

LandTrendr and TimeSync:
Update on new tools to tap the archive

LandTrendr: Robert E. Kennedy, Zhiqiang Yang, Warren B. Cohen

TimeSync: Warren B. Cohen, Zhiqiang Yang, Robert E. Kennedy

Landsat Science Team Meeting
January 2009

LandTrendr: Landsat-based Detection of Trends in Disturbance and Recovery

Steps in the LandTrendr process

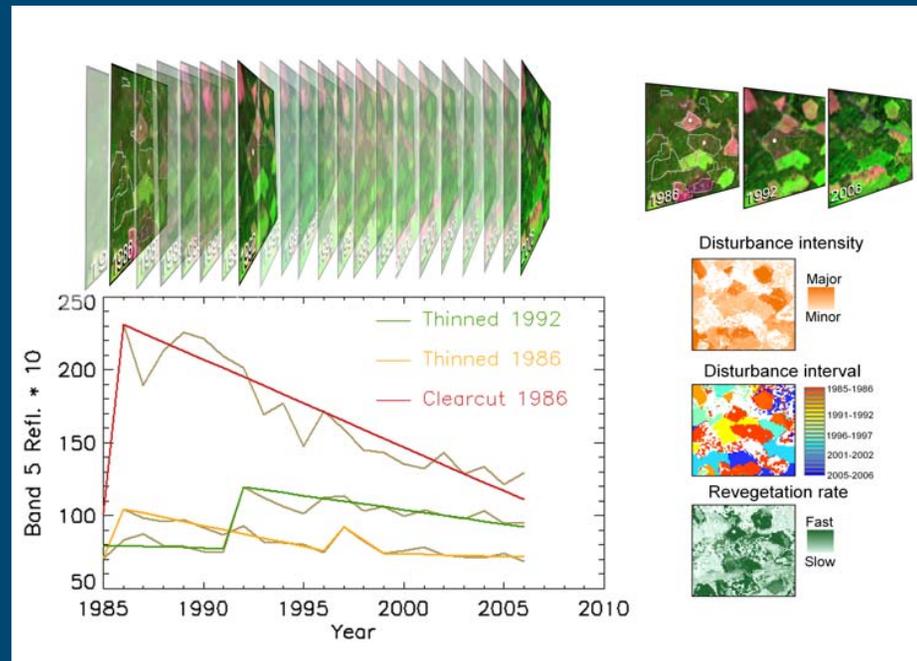
Prepare stack of yearly imagery



Extract spectral trajectories for pixels



Statistically identify and fit segments with consistent trends



Evaluate veracity of selected events: TimeSync



Extract summary information from segments



Outputs – Diversity of Disturbance and Regrowth Processes

High intensity, short duration

Dramatic events (clearcuts, fires) more often -- commensurate with climatic, economic, & ecological cycles

Slow processes such as growth and recovery as well as insect and drought-related mortality, through use of trajectory approach

