BTD (WV – IR window) – informal comments and discussion …

Martin Setvák, Kris Bedka, Dan Lindsey

Why this discussion?

- We do not argue the importance of various BTDs, used either as one of the components of many RGB composite images, or as one of the parameters used for derived products ...
- However, we are not quite happy with the way how some of these are being used, in particular the BTD (WV – IR window) – e.g. for automatic detection of overshooting tops or for identification of deep convective (or precipitating) clouds.
- The BTDs need further studies (RTM, observations, ...), to be used on more credible basis, to eliminate many ambiguities which still accompany them.

BTD (WV – IR window) major open issues, ambiguities :

- Source of the positive BTD (WV – IR window) values: microphysics versus lower stratospheric moisture

- Their correlation to overshooting tops versus coldest cloud-top pixels in general

- Their applicability in various automatic detection algorithms (detection of overshooting tops or precipitating areas) – what is their realistic added value as compared to use of the IR-window BT itself?

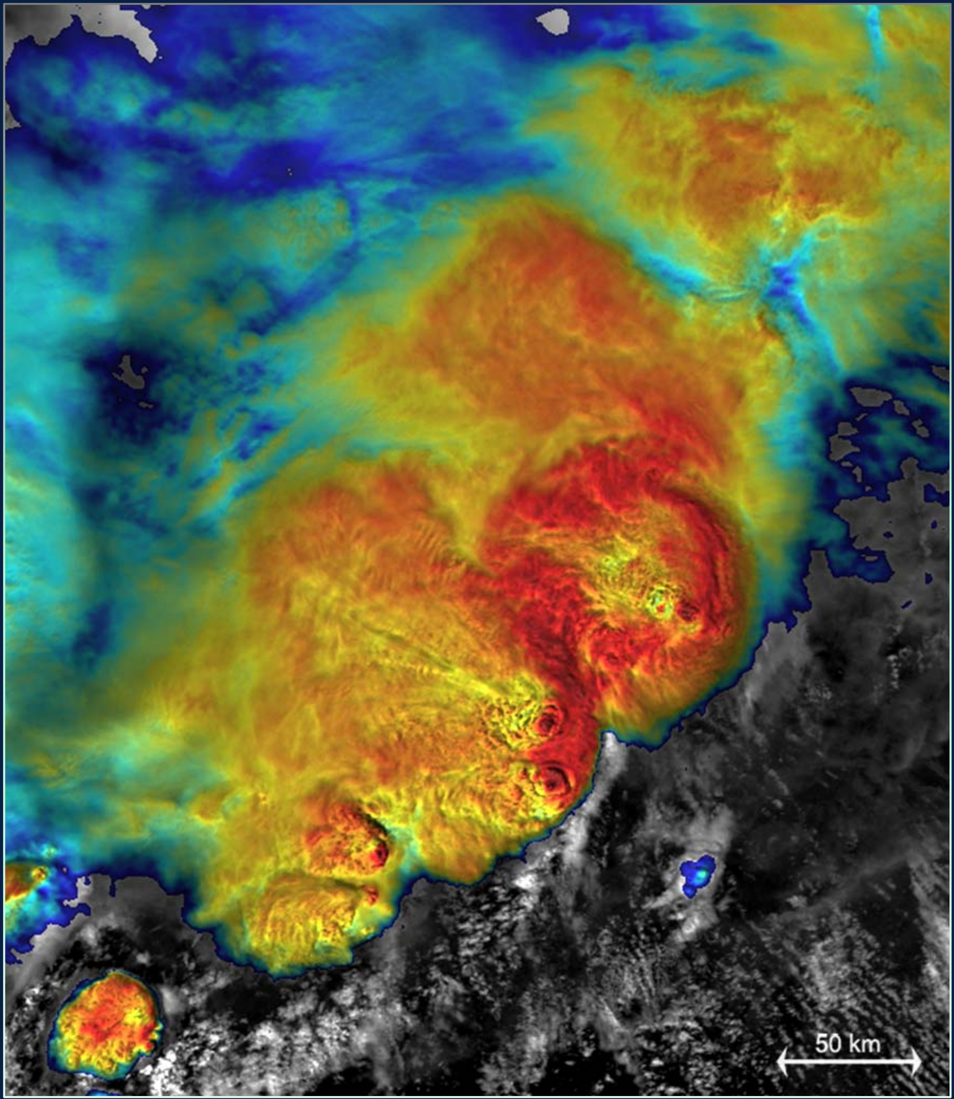
Various „scenarios" as regards the correlation between the BTD and IR-window BT fields:

- In most cases the BTD indeed reaches its maxima approximately above the coldest pixels (not necessarily OTs)
- In many other cases the BTD field does not match the IR-window BT field, the BTD maxima are elsewhere than above the coldest parts of the storm top >>> *BTD „anomalies*"
- Role of the scanning geometry on the BTD (total path of the radiance in the atmosphere)

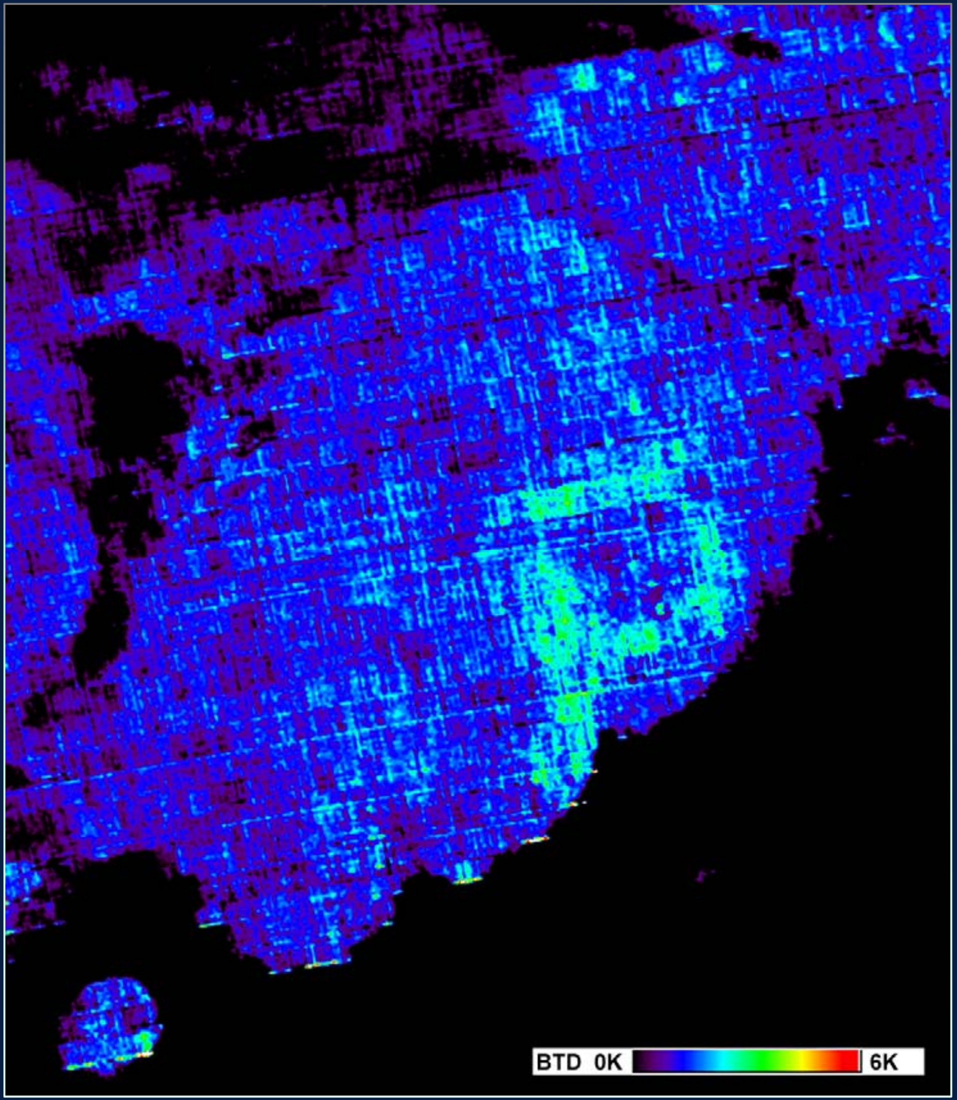
6 May 2007   19:28 UTC

Missouri

2007-05-06 19:28 UTC MODIS/Aqua, Missouri (39°N, 93°W)



MODIS, sandwich of band 1 and band 31 BT (193K – 223K)



BTD b27 (WV abs. band) – b31 (IR window)

