

GEO-LEO/NMA

NMA Task 4: Possible GEO/LEO Combination Projects: LSI-VC

Presenter: Kevin Gallo, NOAA/NESDIS

CEOS SIT-33, Boulder CO, 23 April 2018

Non-meteorological Applications for
Next Generation Geostationary Satellites Study



Review of reference documents.

Non-meteorological Applications for Next Generation Geostationary Satellites Study



1.1 Overview

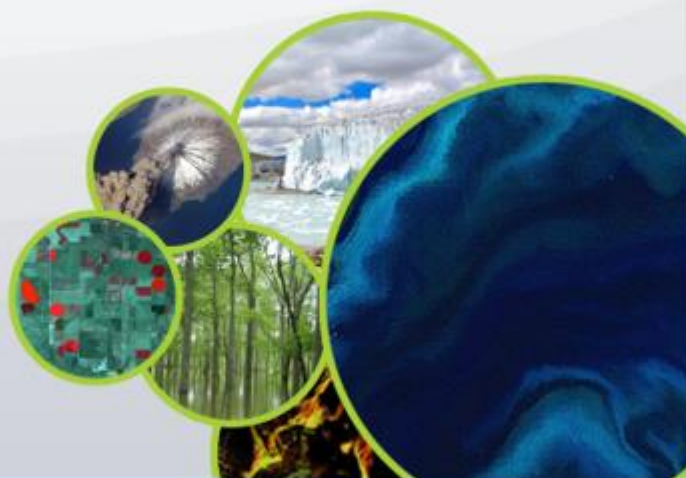
The deployment over the next few years of a constellation of advanced meteorological geostationary (GEO) satellites, with their improved spectral, spatial and temporal resolution sensors, opens up a world of new possibilities for continuous monitoring of the high-temporal dynamics of the land, oceans and atmosphere, addressing a broad range of societal challenges and information needs, particularly in combination with moderate resolution low Earth orbit (LEO) observing satellites.

While the primary mission of the new GEO satellites is to support operational meteorological services, they offer opportunities for non-meteorological applications that can enhance and complement the low Earth orbit (LEO)-based applications that have been the primary tool for monitoring of the broader environment.

The Committee of Earth Observing Satellite (CEOS), under the leadership of Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) and supported by the Australian Bureau of Meteorology, conducted a one-year study initiative in 2015-16 to assess the potential of non-



Committee on Earth Observation Satellites



The Land Surface Imaging Virtual Constellation Implementation Plan

October 12, 2017

LSI-VC objectives include CEOS Analysis Ready Data for Land products.

| | Objective / Deliverable | Description / Context | Linkages | CEOS Work Plan Ref. | Target Date |
|-----|--|--|-----------------------------------|---------------------|-------------|
| ARD | CARD4L Framework Development | LSI-VC will develop the first CARD4L Product Family Specifications, with at least two documents presented for endorsement at CEOS-31. Draft versions of these specifications will be used to inform LSI-VC contributions to FDA-4. A CARD4L Assessment Framework will also follow. | FDA-AHT WGCV | FDA-7 | Q4 2017 |
| ARD | Develop a Roadmap for the Routine Production of Intercomparable CARD4L | Building on agreed specifications of CARD4L products, LSI-VC will develop a roadmap for how interested CEOS Agency missions and programs can start processing land surface imaging data to geometrically and radiometrically intercomparable surface reflectance, surface temperature, and analogous radar products. | WGCV | VC-27 | Q4 2018 |
| ARD | Trial CARD4L Supply to FDA Pilots | Through the production/provision of CARD4L datasets in support of the FDA pilots, LSI-VC will gather evidence on the associated technical challenges. Where possible, WGCV capacity development capabilities will be leveraged. | FDA-AHT SEO WGCV | FDA-4 | Q4 2017 |

CEOS Analysis Ready Data for Land (CARD4L) Description Document

Definition

CEOS Analysis Ready Data for Land (CARD4L) are satellite data that have been processed to a minimum set of requirements and organized into a form that allows immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets.

