DLR

esa

living planet symposium | BONN 23–27 May 2022

TAKING THE PULSE OF OUR PLANET FROM SPACE

EUMETSAT ECMWF EUSPA

Status of the Next Generation of the International Satellite Cloud Climatology (ISCCP-NG)

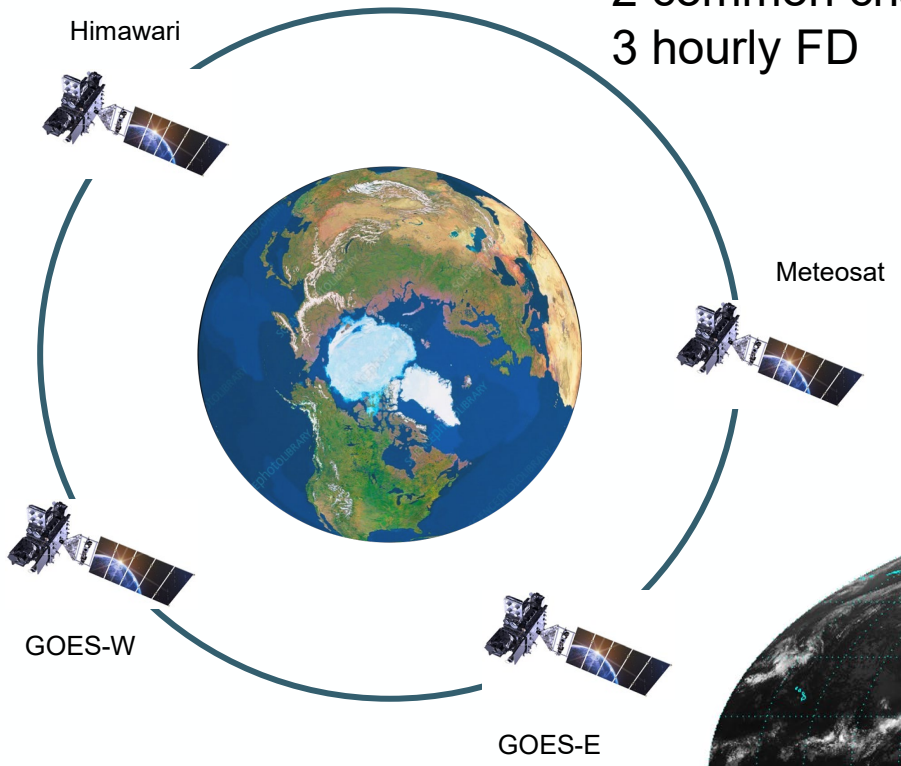
Andrew Heidinger NOAA/NESDIS
ISCCP-NG L1g Team
GEWEX DAP

May 26, 2022

GEO-RING Introduction

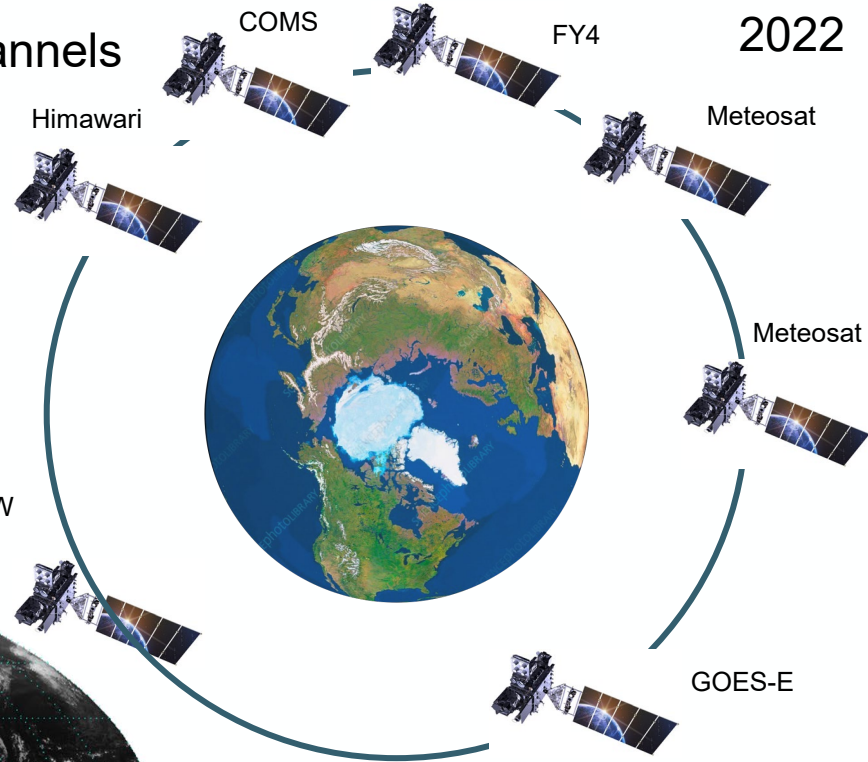
1983

2 common channels
3 hourly FD

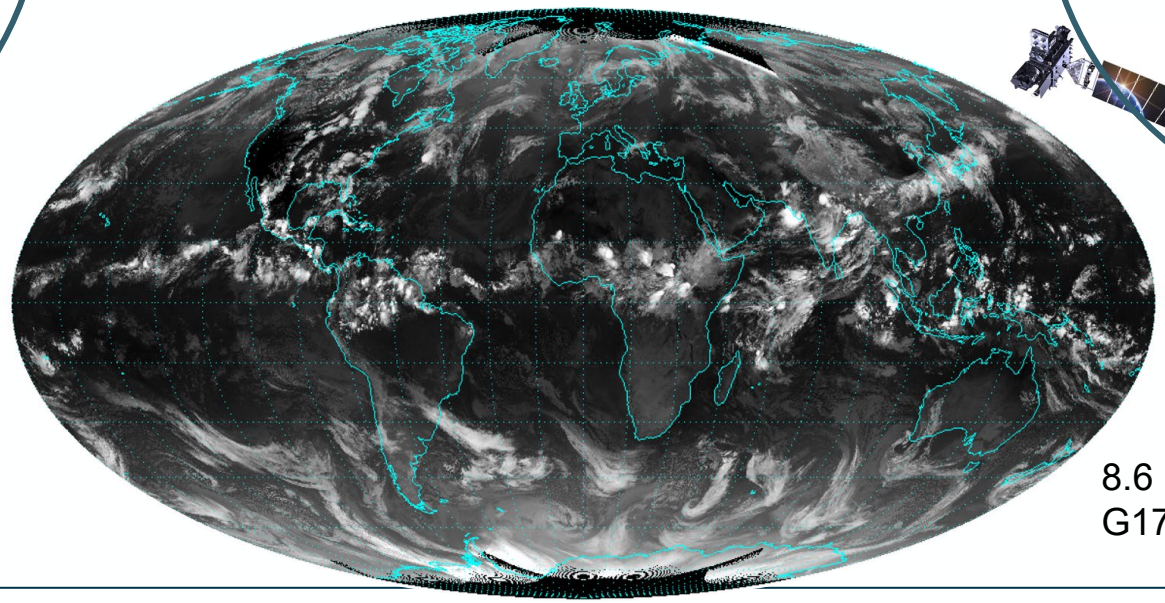


12 common channels
10-minute FD

2022



GEO-RING Projects merge the separate data from each GEO imager into a single global data

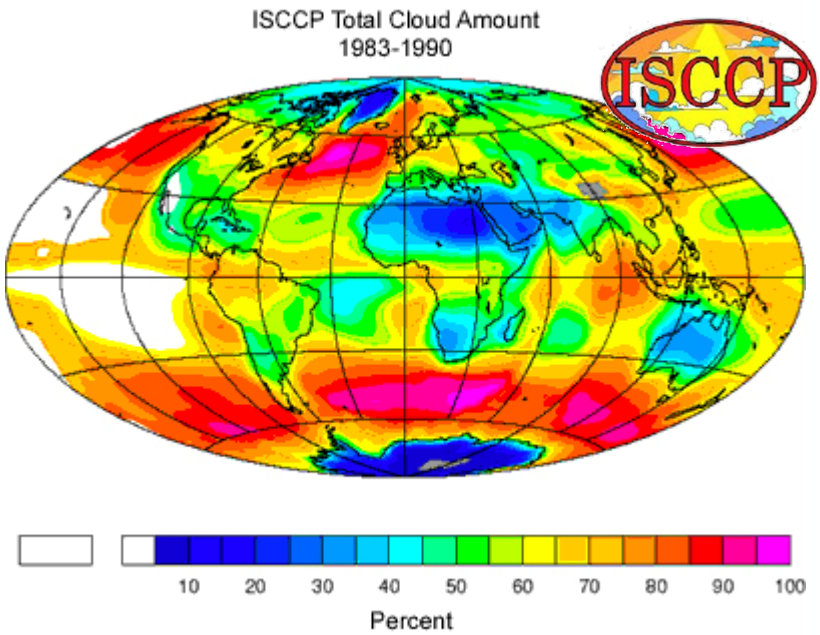


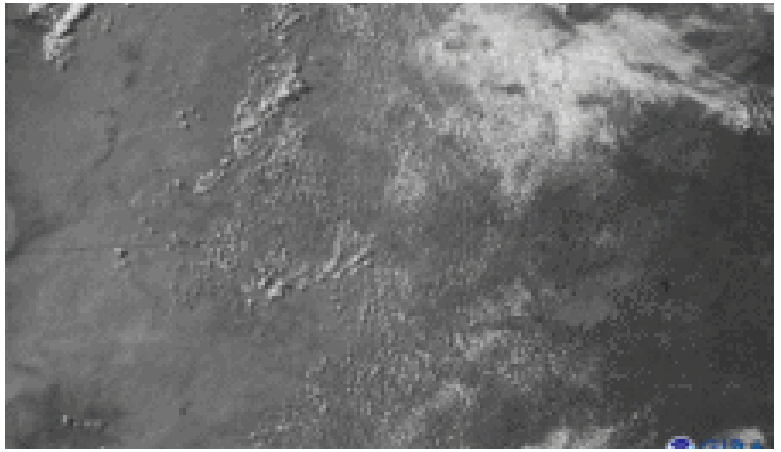
8.6 µm image from
G17,G16,MET11,MET8,HIM8

weather and climate know no borders. GEO-RINGS allow for global high temporal process studies.

