THE UNIVERSITY OF ARIZONA

BE/BAT 485/585

Remote Sensing Data and Methods

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Introduction to Course

- So, what is this course all about?
  - Why am I taking this course?
- Expectations
  - Would I become a good Remote Sensing Data user, Data Producer, Algorithm Developer, Scientist, Data/Image Analyst, etc.?
  - Would I be able to effectively use RS in my research?
- Get to know the Course
  - What will be covered?
  - What will not be covered?
  - What next (for the seriously interested)?
- Syllabus
- Rules & Misc.

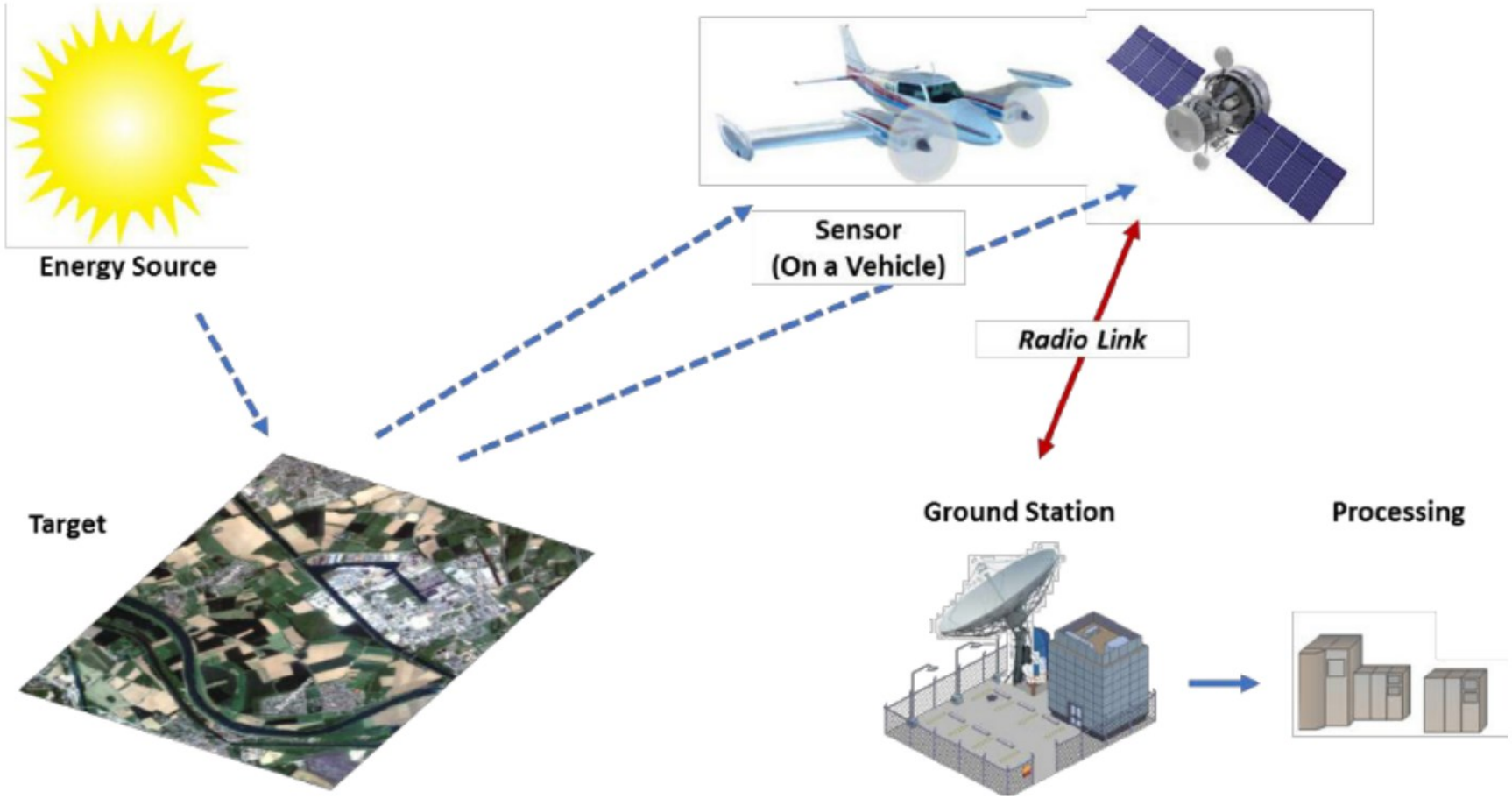
So what is this course all about

- Traditionally RS courses covered one of three topics
  - Basics of remote sensing and electromagnetic energy interaction
  - Covered some basic data (surface reflectance, Vegetation indices, LC, etc.…)
  - Some image processing mostly in space (little in the time domain)
- Learning becomes a personal quest using that basic info
  - Mostly necessitated by research
- As we move towards a sensor and data-rich environments (Big Data) it becomes necessary to understand what is out there (Data) and how to use/fuse it (Methods)
  - There are tens of satellites equipped with different sensors collecting data daily (mostly for free)
  - Hundreds of airborne & ground-based sensors
  - And now Millions of Citizen scientists collecting data in almost every corner of Earth and about everything imaginable
  - We are moving towards a "Data-rich and driven society" (precursor to AI/ML)
  - We are still lacking when it comes to how to use this data efficiently and properly
- So, in this course you will learn:
  - About Data
    - Most of (land) the data out there
    - How that data came to be (provenance)
    - Data limits and proper usage
  - How to use this data
    - Data characteristics
    - Proper use (limitation, validity, error)
    - Spatial and Temporal dimensions of this data

