CSPP Geo Status and Plans

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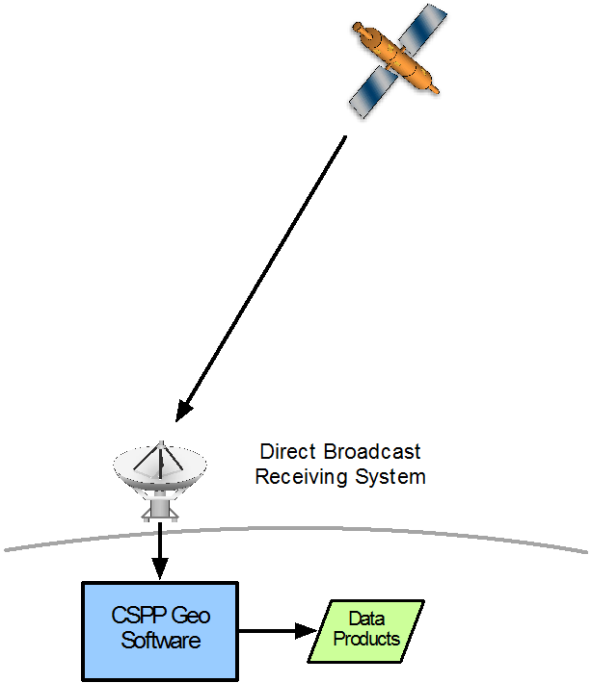
What is CSPP Geo?

- CSPP Geo = “Community Satellite Processing Package for Geostationary Data”
- The CSPP Geo project creates and distributes software allowing direct broadcast users to create products from geostationary satellite data
- The project draws on experience creating software allowing direct broadcast users to process data from polar orbiters (CSPP and IMAPP projects)
- Funded by the GOES-R Program Office
- Supported missions: **GOES-16, Himawari-8, GOES-13 and -15**
- Using Level 2 algorithms that were developed for ABI
- Users include vendors of DB receiving stations, US government, international Met agencies, research institutions



Software philosophy

- CSPP Geo software is:
  - ⇒Publicly available and free of charge: http://cimss.ssec.wisc.edu/csppgeo/
  - ⇒Distributed as binary packages for 64-bit CentOS6-compatible Linux
  - ⇒Distributed with all required 3rd party software bundled
  - ⇒Easy to install and run
  - ⇒Released with an optional test data package
  - ⇒High level of user support
- Software is intended to be run on rack-mounted commodity hardware
- Recommended hardware specs for each software package are on the CSPP Geo website
- Ancillary data is staged on servers at the U. of Wisconsin
- Generally Level 2 software is developed in collaboration with scientists, while Level 1 software may be developed from scratch

Project personnel and collaborators

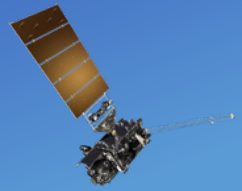
The CSPP Geo team: Liam Gumley (Principal Investigator), Graeme Martin (Project Manager), Nick Bearson, Jessica Braun, Geoff Cureton, Alan DeSmet, Ray Garcia, Tommy Jasmin, Scott Mindock, Eva Schiffer, Kathy Strabala

NOAA / AIT: Walter Wolf, Shanna Sampson and team

GEOCAT: Mike Pavolonis

GOES-R Cloud team: Andy Heidinger (lead), Corey Calvert, Pat Heck, William Straka, Andy Walther, Steve Wanzong

Imagery: Tim Schmit, Kaba Bah, Jordan Gerth, Mat Gunshor



GOES-16

- GOES-16 is the first of a new generation of U.S. geostationary satellites
- Launched in November 2016
- Location during checkout is W 89.5°
  - ⇒Will be moved to GOES-East position (W 75°) when it becomes operational in November 2017
- GOES-16 has a direct broadcast stream called GOES Rebroadcast (GRB)
- GRB receiving systems are currently available from vendors
  - ⇒NOAA list of GRB receiving station vendors: http://www.goes-r.gov/users/docs/GRB_ReceivingSystemManufacturersList.pdf
- More information at http://www.goes-r.gov/

GOES-16 instruments:

Advanced Baseline Imager (ABI)
Geostationary Lightning Mapper (GLM)
Solar Ultraviolet Imager (SUVI)
Space Environment In-Situ Suite (SEISS)
Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS)
Magnetometer (MAG)

GOES-16 L1B observed data volumes

Raw data:

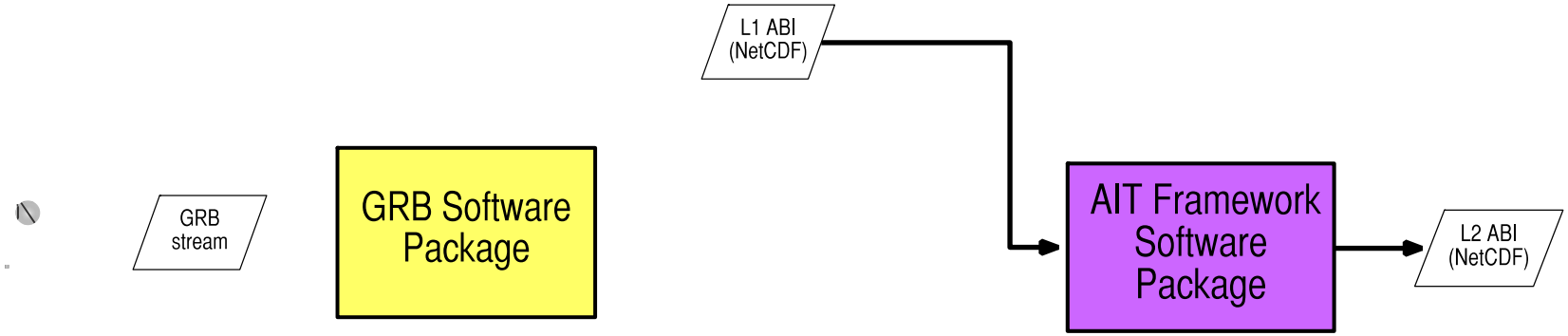
	GOES 13/15 (GVAR)	GOES-16 (GRB)
Data rate	2.1 Mbps	31 Mbps
Raw data volume	21.5 GB/day	310 GB/day
Raw data volume (idle / null data removed)	14.24 GB/day	99 GB/day (Mode 3) 150 GB/day (Mode 4)

ABI L1B Products (NetCDF):

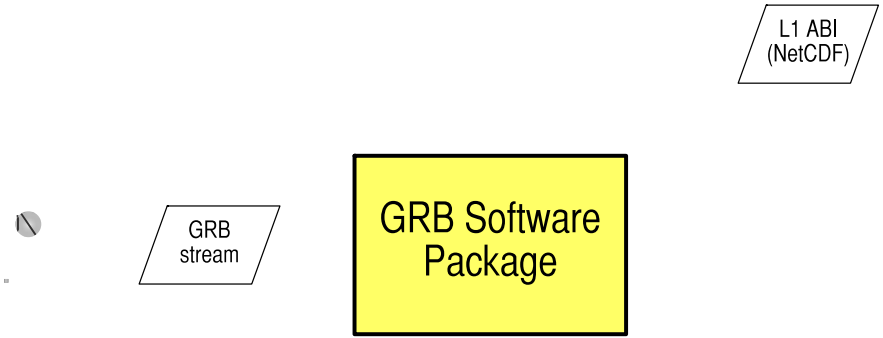
uncompressed	550GB/day (Mode 3)
compressed	135-140 GB/day (Mode 3) 215 GB/day (Mode 4)

Based on representative samples of data volumes observed at U. Wisconsin GRB receiving station during PLT