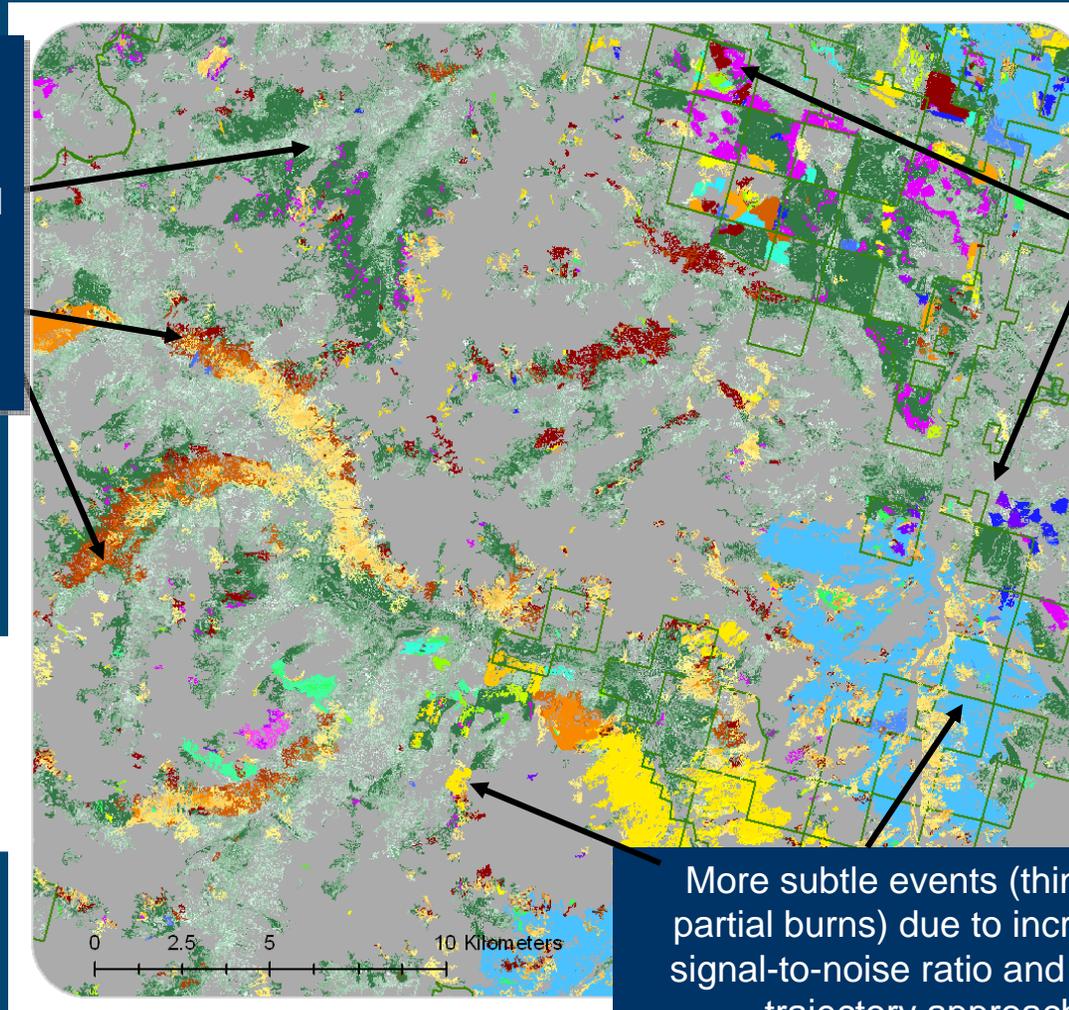
Low intensity, long duration

Vegetation canopy recovery

Fast  Slow

Vegetation canopy removal

Full  Partial



Disturbance Interval	
	1986-1987
	1987-1988
	1988-1989
	1989-1990
	1990-1991
	1991-1992
	1992-1993
	1993-1994
	1994-1995
	1996-1997
	1997-1998
	1998-1999
	1999-2000
	2000-2001
	2001-2002
	2002-2003
	2003-2004
	2004-2005
	2005-2006
	2006-2007

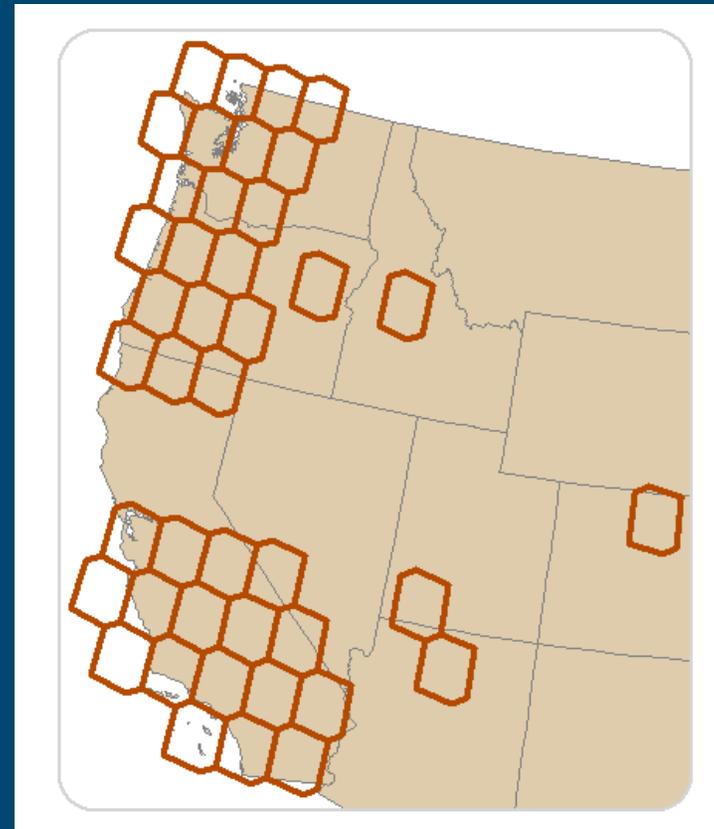
Annual resolution

More subtle events (thinning, partial burns) due to increased signal-to-noise ratio and use of trajectory approach

