



Committee on Earth Observation Satellites

GEO-LEO Activities Update

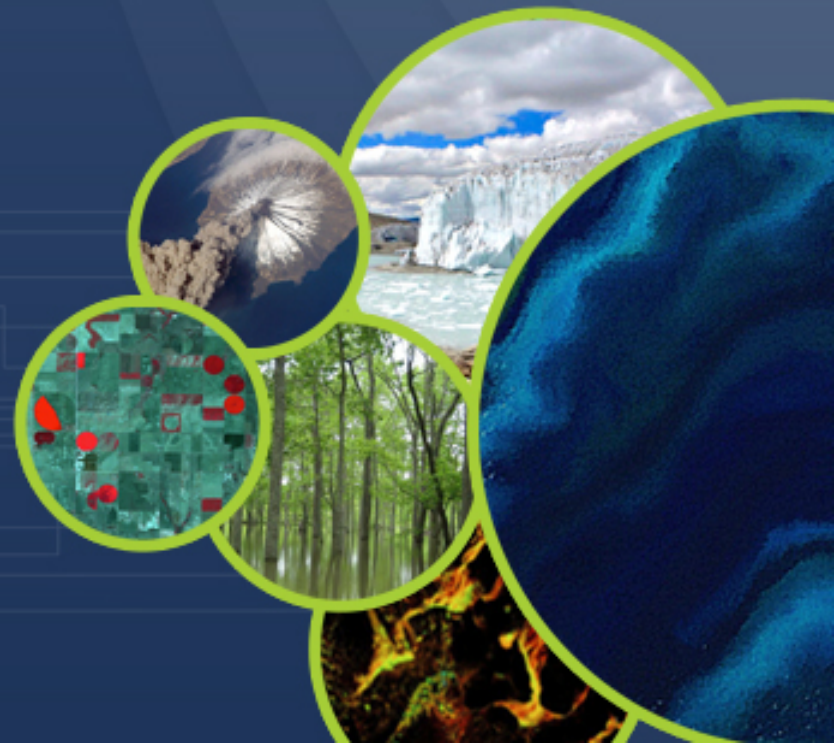
Dan Lindsey and Chuck Wooldridge, NOAA,
SIT Chair Team

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.*

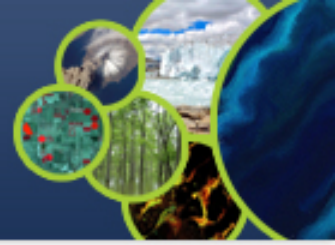
- In progress

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.*

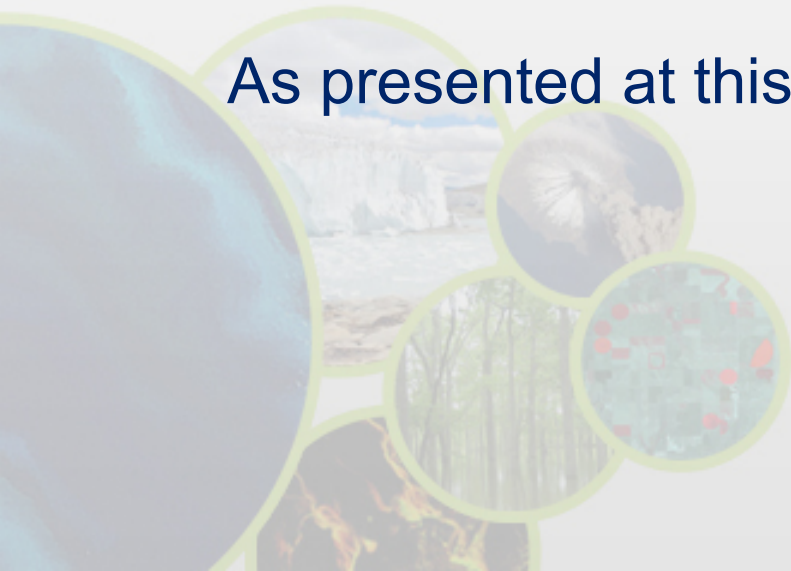
- Complete. Update provided at the CGMS meeting in Bangalore.

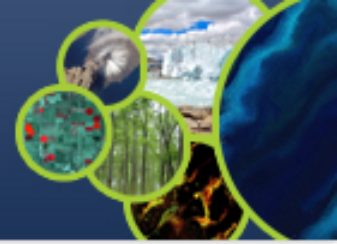


Review of Application Case Study using CARD4L from Multiple GEO and LEO Satellites

Kevin Gallo, NOAA/NESDIS

As presented at this LSI-VC-6 in Ispra, Italy last week



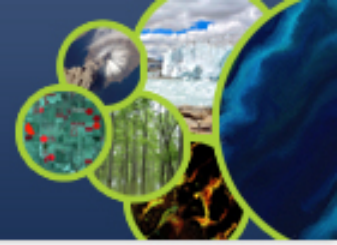


SIT-33-14 (NOAA and CSIRO): Develop a proposal with appropriate CEOS entities for a GEO-LEO application case study using CARD4L and multiple datasets.

- 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.

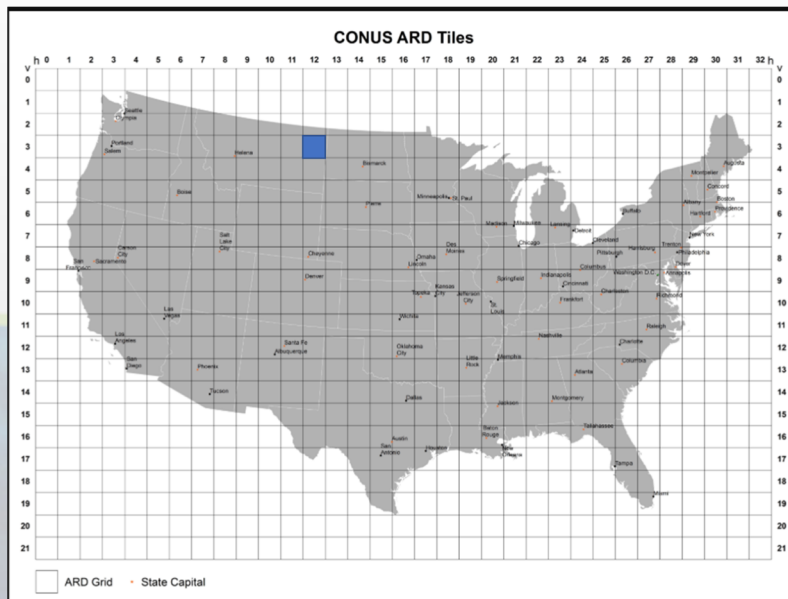


Objective / Deliverable	Description / Context	Linkages	CEOS Work Plan Ref.	Target Date
ARD CARD4L Framework Development	LSI-VC will develop the first CARD4L Product Family Specifications, with at least two documents presented for endorsement at CEOS-31. Draft versions of these specifications will be 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, WGCapD capacity development capabilities will be leveraged.	FDA-AHT SEO WGCapD	FDA-4	Q4 2017



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/Thermal Infrared Sensor (OLI/TIRS) Surface Reflectance data through EarthExplorer.usgs.gov. Surface Reflectance products provide an estimate of the surface spectral reflectance as it would be measured at ground level in the absence of atmospheric scattering or 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 (ESPA) on-demand interface corrects satellite images for atmospheric effects to create Level-2 data products. Landsat 8 Surface Reflectance data are generated from the Landsat Surface Reflectance Code (LASRC). LASRC makes use of the coastal aerosol band to perform aerosol inversion tests, uses auxiliary climate data from MODIS and uses a unique radiative transfer model. Additionally, LASRC hardcodes the view zenith angle to 0°, and the solar zenith and view zenith angles are used for calculations as part of the atmospheric correction. Details about LASRC and Landsat 8 Surface Reflectance data products can be found in the [Landsat 8 Surface Reflectance Product Guide](#).