CEOS Analysis Ready Data for Land (CARD4L) Description Document

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- Measurement-based / Radiometric Calibration – Adjustments for sensor/instrument gains, biases, offsets and adjustments for sensor viewing angle with respect to the pixel position on the surface, which allow the majority of users to apply the data directly rather than, in general, undertaking these steps themselves. Ideally, CARD4L will provide geophysical quantities such as surface reflectance, temperature, or backscatter amplitude facilitating the use of observations from multiple platforms and sensors.

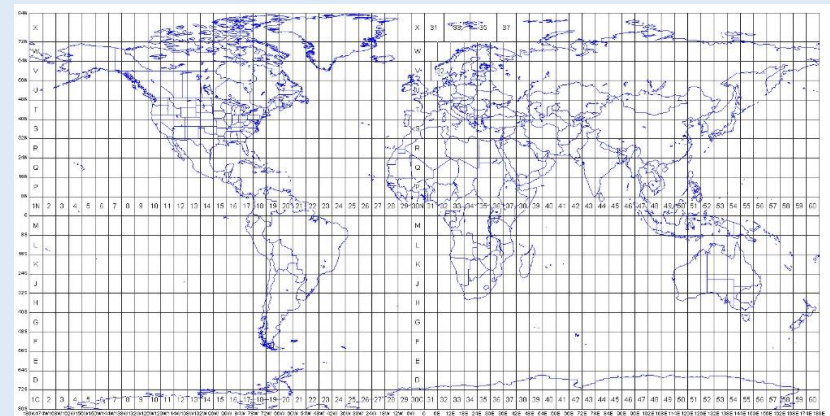
Perhaps we should consider additional, more generic GEO products, similar to those LEO products planned for development within LSI-VC. These GEO products might include:

- GEO products to match the LEO products proposed for an Analysis Ready Data (ARD) format
- Initial products of Surface Reflectance and Land Surface Temperature

The GEO products could be placed in ARD format to facilitate product intercomparisons and integrated product development.



One of global grids under consideration for LSI effort of LEO global ARD.

