

AIRS – Updating Imagery to Meet User Needs & Support Applications

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NASA LANCE & NASA GIBS Teams

Topics

- 1. Rationale for updating imagery**
- 2. The “updating journey” and lessons learned**
- 3. Targeted users**
- 4. AIRS Volcano Rapid Response**
- 5. Requests for future capability**



AIRS

Atmospheric Infrared Sounder *on Aqua*

- Launched May 4, 2002
- Hyperspectral infrared sounder (2378 detectors)
- Level 2 data @ 45 km
- Sun synchronous, 2 daily overpasses 1:30am/1:30pm
- NRT 3 hrs to GES DAAC
- Radiances assimilated at most operational weather prediction centers worldwide

Observes

- **Temperature and water vapor (profiles through troposphere)**
- **Mid-trop CO, CO₂, ozone, methane, ammonia**
- **Cloud properties, surface properties, OLR, SO₂ & dust flags**

AIRS Level 2 on Worldview

OLD

Daily, Day, Night, Standard Projection

Products likely created at 640 x 320

- **CO total column**
- **Dust Score**
- **Precip Estimate**
- **SO2 Index (Prata algorithm)**
- **Relative Humidity** – 400, 500, 600, 700, 850 hPa
- **Temperature** – 400, 500, 600, 700, 850 hPa

NEW (in development)

Daily, Day, Night, Standard & Polar Projection

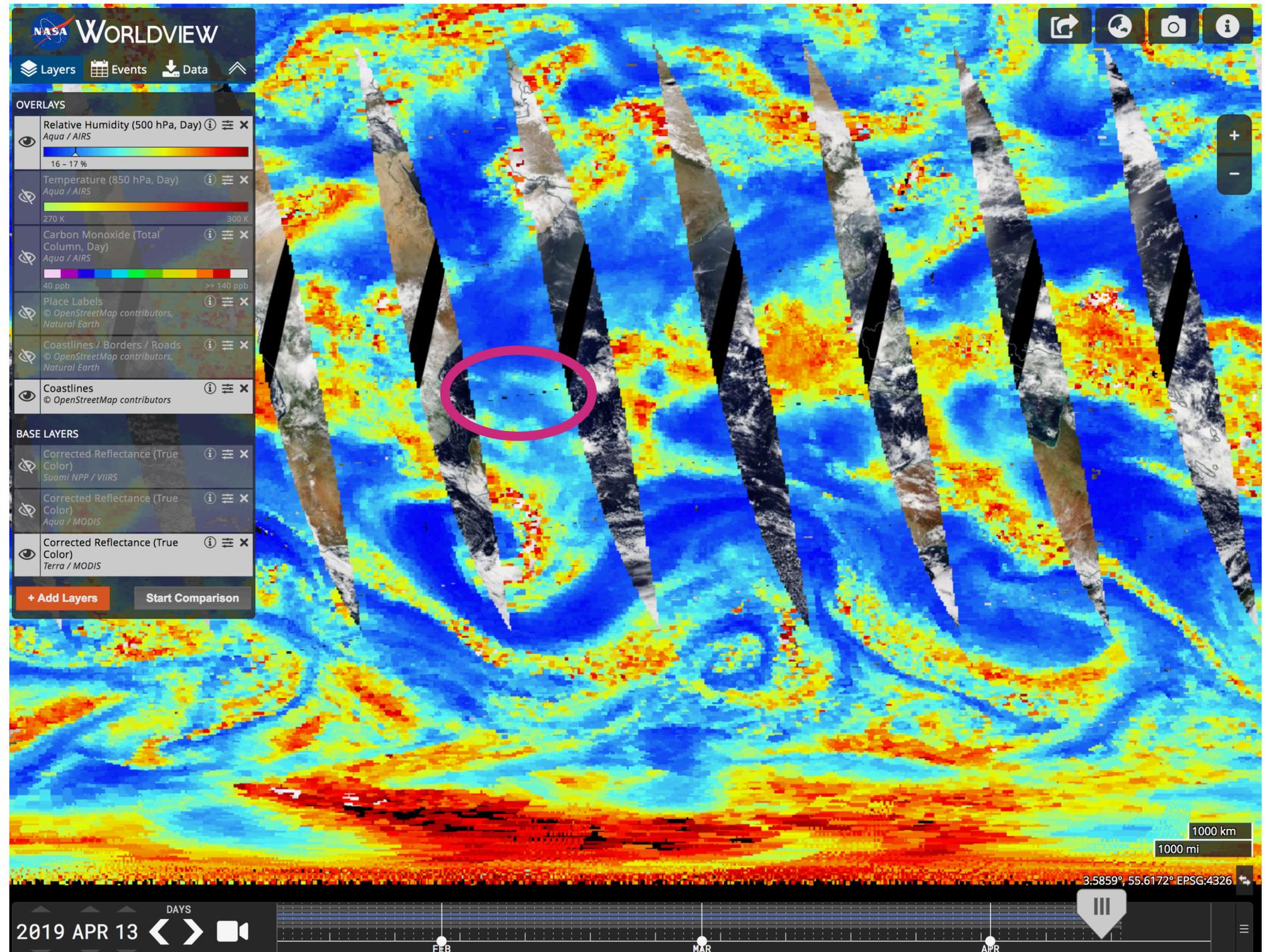
Native resolution: T, RH, CO, CH4 / 45 km; SO2, DUST, CLOUDS / 13.5 km. Images prepped for GIBS @ 1280x640

- **CO 500 hPa**
- **Dust Score**
- **Precip Estimate**
- **SO2 Index (Prata algorithm)**
- **Relative Humidity** – 500, 700, 850 hPa
- **Temperature** – 500, 700, 850 hPa
- **Surface Air Temperature**
- **Surface Skin Temperature**
- **Surface Relative Humidity**
- **Methane 400 hPa**
- **SO2 BT Difference**
- **Cloud Fraction**
- **Cloud Top Height**

Rationale for updating AIRS imagery on Worldview

Not best representation of AIRS products

- Edge effects
- Artifacts between granules
- Color bars not optimal
- Extraneous pressure levels
- CO total column – should not be used
- Additional products should be included



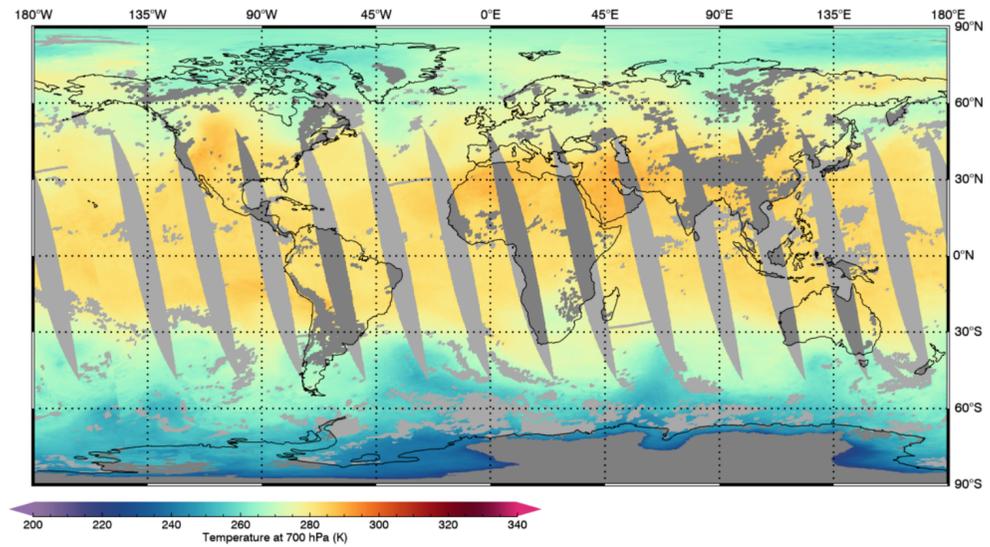
From AIRS to LANCE to GIBS to Worldview: *The Journey*



