

Remote sensing and volcanic ash



Australian Government
Bureau of Meteorology

Lessons from 20 years of Volcanic Ash Advisory Centre operations

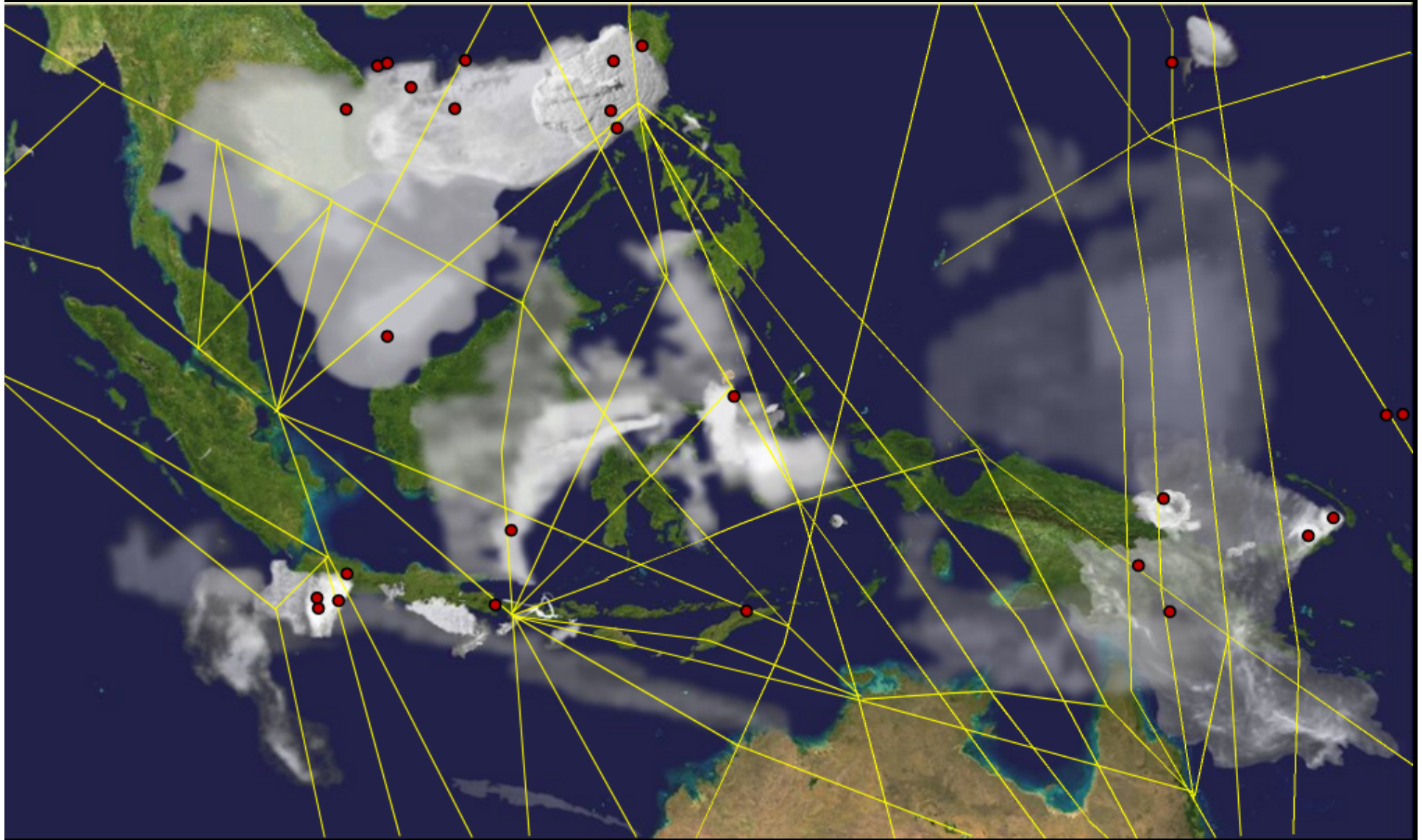
Andrew Tupper



4th Asia-Oceania
Meteorological
Satellite Users
Conference



1982 – 2013 ash encounters SE Asia



1982

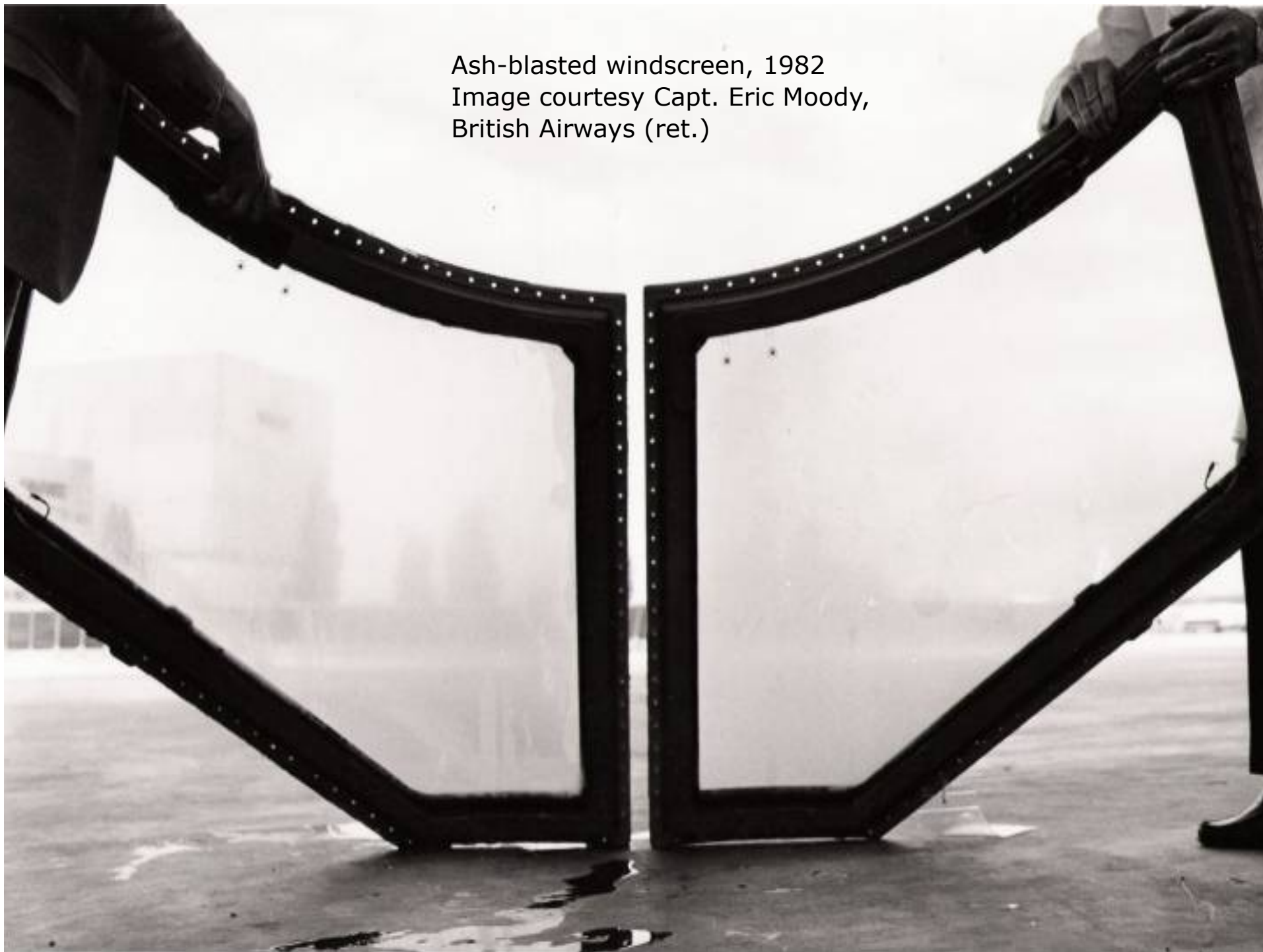




Melted ash residue in engines
(detail), 1982

Image courtesy Capt. Eric
Moody, British Airways (ret.)

Ash-blasted windscreen, 1982
Image courtesy Capt. Eric Moody,
British Airways (ret.)

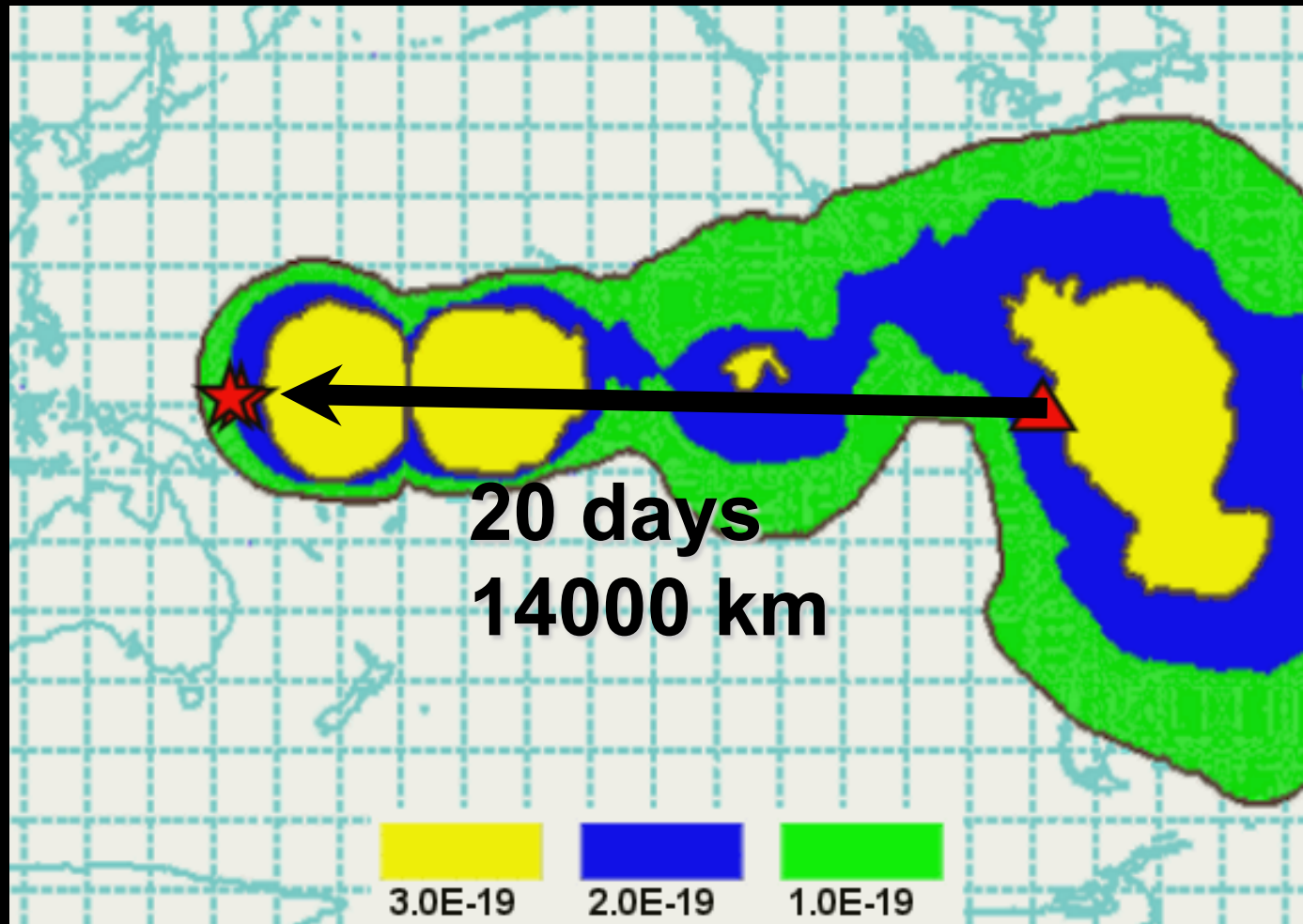


1991

DC-10 caught on ground near Mt Pinatubo
Image courtesy US Navy

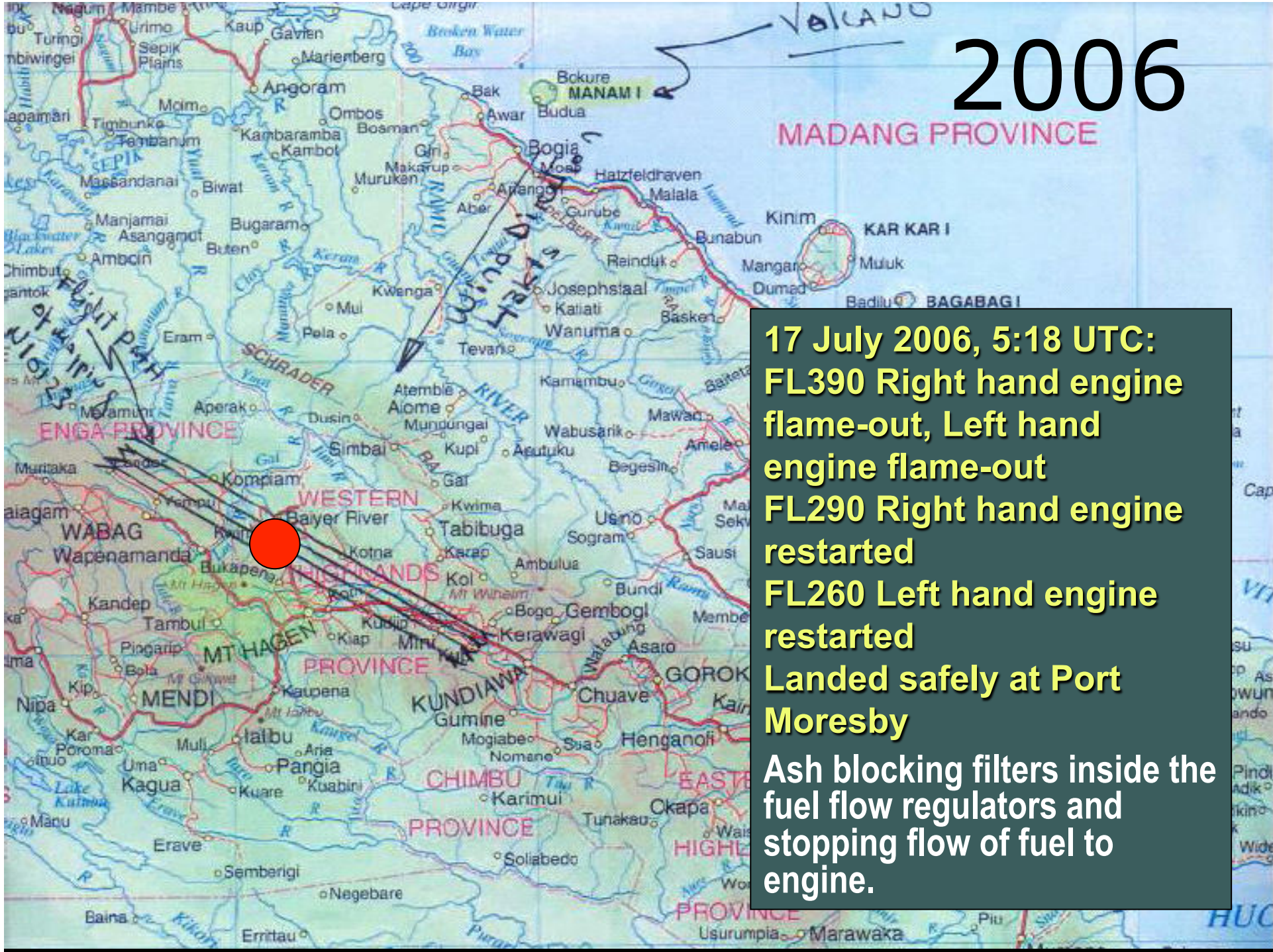


2002



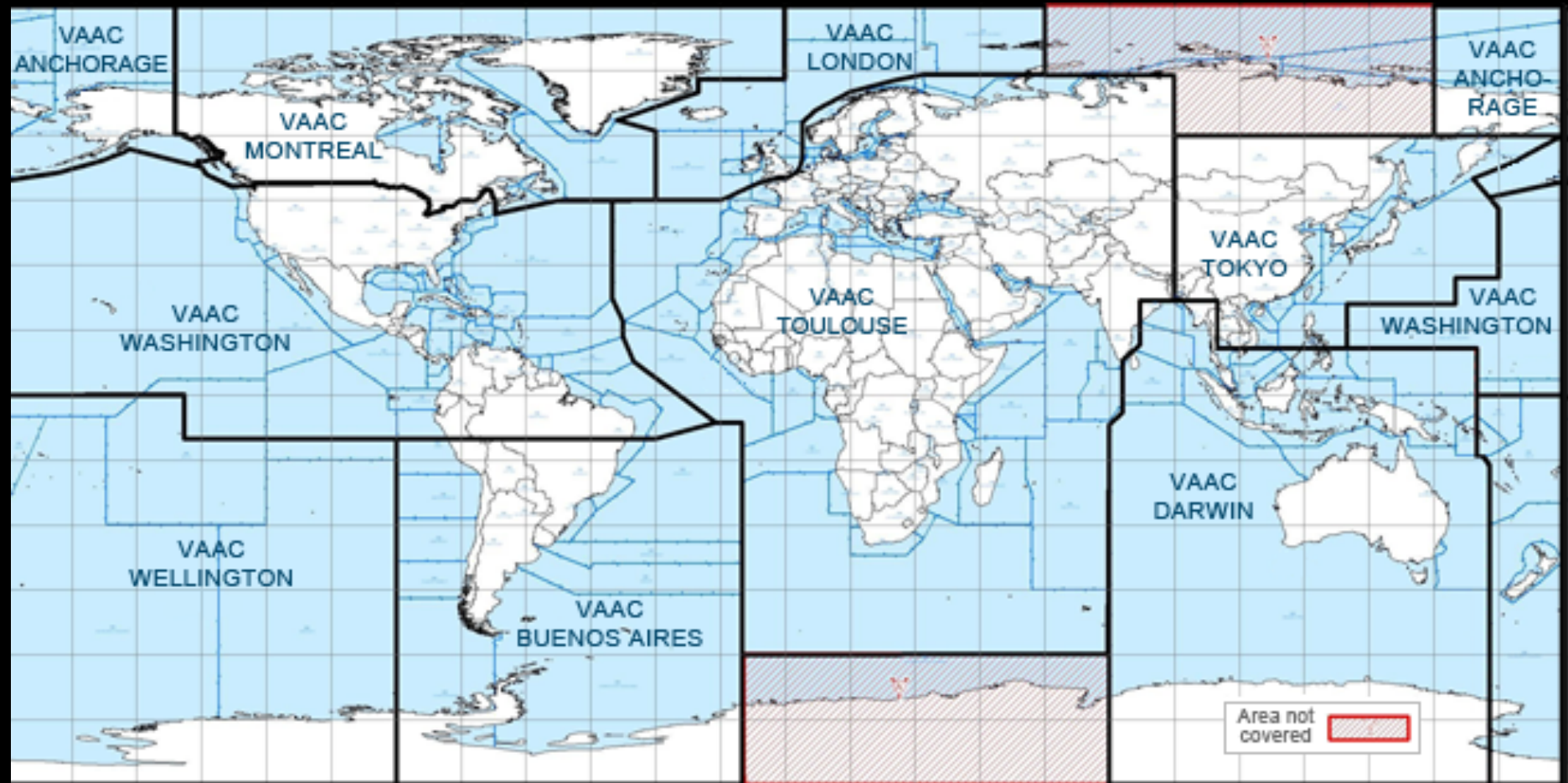
Encounters on 23/24 Nov. eventually traced back to 03/04 El Reventador eruption. Not visible on remote sensing days 3-20.