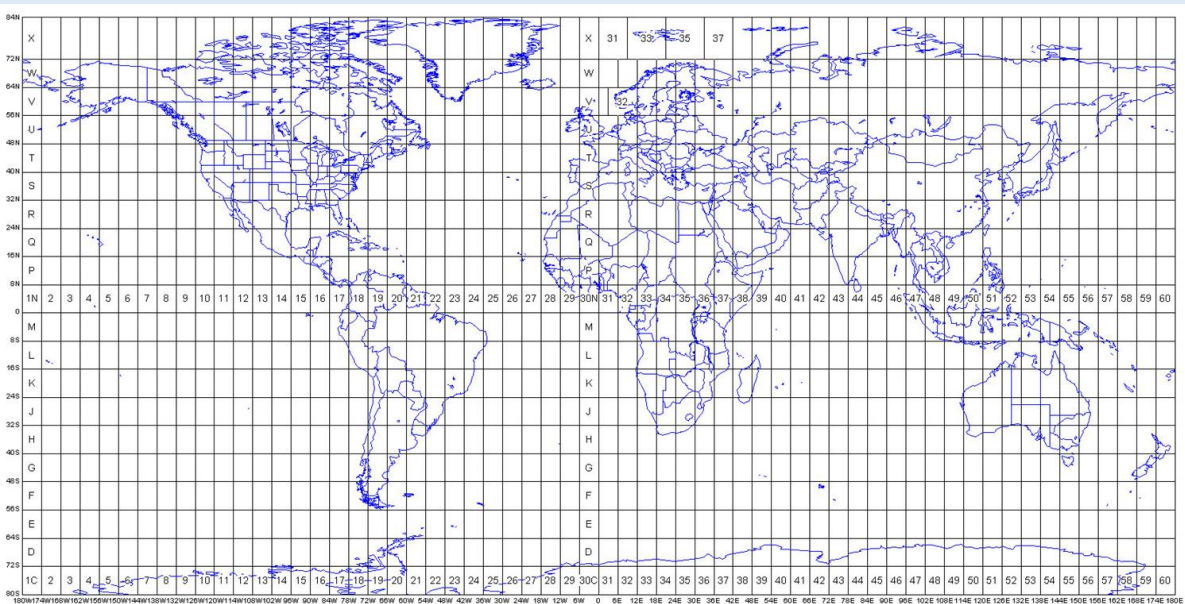


GEO and LEO visible (red), Near-IR, and Thermal IR comparison.

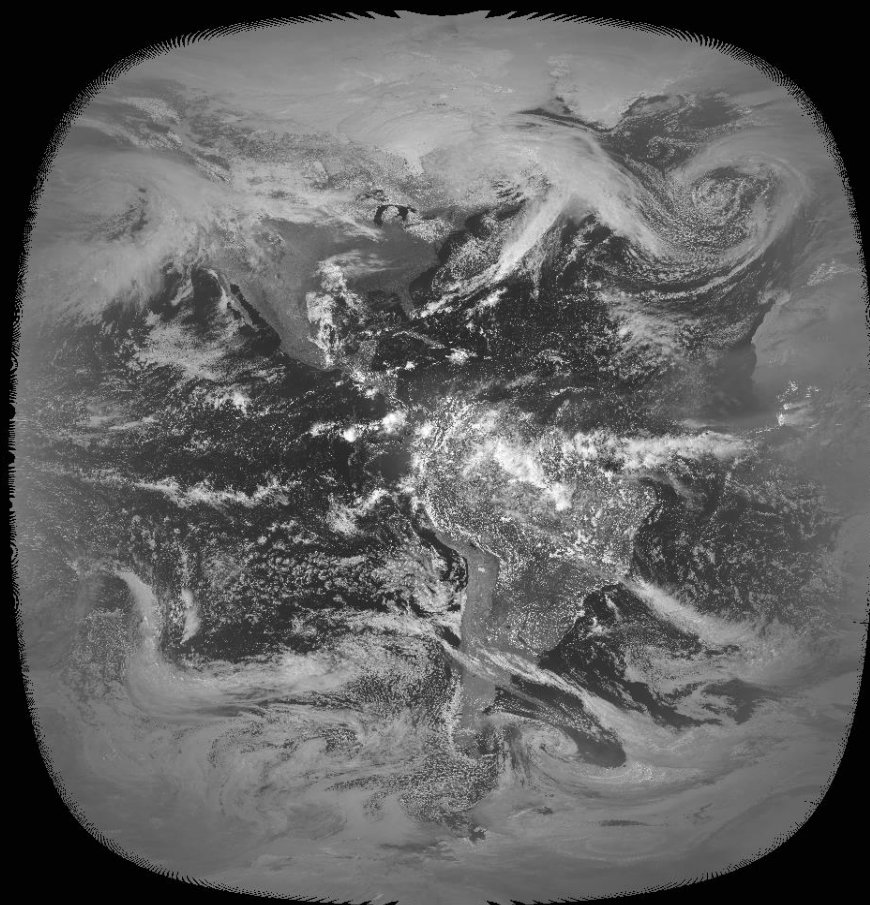
| GEO | | | | LEO | |
|---------------------|-------------|---------------|-----------------|-----------|------------|
| Sensor/ Channels | GOES ABI | MSG SEVIRI | Himawari AHI | Landsat 8 | Sentinel-2 |
| red | 0.64μm | 0.635 | 0.64 | 0.66 | 0.66 |
| Near-IR | 0.86 | 0.81 | 0.86 | 0.86 | 0.86 |
| | | | | | |
| Thermal IR1 | 10.3 | 10.8 | 10.4 | 10.9 | n/a |
| Thermal IR2 | 12.3 | 12.0 | 12.4 | 12.0 | n/a |

