AIRS – Updating Imagery to Meet User Needs & Support Applications

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April 2019

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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 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
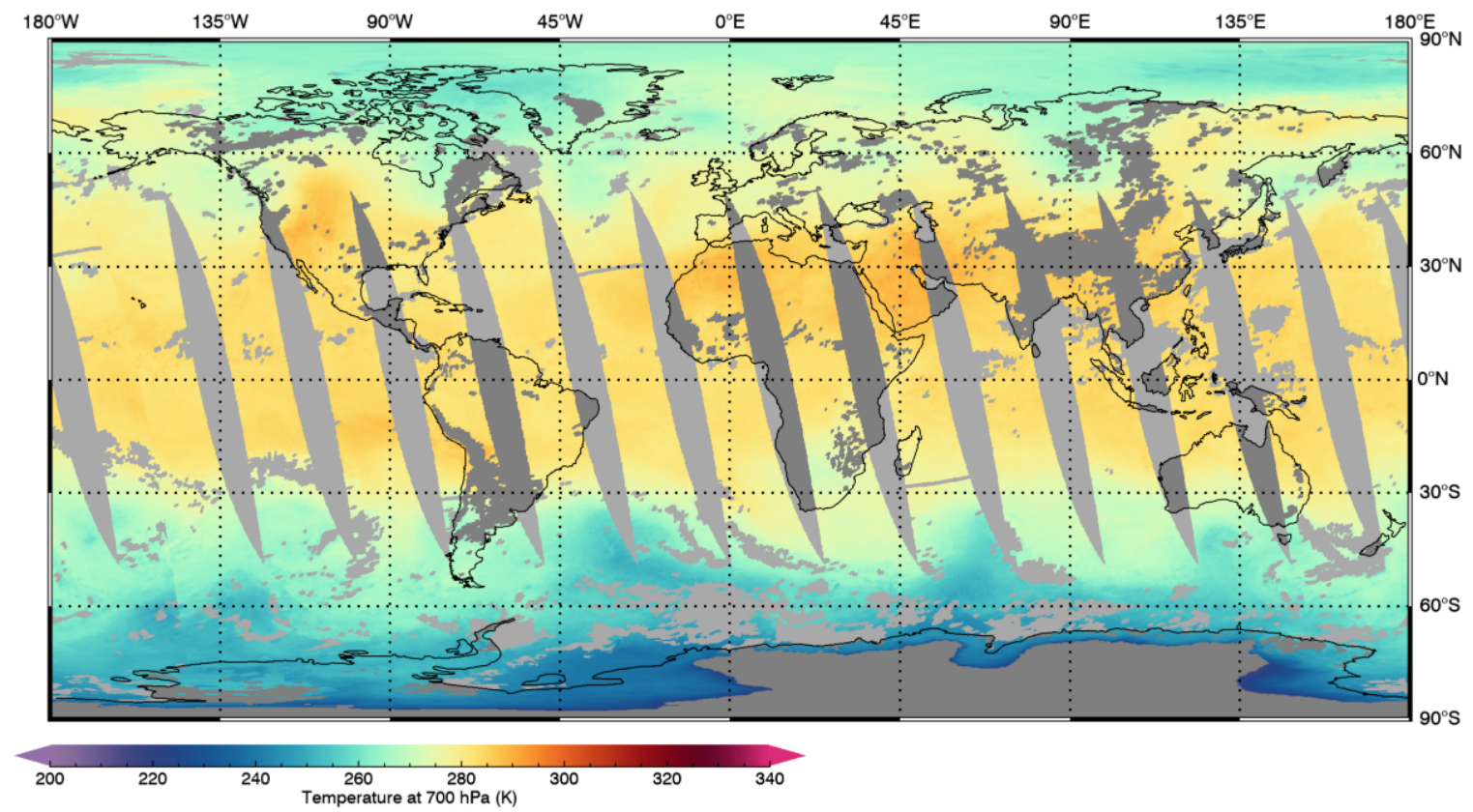- Additional products should be included
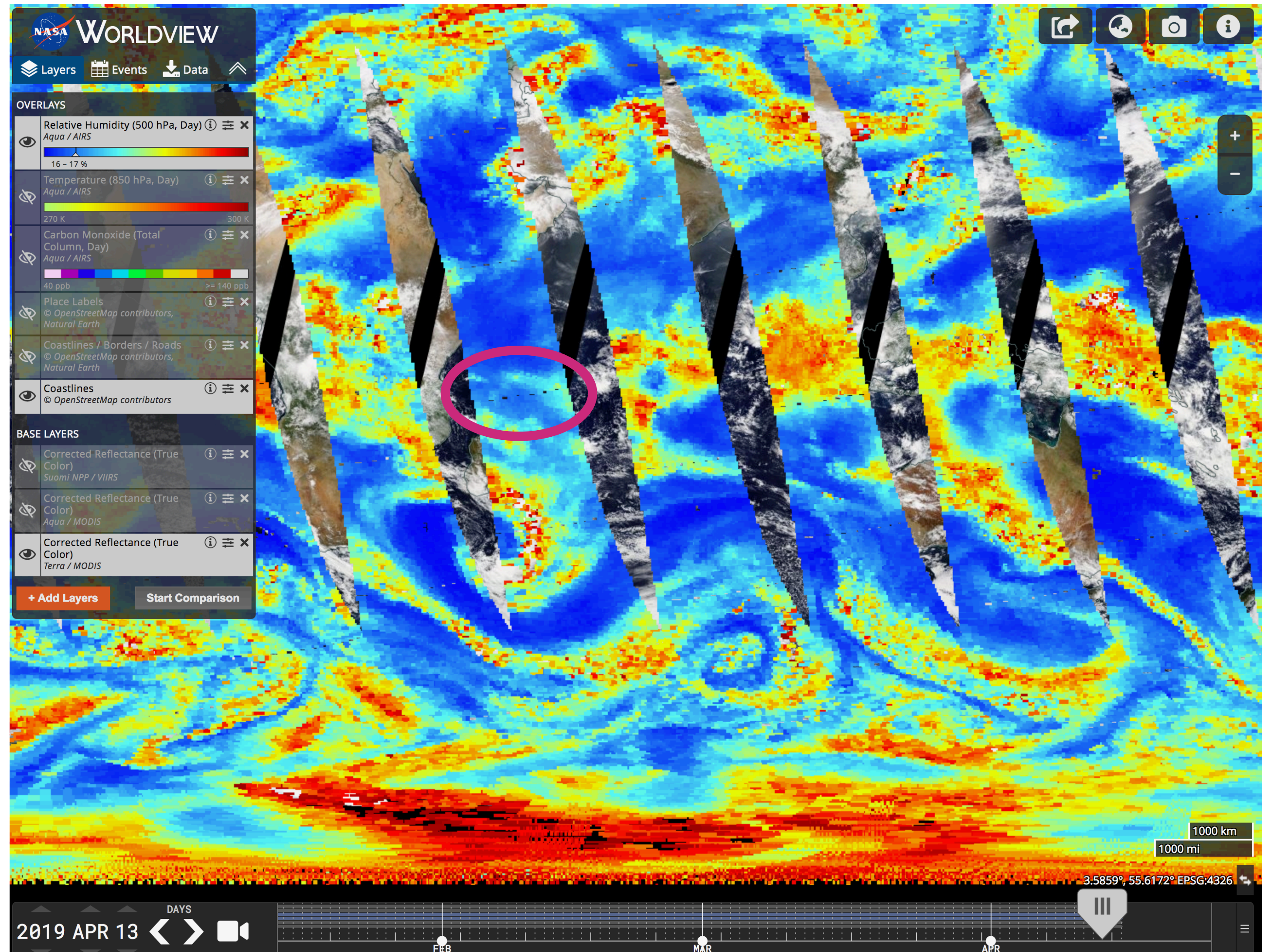
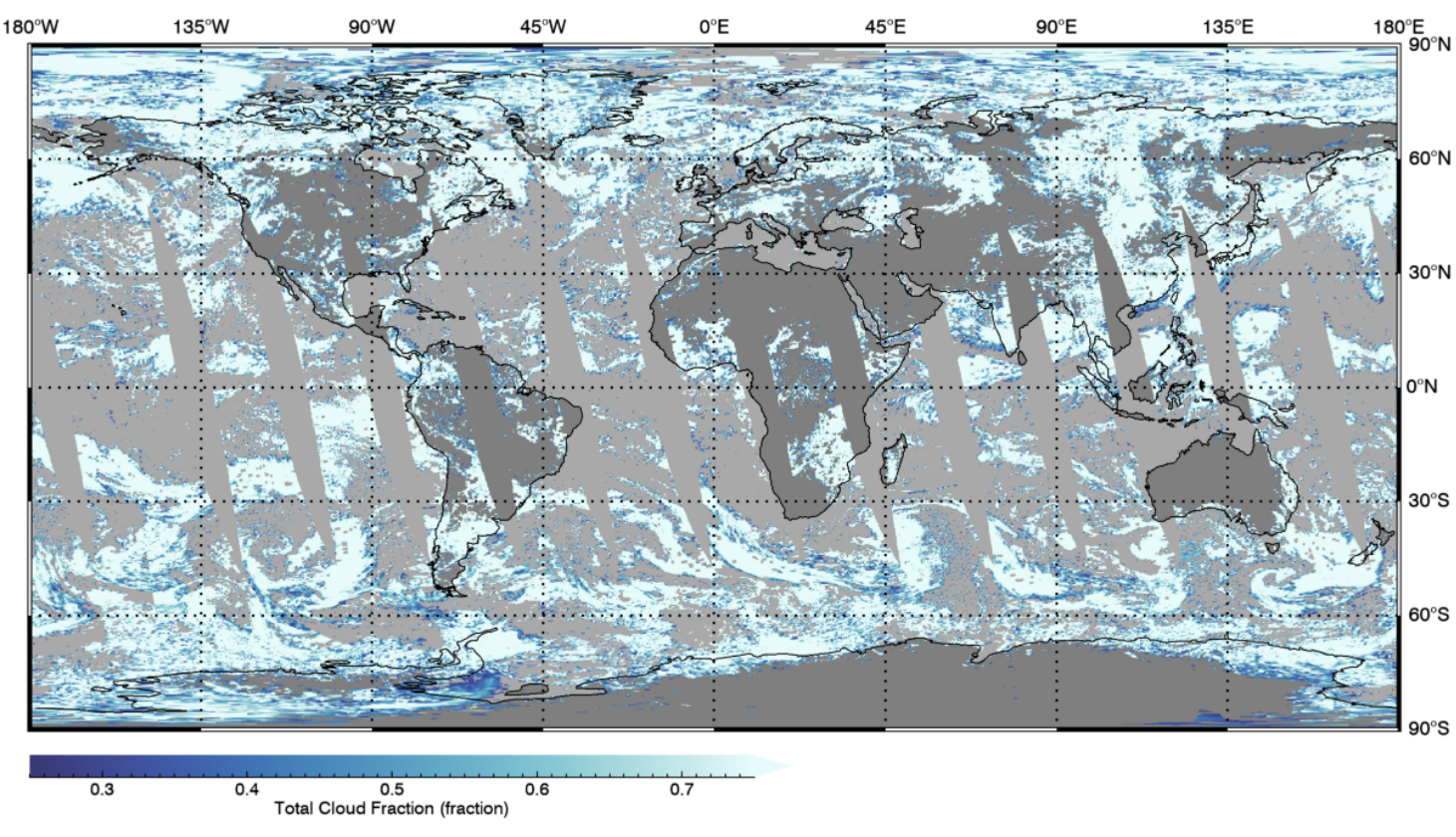# From AIRS to LANCE to GIBS to Worldview: *The Journey*