GOES-R Processing Chain



The GRB Software Package

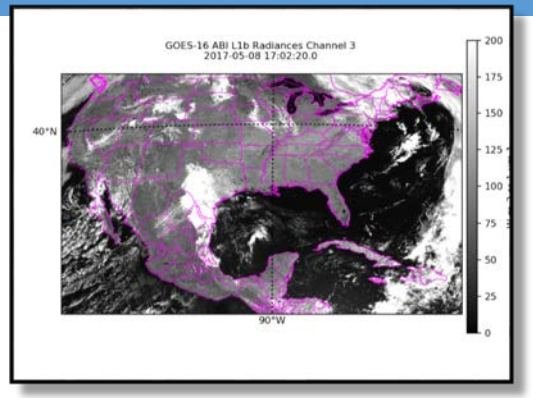


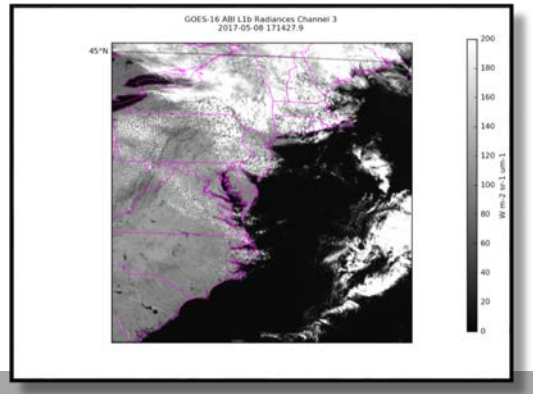
- Runs as a server, processing the raw GRB data stream
  - ⇒ reads CADUs from two sockets
- Ingestor component is a modified version of NASA RT-STPS
- Extracts data payloads, decompresses, reconstructs datasets as they were created on the Ground Segment
- Generates products from all GOES-R instruments
  - ⇒ Level 1 ABI and space weather, Level 2 GLM
- Requires multiple cores, hardware specs published on website
- Includes an experimental tracking interface allowing data to be used as it arrives

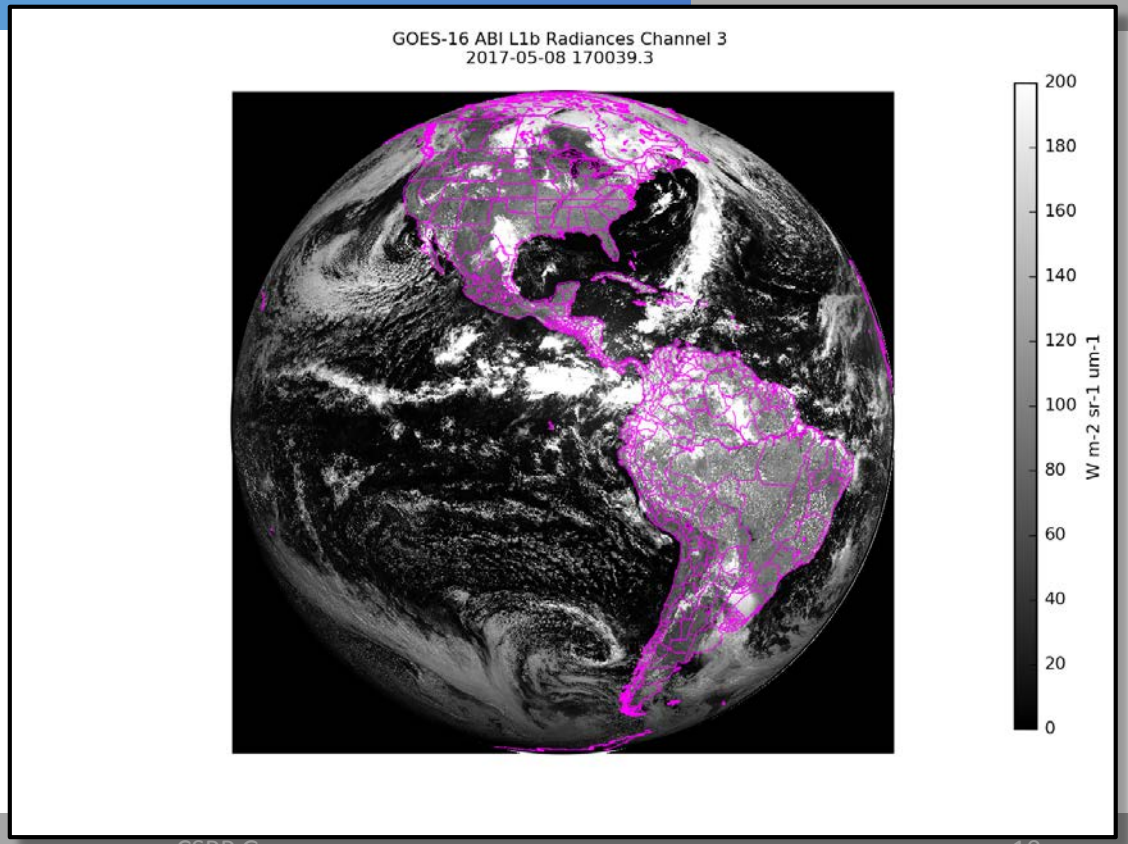
GRB: the first 6 months

- GRB stream was turned on Dec 2016, instruments have been added one-by-one
  - ⇒Currently the GRB stream includes data from all GOES-R instruments except GLM
- Since then have released interim "dev snapshot" versions of the GRB package incorporating the latest software improvements needed to process real data
  - ⇒Interim release GRB v0.4.4 is available from the user forum
- Feedback indicates users are integrating the dev snapshot versions and are routinely generating products
- Will release GRB v1.0 after GLM has been added
- Running software on data from our GRB antenna
- PLT activities via Jim McNitt / GRB User Group
  - ⇒Notifications of events affecting GRB, mechanism for reporting issues affecting the GRB stream
- Standard disclaimer: *"These GOES-16 data are preliminary, non-operational data and are undergoing testing. Users bear all responsibility for inspecting the data prior to use and for the manner in which the data are utilized."*

