

Introduction to TimeSync – A Tool For Landsat Time Series Visualization

Warren B Cohen, USDA Forest Service

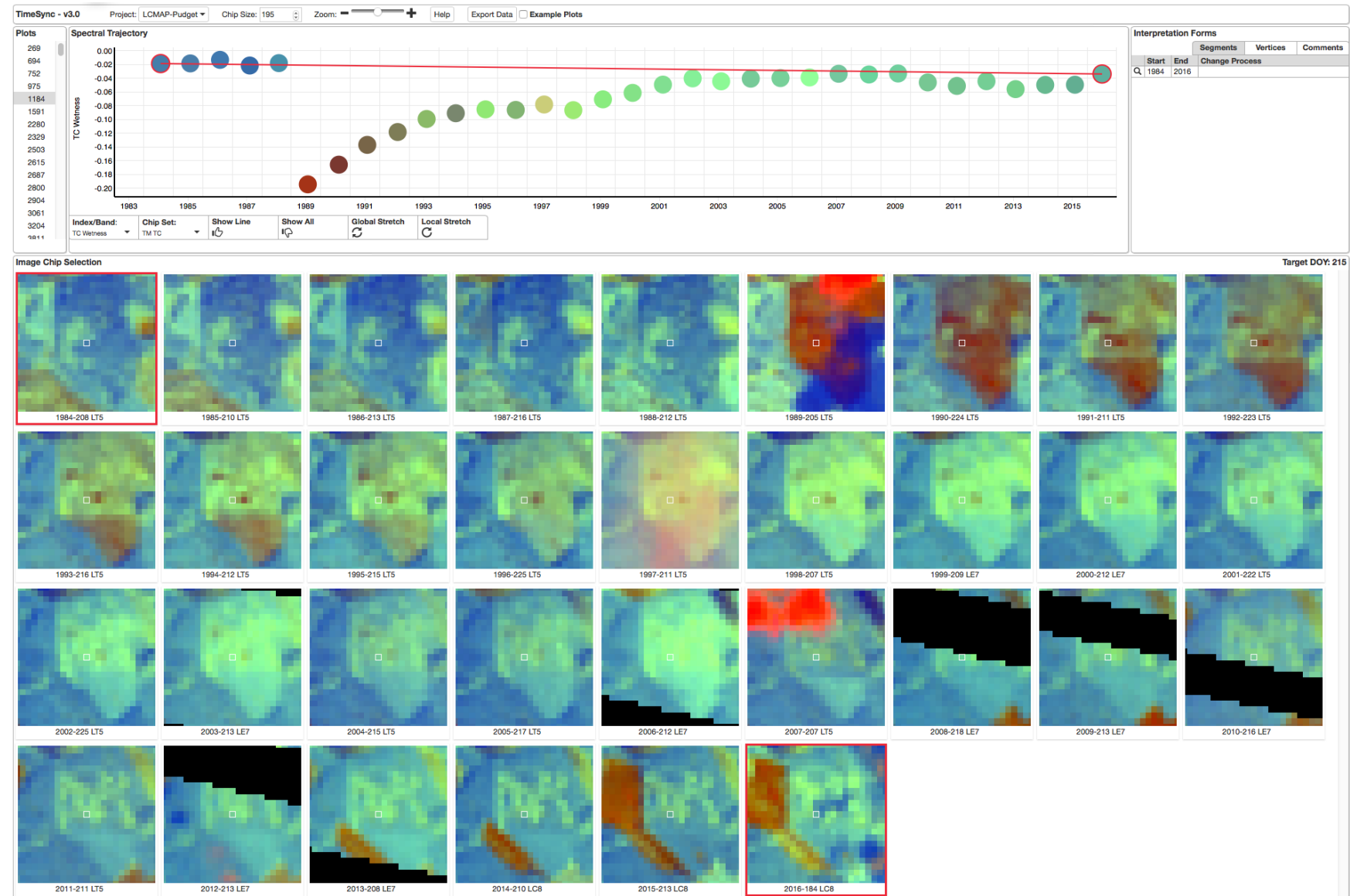
Zhiqiang Yang, Oregon State University

TimeSync – Introduction

- Landsat time series visualization and change data collection tool
- Designed to evaluate quality of change maps derived from Landsat time series data
- Facilitates any reference data collection sample design based on Landsat data
- Every Landsat observation available to algorithms also available in TimeSync
- Basic human visual image interpretation skills (e.g., airphoto interpretation) applied to Landsat time series

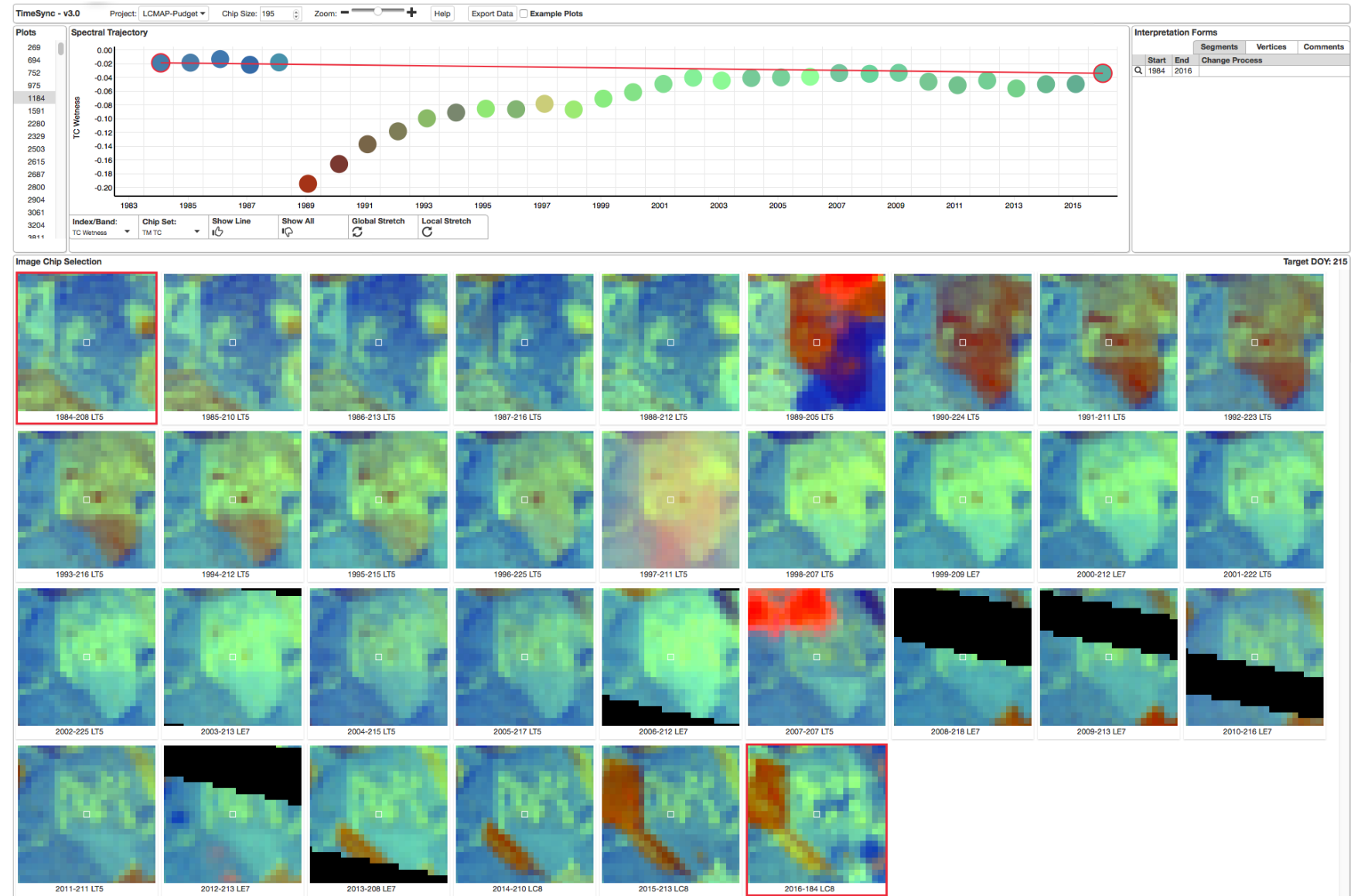
TimeSync – Basic Interface & Related Information

- Generic introduction to Version 3.0
- Three main windows: chip, trajectory, data entry



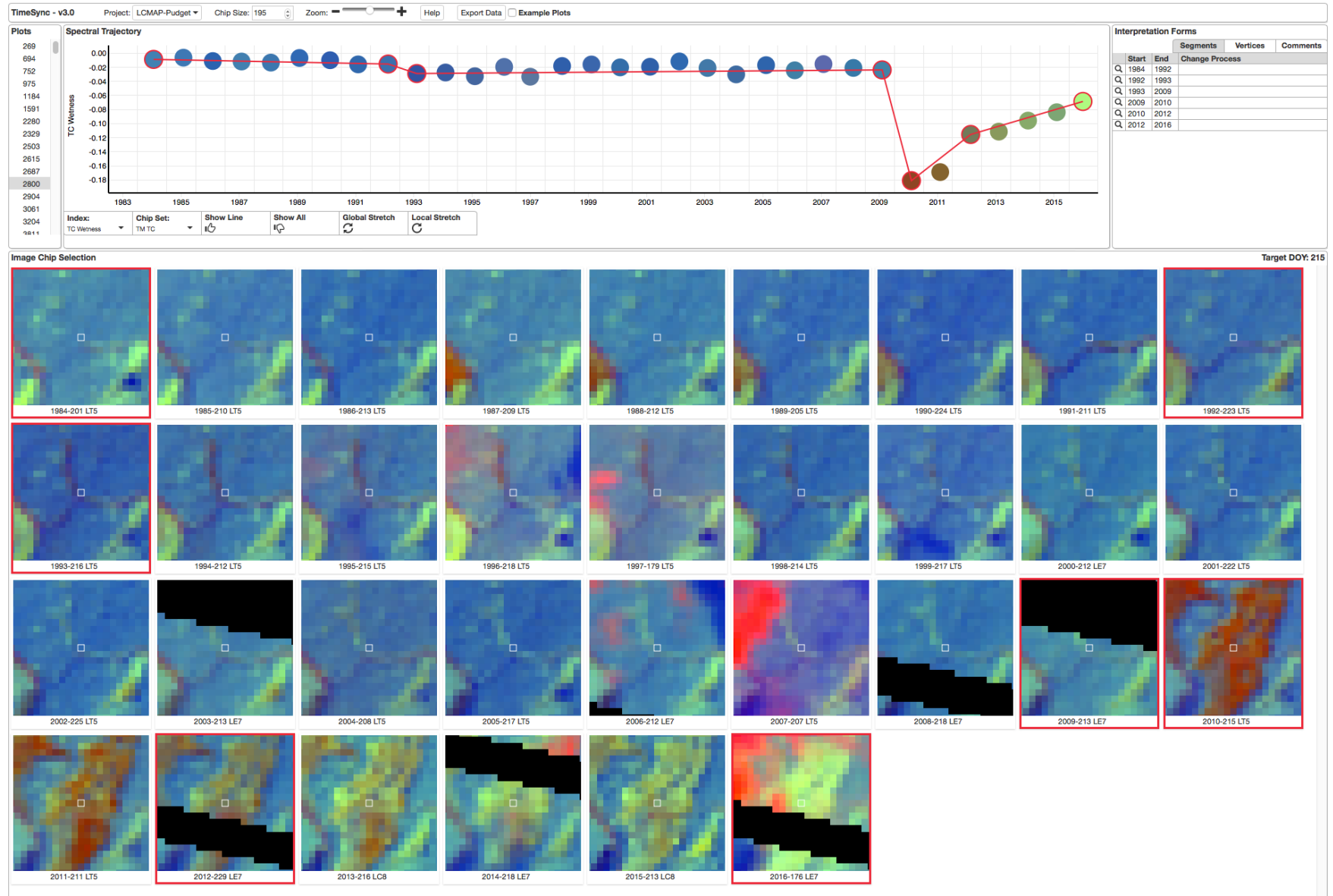
TimeSync – Basic Interface & Related Information

- Basic idea is to use TimeSync for temporal segmentation of time series, identifying and documenting when changes happened and what caused the changes



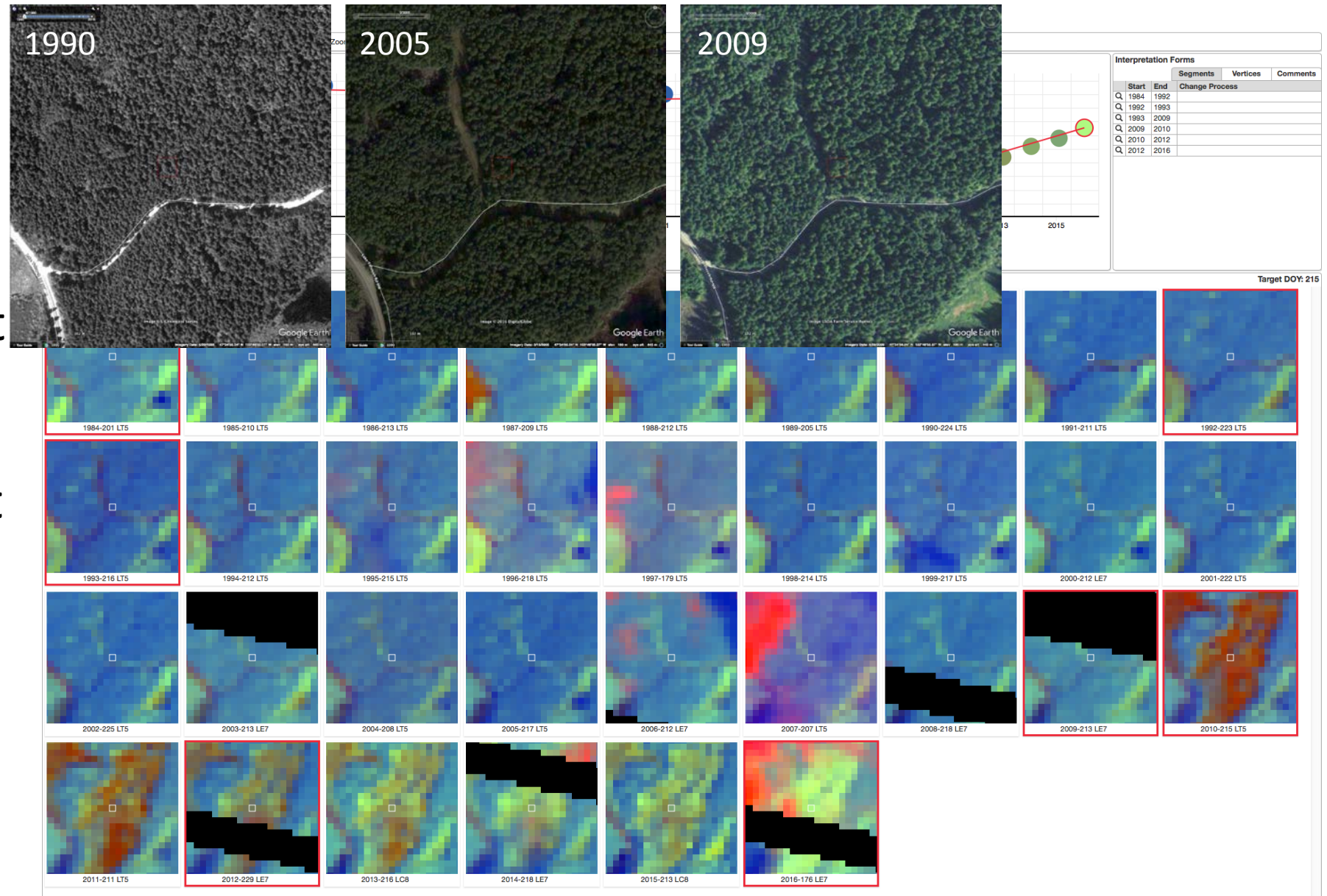
TimeSync – Temporal Segmentation

- Concept of temporal segmentation
- From chips we see several segments: stable, new road spur, stable, harvest, non-linear spectral response to growth