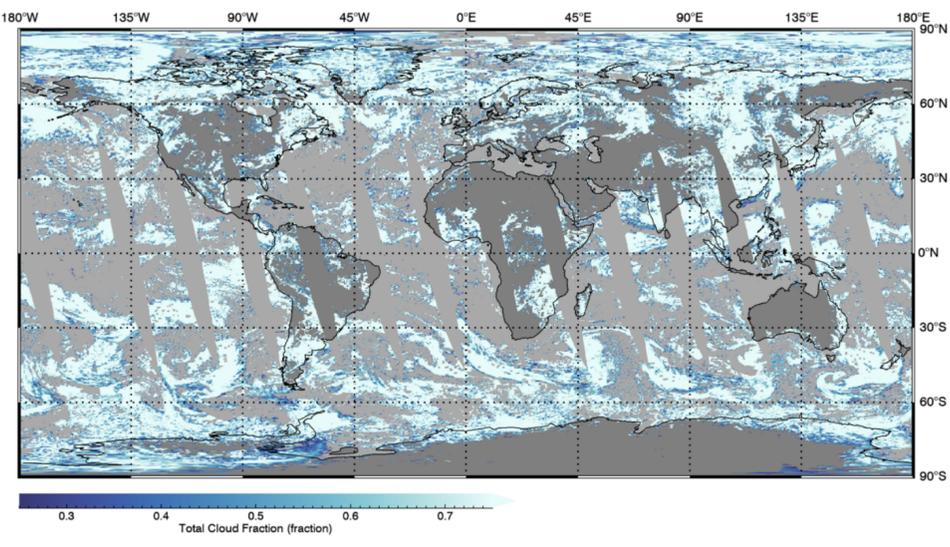
1. LANCE producing AIRS imagery > GIBS > Worldview
2. Determined AIRS on Worldview needs updating
3. Jeff Hall develops initial orbit-based visualization algorithm to improve appearance of images, fix edge effects, fix artifacts between granules
4. BEDI – L3 color tables determined for 8 products, tables tuned to maximize structure (surface air T/skin T/RH; CO 500, CH4 400, O3 all sky/clear sky; CO2 500 monthly)
5. Additional products identified for LANCE process
6. New visualization rules & image resolution determined for GIBS
7. Paulo Penteadó continues to improve visualization, sets GitHub space to easily share code with LANCE team
8. More products identified to support AIRS voice
9. Color table tuning changes: support continuity at the expense of structure
10. Polar projection added
11. Updates to some GIBS variables will require historical record
12. AIRS Project requests historical processing from BOM to be archived in GIBS

- **New visualization algorithm fixes artifacts & improves resolution**
- **Quality color tables**
- **Polar projection**
- **15 new or improved products**
- **GitHub development platform – easy code updates & sharing with LANCE**
- **Historical archive from BOM *in progress***
- **AIRS – LANCE – GIBS process & infrastructure**