Example of GEO red channel data projected into one of global ARD potential map projections (Universal Transverse Mercator).

| GEO | | | | LEO | |
|---------------------|-------------|---------------|-----------------|-----------|------------|
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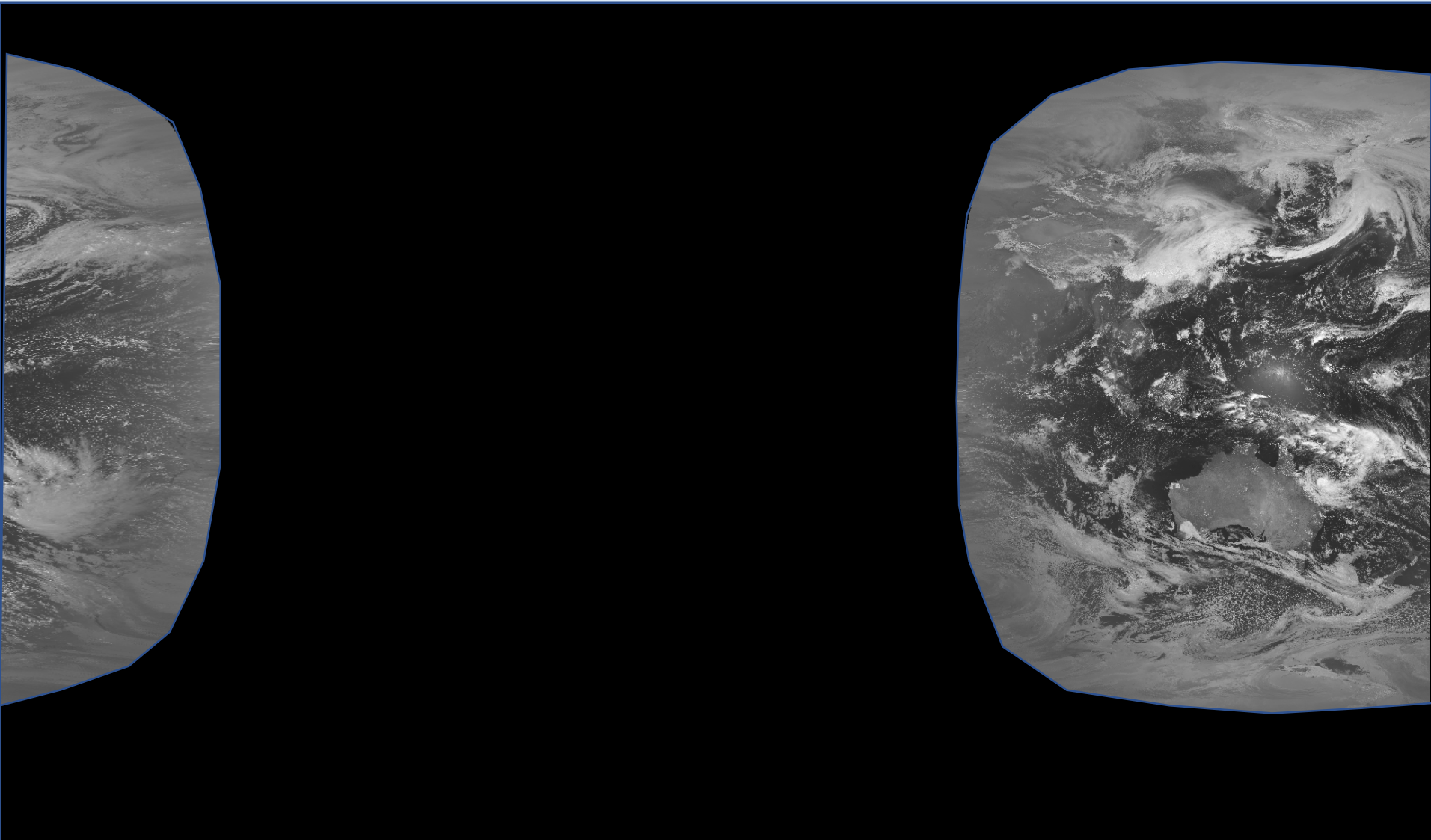