The following date ranges apply to the availability of the Landsat archive for Surface Reflectance processing:

- Landsat 8 OLI/TIRS: April 2013 to Present

Most Landsat 8 Collection 1 Level-1 scenes in the USGS archive can be processed to Surface Reflectance. Please note the following caveats:

- Surface Reflectance is not run for a scene with a solar zenith angle greater than 76°
- Users are cautioned against processing data acquired over high latitudes (> 65°) to Surface Reflectance.
- Efficacy of Surface Reflectance correction will be likely reduced in areas where atmospheric correction is affected by adverse conditions:
 - Hyper-and/or snow-covered regions
 - Low sun angle conditions
 - Coastal regions where land area is small relative to adjacent water
 - Areas with extensive cloud contamination



Landsat 8 OLI/TIRS Surface Reflectance acquired April 5, 2017 (Path 34, Row 41)

VNP09GA: VIIRS/NPP Surface Reflectance Daily L2G Global 1km and 500m SIN Grid V001

Description

The Visible Infrared Imaging Radiometer Suite (VIIRS) daily surface reflectance (VNP09GA) Version 1 product provides an estimate of land surface reflectance from the Suomi National Polar-Orbiting Partnership (S-NPP) VIIRS sensor. Data are provided for three imagery bands (I1, I2, I3) at nominal 500 meter resolution (~463 meter) and nine moderate-resolution bands (M1, M2, M3, M4, M5, M7, M8, M10, M11) at nominal 1 kilometer (~926 meter) resolution. The 500 meter and 1 kilometer datasets are derived through resampling the native 375 meter and 750 meter VIIRS resolutions, respectively, in the L2 input product. These bands are corrected for atmospheric conditions such as the effects of molecular gases, including ozone and water vapor, and for the effects of atmospheric aerosols.

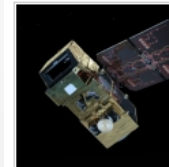
The inputs to the surface reflectance algorithm are top-of-atmosphere reflectance for the VIIRS visible bands, VIIRS cloud mask, aerosol optical thickness and aerosol models, and atmospheric data obtained from the NOAA National Centers for Environmental Prediction (NCEP) reanalysis system. Along with the twelve reflectance bands are reflectance band quality, sensor



VNP09GA, Acquired January 6, 2015. The H02V05, Western US

S-NPP VIIRS

Sentinel-2 MSI



The Sentinel-2 mission comprises a constellation of two polar-orbiting satellites placed in the same orbit, phased at 180° to each other. It aims at monitoring variability in land surface conditions, and its wide swath width and high revisit time (10 days at the equator with one satellite, and 5 days with 2 satellites under cloud-free conditions which results in 2-3 days at mid-latitudes) will support monitoring of changes to vegetation within the growing season. The coverage limits are from between latitudes 56° south and 84° north.

For mission planning information, see the [Copernicus Mission pages](#).

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.

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 corrected for atmospheric conditions such as gasses, aerosols, and Rayleigh scattering. Provided along with the 500 m reflectance and four observation bands are a set of nine 1 km observation bands. The reflectance layers from the MOD09GA are used as the source data for many of the MODIS land products. Validation at stage 3 has been achieved for all MODIS Surface Reflectance products.

Improvements/Changes from Previous Versions

- Improvement to the aerosol retrieval and correction algorithm and use of new aerosol retrieval look-up tables.
- Refinements to the internal snow, cloud, and cloud shadow detection algorithms. Uses BRDF database to better constraint the different threshold used.
- Processes ocean bands to create a new Surface Reflectance Ocean product and provide QA data sets for these bands.
- Improved discrimination of salt pans from cloud and snow and flag salt pan in QA band.



MOD09GA, Acquired December 3, 2004. The H11V05, Southeast US.

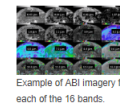
DOI 10.5067/MODIS/MOD09GA.006

Product Reflectance

GOES-16 ABI

NOAA GOES-R Series Advanced Baseline Imager (ABI) Level 2 Cloud and Moisture Imagery Products (CMIP)

ABI-L2-CMIP



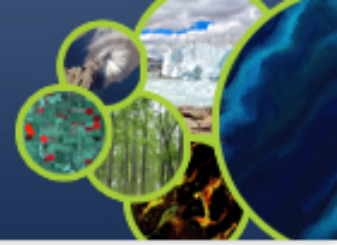
Example of ABI imagery for each of the 16 bands.

The Cloud and Moisture Imagery product contains one or more Earth-view images with pixel values identifying 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-earth pixels. Cloud and Moisture Imagery product files are generated for each of the sixteen Advanced Baseline Imager (ABI) reflective bands (channels 1 - 6 with approximate central wavelengths 0.47, 0.64, 0.865, 1.378, 1.61, 2.25 microns respectively) and emissive bands (channels 7 - 16 with approximate central wavelengths 3.9, 6.185, 6.95, 7.34, 8.5, 9.61, 10.35, 11.2, 12.3, 13.3 microns respectively). In addition, there is a multiband product file where the imagery at all bands is included. The imagery value for the [Show more...](#)

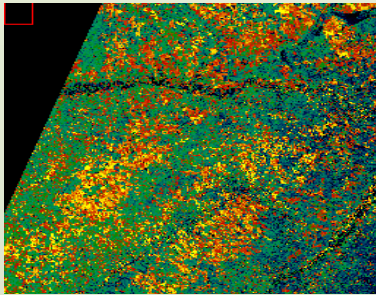
[Dataset Citation](#)

[Dataset Identifiers](#)

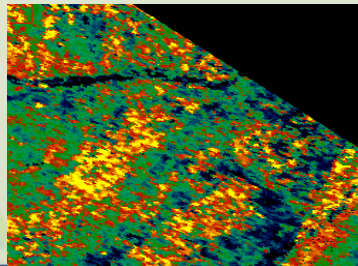
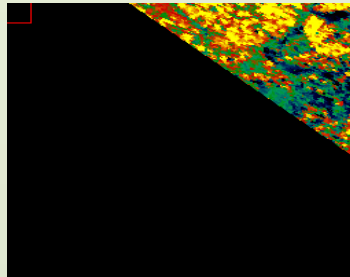
[ISO 19115-2 Metadata](#)



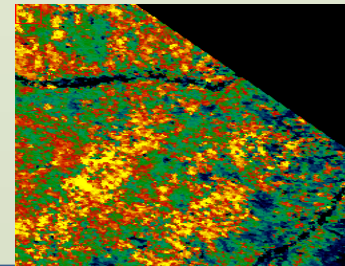
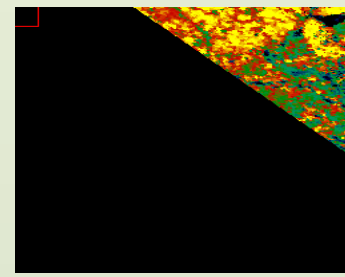
Landsat 8
1748 UTC



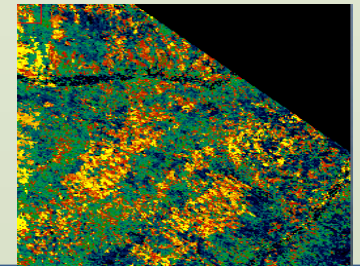
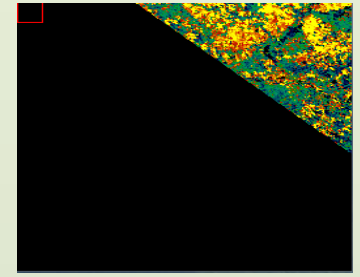
Terra MODIS
1717 & 1855 UTC