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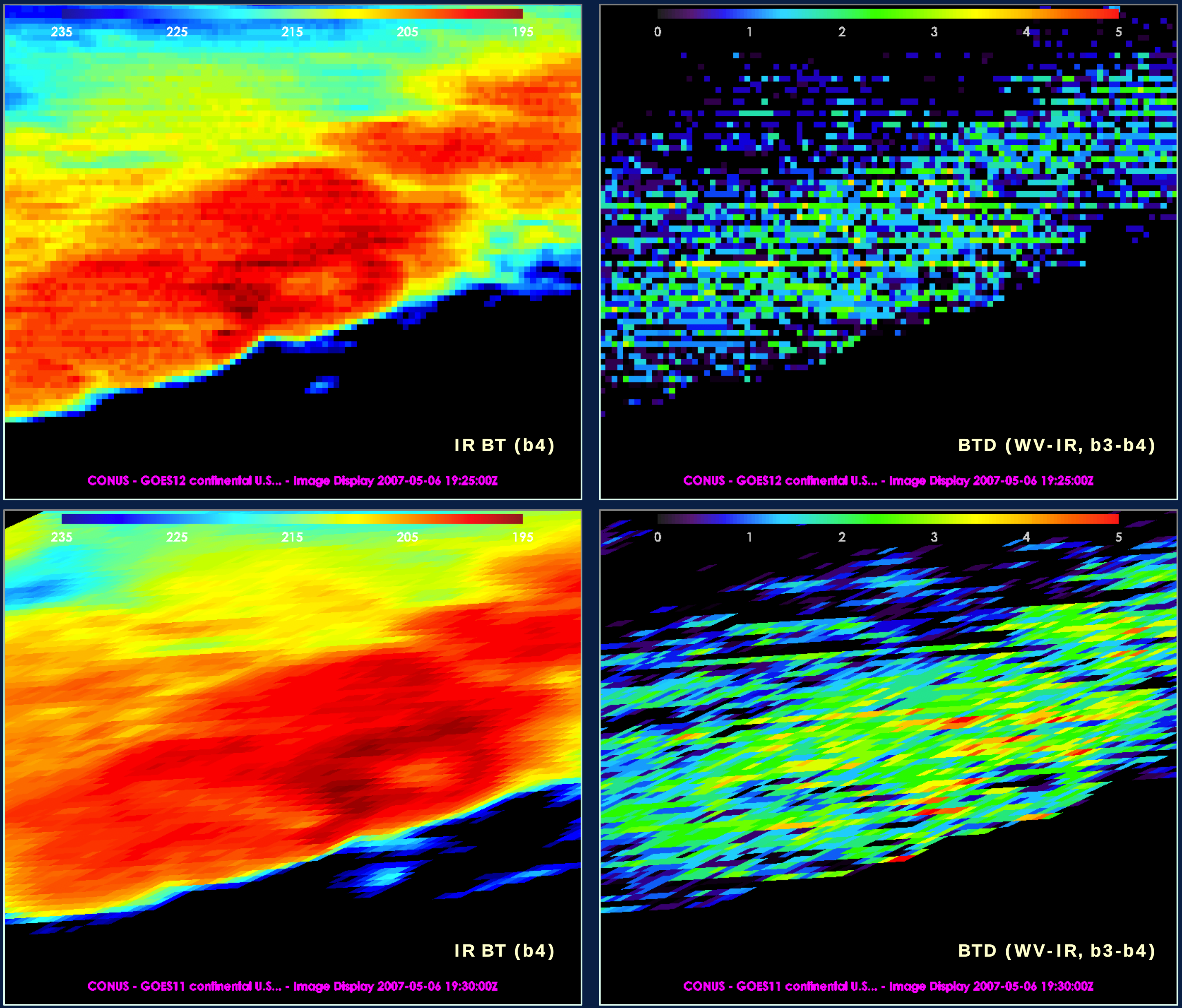
2007-05-06 GOES-East / West (39°N, 93°W)



GOES-East

(GOES-12)

75 W

19:30 UTC

GOES-West

(GOES-11)

135 W

19:25 UTC

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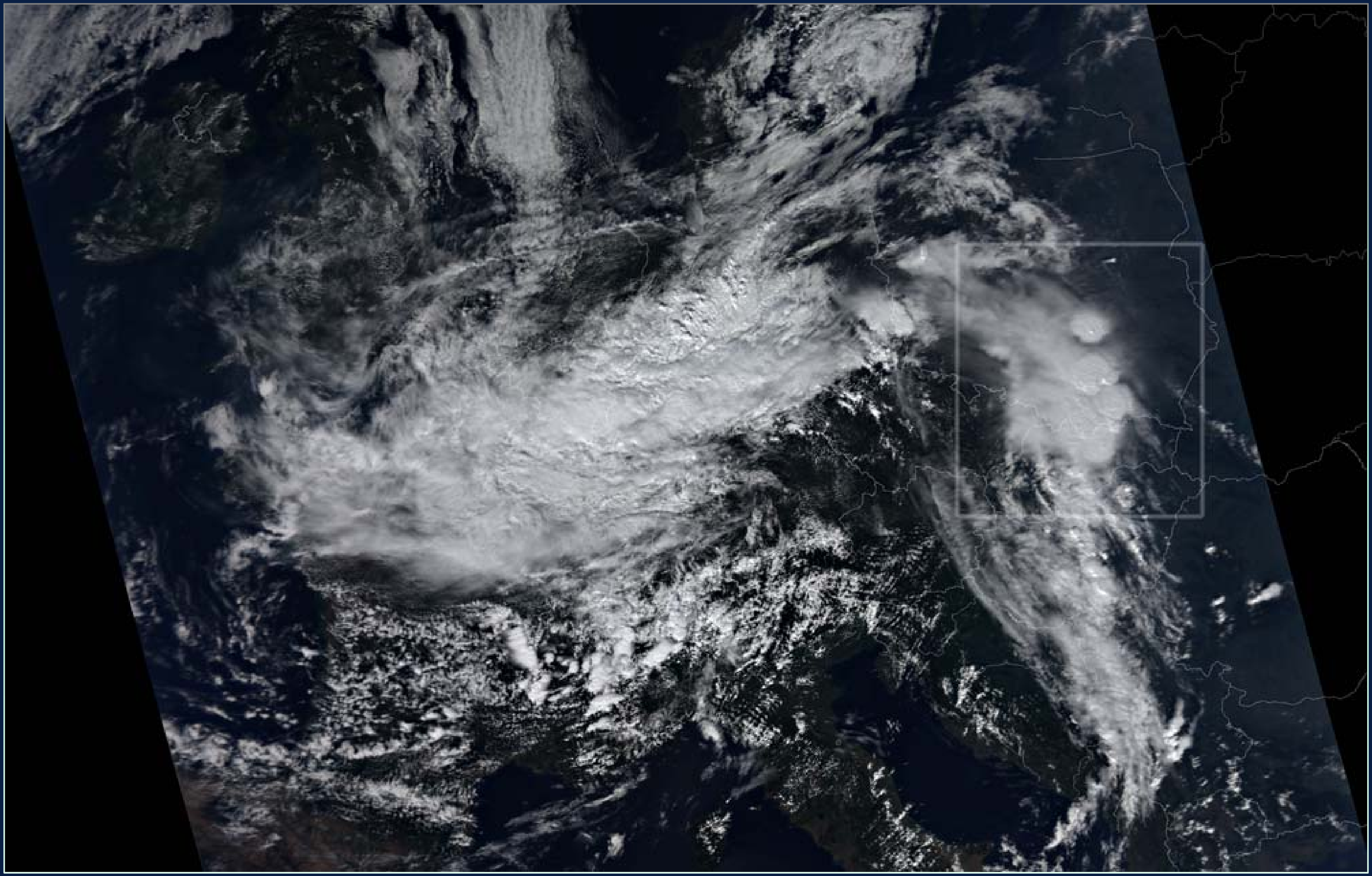
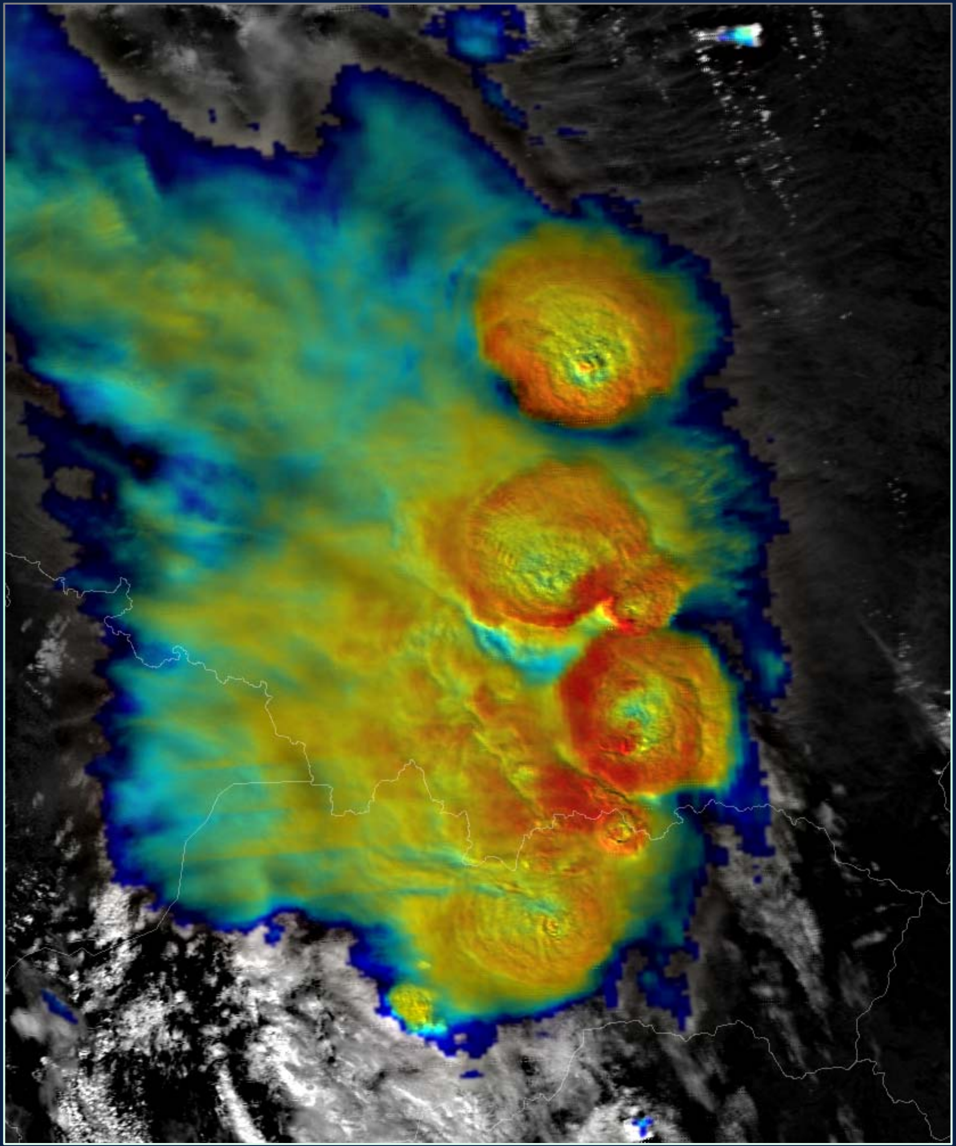
15 August 2010   12:25 UTC