2006



17 July 2006, 5:18 UTC:
FL390 Right hand engine flame-out, Left hand engine flame-out
FL290 Right hand engine restarted
FL260 Left hand engine restarted
Landed safely at Port Moresby
Ash blocking filters inside the fuel flow regulators and stopping flow of fuel to engine.

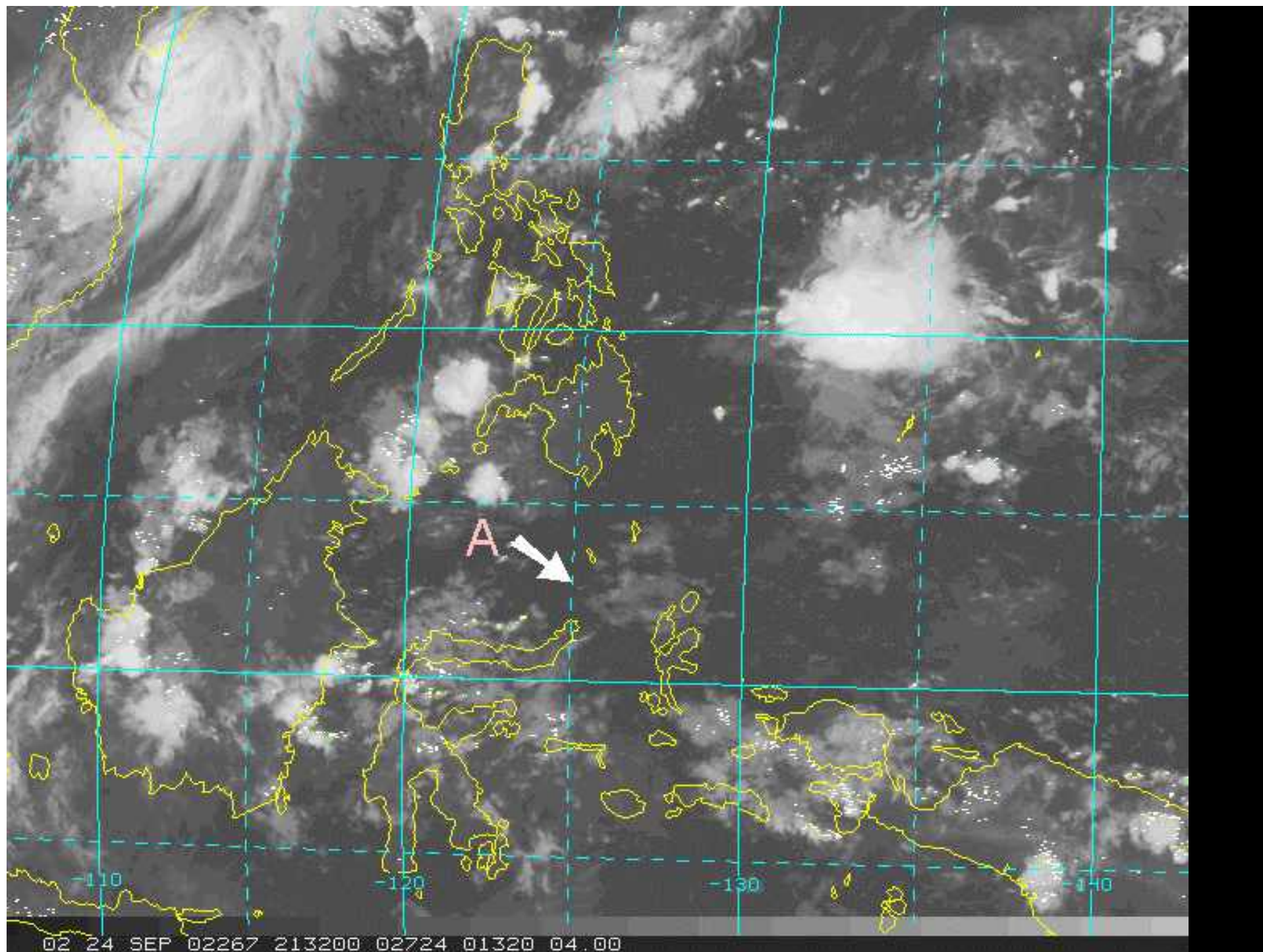
International Airways Volcano Watch, 1993 →



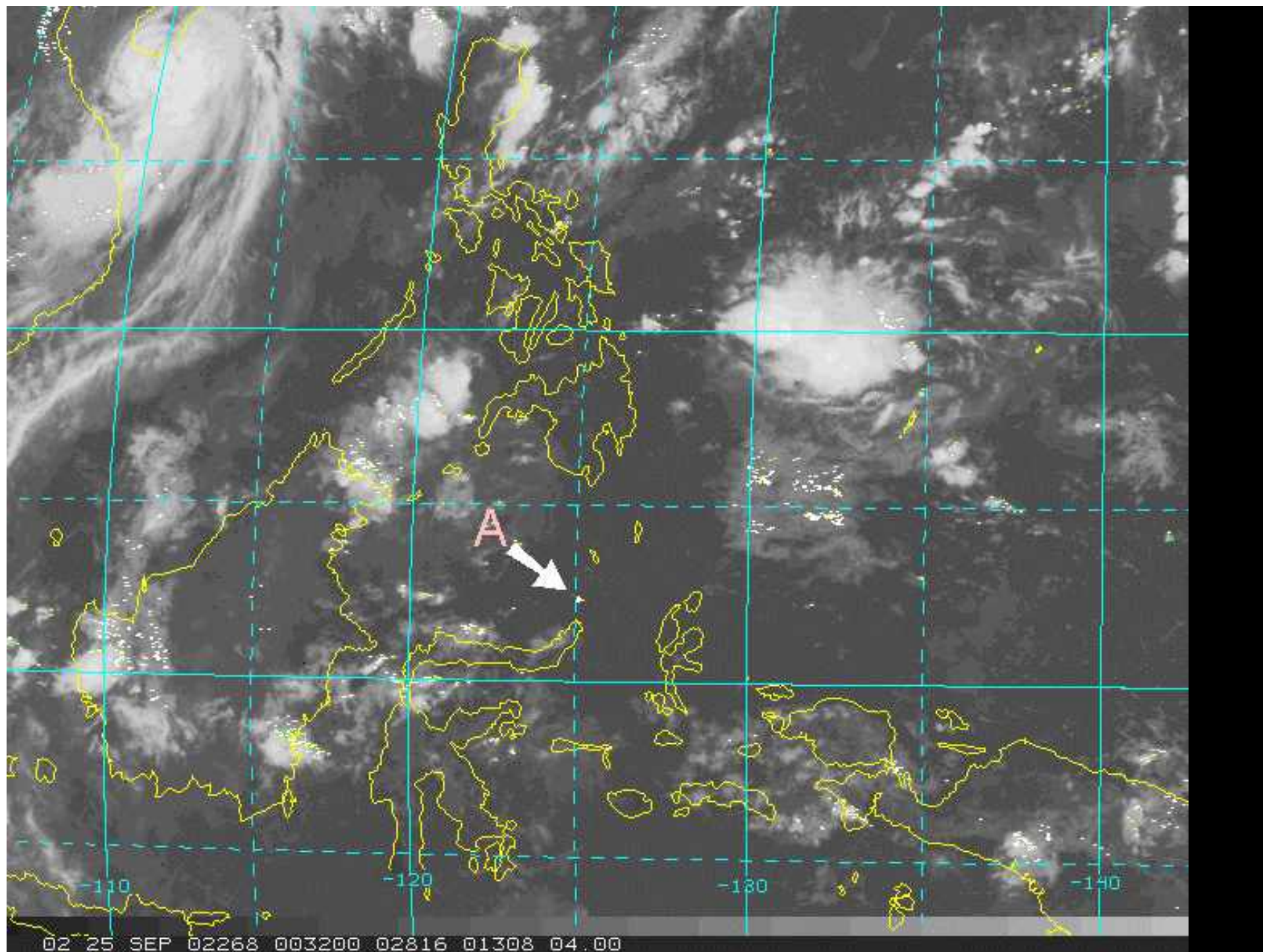
A satellite image showing a volcanic eruption from space. A large, billowing plume of white ash and steam rises from a dark, circular area on the Earth's surface, likely a volcano. The plume extends to the left, forming a long, horizontal cloud. The surrounding Earth shows green landmasses and blue oceans, with scattered white clouds. The word "Example" is overlaid in the top left corner.

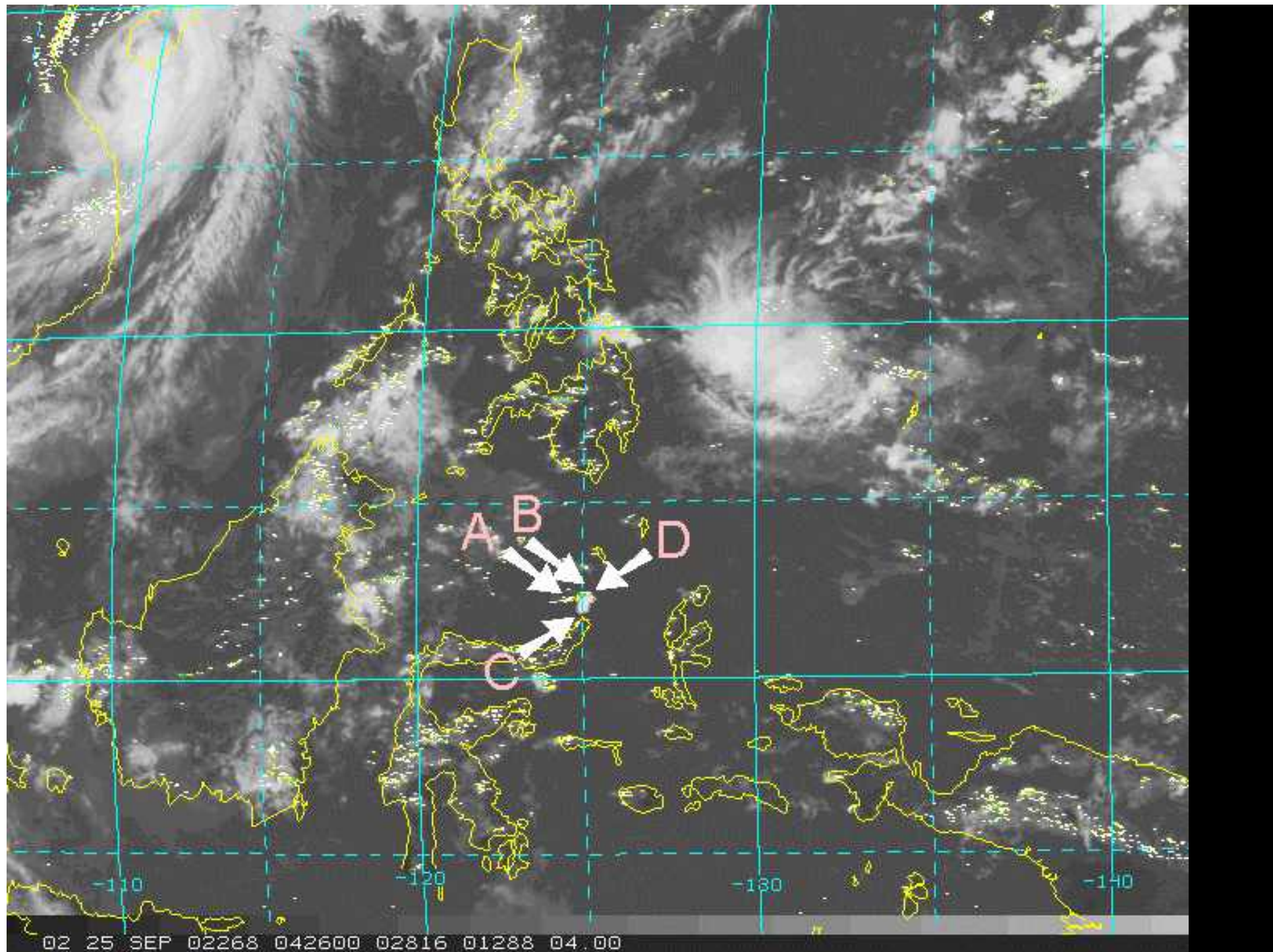
Example

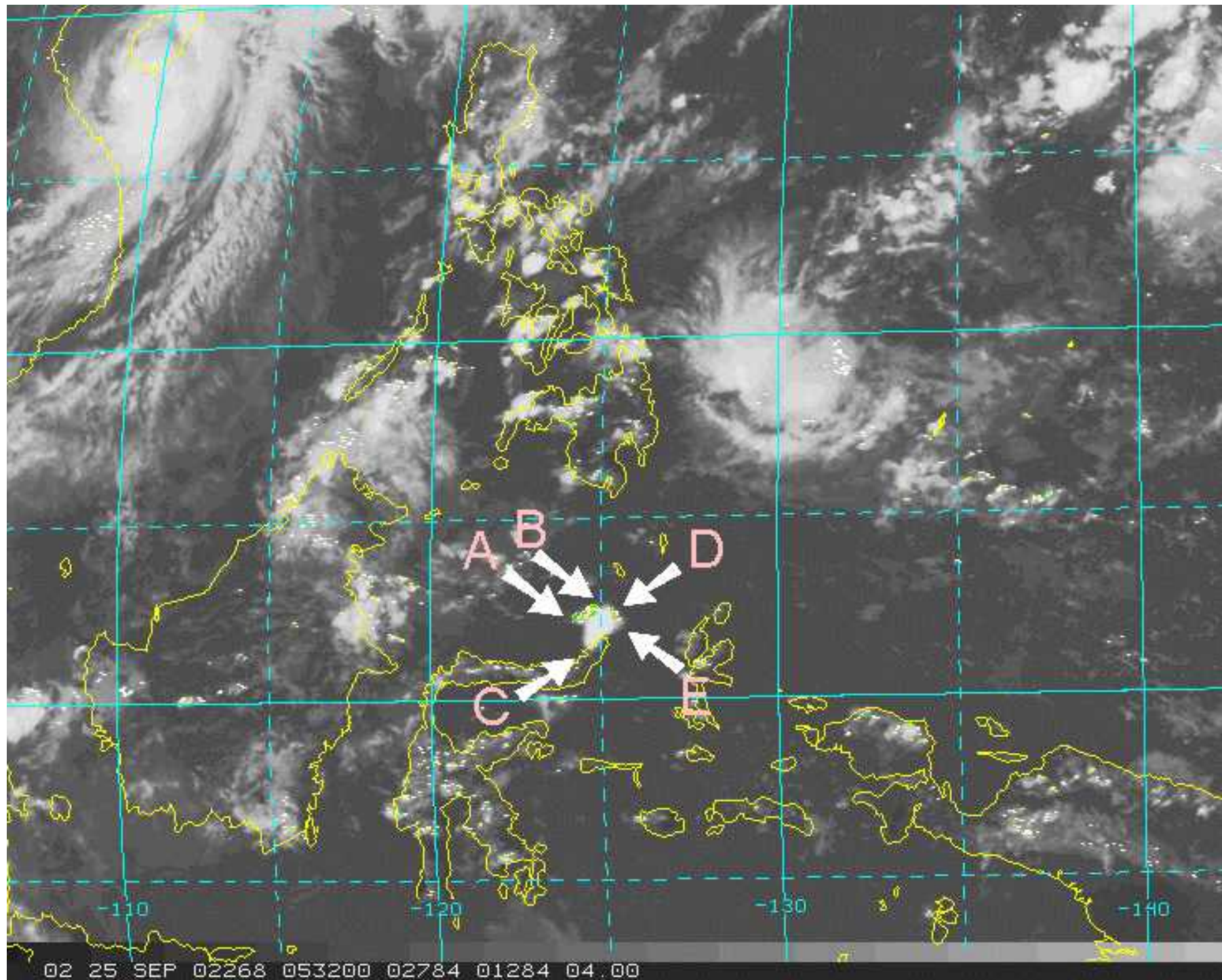
Ruang, Indonesia, 2002
(Aqua/MODIS)



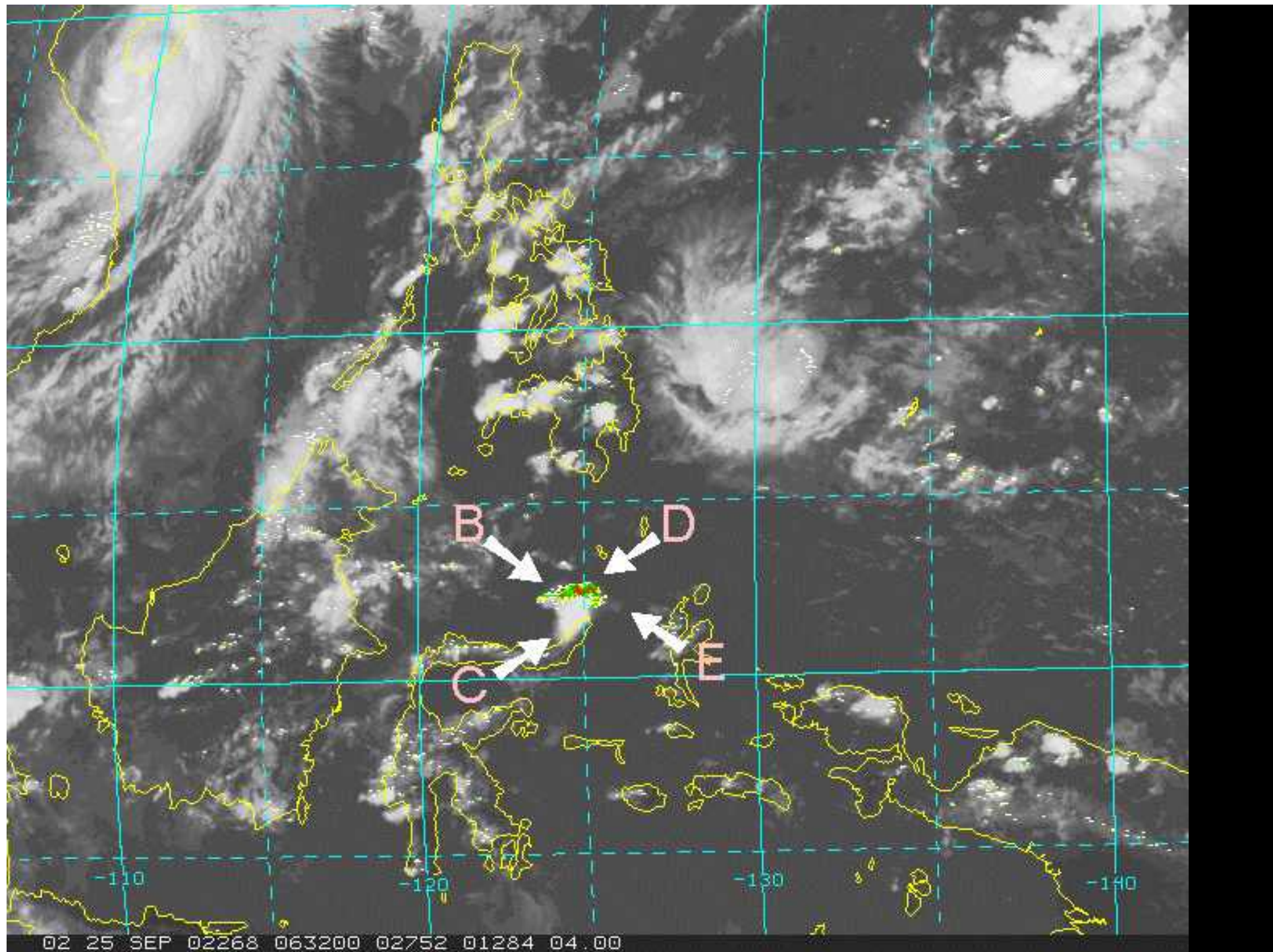
02 24 SEP 02267 213200 02724 01320 04.00

