UNDERSTANDING CONVECTIVE CLOUDS THROUGH THE EYES OF METEOSAT SECOND GENERATION (MSG)

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Low-level Humidity

Picture from Bernhard Muehr

Observing Low-level Humidity

MFG: no channel (indirectly with VIS channel)

MSG: one IR BTDs

BTD IR10.8 - IR12.0

one RGB product

RGB 24-h Microphysics (Dust, Clouds)

three derived products

Nowcasting SAF: TPW, LPW (BL)

MPEF: GII (TPW)

Background Theory

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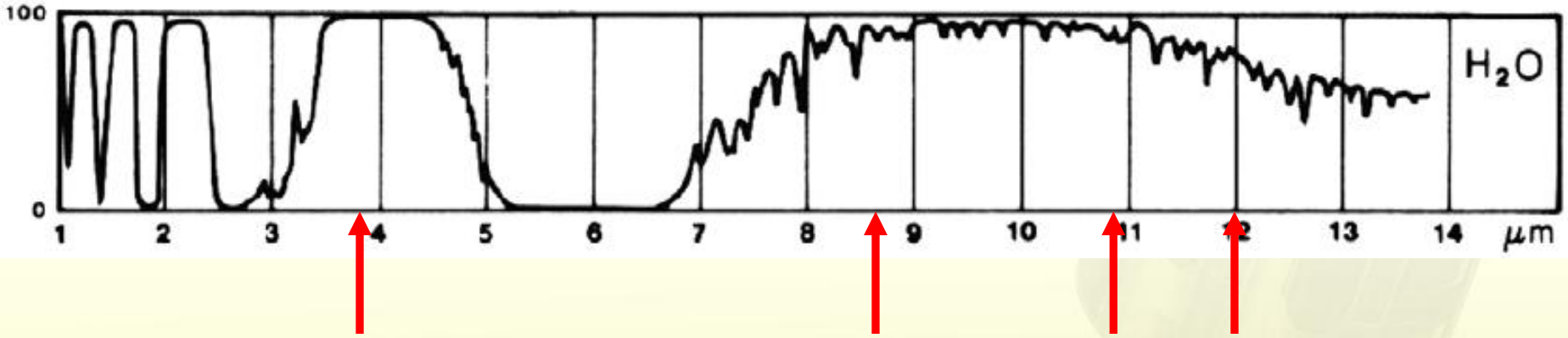
WV Absorption Bands in the IR Region



IR3.9 IR8.7 IR10.8 IR12.0

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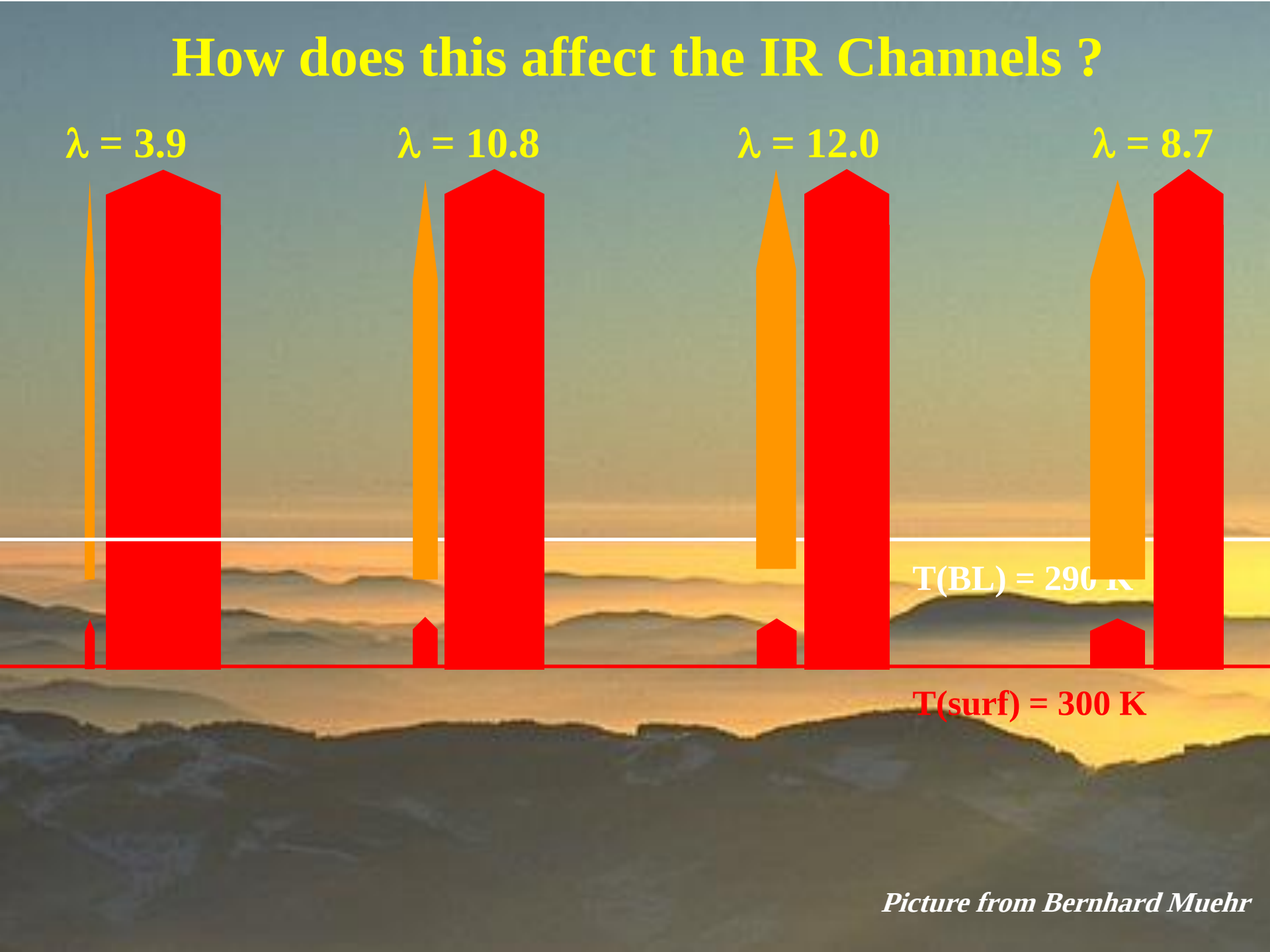
How does this affect the IR Channels ?



Picture from Bernhard Muehr

Effect on Brightness Temperatures

λ = 3.9 λ = 10.8 λ = 12.0 λ = 8.7

BT(3.9) > BT(10.8) > BT(12.0) > BT(8.7)

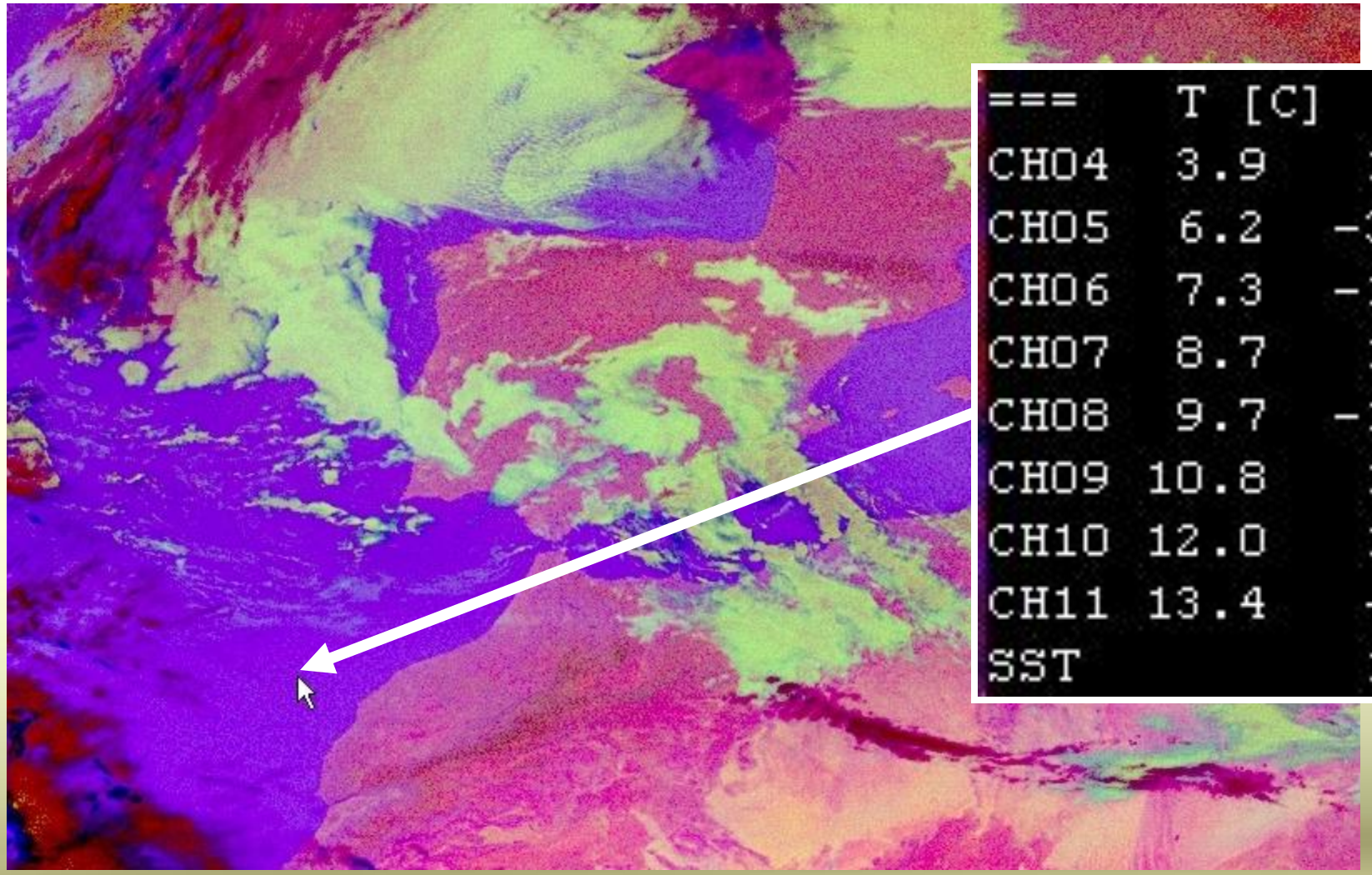
(neglecting other effects)

BTD IR10.8-IR12.0 > 0 K (0 K very dry … +4/6 K very moist)

BTD depends on humidity profile, temperature profile (in part. T(surf)-T(BL)) and viewing angle !