Aqua MODIS
1858 & 2038 UTC



S-NPP VIIRS
1933 & 2113 UTC



Visible Reflectance



Low

High

GOES-16 ABI

1717 UTC

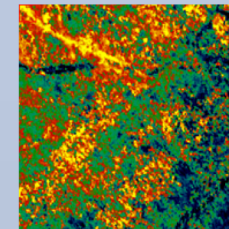
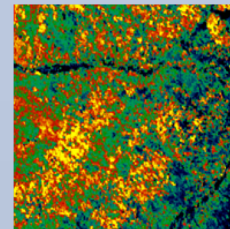
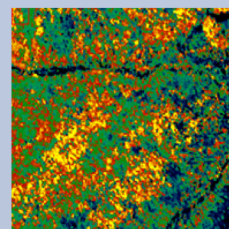
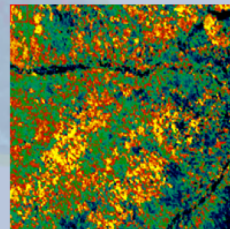
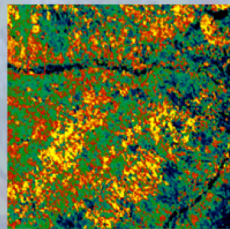
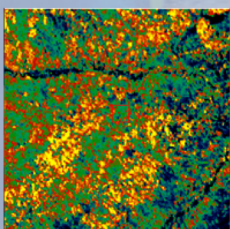
1747 UTC

1857 UTC

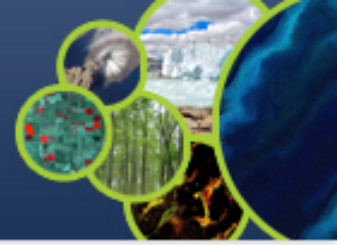
1932 UTC

2037 UTC

2112 UTC



G
E
O

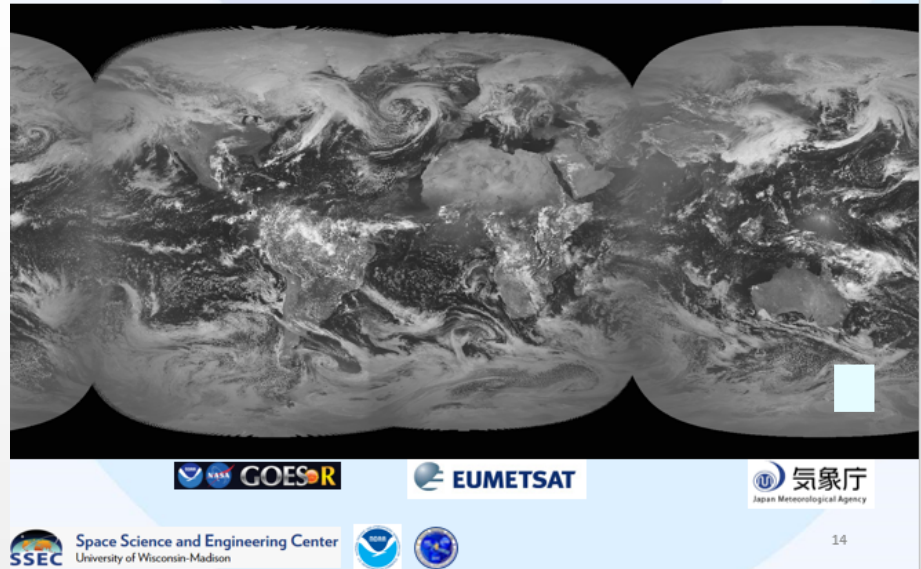


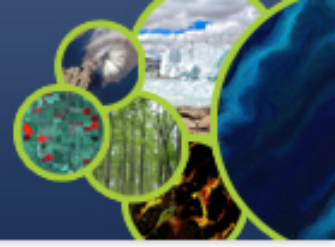
- Consider extending prototype to 20 days to allow for comparisons of greenness change (e.g.)
- The VCs and WGs are requested to consider their respective contributions (e.g., additional data/products) for the next step, a formal proposal as requested in response to SIT-33 action 14
- Coordinate with 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

Contacts: Kevin Gallo (kevin.p.gallo@noaa.gov) and Steve Labahn (labahn@usgs.gov)