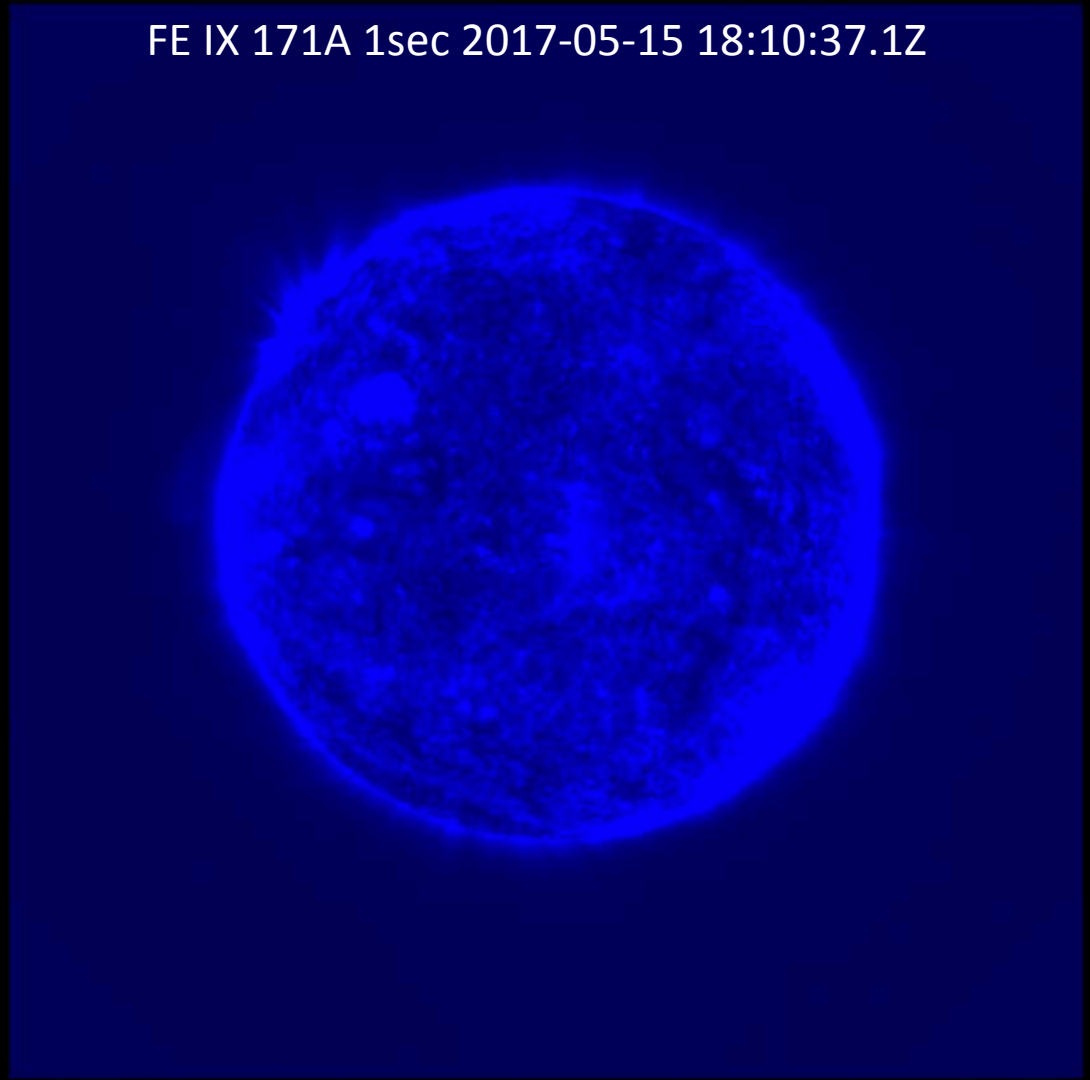
GRB Package Quicklooks







SUVI



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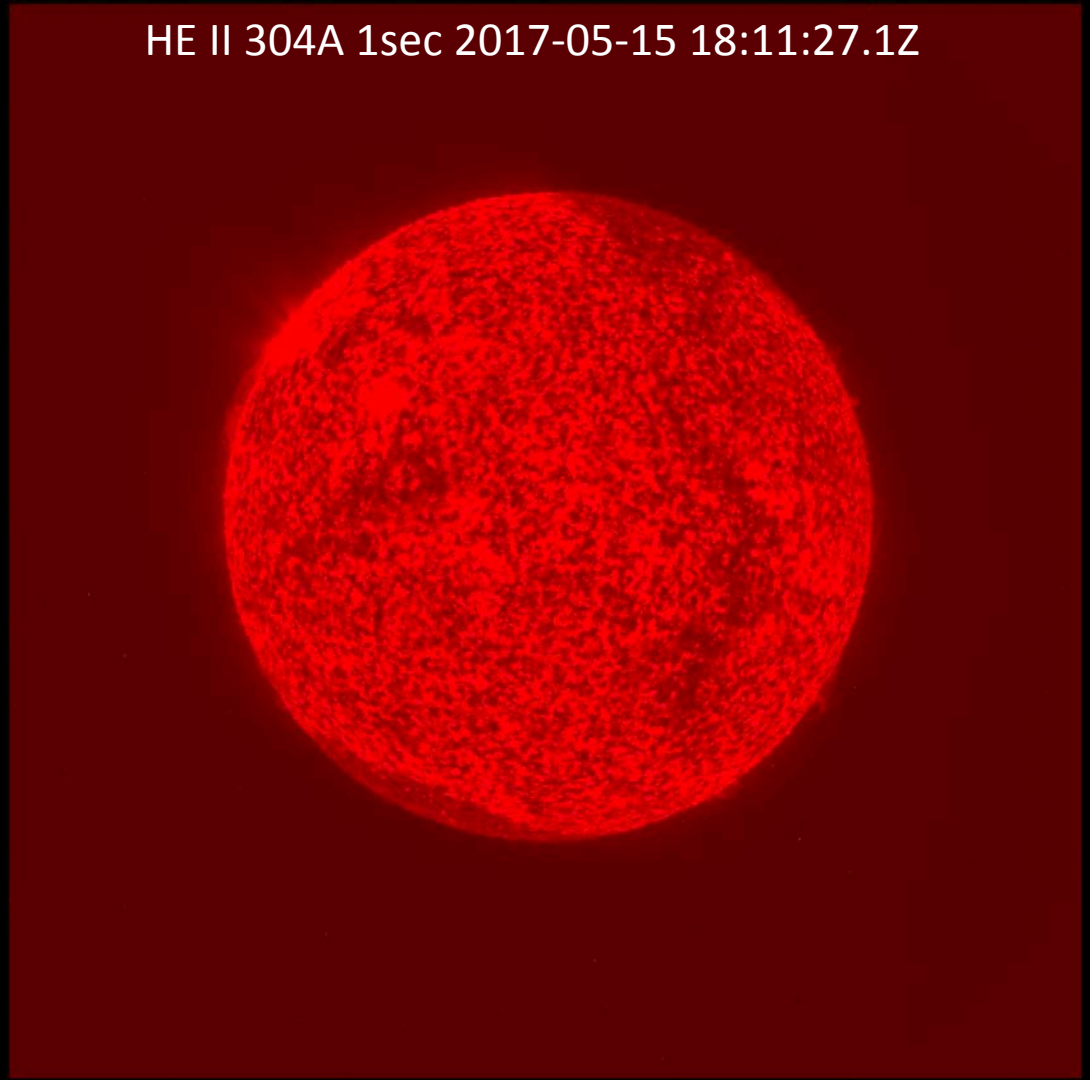

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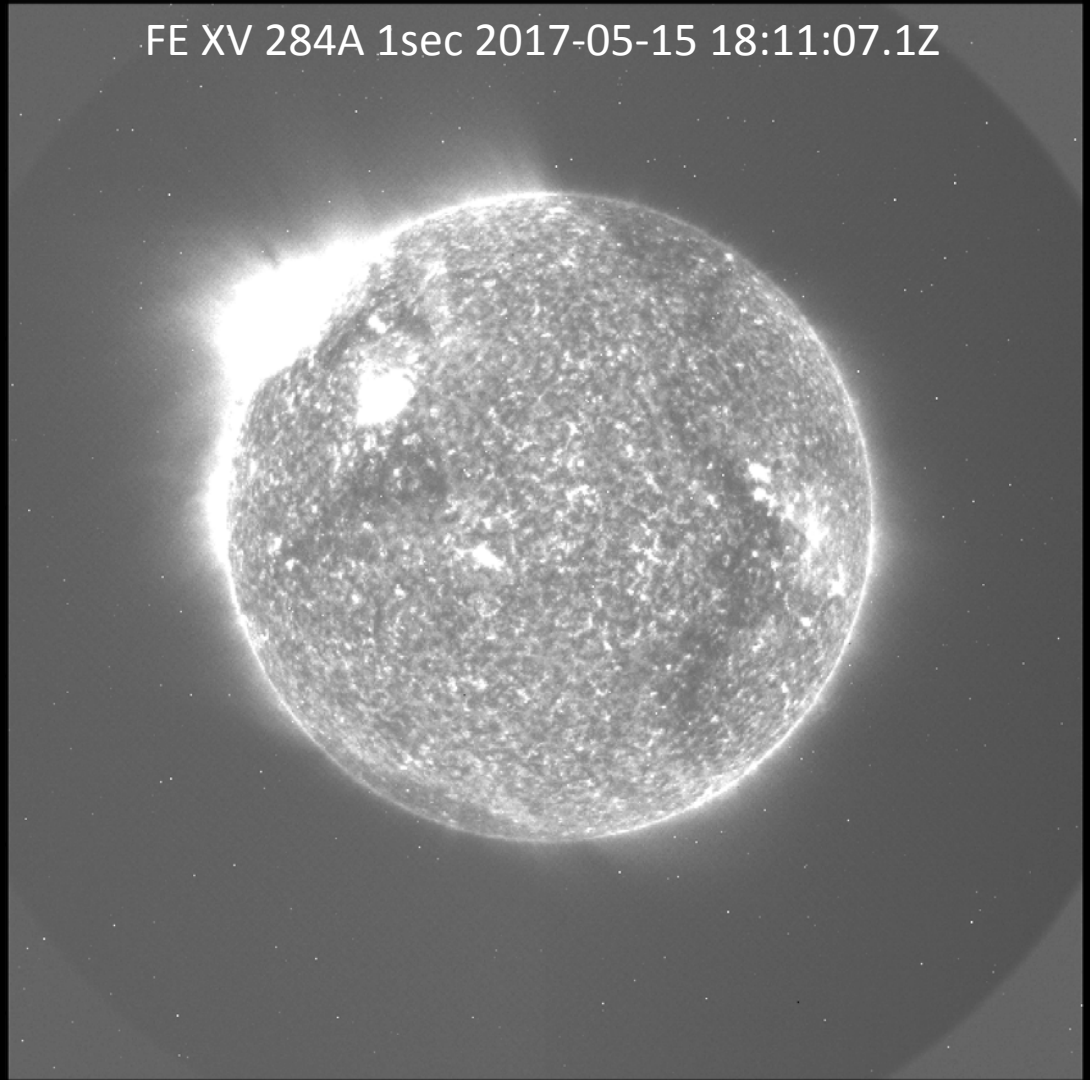

