

Using the OMI Aerosol Index to better understand regional aerosol transport

CK/AK Discussion

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28 Oct 2009

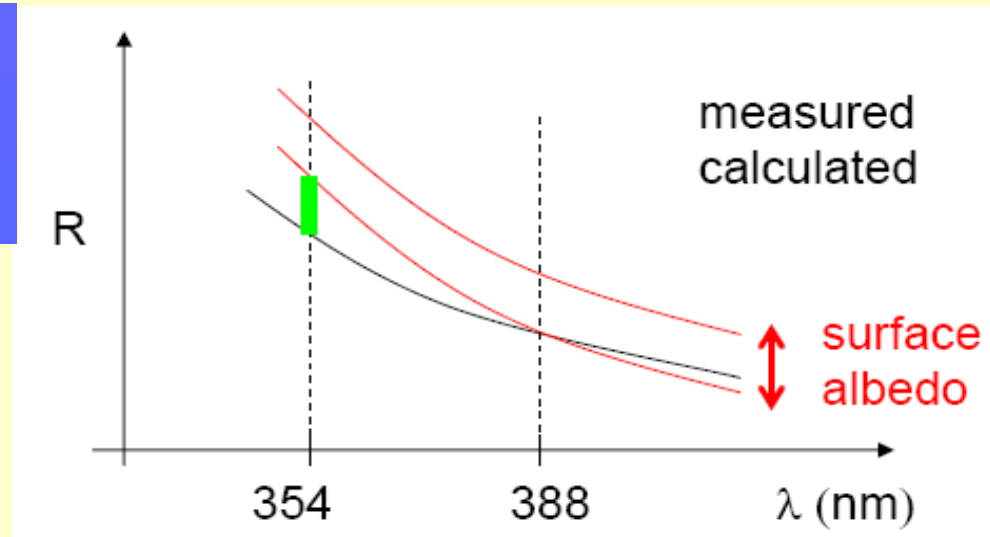
Introduction / Outline

- Aerosol Index Description
- Approach: AI → Regional Transport
- Making Histograms
- Global / Regional Statistics
- Australian Case Study Example
- Discussion / Conclusion

What is the Aerosol Index?

- OMAERO UV Aerosol Index
- Based on 354 / 388nm wavelength pair
- Compares measured radiance to Rayleigh-only scattering environment

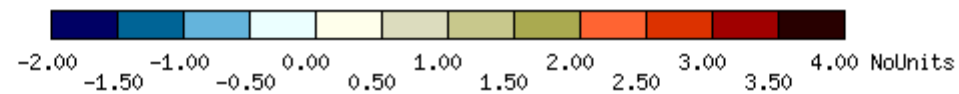
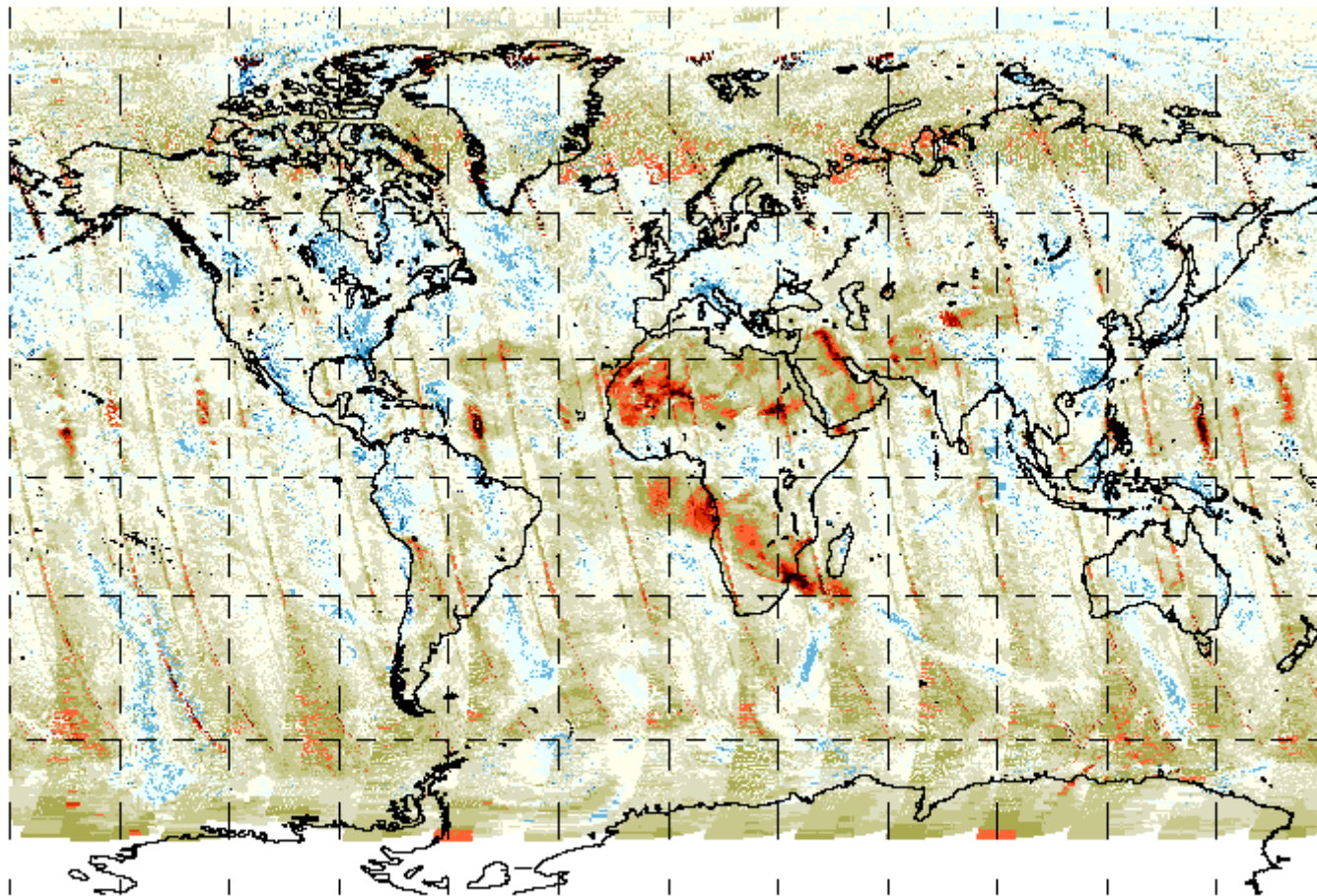
$$a_{354} = 100 \cdot \log_{10} \left(\frac{R_{354meas} \cdot R_{388calc}}{R_{388meas} \cdot R_{354calc}} \right)$$



From B. Veihelmann

Raw Daily AI Plot

UV Aerosol Index on 2008-08-29 for Orbits 21927-21941



How to get at regional transport

1. Analyze long term statistics to get at where aerosol is likely to be → Persistent
2. Analyze transport for case studies where aerosol is present → Episodic
3. Combining these two approaches leads to a more robust understanding of aerosol climatology

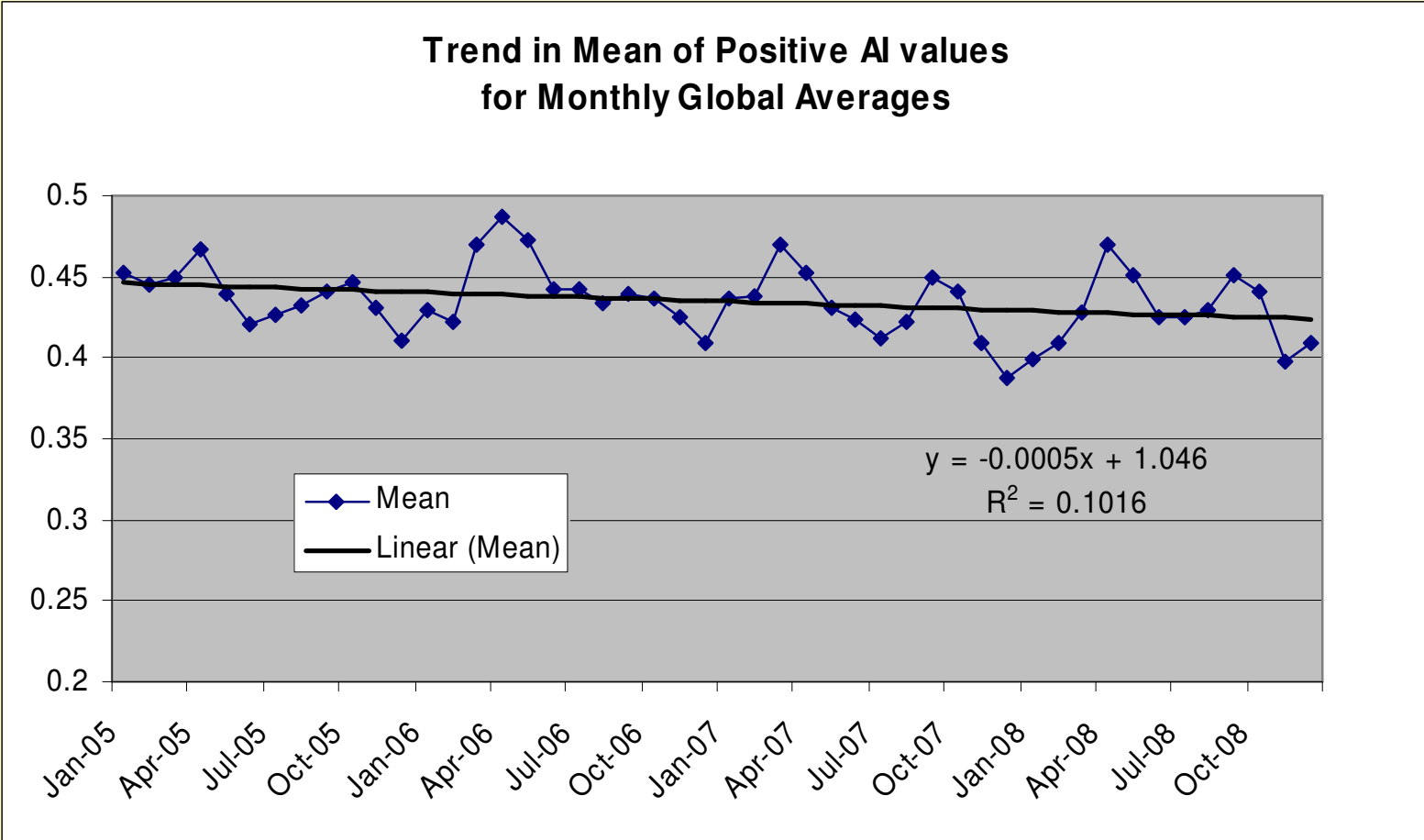
Approach 1: Long-term Stats

- Process Global and Regional Statistics for the OMI Record (2005 - 2008)
 - Next step: Global Oceanic vs. Global Land
- Three Regions
 - South American Outflow
 - Southern African Outflow
 - Australian Continental

Long-term Stats -- Methods

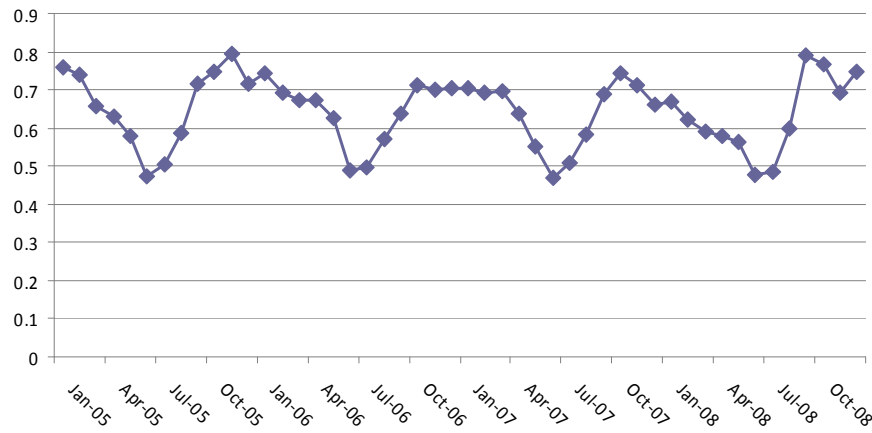
- OMI OMAERO AI product filtered for:
 - Sunglint (over ocean, 40° viewing angle cone)
 - Solar Zenith Angle > 60°
 - Errors and Warnings in Lev-1B radiances
 - AI values greater than 20
 - Eclipses: affected and neighboring orbits
 - Row anomaly affected pixels
 - Last month of data (Dec 2008) is slightly affected

Global Trends

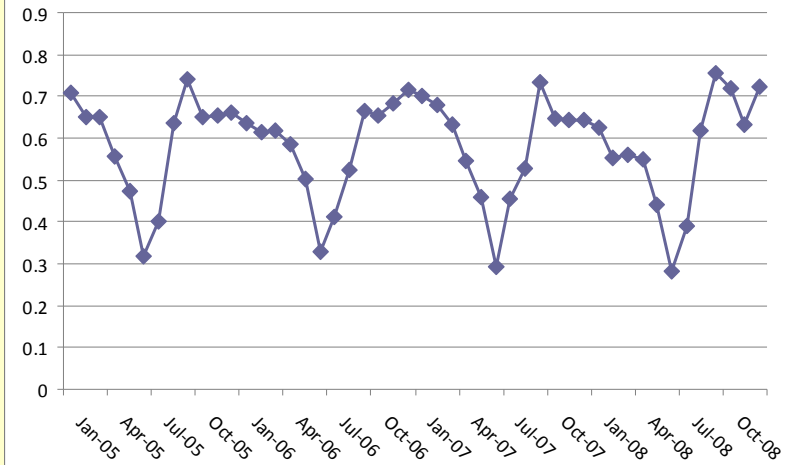


Regional Seasonal Patterns

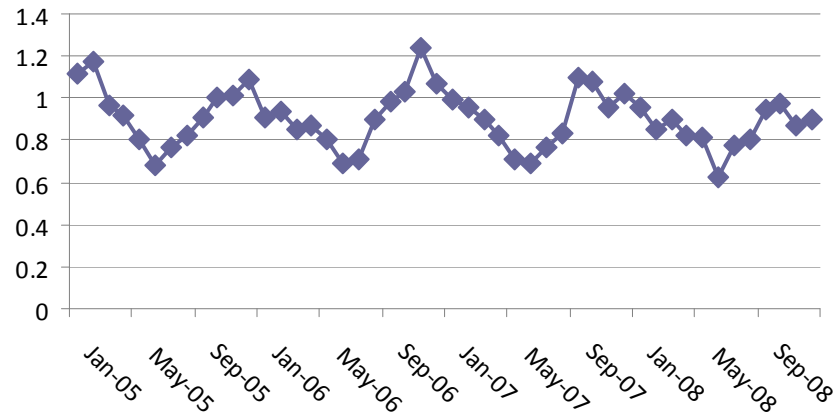
Monthly Mean AI for S. Amer. 2005-2008



Monthly Mean AI for SAFR: 2005-2008



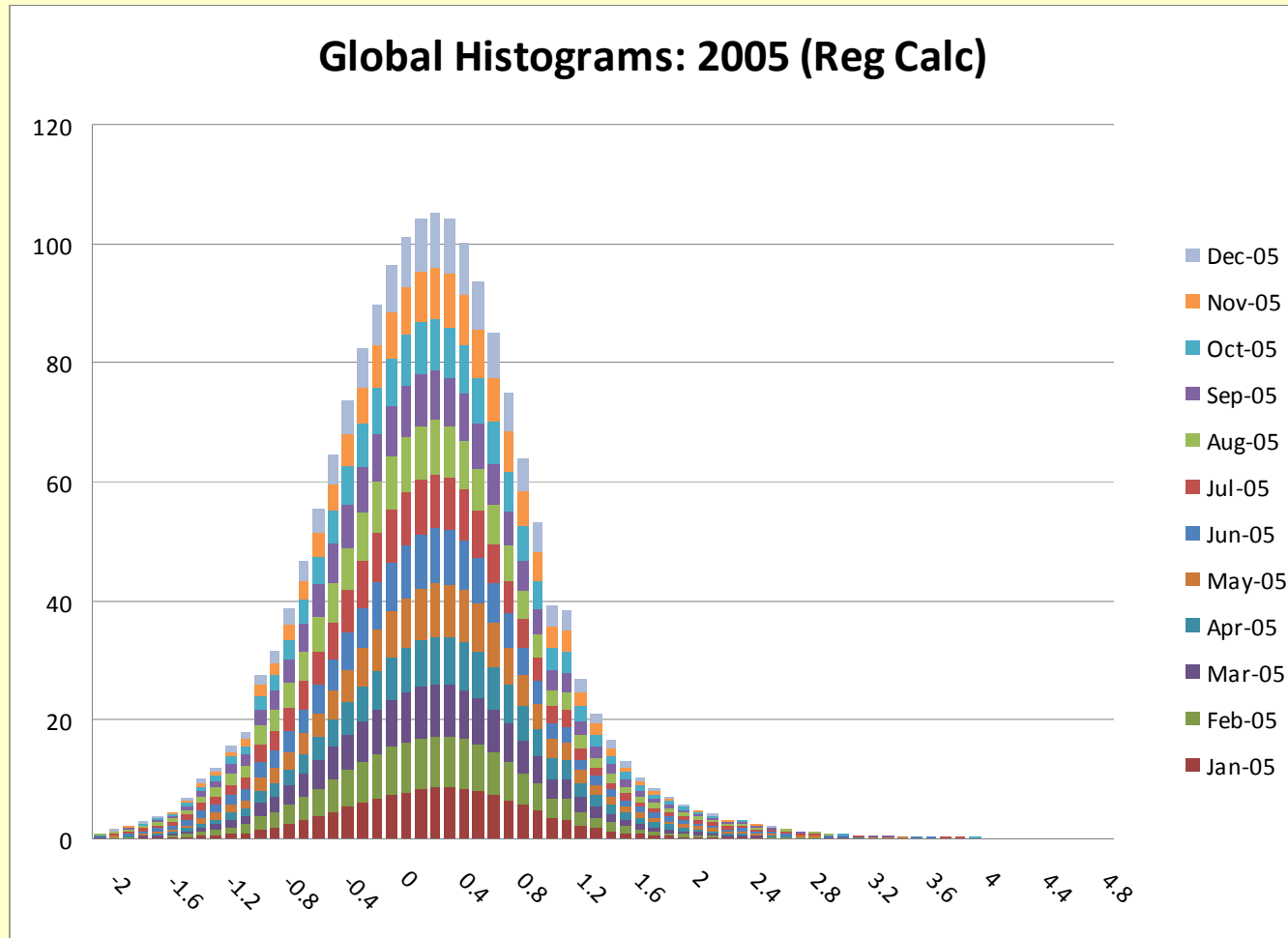
Monthly Mean AI AUS: 2005-2008



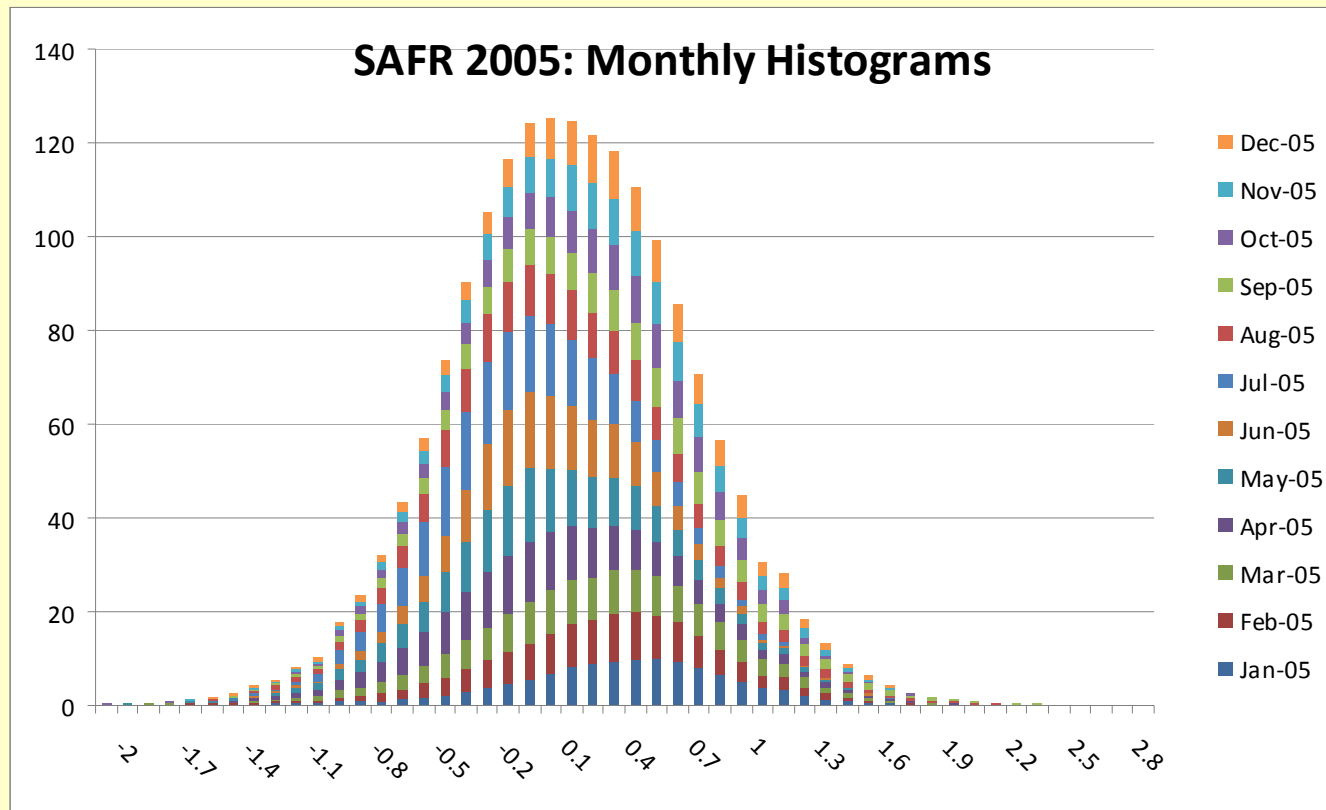
Building Histograms

- Useful for better understanding outlier events – capturing episodic variability
- Looking at the “whole” Aerosol Index
- Each 1 x 1 deg grid box has a month’s worth of values that are separated into histograms
- Histograms for each grid box for a given larger regional or global ‘box’ are averaged together