GOES-16 ABI Channel 2 (0.64 μm): 1700 UTC (noon local time), 5 April 2018



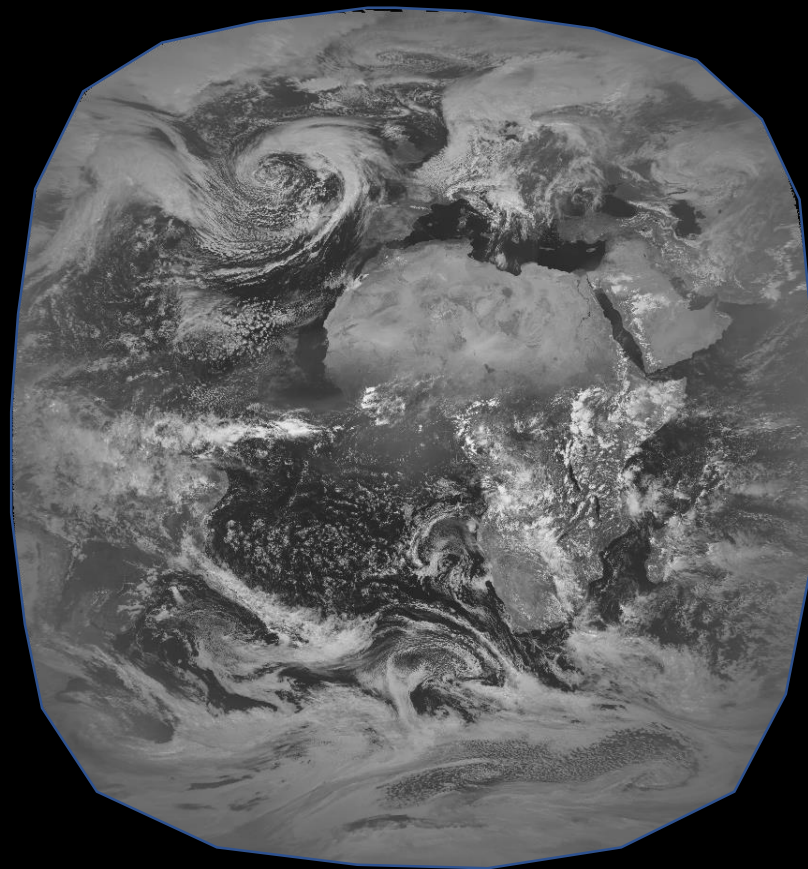
Equatorial orbital location of 75 degrees west longitude.