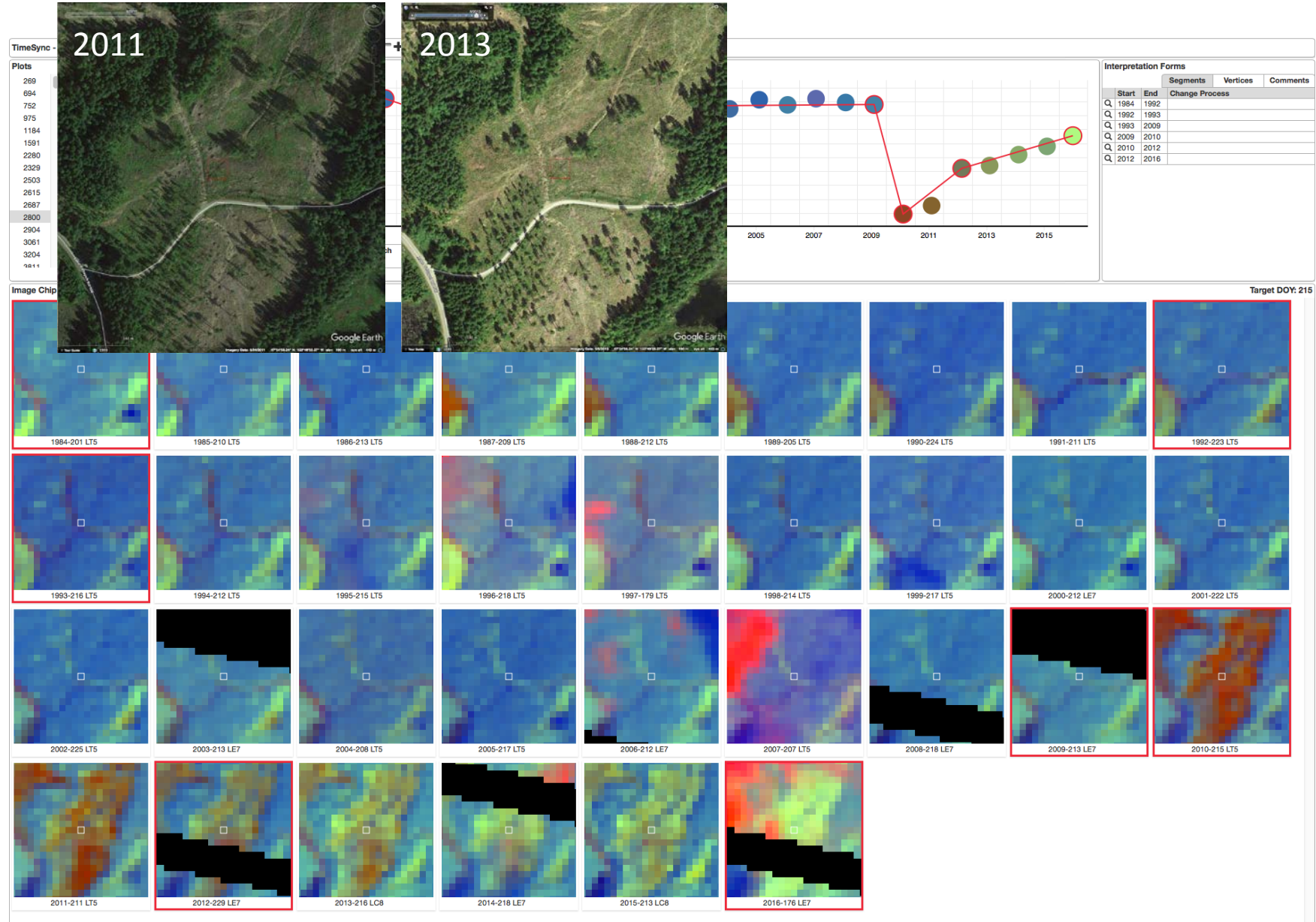
TimeSync – Role of Google Earth

- Historic snapshots important, but don't always exist
- GE images (and Landsat images) not always perfectly aligned (2005 v. 2009), so often best to go with most likely reality based on Landsat images (road spur through edge of plot)



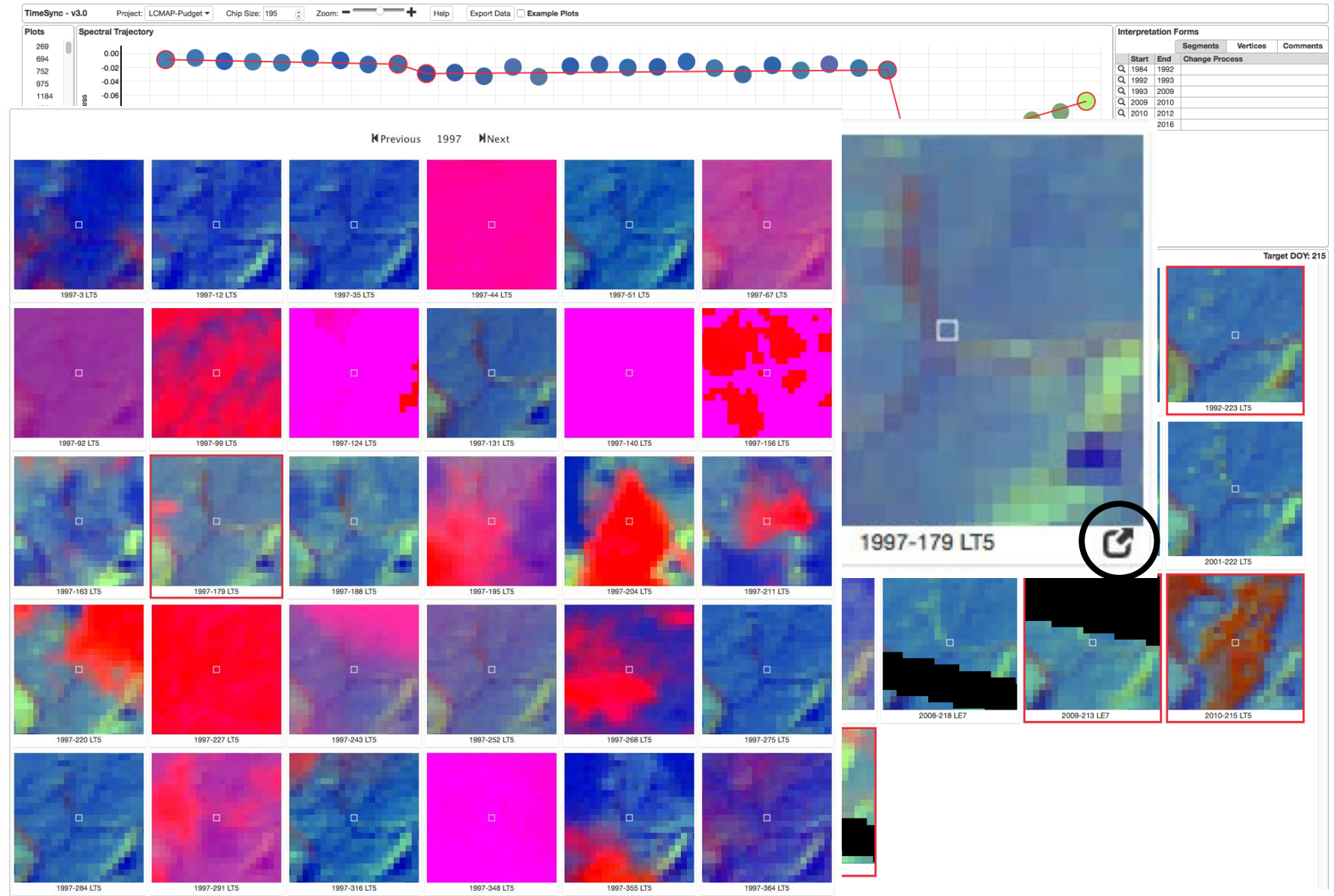
TimeSync – Role of Google Earth

- GE image from 2011 confirms harvest observed in 2010 and that vegetation is beginning to reestablish (also seen in 2013)



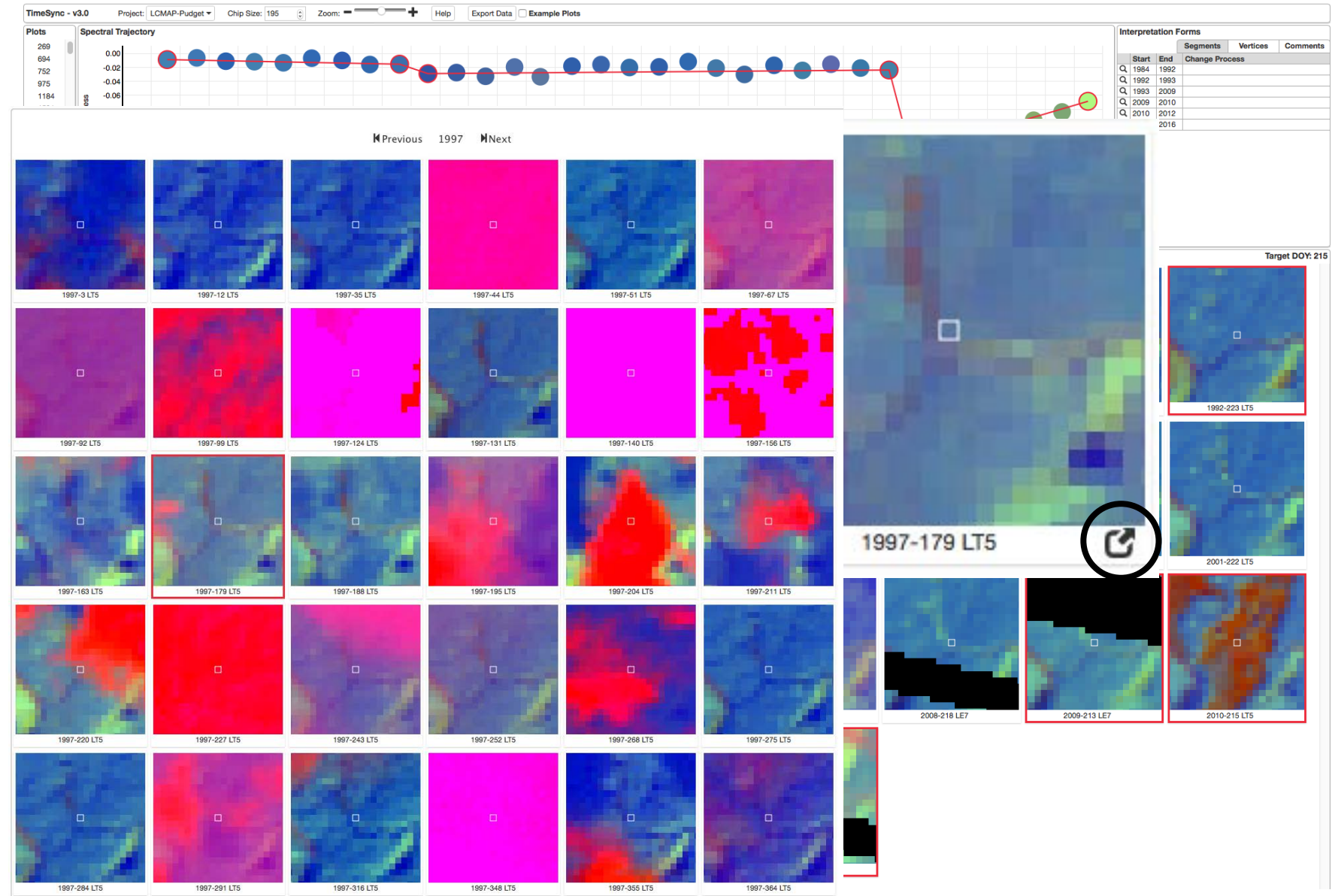
TimeSync – Chip Gallery

- Target date & clouds/haze (1997)
- Automatic logic selects single “best” image chip for each year
- Not always best and not always a better choice
- Chip gallery (shows selected chip)



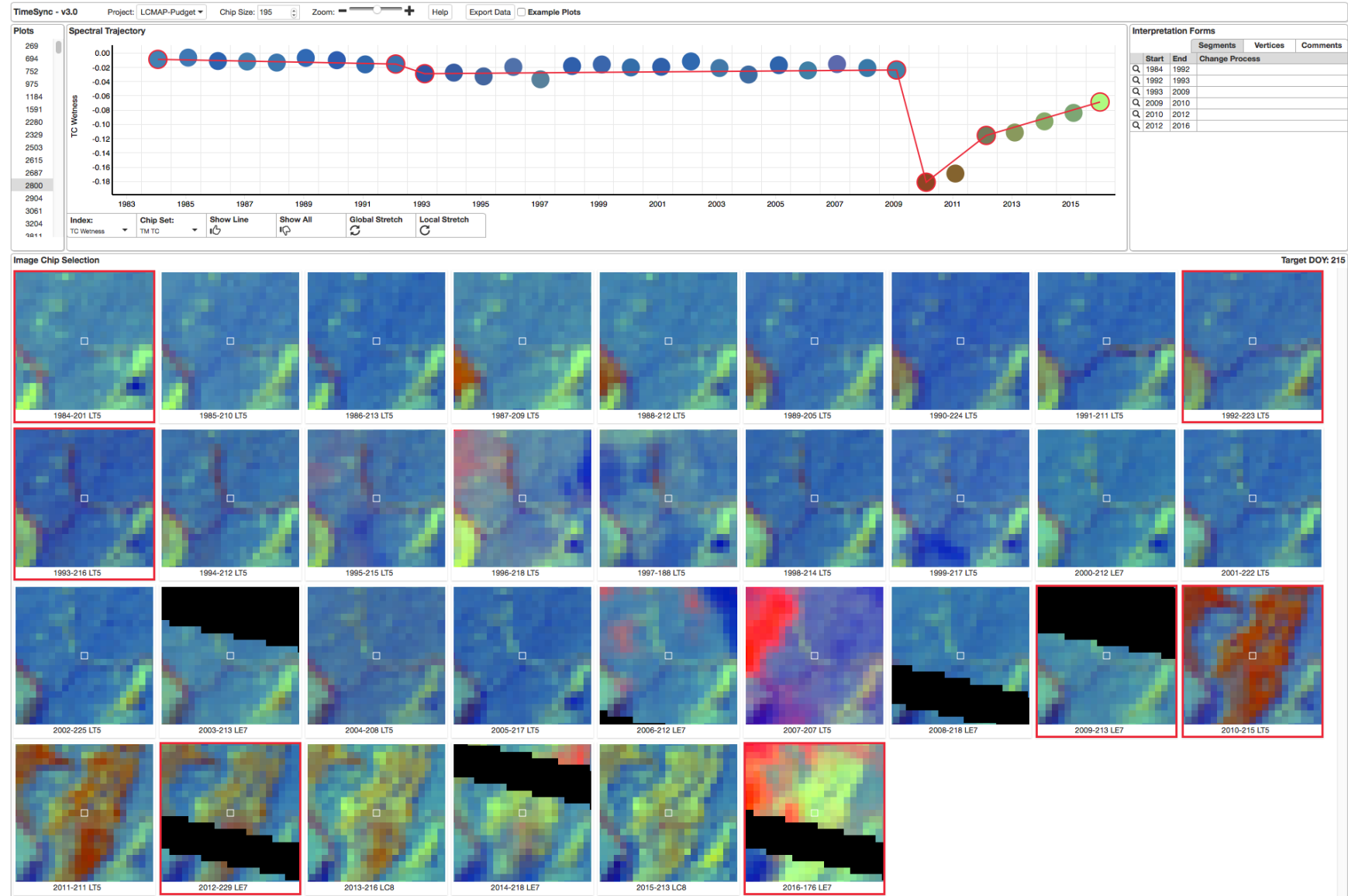
TimeSync – Chip Gallery

- Goal is clear, high quality image chip for all years at approximately target data (e.g., 215)
- Best choice here is DOY 188 (clear and close enough to target date)
- Note previous and next in gallery window