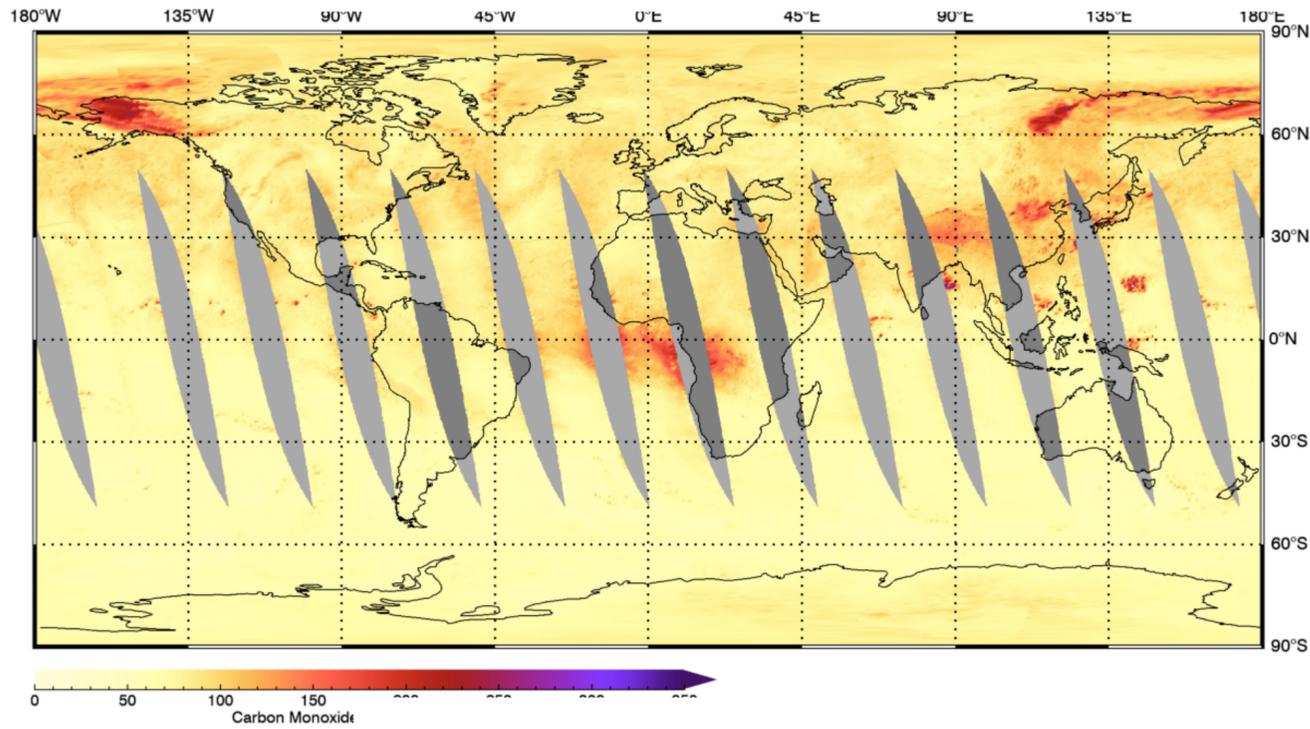
T 700mb



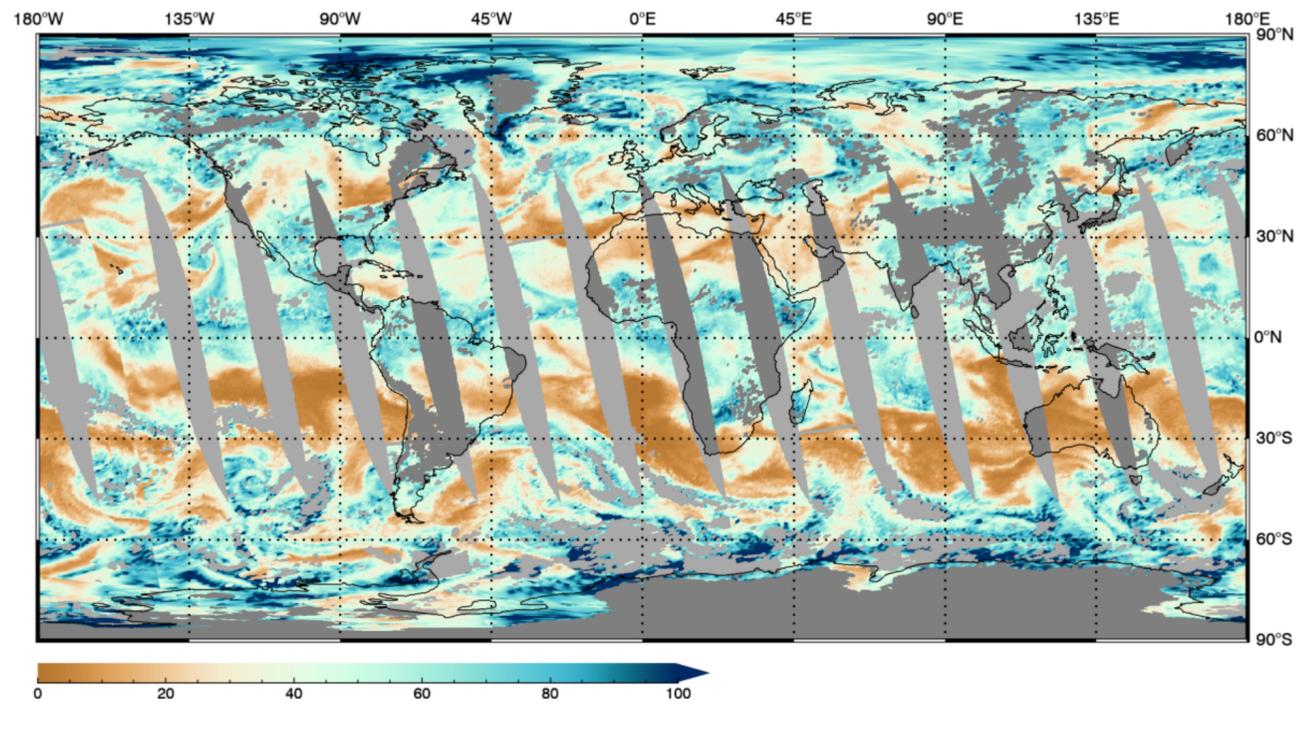
Cloud Fraction



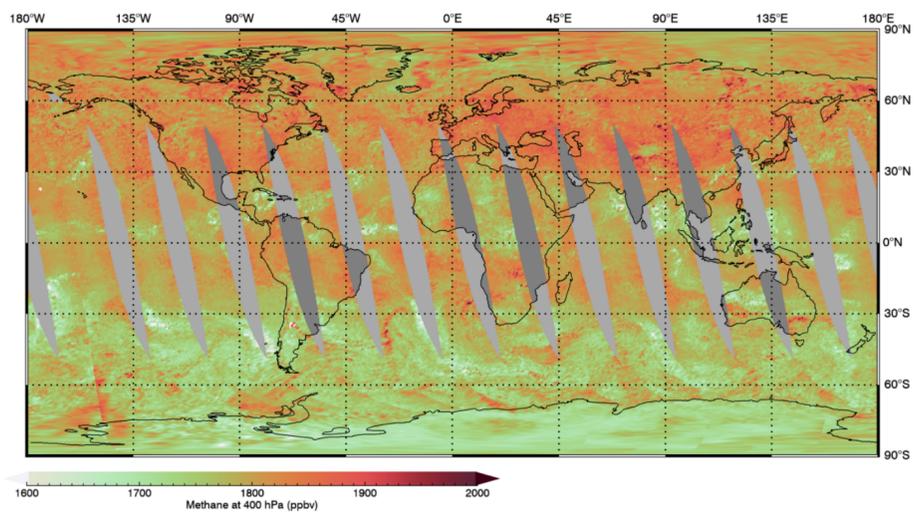
CO 500mb



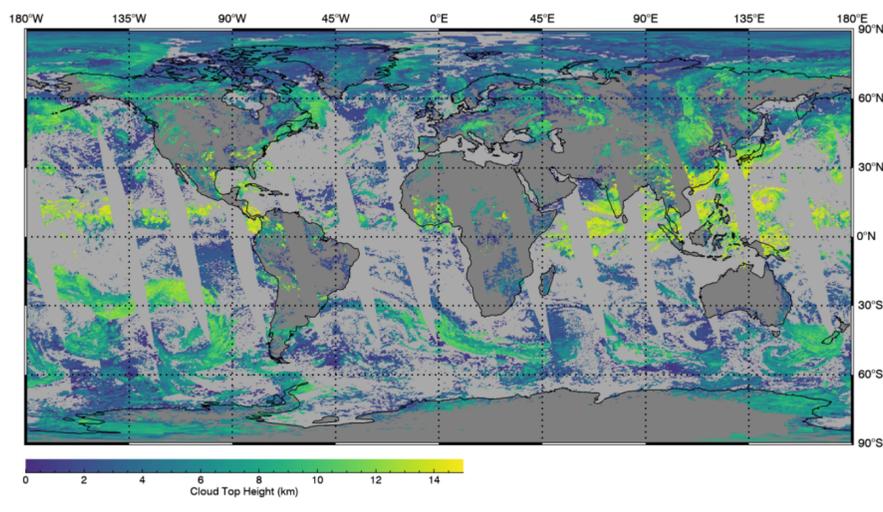
RH 700mb



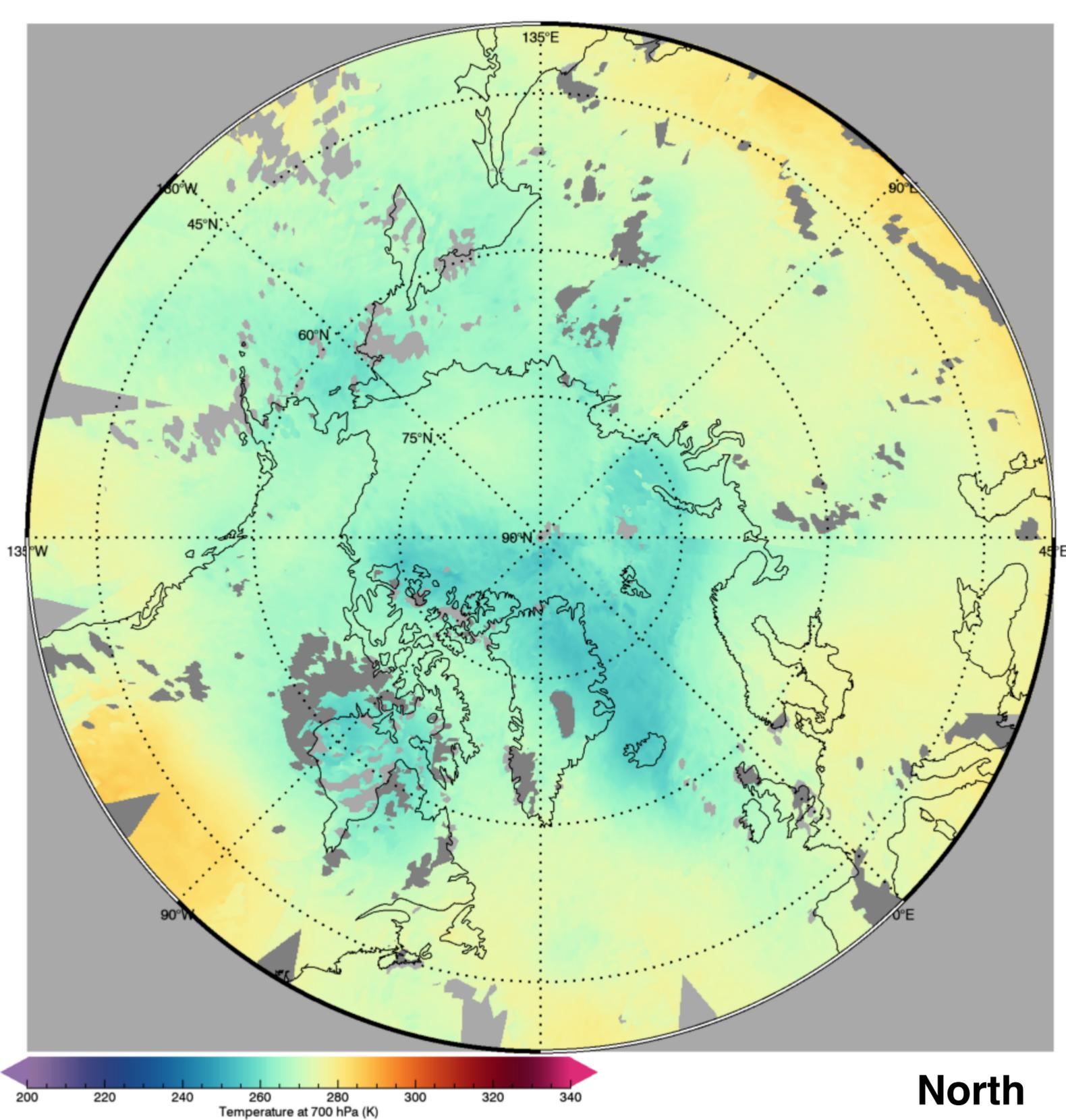
CH4 400m



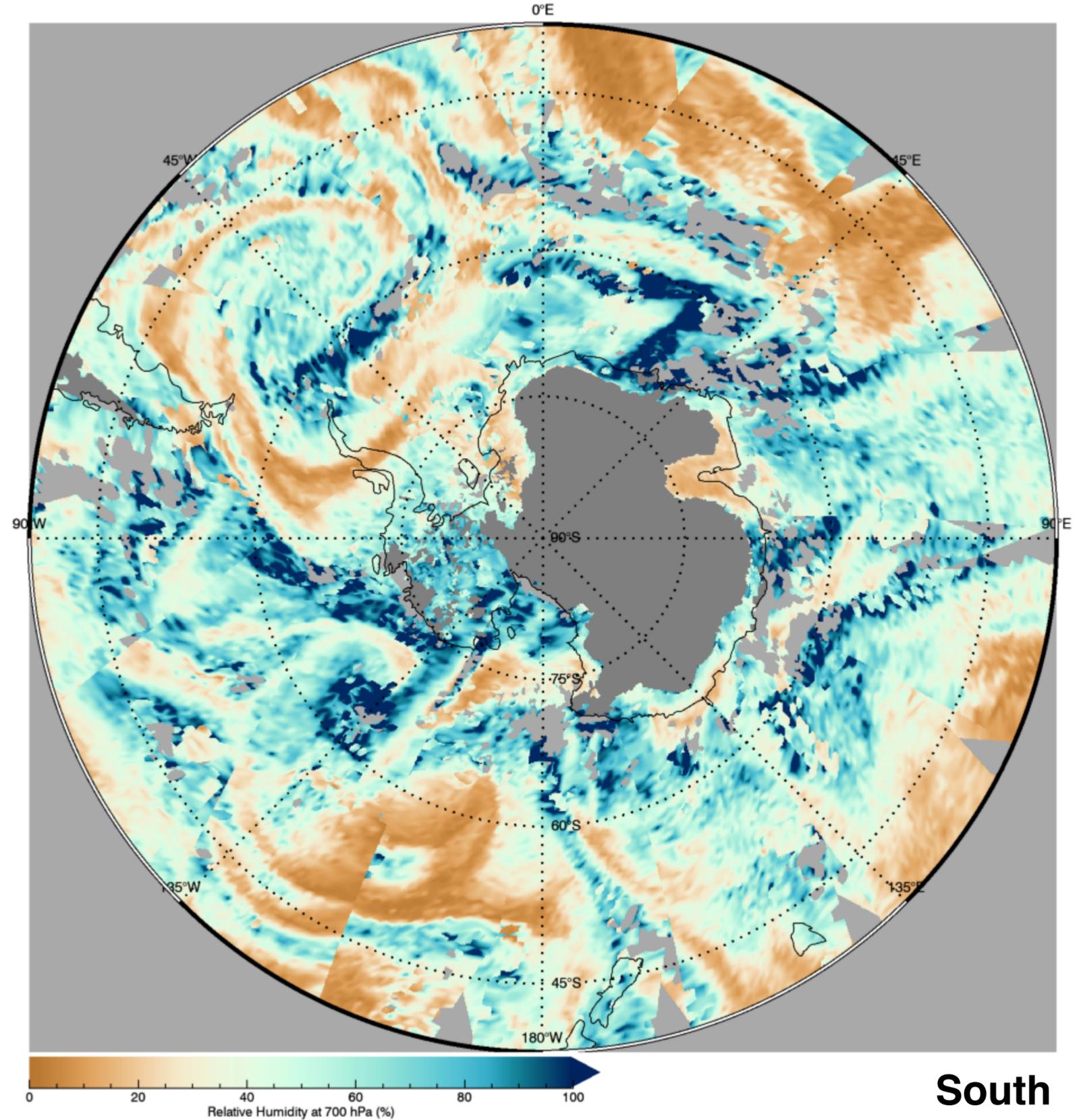
Cloud Top Height



Polar Projections



North



South

JPL/AIRS

Visualization Rules

Color tables
Scaling/Thresholding
Resolution

Visualization Algorithm & Image-Making Code

In GitHub, code for each product

Historical processing

All products, BOM

LANCE

Incorporate visualization algorithm & image-making code into workflow

Generate products, output in NetCDF

Send via WMS to GIBS

(WMS creates layers from NetCDF, GIBS takes PNG images)