Introduction to ISCCP-NG

- International Satellite Cloud Climatology Project (ISCCP) started in 1983 with first GEO-RING. 2 channels and 3 hourly data.
- ISCCP pioneered use a GEO-RING for cloud climate studies with goals of making first global cloud assessment, coordinate research on cloud products and their use in climate models.
- In 2019 GEWEX initiated ISCCP-NG to exploit the new GEO-RING.
- ISCCP-NG will extend the goals with the capabilities from new sensors (2 Chan → ~16 Chan, 3hourly → 10 min)
  - cloud microphysics (precip)
  - aerosol properties
  - cloud dynamics
  - stereo applications
- The challenge facing ISCCP-NG is to define a new baseline from this data and the processing methods to extract meaningful information for the scientific community in the coming decades.





Example of the capabilities of today's geo imagers (G16/ABI) that we want to capture in ISCCP-NG

ISCCP-NG Connections

ISCCP → GEWEX

SCOPE•CM IO-GEO

CEOS WGClimate

ISCCP-NG Steering Group

Graeme Stephens, Remy Roca and Tristan L'Ecuyer , Andy Heidinger

ISCCP-NG Workshop I Late 2019

ISCCP-NG Workshop II 2023(?)

ISCCP-NG L1g Working Group 2020-2022

NOAA, DWD, CIMSS

ICWG ISCCP-NG Topical Group

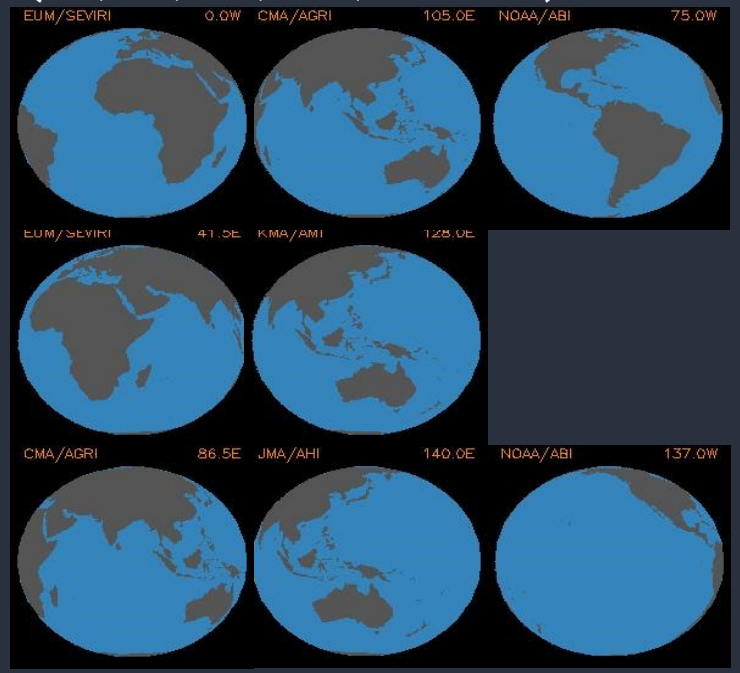
CGMS

Brian Kahn (NASA) and Jan Fokke Meirink (KNMI)

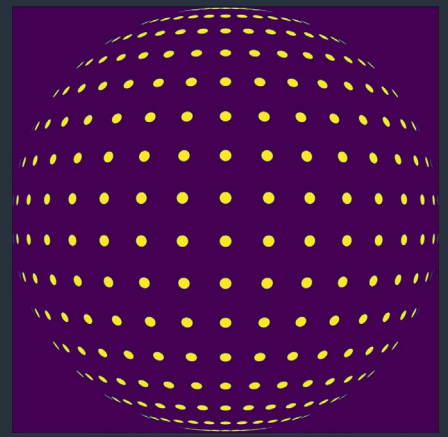
GSICS Global Space-based Inter-Calibration System

Current Concept for ISCCP-NG

Raw L1b from Advanced Geo Imagers (ABI, AHI, AMI, AGRI, SEVIRI/FCI)

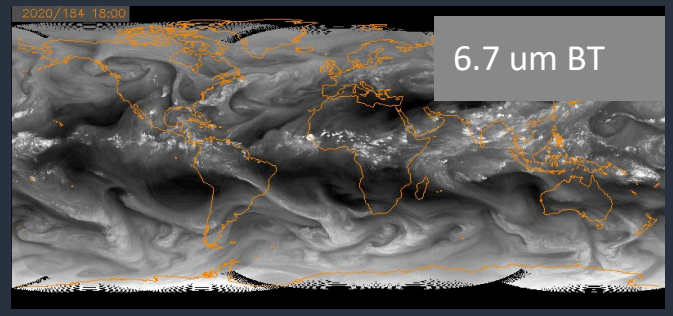


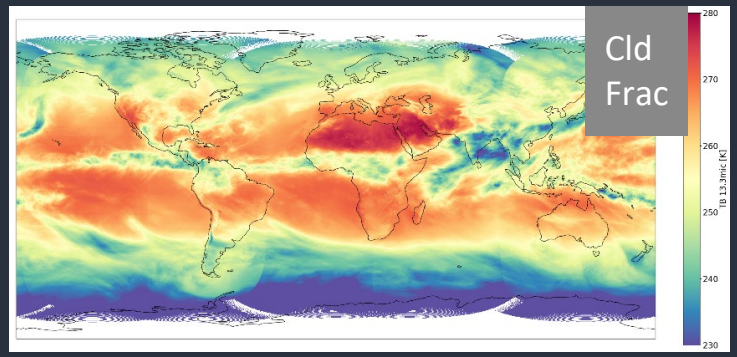
SatPy



GSICS, IOGEO

L1g Data: All Channels mapped to standard grid. When sensors overlap, we keep the data. (6.2 µm BT shown)





L2 Data from Different Agencies and Applied to L1g data. Priority to GCOS.

L2 algorithms will be compared and discussed at CGMS Working Groups such as ICWG and other venues.

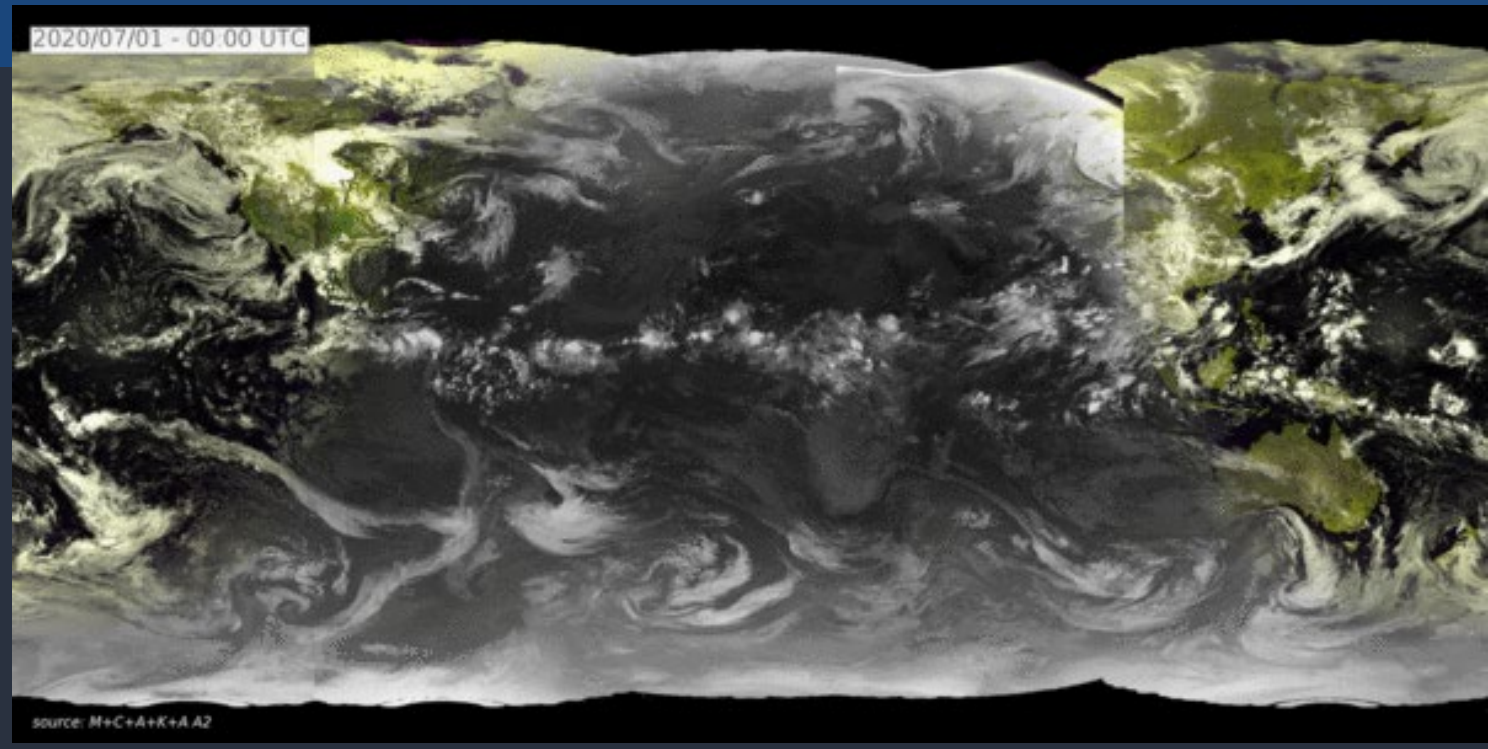
ISCCP-NG Applications

The improved spatial, spatial and temporal characteristics of ISCCP-NG compared to ISCCP will allow:

- **Cloud Microphysics**
- **Multi-spectral Aerosol Retrievals**
- **Improved Day/Night Consistency of Cloud Macrophysics**
- **Ability to track smaller and shorter-lived convection**
- **Improved detection of atmospheric motions**
- **Multi-angular views in overlap regions provide for stereoscopic retrievals of cloud/aerosol heights**

ISCCP-NG L1G Prototypes

- Using the SatPy tools, an L1g prototype code ha been developed and made available via git
- Sample Data for 2020 processed and available on ftp.
- Website provides links to code and data (cimss.ssec.wisc.edu/isccp-ng)
- Default resolution is all channels (19 max), 0.05º, 30 minutes. Final values are TBD (user selectable).
- Overlapped data is kept similar to NOAA GridSat (stereo applications).