Low intensity, short duration

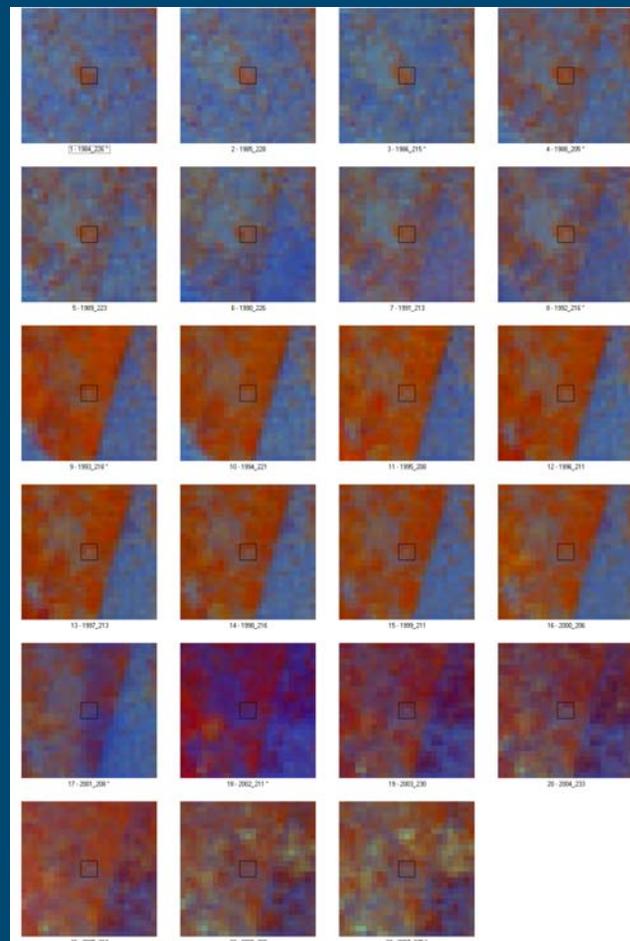
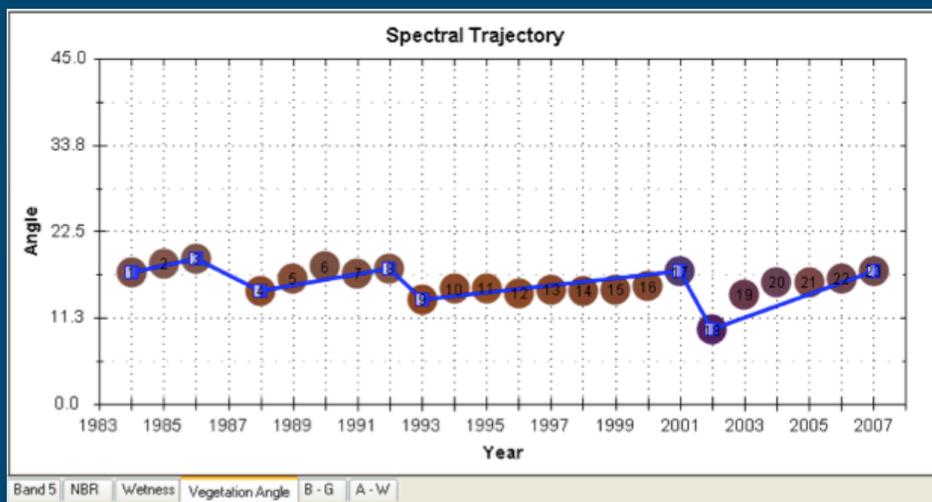
Current LandTrendr Mapping

- LandTrendr mapping:
 - Northwest Forest Plan (NWFP) update - western WA and OR (Jan 2009)
 - ORCA II -- Carbon modeling and integration - Southern California (Spring 2009)
 - National Parks (2008-2009)
 - Idaho and Colorado insect outbreaks (Spring 2009)
 - OWEB - link disturbance to coupled forest/hydrological models (Spring 2009)
 - All of CA, WA, OR to follow



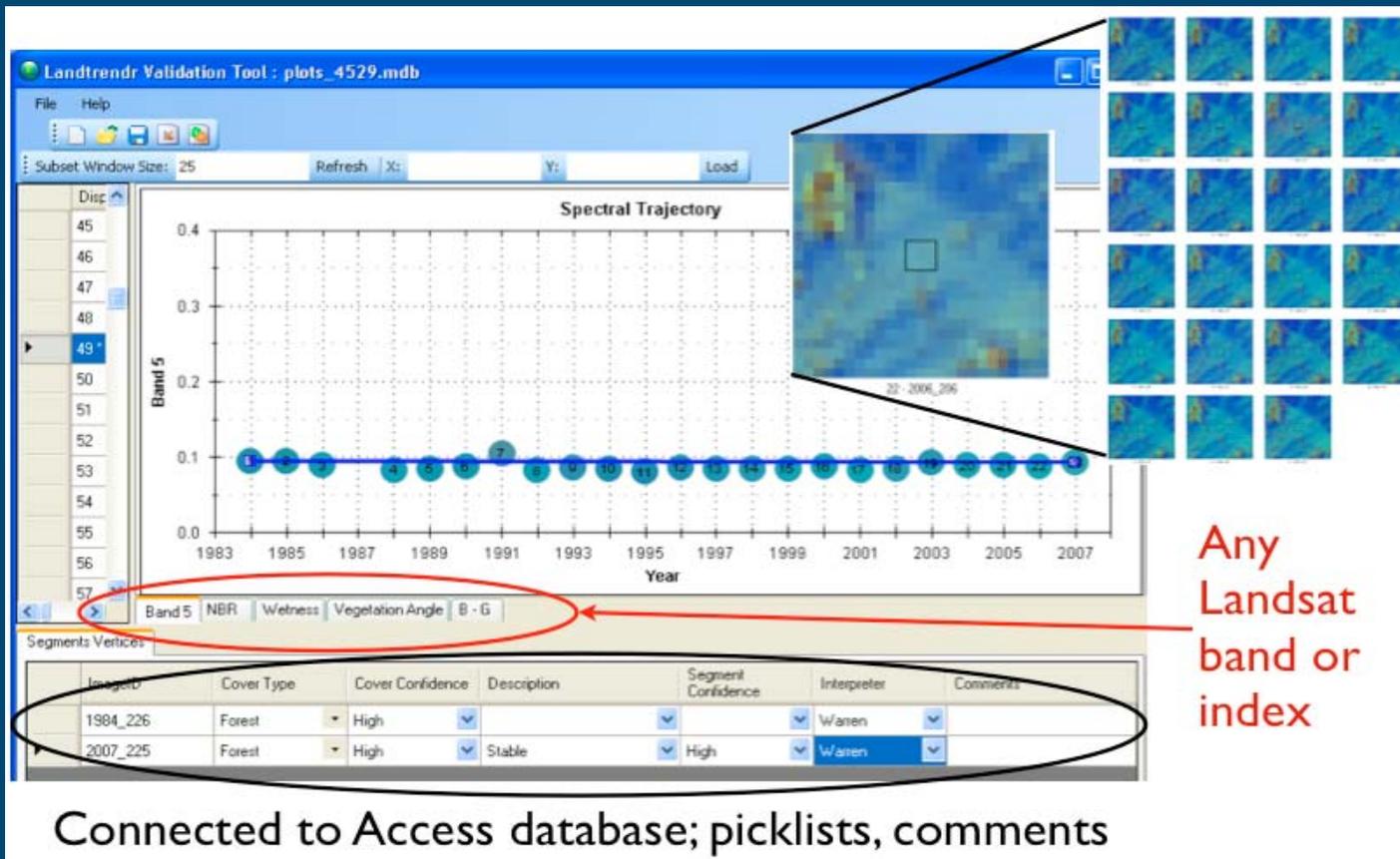
TimeSync: Syncing Automated and Human Interpretations of Landsat Time Series