Credit: Rick Ray

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 ... R all sky/clear sky; CO2 500 monthly)
5. Additional products identified for LANCE process
6. New visualization rules & image resolution deter... d for GIBS
7. Paulo Penteado continues to improve visualizati... es GitHub space to easily share code with LANCE team
8. More products identified to support AIRS volca
9. Color table tuning changes: support continuit... the expense of structure
10. Polar projection added
11. Updates to some GIBS varia... s will requir... ir historical record
12. AIRS Project requests histori... processi... om 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
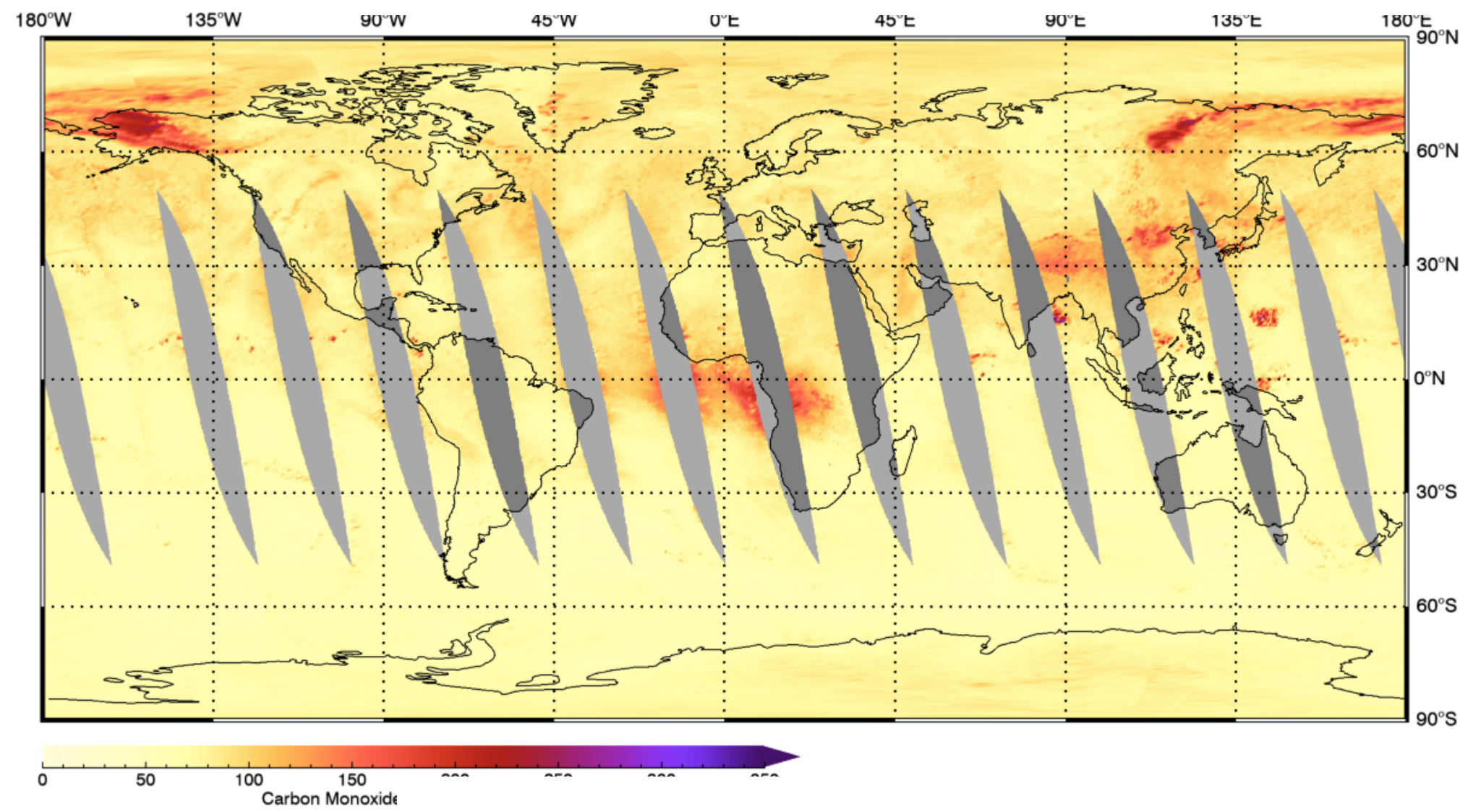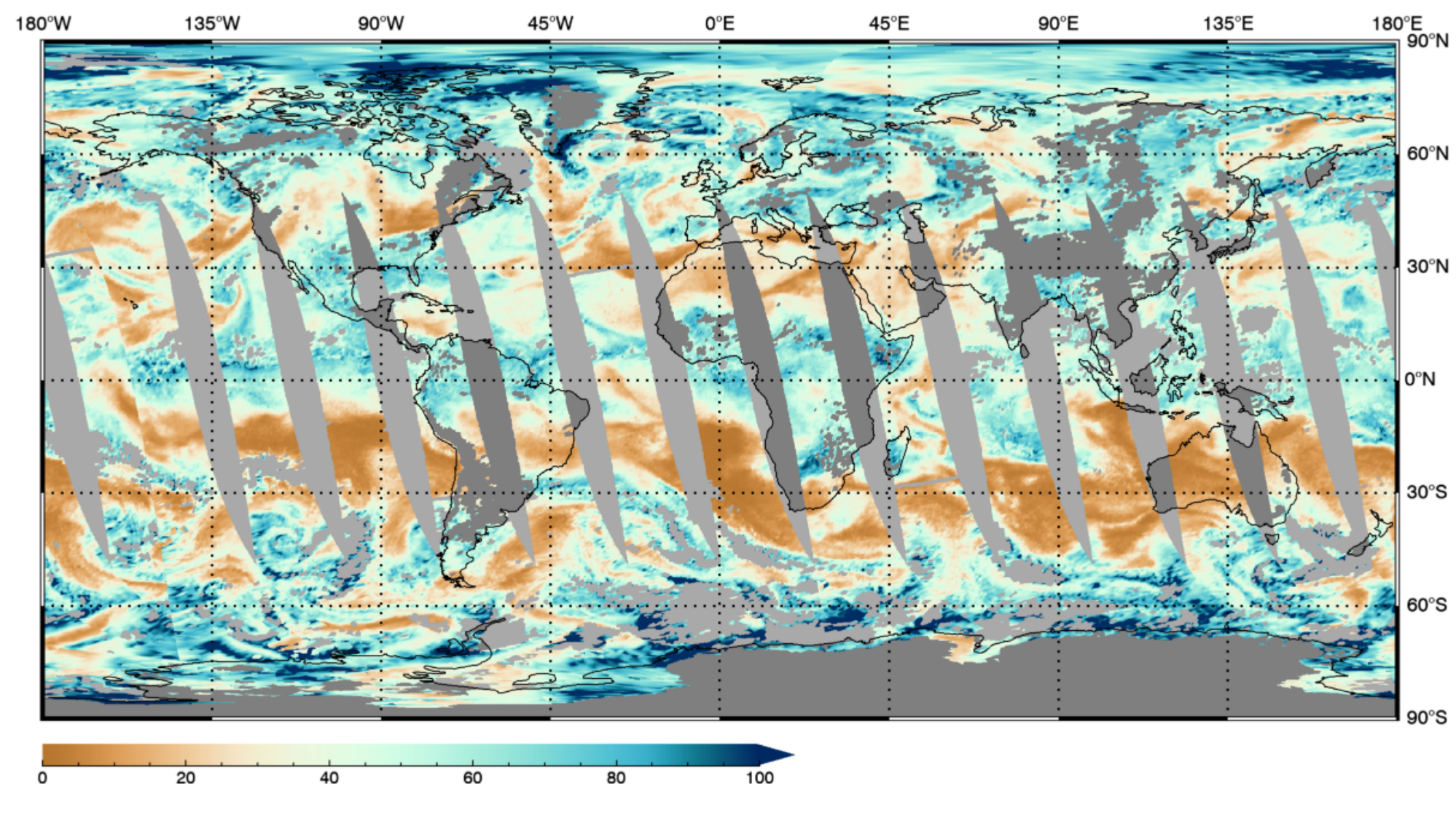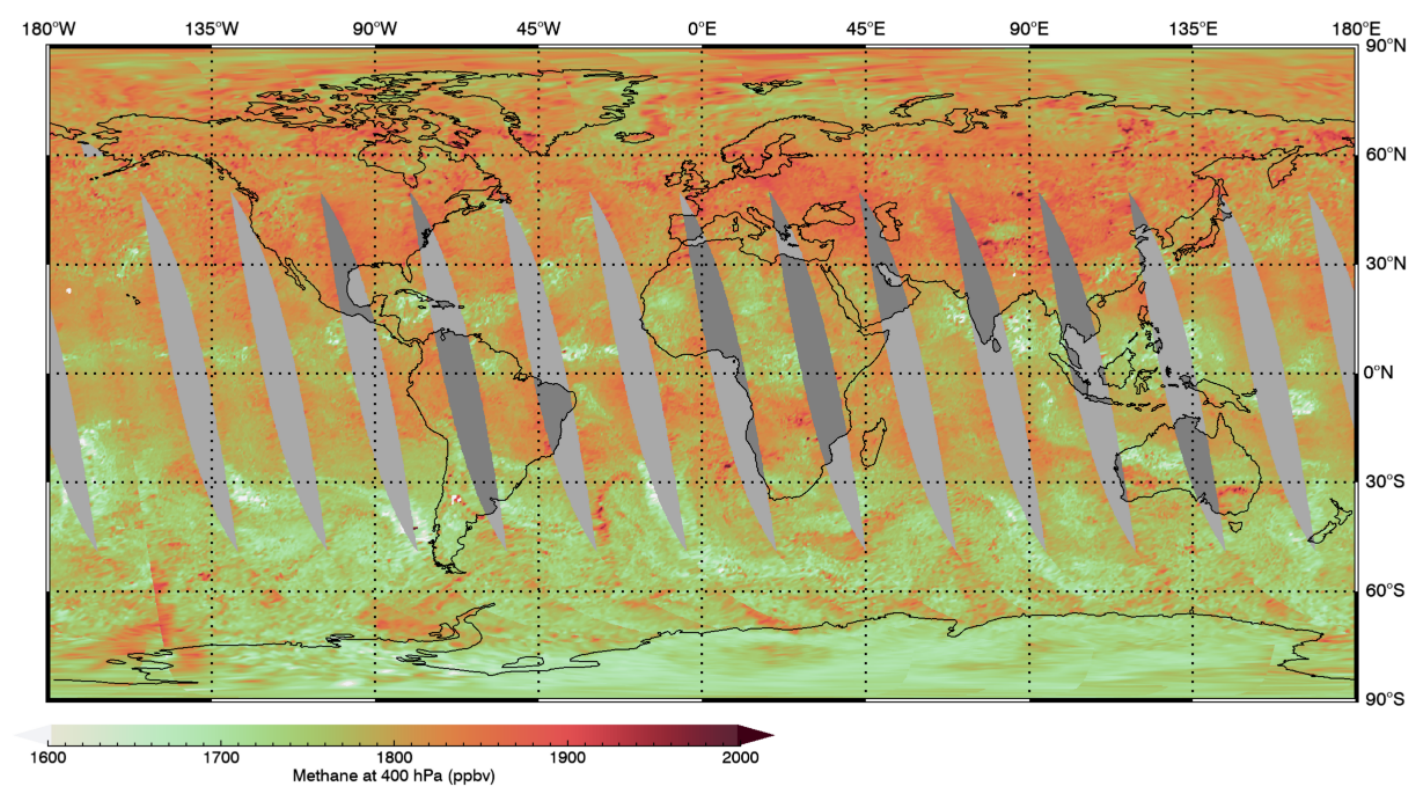- **Historical archive from BOM** *in progress*
- **AIRS – LANCE – GIBS process & infrastructure**
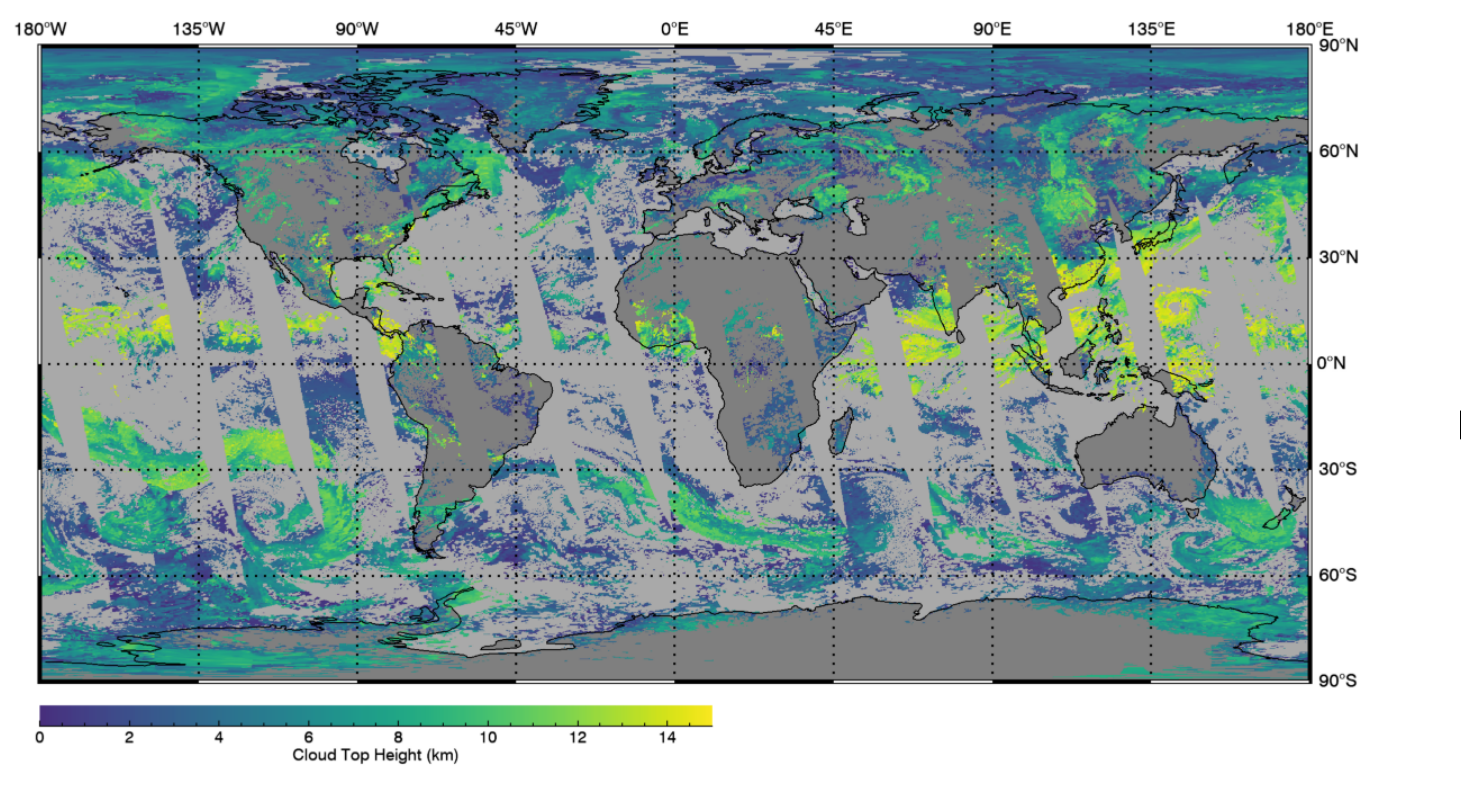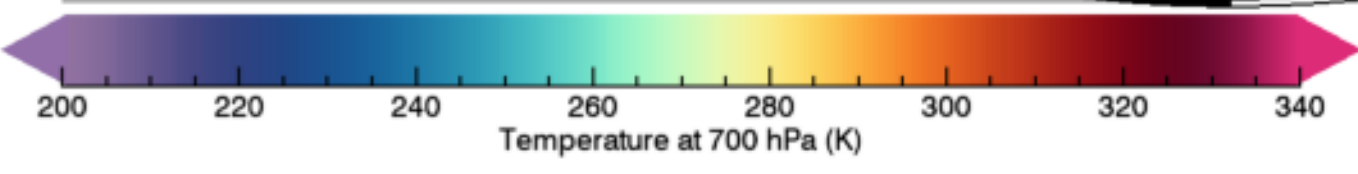
T 700mb