Daytime RGB + Nighttime IR window for one day of ISCCP-NG L1g from GOES-17, GOES-16, Meteosat-11, Meteosat-8 and Himawari-8. (Martin Stengel/DWD). Default Resolution

L1g Development Team

- Coda Phillips (CIMSS)
- Martin Stengel (DWD)
- Ken Knapp (NOAA)
- Arata Okuyama (JMA)
- Kazutaka Yamado (JMA)

L1G Contents

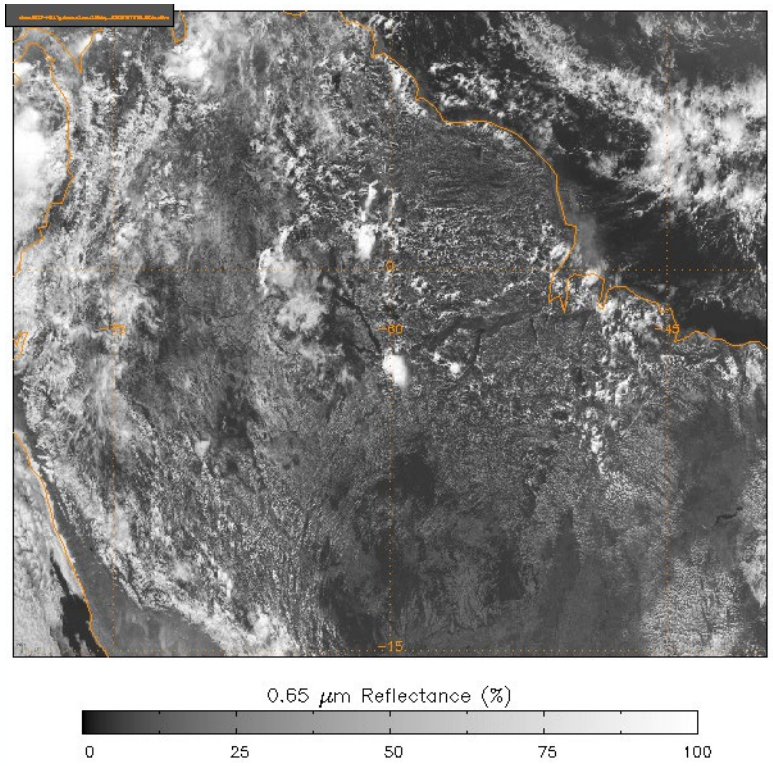
For each L1g Image time, you have …

- 32 files per image time
  - 7 solar reflectances
  - 10 IR brightness temperature
  - 4 angles
  - 8 sub-pixel statistics (0.65+11µm)
  - 3 meta-data fields (wmo, time, sampling method)
- Nominal wavelengths are used for channel names.
- **Attributes that allow one to remove the space agencies nominal calibration and apply the GSICS calibration.**
- Current resolution is 0.05º which results in 7200x3600 pixels per file.
- 2 levels of overlap are contained.

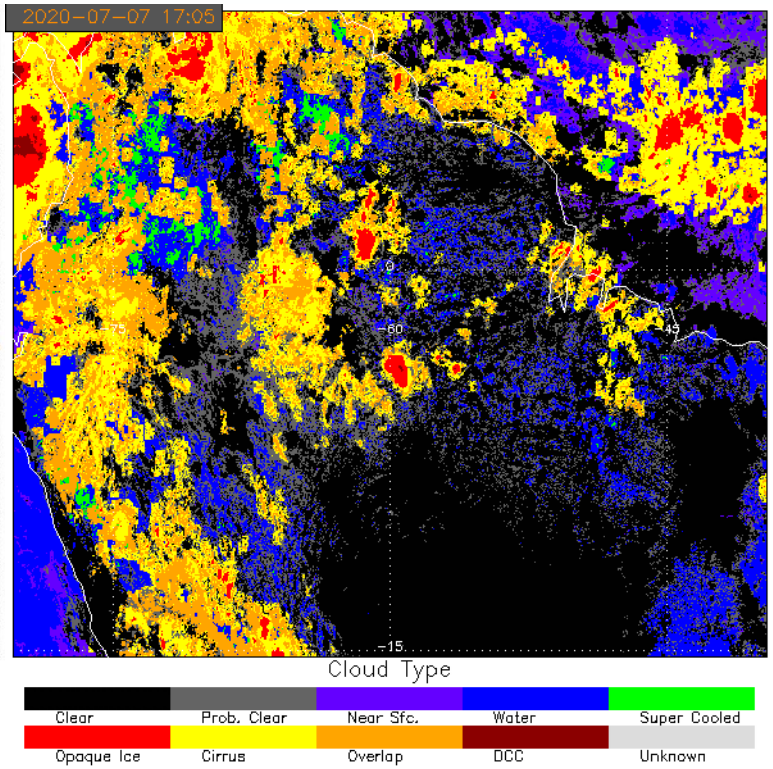
L1G Group has demonstrated that L1G is suitable for L2 creation

NESDIS Enterprise Cloud Algs (aka PATMOS-x)

"refl_00_65um"



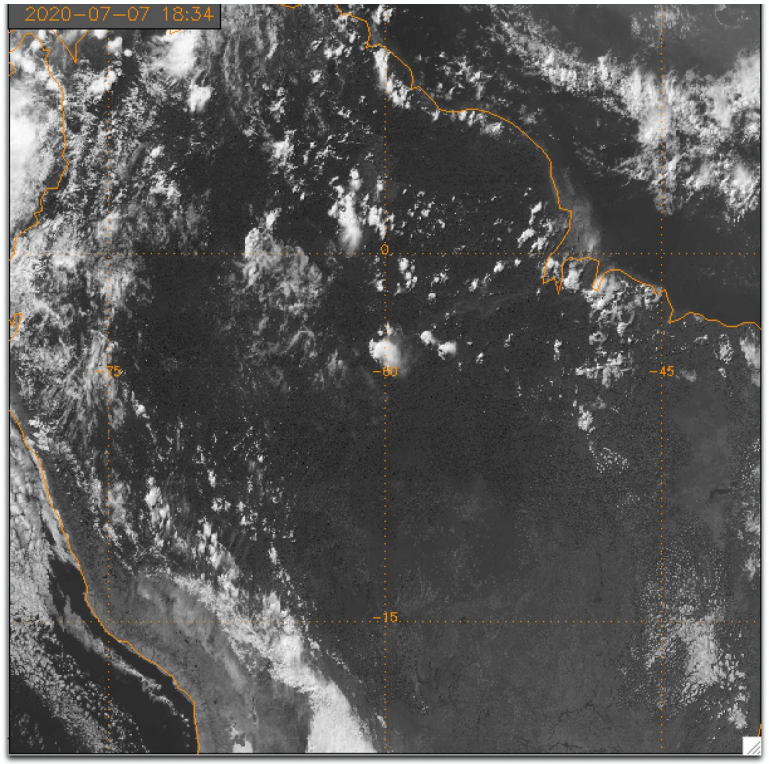
Cloud Type



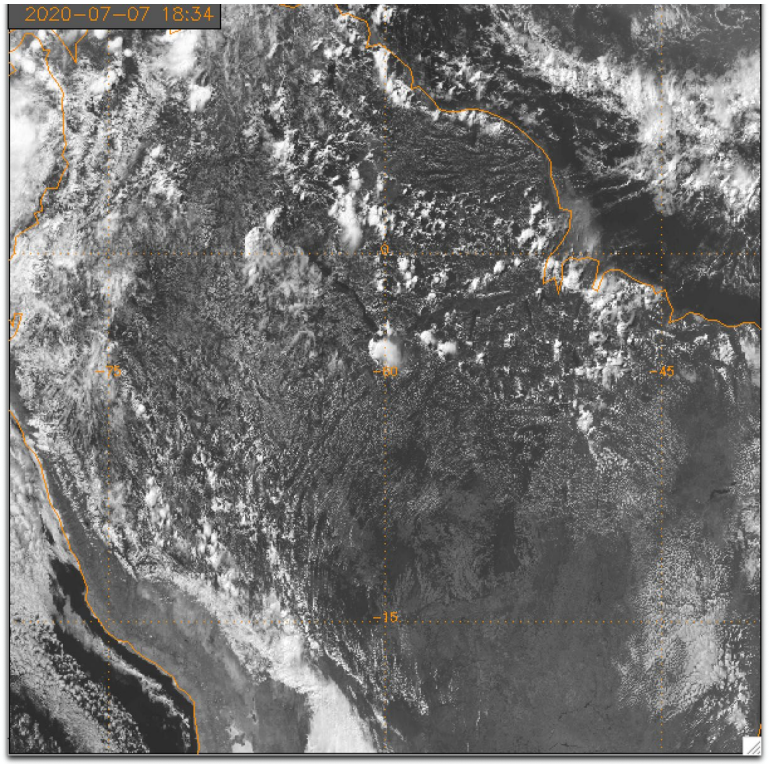
L1G Contents Example: Sub Pixel Stats

- L1g attempts to maintain sub-pixel information for the 0.65 and 11 μm channels.
- This allows for estimation of some sub-pixel cloud characteristics. (July 7, 2020, 18Z South Am.).
- GeoXO plans 250m 0.65 μm. ISCCP-NG needs to exploit these capabilities.

