LANCE: Land Atmosphere Near-real-time Capability for EOS
The Land Atmospheres Near-real time Capability for EOS (LANCE) is a component of Earth Observing System Data and Information System (EOSDIS) that generates and distributes GLOBAL products from 5 instruments:

- AIRS (Aqua) and MLS (Aura)
- MODIS (Aqua and Terra)
- OMI (Aura)

LANCE Objectives:
- Leverage science processing expertise to create high quality NRT products
- To provide Aqua, Terra, and Aura data to applications community within less than 3 hours of observation (The standard, science-quality products are typically available with a latency of 20-48 hours)
- To provide data products with high reliability using redundant systems
- To provide an umbrella environment with uniform high level requirements to foster coordination and cooperation between the individual elements

LANCE Web Site: http://earthdata.nasa.gov/lance
LANCE System Architecture

Earth Science Data Operations

Earth Science Mission Operations (ESMO) | Earth Science Data and Information System (ESDIS)
---|---
Data Acquisition | Data to SIPS
Data Capture & Initial Processing | Science data processing and distribution

EOS Spacecraft: Terra, Aqua, Aura
TDRSS
White Sands Complex
Polar Ground Stations

EOS Front End Processing (data capture)
EDOS LZPF (L0 Processing & Data Distribution)
WAN Transfer

GES DISC
- AIRS
- L1 and L2
- MLS
- L2
- MODIS
  - L2, L2, L2G, and some L3
- MODAPS
- OMI SIPS
  - OMI
  - OMI L2

HTTP/FTP
Imagery

Distribution & Access
Internet: Download/Visualize NRT products
Users

RBD: Rate Buffered Data
S-PDS: Session Based Production Data Set
*L2G and L3 daily products have latency of 27-28 Hours.
The Climate Modeling Grid (CMG) is the only L3 MODIS product produced by LANCE.
Both data and imagery are freely available

**Data products** are available following self registration through FTP and HTTP servers

**Global Imagery Browse Services and Worldview**
Approx. 100 full resolution browse imagery products from MODIS, AIRS, OMI

**Rapid Response**
- MODIS subsets (customized Areas of Interest)
- MODIS Near real time (orbit swath) images
- Gallery images

**FIRMS** (Fire Information for Resource Management)
- MODIS active fire data viewer / downloads
- customized fire email alerts

**Data Casting** feed reader (from PO DAAC) allows users to subscribe to XML-based data feeds using RSS/GeoRSS technologies
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Product Categories</th>
<th>Average Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRS</td>
<td>Radiances, Temperature and Moisture Profiles, Clouds and Trace Gases</td>
<td>1.3 - 2.3 hours</td>
</tr>
<tr>
<td>MLS</td>
<td>Ozone, Temperature</td>
<td>1.3 - 2.3 hours</td>
</tr>
<tr>
<td>MODIS</td>
<td>Radiances, Clouds/Aerosols, Water Vapor, Fire, Snow, Sea Ice, Land Surface Reflectance (LSR), Land Surface Temperature</td>
<td>1.5 - 2.3 hours excluding the L2G and L3 daily, tiled LSR products</td>
</tr>
<tr>
<td>OMI</td>
<td>Ozone, Sulfur Dioxide, Aerosols, Cloud Top Pressure</td>
<td>1.6 - 2.8 hours excluding L3 products</td>
</tr>
</tbody>
</table>

**Over 50 NRT data products are provided by LANCE**
EDOS Enhancements to reduce LANCE Latency

- **EDOS implemented three major latency enhancements in 2011, all focused on decreasing WAN transfer time to LZPF**

  - **Removal of Reed-Solomon decoding bits** (128 bytes/frame)
    - Release C5.4b – all sites – all missions – completed 2/1/2011
      - *Benefit:* 12% decrease in WAN transfer time

  - **Deploy 2ndTerra ebox-R at LZPF to eliminate WAN transfer time for MODIS** – Release C5.4c – completed 3/1/2011
    - *Benefit:* Expedited MODIS RBDs and session-based PDS
      - White Sands Ebox-S configured for dual antenna feeds
      - Ebox-S configured for MODIS and non-MODIS processing
      - New Ebox-R added to LZPF for MODIS-only expedited processing
      - MODIS data receives highest priority QoS routing from White Sands

  - **Implementation of lossless compression/decompression and Terra PN decoding** – Release C5.4d – all sites – all missions - completed 6/1/2011
    - *Benefit:* 20% average decrease in WAN transfer time
Weekly MODIS-Terra LANCE Latency Trend for Orbital Products
(1 January 2010 to 30 December 2012)