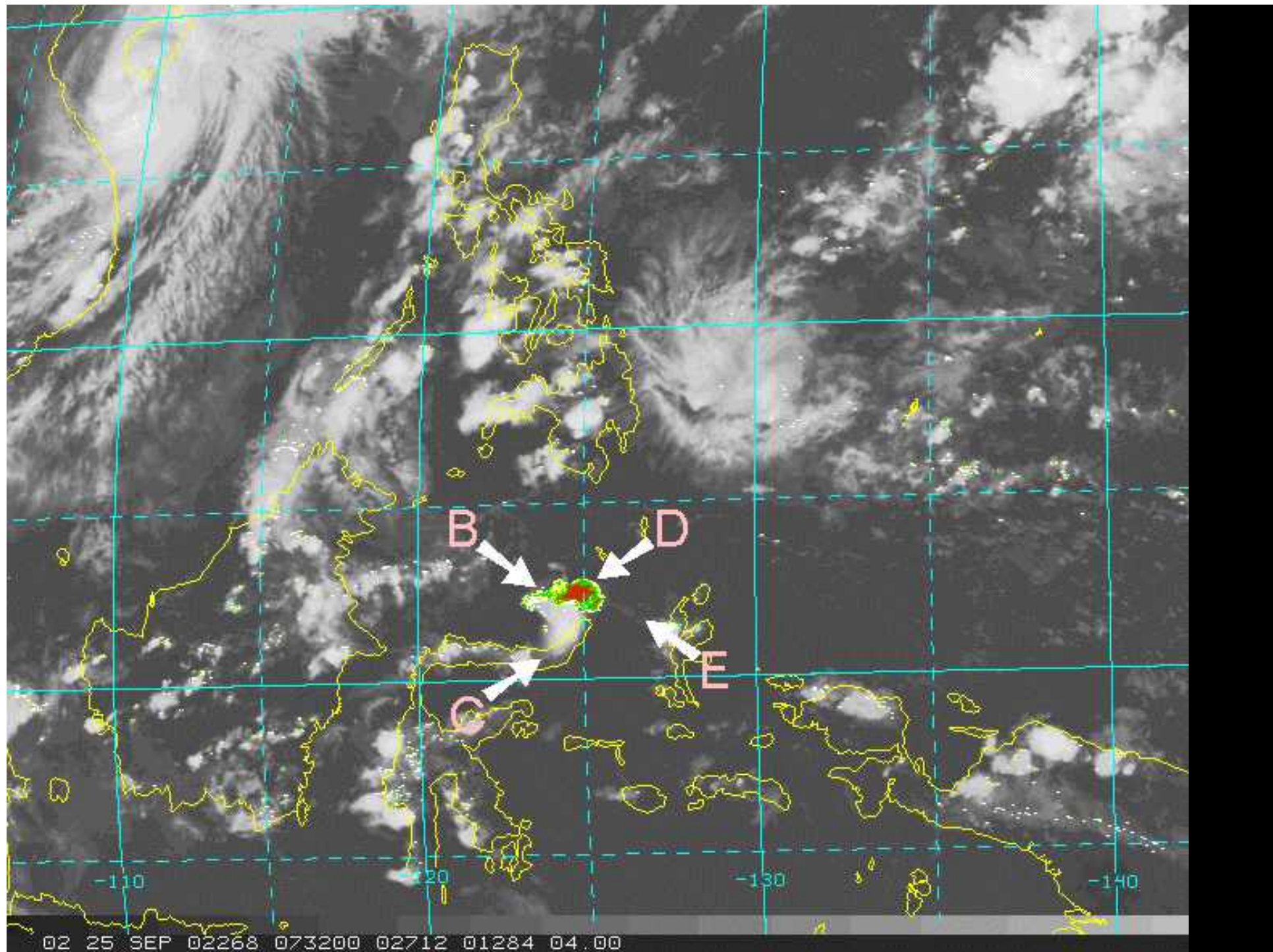


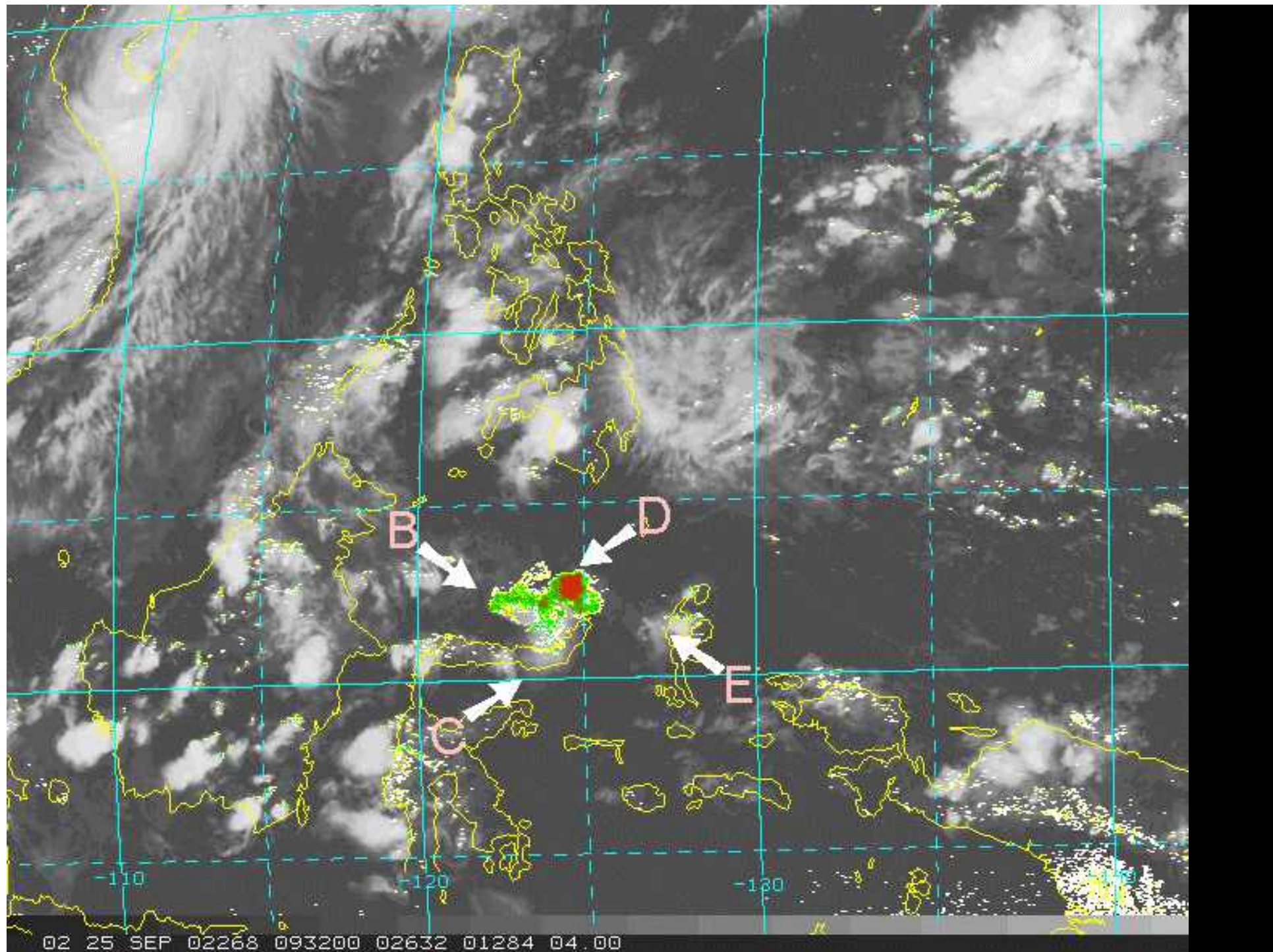


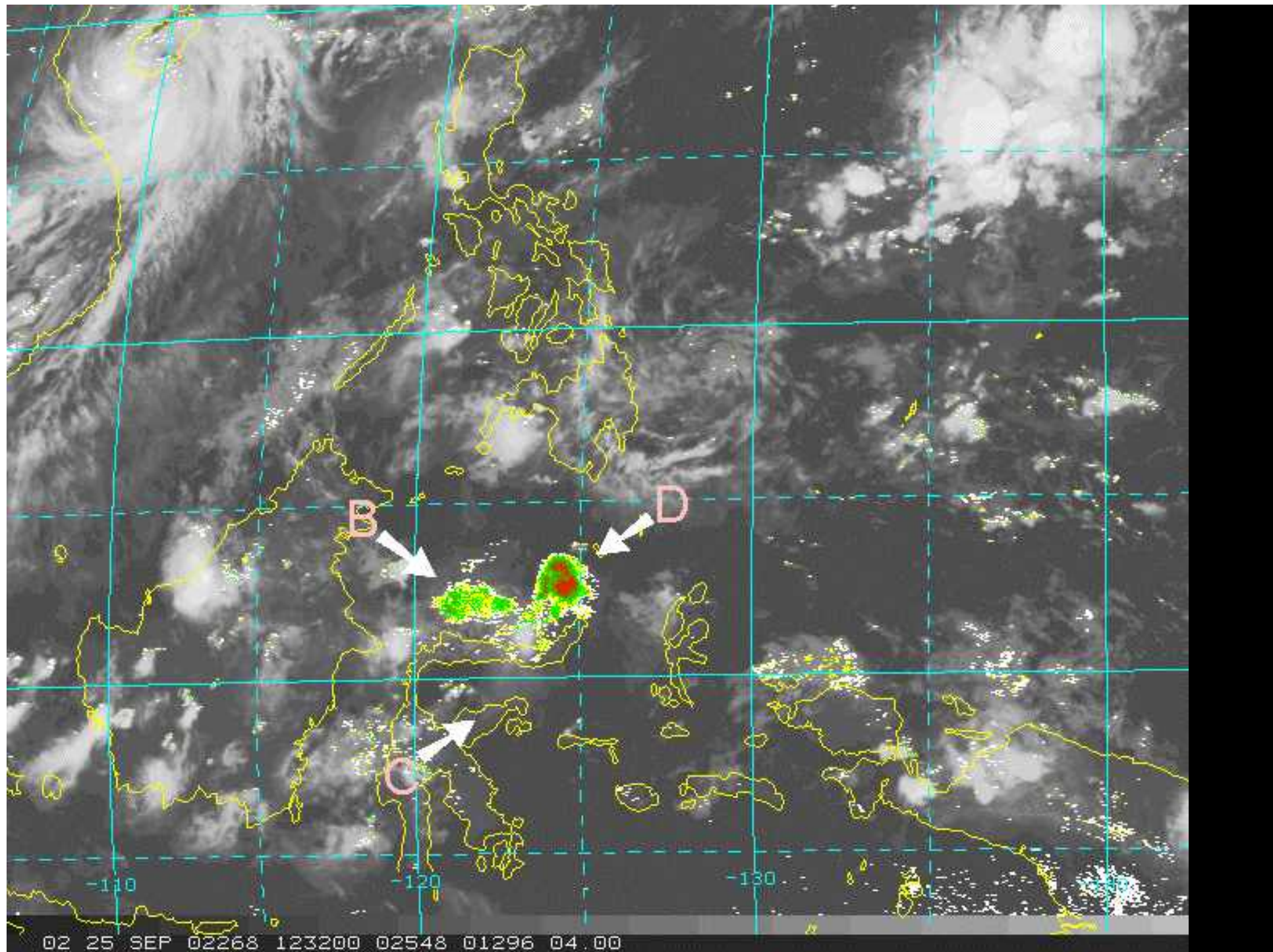


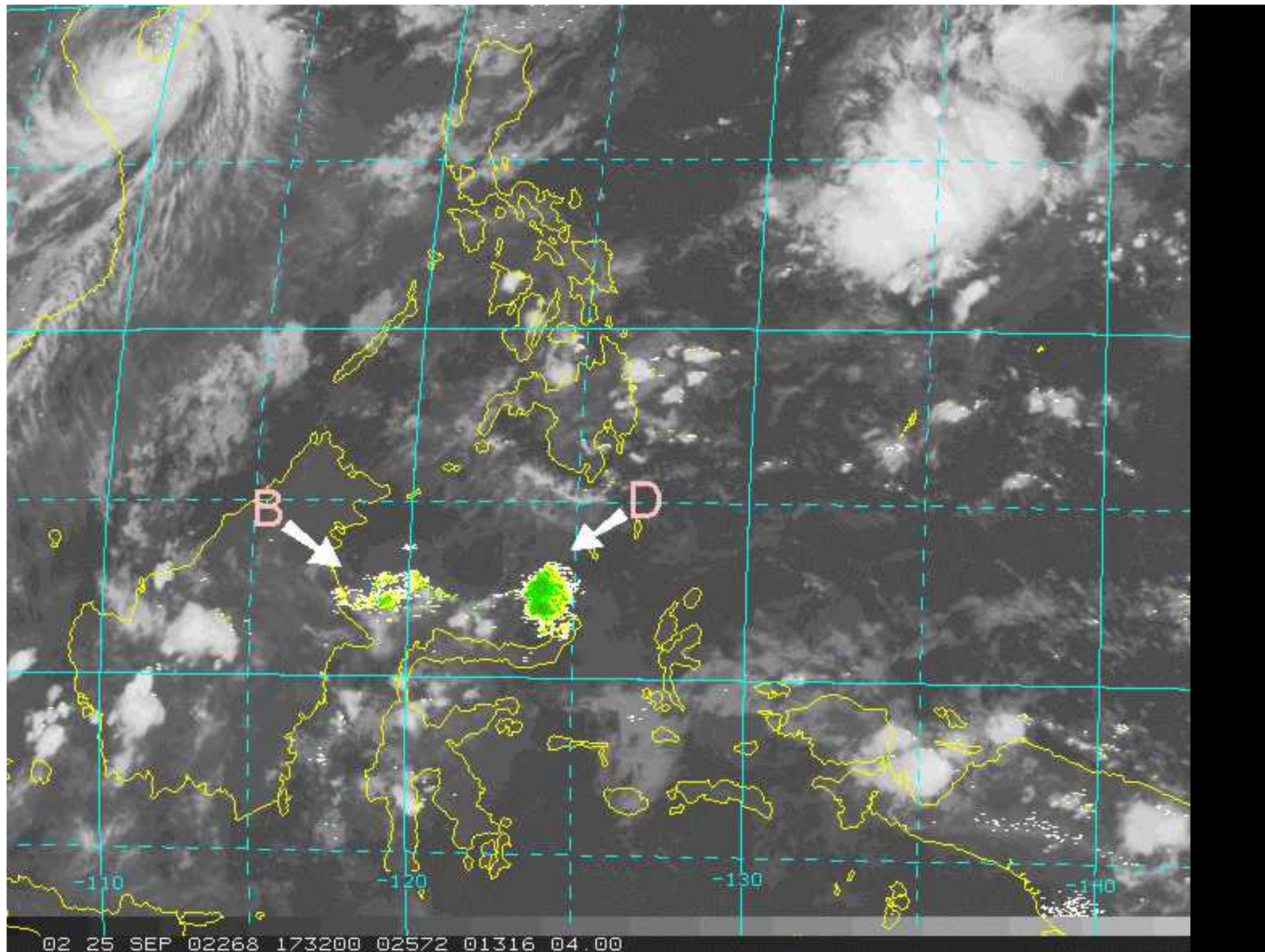
02 25 SEP 02268 053200 02784 01284 04.00







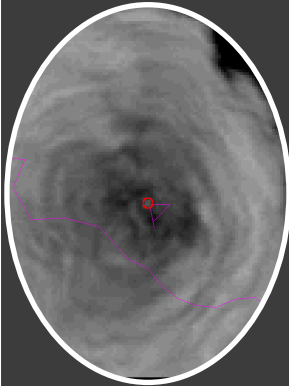




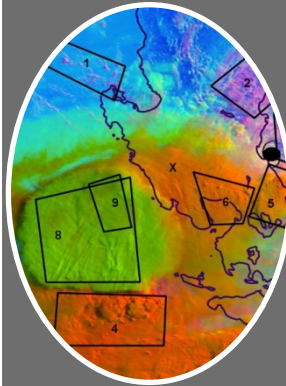
Remote sensing lessons learnt



Use your
brain



Follow the
procedure



Keep it
complicated



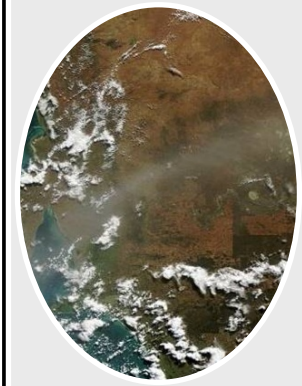
Research



Operations



Integrate
reality



Evidence
builds trust





Use
your
brain

044 18 SEP 94 23:14Z

VOLCANIC ASH ADVICE ISSUED BY DARWIN RSMC 18/09/94 AT 2300Z
IMMEDIATE FOR AVIATION METEOROLOGY
VOLCANIC ASH SIGMET RECEIVED FROM PNG NATIONAL WEATHER SERVICE
RABUAL VOLCANO LAT 4DEG16'S 152DEG12'E HAS ERUPTED AT ABOUT
182000UTC.

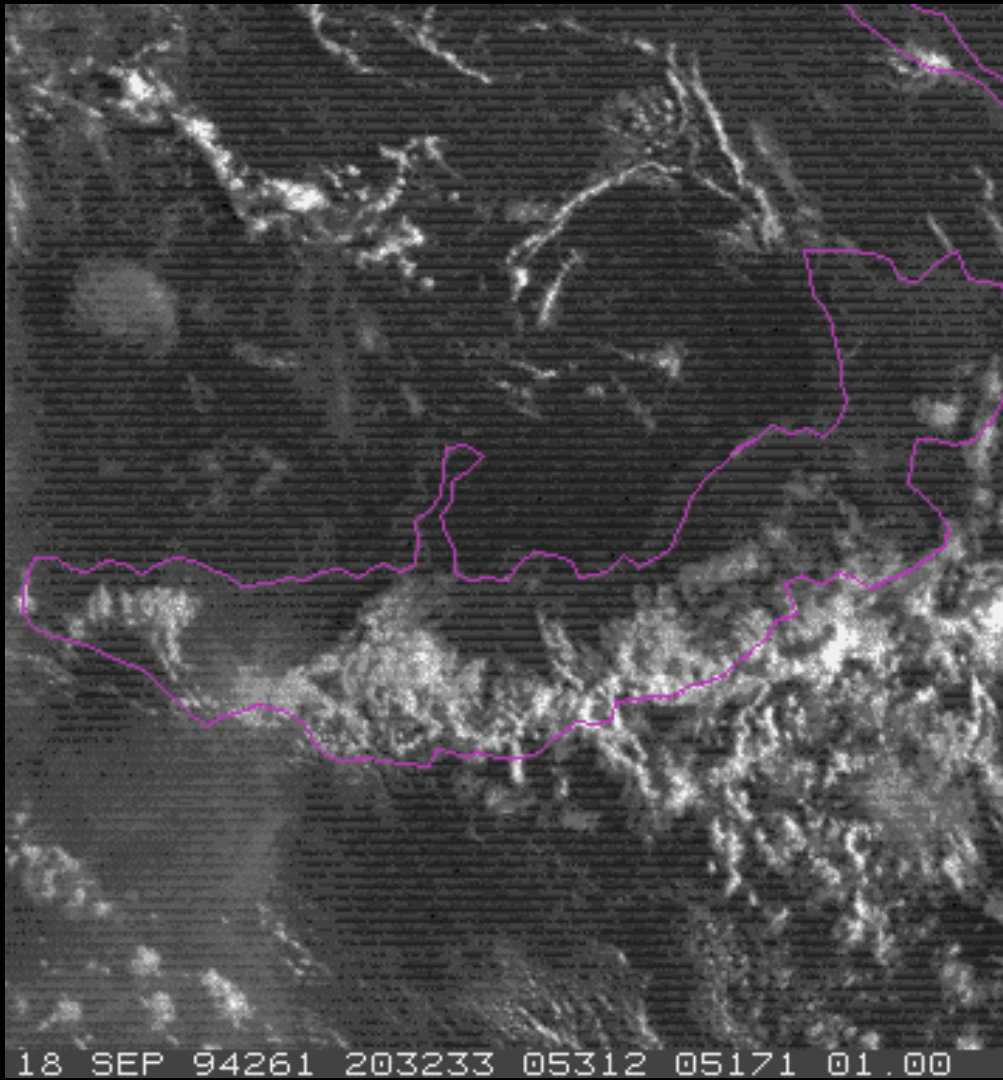
VOLCANIC ASHES FCST TO PERSIST BLW FL300. AYPY FIR.
MOVEMENTS SW AT 05KTS.