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





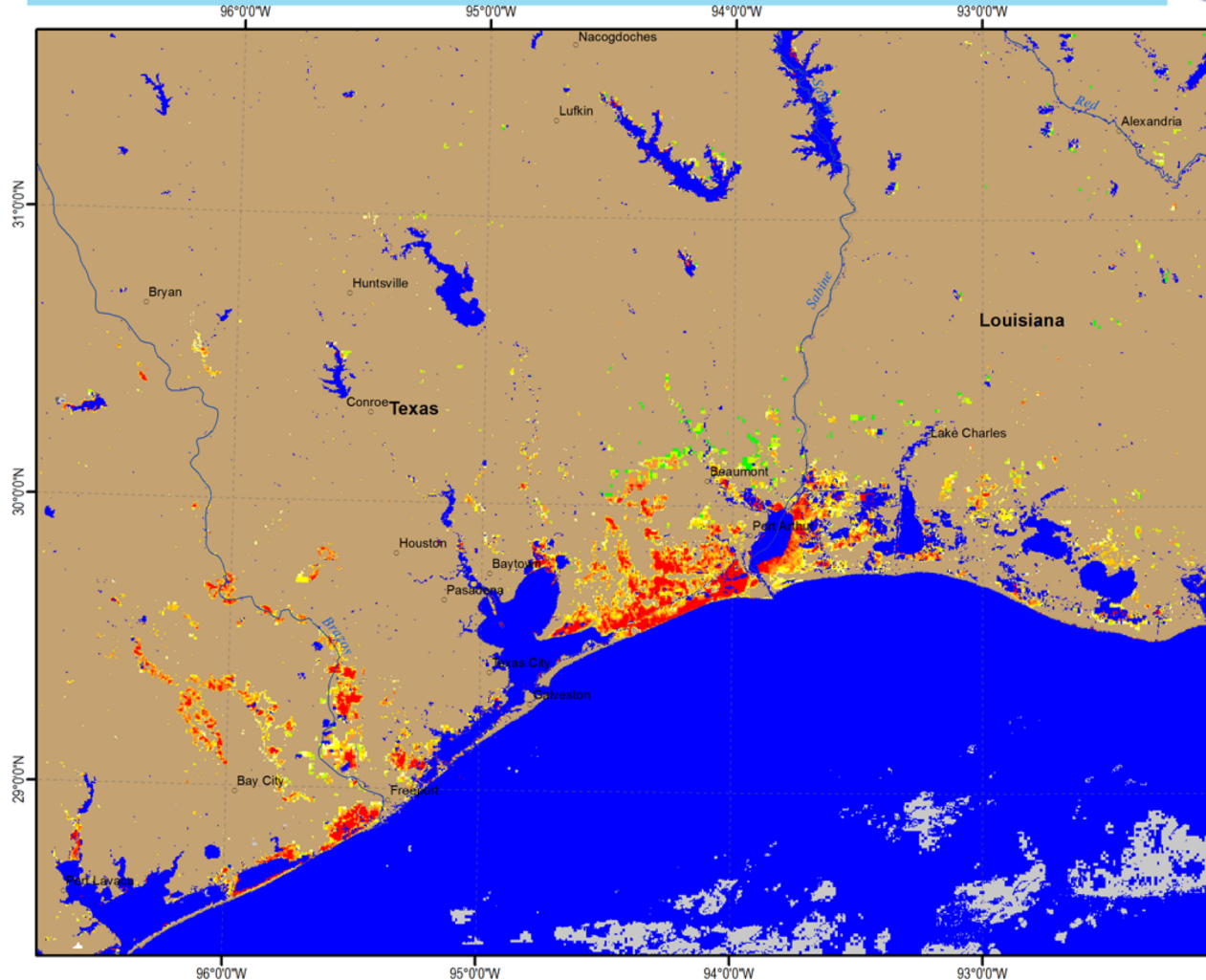
Flood Monitoring Initiative

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

0 6 12 24
 Miles



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

Legend

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

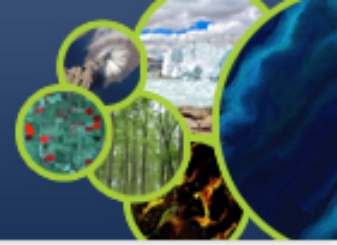
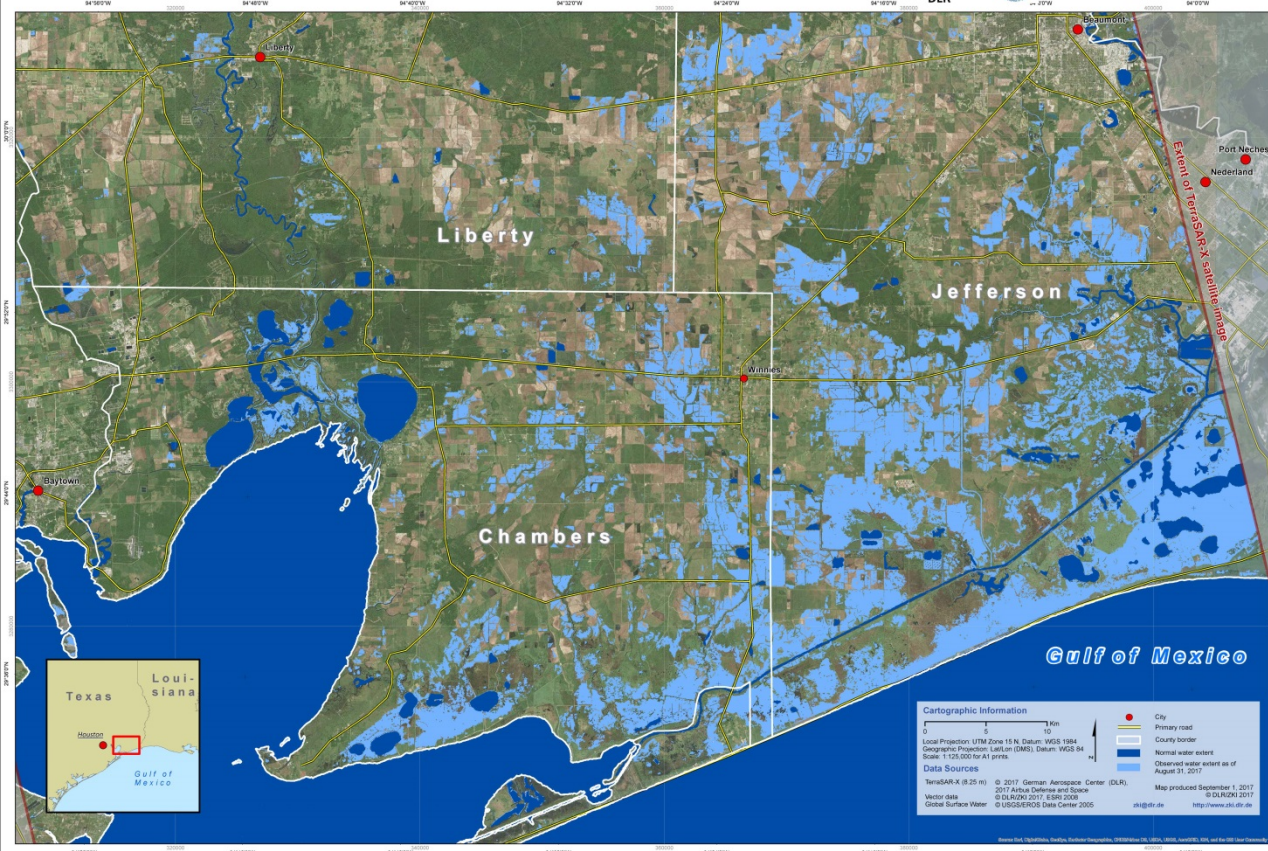
Data Source

Satellite Imagery
 Satellite/sensor: SNPP/VIIRS

GIS data
 Administrative boundary
 and cities: GDAM

Description

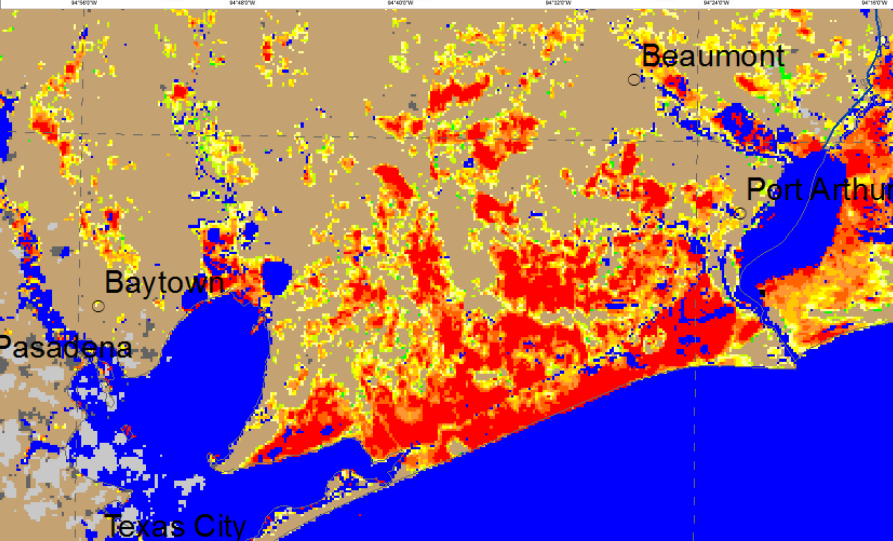
This flood map is merged from Suomi-NPP/VIIRS data around 20:03 (UTC) and GOES-16/ABI data around 15:30 (UTC) on Sep.01, 2017, which shows the flood extent under clear-sky coverage in West Gulf region of the USA due to Hurricane Harvey. Water fraction means open water percentage in a 375-m pixel.