Picture from Bernhard Muehr

IR Brightness Temperatures: Example



Met-8, 23 January 2006, 03:00 UTC
Night Microphysical RGB

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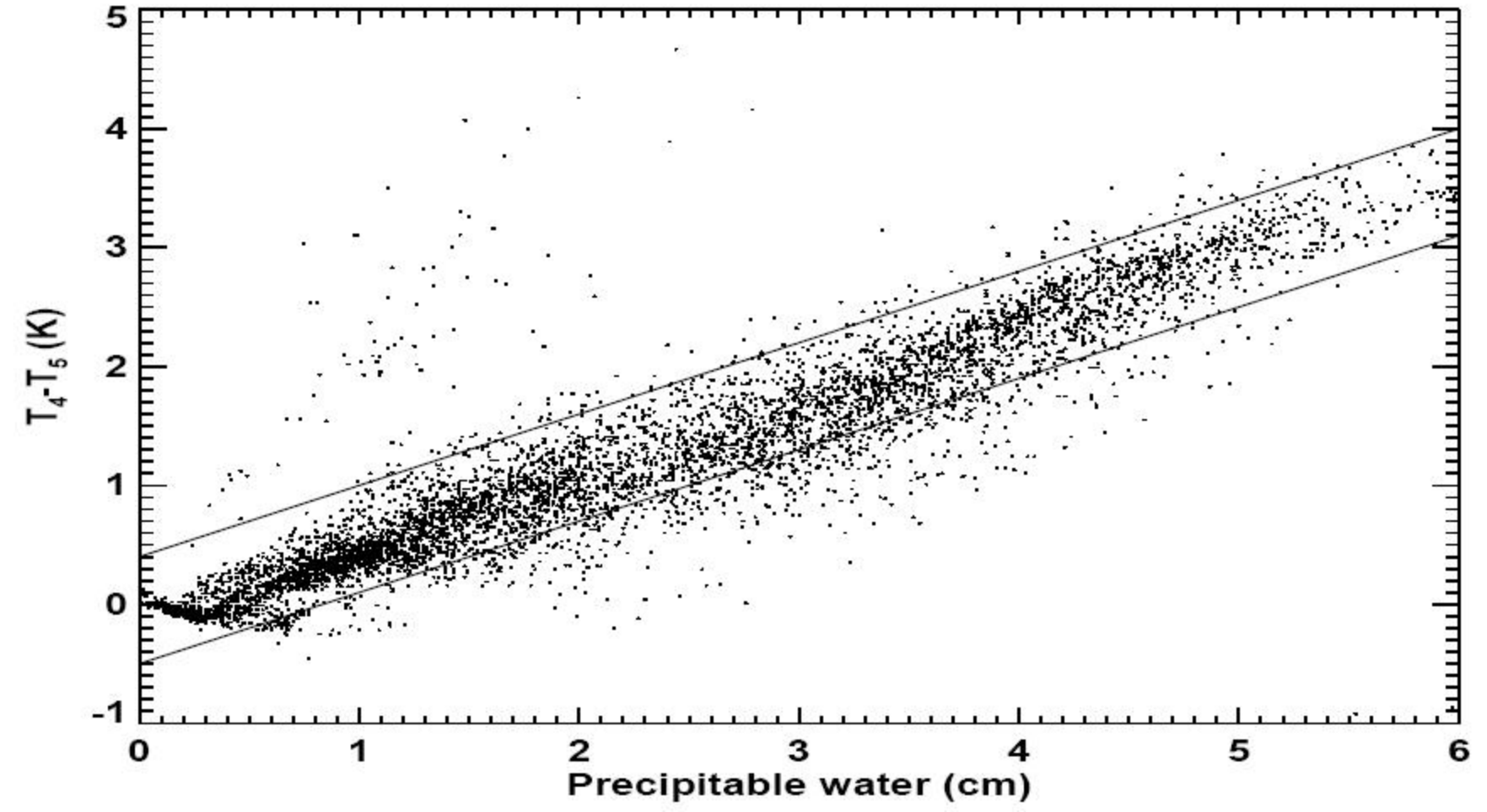
BTD IR10.8 – IR12.0



Global distributions of 11 um - 12 um brightness temperatures vs precipitable water for 26 December 1996 at 00 Z (from NCEP data)

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Exercise: Low-level Temperature Inversion (T(BL) > T(surf))

BT(10.8) > = < BT(12.0) ???

Solution:

BT(10.8) < BT(12.0)

(neglecting other effects)

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Observing Low-level Humidity in BTD IR10.8 - IR12.0 Images

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Case South Africa, 14 December 2009

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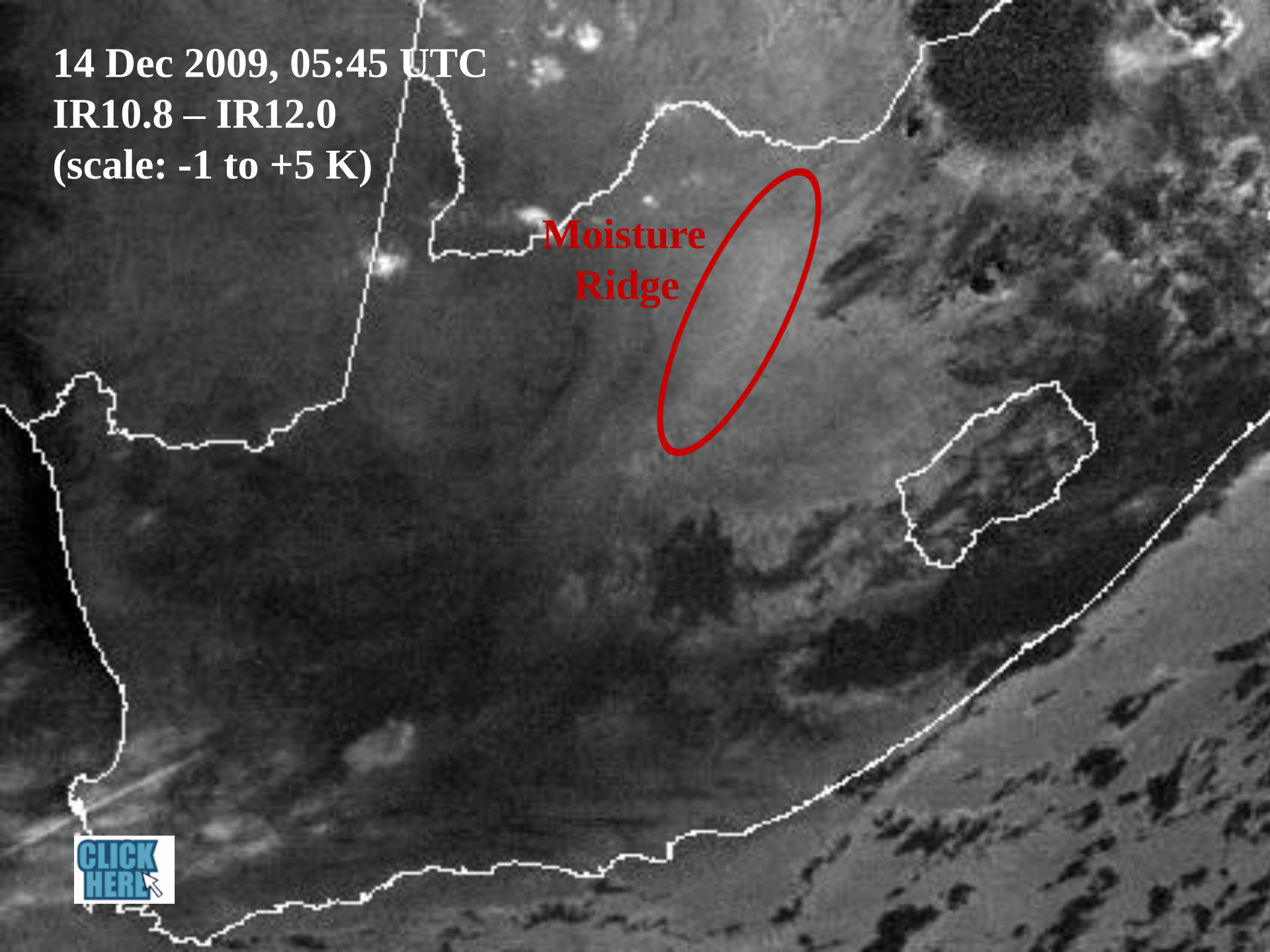
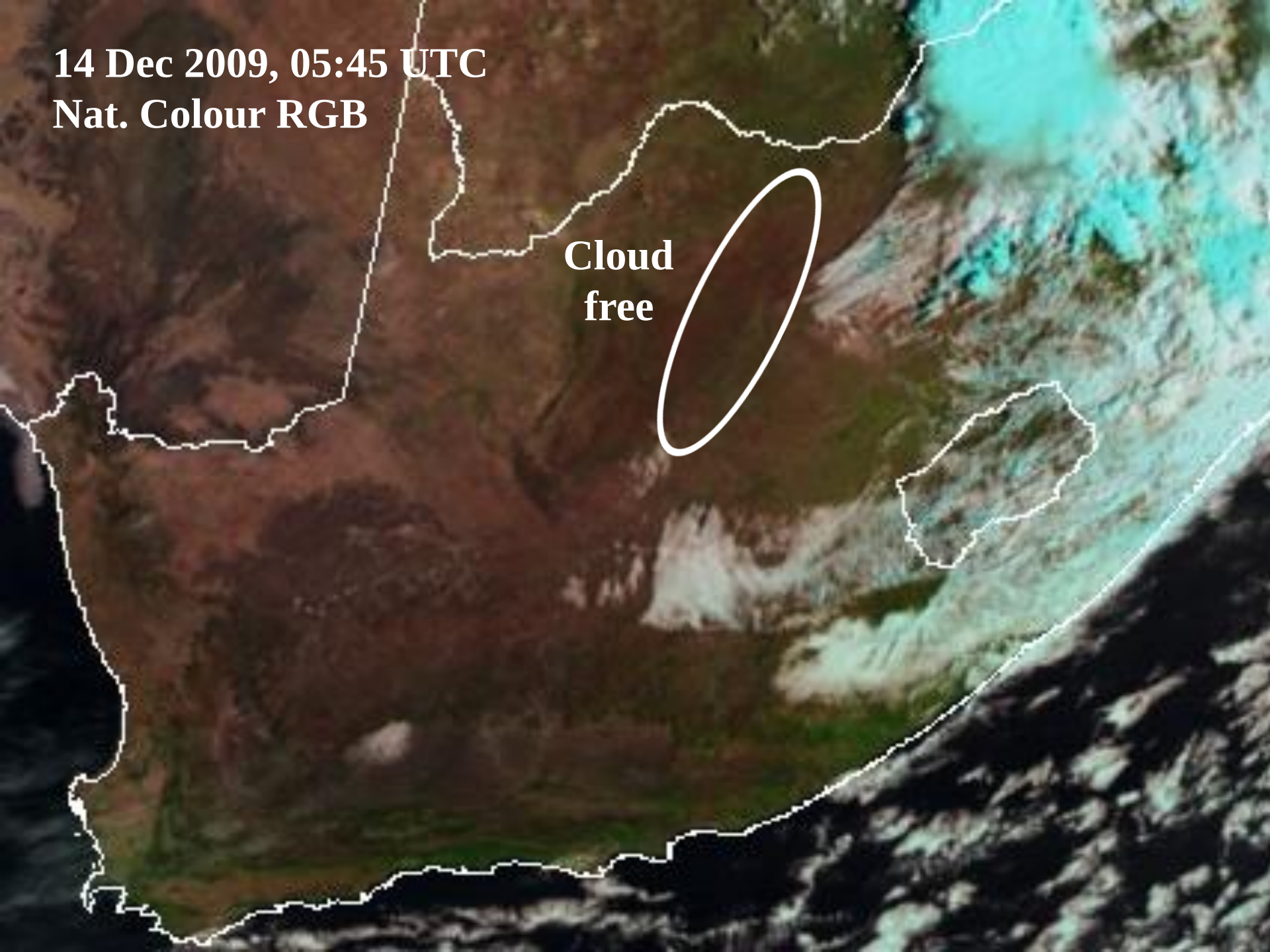
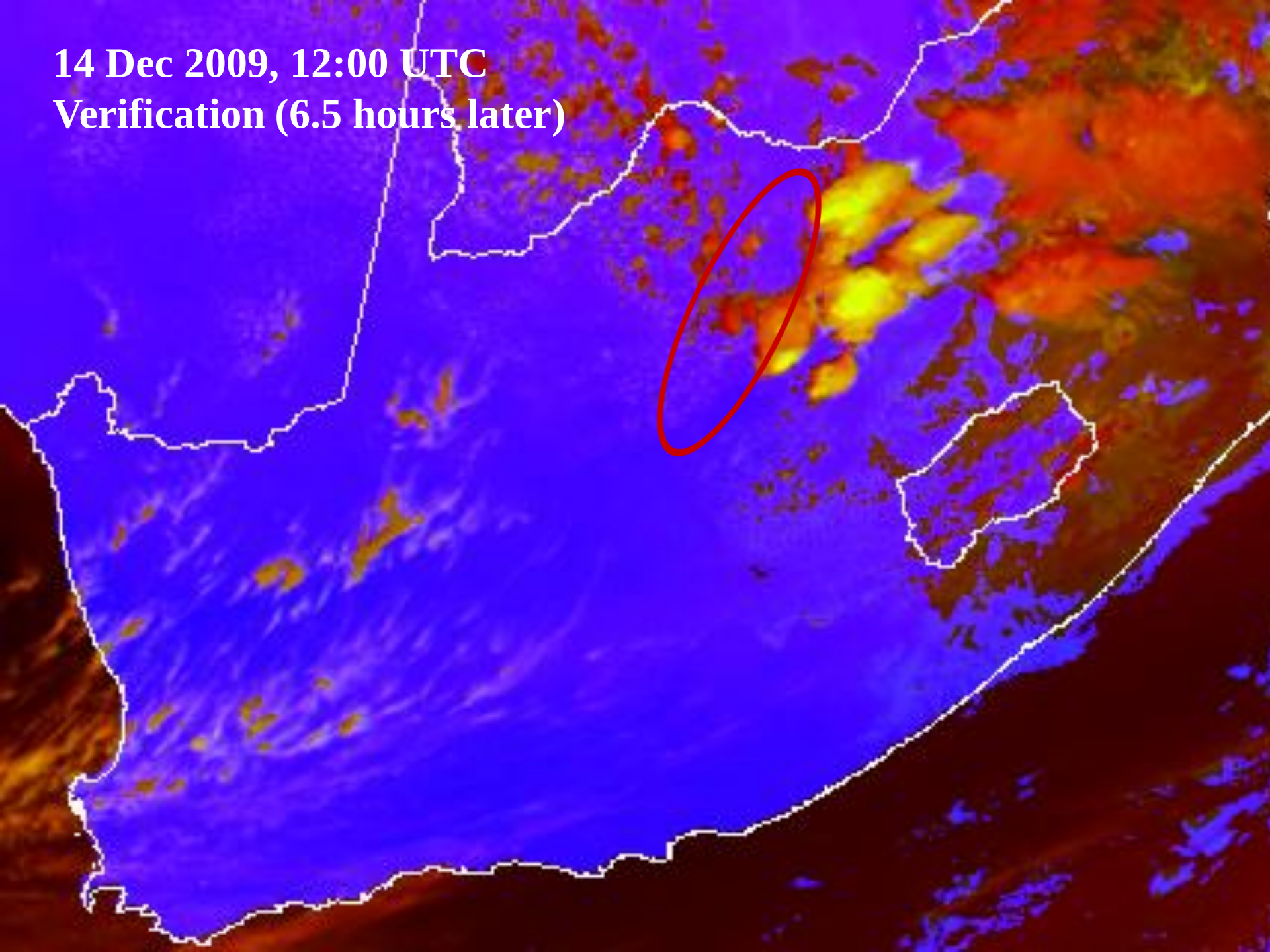
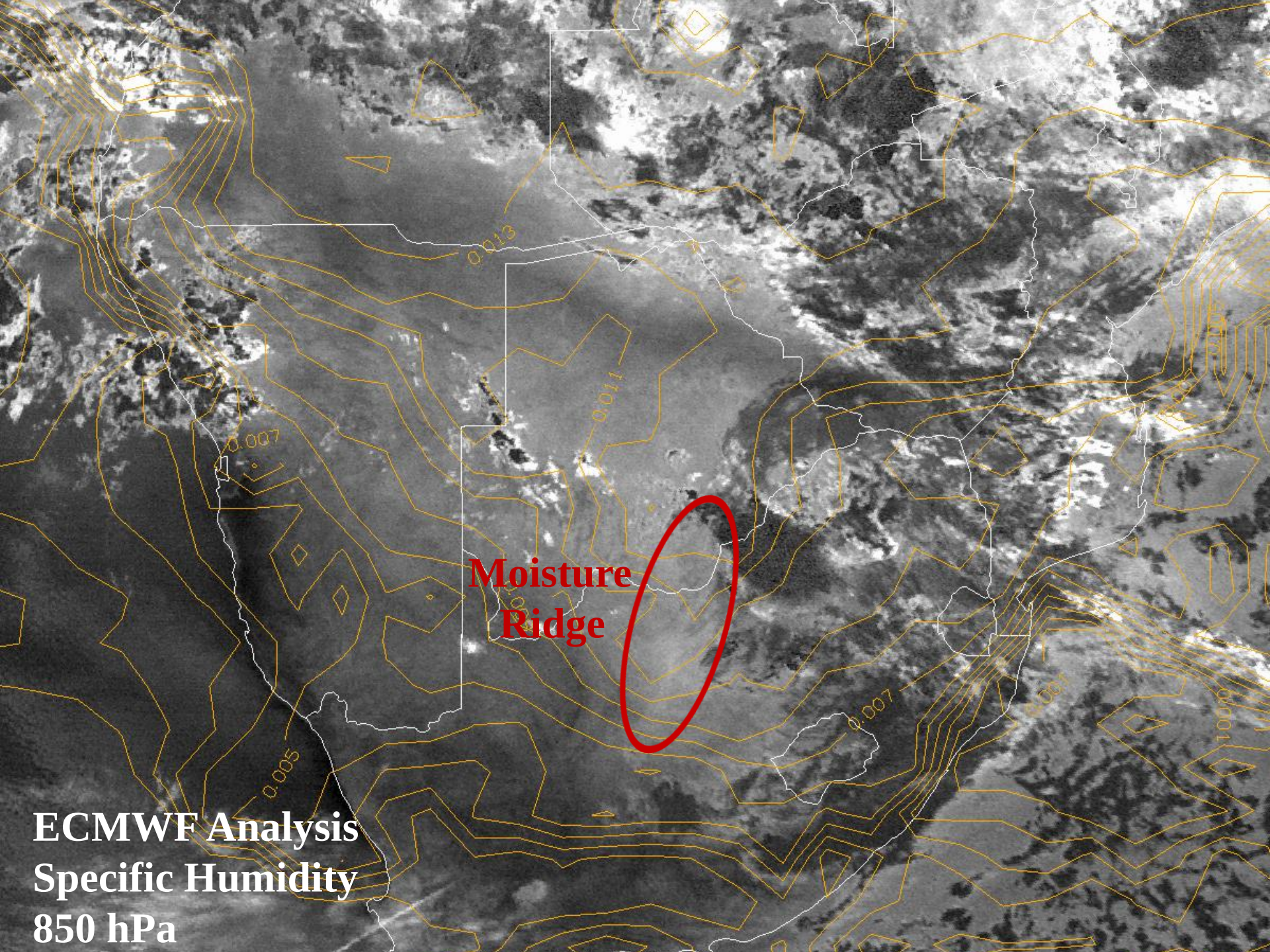

