Airmass RGB

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Outlook

- Learn how to generate the Airmass RGB (Recipe)
- Learn how to use/interpret the WV6.2 - WV7.3 and the IR9.7 - IR10.8 brightness temperature difference (BTD)
- In particular, understand the relationship between the IR9.7 - IR10.8 BTD and the total ozone content
- Interpretation of colours of the Airmass RGB
- Usage of the Airmass RGB composite for monitoring jet streams, deformation zones, PV anomalies, cyclogenesis, severe convection

Airmass RGB

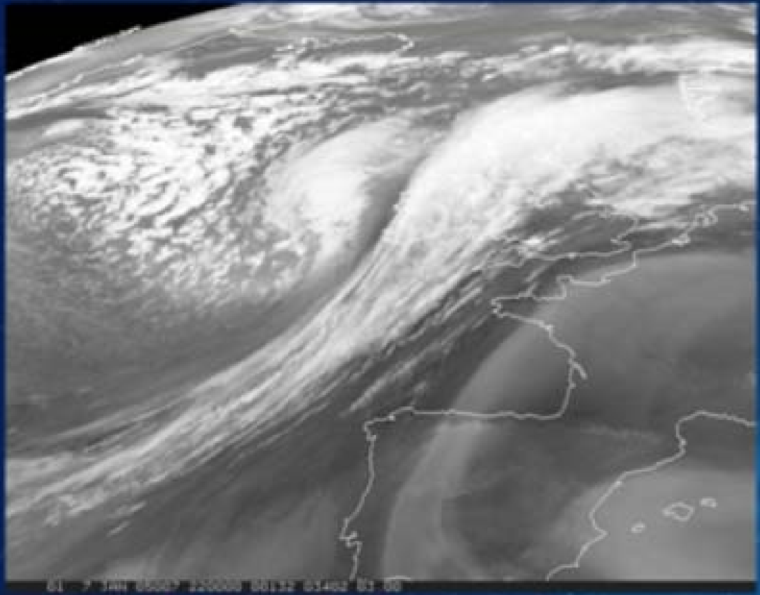
Red = WV6.2 - WV7.3

Green = IR9.7 - IR10.8

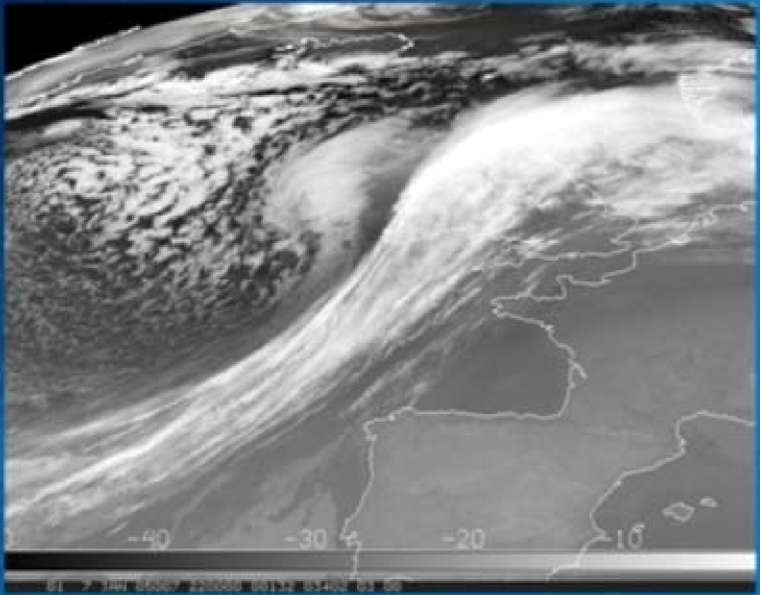
Blue = WV6.2

Applications:	Rapid Cyclogenesis, Jet Stream Analysis, PV Analysis
Area:	Full MSG Viewing Area
Time:	Day and Night

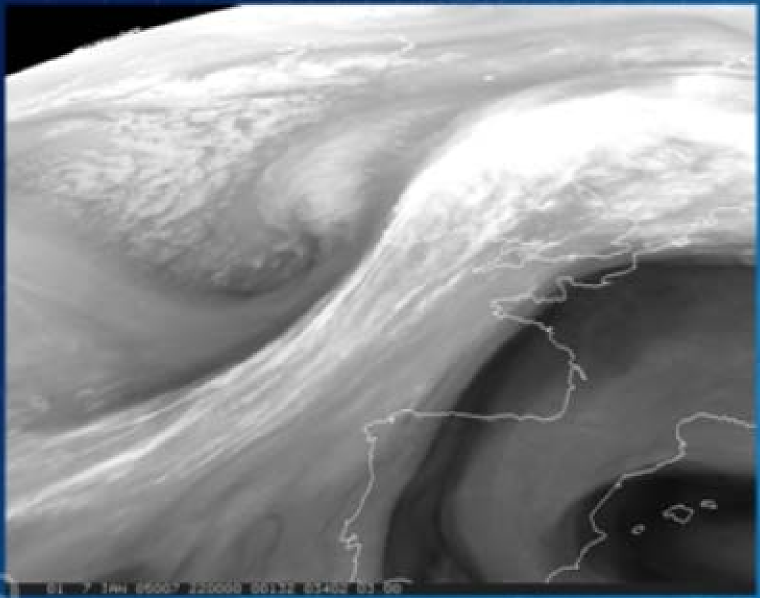
Beam	Channel	Range	Gamma
Red	WV6.2 - WV7.3	-25K to 0K	1.0
Green	IR9.7 - IR10.8	-40 to +5K	1.0
Blue	WV6.2	+243K to +208K	1.0



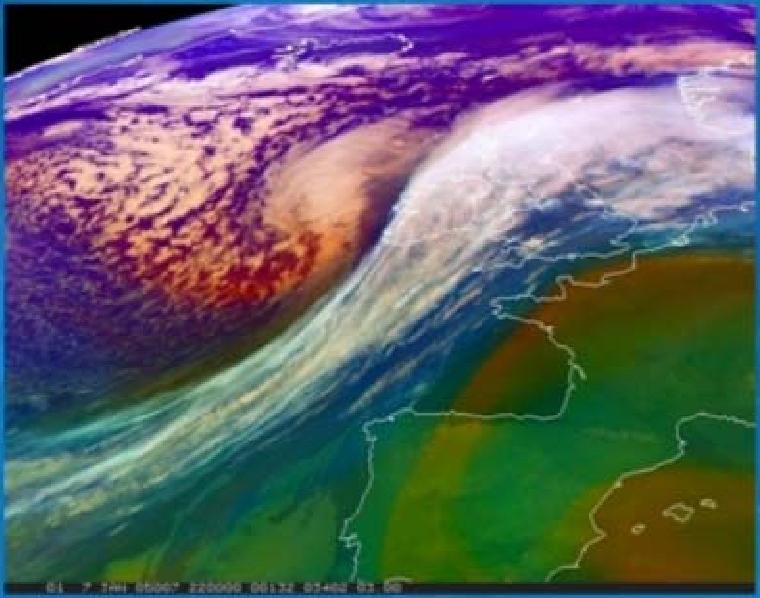
WV6.2 - WV7.3



IR9.7 - IR10.8



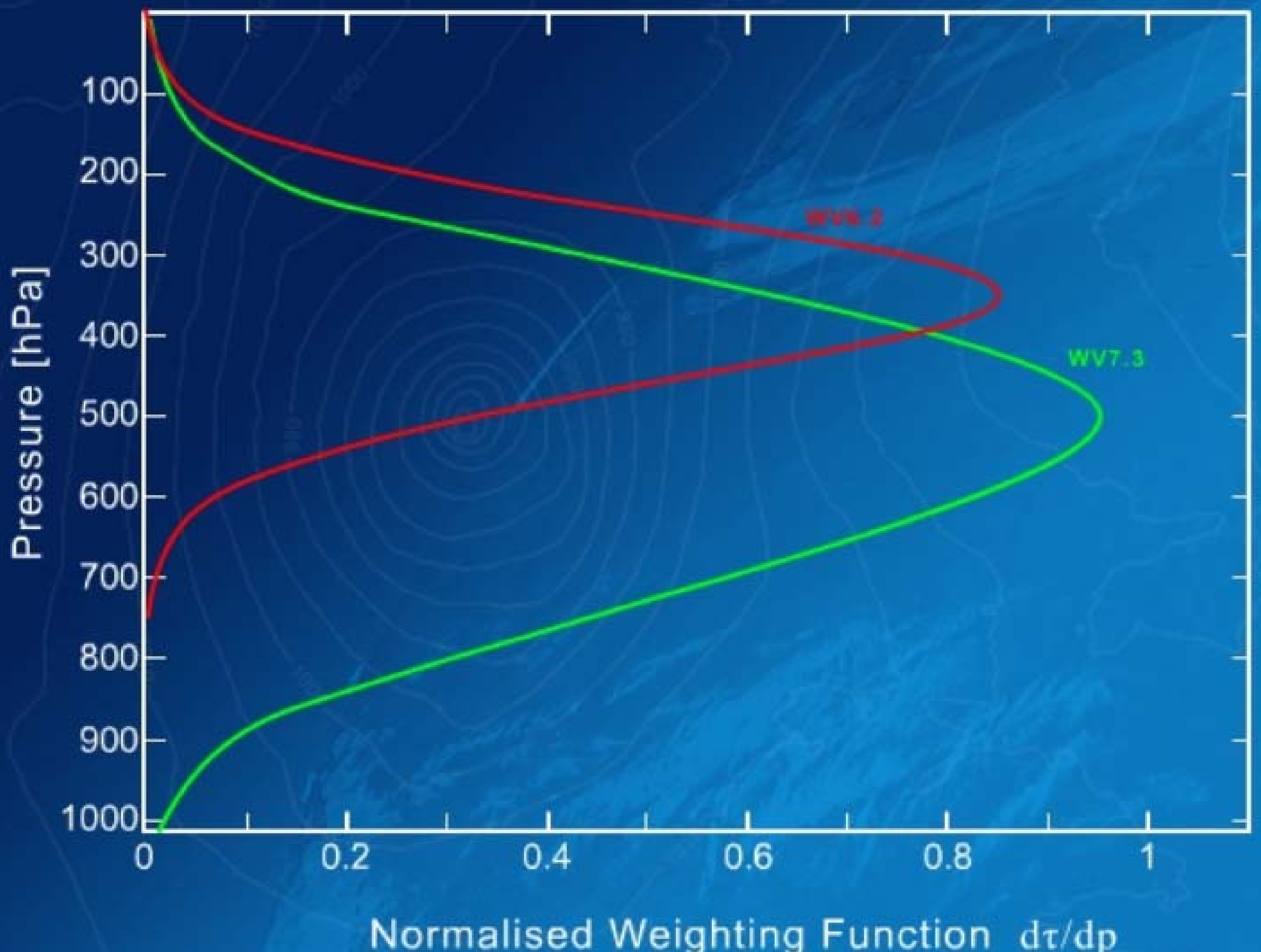
WV6.2i



Airmass RGB

What is the difference between WV6.2 and WV7.3?

Standard Mid-Latitude Summer Nadir



$a = 1$

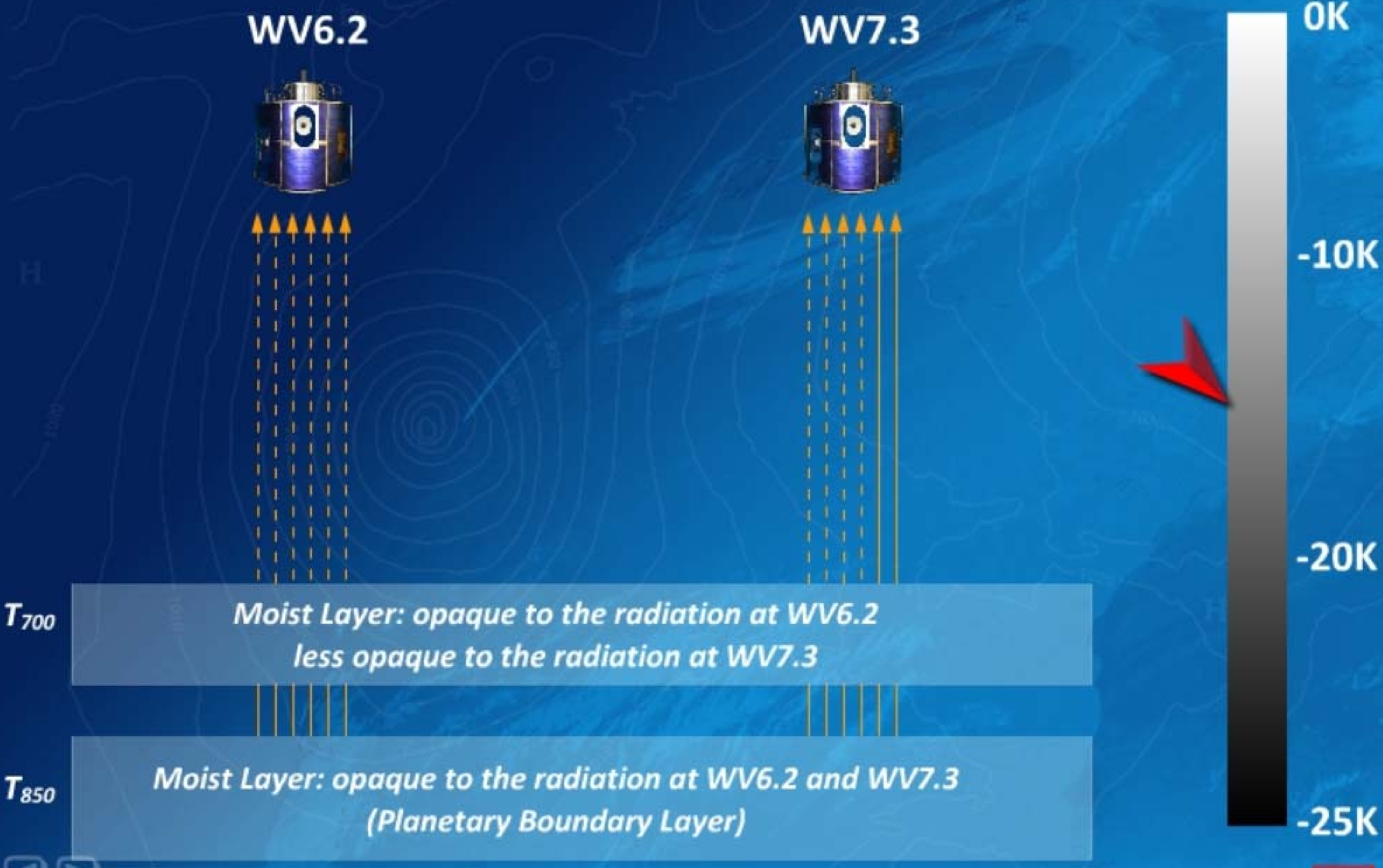
$\tau = 0$

The molecular species in the atmosphere is/are very active:

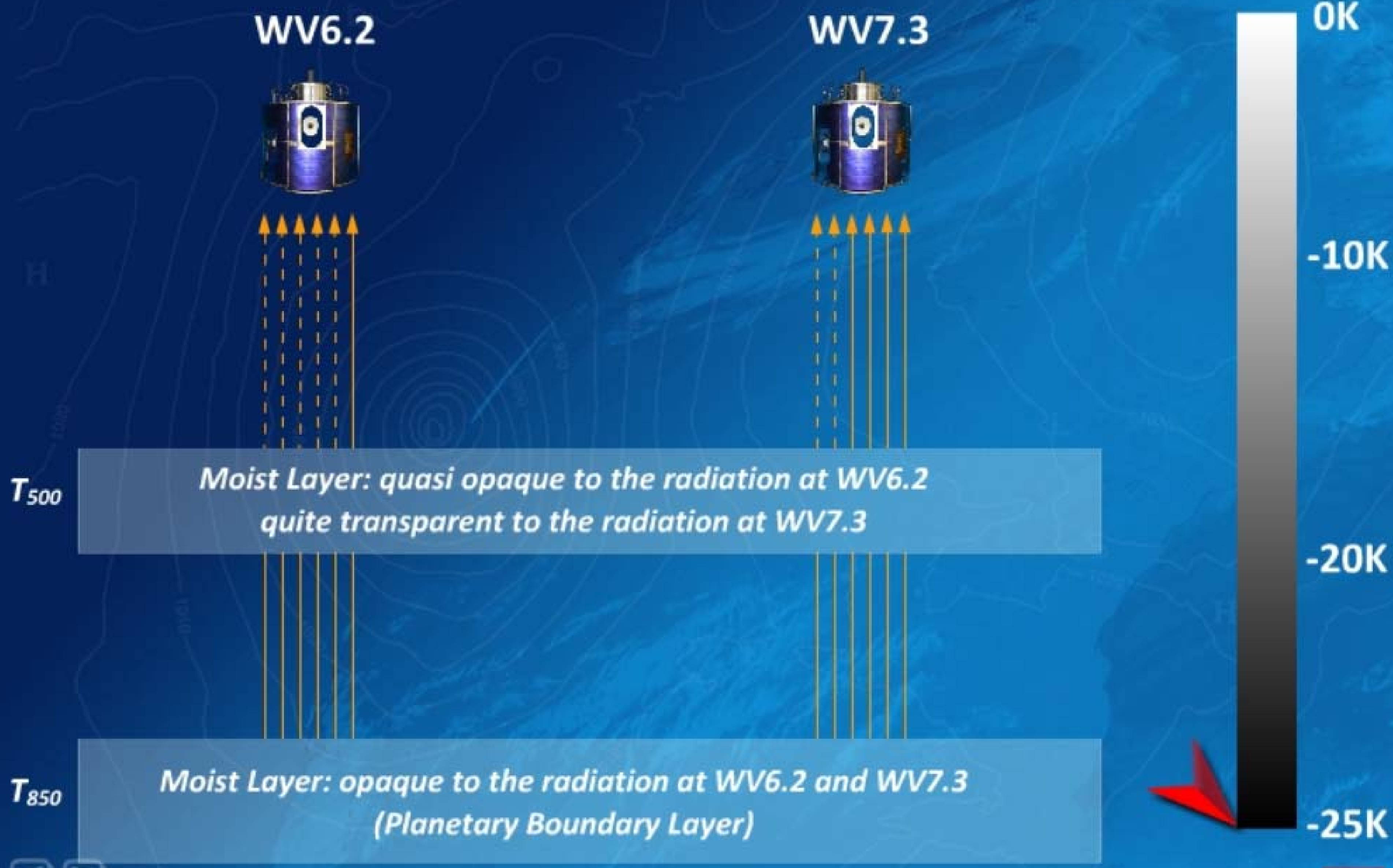
Most of the photons emitted by the surface will not make it to the Satellite but are absorbed.

