

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

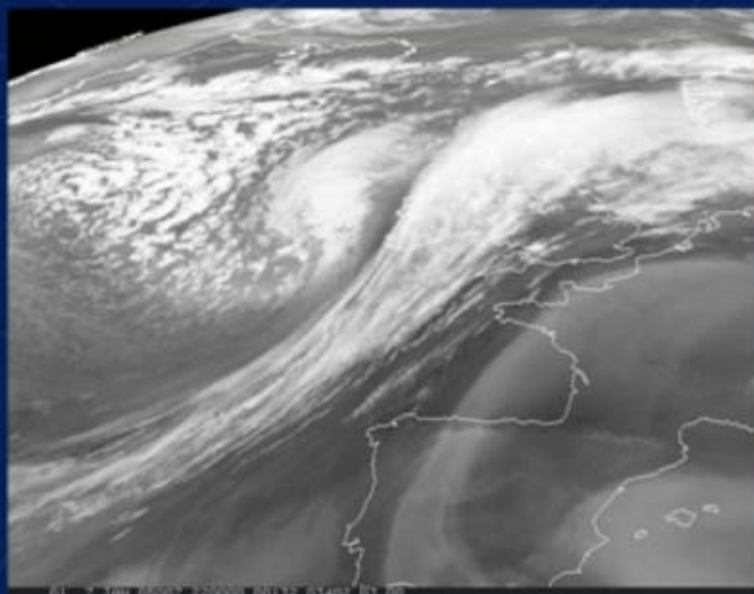
Area: Full MSG Viewing Area

Time: Day and Night

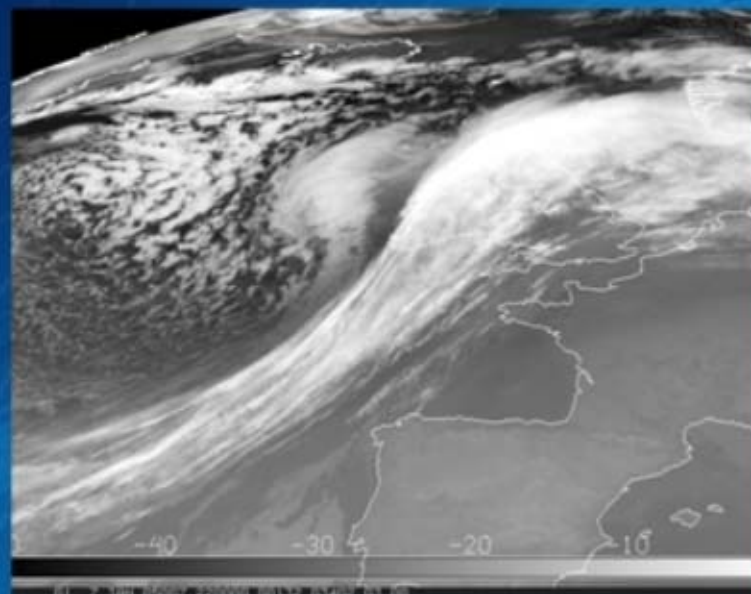


Beam	Channel	Range	Gamma
Red	WV6.2 - WV7.3	-25K to 0K	1.0
Green	IR9.7 - IR10.8	-40 to +5K	1.0
Blue	WV6.2	+243K to +208K	1.0

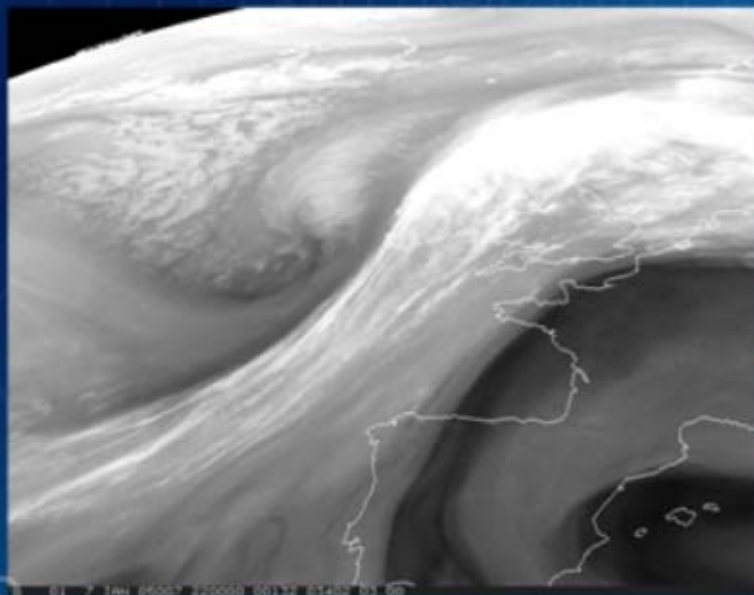




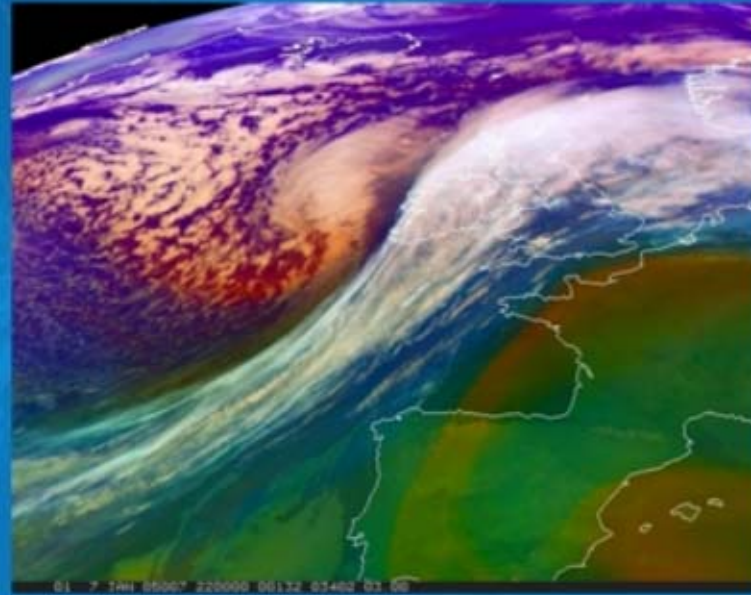
WV6.2 - WV7.3



IR9.7 - IR10.8



WV6.2i



Airmass RGB

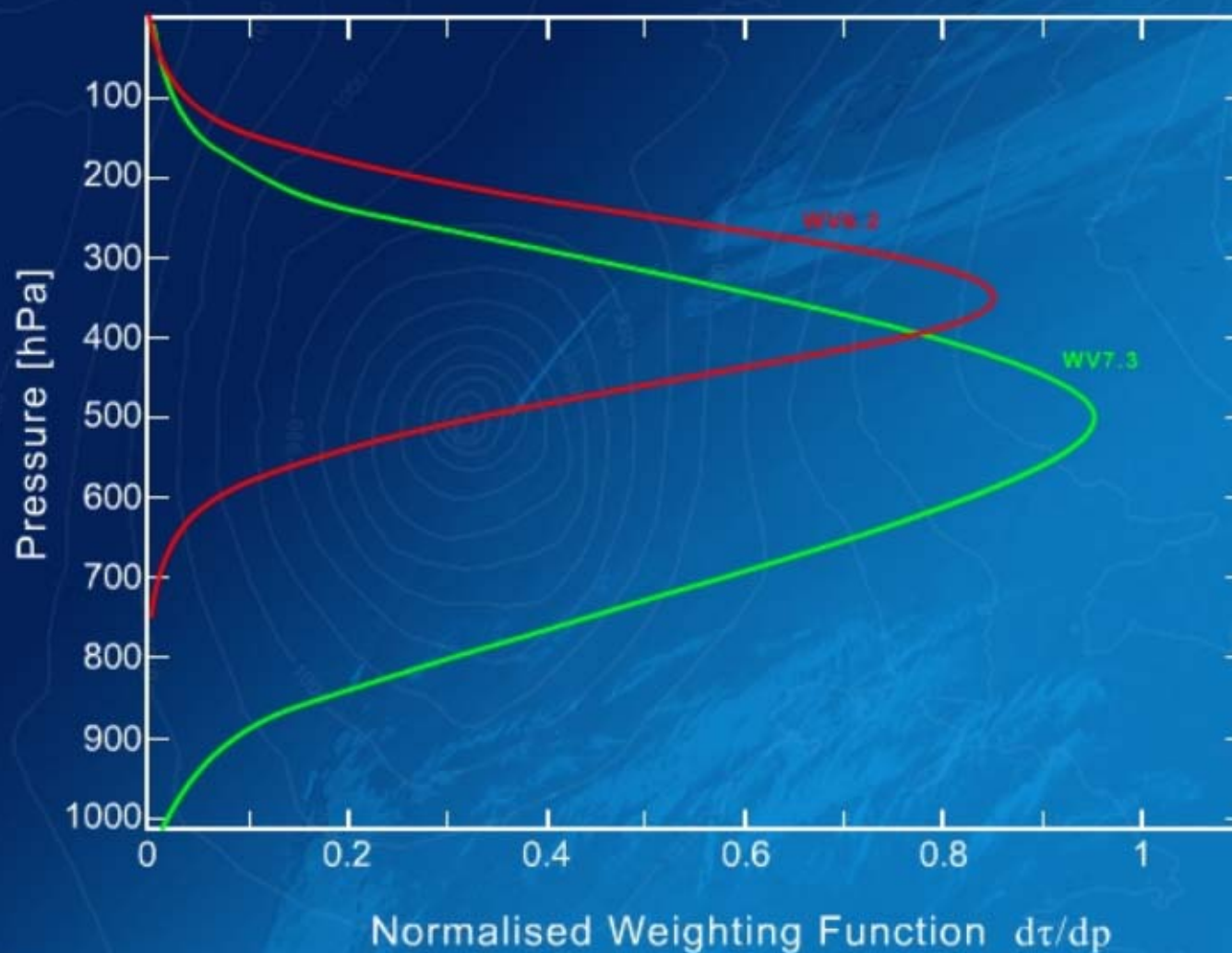
Zentralanstalt für Meteorologie und Geodynamik



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

WV6.2



WV7.3



0K

-10K

-20K

-25K

*Moist Layer: opaque to the radiation at WV6.2 and WV7.3
(Planetary Boundary Layer)*

T_{850}



Case 2 - Moist Layer at 700 hPa

WV6.2



WV7.3



0K

-10K

-20K

-25K



T_{700}

*Moist Layer: opaque to the radiation at WV6.2
less opaque to the radiation at WV7.3*

T_{850}

*Moist Layer: opaque to the radiation at WV6.2 and WV7.3
(Planetary Boundary Layer)*



Case 3 - Moist layer at 500 hPa

WV6.2



WV7.3



*Moist Layer: quasi opaque to the radiation at WV6.2
quite transparent to the radiation at WV7.3*

*Moist Layer: opaque to the radiation at WV6.2 and WV7.3
(Planetary Boundary Layer)*

0K

-10K

-20K

-25K



Case 4 - Moist layer at 200 hPa

WV6.2



WV7.3



*Moist Layer: quite transparent to the radiation at WV6.2
transparent to the radiation at WV7.3*

*Moist Layer: opaque to the radiation at WV6.2 and WV7.3
(Planetary Boundary Layer)*

0K

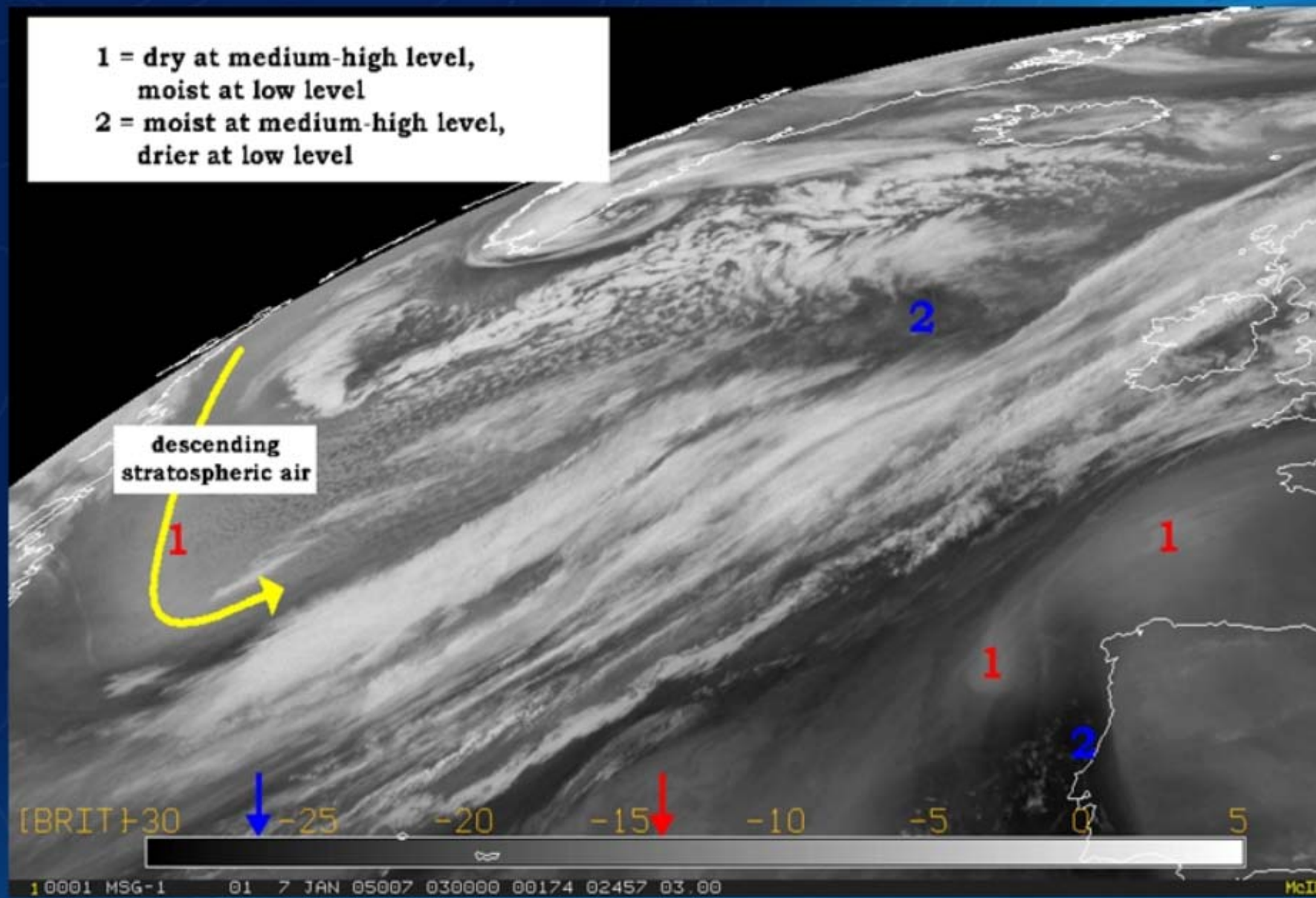
-10K

-20K

-25K

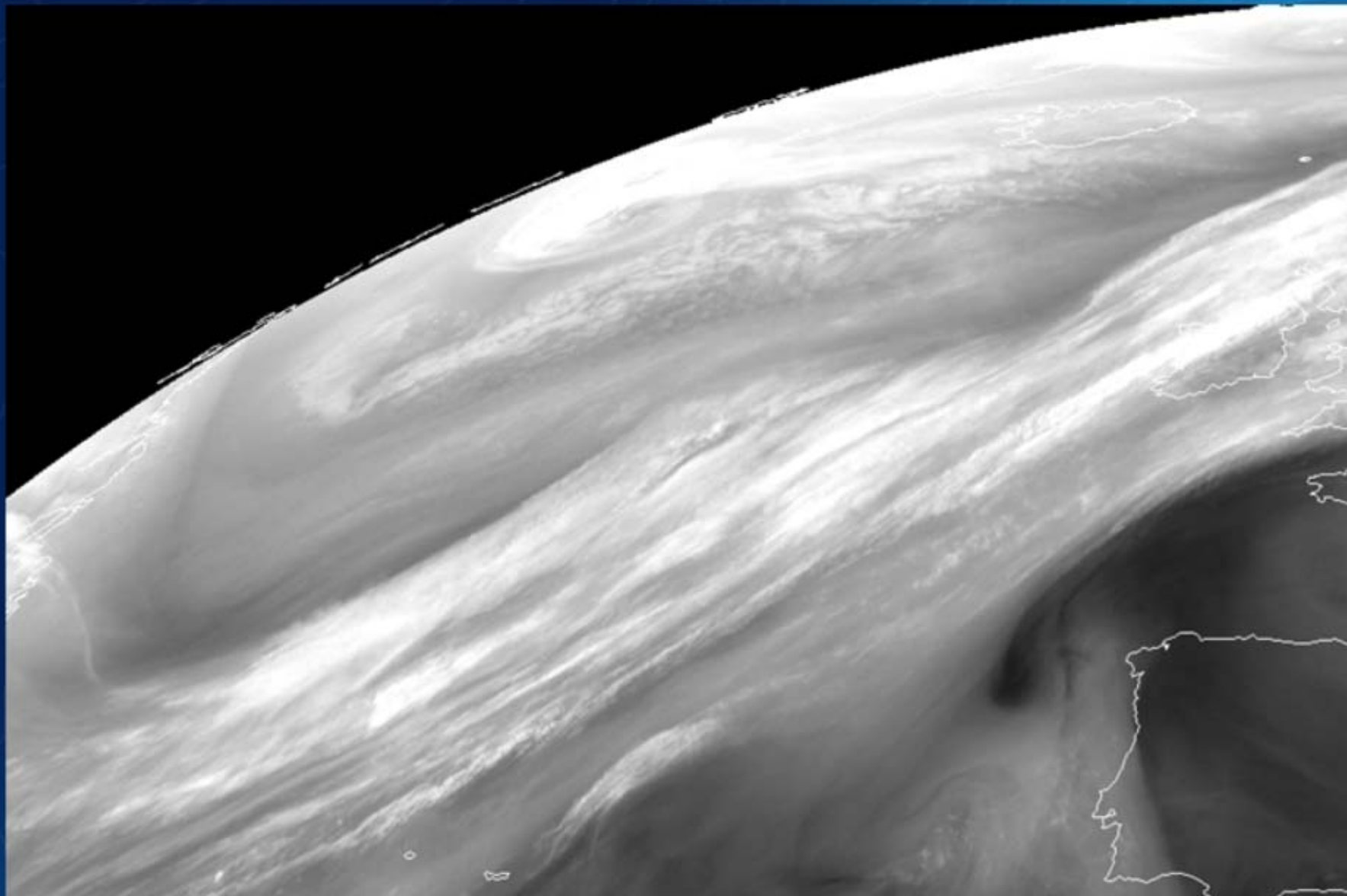


- 1 = dry at medium-high level,
moist at low level
2 = moist at medium-high level,
drier at low level