14 Dec 2009, 05:45 UTC
IR10.8 – IR12.0
(scale: -1 to +5 K)
Moisture
Ridge
CLICK
HERE


14 Dec 2009, 05:45 UTC
Nat. Colour RGB
Cloud
free


14 Dec 2009, 12:00 UTC
Verification (6.5 hours later)


Moisture
Ridge
ECMWF Analysis
Specific Humidity
850 hPa

Limitations

- Must be cloud free (Cirrus clouds disturb)
- Does not work at night (temperature inversion)
- Does not work in high mountain areas
- There is a very strong diurnal cycle
- Difficult to separate the temperature effect from the moisture effect (e.g. low moisture over hot surfaces gives the same signal as high moistures over cooler ground)
- Emissivity effects (sandy surfaces) are also contaminating the BTD product

Low-level Humidity In RGB Products

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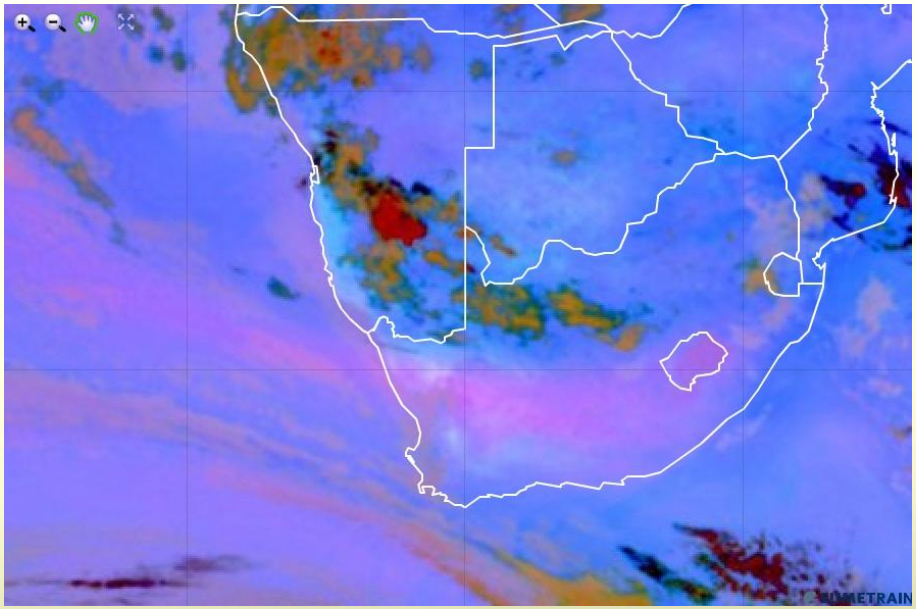
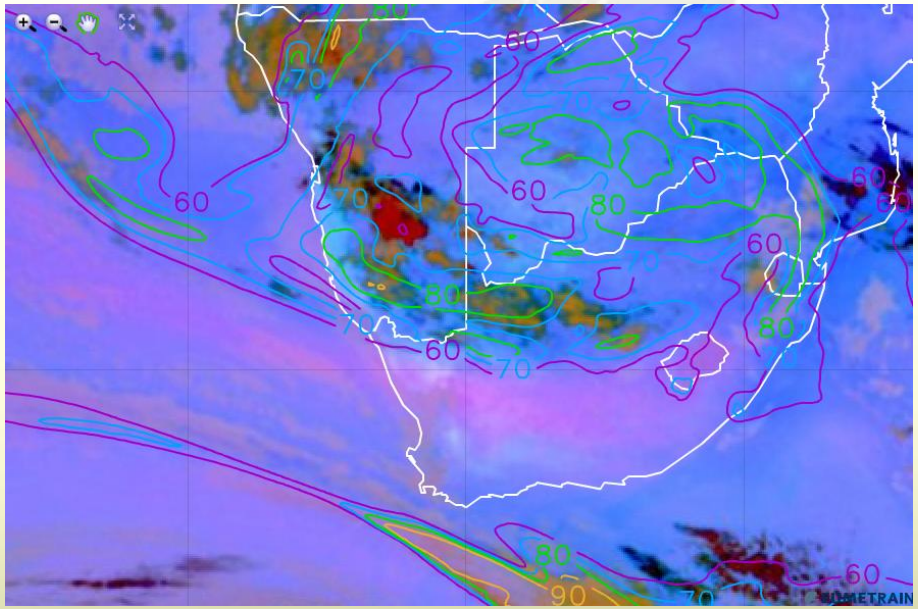
Color Selector