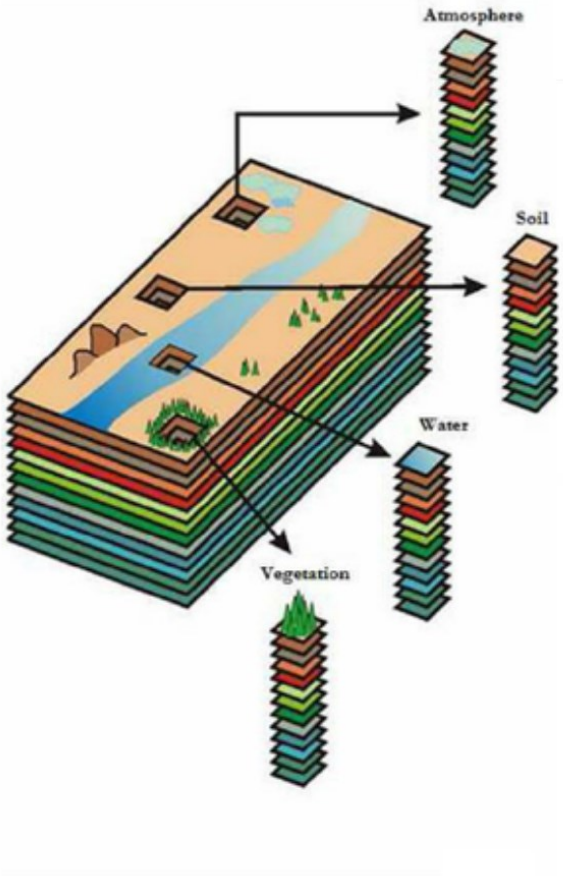
Expectations

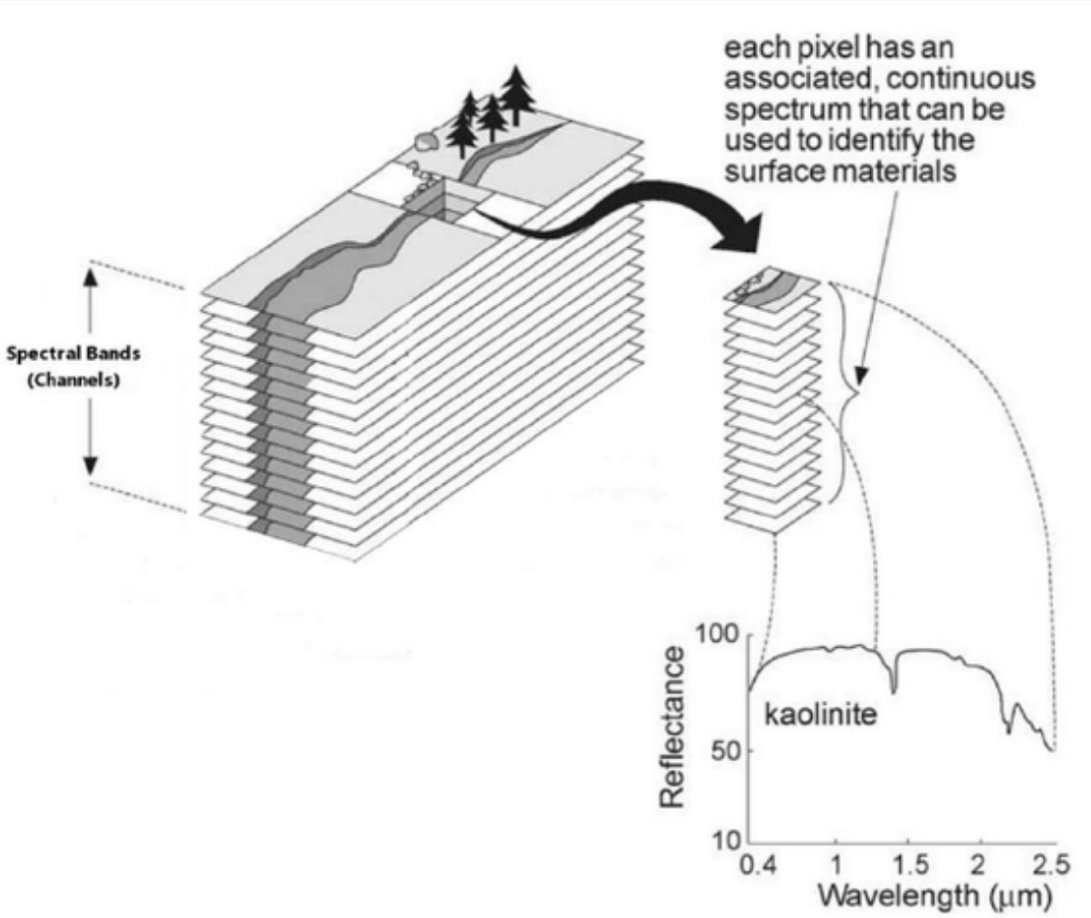
- **You will:**
  - Develop an in depth understanding of the practical topics of land remote sensing with big data, data sourcing and provenance, data characteristics, generating algorithms, data discovery, advanced analysis techniques, and data limitations.
  - Learn how to discover and acquire a variety of global to regional remote sensing data records and time series, learn about the various sensors/platforms collecting these data, learn how to interpret and use these data emphasizing real-world applications and research topics.
- While the course is aimed at students of environmental sciences, natural resources & management, and engineering
  - Anyone interested in big data and analytic in the context of spaceborne observations will benefit
  - The course aims at bridging the gap between the theoretical aspects of remote sensing and current Earth science data records, algorithms, and analytics.
- Upon completing this course:
  - You will become an advanced user of remote sensing big data and time series
