GEO-LEO Activities Update

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SIT Chair Team

CEOS SIT Technical Workshop
EUMETSAT
Darmstadt, Germany
13-14 September 2018
SIT-33-14: NOAA and CSIRO: Develop a proposal with appropriate CEOS entities for a GEO-LEO application case study using CARD4L and multiple datasets.  
**Rationale:** SIT Chair has challenged CEOS to identify productive avenues of collaboration to build on the GEO-LEO initiative started in 2016 by CSIRO and JAXA.  

**- In progress**

SIT-33-15: SIT Chair: Identify CEOS Agency participants for the GEO-LEO flood mapping inter-comparison studies with CGMS.  
**Rationale:** CGMS has proposed to take forward a number of pilot activities from the CEOS GEO-LEO report and interested CEOS agencies are sought.  

**- In progress**

SIT-33-16: SIT Chair: Report CEOS update on GEO-LEO activities and proposals to the CGMS Plenary in Bangalore and explore a coordinated way ahead with CGMS.  
**Rationale:** Both CEOS and CGMS have identified interests around the GEO-LEO activity.  

**- Complete. Update provided at the CGMS meeting in Bangalore.**
Review of Application Case Study using CARD4L from Multiple GEO and LEO Satellites

Kevin Gallo, NOAA/NESDIS

As presented at this LSI-VC-6 in Ispra, Italy last week
SIT-33-14 (NOAA and CSIRO): Develop a proposal with appropriate CEOS entities for a GEO-LEO application case study using CARD4L and multiple datasets.

- Proof of concept example developed
- Includes GEO and LEO products acquired for 1 day
- Some products in Analysis Ready Data format, others not
- The primary suggested application is for **Multi-Sensor Monitoring of Vegetation Condition**
- Effort being initiated within the CARD4L effort of the Land Surface Imaging-Virtual Constellation.
Example of **single-day visible band** GEO-LEO data for a single US ARD tile.

- Chosen tile includes several in situ networks (SURFRAD and USCRN) that measure surface reflectance, land surface temperature, soil moisture, and additional variables.
- The tile is located in a region with vegetation, and low frequency of cloudy days during summer months.

**CONUS ARS tile h12 v03.**

**Surface Radiation Budget Network (SURFRAD) station**
Sensor data evaluated for the single-day (30 May 2017) GEO-LEO example

**Landsat OLI**

- Landsat 8 OLI/TIRS Level-2 Data Products - Surface Reflectance
  - The U.S. Geological Survey (USGS) offers on-demand production of Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) data through the Landsat Data Accesst (LDA) service. Surface reflectance products provide an estimate of the surface spectral reflectance at the sensor measured at ground level in the absence of atmospheric scattering and absorption.
  - The surface reflectance products are generated at the Earth Resources Observation and Science (EROS) Center at a 30-meter spatial resolution. The EROS Science Processing Architecture (SPA) re-processes Landsat 8 data to ensure consistent products for use in science. Landsat 8 Surface Reflectance products are available for Military and Civilian customers.
  - Landsat OLI and TIRS Level 2 Surface Reflectance products can be found in the Landsat Surface Reflectance Product Guide.

**Terra (and Aqua) MODIS**

- MOD09GA: MODIS/Terra Surface Reflectance Daily L2G Global 1 km and 500 m SIN Grid V006
  - Description:
    - The MOD09GA Version 6 product provides an estimate of the surface spectral reflectance of Terra MODIS bands 1 through 7 (10.65 µm) for specific atmospheric conditions such as aerosols, cirrus, and Rayleigh scattering. Provided along with the MOD09GA reflectance and surface emissivity are four sets of cloud data. The reflectance products are derived from the MOD09GA product, which provides the surface reflectance data for the MODIS land products. Validation of the MOD09GA product and improvements in previous versions include:
      - Improved aerosol retrieval and correction algorithms.
      - Improved cloud and snow detection algorithms.
      - Improved cloud screening.
    - DOI: 10.5067/MODIS/MOD09GA.000

**S-NPP VIIRS**

- VN009GA: VIIRS/NPP Surface Reflectance Daily L2G Global 1 km and 500 m SIN Grid V001
  - Description:
    - The Visible Infrared Imaging Radiometer Suite (VIIRS) is a visible, near-infrared, and thermal infrared imager on the Suomi National Polar-Orbiting Partnership (S-NPP) satellite. The VIIRS sensor is configured with 22 bands spanning the visible and infrared spectral regions. The 1-kilometer and 500-meter resolution products are derived through resampling the native 750-meter VIIRS reflectance products, respectively, in the VIS and near-infrared bands. These bands are corrected for atmospheric conditions as the effects of molecular gases, including ozone and water vapor, and for the effects of atmospheric aerosols. The reflectance products are derived from the surface reflectance product and are top-of-atmosphere reflectance for the VIIRS visible bands. VIIRS cloud mask, aerosol optical thickness, and aerosol models, and atmospheric data obtained from the NOAA National Centers for Environmental Prediction (NCEP) reanalysis system. Along with the twelve reflectance bands, the MODIS product also contains sensor and instrument metadata information for mission planning. The MODIS product is available through the Copernicus Mission pages.

**Sentinel-2 MSI**

- This Sentinel-2 Mission Guide provides a high-level description of the mission objectives, satellite description, and ground segment. It also addresses the related heritage missions, thematic areas and Copernicus services, orbit characteristics and coverage, instrument payload, and data products.