ICE applet



Dust RGB Product
MSG (Meteosat-9) 22 Feb 2012, 06 UTC



RH 700
22 Feb 2012, 06 UTC

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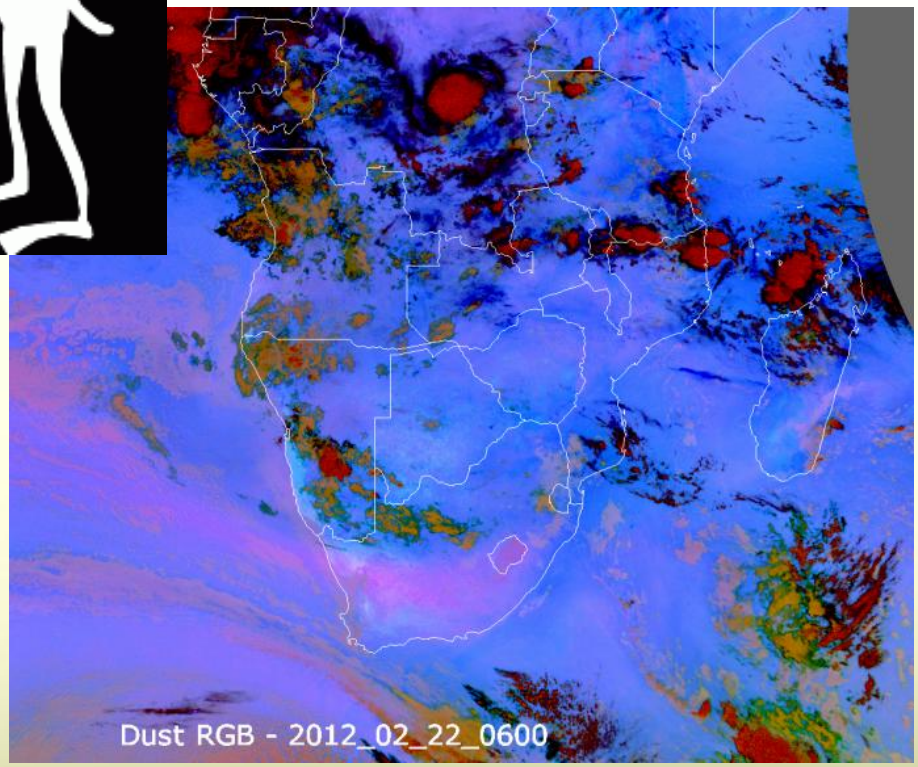
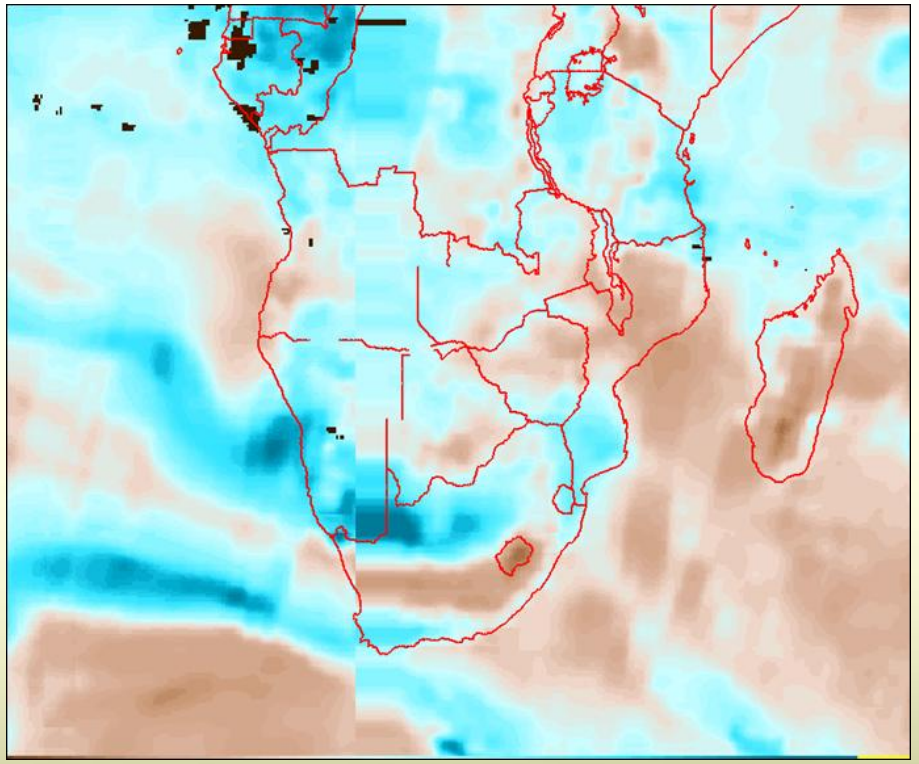
Do a storm forecast ?



Dust RGB Product
MSG (Meteosat-9) 22 Feb 2012, 06 UTC



Blended Total Precipitable Water Percent of Normal
03-08 UTC 22 Feb 2012

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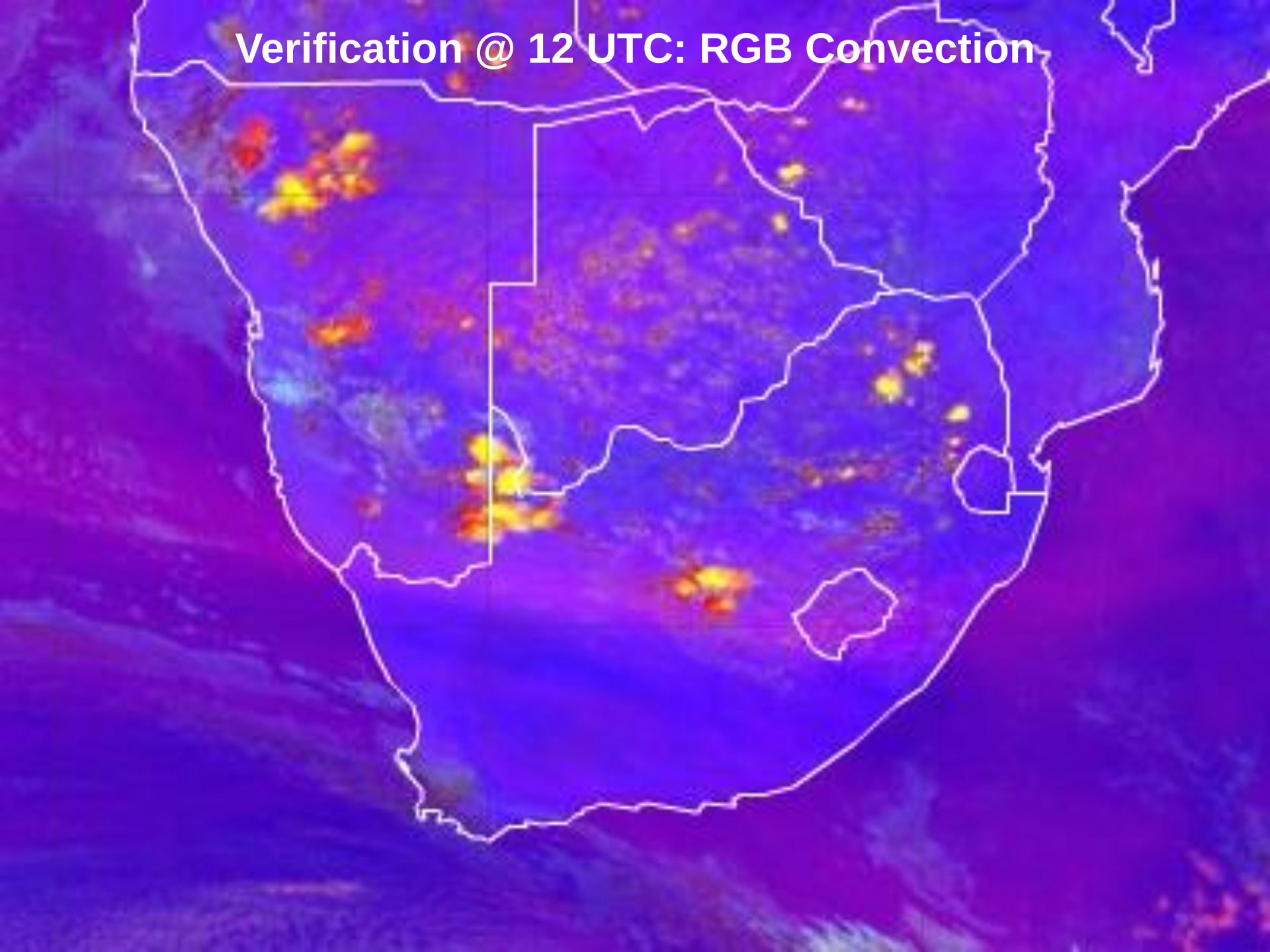
Verification @ 12 UTC: RGB Convection



Works only in Southern Africa?