- Use good, old-fashioned photo-interpretation skills, but applied to “plots” within Landsat time series
- Examine spectral trajectories and identify temporal vertices & segments



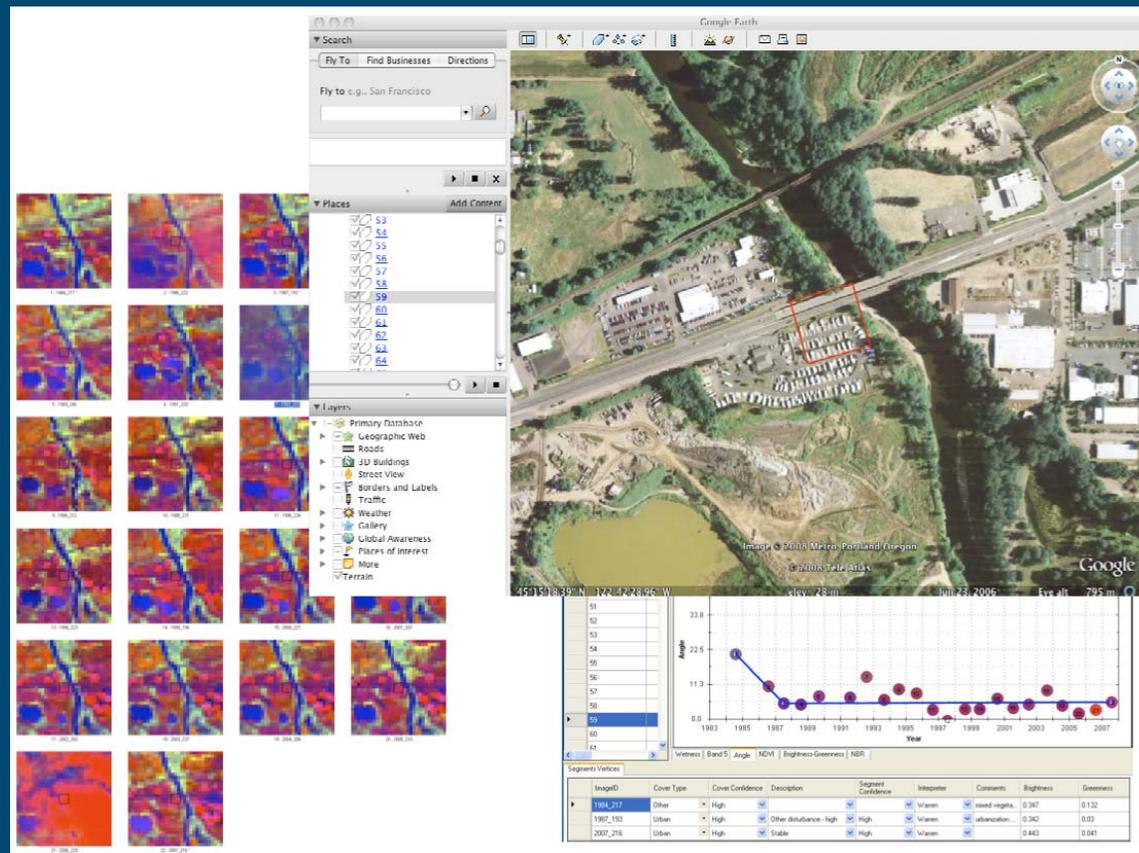
TimeSync

- Any band or index
- Populate database with observations
- Sample design for "validation"