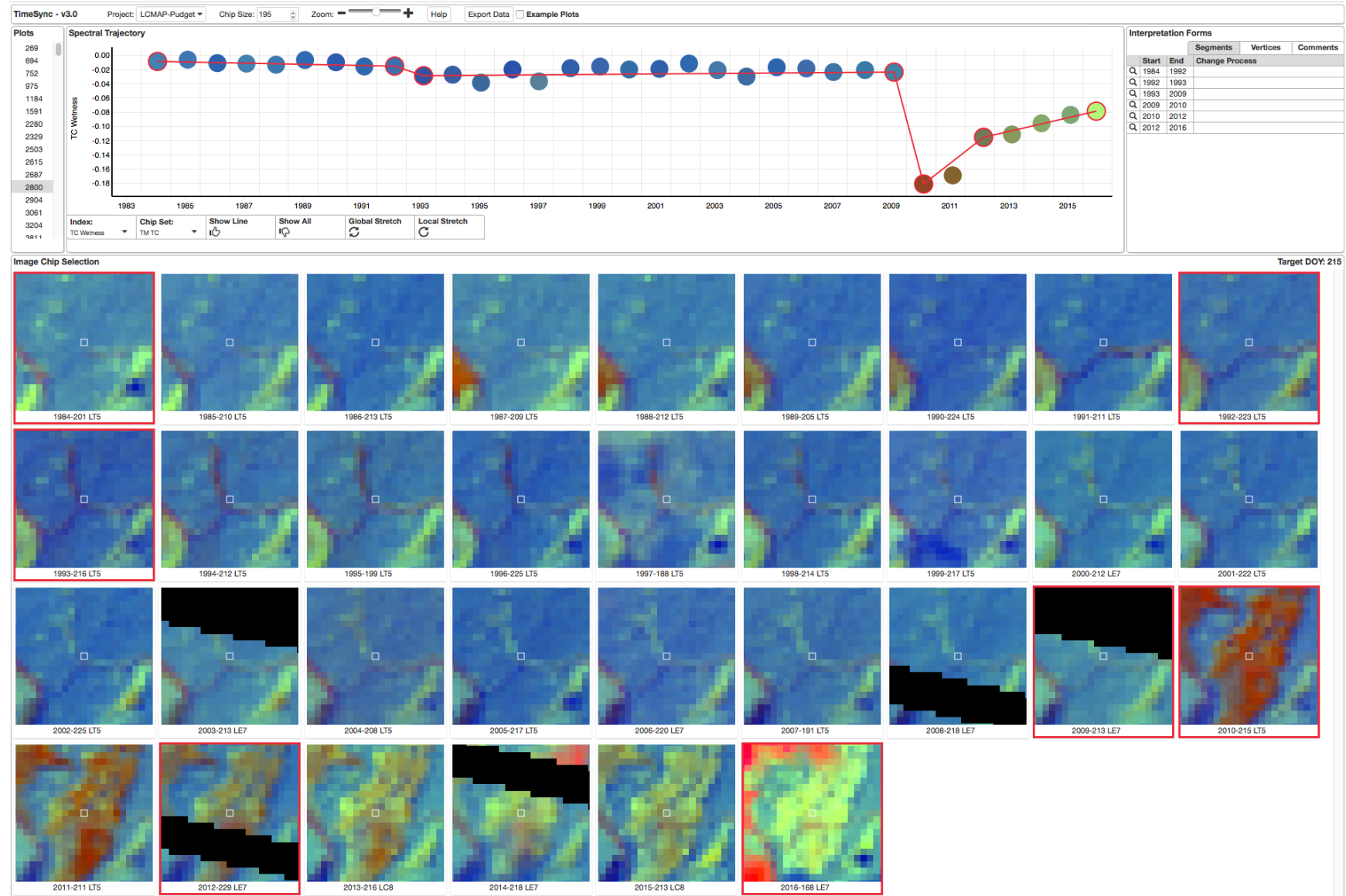
TimeSync – Chip Gallery

- Also cloudy/hazy are 1995, 1996, 2006, 2007, 2016
- Can also remove “no-data” strips from L7 SLC-off (2003, 2008, 2009, 2012, 2014, 2016, if desired; sometimes essential as when plot falls in strip)



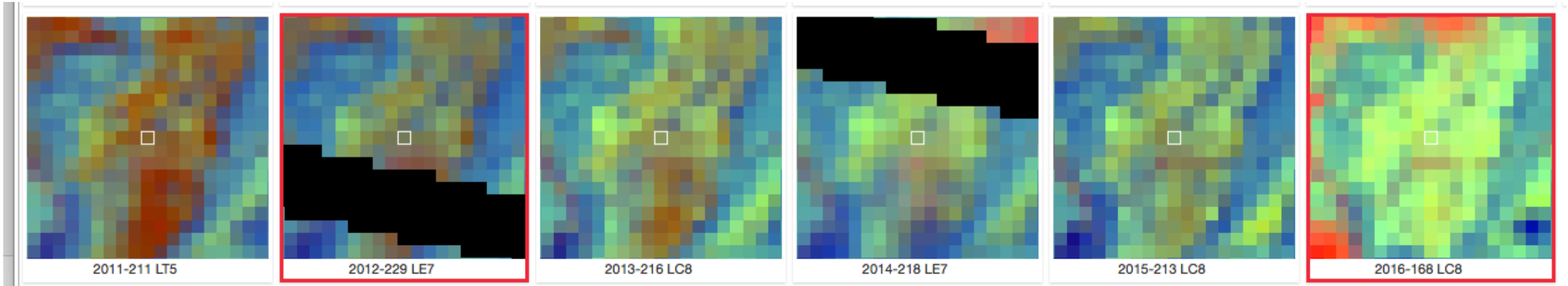
TimeSync – Chip Gallery

- A final, best selection
- Note that 2016 is DOY 168, but there was no better choice that was clear and closer to target date
- Note SLC-off strip gone for 2016, but left in place for other years because not a problem for interpretation

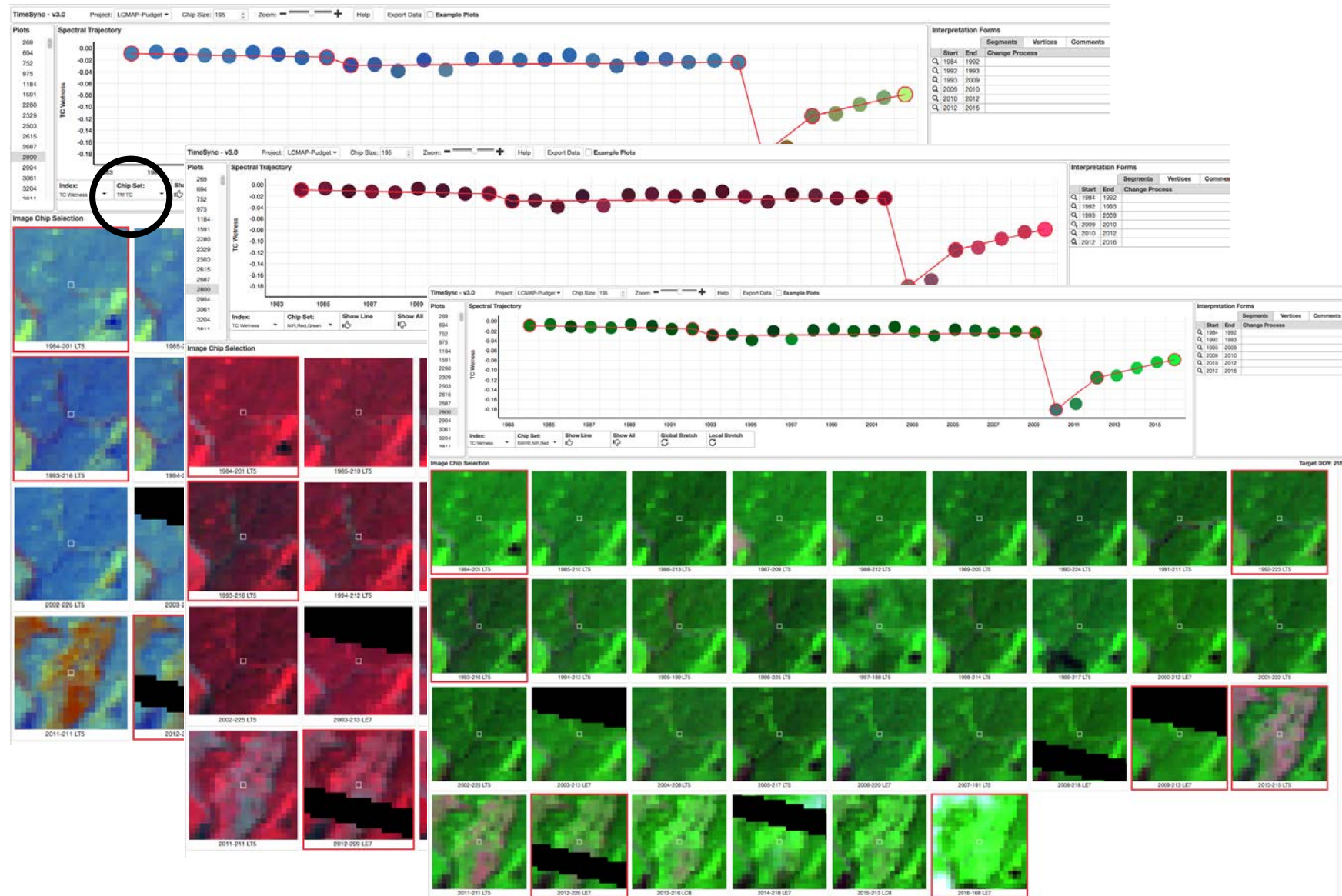


TimeSync – Chip Origin

- A given chip comes from a given sensor and a given acquisition date
- This information shown under each chip
- Year, DOY (Day of Year), Sensor
- Sensor e.g., LT5 = Landsat 5 TM, LE7 = Landsat 7 ETM+, LC8 = Landsat 8 Continuity (?) = OLI

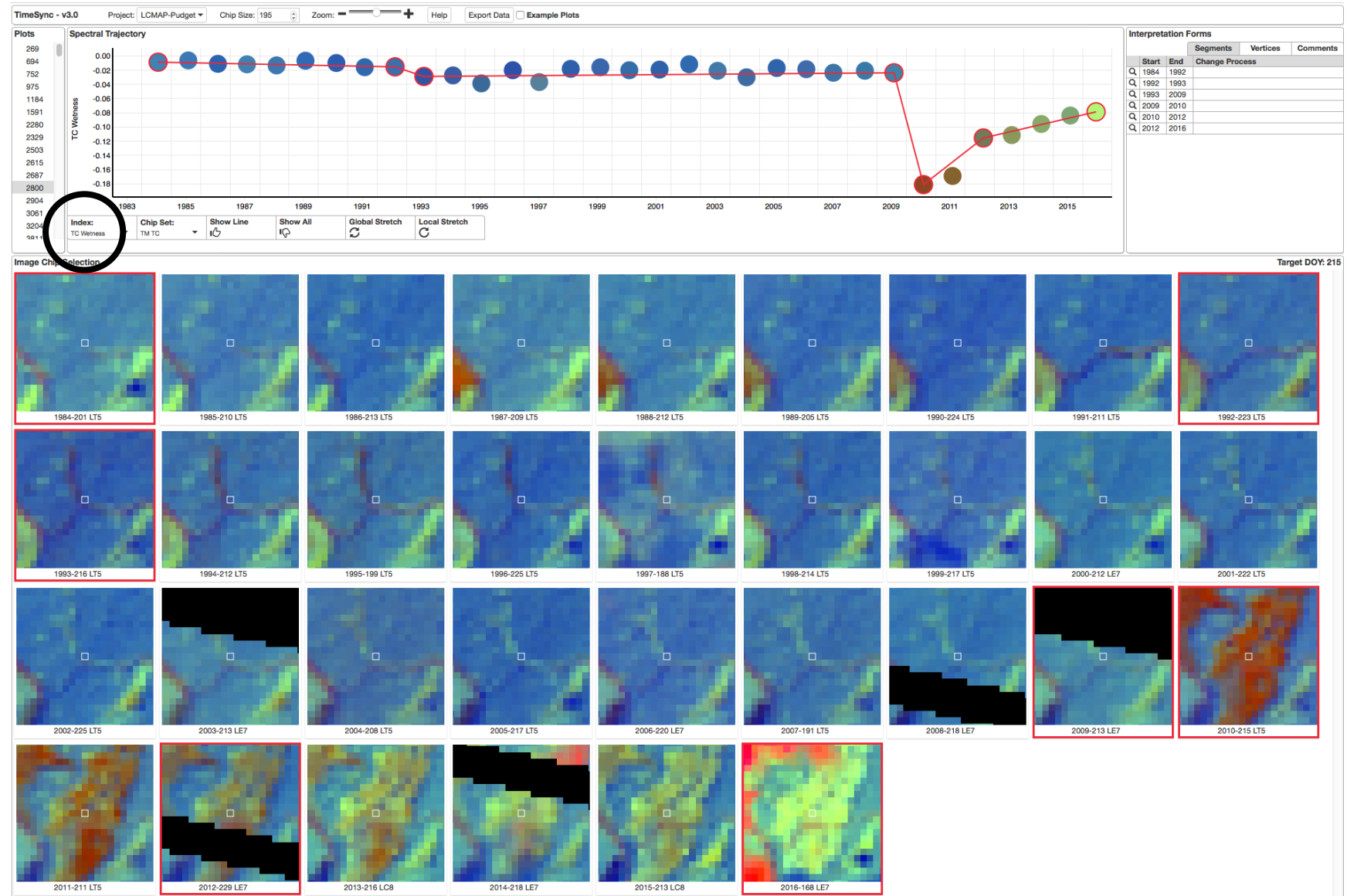


- Three RGB sets
 - TM Tasseled Cap
brightness (R),
greenness (G),
wetness (B) –
default
 - NIR (R), Red (G),
Green (B)
 - SWIR2 (R), NIR (G),
Red (B)



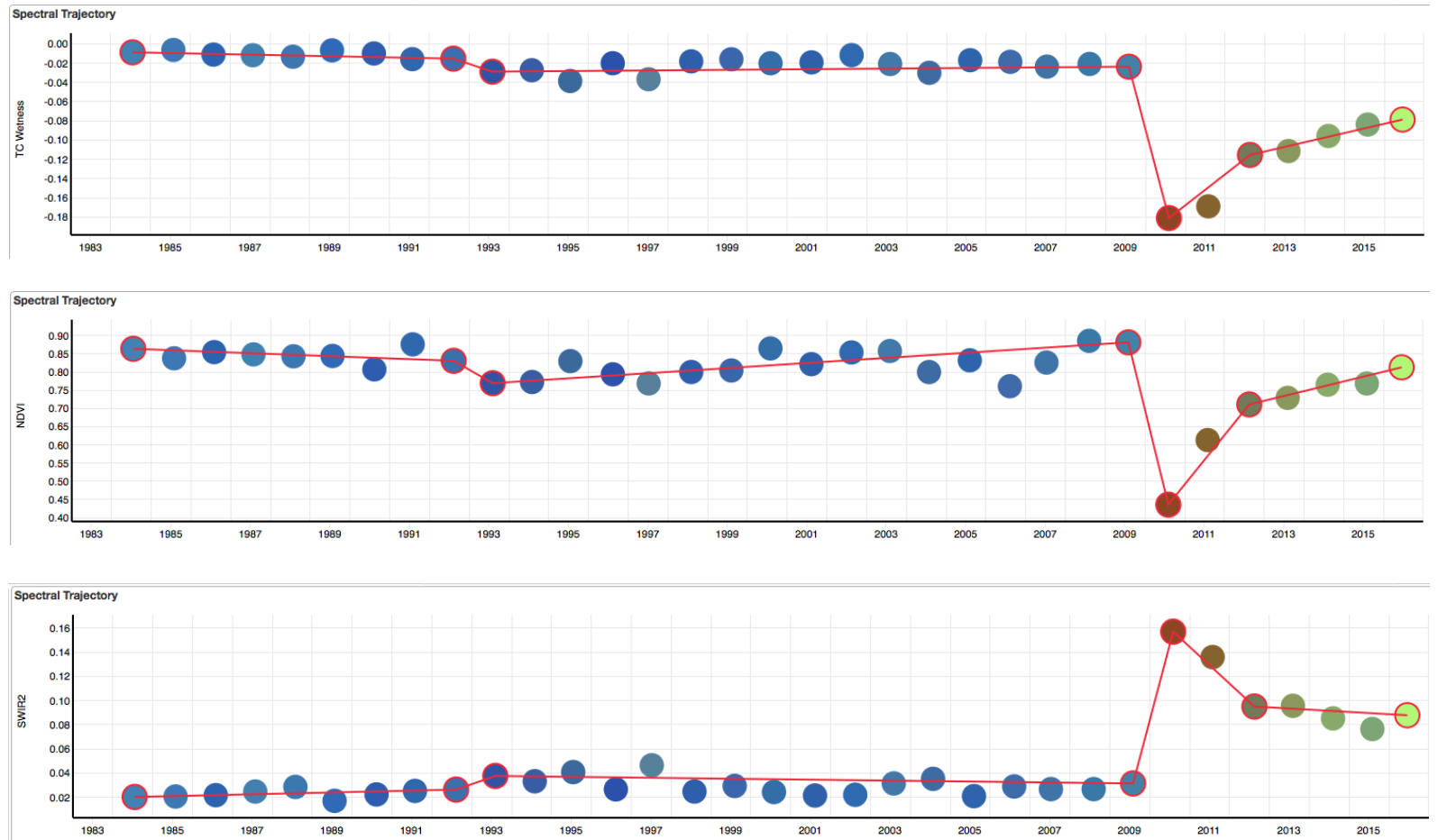
TimeSync – Band/Index

- Can select any band or available spectral index
- Each one shows how the spectral trajectory looks in given band/index
- Shown here is wetness