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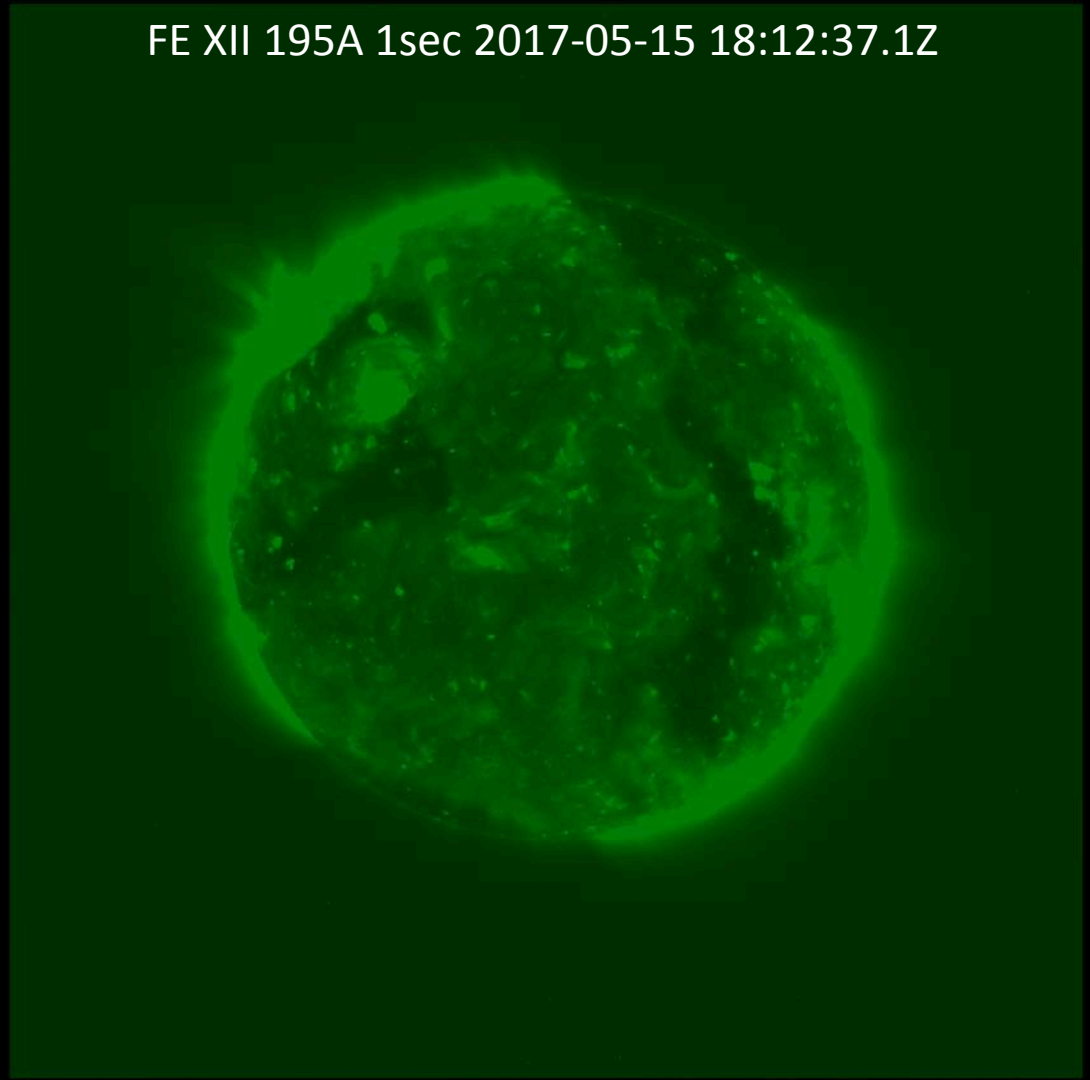

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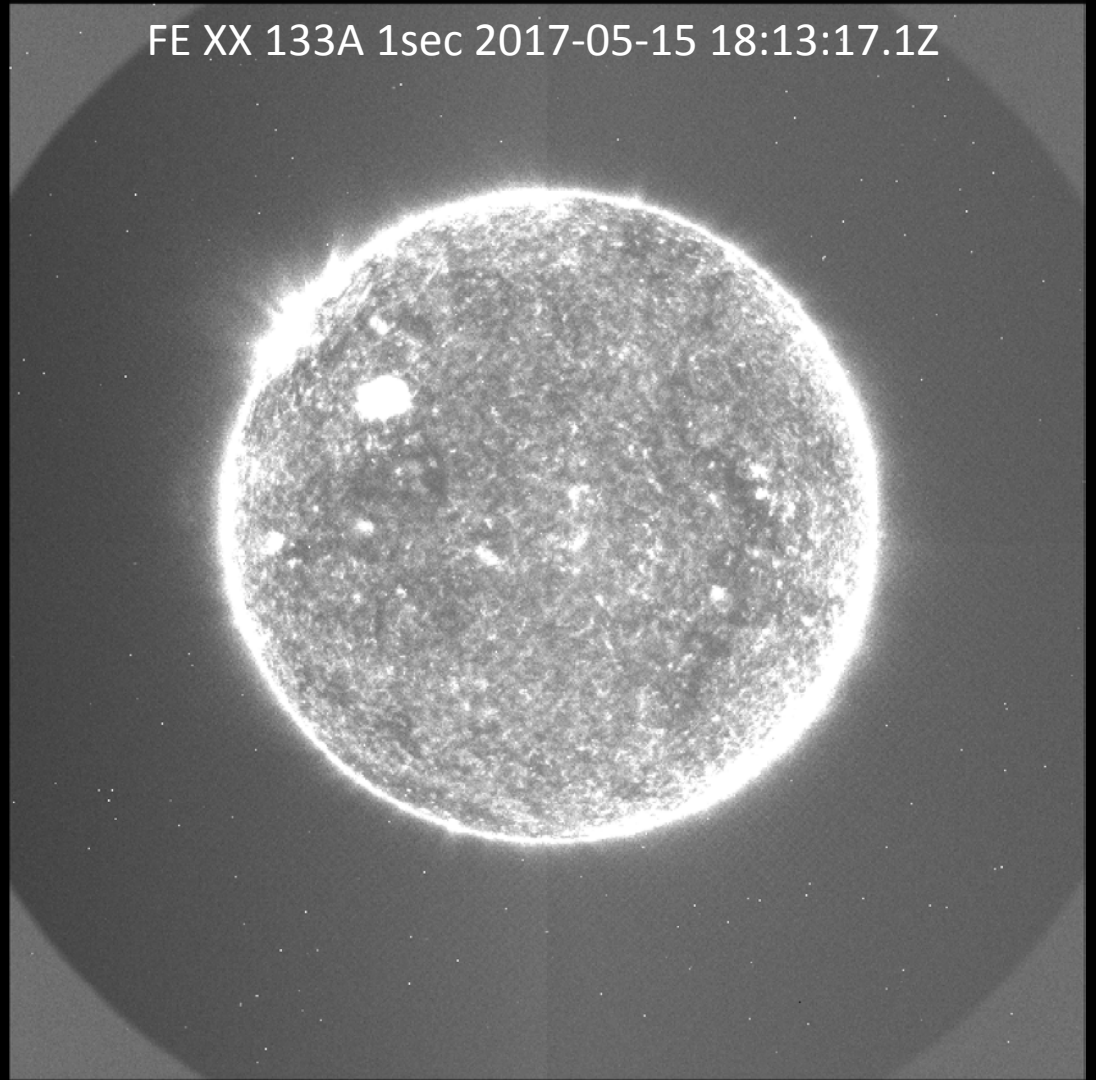
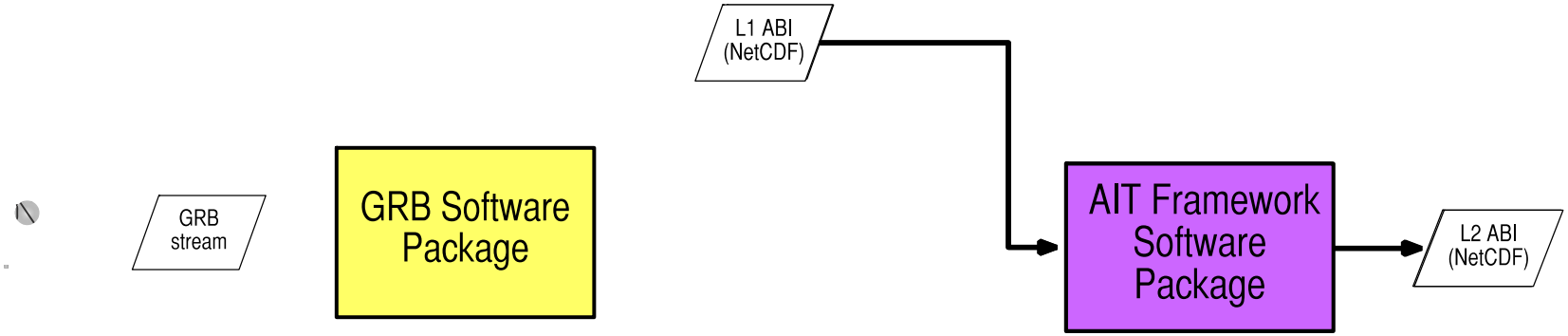


