Ecological Applications of Landsat Data—USDA Forest Service Science and Operational Needs (with partners)

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Landsat 8 Launch & Landsat Science Team Meeting
10-14 February, near Vandenberg Air Force Base, CA
Primary Collaborators

Zhiqiang Yang, Justin Braaten, David Mildrexler, Kevin Briggs, Peder Nelson, Eric Pfaff [Oregon State University]

Sean Healey, Gretchen Moisen, Todd Schroeder, Andy Gray, Hans-Erik Andersen, Ken Brewer, Brain Schwind [USDA Forest Service]

Steve Stehman [Syracuse University of New York]

Dirk Pflugmacher [Humboldt University of Berlin, Germany]

…and others in this room
Objectives

1. **Temporal integration across all Landsat sensors for change detection applications**

   - MSS-TM-ETM+ integration has always been valuable for forest monitoring (with Healey)
   - Recent inclusion into annual time-series analyses to predict forest structure (with Pflugmacher, Yang, Kennedy)
   - Next: → OLI, automate process for large areas (i.e., western US) to examine climate effects on vegetation (with Braaten, Yang)
Motivation

• Integration across all Landsat sensors is critical for US Forest Service and related agency science & applications
  – Long time periods of observation are important for understanding ecosystem resilience to historic management and policy decisions & to guide future decisions under the influence of climate change
2. **Further a nascent Landsat-based inter-agency monitoring system for the US: Landscape Change Monitoring System (LCMS)**
   
   - Statistical modeling framework that *integrates map output from multiple time series algorithms* and other relevant data
   
   - Includes sampling & estimation context to *adjust map-based change rates for disturbance omission errors* (a la Olofsson et al.) using plot-level reference time series interpretations
   
   - Roll adjusted estimates back to the map
Motivation

- Change maps from Landsat data are critical for quantification of forest dynamics in the context of management, policy, and international treaties.
- But, change maps derived from any automated algorithm using can be loaded with error.

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<th>Map</th>
<th>Reference</th>
<th>Disturbed</th>
<th>Undisturbed</th>
<th>Agreement</th>
<th>Commission</th>
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</table>

Across years

- Needed is a statistical adjustment from plots...
**TimeSync Workflow for Plot-based Observations**

1. **Other datasets**
2. **Check Disagreements**
3. **Roll-back to maps**
4. **Sample Design**
5. **TimeSync Interpretations**
6. **Change Map Uncertainty Analyses**
7. **Agreement Reports**
8. **Stand-alone results**
9. **Change Area Estimation & Adjustment**

**Flowchart Diagram:**
- Other datasets → Check Disagreements → Roll-back to maps
- Other datasets → Sample Design → TimeSync Interpretations
- TimeSync Interpretations → Change Map Uncertainty Analyses → Agreement Reports
- Change Map Uncertainty Analyses → Stand-alone results
- Change Map Uncertainty Analyses → Change Area Estimation & Adjustment

**Graph Chart:**
- Mapped disturbed (%/yr)
- Adjusted map disturbed (%/yr)

**Legend:**
- **Blue Line:** Mapped disturbed (%/yr)
- **Red Line:** Adjusted map disturbed (%/yr)

**Timeline:**
- 1985 to 2011