Comparison with Sentinel-1 flood product

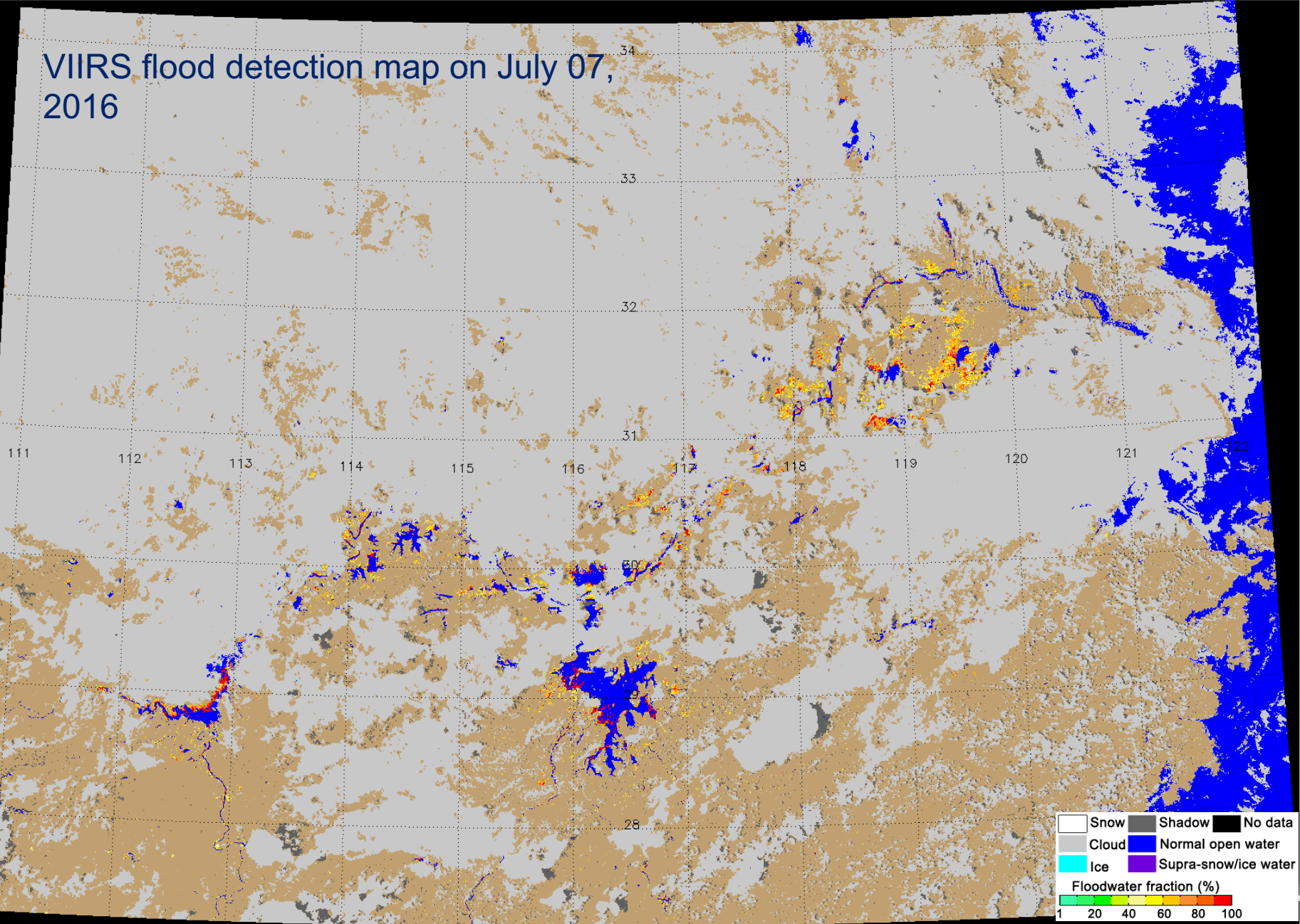
Sentinel-1 flood map on Aug. 31, 2017 in West Gulf region, USA

- Overall, VIIRS shows consistent flood detection results with Sentinel-1.



VIIRS 375-m flood map in the similar region with Sentinel-1 on Aug. 31, 2017

VIIRS flood detection map on July 07, 2016

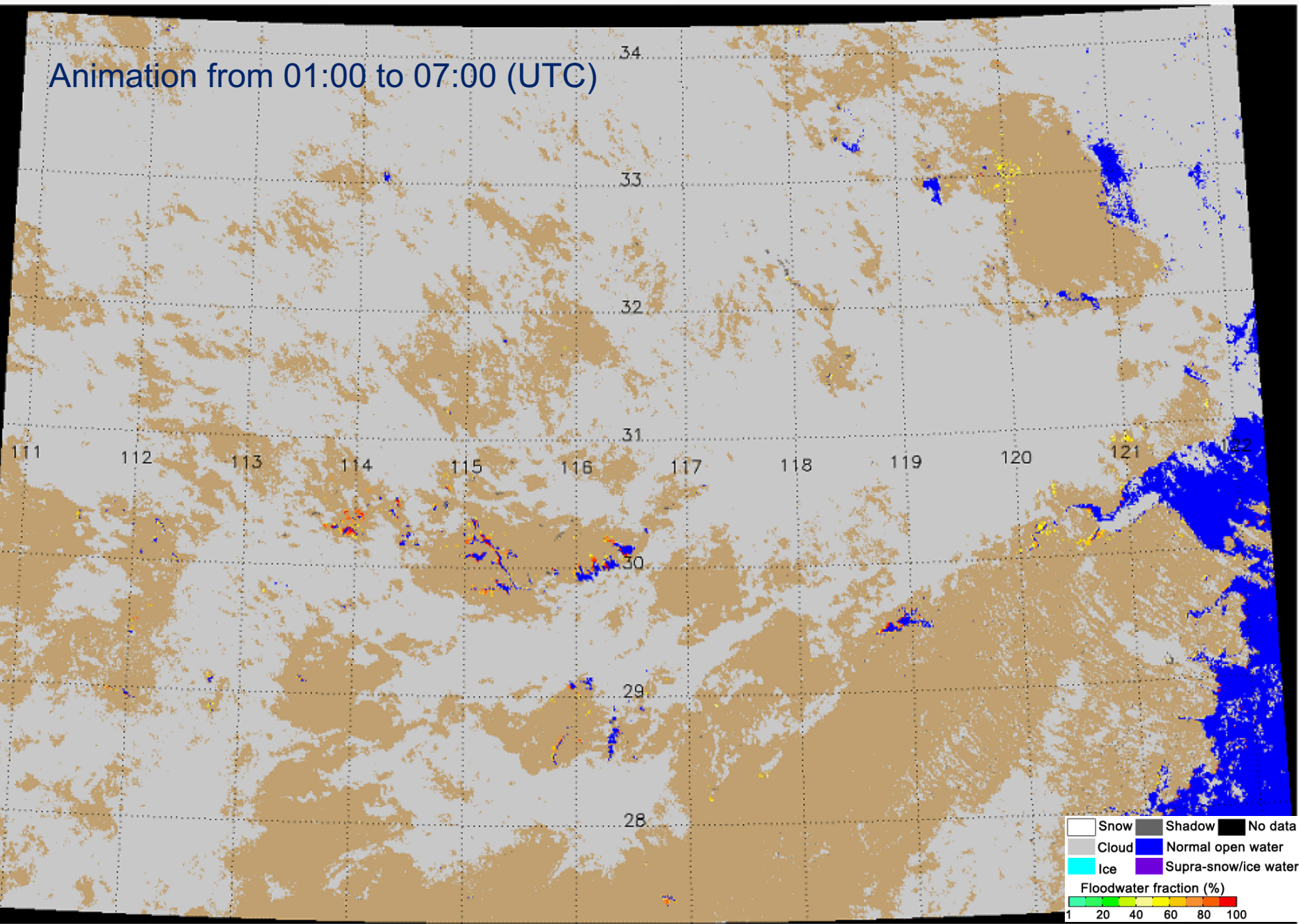


White	Snow	Black	Shadow	Dark Grey	No data
Light Grey	Cloud	Blue	Normal open water		
Cyan	Ice	Purple	Supra-snow/ice water		

