

Use of Microwave and Optical Remote Sensing Data in Near Eastern Archaeology

GEOG 596a, Spring 2

May 5, 2020

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Presentation Overview

- I. A Brief History of Remote Sensing in Archaeology
- II. Synthetic Aperture Radar's Characteristics and Capabilities
- III. Research Problem: What Can SAR Offer to Archaeology?
- IV. Project Design: Test Sites
- V. Project Goals and Timeline

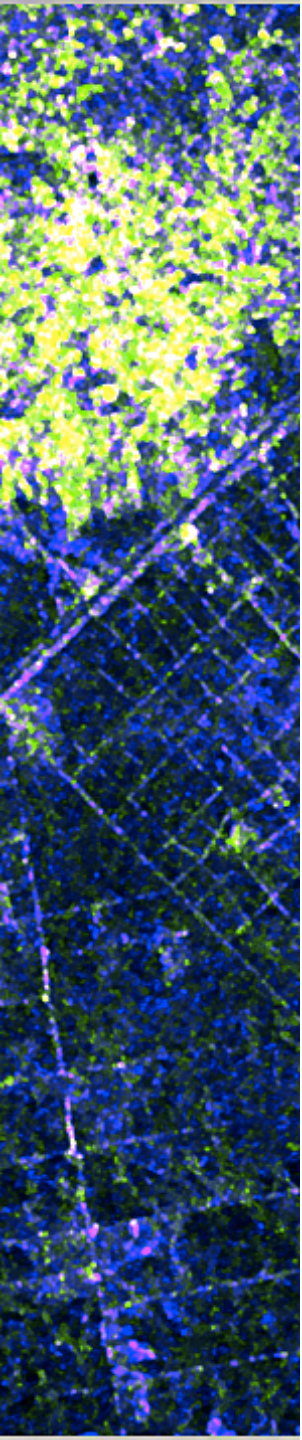
A Brief History of RS in Archaeology

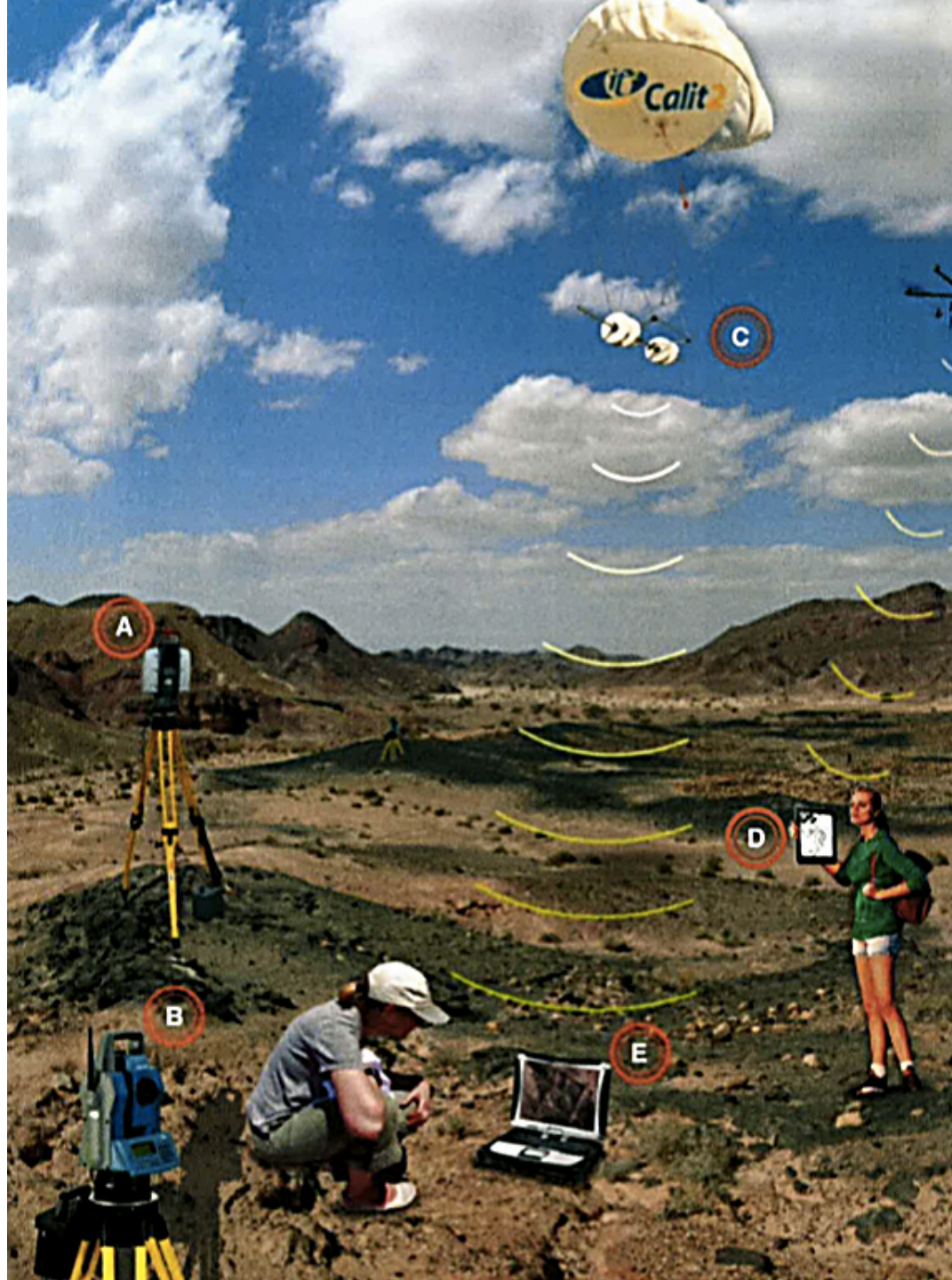
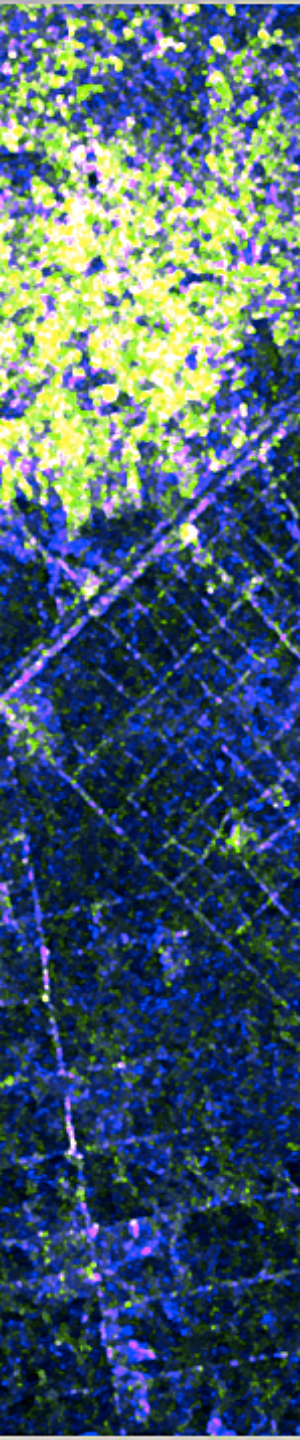
The 20th century:

- Landsat
- Cold War imagery, such as CORONA and U-2
- SRTM

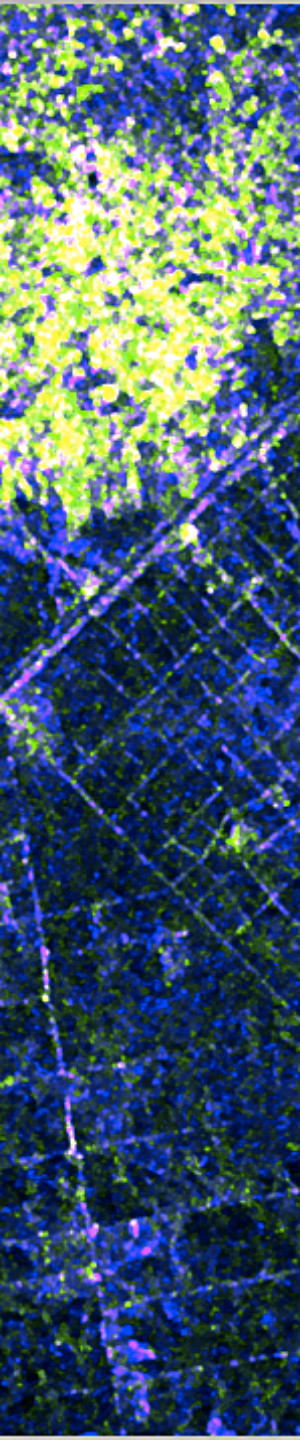
The Past 20 Years:

- UAVs and Structure for Motion
- GIS systems
- Lidar
- Radar?





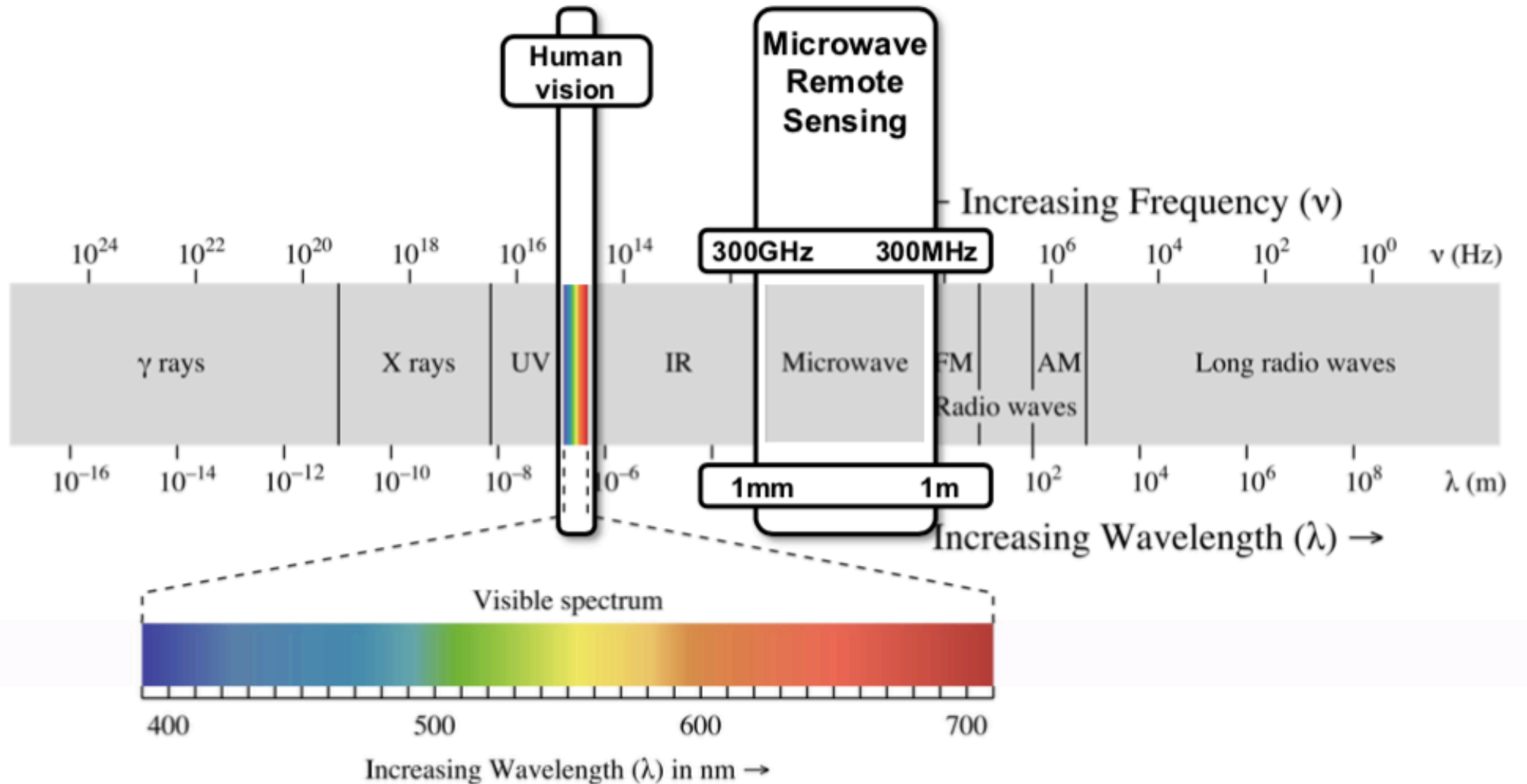
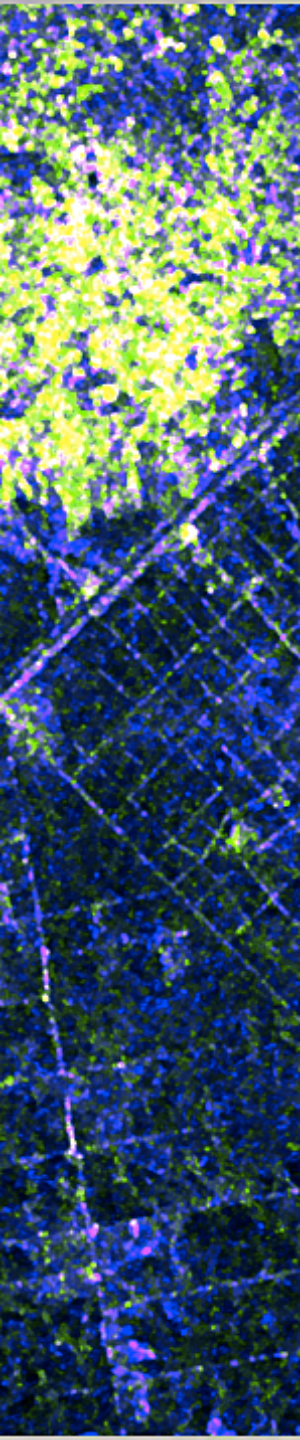
Levy, T, et al, 2014. New Insights into the Iron Age Archaeology of Edom, Southern Jordan: p. 1