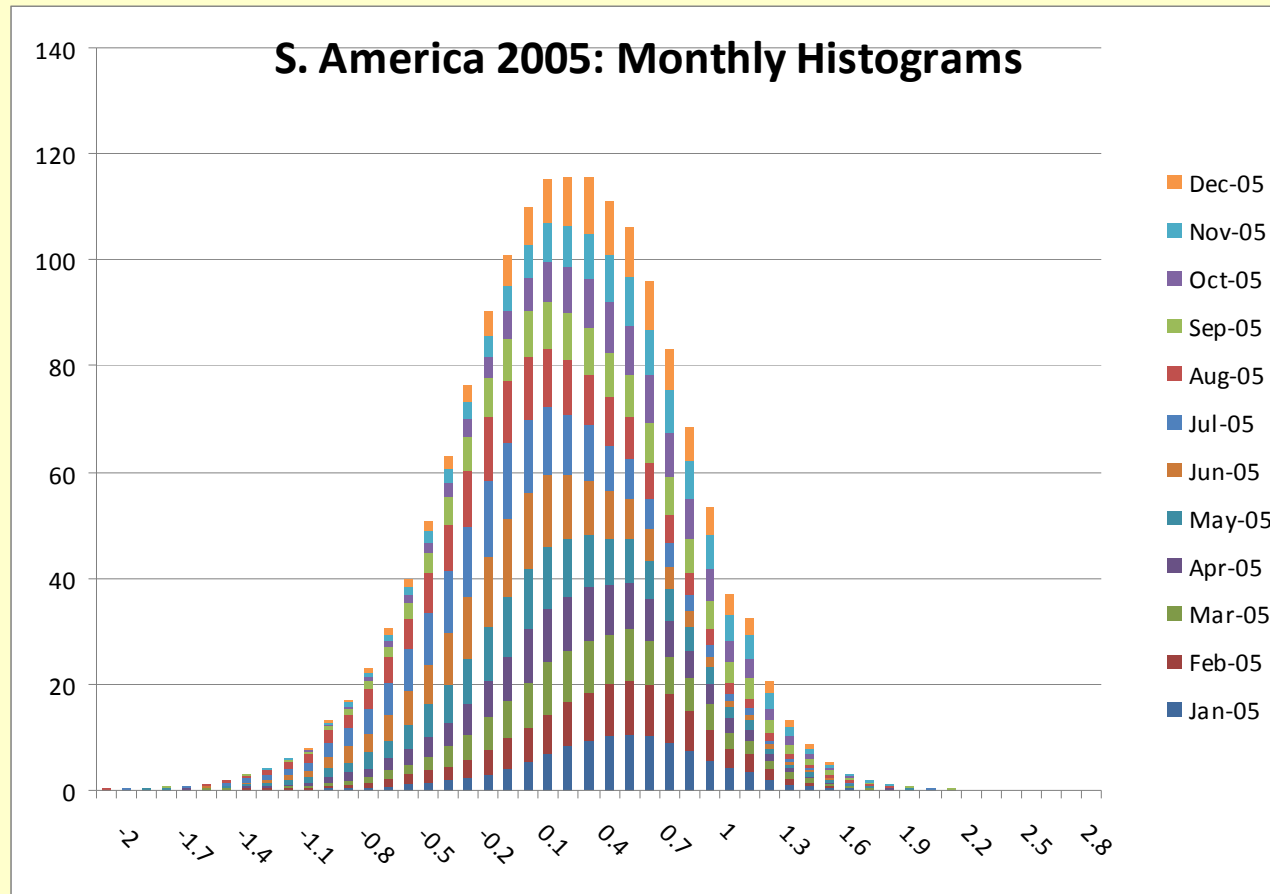
Global / Regional Histograms



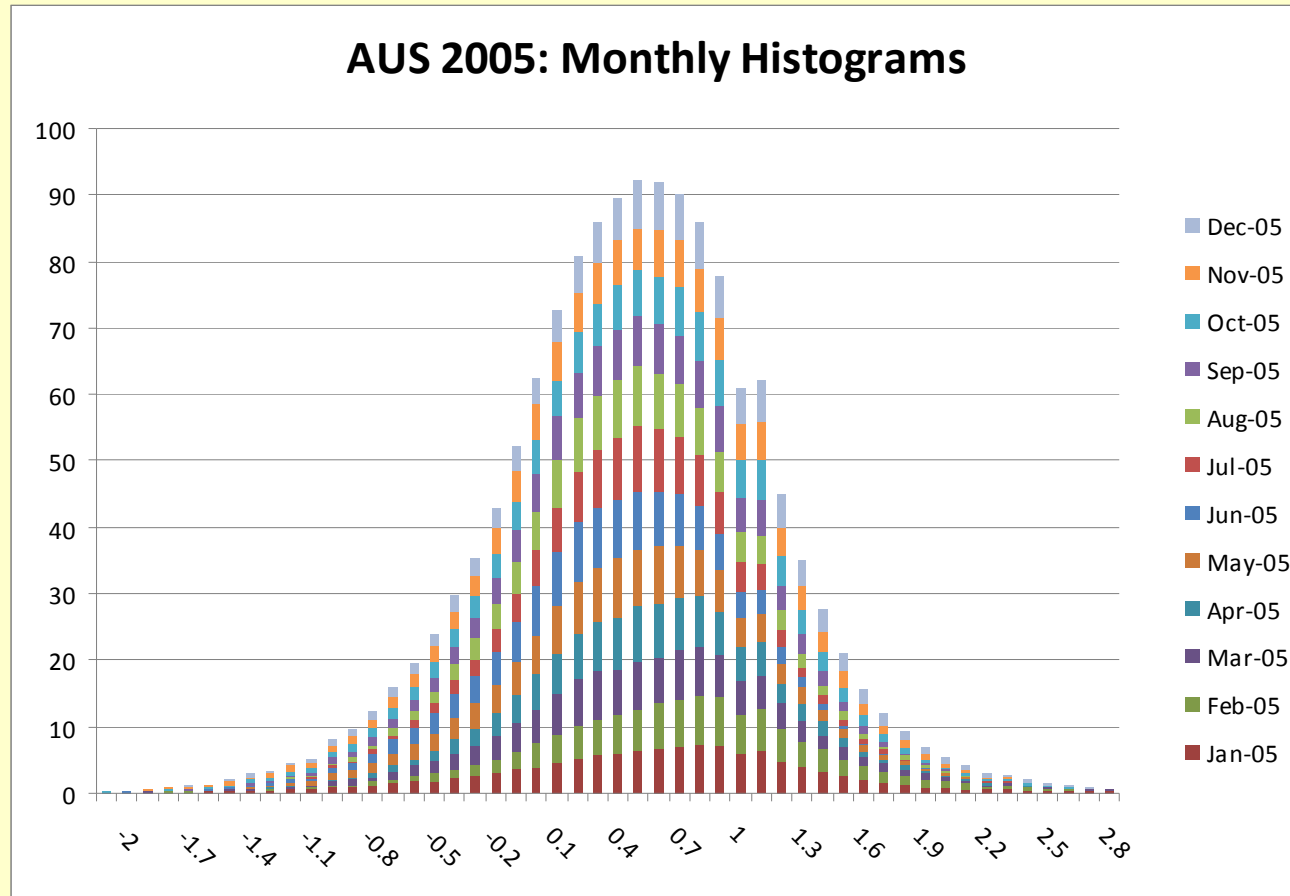
Global / Regional Histograms



Global / Regional Histograms



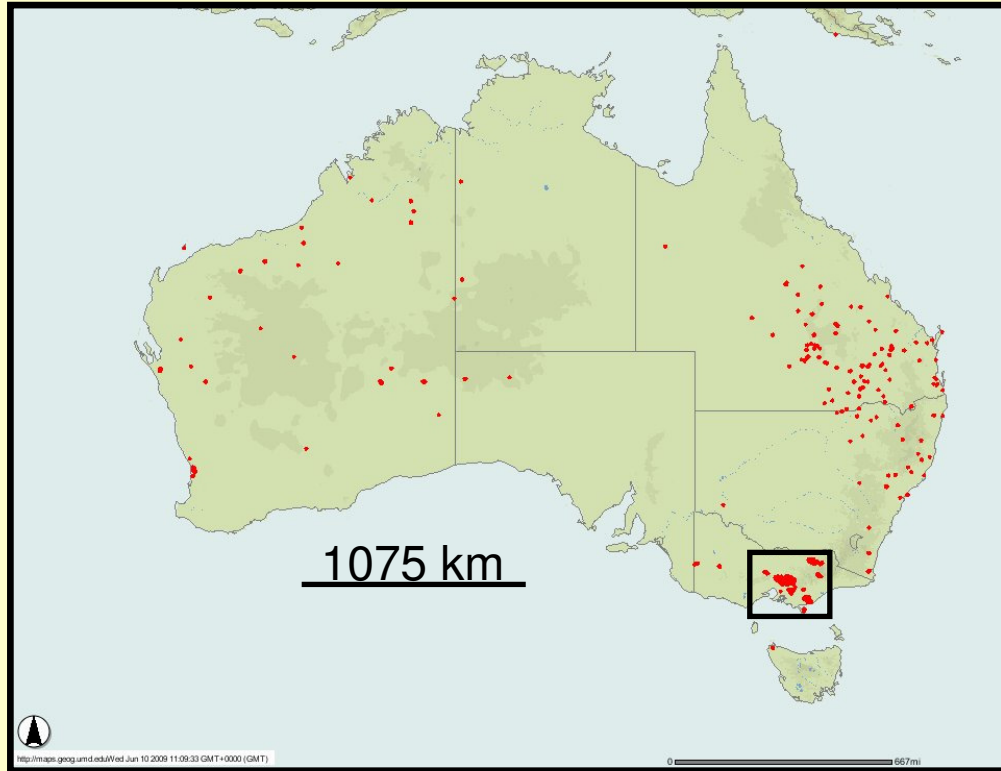
Global / Regional Histograms



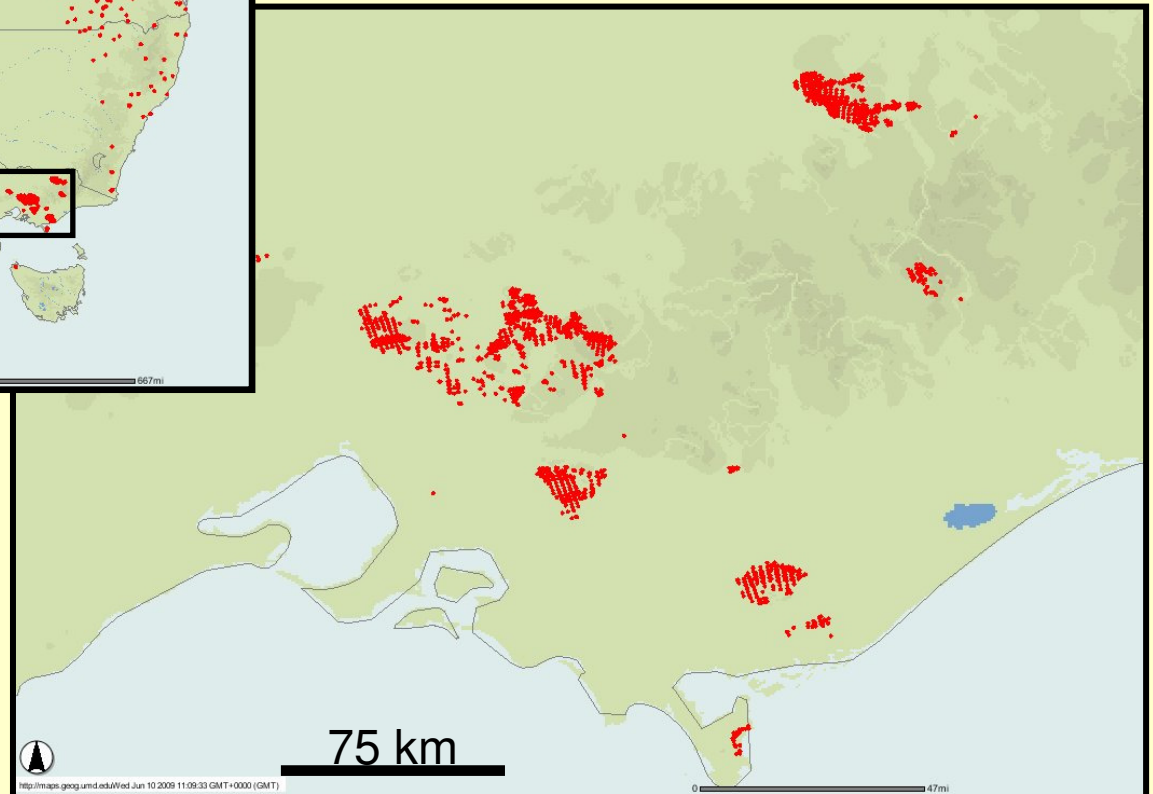
Approach 2: Case Study

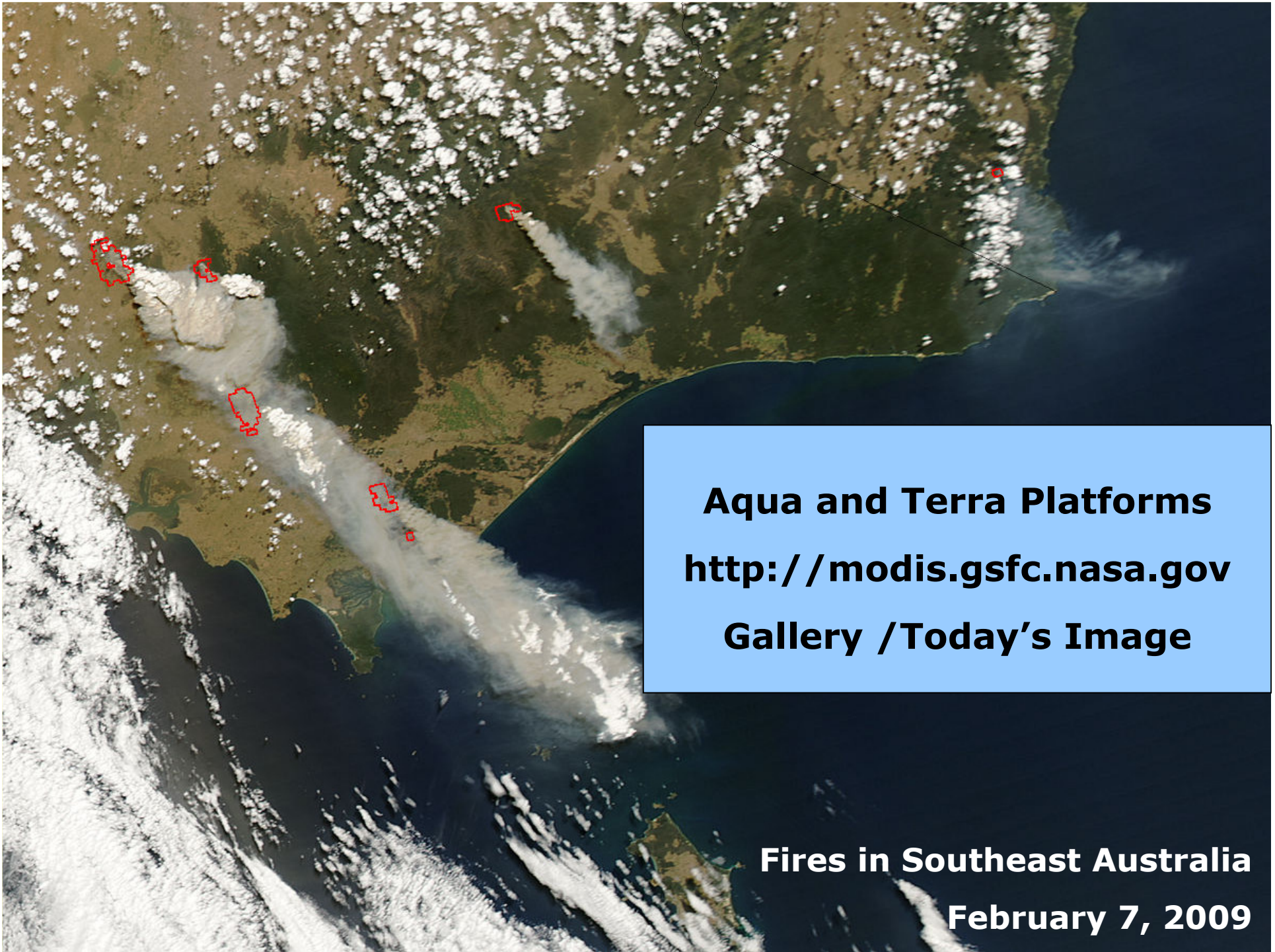
- Australian Black Friday Fires
- High values of Aerosol Index for an unusually long period
- Unique UTLS transport pattern enhanced plume lifetime
- Evidence for Frontal Lifting Mechanism

Fire Maps: 05-10 Feb 2009



from: <http://maps.geog.umd.edu>
Based on MODIS Fire Detection

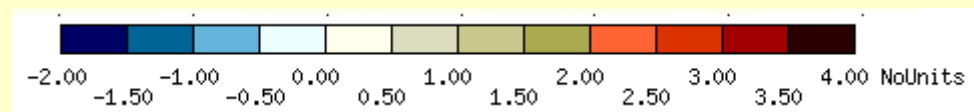
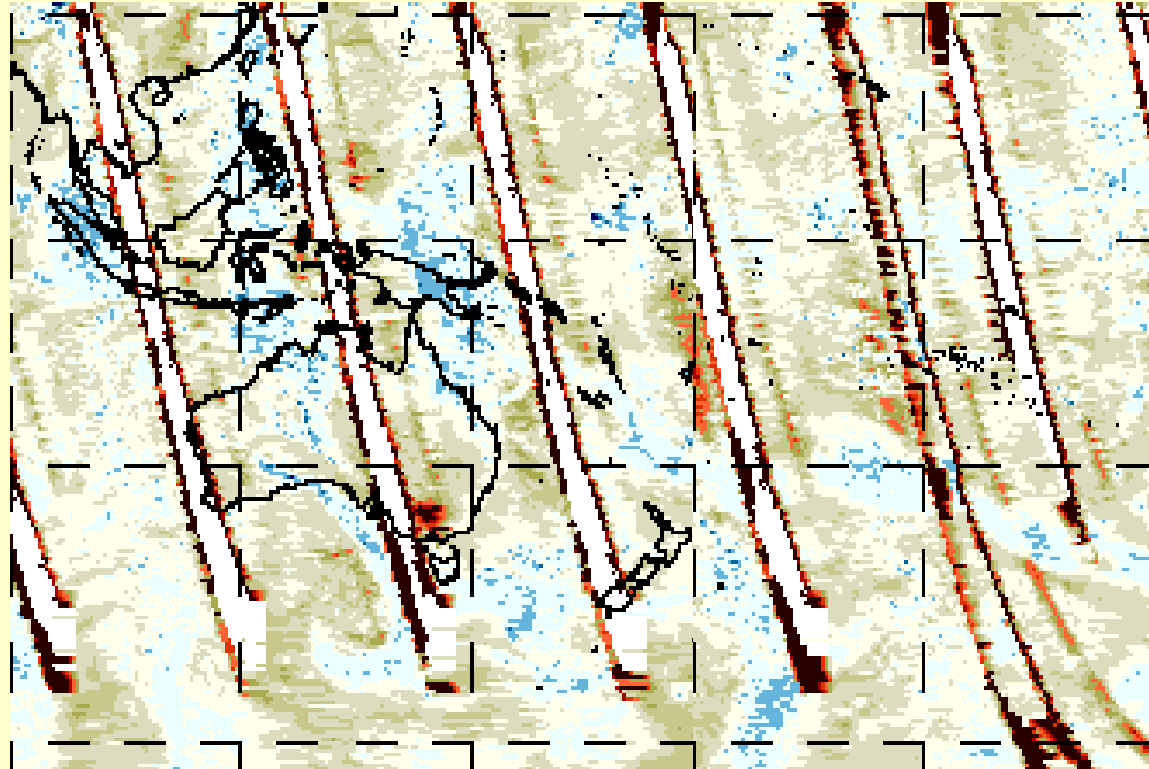




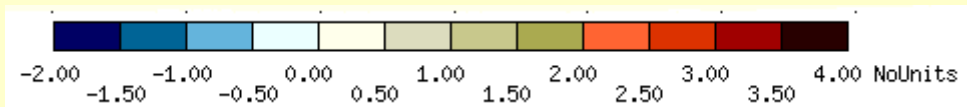
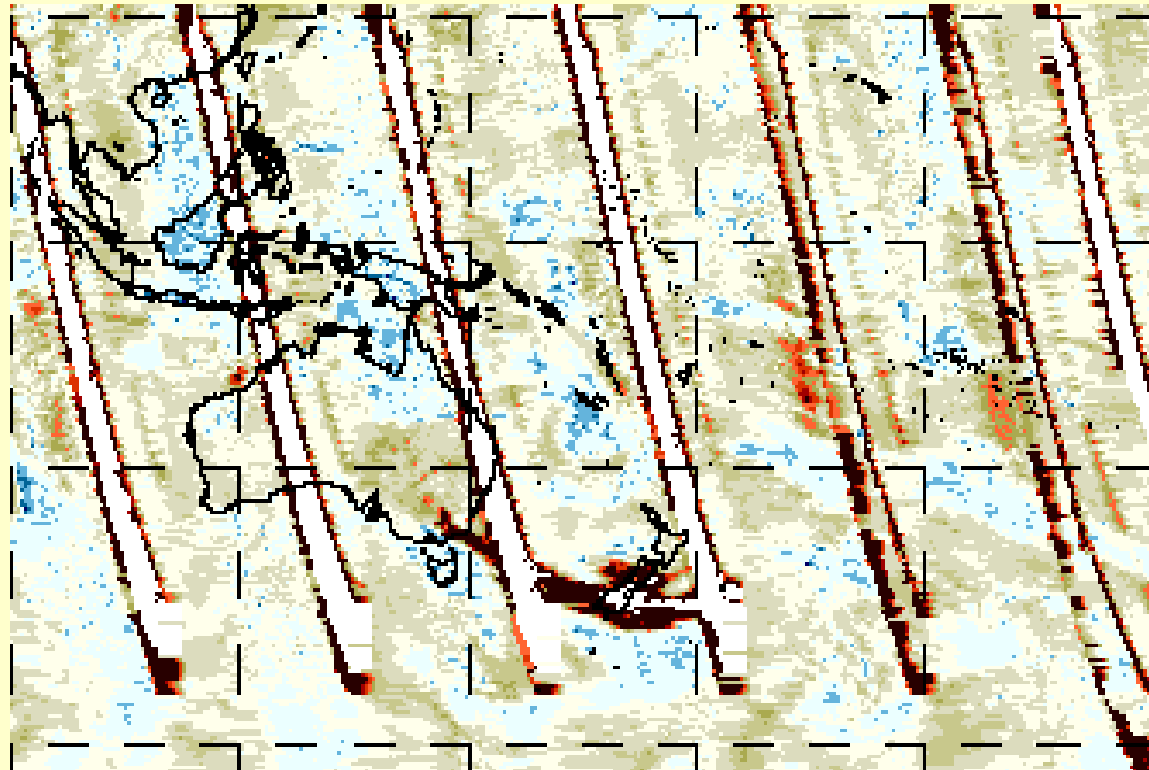
Aqua and Terra Platforms
<http://modis.gsfc.nasa.gov>
Gallery /Today's Image

Fires in Southeast Australia
February 7, 2009

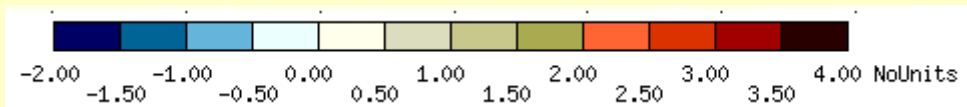
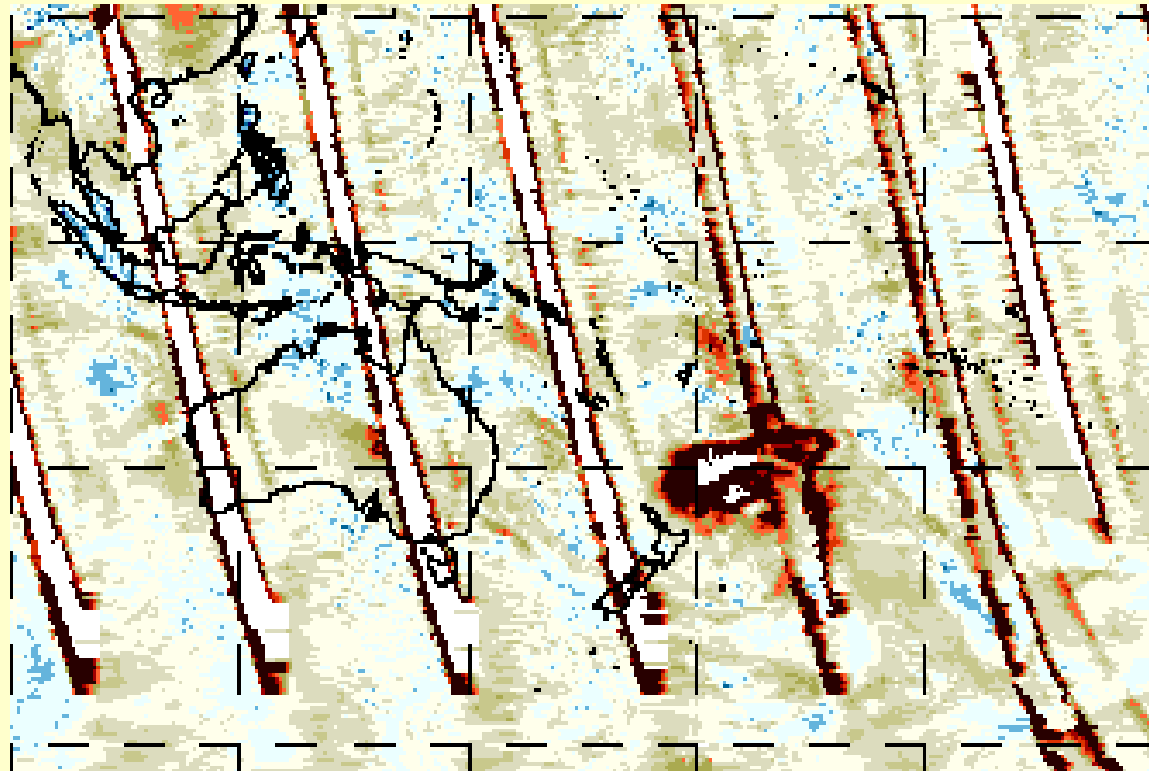
OMI: 07 Feb



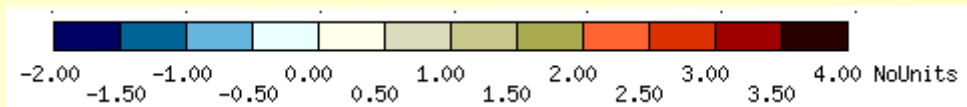
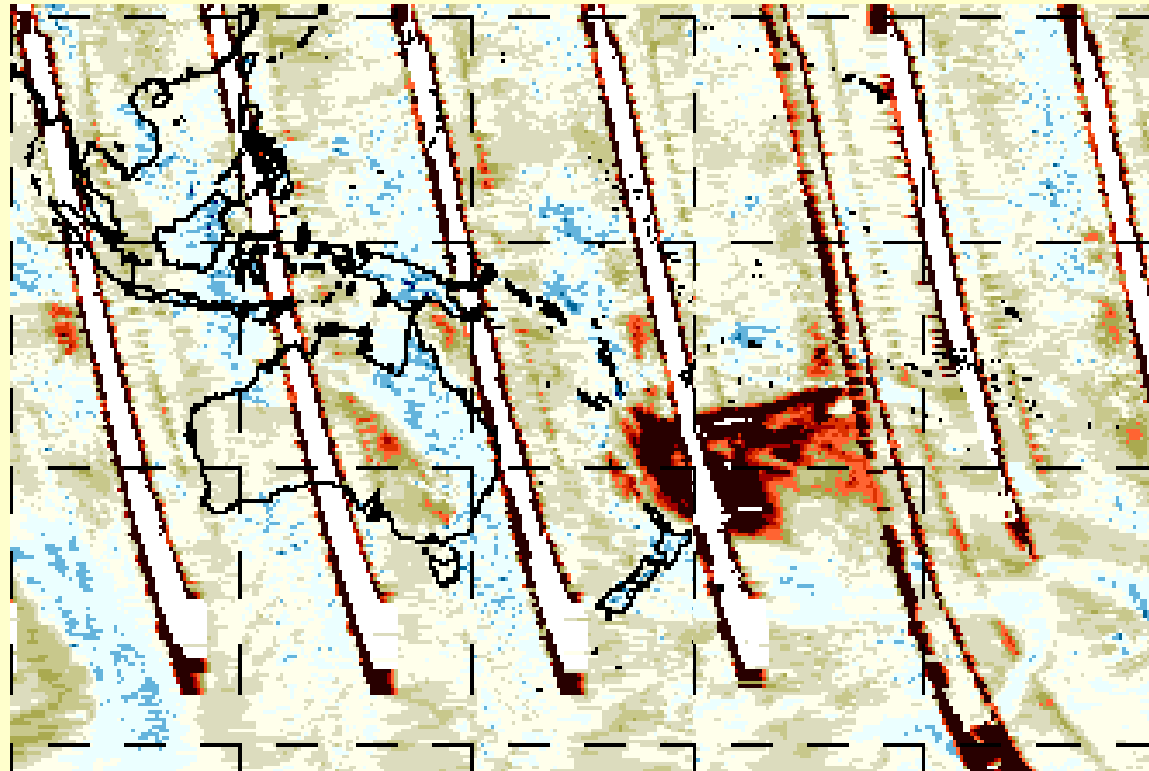
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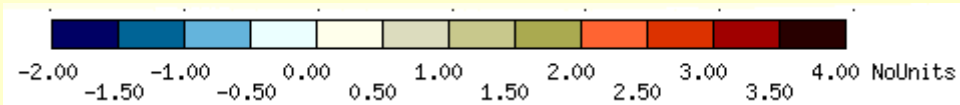
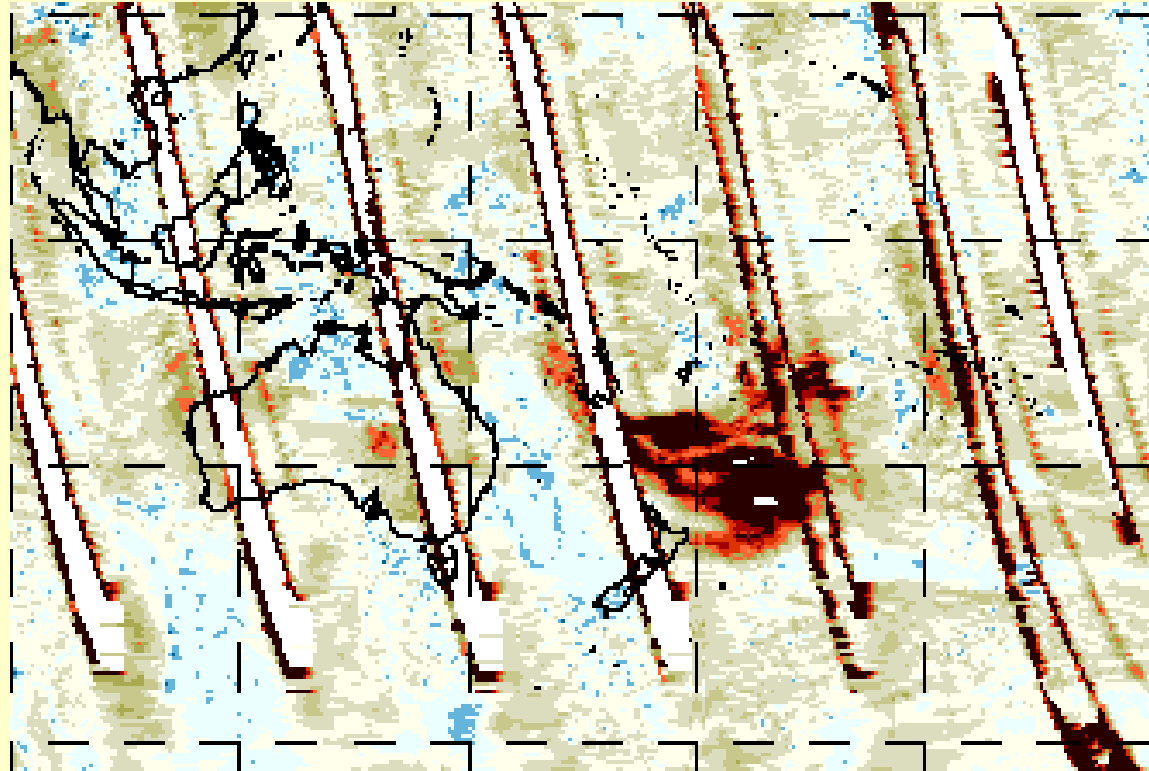
OMI: 09 Feb