Cloud Fraction

CO 500mb

RH 700mb

CH4 400mb

Cloud Top Height

Temperature at 700 hPa (K)

Total Cloud Fraction (fraction)

Carbon Monoxide

Methane at 400 hPa (ppbv)

Cloud Top Height (km)

Polar Projections

North   **South**

Temperature at 700 hPa (K)

200 220 240 260 280 300 320 340

Relative Humidity at 700 hPa (%)

0 20 40 60 80 100
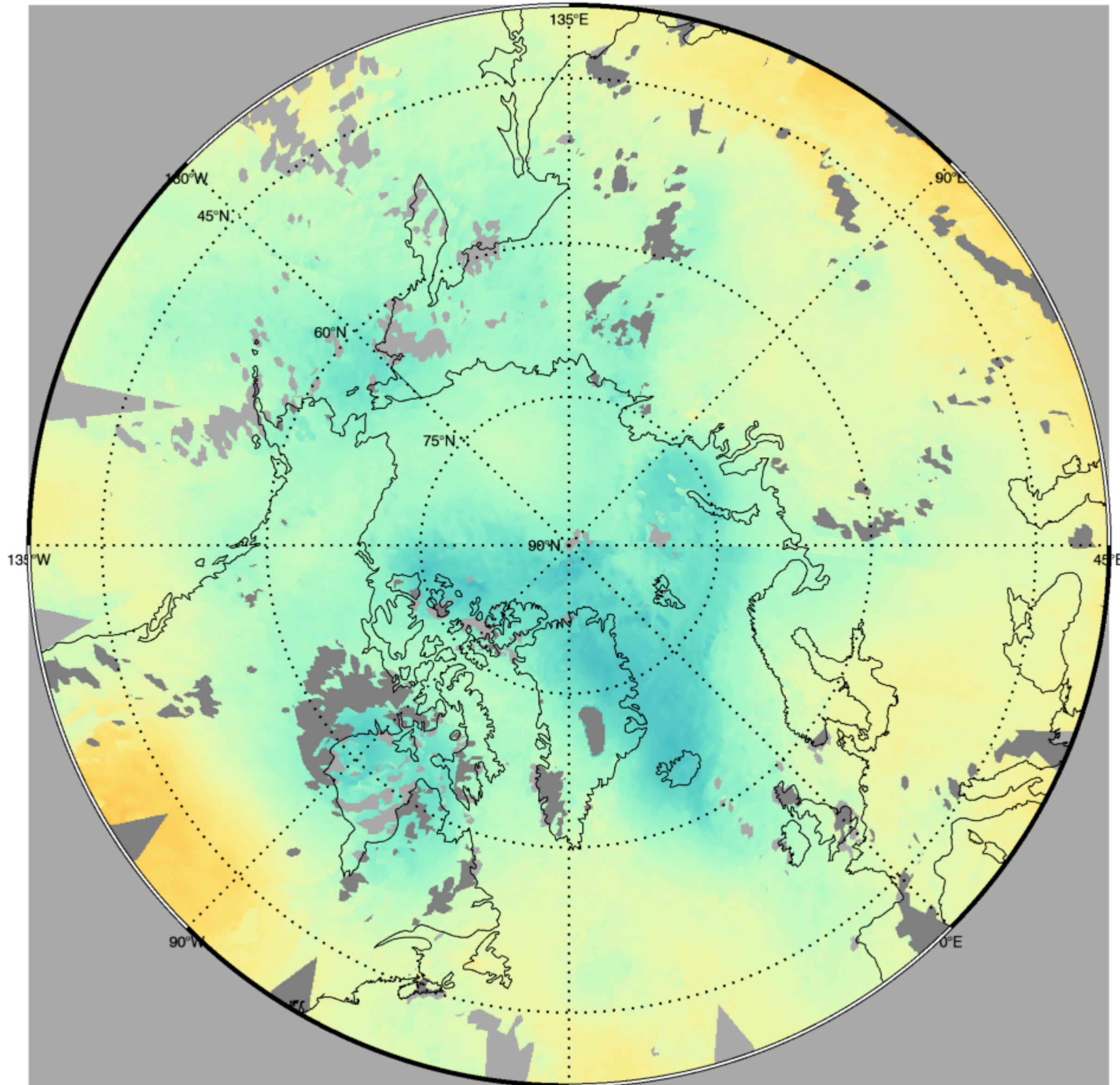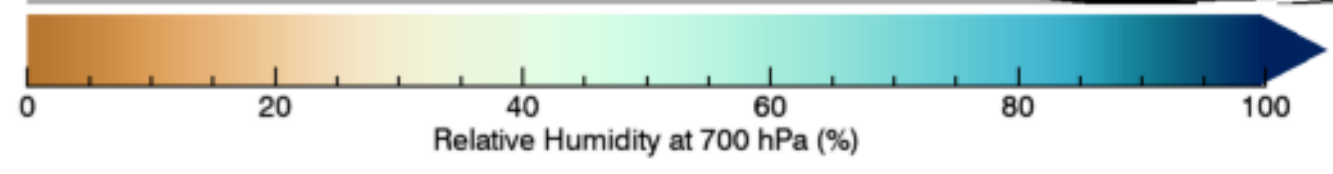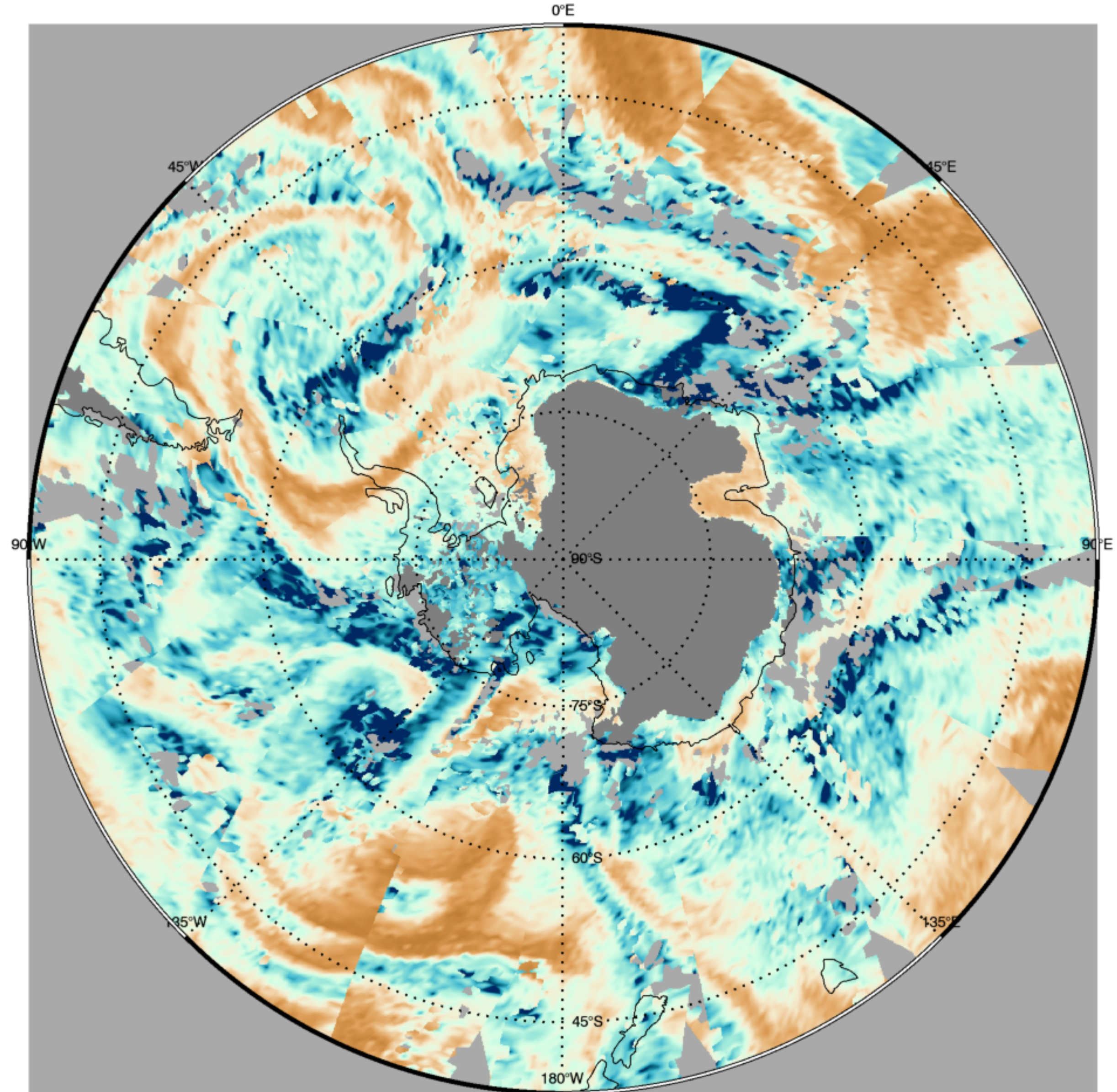
JPL/AIRS