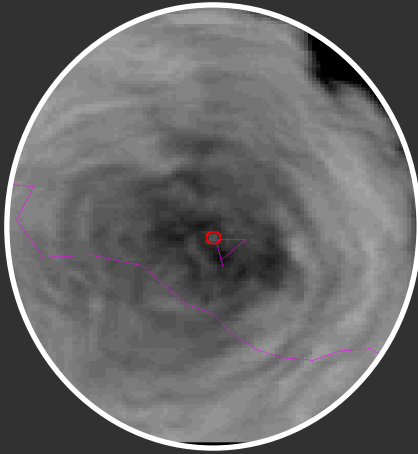
ACFT REPORT VIA MORESBY AACC STATES VOLCANIC ASH OVER RABUAL IN A
MUSHROOM FORMAT. NO DRIFT DETECTED BUT WINDS IN AREA (FL290) TO BE
050/26 AND 070/24.

DARWIN RSMC ADVISE NO SUITABLE ENHANCED IMAGERY AVAILABLE UNTIL AT
LEAST 190930UTC, PRIMARILY DUE TO EQUIPMENT FAILURE ON BOARD THE
NOAA 11 SATELLITE.

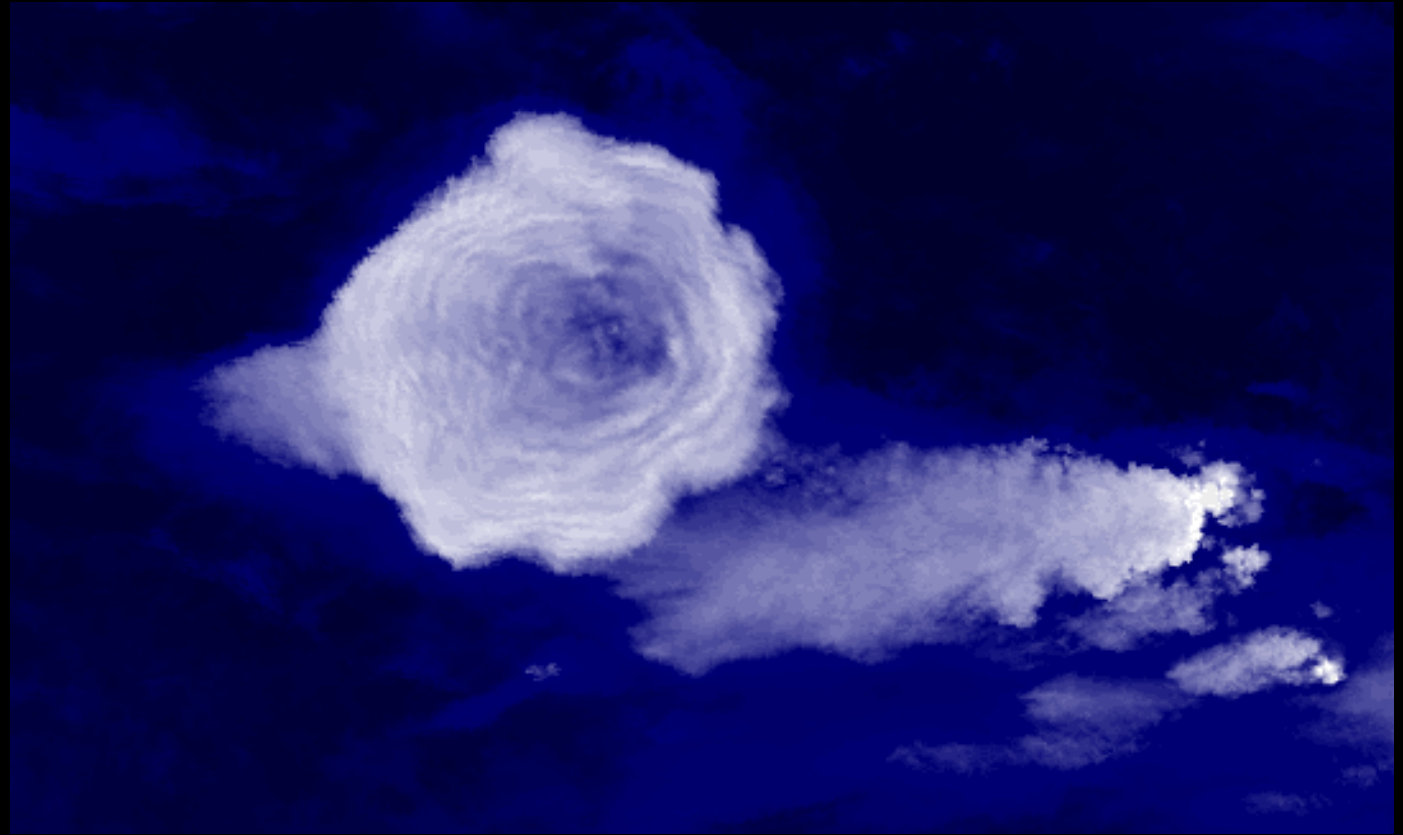
AVAILABLE GMS VISUAL IMAGERY INCONCLUSIVE DUE TO CLOUD IN THE AREA.
FURTHER ADVICE WILL BE ISSUED WHEN NEW INFORMATION BECOMES AVAILABLE.
DARWIN RSMC.
FROM: YPDMYMYX

"... aircraft report... volcanic ash over Rabaul in a mushroom format.... No suitable enhanced imagery available....GMS visual imagery inconclusive due to cloud in the area.."

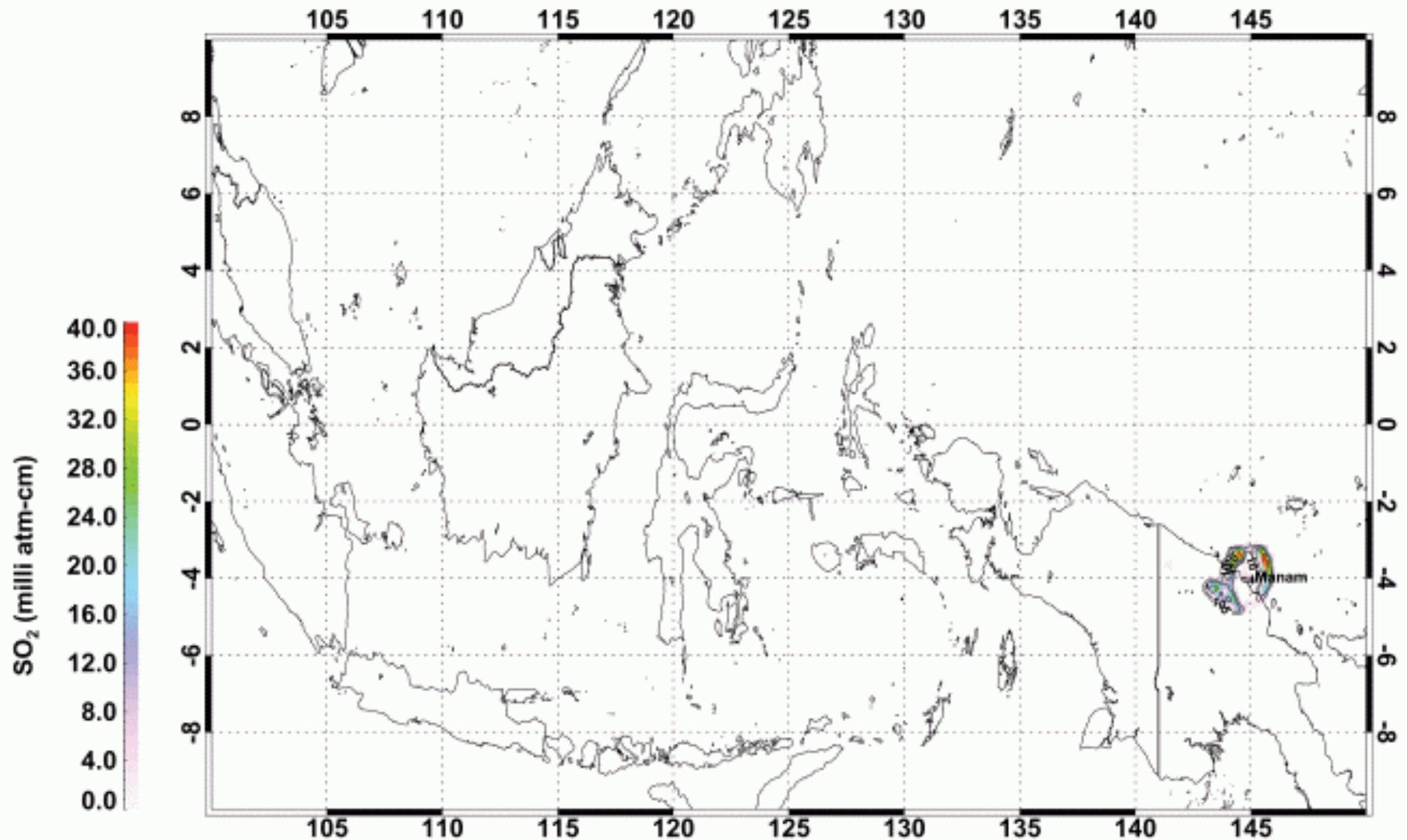




Follow
the
procedure



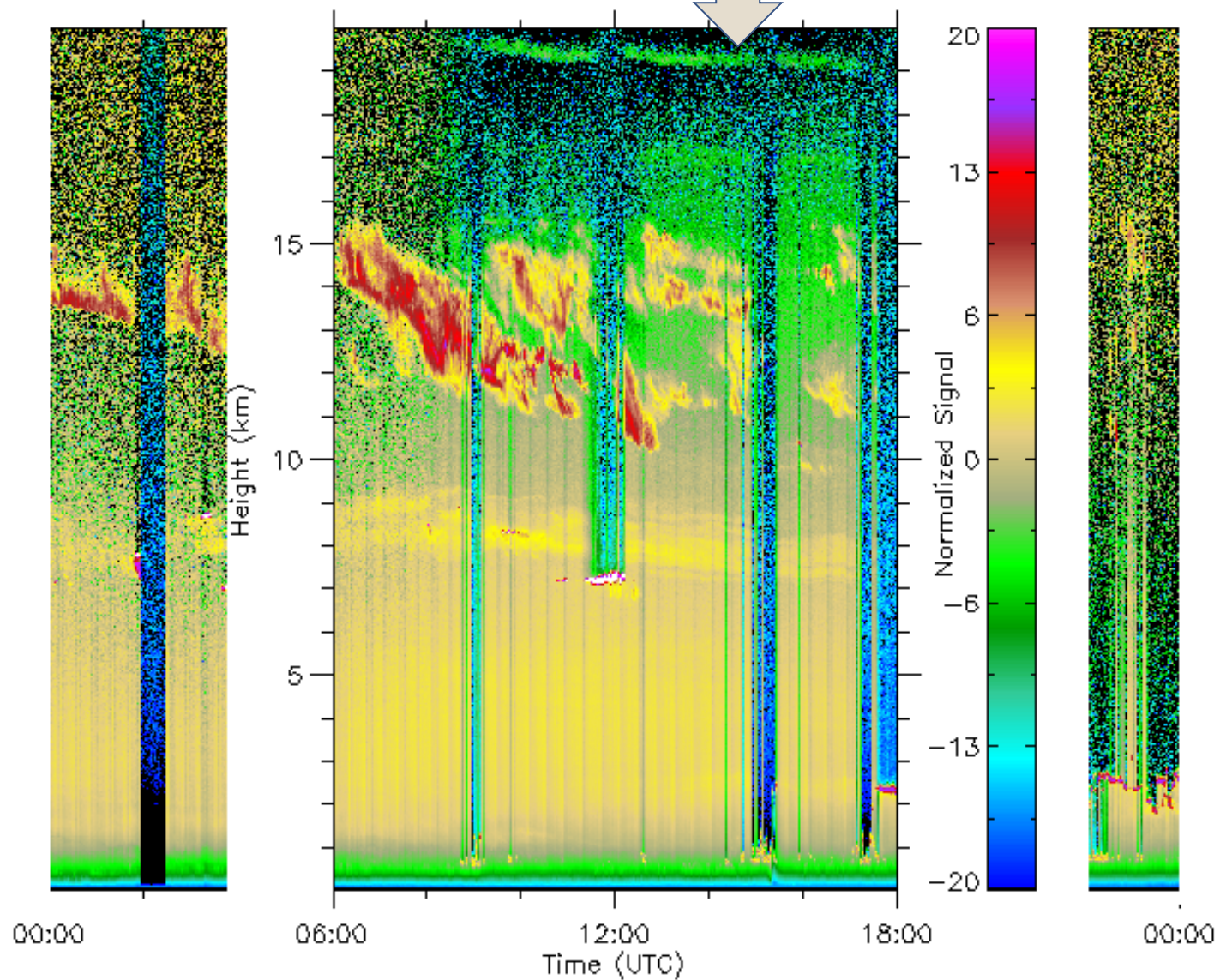
Mass= 0.0087 Tg Area= 13384 km² Max SO₂= 47.0DU AIRS Manam 2005.01.27 1535UT Granule:156