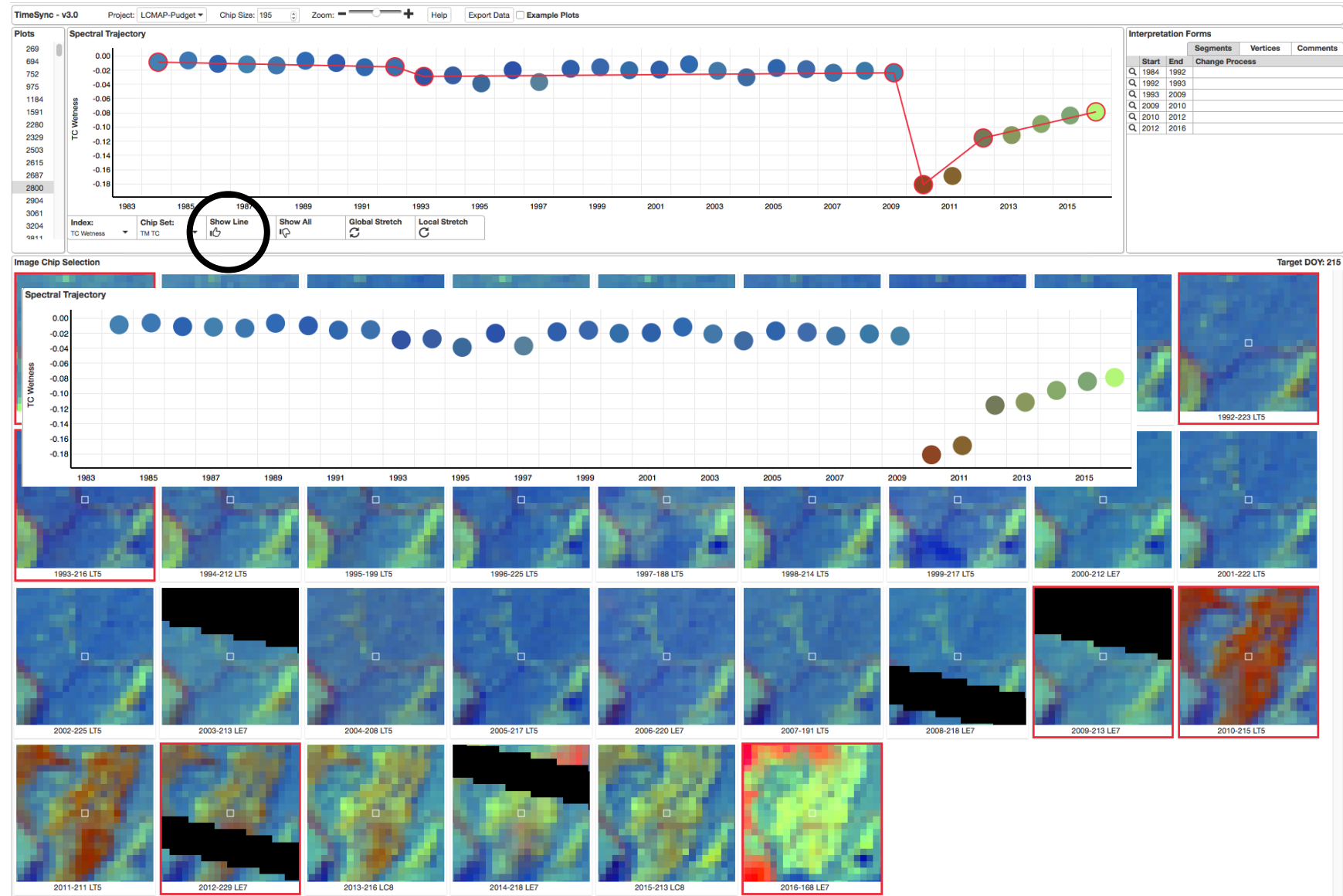
TimeSync – Band/Index

- Generally, they are similar, but often opposite direction
- Sometimes they are different enough, that you have to decide whether a different segmentation is more appropriate



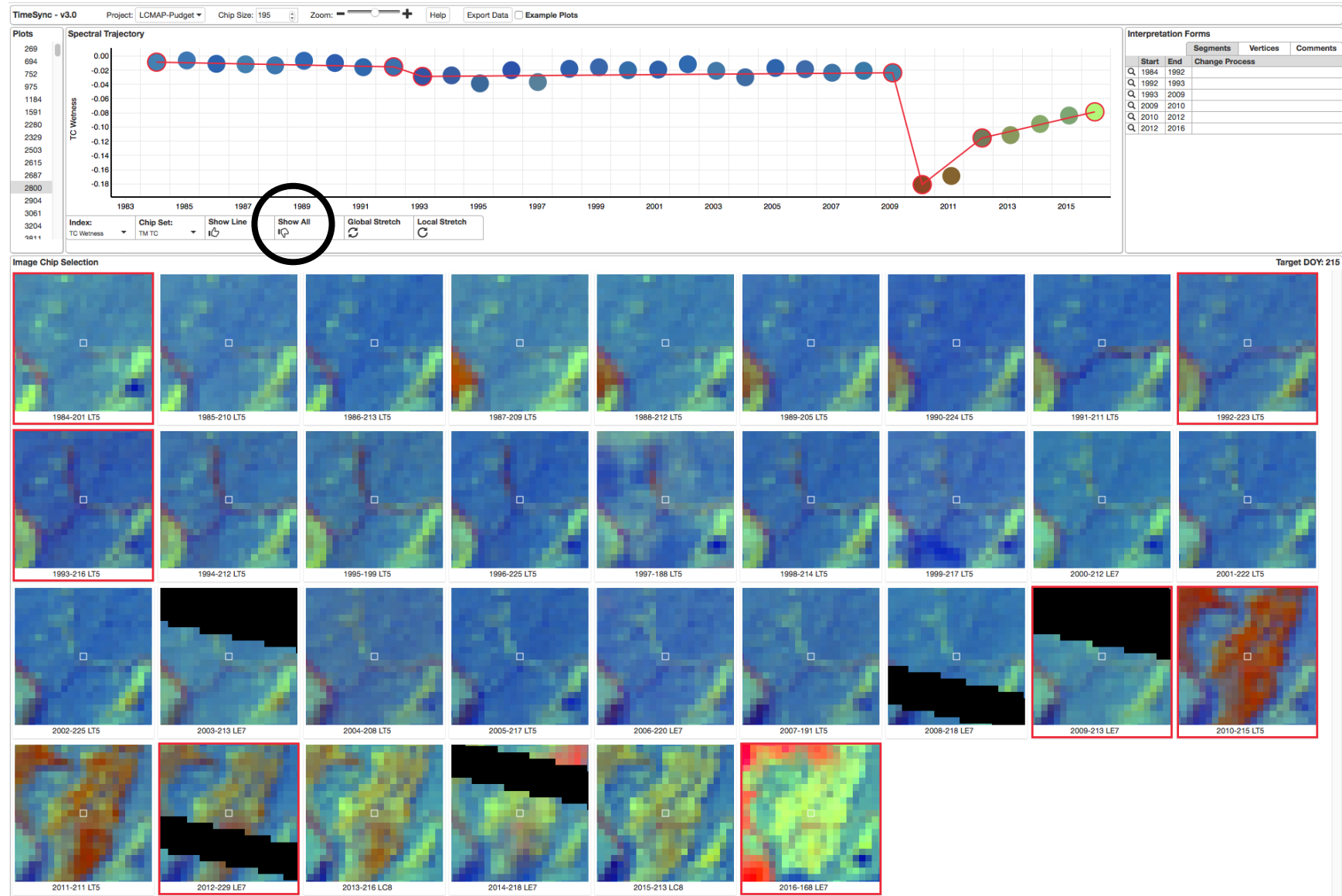
TimeSync –Show Line

- Can be a good idea to turn off your segmentation (without losing it) for a reality check
- Often your eye will be falsely guided by your previous decisions



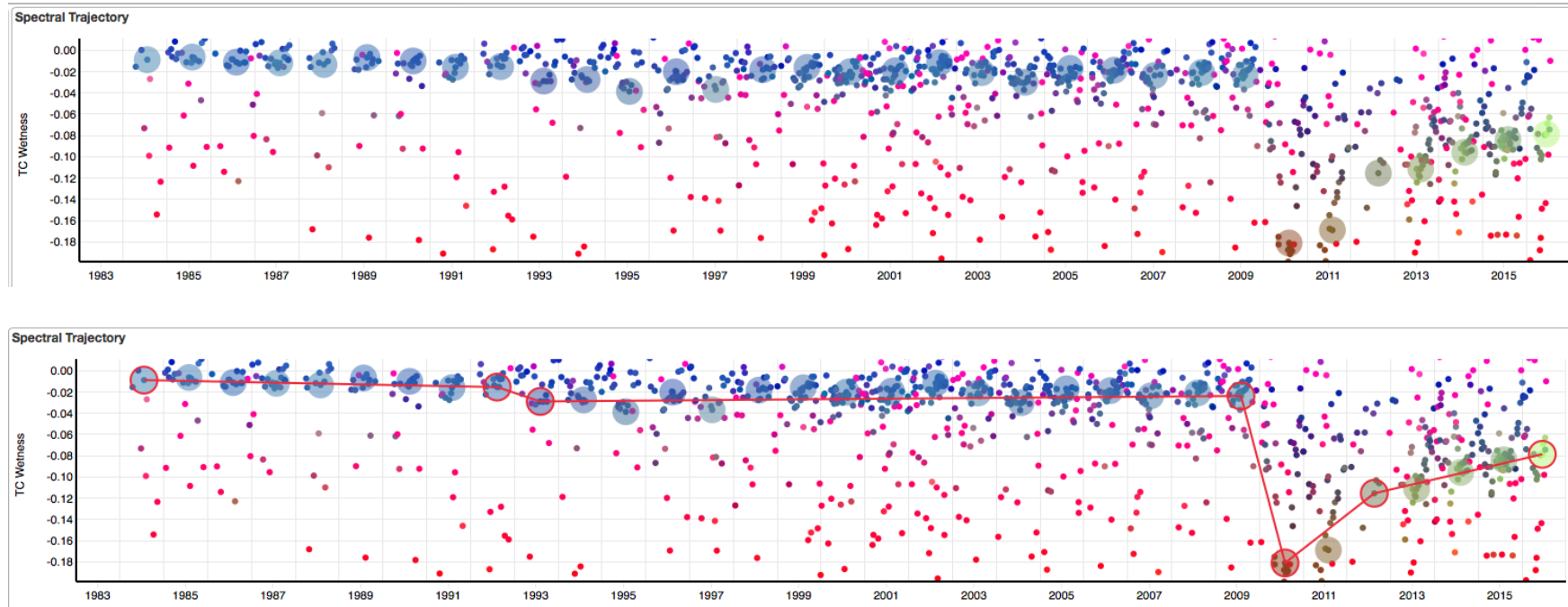
TimeSync – Show All

- Default is a single chip data point per year in the trajectory window, based on final selection (default or adjusted using chip gallery)



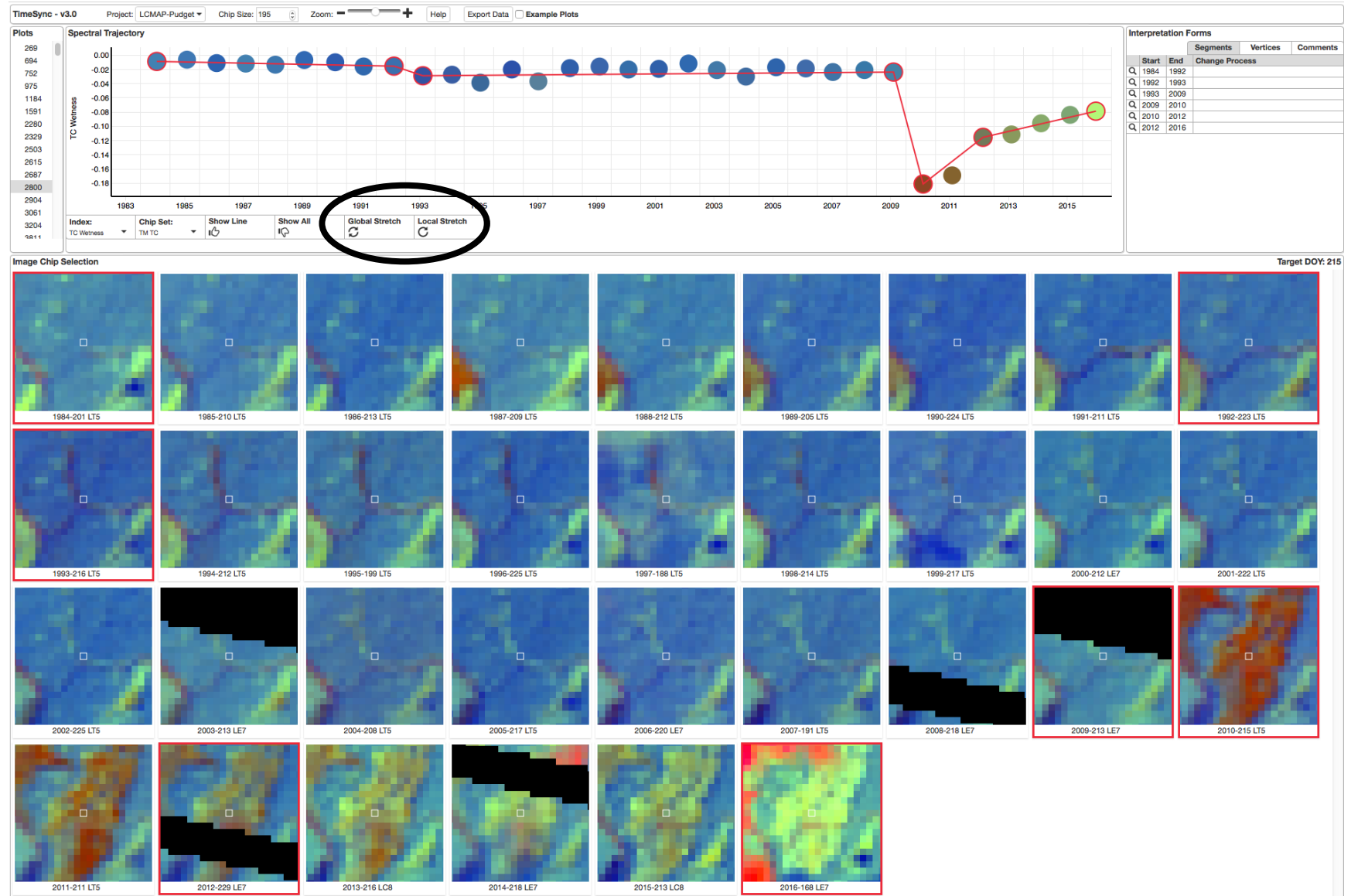
TimeSync – Show All

- But we can also see all points for all years, as a guide to understanding how the selected annual chips fit in the phenological sequence across years
- This can influence decision about which chip to use for a given year and consequences for choosing a DOY not near target date



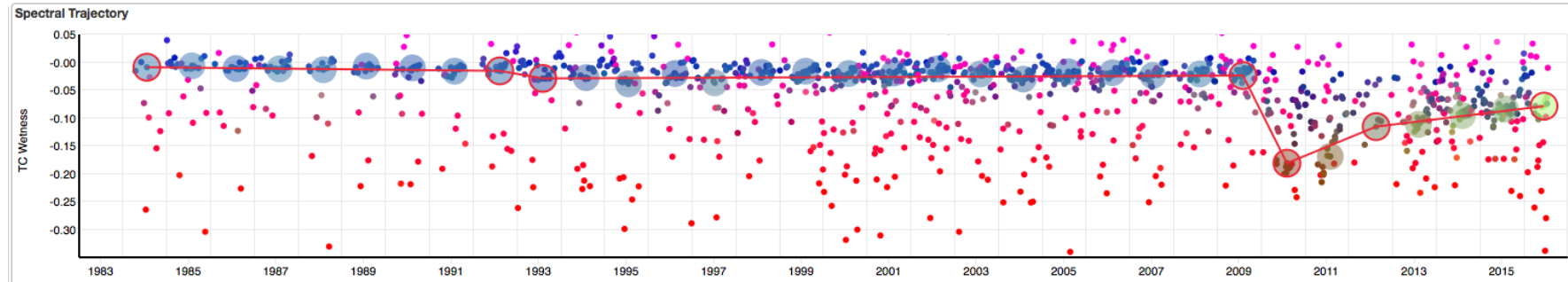
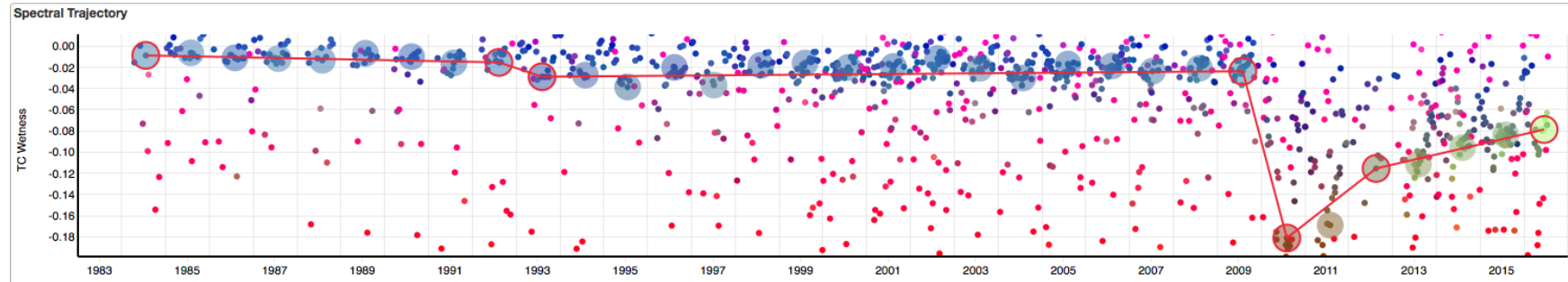
TimeSync – Local and Global Stretches