Case 1 - Very dry in the Atmosphere

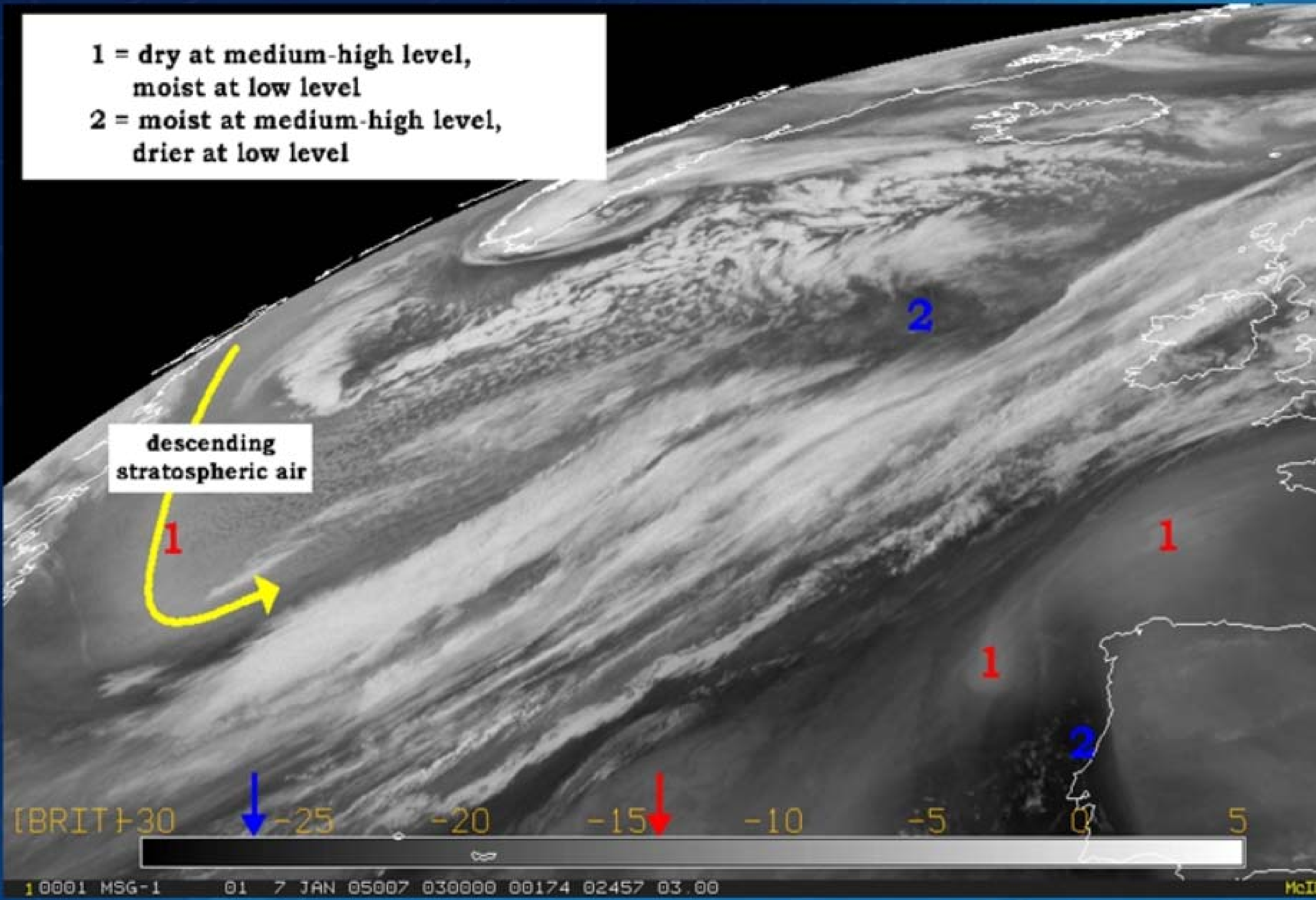
Case 2 - Moist Layer at 700 hPa



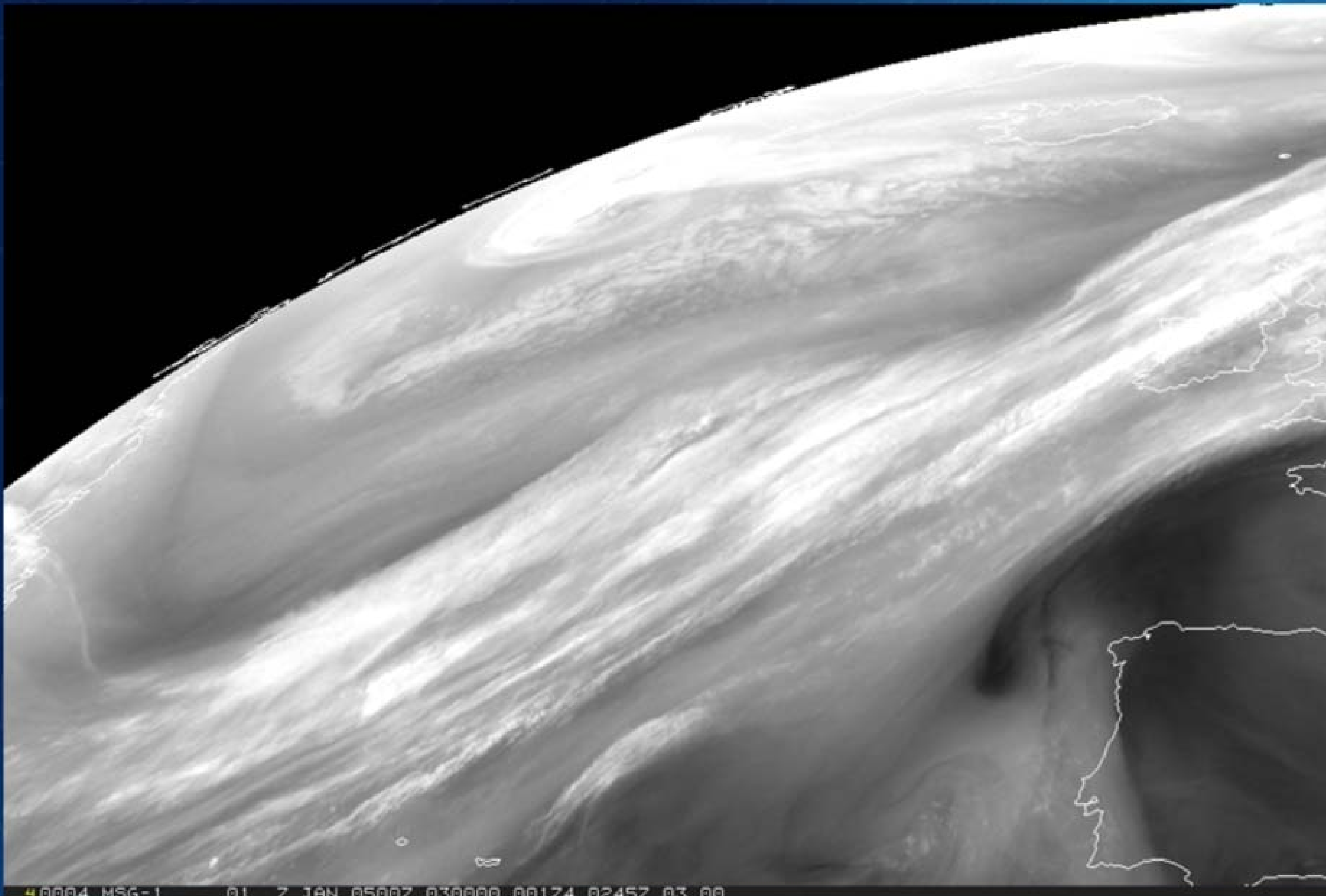
Case 3 - Moist layer at 500 hPa



Case 4 - Moist layer at 200 hPa



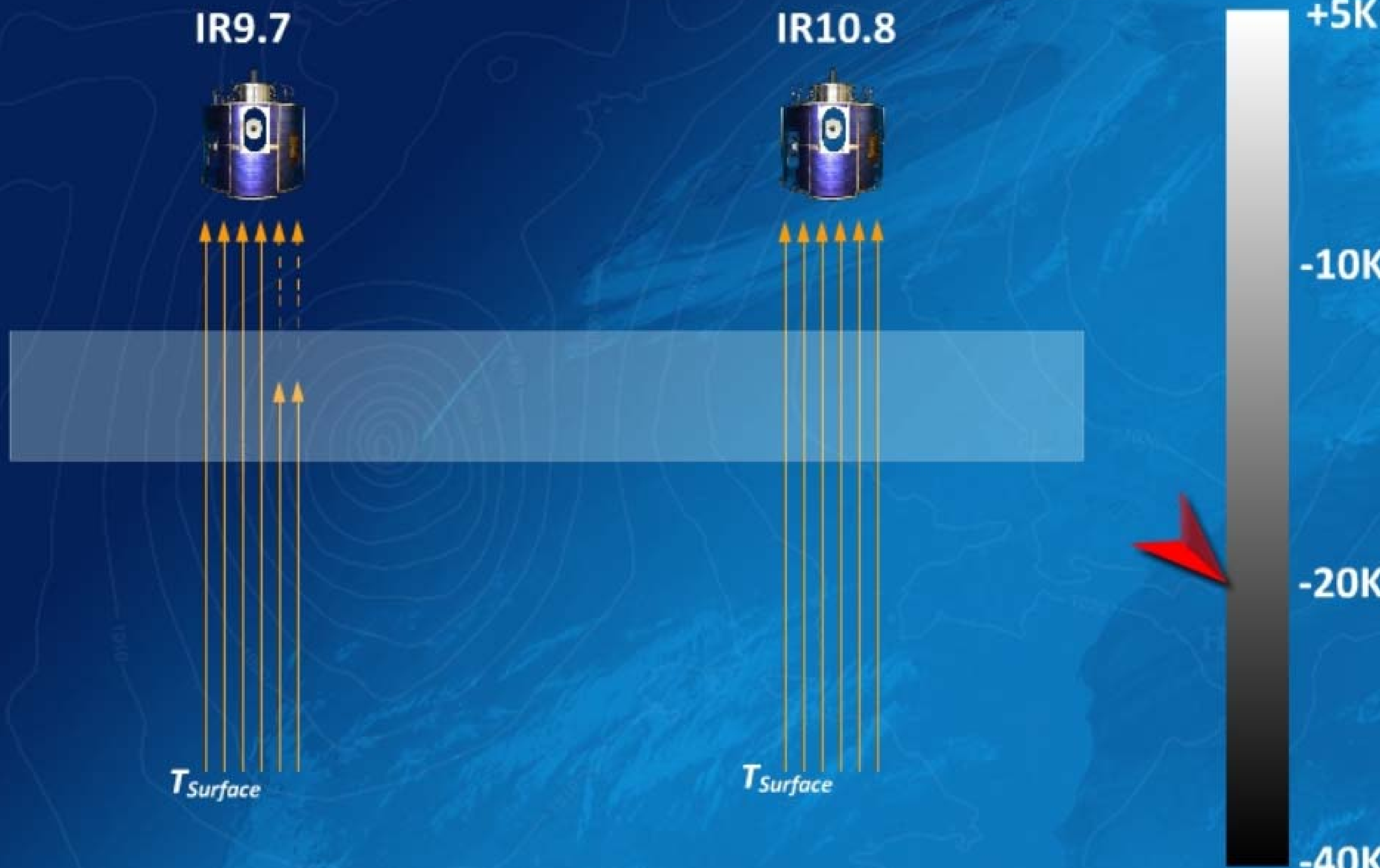
Meteosat 8: 7 January 2005, 03:00 UTC, BTD WV6.2 - WV7.3 Range: -30 K (black) to +5 K (white)

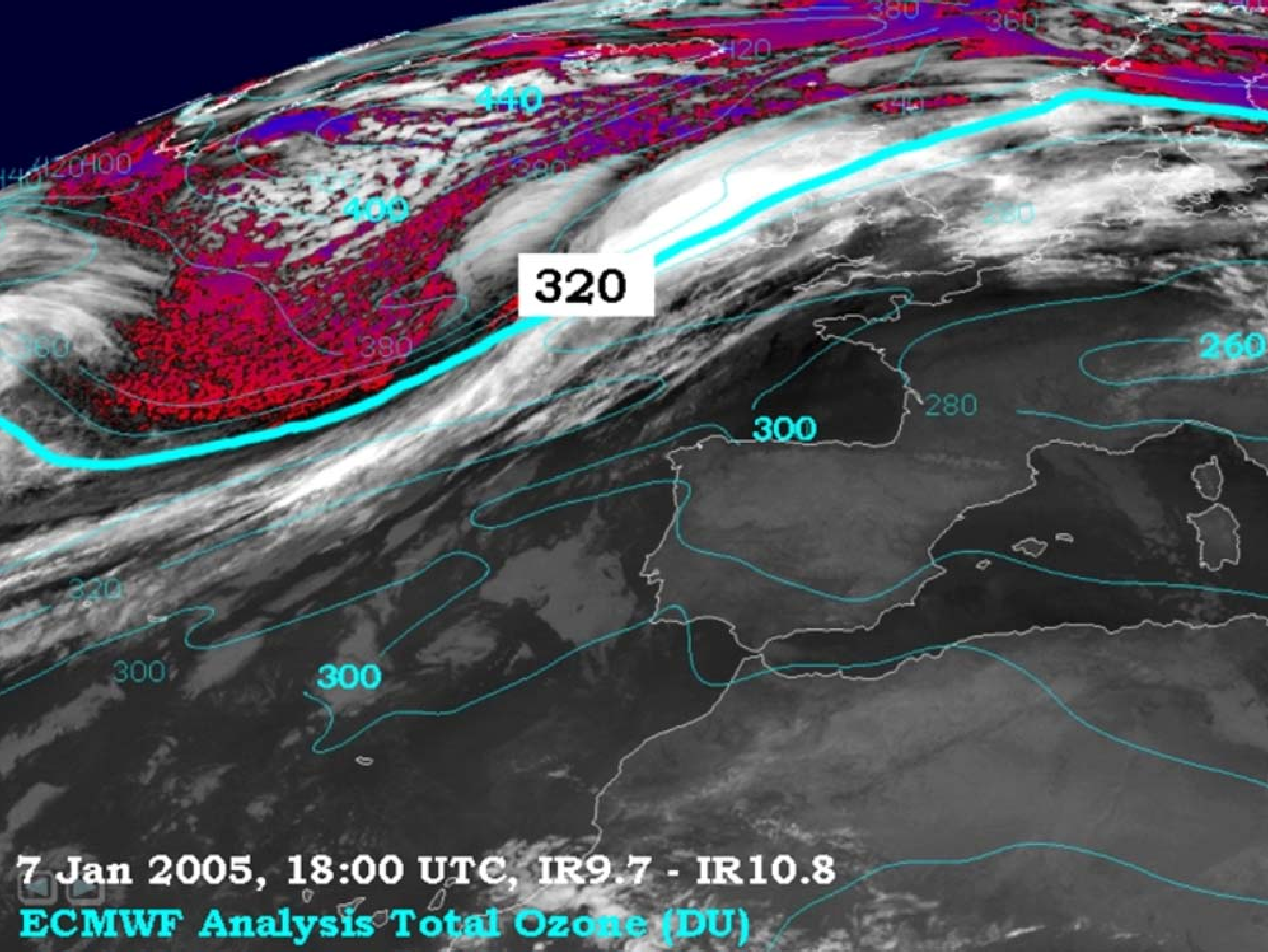


Meteosat 8: 7 January 2005, 03:00 UTC, Channel 05 (WV6.2) Range: 253 K (black) to 213 K (white)

Case 1 - Rich Ozone / Polar Airmass

Case 2 - Poor Ozone / Tropical Airmass





440
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320
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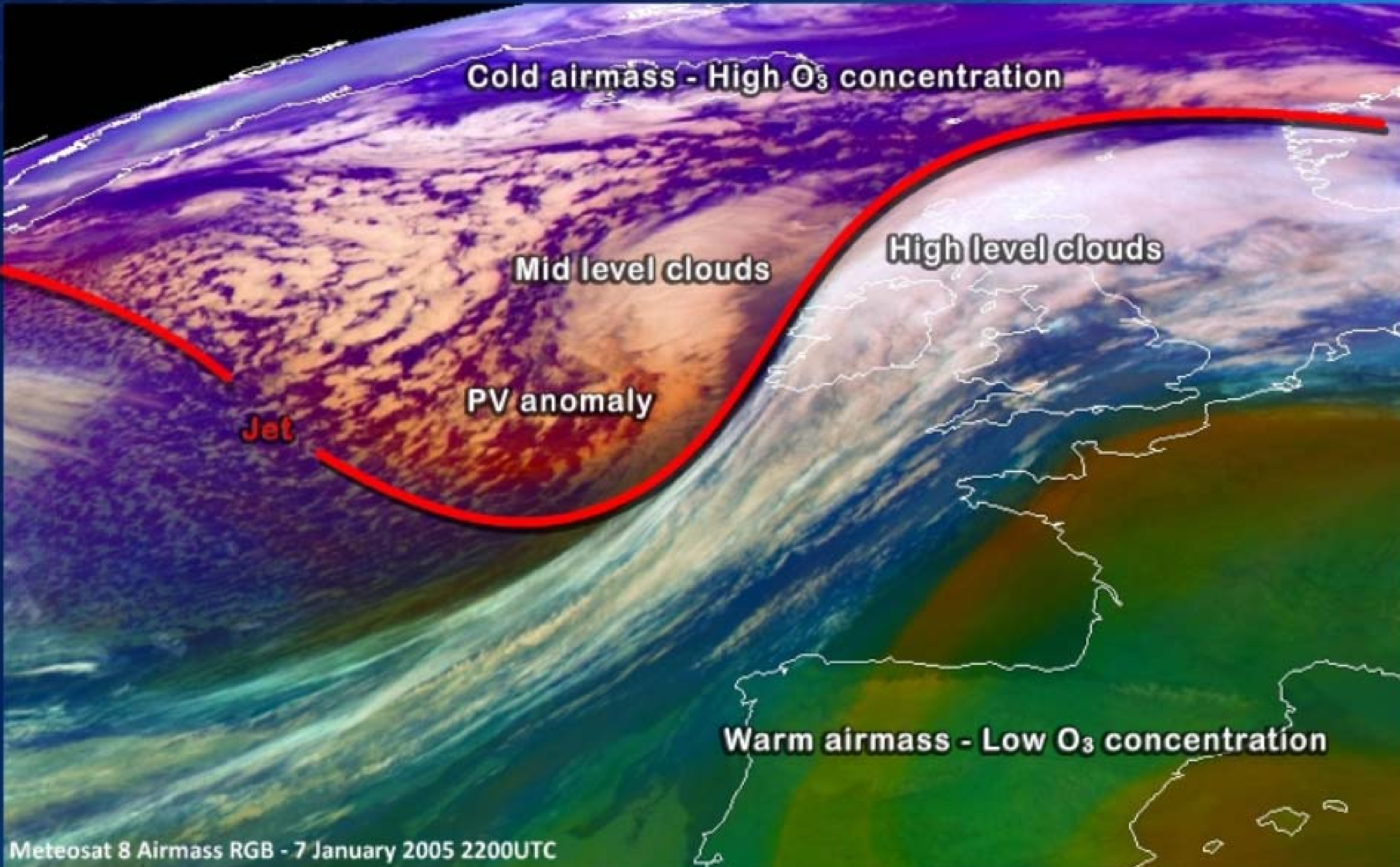
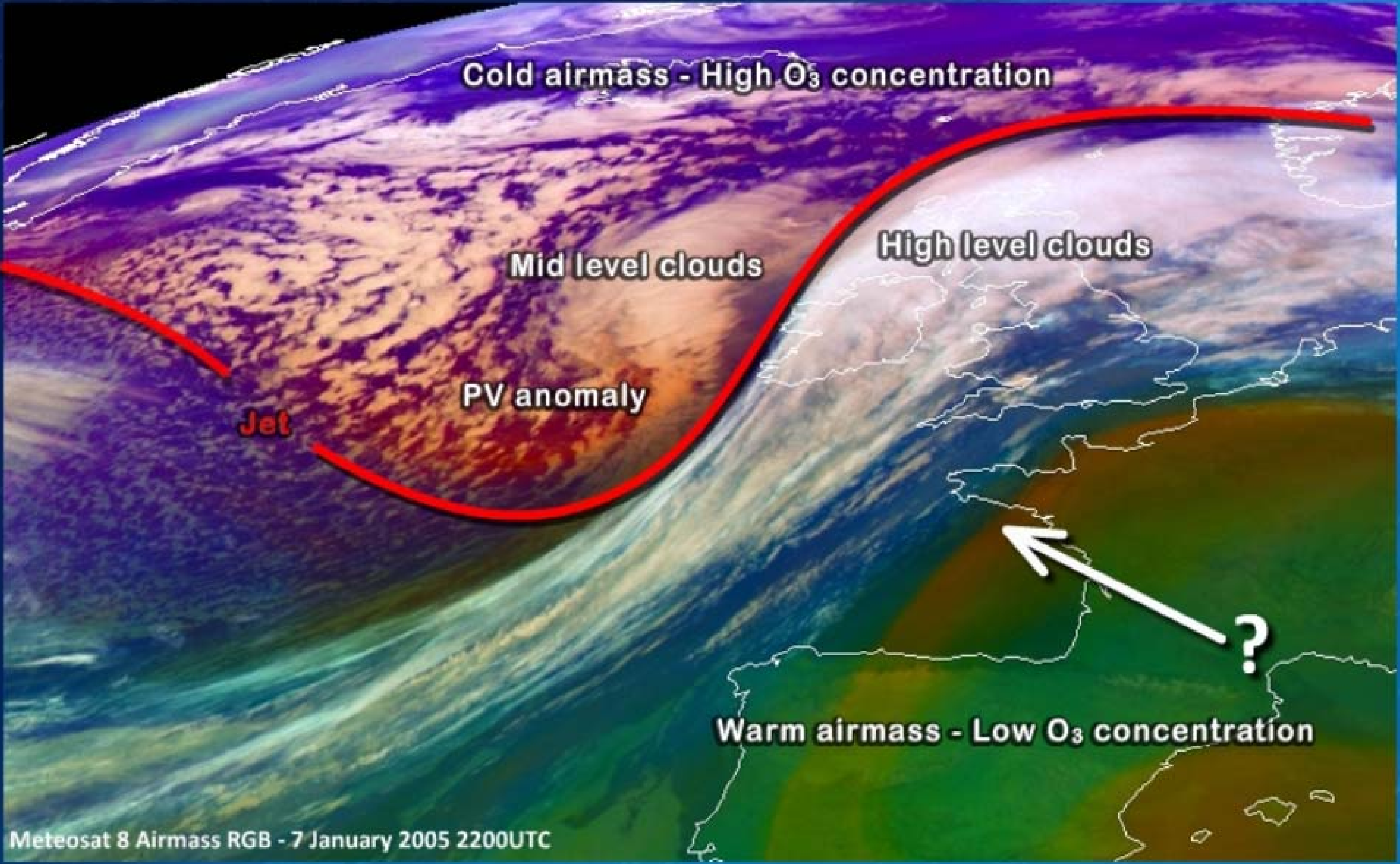
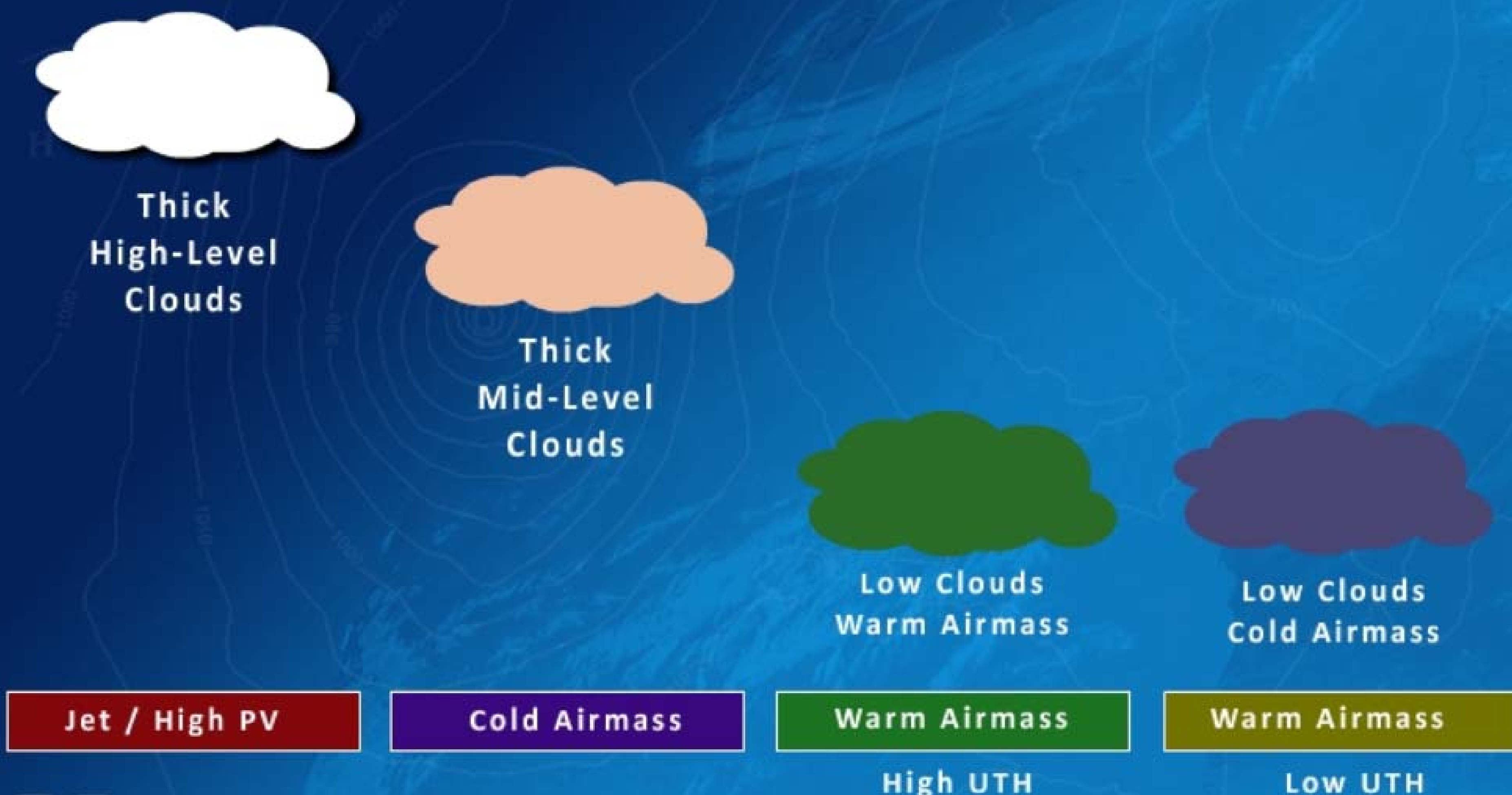
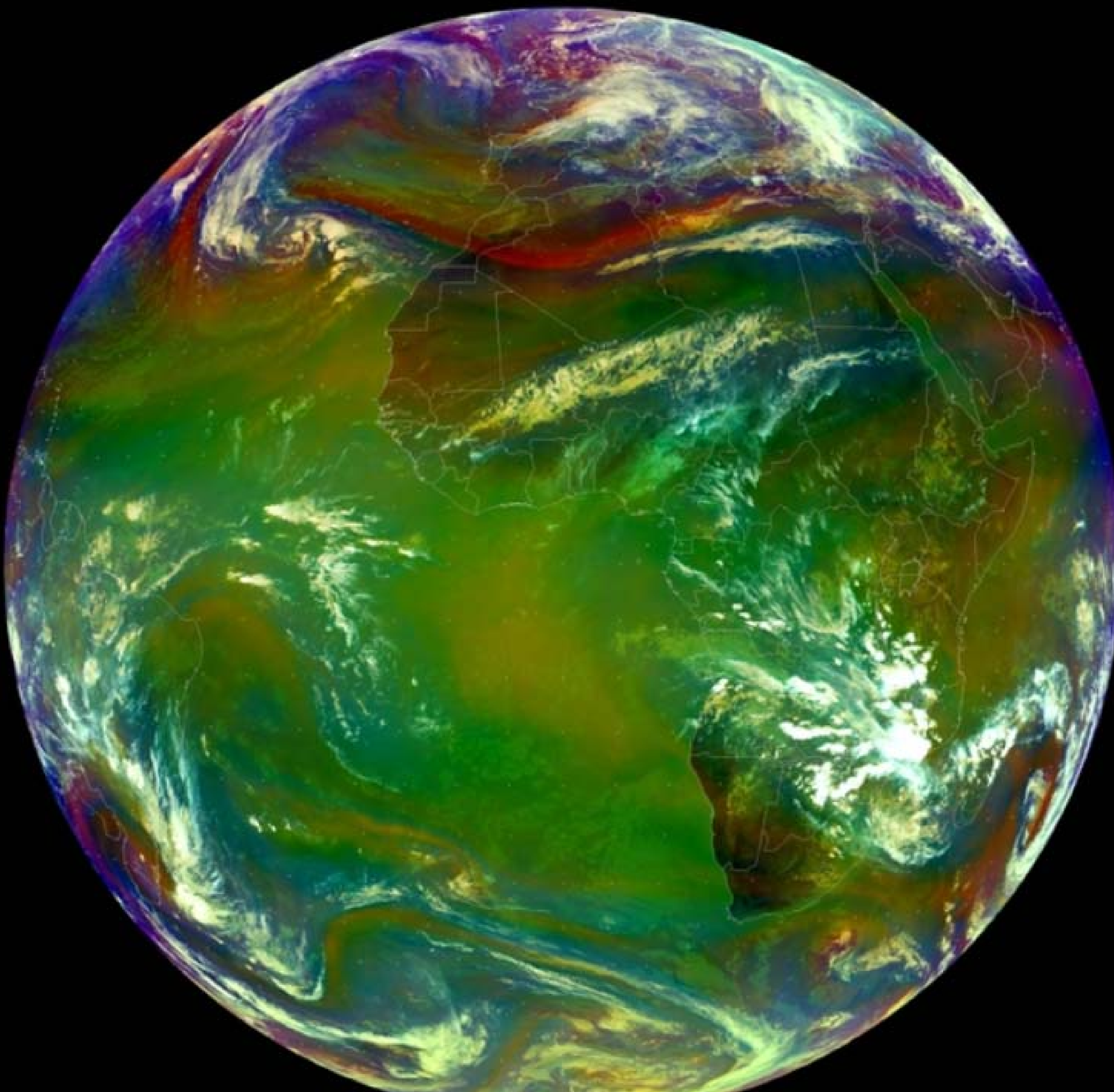
300
7 Jan 2005, 18:00 UTC, IR9.7 - IR10.8
ECMWF Analysis Total Ozone (DU)


Cold airmass - High O3 concentration
Mid level clouds
High level clouds
PV anomaly
Jet
Warm airmass - Low O3 concentration
Meteosat 8 Airmass RGB - 7 January 2005 2200UTC


Cold airmass - High O3 concentration
Mid level clouds
High level clouds
PV anomaly
Jet
?
Warm airmass - Low O3 concentration
Meteosat 8 Airmass RGB - 7 January 2005 2200UTC

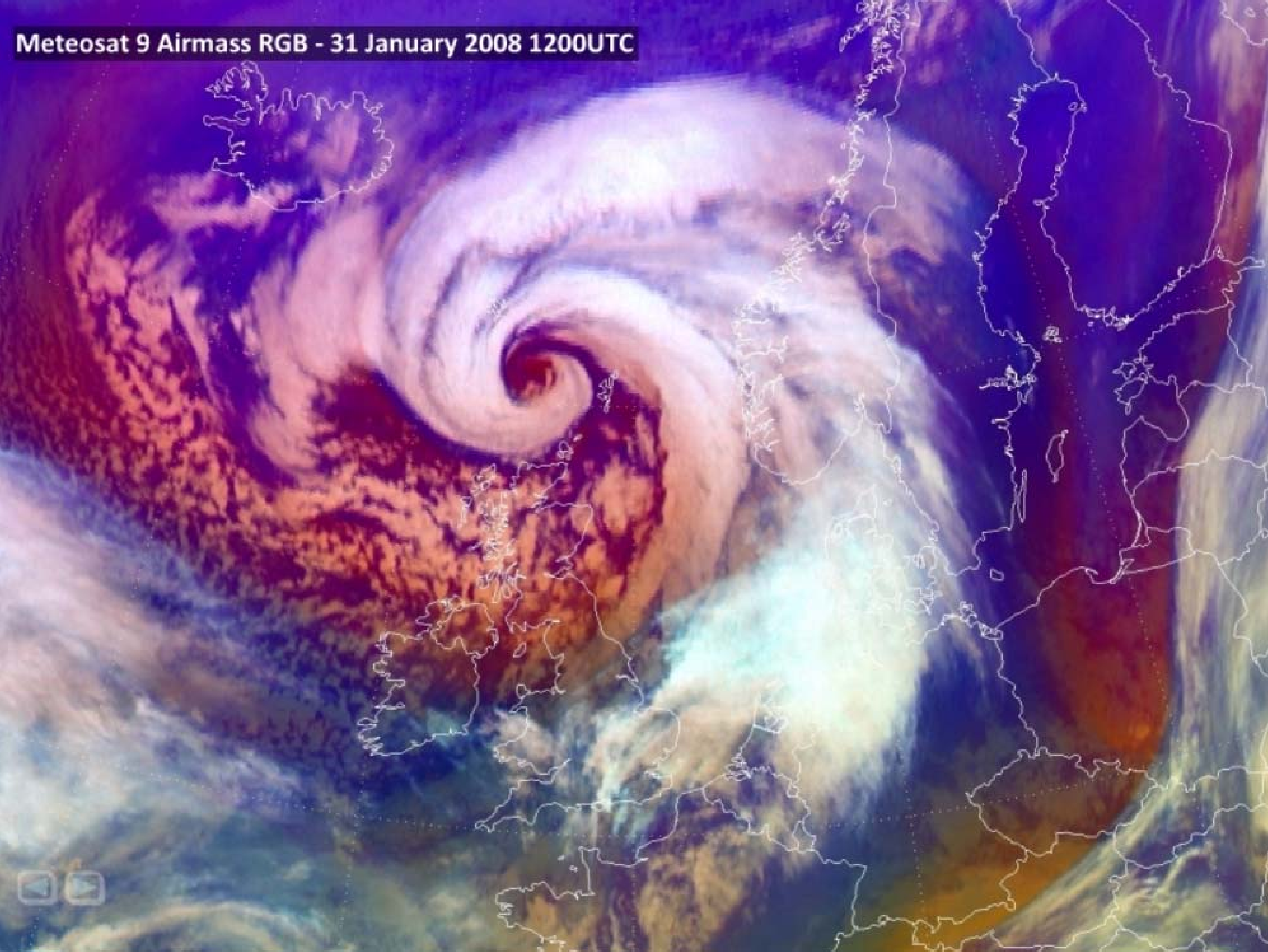

Thick
High-Level
Clouds
Thick
Mid-Level
Clouds
Low Clouds
Warm Airmass
Low Clouds
Cold Airmass
Jet / High PV
Cold Airmass
Warm Airmass
Warm Airmass
High UTH
Low UTH