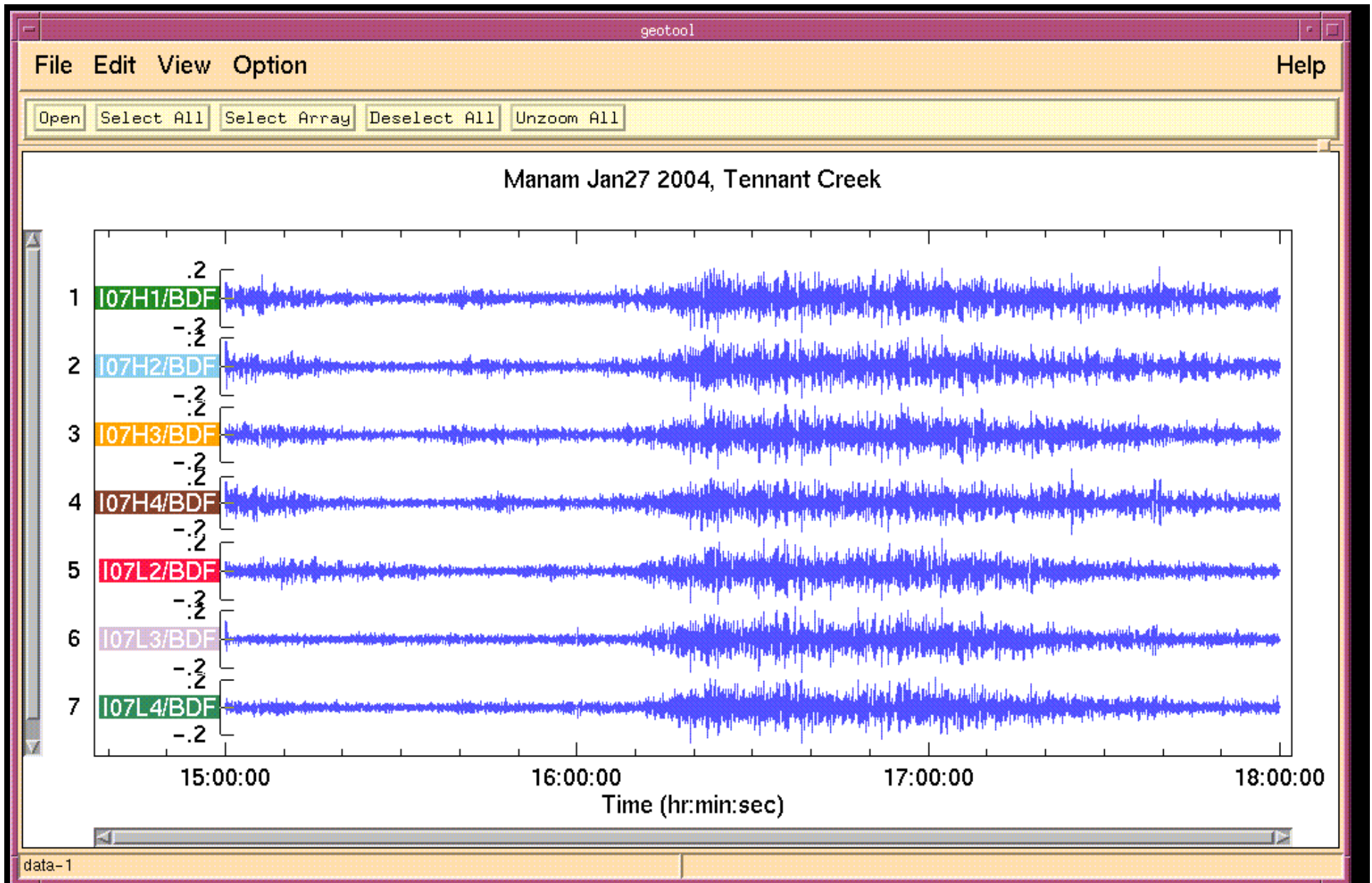


AIRS SO₂ courtesy Fred Prata

TWP C1 MicroPulse Lidar Observations, 29 January 2005
twpmp1C1.a1

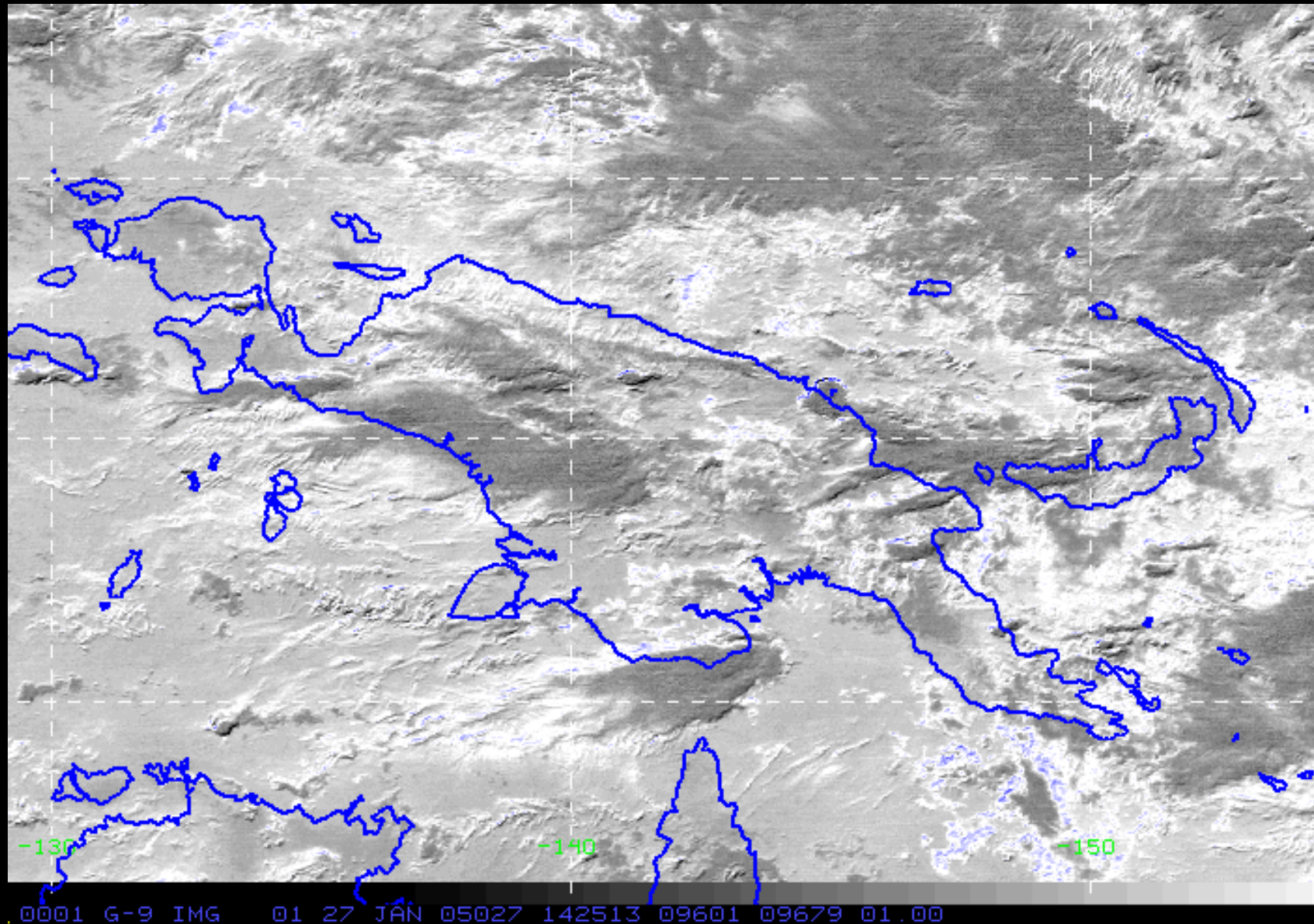
Manus Island – stratospheric ash



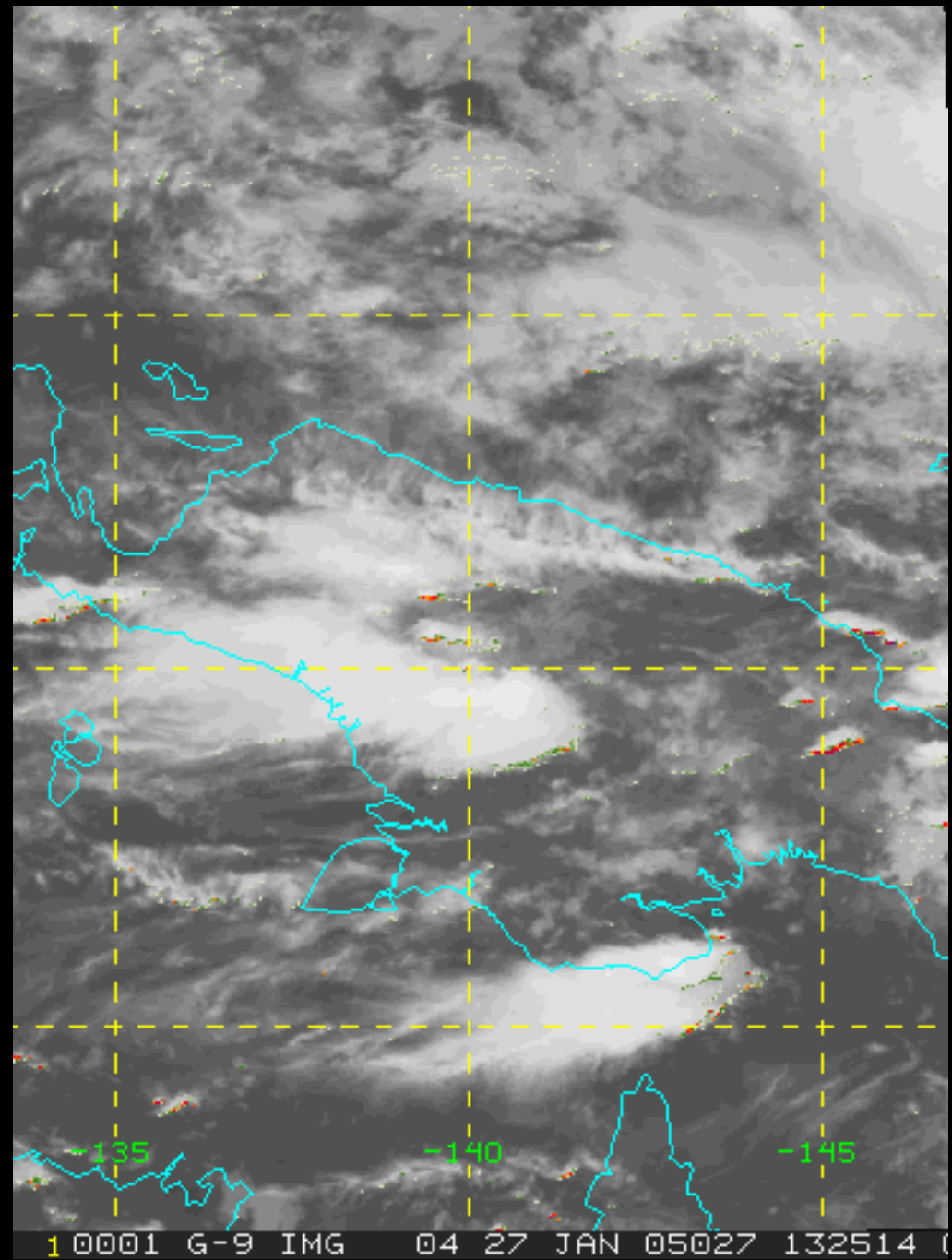


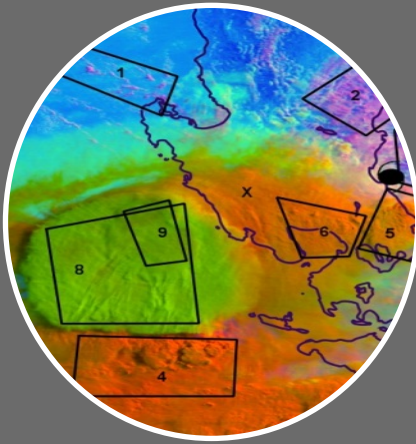
Infrasound courtesy Geoscience Australia

Strongly +ve split window (small particle size)



....but in real time, no advisory was issued



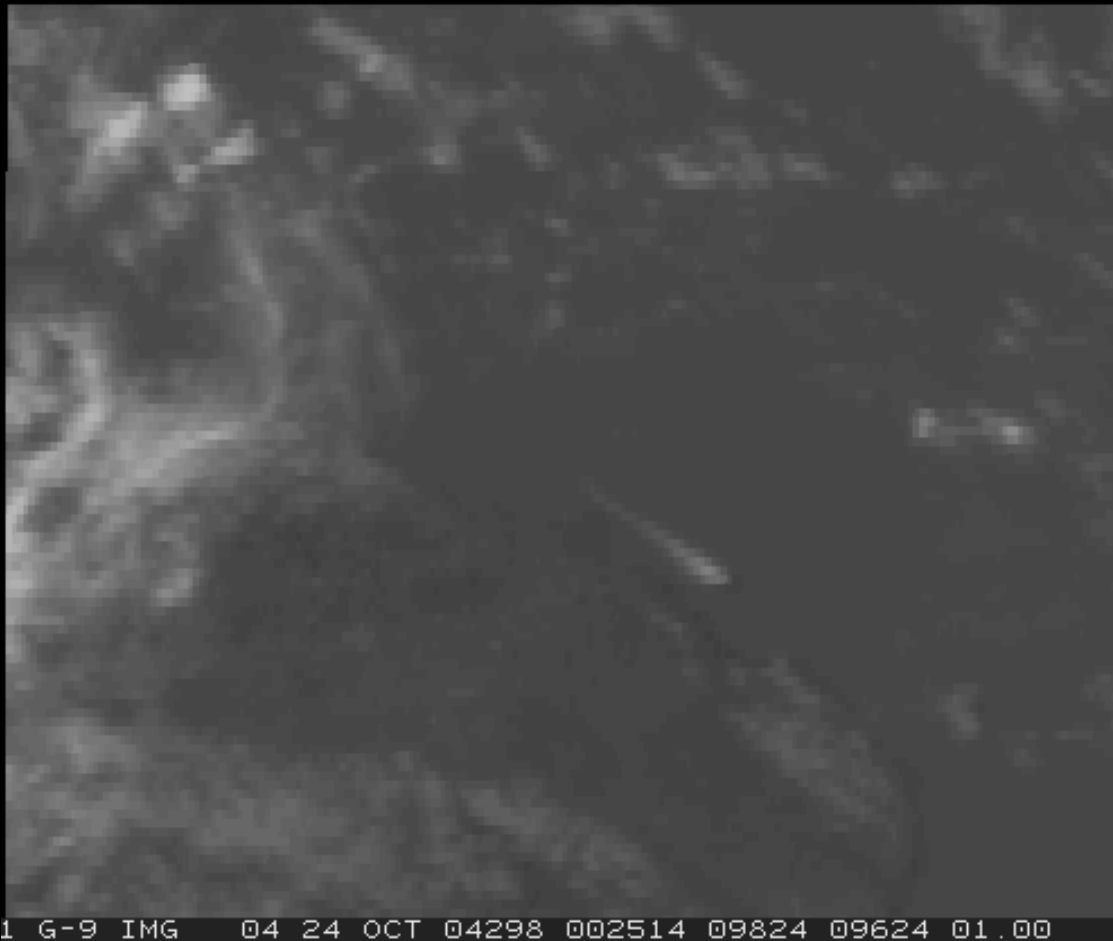


Keep it
complicated



"Streamers of clouds stretch from the coast northeastward over the ash plume and farther out to sea....."

(NASA describing Manam eruption cloud of 24/10/04)

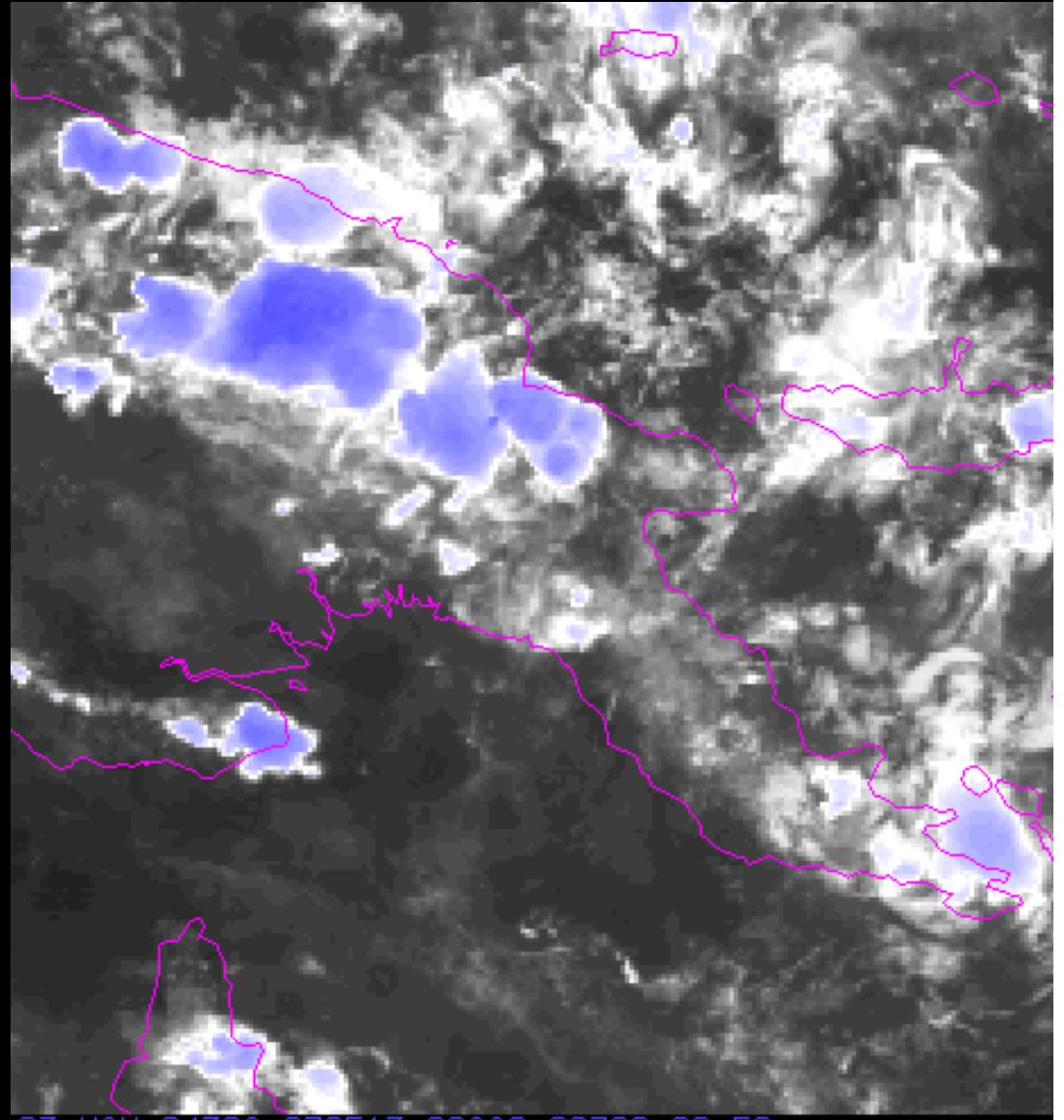


"Streamers of clouds stretch from the coast northeastward over the ash plume and farther out to sea....."

1 G-9 IMG 04 24 OCT 04298 002514 09824 09624 01.00



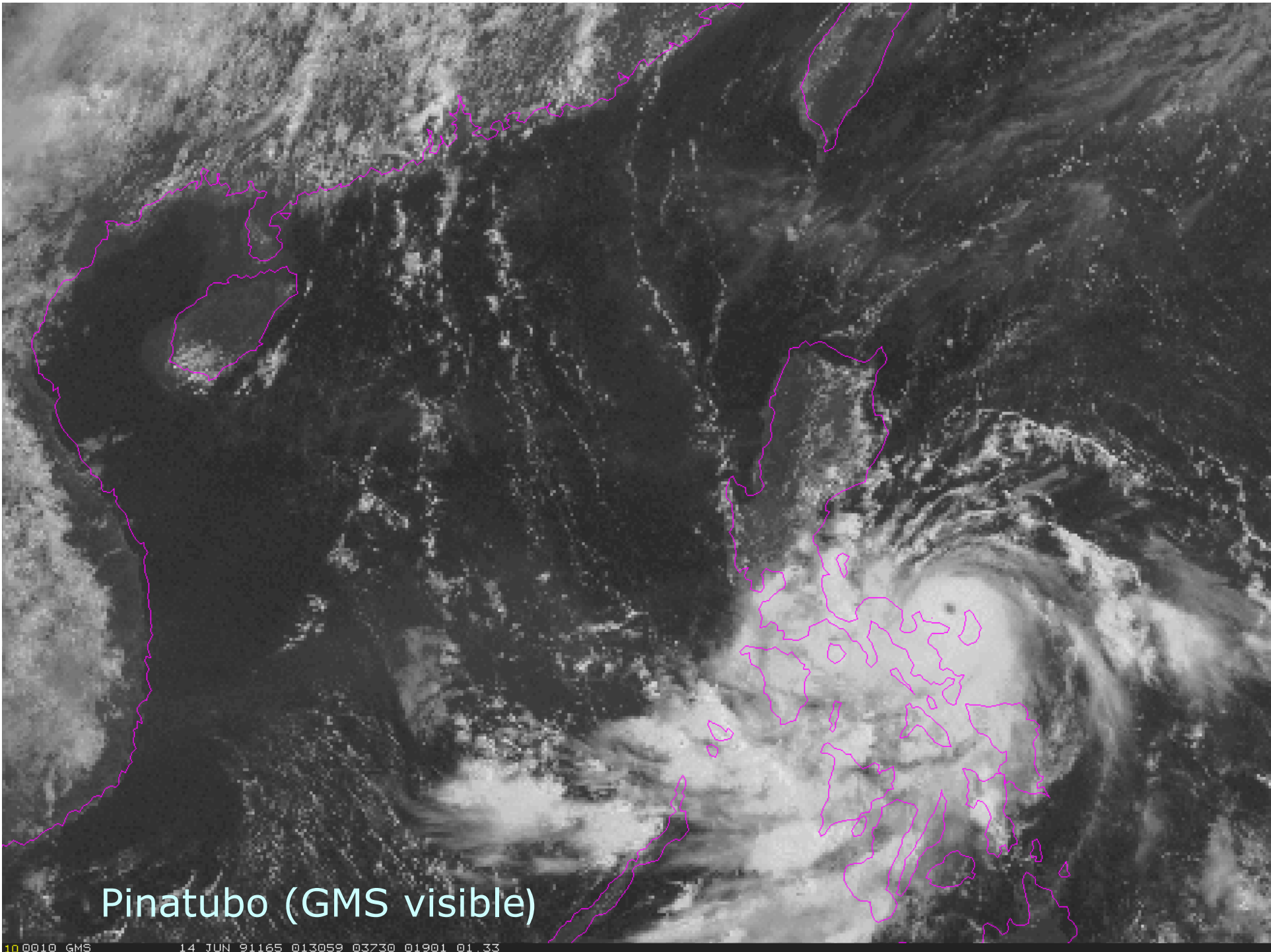
Courtesy David Innes



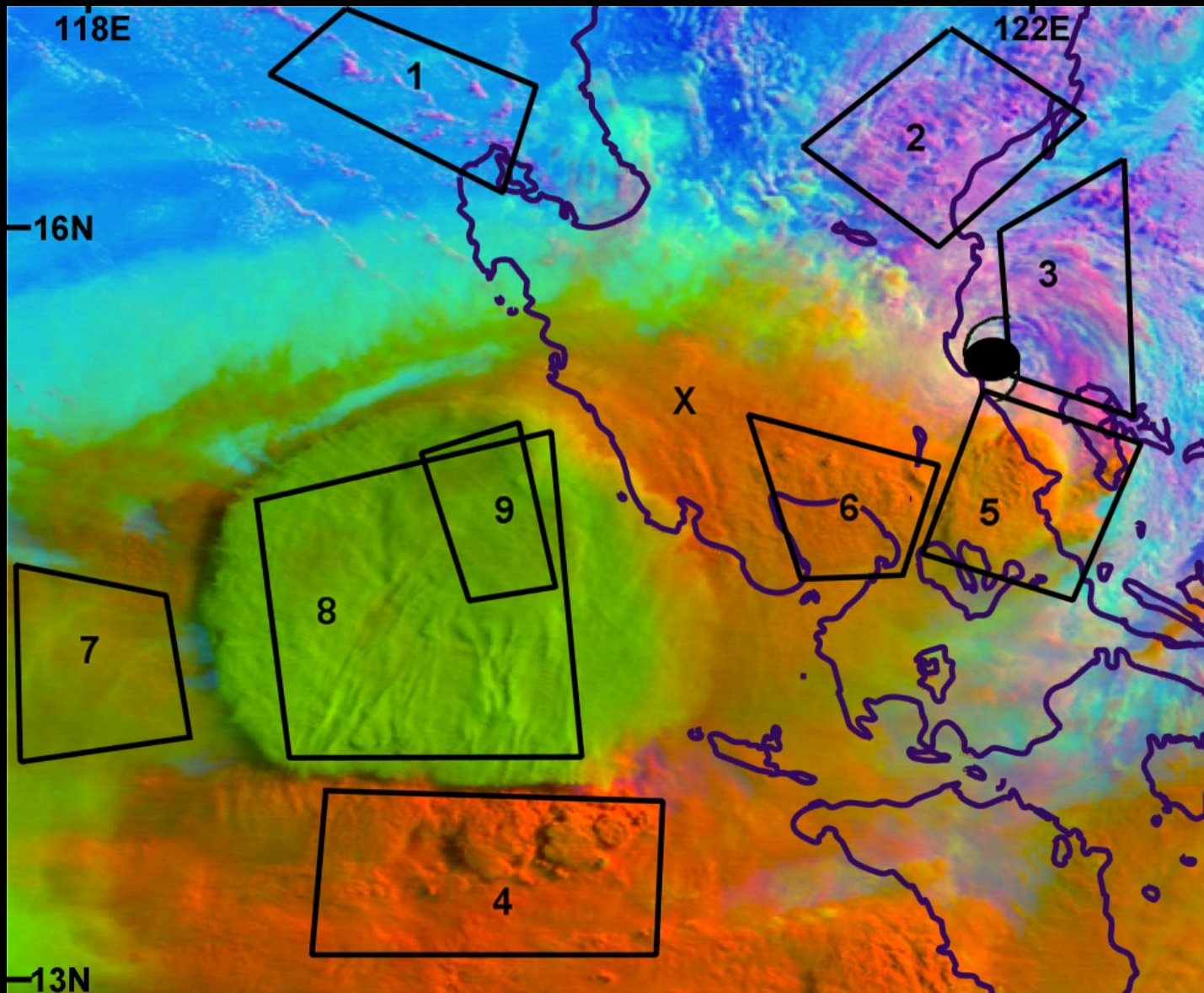
23 NOV 04328 072513 09889 09700 00.50

Courtesy David Innes





Pinatubo (GMS visible)