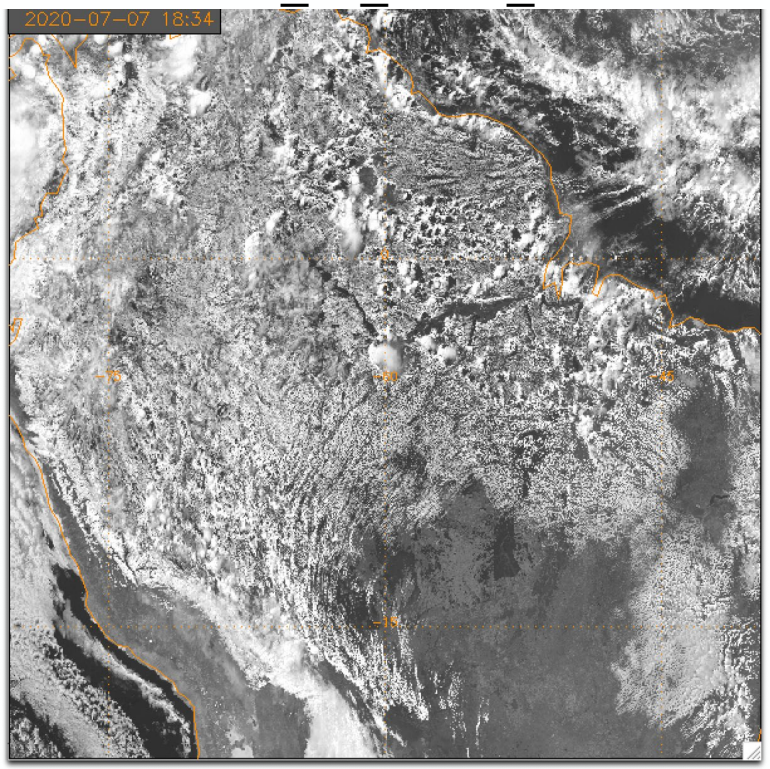
refl_00_65um_min



refl_00_65um



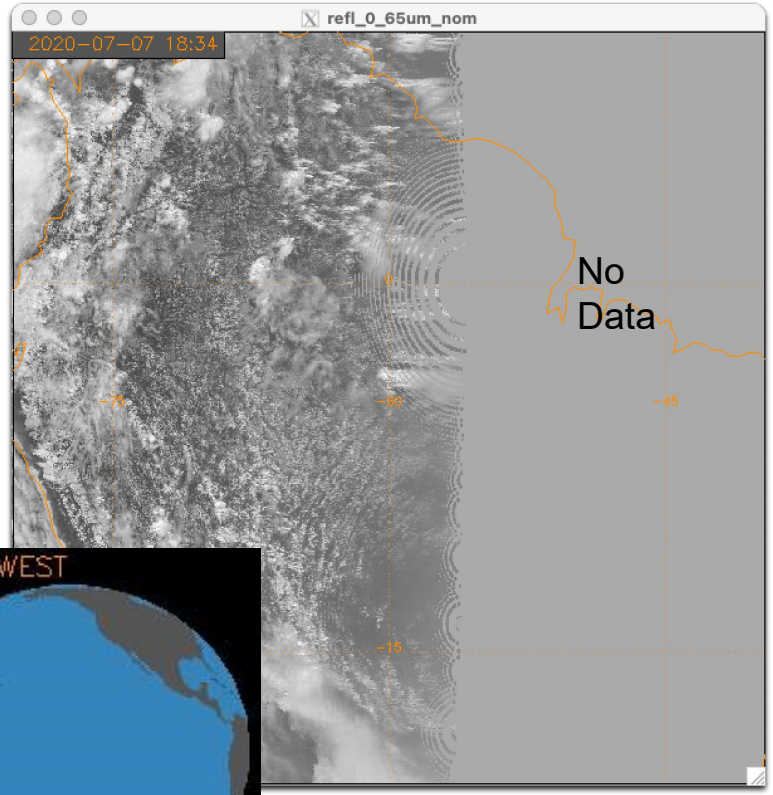
refl_00_65um_max



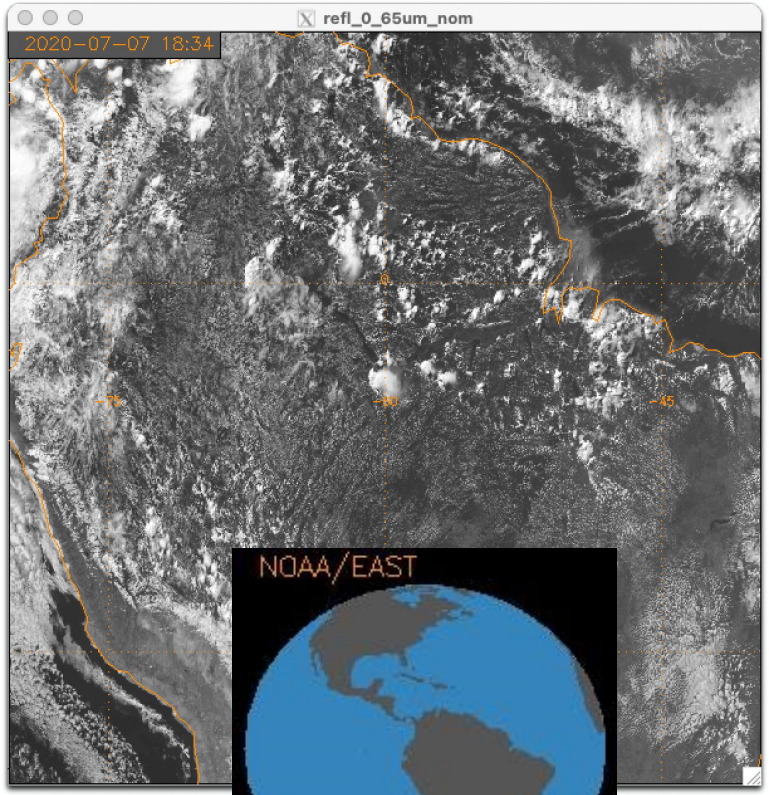
L1G Contents Example: Multiple Views

- L1g keeps up tp 3 layers of data when different geo satellites view the same region at different angles.
- This information allows for stereo and shadow techniques to estimate height and motions