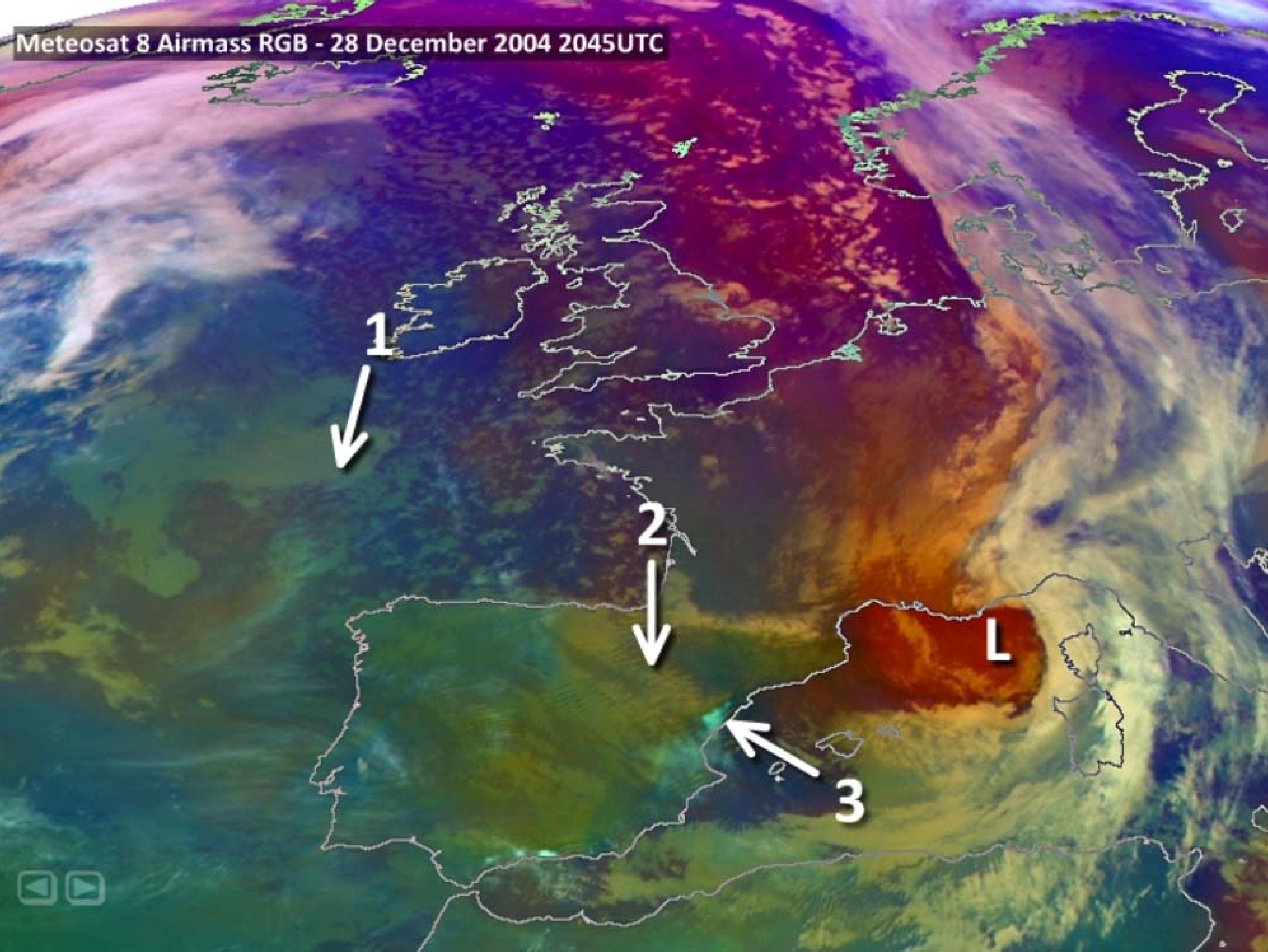


Meteosat 9 - Airmass RGB: 29 January 2010 1300UTC

Summary

- The "Airmass" RGB is a combination of 4 channels: WV6.2, WV7.3, IR9.7 and IR10.8
- It helps to detect the position of jet streams, deformation zones and PV anomalies (red areas)
- It also helps to discriminate airmasses (low ozone tropical airmass, rich ozone polar airmass)
- It is also useful to detect typical WV features like deformation zones and wave features
- At the same time, through the use of the IR channels, it allows to monitor cloud development at low, mid and high levels


Meteosat 9 Airmass RGB - 31 January 2008 1200UTC



Meteosat 8 Airmass RGB - 28 December 2004 2045UTC
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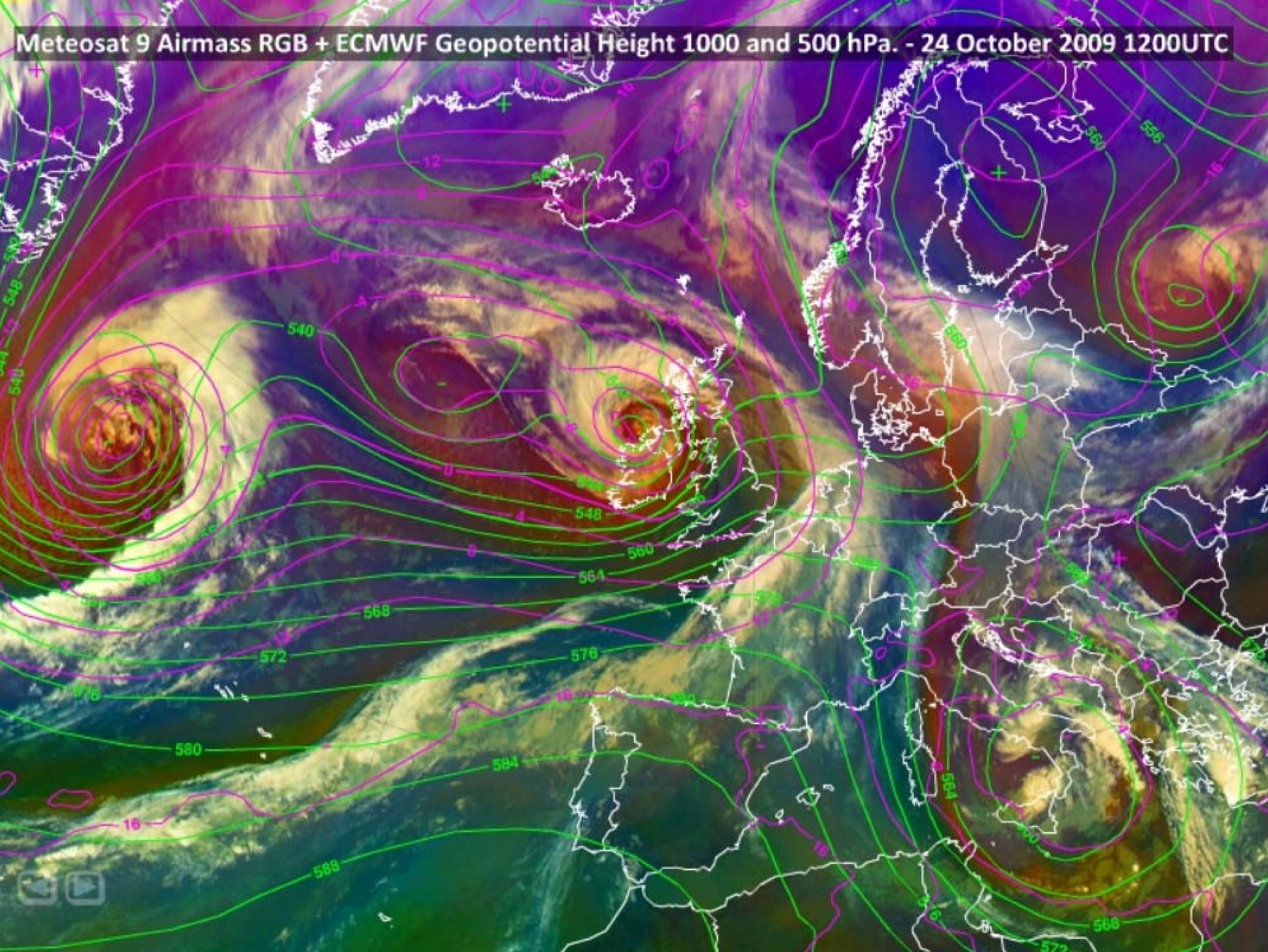
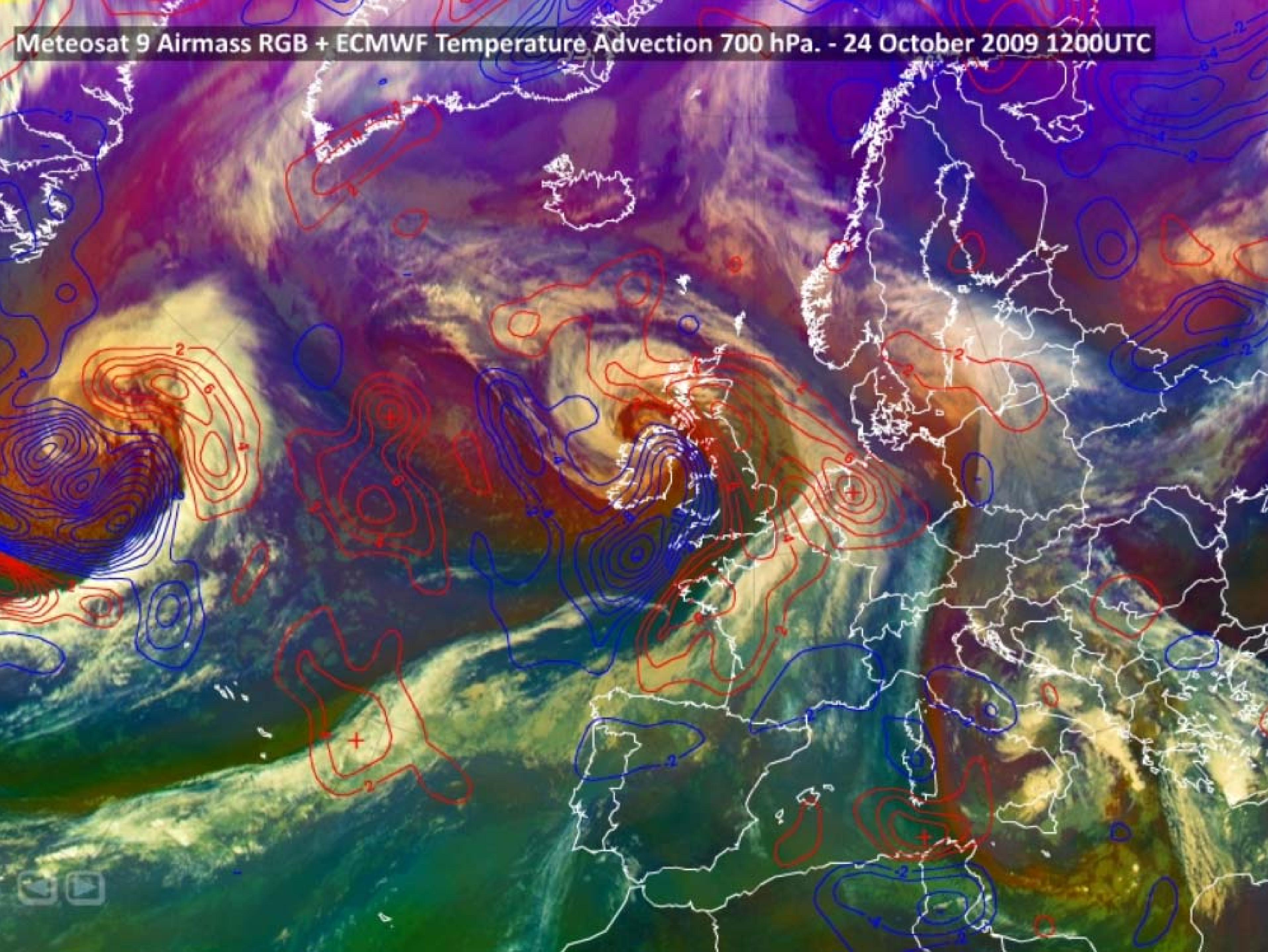
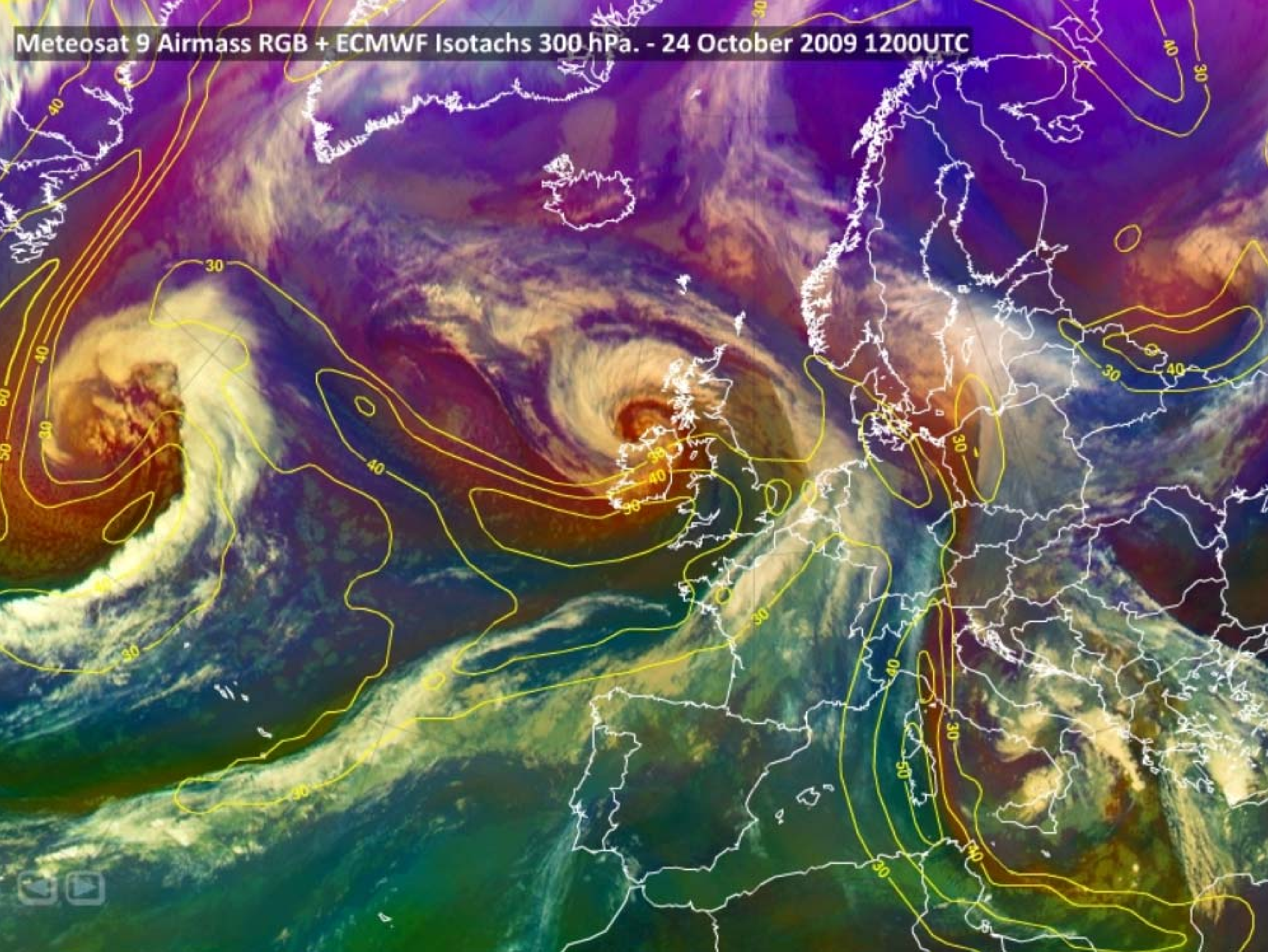

Meteosat 9 Airmass RGB + ECMWF Geopotential Height 1000 and 500 hPa. - 24 October 2009 1200UTC


Meteosat 9 Airmass RGB + ECMWF Temperature Advection 700 hPa. - 24 October 2009 1200UTC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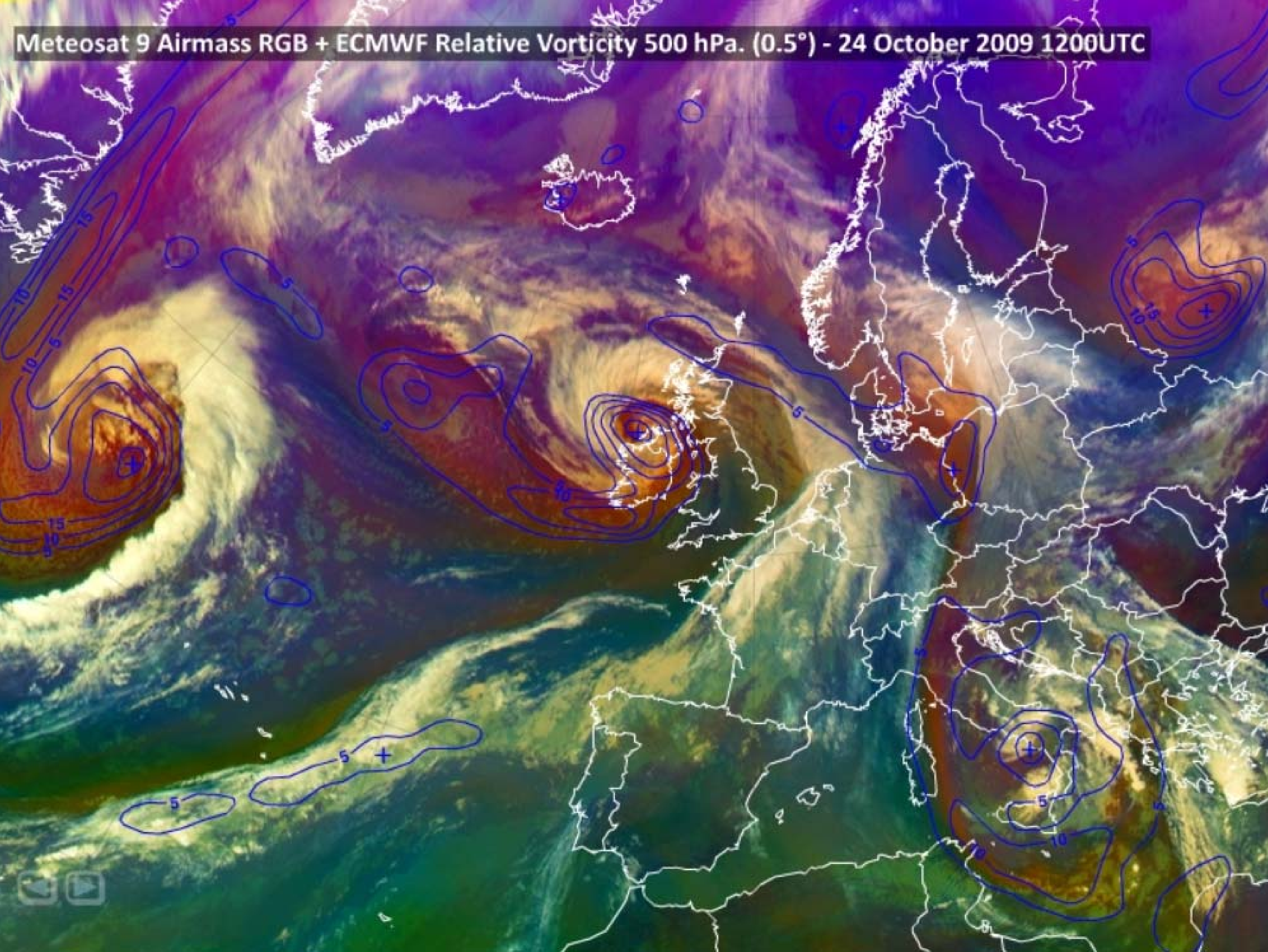
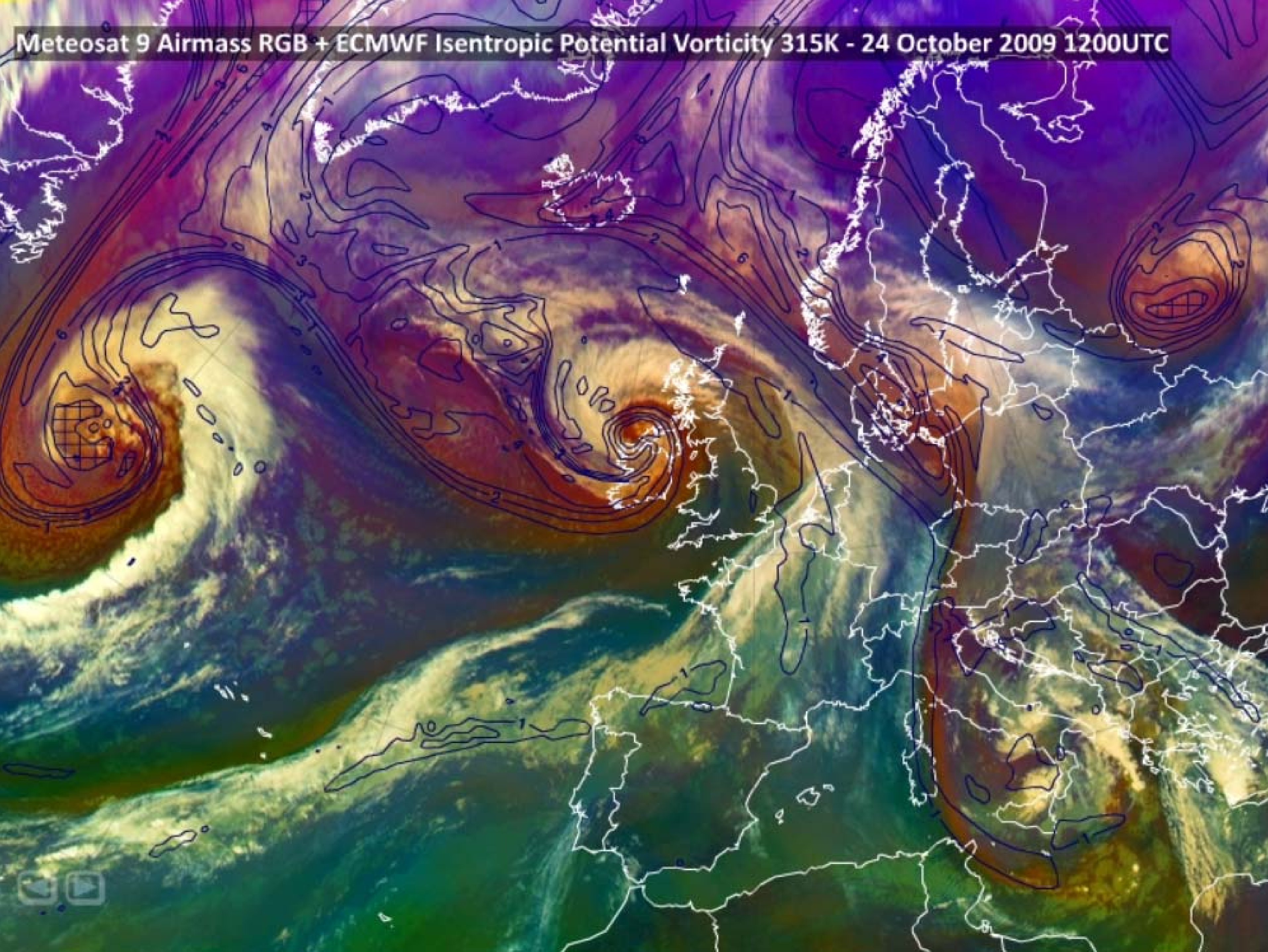
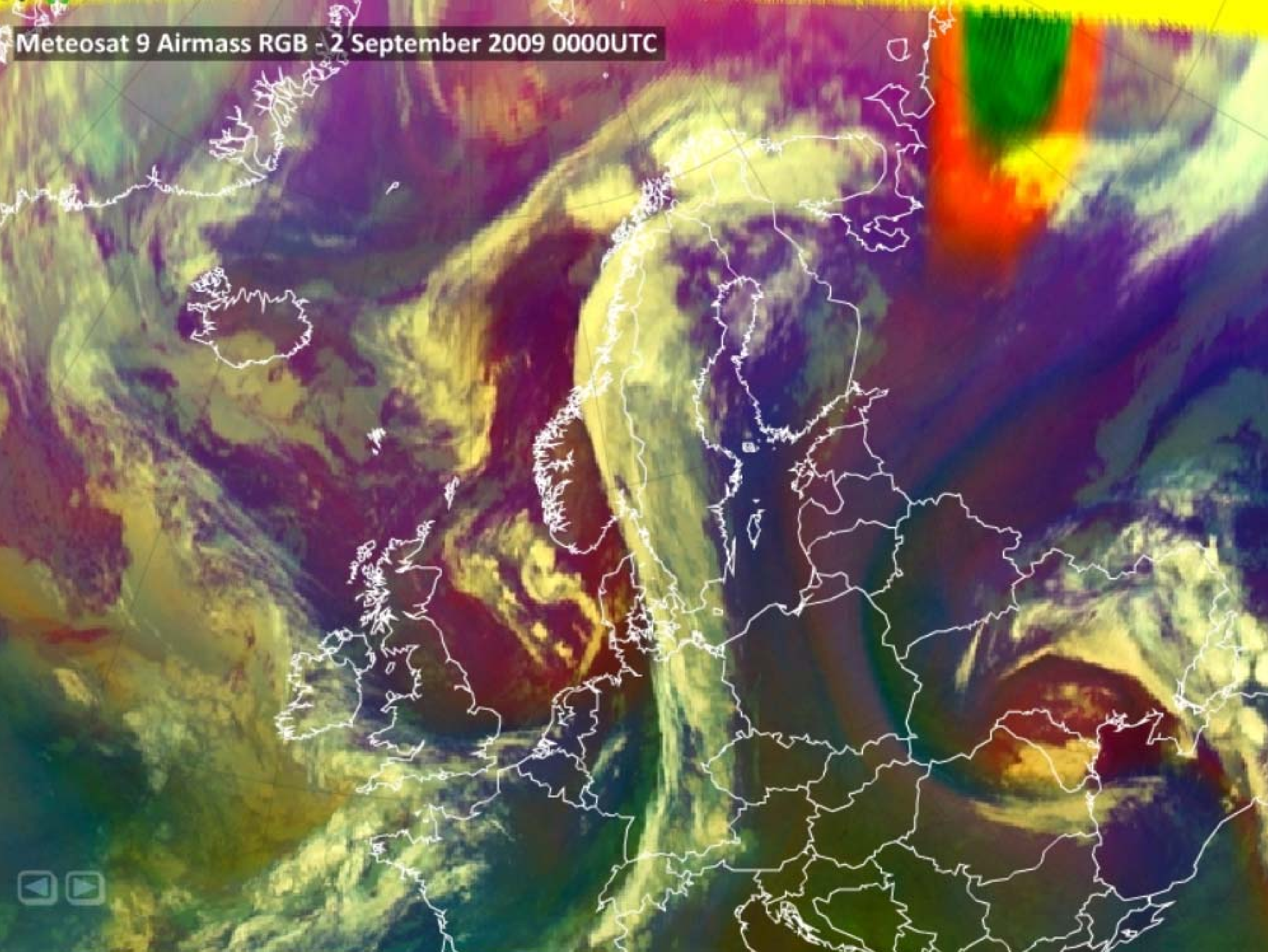
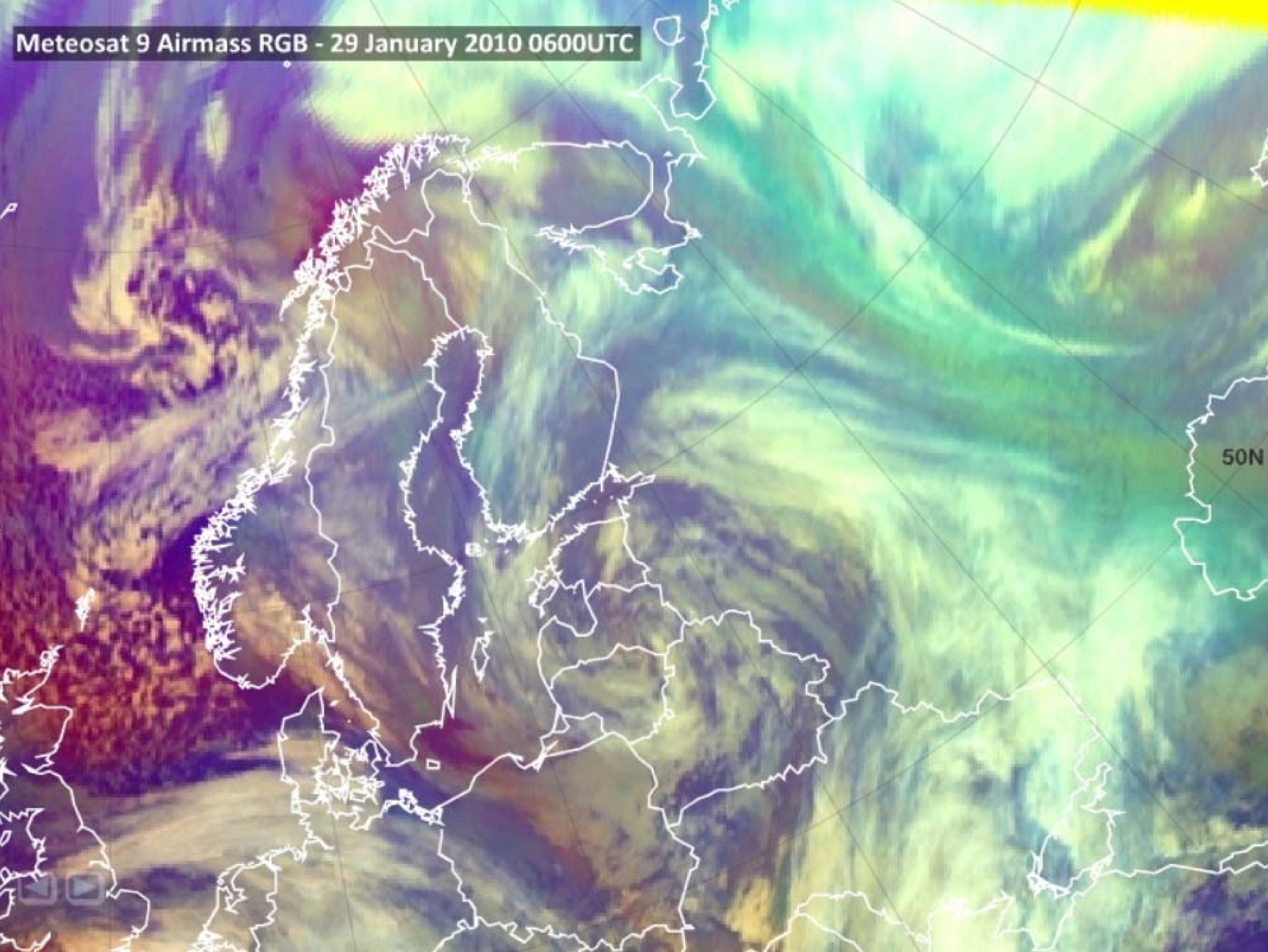