SAR's Characteristics and Capabilities

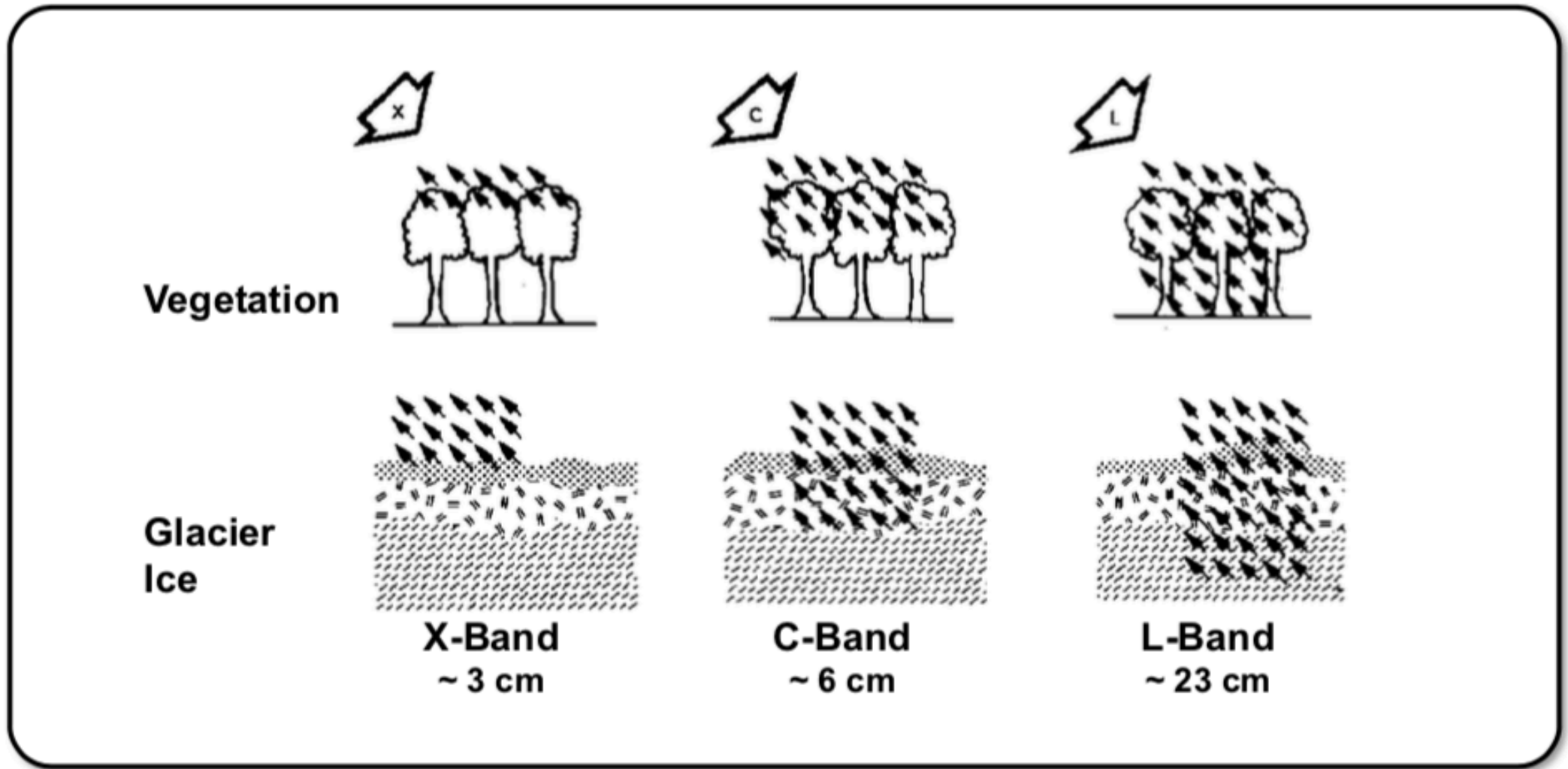
- 1. What IS SAR? What are its characteristics?**
2. What kind of data is available?
3. How do you process and use the imagery?

What is Microwave Remote Sensing?

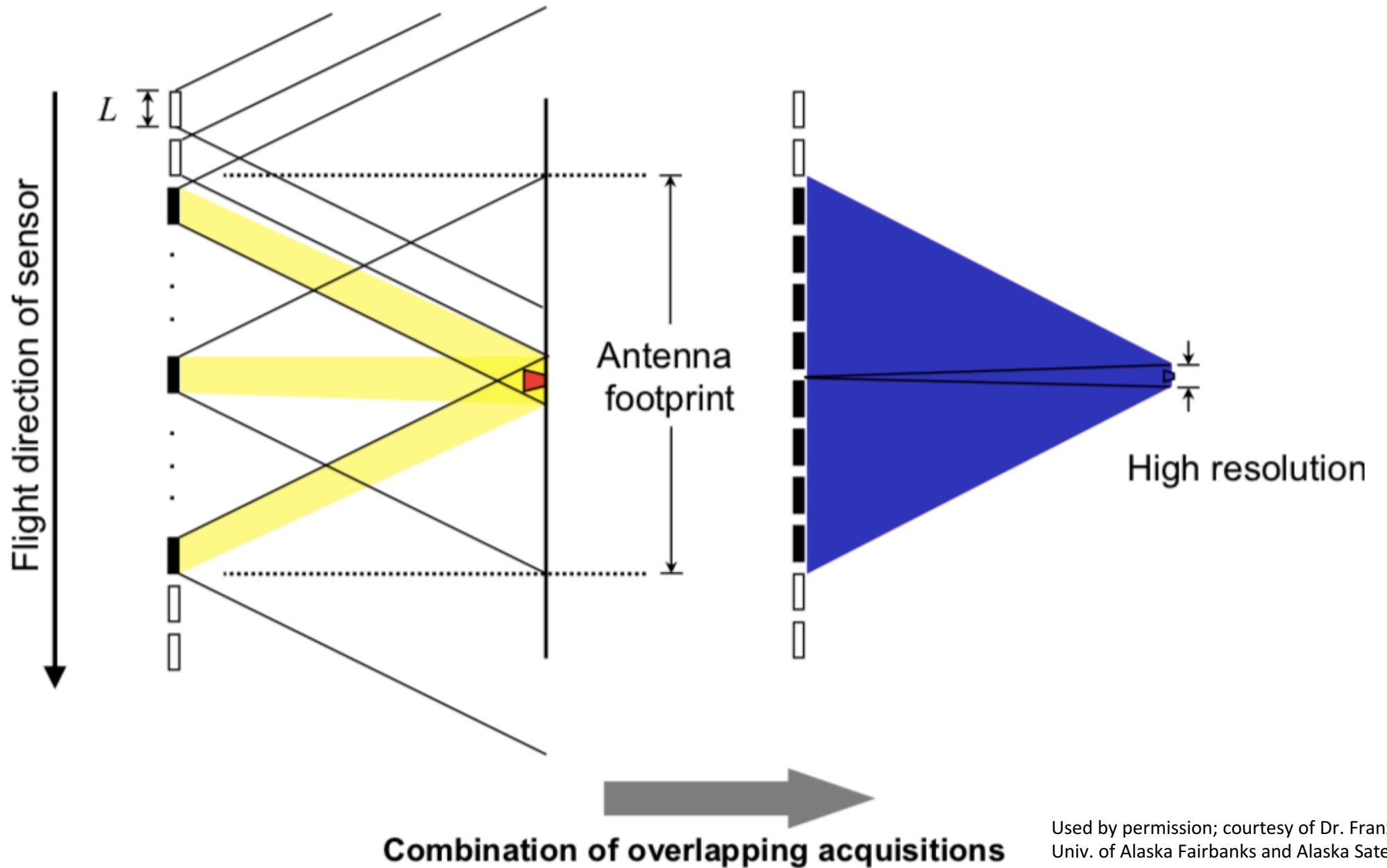


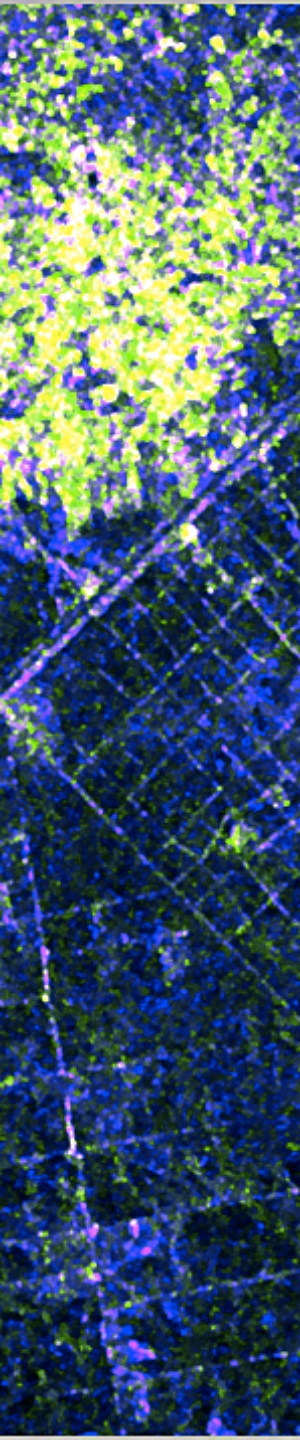
Advantages of Microwaves

Penetration into the top surface layer



Principle of Synthetic Aperture Radar (SAR)