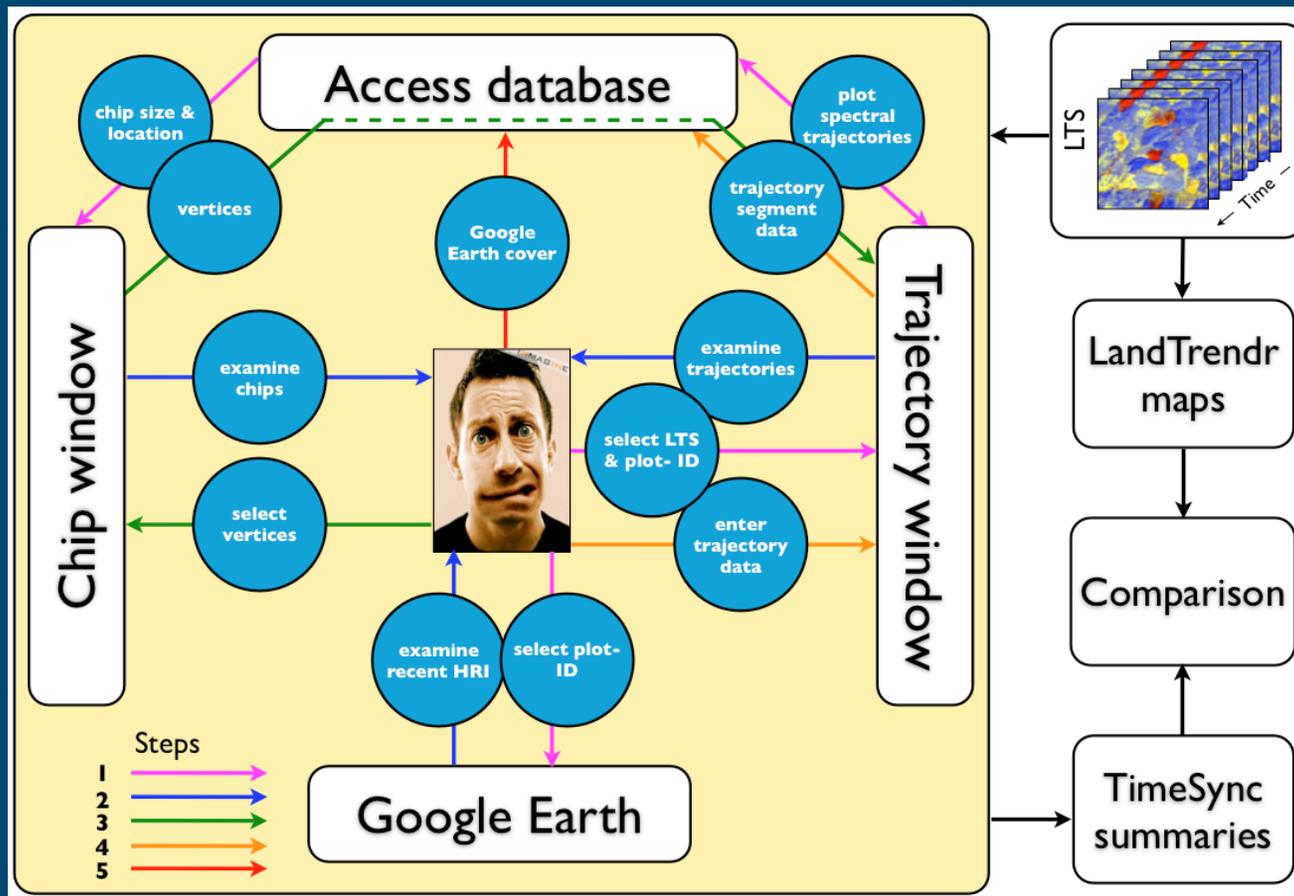
TimeSync

- Reality check against recent Google Earth image
- Compare with other databases (harvest records, fire catalogs), as available



