MAPPING REMOTE SENSING TOOLS FOR UNDERSTANDING DISTURBANCE VEGETATION CHANGE

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Why care about vegetation dynamics?

• Vegetation is a natural indicator of environmental change
• Response can be rapid and dramatic

Observe carefully to:
• Improve understanding
• Influence management and policy
• Ensure accountability

Remote sensing can contribute to all of the above
Basic principles

- Sensor (camera) mounted on aircraft or satellite
- Image capture in multiple bandwidths
- Georectification (digital alignment of image to physical area)
- Image analysis
  - Filtering
  - Compositing
  - Differencing
- Synthesis and interpretation

Off-the-shelf products facilitate use by completing initial steps for you.
Common Platforms

- MODIS (Moderate Resolution Imaging Spectroradiometer)
  - Mounted on 2 satellites, launched in 2000 and 2002
  - Views entire earth every 1 to 2 days
  - 36 bands, at 250, 500, and 1 km resolution
Landsat

- Longest temporal record (series of satellites)
  - 1972 to present (Analysis Ready Data from 1982)
- 11 bands
- 30 m resolution
- 8 – 16 day return interval
- Thousands of applications
- User-friendly applications readily available
Sentinel

• Family of satellite missions
• Sentinel 2 – land and coastal monitoring
  • Launched in June 2015 and March 2017
• Global coverage every 5 days
• 13 spectral bands
• 10 and 20 m resolution
Inherent trade-offs

![Graph showing image resolution and frequency, with points for Sentinel 2015, Landsat 1982, and MODIS 2000.]
The spatial resolutions of 10m Sentinel 2 versus 30m Landsat
Normalized Difference Vegetation Index (NDVI)

\[
\text{NDVI} = \frac{(\text{Near infrared}) - (\text{Red})}{(\text{Near infrared}) + (\text{Red})}
\]

Reflectance of stressed plants

Reflectance of healthy plants

MODIS wavelengths used: 630 - 690 nm

780-900 nm

Modified from Kyllö 2003 (sugar beets)
Seasonal change in NDVI reflects vegetational phenology.
Phenoclasses: phenological similarity shown by color similarity

All years, 2001 - 2015
Baseline phenology compared to disturbance effects

Defoliating insects
Defoliating wind
Defoliating hail
Hard freeze
Thinning
Light fire
Heavy snowpack
Severe blowdown
Severe fire
Hard freeze
Heavy logging
Development

Baseline "NORMAL"

DEPARTURE

Higher
Lower
% change from baseline
Long-term monitoring
Gradual mortality from the non-native Hemlock Woolly Adelgid

*Evergreen forests have a high winter NDVI and low inter-seasonal amplitude.*
Near-real-time change detection
2011 Pagami Creek Fire and early fall, MN

1 Year Baseline

All Year Maximum Baseline

24 day window
Two views of Chimney Tops 2 fire severity: 2017 vs. 2016

24-day MODIS April composite  Summer Sentinel-2 composite
An aerial view of the Camp Branch Fire
July 2017; Credit Kenny Frick, FHM
Reduction in growing season NDVI 2016-2017 showing canopy change from fire

Camp Branch Fire, NC
Reduction in late winter NDVI 2016-2017 showing over-story and under-story evergreen change from fire.
Summary

• Multiple remote sensing platforms and products are publically and freely available

• Finding the best choice involves
  1) asking the right questions
  2) understanding trade-offs in spatial and temporal resolution

• Optimal solution may require using a combination of platforms and products
  1) Moderate resolution for broader landscape context
  2) Fine resolution for improved understanding
For more information, see the *ForWarn* and *LanDAT* websites:

https://forwarn.forestthreats.org

https://landat.org

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