Effective cloud top particle radius for pre-climactic eruptions at Pinatubo, June 1991 (Rosenfeld/Tupper, unpublished)



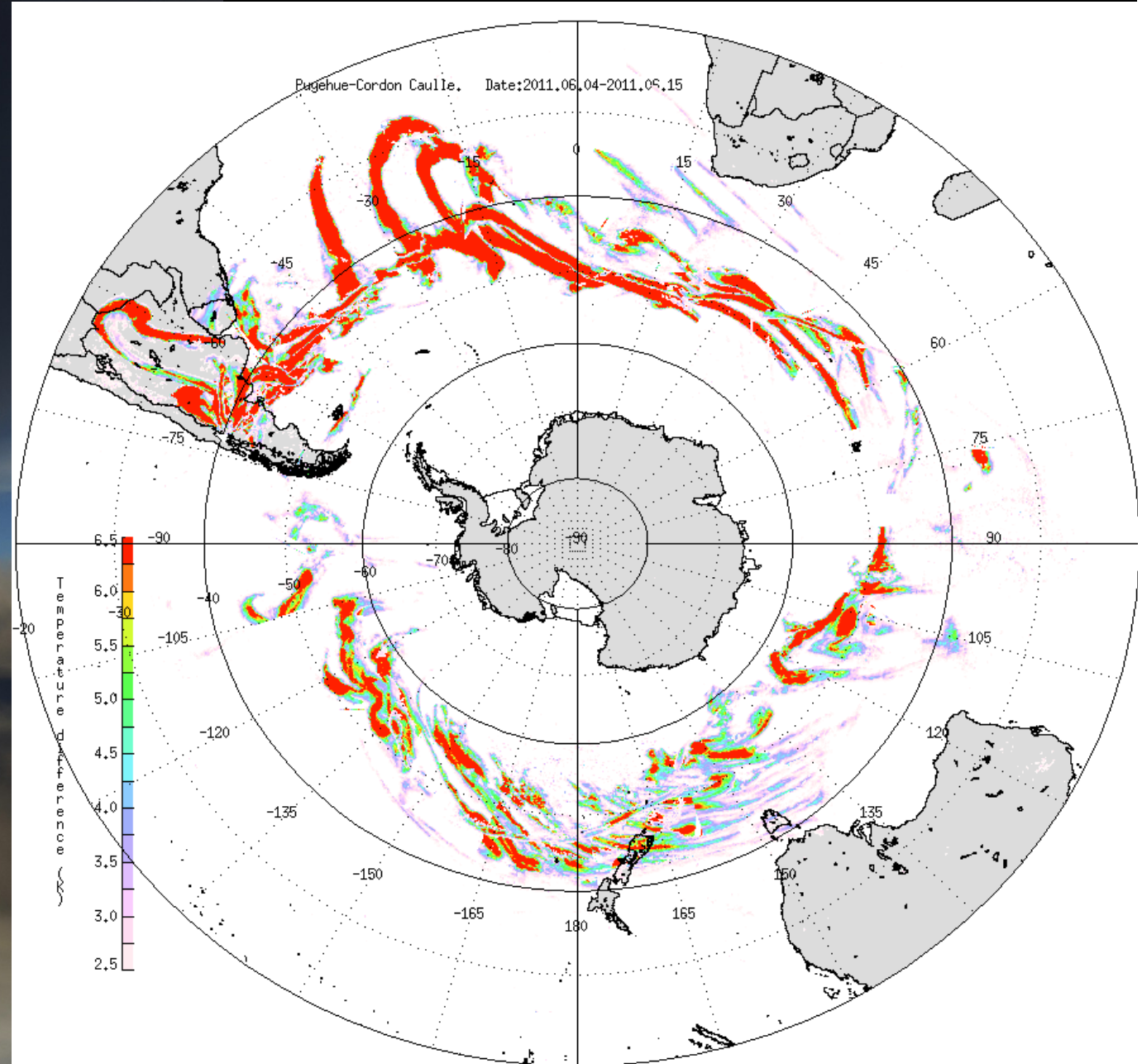
Research



Operations

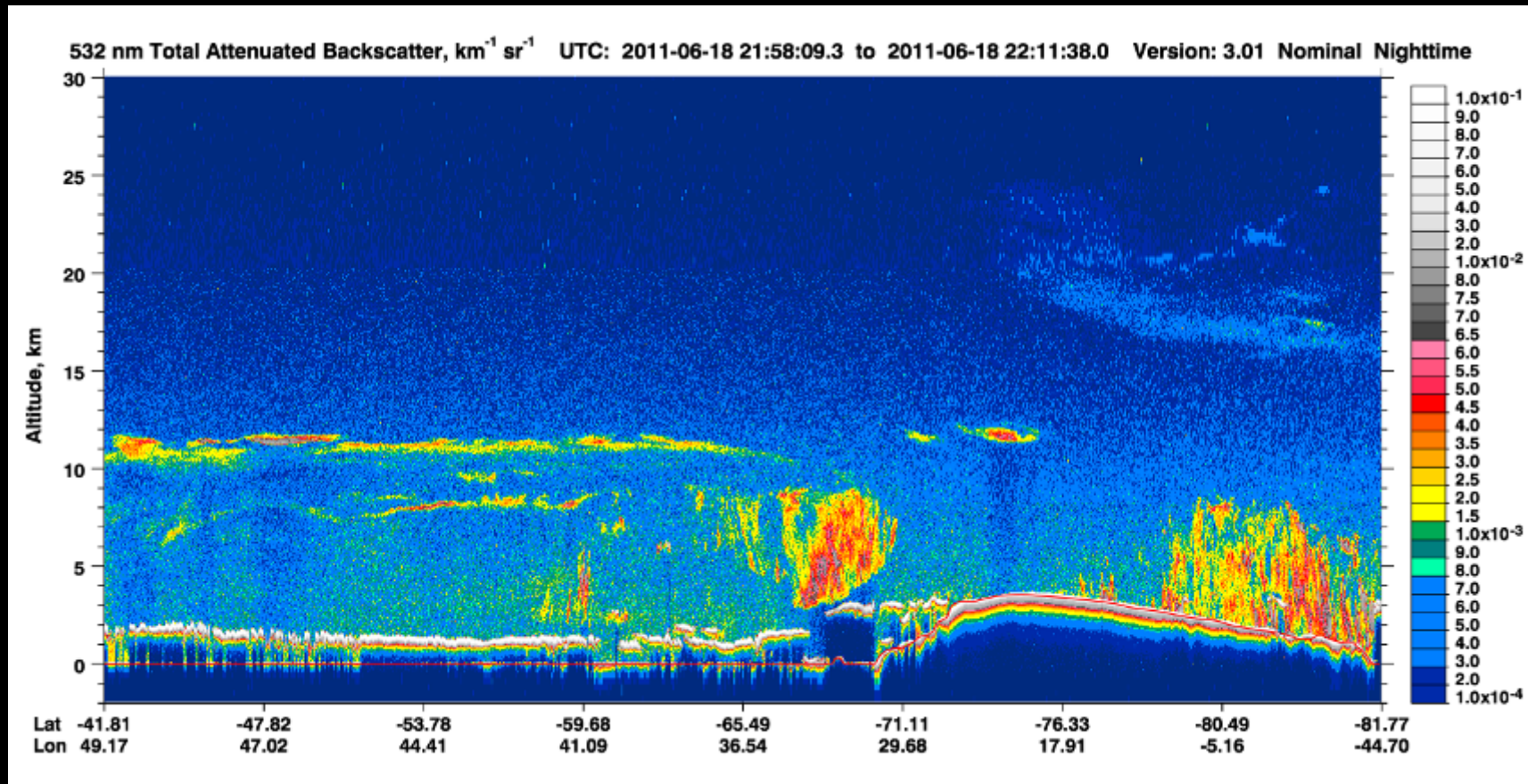
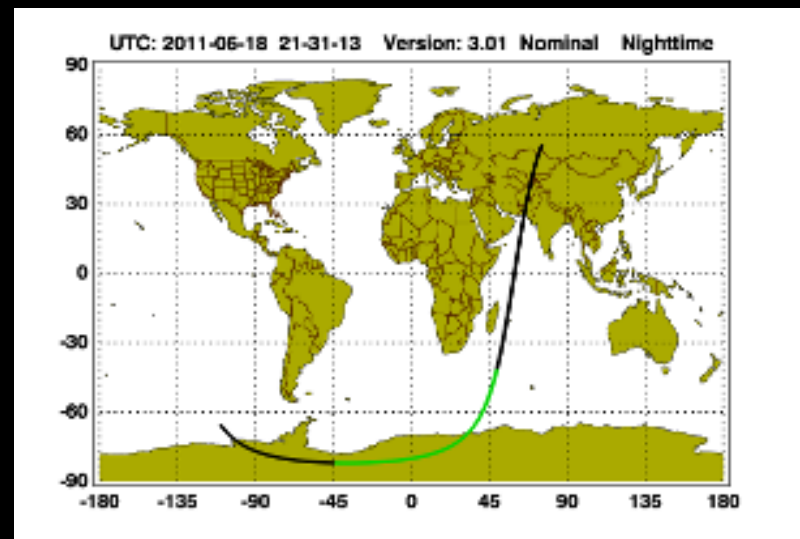




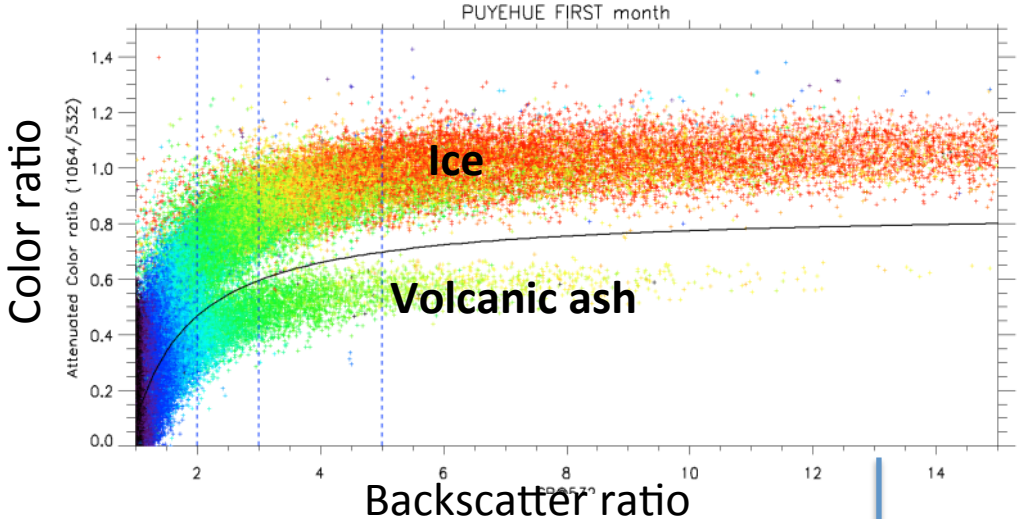


Courtesy Fred Prata

Use of Calipso data



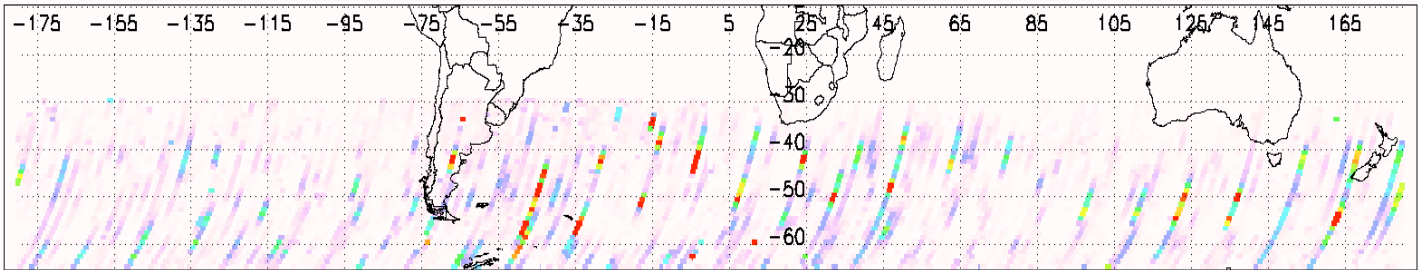
Vernier et al (in press)



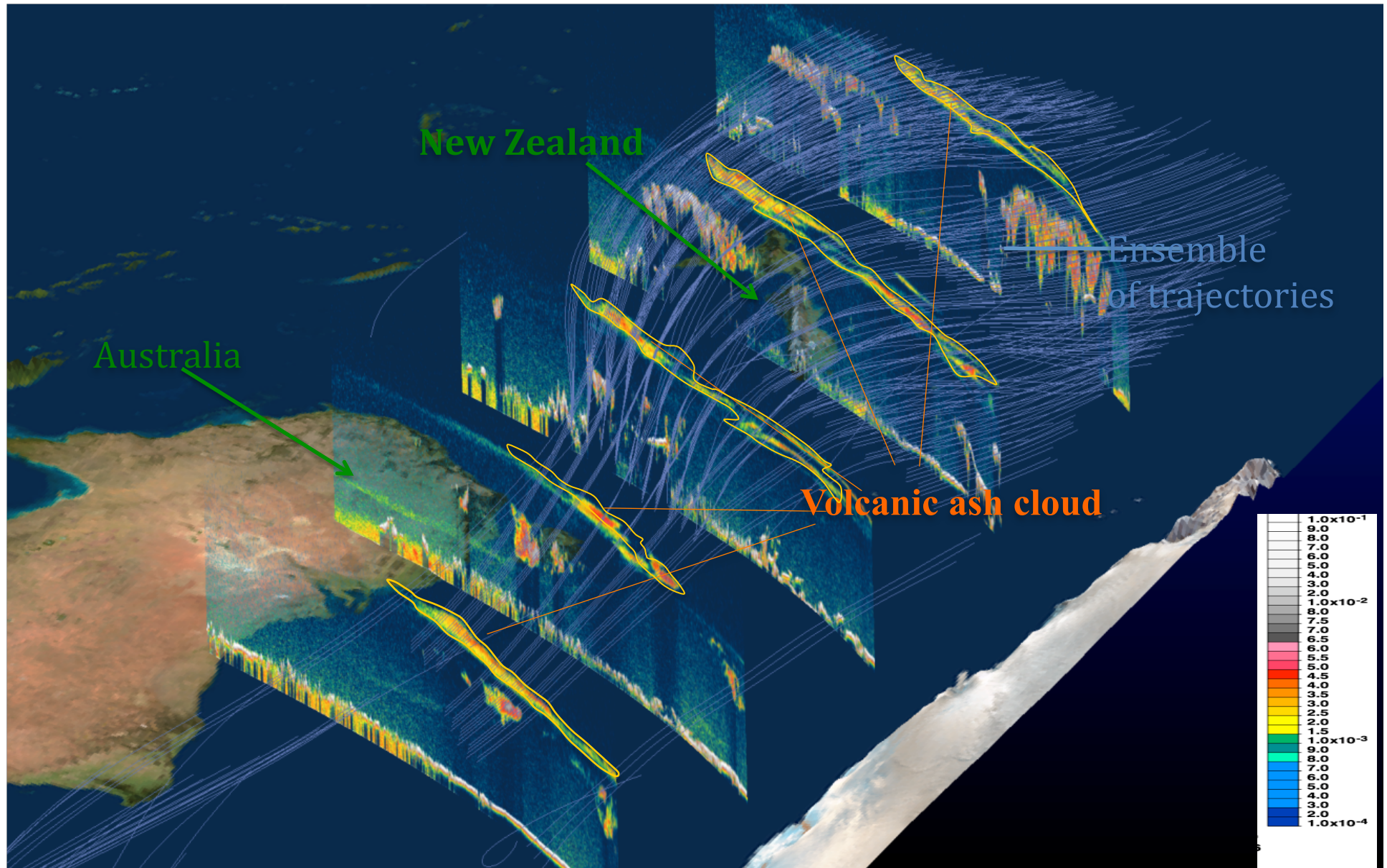
- Very similar depolarization properties between ash and Ice
- Detection of ash based on its lower color ratio compare to ice

Ash backscatter retrieved from Total Backscatter (Ansmann et al., 2011)