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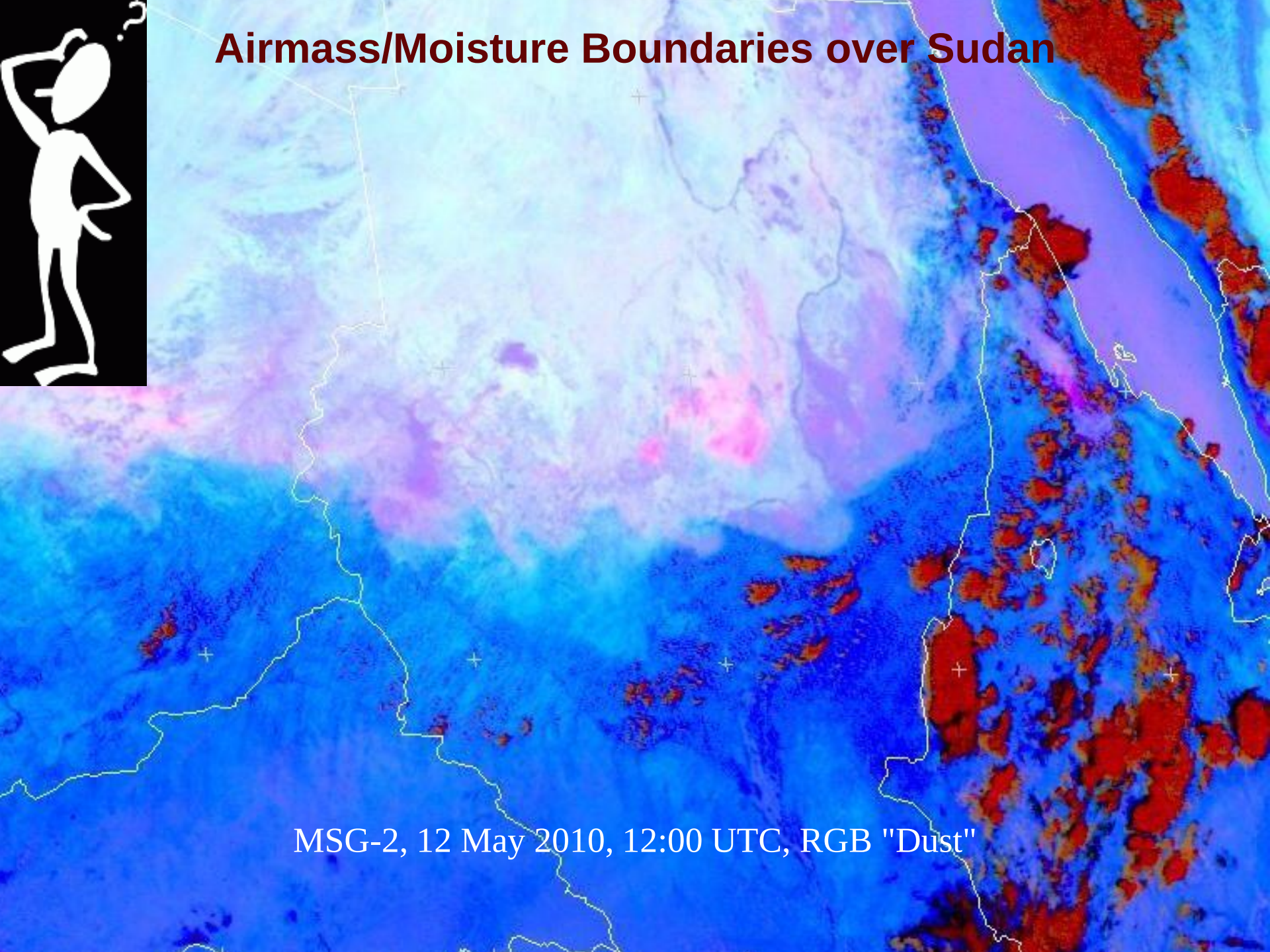
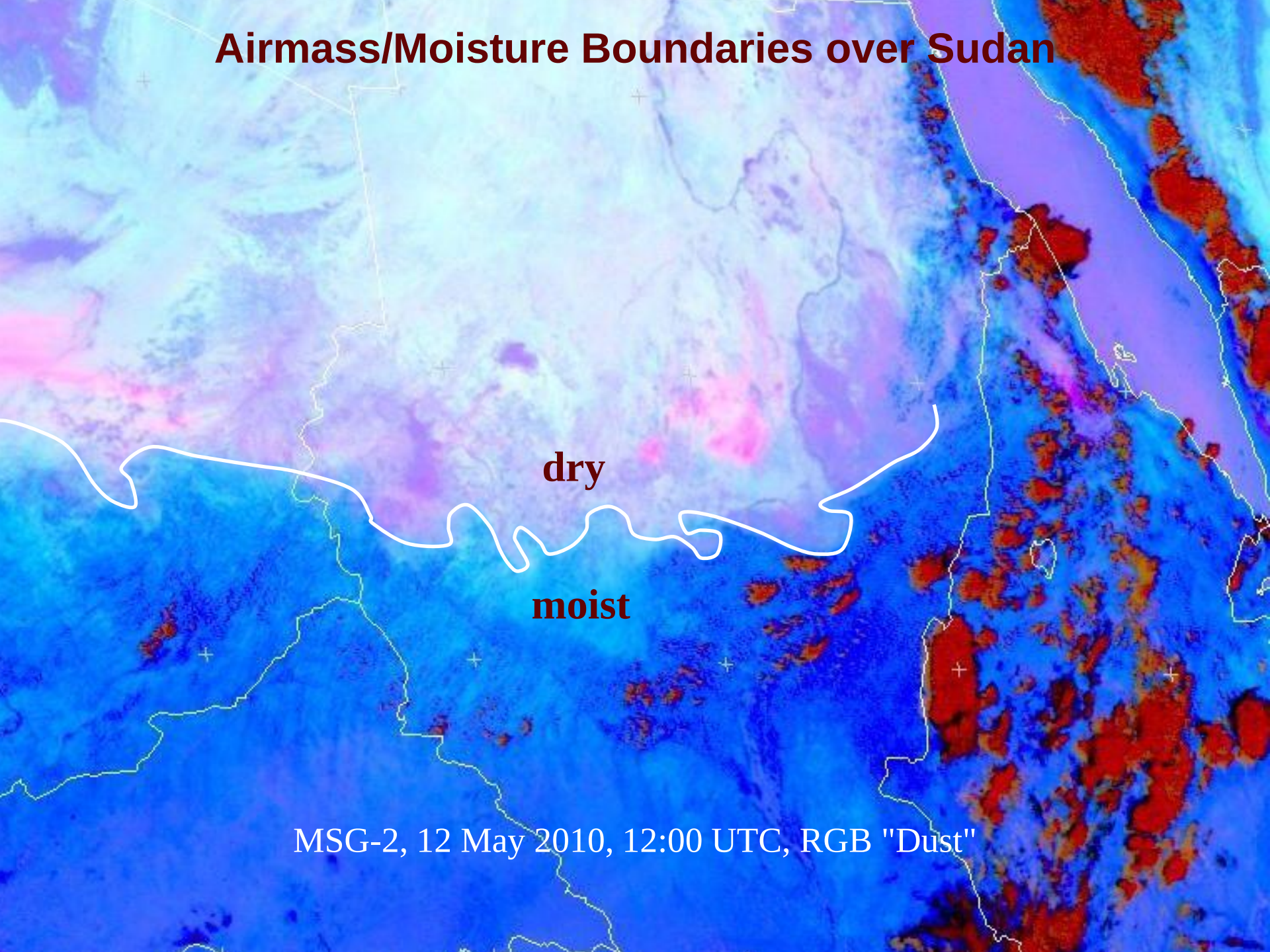
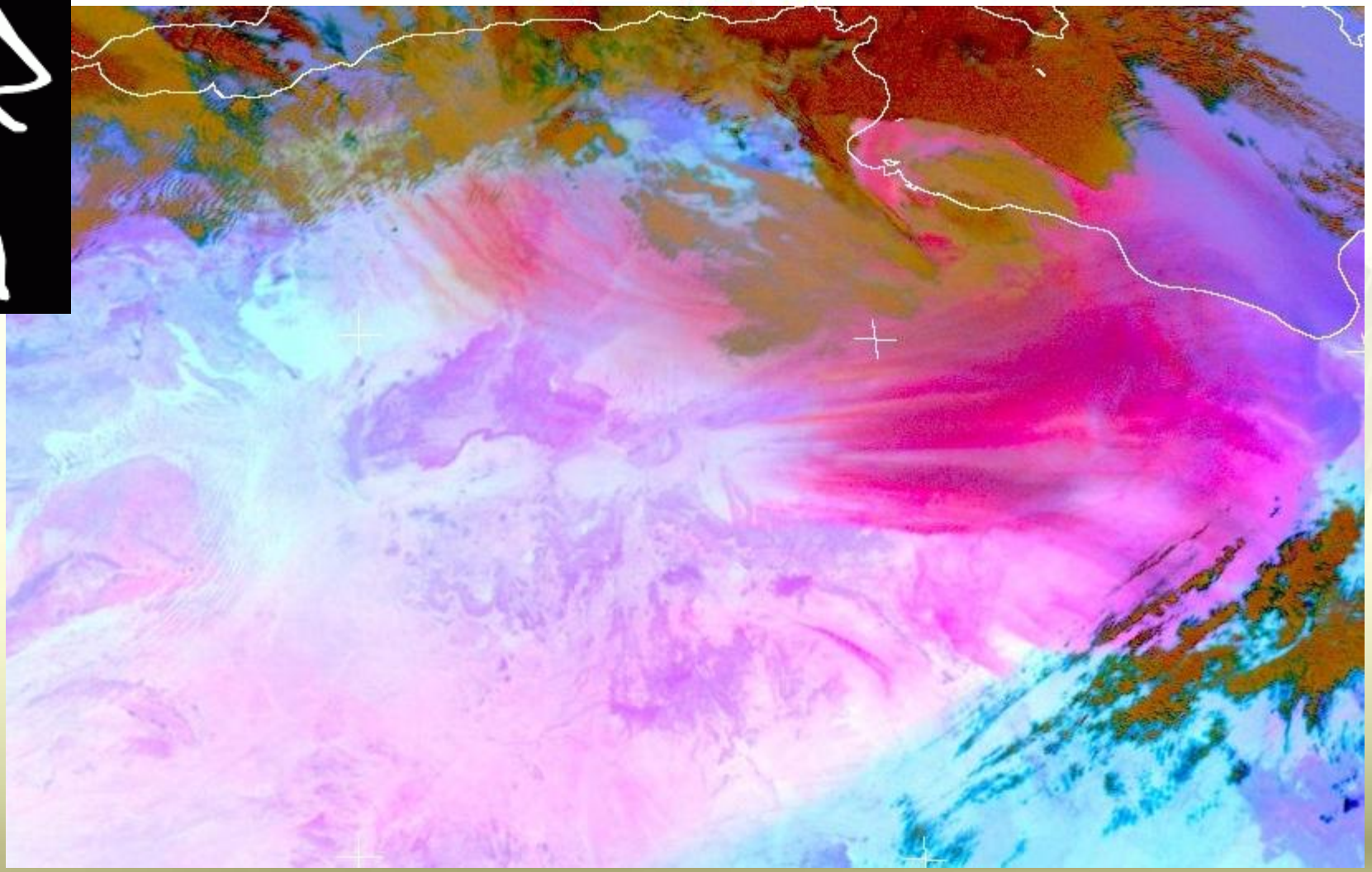
Airmass/Moisture Boundaries over Sudan



MSG-2, 12 May 2010, 12:00 UTC, RGB "Dust"


Airmass/Moisture Boundaries over Sudan
dry
moist
MSG-2, 12 May 2010, 12:00 UTC, RGB "Dust"

Airmass/Moisture Boundary over Northern Africa



MSG-1, 23 February 2006, 12:00 UTC, RGB "Dust"

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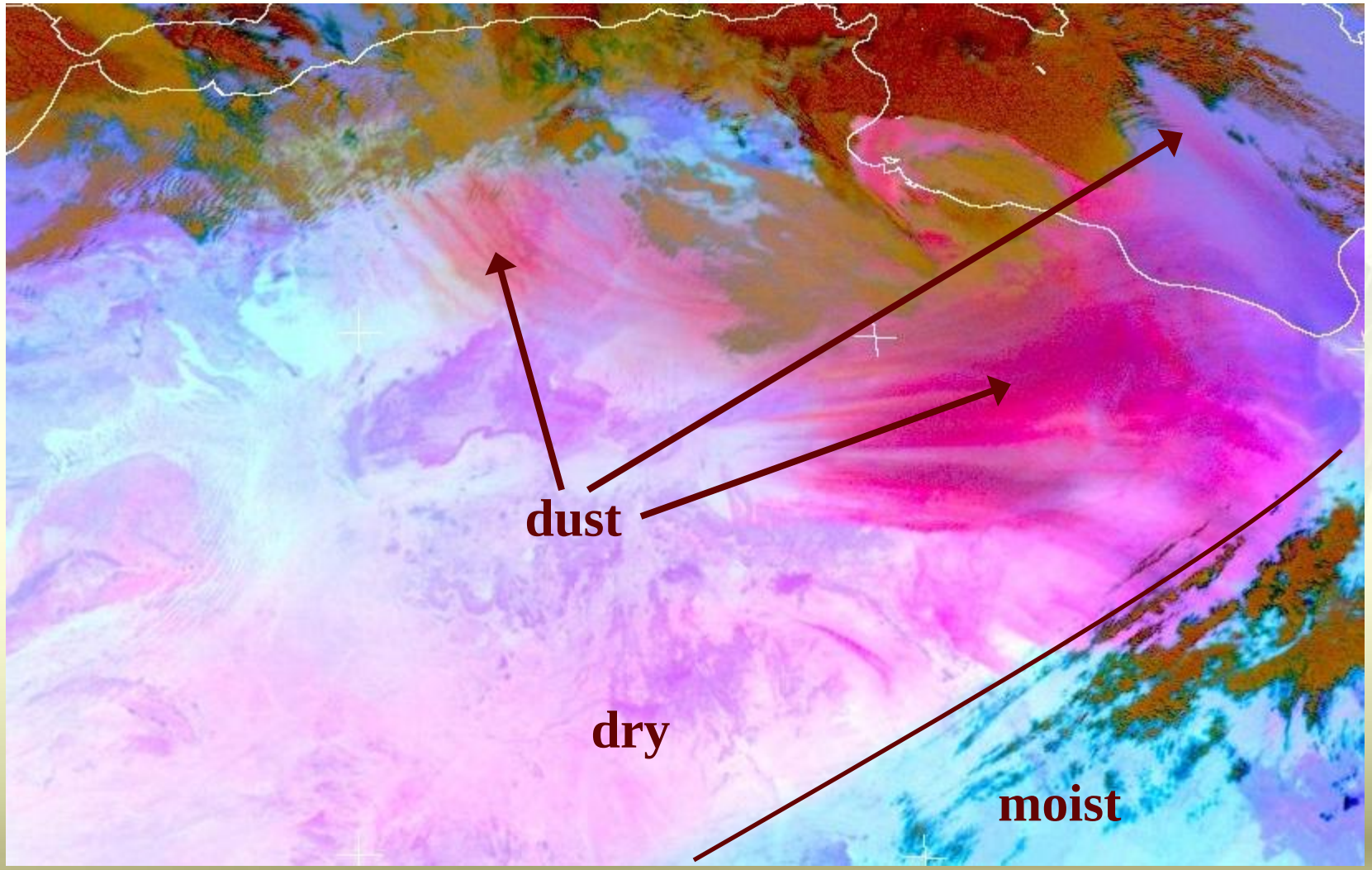
Airmass/Moisture Boundary over Northern Africa



MSG-1, 23 February 2006, 12:00 UTC, RGB "Dust"