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





40004 MSG-1 01 7 JAN 05007 030000 00174 02457 03.00

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

IR9.7



$T_{Surface}$

IR10.8



$T_{Surface}$

+5K

-10K

-20K

-40K



Case 2 - Poor Ozone / Tropical Airmass

IR9.7



$T_{Surface}$

IR10.8



$T_{Surface}$

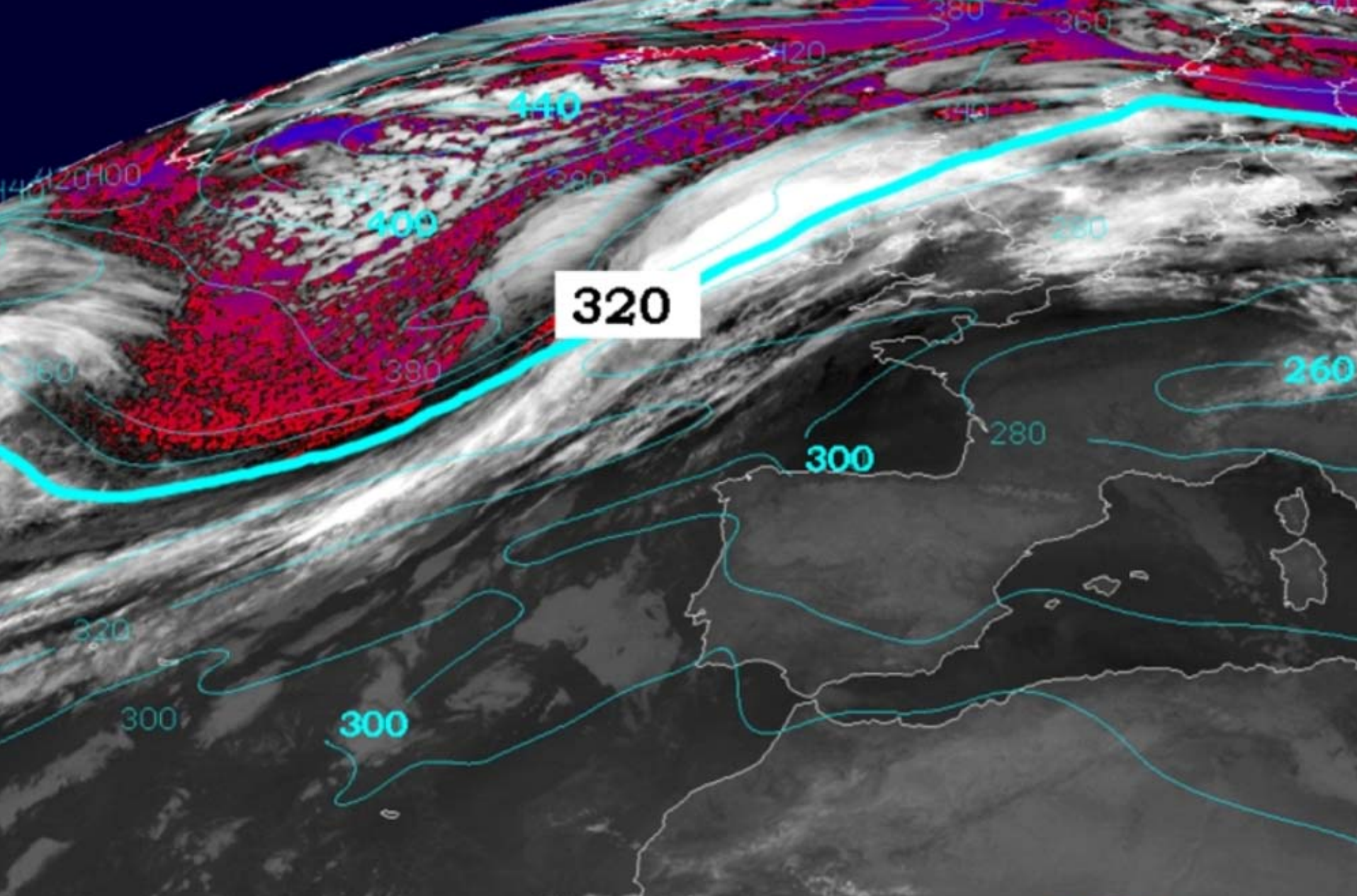
+5K

-10K

-20K

-40K





320

260

300

280

300

300

320

380

400

440

420

380

360

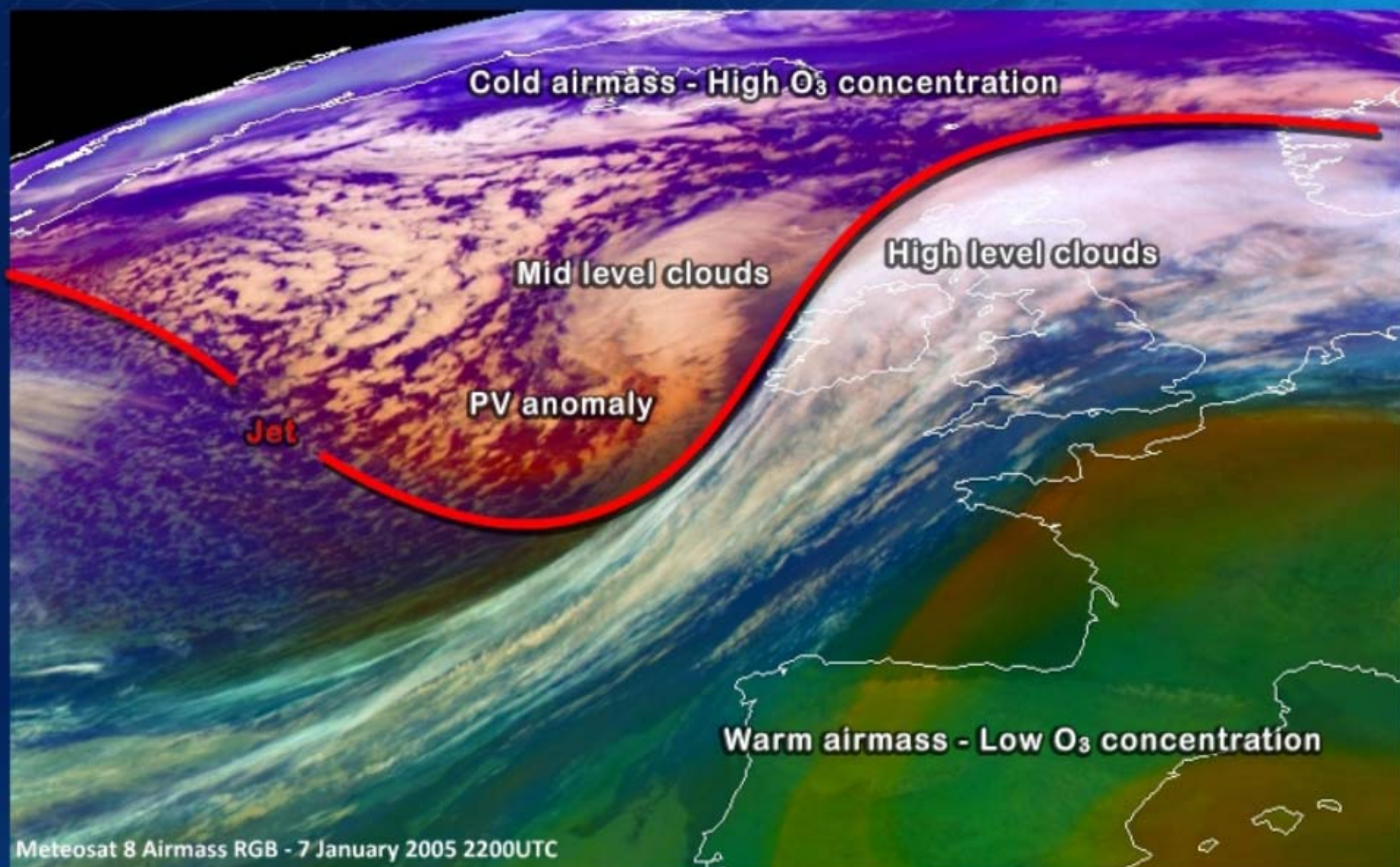
340

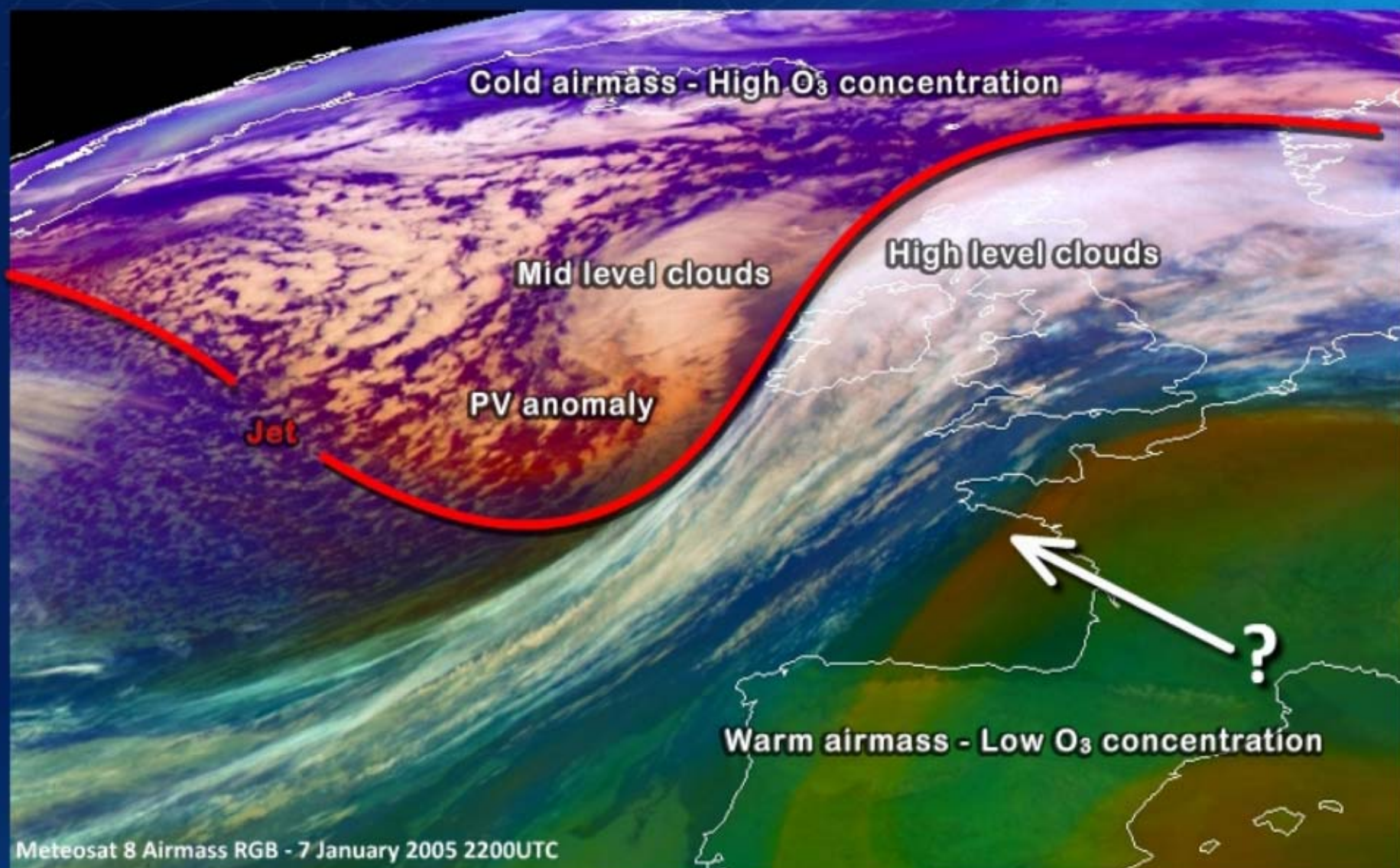
420

400

360

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







Thick
High-Level
Clouds



Thick
Mid-Level
Clouds



Low Clouds
Warm Airmass



Low Clouds
Cold Airmass

Jet / High PV

Cold Airmass

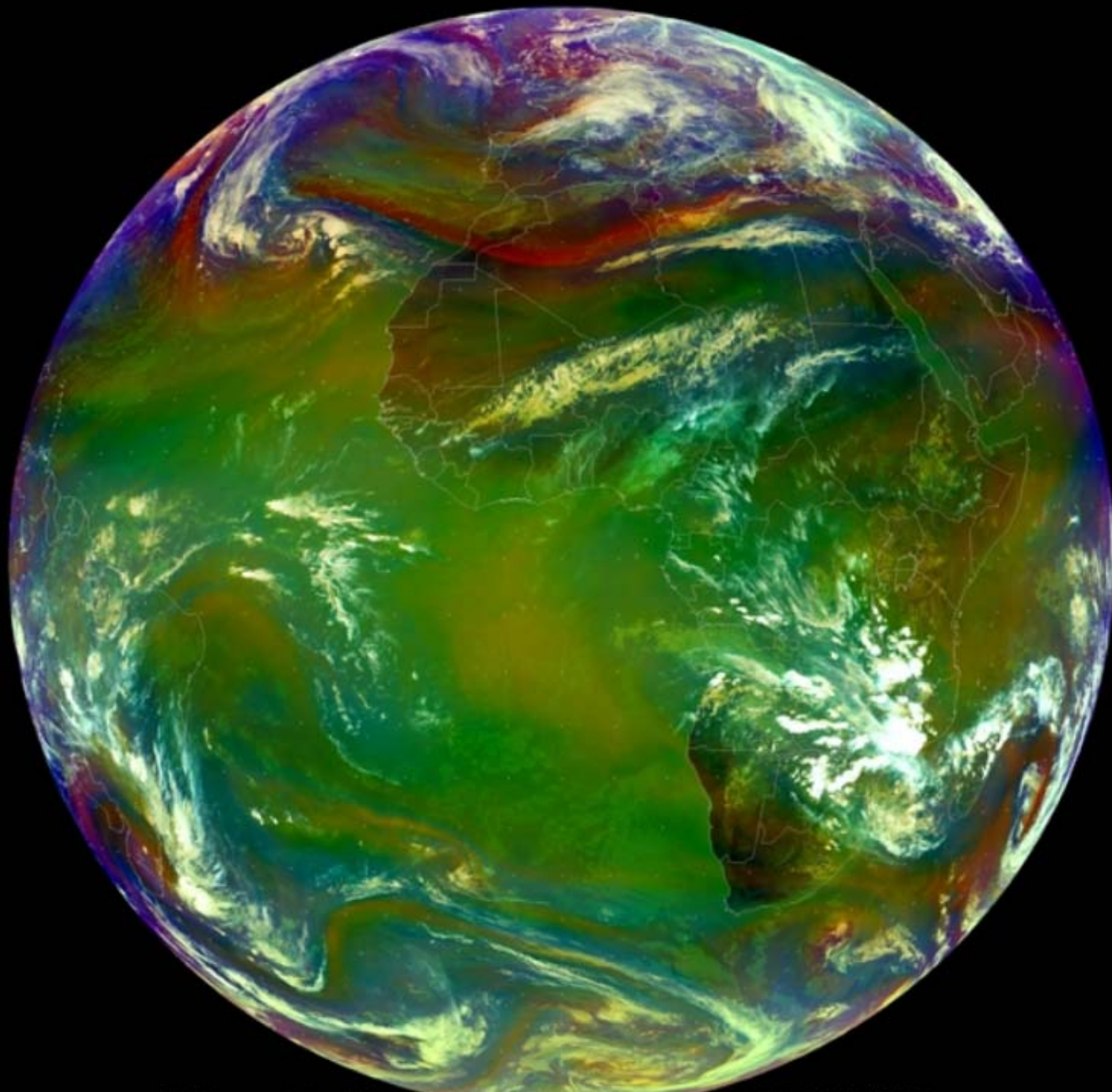
Warm Airmass

Warm Airmass

High UTH

Low UTH





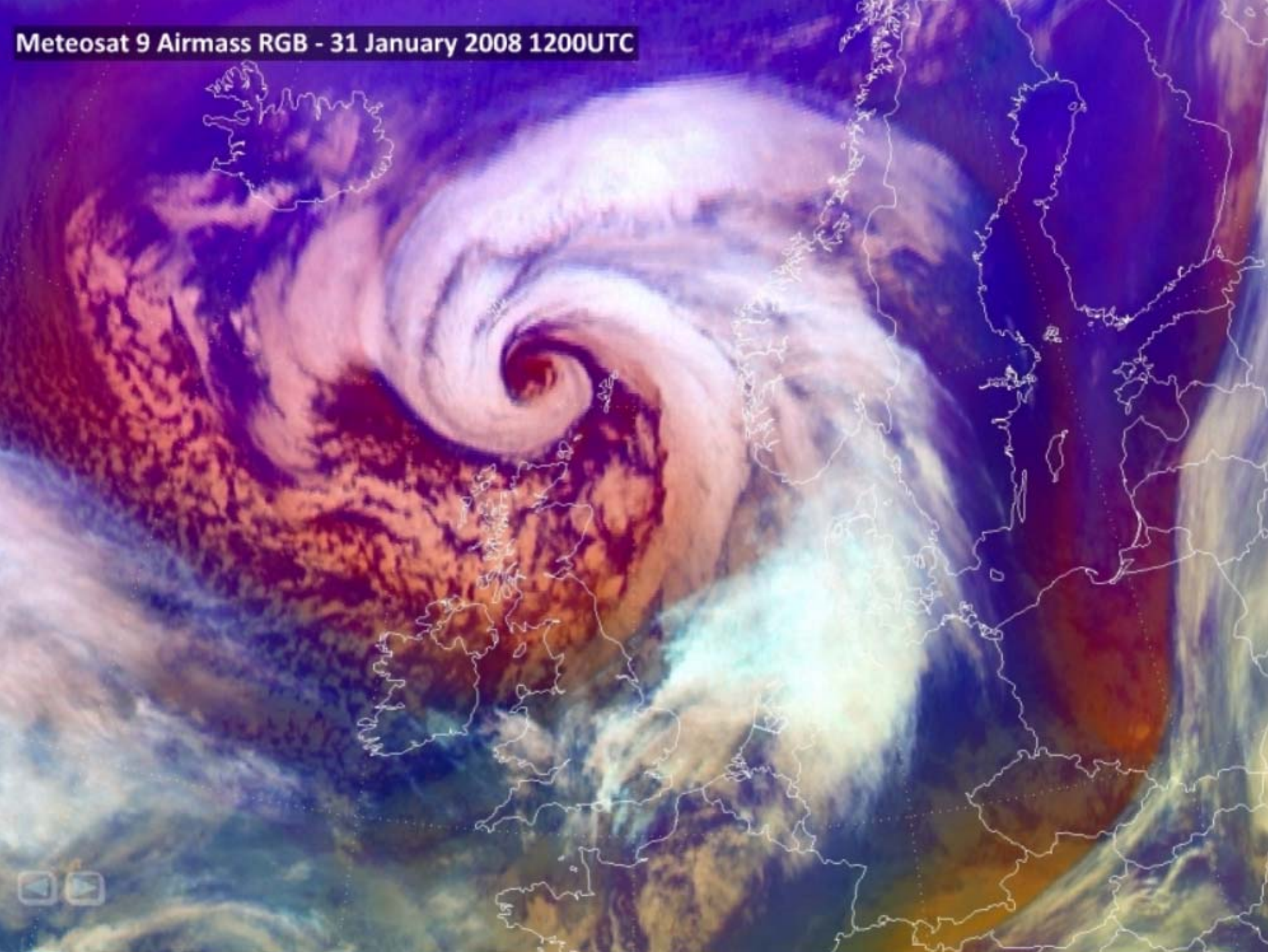
Meteosat 9 - Airmass RGB: 29 January 2010 1300UTC



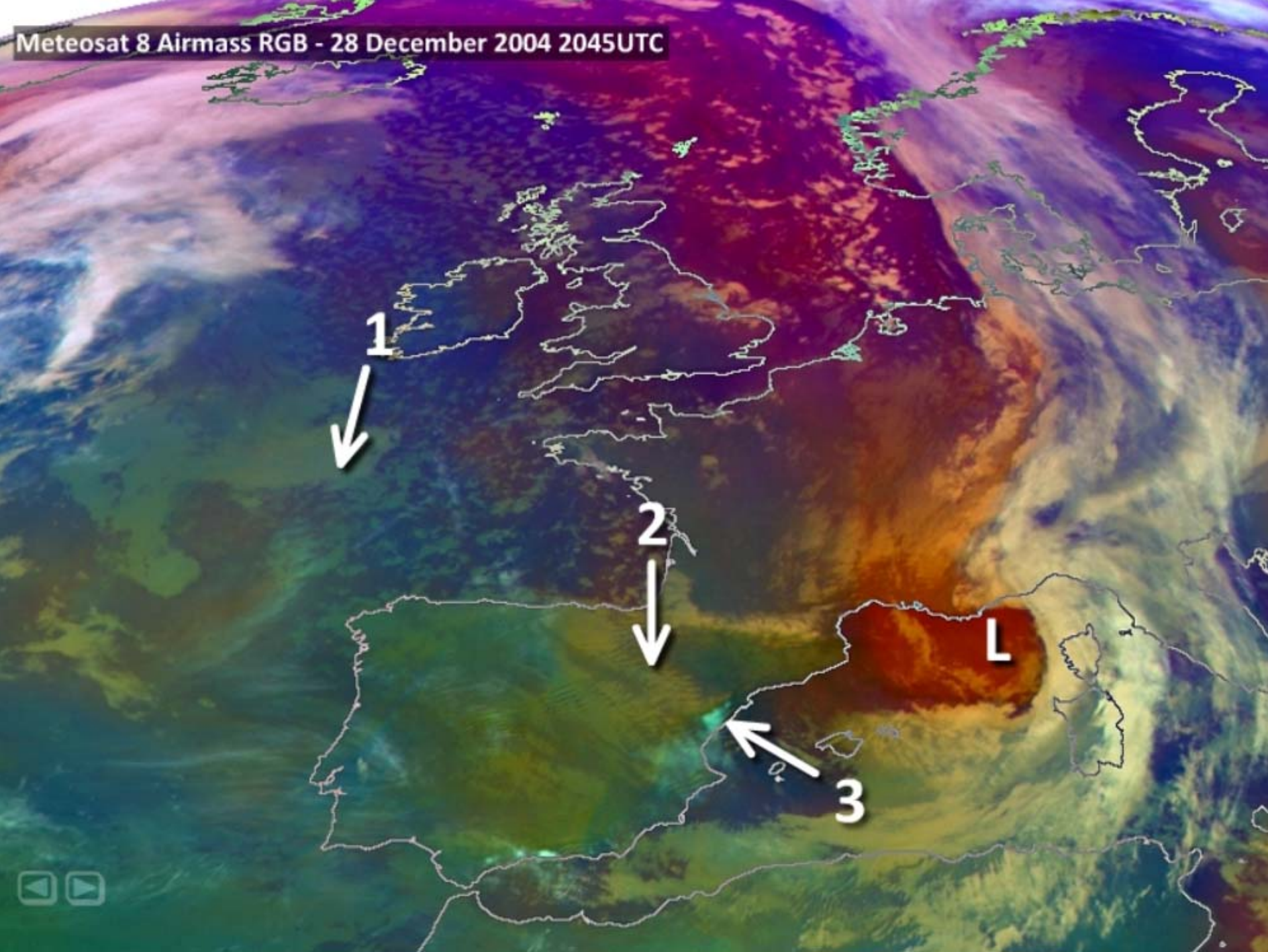
Summary

- 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

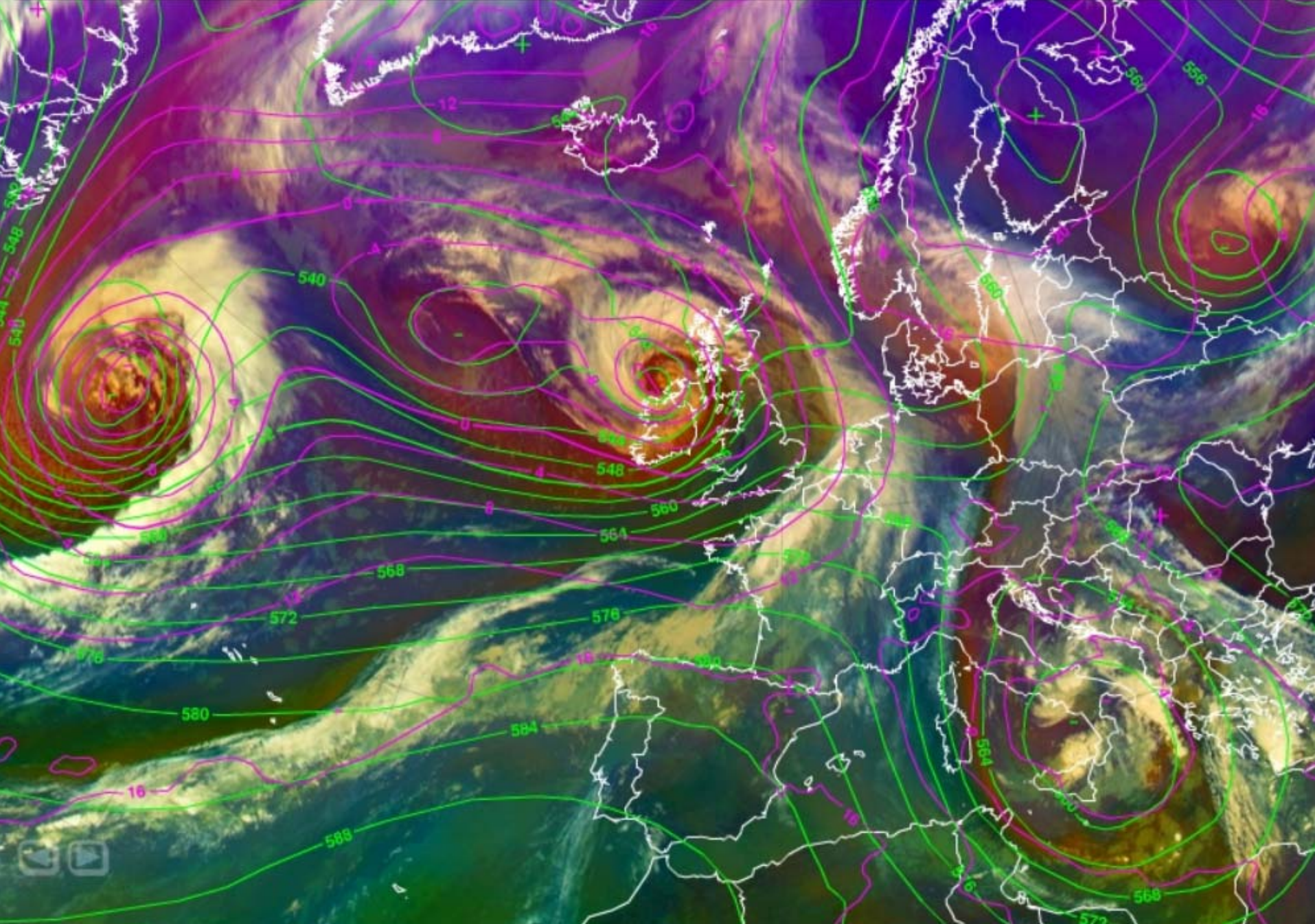
Meteosat 9 Airmass RGB - 31 January 2008 1200UTC



