written work for fulfillment of any course requirement. Scholastic dishonesty is punishable by removal from the course and a grade of "F." For more information go to Student Code of Conduct. (http://uaf.edu/usa/student-resources/conduct)

Support Services: UAF Student Support Services helps students with registration and course schedules, provides information about lessons and student records, assists with the examination process, and answers general questions. Our Academic Advisor can help students communicate with instructors, locate helpful resources, and maximize their learning experience. Contact the UAF Student Support Services staff at 907. 455.6844 or email: trio.sss@alaska.edu or contact staff directly – for directory listing see: https://uaf.edu/sss/sss-staff/index.php

UAF Help Desk
Go to http://www.alaska.edu/oit/ to see about current network outages and news. Reach the Help Desk at:
- Email at helpdesk@alaska.edu
- Fax: 907450-8312
- phone: 450.8300 (in the Fairbanks area) or 1.800.478.8226 (outside of Fairbanks)

Disability Services: The UAF Office of Disability Services operates in conjunction with UAF Student Support Services. Disability Services, a part of UAF's Center for Health and Counseling, provides academic accommodations to enrolled students who are identified as being eligible for these services. If you believe you are eligible, please visit their website (http://www.uaf.edu/disability/) or contact a student affairs staff person. You can also contact Disability Services on the Fairbanks campus by phone, 907.474.5655, or by email (uaf-disabilityservices@alaska.edu).

UAF Honor Code: As a UAF student, you are subject to the student Code of Conduct. The university assumes that the integrity of each student and of the student body as a whole will be upheld. It is your responsibility to help maintain the integrity of the student community. For additional information, contact the Center for Student Rights and Responsibilities or web https://uaf.edu/csrr/. The UAF Honor Code (Student Code of Conduct) defines academic standards expected at the University of Alaska Fairbanks.

Title IX Protection: University of Alaska Board of Regents have clearly stated in BOR Policy that discrimination, harassment and violence will not be tolerated on any campus of the University of Alaska. If you believe you are experiencing discrimination or any form of harassment including sexual harassment/misconduct/assault, you are encouraged to report that behavior. If you report to a faculty member or any university employee, they must notify the UAF Title IX Coordinator about the basic facts of the incident.

Your choice for reporting include:
1. You may access confidential counseling by contacting the UAF Health and Counseling Center at 474-7043;
2. You may access support and file a Title IX report by contacting the UAF Title IX Coordinator at 474-6600;
3. You may file a criminal complaint by contacting the University Police Department at 474-7721.

University of Alaska is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: alaska.edu/nondiscrimination.

Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English's Department's Writing Center (907-474-5314, Gruening 8th floor).

COVID-19: Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this

website: https://sites.google.com/alaska.edu/coronavirus/uaf/uaf-students. Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: https://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/.

Student Academic Support:
- Speaking Center (907-474-5470, uaf-speakingcenter@alaska.edu, Gruening 507)
- Writing Center (907-474-5314, uaf-writing-center@alaska.edu, Gruening 8th floor)
- UAF Math Services, uafmathstatlab@gmail.com, Chapman Building (for math fee paying students only)
- Developmental Math Lab, Gruening 406
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 120, https://www.ctc.uaf.edu/student-services/student-success-center/)
- For more information and resources, please see the Academic Advising Resource List (https://www.uaf.edu/advising/lr/SKM_364e19011717281.pdf)

Student Resources:
- Disability Services (907-474-5655, uaf-disability-services@alaska.edu, Whitaker 208)
- Student Health & Counseling **[6 free counseling sessions]** (907-474-7043, https://www.uaf.edu/chc/appointments.php, Whitaker 203)
- Center for Student Rights and Responsibilities (907-474-7317, uaf-studentrights@alaska.edu, Eielson 110)
- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, asuaf.office@alaska.edu, Wood Center 119)

Nondiscrimination statement: The University of Alaska is an affirmative action/equal opportunity employer and educational institution. The University of Alaska does not discriminate on the basis of race, religion, color, national origin, citizenship, age, sex, physical or mental disability, status as a protected veteran, marital status, changes in marital status, pregnancy, childbirth or related medical conditions, parenthood, sexual orientation, gender identity, political affiliation or belief, genetic information, or other legally protected status. The University's commitment to nondiscrimination, including against sex discrimination, applies to students, employees, and applicants for admission and employment. Contact information, applicable laws, and complaint procedures are included on UA's statement of nondiscrimination available at www.alaska.edu/nondiscrimination.

For more information, contact:
UAF Department of Equity and Compliance
1760 Tanana Loop, 355 Duckering Building, Fairbanks, AK 99775
907-474-7300
uaf-deo@alaska.edu

Additional syllabi statement for courses including off-campus programs and research activities:
University Sponsored Off-Campus Programs and Research Activities

We want you to know that:

1. UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/nondiscrimination.
2. Incidents can be reported to your university's Equity and Compliance office (listed below) or online reporting portal. University of Alaska takes immediate, effective, and appropriate action to respond to reported acts of discrimination and harassment.
3. There are supportive measures available to individuals that may have experienced discrimination.
4. University of Alaska's Board of Regents' Policy & University Regulations (UA BoR P&R) 01.02.020 Nondiscrimination and 01.04 Sex and Gender-Based Discrimination Under Title IX, go to: http://alaska.edu/bor/policy-regulations/.
5. UA BoR P&R apply at all university owned or operated sites, university sanctioned events, clinical sites and during all academic or research related travel that are university sponsored.

For further information on your rights and resources click here.