Poland & Slovakia

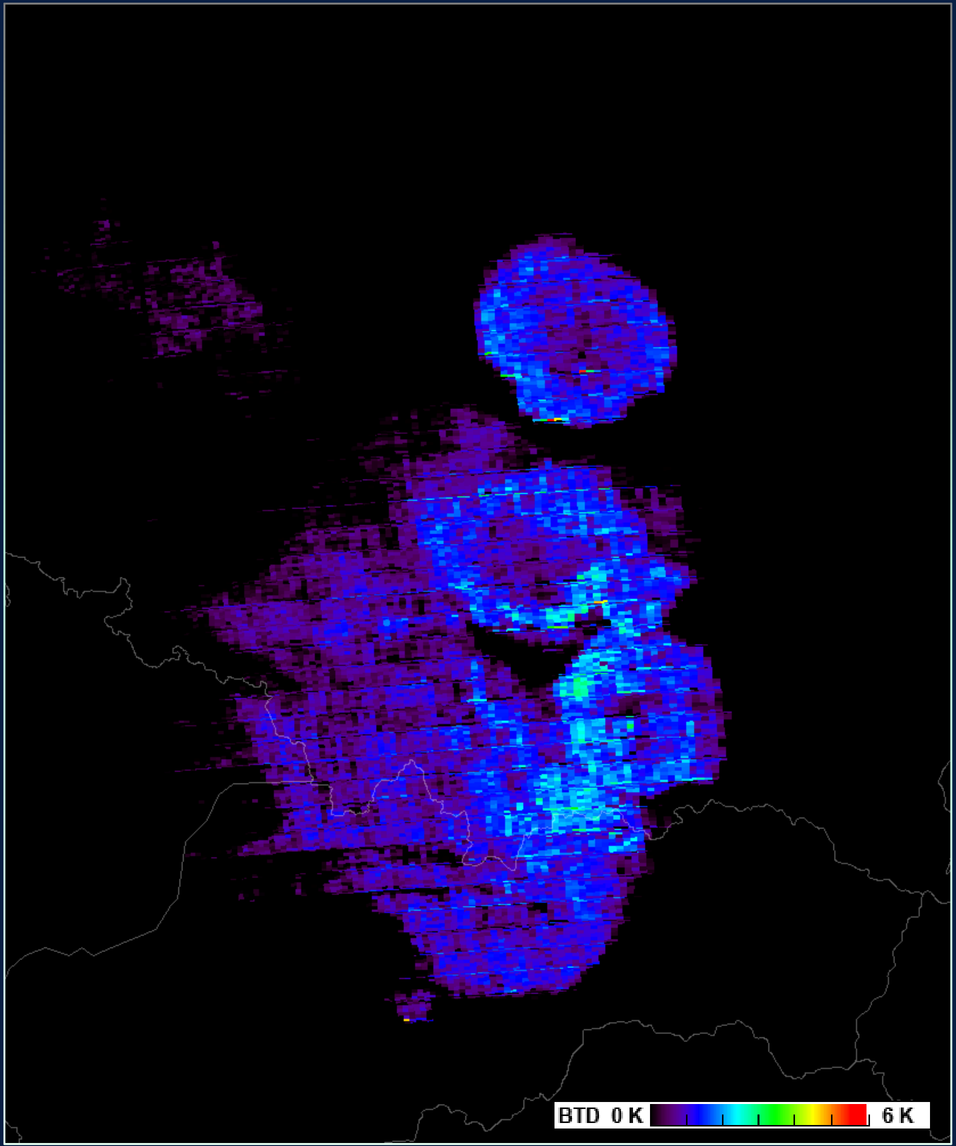


Though from MODIS, given the position within the swath also an oblique view (zenith angle ~ 55°)!

2010-08-15 12:25 UTC MODIS/Aqua, Poland and Slovakia



MODIS, sandwich of band 1 and band 31 BT (205K – 240K)



BTD b27 (WV abs. band) – b31 (IR window)

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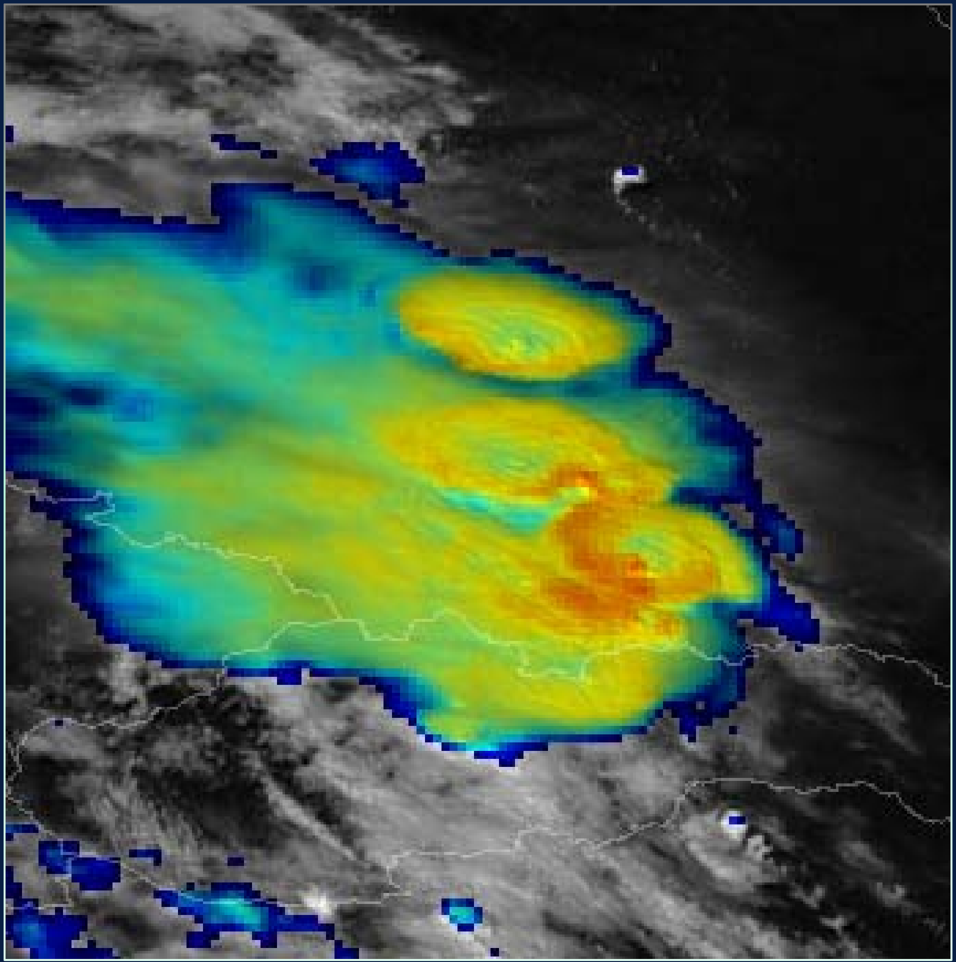
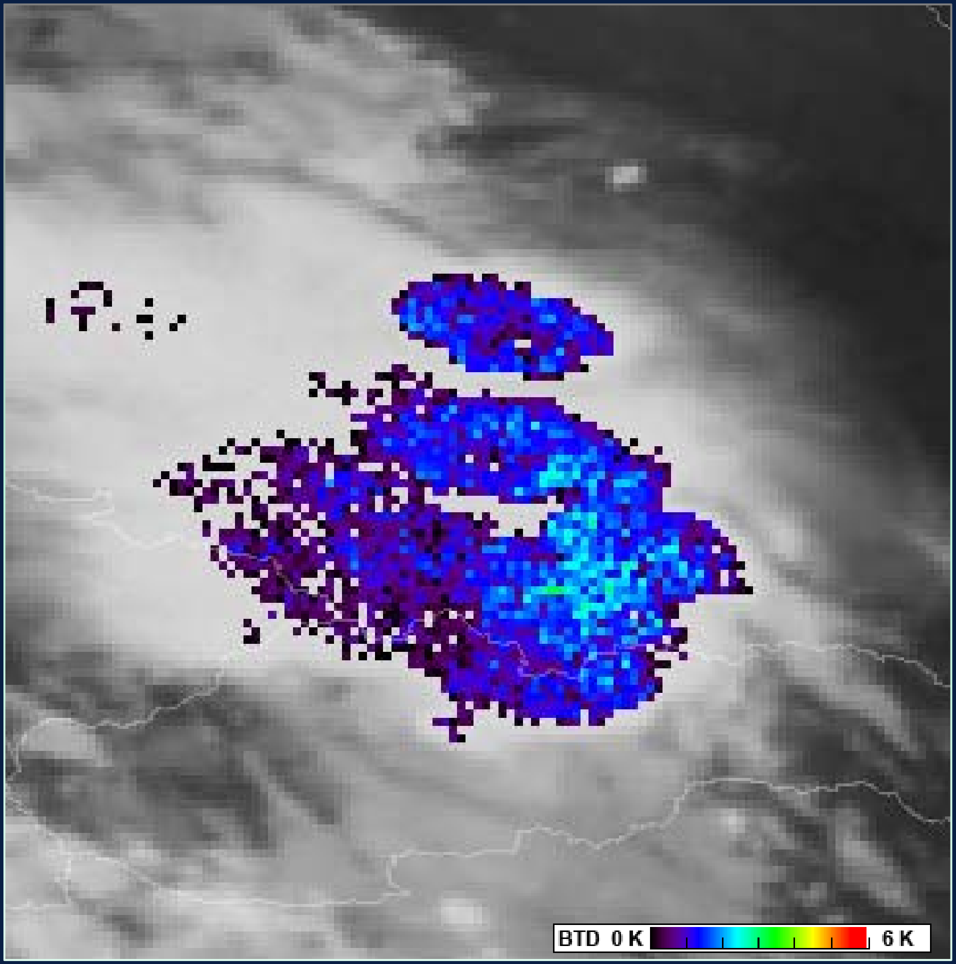
2010-08-15 12:25 UTC Meteosat-8 (MSG-1) Poland and Slovakia