Himawari (AHI), Channel 3 (0.64 μm): 0230 UTC, 5 April 2018

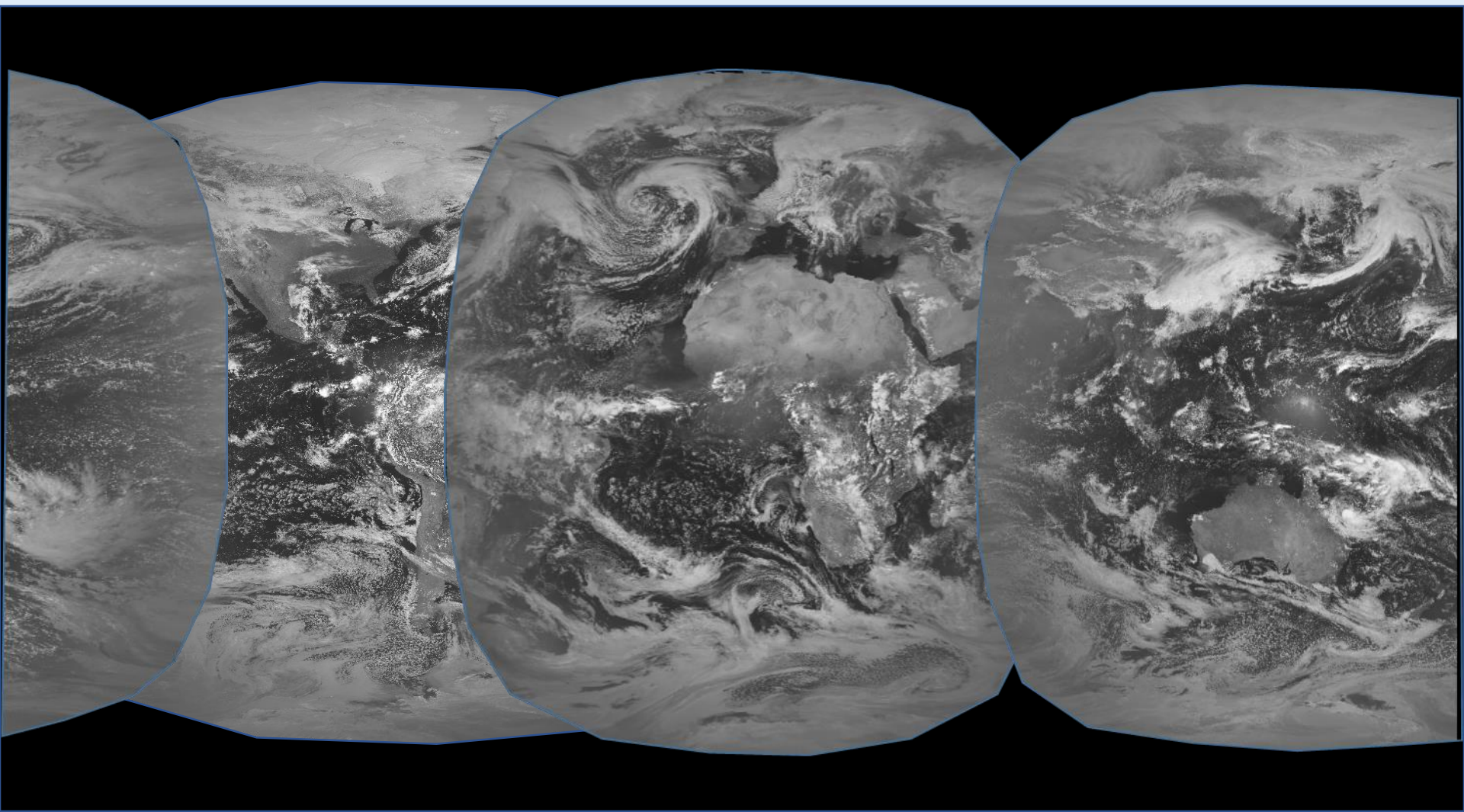


Equatorial orbital location of 141 degrees east longitude.