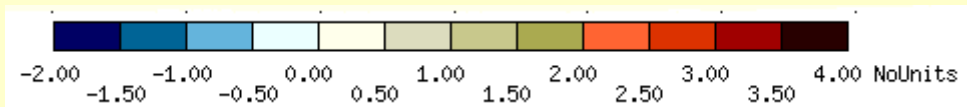
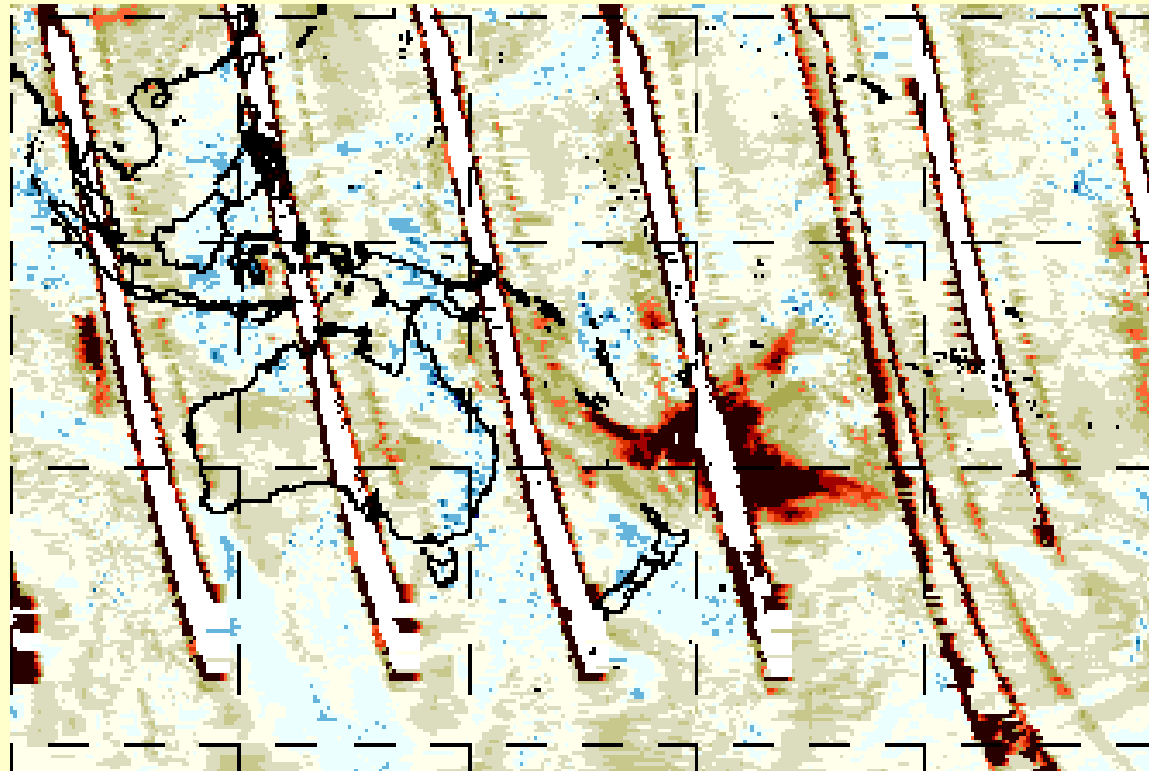
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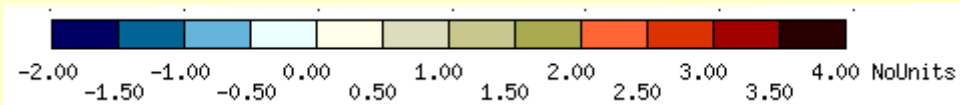
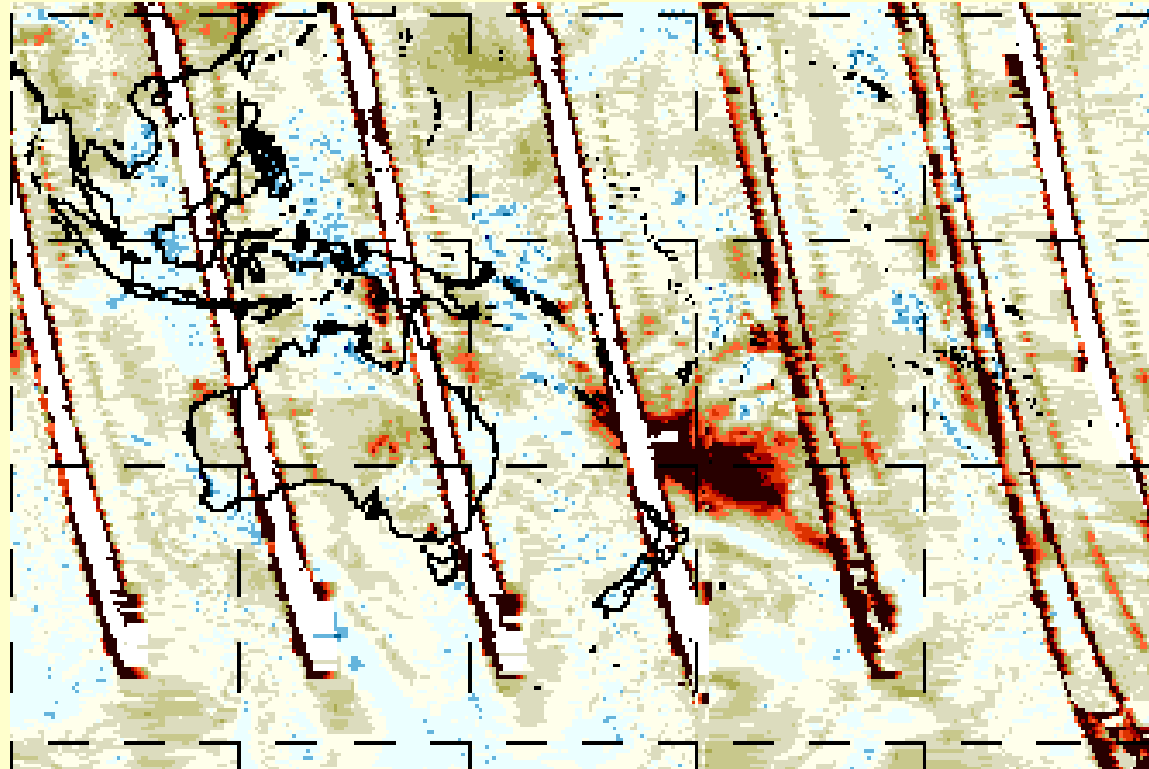
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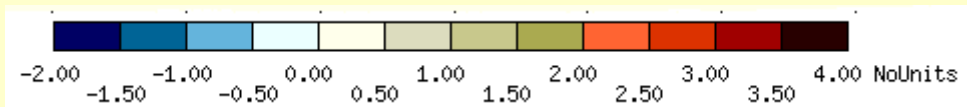
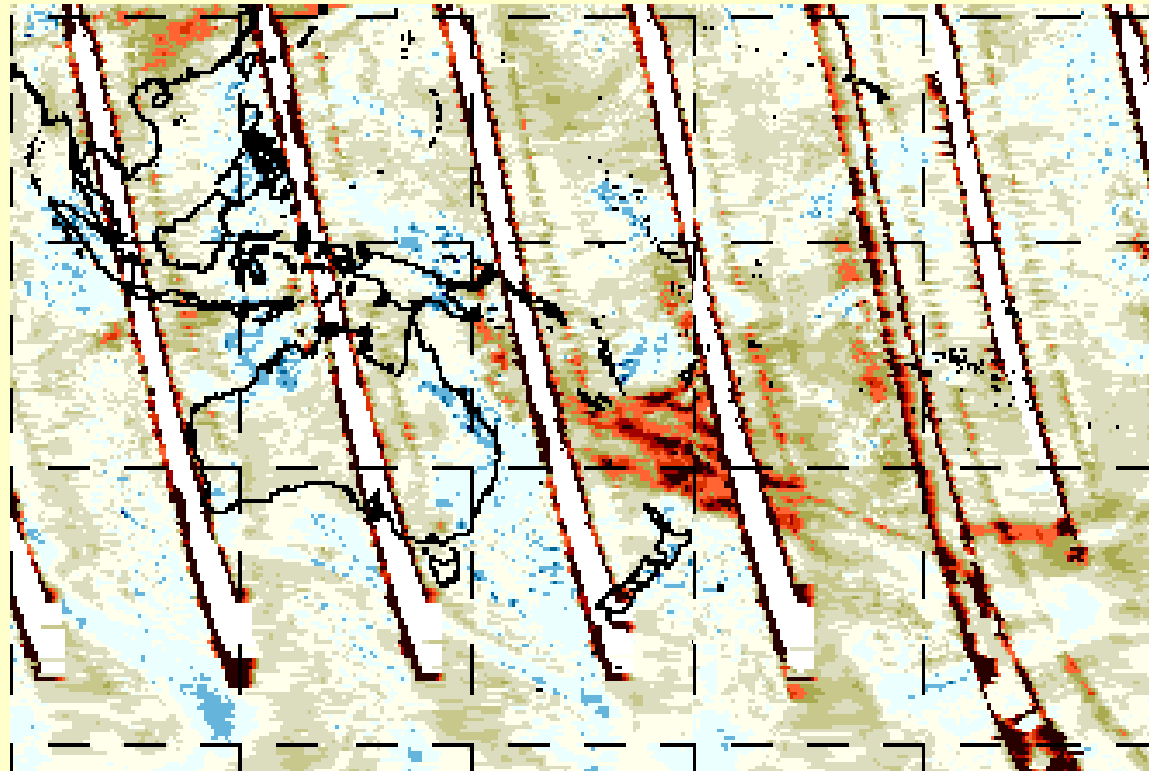
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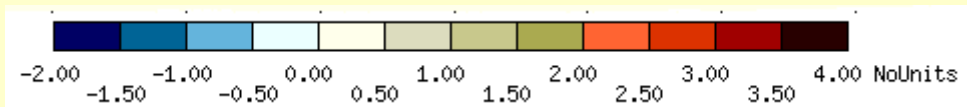
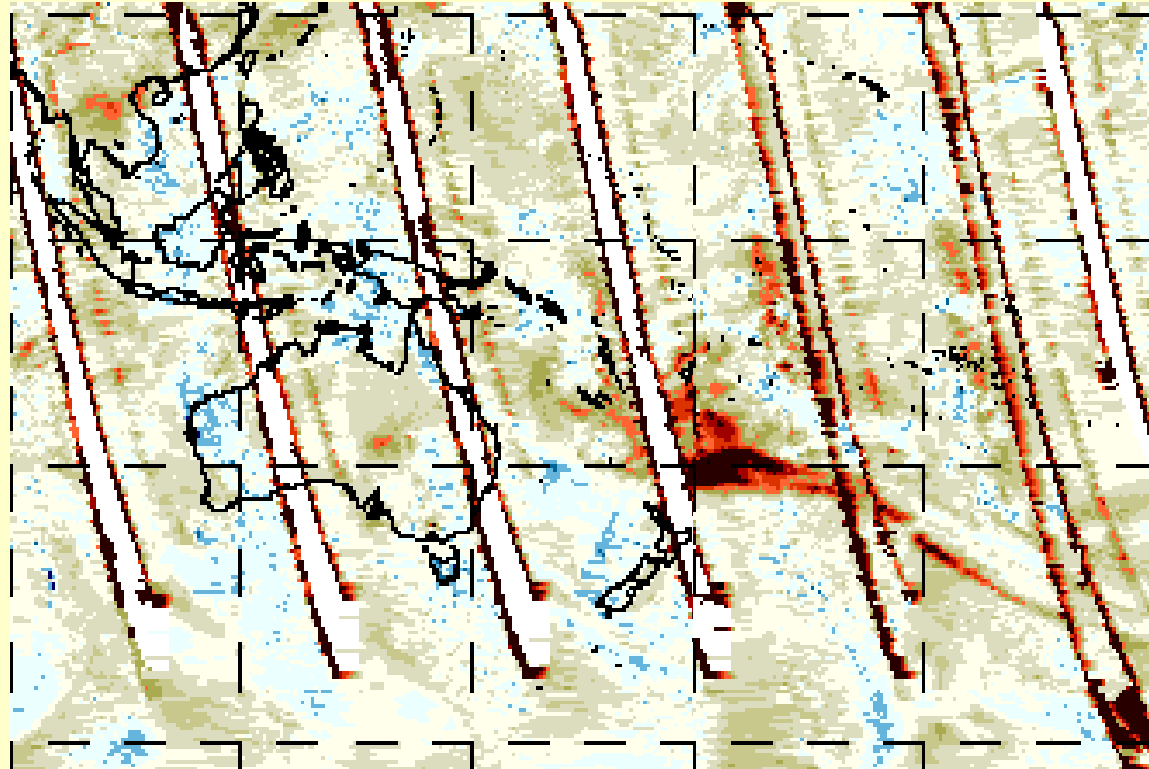
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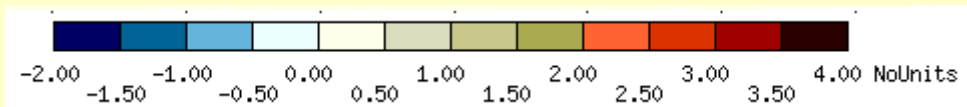
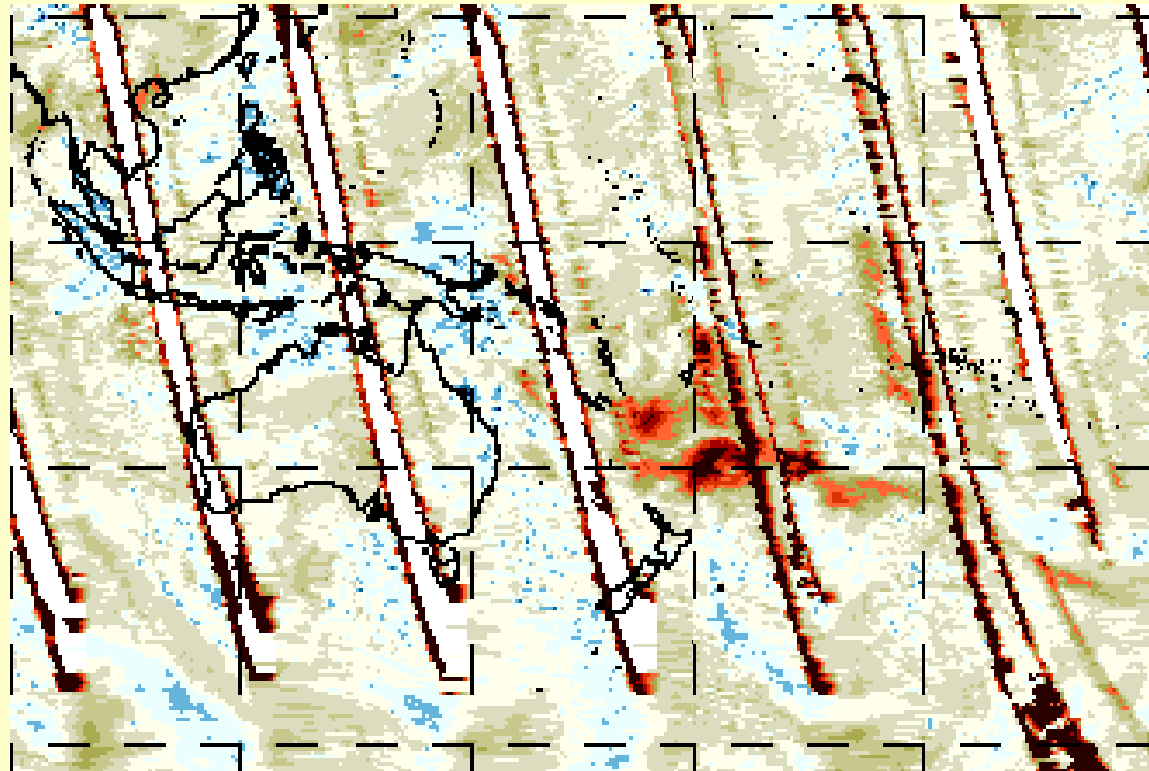
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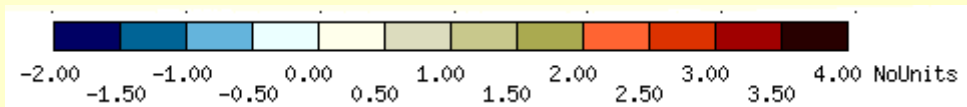
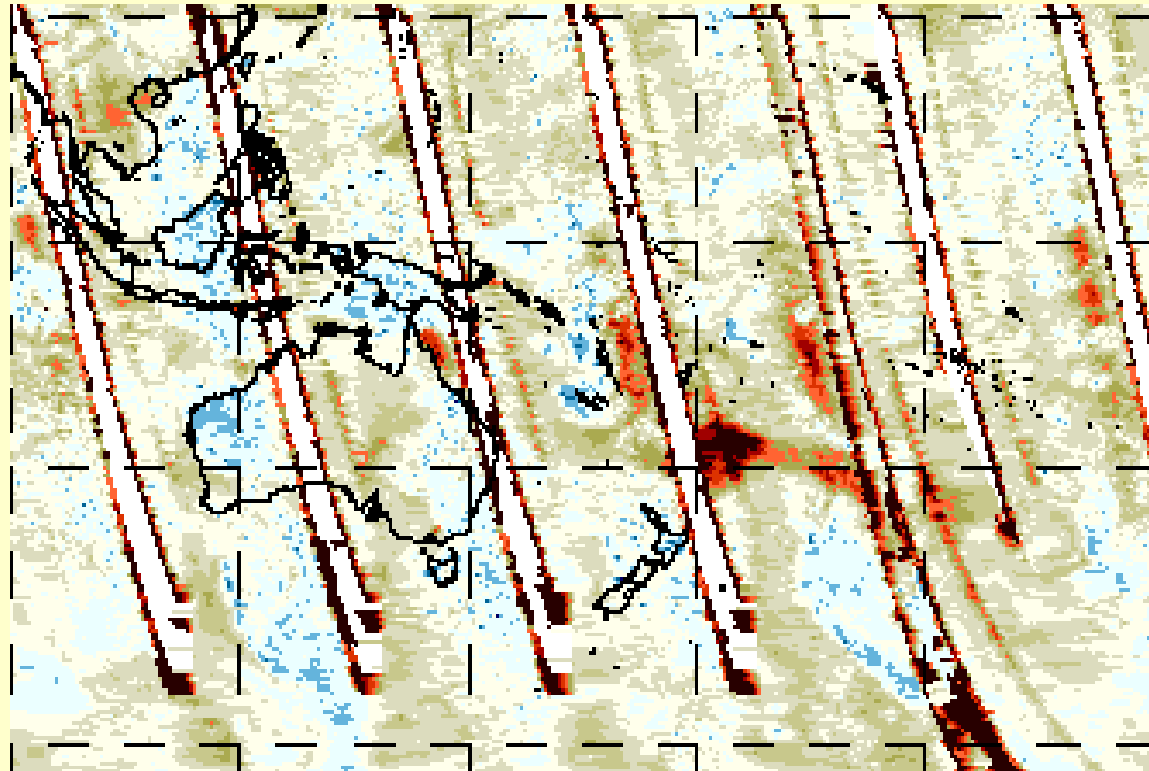
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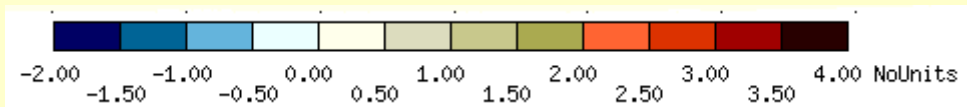
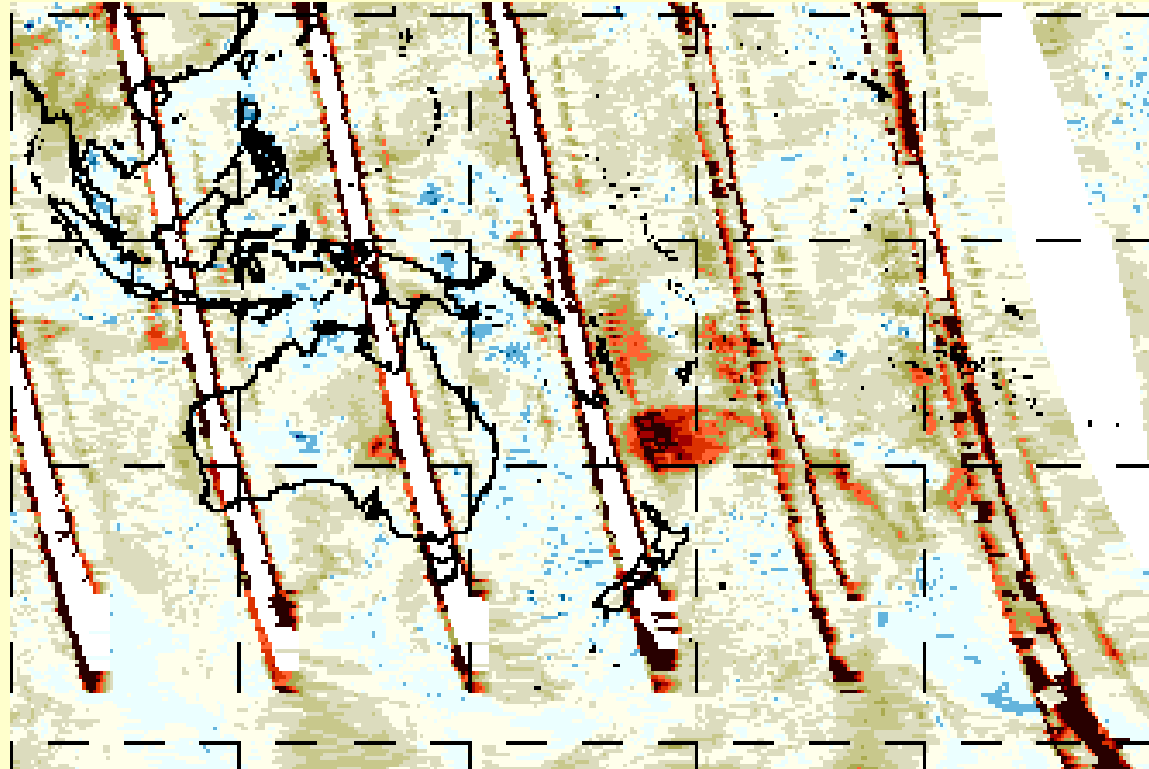
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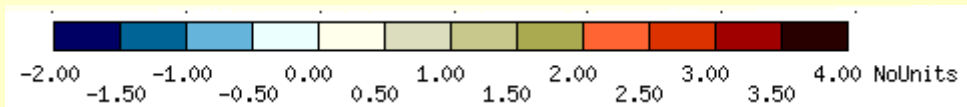
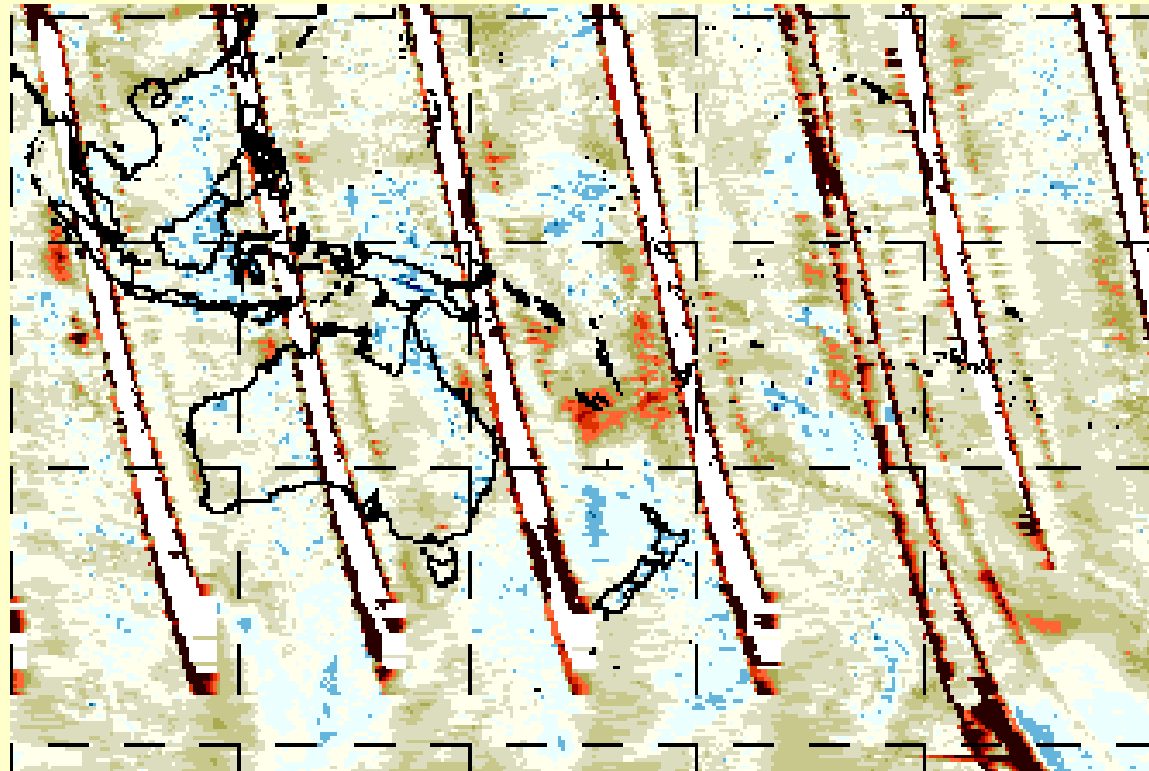
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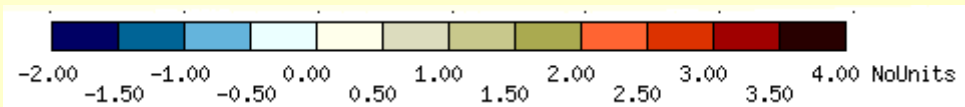
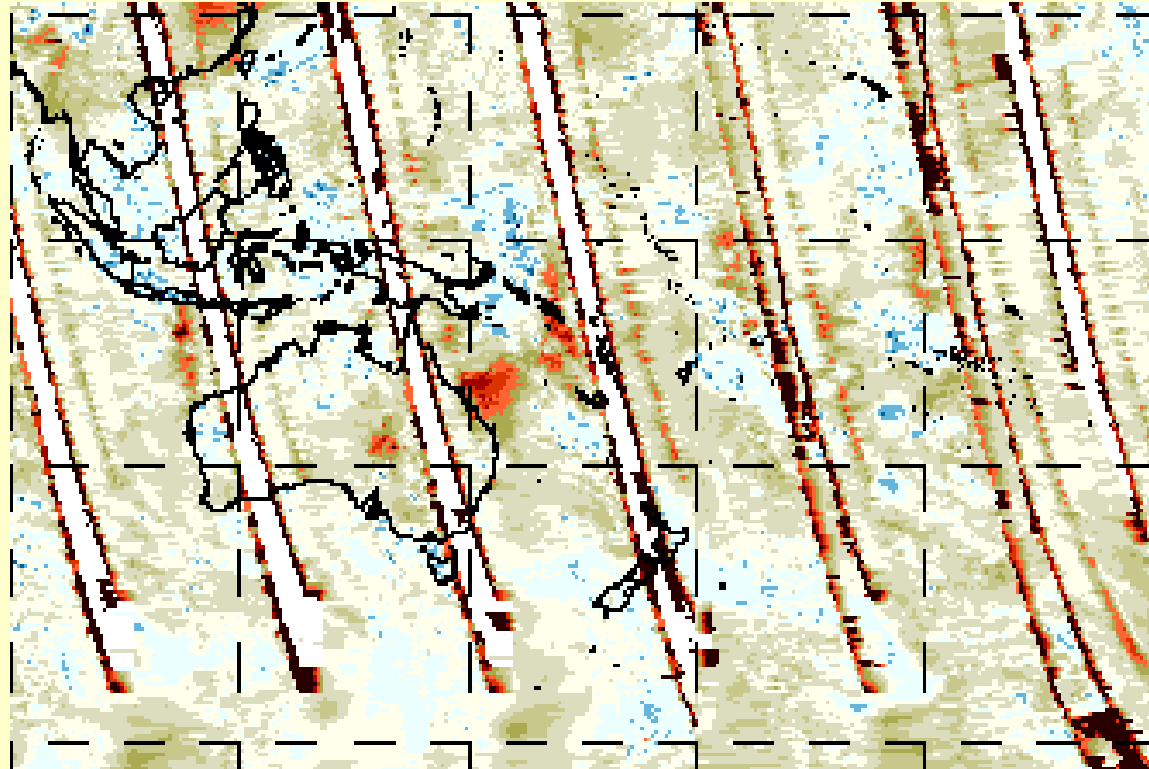
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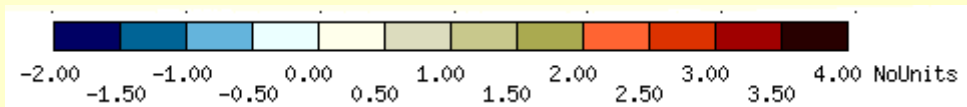
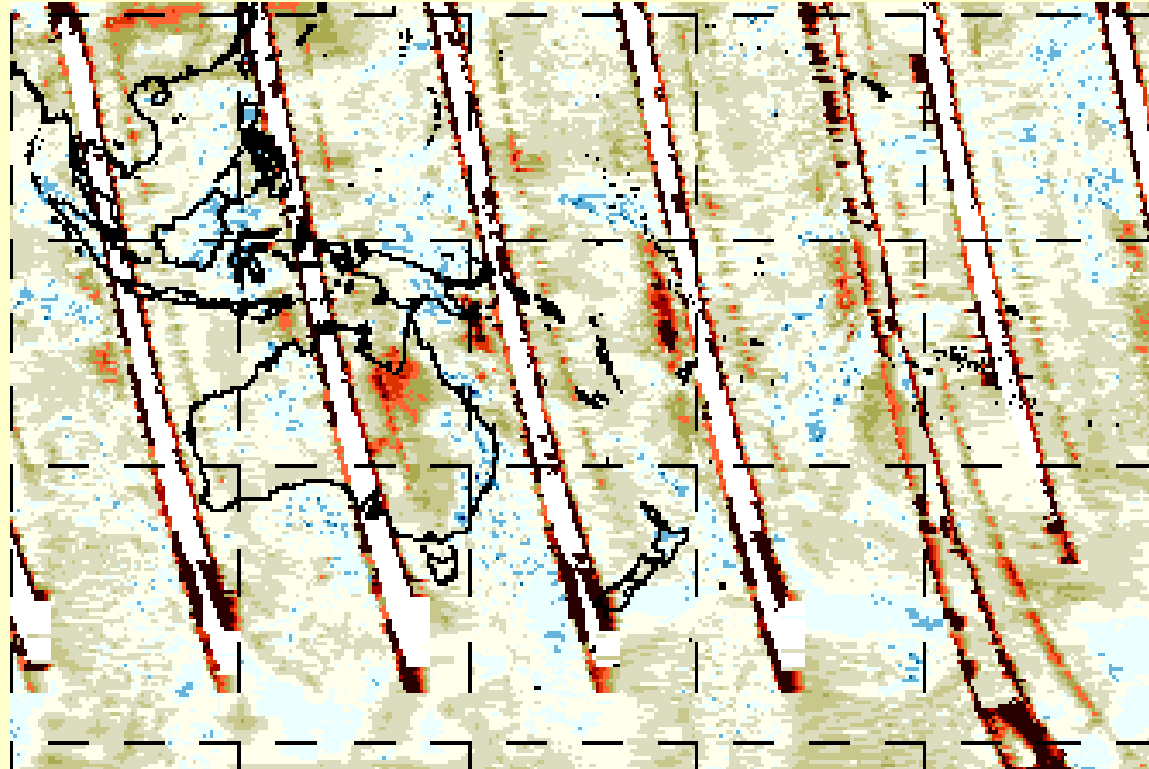
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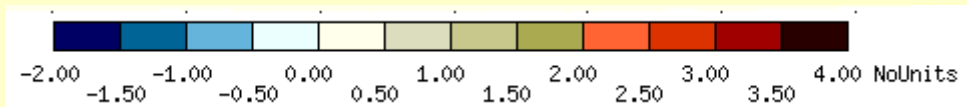
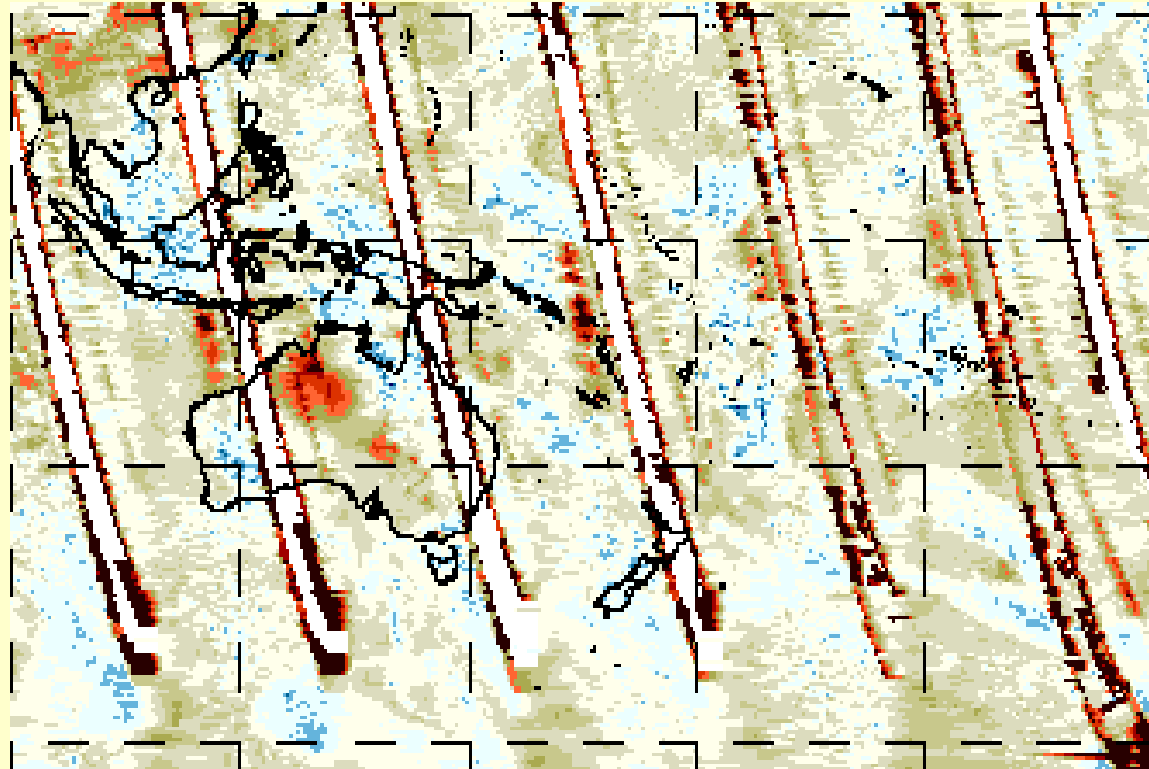
OMI: 20 Feb