Cumulative CALIPSO backscatter (8-13 km) for June 2011

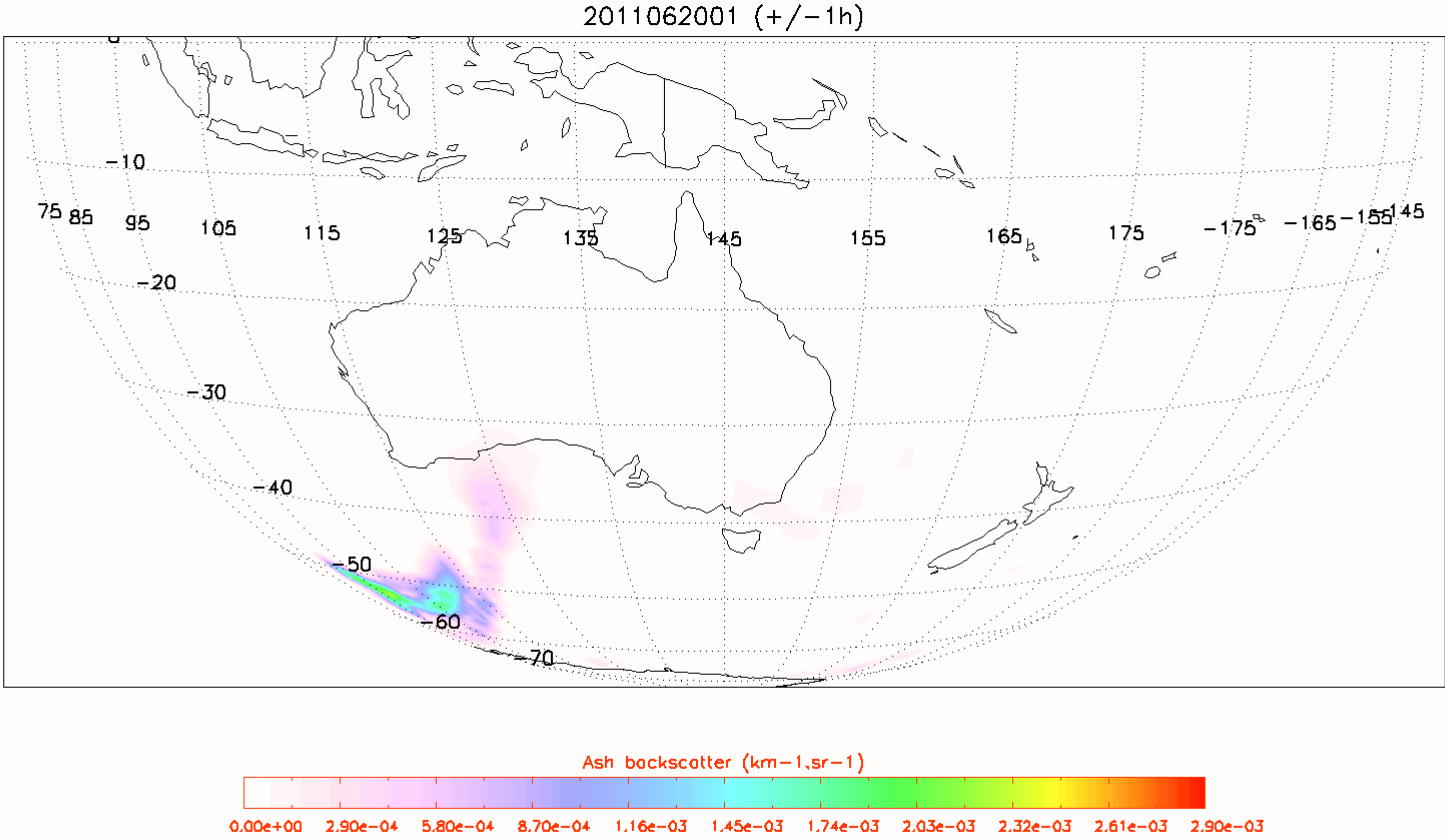


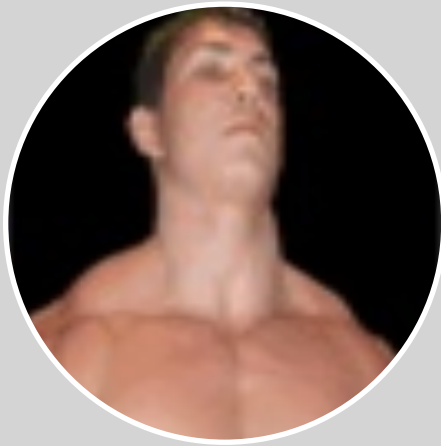
A bridge between CALIPSO observations



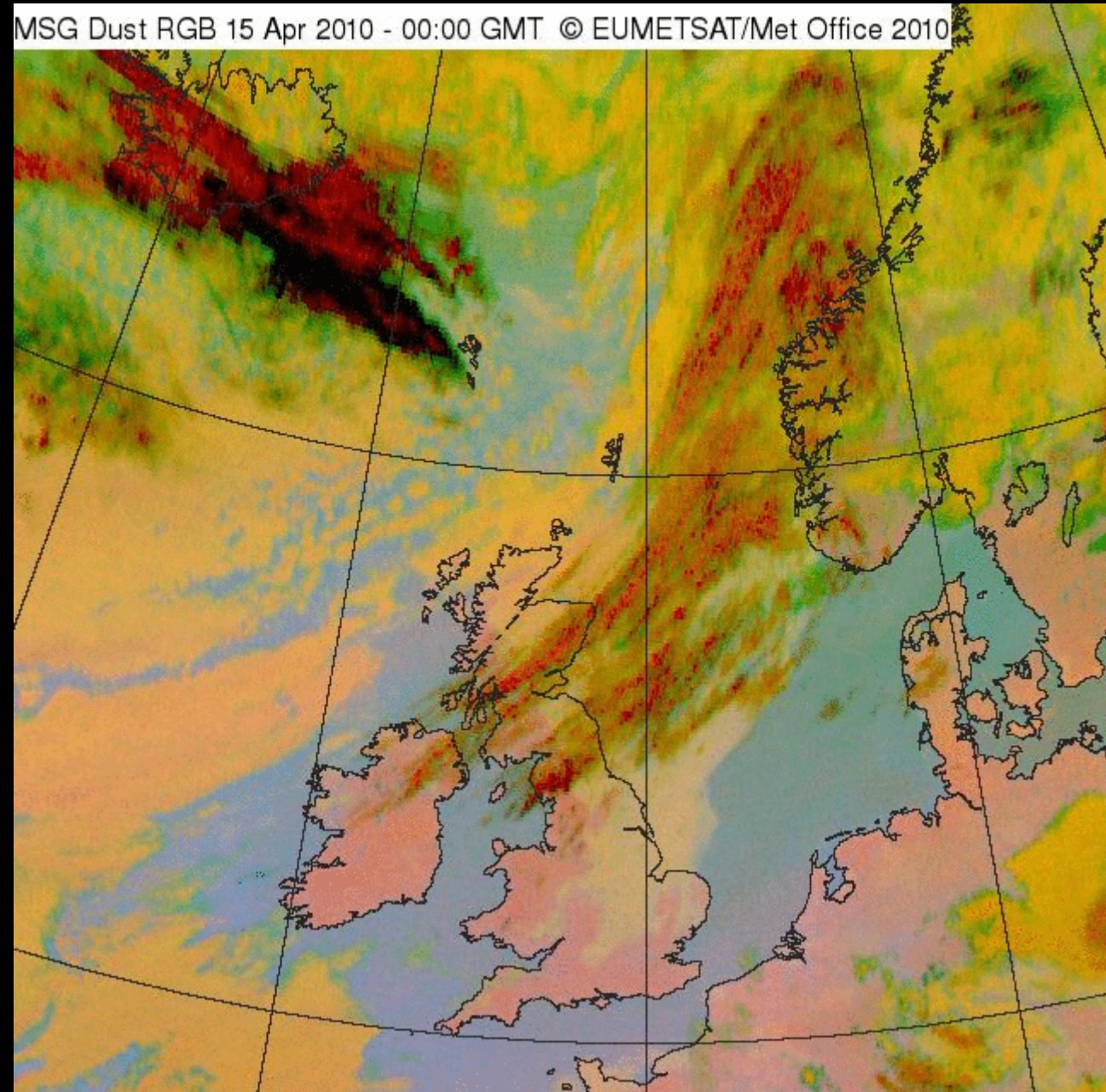
Cordon ash episode between Australia and New Zealand 20-24 June 2011

20000-40000 ft.





Integrate
reality



SHERFFIUS

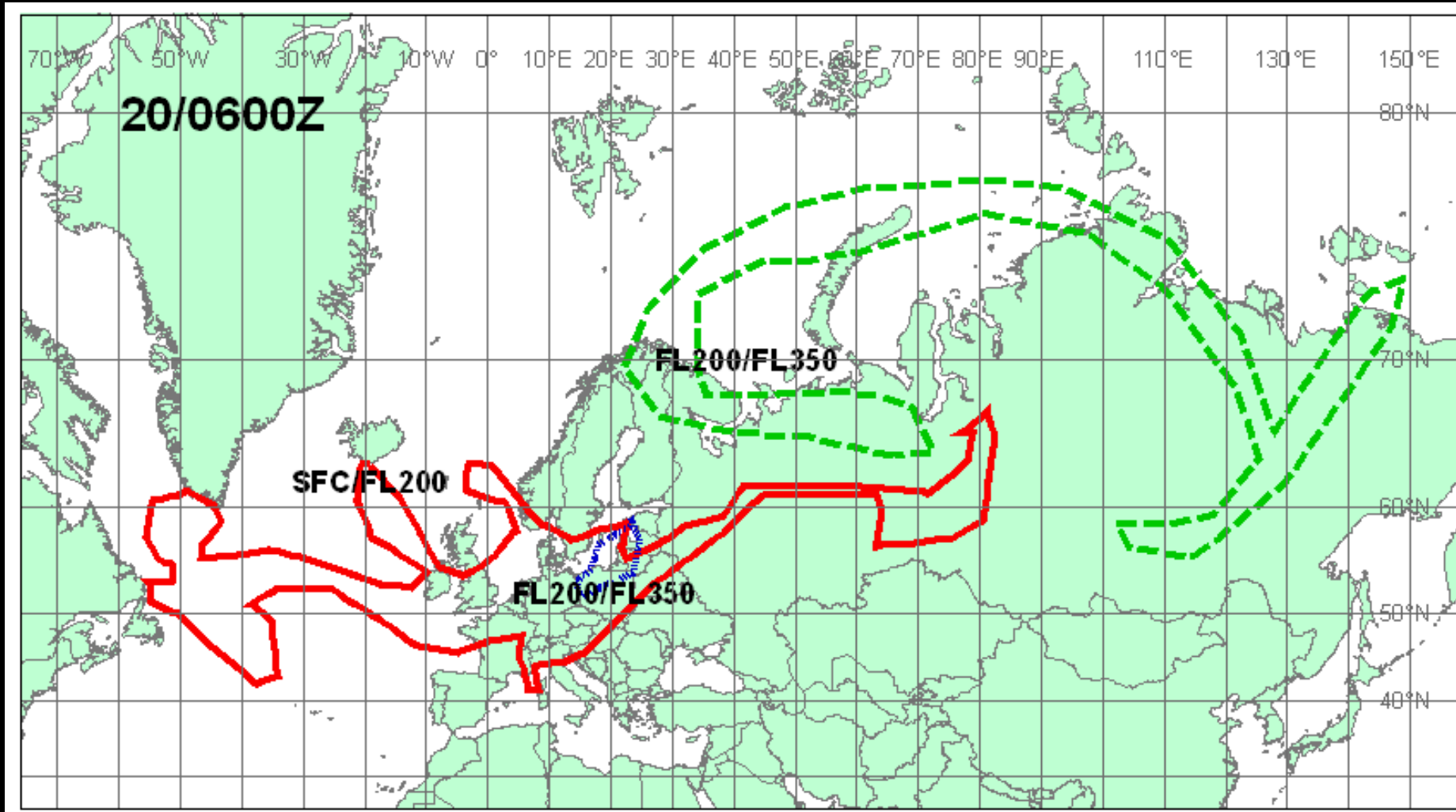
Boulder Camera © 4/16/10 creators.com
sherffius@gmail.com
sherffius.com

Eyjafjallajökull

I C E L A N D

E U R O P E

E&%#@!!*@!*#!



Volcanic ash graphic courtesy UK Met Office

MailOnline News

Free*
First Month

Plus Free* iQ

Plus Free* Installation




Remember that ash cloud? It didn't exist, says new evidence

By SEAN POULTER
Last updated at 10:28 AM on 26th April 2010

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Britain's airspace was closed under false pretences, with satellite images revealing there was no doomsday volcanic ash cloud over the entire country.

Skies fell quiet for six days, leaving as many as 500,000 Britons stranded overseas and costing airlines hundreds of millions of pounds.

Estimates put the number of Britons still stuck abroad at 35,000.



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"I GOT RIPPED IN 4 WEEKS"

Don't Waste your money on protein powders or creatine. I found a ***FREE*** way to get ripped without killing myself in the gym or dieting

Click Here to Read More

FEMAIL TODAY

▶ Alex Curran puts on united front with husband Steven Gerrard as she attends opening of his new bar
Model was in good spirits (and a very short dress)



Best practice analysis and forecasting

Volcanic Ash Advisory Centre best practice is...

The expert evaluation of the best available sources of meteorological and volcanological information:

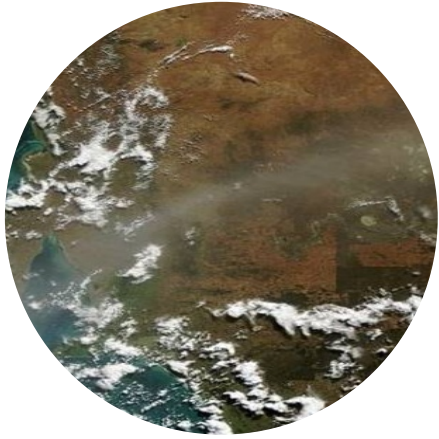
qualitative and quantitative satellite data

model output

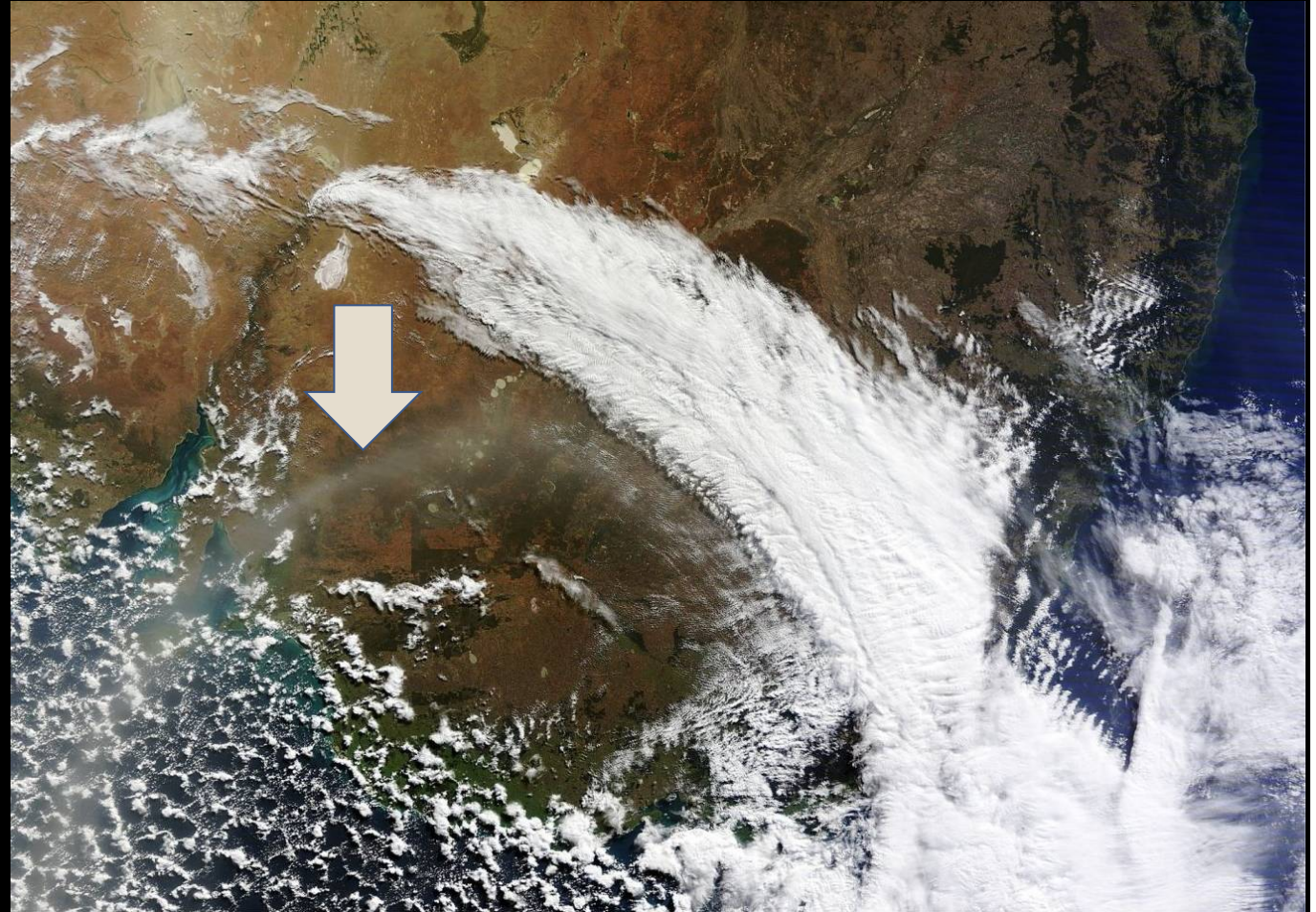
ground and airborne based in-situ and remotely sensed observations

pilot reports

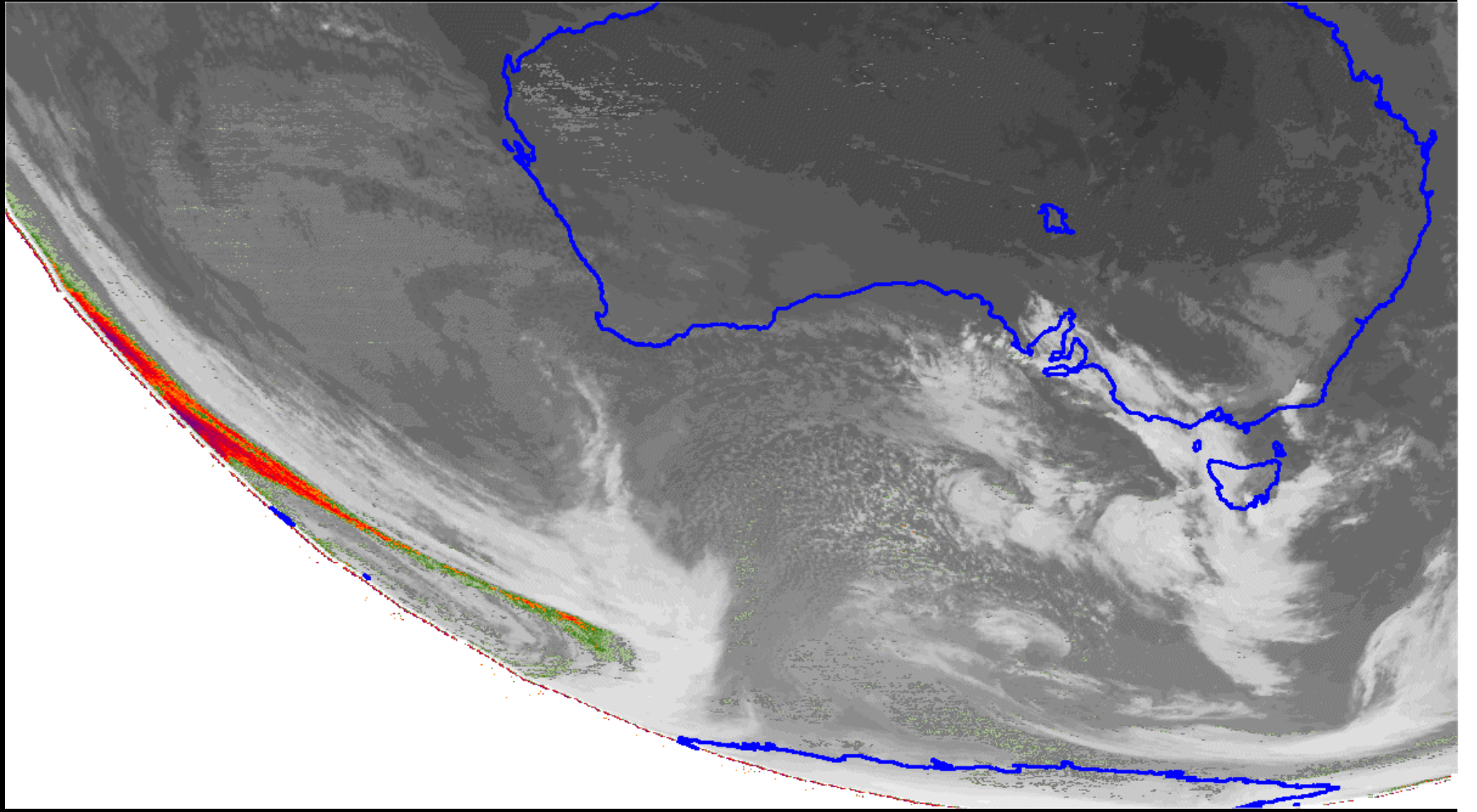
using (where possible) collaborative approaches, to derive authoritative, high quality, evidence based and globally consistent analysis and forecasts.