Meteosat 9 Airmass RGB + ECMWF Relative Vorticity 500 hPa. (0.5°) - 24 October 2009 1200UTC


Meteosat 9 Airmass RGB + ECMWF Isentropic Potential Vorticity 315K - 24 October 2009 1200UTC


Meteosat 9 Airmass RGB - 2 September 2009 0000UTC



Meteosat 9 Airmass RGB - 29 January 2010 0600UTC
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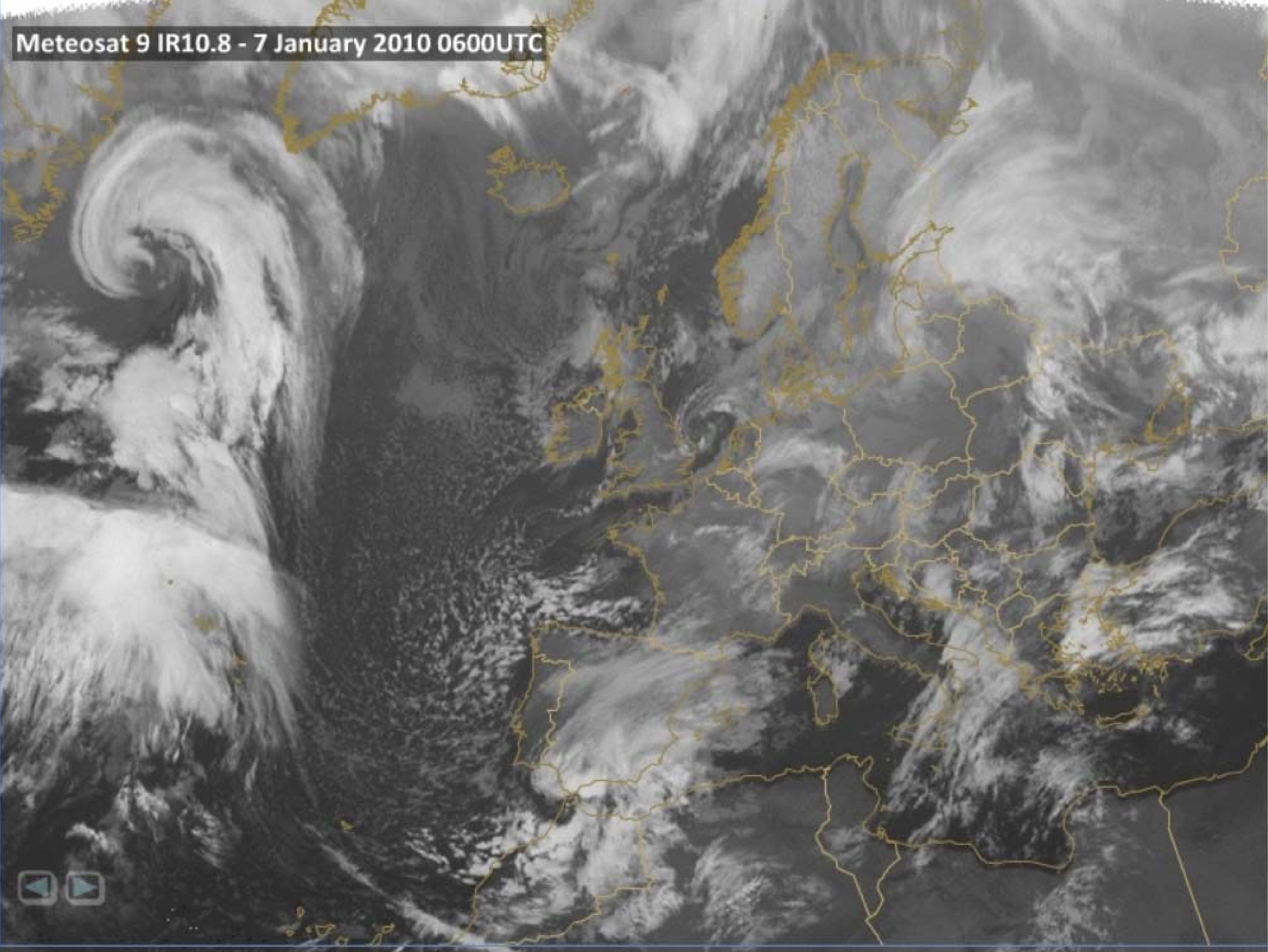
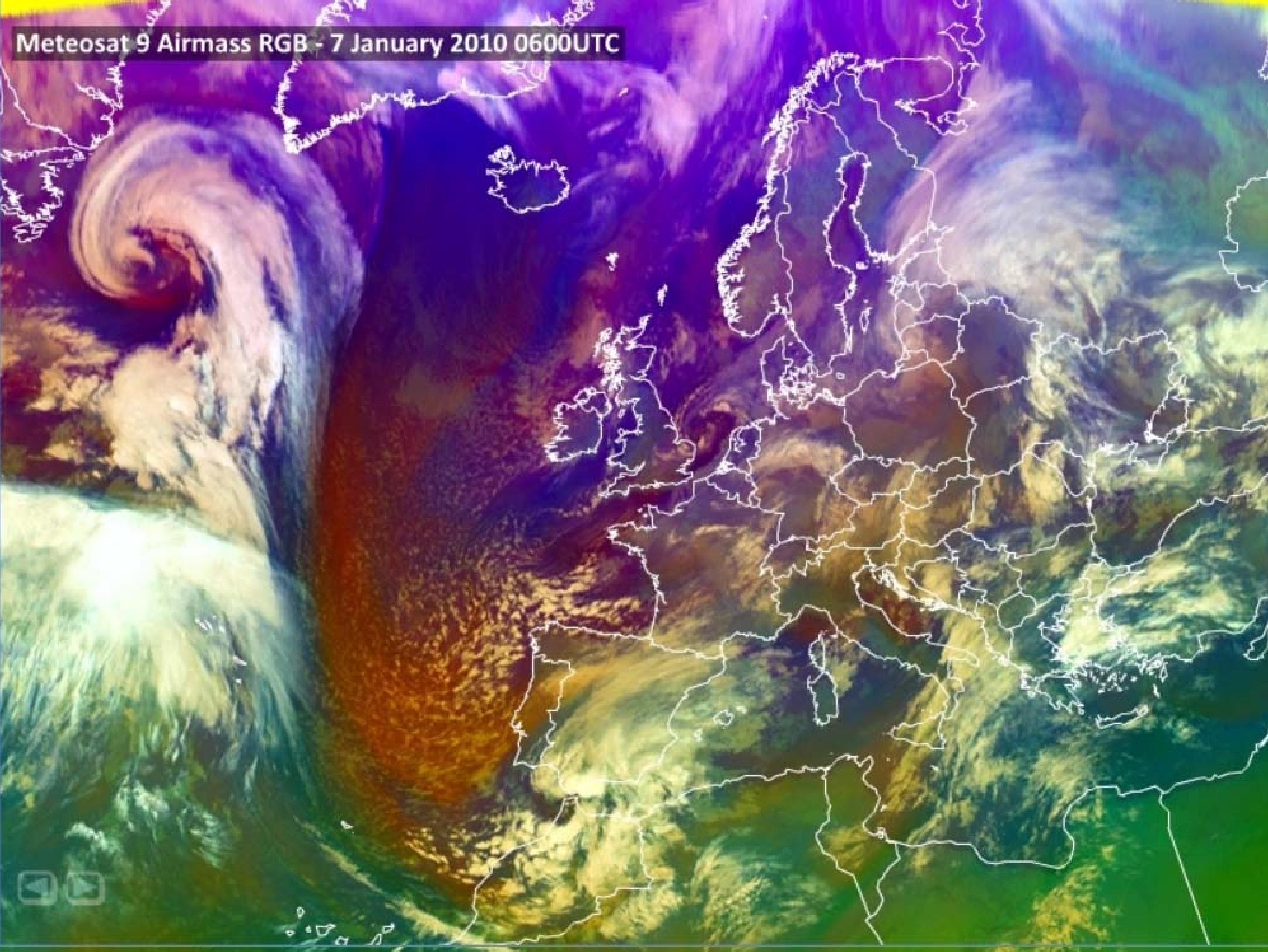
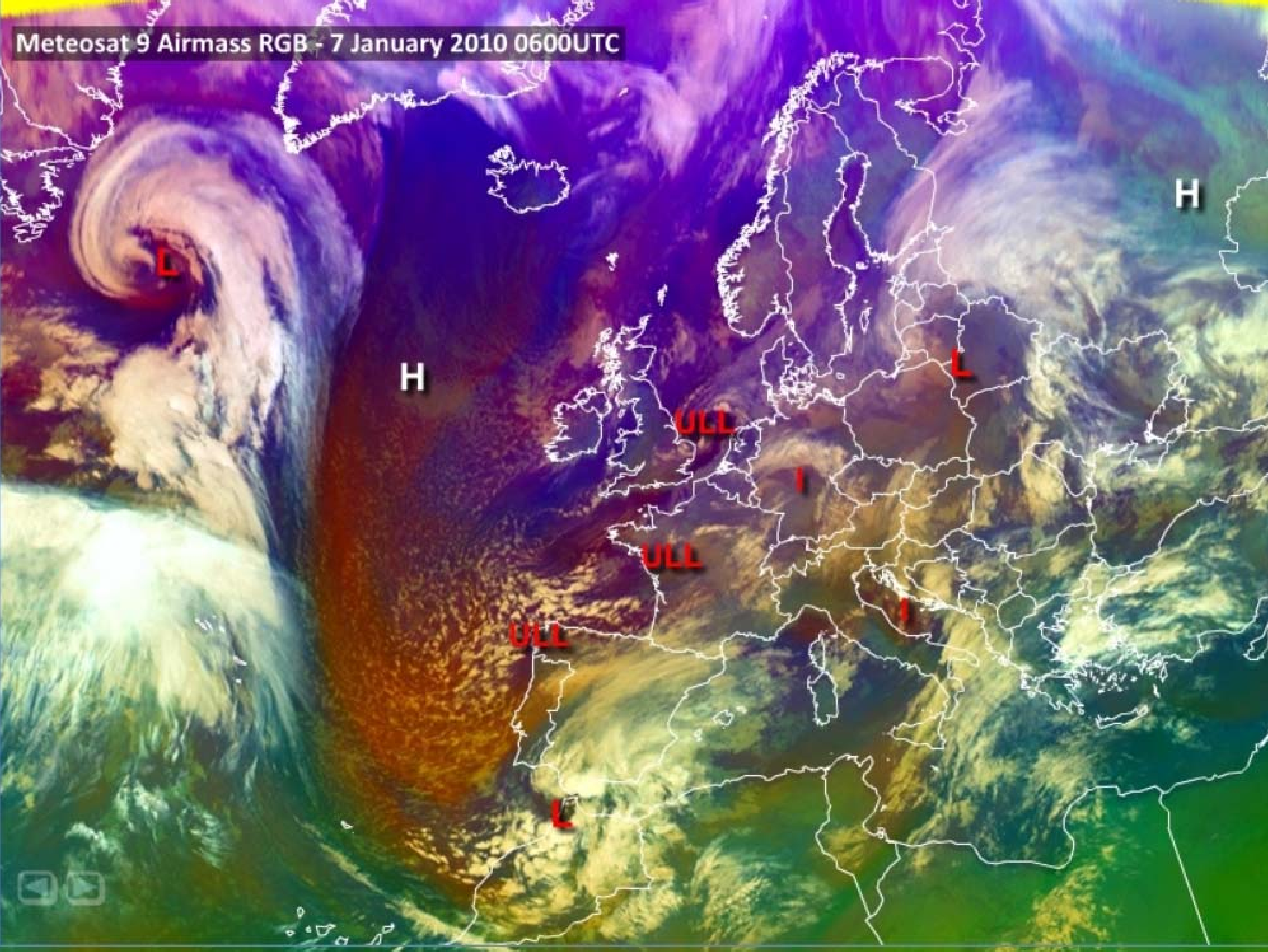

Meteosat 9 IR10.8 - 7 January 2010 0600UTC


Meteosat 9 Airmass RGB - 7 January 2010 0600UTC


Meteosat 9 Airmass RGB - 7 January 2010 0600UTC
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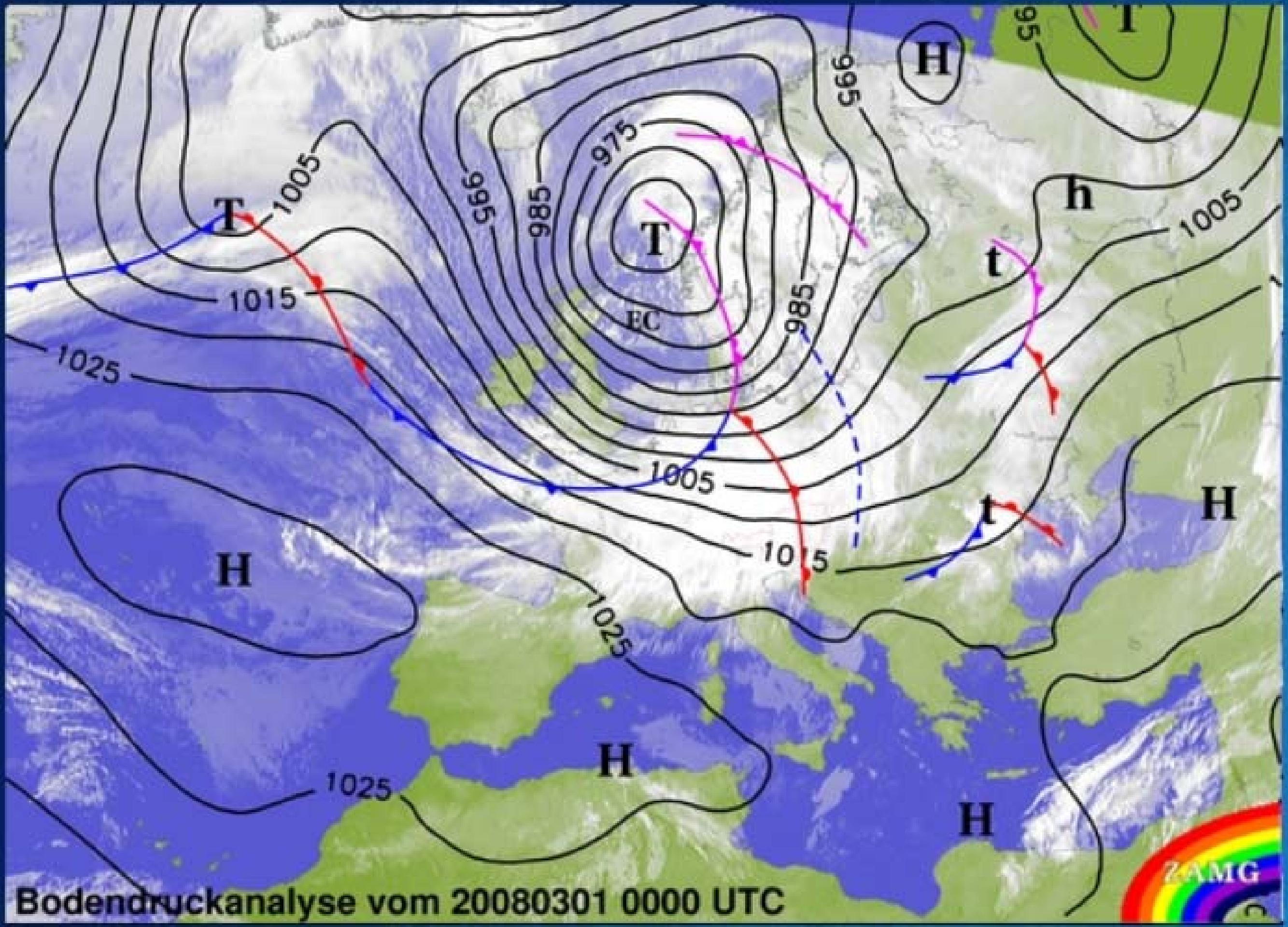
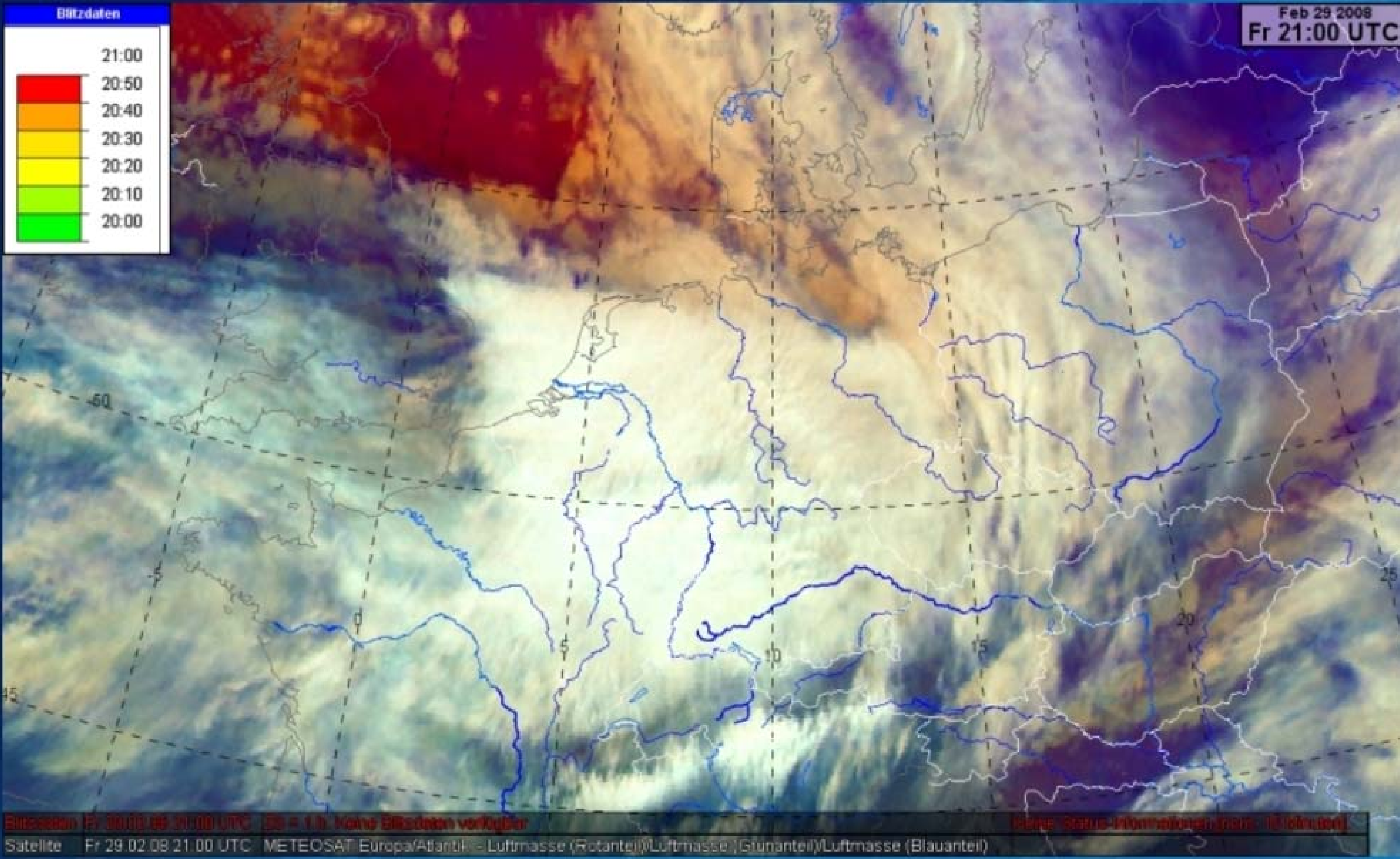
Storm Emma - 1 March 2008



In a cold front with a strong postfrontal flow the appearance of line convection with downburst winds are common. The preconditions are well recognisable with use of Airmass RGB.