GOES-R Processing Chain



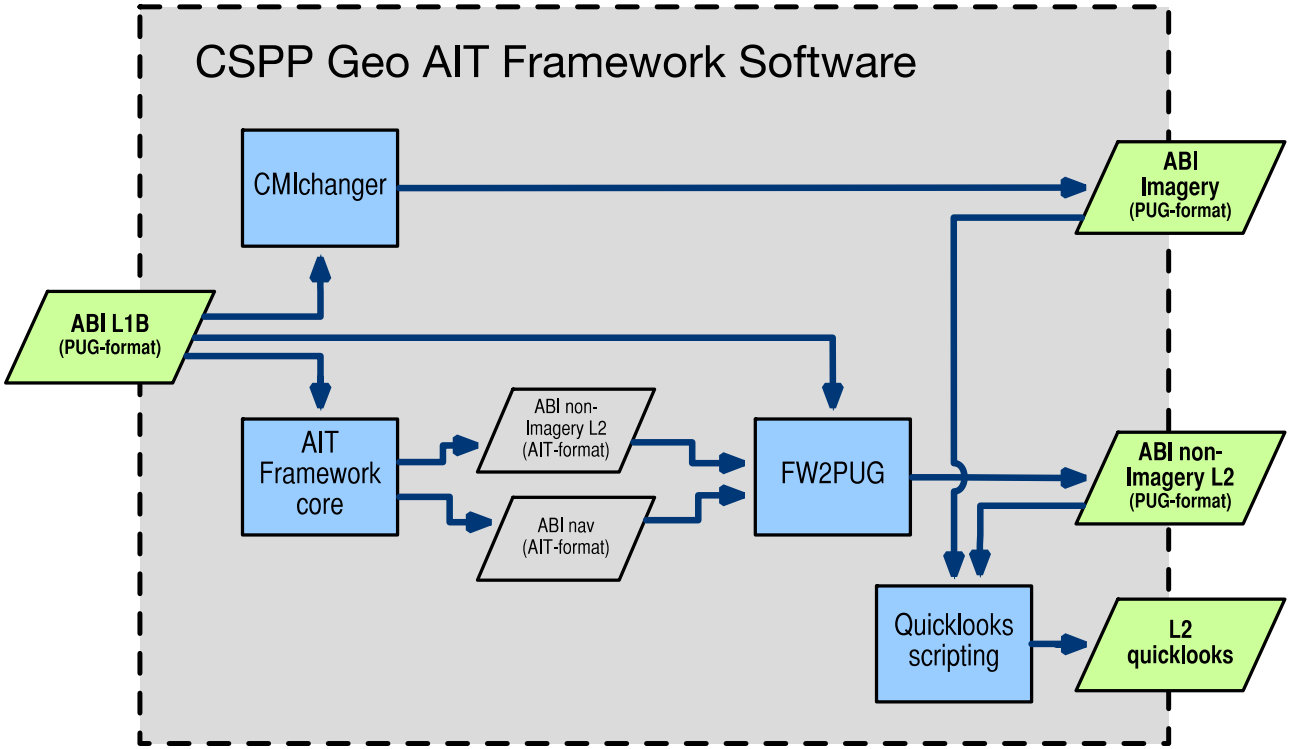
The AIT Framework Software Package

- Further processes ABI L1B data to generate Level 2 products
- AIT is the “Algorithm Integration Team” at NOAA STAR
- The AIT Framework was developed by the AIT as an integration point for research implementations of GOES-R Level 2 research algorithm
- Initial version will generate a subset of the GOES-R Baseline products
- Alpha version has been released
  - ⇒Contact csppgeo.issues@ssec.wisc.edu to become an alpha tester
- Planning beta in August 2017, v1 to follow
- Later releases will add products and include updates to existing algorithms, LUTs, etc.

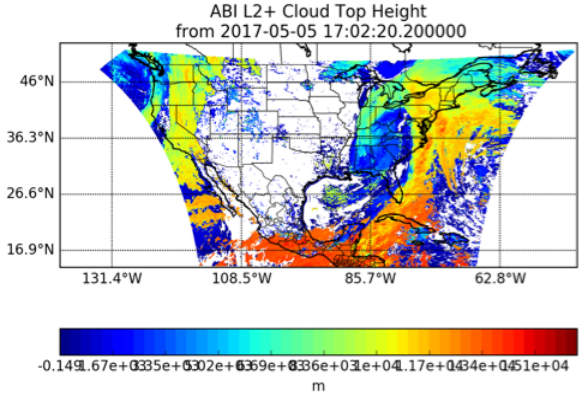
Initial set of products:

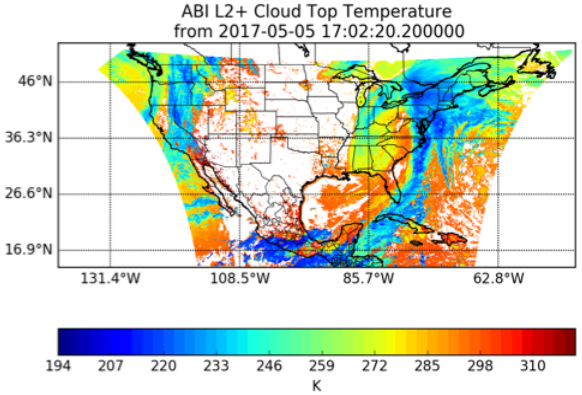
Aerosol Detection: Smoke and Dust
Aerosol Optical Depth
Clear Sky Masks
Cloud and Moisture Imagery
Cloud Optical Depth (day/night)
Cloud Particle Size Distribution (day/night)
Cloud Top Height
Cloud Top Phase
Cloud Top Pressure
Cloud Top Temperature
Land Surface Temperature (Skin)

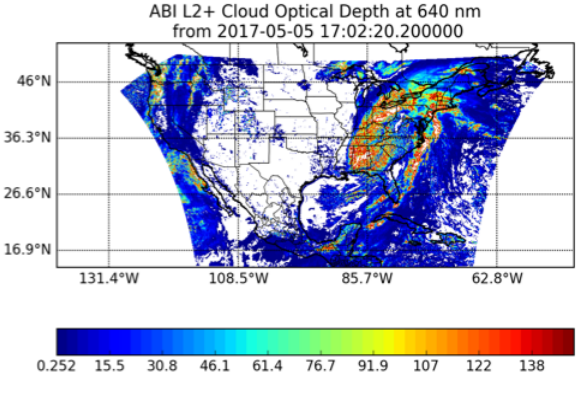
AIT Framework Software Package Internals