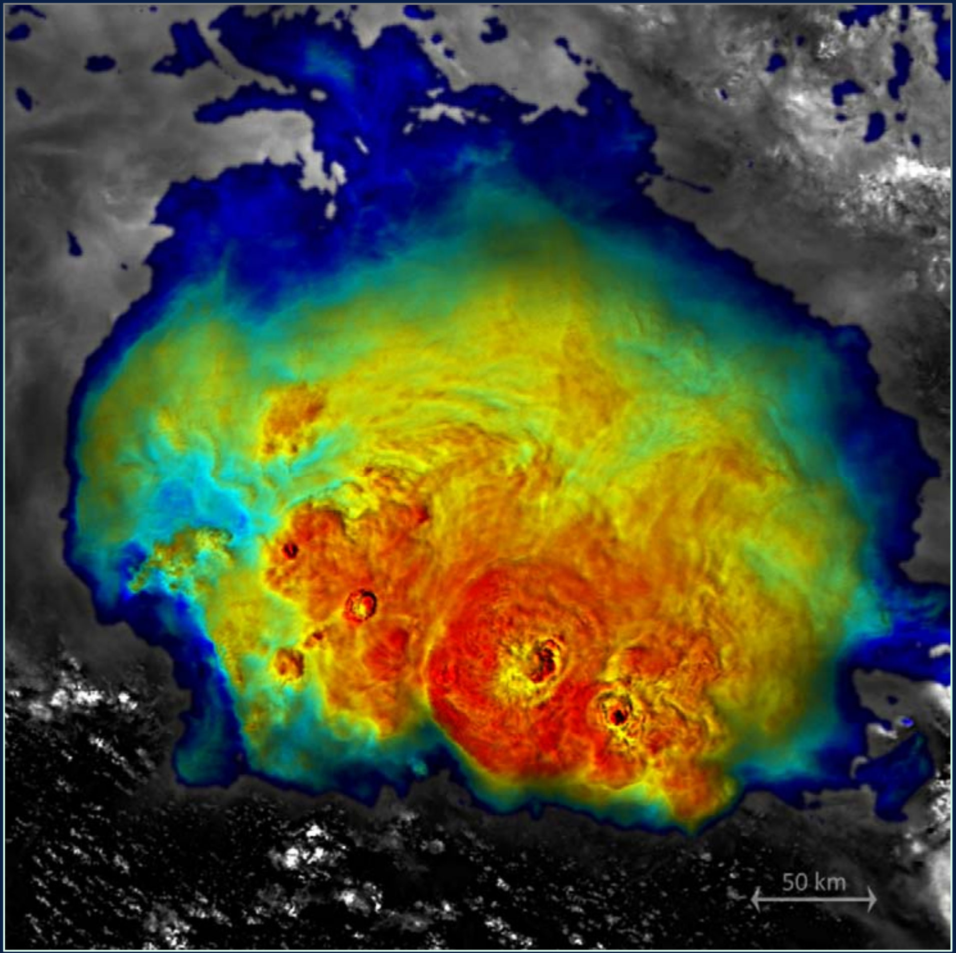




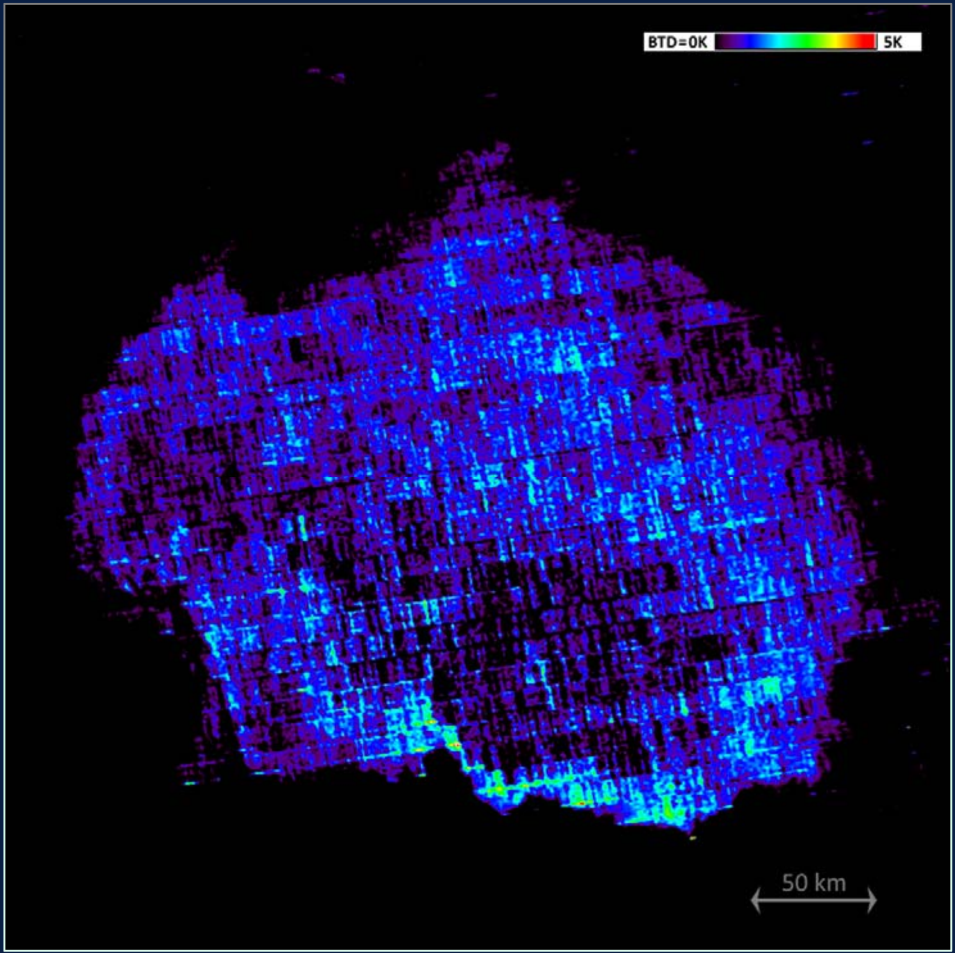
22 December 2007 18:37 UTC

Brazil

2007-12-22 18:37 UTC MODIS/Aqua, Brazil (9°S, 72°W)



MODIS, sandwich of band 1 and band 31 BT (205K – 240K)



BTD b27 (WV abs. band) – b31 (IR window)

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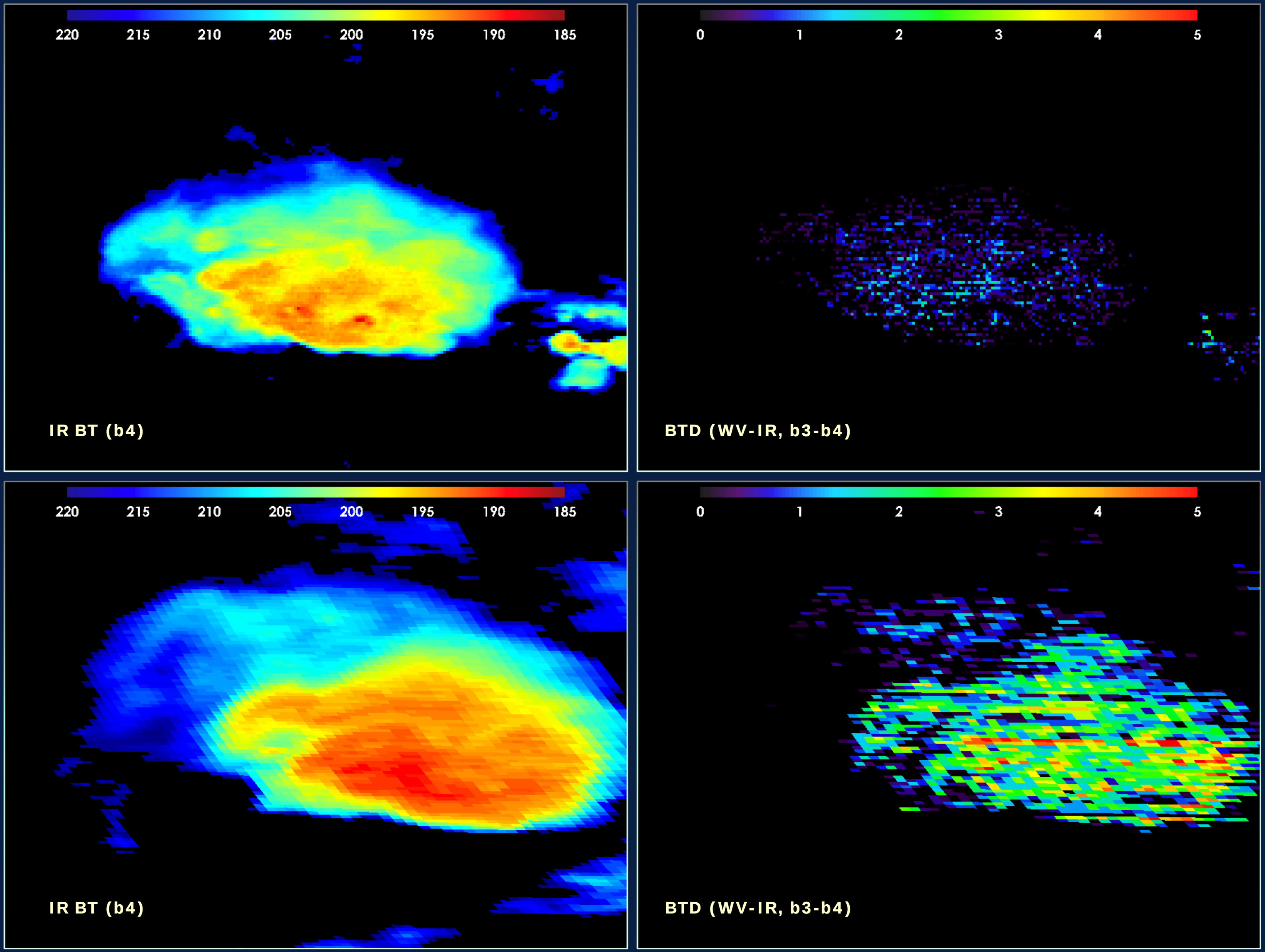
2007-12-22 GOES-East / West, Brazil (9°S, 72°W)



