



Introducing CSPP GEO: A Geostationary Satellite Data Processing Package for Direct Broadcast Users



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Abstract

The Community Satellite Processing Package serves the direct broadcast community by providing a freely available suite of software to generate calibrated and geolocated sensor observations and geophysical products from raw satellite telemetry. Currently supported instruments include VIIRS, CrIS and ATMS, aboard the Suomi NPP satellite in low Earth orbit.

In preparation for the launch of the geostationary GOES-R satellite, scheduled for early 2016, the CSPP team will release a software package to generate products from geostationary satellite data. The initial version will include cloud and fog detection algorithms developed under the GOES-R Algorithm Working Group effort, and will allow Direct Broadcast users to process current-generation GOES data received on their own antennas. Future versions will include updated and additional science algorithms and will be able to process GOES-R Advanced Baseline Imager (ABI) data. Here we discuss software design considerations and project status, as well as current and future capabilities of CSPP GEO.

A New Geostationary Data Processing Package

Under current funding from NOAA/NESDIS, we are developing a software package that will allow users to run product algorithms that were developed for GOES-R on data from the current generation of GOES imagers.

This is intended to give the US and international community of direct broadcast users an early look at GOES-R Level 2+ geophysical products, and is first step and proof of concept toward a software package that will eventually allow users to process GOES-R Rebroadcast (GRB) data received on their antennas.

Under continuing funding, we plan to provide direct readout users with:

- Software to ingest GRB data and generate sensor observation data for all of the GOES-R instruments.
- Software to process Advanced Baseline Imager (ABI) sensor observation data through to Level 2+ geophysical products.

The software will be easy for users to download, install and run, and will generate products in a form that can be readily used in downstream processing, visualization and analysis.

Why Direct Readout for GOES-R?

NOAA has said that Level 1B and Level 2+ data will also be available to users via the Internet. Users who do not have sufficient Internet bandwidth, or who are concerned about potential interruptions in Internet service, may prefer to receive data directly on an antenna via the GRB stream. The CSPP GEO software will also potentially offer newer versions of the operational product algorithms that include recent science improvements.

Reconstructing Datasets from the GRB Stream

Scheduled for launch in 2016, GOES-R will host a suite of instruments to observe the Earth and the sun, and to collect in-situ measurements.

Direct readout users who are within range of the satellite and have appropriate hardware will be able to receive data on their antennas via the GOES-R Re-Broadcast (GRB) data stream. This data will be in the form of CCSDS packets containing Level 1B radiometrically calibrated sensor observations from all instruments, and Level 2+ geophysical products for the Geostationary Lightning Mapper (GLM).

In order to use this data, users will need software to parse and error-correct the CCSDS packets, unpack and decompress the data payloads, and reconstruct the datasets for each instrument. The GRB formats and payload recovery process are described in the GOES-R Product Definition and Users' Guide (PUG), Vol. 4.

Data from all GOES-R instruments (below) will be available via the GRB data stream.

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

The reconstructed datasets and accompanying metadata will be written to NetCDF files or, in the case of SUVI data, to FITS files. Data from EXIS, SEISS and Magnetometer will be aggregated at pre-determined temporal resolutions.

The spatial, temporal and spectral resolution of data collected from the imager, ABI, will be significantly greater than the resolution of data from the current generation of GOES imagers. As a result, the data rate of GRB will be significantly higher than the data rate of the current direct readout stream, GVAR.

It is expected that parallel processing will be needed in order to process data at the GRB downlink rate, nominally 31 Mbps.