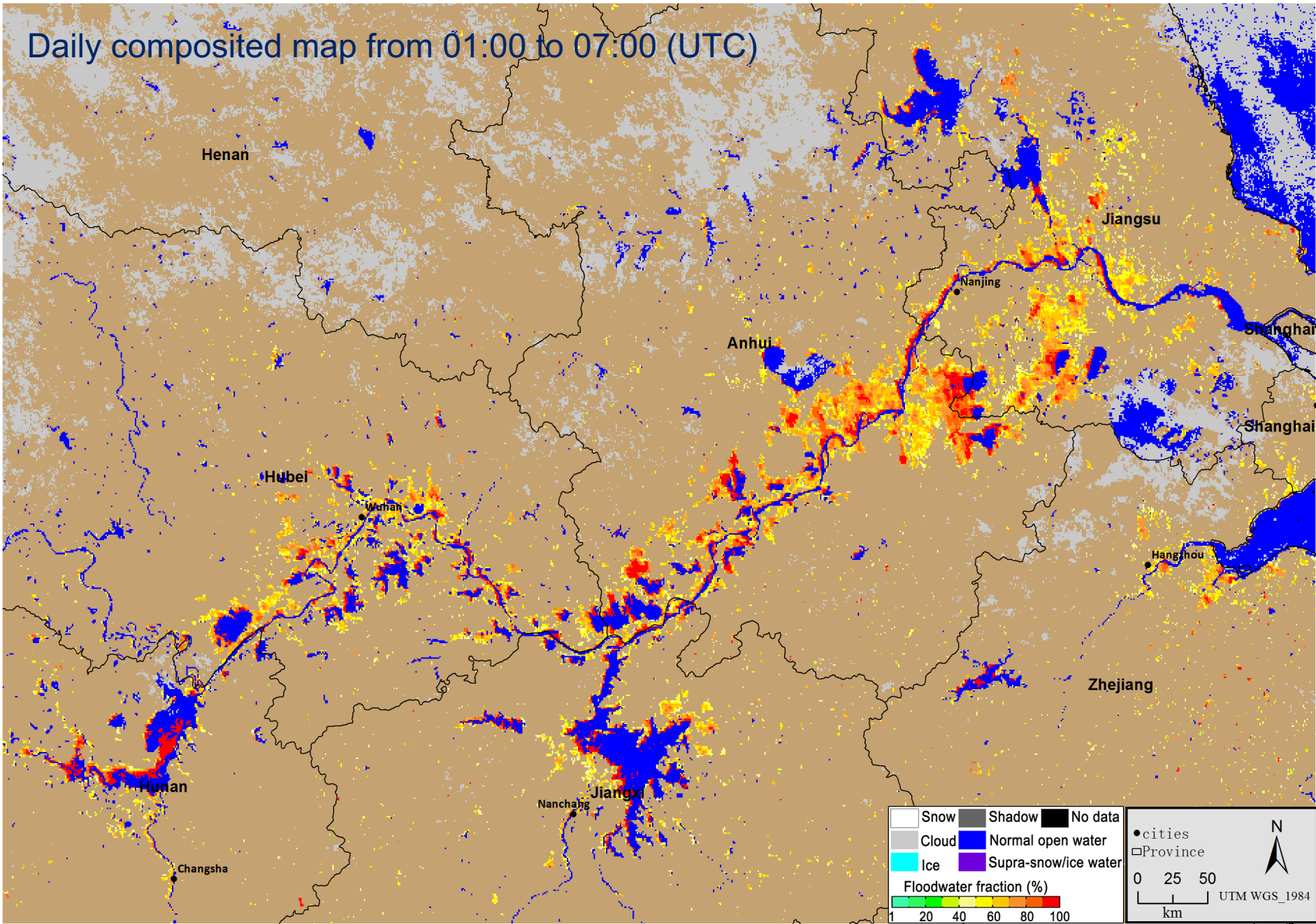
Floodwater fraction (%)

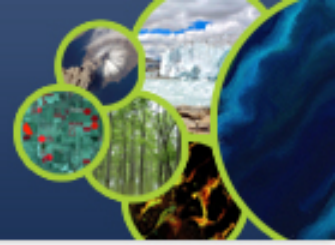
1 20 40 60 80 100

Animation from 01:00 to 07:00 (UTC)



Daily composited map from 01:00 to 07:00 (UTC)

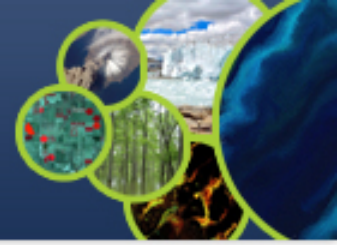




Comments and suggestions from Side Meeting

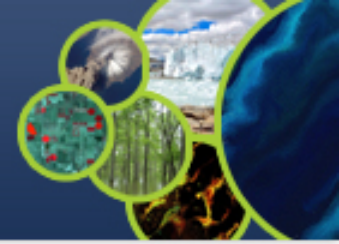
- Work with WG Disasters on a flood pilot – lots of overlapping interest
- Consider additional data sources beyond just VIIRS and Geo Imagers (e.g., SAR)
- Coordinate with WGCapD
- Involve GEO