GOES-East

(GOES-12)

75 W

18:45 UTC

GOES-West

(GOES-11)

135 W

18:00 UTC

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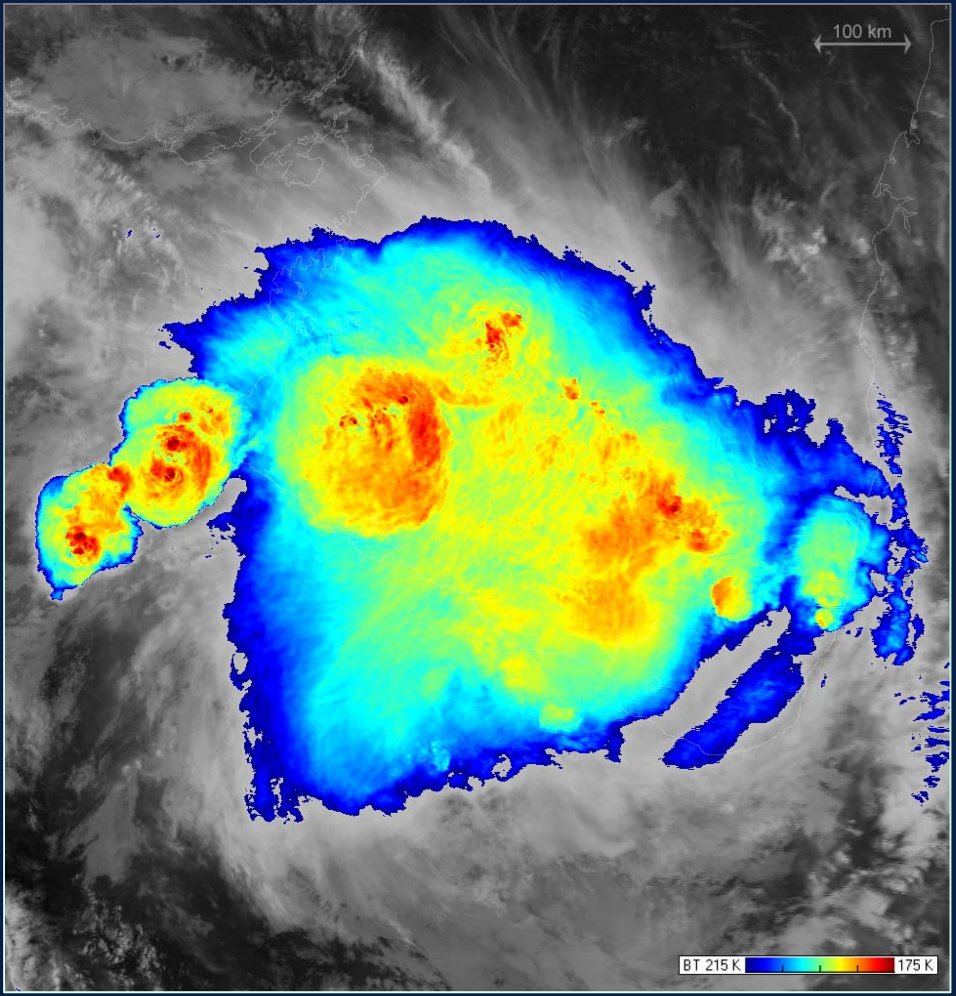
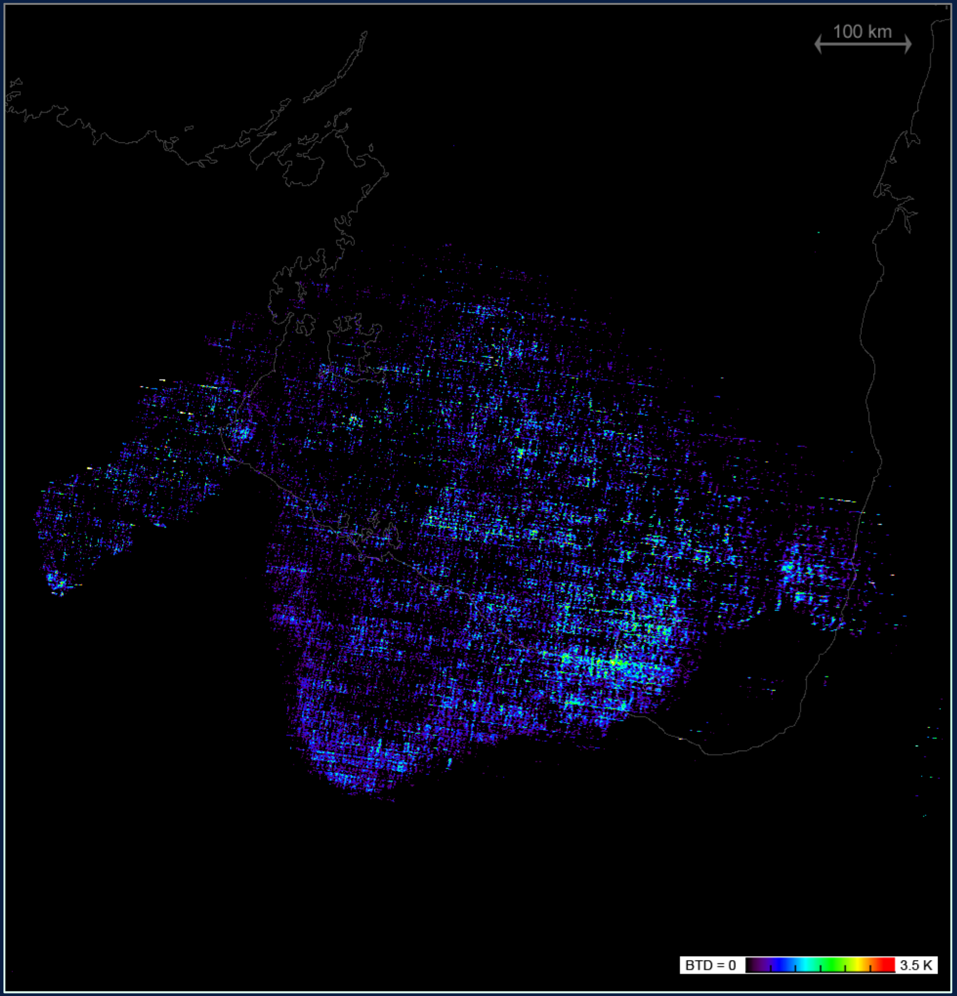
26 January 2010   13:30 UTC

Australia

2010-01-26 13:30 UTC MODIS/Aqua, Australia (15°S, 137°E)



