



# Drones for Environmental Mapping

## INSTRUCTORS

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## ABOUT THIS COURSE

### DESCRIPTION

This course will study Unmanned Aircraft Systems (UAS) or drones. UAS have provided us with new ways to map, monitor, and measure our changing landscape. UAS are relatively inexpensive, easy to operate, and can deploy rapidly. Advances in digital image processing allow one to go from flying a drone to working with accurate maps and 3D models in a matter of hours. These factors make UAS ideal for many applications in which speed, accuracy, resolution, cost, and timeliness are key factors. In this course, you will learn how to operate UAS and process UAS data to in support of environmental mapping and monitoring. Example case studies will be used. The course covers three main topics: data collection, data processing and analysis, and critical thinking. The goals for this course are to provide students with an in-depth understanding of drone technology and how it can be applied for environmental assessment. The course is technical in nature but it is designed to be accessible to anyone who has an interest in drones and the environment. Technologies students will be exposed to include: drone platforms, drone sensors, flight planning software, image processing software, desktop Geographic Information Systems (GIS), and web mapping. Students will work closely with members of the University of Vermont UAS Team, one of the most experience drone groups in the United States.

### LEARNING OBJECTIVES

- State the regulations that govern recreational and commercial use of UAS.
- Develop safety procedures for UAS flight operations.
- Implement a UAS pre-flight checklist.
- Understand the capabilities and limitations of UAS in the context of environmental mapping.
- Categorize the different types of UAS.
- Recognize the various sensors that can be mounted on a UAS.
- Plan a UAS mission.
- Operate fixed-wing and multi-rotor UAS.
- Complete Manual and Automated Flights.
- Process UAS imagery to generate geospatial data products.
- Evaluate the quality of UAS data products.

- Integrate UAS data with other types of geospatial products.
- Analyze UAS data products.
- Create web apps and other decision support products from UAS data.
- Compare UAS products to other types of geospatial data products in the context of environmental assessment.

## PREREQUISITES

There are no formal prerequisites for this course. Students should have a strong interest in the environment and natural resources along with an awareness of drone technology. A high level of comfort using desktop and mobile computing is recommended.

## FORMAT

This course consists of two weeks of resident instruction on the UVM campus and two weeks of coursework off campus. Much of the time will be spent outdoors flying drones.

## COMPONENTS

This course consists of three components: 1) data collection, 2) data processing and analysis, and 3) critical thinking. The first two components will largely take place during the residency portion of the course. The final component will primarily take place during the non-residency portion. The first component, data collection, largely consists of flight operations. You will be expected to demonstrate an understanding of UAS regulations and safety along with proficiency in operating fixed-wing and multi-rotor UAS platforms in support of environmental mapping. The second component focused on processing UAS data to turn it into geospatial products and then analyzing those data. You will be expected to operate geospatial software, generate decision-support products, and draw conclusions from your analysis. In the final component, critical thinking, you will reflect on the work you have done as part of this course and write a paper on the use of UAS technology for environmental mapping, monitoring, and analysis.

## GRADES

There are 15 graded activities in this course. The total number of points is 100. The distribution of those points, by graded activity, is presented below. Late assignments will not be accepted except for the most extenuating circumstances, such as a death in the family. Students are expected to plan ahead for all assignments, practice good data management skills, and post any questions they may have to the appropriate Blackboard discussion forum.

	Activity	%	Type
Collect Data	Safety checklist	5%	Pass/Fail
	Safety test	5%	Graded
	Multi-rotor flight ops	5%	Pass/Fail
	Fixed wing flight ops	5%	Pass/Fail
	Subtotal	<b>20%</b>	
Process and Analyze Data	Lab1: Getting started with GIS	10%	Graded
	Lab 2: 3D Modeling	10%	Graded
	Lab 3: Orthophoto	10%	Graded
	Lab 4: Web app	10%	Graded
	Lab 5: Volumetric analysis	10%	Graded
	Subtotal	<b>50%</b>	
Critical Thinking	Participation	10%	Graded
	Story Map	10%	Graded
	Paper	10%	Graded
	Subtotal	<b>30%</b>	
	Total	<b>100%</b>	

## COURSE MATERIALS

### E-LEARNING PLATFORM

This course will use UVM's e-learning platform, [Blackboard](#).

### TEXTBOOK

There is no textbook requirement for this course.

### REQUIREMENTS

For the off-campus portion of this course students will need access to a computer with a broadband internet connection. Students will receive a 1-year Pix4D license as part of this course. The Pix4D software can be run on a computer with the Windows operating system or in the cloud using any modern web browser. Students will receive both UVM network accounts and ArcGIS accounts.

## SCHEDULE

As UAS flight operations are highly dependent on weather, we will have a flexible course schedule. The course schedule will be posted at the start of each day. The general plan is to have the first week of the residency portion focus more on flight

operations and the second week focus more on data processing and analysis. The final two non-residency weeks will center on critical thinking activities.

## POLICIES

### OUR COMMON GROUND

The University of Vermont is an educationally purposeful community seeking to prepare students to live in a diverse and changing world. We who work, live, study, teach, do research, conduct business, or participate in the University of Vermont are members of this community. As members, we believe in the transforming power of education and agree to help create and foster an environment where we can discover and reach our true potential.

We aspire to be a community that values:

**RESPECT.** We respect each other. We listen to each other, encourage each other and care about each other. We are strengthened by our diverse perspectives.

**INTEGRITY.** We value fairness, straightforward conduct, adherence to the facts, and sincerity. We acknowledge when things have not turned out the way we had hoped. As stewards of the University of Vermont, we are honest and ethical in all responsibilities entrusted to us.

**INNOVATION.** We want to be at the forefront of change and believe that the best way to lead is to learn from our successes and mistakes and continue to grow. We are forward-looking and break new ground in addressing important community and societal needs.

**OPENNESS.** We encourage the open exchange of information and ideas from all quarters of the community. We believe that through collaboration and participation, each of us has an important role in determining the direction and well-being of our community.

**JUSTICE.** As a just community, we unite against all forms of injustice, including, but not limited to, racism. We reject bigotry, oppression, degradation, and harassment, and we challenge injustice toward any member of our community.

**RESPONSIBILITY.** We are personally and collectively responsible for our words and deeds. We stand together to uphold our common ground.

### INSTRUCTOR ROLES & RESPONSIBILITIES

Your instructor will oversee all aspects of the course. You should expect your instructor and teaching assistants to be knowledgeable, professional, approachable, and take an interest in your performance in this course.

### STUDENT ROLES & RESPONSIBILITIES

Students should be guided by UVM's "Our Common Ground" principals throughout this course. This is a college-level course and students, although they may still be in high school, will be treated the same as any other UVM student. Students are expected to come prepared and show up promptly for all sessions. UVM's academic integrity policy (<https://www.uvm.edu/policies/student/acadintegrity.pdf>) will be strongly enforced. Students are encouraged to take advantage of the multitude of resources UVM offers to ensure student success ranging from the [ACCESS](#) office to the [Center for Health and Wellbeing](#). Students requiring any accommodations for this course should notify the instructors at the start of class.