Harmonized Landsat/Sentinel-2 Reflectance Products for Land Monitoring

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Presentation contains modified Copernicus Sentinel data (2015-17) processed by ESA
Harmonized Landsat Sentinel-2 (HLS) Project

- Merging Sentinel-2 and Landsat data streams can provide 2-3 day global coverage
- Goal is “seamless” near-daily 30m surface reflectance record including atmospheric corrections, spectral and BRDF adjustments, regridding
- Project initiated as collaboration among GSFC, UMD, NASA Ames

**Sentinel 2A and B - LDCM Europe**

- The picture shows the number of times LDCM and the Sentinel 2 satellites accessed areas on the ground over an 80 day period of time.
  - 21 accesses indicates a maximum revisit interval of ~3 days 19 hours
  - 46 accesses indicates a minimum revisit interval of ~1 day 18 hours

*Courtesy Brian Killough, NASA LARC*
**HLS Test Sites (v 1.3)**

- 69 Test sites (45 from NASA MuSLI team)
- 783 MGRS tiles
- >7.5 million sq. km²

- Landsat-8 data set: 147k products
  From Mar-2013 to Sep-2017
- Sentinel-2 data set: 47k products
  From Jun-2015 to Sep-2017

**Map showing HLS - 1-year (2016) number of cloud-free observations (L30+S30)**

- North America: 95
- South America: 28
- Alaska / NW Canada: 16
- South Africa: 166
- South Africa: 166
- Tanzania: 121
- S Asia: 122
- NE Asia: 11
- Europe: 15 (w/o Germ.)
- Germany: 62
- Africa: 6 (w/o SA and TZ)
- SE Australia: 141
Seasonal phenology (greening) for natural grassland (blue line) and irrigated alfalfa fields (red line) near Cheyenne, Wyoming observed from Harmonized Landsat/Sentinel-2 data products. The high temporal density of observations allows individual mowing events to be detected within alfalfa fields. HLS Products available from https://hls.gsfc.nasa.gov
Recent work focused on assessing product accuracy and algorithm improvements

HLS reflectance accuracy assessed via:
- Independent validation of LaSRC atmospheric correction (e.g. WGCV ACIX)
- Comparison of HLS with SURFAD albedometer measurements (see next slide)
- Quantifying temporal stability of invariant sites (e.g. deserts)

Algorithm improvements
- Cloud masking remains challenging, especially for Sentinel-2
  - Too conservative, and many valid points are flagged as cloud; too lenient, and time series become noisy
  - Current approach
    - L30: union of LaSRC and USGS L1 cloud masks
    - S30: union of LaSRC and Fmask cloud masks
  - Working with Boston University on intercomparison of current S2 cloud masking algorithms (see Slide 7)
- Current BRDF correction (Roy et al., 2016) does not work well for non-vegetated surfaces – looking for alternatives.
HLS albedo compared to SURFRAD albedometer measurements (B. Franch et al, AGU 2017)

- hemispheric integration using MCD43 BRDF
- narrow-to-broadband conversion using fixed coefficients (Liang et al, 2001)
- RMSE ~0.02 absolute
- For 0.2 SR targets -> ~10% relative uncertainty

Includes errors due to (i) HLS product; (ii) conversion from NBAR to albedo; (iii) in-situ measurements
Sentinel-2 Cloud mask intercomparison example

High cirrus values in much of scene

Courtesy Boston University - 2 Cloud mask intercomparison example
Status and Future Directions

• Version 1.3 released July 2017
  – Available for download and testing

• Version 1.4 to be released Q2 2018
  – Wall-to-wall North America + global test sites
  – Incorporates Collection 1 Landsat 8 (2013-current) and S2b data
  – < 7 day latency
  – Processing via Amazon Web Services (AWS)

• Support for new NASA MuSLI investigations (2018-20)

• Beginning dialog with NASA HQ about long-term stewardship of HLS processing
**Websites and Public Interface**

**HLS website**

- https://hls.gsfc.nasa.gov
- Public access
- Sample data available (via FTP)
- Algorithm & Product descriptions
- Request new sites

**NEX project page**

- https://nex.nasa.gov/nex/projects/1371
- Registered user access
- All HLS data available
- Documents (slides, user guides)
Thank You

Delaware / New Jersey