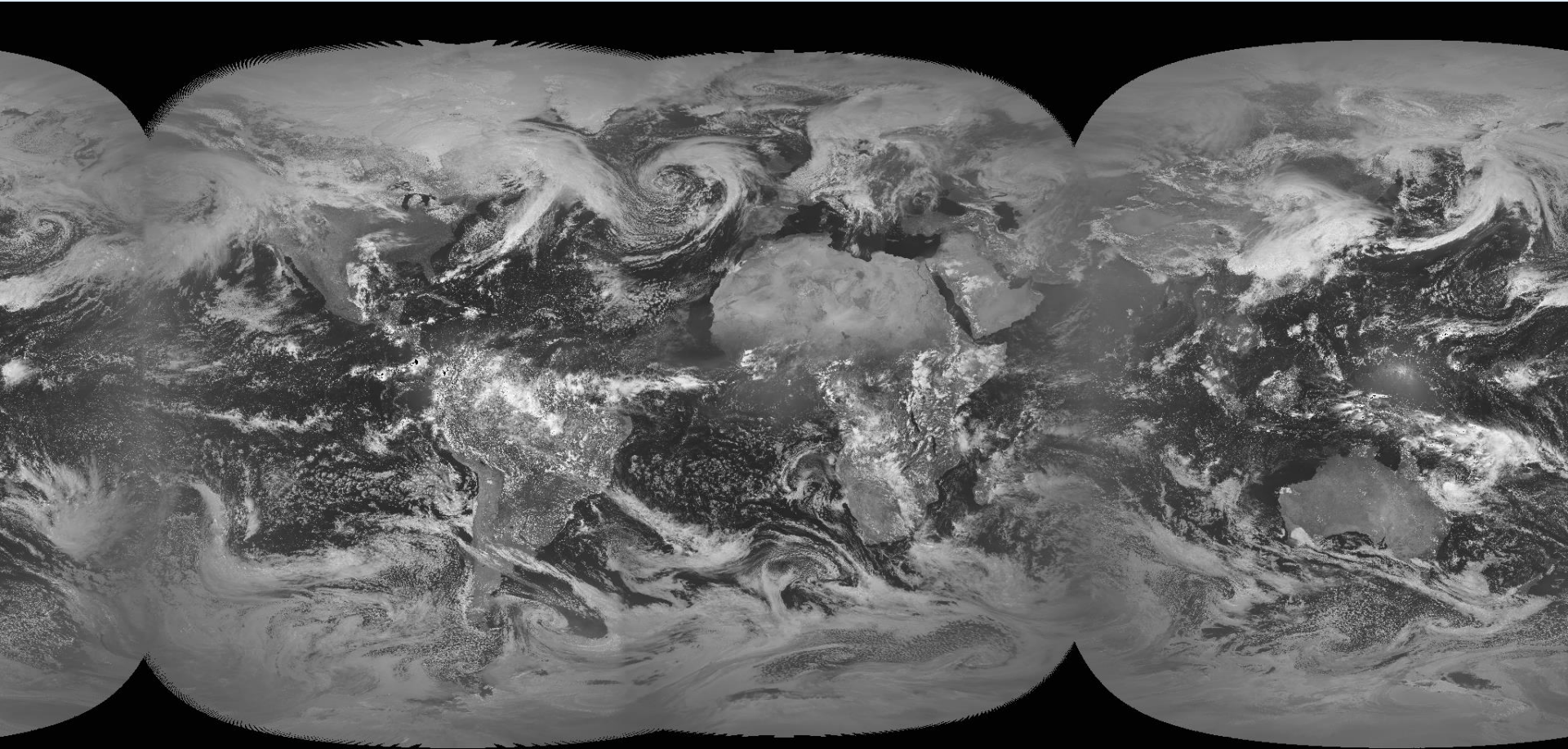
MSG-SEVIRI Channel 1 (0.64 μm): 1200 UTC, 5 April 2018



Equatorial orbital location of 0 degrees longitude.



GEO composite of 5 April 2018 at local noon of equatorial orbit longitude, projected into UTM map projection.