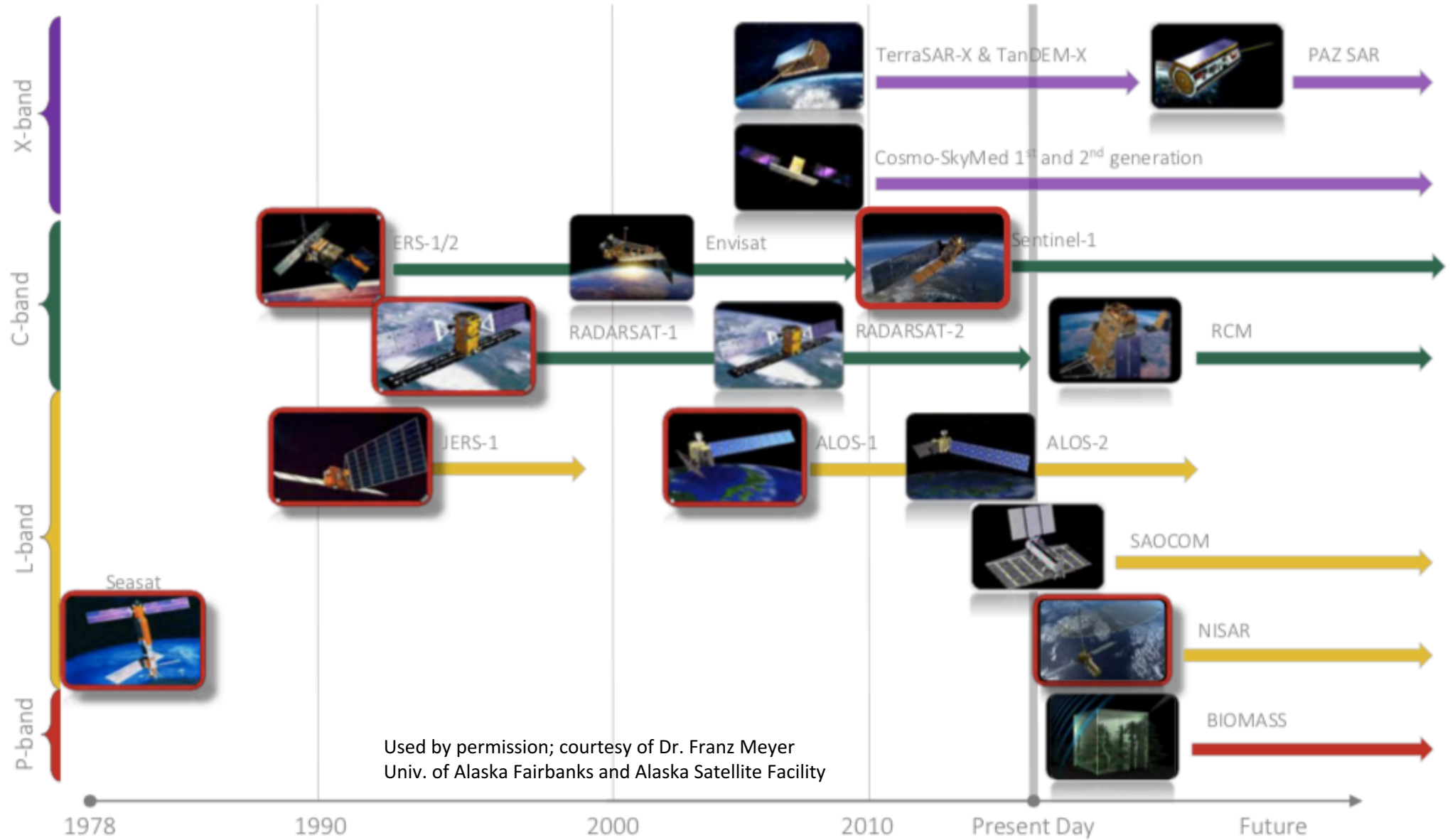




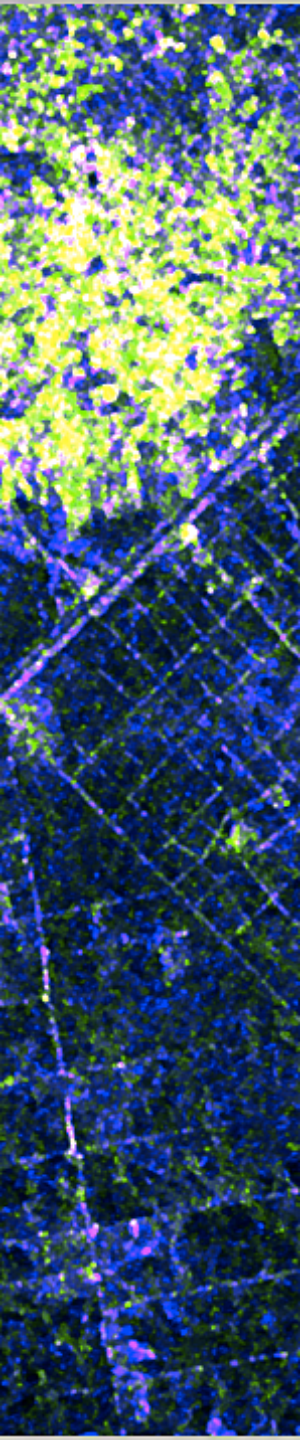
SAR's Characteristics and Capabilities

1. What IS SAR? What are its characteristics?
- 2. What kind of data is available?**
3. How do you process and use the imagery?

Past, Current, and Future Datasets

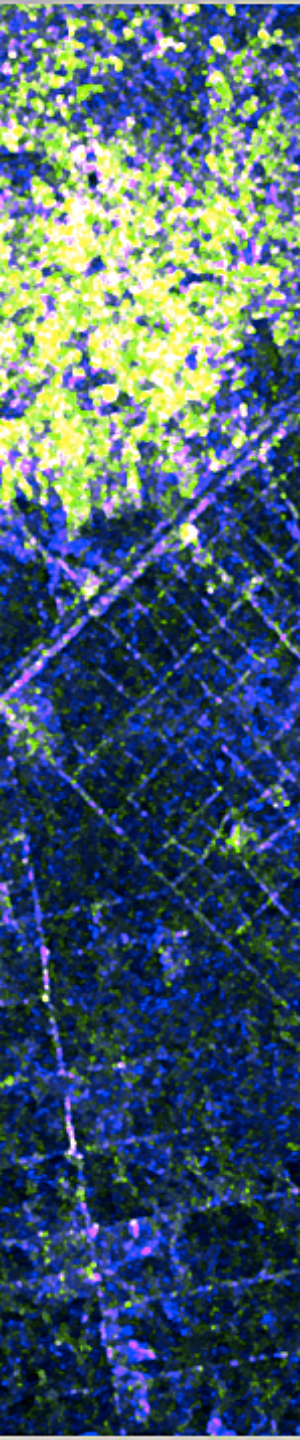


Used by permission; courtesy of Dr. Franz Meyer
Univ. of Alaska Fairbanks and Alaska Satellite Facility