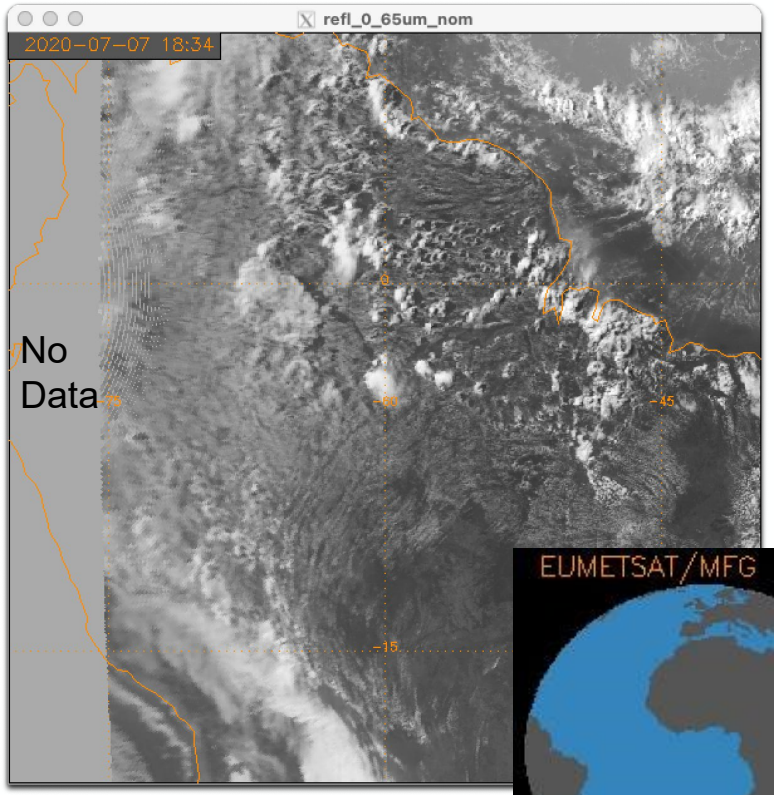
G17 refl_00_65um

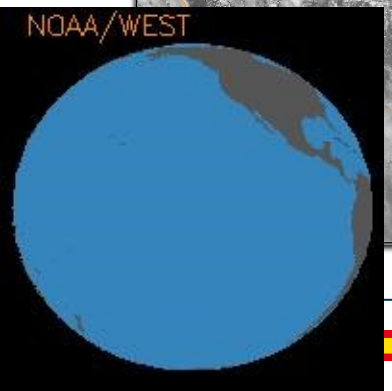


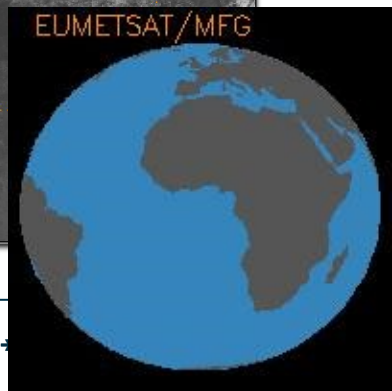
G16 refl_00_65um



Meteosat 11 refl_00_65um







GCOS Essential Climate Variables (EVC) for Cloud

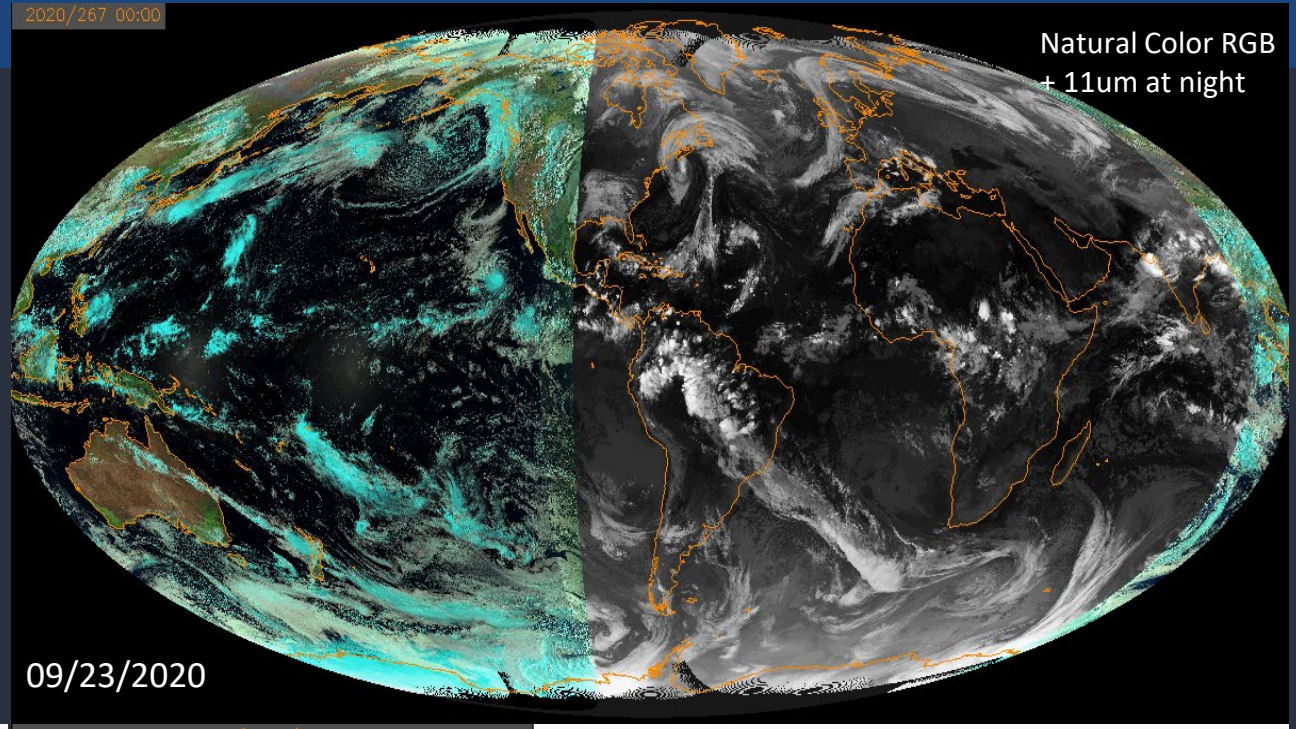
= Consistent Day and Night
= Inconsistent Day and Night
= Day only
= Not Possible

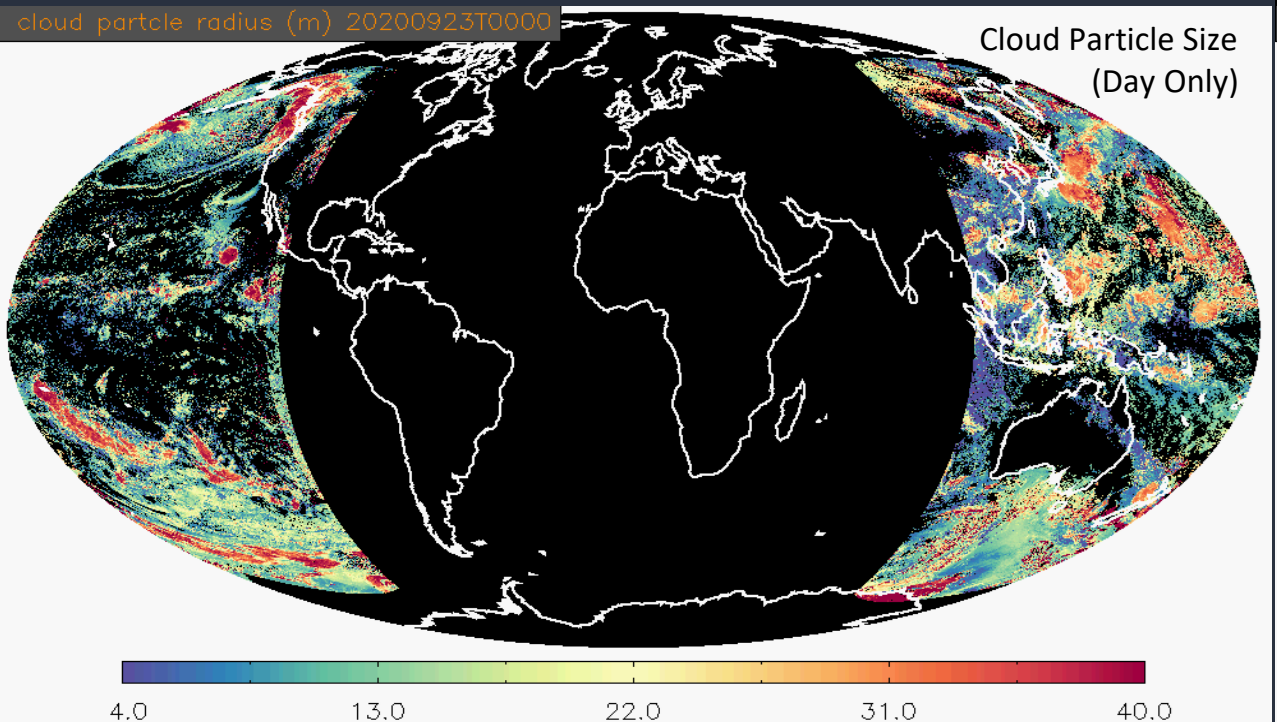
ECV	Temporal	Spatial	ISCCP	ISCCP-NG	Improvement
Cloud Amount	3hr	50 km			
Cloud Top Press	3hr	50 km			Yes
Cloud Top Temp	3hr	50 km			Yes
Cloud Optical Depth	3hr	50 km			Yes
Cloud Water Path	3hr	50 km			Yes
Cloud Particle Size	3hr	50 km			Yes
Cloud Phase	N/A	N/A			Yes

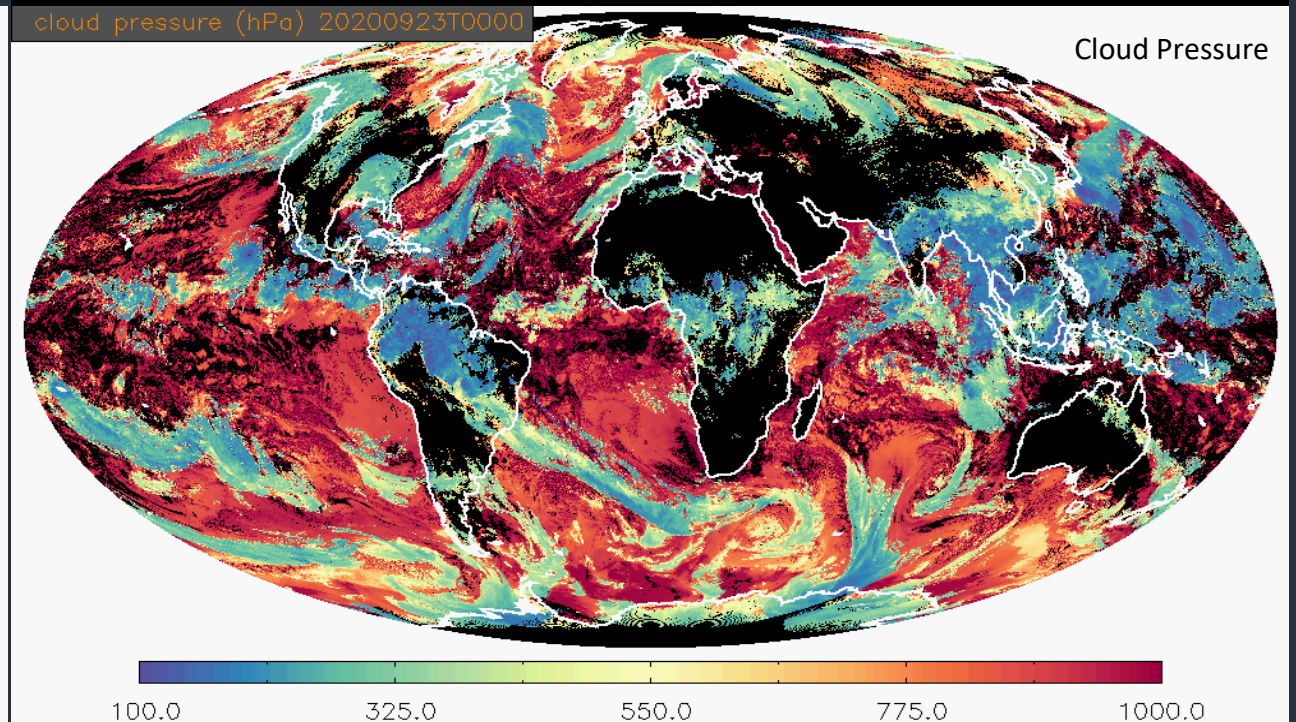
These estimates are based on current standard physical retrievals - AI/ML may be used to improve day/night consistency for both ISCCP and ISCCP-NG

L2 Examples: NOAA/NESDIS

- NOAA/NESDIS Enterprise Algs ported to ISCCP-NG L1g
- Products highlight improvements of ISCCP-NG over ISCCP
  - Cloud particle size from NIR channels
  - Day/Night consistent cloud pressure from multiple IR channels.