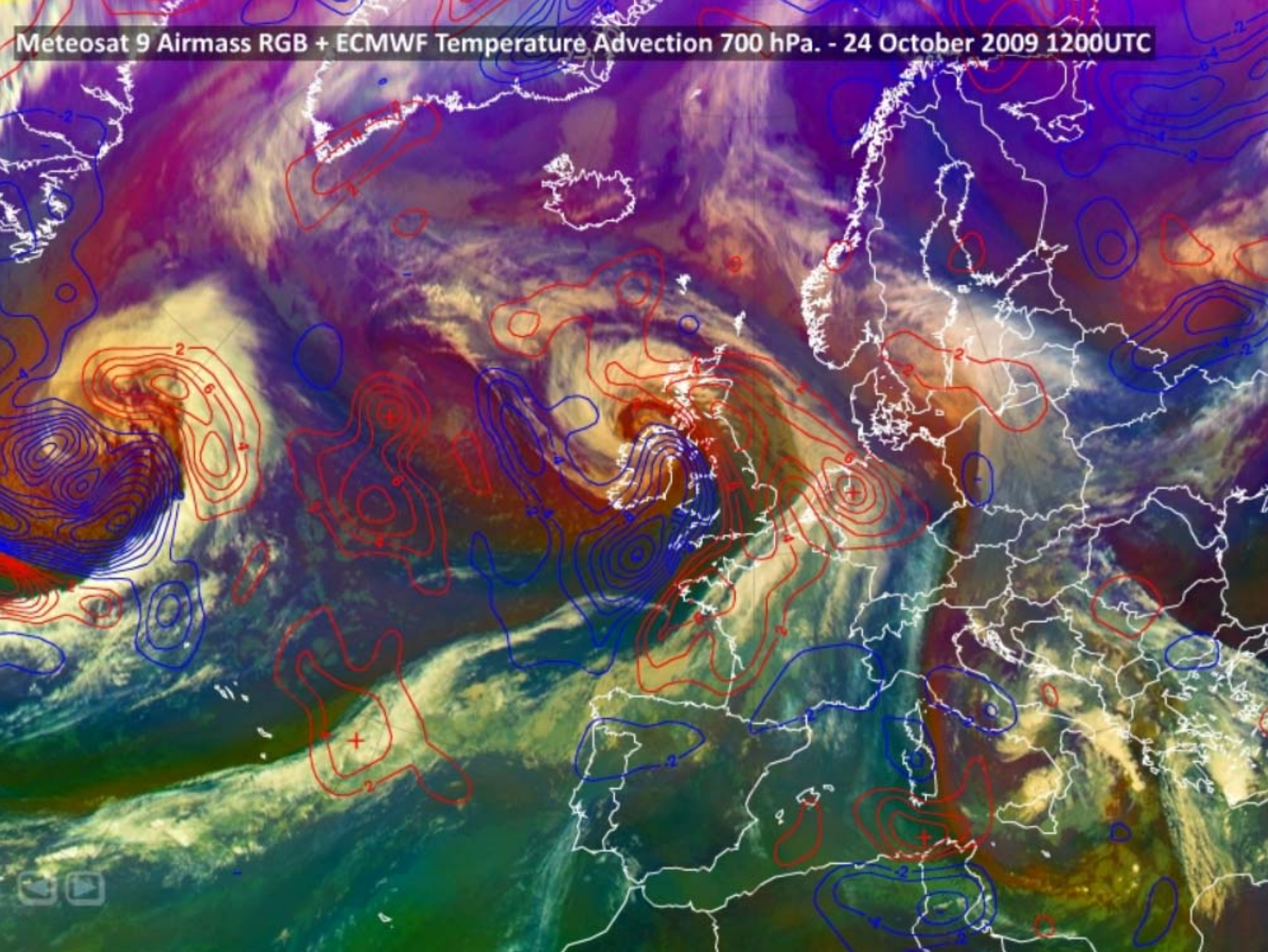
Meteosat 8 Airmass RGB - 28 December 2004 2045UTC



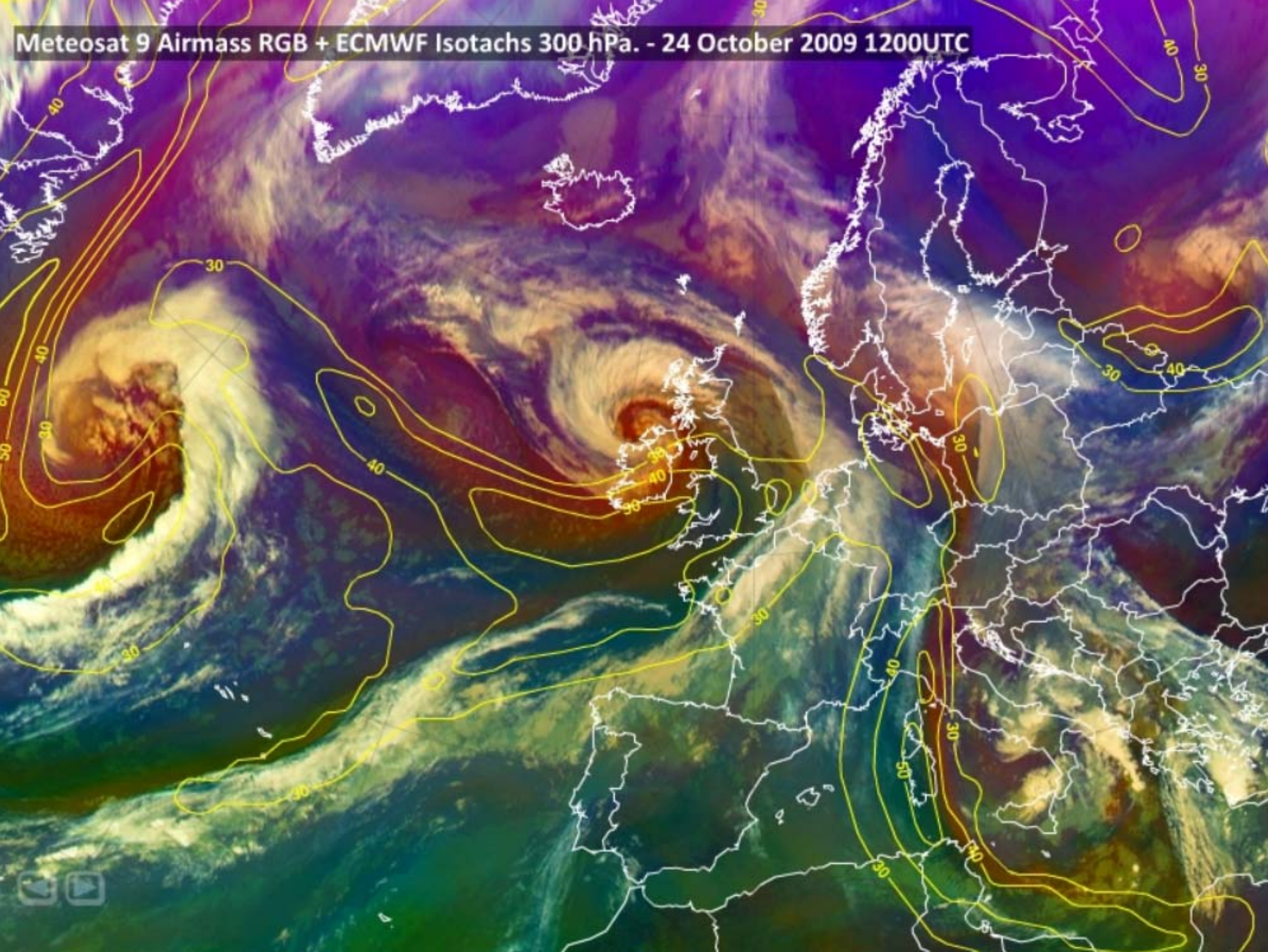
Meteosat 9 Airmass RGB + ECMWF Geopotential Height 1000 and 500 hPa. - 24 October 2009 1200UTC



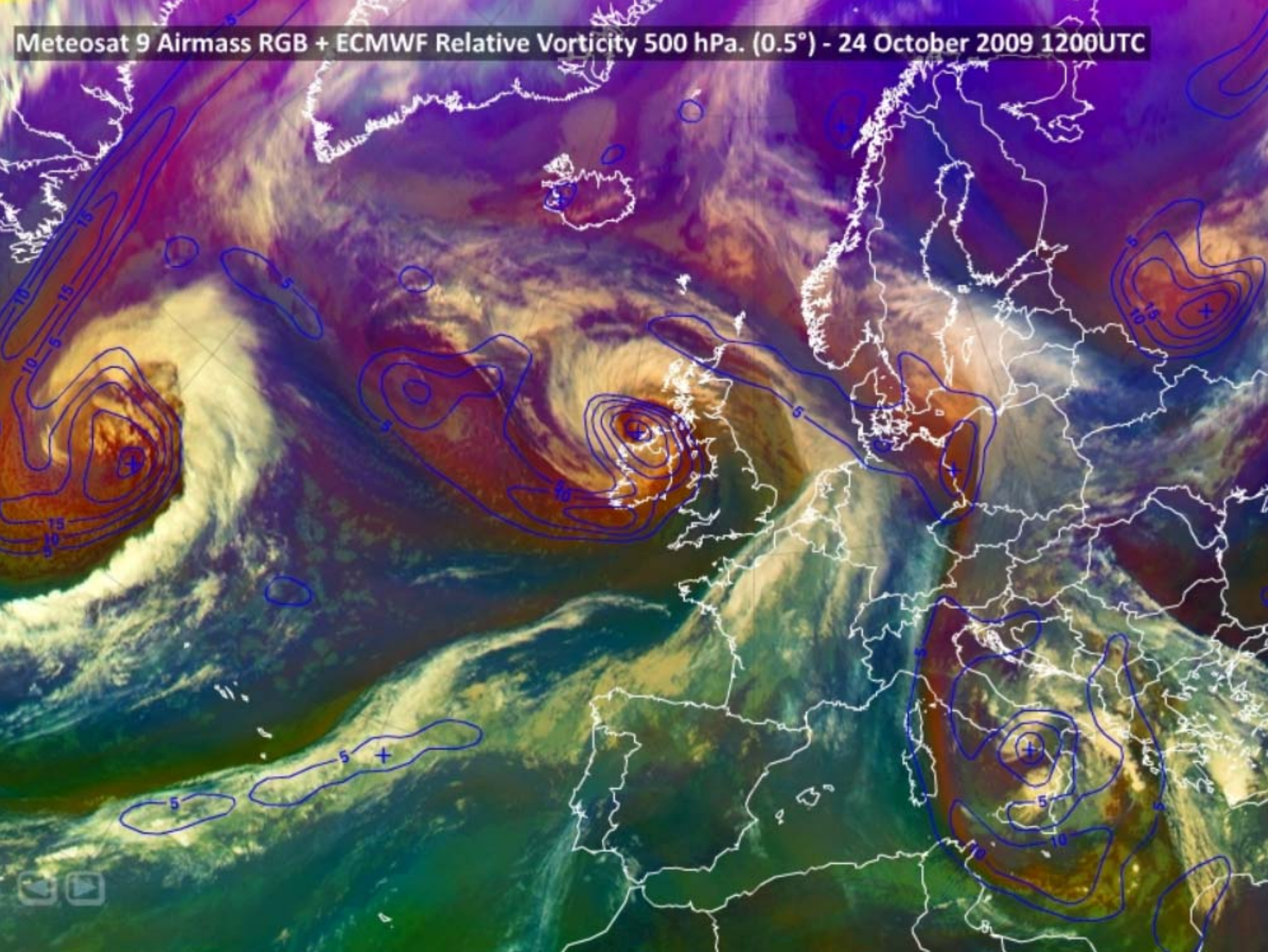
Meteosat 9 Airmass RGB + ECMWF Temperature Advection 700 hPa. - 24 October 2009 1200UTC



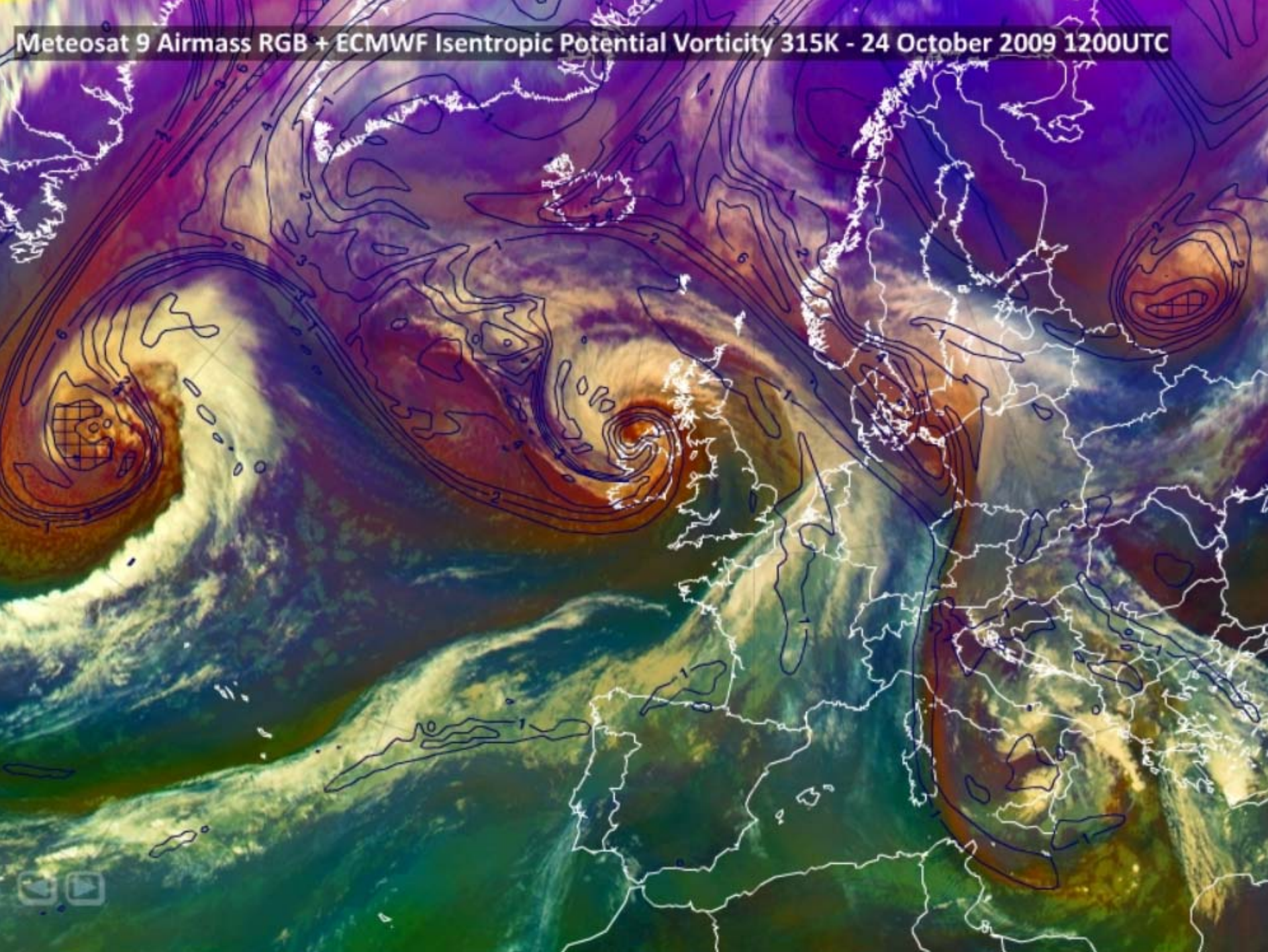
Meteosat 9 Airmass RGB + ECMWF Isotachs 300 hPa. - 24 October 2009 1200UTC

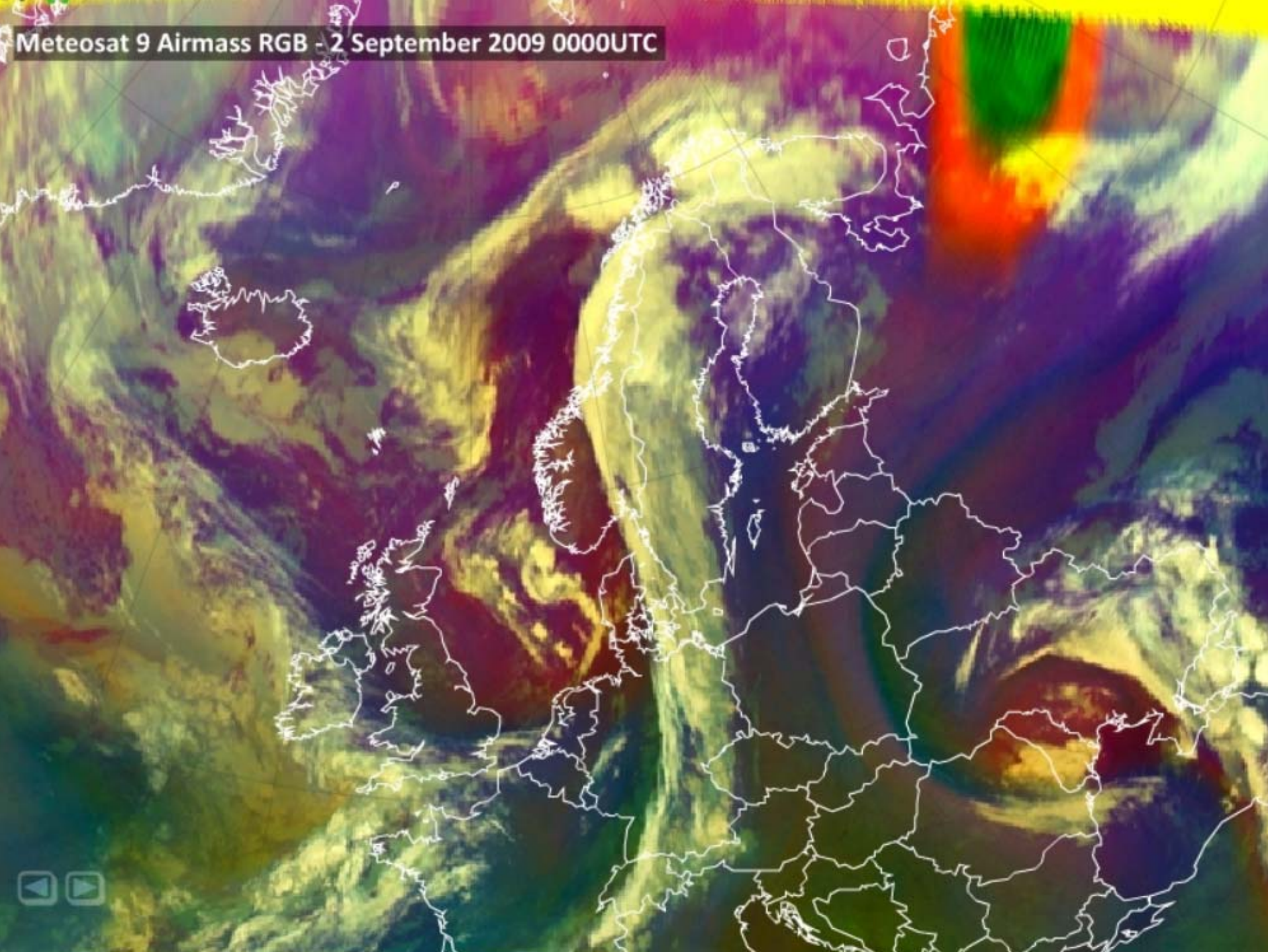


Meteosat 9 Airmass RGB + ECMWF Relative Vorticity 500 hPa. (0.5°) - 24 October 2009 1200UTC

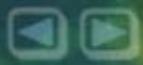


Meteosat 9 Airmass RGB + ECMWF Isentropic Potential Vorticity 315K - 24 October 2009 1200UTC