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**

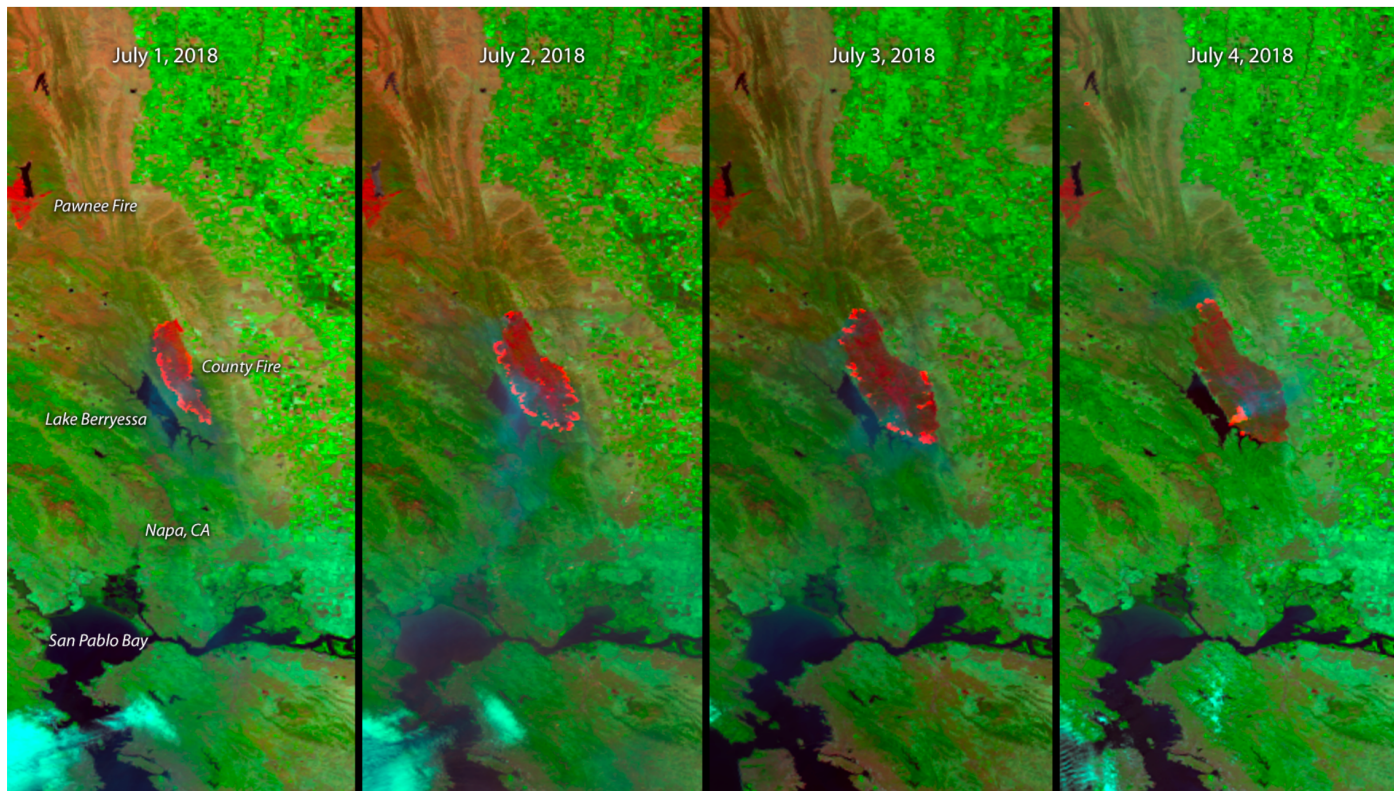


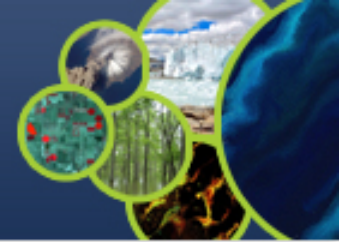
Fire and Smoke Detection - VIIRS

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

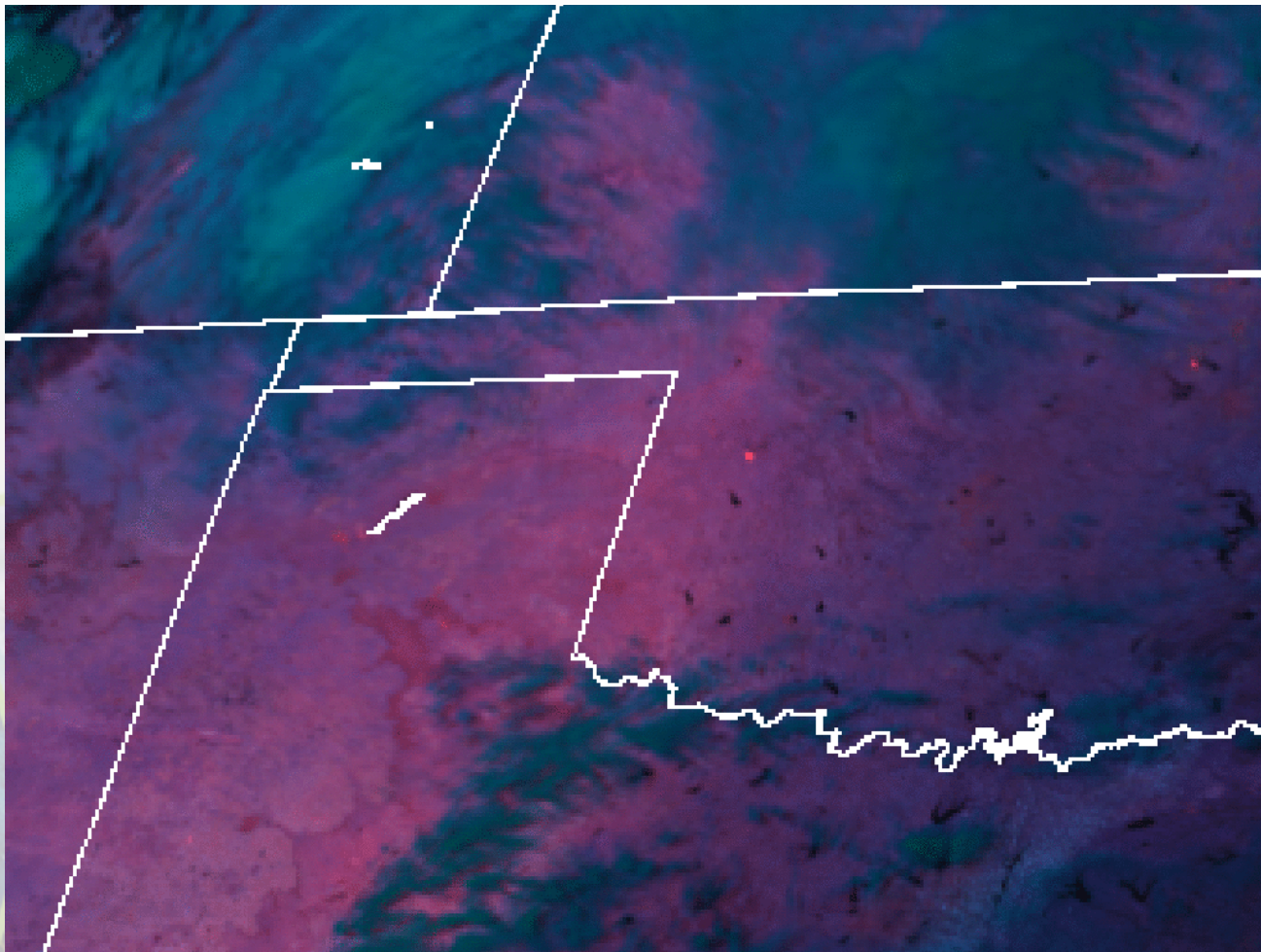
July 05, 2018

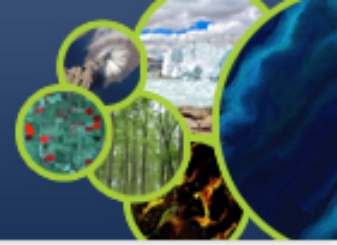
The Expanding County Fire in Northern California