GIBS

Creates tiles from image

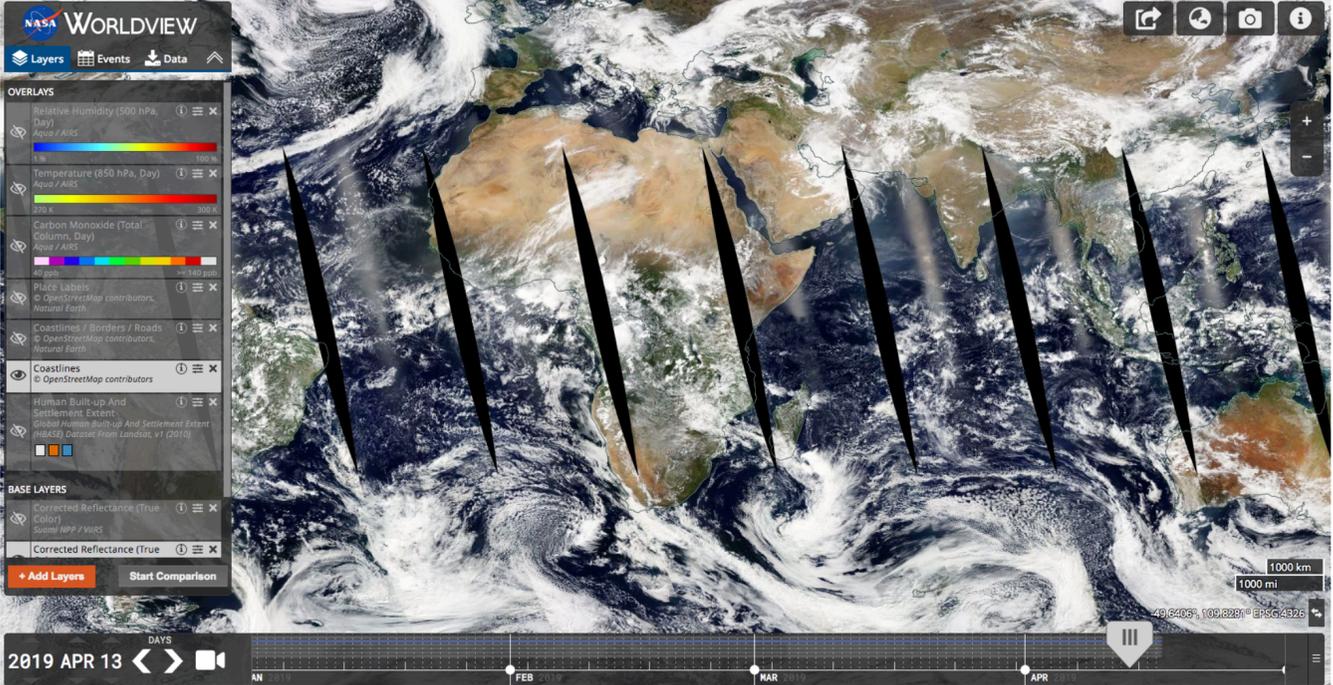
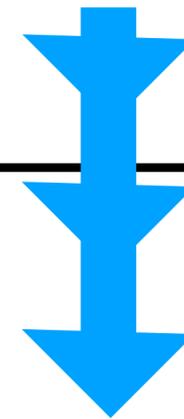
Holds library of AIRS color tables, applies to image tiles

Eventually swaps NRT for STD to allow links to data

DAAC

Generates 8 L3 images
Surface Air T, Surface Skin T, CO 500, CO2 500 (monthly), CH4 400, OLR clear sky, OLR all sky,

Sends via WMS to GIBS



WORLDVIEW
Pulls from GIBS

AIRS Historical Processing – *Status*

- 1. Sample processing run to create test images *will be completed this week***
- 2. Sample suite then sent to GIBS – GIBS confirms imagery & support files are good**
- 3. Upon go-ahead from GIBS, historical processing commences *2-3 weeks run time***

Lessons Learned

1. For products that span multiple pressure levels –
opt for one color table for all layers vs structure

Allows users to compare

***New GIBS rule: One color table per instrument
across pressure levels***

2. Understand your color bar endpoint options

3. Consult with GIBS on image-making best practices
before creating imagery for the archive (color table
approach, endpoints, resolution)

GIBS best practices cheat sheet for new suppliers?

Targeted ~~Users~~ Use Cases For AIRS on Worldview

Browse & Compare

- Researchers can easily explore to find data they're looking for; links to data
- Researchers who want a sense of the AIRS data but don't want to go through the process of downloading, reading, and plotting Level 2 files
- Users who don't do a lot of programming who want a tool to overlay data sets

Rapid Response

- Quick access to imagery for disaster or severe weather assessment (volcanic plumes, CO transport from wildfires, polar vortex, atmospheric rivers)

Applications

- Typically won't require access to data, want easy access to repository of image products

General Public

- Interested citizens, teachers, community leaders, students...

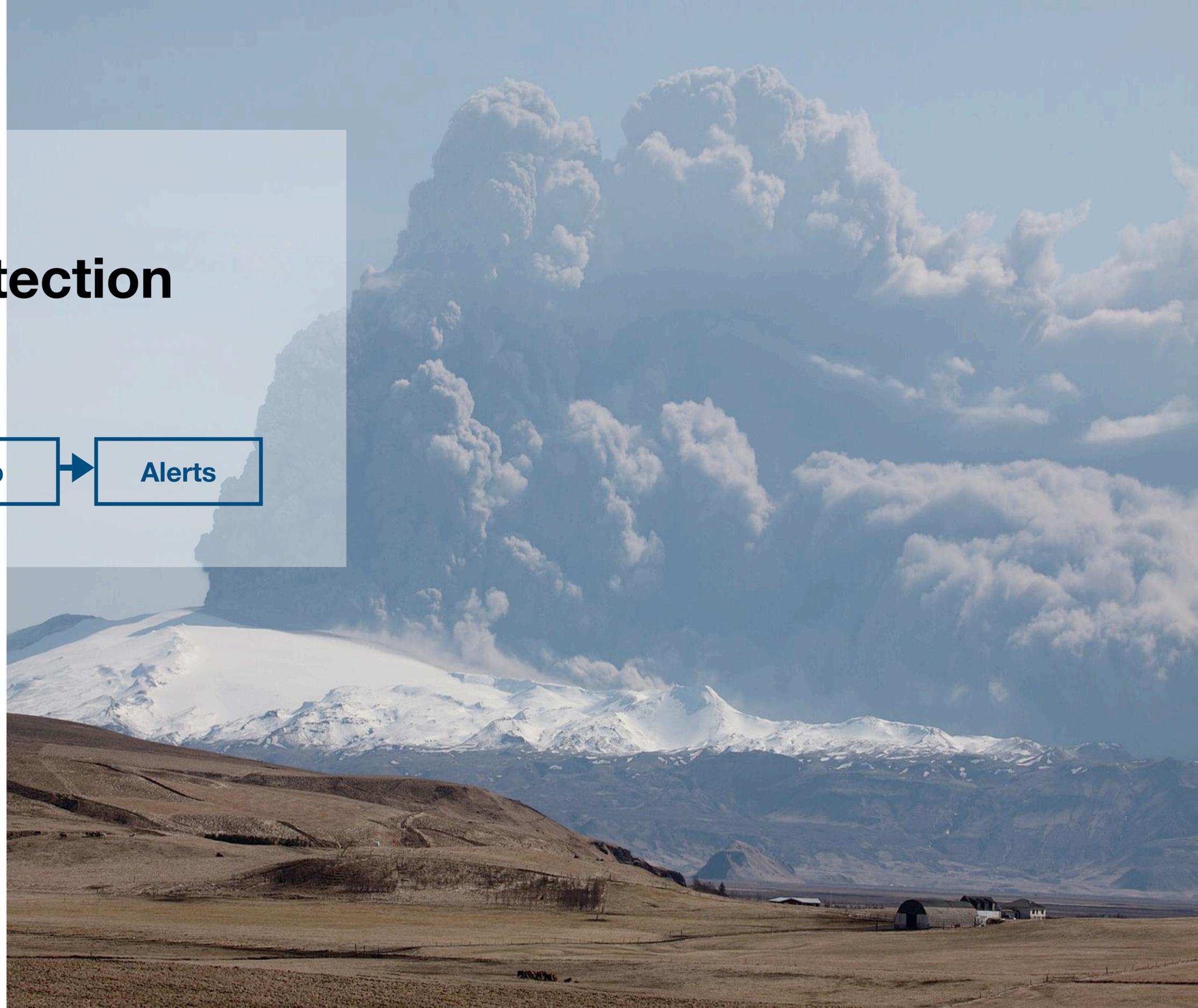
Some products on Worldview generated by LANCE, some by GES DAAC. Depends on NRT need.