TimeSync

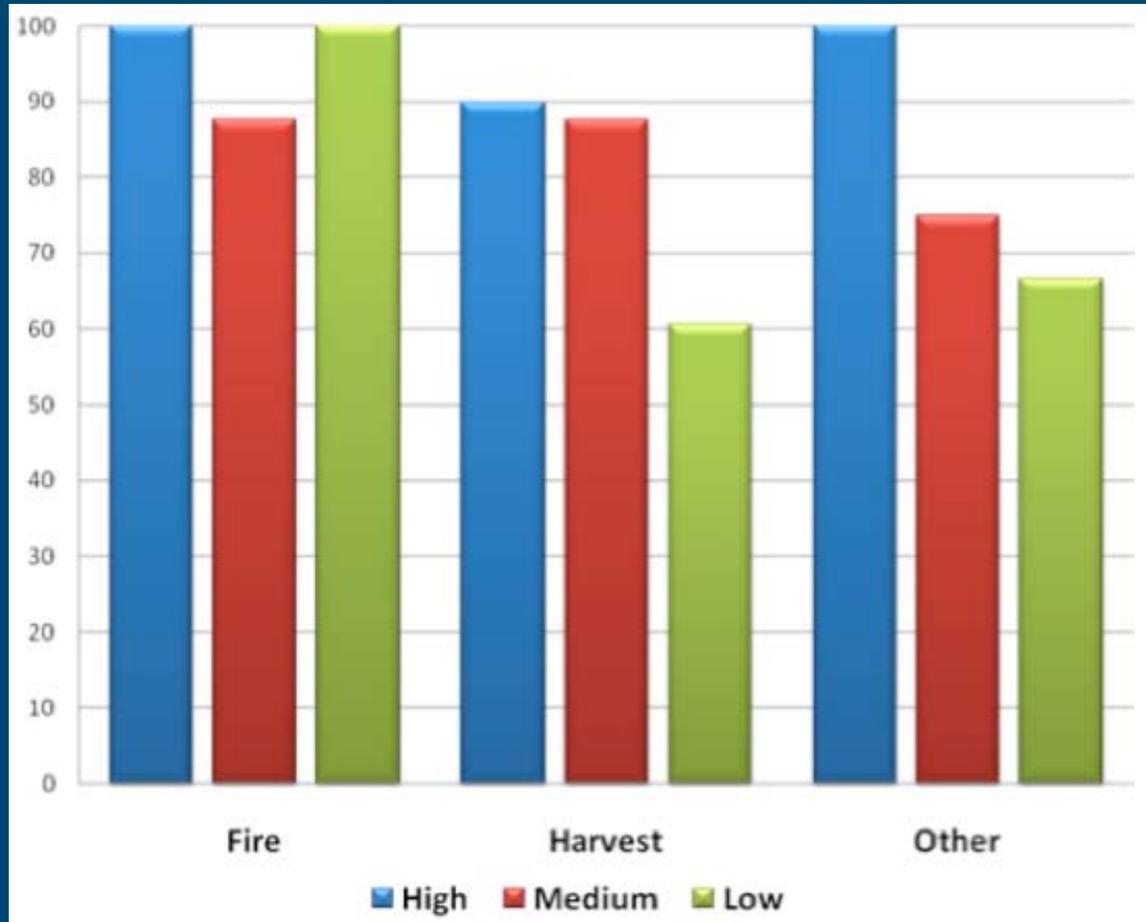
- Complicated, but intuitive, effective process
- Applicable to any Landsat time series
- Variety of applications (exploration, calibration, validation)



TimeSync

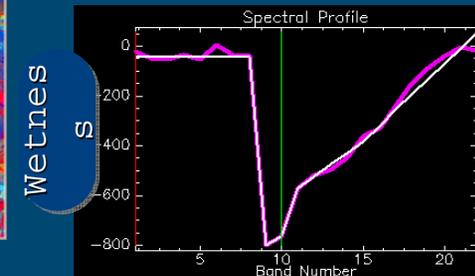
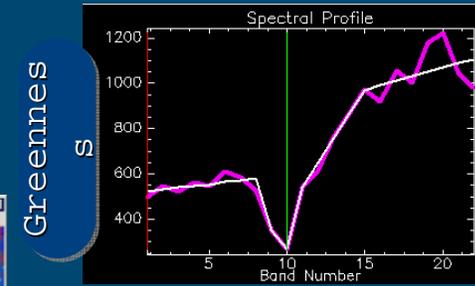
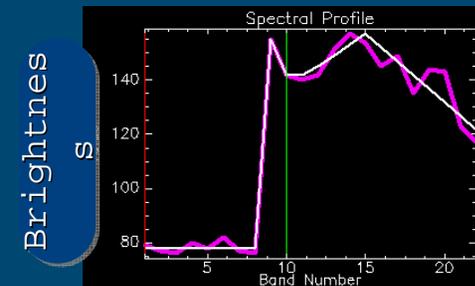
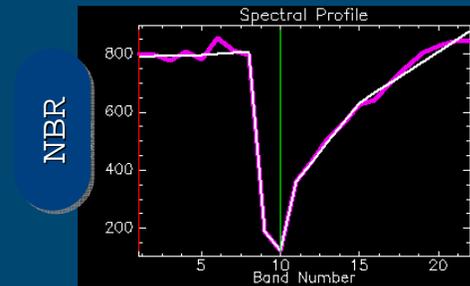
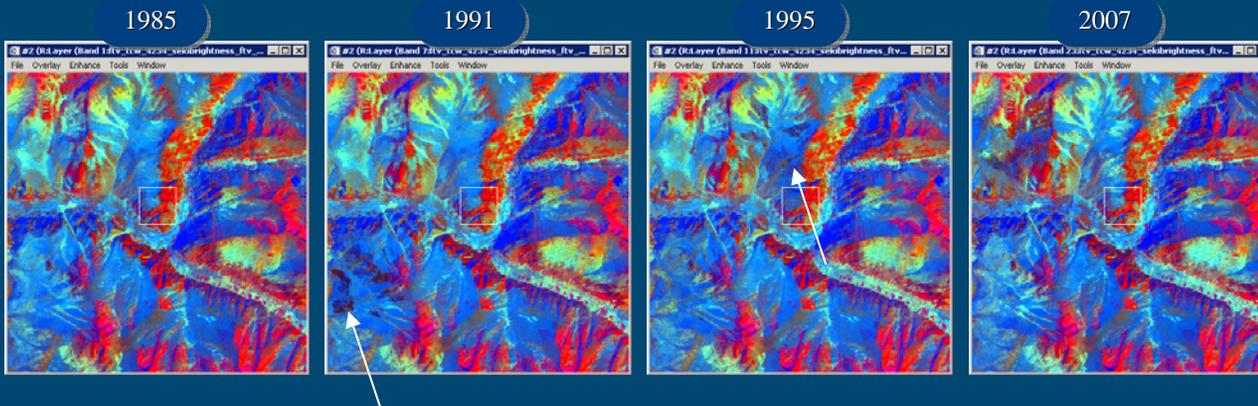
- Summarize agreement with LandTrendr map output...