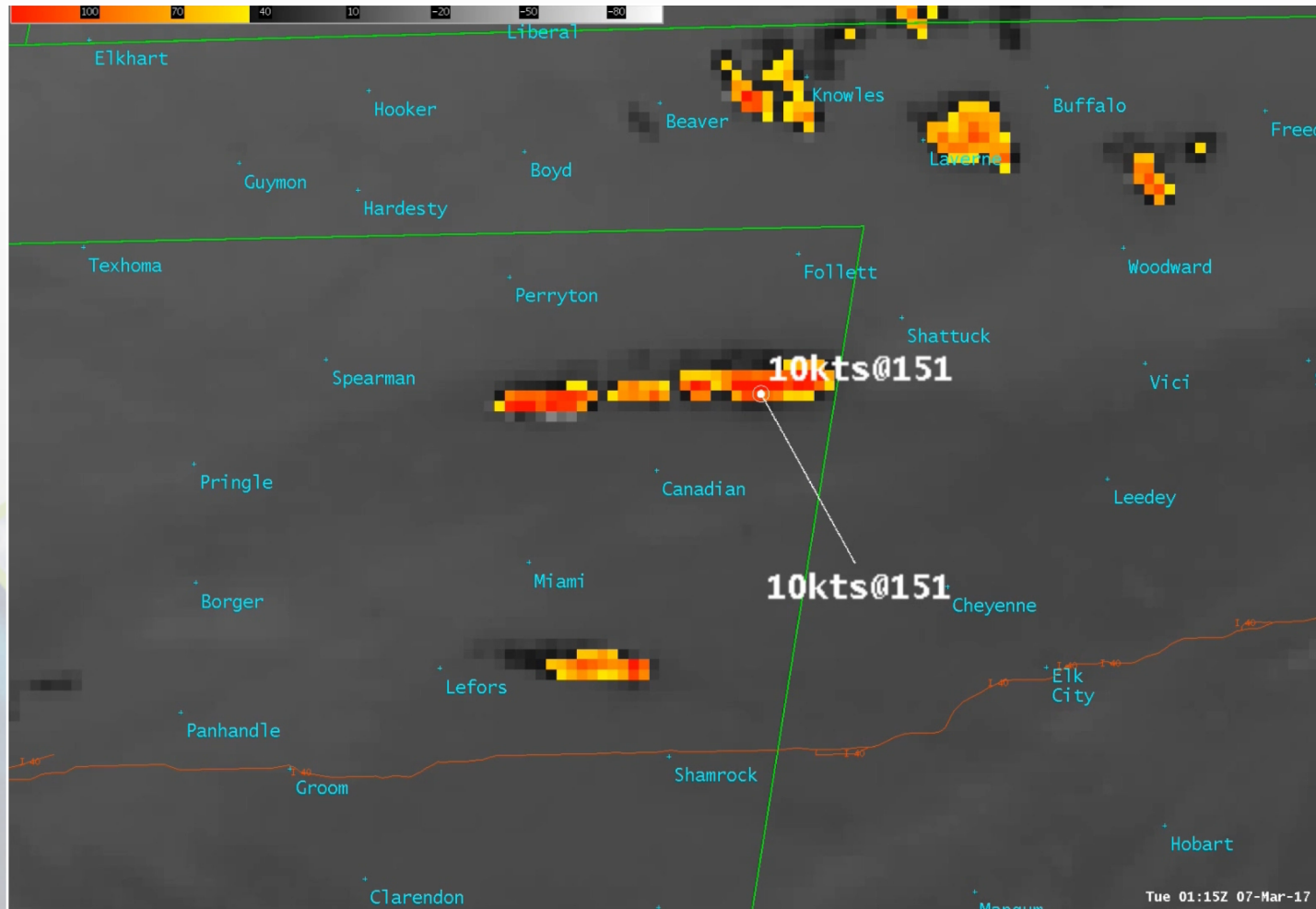


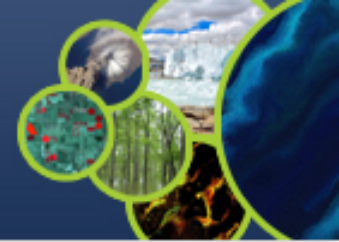
Fire and Smoke Detection – GOES-16



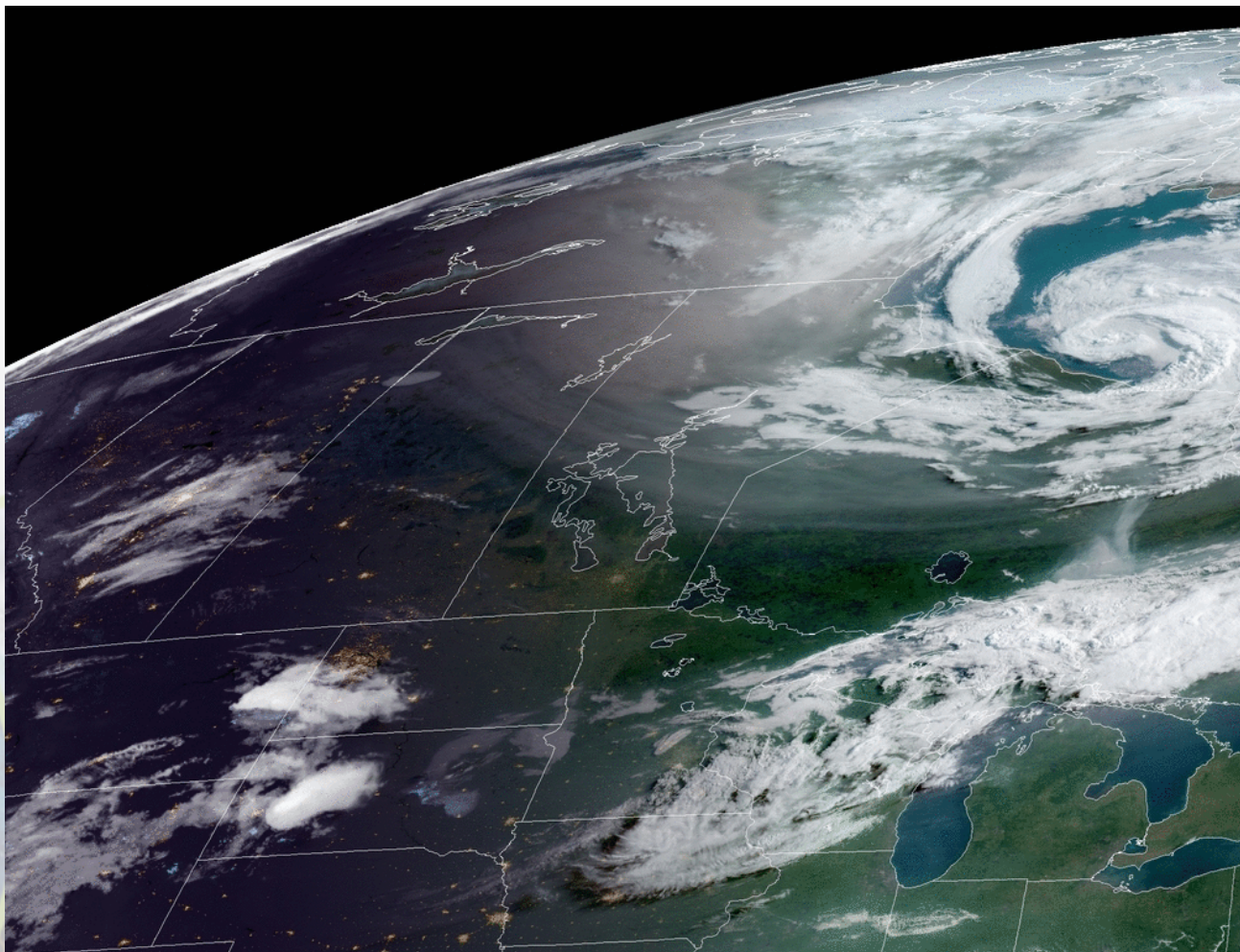


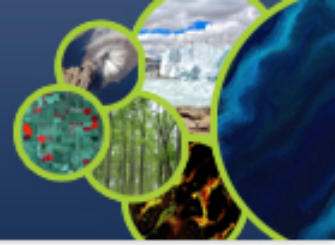
Fire and Smoke Detection – GOES-16





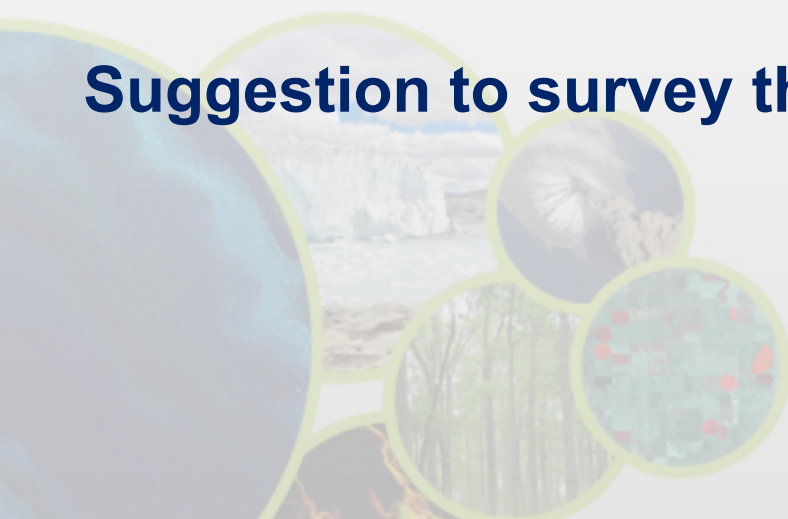
Fire and Smoke Detection – GOES-16





- 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.



- 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, VNASC, 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.