OMI: 21 Feb



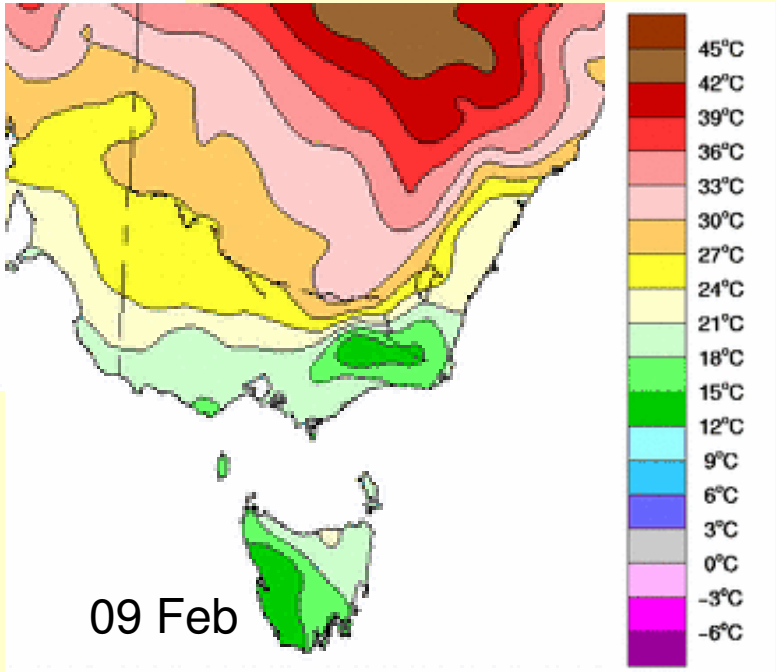
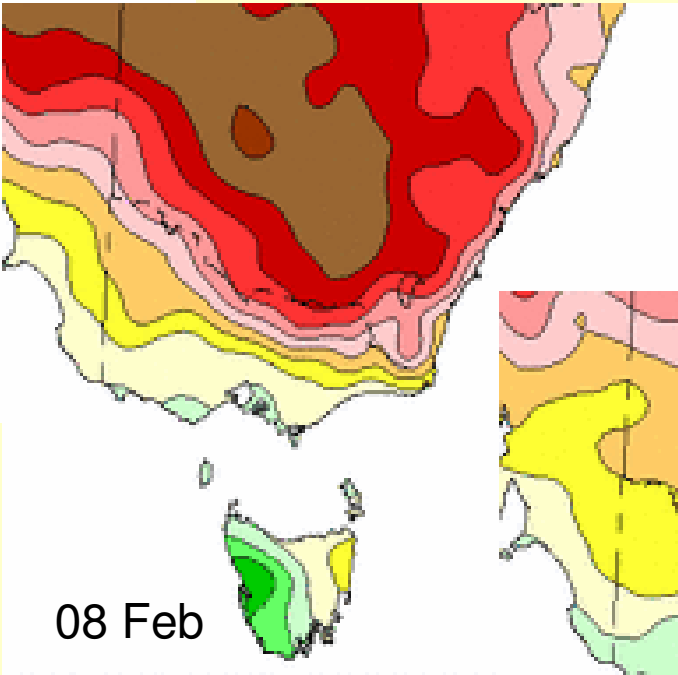
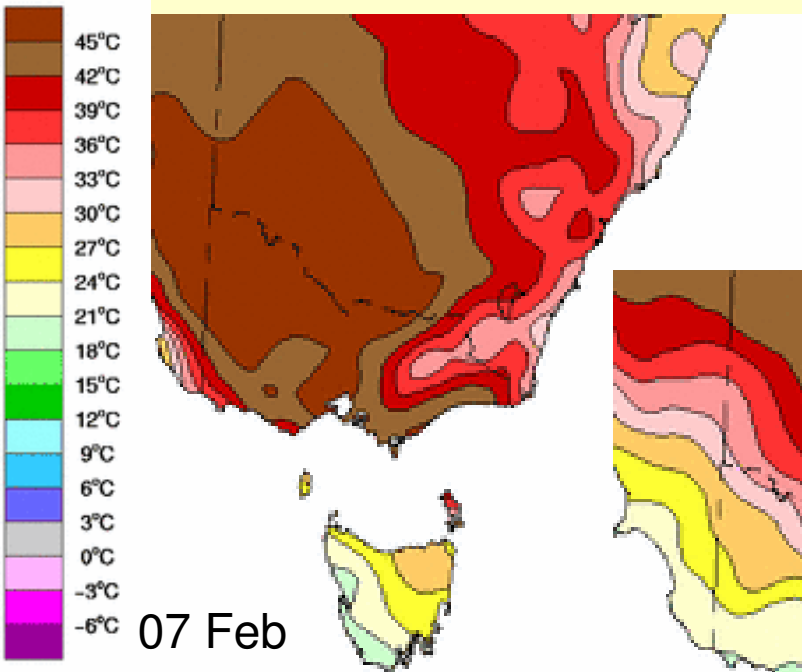
OMI: 22 Feb



Synoptic Summary: SE Aus, NZ & neighboring Pacific

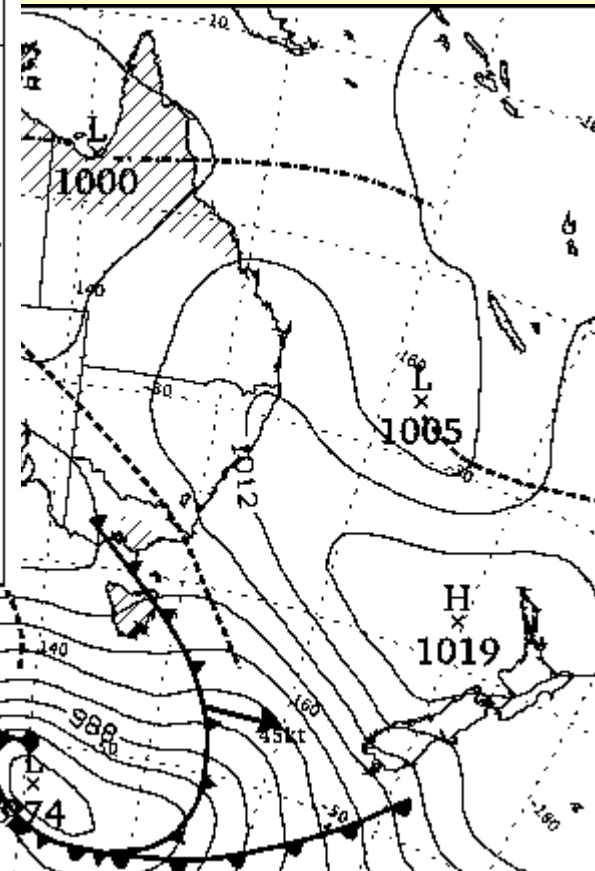
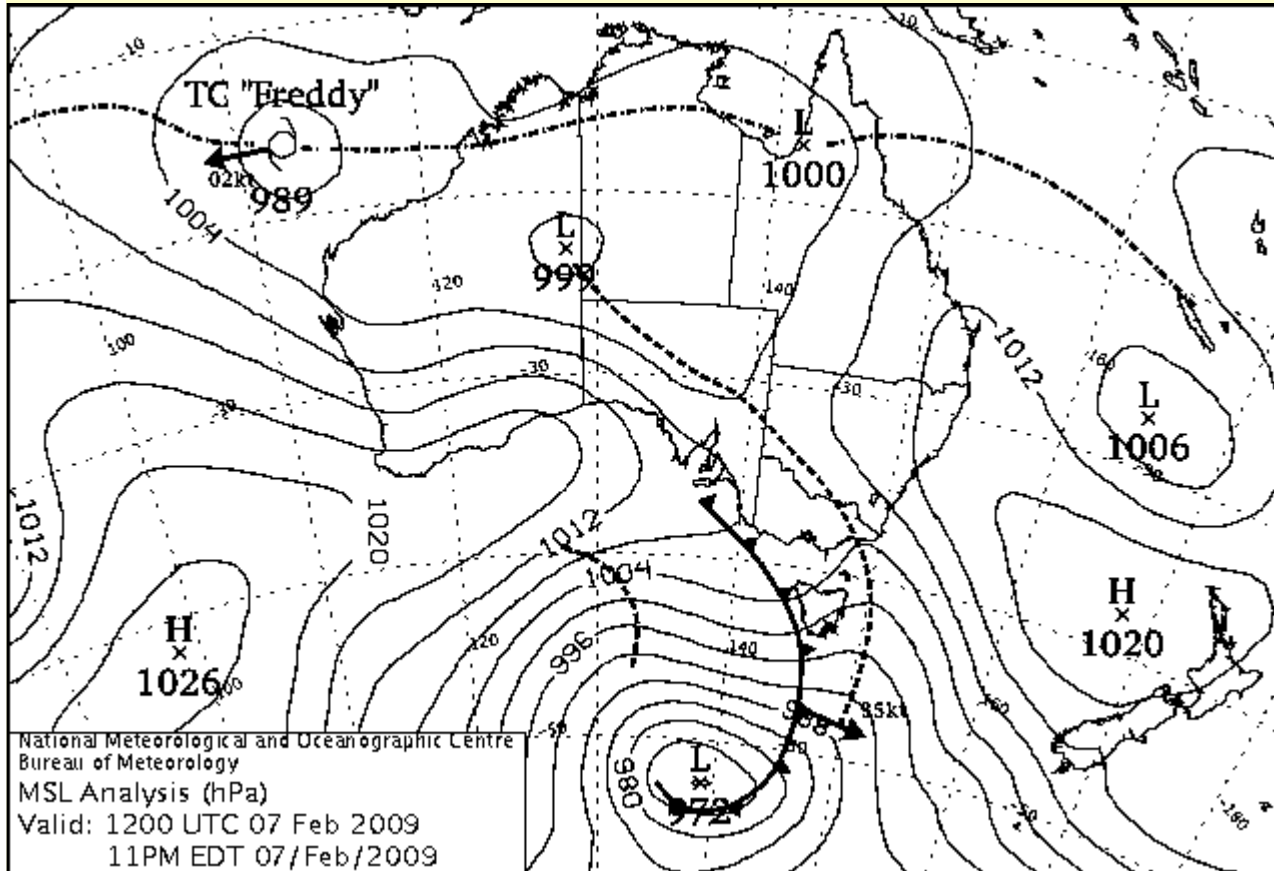
- Before Feb 07: T_{sfc} far above average, little rain
- Feb 07: Cold front passage at Melbourne
- Feb 08: Plume appears to 'split' at S. NZ
- Feb 09: Plume does not catch the jet stream, transported NE of NZ
- Feb 10-13: Stagnation N of NZ
- Feb 14-17: 'Tail' of westerly transport/dispersion develops on eastern most portion of stagnated plume
- Feb 18-22: Blob of plume subject to easterly transport moves back over NE Aus.

Max Temperature Maps: pre- and post-frontal

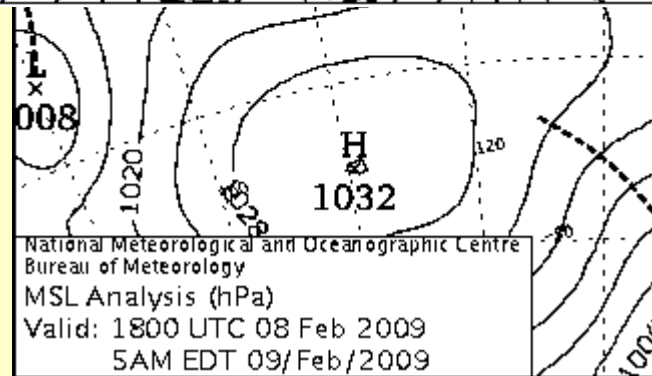
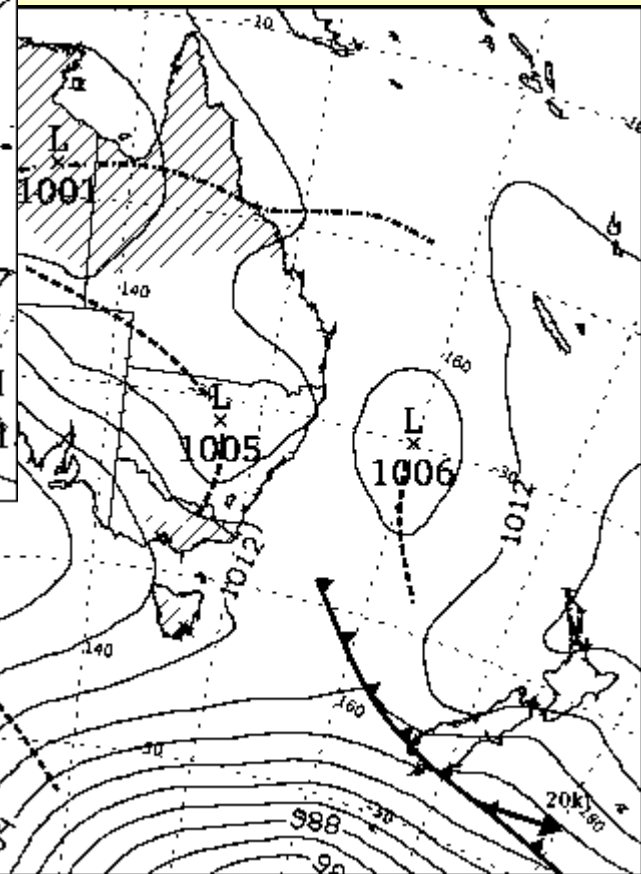
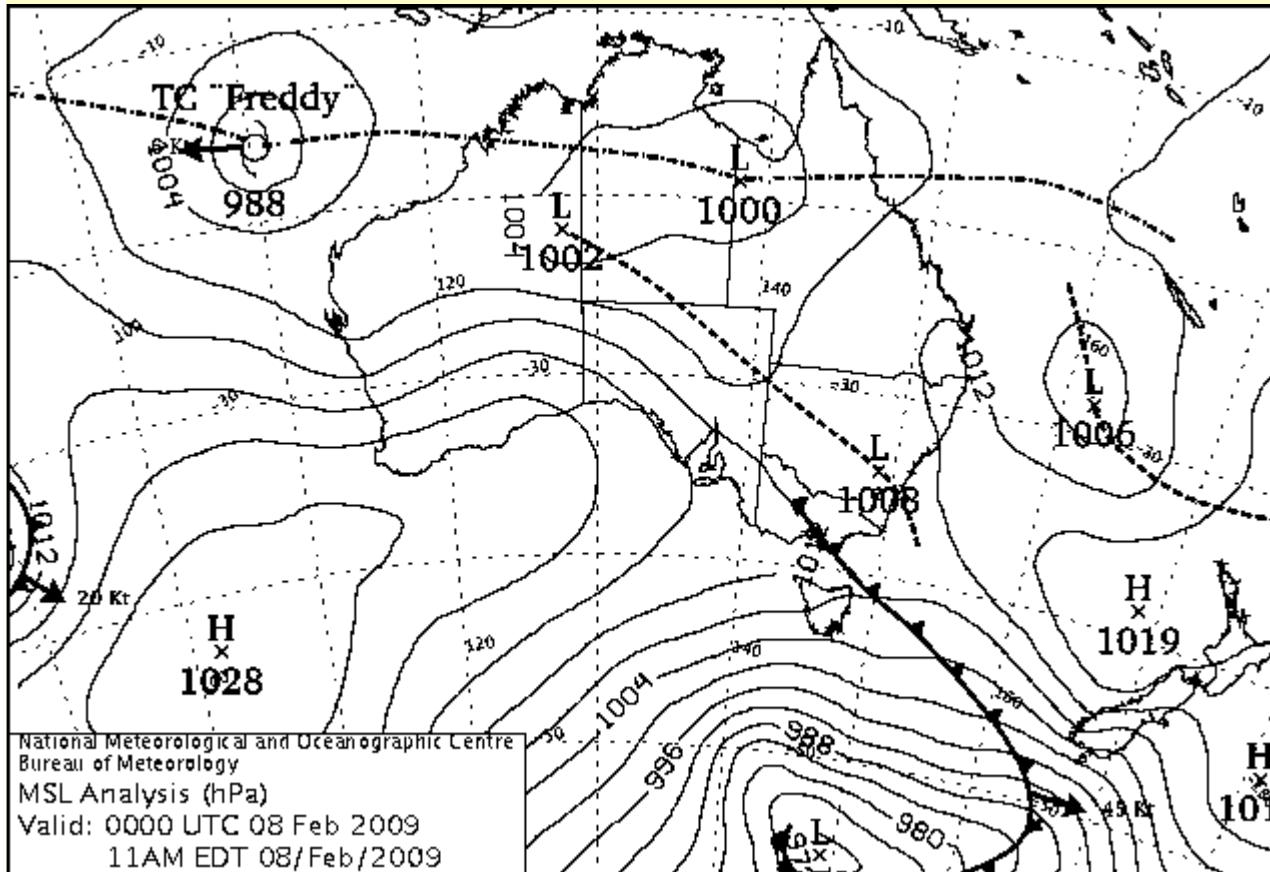