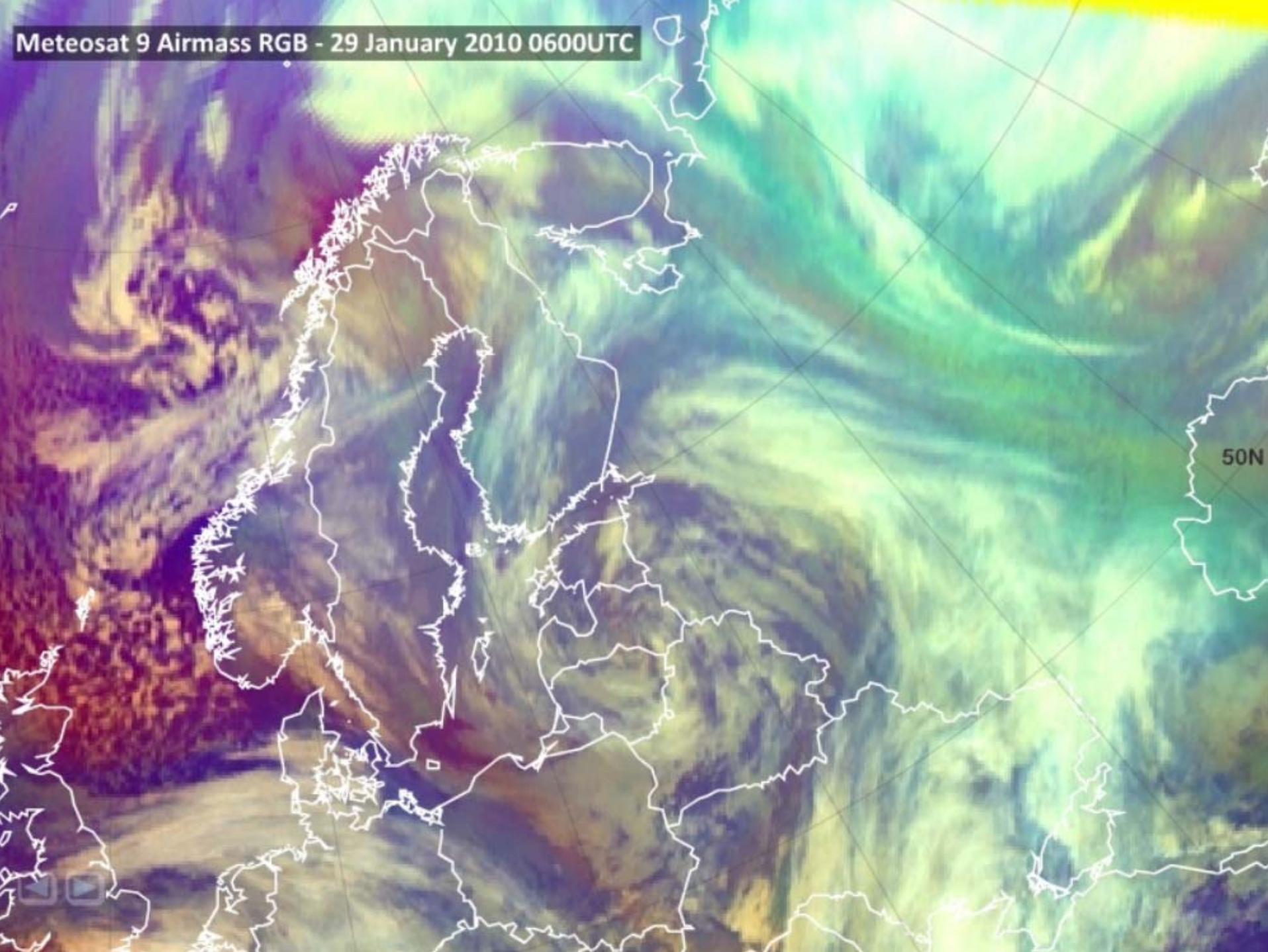




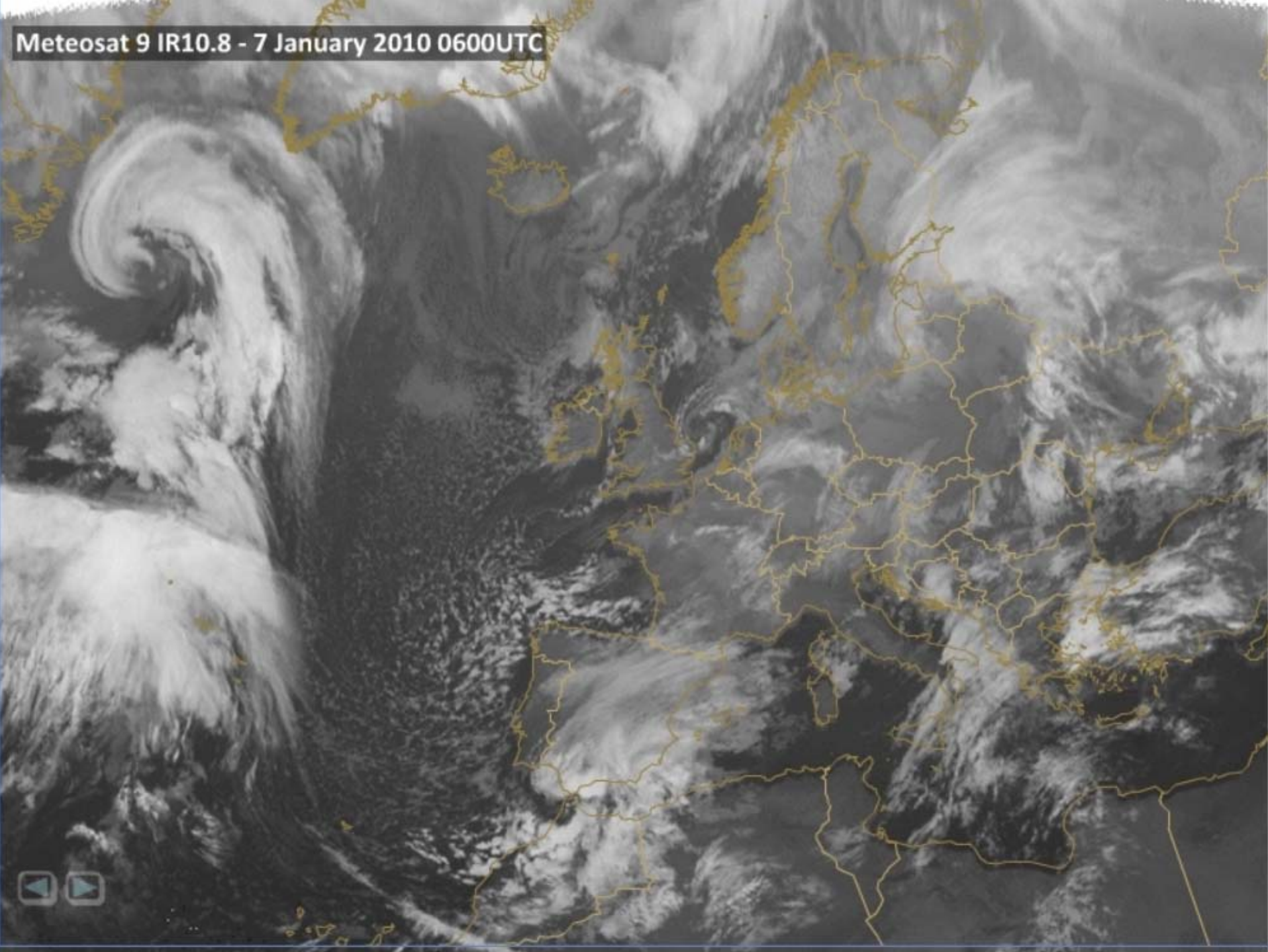
Meteosat 9 Airmass RGB - 2 September 2009 0000UTC



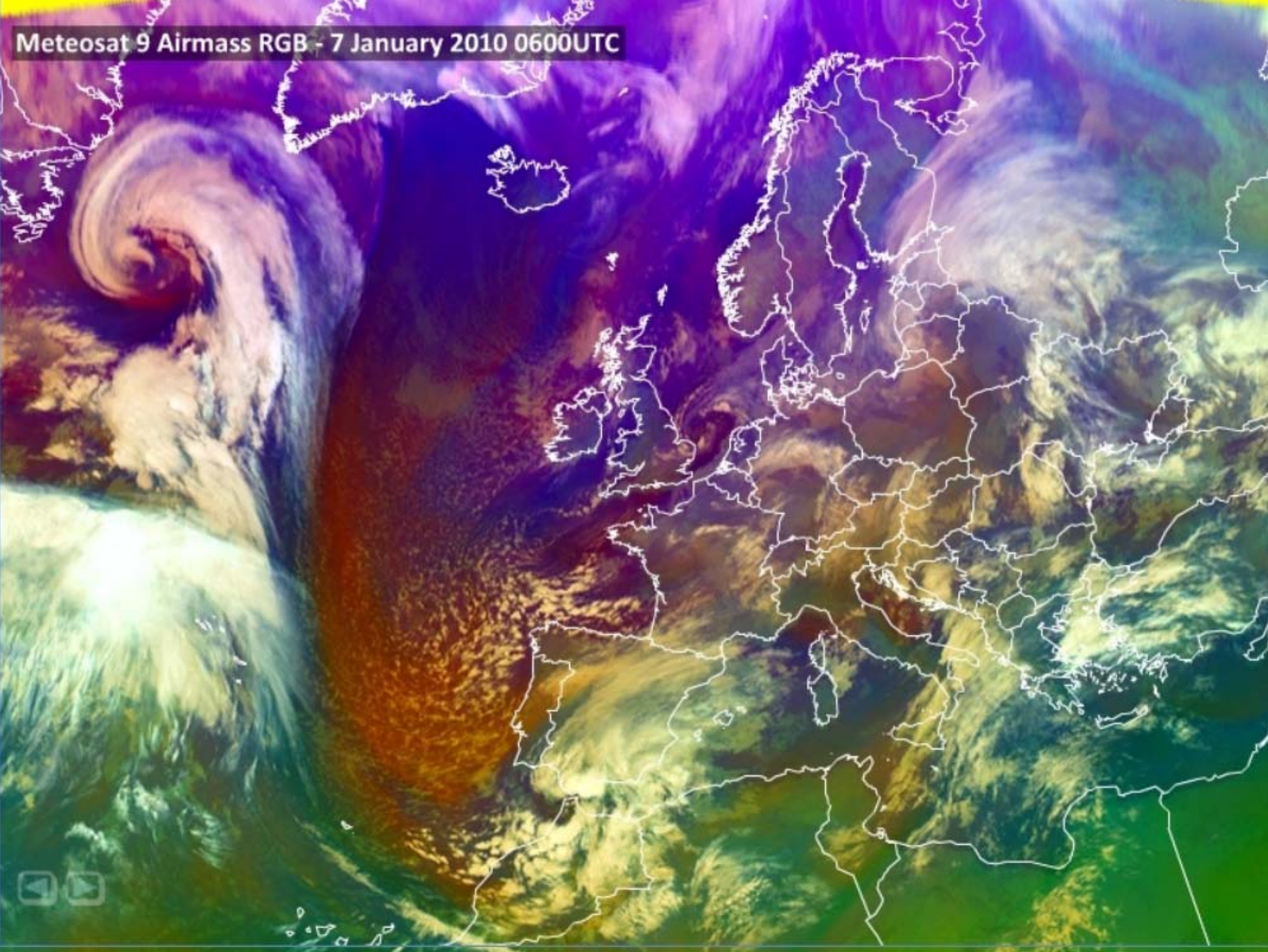
Meteosat 9 Airmass RGB - 29 January 2010 0600UTC



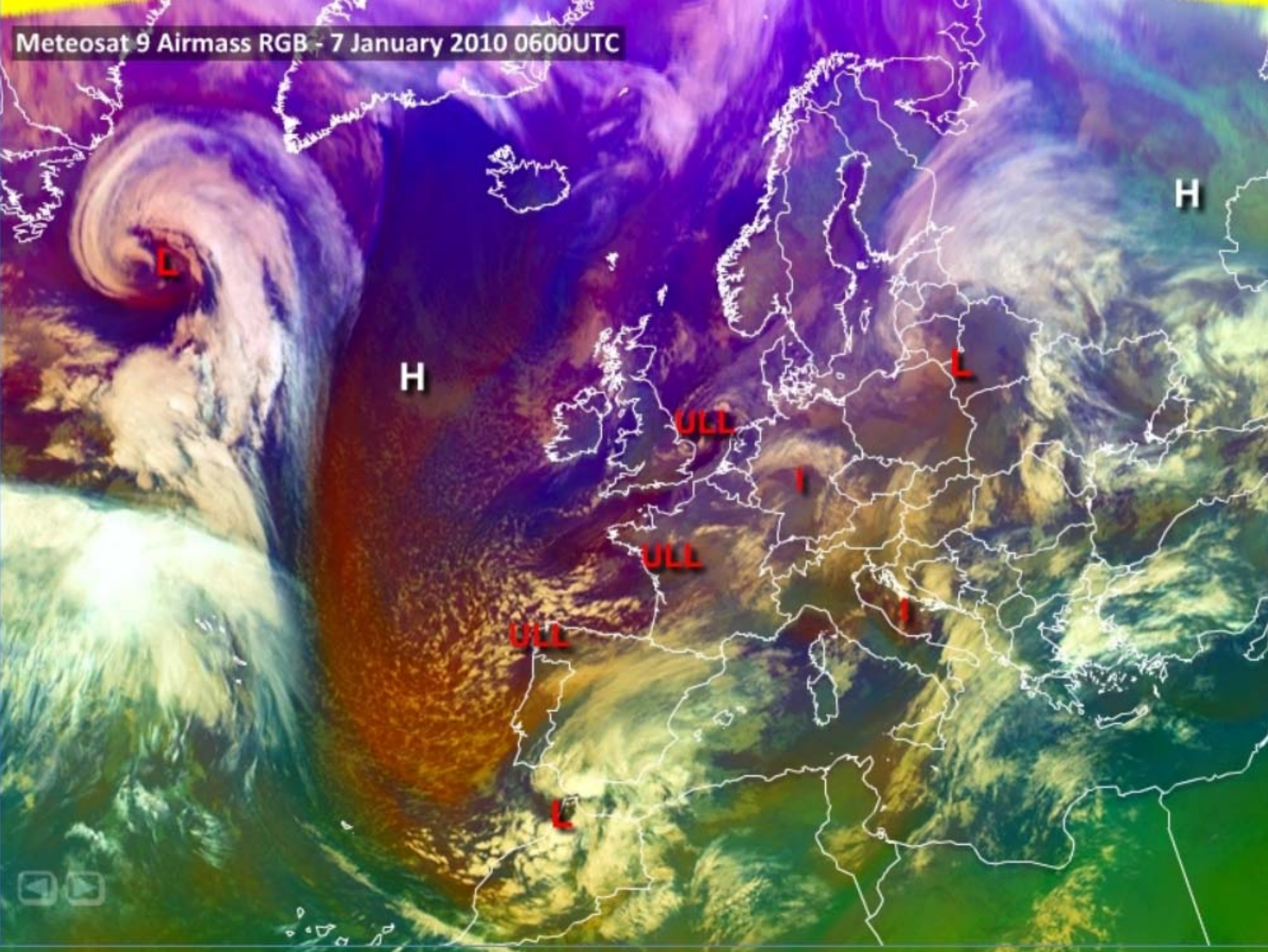
Meteosat 9 IR10.8 - 7 January 2010 0600UTC



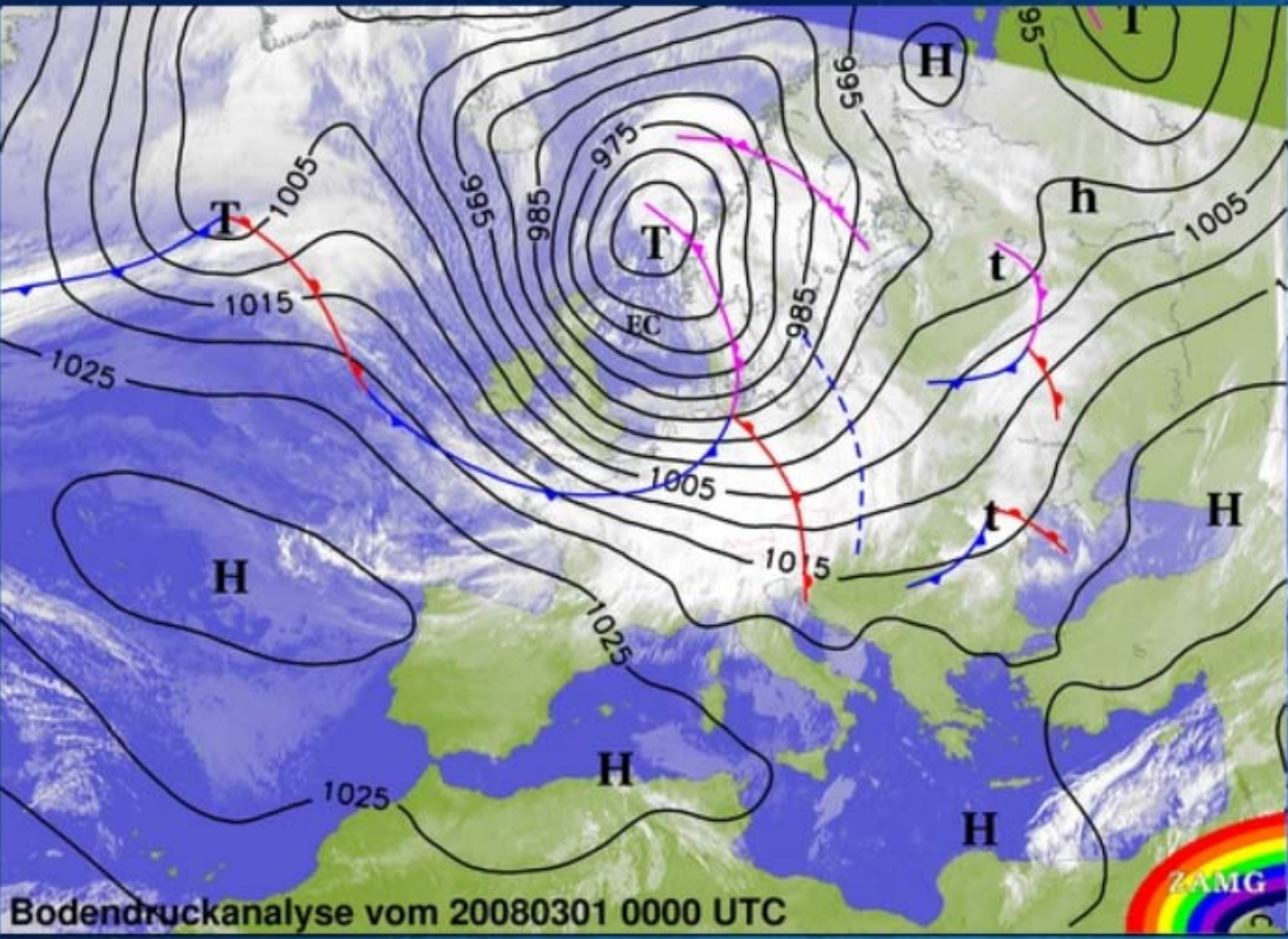
Meteosat 9 Airmass RGB - 7 January 2010 0600UTC



Meteosat 9 Airmass RGB - 7 January 2010 0600UTC

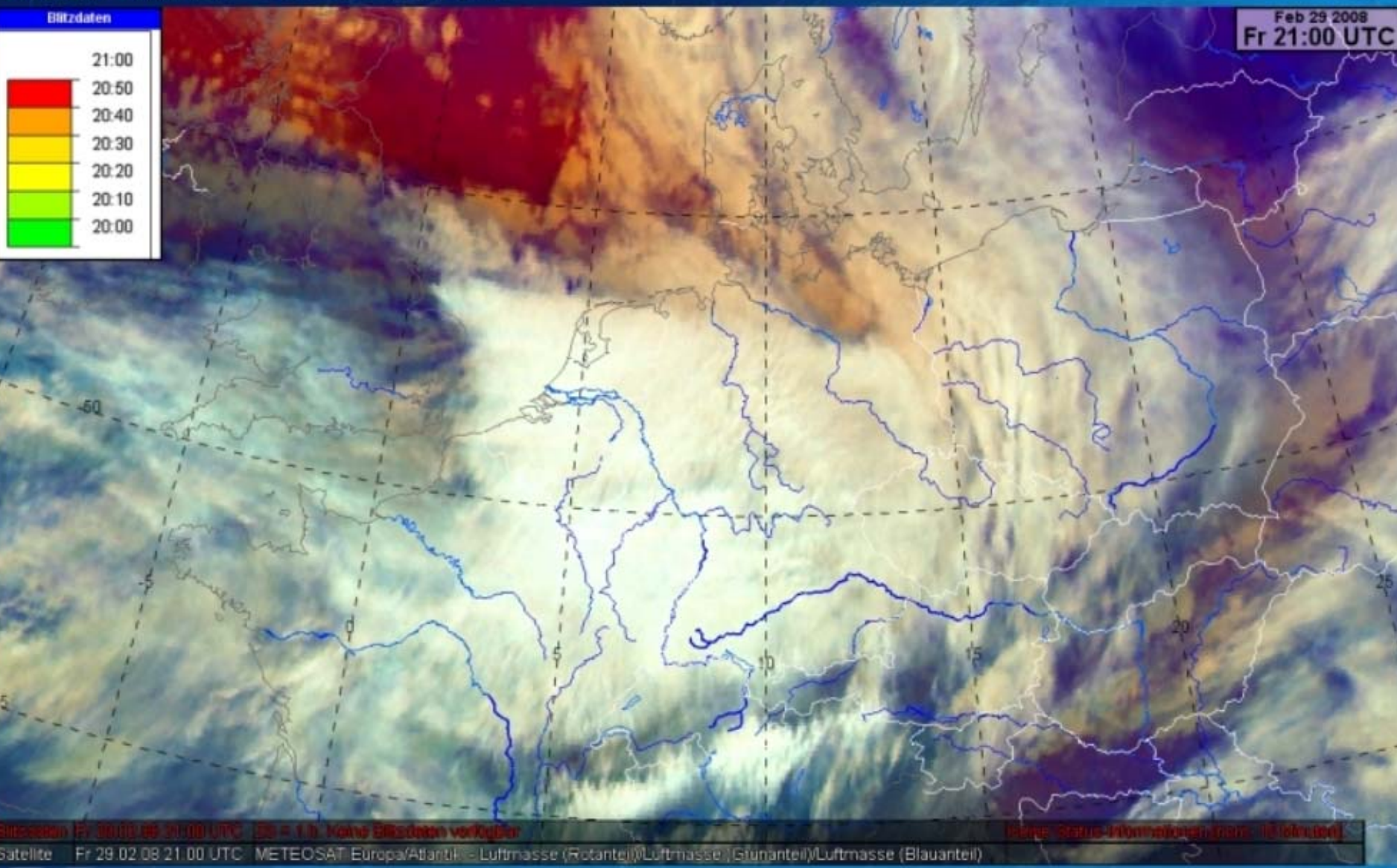


Storm Emma - 1 March 2008

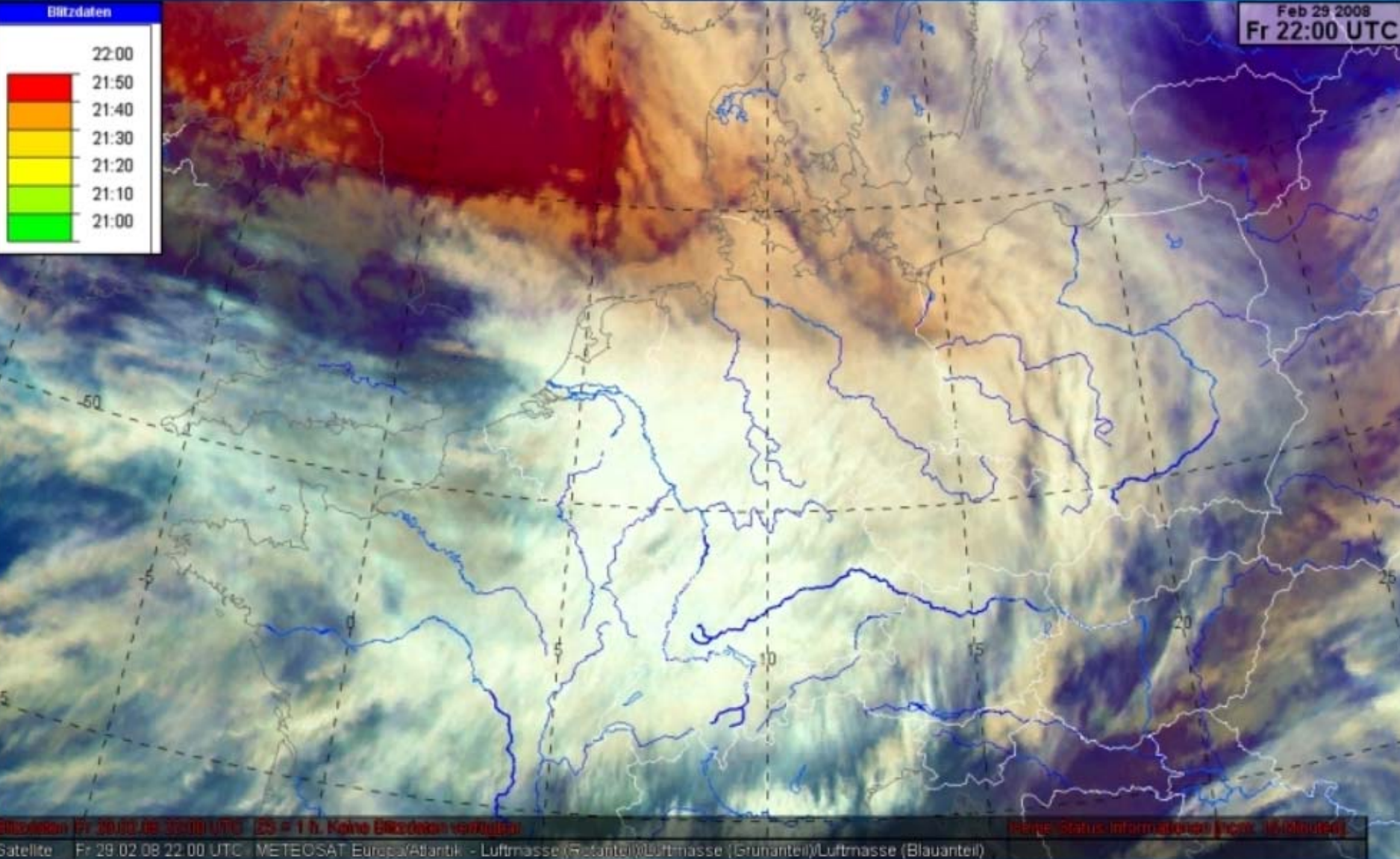


In a cold front with a strong postfrontal flow the appearance of line convection with downburst winds are common. The preconditions are well recognisable with use of Airmass RGB.

