Exercise 14: Synthetic Aperture RaDAR (SAR) for Flood Mapping

84 Points scaled to 20 Points

Introduction

In this exercise, you will process and work with Synthetic Aperture RaDAR (SAR) data to analyze flood inundation. The tutorial and associated lab exercise were created by NASA's Applied Remote Sensing and Training Program (ARSET). It makes use of Sentinel-2 data from the European Space Agency (ESA).

Objectives

- *Process SAR data including subsetting, radiometric correction, speckle filter, and geometric correction*
- *Composite multiple SAR images to a single, multitemporal data stack*
- *Interpret SAR imagery*
- *Use thresholds and supervised classification to map flood inundation from SAR data*
- *Explain backscatter signatures of different surface materials*
- *Explain geometric distortions inherent to SAR and their causes*

Prerequisite Materials

- Modules: Thermal/Hyperspectral/SAR
- Videos
    - Lab 16 Intro: https://youtu.be/qtaSg4mnEWQ

Prerequisite Requirements

- Download and install the Sentinel Toolbox/Science Toolbox Exploration Platform (SNAP) software (http://step.esa.int/main/download/). This software is free of charge.
- We have provided the required SAR data on the class page for download, similar to the other labs.

Background Questions

Question 1. What portion of the electromagnetic spectrum does SAR use? Is SAR an example of active or passive remote sensing? Please explain. (4 Points)

Question 2. Explain why SAR data are collected using a side-looking geometry. (4 Points)

Question 3. Explain the impact of surface roughness on SAR backscatter. (4 Points)

Question 4. What is meant by the term dielectric properties? Explain the impact of dielectric properties on SAR backscatter. (4 Points)

Question 5. Explain the difference between VH and VV polarization. (4 Points)

Question 6. Explain why water tends to show low SAR backscatter. (4 Points)

Question 7. Explain why urbanized areas tend to show high SAR backscatter. (4 Points)

Question 8. Explain why forested areas tend to have high levels of volume and diffuse scattering. (4 Points)

ARSET Exercise

- Navigate to the following page:

https://appliedsciences.nasa.gov/join-mission/training/satellite-remote-sensing-flood-monitoring-and-management

- Read through the "Overview and Applications of Synthetic Aperture RaDAR (SAR)" materials in the Day Two section.
- Complete the "SAR Applications for Flood Mapping" exercise in the Day Two section. Since we have provided the required data, you can skip to Page 13; however, do read over the introductory materials. Complete to Page 41. You do not need to complete the Google Earth Engine section.

Deliverable 1: Provide screen captures of (1) the RGB multi-temporal composite (Page 26), (2) your water vs. land result based on a threshold (Page 31), and your supervised classification result (Page 41). These just need to be screen captures, not formal map layouts. (20 Points)

- Use the information from the two required modules to answer the following questions.

Question 9. List four advantages of SAR data over optical remote sensing. (4 Points)

Question 10. List two disadvantages of SAR data over optical remote sensing. (2 Points)

Question 11. Explain how canopy penetration varies with the wavelength used by different SAR systems. (4 Points)

Question 12. How does moisture content of soil impact the level of SAR penetration? (4 Points)

Question 13. Why is L-band SAR generally preferable for wetland mapping? (4 Points)

Question 14. How does backscatter change as a land surface transitions from frozen to thawed? (2 Points)

Question 15. Explain why double-bounce backscatter is an indication of wetlands under a forest canopy. (2 Points)

Question 16. What causes speckle in SAR data? (2 Points)

Question 17. List four cases of radiometric distortions in SAR data. (4 Points)

Question 18. List four cases of geometric distortions in SAR data. (4 Points)