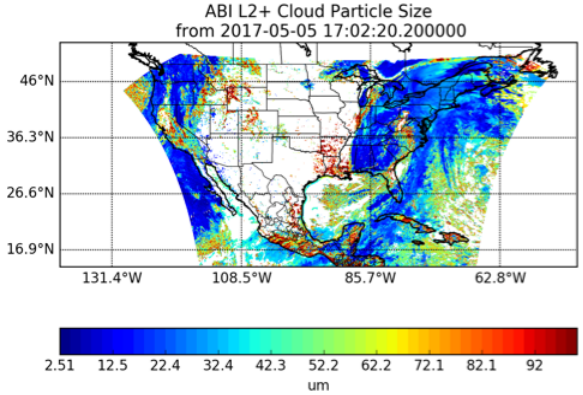


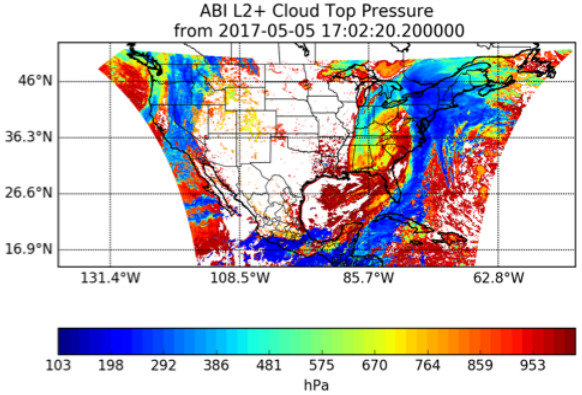
Example GOES-16 Level 2 products: CONUS

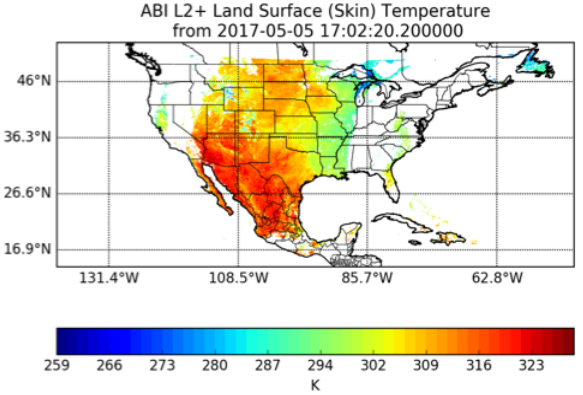




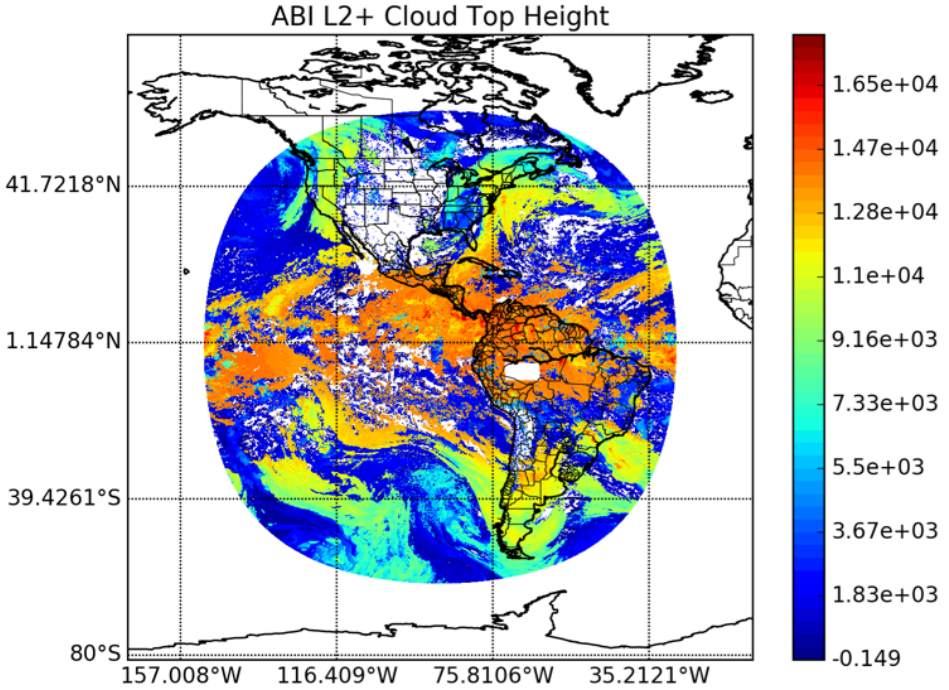


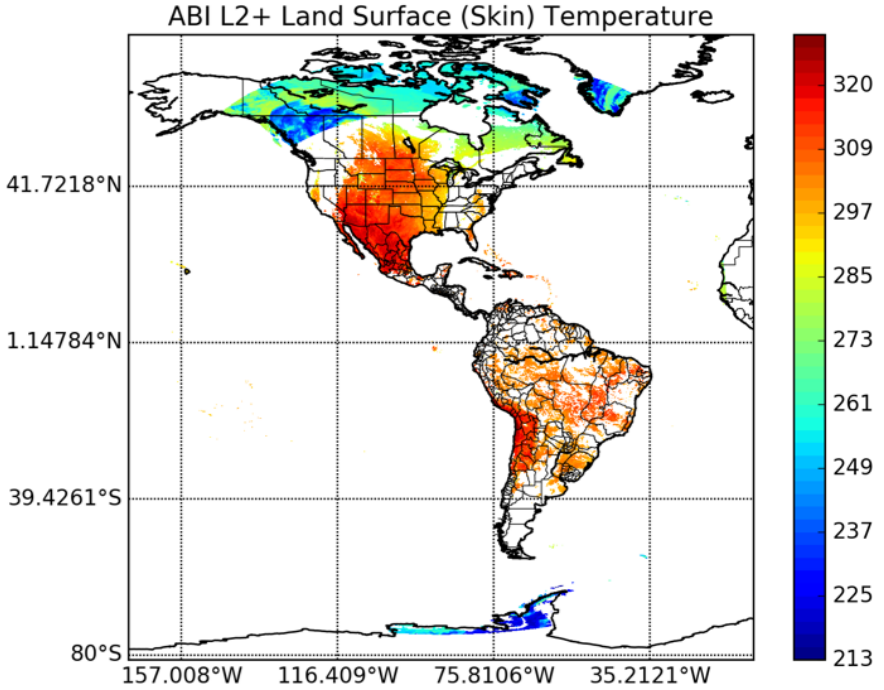






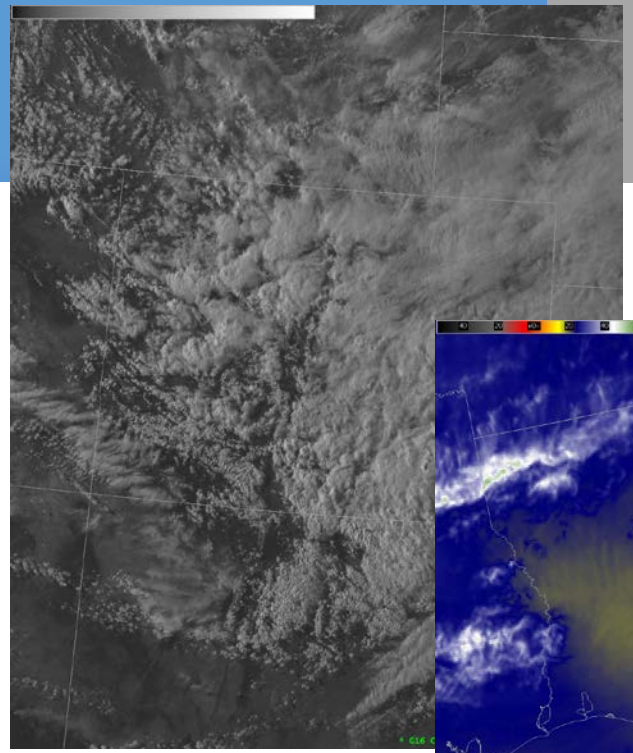
Example GOES-16 Level 2 products: Full Disk