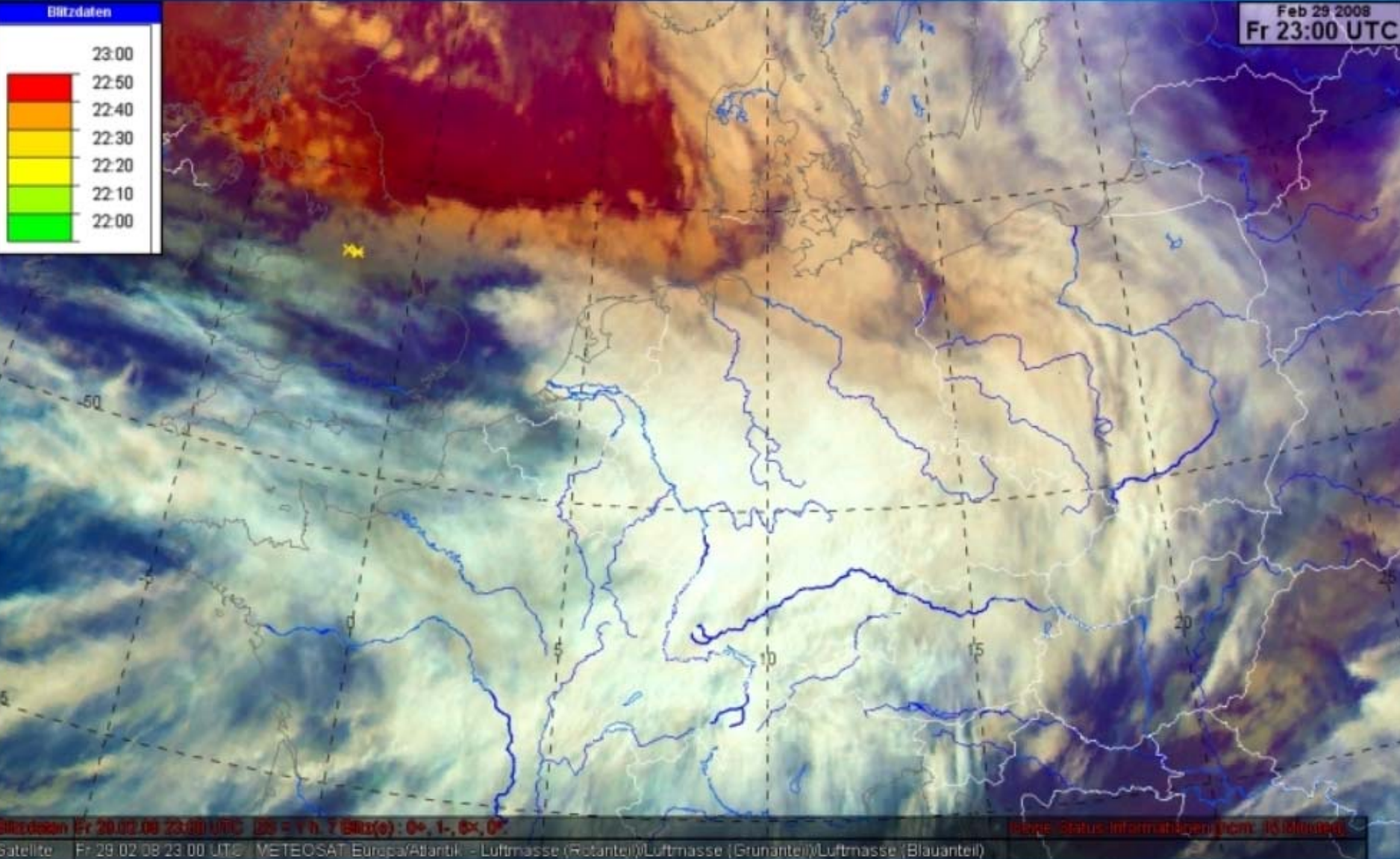
Storm Emma - 1 March 2008



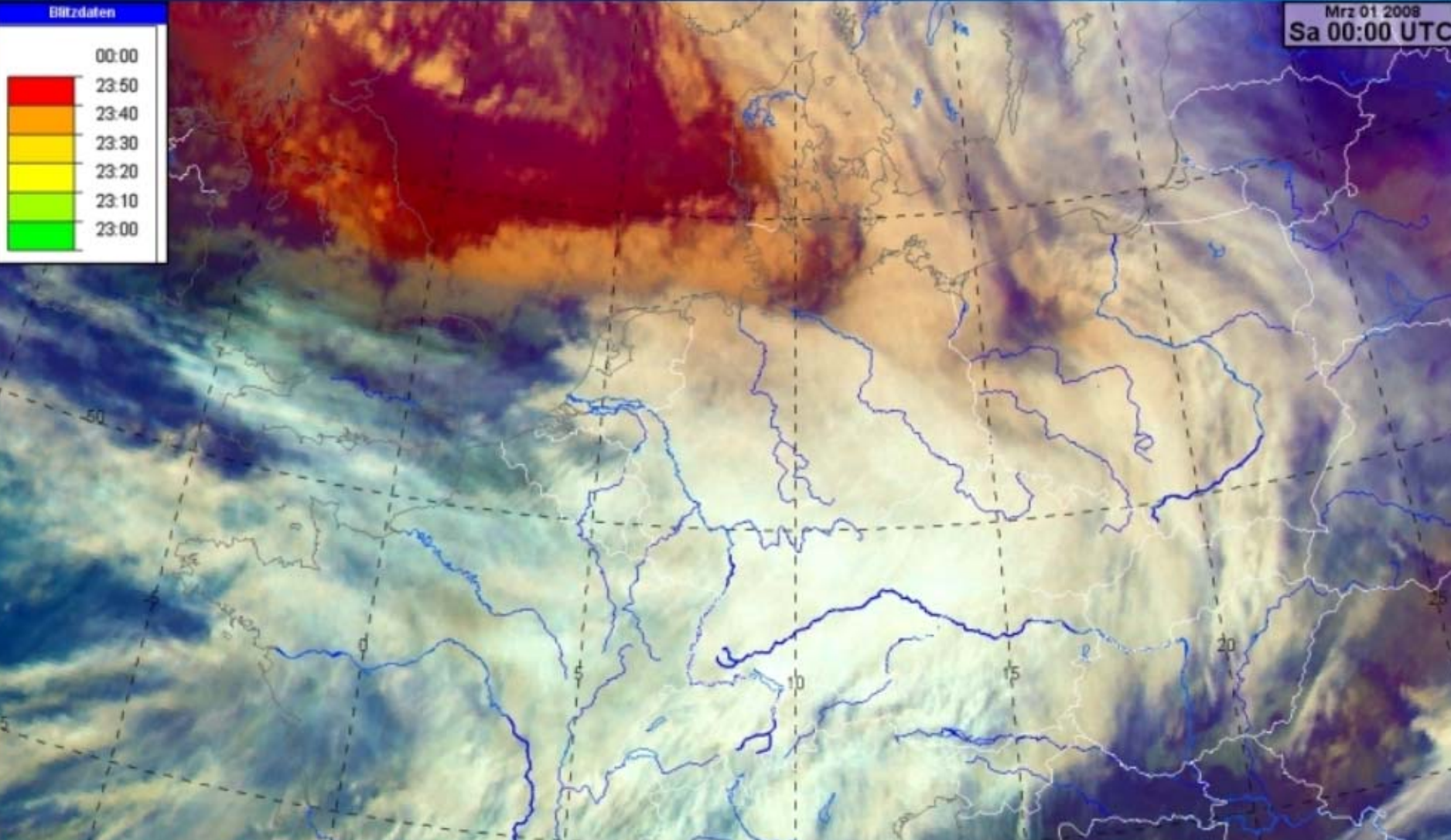
Storm Emma - 1 March 2008



Storm Emma - 1 March 2008

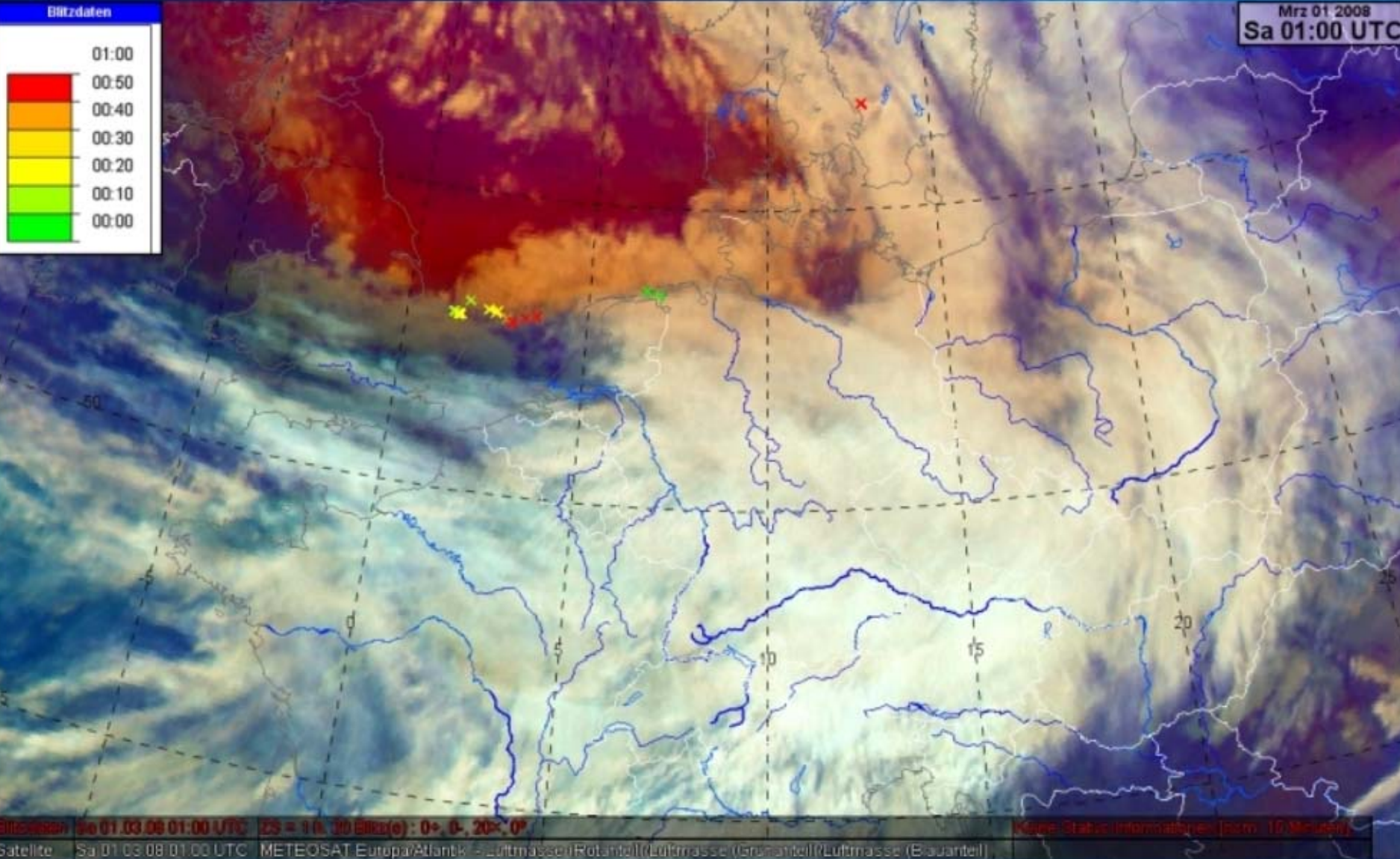


Storm Emma - 1 March 2008



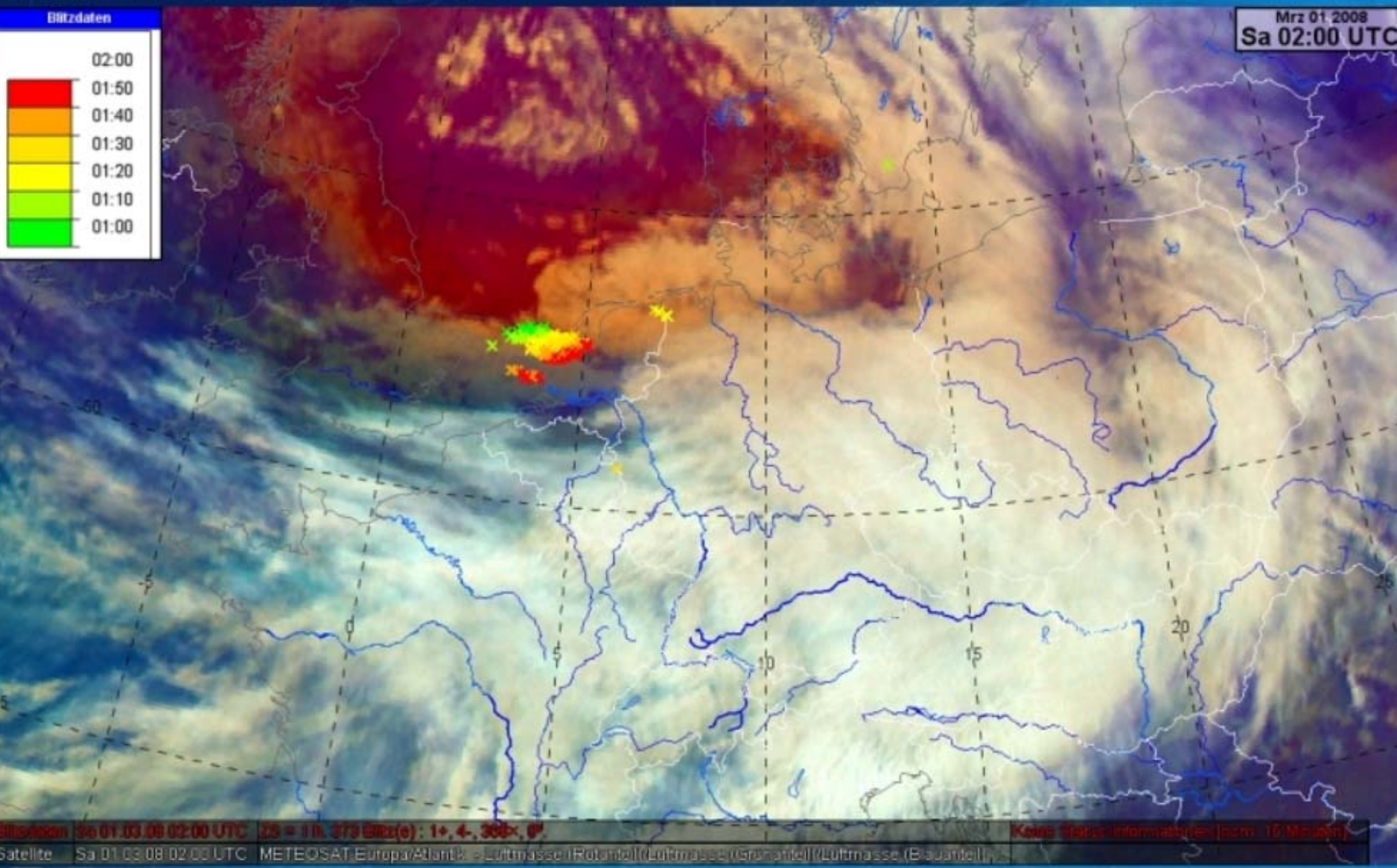
Blitzdaten Sa 01.03.08 00:00 UTC ZS = 1 h. Keine Blitzdaten verfügbar. Keine Statusinformationen (norm. 15 Minuten).
Satellite Sa 01.03.08 00:00 UTC METEOSAT Europa/Atlantik - Luftmasse (Rotanteil)/Luftmasse (Grünanteil)/Luftmasse (Blauanteil)

Storm Emma - 1 March 2008

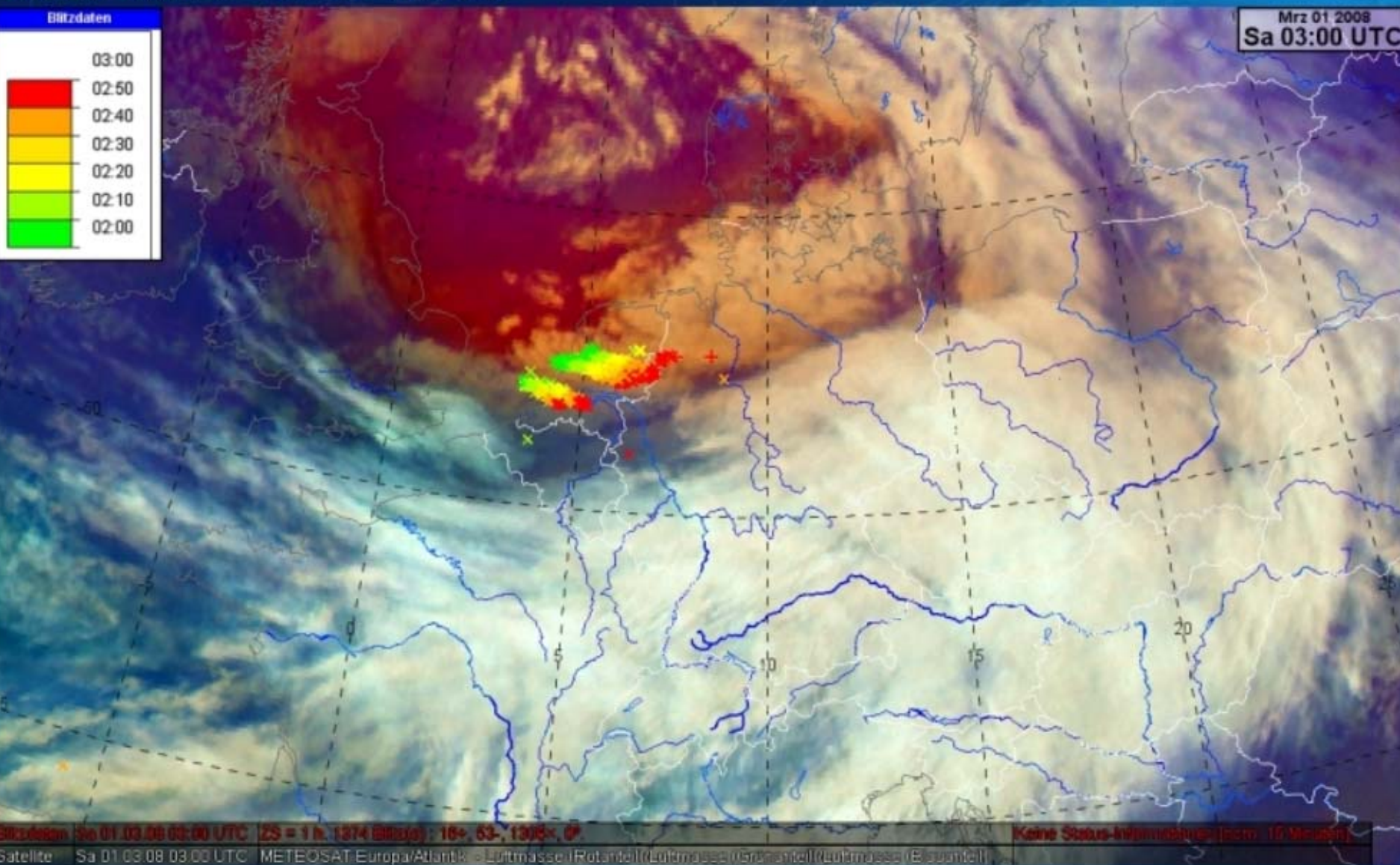


Stations: Sa 01.03.08 01:00 UTC ES = 16.30 km(s) 0° 0' 20" 0°
Satellite: Sa 01.03.08 01:00 UTC METEOSAT Europa/Atlantik (Luftmasse) Rotanteil (Luftmasse) Grünanteil (Luftmasse) Blauanteil