Storm Emma - 1 March 2008



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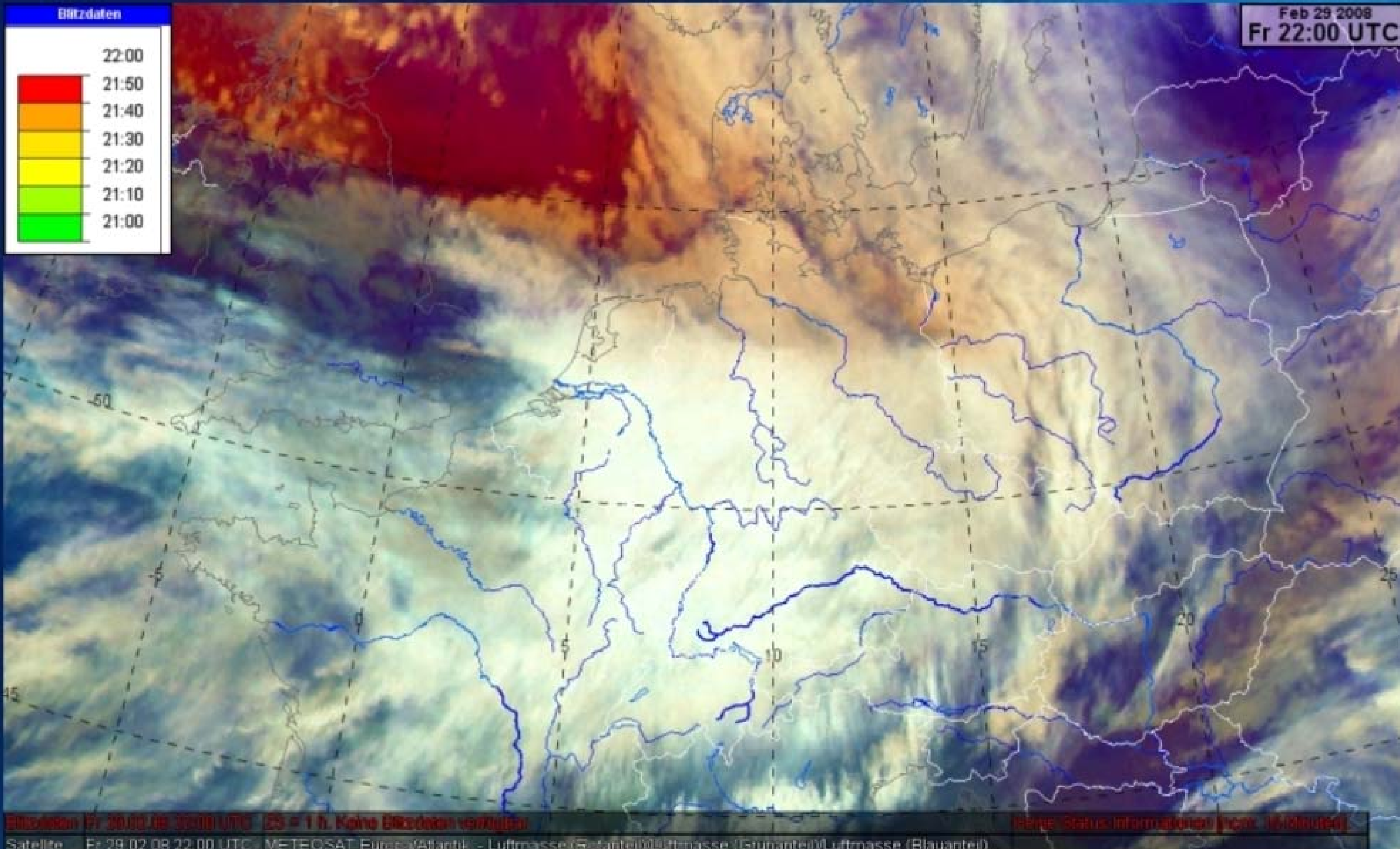
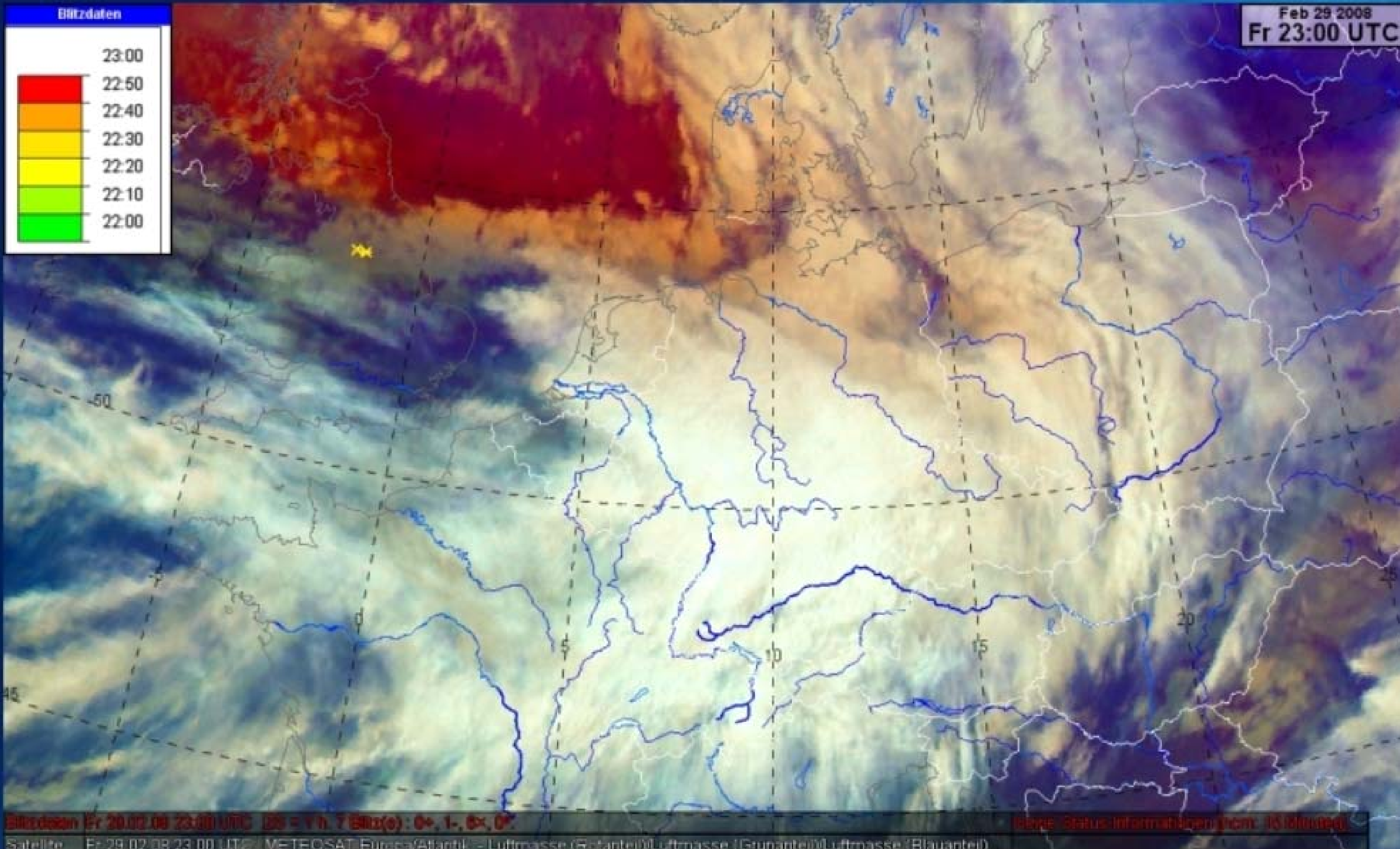
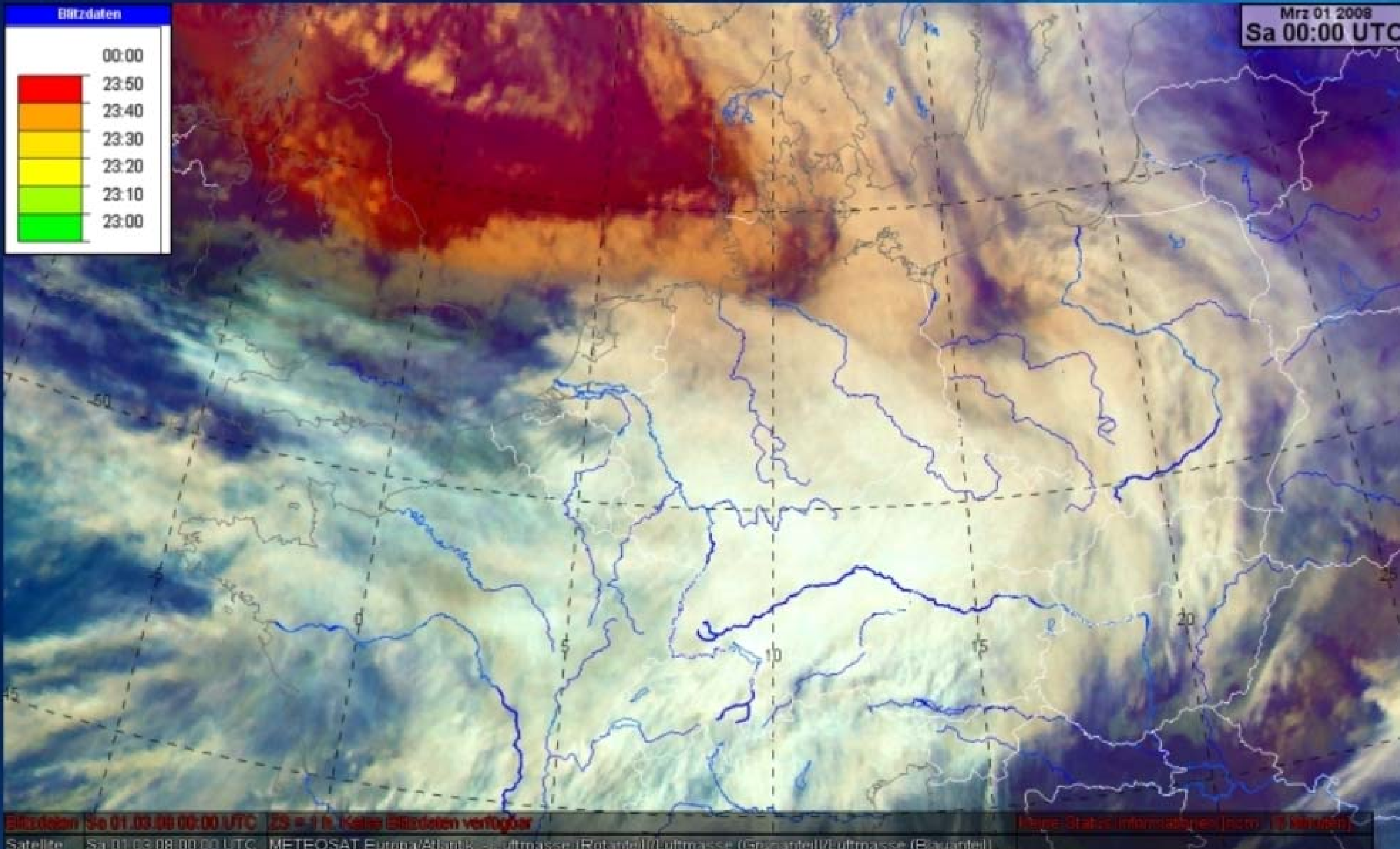


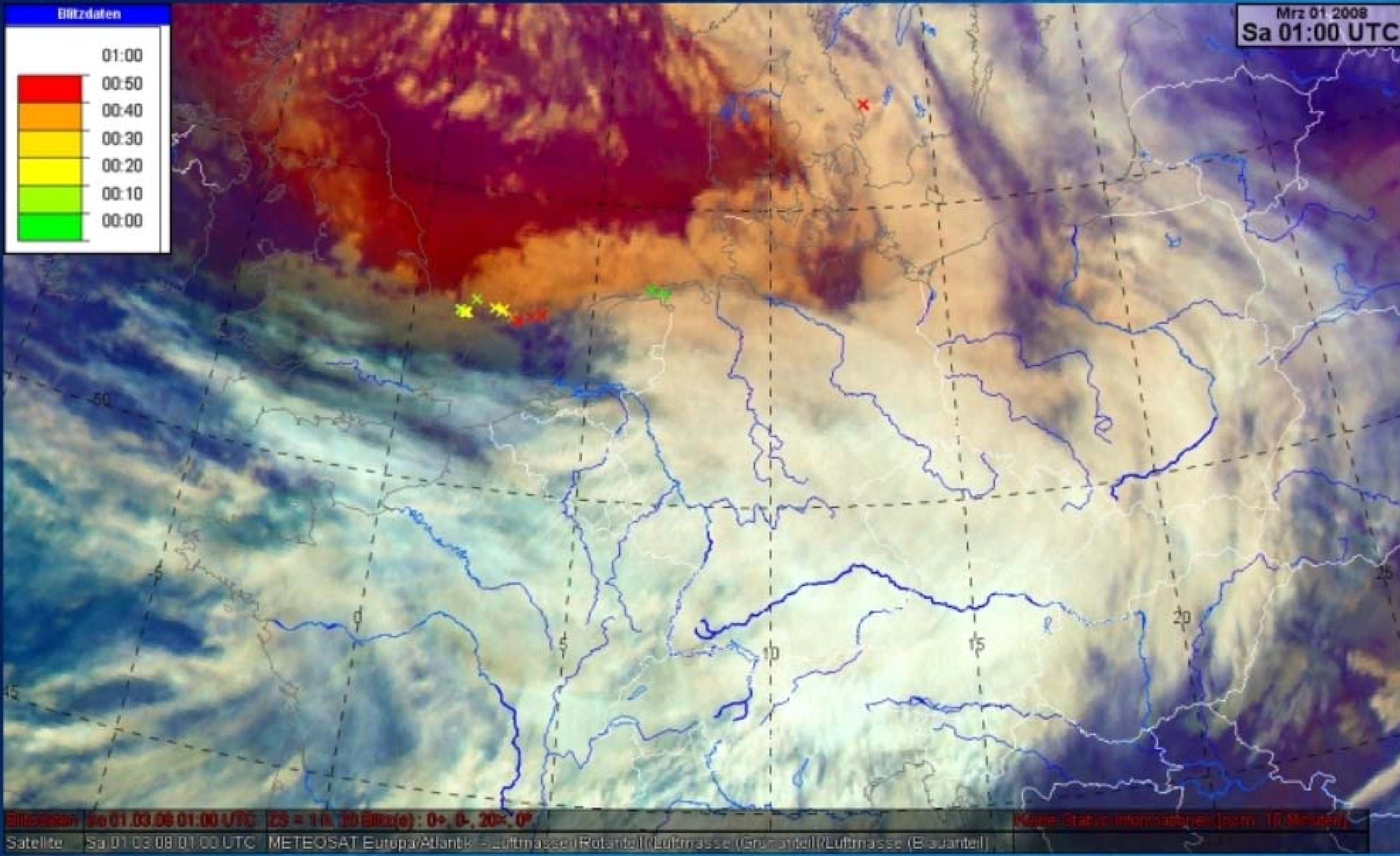
Storm Emma - 1 March 2008



Storm Emma - 1 March 2008



Storm Emma - 1 March 2008



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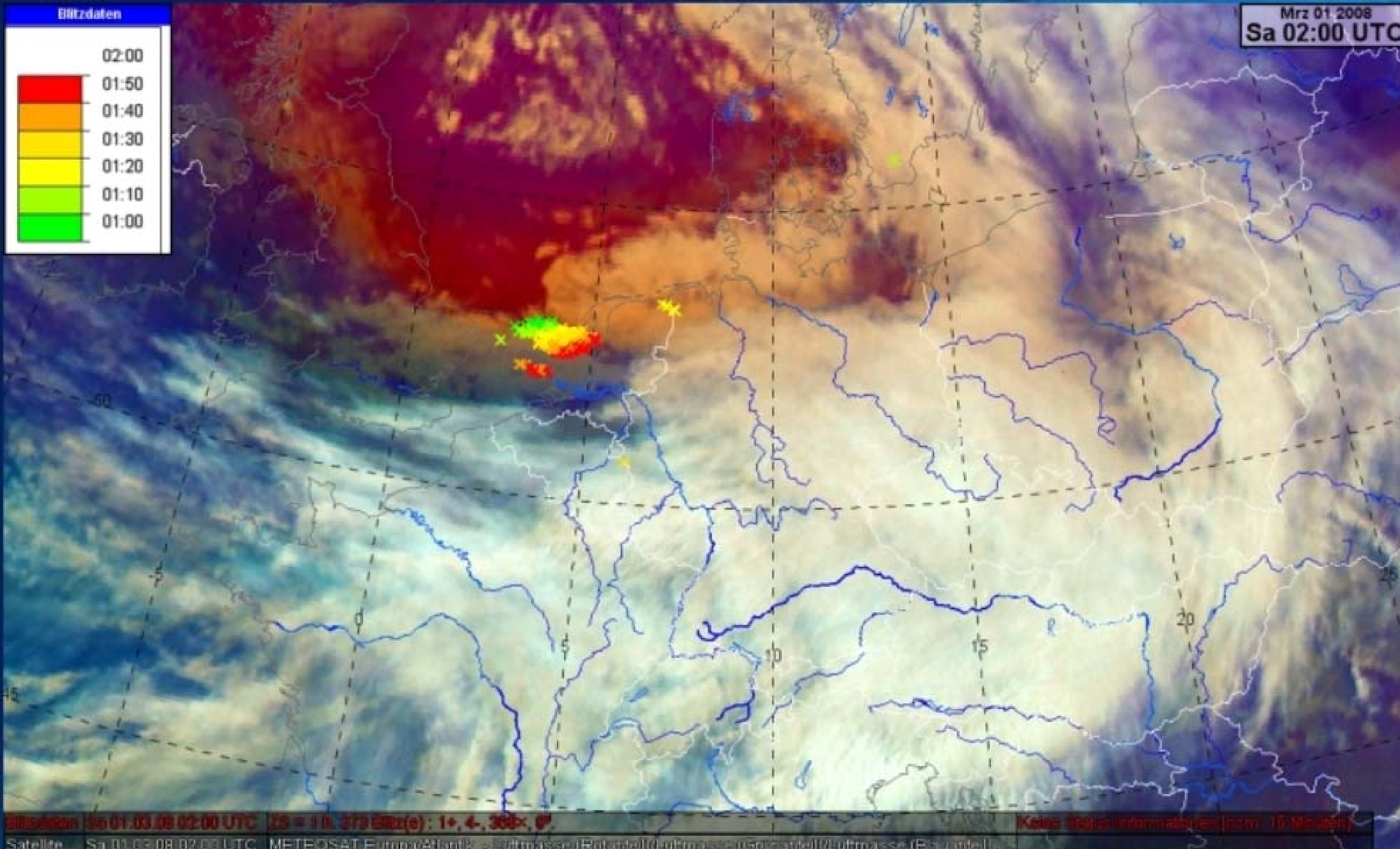

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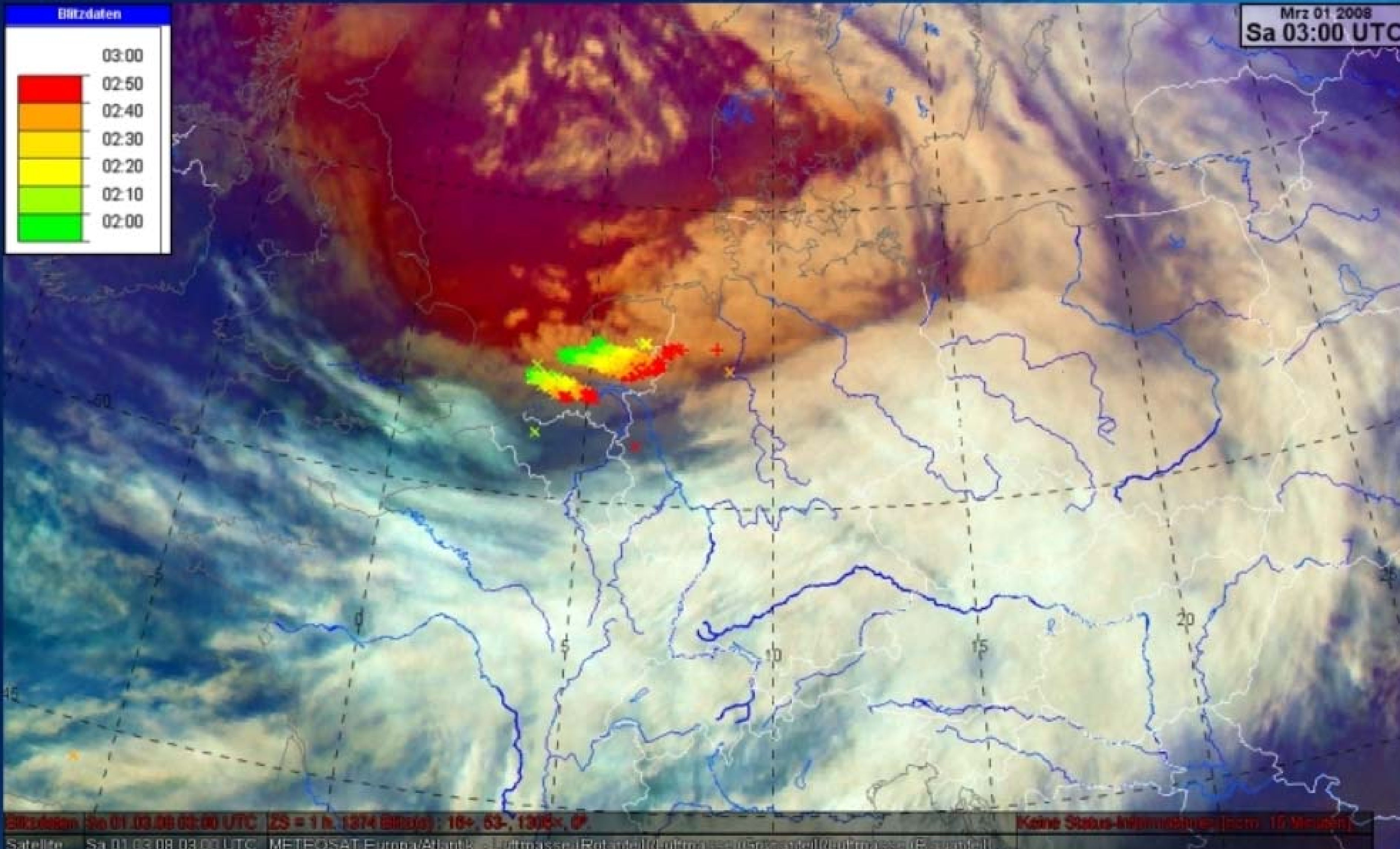
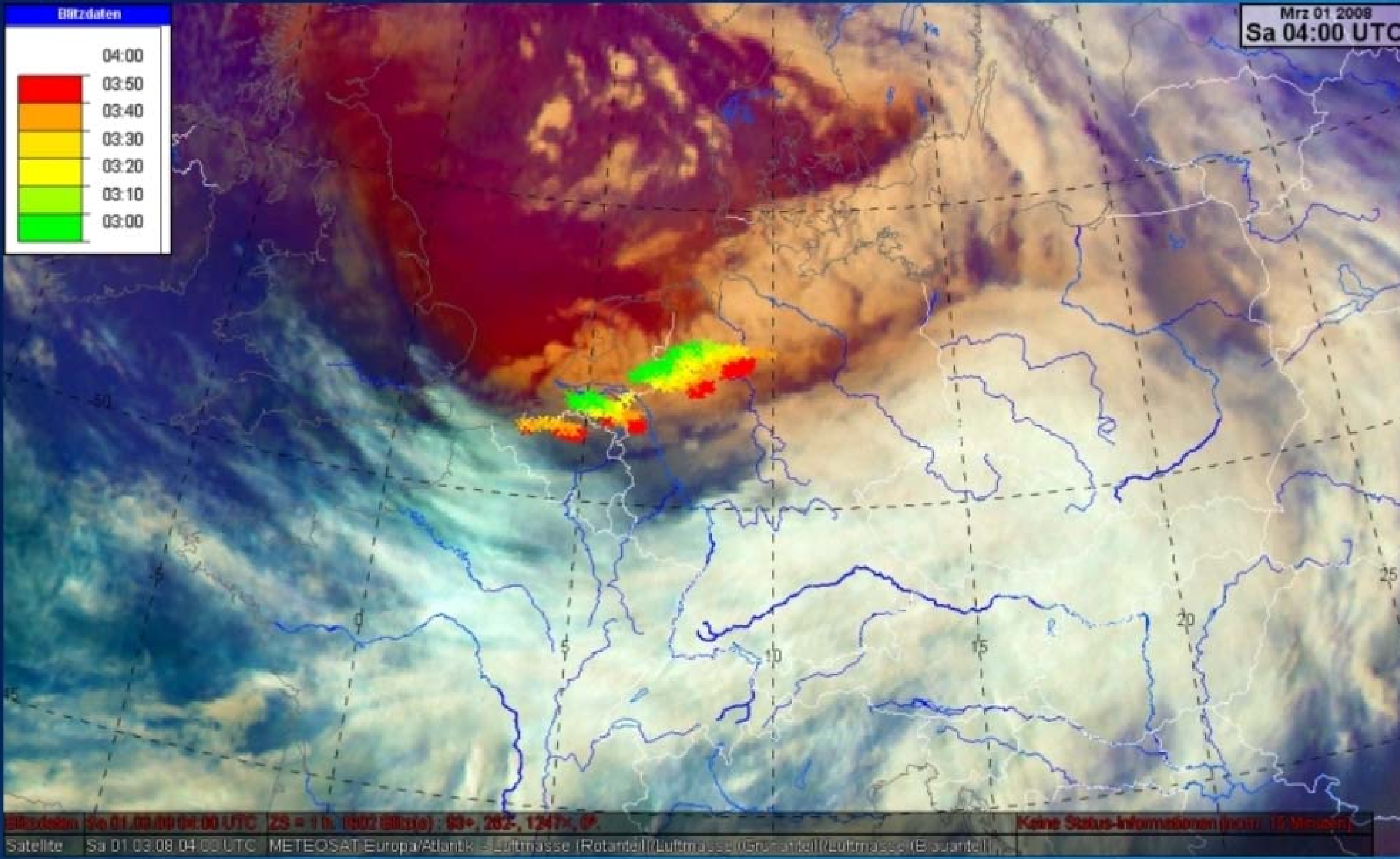