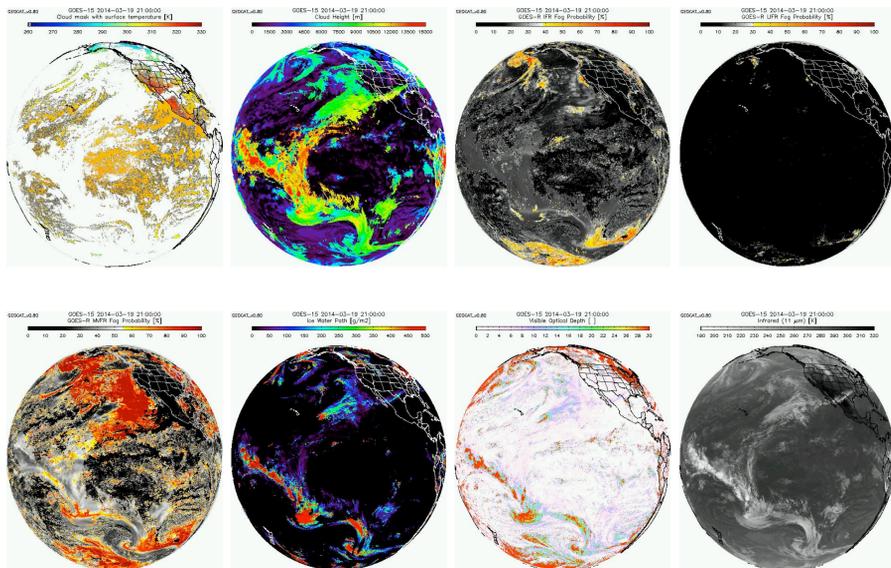
Generating Level 2+ Geophysical Products for ABI

Users who are interested in higher-level geophysical products from the main instrument, ABI, will also need software to generate those products.

The research versions of many of the ABI product algorithms currently run in an algorithm development platform and testbed called GEOCAT, including cloud and low cloud / fog products. The design considerations that have made GEOCAT useful for algorithm development (light weight, portability) also make it suitable for distribution as part of a GRB processing package.

GEOCAT therefore offers a straightforward and low-cost means of releasing many of the product algorithms to direct readout users, and will offer a means of releasing updated algorithms as they become available from the science teams.

The images below show examples of GOES-R cloud and fog detection products that were generated using data from GOES-15 (current GOES imager).



images courtesy of Michael Pavolonis

Support for Current GOES Imager

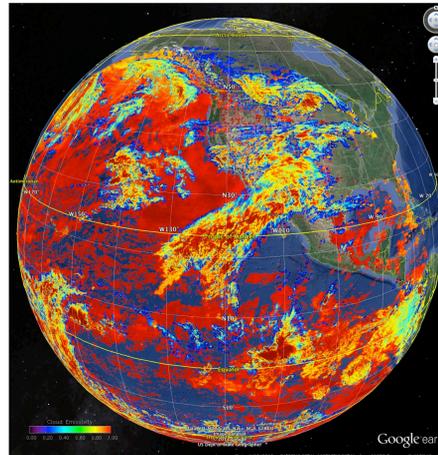
Under current NOAA/NESDIS funding, we are developing software to ingest GVAR data from the current generation of GOES imagers, and generate products using the research versions of the Level 2+ cloud and fog detection algorithms that were developed for GOES-R.

This will allow direct readout users to run the GOES-R research algorithms on data received at their own antennas, giving them an early look at GOES-R products (albeit generated with current GOES channels and lower spatial and temporal resolution).

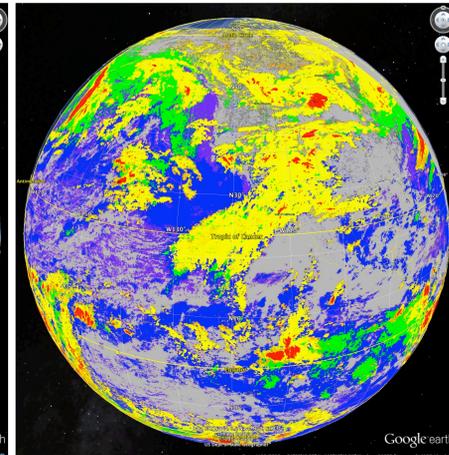
This preparatory step is possible because the algorithms were designed to run on current GOES imager data as a proxy for ABI.

The initial version of CSPP GEO will run cloud and fog detection algorithms that were developed for GOES-R on data from the current generation of GOES imagers. The images below show sample products that were generated with GOES-15 data.