SAR's Characteristics and Capabilities

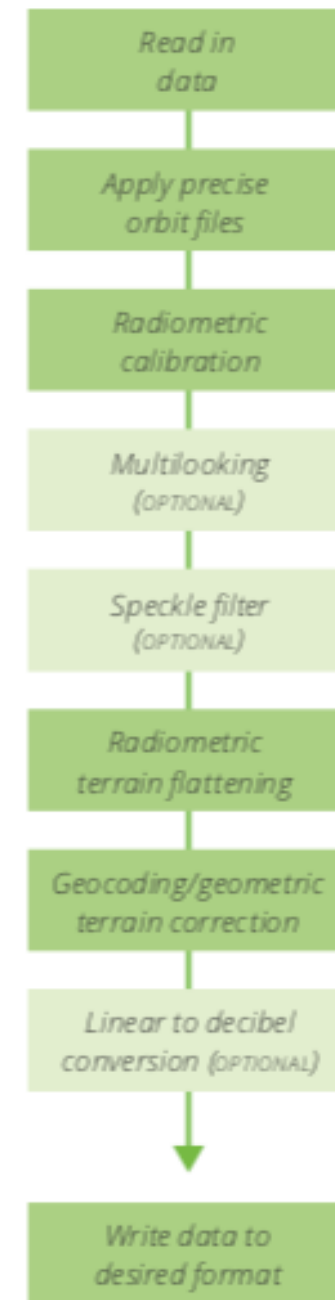
1. What IS SAR? What are its characteristics?
2. What kind of data is available?
3. **How do you process and use the imagery?**



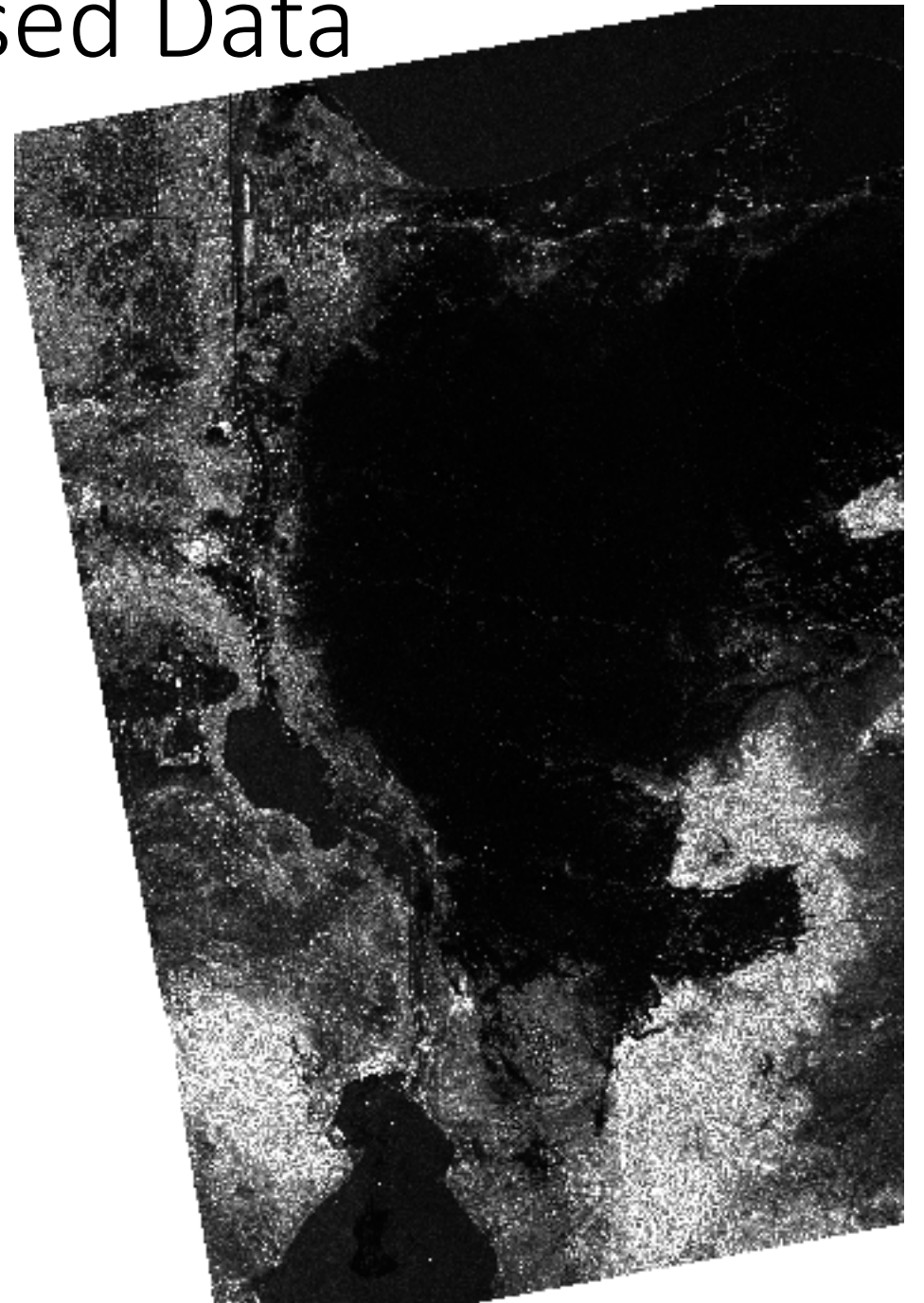
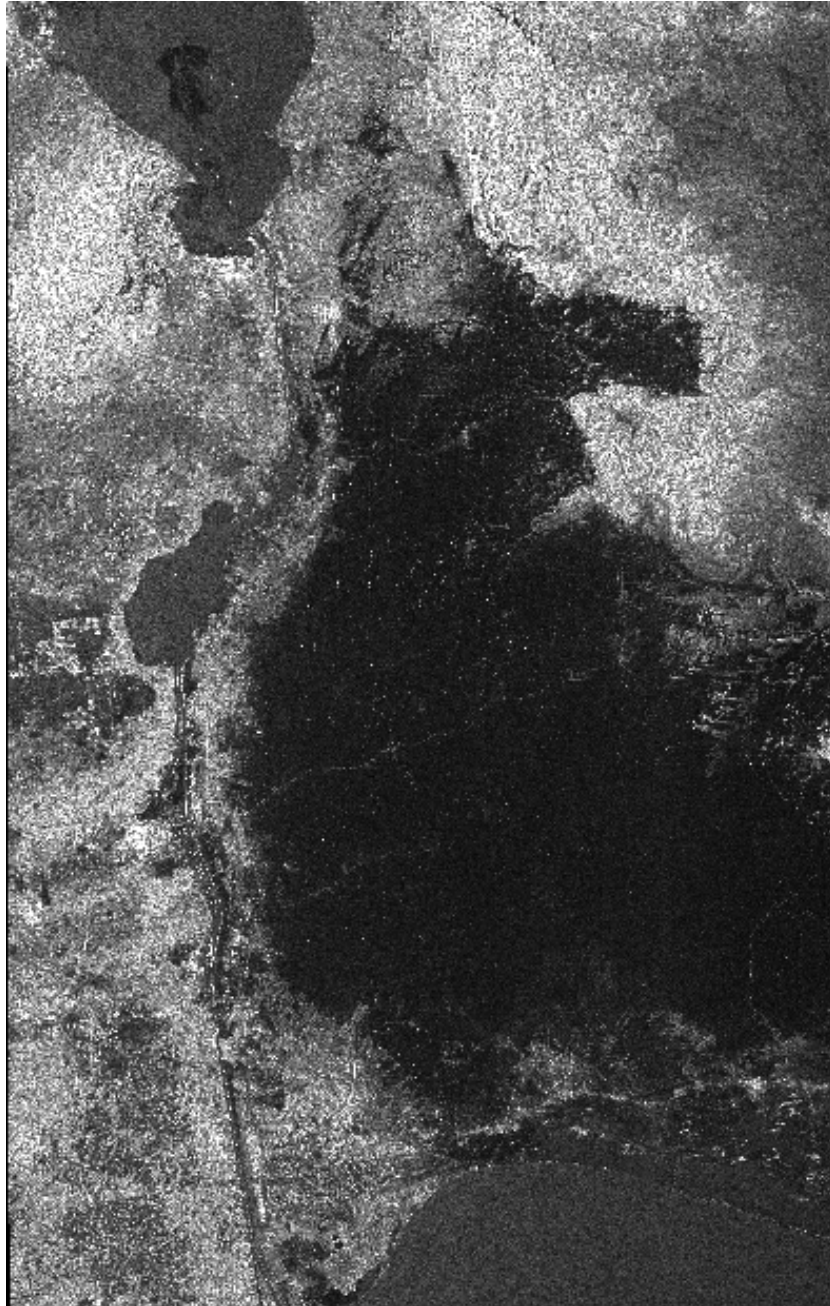
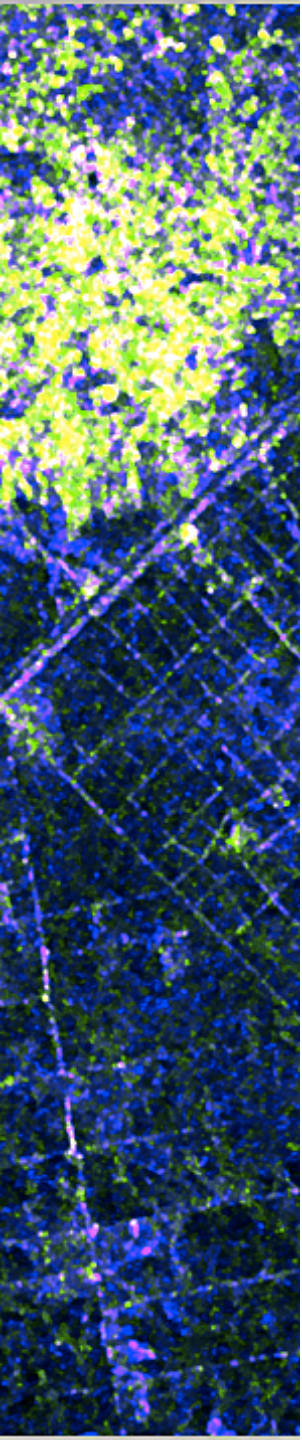
SAR Workflows