Visualization Algorithm
In GitHub, contains image-making code for all products

Visualization Rules
Color tables
Scaling
Thresholding
Resolution

Historical processing
All products, BOM

LANCE

Incorporate Visualization Algorithm into workflow

Generate products, output in NetCDF

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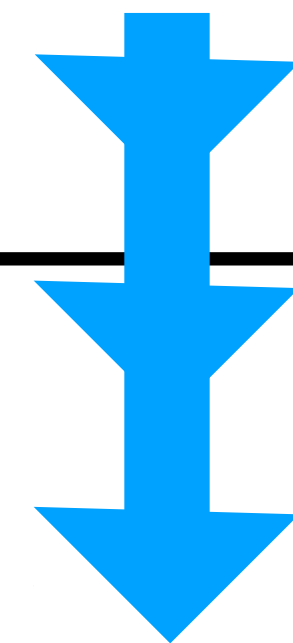
GIBS

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

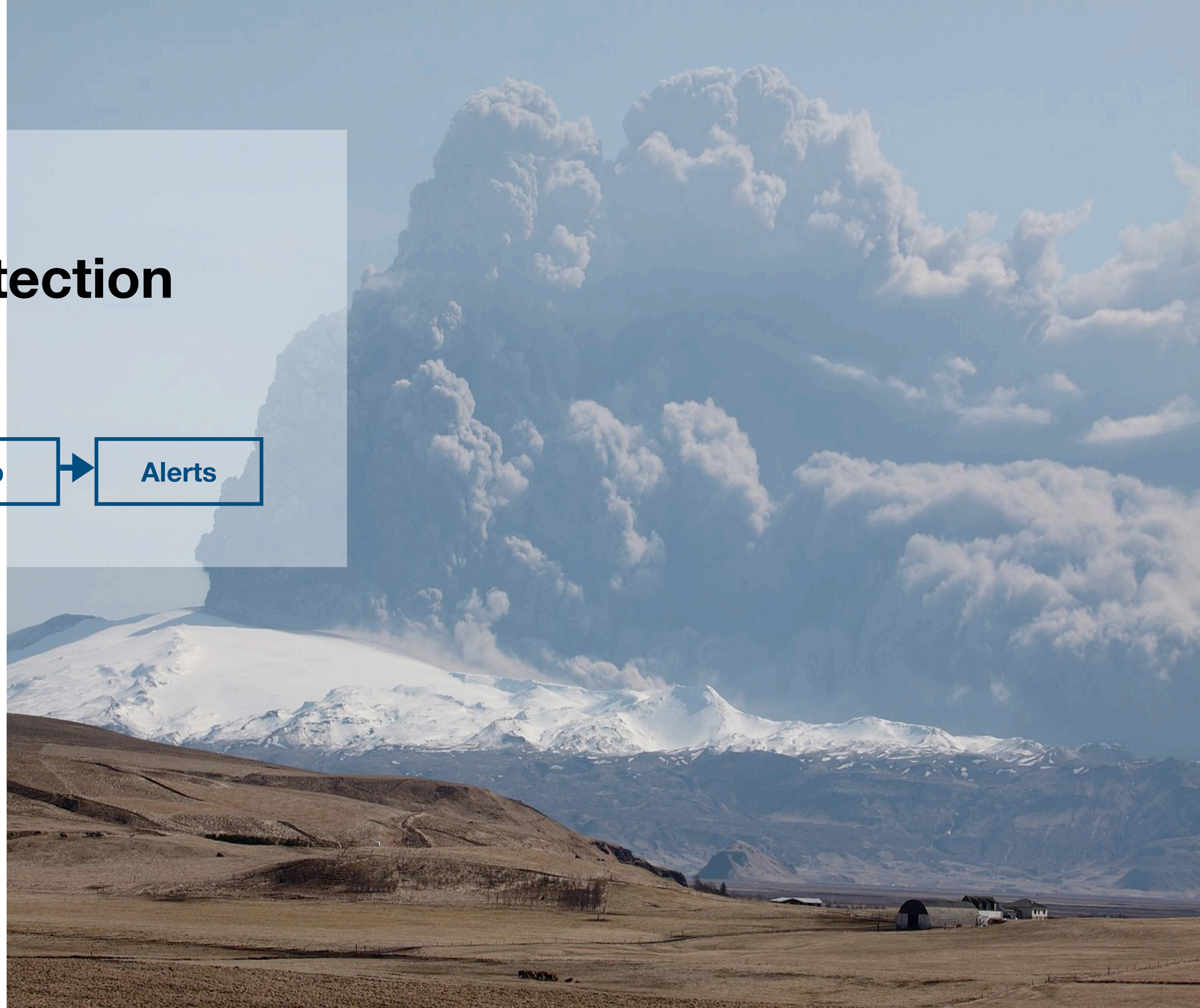- Interested citizens, teachers, community leaders, students…

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

AIRS Automated Volcanic Plume Detection Rapid Response

Detection → Imagery → Web → Alerts
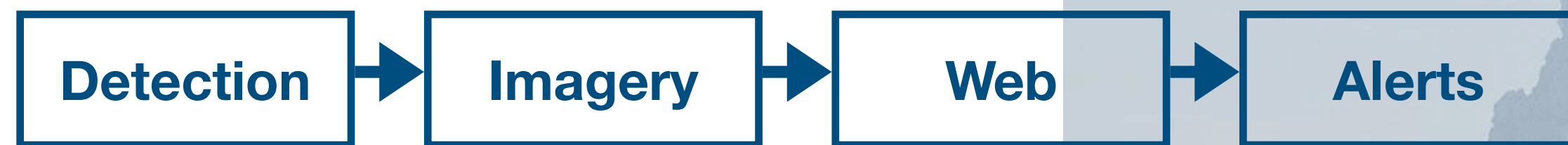
AIRS contribution