<http://www.bom.gov.au>

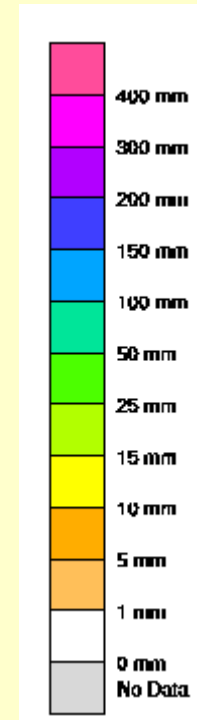
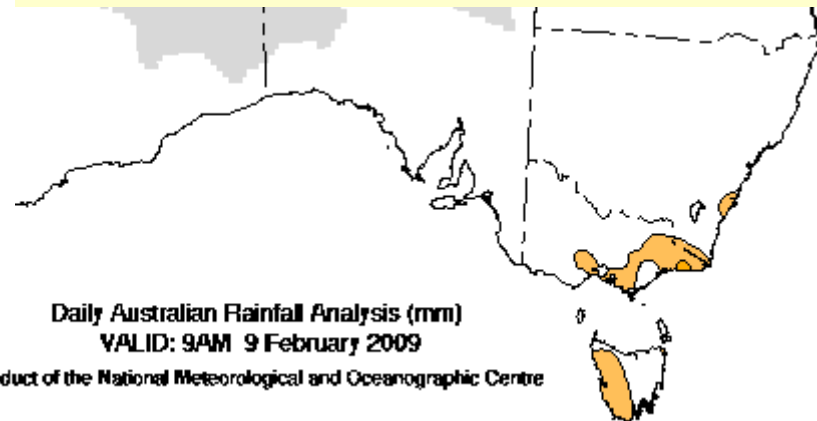
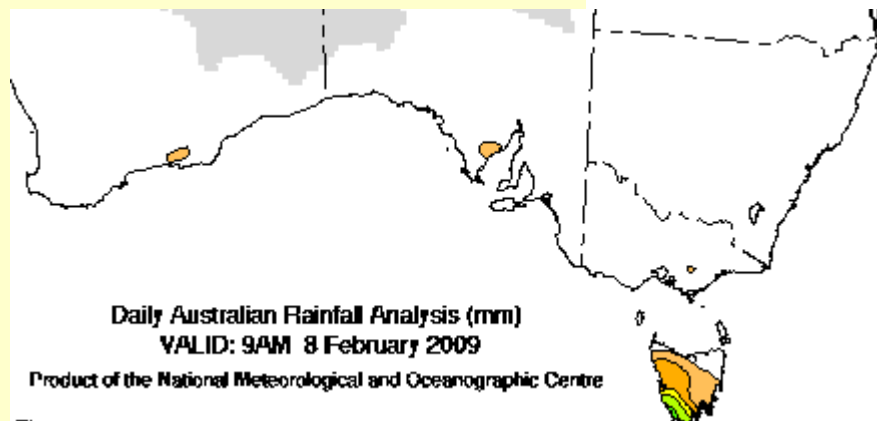
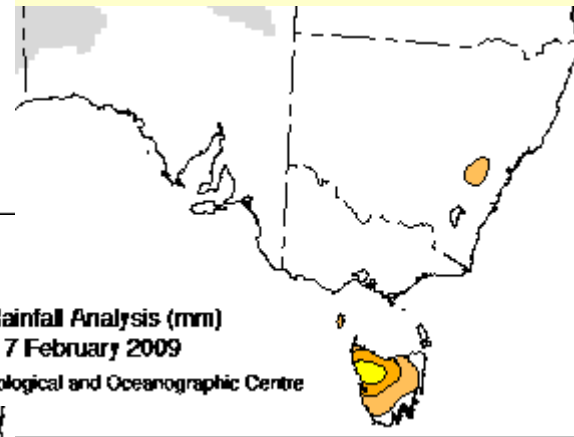
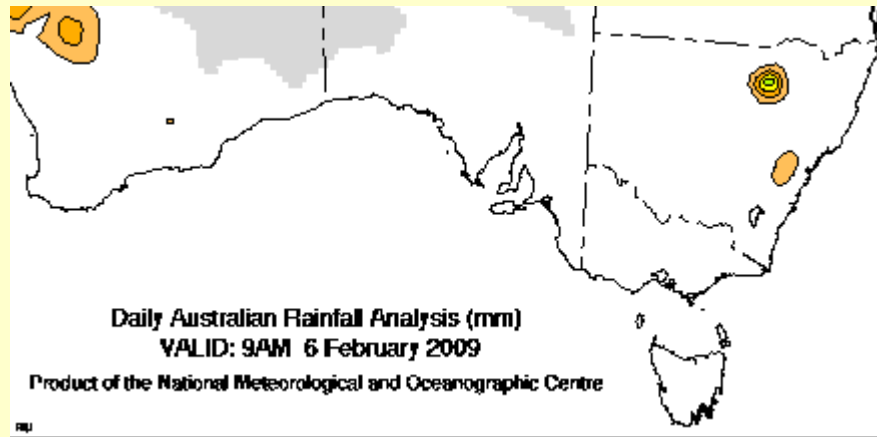
Surface Synoptics: Feb 07



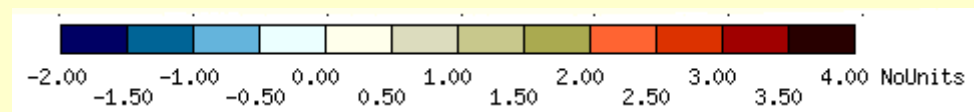
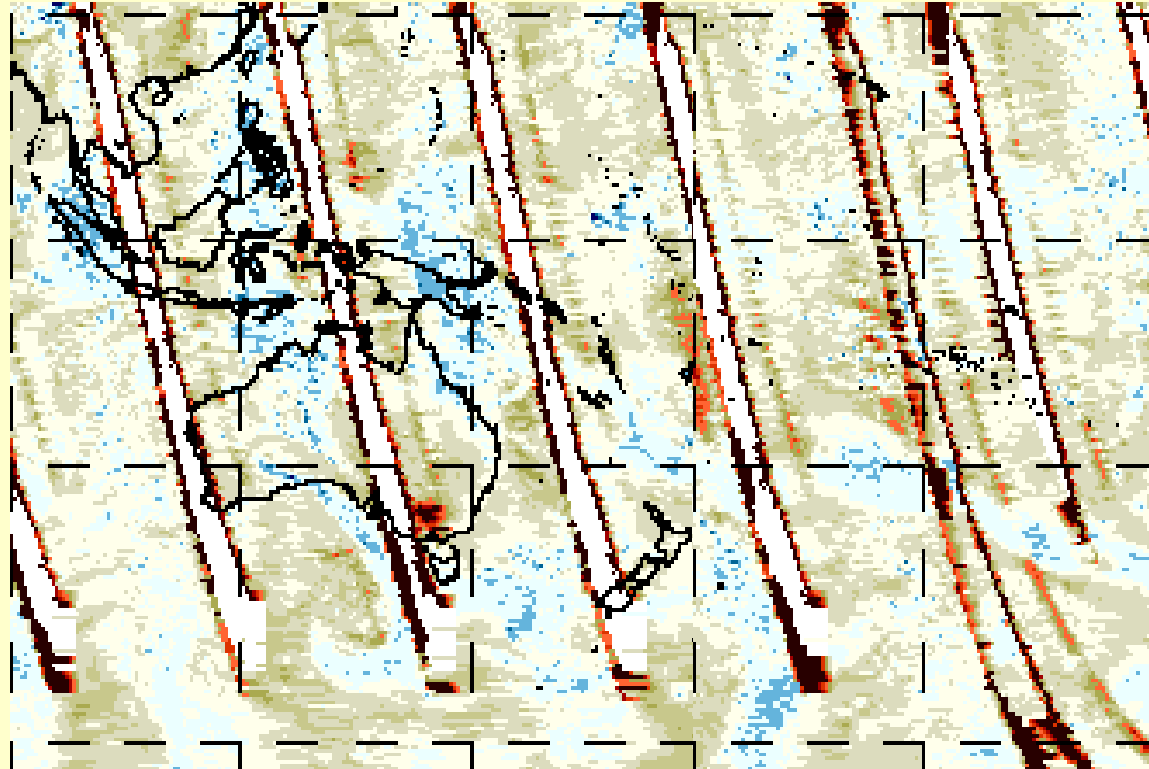
Surface Synoptics: Feb 08



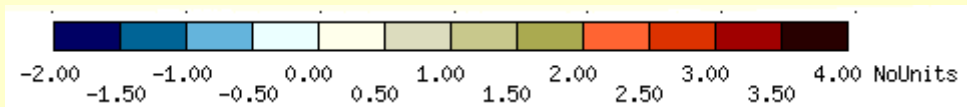
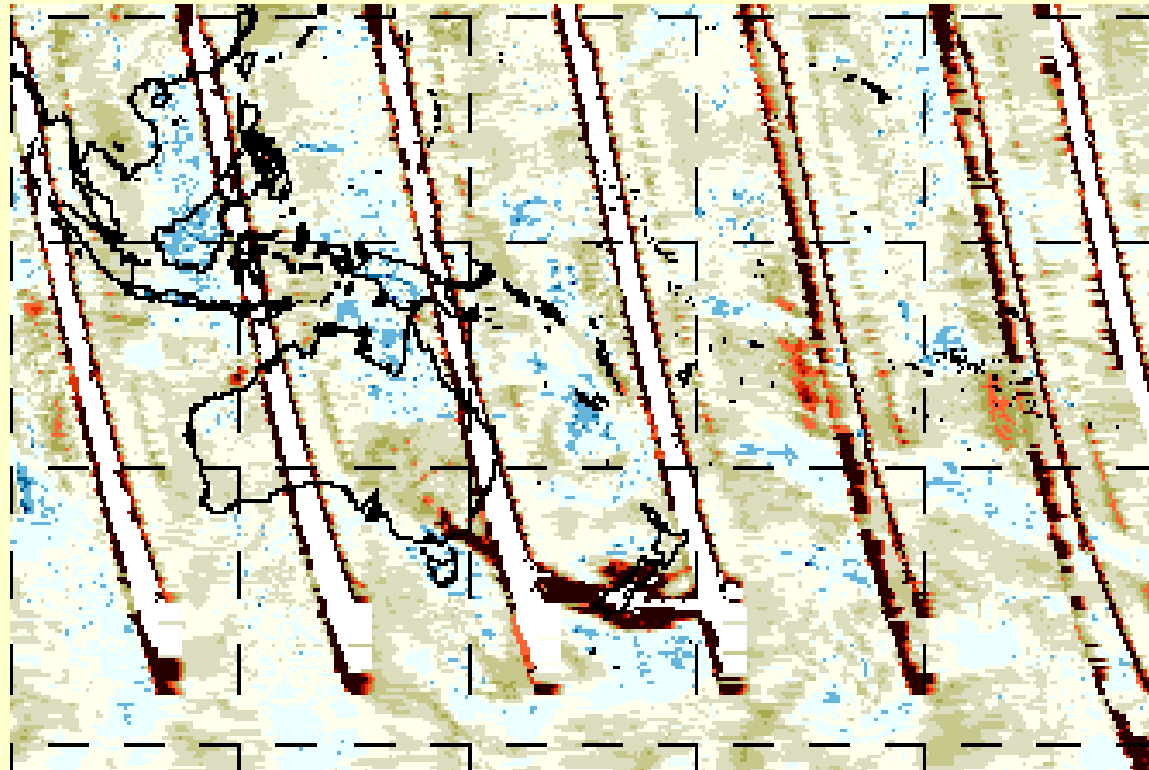
Precipitation Maps: pre- and post-frontal



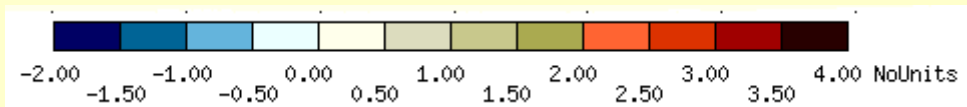
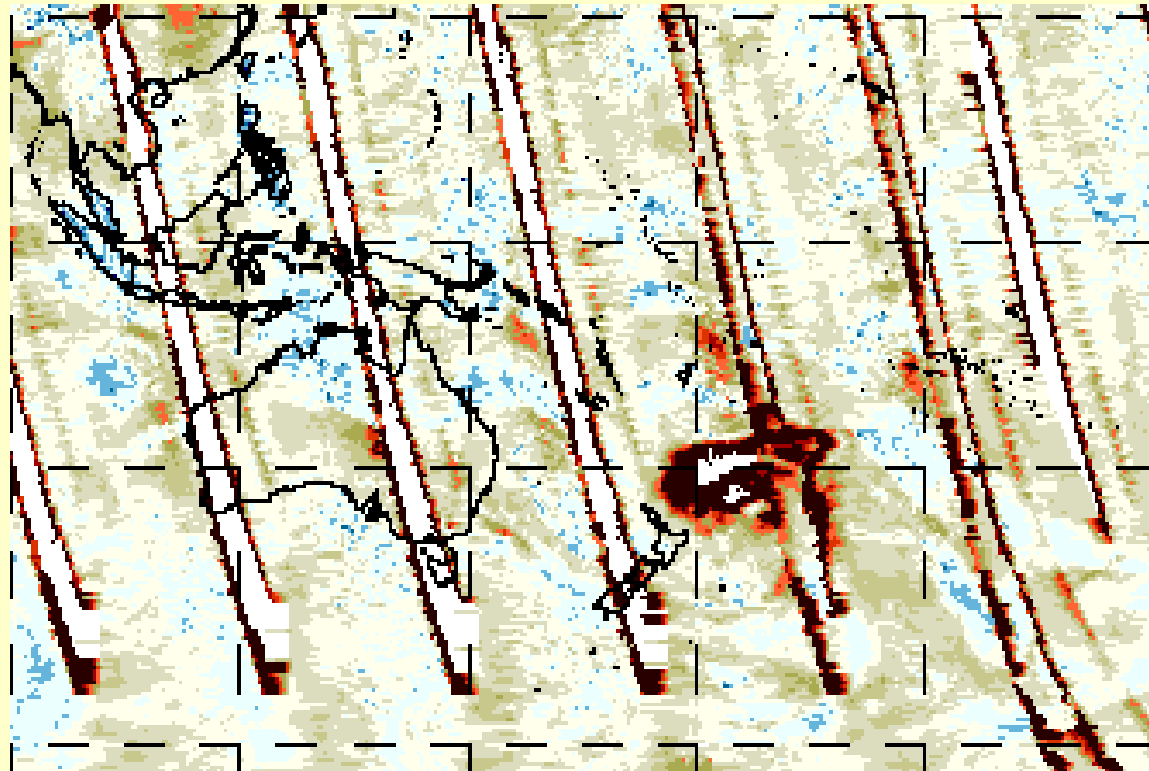
OMI: 07 Feb



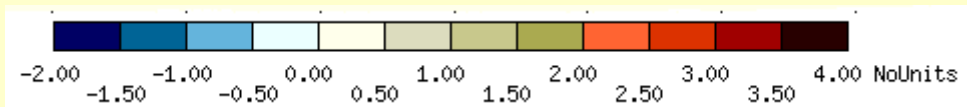
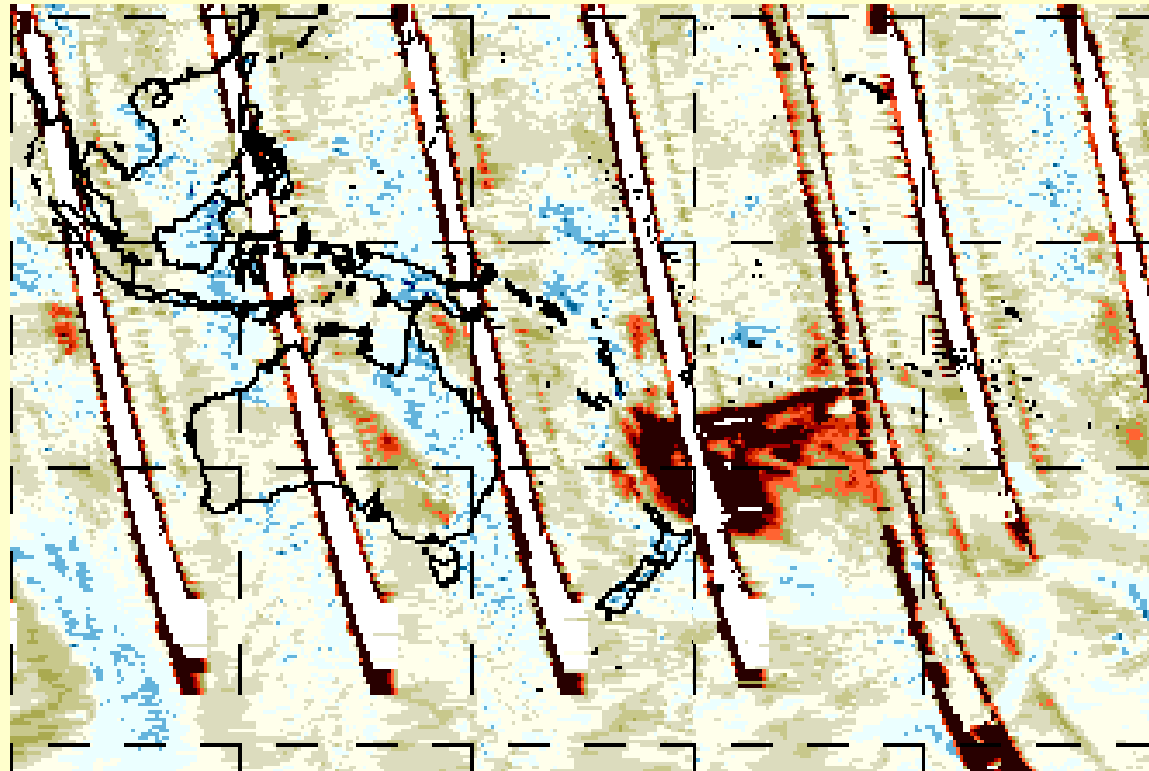
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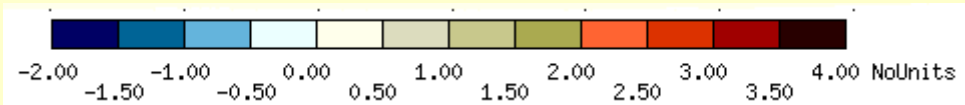
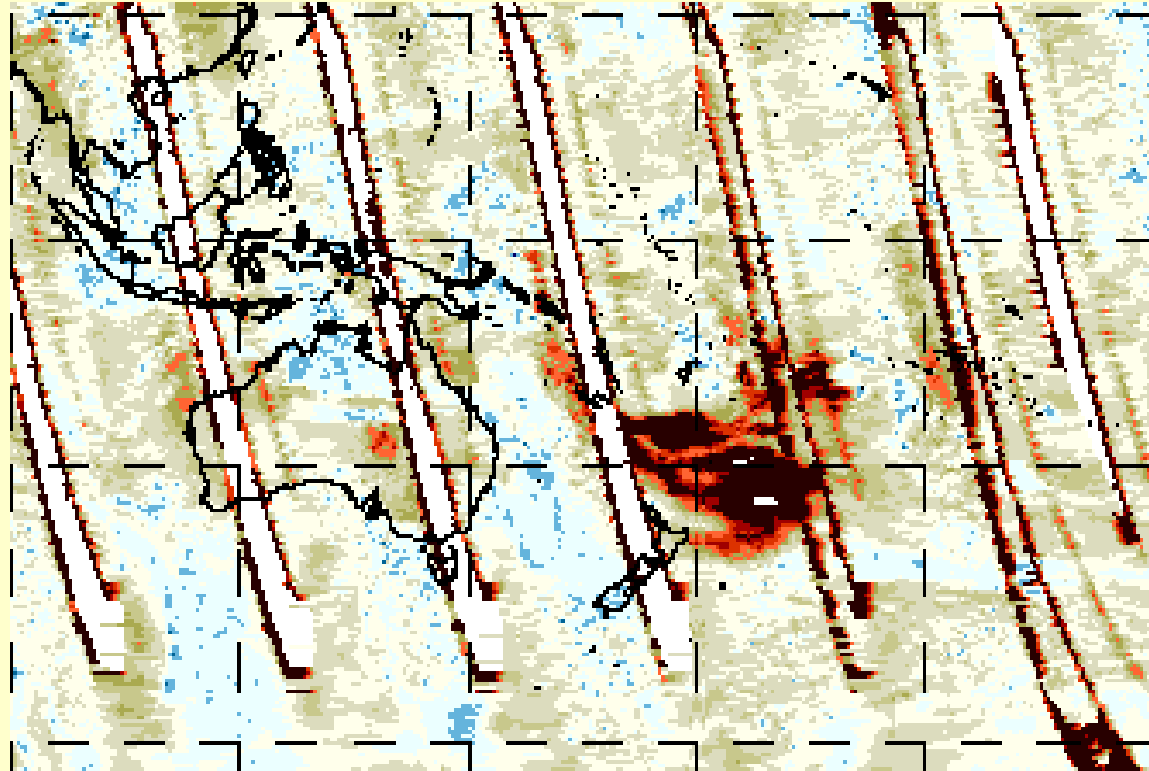
OMI: 09 Feb



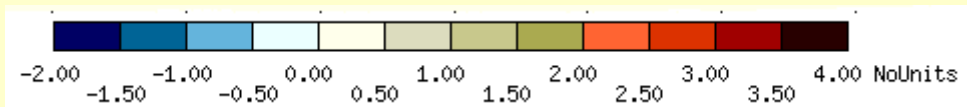
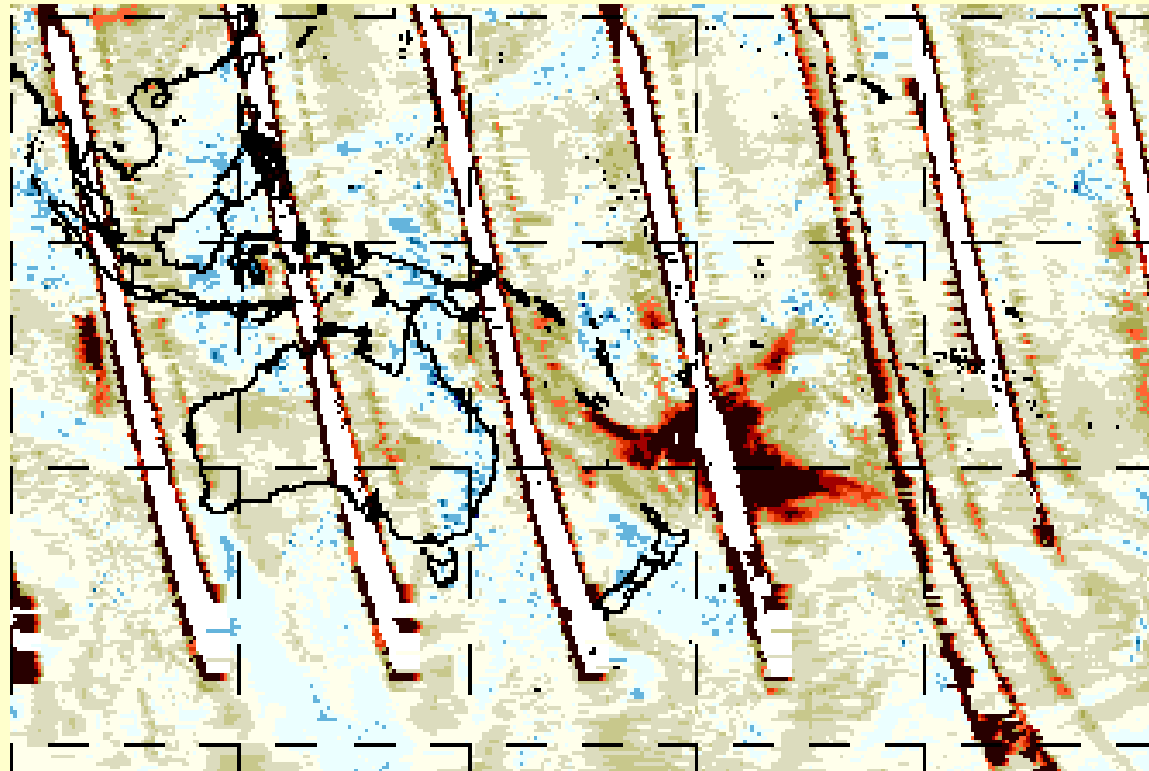
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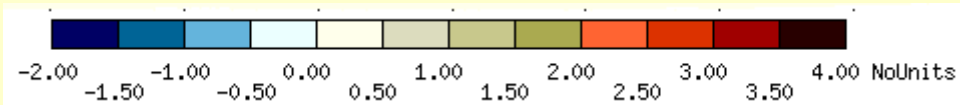
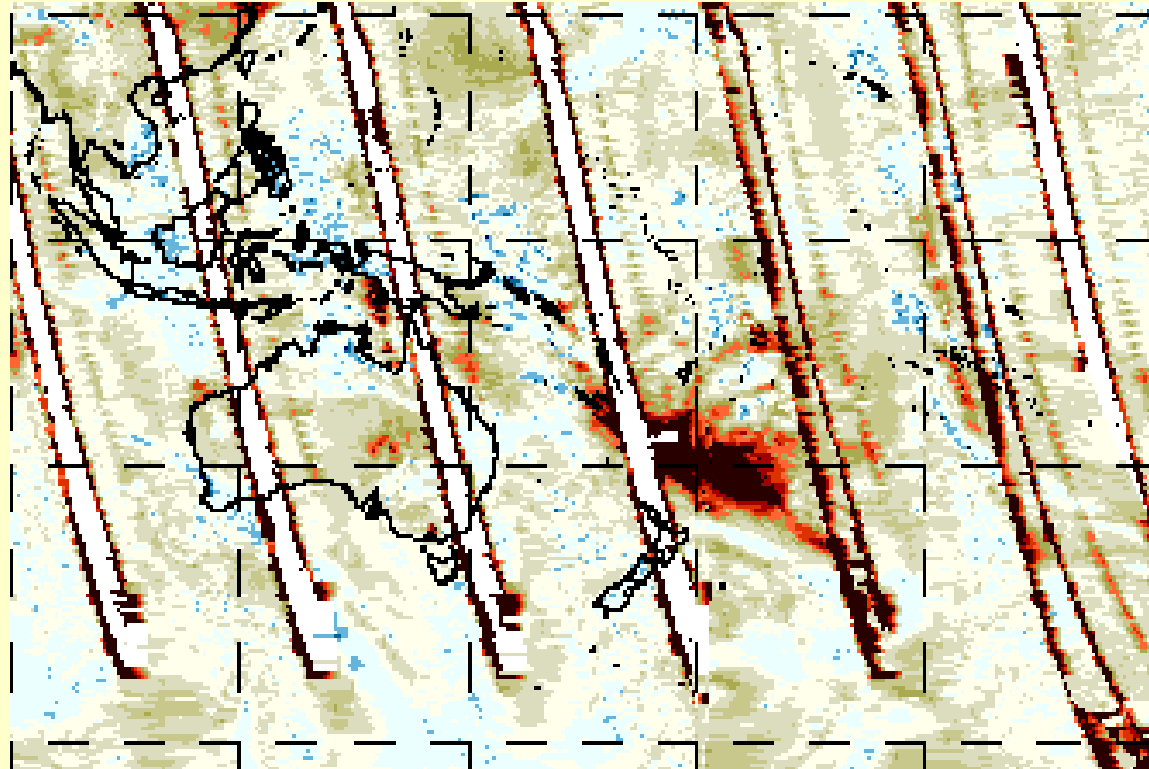
OMI: 11 Feb