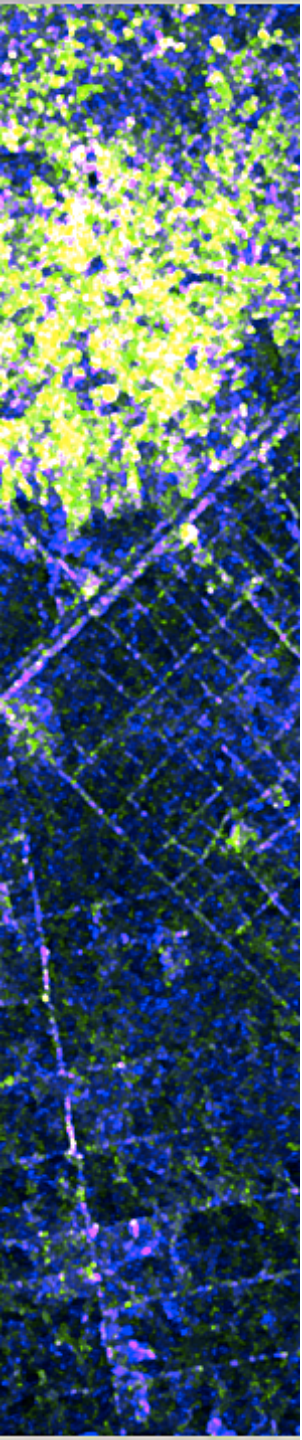
There are various techniques for processing and analyzing SAR data:

- Basic image processing and geocoding
- Polarimetric SAR (PolSAR)
- Time series analysis
- Interferometry and phase unwrapping (d-InSAR)
- PS-InSAR and SBAS InSAR
- Fusion images



Unprocessed vs. Processed Data

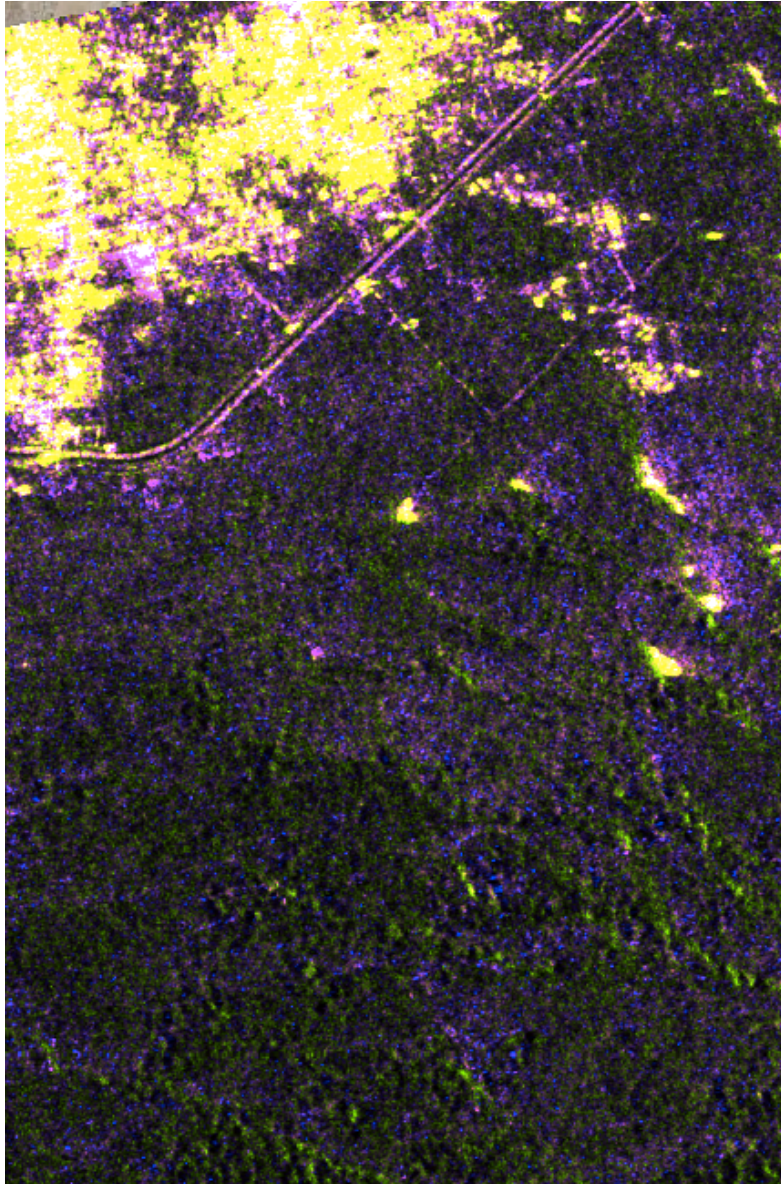




Research Problem: What Can SAR Offer to Archaeology?