e.g., disturbance agreement (%) as a function of TimeSync-observed disturbance agent and relative intensity.



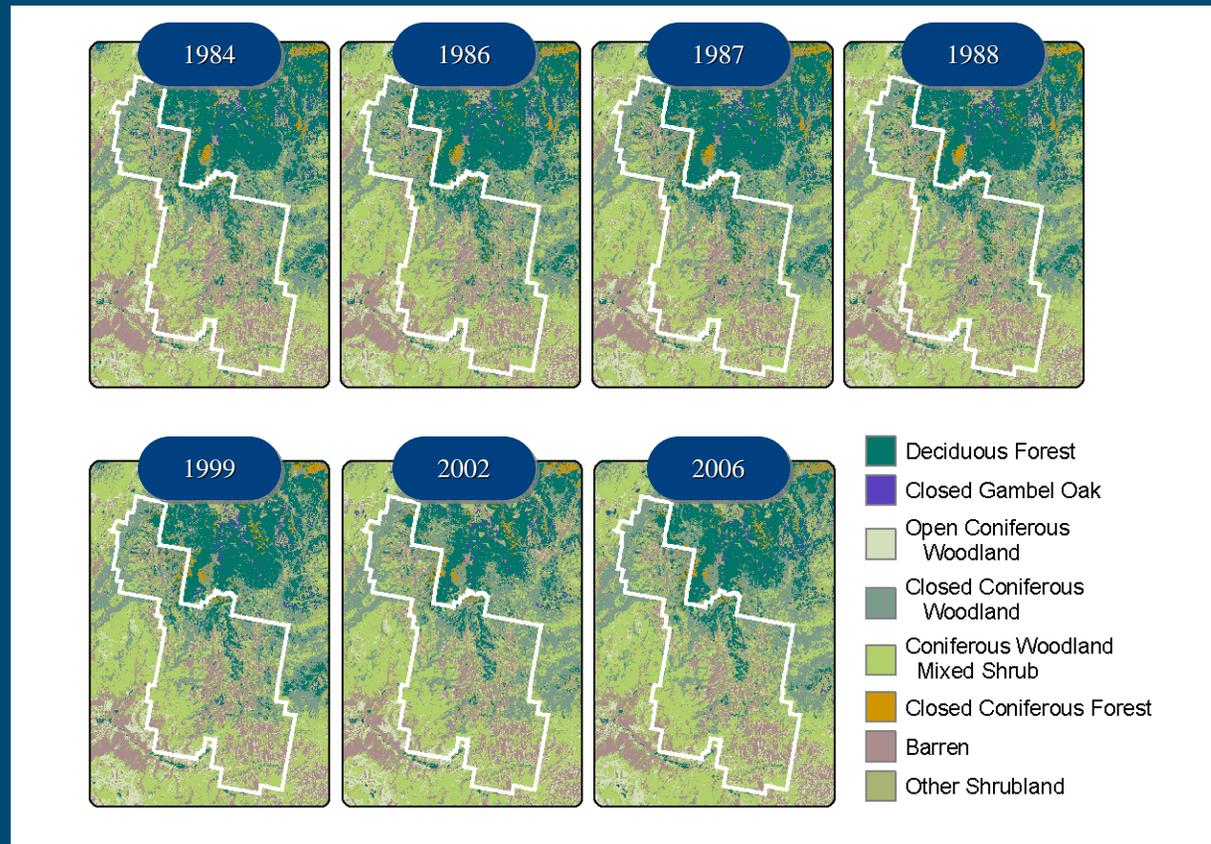
LandTrendr: Beyond change detection

- Use segmentation of one band to identify “vertices” in time series
- Smooth between vertices in other bands
- Result: “Pseudo-images” with year-to-year noise removed, but actual change retained