MODIS band 31 BT 175 – 215 K



BTD b27 (WV abs. band) – b31 (IR window) <0K, 3.5K>

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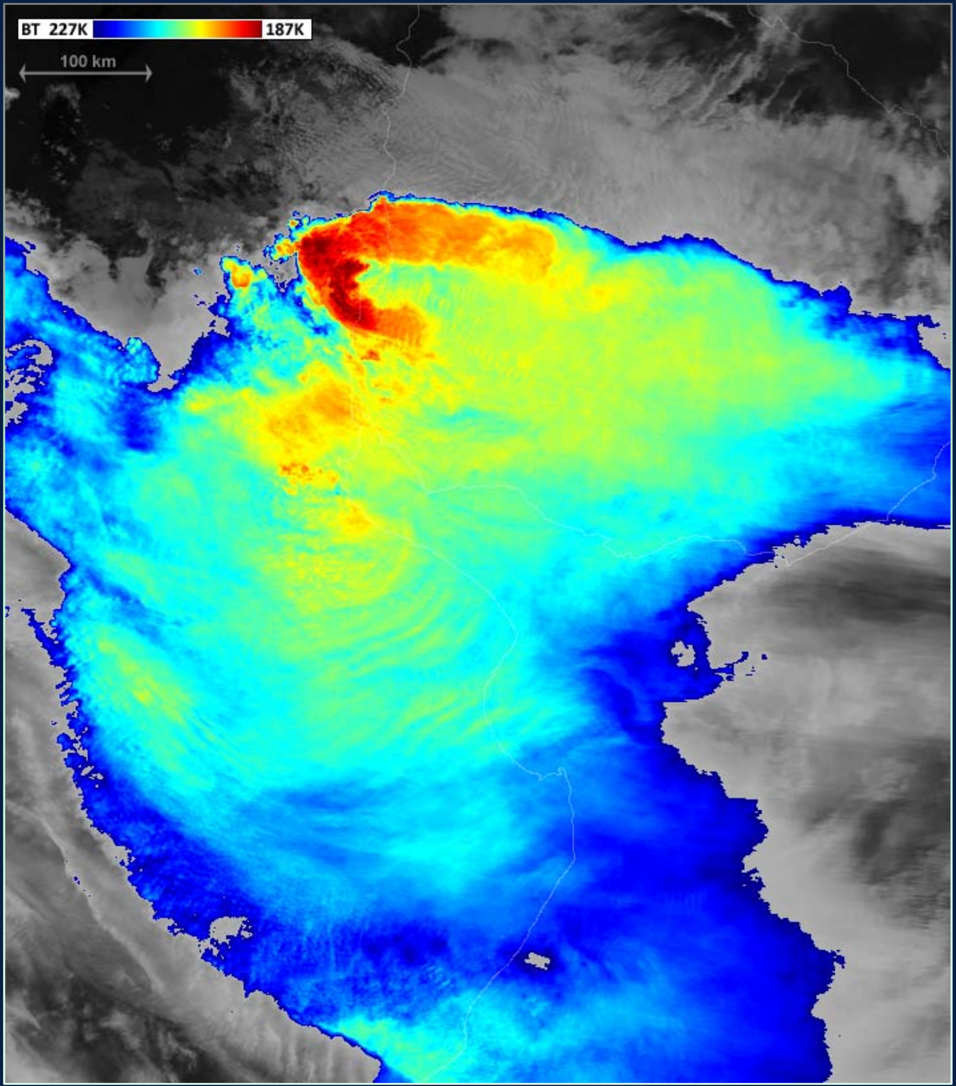
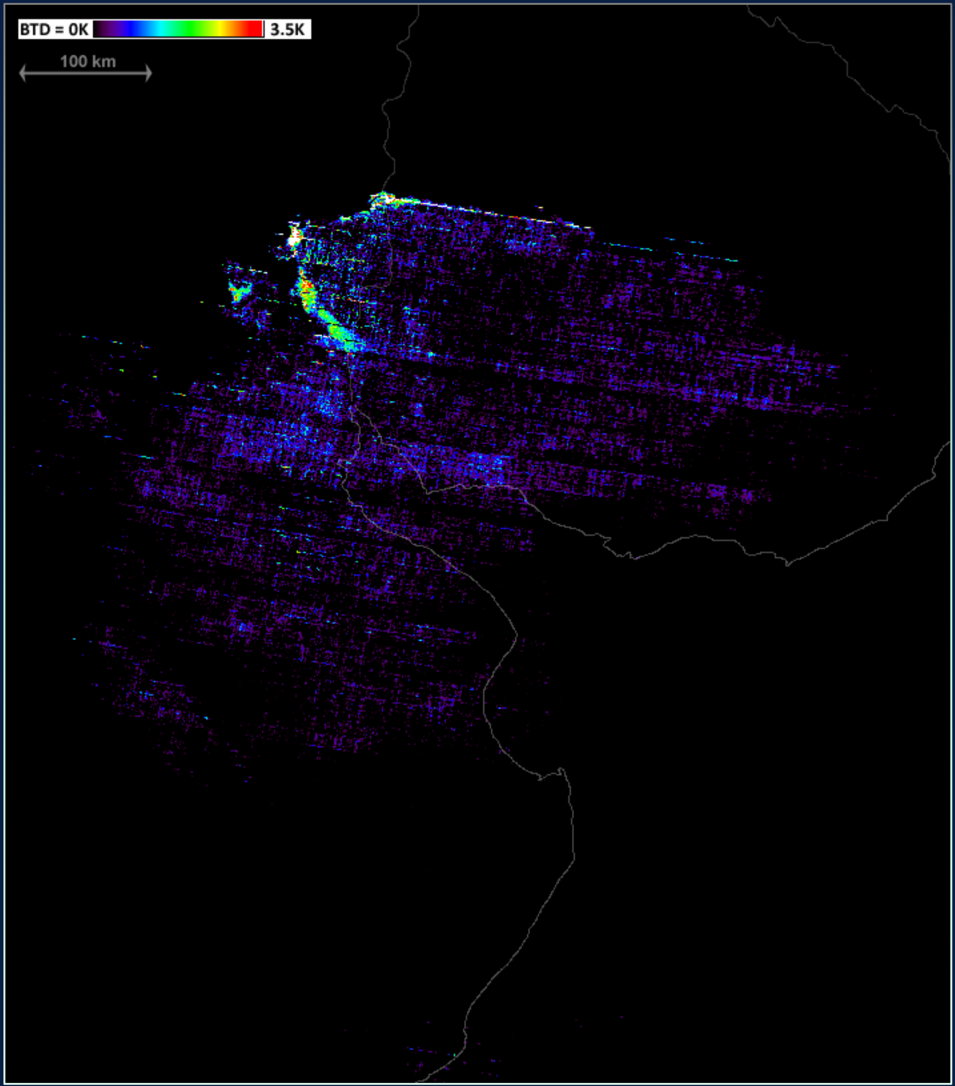
23 December 2009   05:15 UTC

Argentina, Uruguay

2009-12-23 05:15 UTC MODIS/Aqua, Argentina & Uruguay (33°S, 58°W)



MODIS band 31 BT 187 – 227 K



BTD b27 (WV abs. band) – b31 (IR window) <0K, 3.5K>

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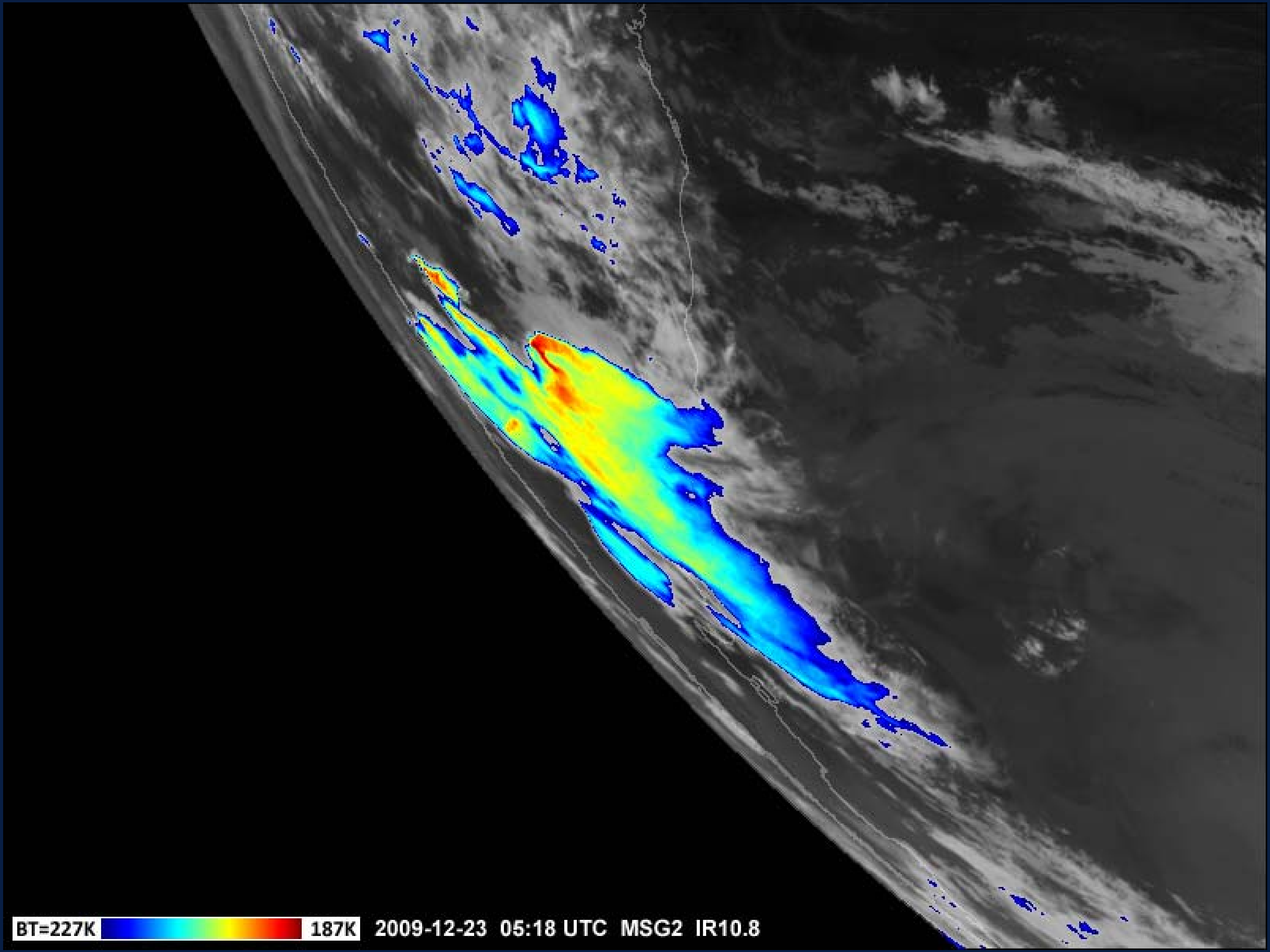
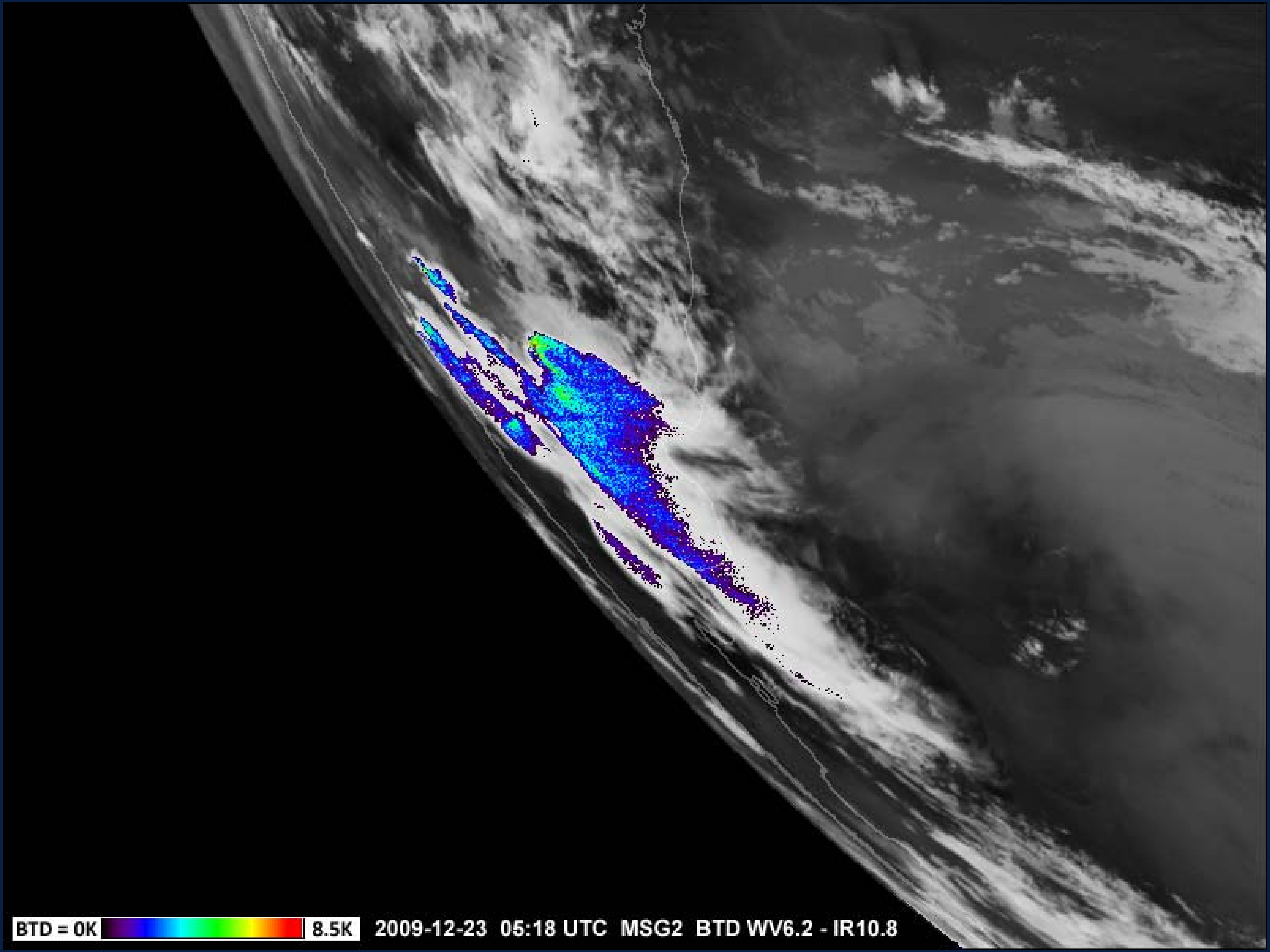
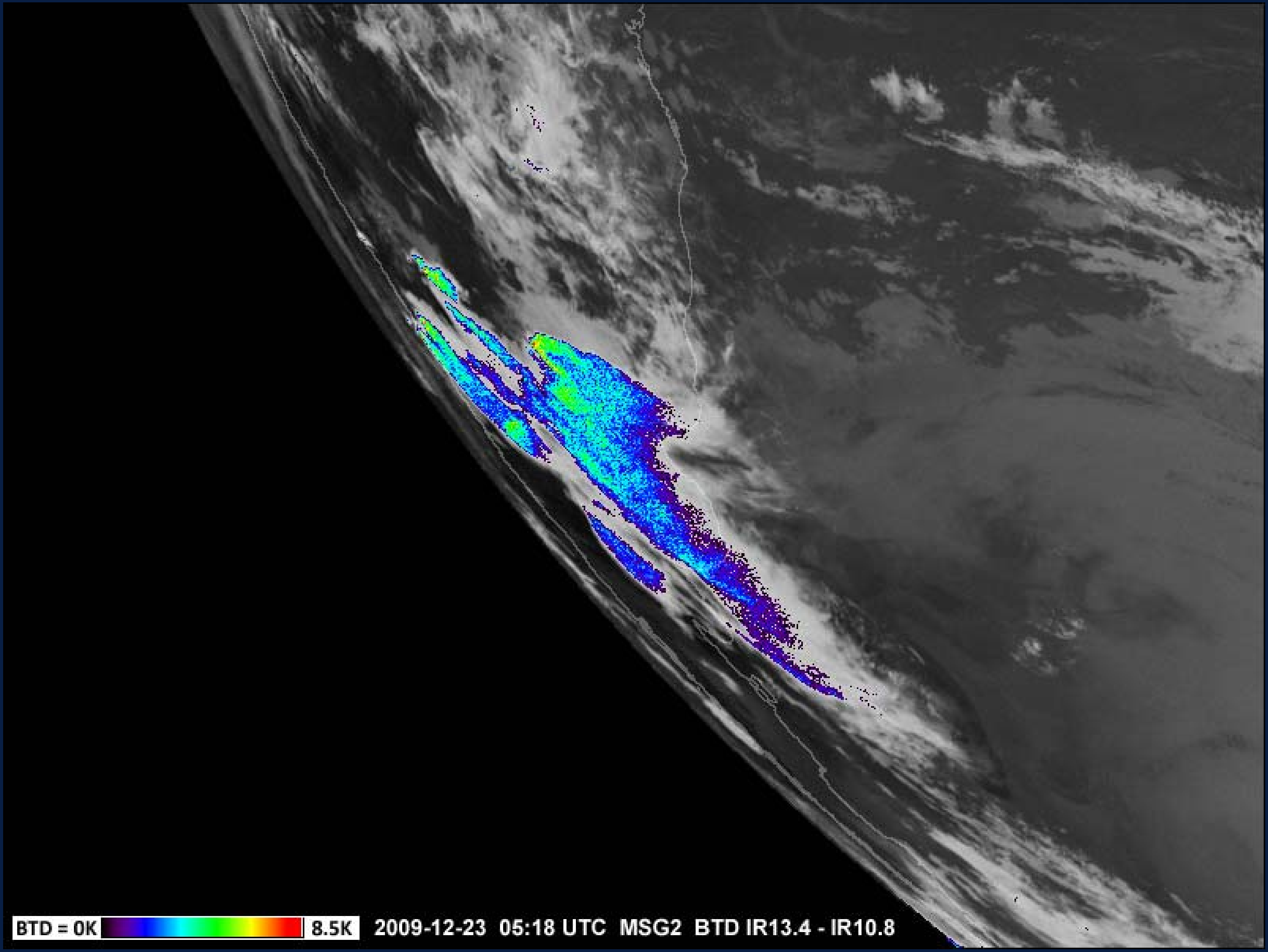
2009-12-23 05:18 UTC Meteosat-9 (MSG-2) (33°S, 58°W)