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
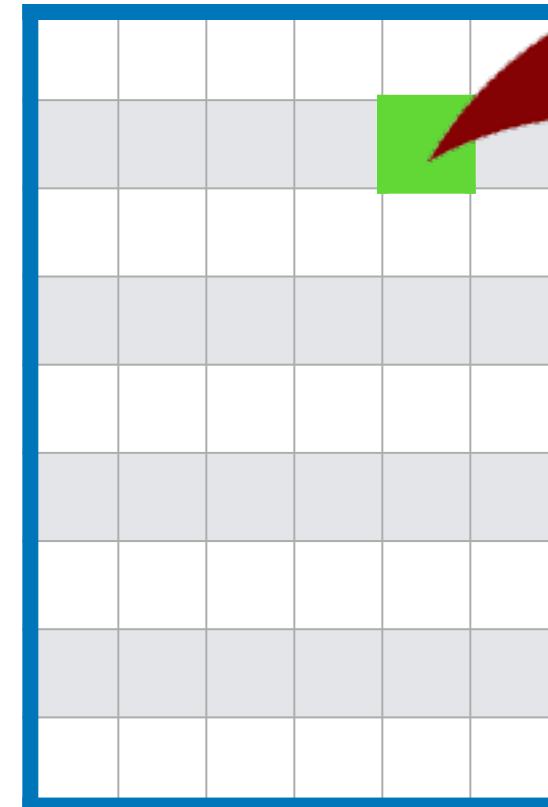
Subregion
- Divided into 15x15 L1B footprints
- 225 footprints/subregion
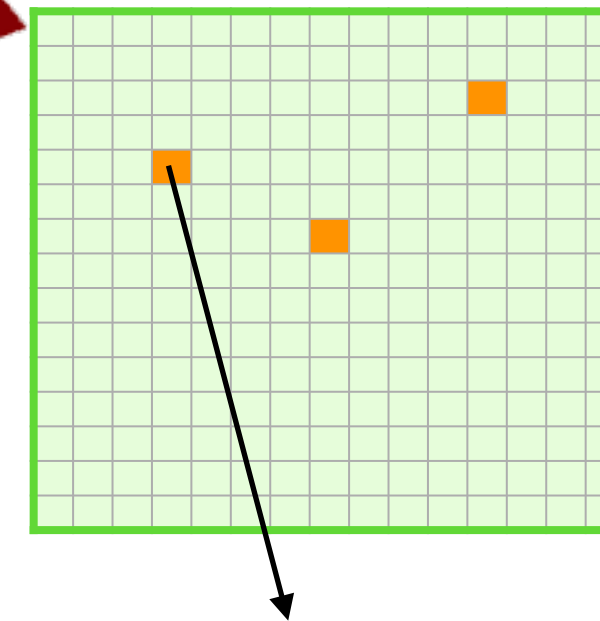
Any footprint with SO2 BT Diff < -5.0 K is tagged as an SO2 event

Plume Event Declared when two conditions met in subregion:
1. >= 20 SO2 events
2. Mean value of all SO2 events <= -5.5 K
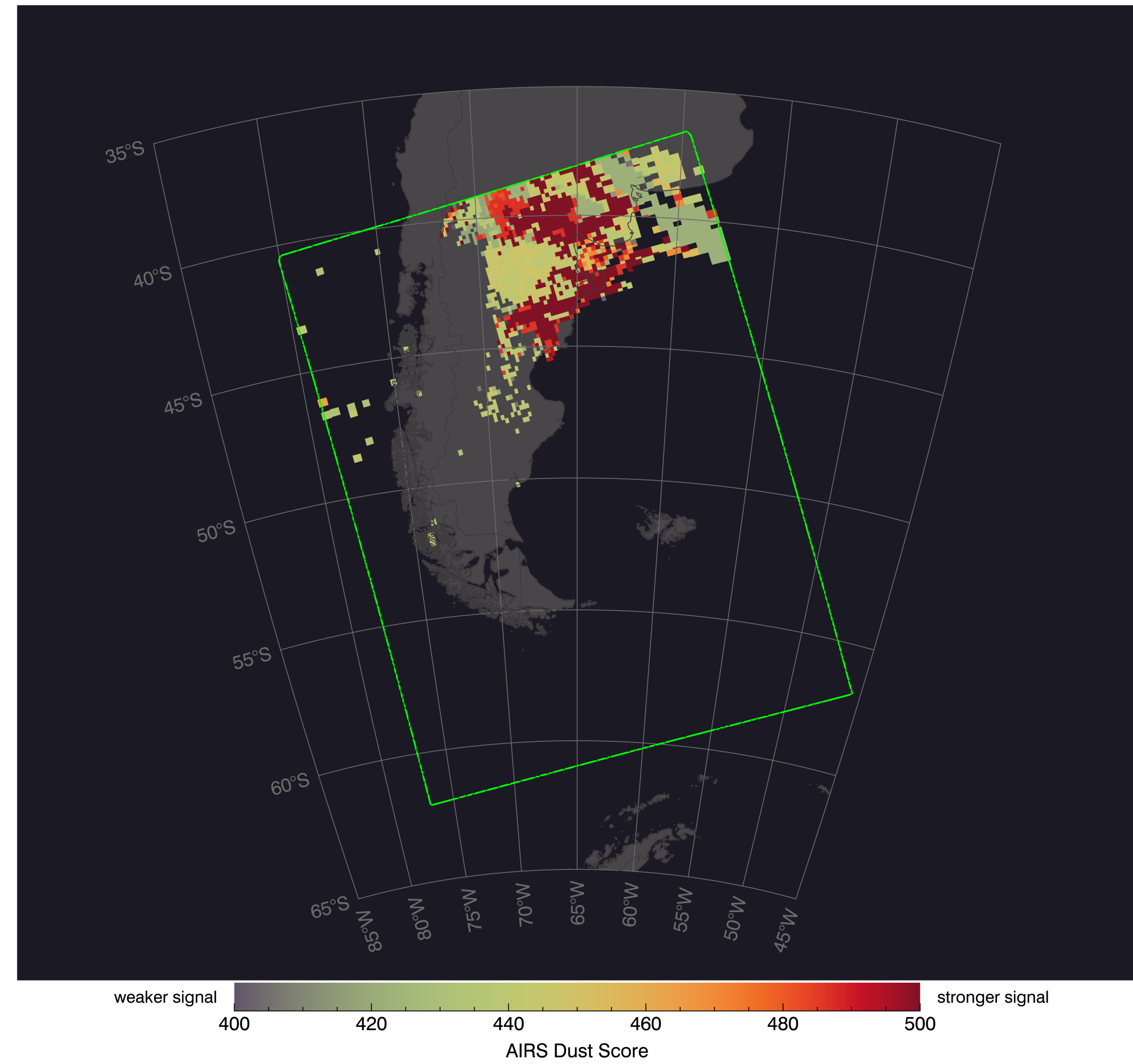
Puyehue Cordon Caulle Eruption, Chile

