Summer Session 2024

GPHY 474 Unmanned Aerial Vehicle (UAV) Remote Sensing for Field Ecology
Syllabus

3 credits: Lectures, Labs, Field Work
Course dates: Summer 2024
Instructors: Dr. Michael Doering and Diane Whited
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https://www.zhaw.ch/en/about-us/person/doei/, https://flbs.umt.edu/urls/peo

General note: This draft version of the course syllabus is subject to change. Revisions will be posted to the FLBS website as they are received. The final syllabus will be marked final and will be distributed on day one of the course.

Prerequisites: Basic coursework in GIS is mandatory (can be met with FORS 250 Introduction to GIS for Forest Management or GPHY 284 Introduction to GIS and Cartography). Knowledge of or course work in remote sensing is preferred, but not required.

Course Description:
This course will introduce students to field-based methods of remote sensing for field ecology. Students will gain knowledge of basic spatial analysis through GIS and remote sensing techniques. Students will learn basic application remote sensing products in particular of UAVs and Acoustic Doppler Profilers, two remote sensing instruments of fast growing interest in ecological research and application. Students will learn about essentials to operate UAVs and ADPs, initial post processing of data products and integrating these data into ecological research and application.

Ecological systems are diverse and spatially heterogeneous areas characterized by interacting natural and impacted terrestrial and aquatic mosaics, which consist of features, such as forests, grasslands, rivers or lakes. Key research topics in these landscape mosaics include the analyses, quantification and scaling of ecological flows, land-use and land-cover change, relating landscape pattern analysis with ecological processes, conservation and sustainability. In this context GIS analyses in concert with remote sensing in particular using unmanned aerial or aquatic vehicles (UAVs), autonomously or remotely operated and equipped with various sensors such as NIR (Near infrared), TIR (Thermal infrared) or ADP (Acoustic Doppler Profiler) offer new opportunities for scale appropriate measures of ecological phenomena at high spatial-temporal resolutions.

Student Learning Outcomes:
After completing this course students will be able to:

<u>Ecological</u>

- Describe how remote sensing can be used to assess, quantify, and monitor landscape and habitat properties and changes in freshwater environments.
- Link remotely assessed data to ecological relevant data, e.g., habitat properties, vegetation distribution, potential species distribution.
- Integrate collection, processing, and analysis of RS and ecological data for freshwater research and application into a proposal/report

- Critically evaluate and interpret remote sensing data for ecological research and application (quality control, data calibration, limits of application)

GIS/RS and Technology

- Overview and evaluate the technical use of various remote sensing products for ecological research and practice
- Describe basic UAV protocols for collecting data (flight planning, air space classifications, height restrictions, weather patterns, permits, etc.)
- Collect, process, control, clean up, and import UAV and Acoustic Doppler Profiler (ADP) data into ArcGIS.
- Classify UAV imagery in ArcGIS, discerning water from other habitat and land use categories.
- Integrate ADP and UAV imagery in ArcGIS for aquatic and terrestrial spatial analyses (Habitat diversity, depth, velocity, and temperature distributions).

Required Text: None.

Reference Texts: (1) Carbonneau, P.E. and H. Piegay. 2012. Fluvial Remote Sensing for Science and Management. Wiley-Blackwell. (2) van der Meer, F.D. and S.M. de Jong. 2001: Imaging spectrometry – Basic principles and prospective applications. Springer. Note: Students who already own these texts are encouraged to bring them; however, it is not necessary to purchase the texts for the course. Electronic copies of reference readings and excerpts will be provided by the instructors.

