Level-2 Land Surface Temperature Emissivity, and Cloud Mask update

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Outline

1. Validation
2. L2 product updates
3. Cloud mask algorithm update
Temperature-based validation sites

- Gobabeb, Namibia
- Lake Constance, Switzerland
T-based validation, All sites, 08/2018-04/2020

bias = -0.69 K
rmse = 1.13 K
$r^2 = 0.993$
n = 493
LST validation summary: T-based and R-based sites

bias = -0.38 K
rmse = 1.07 K
n = 1139
Algodones Dunes, CA

5-band Emissivity: Algodones Dunes, CA

3-band Emissivity: Algodones Dunes, CA

Emissivity vs. Wavelength [μm]

- Lab Convolved
- ECOSTRESS 5-band

Emissivity vs. Wavelength [μm]

- Lab Convolved
- ECOSTRESS 3-band
L2 LSTE changes in Collection 2 (build 7)

• New, improved cloud mask algorithm
• L2_Cloud contents revised:
  – Data layers instead of bitmask (for ease of use)
  – Binary cloud mask of each test (0=clear, 1=cloud), and a combined final cloud mask
• L2_LSTE content changes
  – Binary cloud mask is added as additional layer (so users don’t need to download L2_Cloud)
  – Water mask is added (0=land, 1=water)
# L2 LSTE products in Collection 2

<table>
<thead>
<tr>
<th>Short name</th>
<th>Long name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO_L2_LSTE.002</td>
<td>ECOSTRESS Swath Land Surface Temperature and Emissivity Instantaneous L2 Global 70 m</td>
</tr>
<tr>
<td>ECO_L2_CLOUD.002</td>
<td>ECOSTRESS Swath Cloud Mask Instantaneous L2 Global 70 m</td>
</tr>
<tr>
<td>ECO_L2G_LSTE.002</td>
<td>ECOSTRESS Gridded Land Surface Temperature and Emissivity Instantaneous L2 Global 70 m</td>
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<tr>
<td>ECO_L2G_CLOUD.002</td>
<td>ECOSTRESS Gridded Cloud Mask Instantaneous L2 Global 70 m</td>
</tr>
<tr>
<td>ECO_L2T_LSTE.002</td>
<td>ECOSTRESS Tiled Land Surface Temperature and Emissivity Instantaneous L2 Global 70 m (100x100 km Sentinel tiles in UTM projection, cloud-optimized GeoTIFF)</td>
</tr>
</tbody>
</table>
Cloud mask statistical Look-Up-Table Approach in Collection 2

New V2 cloud mask uses a LUT approach based on MODTRAN clear-sky simulations of ECOSTRESS brightness temperatures (band 4, 10.6 micron) for a range of atmospheric and surface conditions including time of year, time of day, and emissivity.
Example 1: Cloud commission errors

Band 4 brightness temperature (blues, greens = cold = cloud)

V1: Most of the scene has cloud commission errors (cloud overestimated = loss of usable L3 and L4 data)

V2: Much better agreement with visual appearance of clouds in brightness temperature image!
Example 2: Cloud omission errors

Most of the scene has cloud omission errors (cloud underestimated = potential bad and underestimated L3 ET data)

Big improvement in detection of low-level warmer clouds previously missed in v1
Cloud omission errors over water and land

Vast majority of clouds removed (still need to watch for edges of cloud, but cloud growing algorithms can be applied by users)

Slide courtesy Gregory Halverson, JPL
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Image credit: John Noble