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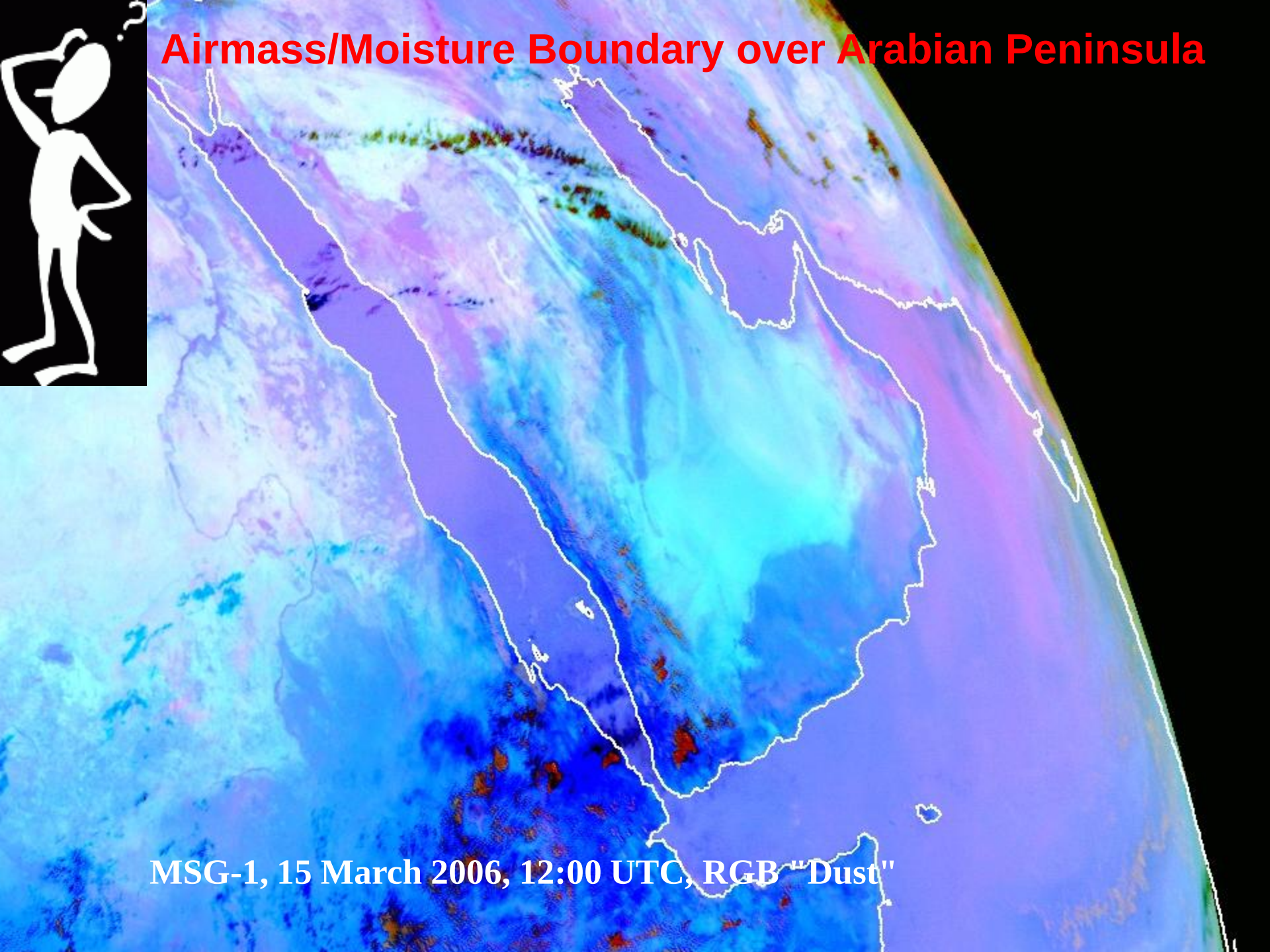
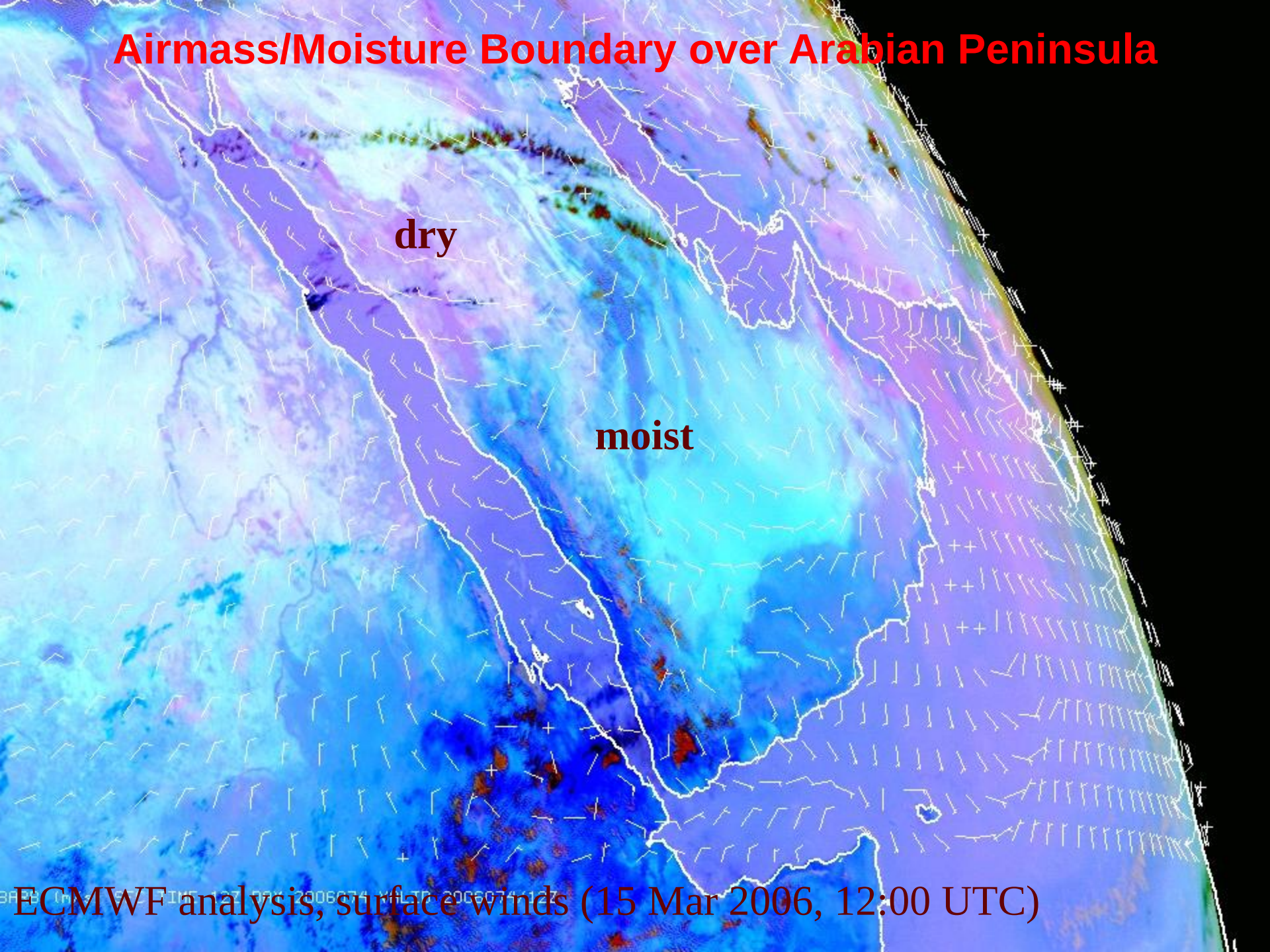
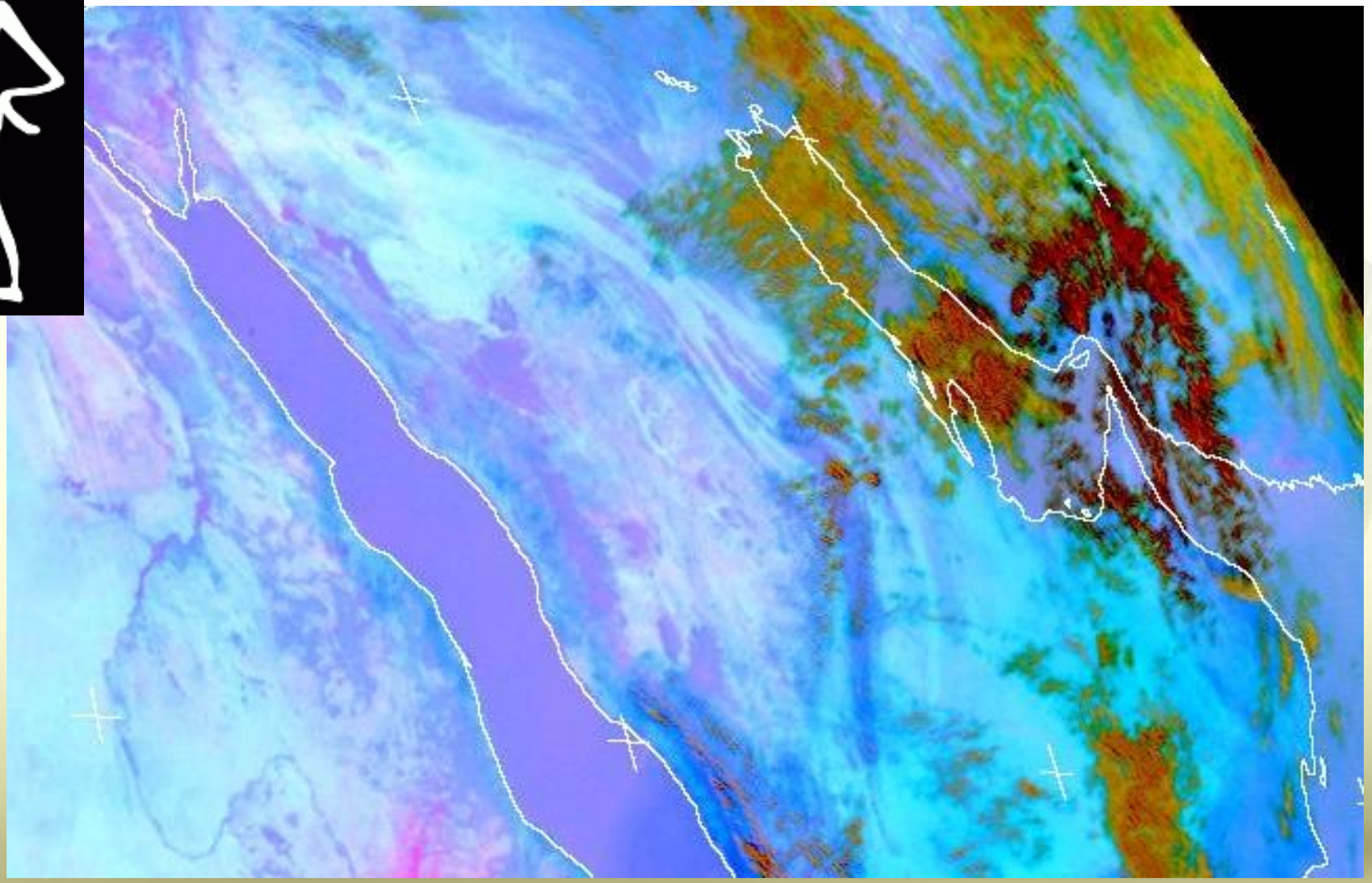

Airmass/Moisture Boundary over Arabian Peninsula
MSG-1, 15 March 2006, 12:00 UTC, RGB "Dust"


Airmass/Moisture Boundary over Arabian Peninsula
dry
moist
ECMWF analysis, surface winds (15 Mar 2006, 12:00 UTC)