Course and Field Supplies/Equipment (*available for purchase at the FLBS Bookstore)

- Waterproof field notebook (Rite in the Rain No. 393 spiral notebook)*
- Pencils or All Weather Clicker Pen*
- Hot/cold mug*
- Plastic, resealable containers for lunch pack-up*
- Laptop
- Proper clothing, rain gear
- Water bottle*
- Wading shoes
- Bear spray (optional)*
- Sunglasses, sunscreen, cap/hat
- Daypack
- First aid kit (personal size)
- Insect repellent

- No camping gear for this course

- Other items to bring checklists: http://flbs.umt.edu/urls/lists

Evaluation and Grading:

Grading	A	≥94%	A-	90–93%
	B+	87–89%	B	84–86%
	B-	80–83%	C+	77–79%
	C	74–76%	C-	70–73%

Research proposal written report	40%
Project work and research presentation	40%
Participations and Discussion	20%

Research Proposal – Written Report and Presentation

As students' progress in their academic and professional career, they will find the need to write proposals to guide their research, solicit funding, and meet reporting requirements. During the first week of class, students will review research integrating remote sensing and freshwater ecosystems. By the end of week 1, students will write group proposals, incorporating baseline field data you that they will collect during the course. The last day of the class the students will present a power point or prezi presentation describing their group project for colleagues from class and at FLBS.

Graduate Increment/s
There are 2 options for graduate student increments

1) Literature review
   - Students can choose to write a literature review on their topic of interest in for remote sensing of ecological systems. Their topic of interest can range from applications (forestry, agriculture, aquatic, etc) or the role of various sensors (thermal, multi-spectral, etc) in these applications. The literature review will consist of a review of 6 to 8 recent peer-reviewed papers of the student's choice. The literature review will contain: a properly formatted cover page, a table of contents, 1.5-2 line spaced text, a short bibliography/list of sources, and brief summary of each paper.

2) Comparison of UAV post-processing software
   - Using data collected during the class, the students will post-process the data in two common UAV post-processing software products (agisoft and PIX4d). Students will compare processing steps, data output, potential analyses completed in the software, and relative accuracy of each data output. A technical report (4- 5 pages) describing the pros and cons of each software package will be submitted as their graduate portion of the class.

Course Policies:
Students will adhere to University of Montana Student Conduct Code and Discrimination, Harassment, Sexual Misconduct, Stalking, and Retaliation Policy and to the Biological Station Code of Conduct re: form signed to complete student registration. Students who have not completed the University of Montana PETSA training will need to do so before the course.

Students must also follow FLBS Rules and Regulations and abide by the Safety Orientation Checklist.

Schedule: The schedule below is subject to change.

Note: Make sure you pack your brown bag lunch each day at breakfast!

Date	Lectures/Exercise/Field Work
(M)	*Lecture and discussion* - General introduction and goals of the course. Introduction to GIS/ Remote Sensing and river/floodplain ecology. *Exercises* - Hands on examples and exercises, data processing, classification and information extraction using ArcGIS
(T)	*Lecture and discussion* - Introduction to UAV and ADP systems, FAA regulations *Fieldtrip* – Trip to Foothills Drive for UAV demonstration and student UAV practice
(W)	*Lecture and discussion* - Case study examples Exercises – Work through electronic work book (planning flight, processing, analyzing and evaluating data). ArcGIS exercises. UAV collection and Pix4D processing on station grounds.

(Th)	*Fieldtrip* – Nyack floodplain in the morning – evaluate potential field collection sites. *Exercises* – Start exploration and discussion of student group projects. Hypotheses, design, and data needs.
(F)	*Exercises* - Revision and finalization of group projects proposals. Groups present research proposals. Afternoon -Potential Trip to local Consulting frim
(M)	*Fieldtrip* - Nyack for data collection.
(T)	*Fieldtrip* - Nyack for data collection (if needed) *Exercises*- Imagery and data analysis of data collected. Begin analysis and interpretation for group projects.
(W)	*Exercises*- Imagery and data analysis of data collected. Begin analysis and interpretation for group projects.
(Th)	*Exercises*- Final analysis and interpretation of data for group projects. Preparation of presentation and report.
(F)	Group Presentations and discussions in the morning. Wrap up, feedback on goals achieved. Discussion of overall class content and improvements.

Students with disabilities may request reasonable modifications by contacting the instructor. The University of Montana assures equal access to instruction for students with disabilities in collaboration with instructors and the Office for Disability Equity. The University does not permit fundamental alterations of academic standards or retroactive modifications. If you have a disability that adversely affects your academic activities, please let us know at summersession@flbs.umt.edu so we can discuss an accommodation.