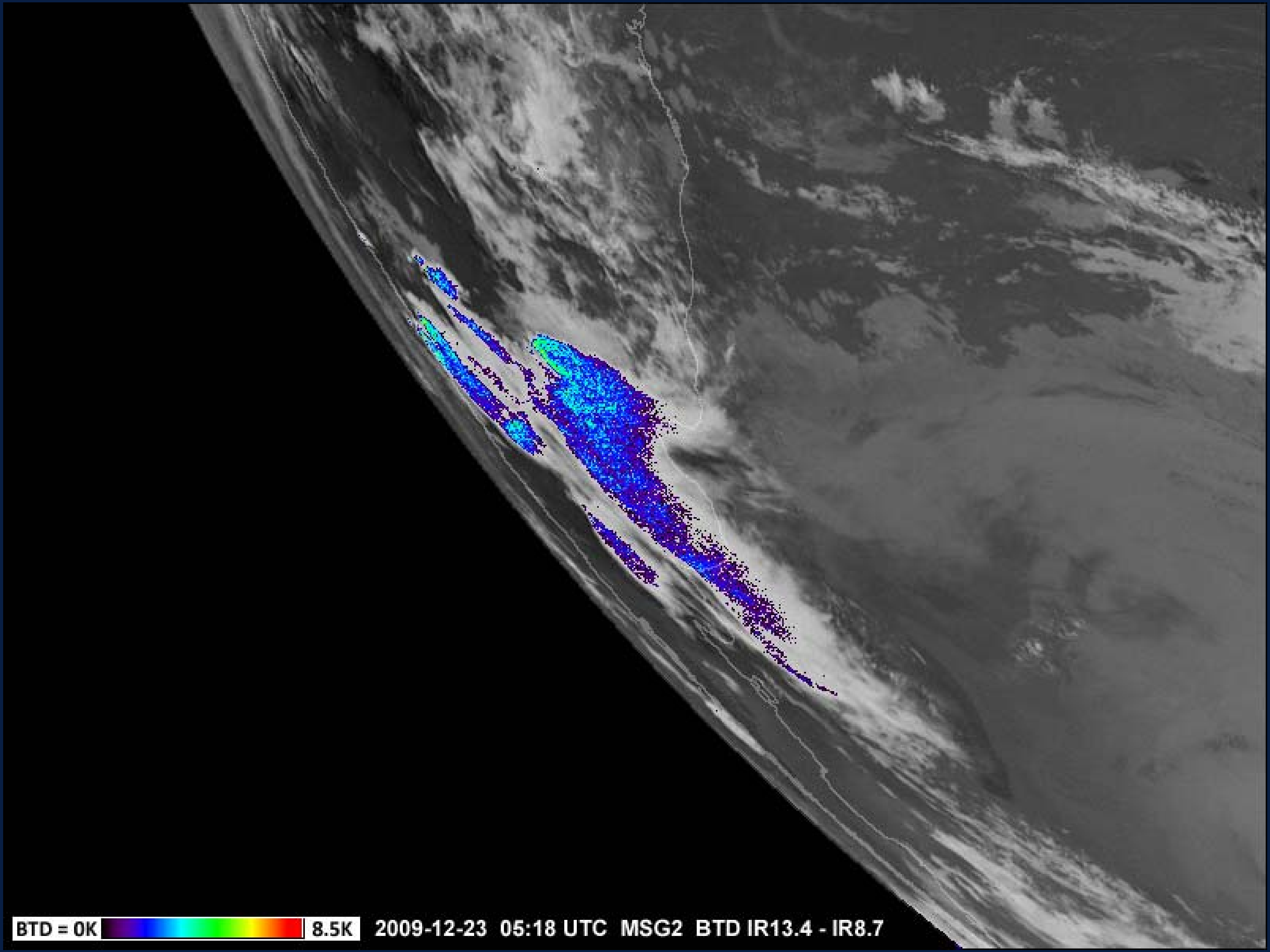
2009-12-23 05:18 UTC Meteosat-9 (MSG-2) (33°S, 58°W)