Takeaways

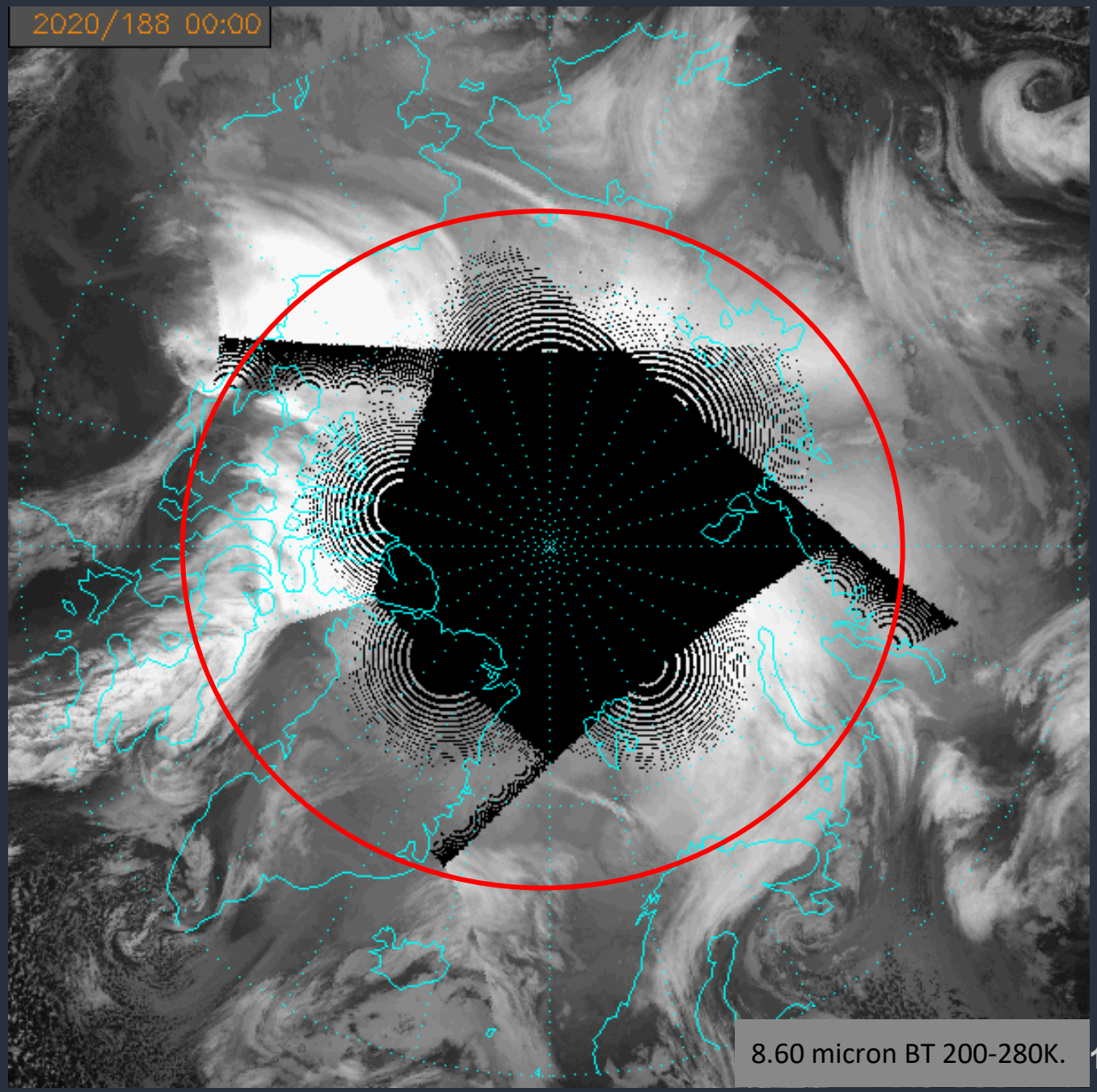
- ISCCP-NG is a GEO-RING project initiated by GEWEX involving many space agencies that attempts to merge the data from the advanced geostationary data into a data set useful to the climate (process) community. Grows the user base outside of real-time meteorological applications.
- ISCCP-NG has released a test data-set of its 2020 Level-1 Gridded Data (L1g).
- L1g code is available on GitLab and data from ftp: cimss.ssec.wisc.edu/isccp-ng
- ISSCP-NG Product (L1/L2) Work is beginning within the GSICS and CGMS ICWG
- We are planning the next workshop in 2023 (check GEWEX website)
- We thank UW/SSEC for hosting ISCCP-NG and NOAA/NESDIS for supporting it.
- **All are welcome to try our data and join this effort (andrew.heidinger@noaa.gov).**

The End, Thank you!

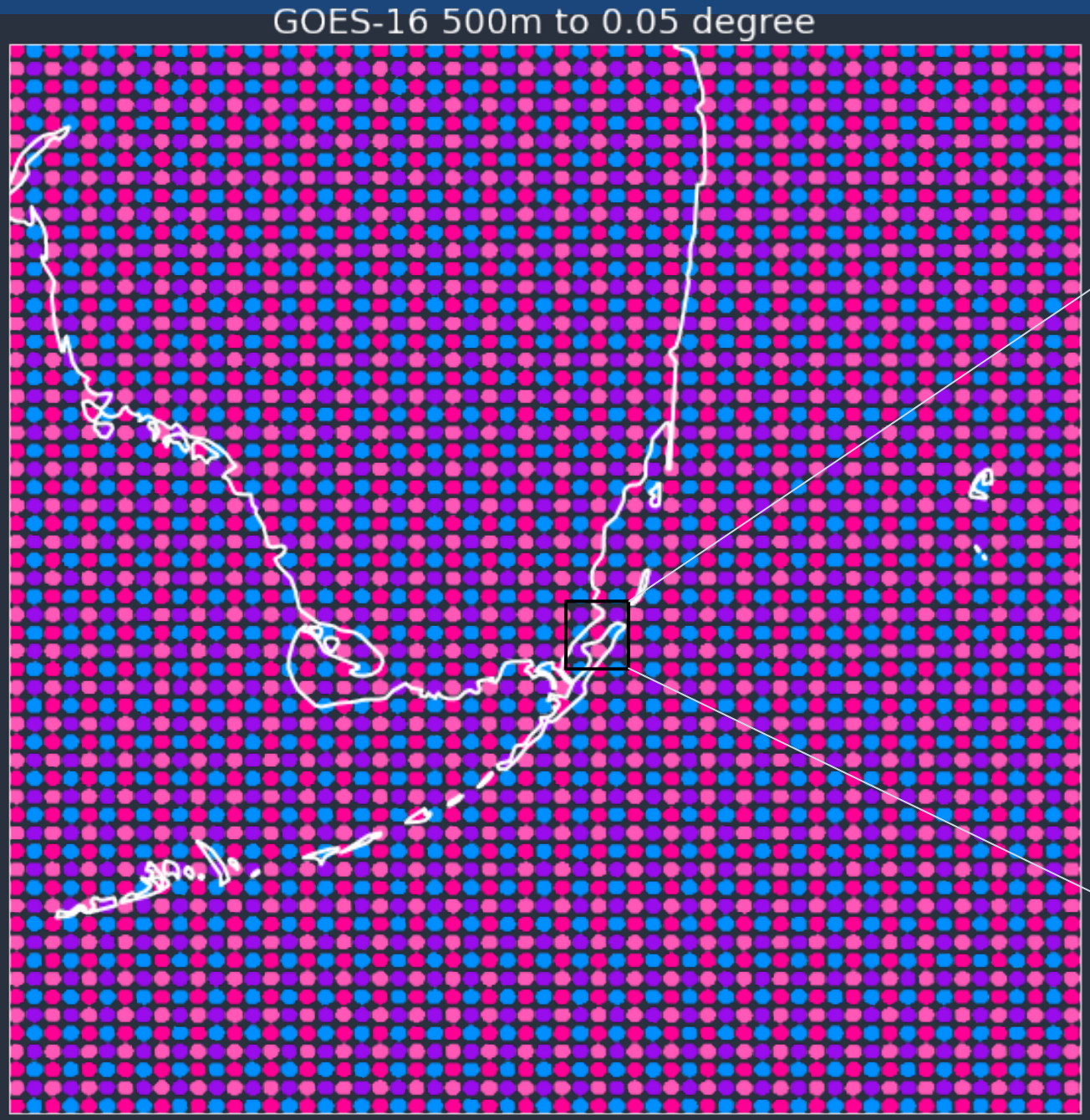
andrew.heidinger@noaa.gov

L1g at the Poles

- Currently L1g has no limit on latitude
- Given the higher spatial resolution of newer sensors, data is useful to about 70º N/S.
- Orbital drift of Meteosat-8 is evident.
- No plan to augment with LEO imager data yet.