1. Monitoring cultural heritage sites, particularly for the identification of looting.
2. Highlighting or identifying barely visible or near surface features.
3. Helping archaeologists make decisions about where to look for features.

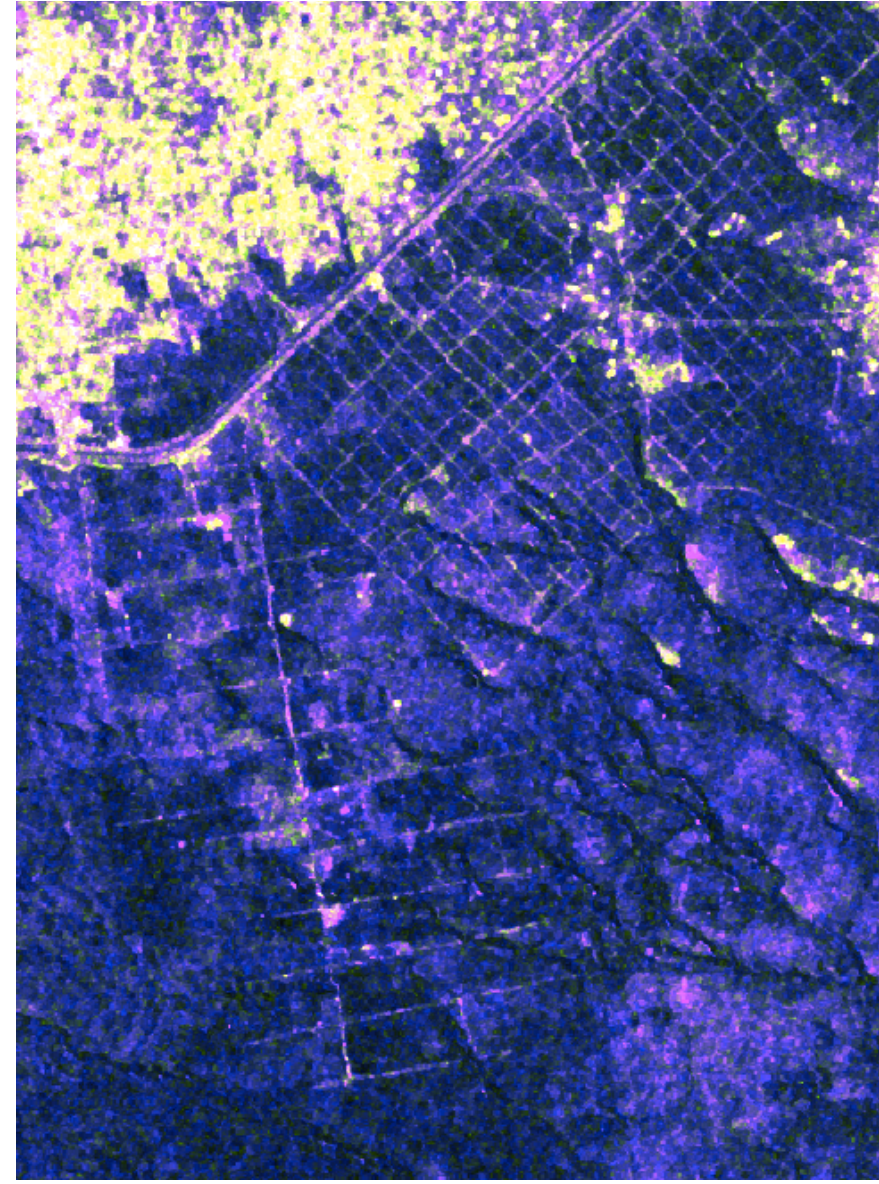
ALOS 1 RGB: HH, HV, HH/HV
L-band, April 27, 2008