- Default is local, plot-based y-axis stretch



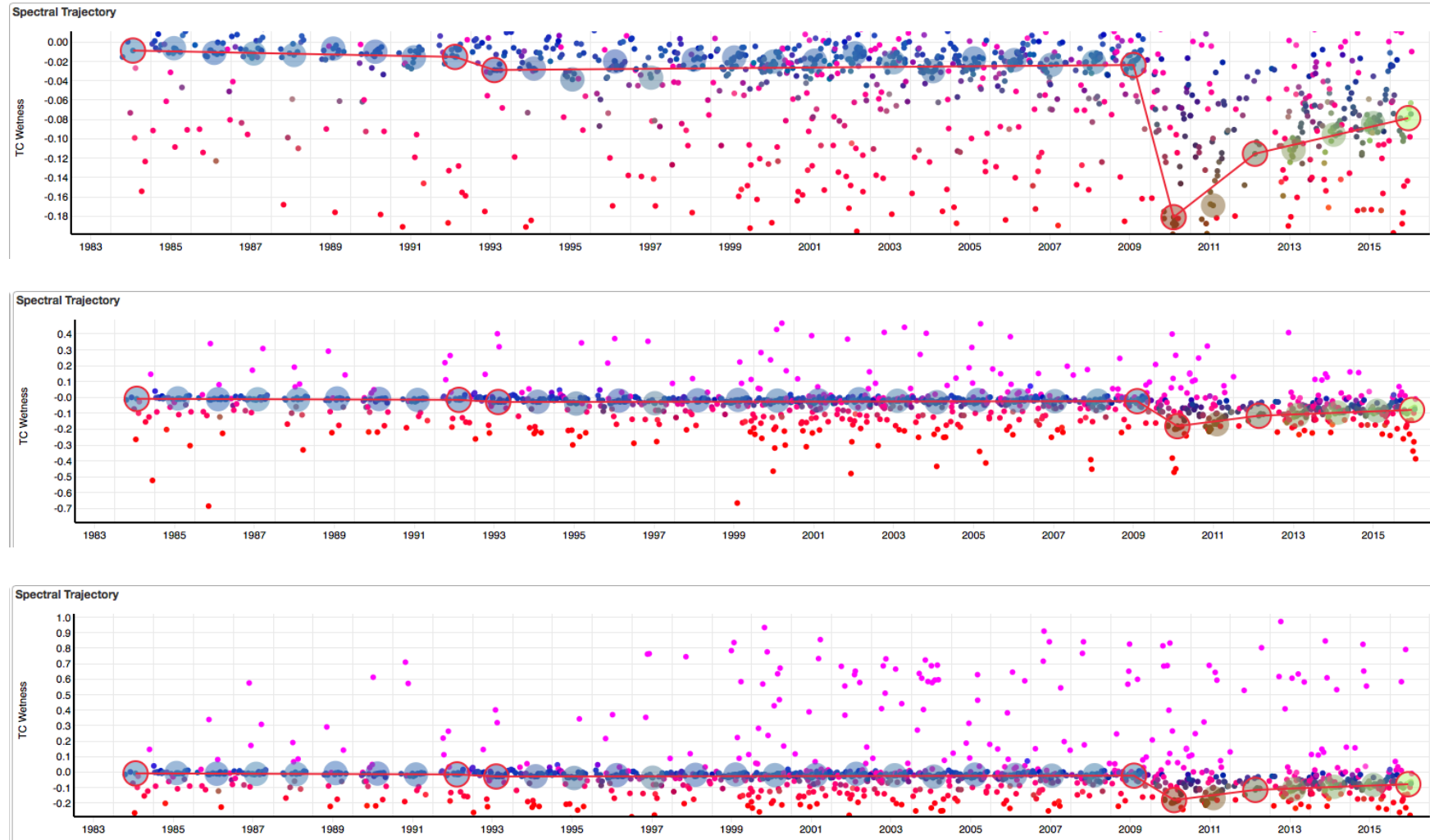
TimeSync – Local v. Global Stretch

- Local stretch (top) maximizes y-axis stretch for the plot based on selected annual chip set
- Global stretch (bottom) uses more generalized (across plot) stretch so that you can check whether you are zooming in to closely to the noise and thus over-interpreting the data



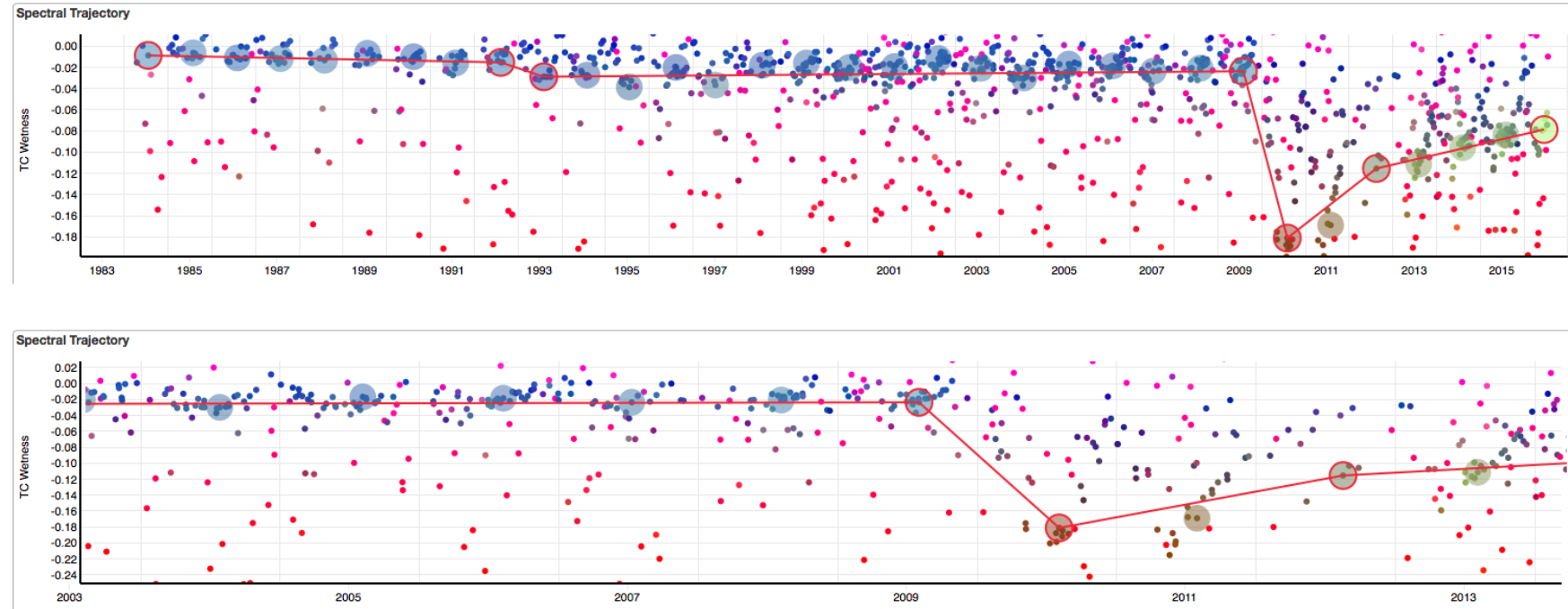
TimeSync – Other Stretch Options

- Shrink y-axis to show all points (including those outside of local stretch)
- And can shift y-axis up and down



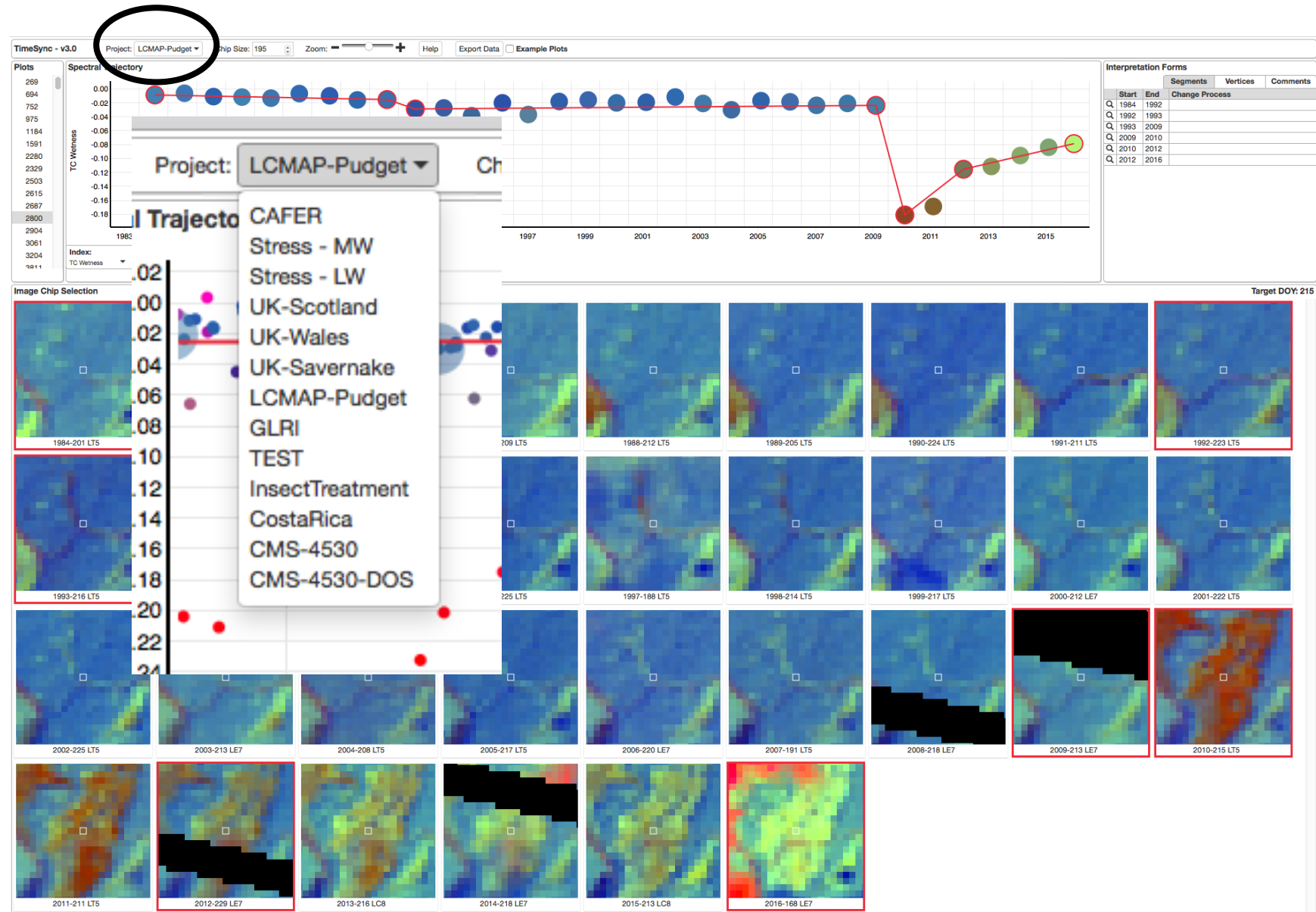
TimeSync – Other Stretch Options

- Can also zoom and shift x-axis
- Shifting usually not helpful, but sometime necessary



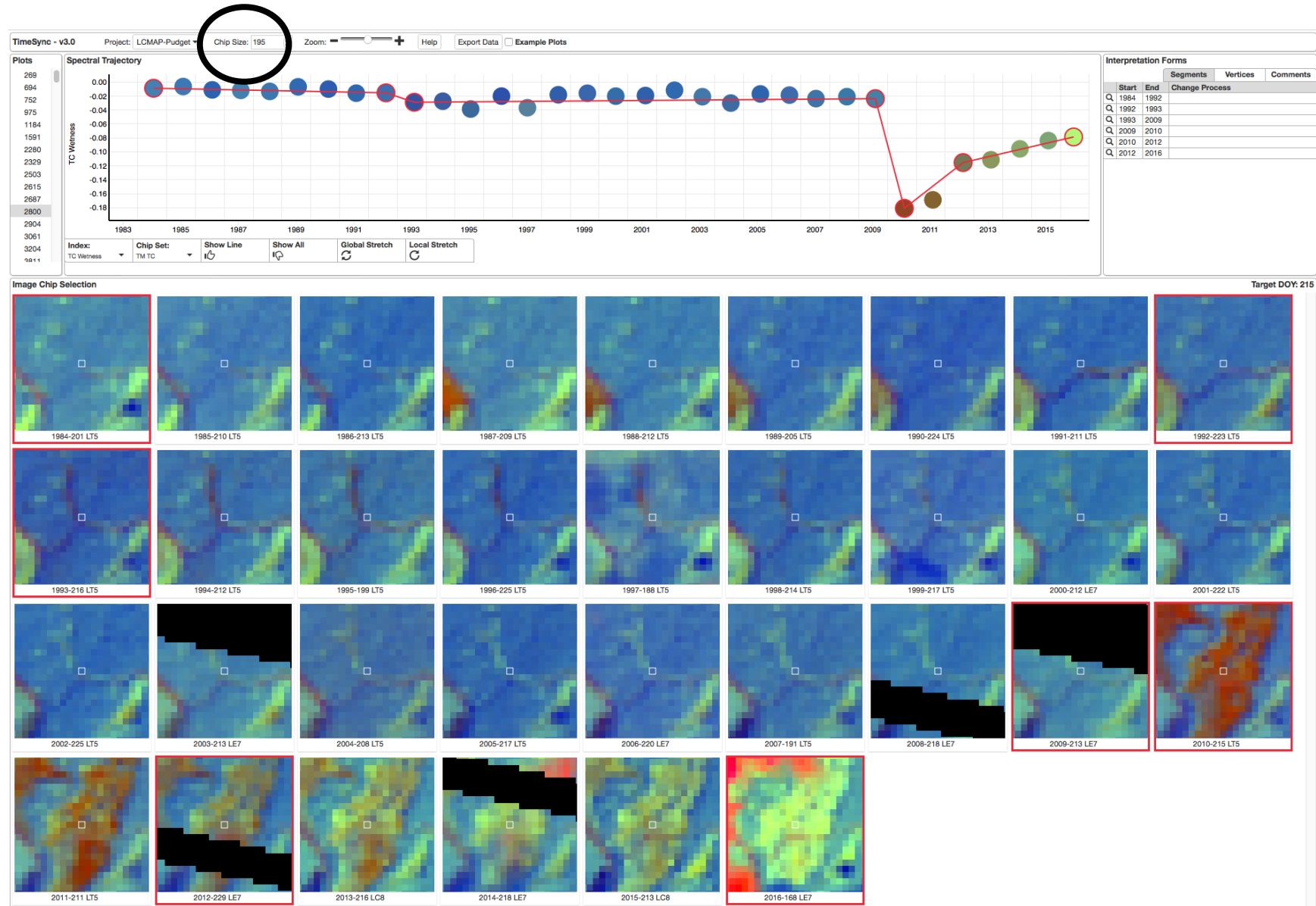
TimeSync – Projects

- There may be many different projects from which to choose
- Could be different geographic areas, or plot sets within an area for different interpreters, etc.