Airmass/Moisture Boundary over Arabian Peninsula



MSG-1, 22 February 2006, 12:00 UTC, RGB Dust

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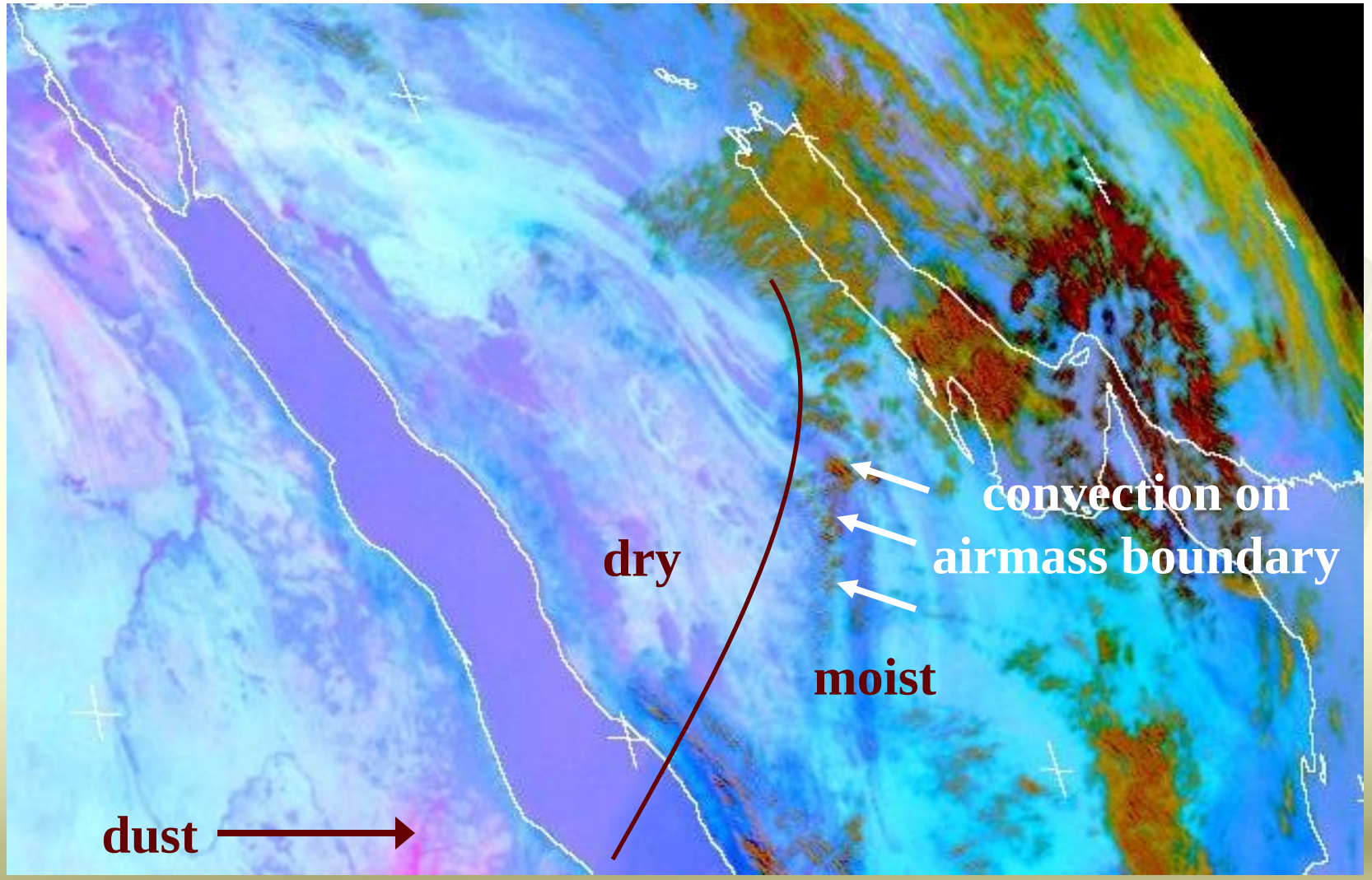
Airmass/Moisture Boundary over Arabian Peninsula