Storm Emma - 1 March 2008



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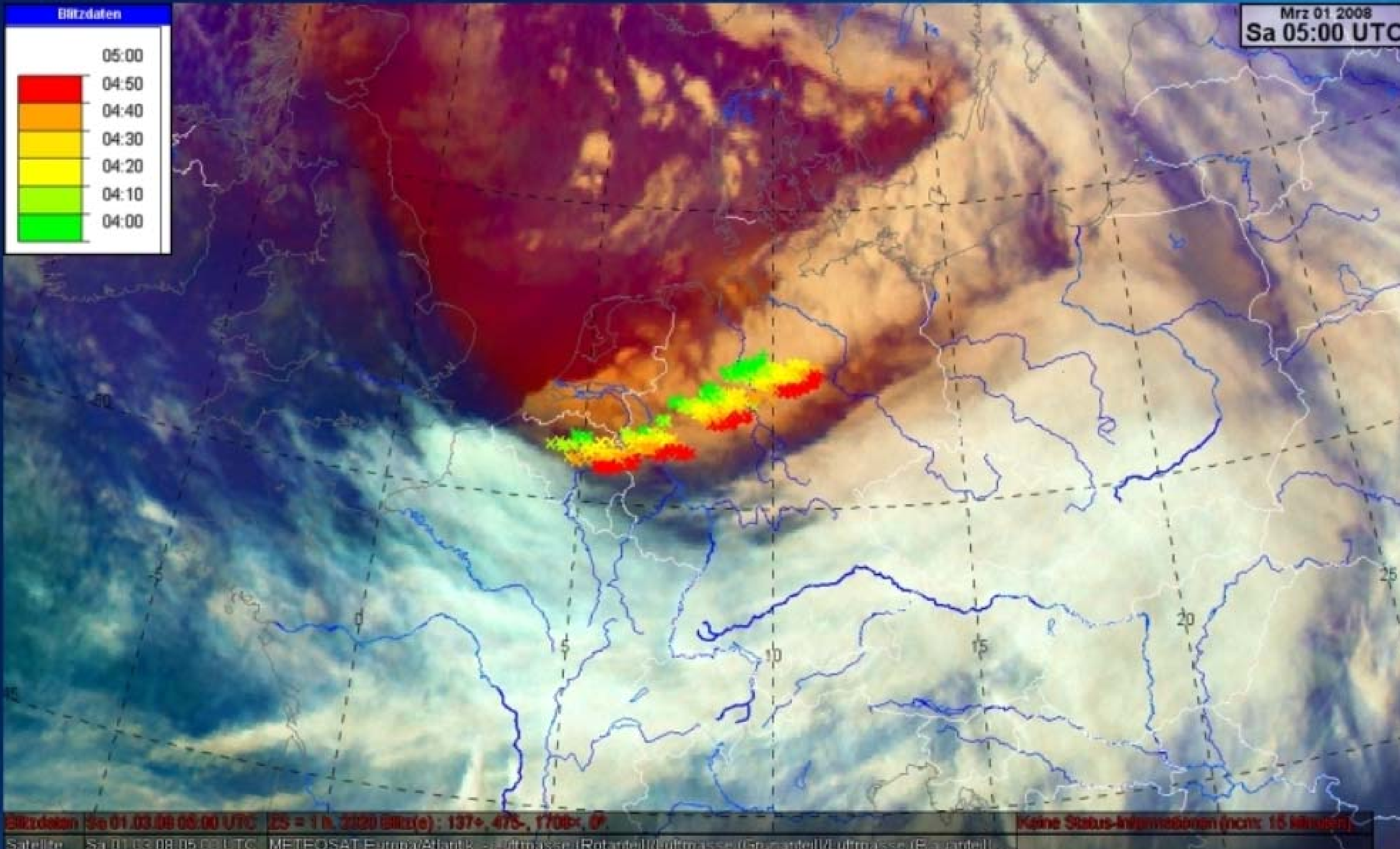

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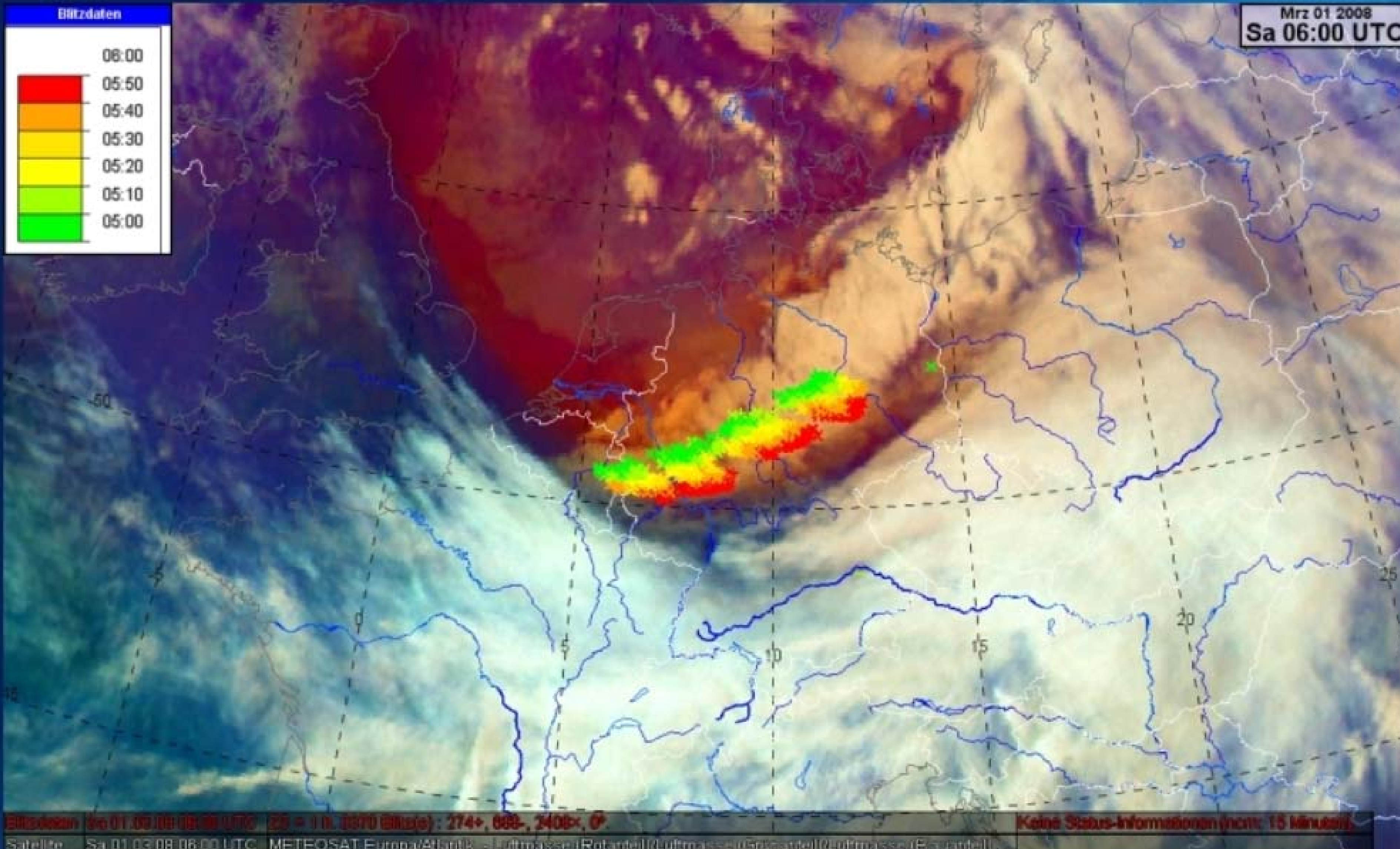

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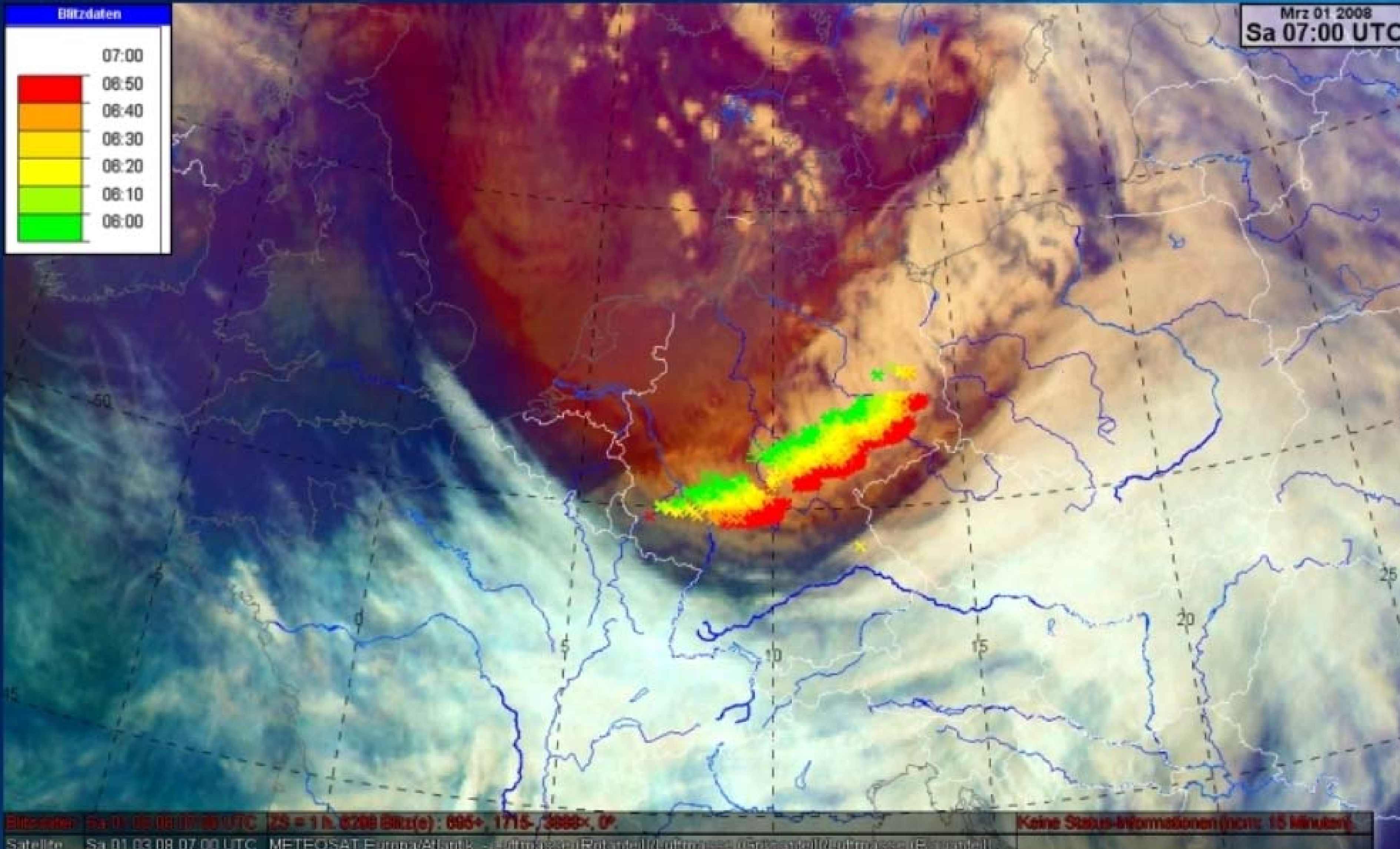

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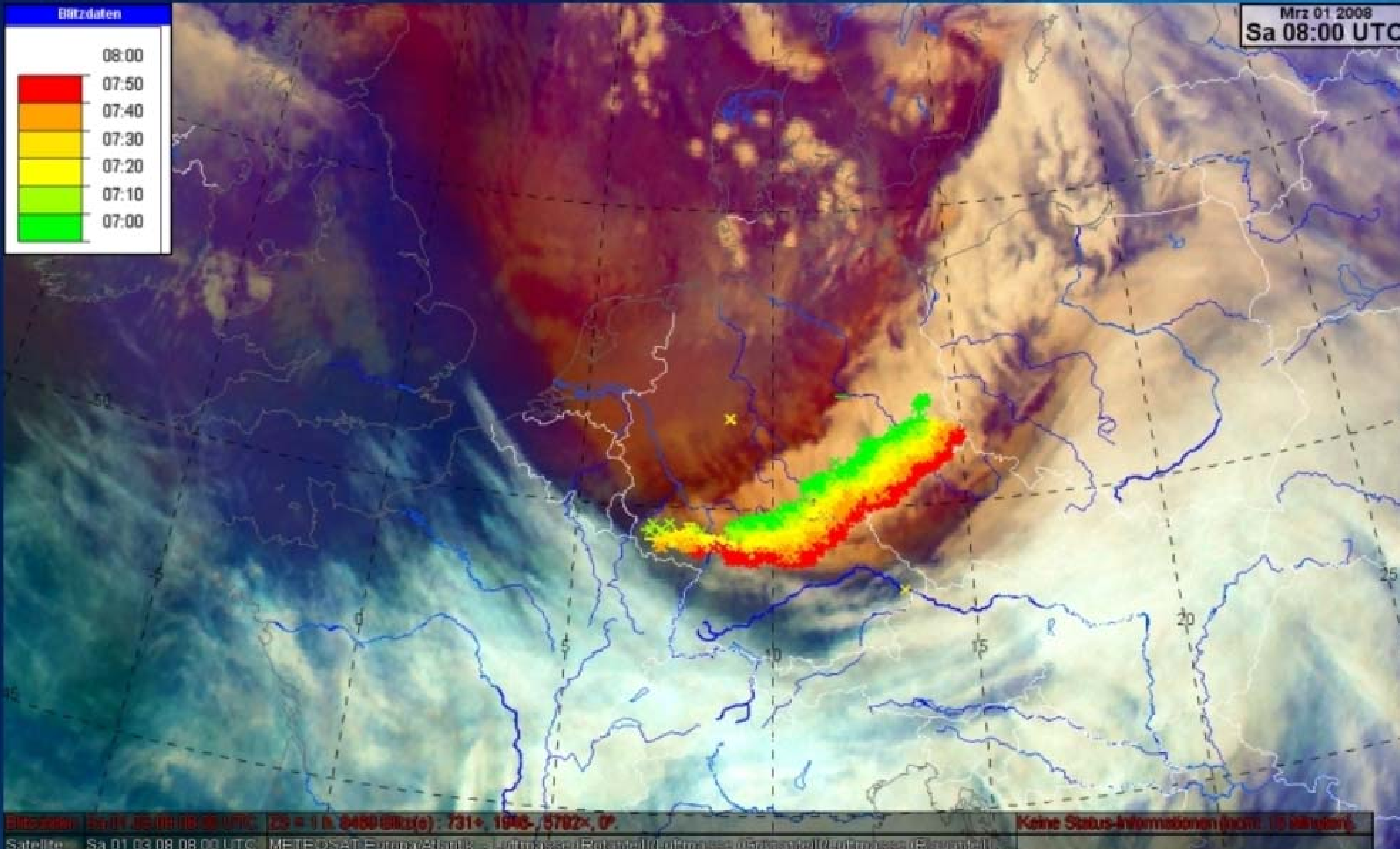

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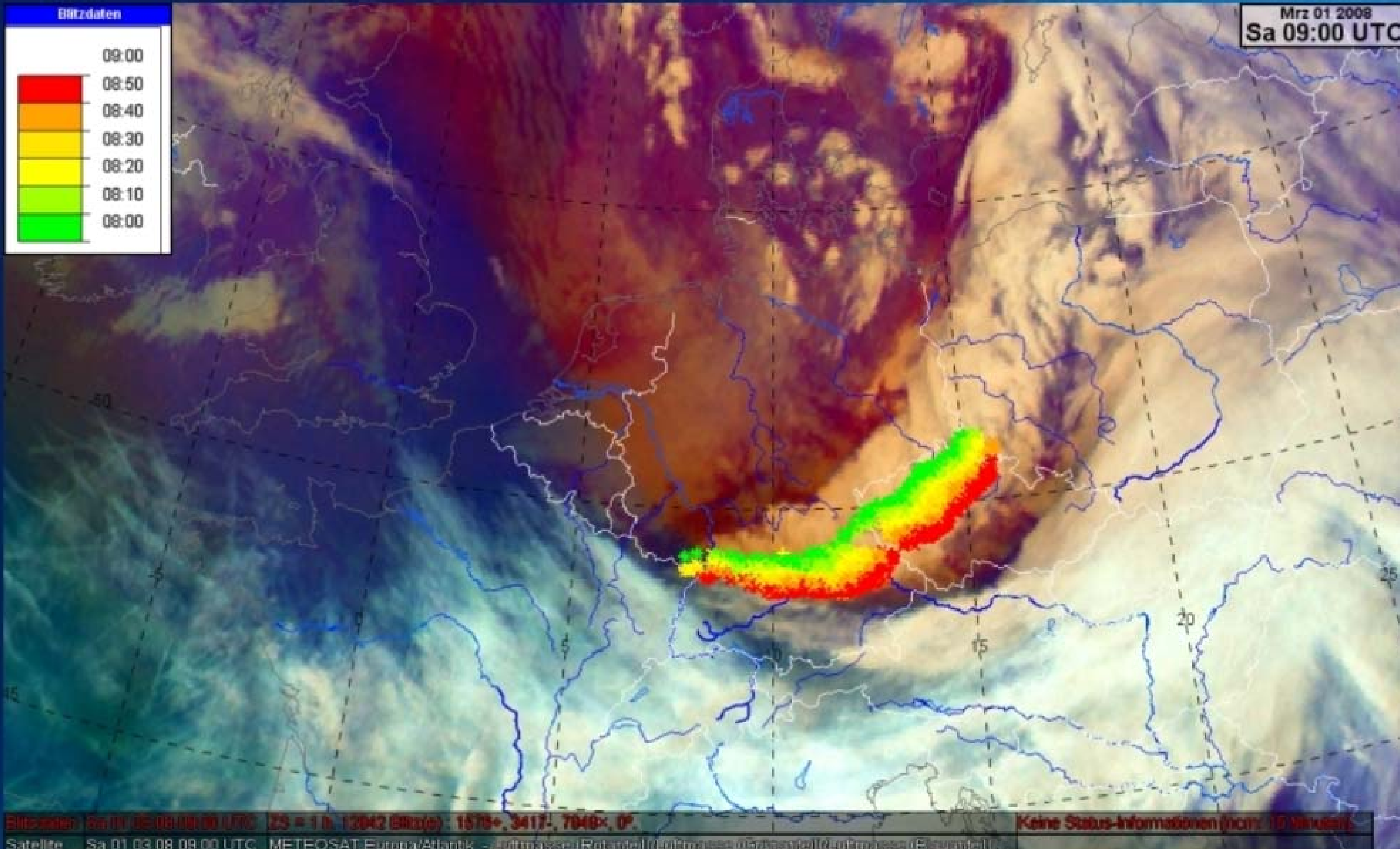

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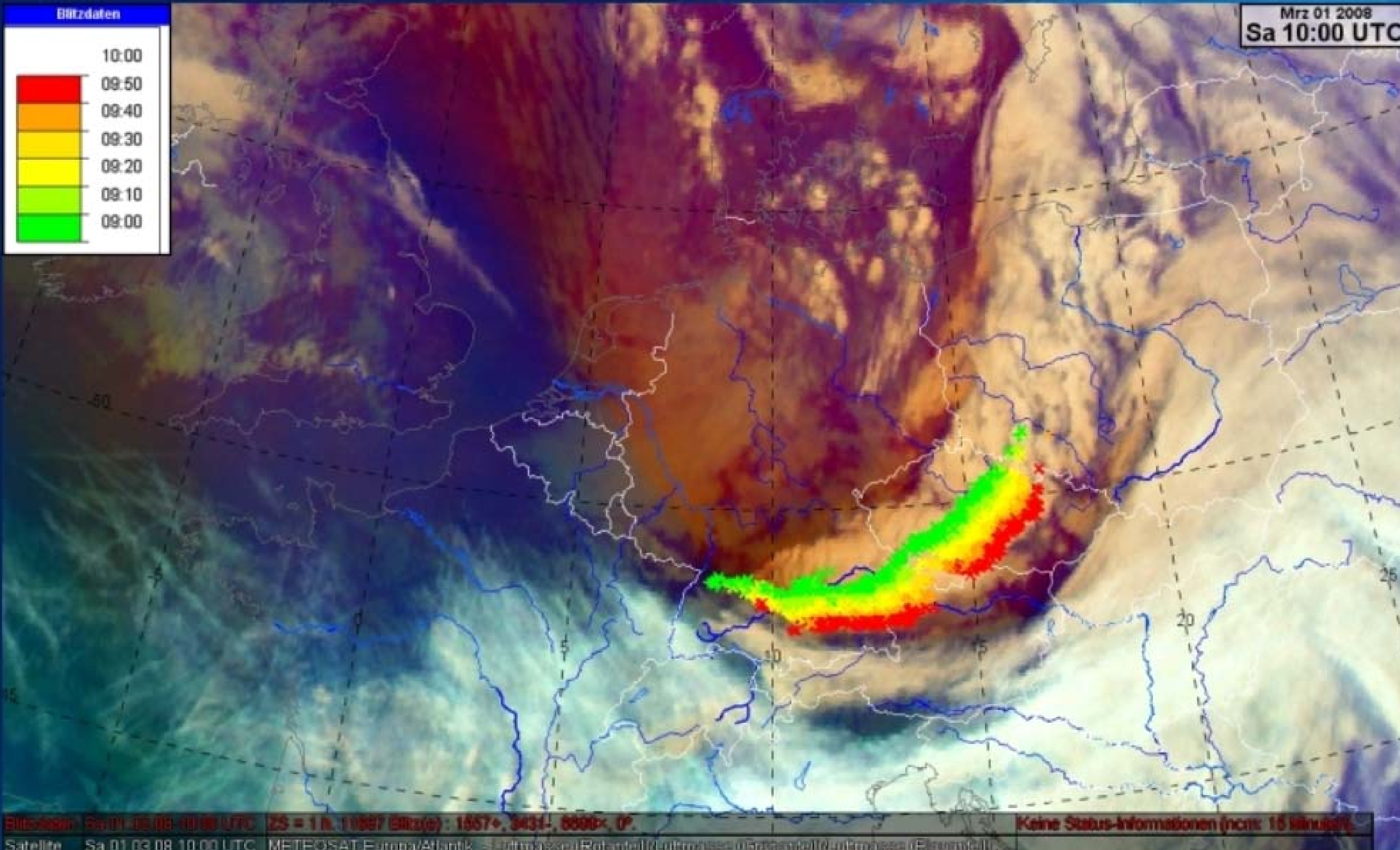

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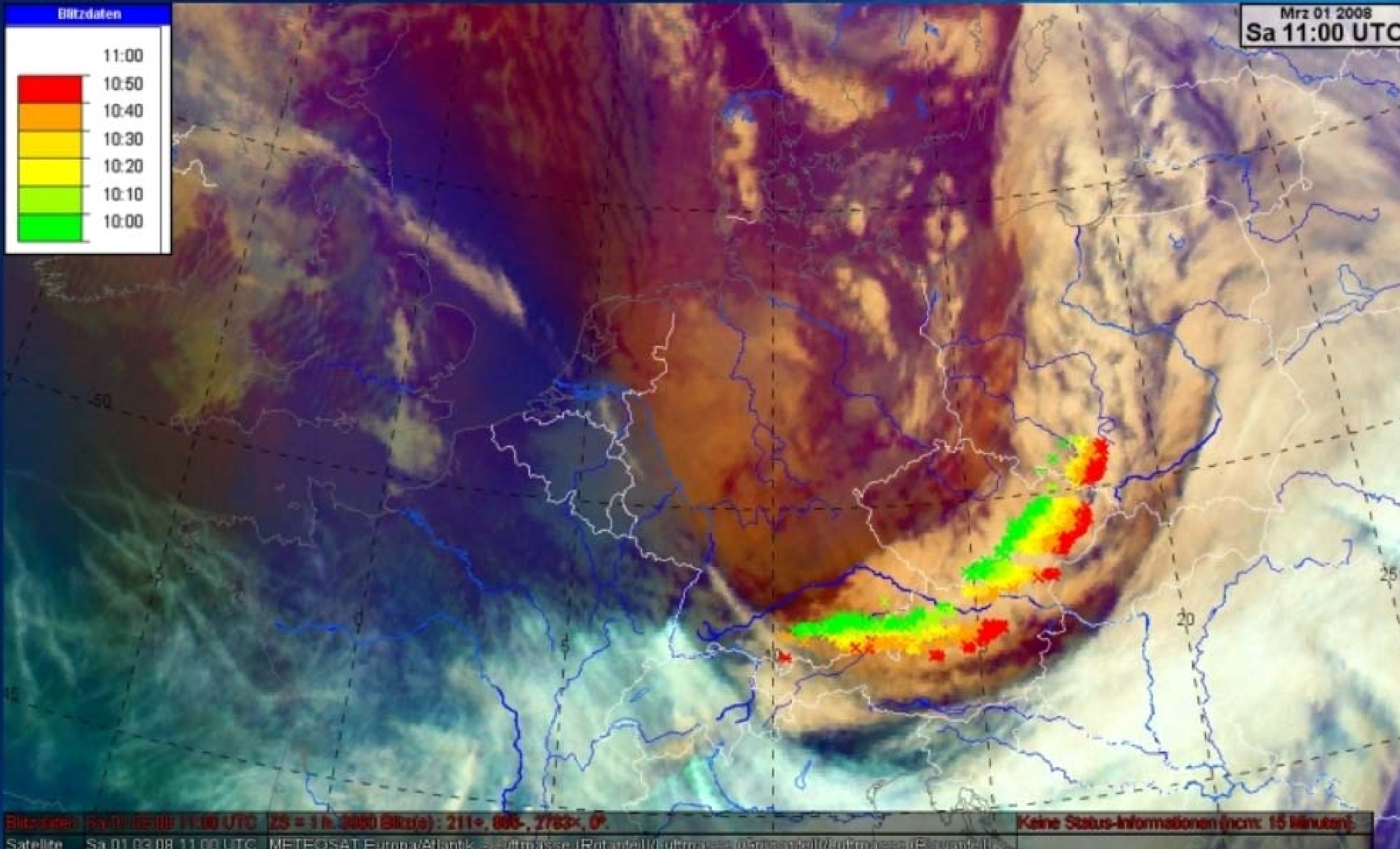