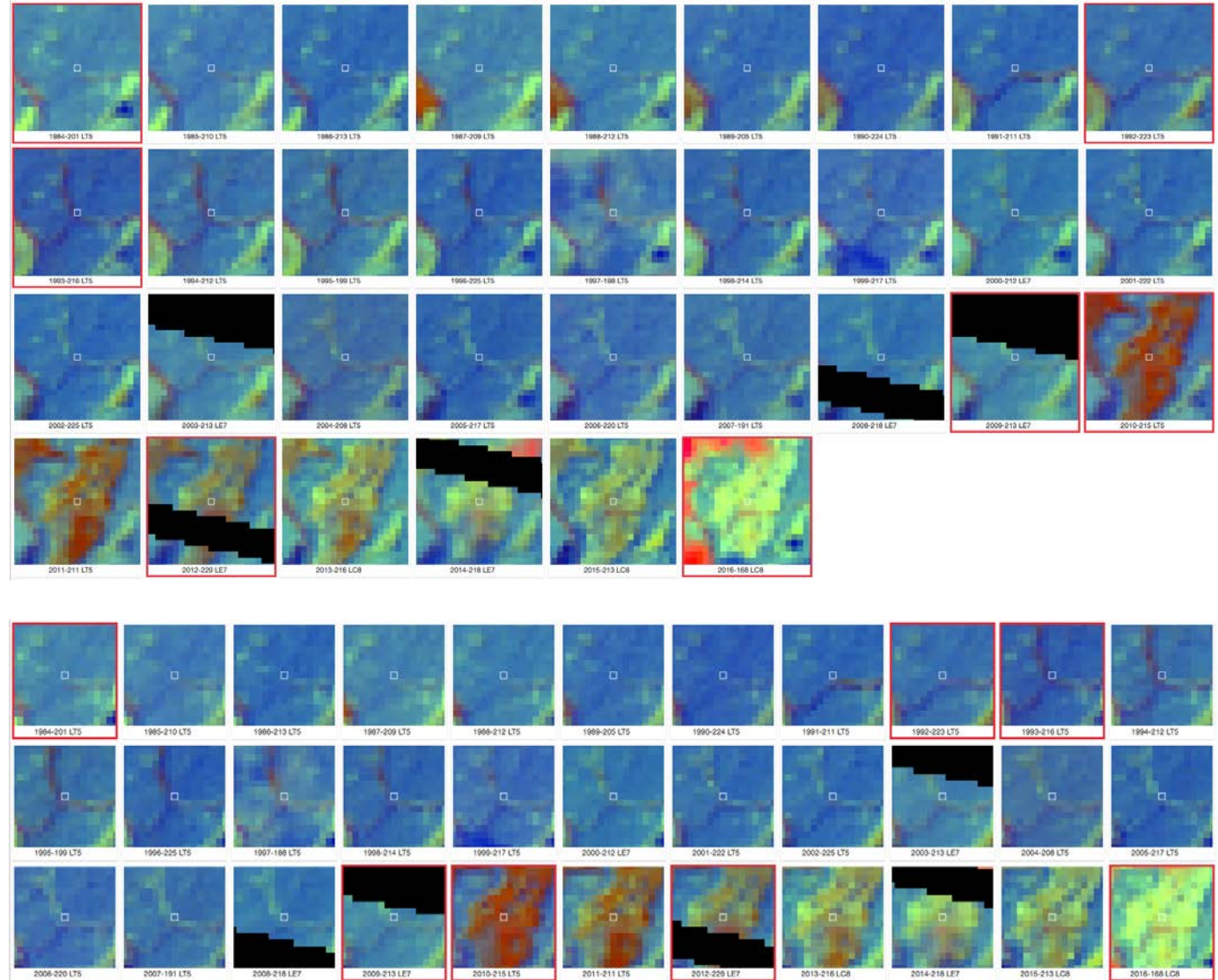
TimeSync – Chip Size

- TimeSync works best with ample screen real estate
- But for smaller screens chip size can be changed (default 195 x 195 screen monitor pixels)



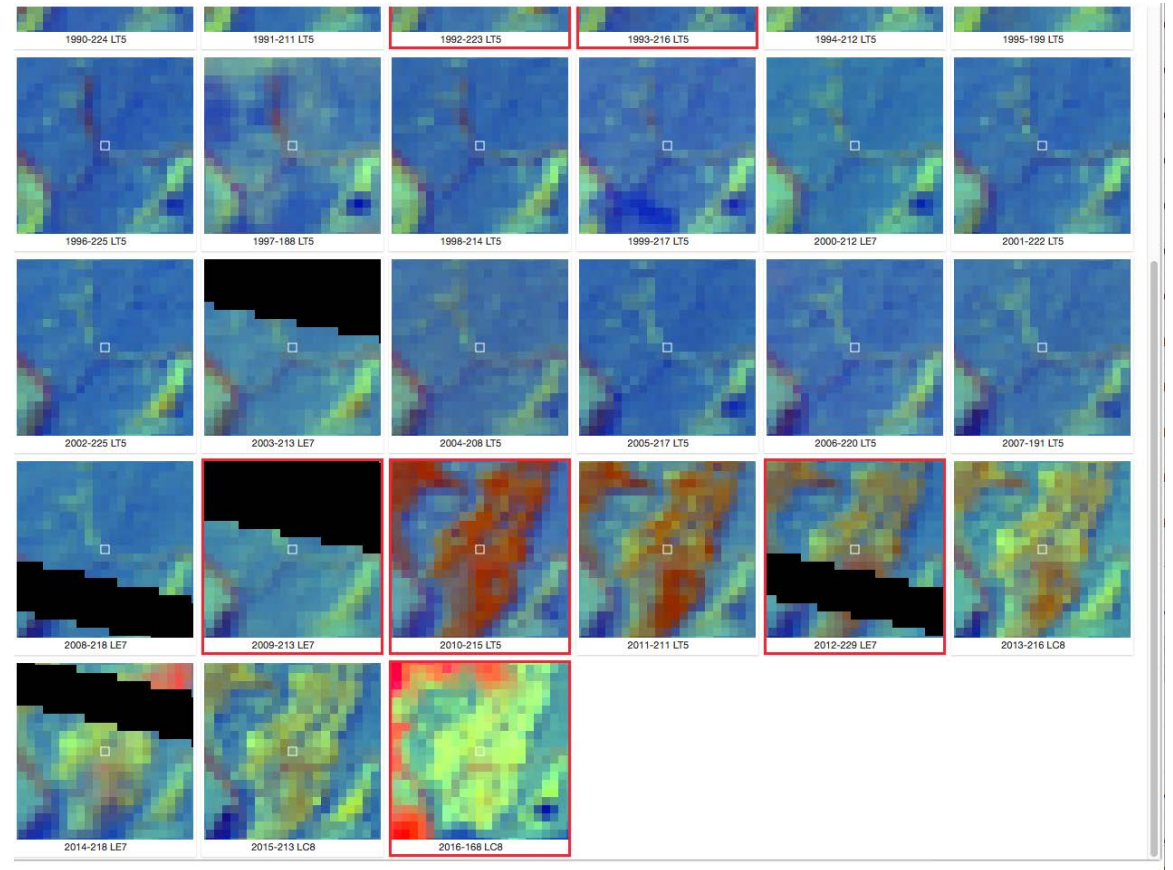
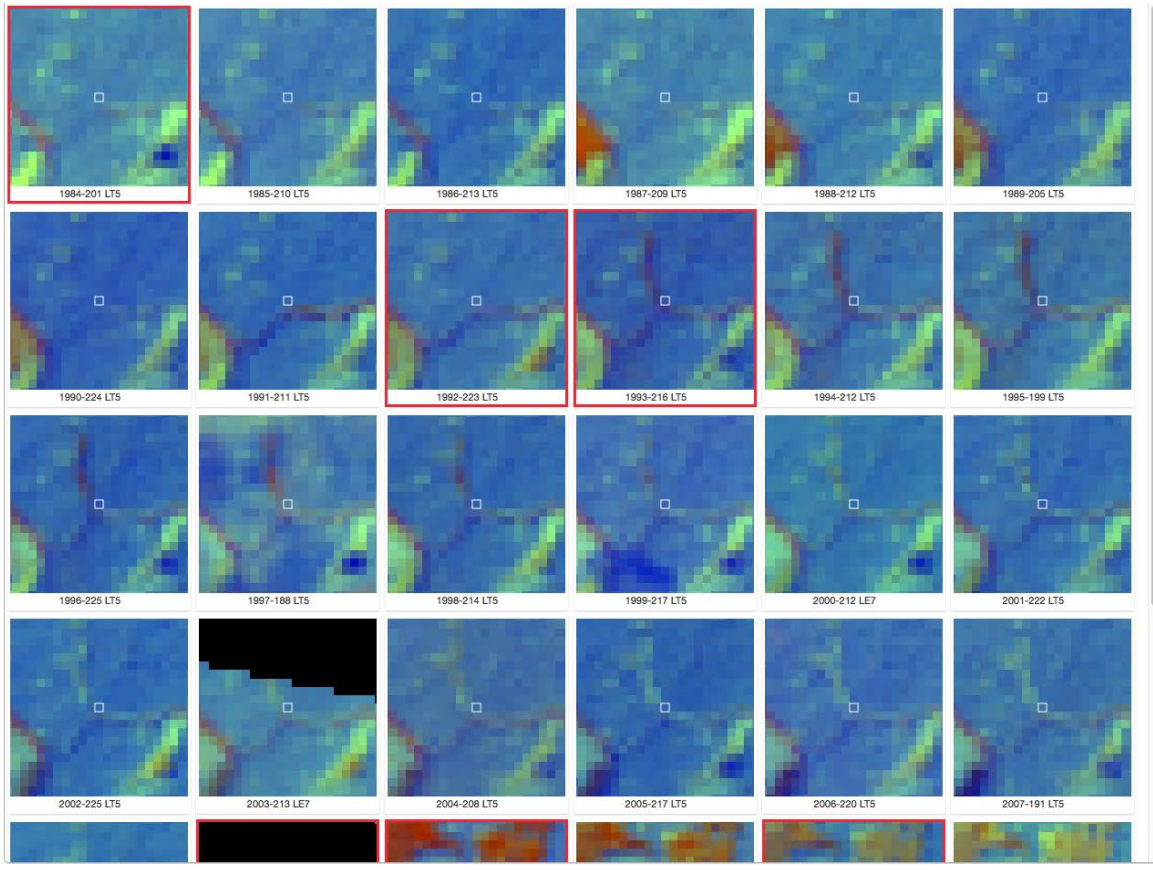
TimeSync – Chip Size

- The actual number of Landsat pixels shown does not change, but each chip takes up less space on the monitor



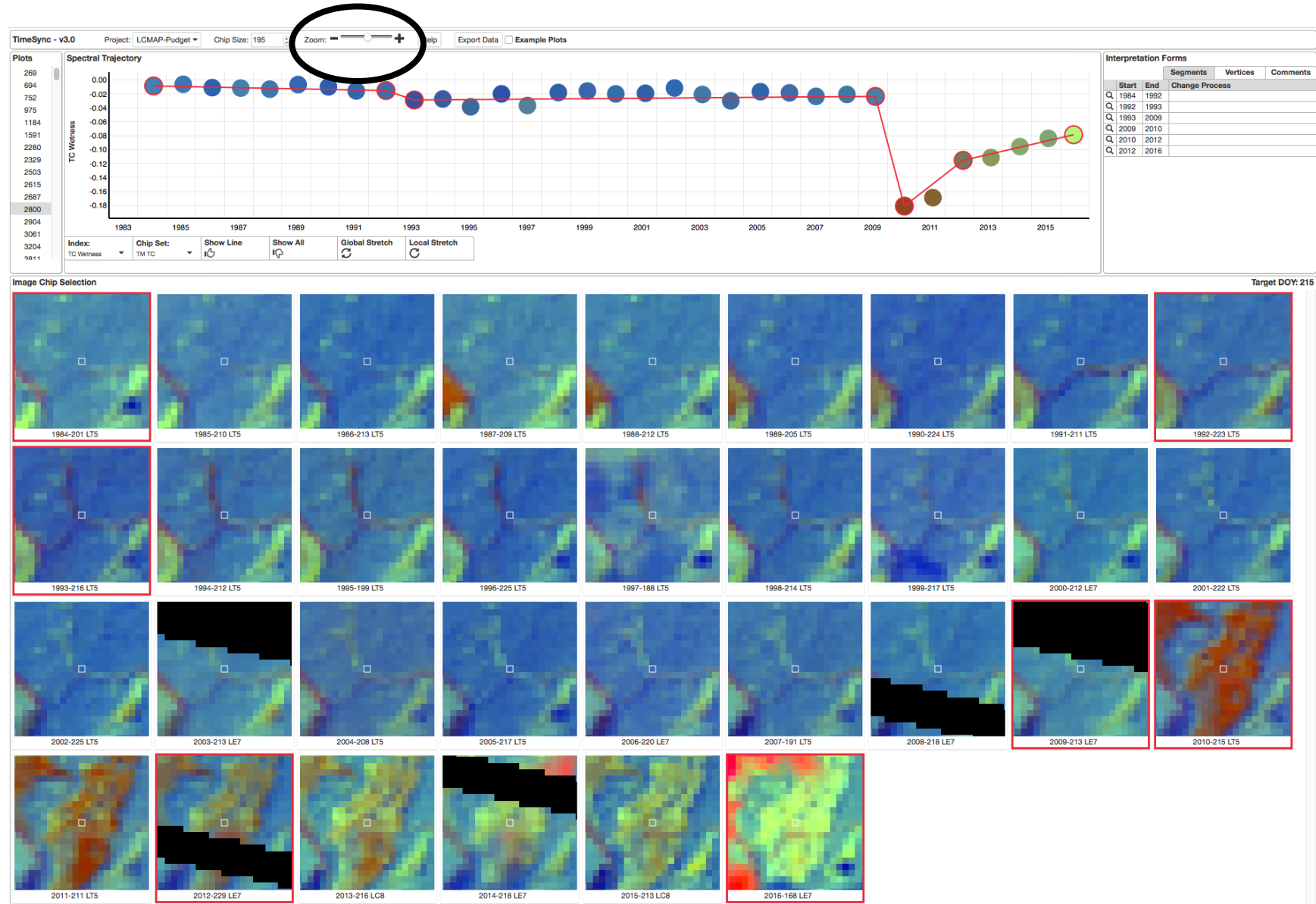
TimeSync – Scrolling

- Other option is to keep chip size larger but use scrolling (note scroll bar)
- Left first part of series, right is last part of series



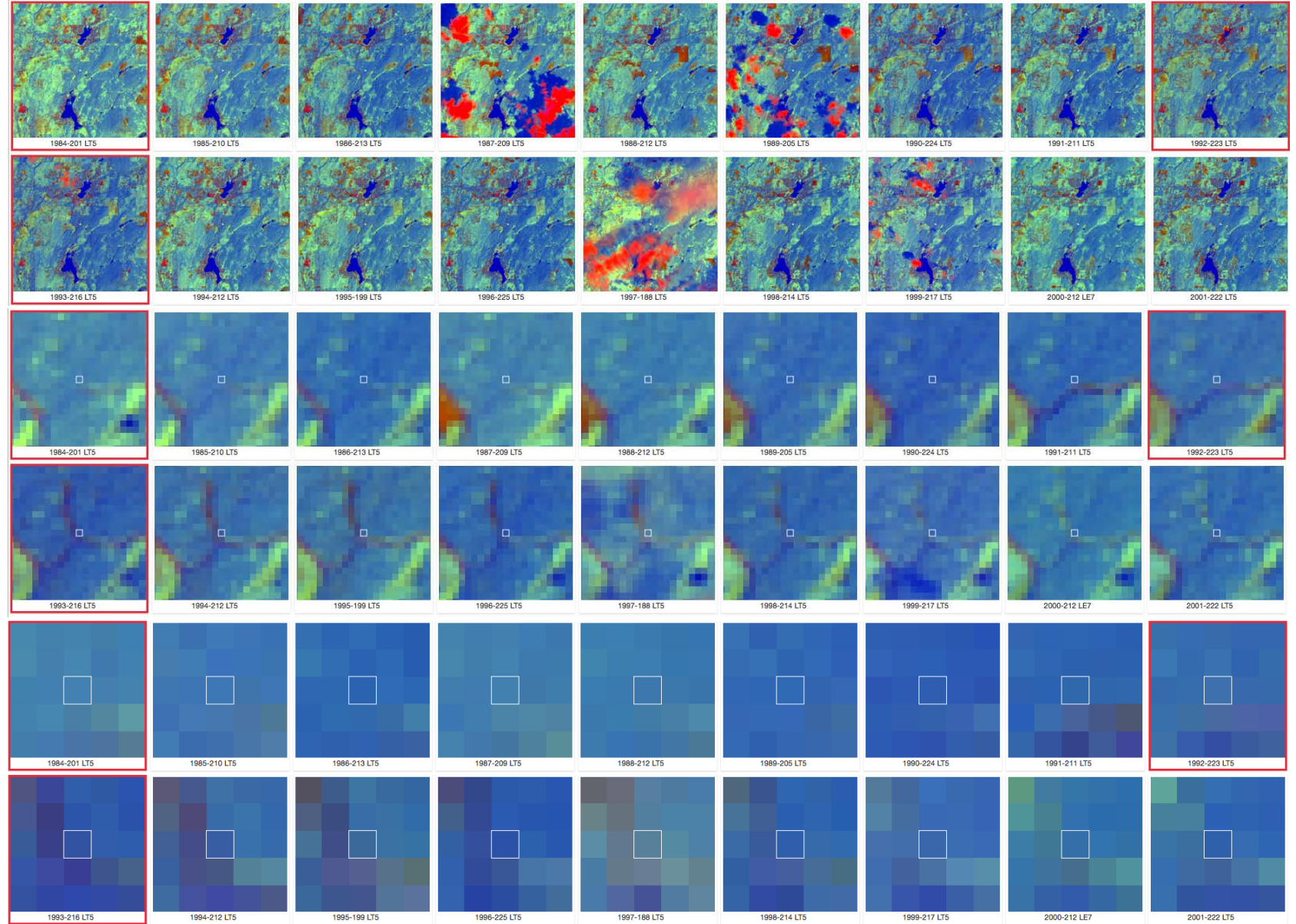
TimeSync – Zoom

- Zooming in and out changes the number of Landsat pixels shown, independent of chip size
- Is a good way to get spatial context (zoom out) and spatial detail (zoom in)