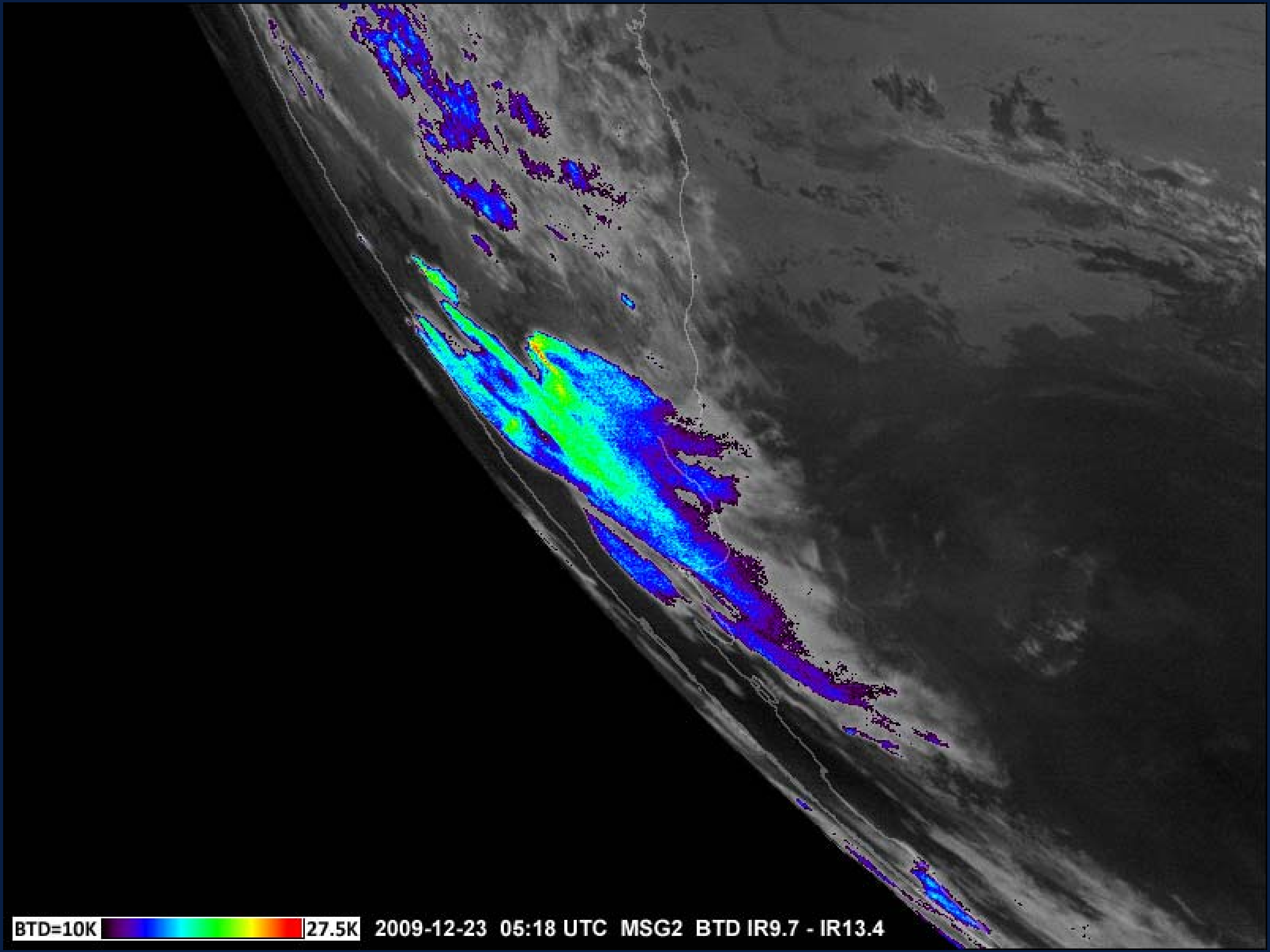
2009-12-23 05:18 UTC Meteosat-9 (MSG-2) (33°S, 58°W)



2009-12-23 05:18 UTC Meteosat-9 (MSG-2) (33°S, 58°W)



2009-12-23 05:18 UTC Meteosat-9 (MSG-2) (33°S, 58°W)

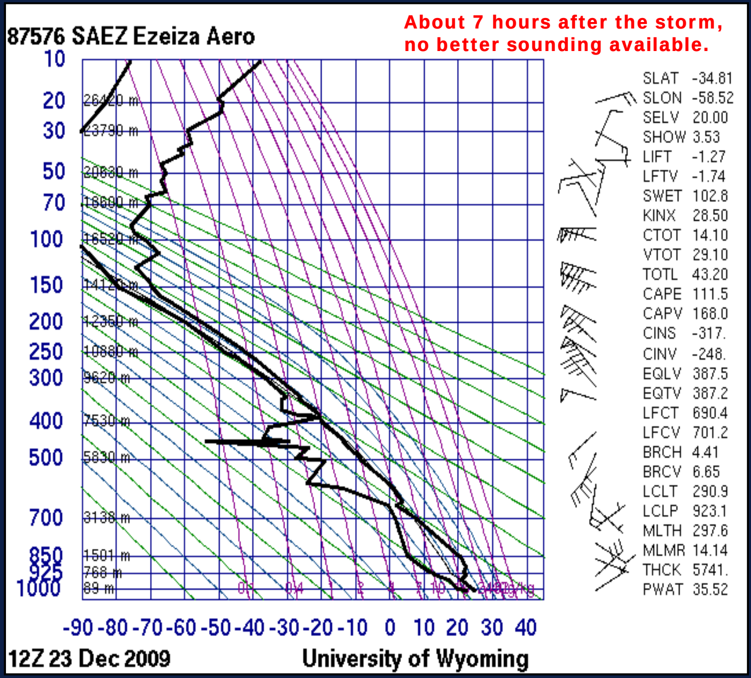


Some preliminary RTM simulations for the Argentina 2009-12-23 case
(Dan Lindsey, Louis Grasso)

Using the SAEZ Azeiza Aero (87576) 12Z sounding, with the water vapor mixing ratio above the anvil top set to 0.001 g/kg. An opaque anvil top is placed at 200K (14.8 km, close to the tropopause), the "thin cloud" case assumes additional optically thin (0.25) cirrus layer between 15.3-16.4km (warm layer), while the "moisture" case assumes the same layer containing 0.007 g/kg of water vapor.

BTD (6.2-11.2) for GOES-E and "MSG"
BTD (6.8-11.0) for MODIS

Bare storm top – MODIS	0.0195 K
Bare storm top – GOES-E	0.0884 K
Bare storm top – MSG	0.8457 K
Thin cloud – MODIS	0.0455 K
Thin cloud – GOES-E	0.0441 K
Thin cloud – MSG	0.4619 K
Moisture – MODIS	0.0278 K
Moisture – GOES-E	0.1492 K
Moisture – MSG	0.9728 K



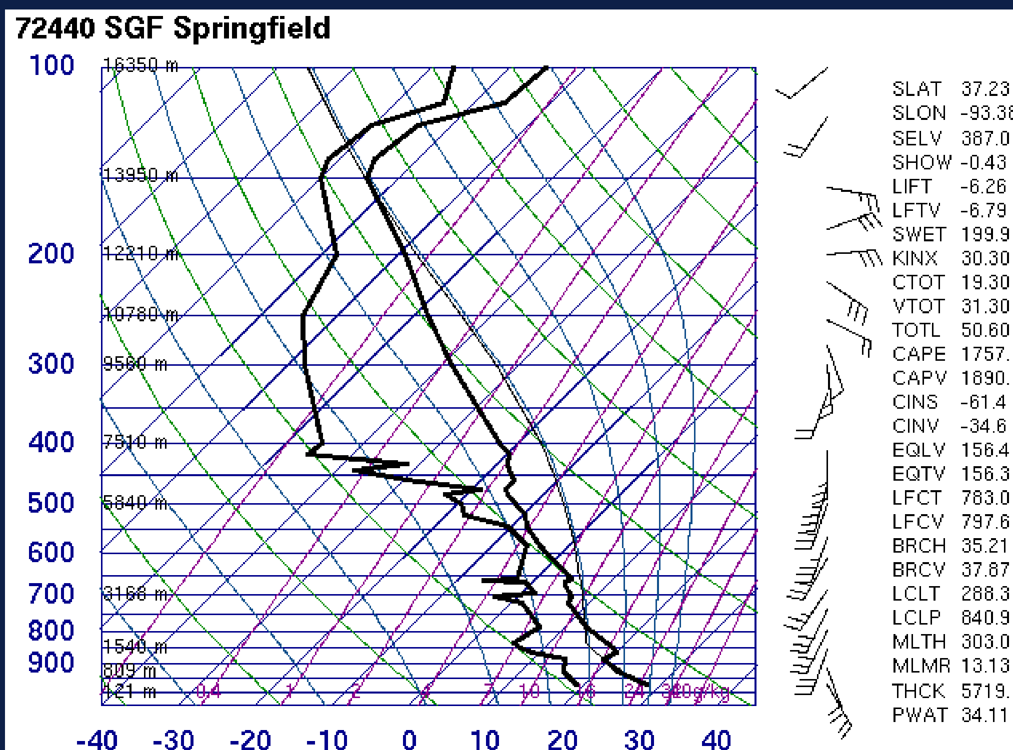
"GOES-E" assumes the GOES-R ABI bands, "MSG" represents the values if observed by GOES-R with the storm at a satellite-relative location as if viewed from MSG, and "MODIS" represents the nadir view.

These results support the "limb effect", i.e., an increase of the BTD values when observing the storm close to the edge of the globe (tilted view). Similar effects also occur for other BTDs utilizing any of the absorption bands. For the "MSG" case, higher BTD values are seen even without increased moisture directly above the storm. The disclaimer here is that we are not confident the RTM is handling the limb simulations properly.

Some preliminary RTM simulations for the Missouri 2007-05-07 case (Sounding from 18 UTC)

MODIS RTM Simulations

	6.8 µm	11.0 µm	6.8-11.0 µm
Base Case	200.483	199.711	0.772
Enhanced WV	200.642	199.711	0.931
Thin Cloud	201.636	201.013	0.623



- The base case results show warmer BTs at 6.8 µm compared to 11.0 µm, suggesting that water vapor above the cloud top is absorbing 6.8 µm and reradiating at the warmer temp
- Enhancing WV above storm top increases the 6.8 µm BT, but the 11.0 µm BT remains the same
- A thin cloud above the storm having an 11.0 µm optical depth of 0.27 increases the 6.8 µm BT, but the 11.0 µm BT increases even more, resulting in a *lower* BTD compared to the base case