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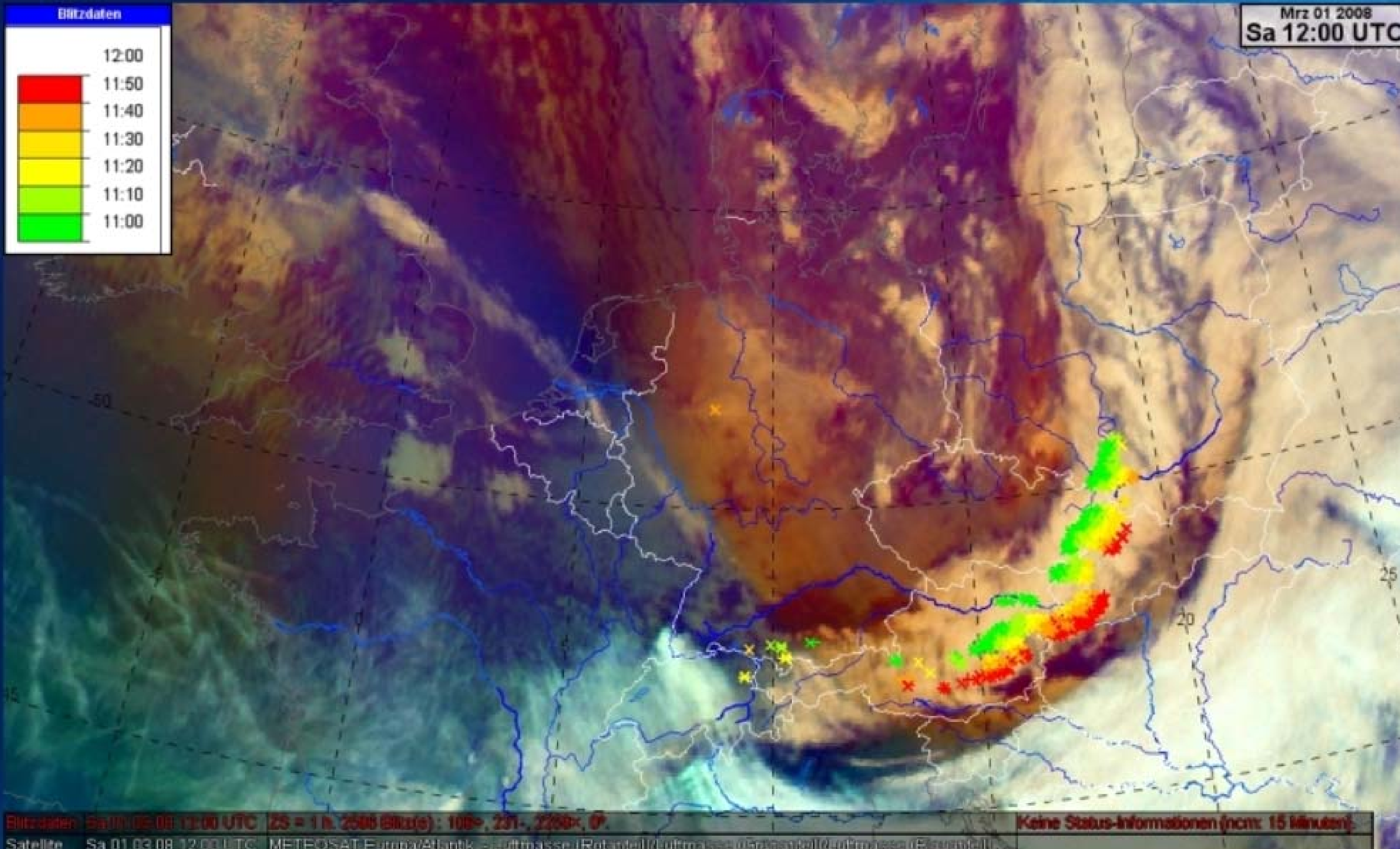

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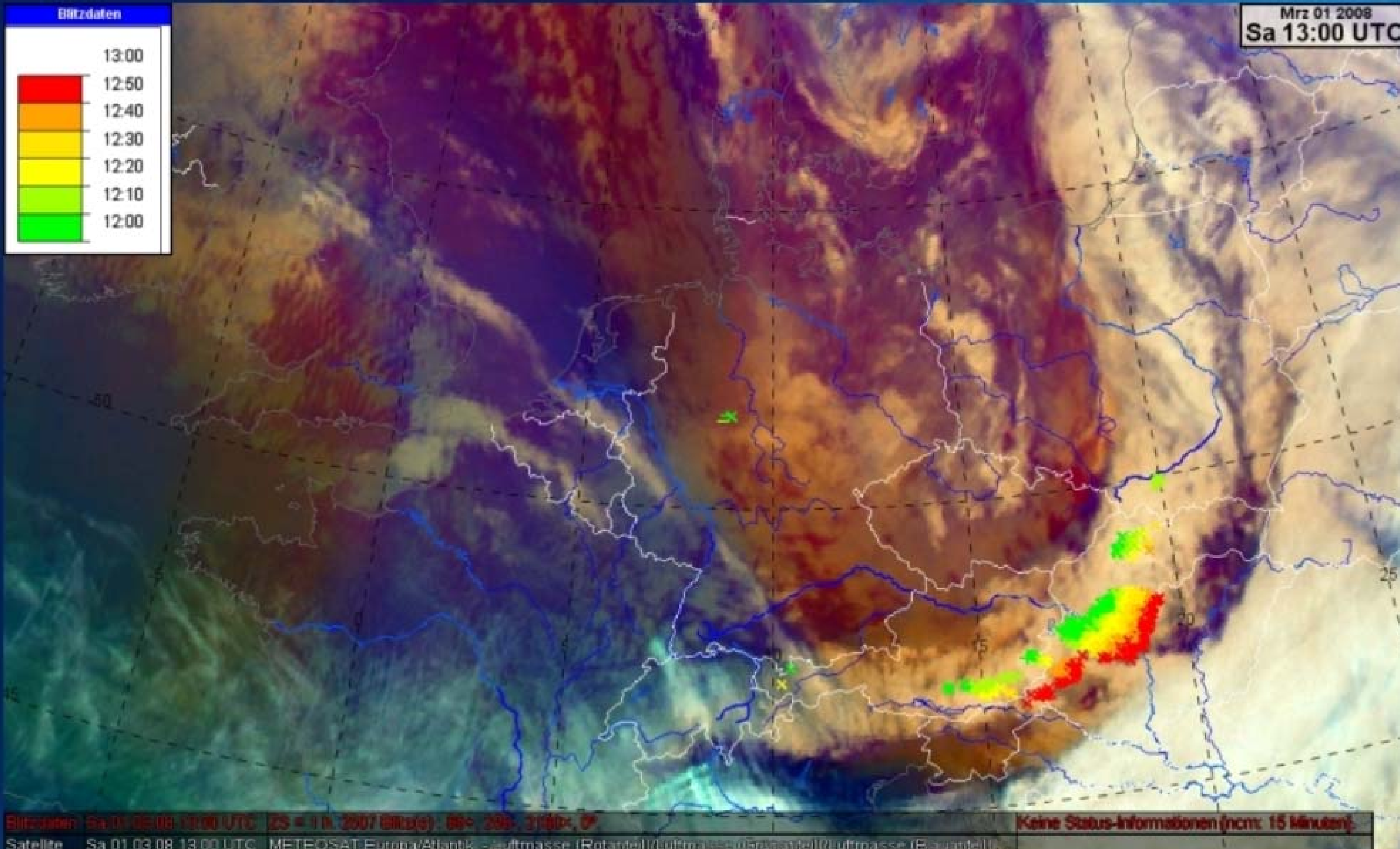

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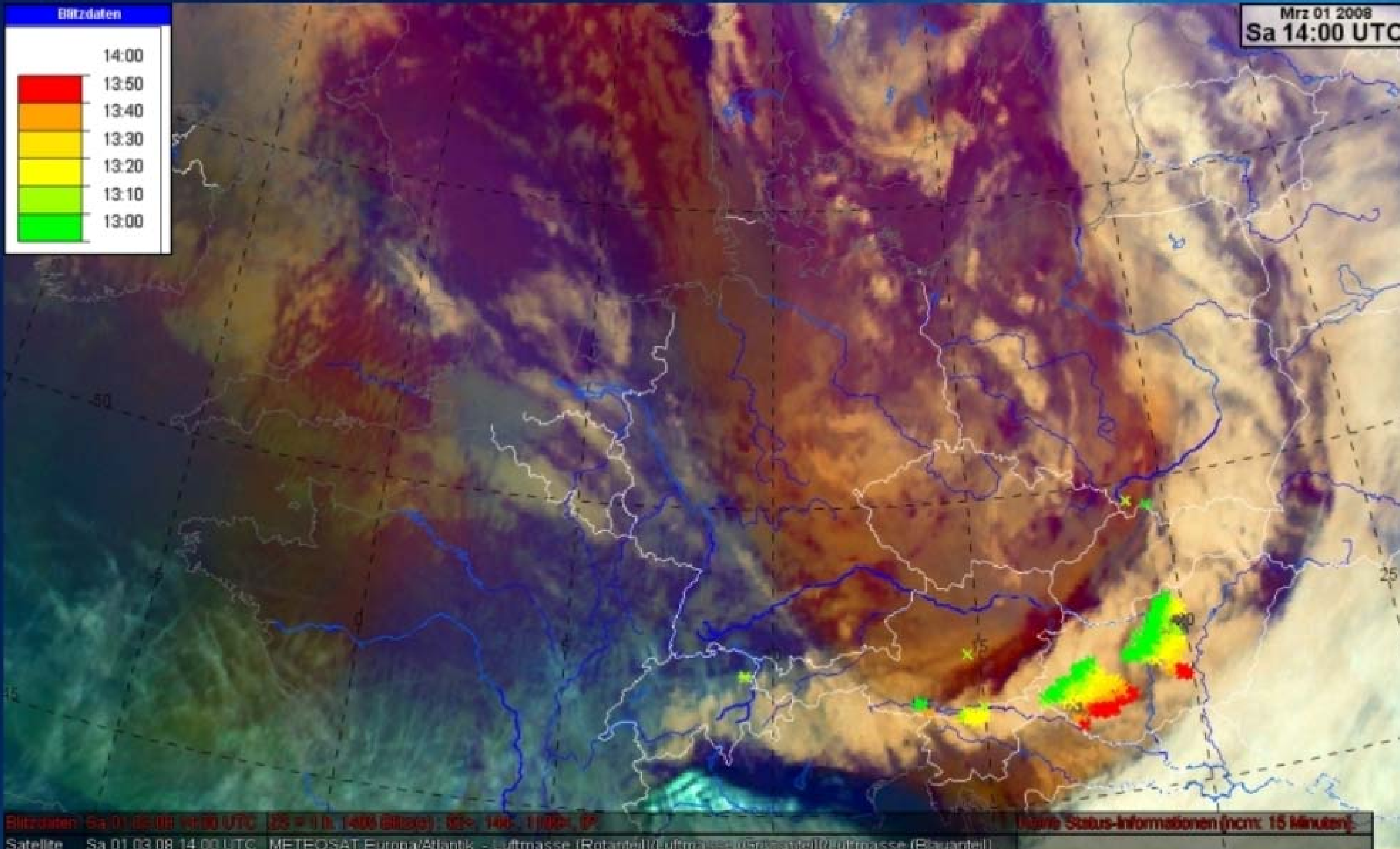

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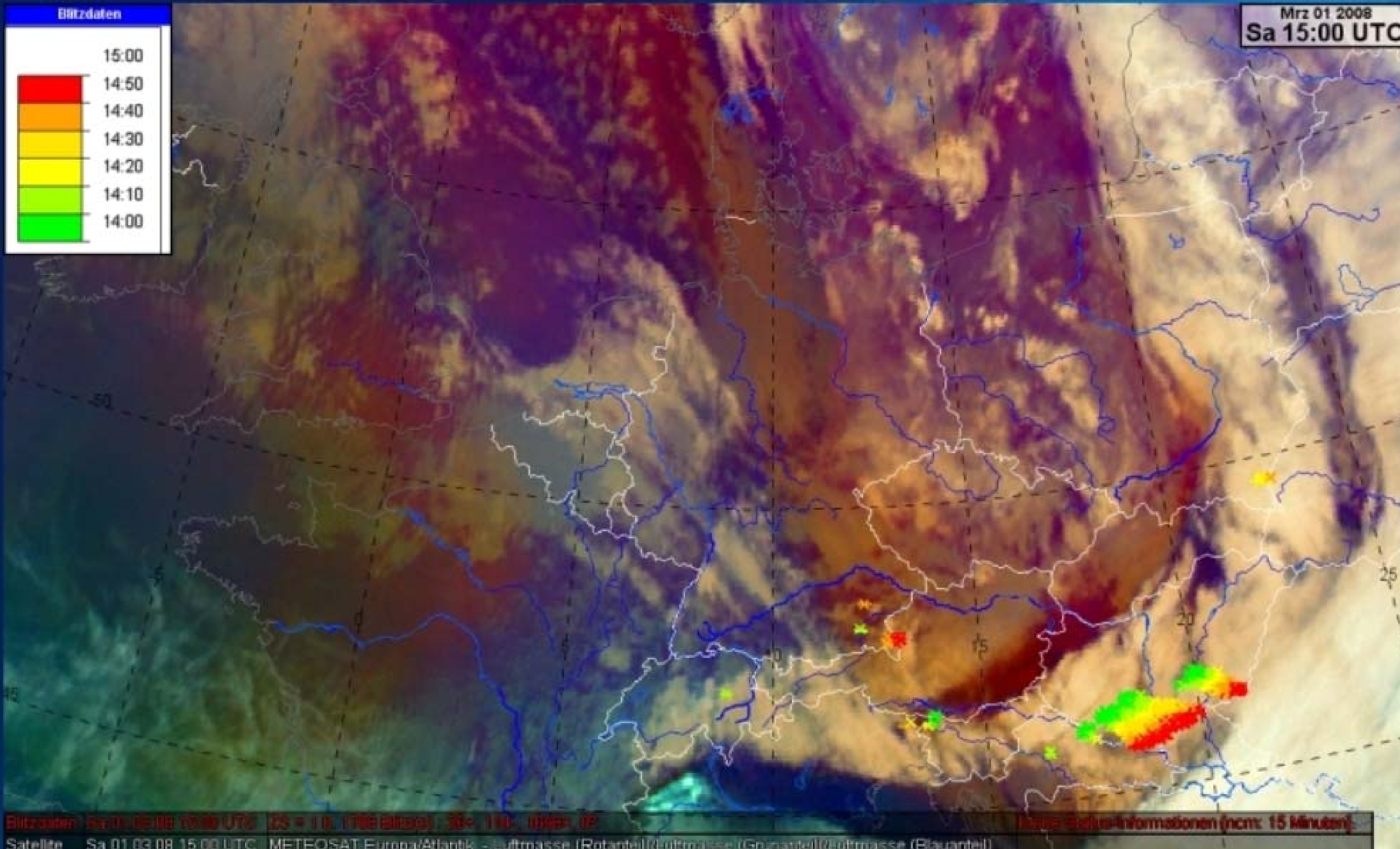
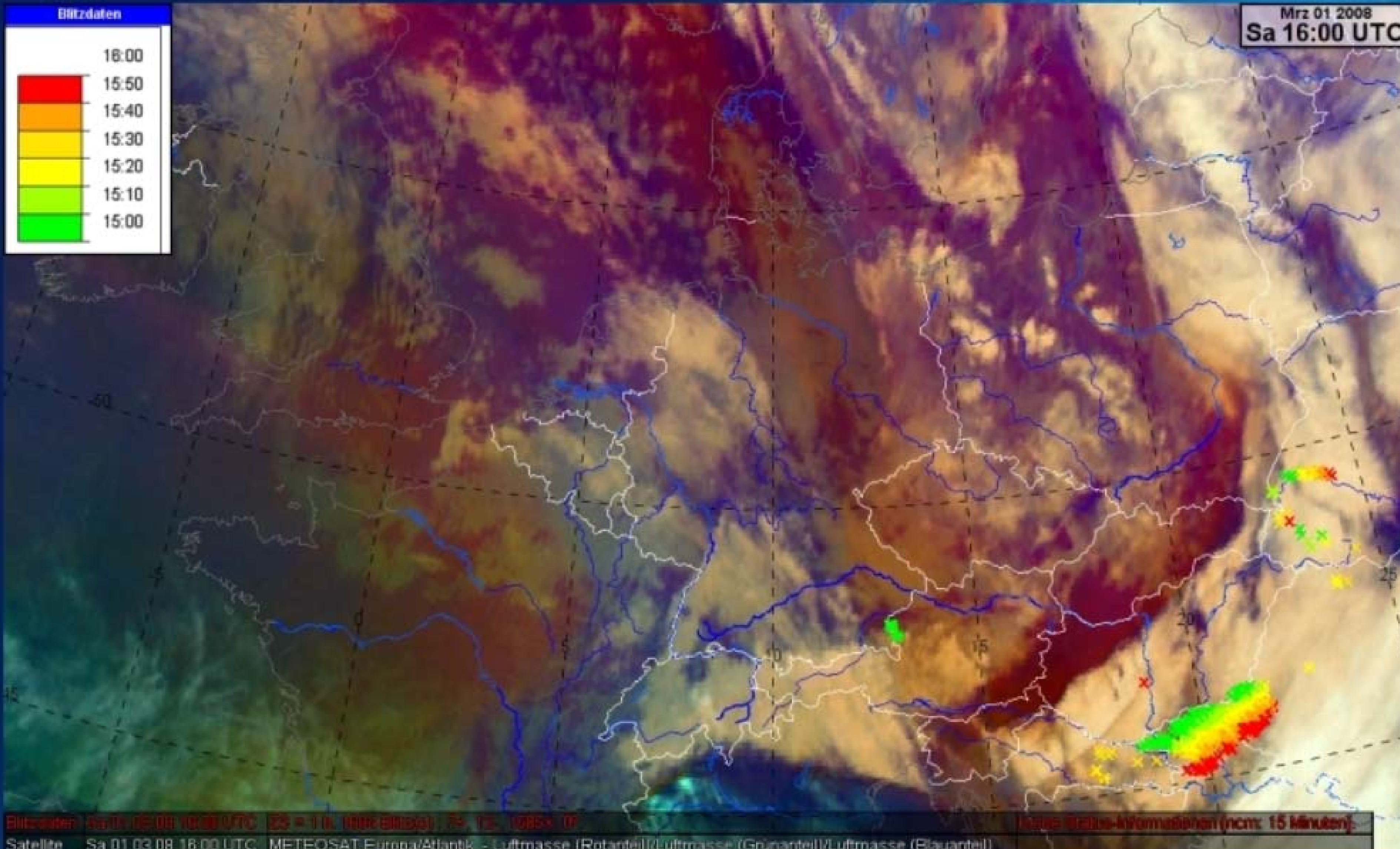


Storm Emma - 1 March 2008



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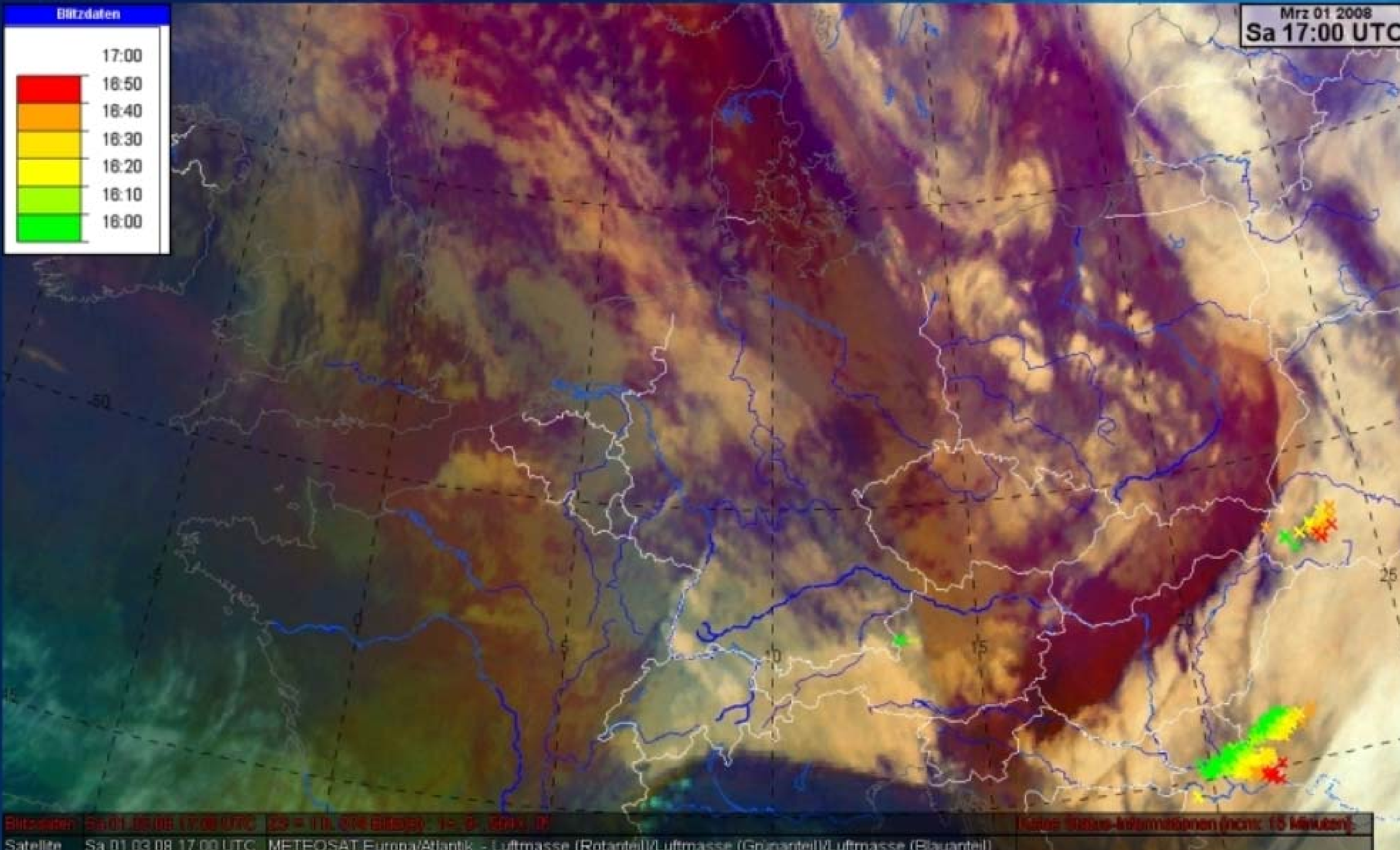
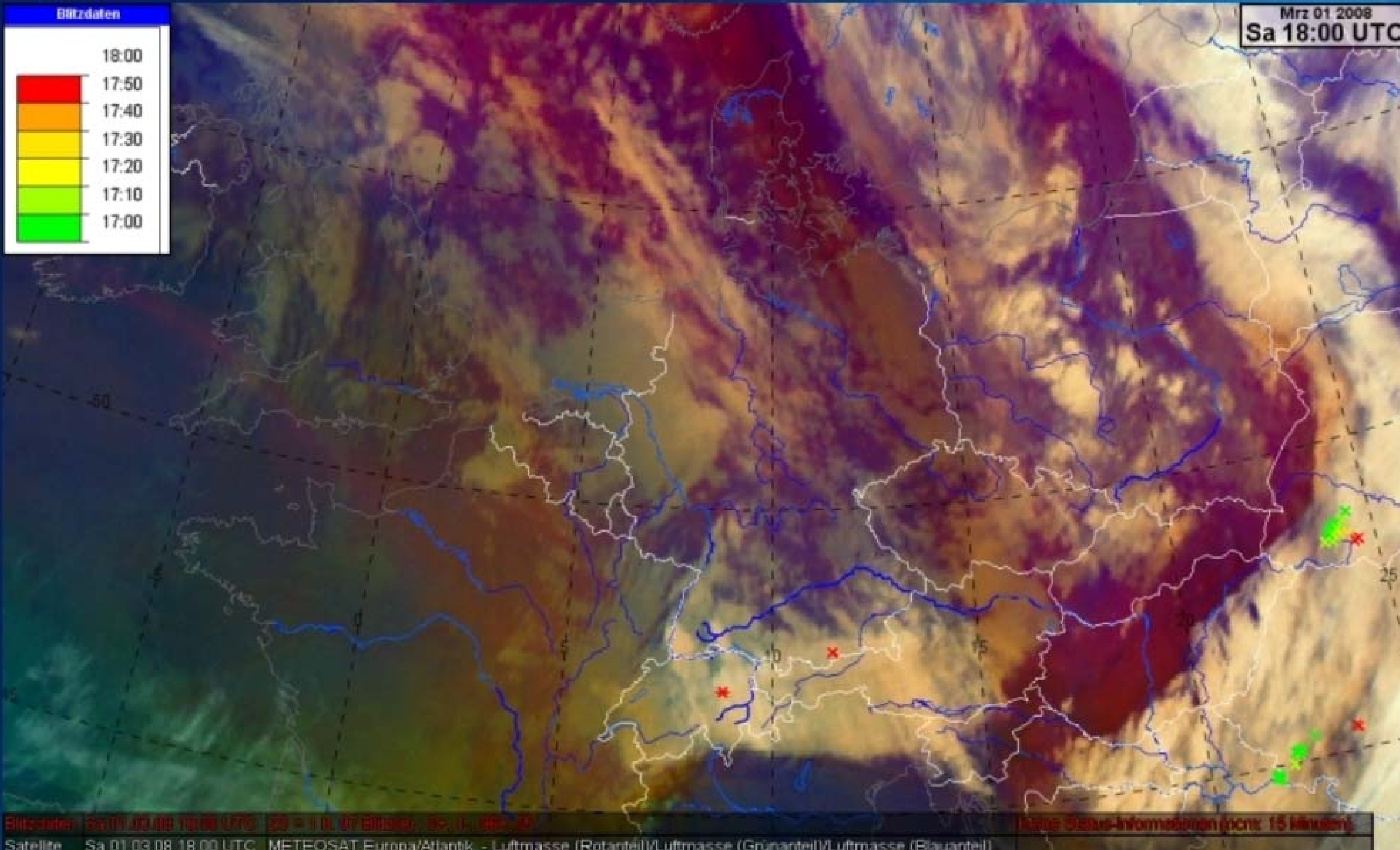