TimeSync – Zoom

- Zooming in and out changes the number of Landsat pixels shown, independent of chip size
- Is a good way to get spatial context (zoom out) and spatial detail (zoom in)



TimeSync – Help

- How-To Guide opens document that describes the functions described here and other important items
- Also opens response design labeling document (introduced earlier and detailed later)

TimeSync - v3.0 Project: LCMAP-Pudget Chip Size: 195 Zoom: + Help Export Data Example Plots

Plots

Spectral Trajectory

TC Winess

Index: TC Winess Chip Set: TM TC Show Line Show All Global Stretch Local Stretch

Image Chip Selection

1984-201 LT5 1985-210 LT5 1986-213 LT5 1993-216 LT5 1994-212 LT5 1995-195 LT5 2002-225 LT5 2003-213 LE7 2004-208 LT5 2011-211 LT5 2012-229 LE7 2013-216 LC8 2014-218 LE7 2015-213 LC8 2016-168 LE7

How To Use Timesync For Interpretations Of Change

TimeSync is a Landsat satellite image time series visualization and data collection tool. It is used to record and describe events and periods in the history of land cover and use as represented by Landsat satellite image pixels. This guide walks through the basic procedure for interpreting a plot. Information about the TimeSync user interface and functionality is available as tool tips activated from the Help button dropdown. When tool tips are active you can hover over most program elements to produce a description of the element and any functionality it has. This document should be used in conjunction with the default "Response Design" available through the Help button. Although a given project may use a different response design, the same basic overview represented in the default version is relevant to your understanding of how to use TimeSync. Some of the detail below is relevant only to the default response design, but the mechanics for all designs are the same.

The basic steps of TimeSync interpretation are as follows:

- [1. Load a project](#)
- [2. Load a plot from the project plot list](#)
- [3. Visually assess the spectral image series points and image chips for change events](#)
- [4. Set change events as vertices](#)
- [5. Fill out the vertex and segment interpretation forms.](#)

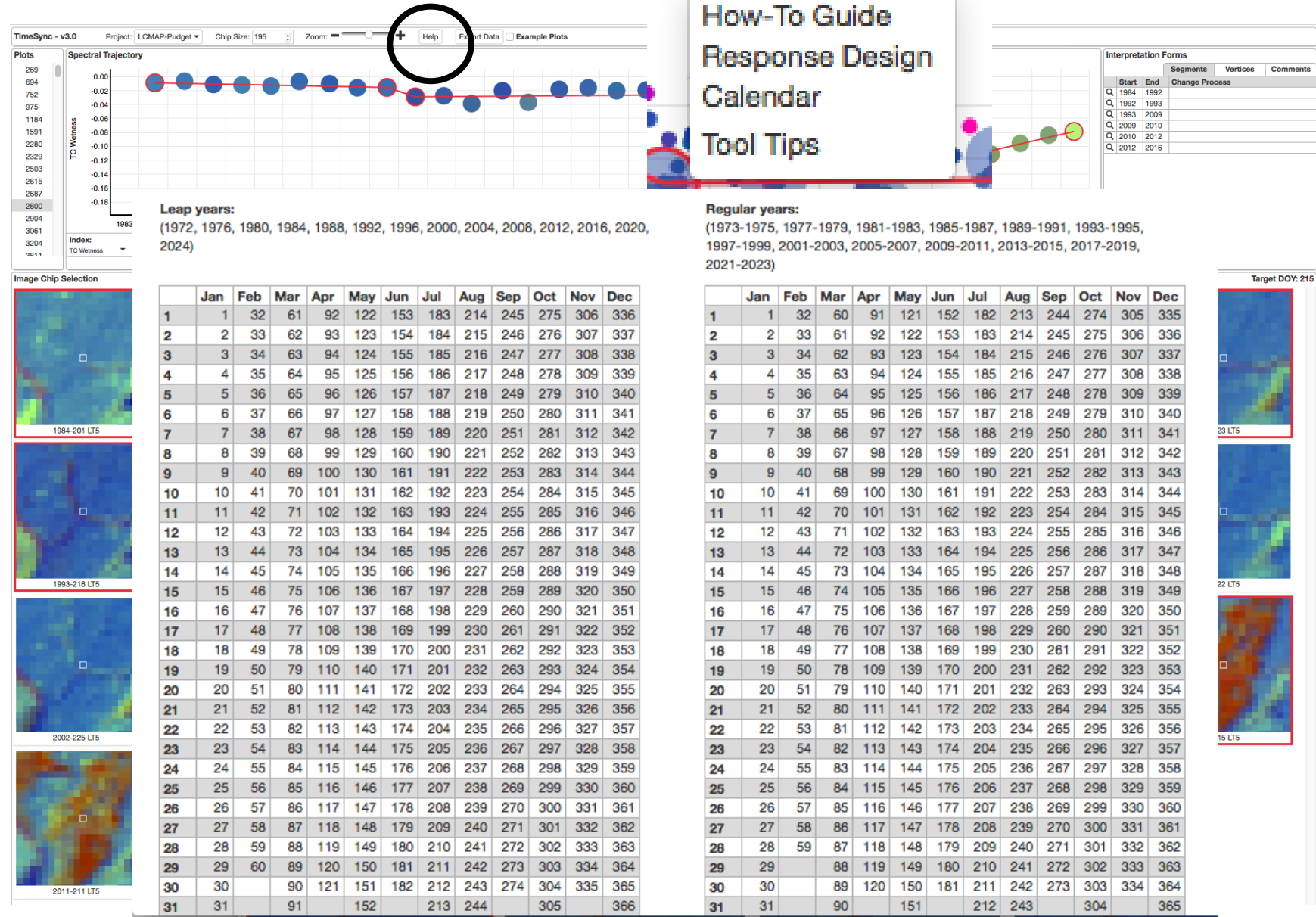
Interpretation Forms

Start	End	Segments	Vertices	Comments
Q 1984	1992			
Q 1992	1993			
Q 1993	2009			
Q 2009	2010			
Q 2010	2012			
Q 2012	2016			

Target DOY: 215

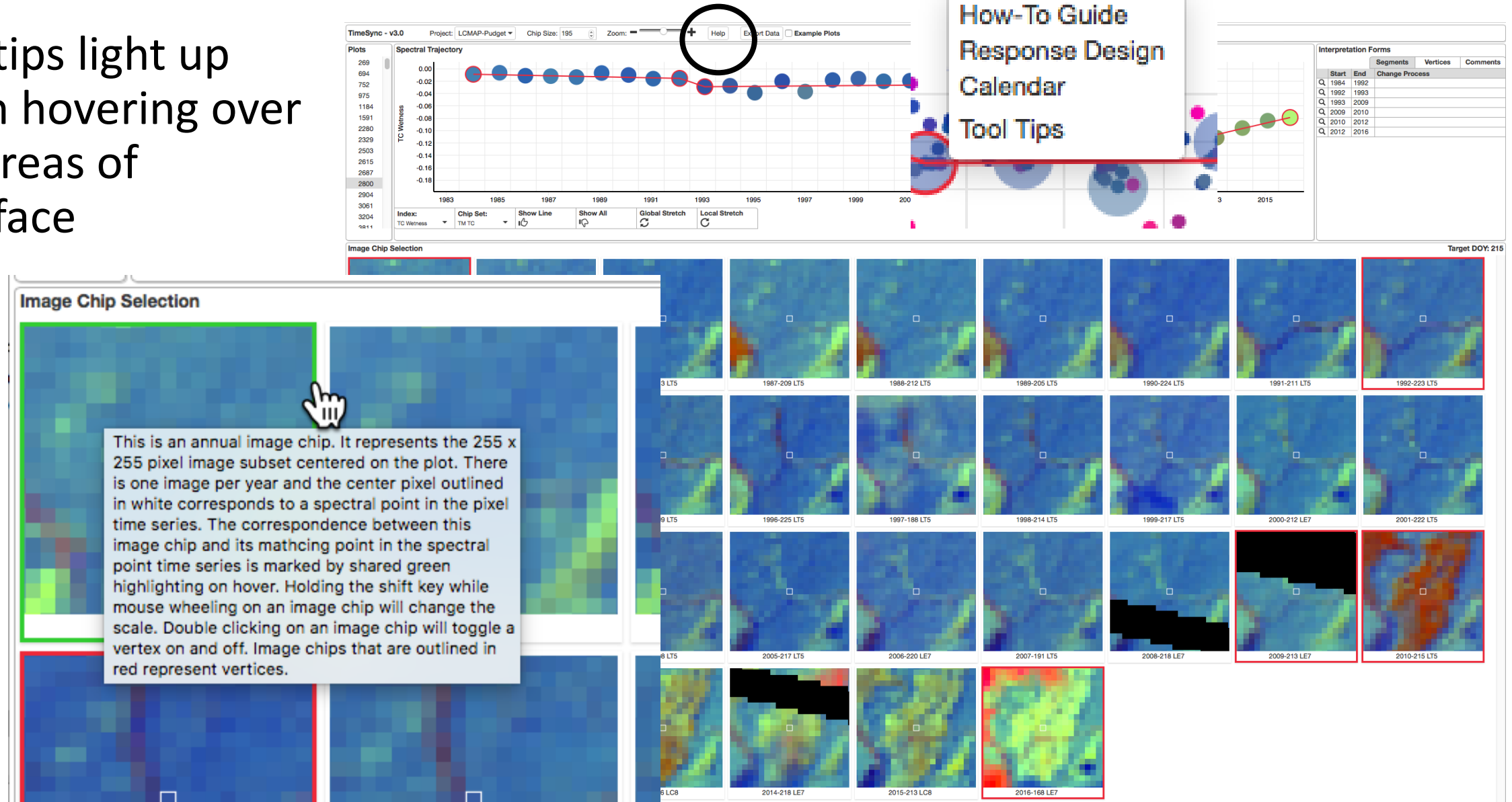
TimeSync – Help

- Also opens a calendar for use with DOY chip considerations
- And toggles on and off tool-tips that describe context-specific functions