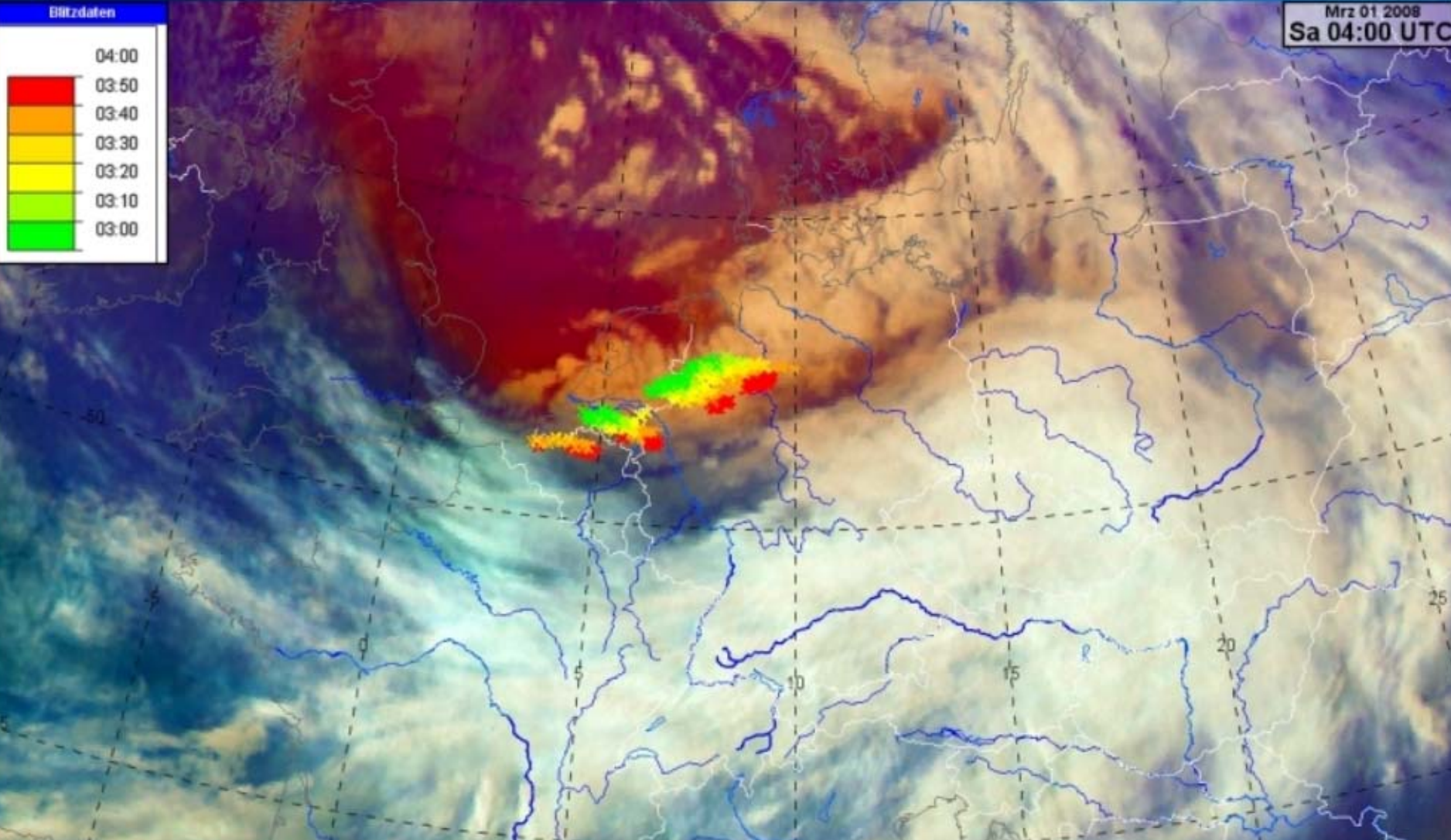
Storm Emma - 1 March 2008



Storm Emma - 1 March 2008

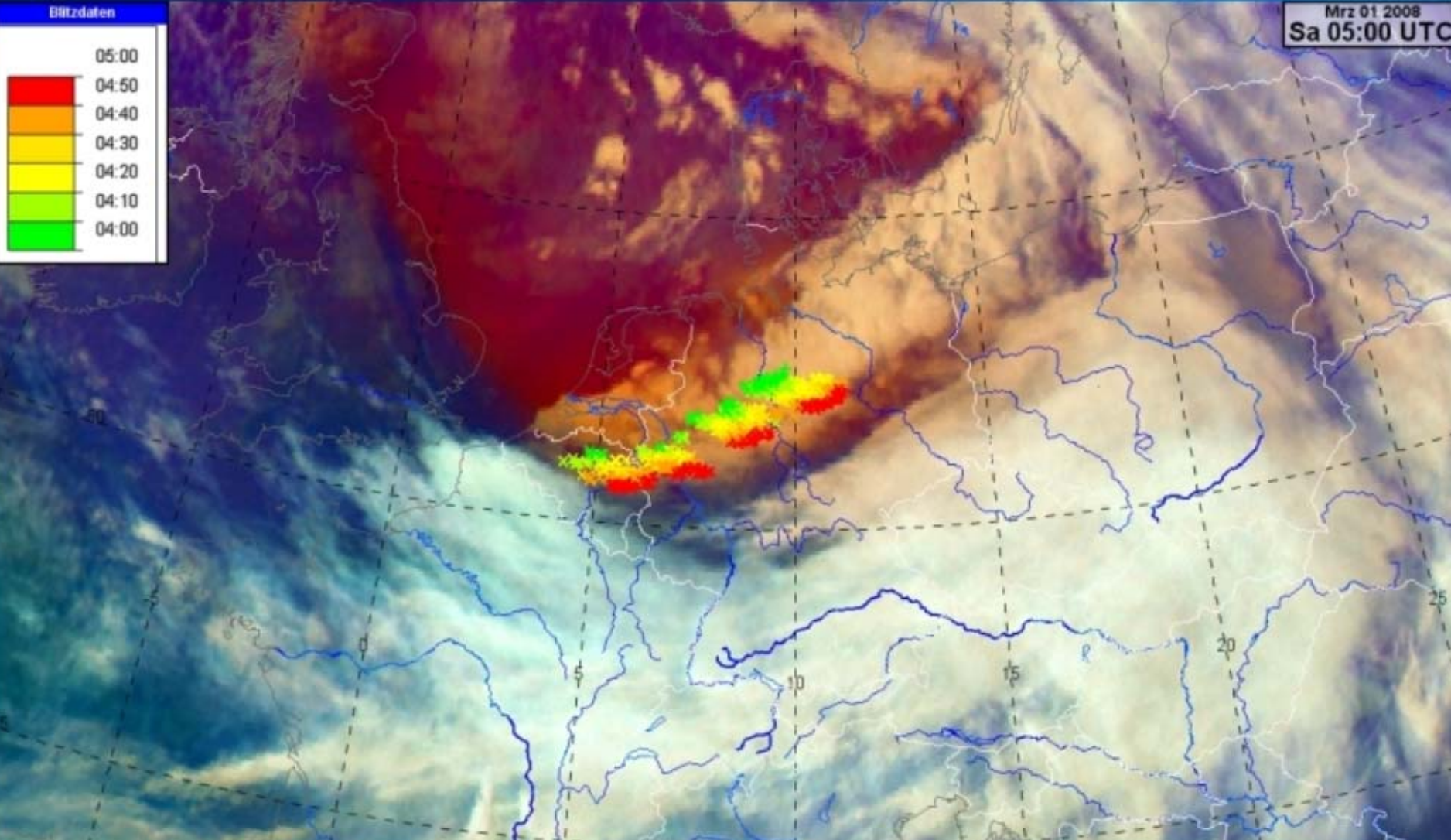


Storm Emma - 1 March 2008



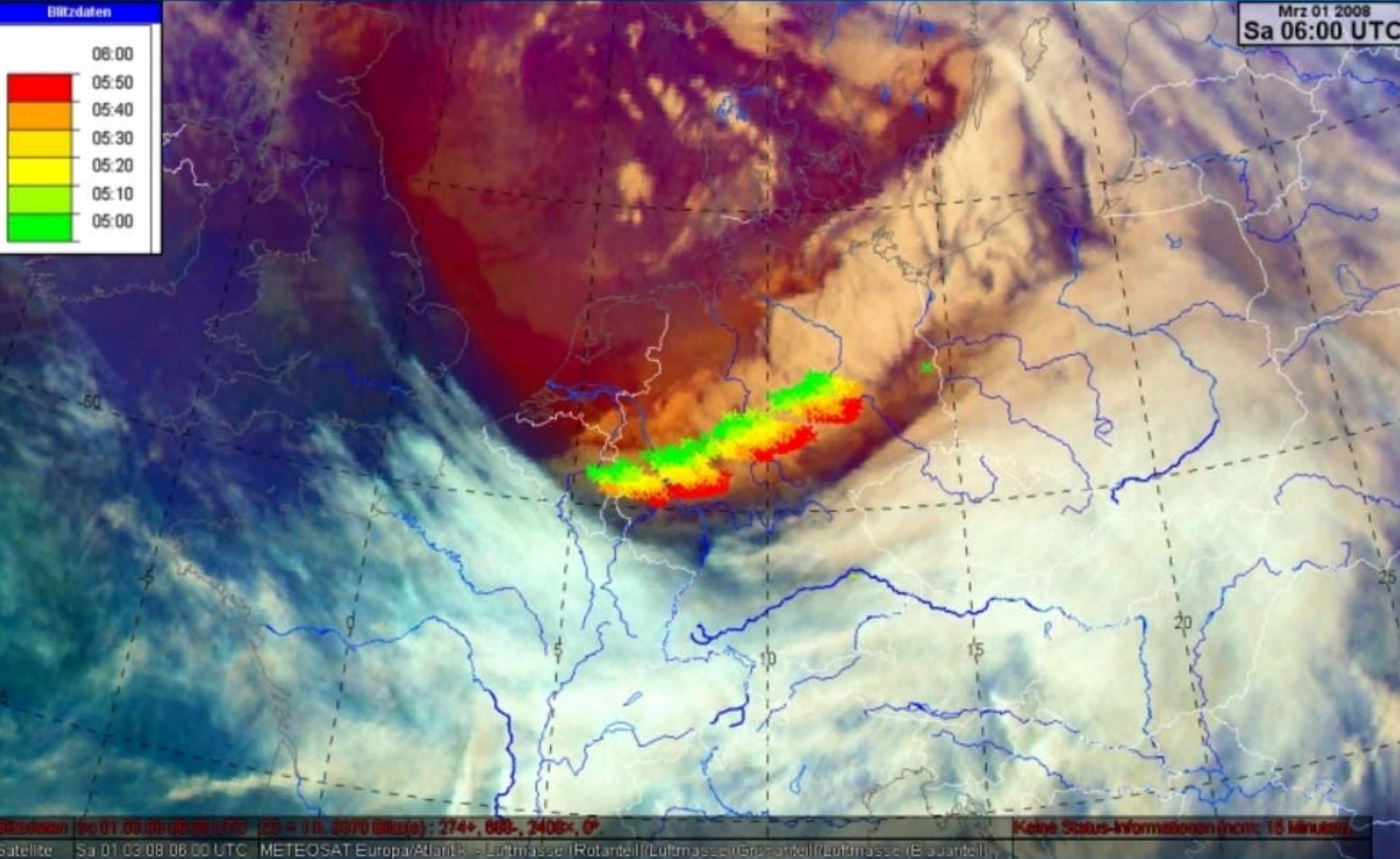
Blitzdaten: Sa 01.03.08 04:00 UTC ZS = 1 k (502 Blitze) : 93°, 262°, 1247%, 0°
Satellite: Sa 01 03 08 04:00 UTC METEOSAT Europa/Atlantik - Luftmasse (Rotanteil)/Luftmasse (Grünanteil)/Luftmasse (Blauanteil)
Keine Status-Informationen (vom 15 Minuten)

Storm Emma - 1 March 2008



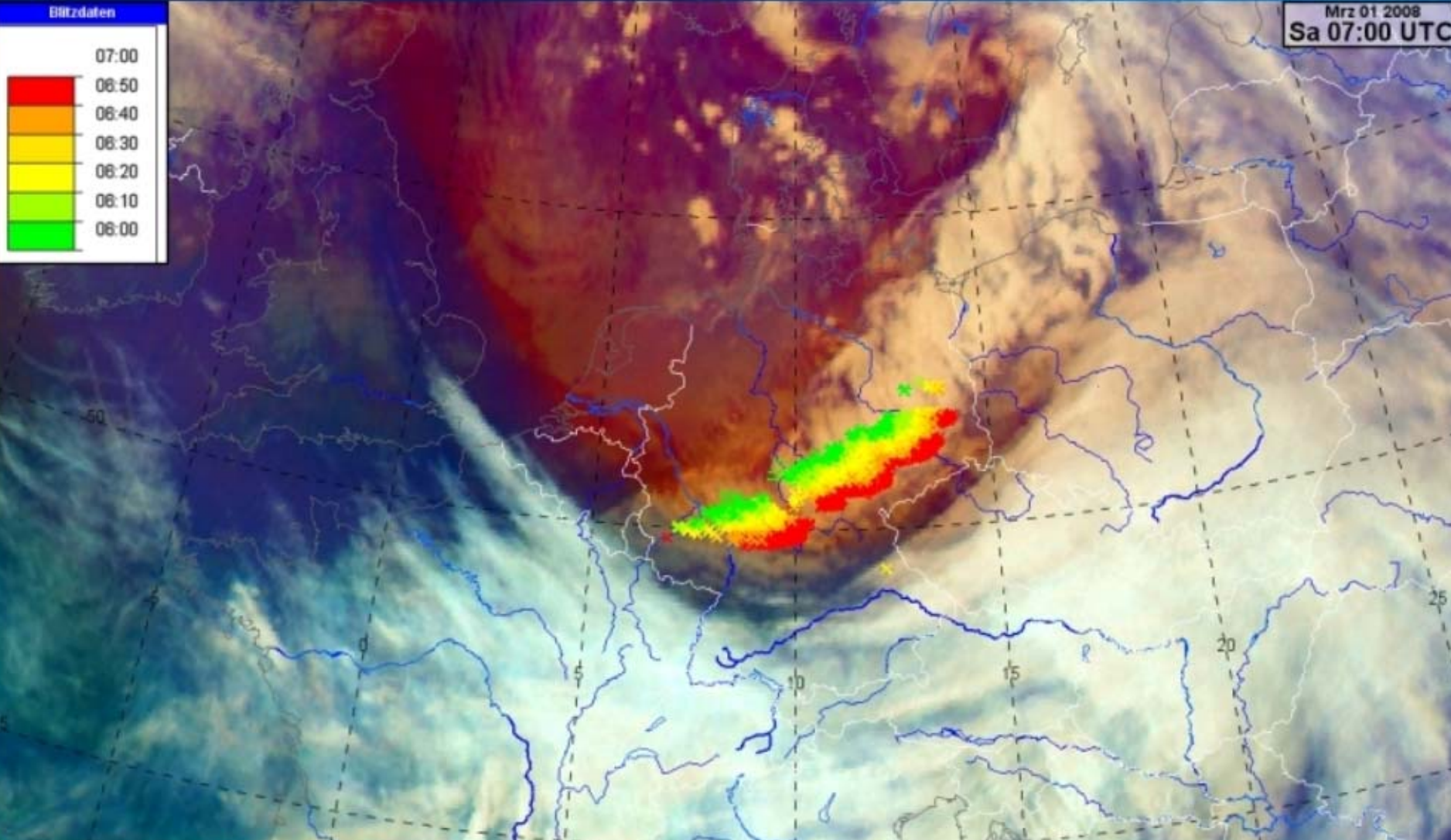
Zeitdaten: Sa 01.03.08 05:00 UTC ES = 1 h, 2020 km(e): 137°, 475°, 1700°, 0°
Satellite: Sa 01.03.08 05:00 UTC METEOSAT Europa/Atlantik - Luftmasse (Rotanteil)/Luftmasse (Grünanteil)/Luftmasse (Blauanteil)
Keine Status-Informationen (nächste 15 Minuten)

Storm Emma - 1 March 2008



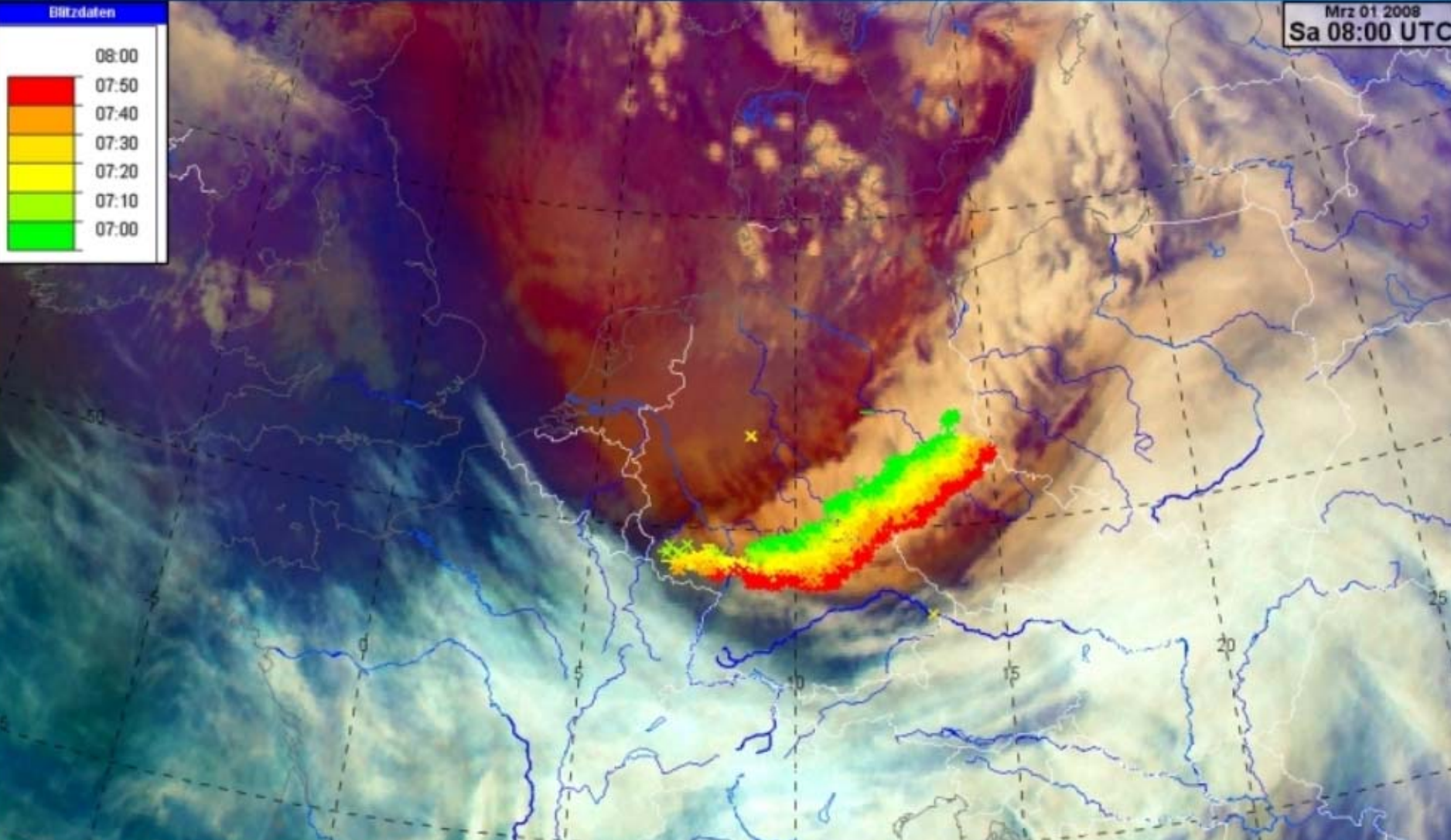
Strahlung: Sa 01.03.08 06:00 UTC (20 = 10.0000 Grad): 274°, 688°, 3408°, 0°
Keine Status-Informationen (noch 15 Minuten)
Satellit: Sa 01.03.08 06:00 UTC METEOSAT Europa/Atlantik - Luftmasse (Rotanteil) (Luftmasse (Grünanteil) (Luftmasse (Blauanteil))

Storm Emma - 1 March 2008



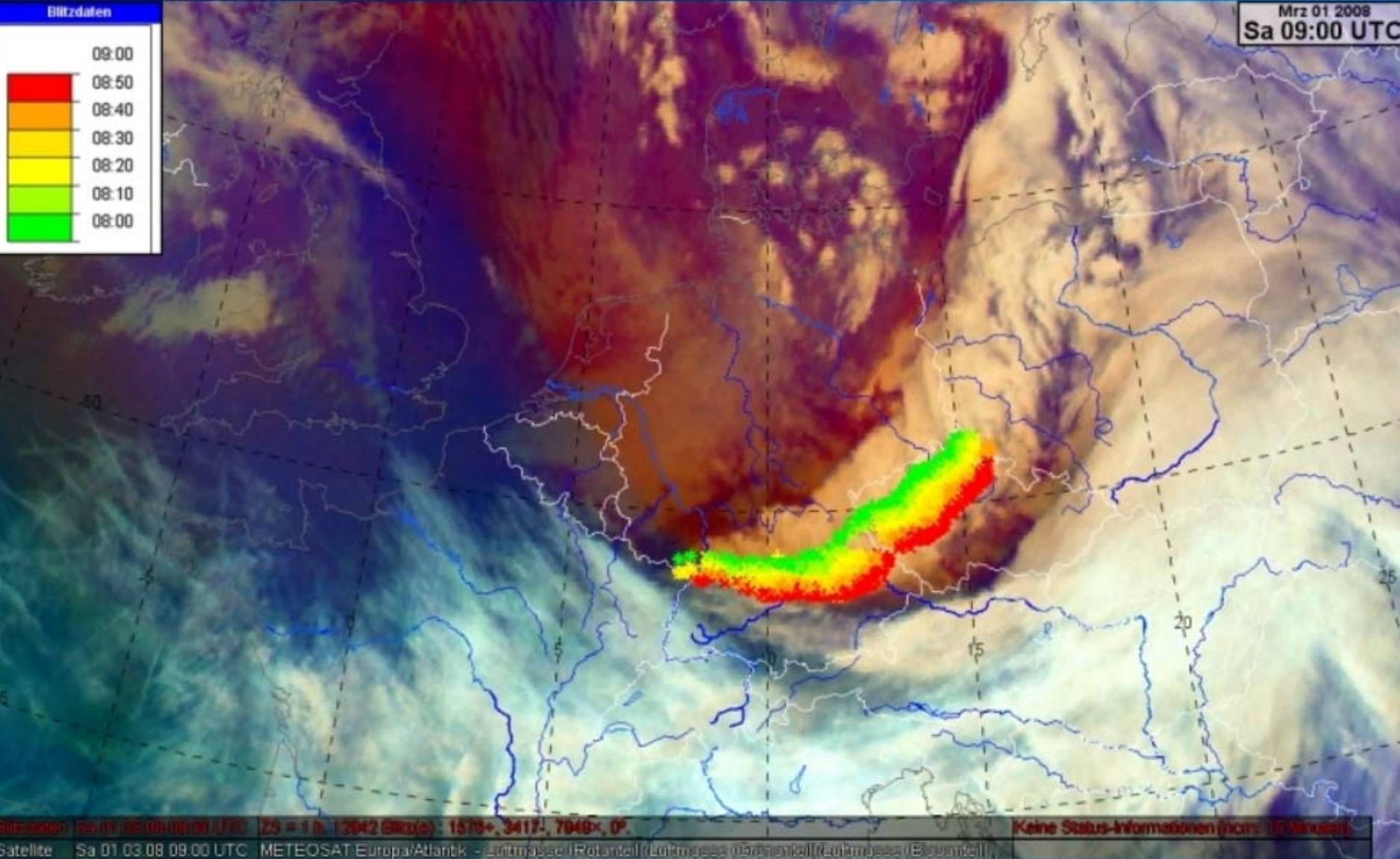
Stations: Sa 01 06:00:00 UTC ZS = 1 h. 8200 Bild(e): 695x, 1715x, 3000x, 0x.
Satellite: Sa 01 03 08 07:00 UTC METEOSAT Europa/Atlantik - Luftmasse/Rotanteil/Luftmasse/Grünanteil/Luftmasse/Blauanteil
Keine Status-Informationen (nächste 15 Minuten)