Storm Emma - 1 March 2008



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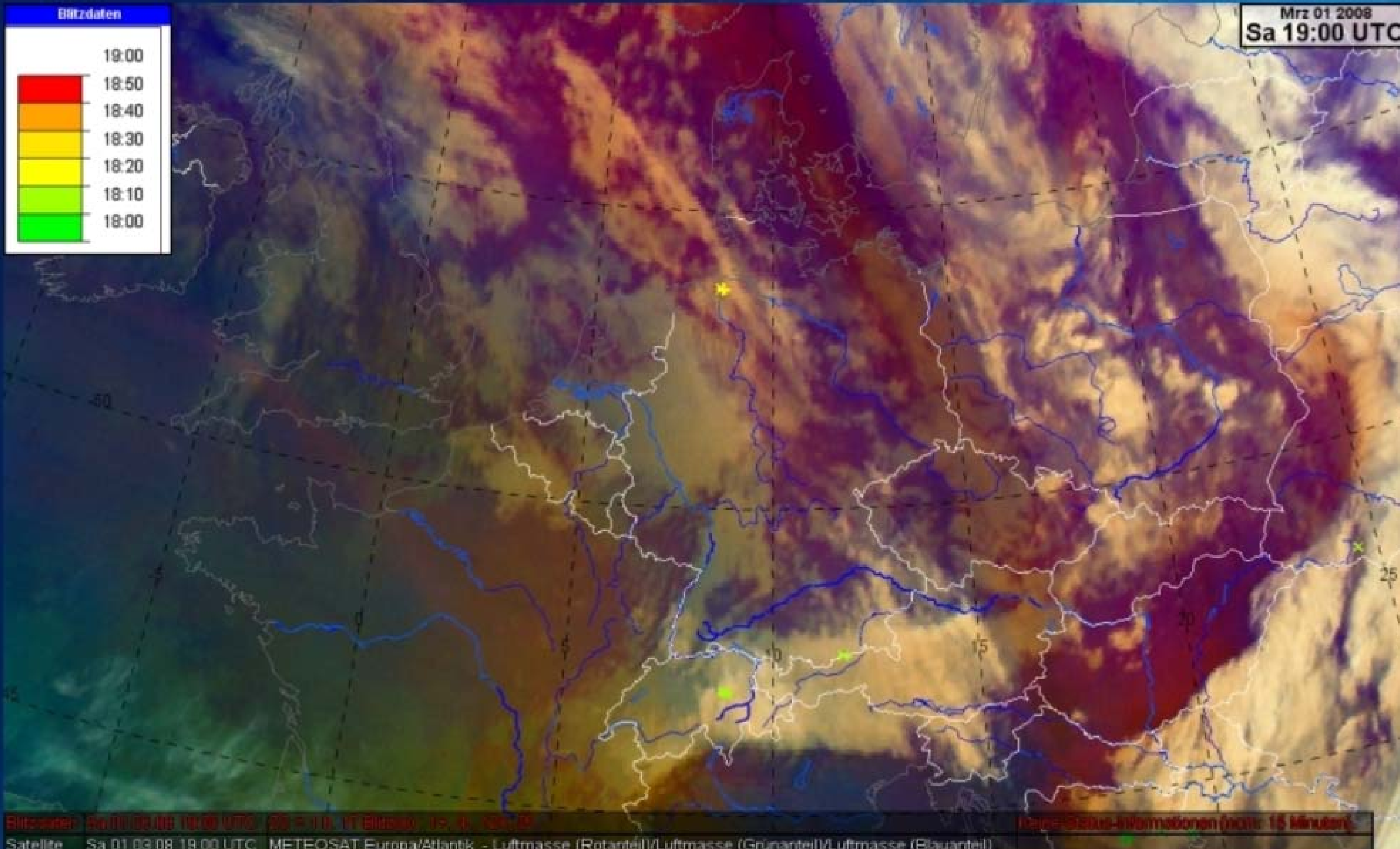
Storm Emma - 1 March 2008



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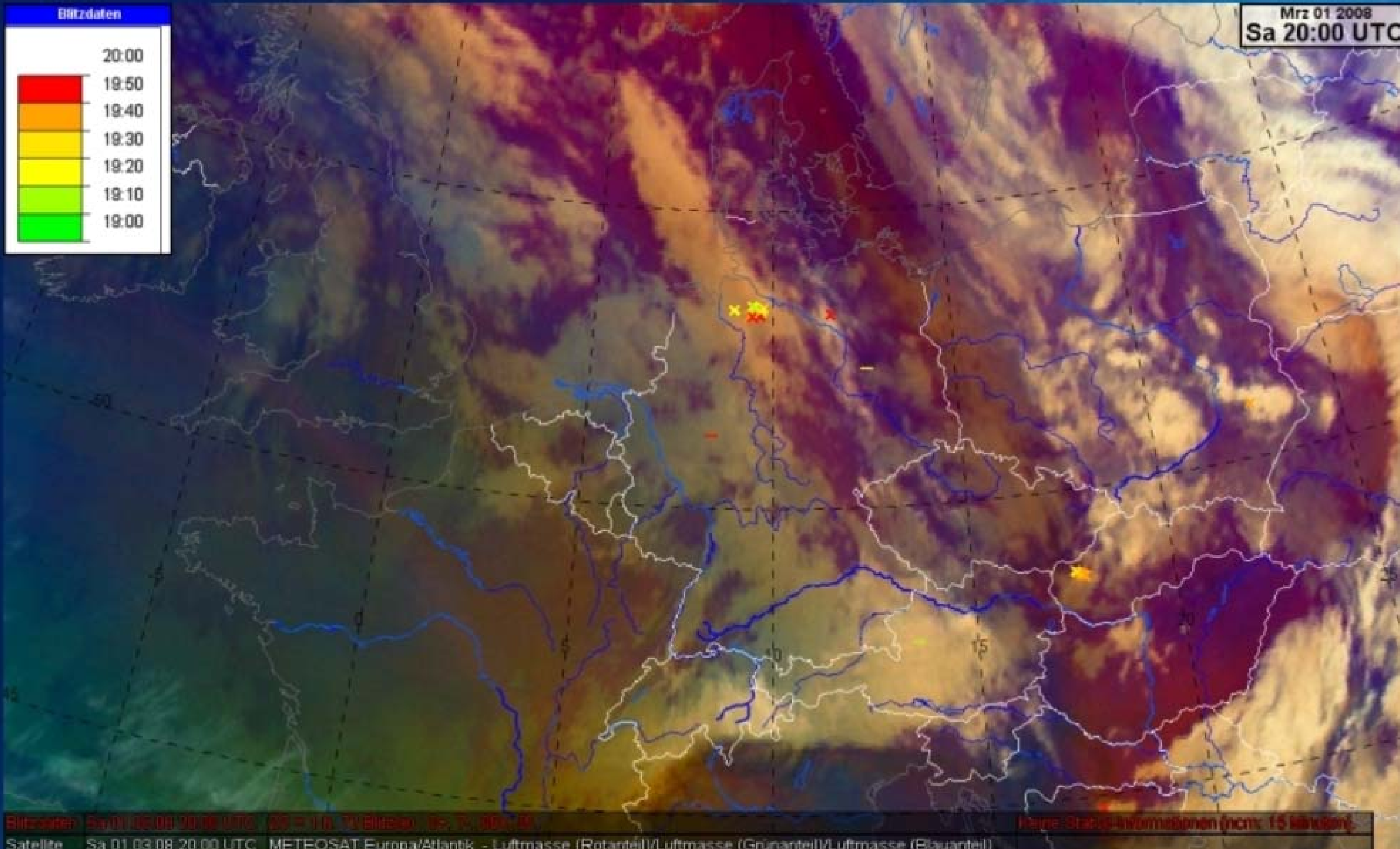
Storm Emma - 1 March 2008



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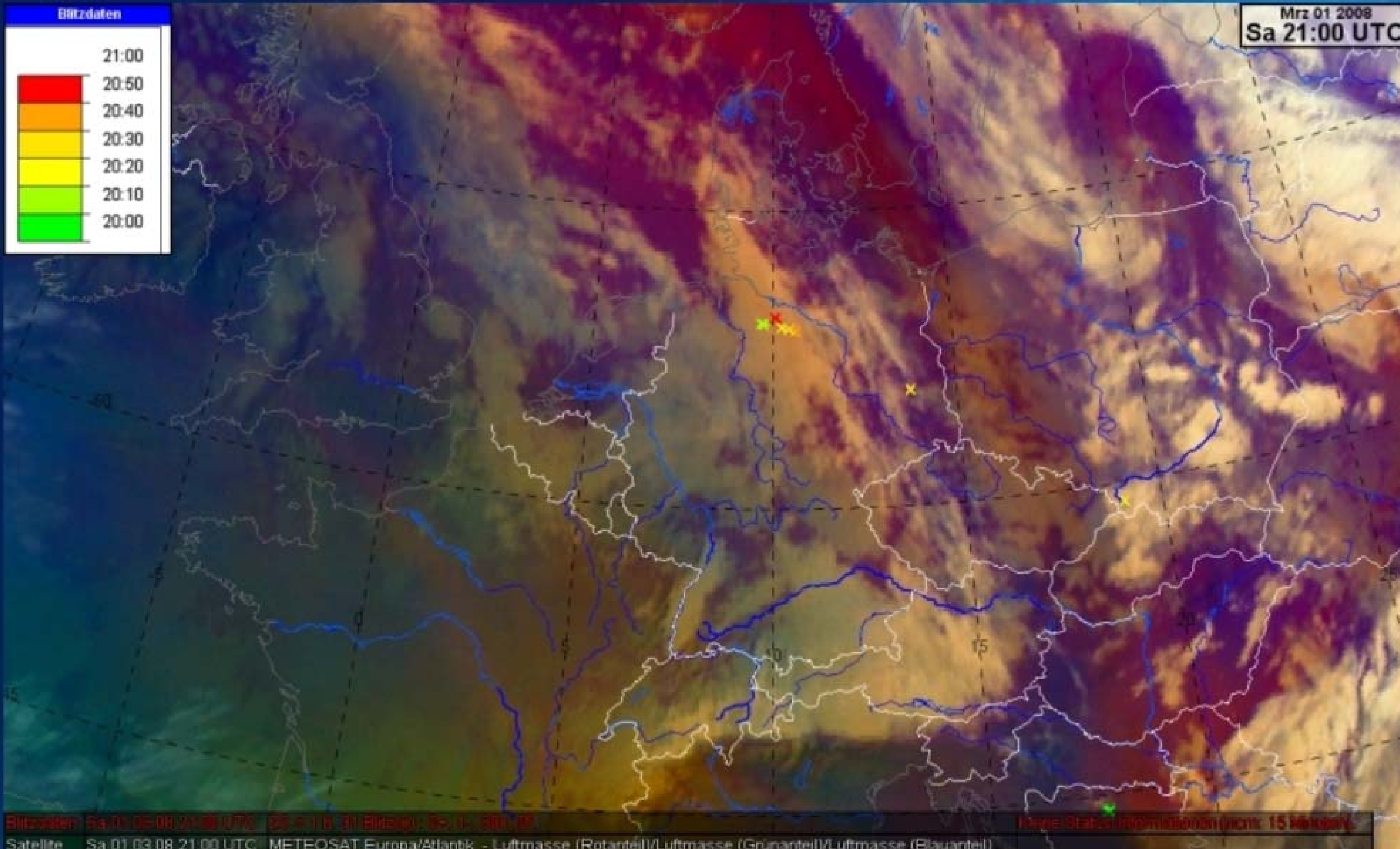
Storm Emma - 1 March 2008



Line convection and downburst winds

Cold fronts that are characterised by a strong postfrontal flow give the indication of the presence of severe line convection with strong windguststst.

The line convection is caused by triggering of potential instability by PVA and a vertical exchange of impulse in the boundary layer due to strong wind shear.

These preconditions are good recognised with satellite and NWP output.

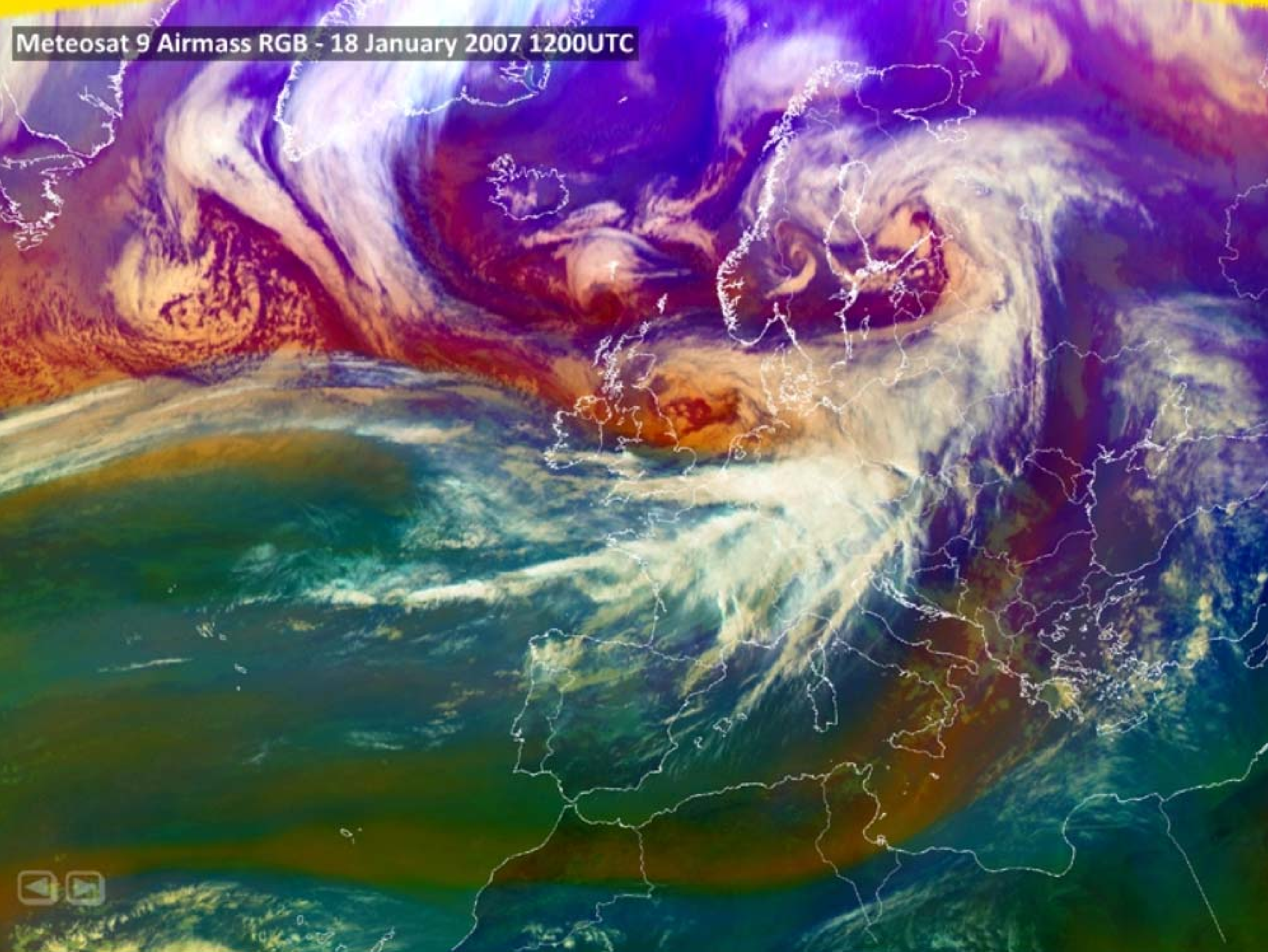
- The overrunning dry upper air (reddish to brownish) in combination with the warm moist air in the lower layers is a clear sign of the potential instability. MOIST BELOW, DRY ALOFT!
- The trigger to this convection is a PVA maximum in the left exit region of the jet, which causes rising motions in the top of the moist layer.
- The strong windshear in the boundary layer (10 ms^{-1} at surface and 40 ms^{-1} at 1300 m.) are favouring line convection within a cold front (Bader et al., 1995). Wind gusts at surface could match those at upper layers.
- Passage of convective line marks the boundary of the cold and dry air

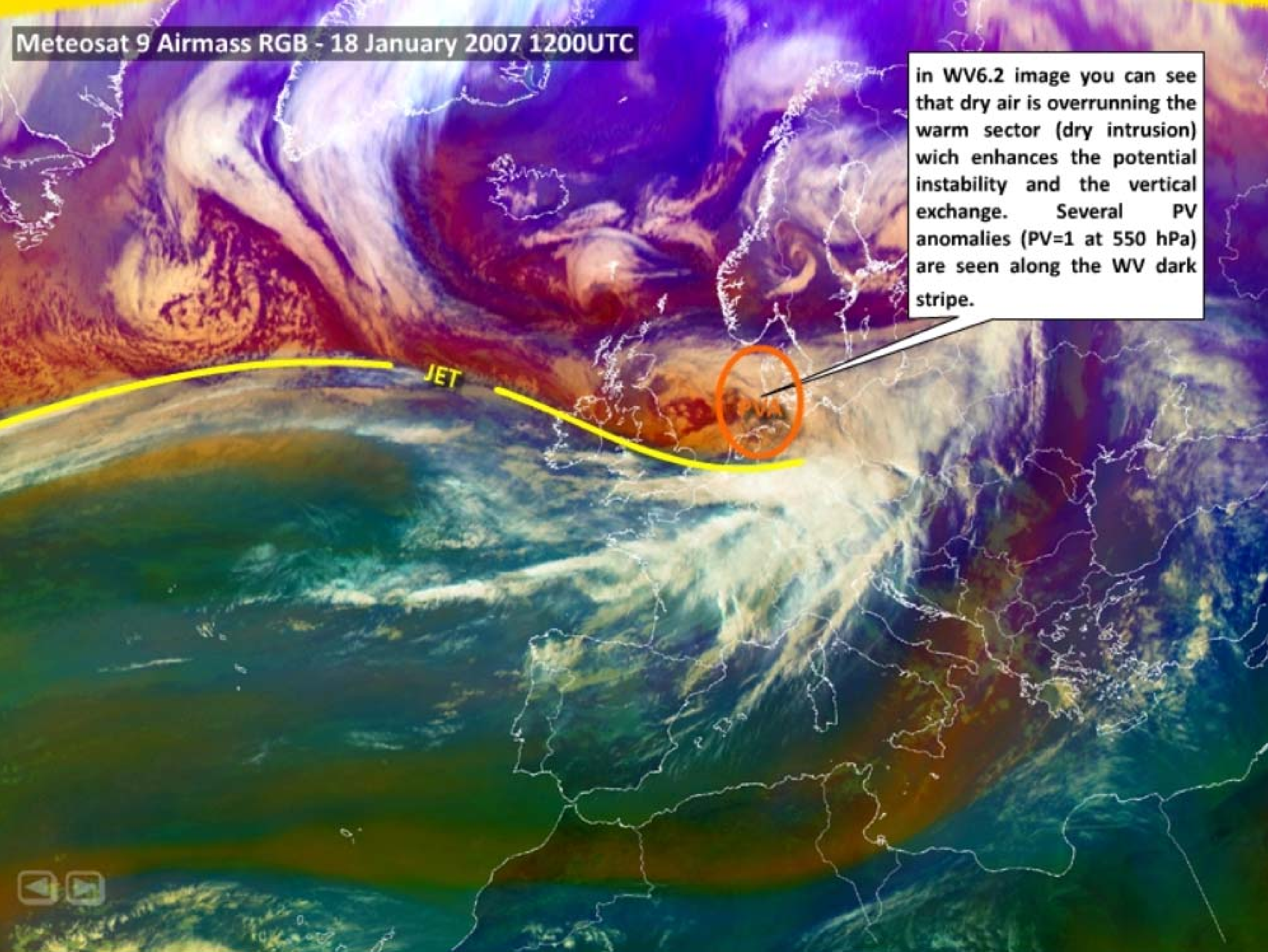
Explain what PVA stands for?

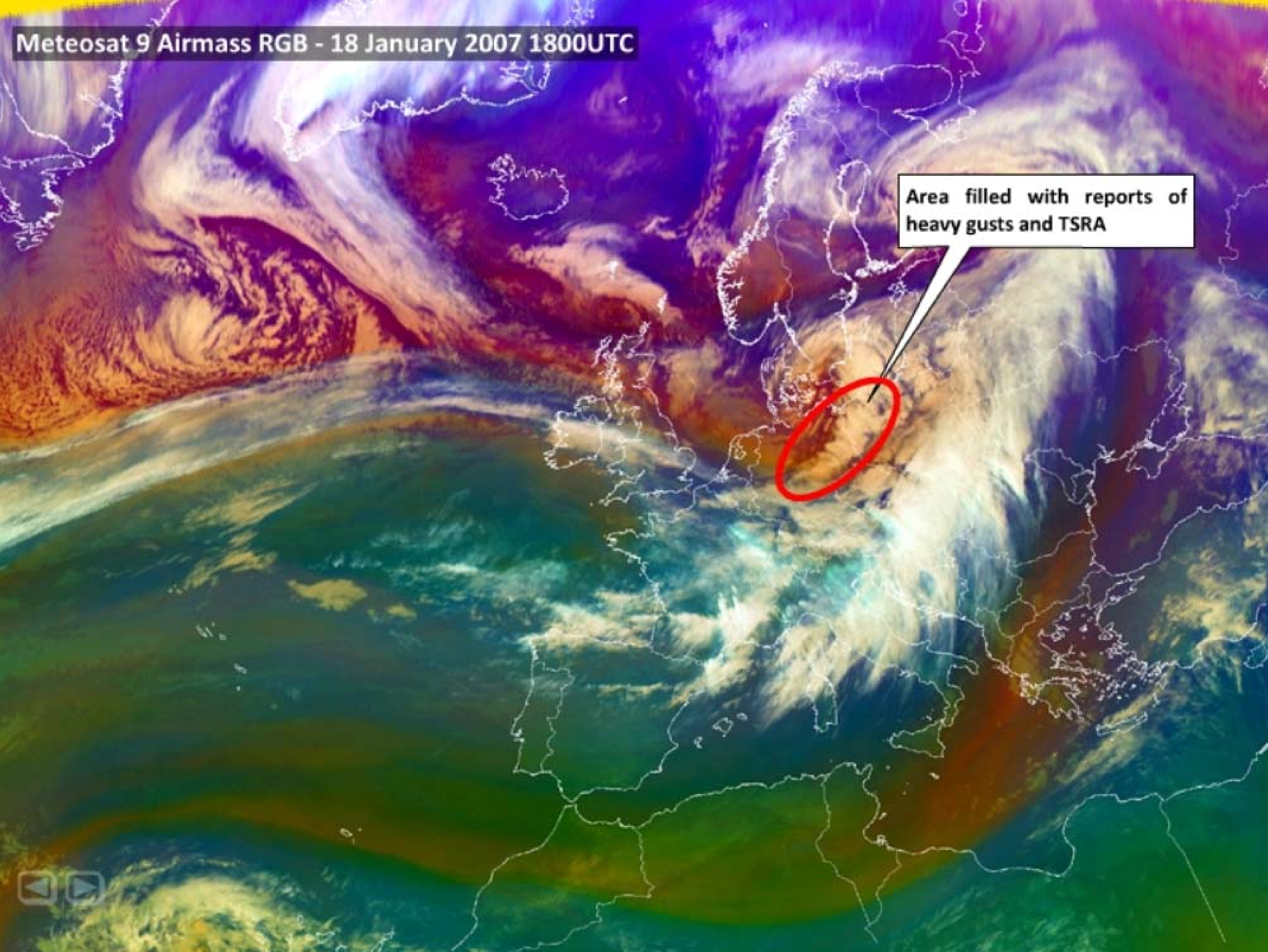
Where do we typically find maxima of PVA?

Line convection and downburst winds

From a satellite point of view the Forecasters should monitor the Airmass image closely. The forecaster can identify the position and orientation of the jet[1] and the overrunning dry air (dry intrusion)[2]. In combination with strong shear in boundary layer line convection with strong gusts are likely (radio soundings).


Meteosat 9 Airmass RGB - 18 January 2007 1200UTC


Meteosat 9 Airmass RGB - 18 January 2007 1200UTC
in WV6.2 image you can see that dry air is overrunning the warm sector (dry intrusion) wich enhances the potential instability and the vertical exchange. Several PV anomalies (PV=1 at 550 hPa) are seen along the WV dark stripe.
JET
PVA


Meteosat 9 Airmass RGB - 18 January 2007 1800UTC
Area filled with reports of heavy gusts and TSRA

Conclusion

- After breakfast and brushing teeth, this should be the third thing on your agenda
- Start your shift with a cup of Airmass RGB
- Analyse the image and parse it into conceptual models such as frontal systems, cold core low and the jet
- Locate your PV anomalies, thy can screw up your forecast!
- Where is your PVA maximum?