MSG-1, 22 February 2006, 12:00 UTC, RGB Dust

CLICK HERE

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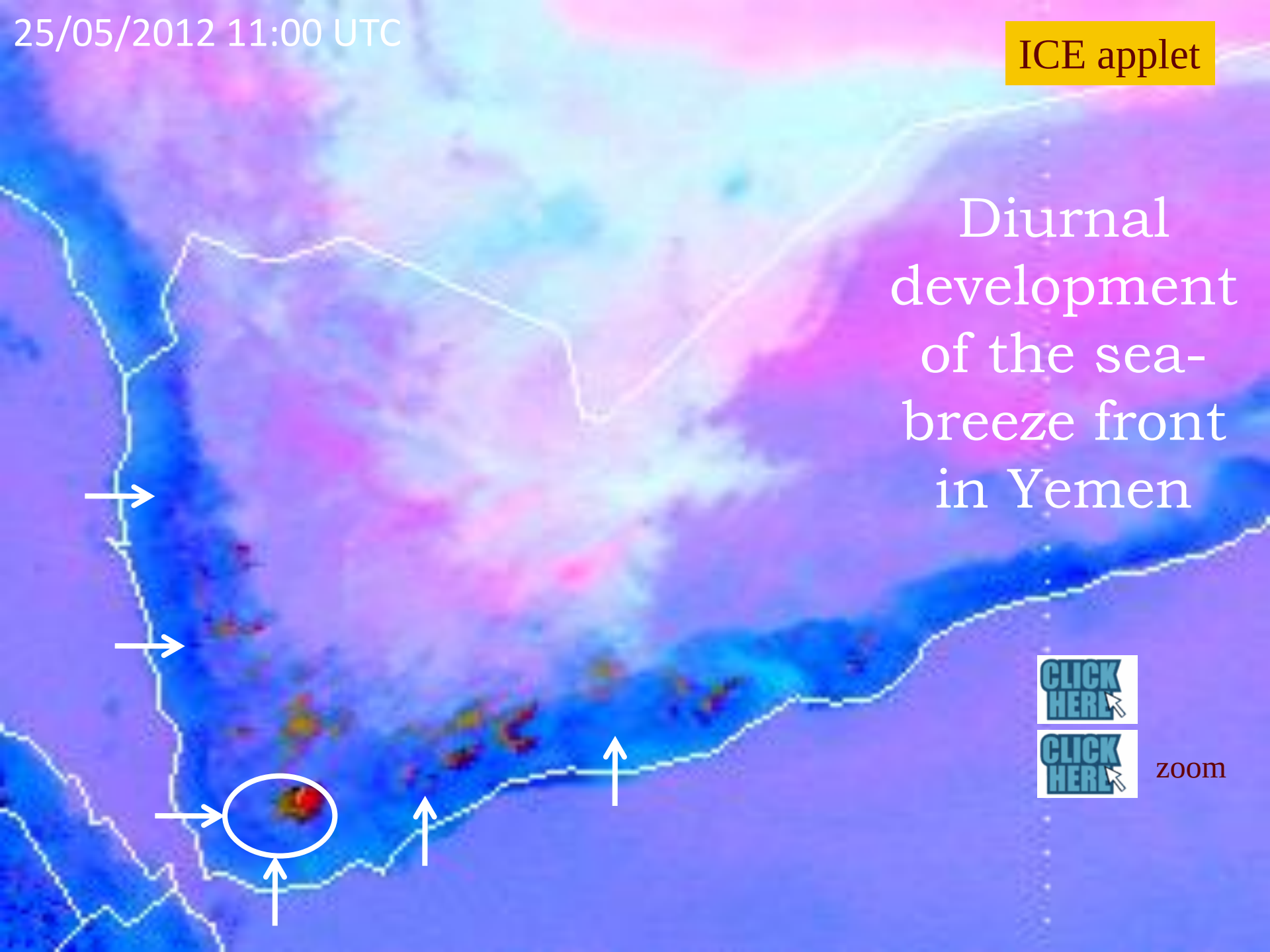
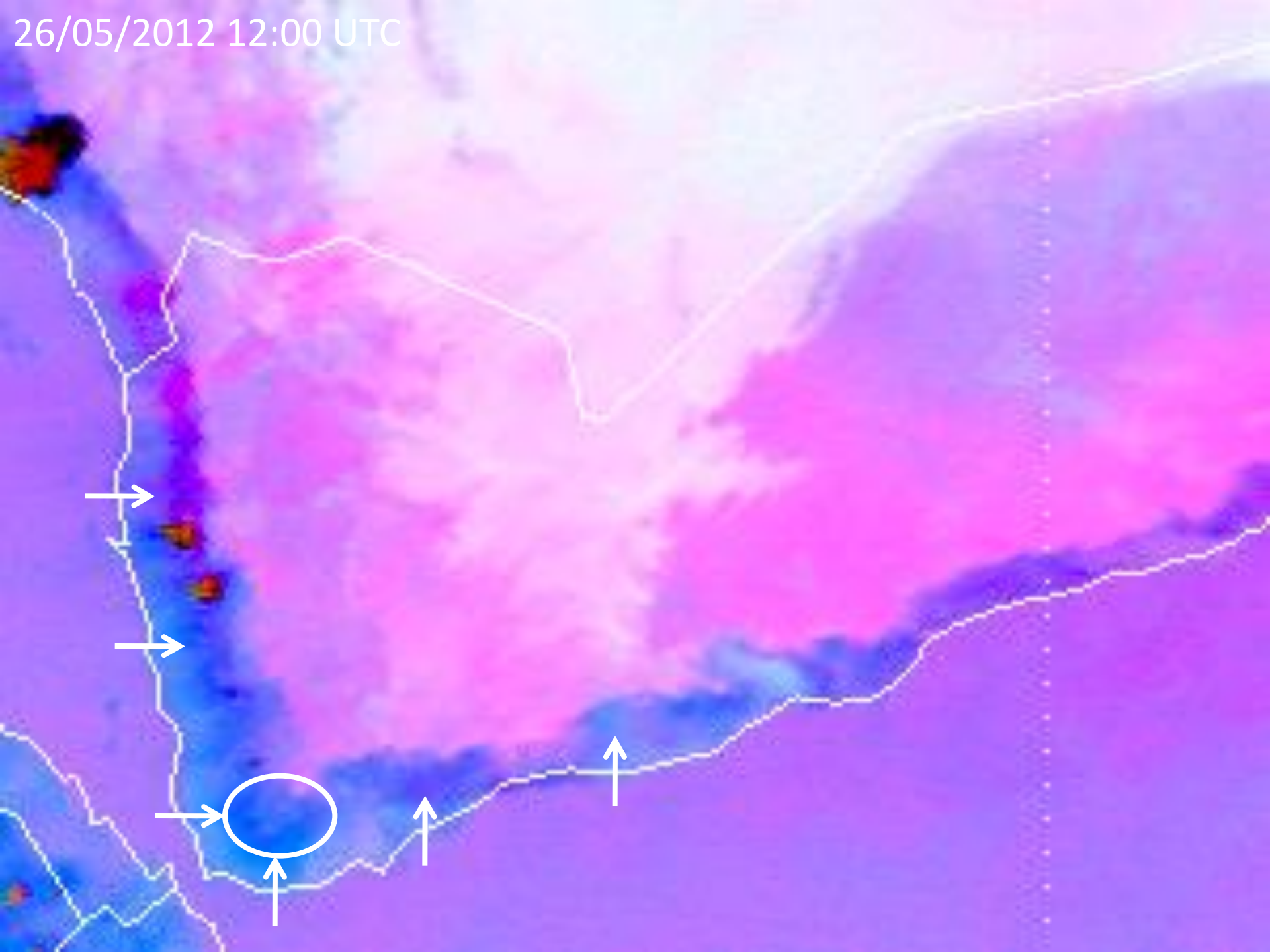
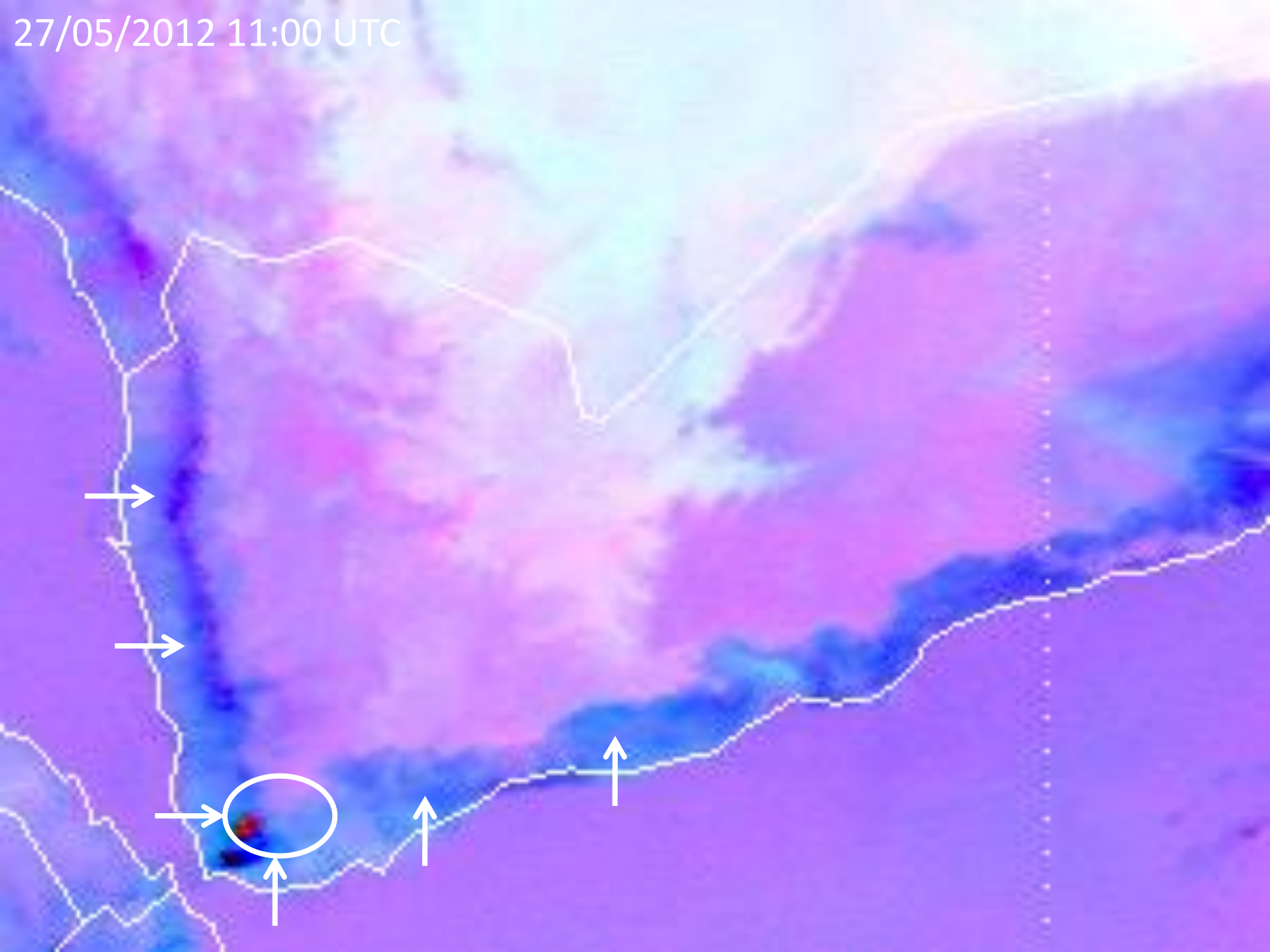
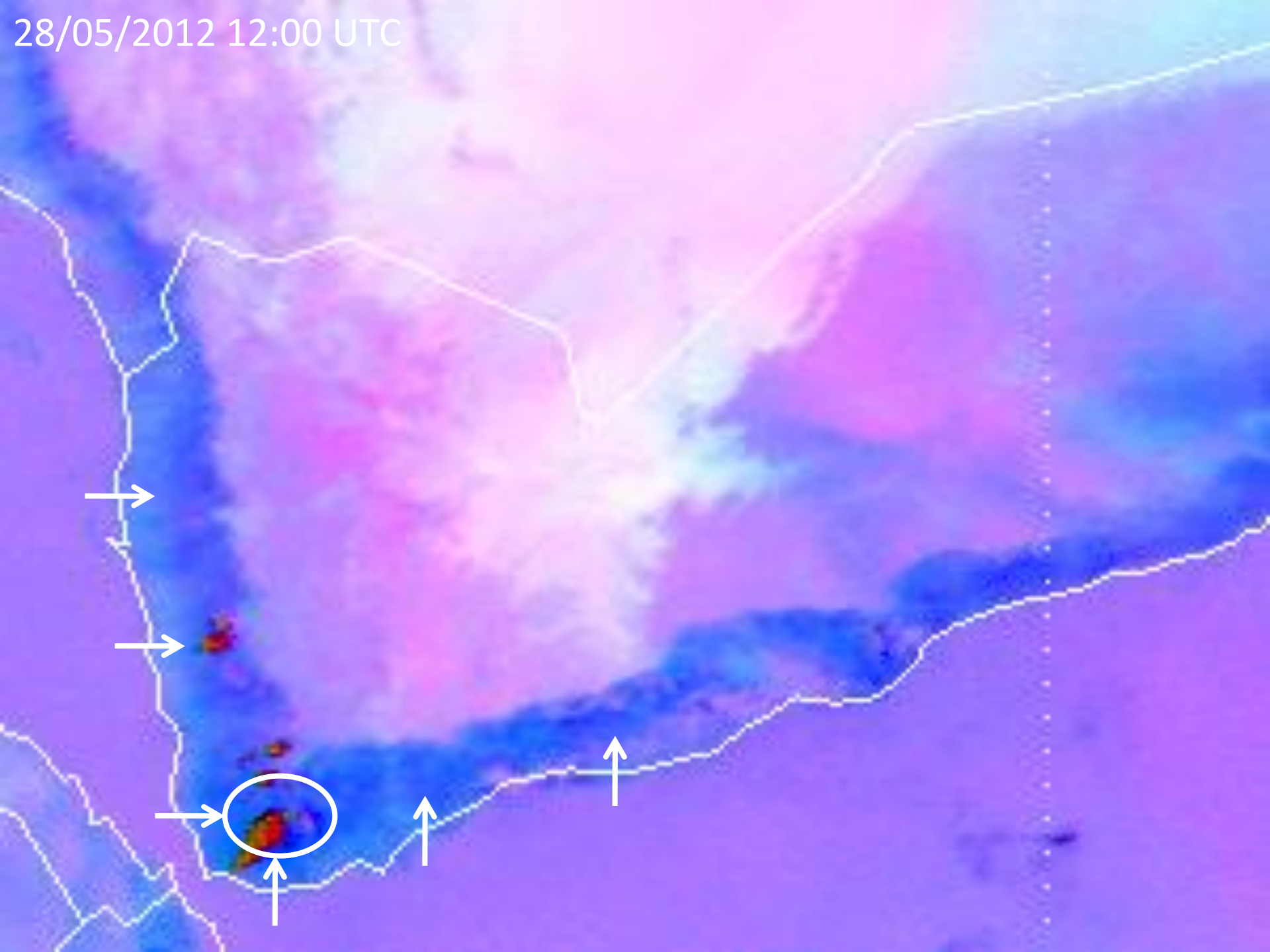
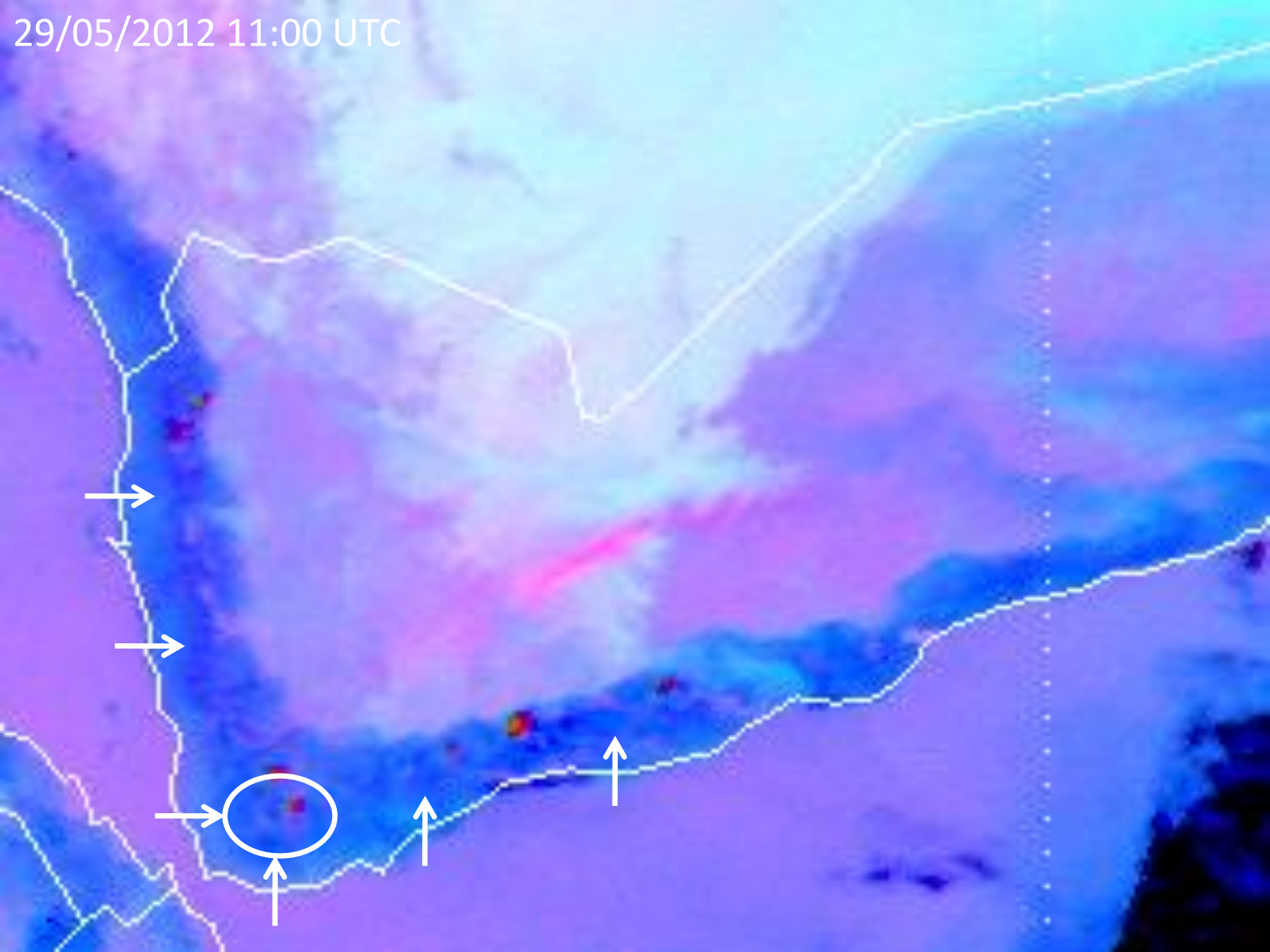

25/05/2012 11:00 UTC
ICE applet
Diurnal development of the sea-breeze front in Yemen
CLICK HERE
CLICK HERE
zoom


26/05/2012 12:00 UTC


27/05/2012 11:00 UTC


28/05/2012 12:00 UTC


29/05/2012 11:00 UTC

Summary

	Dry	Moist
<u>BTD Products</u>		
IR10.8 - IR12.0	0 to +1 K	+2 K to +4 K
<u>RGB Products</u>		
24-h Micro RGB	More Red	Less Red
<u>Derived Products</u>		
TPW	0-10 mm	30-40 mm
LPW	0-5 mm	15-25 mm

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