Storm Emma - 1 March 2008

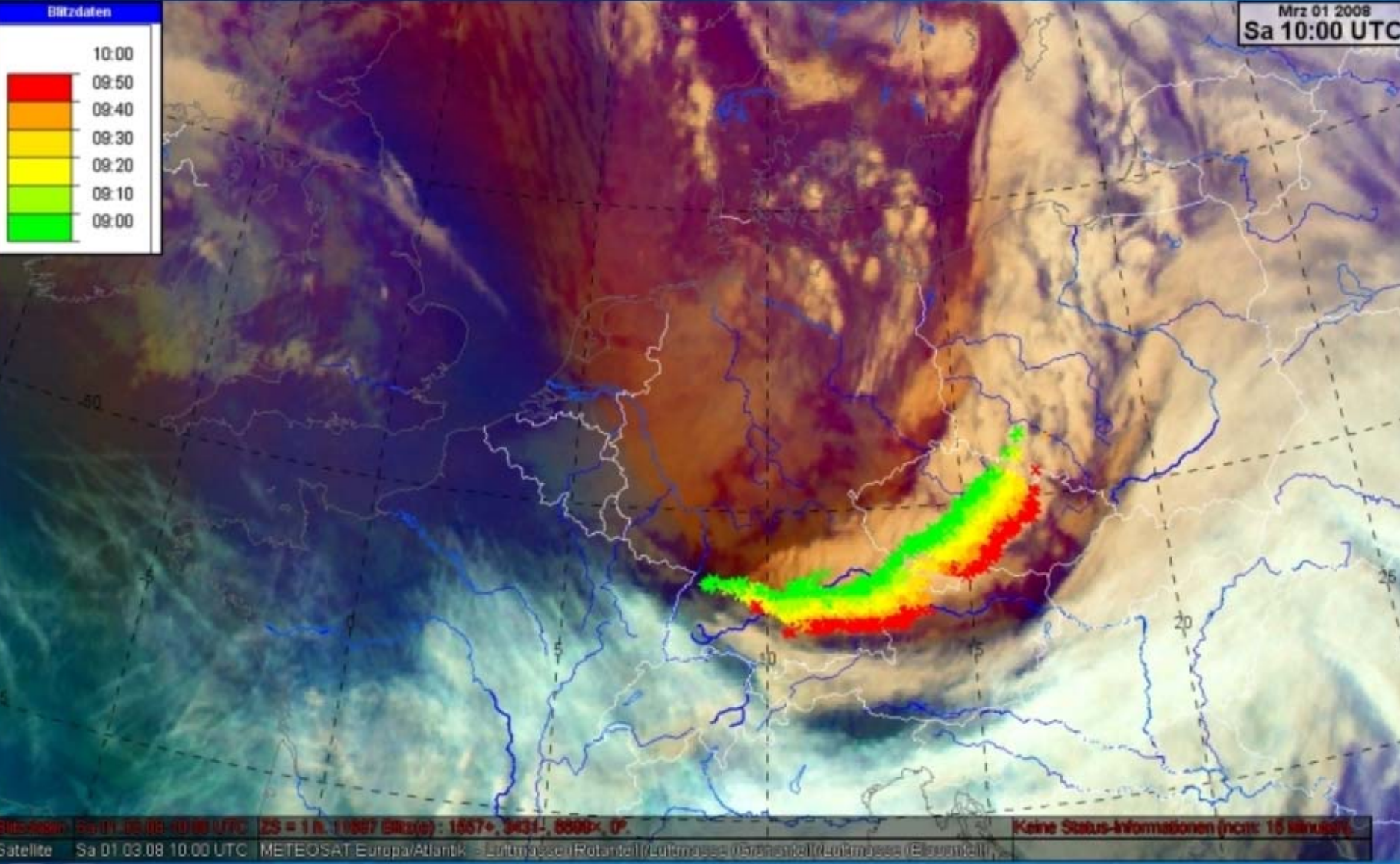


Storm Emma: 08:00 UTC 01.03.2008
TS = 1 h. 0450 UTC (e): 731°, 1948', 5702', 0°
Keine Status-Informationen (nach 15 Minuten)
Satellite: Sa 01.03.08 08:00 UTC METEOSAT Europa/Atlantik - Luftmassen/Rotanteil/Luftmassen/Garbenanteil/Luftmassen (Bewertung)

Storm Emma - 1 March 2008

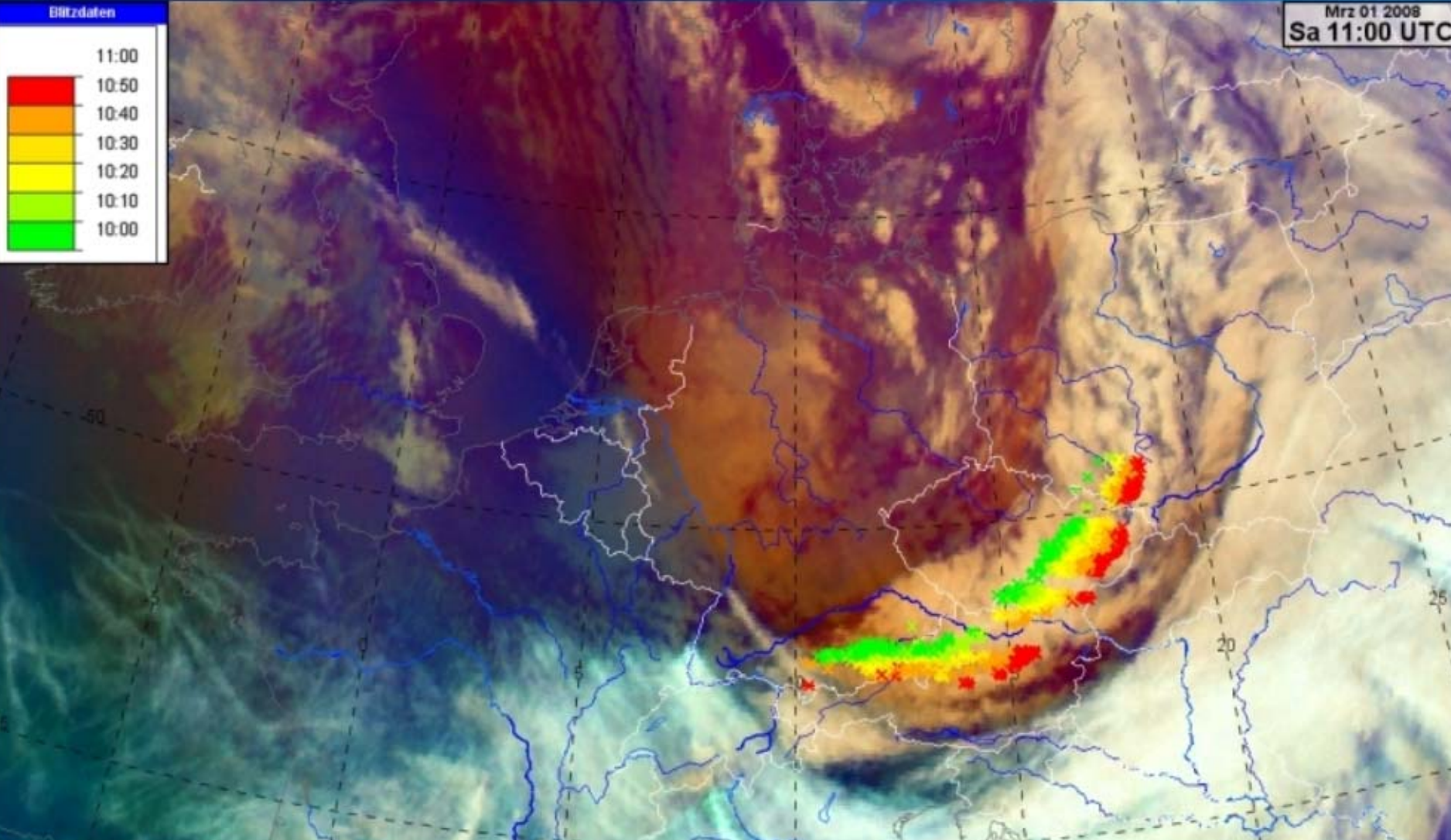


Storm Emma - 1 March 2008



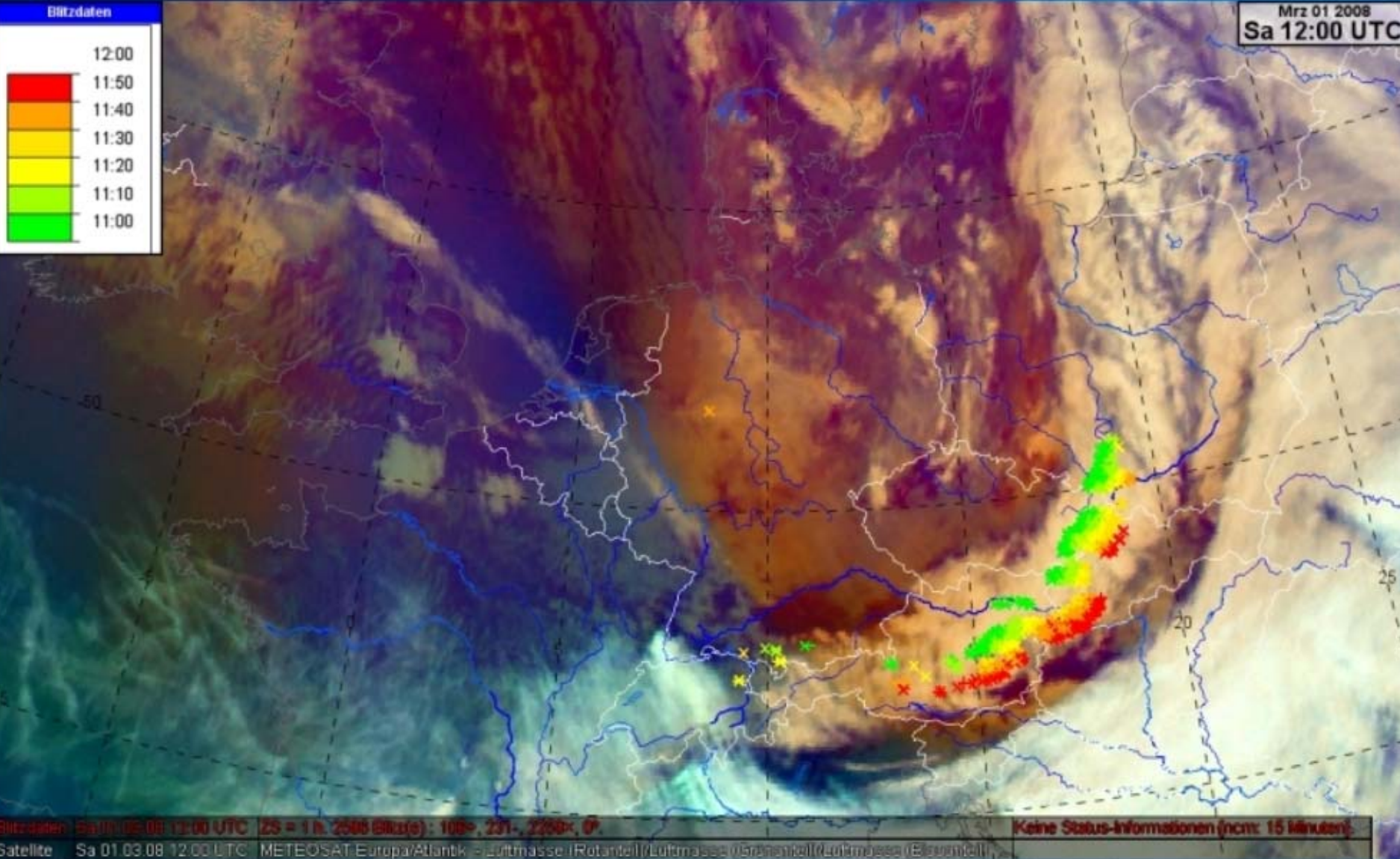
Stations: Sa 01 03 08 10:00 UTC ZS = 1 h, 11567 km/h (g): 1557°, 3431°, 6800°, 0°
Satellite: Sa 01 03 08 10:00 UTC METEOSAT Europa/Atlantik - Luftmassen/Rotanteil/Luftmassen/Grünanteil/Luftmassen/Blauanteil
Keine Status-Informationen (nächst: 15 Minuten)

Storm Emma - 1 March 2008

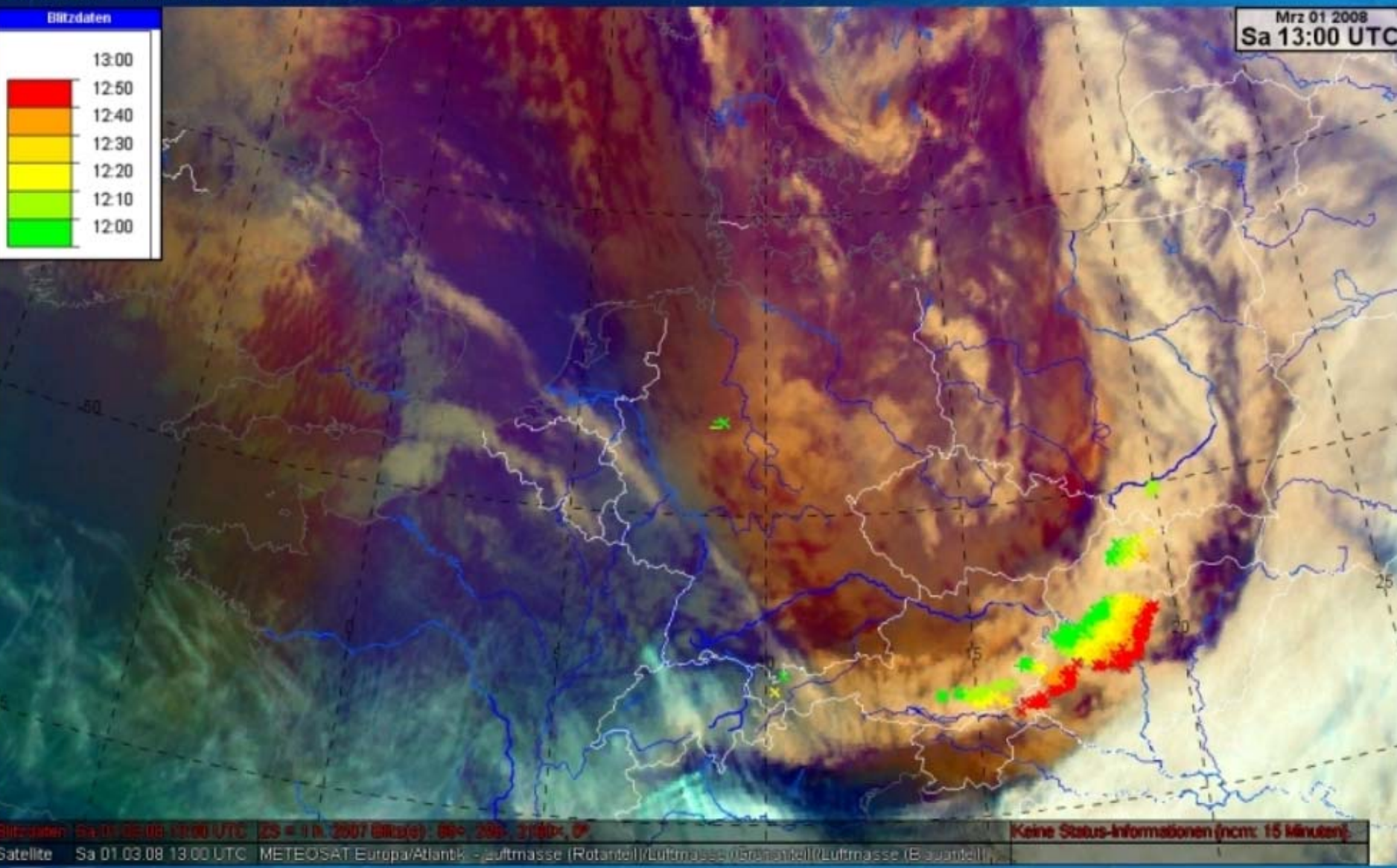


Zeitdaten: Sa 01 03 08 11:00 UTC ZS = 1 h, 3000 Bilder: 211°, 005°, 2783°, 0°
Satellite: Sa 01 03 08 11:00 UTC METEOSAT Europa/Atlantik - Luftmasse (Rotanteil)/Luftmasse (Grünanteil)/Luftmasse (Blauanteil)
Keine Status-Informationen (nächste 15 Minuten)