AIRS Automated Volcanic Plume Detection Rapid Response



AIRS contribution

1. Can confirm eruptions in remote areas
2. Track long-lived ash clouds (days after eruption)

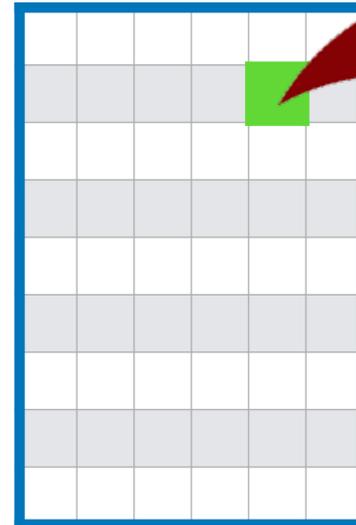


Algorithm operates on threshold breaches of AIRS SO2 BT DIFF and Dust Score for rapid response detection of volcanic plumes

- 240 AIRS Level 1B granules examined daily in NRT
- Plume Event detection operates on a granule at the subregion level
- Subregion size determined smallest unit to capture a plume (~ 220km x 220km)

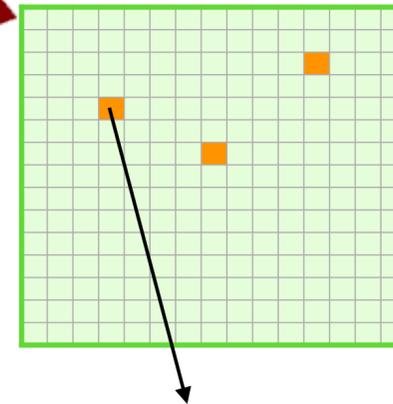
Granule

- Divided into 6x9 subregions
- 54 subregions/granule



Subregion

- Divided into 15x15 L1B footprints
- 225 footprints/subregion



Any footprint with SO2 BT Diff < -5.0 K
is tagged as an SO2 event

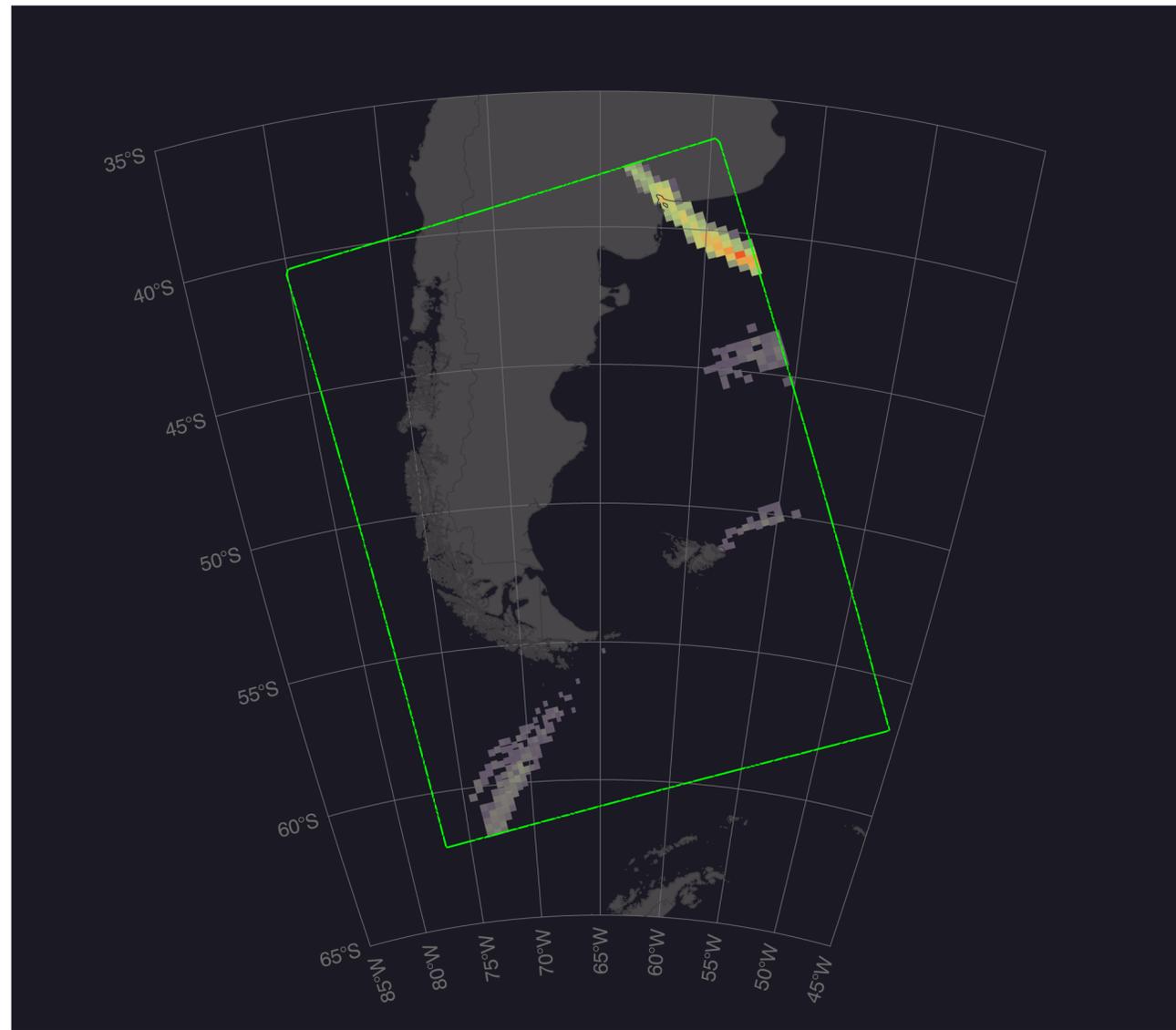
Plume Event Declared when two conditions met in subregion:

1. ≥ 20 SO2 events
2. Mean value of all SO2 events ≤ -5.5 K

Puyehue Cordon Caulle Eruption, Chile

SO2 BT Difference

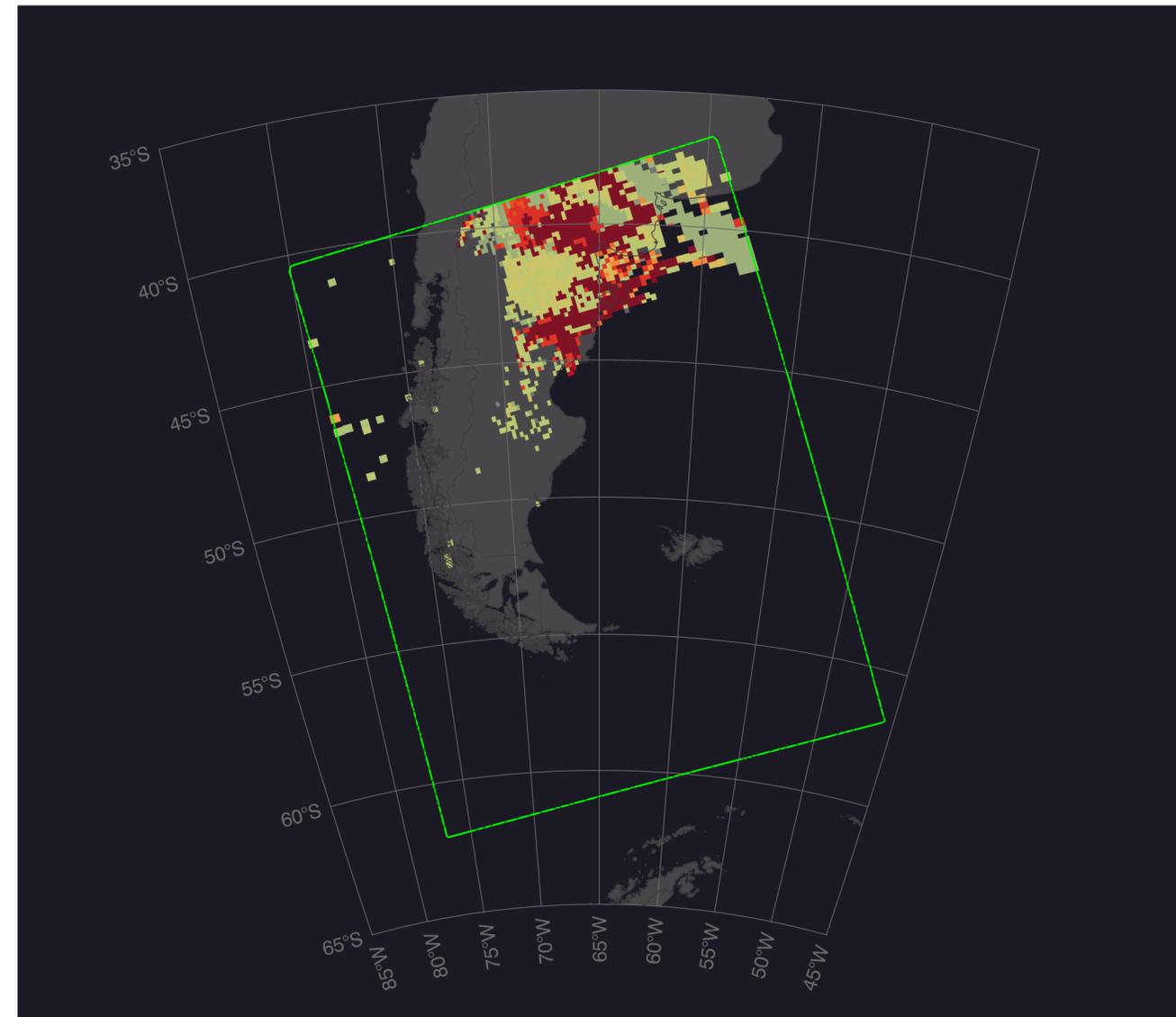
AIRS Detection of Sulfur Dioxide 2011/06/06/18:35:24 UTC



weaker signal stronger signal
Brightness Temperature Difference, 1361.44 - 1433.06 cm^{-1} (K)