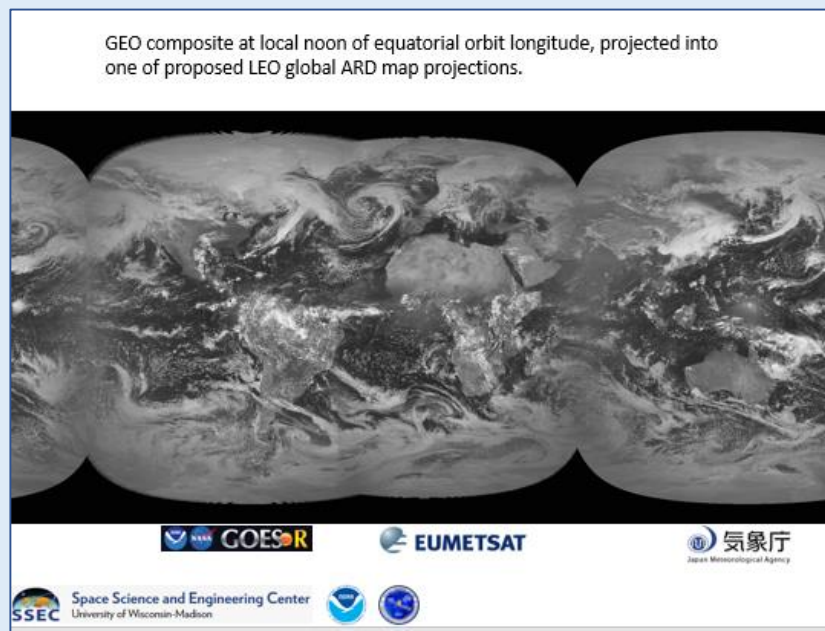
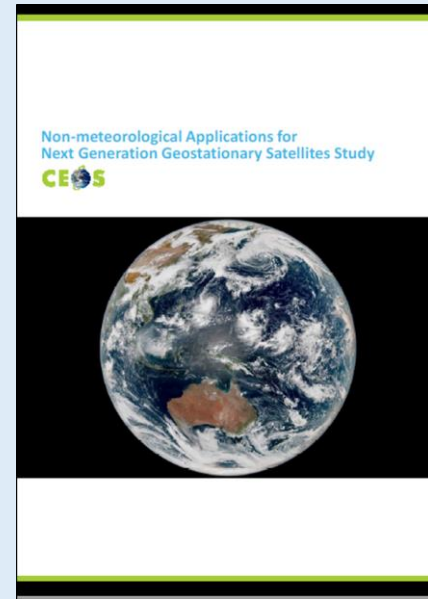


Summary

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Backup slides

Document prepared that provides requirements and potential uses of GEO data (GOES-16 ABI surface reflectance) within initiatives of LSI-VC.

Requirements and potential uses of GOES-16 ABI surface reflectance within the Focus Themes and initiatives of the CEOS Land Surface Imaging-Virtual Constellation (LSI-VC).

There are currently three **Focus Themes** within the LSI-VC which include [1]:

- 1) Promoting **analysis-ready data** and minimizing the need for end users to understand satellite overpass differences, and sensor-specific processing,
- 2) Compilation of **land user community requirements** related to (i) better optimization of land surface imaging programs (ii) identification of current data gaps, and
- 3) Development of a **Moderate Resolution Interoperability (MRI)** framework for complementarity and compatibility among Earth observing systems.

Summary

The availability of ABI surface reflectance data in a similar ARD format as proposed for Landsat and Sentinel sensor data (Theme 1) will encourage:

- Sensor interoperability proposed in Theme 3 expanded to LEO and GEO interoperability,
- Synergistic use of GEO and LEO data for enhanced non-meteorological applications of GEO satellites [2] for products of interest by land community (Theme 2),
- Use of ABI as a data gap-filler for the LEO data and products when LEO data are unavailable (Theme 3),
- Intercomparison and characterization of products in support of land product validation (e.g., as within the NOAA-USGS Land Product Characterization System [4]).

LPCS plans include addition of GEO SR and LST products as available.



LPCCS

Land Product Characterization System



USGS

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Land Product Characterization System (LPCCS)

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Data Set Search:

GOES-16

☒ ABI

Landsat

☒ Landsat Collection 1 Level-2 (On-Demand)

☐ Landsat 8 OLI/TIRS C1 Level-2

☐ Landsat 7 ETM+ C1 Level-2

☐ Landsat 4-5 TM C1 Level-2

NASA LPDAAC Collections (MODIS)

☒ MODIS Vegetation Indices
 ☒ MODIS Land Surface Reflectance
 ☒ MODIS Land Cover
 ☒ MODIS Land Surface Temp and Emiss
 ☒ MODIS Albedo

VIIRS

☒ NASA
 ☒ NOAA

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Map

Satellite

(25° 28' 58" N, 093° 09' 50" W)

Options

Overlays