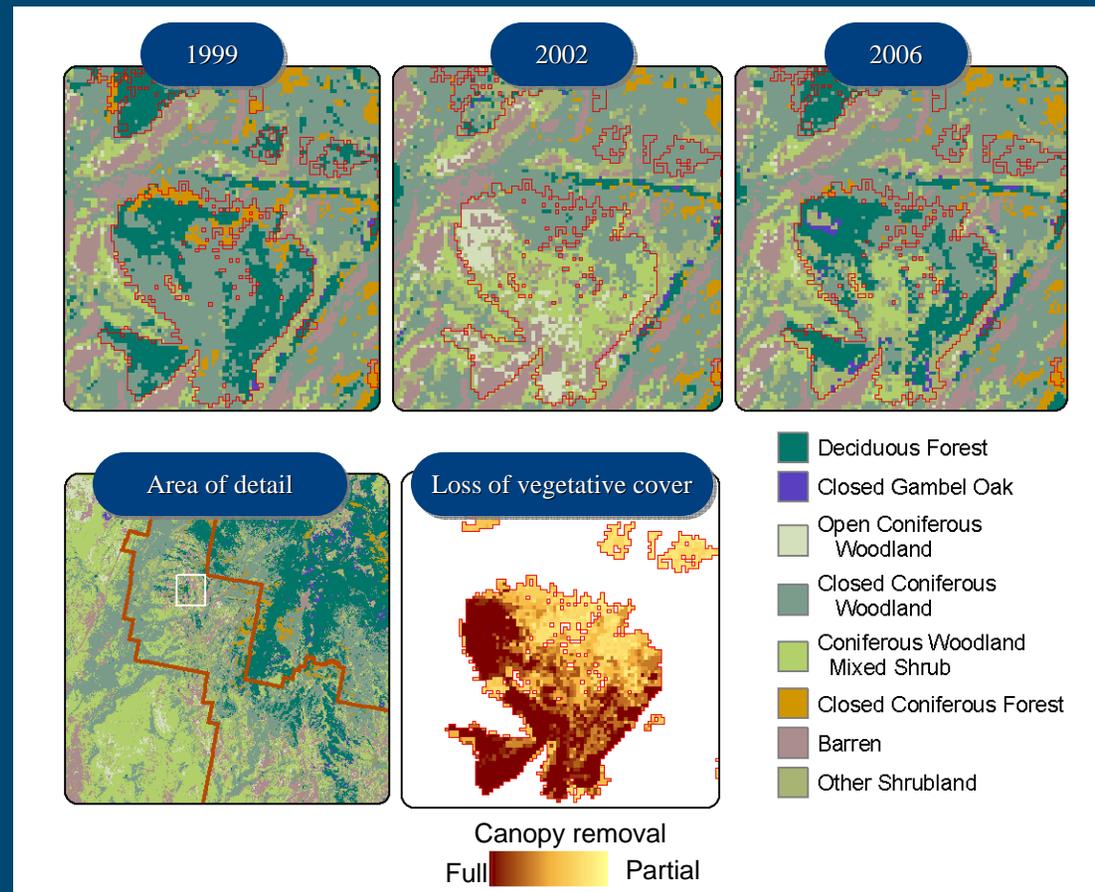
Stable cross-time classification

- Stable spectral space allows application of consistent models, classification rules across time



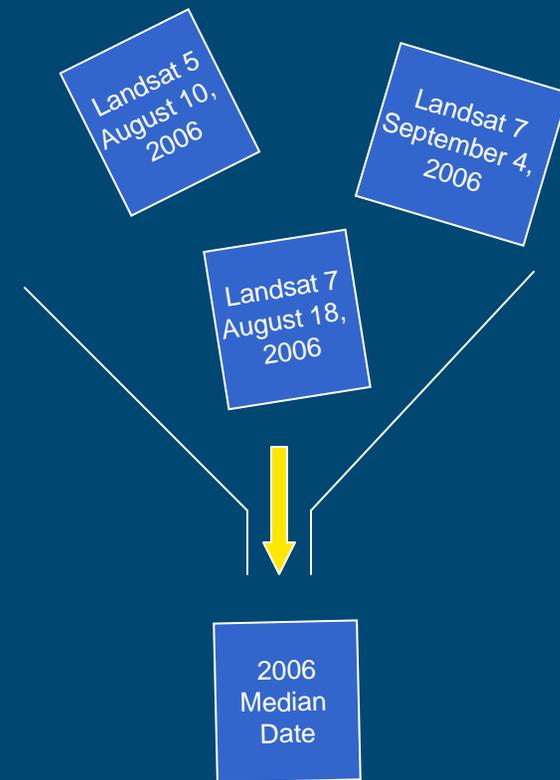
Stable cross-time classification

- Stable spectral space allows application of consistent models, classification rules across time



Extension: L7 Gap-filling, cloud filling

- Multiple images ingested per year
 - Best image (closest to median date) chosen if cloud-, gap-free
 - Otherwise use secondary images
- Resultant image without gaps, clouds
 - Result of both standard mosaicking + fitting



LandTrendr & TimeSync

- Opening of the archive = paradigm shift in Landsat change detection
- Automated algorithms (LandTrendr - Kennedy, Vegetation Change Tracker – Huang) already exploiting the archive regionally, nationwide, as well as internationally (plus: exploring MSS-ETM+)
- LandTrendr composites to remove clouds and SLC-off gaps
- Smooths time series between change vertices enabling functional linkage between spectral properties and map classifications through time
- Given temporal and spatial richness of change information from algorithms, paucity of independent data to conduct validation
- TimeSync fills this void, and is backed up with more traditional reference data, where available.