Introduction to TimeSync – A Tool For Landsat Time Series Visualization

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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
• 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

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
TimeSync – Chip Sets

• 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.
• 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)
• 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
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

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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 – 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
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.