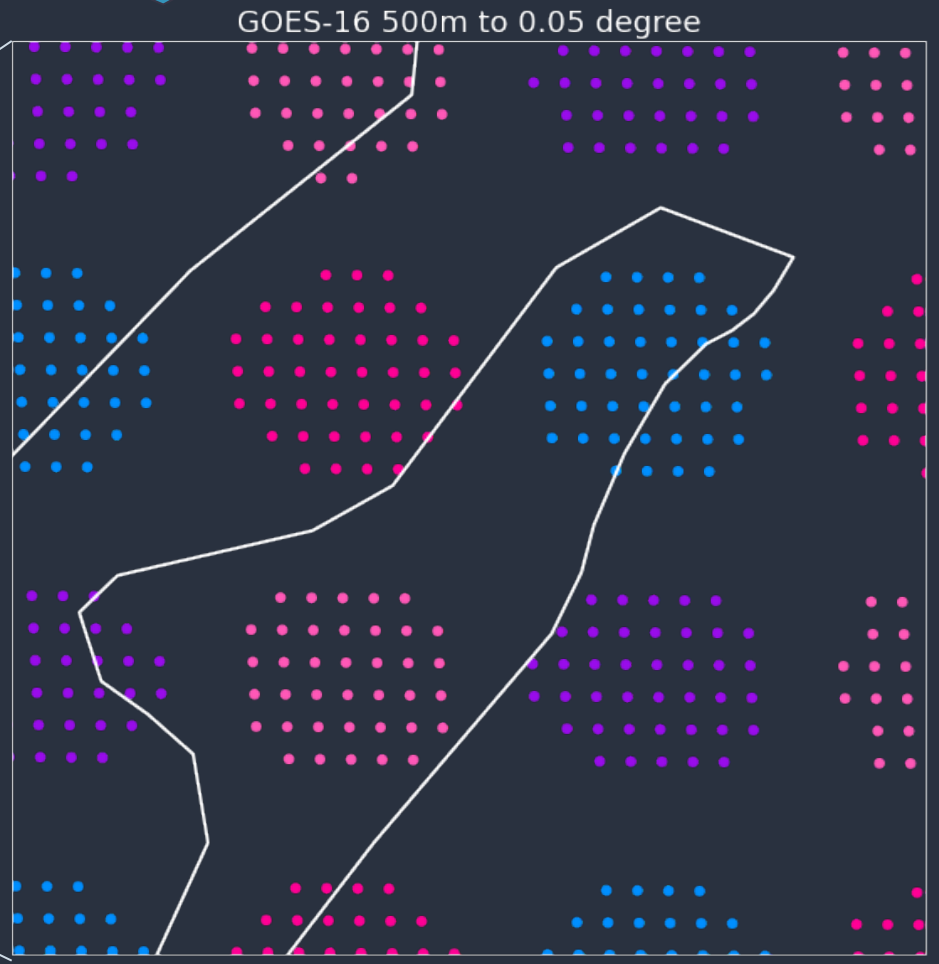


8.60 micron BT 200-280K.



indices are precomputed

L1G Gridding



Statistics computed within clusters (in radiance space)

L1G Files

```
[ isccp_l1g]$ ls demo_20211206/2020/202007/20200701/20200701T0000

ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__refl_00_47um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__refl_00_51um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__refl_00_65um_20200701T0000.nc
                                05deg__refl_00_86um_20200701T0000.nc
                                0_05deg__refl_01_38um_20200701T0000.nc
                                0_05deg__refl_01_60um_20200701T0000.nc
                                0_05deg__refl_02_20um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_03_80um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_06_20um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_06_70um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_07_30um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_08_50um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_09_70um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_10_40um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_11_00um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_12_00um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_13_30um_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_11_00um_count_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_11_00um_max_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_11_00um_min_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_11_00um_std_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__refl_00_65um_count_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__refl_00_65um_max_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__refl_00_65um_min_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__refl_00_65um_std_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__wmo_id_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__pixel_time_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__sample_mode_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__satellite_azimuth_angle_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__satellite_zenith_angle_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__solar_azimuth_angle_20200701T0000.nc
ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__solar_zenith_angle_20200701T0000.nc
```

0.05º Lat-Lon Grid

Single-variable NetCDF files

7 Reflectances

11 Brightness Temps

Sub-grid stats for 0.65µm refl. and 11µm BT

Metadata and Convenience Variables (TBD)

L1G File Structure

```
netcdf ISCCP-NG_L1g_demo_A1_v1_res_0_05deg__temp_11_00um_20200701T0000 {
dimensions:
        time = 1 ;
        layer = 3 ;
        latitude = 3600 ;
        longitude = 7200 ;
variables:
        short temp_11_00um(time, layer, latitude, longitude) ;
                temp_11_00um:_FillValue = -32767s ;
                temp_11_00um:ahi_band_number = "14" ;
                temp_11_00um:ahi_original_nadir_resolution_km = 2LL ;
                temp_11_00um:abi_band_number = "14" ;
                temp_11_00um:abi_original_nadir_resolution_km = 2LL ;
                temp_11_00um:band_nickname = "IR Longwave Window Band" ;
                temp_11_00um:central_wavelength_um = 11. ;
                temp_11_00um:em_class = "infrared" ;
                temp_11_00um:units = "K" ;
                temp_11_00um:standard_name = "brightness_temperature" ;
                temp_11_00um:gsics_calibration = "{}" ;
                temp_11_00um:coordinates = "end_time start_time" ;
                temp_11_00um:add_offset = 250. ;
                temp_11_00um:scale_factor = 0.25 ;
                temp_11_00um:_Storage = "chunked" ;
                temp_11_00um:_ChunkSizes = 1, 1, 3600, 7200 ;
                temp_11_00um:_DeflateLevel = 1 ;
                temp_11_00um:_Endianness = "little" ;
```

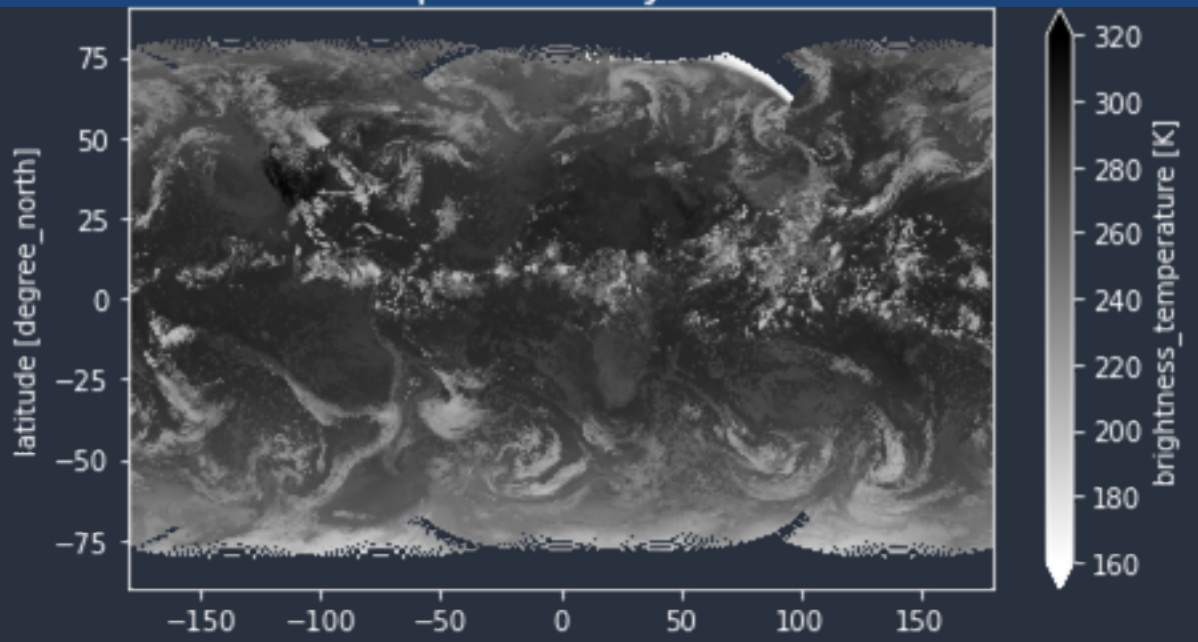
Time always has length=1
The number of layers is identical for all variables