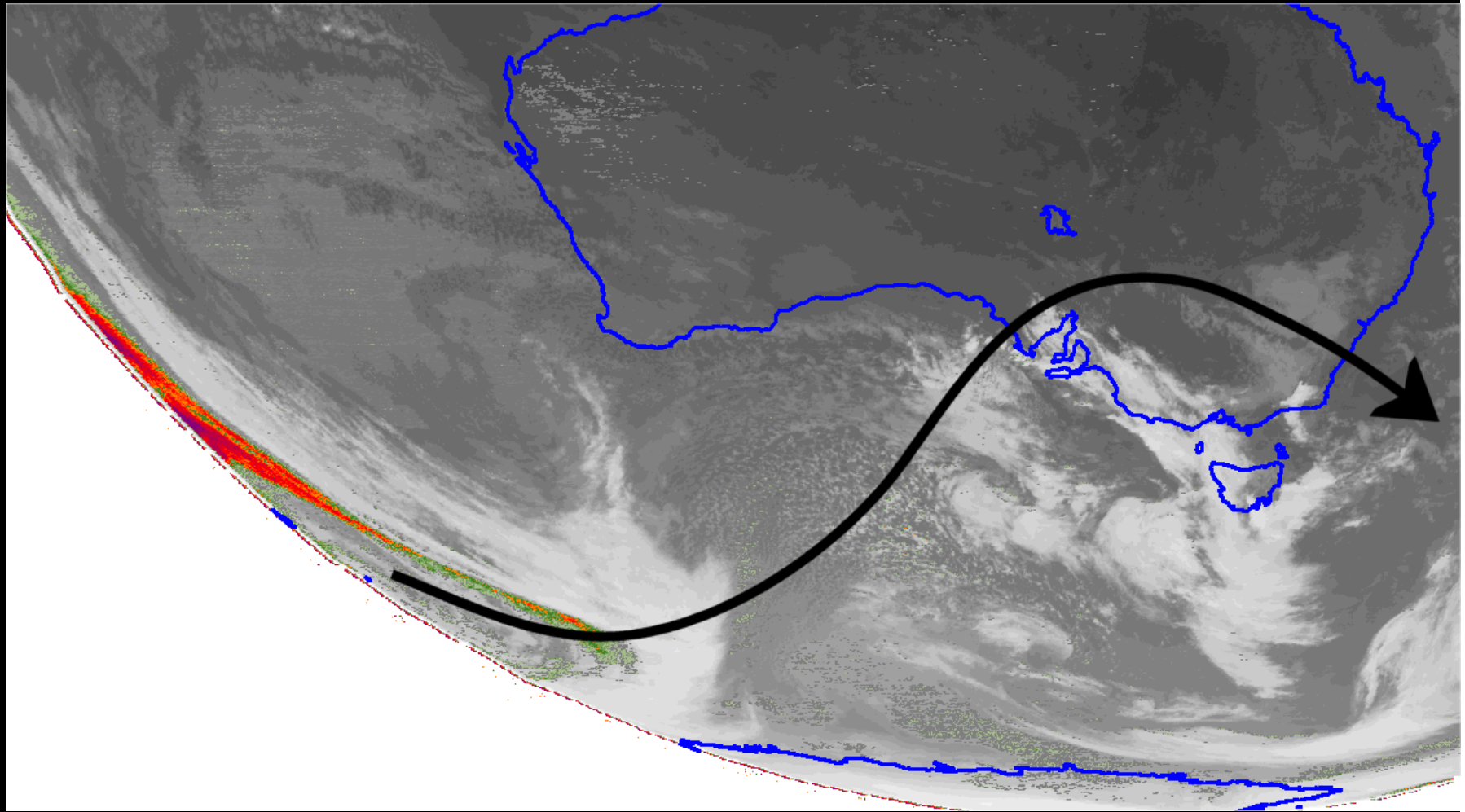


Evidence
builds
trust



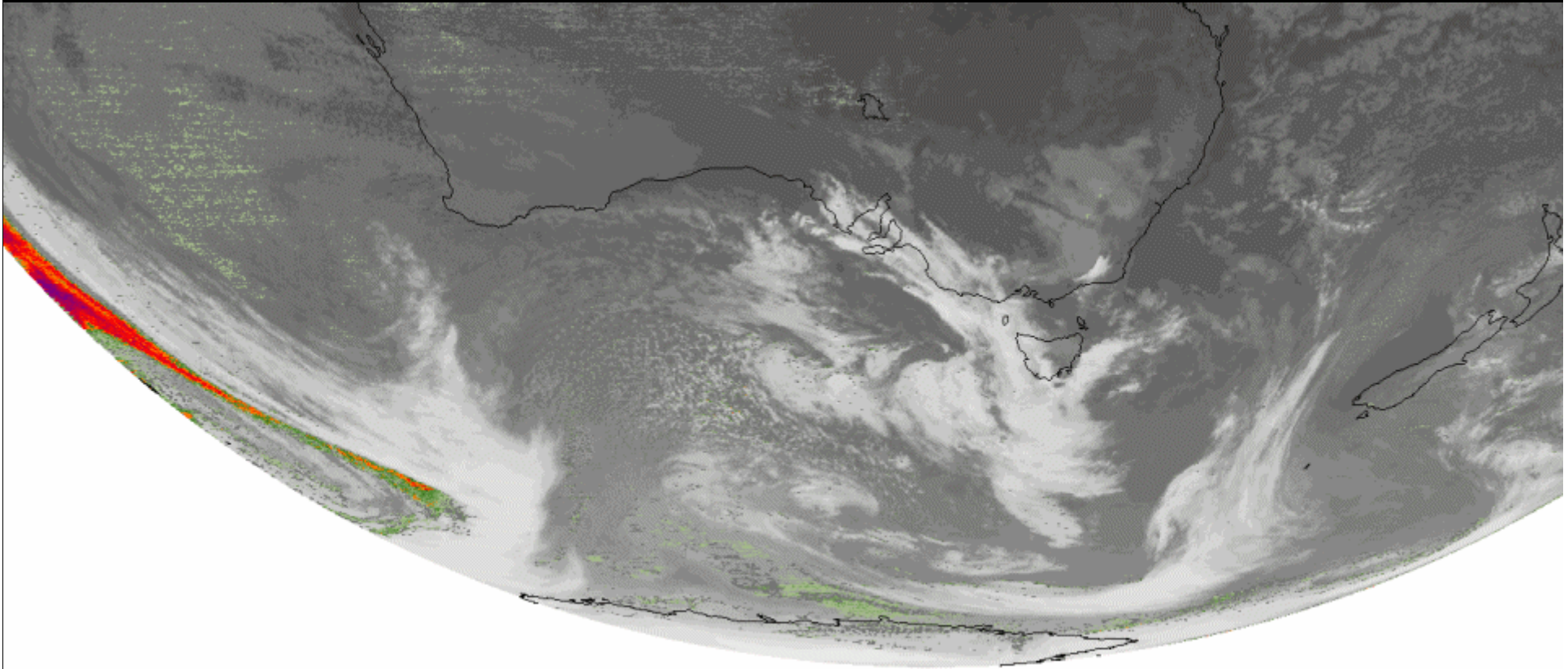
Cordon-Caulle ash over SE Australia, 21 June 2011



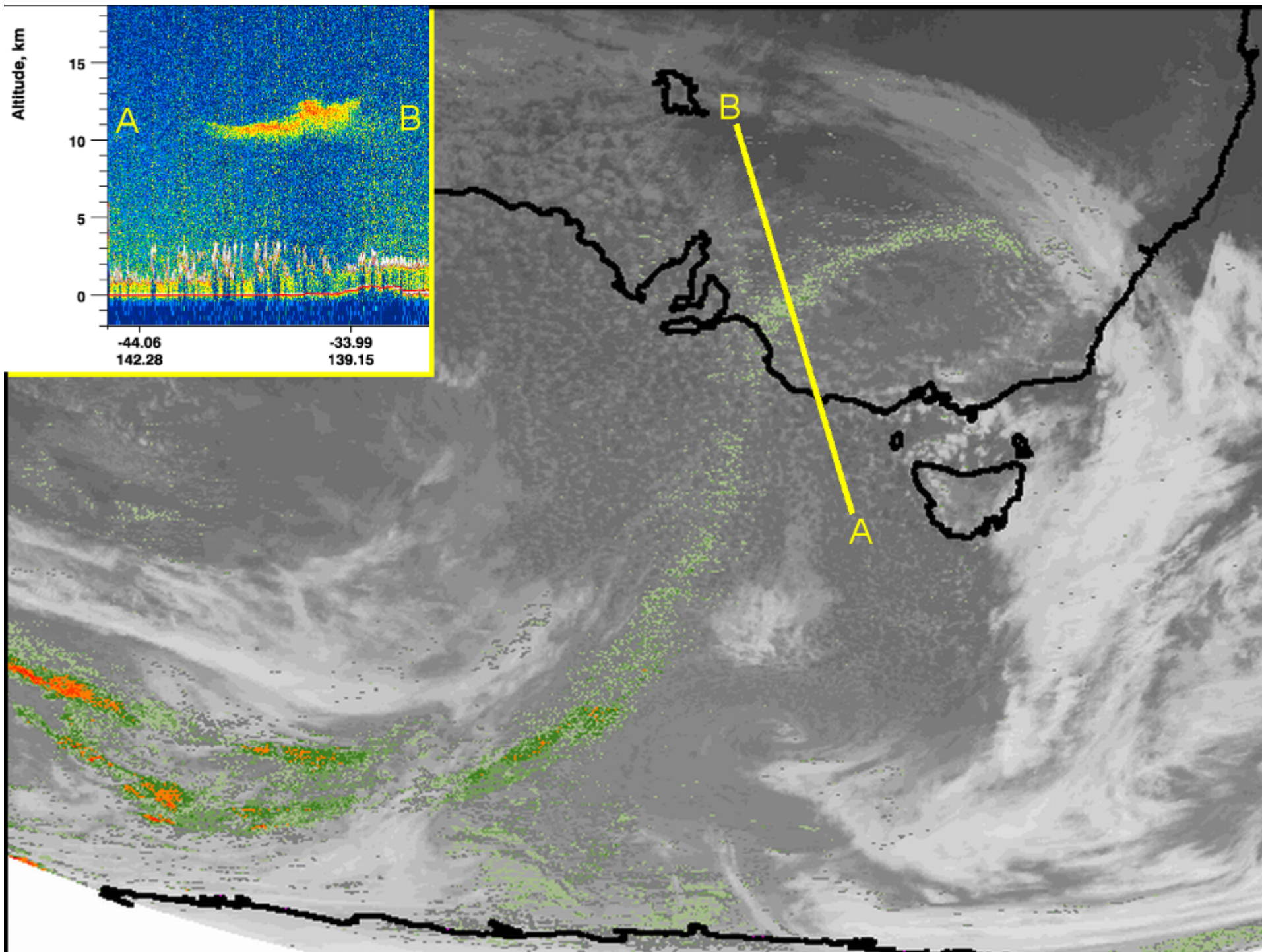


Issued to media on 20 June 2011

Infrared satellite loop



2 20 JUN 11171 003200 05974 00840 04.00



Pilot reports

21 June, over SE Australia

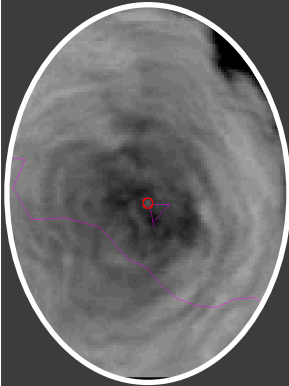
- Higher plume approx FL350-410. Edge approx 100nm W of line MEL/GTH/NYN/JAK
- 2 distinct ash clouds. Easily visible. Approx low level to FL250. Plume approx 150nm E of 0245Z picture.
- Ash viewed north of CULIN (34S 149.4E) and to the west but clear to south. Ash estimated above FL300
- Ash consistent with graphics supplied preflight
- Would strongly recommend not flying above FL200, confirm FL200
- Ash identified as from FL390/FL410 down to about FL200. Confirmed the FL200 level. Photographs included.



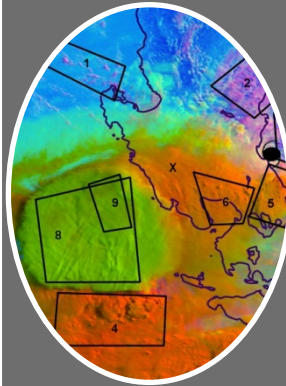
Remote sensing lessons learnt



Use your
brain



Follow the
procedure



Keep it
complicated



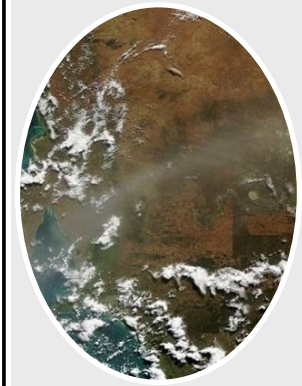
Research



Operations



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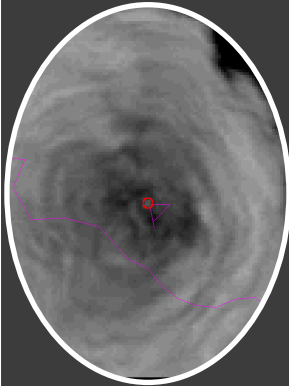
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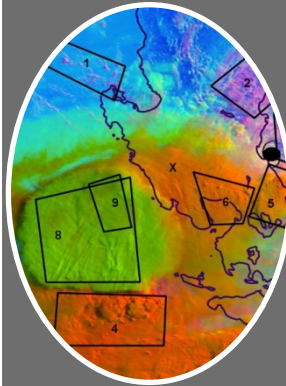
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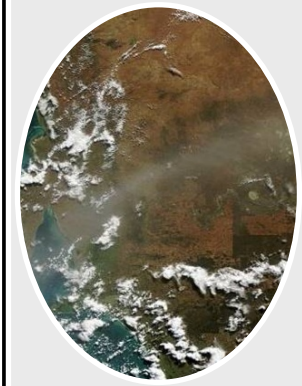
Research



Operations



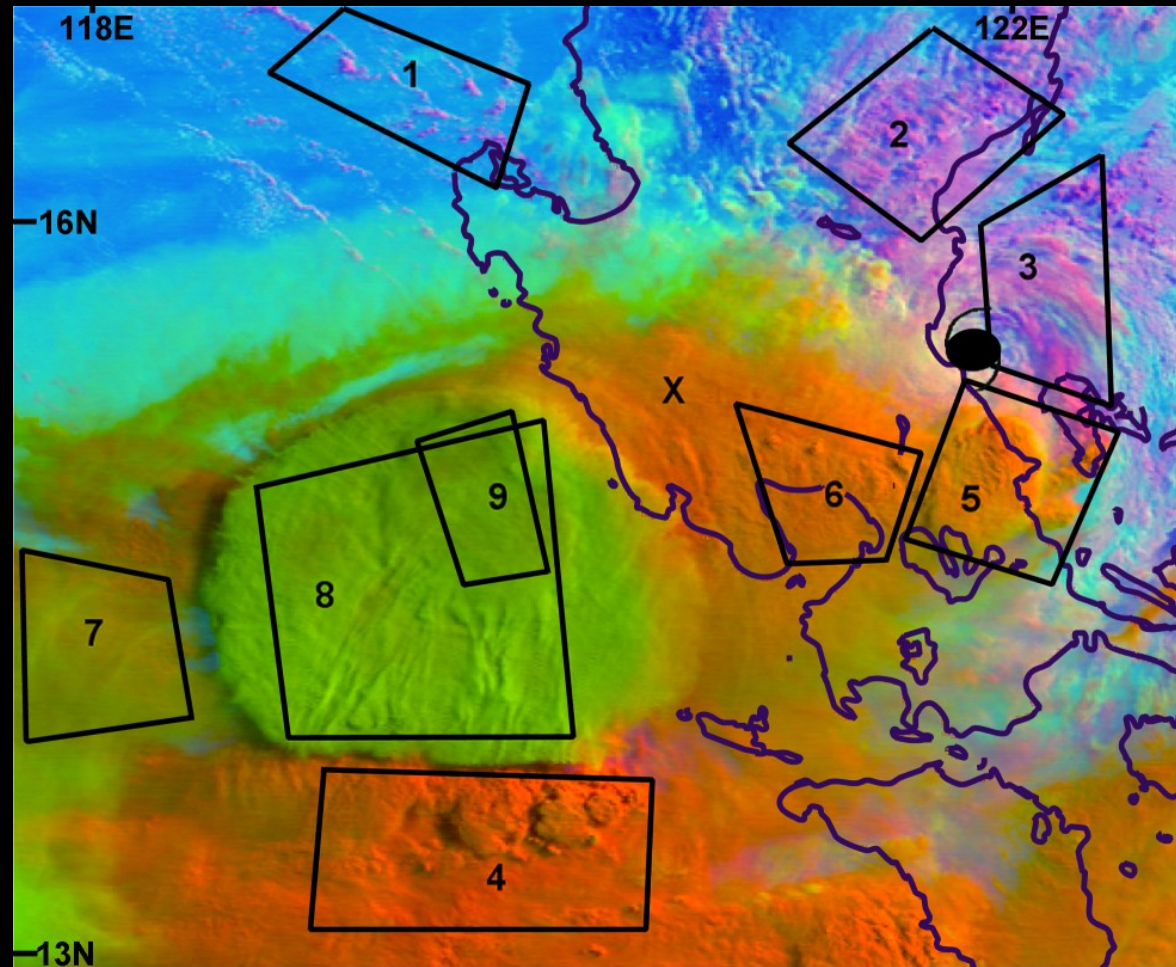
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reality



Evidence
builds trust

Quality management

Fly me through this?



Not yet a solved problem... the future scope for science is endless!

Thank you....