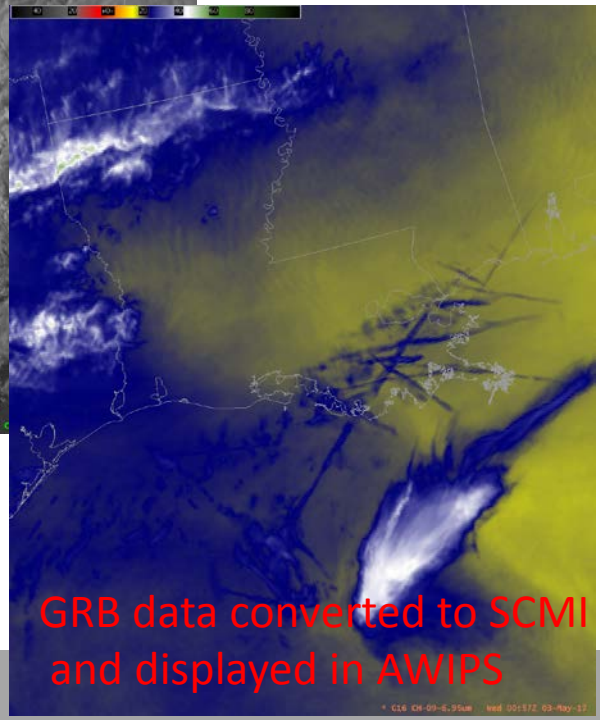


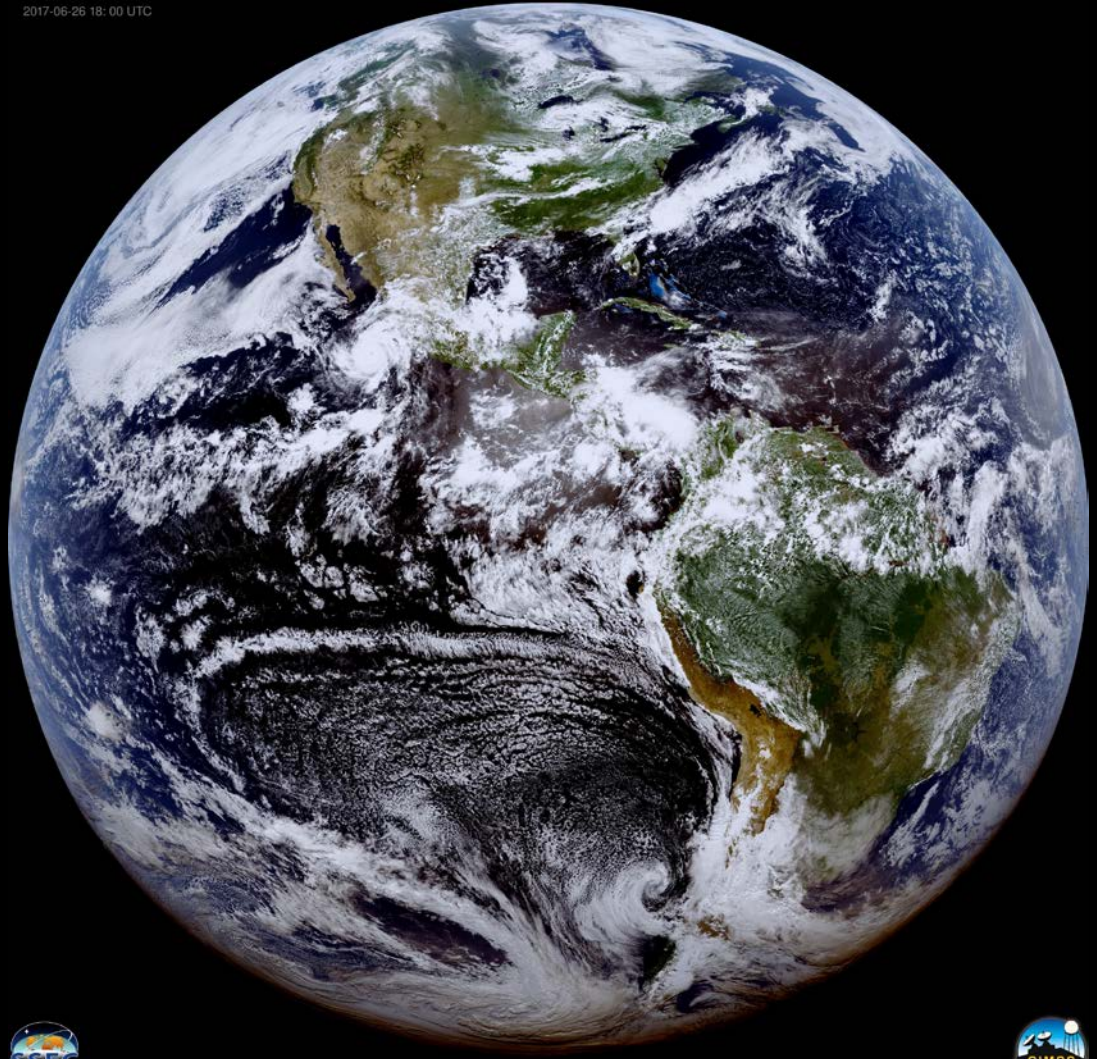


CMI Changer

- Developed a tool to convert ABI L1B data to imagery (i.e. brightness temperatures and reflectances)
- Output is NetCDF4 files in AWIPS-compatible "Sectorized Cloud Moisture Imagery" format
- Supports tiling
- Used by the NWS to load data in AWIPS
- Included in the AIT Framework Level 2 Package

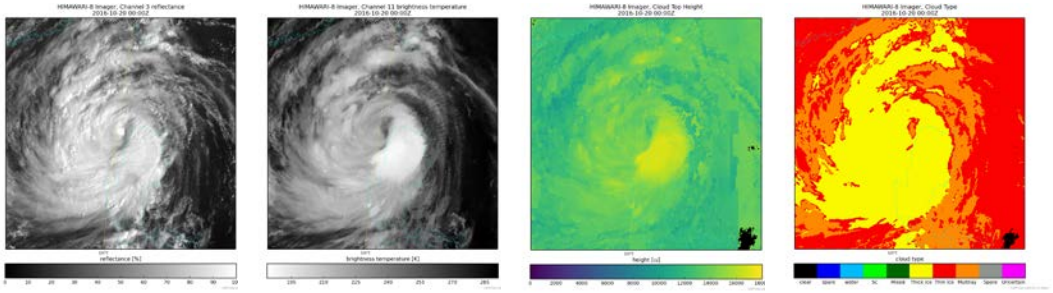






ABI true color image developed by the GOES-R Imagery Team

The GEOCAT Software Package for Level 2 AHI, GOES-13 and -15



- GEOCAT = “Geostationary Cloud Algorithm Testbed”
- Originally developed by NOAA Scientist Mike Pavolonis for GOES-R algorithm development
- Products are generated by research versions of GOES-R algorithms that have been updated and adapted for the Japanese ABI-class instrument “AHI”
  - ⇒ Korea is planning to launch their AMI instrument into geostationary orbit in 2018
- CSPP Geo team integrated updated algorithms for AHI, developed “glue” code
- Parallel processing is needed to keep up with the data rate
- V1.0 beta was released in Fall 2016
- V1.0 planned for Summer 2017

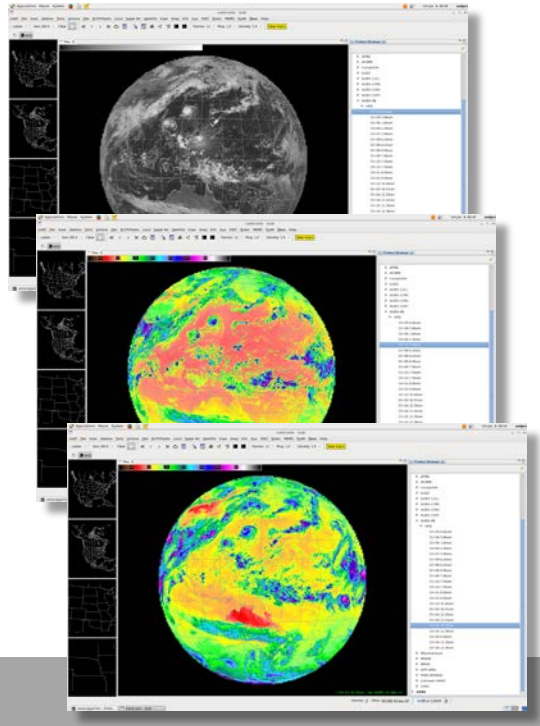
Products planned for initial release:

Cloud and Moisture Imagery
Clear Sky Masks
Cloud Phase
Cloud Type
Cloud Top Height
Cloud Top Pressure
Cloud Top Temperature
Cloud Optical Depth (day/night)
Cloud Particle Size Distribution (day/night)
Cloud Liquid Water Path (day/night)
Cloud Ice Water Path (day/night)
Low Cloud and Fog

Himawari Ingest Software Library

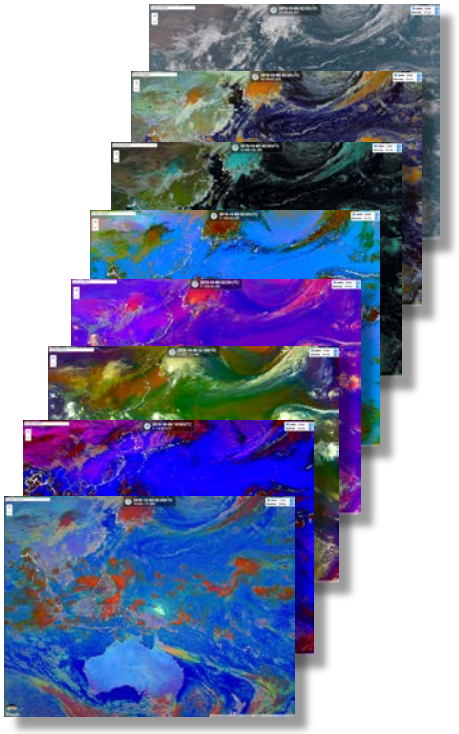
- Himawari ingest library was developed at U. of Wisconsin by Ray Garcia, with help from Scott Mindock and William Straka
- Offers radiances, reflectance and brightness temperatures, as well as metadata
  - ⇒Data conversions are done on-the-fly using parameters in files when available
- Supports HimawariCloud and HimawariCast formats
  - ⇒Programs can be written to read both
- Offers high level of abstraction from file layer
  - ⇒Transparently handles datasets spanning multiple files
- Used in multiple programs maintained at U. of Wisconsin
- Open source: https://gitlab.ssec.wisc.edu/rayg/himawari

AHI data converted with libHimawari and loaded in AWIPS2



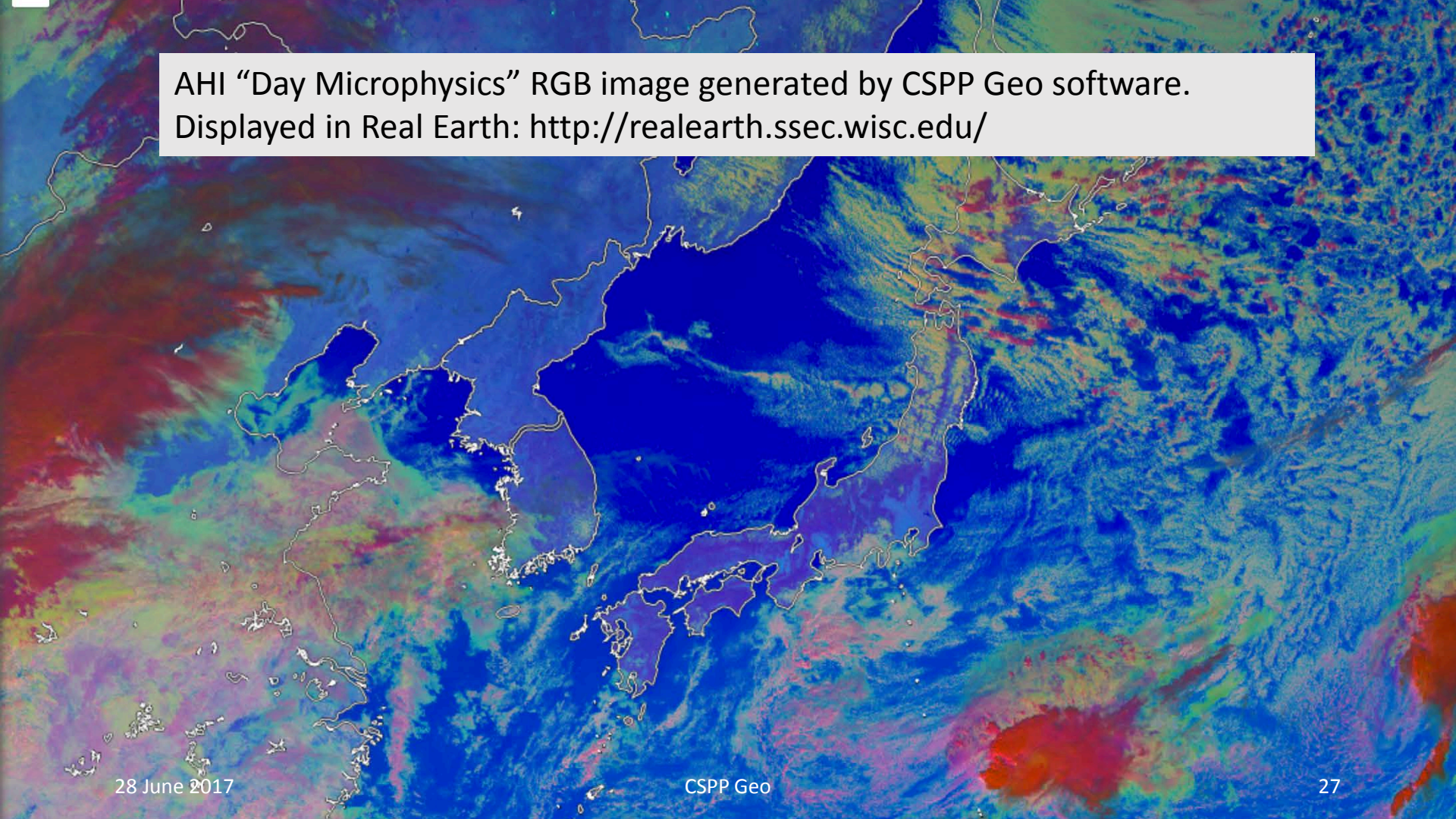
The Composite RGB Software Package

- Composite RGBs are color images that highlight information about the atmosphere and surface
- Output files contain projection information, allowing them to be mapped
- Output format is GeoTiff, which can be displayed in GIS-aware applications, like Google Earth, ArcGIS
- Initially AHI will be supported
- RGB formulas were obtained from JMA and GOES-R Imagery team
  - ⇒Refer to the JMA real-time RGB image webpage http://www.data.jma.go.jp/mscweb/data/himawari/sat_img.php
- Version 1.0 beta is currently being tested



Products created by the initial beta version

Airmass
Day Convective Storm
Day Microphysics
Night Microphysics
Dust
Day Snow / Fog
Natural Color
True Color



AHI “Day Microphysics” RGB image generated by CSPP Geo software.
Displayed in Real Earth: http://realearth.ssec.wisc.edu/

Future plans

- Version 1.0 releases of GOES-16 and AHI software packages later in 2017
- Support additional Level 2 products that have been identified as a high priority for NWS and other users, such as AMV (Winds), Rainfall Rate, Fires, HIE (Hurricane Intensity)
- Add image generation capabilities, including true-color ABI
- Features and tools to help users handle challenges and opportunities of the GOES-16 era (more data = greater hardware requirements and more complex software):
  - ⇒Data sub-setting
  - ⇒Tiling
  - ⇒System and product monitoring and visualization
  - ⇒Support for data processing in a “streaming mode”
- Add support for future instruments in collaboration with international partner agencies, such as Korea’s AMI

Thank you!

For more information on CSPP Geo:

website: http://cimss.ssec.wisc.edu/csppgeo/

support: csppgeo.issues@ssec.wisc.edu