  - Capable of understanding the algorithms used to derive them, identifying, using, analyzing, and understanding the limitations of any remote sensing data with a focus on data fusion and advanced research.

Remote Sensing Systems-1



Remote Sensing Systems-2





Syllabus

Scheduled Topics/Activities – Spring Semester

BE 485/585 Remote Sensing Data and Methods

Things will likely change

Week	Topic	Special notes
Week 1	First day of classes Introduction to the course, format, and expectations	First session devoted to discussing expectation, establishing class rules, format, and miscellaneous
	No Lab.	No Lab.
Week-2	**Monday - MLK Day**	No classes
	Why Remote Sensing Introduction to remote sensing and systems	
Lab - Day	Lab 1: Intro to Python	First session will introduce python with few data manipulation, images, and plotting exercises.
Week-2	Active Remote Sensing Platforms and Characteristics Solar Radiation Radiation laws	
Lab - Day	Lab 2: Intro to Data manipulation with python	Continue with Python
Week -3	Spectral, Spatial, Temporal, and Radiometric characteristics	
Lab - Day	Lab. 3	
Week-4	Remote Systems and Earth resources Perspectives	
Lab - Day	Lab. 4	
Week-5	Electromagnetic Spectrum and Interactions with Atmosphere	
Lab - Day	Lab. 5	
Week - 6	Data Storage, Format and geometric considerations	