variables are 4D
varname from filename

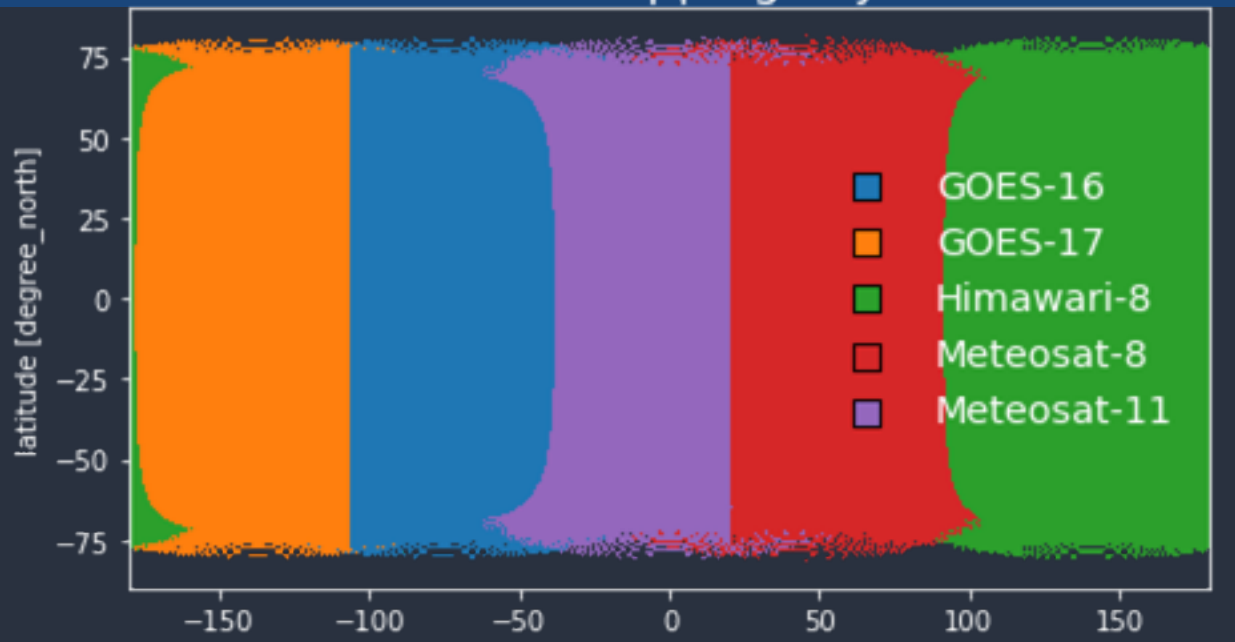
Integer data type with scale/offset

Compression and layer-chunking

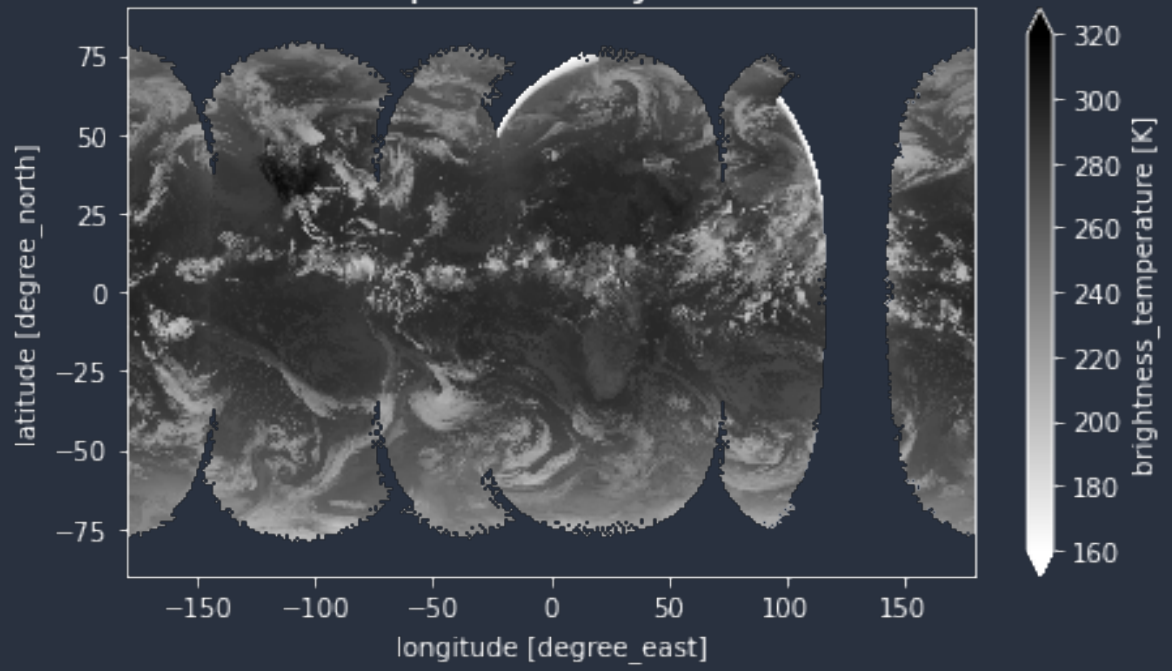
11µm BT Layer 1



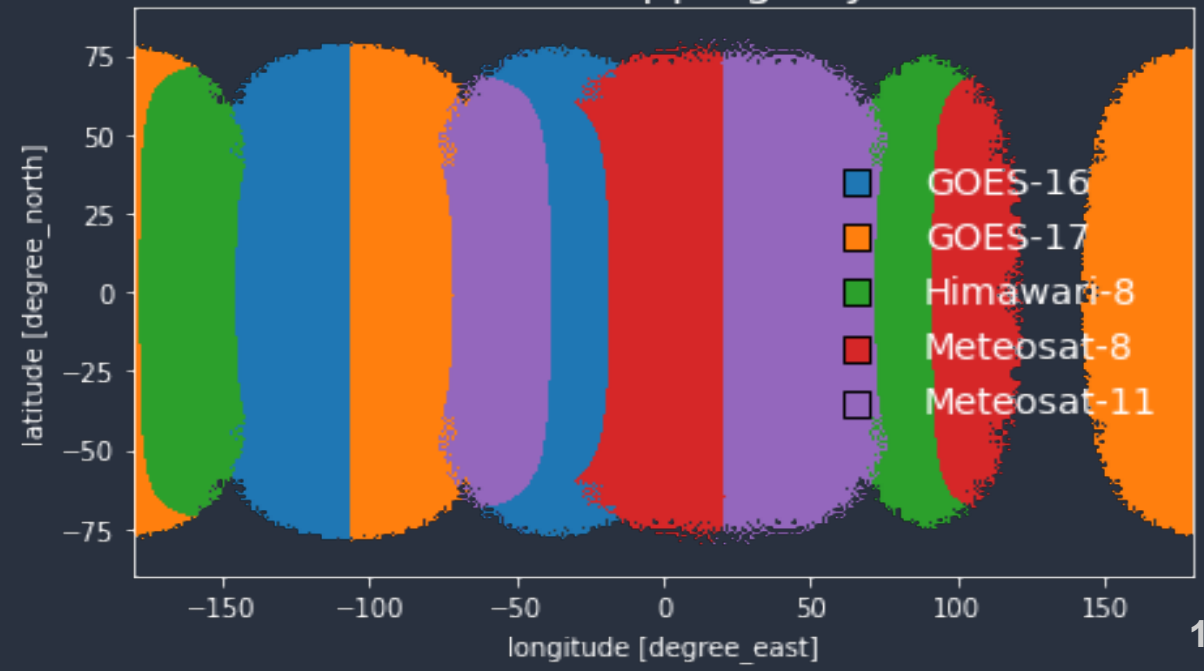
Satellite Mapping Layer 1



11µm BT Layer 2

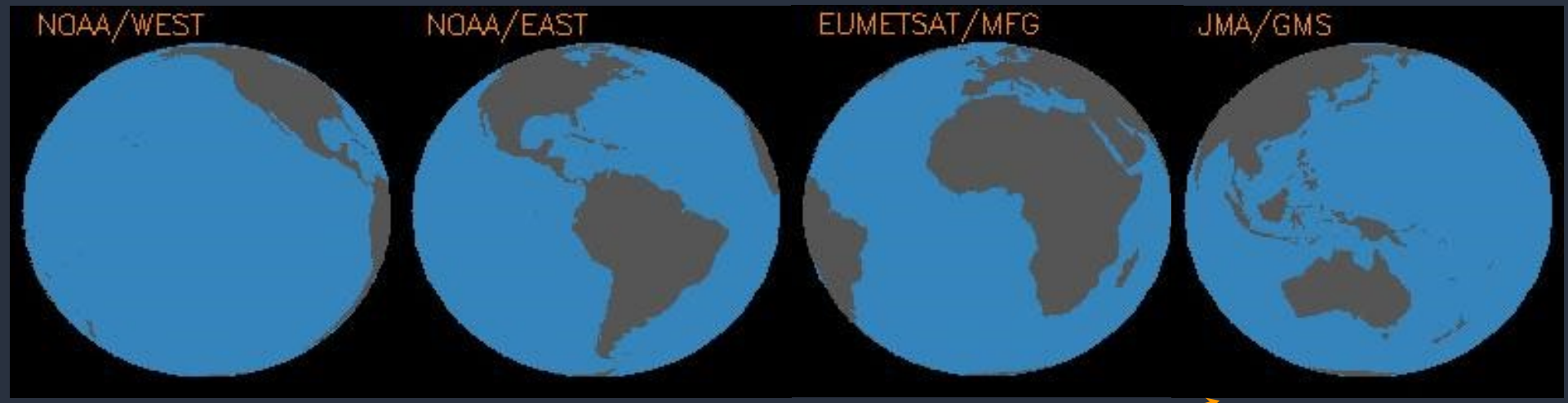


Satellite Mapping Layer 2



Adv GEO Global Coverage

ISCCP-1: Sub-Longitudes = -135, -75, 0, 140 (Note Gap over India)



ISCCP-NG: Sub-Longitudes -135, -75, 0, 86.5, 128, 105, 140
Note Oversampling of Asia

- How should ISCCP-NG Exploit this overlap?
- **We baselined keeping 3 layers of overlap.** (i.e. *we keep the 3 most nadir views of Australia*)

Summary

- GEWEX is formulating an international activity to exploit the current and coming GEO-RING of advanced imagers.
- This is leading to the Next Generation of the International Cloud Climatology Project (ISCCP-NG).
- First step of ISCCP-NG was creation of a gridded Level-1 (L1g) that makes using the GEO-RING easy for the cloud climate community. (NESDIS /CIMSS Support)
- **L1g code and prototypes are available now and feedback is sought and appreciated.**
- L2 working beginning and coordinated through the CGMS/ICWG.
- Next step is to establish the GSICS connection and provide feedback to GSICS.
- Next next step is to finish L1g and work with space agencies to make it operational and archived.

2nd ISCCP-NG Workshop will be Announced on GEWEX Website and https://cimss.ssec.wisc.edu/isccp-ng/.