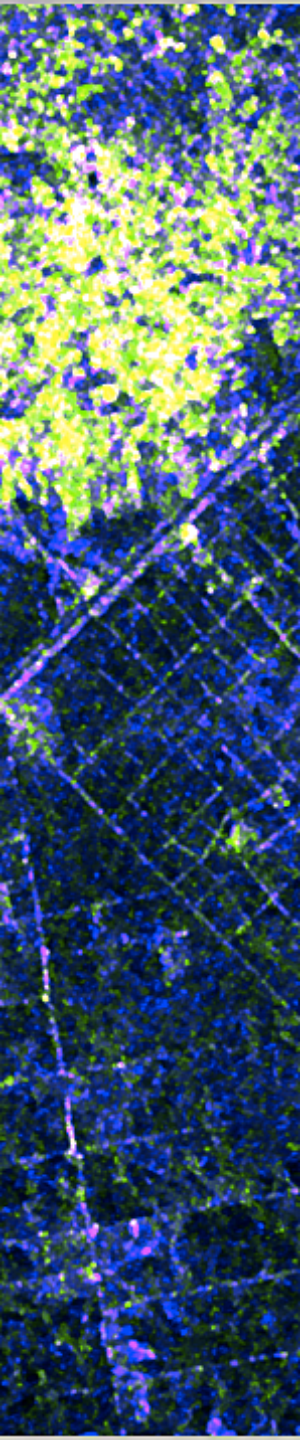


Google Earth
2020



Sentinel-1B RGB: VV, VH, VV/VH
C-band, July 14, 2017





Project Design: Test Sites

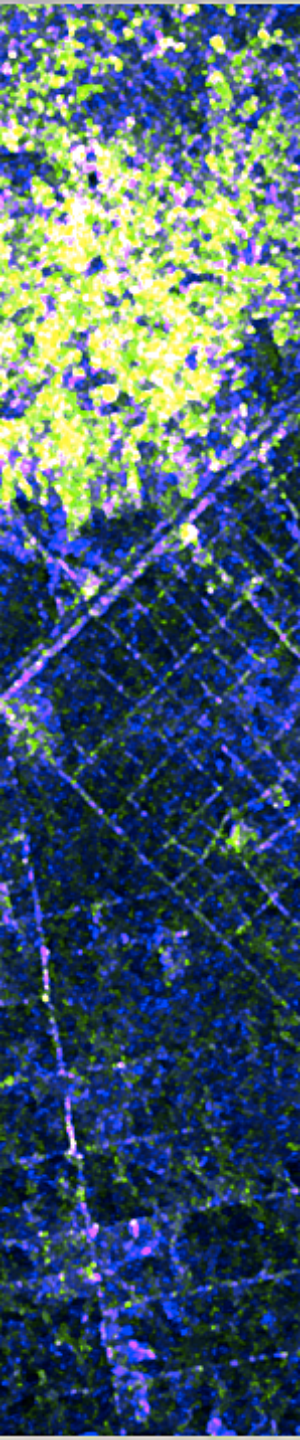
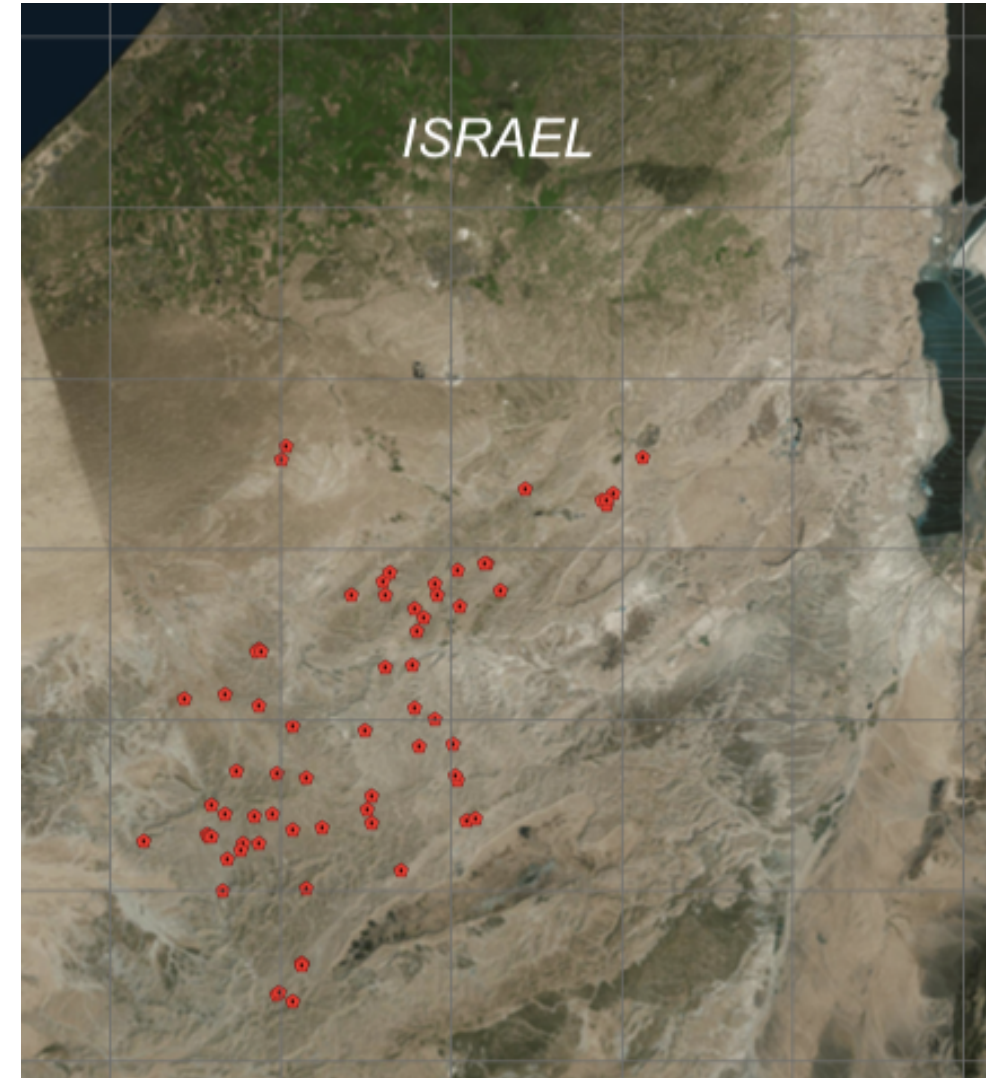
My goal is to take three sites in the Near East with varying topographic and archaeological features, and to apply a selection of radar processing and analysis techniques to assess them.

I will also attempt to identify specific aspects or elements that lead to one workflow being more successful depending on the site type.

Site 1: The Negev Highlands

This group of sites covers roughly an 80 x 80 km area, and dates to the late 10th century BCE; there are about 60 sites known.

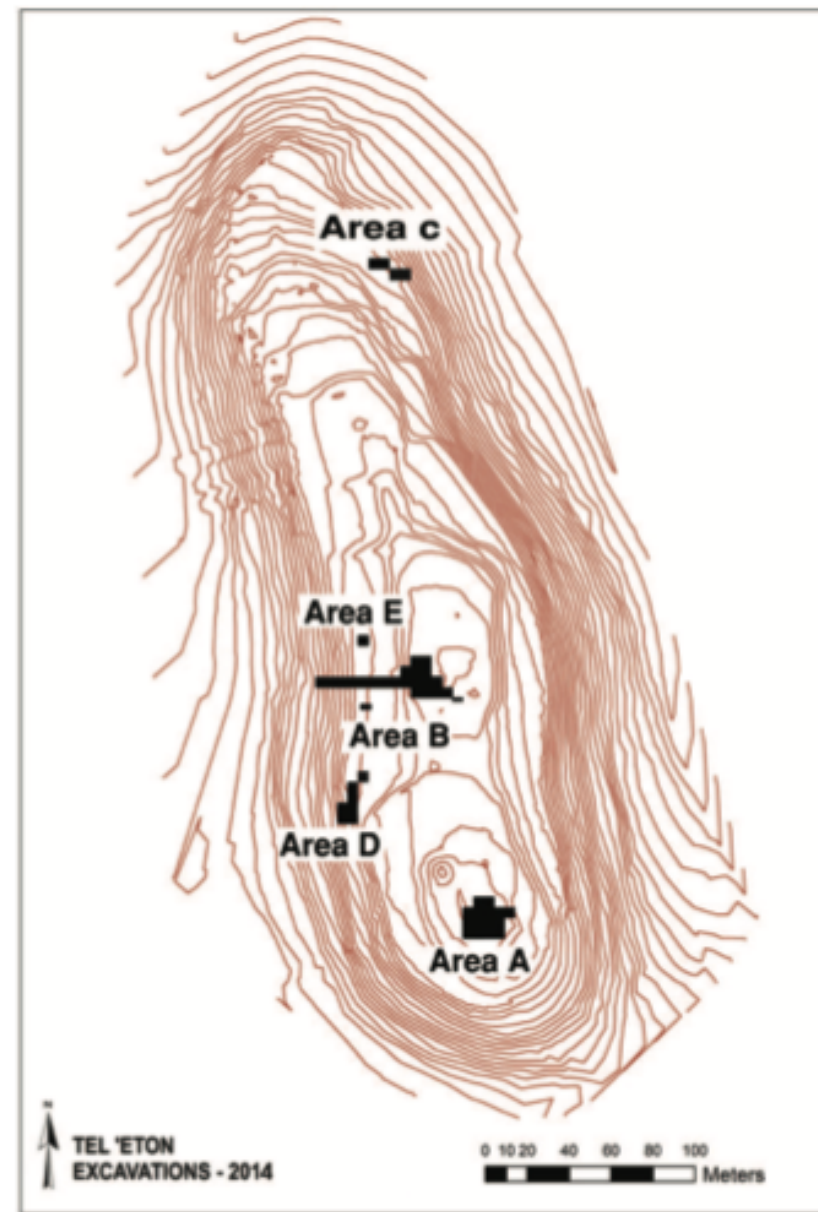
I will use radar to investigate a subset of the area, as well as to see whether medium-resolution imagery is capable of locating any of the sites.



Site 2: Tel 'Eton

Tel 'Eton, located in the Judean Hills in Israel, has been under excavation since 2006.

I will use radar to see whether I can trace the wall(s) further around the tell, as well as whether I can find indications of other structures or areas of significance that could merit further investigation.



Faust, Avraham, & Hayah Katz, 2015. "A Canaanite Town, A Judahite Center, and a Persian Fort: Excavating over 2000 Years of History at Tel 'Eton" *Near Eastern Archaeology*, vol 78.2: 88-102

Site 3: The Erbil Plain Archaeological Survey

The Erbil Plain Archaeological Survey, in the Kurdistan region of Iraq near the city of Erbil, is directed by Jason Ur and has been in progress since 2012.

The Erbil plain was an integral part of the ancient empire of Assyria. The EPAS project is attempting to map the hinterland, small villages, ancient roads, canals and irrigation systems.



Ur, Jason, 2017. "The Archaeological Renaissance in the Kurdistan Region of Iraq". *Near Eastern Archaeology*, vol. 80.3: 176-187.



Project Goals and Timeline

- Use the three identified test sites
- Apply radar analysis techniques as listed on the earlier slide about workflows
- Use ground truthing to the extent possible to verify results

Given the current situation, I am looking at a possible publication rather than a conference presentation. I hope to complete my MGIS before the end of 2021.



Thank you!

I will be happy to take questions...