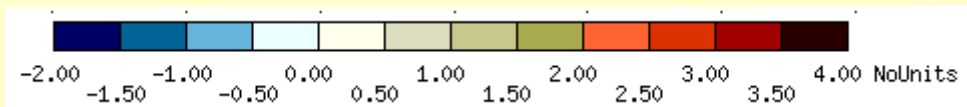
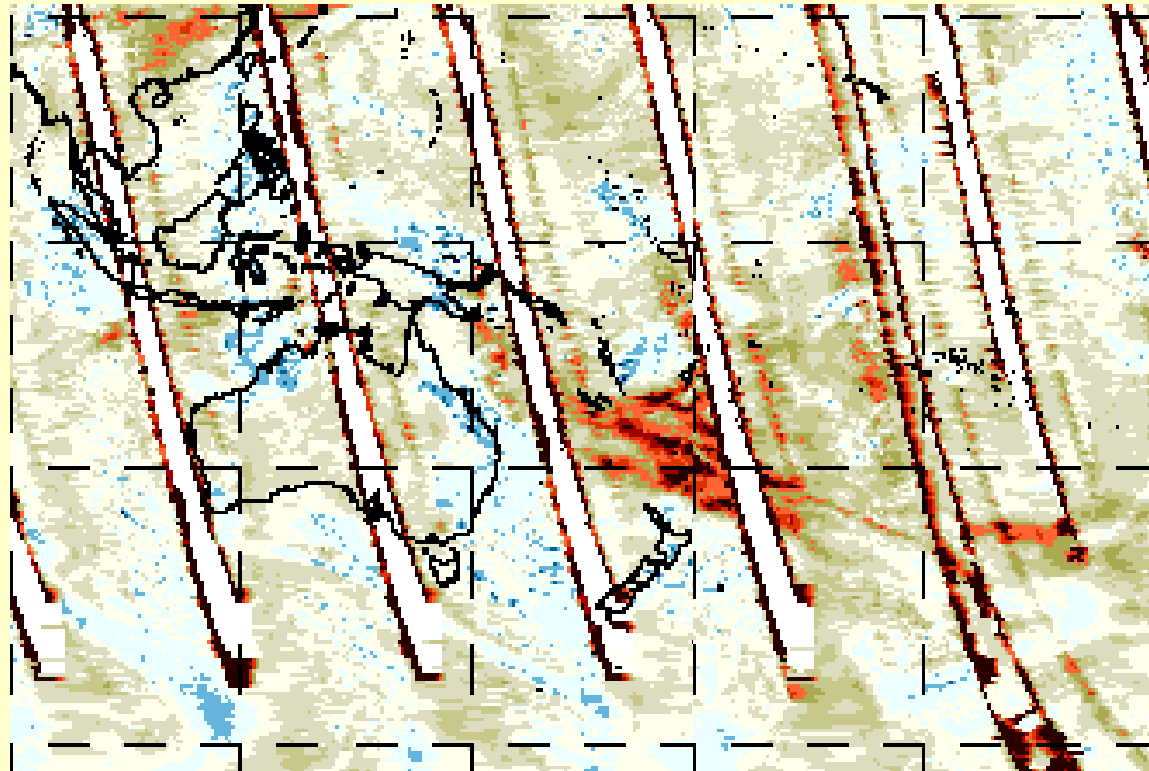
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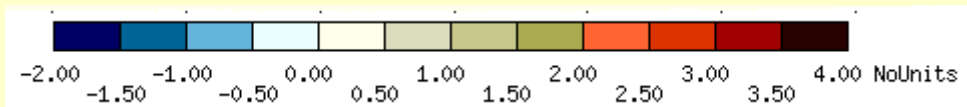
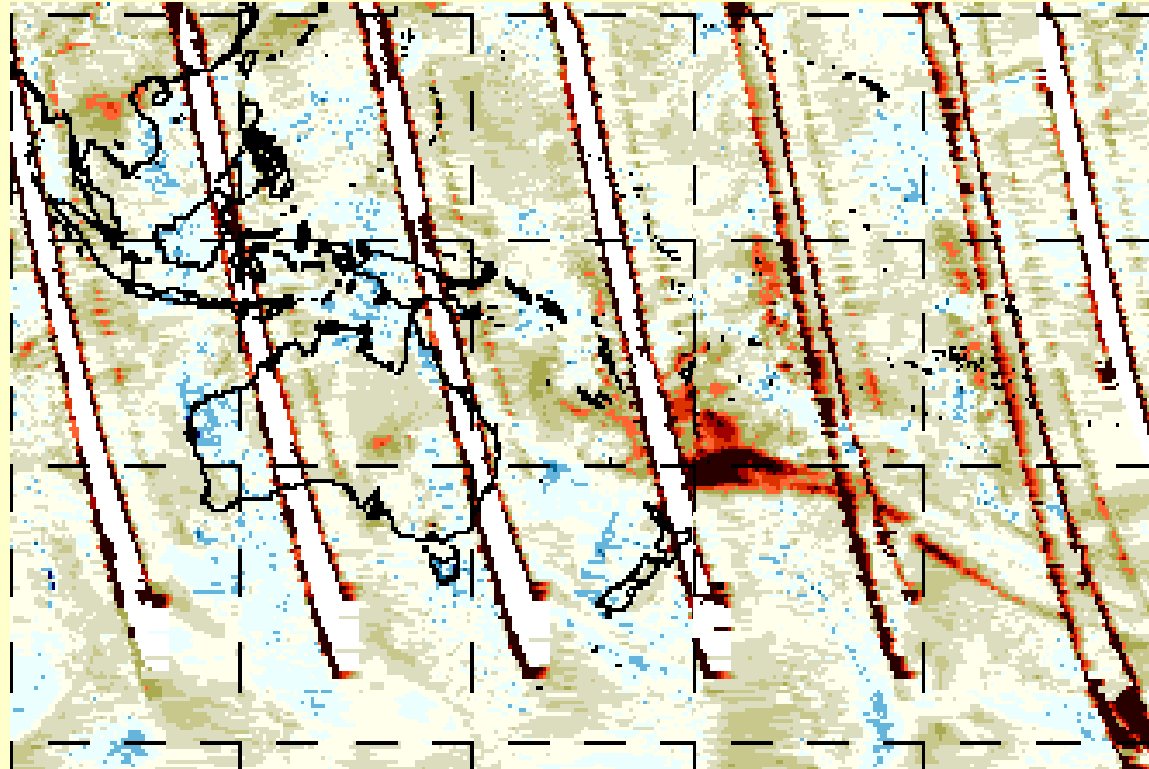
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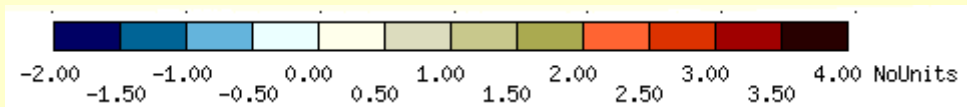
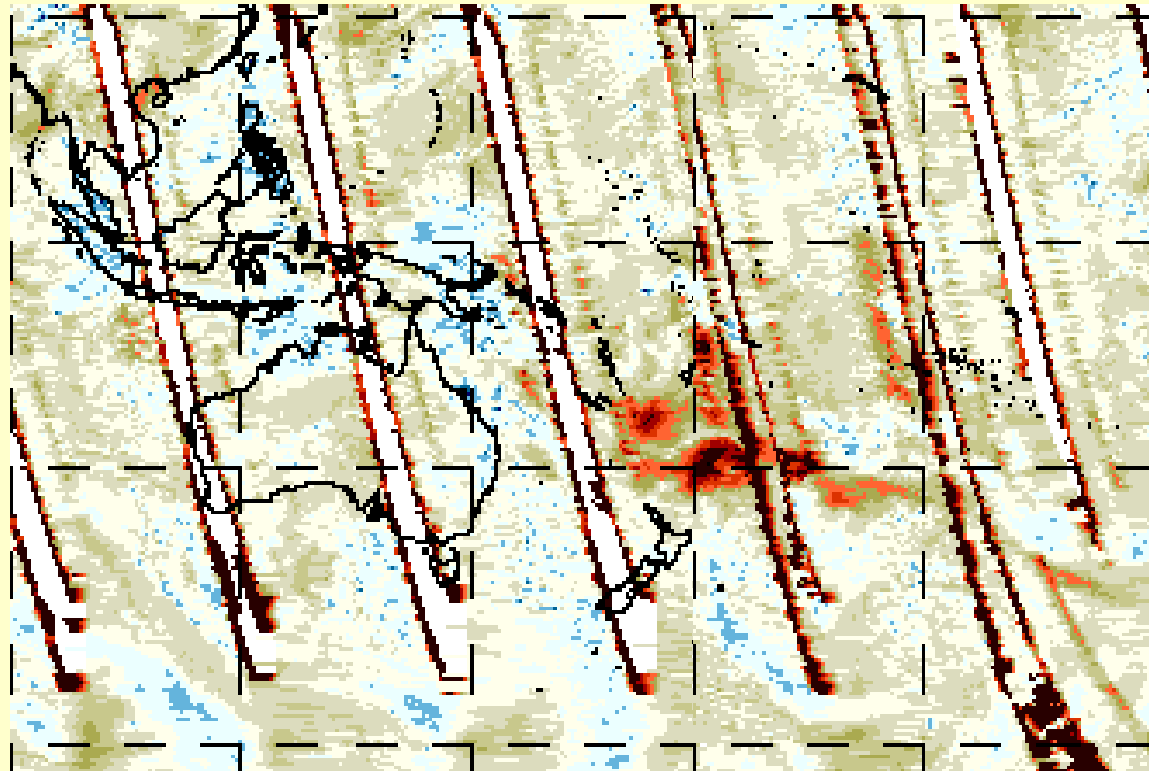
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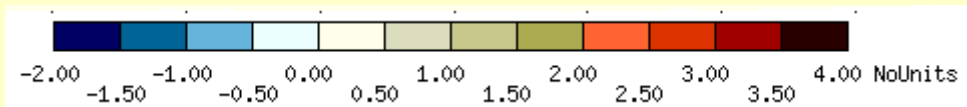
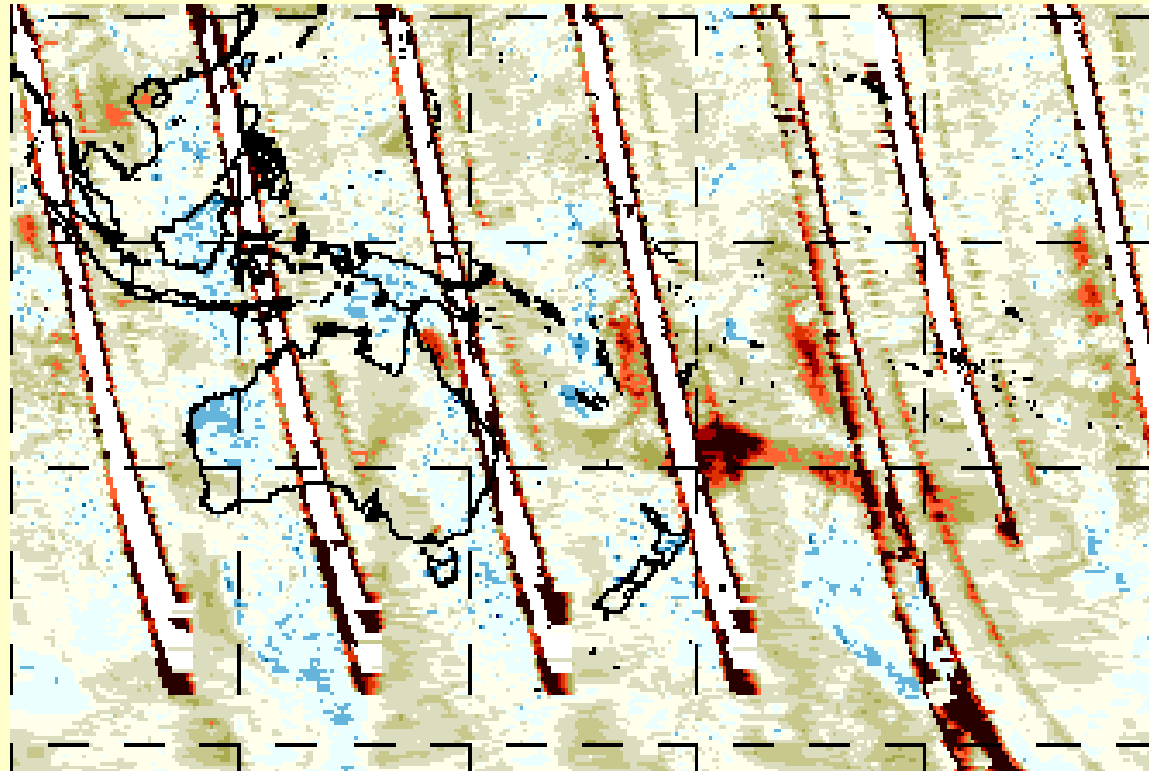
OMI: 15 Feb



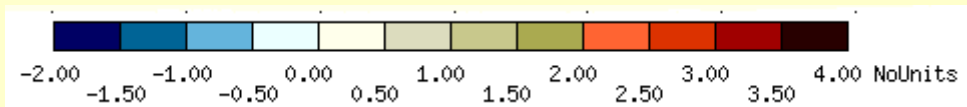
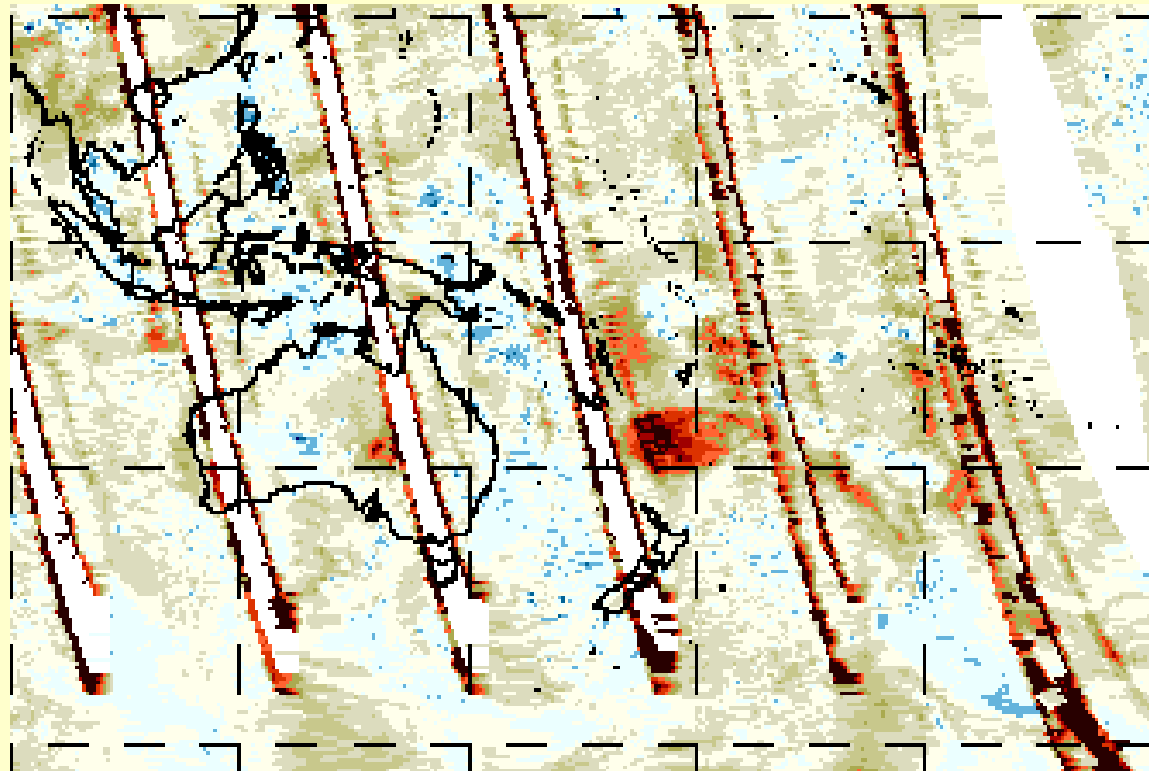
OMI: 16 Feb



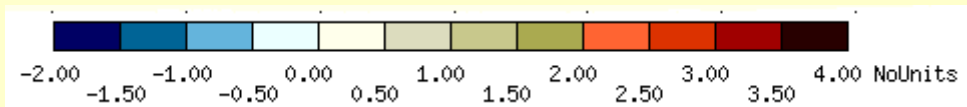
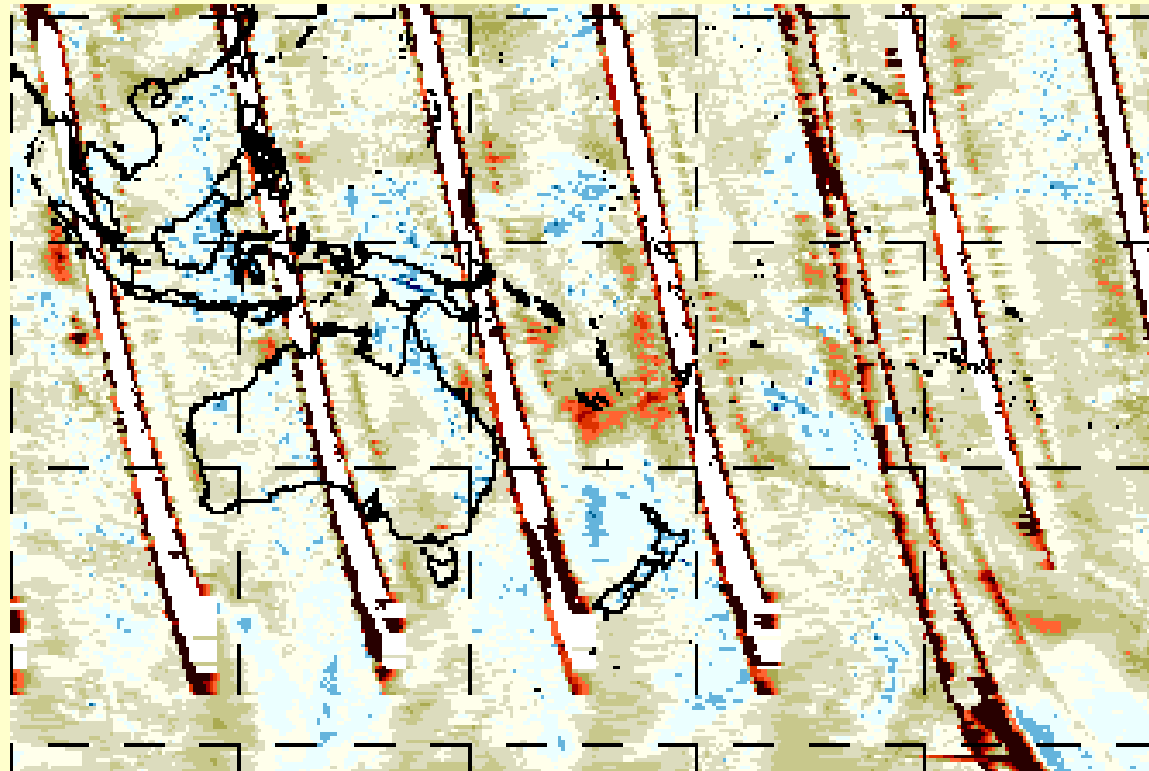
OMI: 17 Feb



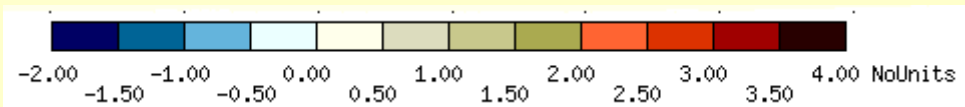
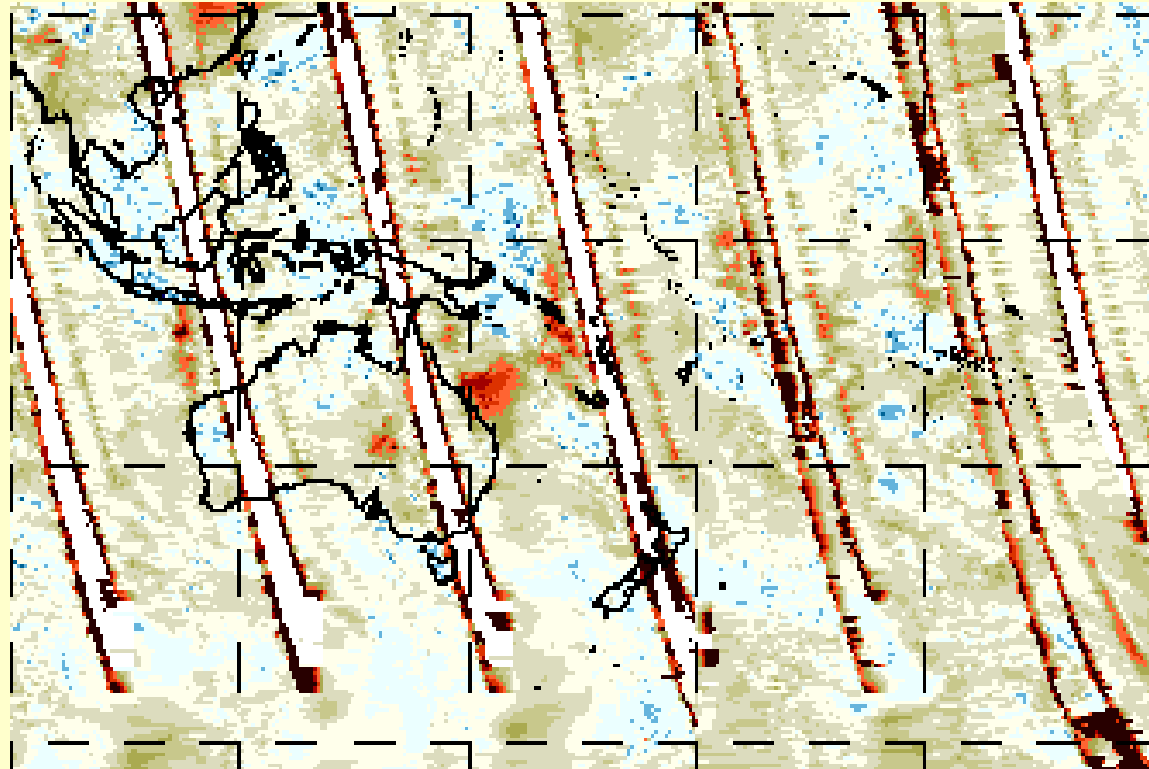
OMI: 18 Feb



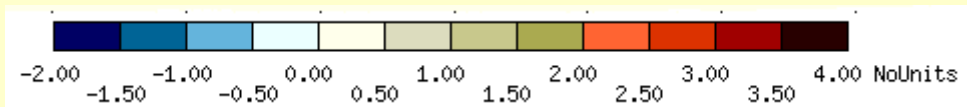
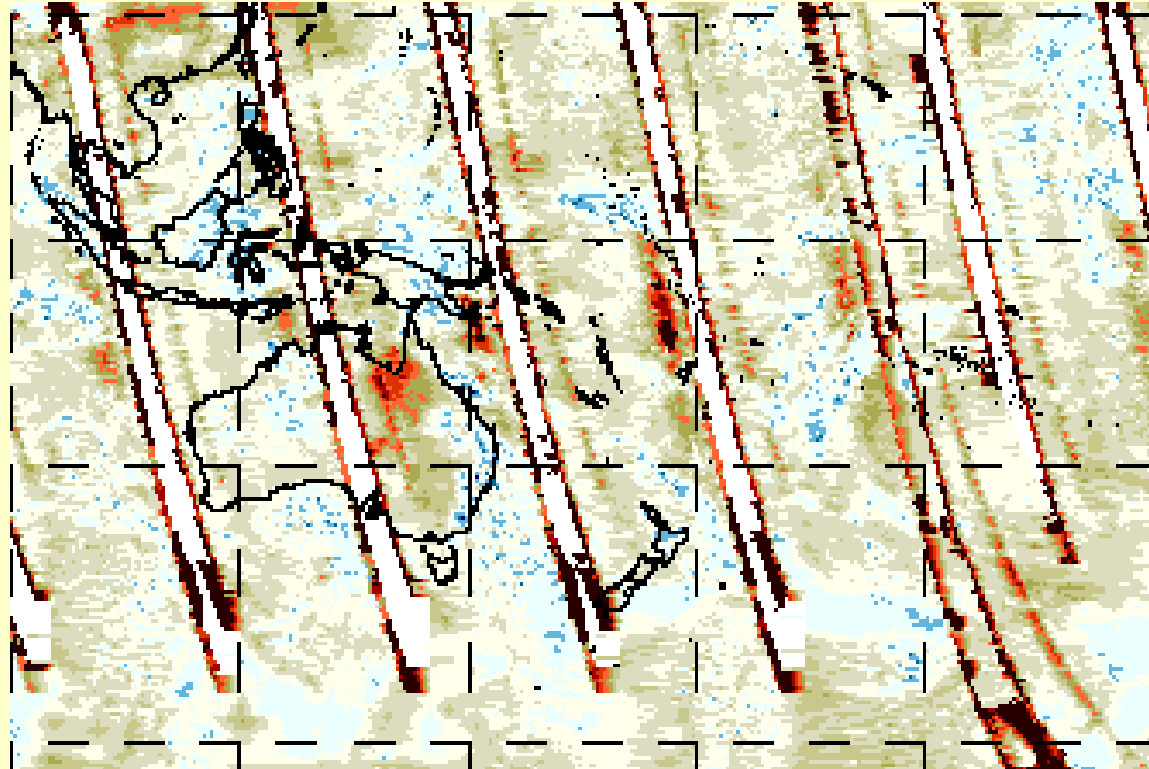
OMI: 19 Feb