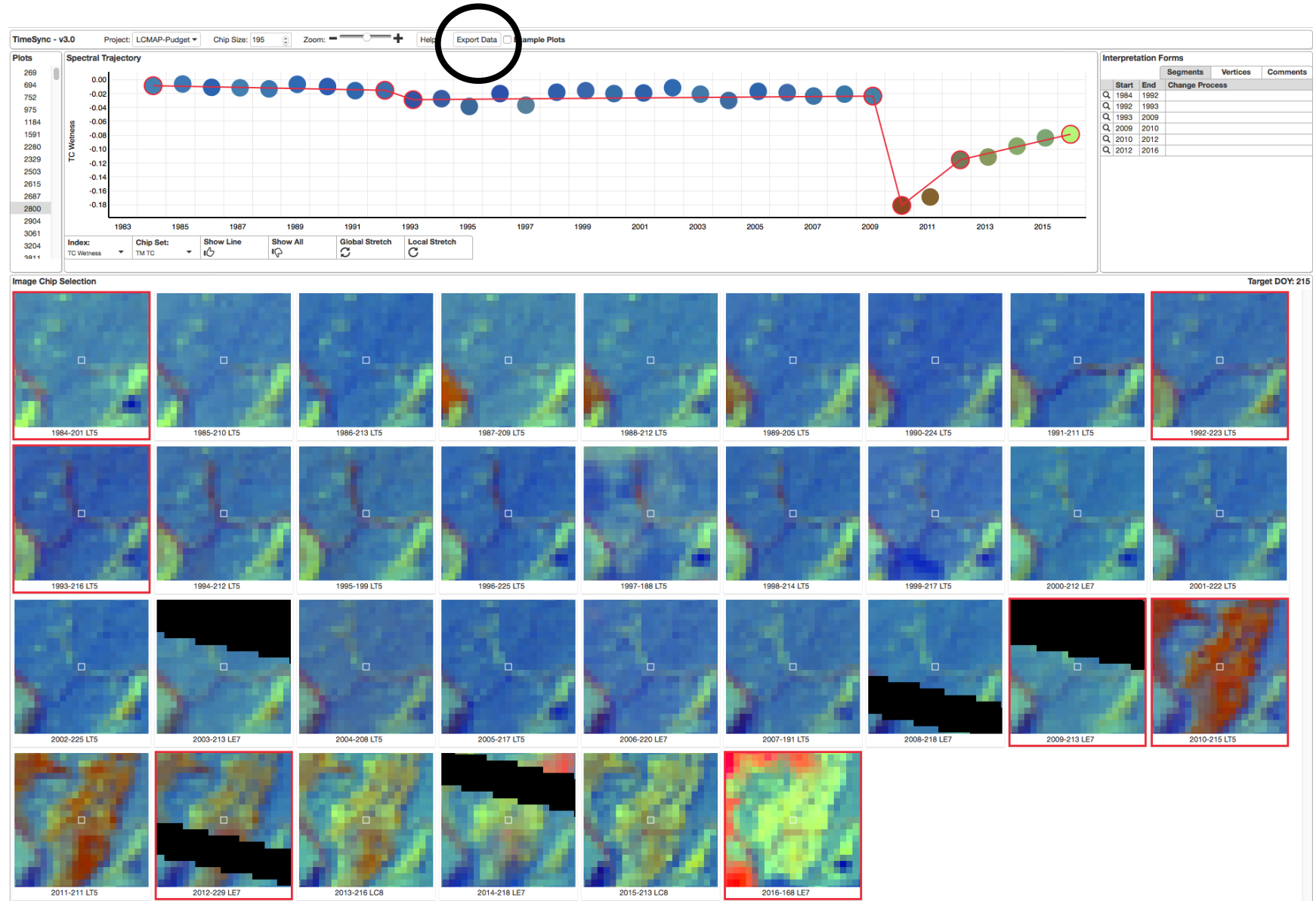
TimeSync – Help

- Tool tips light up when hovering over key areas of interface



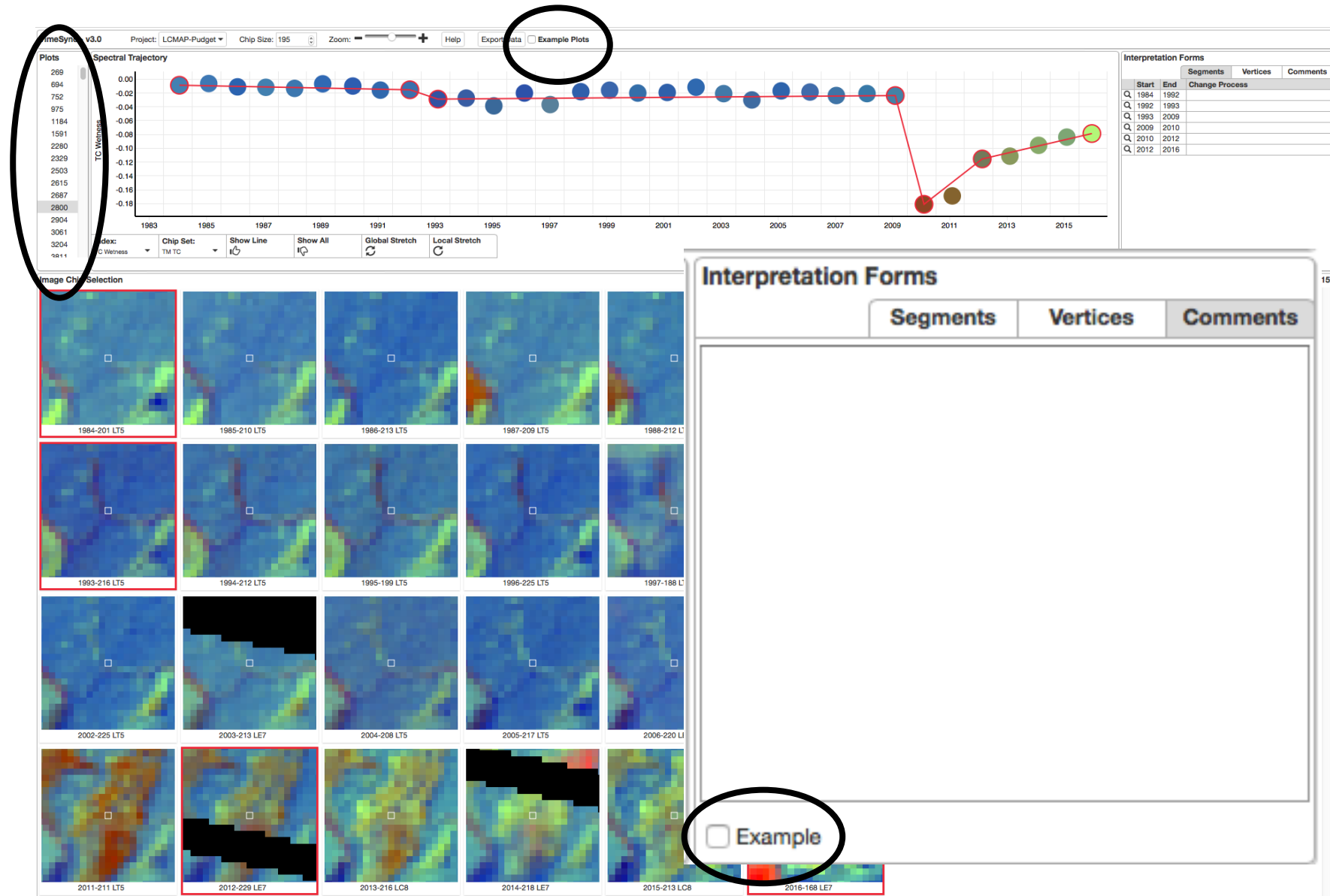
TimeSync – Export Data

- Exports interpretations after data is collected



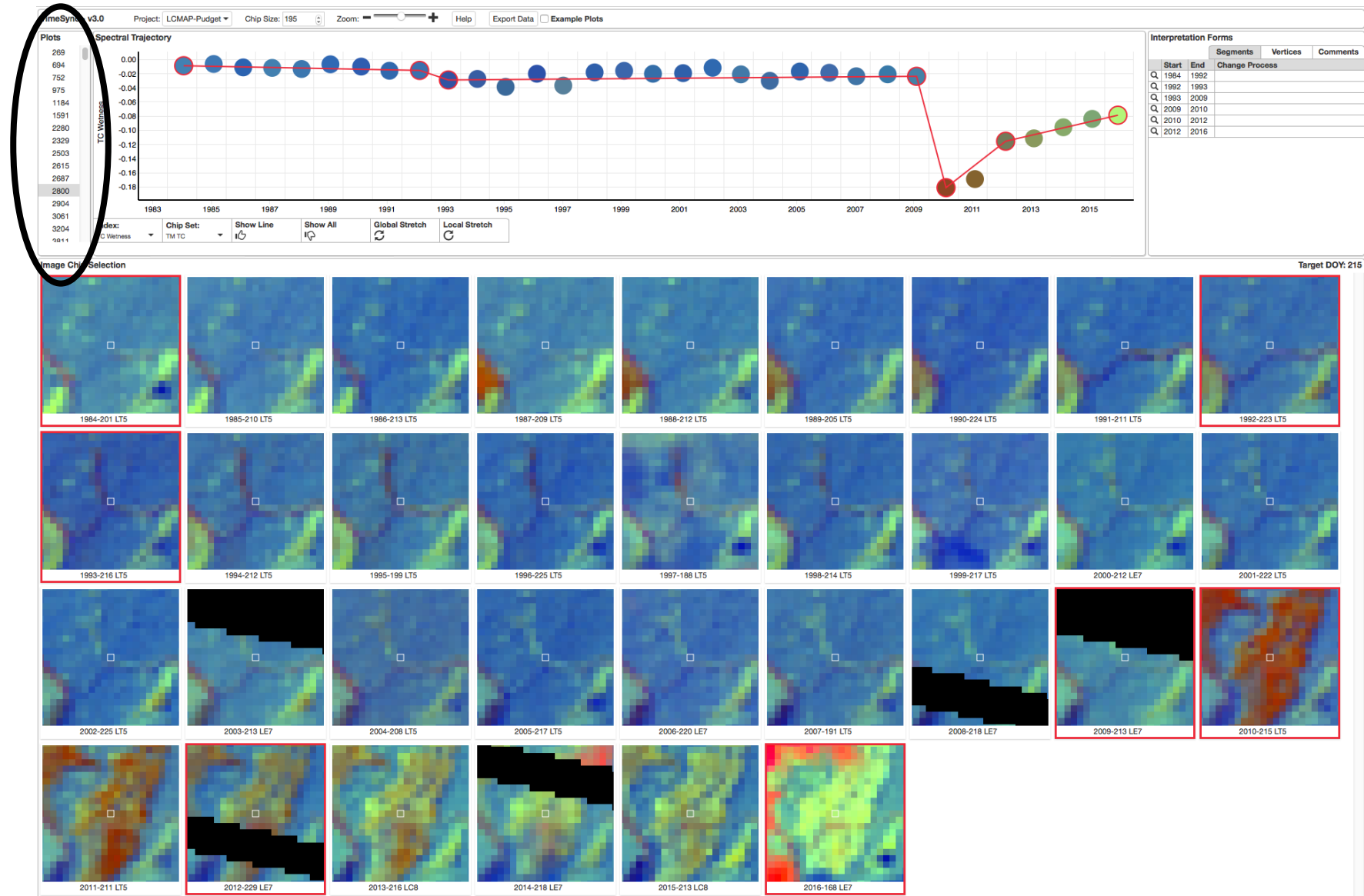
TimeSync – Example Plots

- Can be useful to easily recall special plots (examples for demonstration, ones that need to be looked at again, etc.)
- Checking this box (top middle) shows, from the full list of plots (top left), only those that were identified as examples in Comments box (bottom)



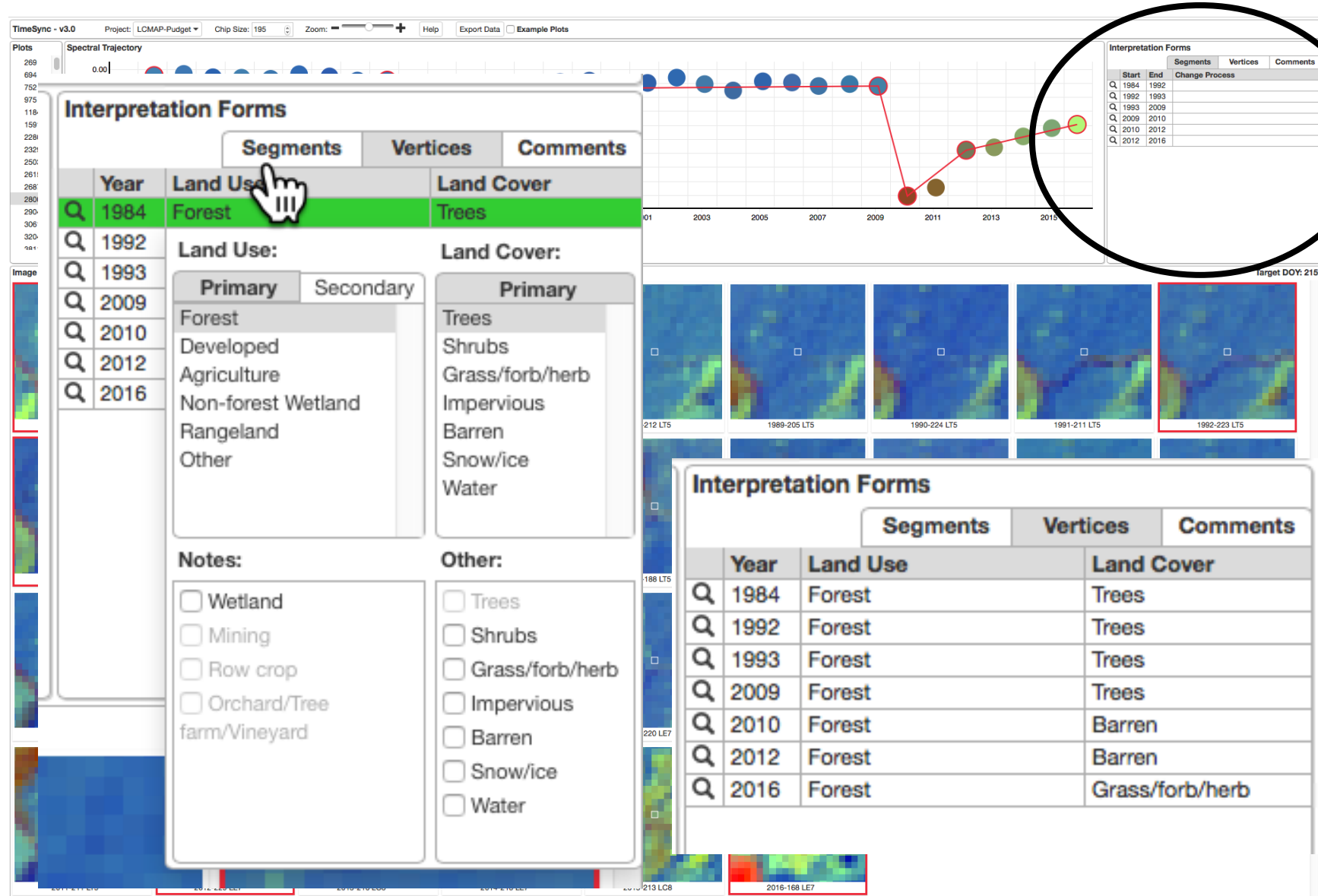
TimeSync – Plot List

- Each project has a list of plots that can be interpreted
- Generally speaking, a project will belong to a only one person, and that person responsible for all/most/some plots in the list
- Number in a given project usually limited for practical reasons, but there are often extras to facilitate “bad” plots



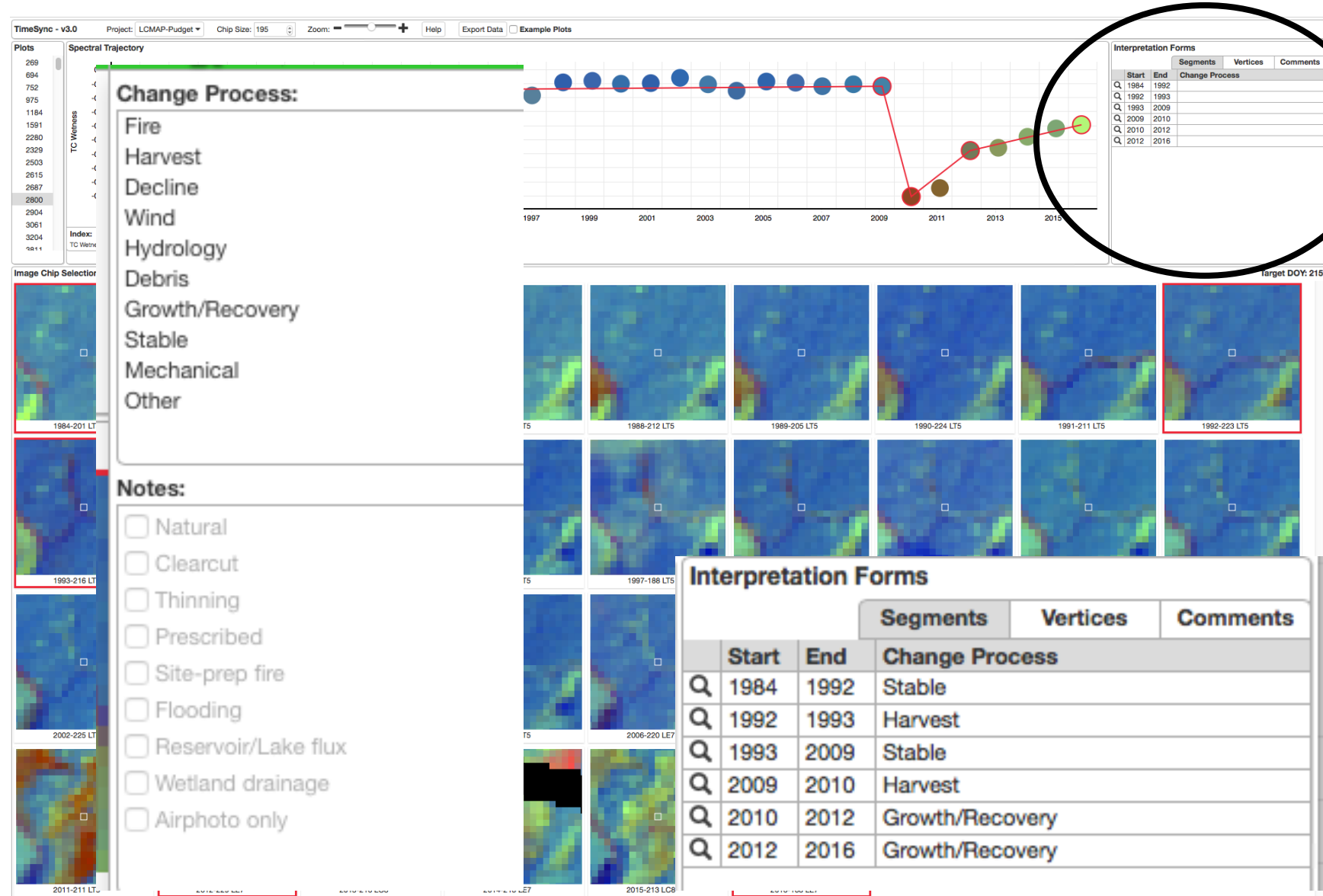
TimeSync – Interpretation Forms

- Segment and vertex labels are specific to a project
- Shown here are the vertex labels chosen for this plot (use and cover), selected from a list that includes secondary use labels and a series of checkboxes relevant to specific choices (notes, other)



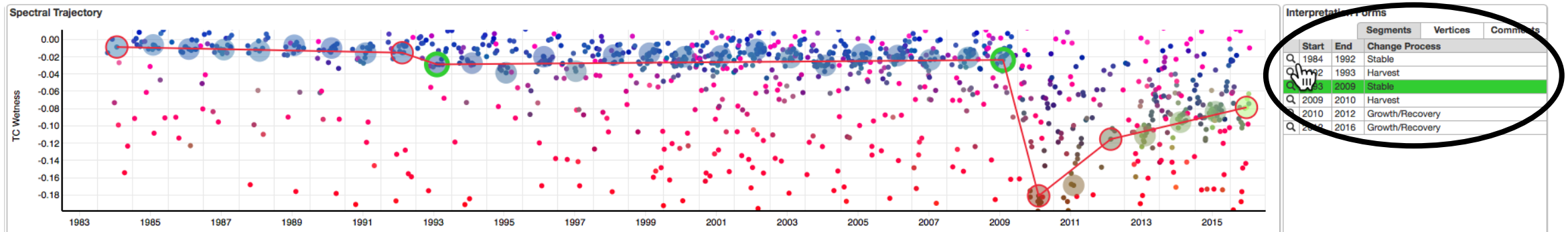
TimeSync – Interpretation Forms

- Shown here are the segment labels chosen for this plot, selected from a list that includes secondary use labels as a series of checkboxes relevant to specific choices
- Comments box for interpreter notes related to plot being interpreted

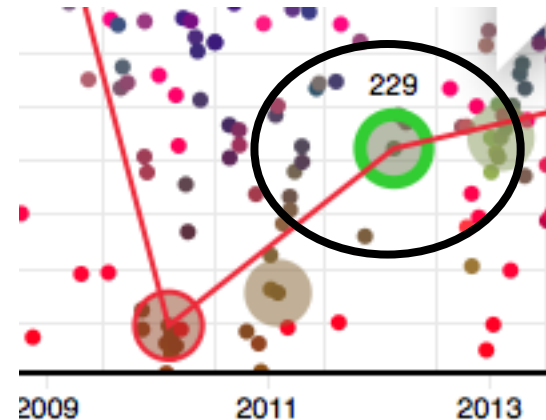


TimeSync – Query Button, and DOY “Tip”

- Clicking on query button associated with segments and vertices highlight the relevant vertices in the trajectory window
- For segments there are two relevant vertices



- Hovering over a data point in the trajectory window shows the DOY for that point



TimeSync – Data Set-up, Versions, Independence

- There is a process for setting up a project in TimeSync, and it is described, and some people do it themselves, but mostly this currently falls on Yang
- There are two current versions of TimeSync
 - Online version (OLTS, v3.0)
 - Stand alone version (SATS, v1.0)
 - The versions are supposed to have identical functionality, but development occurs on OLTS, with SATS often lagging behind
 - Currently some of the functionality of OLTS is not available in SATS
- Our goal is to have TimeSync software on GitHub (or similar), and let folks run with it
 - This will involve ability to design and load user-specified response design labels, load sample points, and download data