Dust Score

AIRS Detection of Silicate Mineral Dust 2011/06/06/18:35:24 UTC

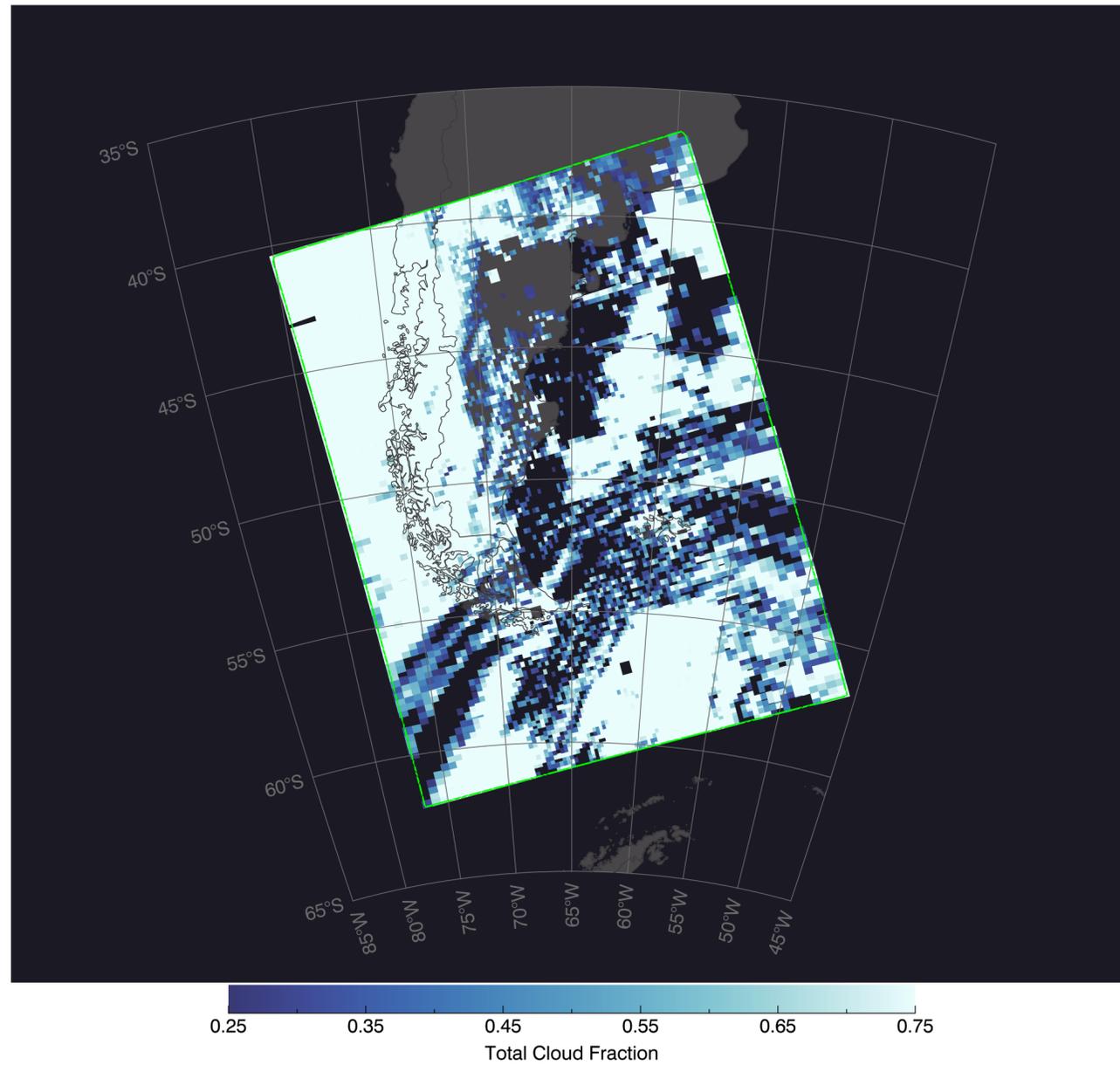


weaker signal stronger signal
AIRS Dust Score

Puyehue Cordon Caulle Eruption, Chile

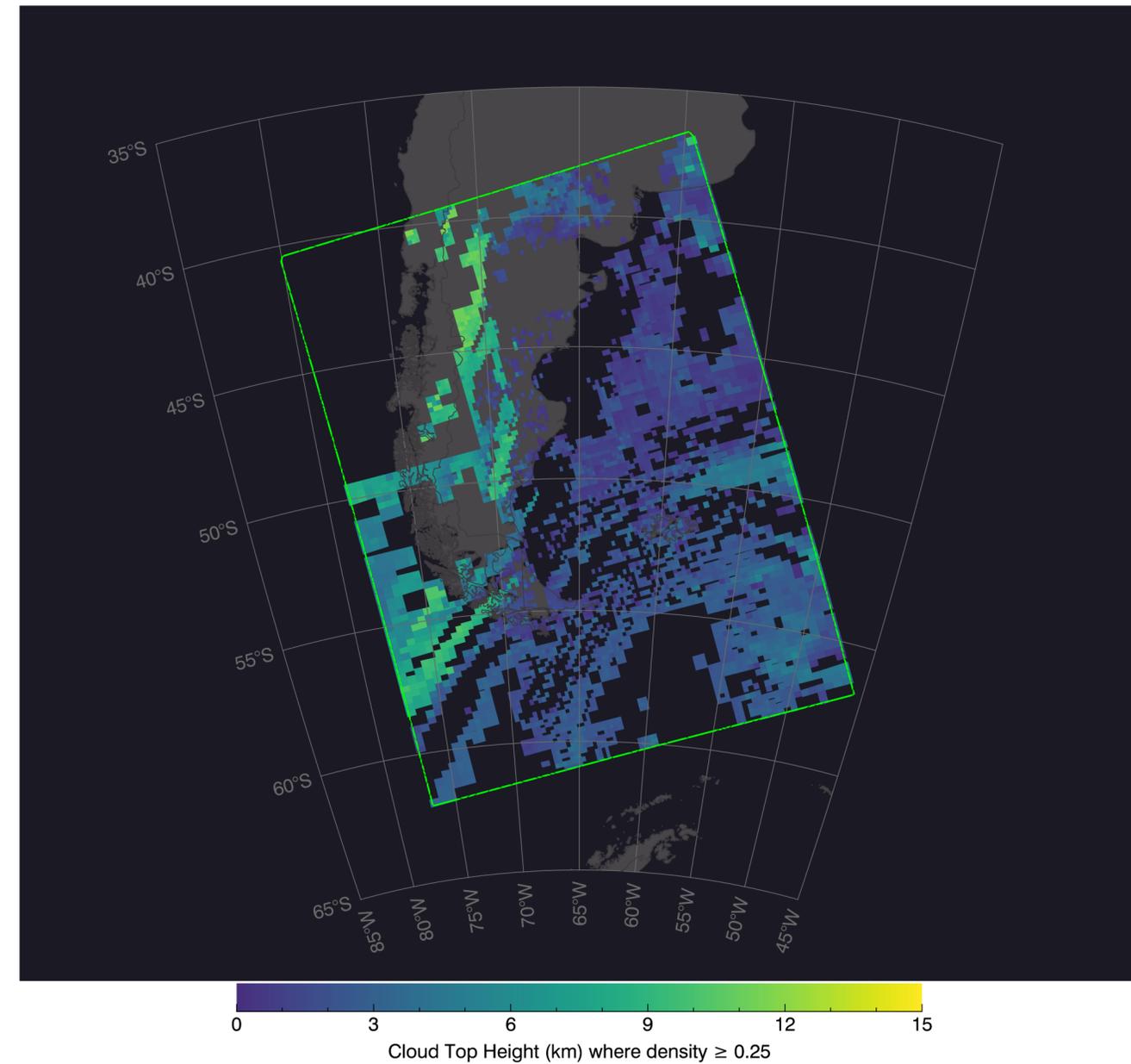
Total Cloud Fraction

AIRS Cloud Detection 2011/06/06/18:35:24 UTC



Cloud Top Height

AIRS Cloud Detection 2011/06/06/18:35:24 UTC



AIRS ATMOSPHERIC INFRARED SOUNDER

WEATHER & CLIMATE MISSION & INSTRUMENT DATA RESOURCES NEWS EVENTS PEOPLE ASK AIRS

AIRS Rapid Response: Latest Sulfur Dioxide and Dust Detection

DETECTION TIME: 2018/04/07, UTC 02:59:22
Region plotted represents one AIRS data granule.

SO2 DETECTION

AIRS Detection of Sulfur Dioxide 2018/04/07/02:59:21 UTC

DUST DETECTION

AIRS Detection of Silicate Mineral Dust 2018/04/07/02:59:21 UTC

CLOUDS

AIRS Cloud Fraction 2018/04/07/02:59:21 UTC

AIRS Cloud Top Altitude 2018/04/07/02:59:21 UTC

VISIBLE AND INFRARED

AIRS Visible Light Image 2018/04/07/02:59:21 UTC

AIRS Infrared Image 2018/04/07/02:59:21 UTC

SHARE

OBSERVATION AREA CENTER
-20.0 latitude, 161.0 longitude

SO2 AND DUST DETECTION ARCHIVE **VIEW**

VOLCANO RESOURCES

- NASA Global SO2 Monitoring
- Smithsonian Volcano Site
- NOAA/CIMSS Volcanic Cloud Portal
- Volcanic Ash Advisory Centers
- Support to Aviation Control Service
- USGS Volcano Finder & Alerts

HELPFUL AIRS USER GUIDE SELECTIONS

AIRS Level 2 Product User Guide
Provides a description of the AIRS SO2 Flag and Dust Flag along with quality indicators and caveats. See chapter 24, titled "LEVEL 2 PHYSICAL RETRIEVAL: SURFCLASS, DUST FLAG, SO2 FLAG AND CLOUD PHASE FLAG".

AIRS Retrieval Channel Sets
Defines the SO2 Flag and Dust Flag tests plus important notes concerning contamination due to volcanic ash and dust. See section 2.12 SO2 Flag (L1B radiances) and Section 2.13 Dust Flag Determination (L1B radiances).

GET AIRS DATA

Near Real-time AIRS Products
Standard Data Products

Ask AIRS

Type your question here... ?
or browse our faq

FOLLOW AIRS

flickr You Tube issuu

Web page: images, volcano locator, link to event archive, links to resources, user guides, data, KMZ, Geotiff formats available for images

Using LANCE/GIBS/Worldview for AIRS Volcano RR – coming soon

Event archive to leverage LANCE/GIBS/Worldview when AIRS volcano imagery available (SO2 BT DIFF, Dust Score, Cloud Fraction, Cloud Top Pressure)

Custom link to Worldview seeded with granule boundaries and layer "SO2 Index (Prata)"

NASA WORLDVIEW

Layers Events Data

OVERLAYS

- Sulfur Dioxide (Night, Prata Algorithm) Aqua / AIRS
- Sulfur Dioxide (Day, Prata Algorithm) Aqua / AIRS
- Place Labels OpenStreetMap contributors, Natural Earth
- Coastlines / Borders / Roads OpenStreetMap contributors, Natural Earth
- Coastlines OpenStreetMap contributors

BASE LAYERS

- Corrected Reflectance (True Color) Aqua / MODIS

+ Add Layers Start Comparison

2018 APR 07

500 km 500 mi

LANCE / GIBS / Worldview

Requests for Future Capability & Questions

Supporting AIRS volcanic plume detection rapid response

- On trigger from AIRS volcano rapid response, can LANCE create images and pushes them to GIBS (SO2 BT DIFF, Dust Score, Total Cloud Fraction, Cloud Top Height)?
- Worldview – Volcano locations base map available?

Worldview titles need to include L2 or L3 designation

GIBS > Replace AIRS NRT with AIRS STD?

Non-NRT L2 or L4 applications products: Is image generation a future GES DAAC capability?

***Idea:* Worldview themes (a layer bundle?). Might support applications (drought bundle, volcano bundle...)**

Getting images into GIBS

Questions from applications leads

“Imagery accessible in Worldview would definitely be helpful. Both as DPA of a mission and as a researcher.”

Who controls the imagery that is allowed in GIBS?

PIs can request a DAAC archive their data set, but a mission must get permission from HQs since flight projects are HQ directed

For products created beyond the original mission scope, what is the process to get these products into GIBS?

Is there a cheat sheet “What’s the process for getting imagery into GIBS and who do you talk to?”

It would include information on how get imagery automatically generated

Thank you!