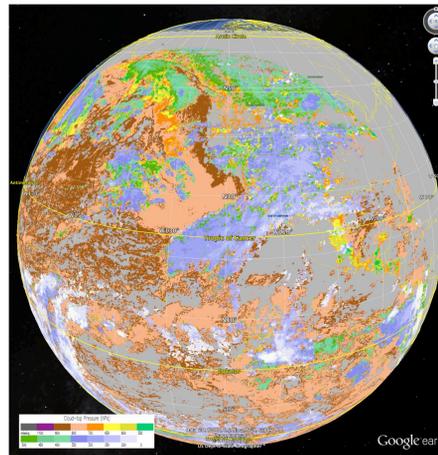
Cloud Emissivity, 2014-03-21 0300h



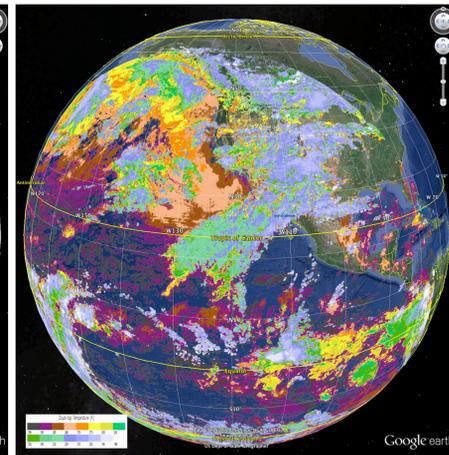
Cloud Type, 2014-03-21 0300h



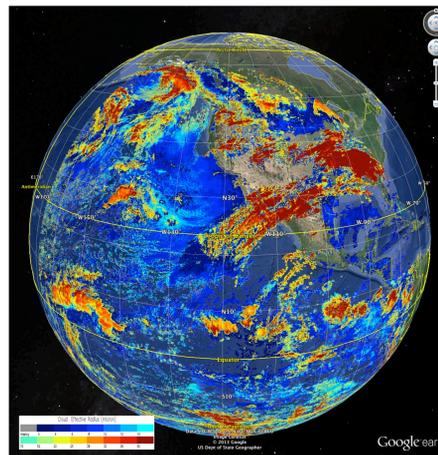
Cloud Top Pressure, 2014-03-21 0300h



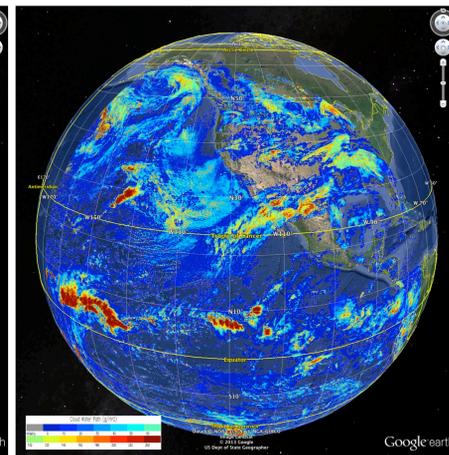
Cloud Top Temperature, 2014-03-21 0300h



Cloud Effective Radius, 2014-03-21 1800h



Cloud Water Path, 2014-03-21 1800h



images courtesy of Andrew Heidinger

Support for Himawari AHI

As a follow-on to this effort, we plan to provide a version of the Level 2+ software that can process AHI data from the Japanese Himawari mission. AHI is scheduled for launch in late 2014 and will offer an excellent proxy for ABI data, having similar bands, resolution and data volume. Existing ABI product algorithms are expected to run on AHI data with little or no modification.

By running the GOES-R product algorithms on data from an ABI-like instrument, we hope to identify potential issues with software, hardware and data products before ABI is launched, and to allow users to generate potentially useful products from AHI data.

The supported AHI data format will be Himawari Standard Format (HSF).

Support for GOES-R ABI

Finally, we plan to release a version of the Level 2+ software that can process ABI data. The initial version will produce cloud and fog detection products. Subsequent versions will include additional products, and algorithm updates as they become available.

Project Status

Currently we are developing an initial version of CSPP GEO, which will process GVAR data from the current generation of GOES imagers, and generate a suite of cloud and fog detection products. We expect to release a limited demo version in spring 2013 and a full version in summer 2014.

Given funding, we expect to add support for Himawari AHI in 2015, and to add support for GOES-R ABI in 2016.

References

- CSPP website: <http://cimss.ssec.wisc.edu/cspp/>
- NOAA GOES-R GRB website: <http://www.goes-r.gov/users/grb.html>
- JMA Himawari website: <http://mscweb.kishou.go.jp/himawari89/index.html>
- Geocat realtime website: <http://cimss.ssec.wisc.edu/geocat/>
- AWG cloud realtime products website: http://cimss.ssec.wisc.edu/clavr/google_earth_main.html

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