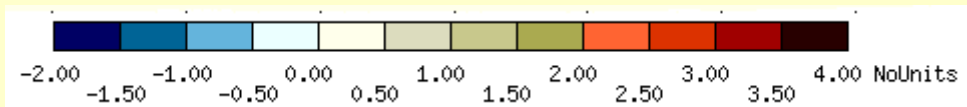
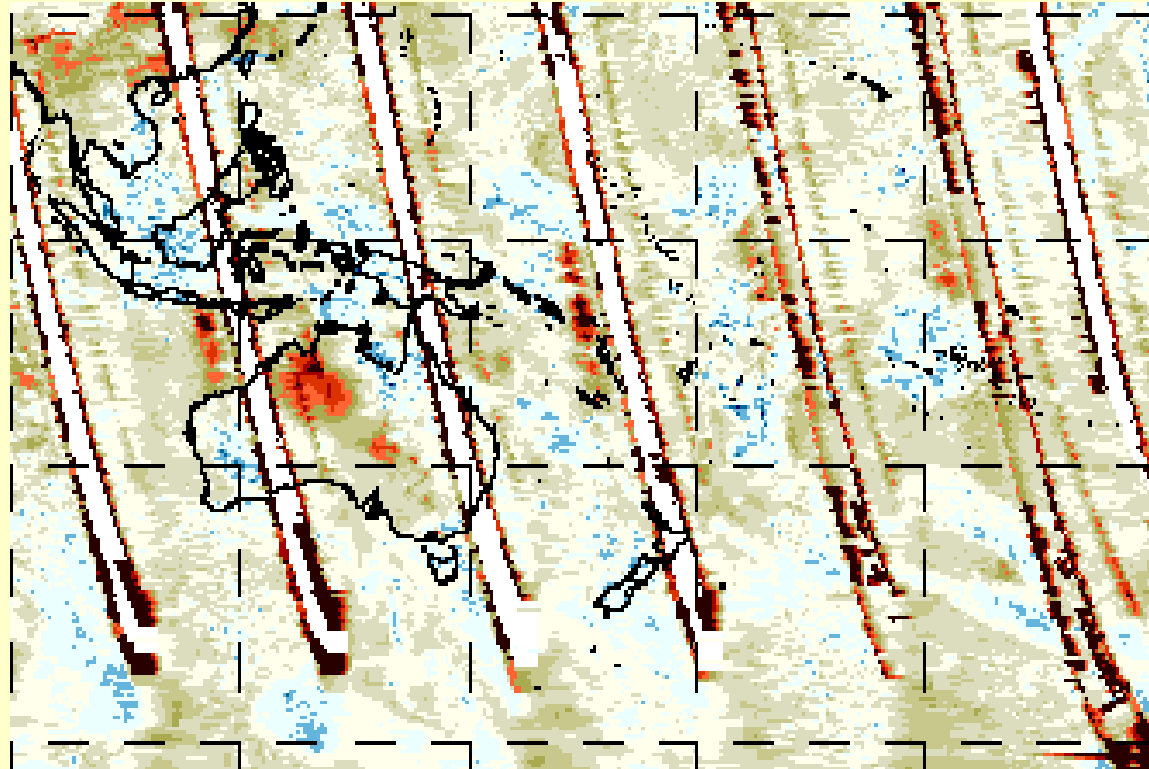
OMI: 20 Feb



OMI: 21 Feb



OMI: 22 Feb

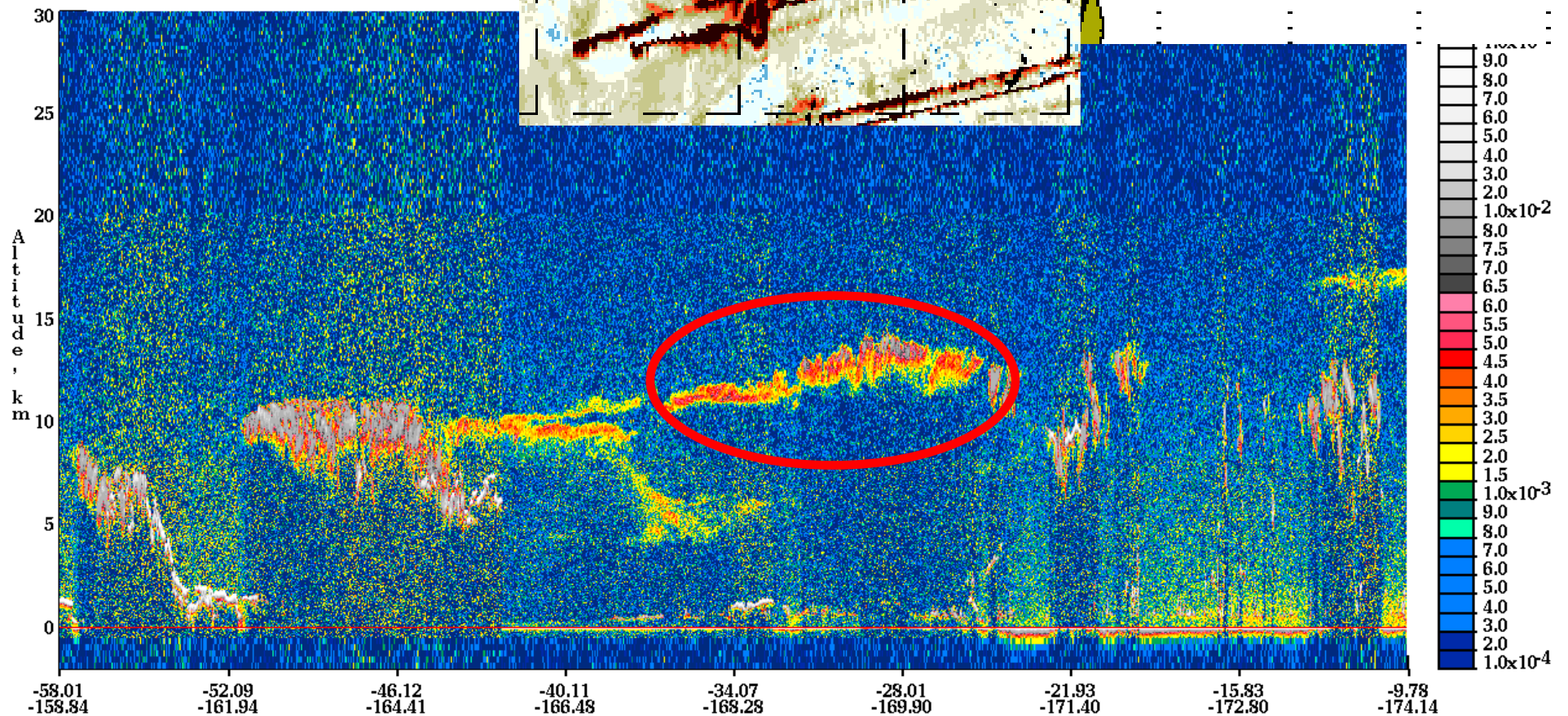
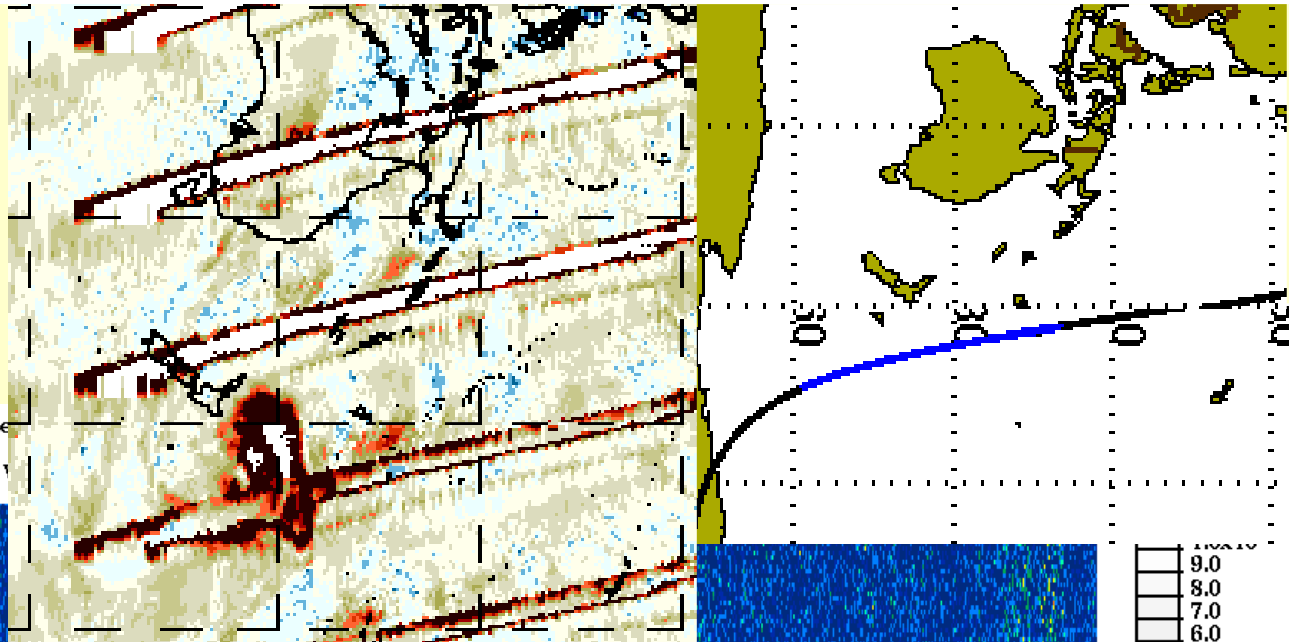


CALIPSO Data

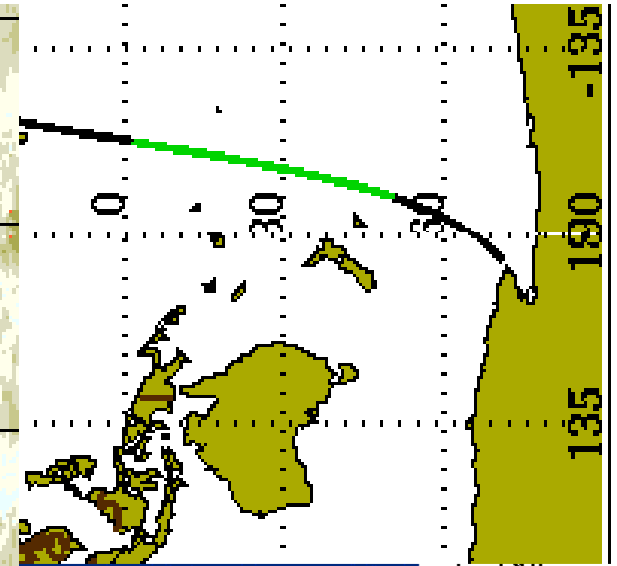
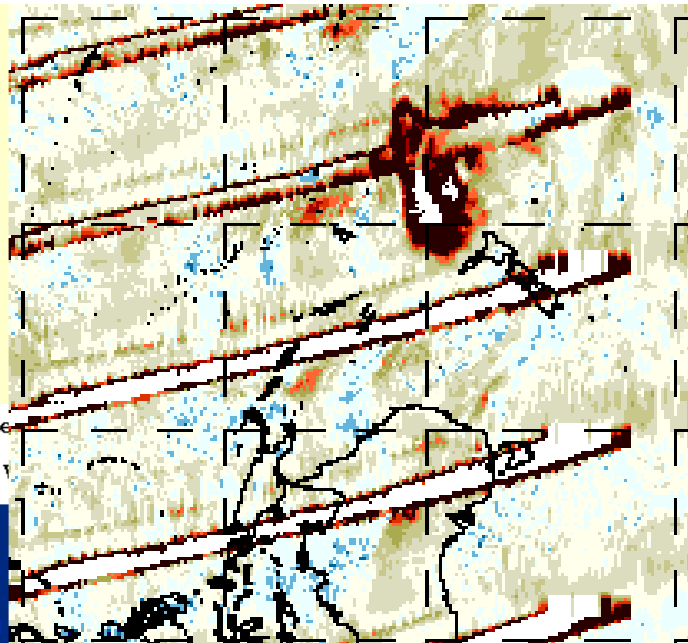
- Cross-sections through aerosol plume indicate steadily increases
- Aerosol near-surface at initial emission
- Quickly transported to the upper troposphere – lower stratosphere

CALIPSO:
09 Feb
0103 UTC (day)

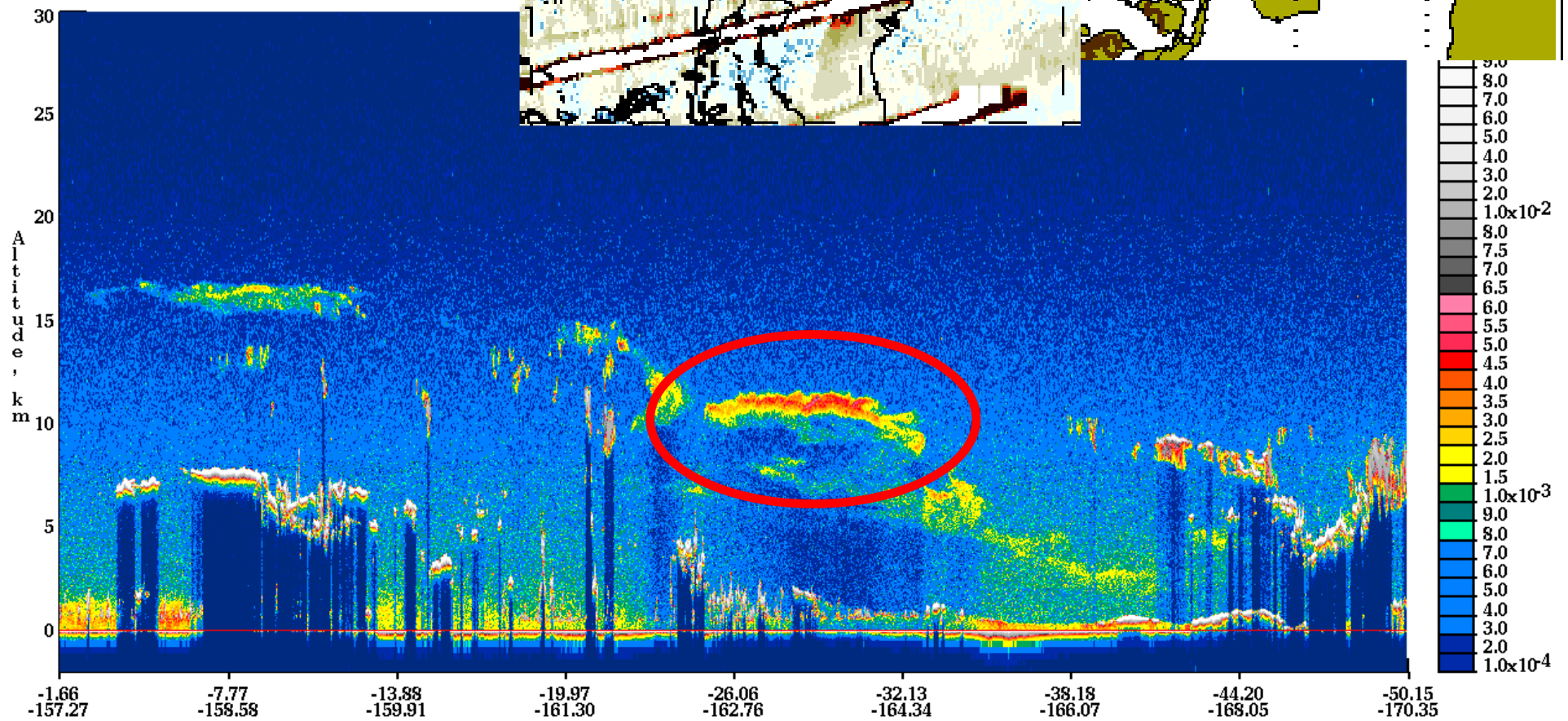
532 nm Total Attenuated Backscatter



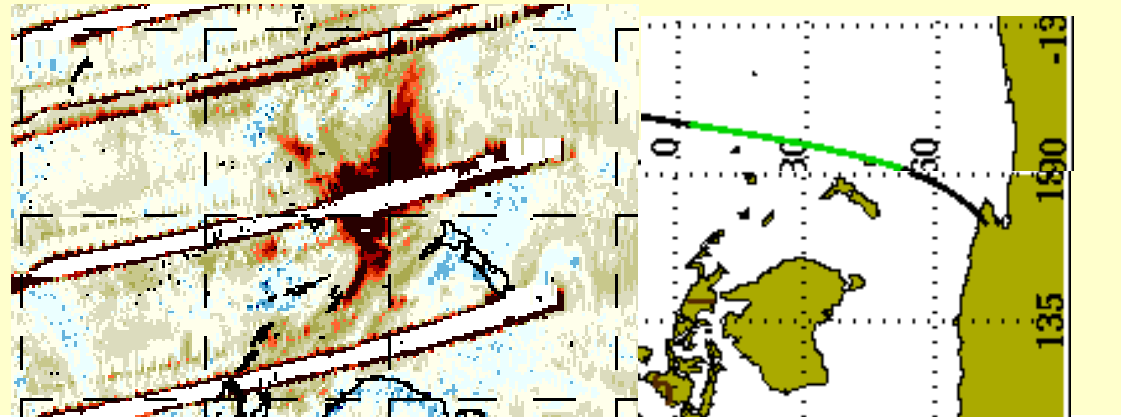
CALIPSO:
09 Feb
1149 UTC (night)



532 nm Total Attenuated Backscatter



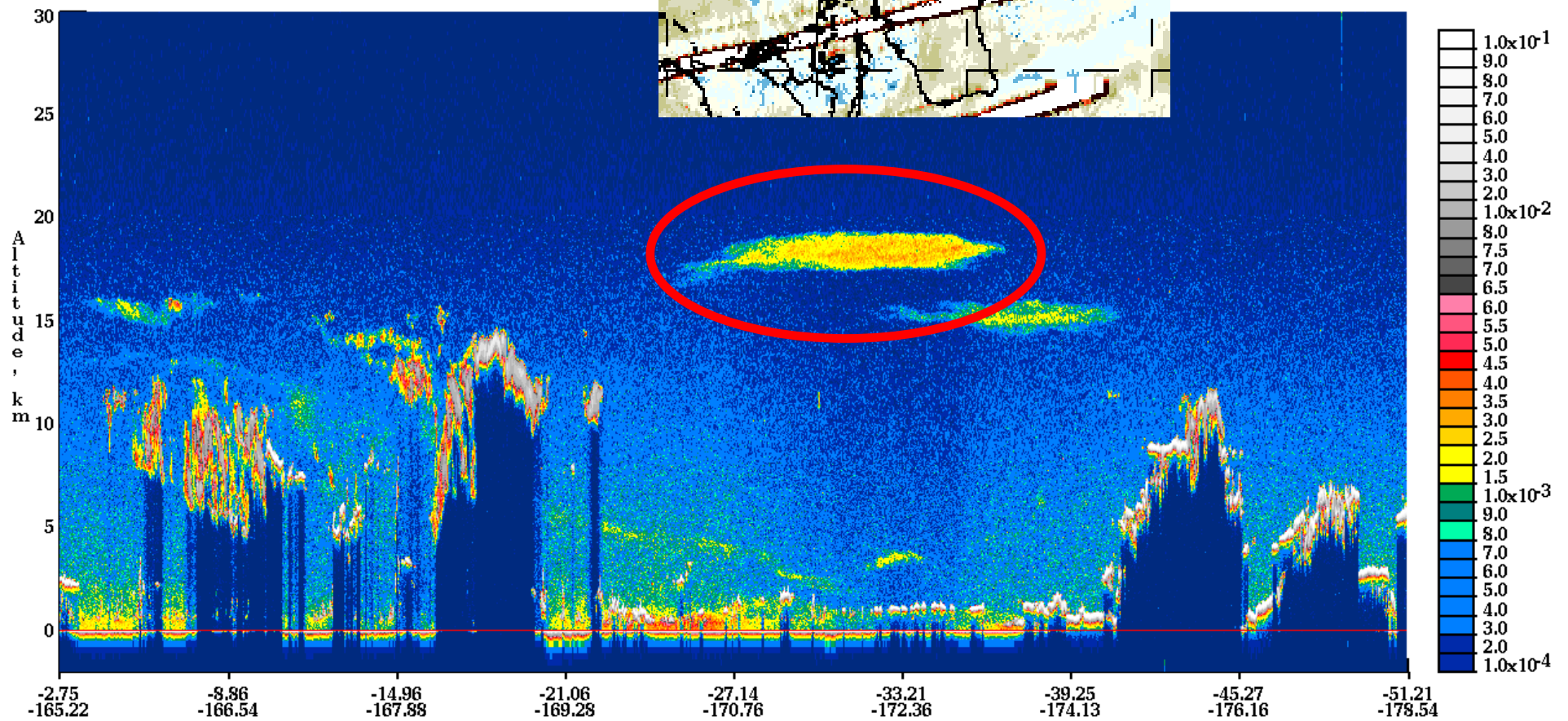
CALIPSO: 12 Feb 1247 UTC (night)



532 nm Total Attenuated Backscatter, /km /sr

13:01:20.4081

Version: 2.02



Future Work

- Presenting More of the Australian Case Study – AGU Fall Meeting Poster
 - More in-depth meteorological transport description showing the role of frontal lifting and jet-stream positioning
- Comparison of OMI AI Trends with SCIA & GOME-2 Trends
 - Initial work show agreement of seasonal trends
- Combining TOMS and OMI AI Records

Discussion / Conclusions

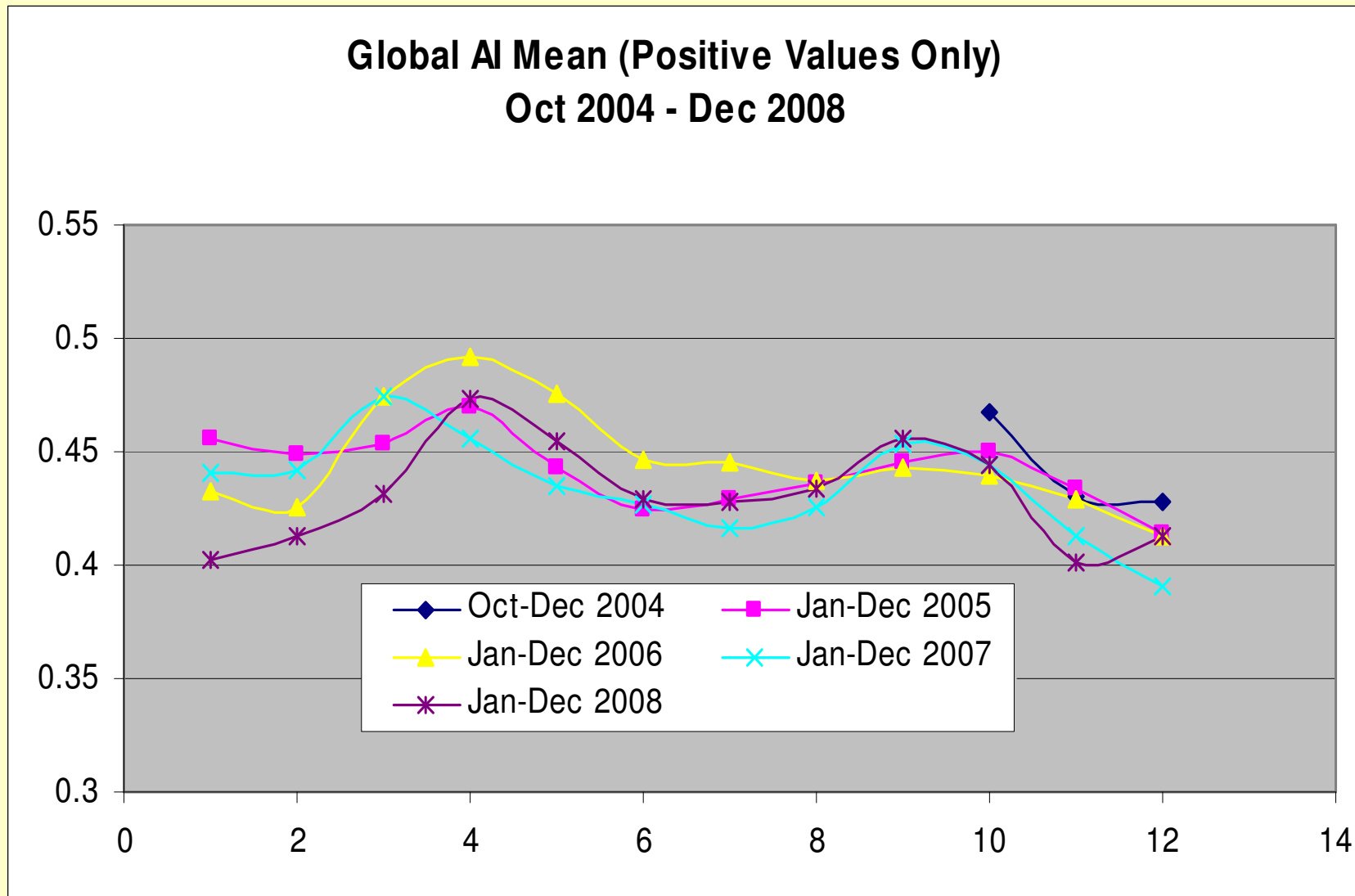
- Aerosol Index is a product that facilitates better understanding of both long-term trends and short-term episodes

Another Aerosol Talk Today!