Latency - Annual Comparison

EDOS ground system upgrades
Four Week LANCE-Wide Latency and Distribution Trend for Level 0, 1, & 2 Products
(6 October - 2 November, 2013)

<table>
<thead>
<tr>
<th>LANCE Instrument-Mission</th>
<th>Distribution Vol (GB)</th>
<th># of Files Distributed</th>
<th>Average Latency (Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4-Wk</td>
<td>4-Wk</td>
<td></td>
</tr>
<tr>
<td>AIRS-AQUA</td>
<td>3,329.37</td>
<td>249,960</td>
<td>102</td>
</tr>
<tr>
<td>MLS-AURA</td>
<td>50.87</td>
<td>178,158</td>
<td>93</td>
</tr>
<tr>
<td>MODIS-AQUA</td>
<td>32,059.75</td>
<td>2,472,833</td>
<td>107</td>
</tr>
<tr>
<td>MODIS-TERRA</td>
<td>25,971.05</td>
<td>3,069,787</td>
<td>74</td>
</tr>
<tr>
<td>OMI-AURA</td>
<td>233.47</td>
<td>7,400</td>
<td>75</td>
</tr>
</tbody>
</table>

Trend for Level 0, 1, & 2 Products (6 October - 2 November, 2013)
Potential Future Latency Enhancements

- Upgrades to the NASA McMurdo ground station capability in Antarctica or use of nearby commercial stations (such as TrollSat) will provide increased half-orbit opportunities for polar missions to decrease latency from observation time by as much as 45-50 minutes.

- Increases of WAN bandwidth to a minimum of 150 Mbps to all ground stations will essentially eliminate the WAN transfer latency to GSFC – data will be available at GSFC for EDOS distribution at the end of the spacecraft contact.

- On board enhancements for new missions to prioritize the downlink of science data so that high-priority low-latency data is transmitted first, and further enhancements to perform on-board processing so that the data downlinked is already in a format needed by low-latency users (e.g. first responders) without further ground processing.

- Upgrades to EDOS level Zero processing can be made to prioritize both the processing and distribution of selected science data to expedite EDOS delivery of low-latency data.

- Use of a new WAN accelerator protocol to optimize effective use of the WAN bandwidth (ground station to GSFC) will improve science data WAN transfer latency by removing the round trip delay for acknowledgements inherent in the standard TCP protocol. [in progress]

- For future high volume/high rate missions, use of a decentralized EDOS architecture that permits low-latency data to be transmitted to the level zero user directly from the ground station removes the time required to transmit the data to the central site. Requires high-rate network availability.
Global Imagery Browse Services (GIBS)

- **Access Interfaces**
  - Web Map Tile Service (WMTS)
  - Tiled Web Map Service (TWMS)
  - Keyhole Markup Language (KML)
  - Web Map Service (WMS)
  - Not externally visible at present.

More Information: https://earthdata.nasa.gov/gibs
The Rapid Response component of LANCE allows MODIS images to be downloaded for swaths and user-specified geographic subsets.
FIRMS became operational in LANCE on May 1st 2012

Users can interactively view and query the fire hotspot data in Web Fire Mapper, download data (text, shape or KML files) or subscribe to fire email alerts for their area of interest.

- There are over 6000 fire email alert subscriptions
- Approximately 2000 fire email alerts are sent daily to users in over 120 countries.
End Users of LANCE products

- LANCE products are routinely used by **direct users**, who access data for their own purposes, and by **brokers** who add value to the data by combining it with other specialist knowledge and serve it to targeted end users.

- The beneficiaries include natural resource managers, those working with hazards and disasters and scientists and researchers monitoring and analyzing natural and man-made phenomena.

- In excess of 1.3 TB of data products are distributed each day and approximately 50000 images are downloaded daily.
New Capabilities

- Products being added to LANCE – Endorsed by LANCE UWG
  - MODIS Rolling 8-Day NDVI
  - MODIS Rolling Surface Albedo - Level 3 filtered, corrected, and aggregated product when collection 6 processing begins

- Products/Instruments under consideration for inclusion in LANCE:
  - Lighting Imaging Sensor (LIS) - Products generated at the GHRC since the launch of TRMM. Proposal is to provide the near-real time LIS products for LANCE within 2 hours (~90 min) of data observation, thereby reducing the delay in generating science-quality lightning products by 16 hours. In addition to the existing LIS on TRMM, there are plans underway to fly the LIS flight spare for TRMM on the International Space Station (ISS) - Continuity.
  - MISR – Under investigation (Winds and AOD)
Questions