Syllabus

Exam Day	Midterm 1	
Week -7	Data processing levels	
Lab - Day	Lab 6	
	Spring Break	
Week -8	Current RS Land surface imaging missions and characteristics. Calibration and post-processing	
Lab - Day	Lab 7	
Week -9	Spectral reflectance and Atmosphere correction	
Lab - Day	Lab. 8	
Week -10	Image rectification, Geo-referencing, and transformation	
Exam Day	Midterm 2	
Week - 11	Image registration and enhancements	
Lab - Day	Lab 9	
Week - 12	Evaluate progress of class projects	Optional for Undergrads
	Image projection and geometric transformation	
Lab - Day	Lab 10	
Week -13	Resampling, Enhancement Convolution and Filtering Spectral Signatures	
Lab - Day	Lab 11	
Week -14	Land Products Vegetation indices Compositing Phenology Hyperspectral and Lidar	
Lab - Day	Lab 12	
Week 15	Drone data and precision observations	
	Class Project - Presentations	Students/Teams will have 15 minutes to present their work to the class
Finals Week	**Final Exam**	**We will discuss and agree on the final exam terms**

Grading

A final comprehensive (likely open book) exam will be given to all students.

- The instructor will confirm the exact date as the course progresses.

Grading Scale and Policies

Your final grade will be based on:

	Graduate students	Undergraduate students
Activity		
Homework	25%	35%
Midterm exams	25%	40%
Project	25%	N/A
Final Exam	25%	25%
Total	100%	100%

Final letter grades for the course are computed as:

Score	Grade
90-100	A
80-89	B
70-79	C
60-69	D
<60	E

Depending on the overall class performance, the scores for the different final letter grades may be curved.

Rules

- We will use D2L (+ ZOOM pending UA decisions)
- keep an eye on the course site
- Attendance is “mandatory” (unless excused) especially the Friday Lab sessions
- HW and Lab reports need to be turned in time via D2L Dropboxes (2-week cycle)
- Lab. work (Python oriented) is a must, and you can work in groups
- Exams will be comprehensive and about what you learned in class
- Class project is for Graduate (585) students only
  - Optional for Undergraduate. You can shadow a group and get extra points
- Invest if not already in a good Laptop/PC
- “Save the Trees” –
- Minimalist approach to things
  - I do not need long explanations
  - I need you to show me you understand and be creative

Misc.

- We will learn together
- No need to worry ‘too much’ about grades
  - Show up, do your work, and you will not be disappointed
- While the Syllabus is my contract with you a few things may and will change to reflect need and interest and progress
- My office is Shantz 501A
- Helpers are
  - Mr. Truman Combs, and
  - Dr. Armando Barreto (Forbes #134)
- New this year
  - We will try to explore (hands-on) the DAACs
  - We will learn Structure from Motion (to create 2D and 3D maps from drone images) and learn more about Lidar
  - We will add new Machine learning topics

Homework #1

- Write an essay about your expectations from this course, with focus on
  - What is the extent of your exposure and experience with remote sensing and images?
  - What are your 'exact' expectations or research objectives?
  - Any future plans around what you will learn?
    - Career, acquire new skills, research interest, curious, advised, etc.
  - Keep it simple
    - My goal is to tailor the topics/lectures based on your feedback
  - Due ~2 weeks from today (Fri. January 21st, 2022)

Any Questions?

- Reach out whenever necessary, but arrange ahead
- I have an open door/zoom policy
- We are here to help you with anything academic
- Learn to work with colleagues and in groups

- Please attend the lectures and Labs are mandatory