SO2 BT Difference

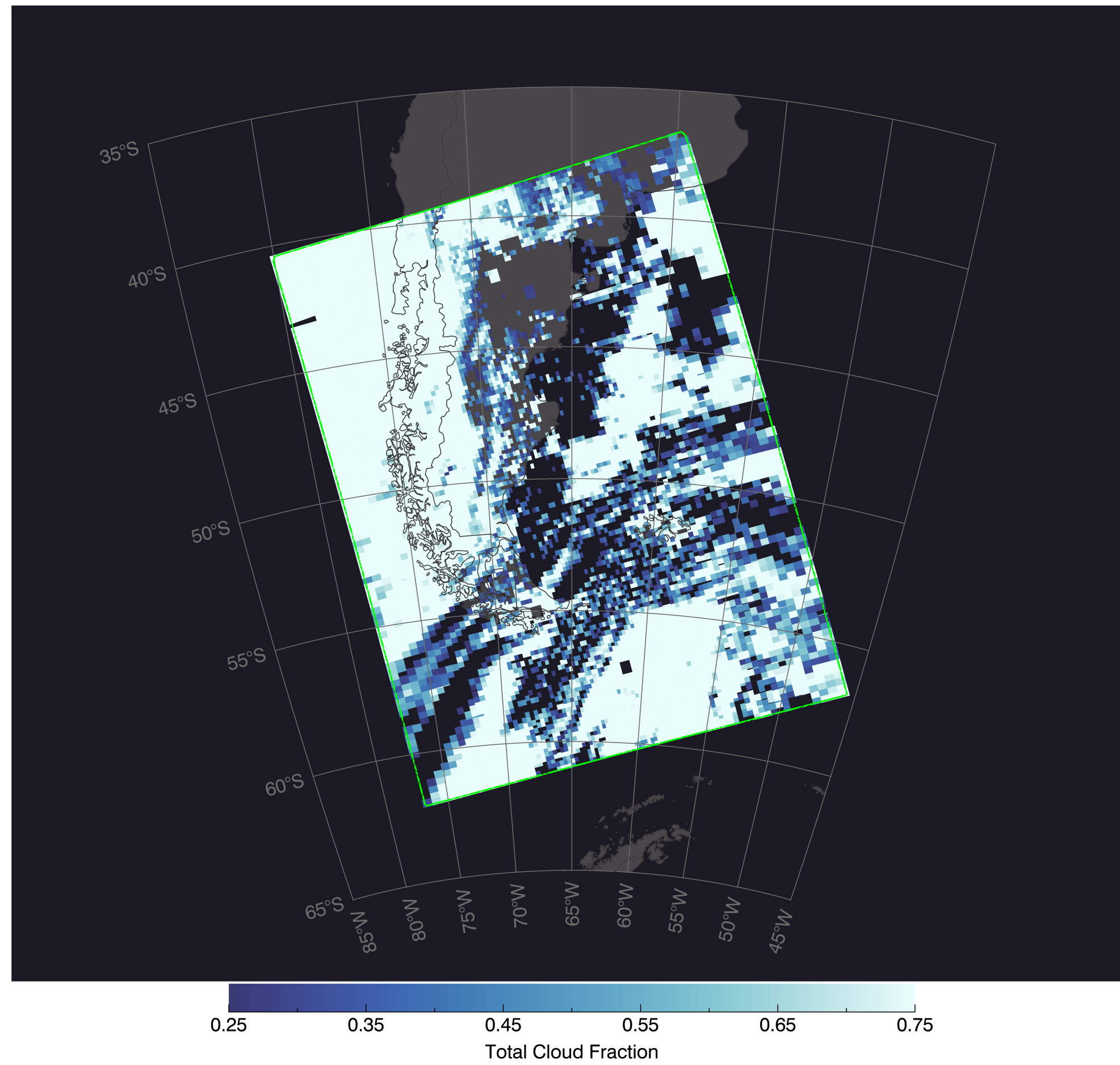**AIRS Detection of Sulfur Dioxide** 2011/06/06/18:35:24 UTC
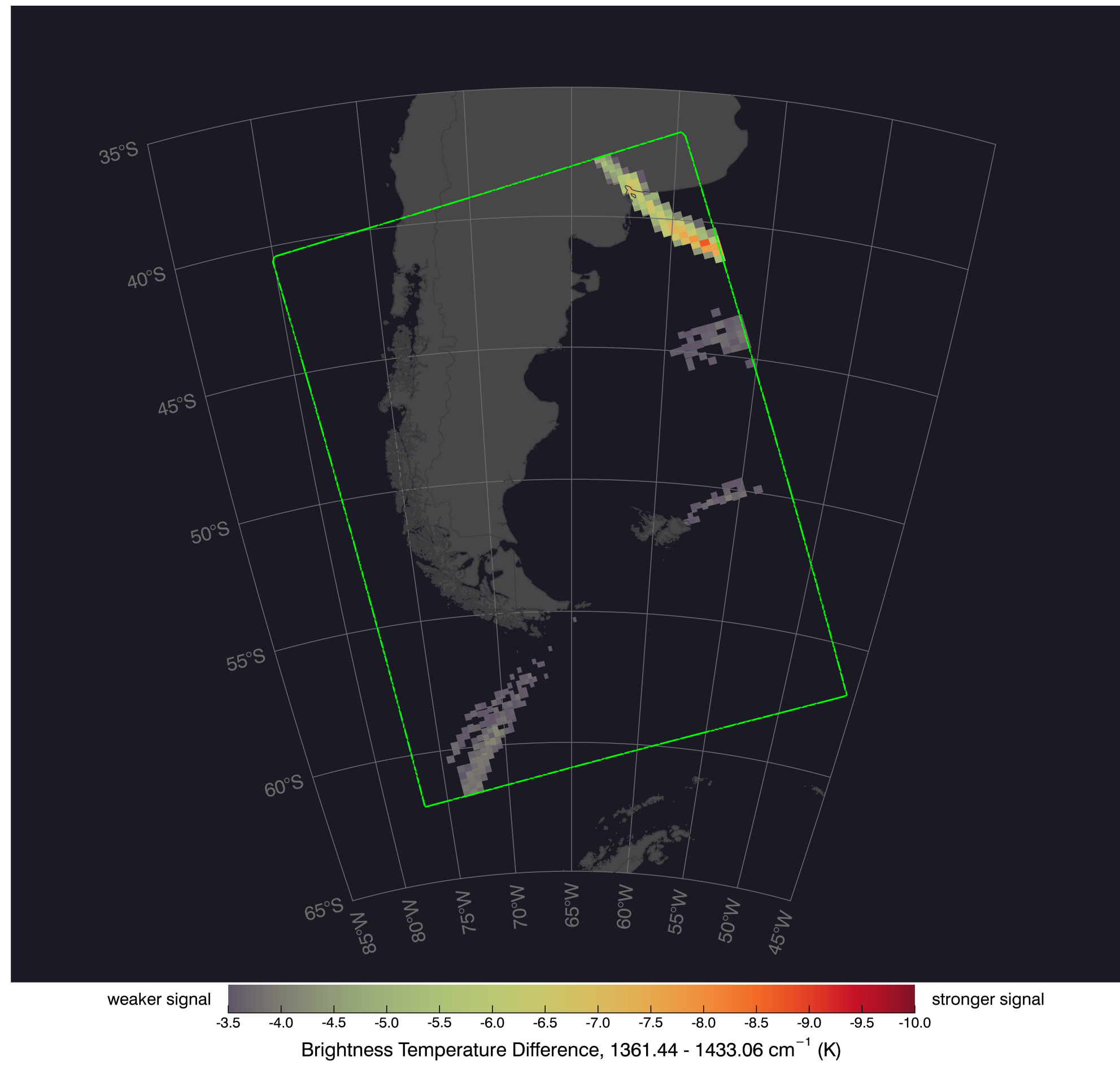
Dust Score

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

weaker signal stronger signal

-3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0

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

weaker signal stronger signal

400   420   440   460   480   500

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

Total Cloud Fraction

0.25   0.35   0.45   0.55   0.65   0.75

Cloud Top Height (km) where density ≥ 0.25

0   3   6   9   12   15

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

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)"

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!