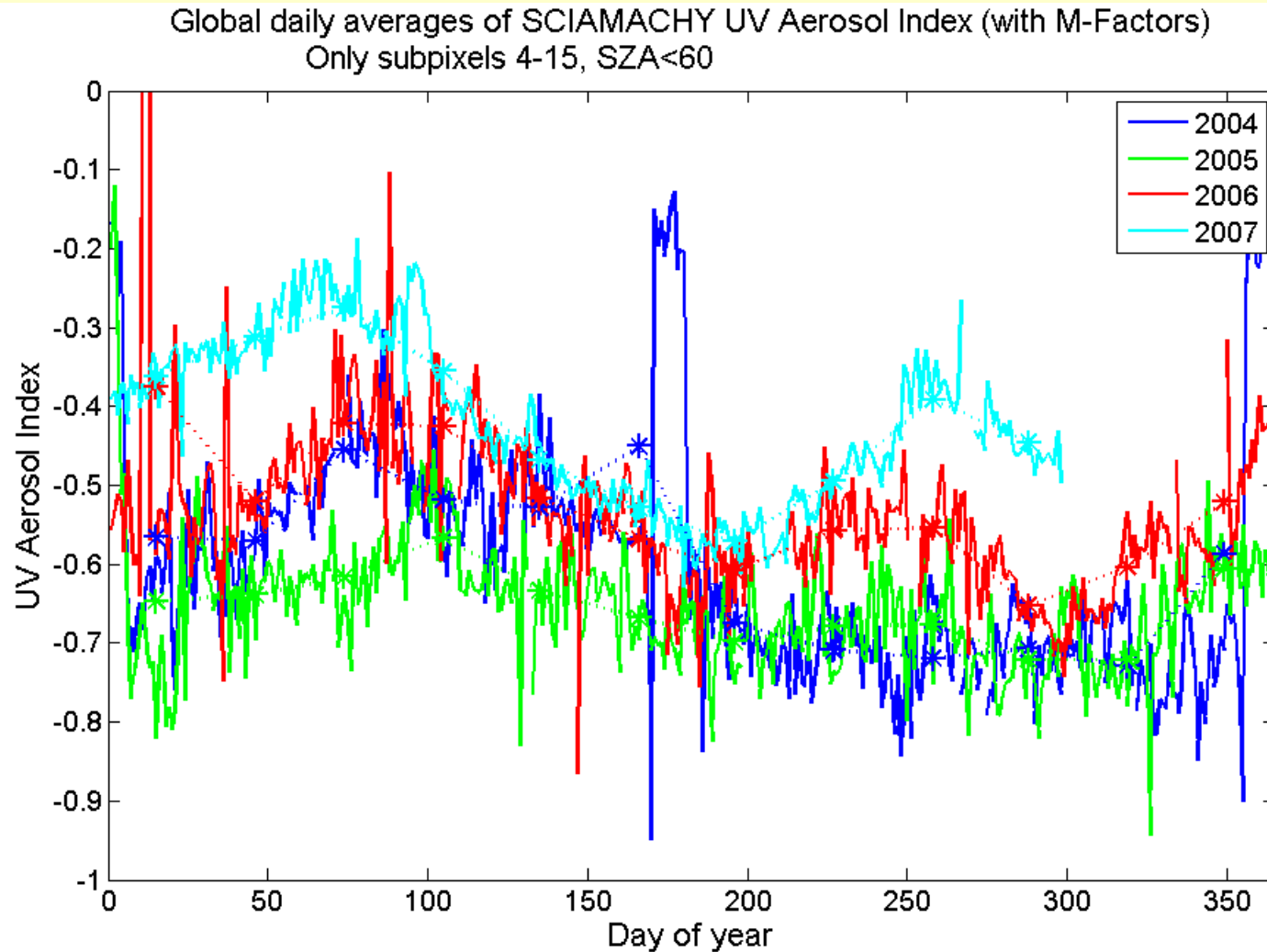
- Speaker: Thorsten Mauritsen
 - Max-Planck Institute for Meteorology
- Subject: “A warming regime of the aerosol indirect effect”
- Location: Vening Meinesz-room
- When: **13.30**, Wed 28 Oct 2009

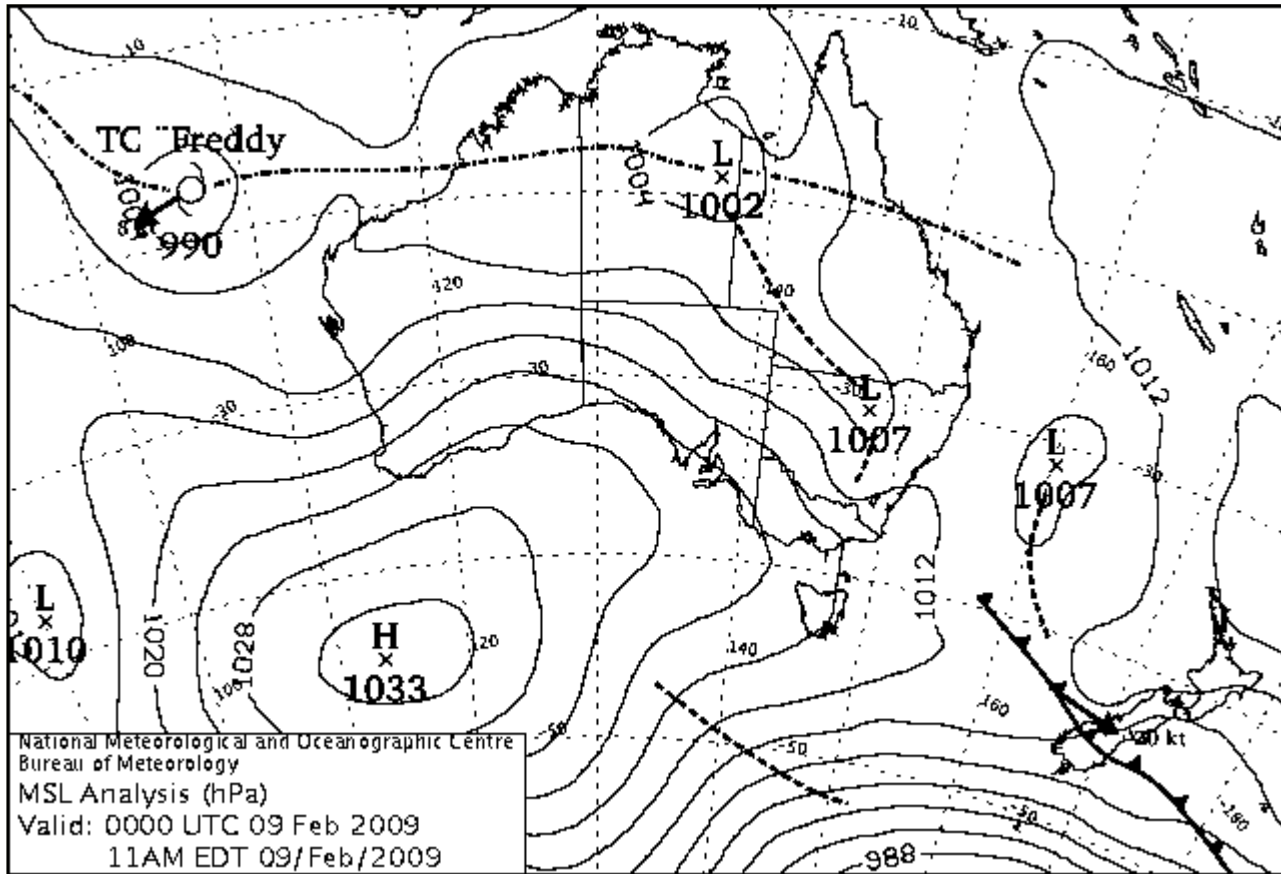
Extra Slides

Dual peaks: 2007 (Mar / Sep), 2008 (Apr / Sep)
Spring peaks: 2005 (Apr, v. weak in Oct), 2006 (Apr)

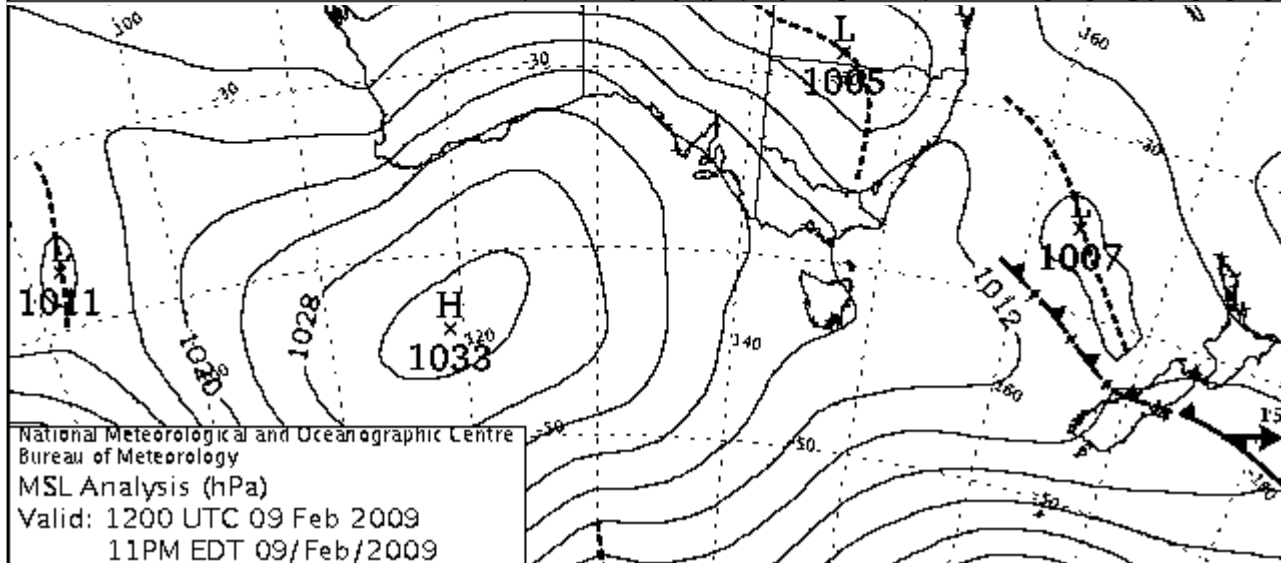
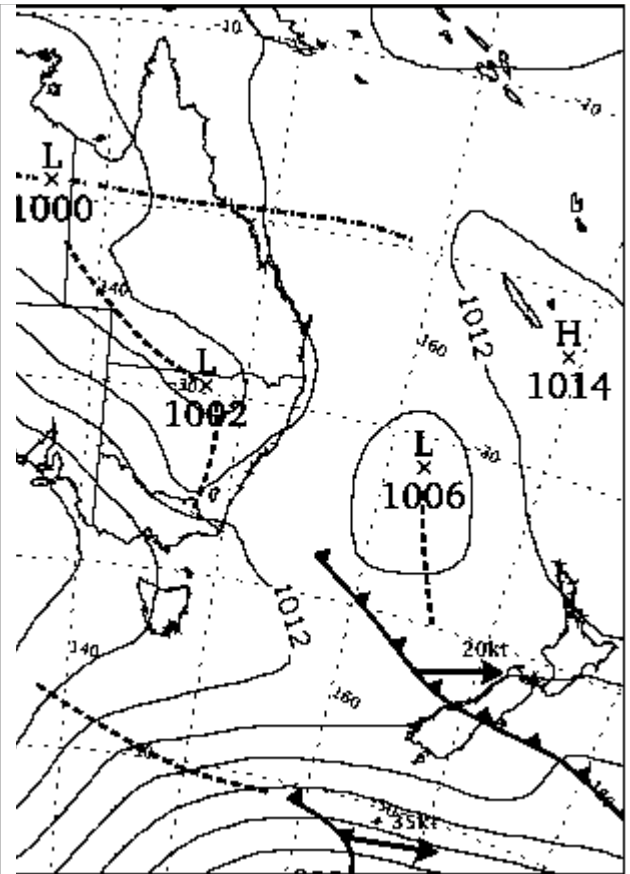


Dual Peaks: 2006 (Apr, Aug/Sep), 2007 (Mar, Sep)
Spring Peaks: 2004 (Apr), 2005 (May?)

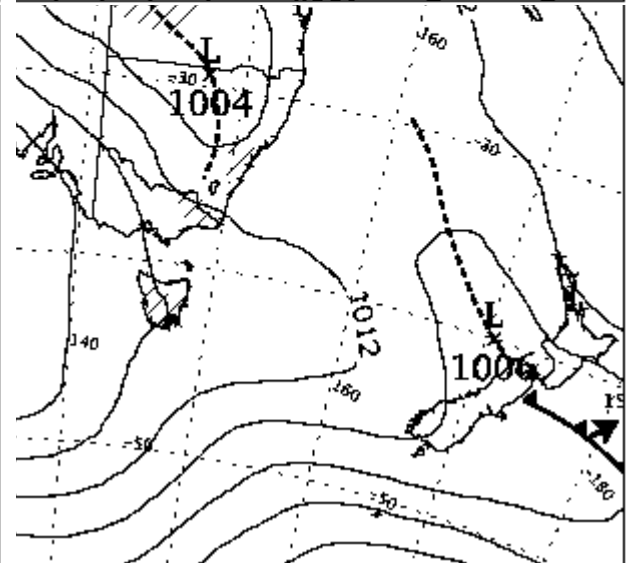




National Meteorological and Oceanographic Centre
Bureau of Meteorology
MSL Analysis (hPa)
Valid: 0000 UTC 09 Feb 2009
11AM EDT 09/Feb/2009

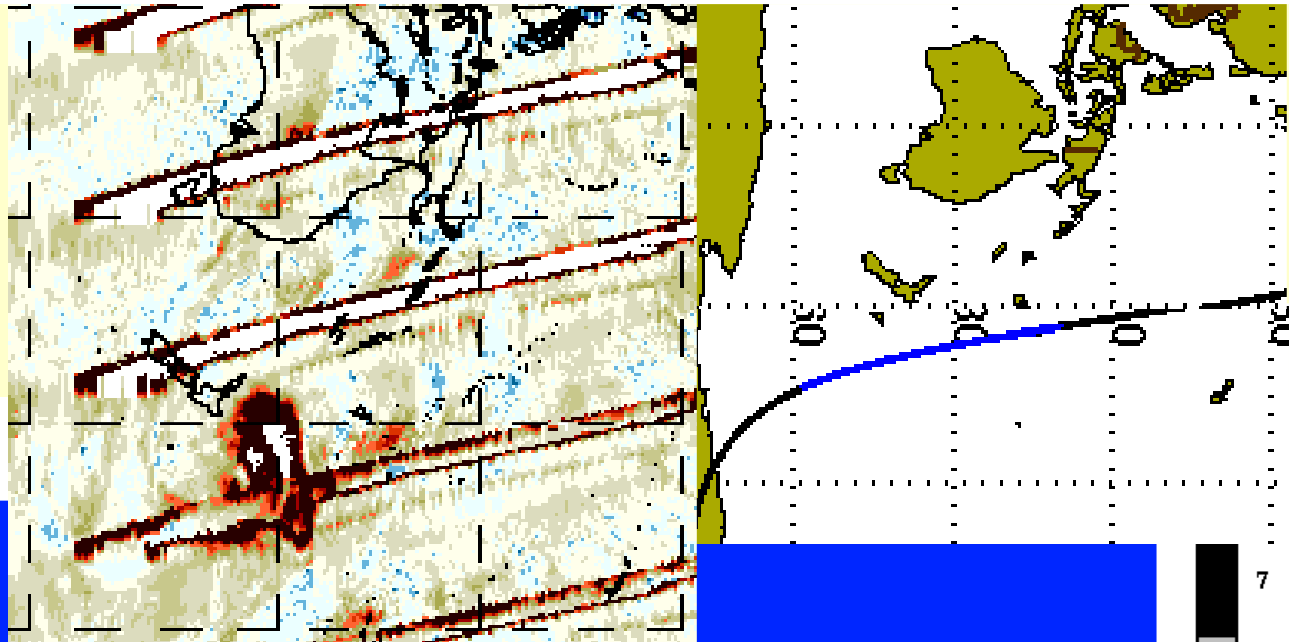


National Meteorological and Oceanographic Centre
Bureau of Meteorology
MSL Analysis (hPa)
Valid: 1200 UTC 09 Feb 2009
11PM EDT 09/Feb/2009

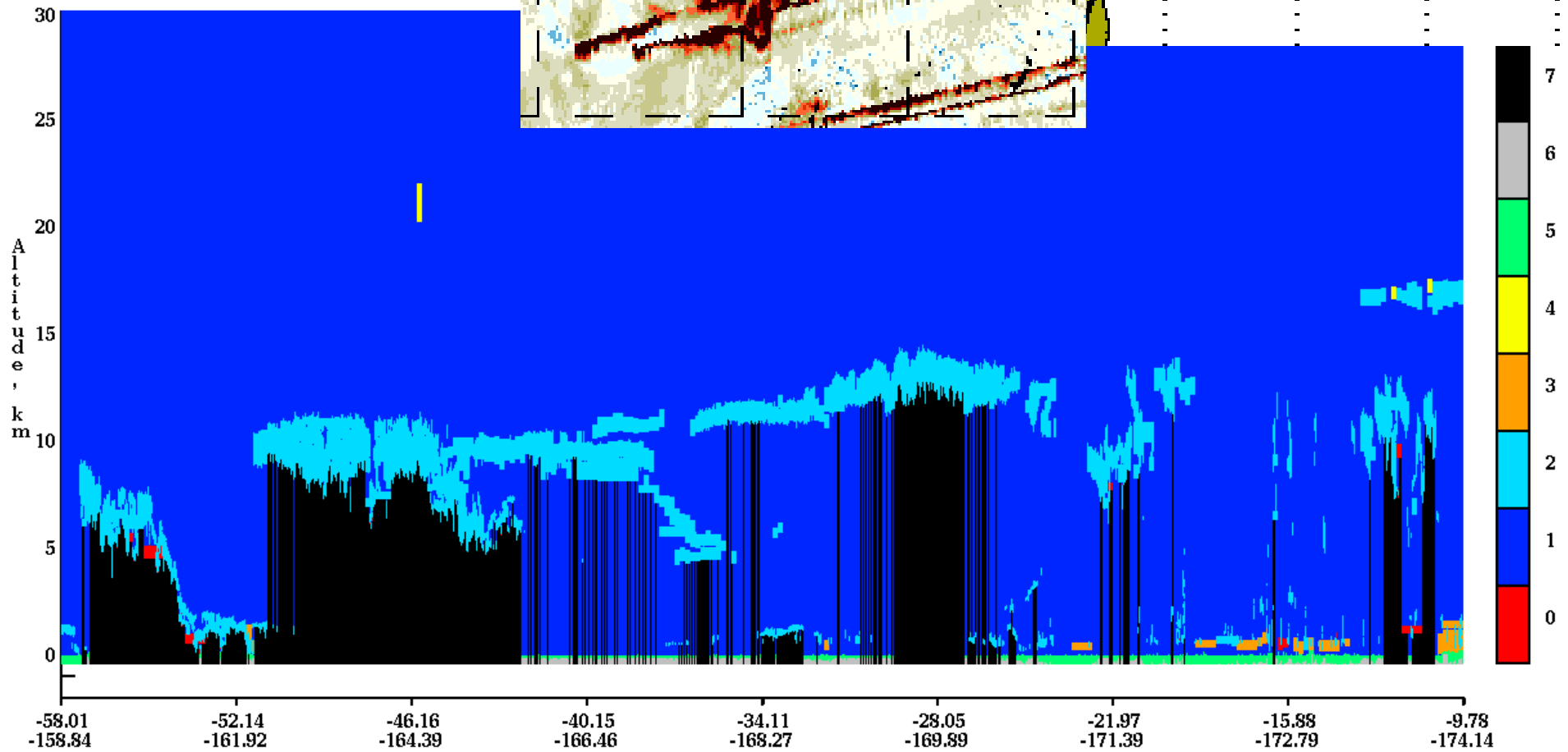


Upper Level Synoptics

CALIPSO:
09 Feb
0103 UTC (day)

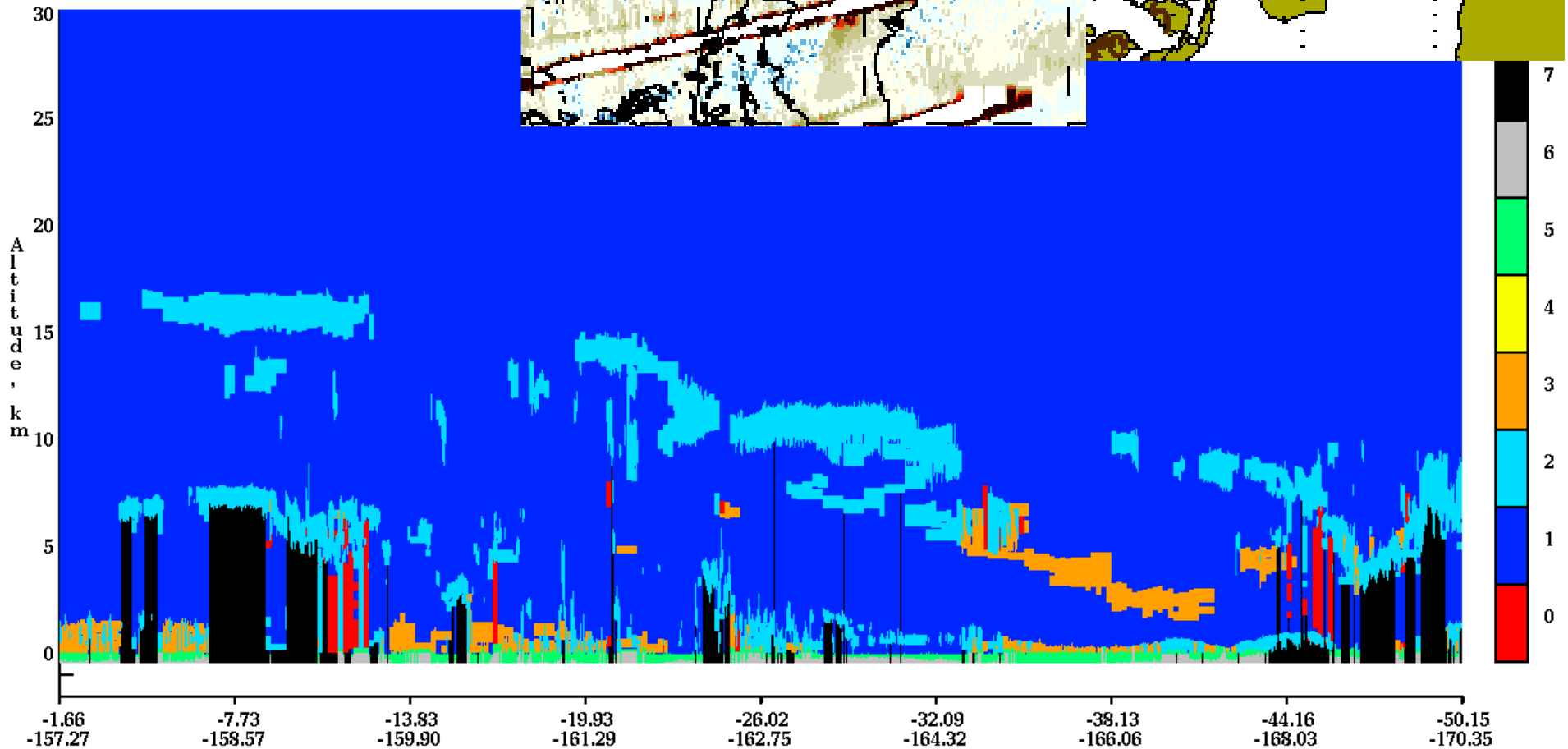
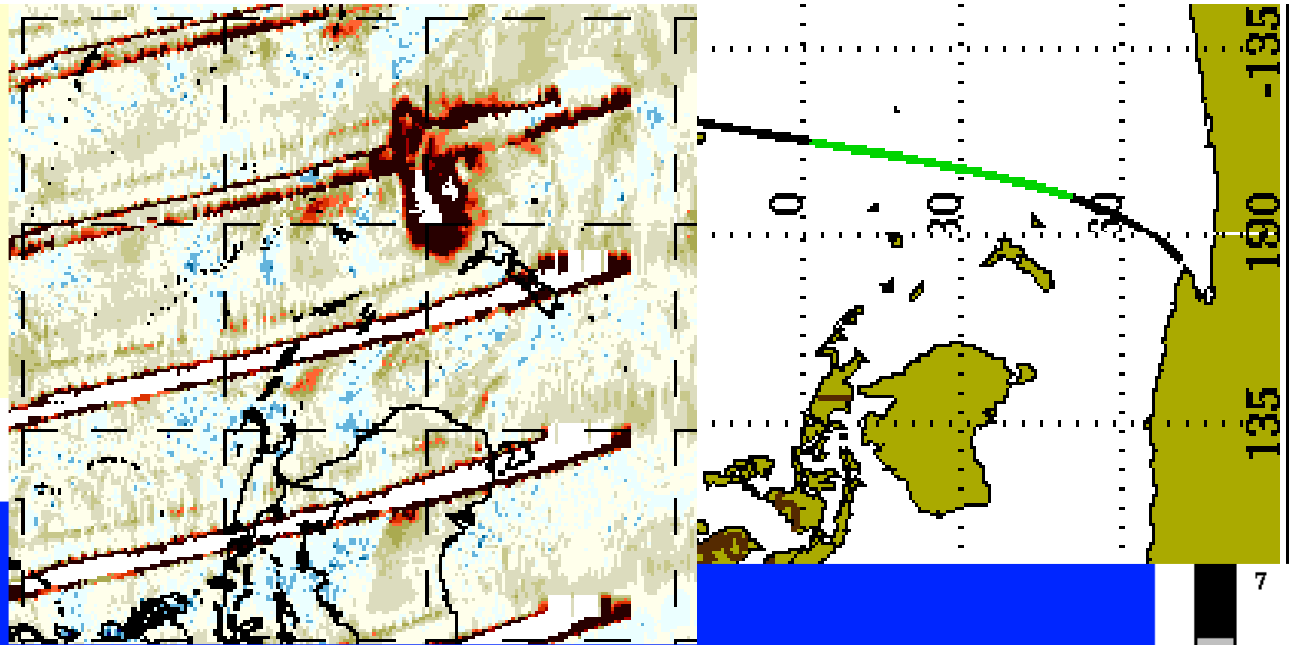


Vertical Feature Mask



CALIPSO:
09 Feb
1149 UTC (night)

Vertical Feature Mask



CALIPSO:

10 Feb

xxxx UTC ()

OMI UV Aerosol Index Data

- OMAERO-UV

Met Fields