**GOES-16 ABI**

- NOAA GOES-R Series Advanced Baseline Imager (ABI) Level 2 Cloud and Moisture Imagery Products (CMIP)
  - ABI L2-CMPI
    - The Cloud and Moisture Imagery product contains one or more Earth-view images with pixel values indicating brightness values that are scaled to support visual analysis. The product includes data quality information that provides an assessment of the cloud and moisture imagery data values for on-land pixels. Cloud and Moisture Imagery product files are generated for each of the satellite Advanced Baseline Imager (ABI) reflective bands (channels 1-6 with appropriate central wavelengths 0.47, 0.86, 0.86, 1.25, 3.73, 3.93, 6.21, 6.66, 8.66, 10.83), and 12.4 microns respectively) and emissive bands (channels 7-15 with appropriate central wavelengths 3.5, 6.21, 6.66, 8.66, 10.83, 12.4, 12.5, 13.3 microns respectively). In addition, there are additional bands where the intensity of all bands is listed. The intensity vector for each band is provided in the product metadata file.
30 May (day 150) 2017: Visible Channel Reflectance for CONUS ARD tile h12 v03

**Landsat 8**
1748 UTC

**Terra MODIS**
1717 & 1855 UTC

**Aqua MODIS**
1858 & 2038 UTC

**S-NPP VIIRS**
1933 & 2113 UTC
Next Steps

- Consider extending prototype to 20 days to allow for comparisons of greenness change (e.g.)

- The VCs and WGs are requested to consider their respective contributions (e.g., additional data/products) for the next step, a formal proposal as requested in response to SIT-33 action 14

- Coordinate with CSIRO and consider another case study in their region of interest

- Suggest CARD4L data format

New Action: Work with CSIRO to select case study over their region

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Flood Monitoring Initiative

Mitch Goldberg and Dan Lindsey, NOAA/NESDIS
GOES-16/ABI and Suomi-NPP/VIIRS Merged Flood Map in West Gulf Region, USA
Merged Flood Extent from ABI and VIIRS on Sep.01, 2017

Map Information
Projection: UTM, Zone 15 N
Coordinate System: GCS WGS1984
Unit: Mile

Legend
- cities
- river/lake
- state border
- Snow
- Shadow
- No data
- Cloud
- Normal open water
- Ice
- Supra-snow/ice water
- Land Floodwater fraction (%)

Data Source
Satellite Imagery
- Satellite/sensor: SNPP/VIIRS

GIS data
- Administrative boundary and cities: GDAM

Description
This flood map is merged from Suomi-NPP/VIIRS data around 20:03 (UTC) and GOES-16/ABI data around 15:30 (UTC) on Sep.01, 2017, which shows the flood extent under clear-sky coverage in West Gulf region of the USA due to Hurricane Harvey. Water fraction means open water percentage in a 375-m pixel.
VIIRS 375-m flood map in the similar region with Sentinel-1 on Aug. 31, 2017

Overall, VIIRS shows consistent flood detection results with Sentinel-1.
VIIRS flood detection map on July 07, 2016
Animation from 01:00 to 07:00 (UTC)
Daily composited map from 01:00 to 07:00 (UTC)
Flood Monitoring Initiative

Comments and suggestions from Side Meeting

- Work with WG Disasters on a flood pilot – lots of overlapping interest
- Consider additional data sources beyond just VIIRS and Geo Imagers (e.g., SAR)
- Coordinate with WGCapD
- Involve GEO

New Action: NESDIS coordinate with WG Disasters and WGCapD on flood monitoring initiative
SIT-33-15: SIT Chair: Identify CEOS Agency participants for the GEO-LEO flood mapping inter-comparison studies with CGMS.

• Vietnam has expressed interest in participating. Will provide SAR data sets to help address challenges in tropics

• JAXA recommends engaging JMA – this will be done at the Asia Oceania Meeting in Indonesia next month (KMA will be engaged too)

• Planning to discuss with Vietnam and Indonesia at AOMSUC in Jakarta from user perspectives
Other Examples of GEO/LEO Activities

Fire and Smoke Detection - VIIRS

https://www.nesdis.noaa.gov/content/expanding-county-fire-northern-california

July 05, 2018

The Expanding County Fire in Northern California

July 1, 2018  July 2, 2018  July 3, 2018  July 4, 2018
Other Examples of GEO/LEO Activities

Fire and Smoke Detection – GOES-16
Other Examples of GEO/LEO Activities

Fire and Smoke Detection – GOES-16

[Map showing fire and smoke detection areas]
Other Examples of GEO/LEO Activities

Fire and Smoke Detection – GOES-16
Other Examples of GEO/LEO Activities

• Blended Sea Surface Temperature Product
• Blended Total Precipitable Water
• Blended Rain Rate
• Soil Moisture blended 6-hour and daily retrievals
• Blended ozone
• Volcanic ash detection
• Multilayer cloud detection

Suggestion to survey the VCs for other examples.
Next Steps

- Finalize LSI-VC CARD4L proposal to present to Plenary factoring in CSIRO interests in a second case study in their area
- Coordinate possible participation by WG Disasters and WGCapD, VNSC, JMA, KMA, others on Flood Mapping Project and report Progress to Plenary and to CGMS.
- Survey VCs on examples of other possible GEO/LEO blended products of interest.