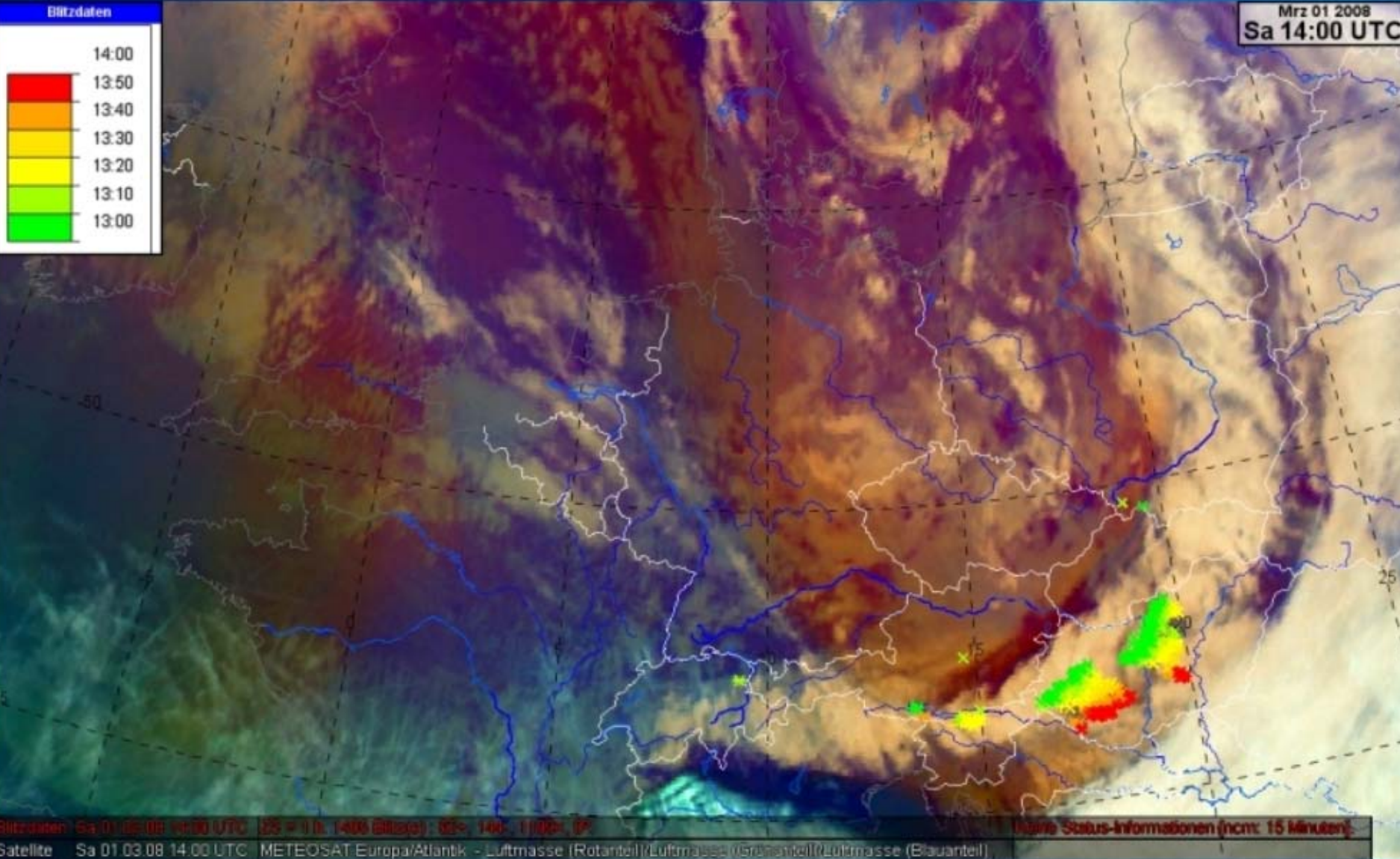
Storm Emma - 1 March 2008



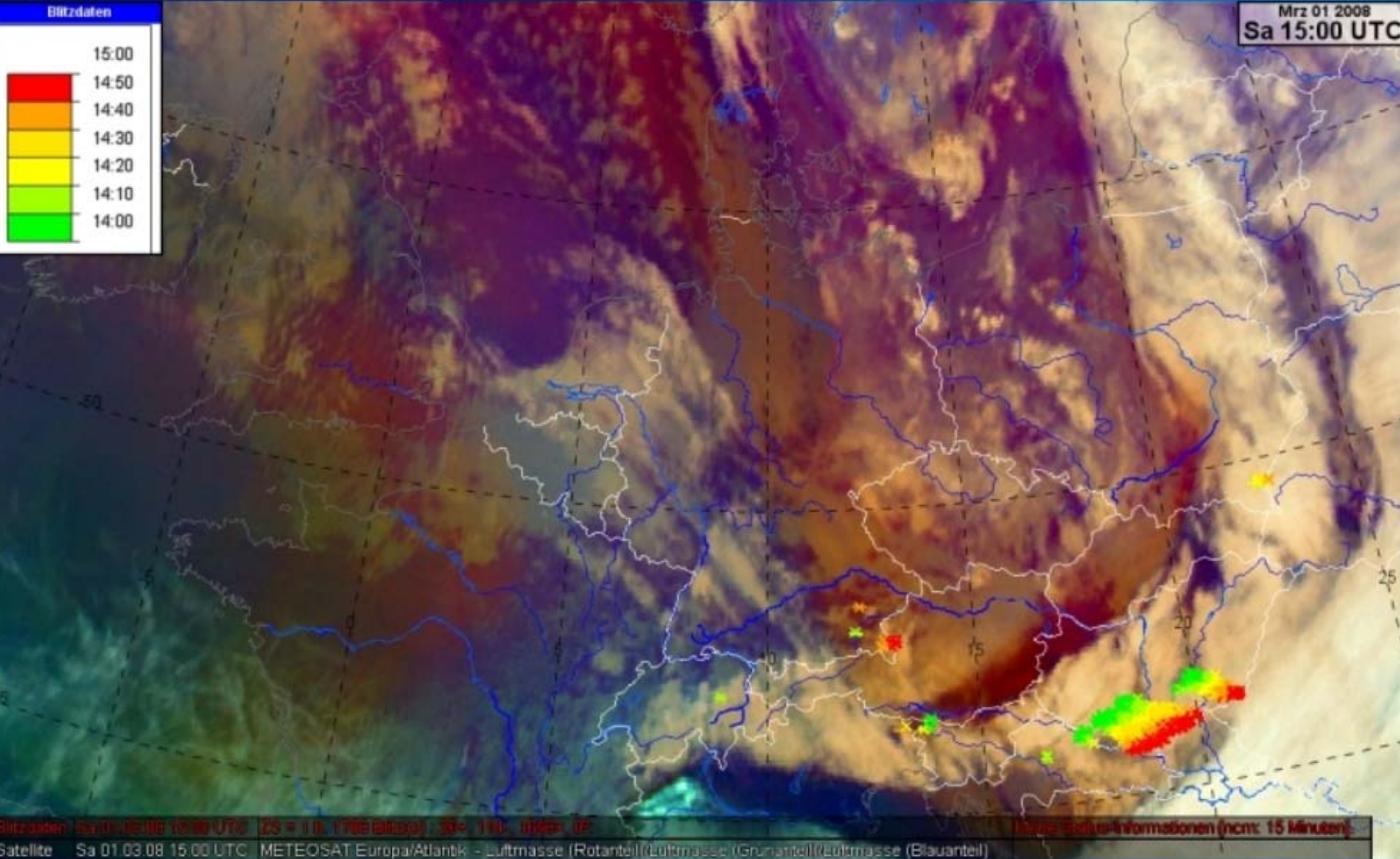
Storm Emma - 1 March 2008



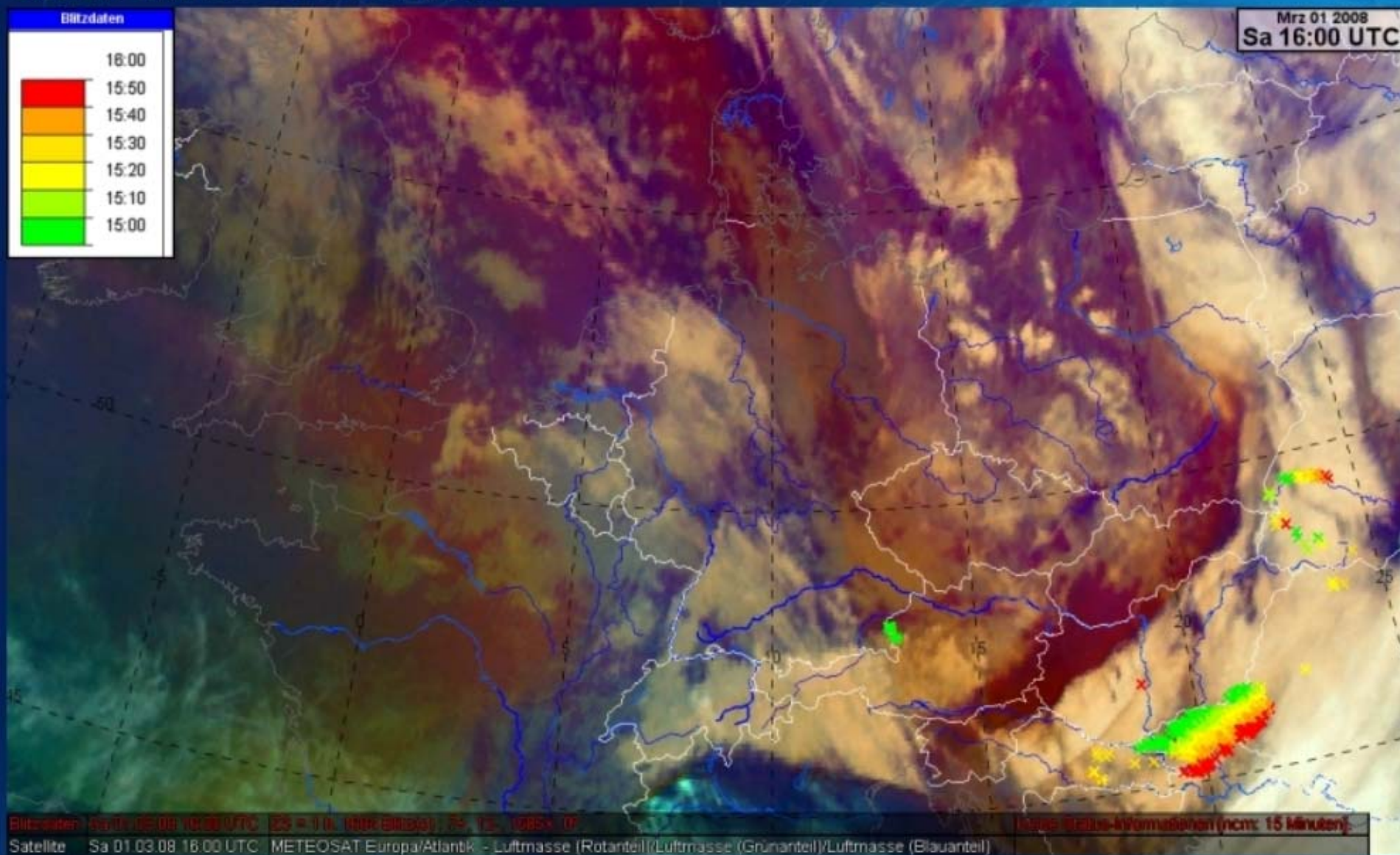
Storm Emma - 1 March 2008



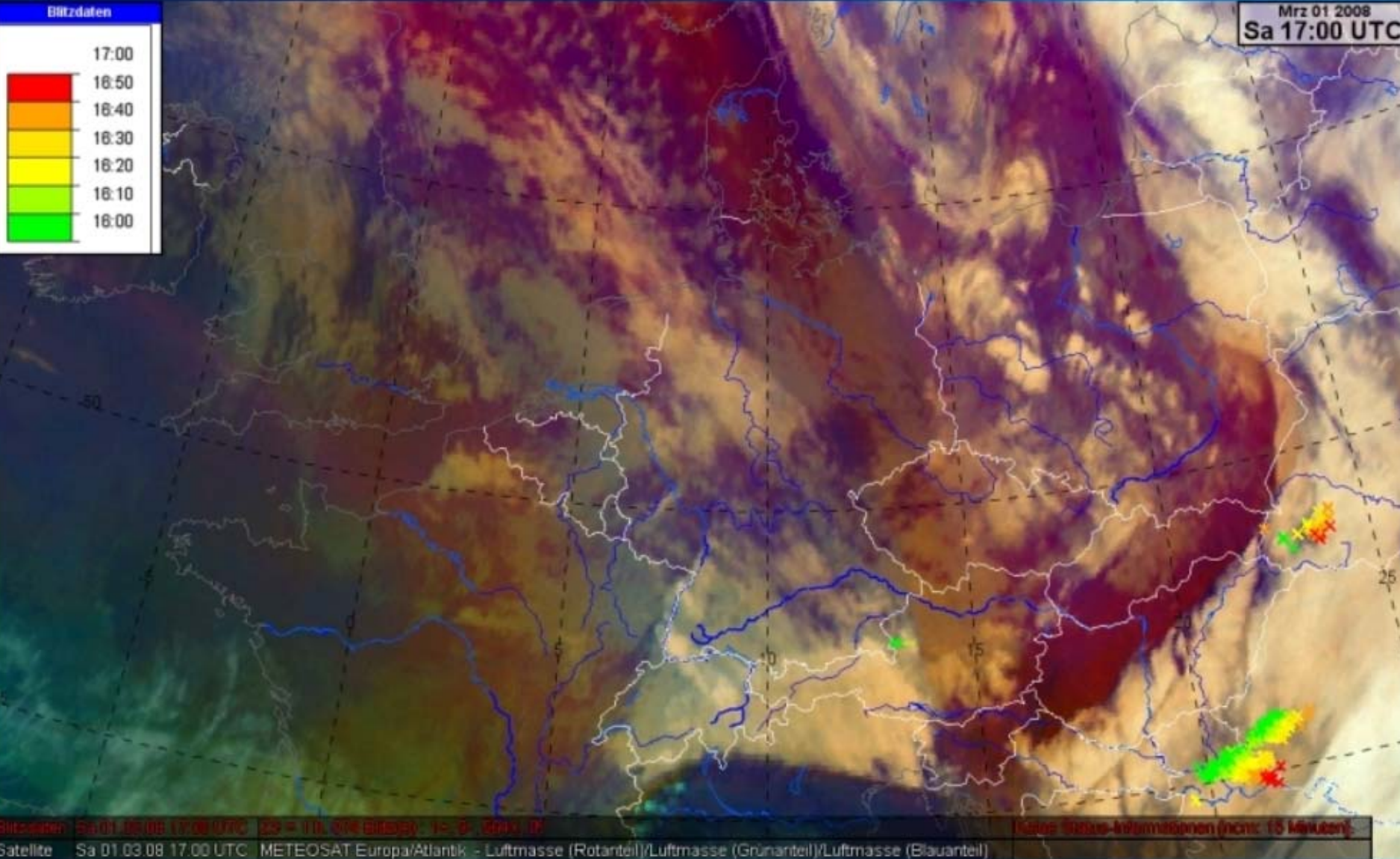
Storm Emma - 1 March 2008



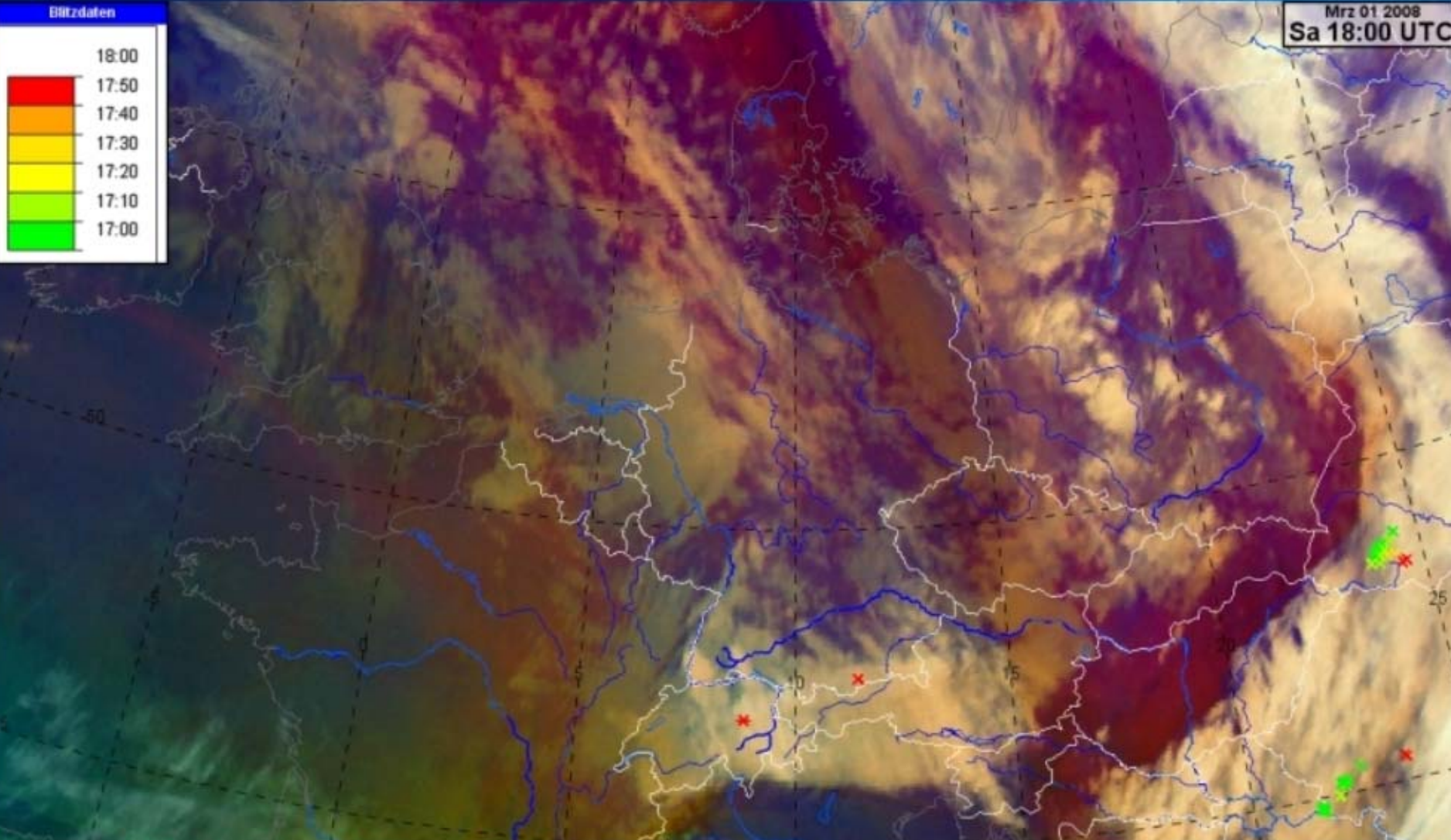
Storm Emma - 1 March 2008



Storm Emma - 1 March 2008

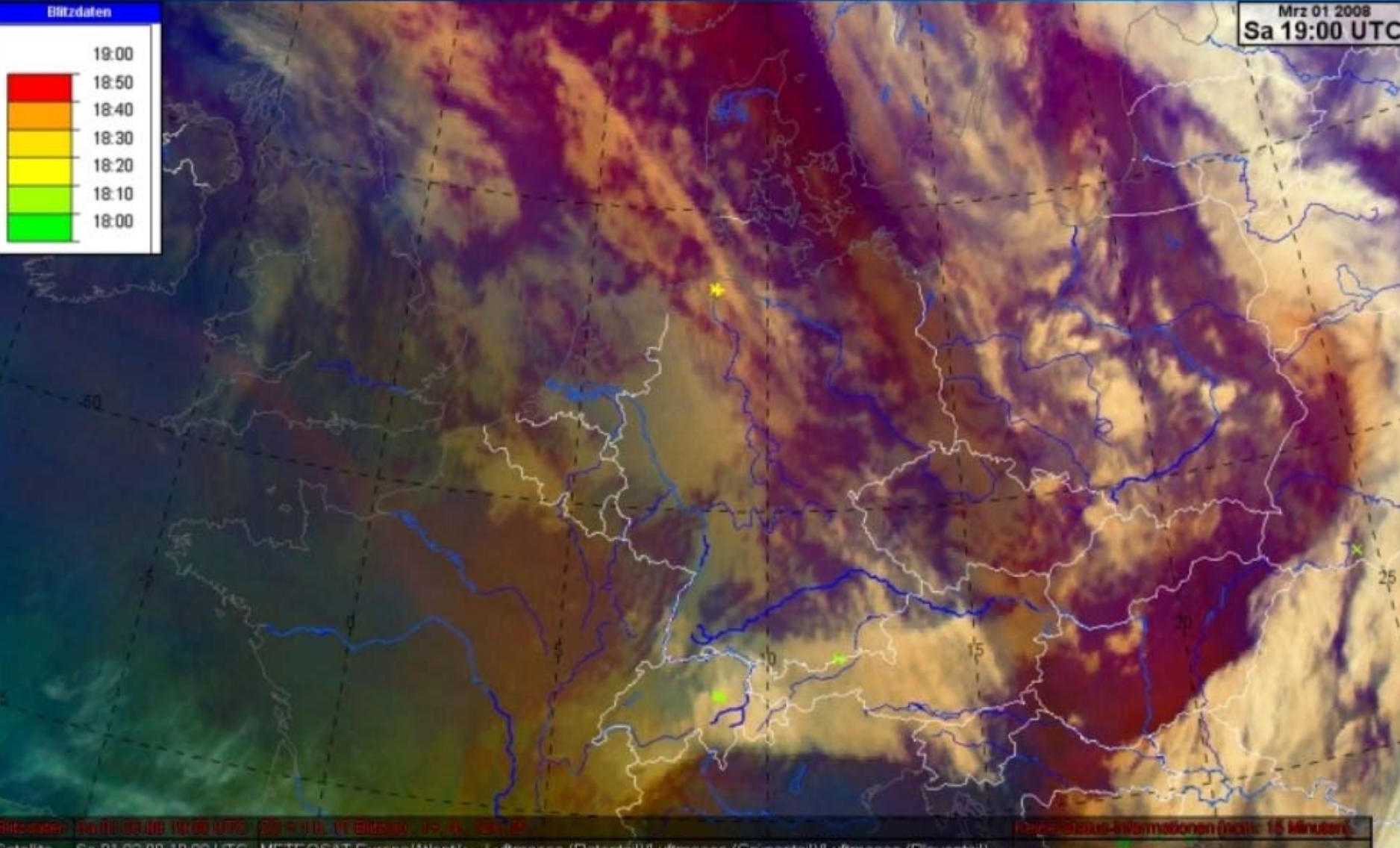


Storm Emma - 1 March 2008

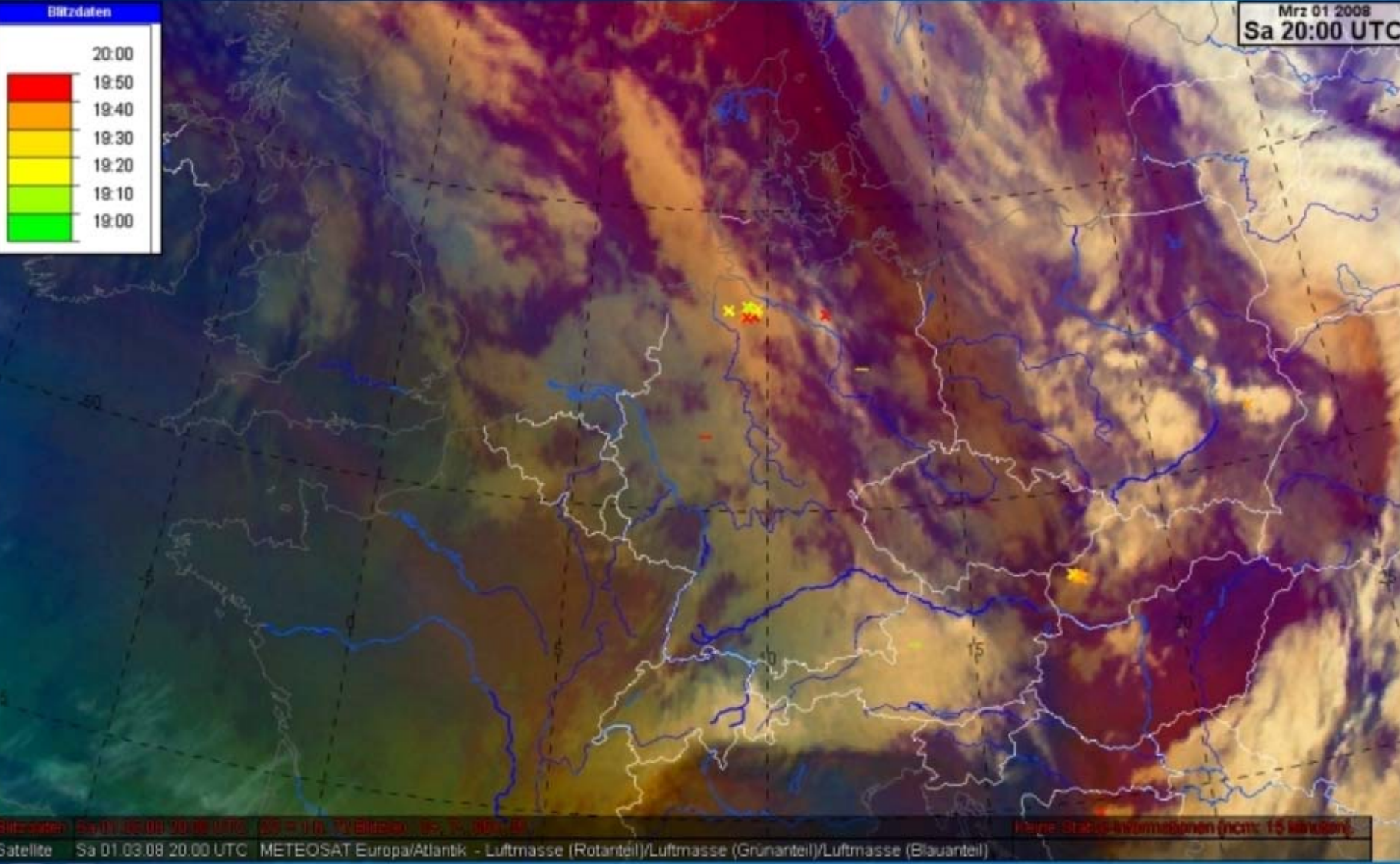


Witzdaten: Sa 01.03.08 18:00 UTC 20 = 10.07.08 18:00 UTC 20 = 10.07.08 18:00 UTC
Satellite: Sa 01.03.08 18:00 UTC METEOSAT Europa/Atlantik - Luftmasse (Rotanteil)/Luftmasse (Grünanteil)/Luftmasse (Blauanteil)
Hoch Status-Informationen (pcnr: 15 Minuten)

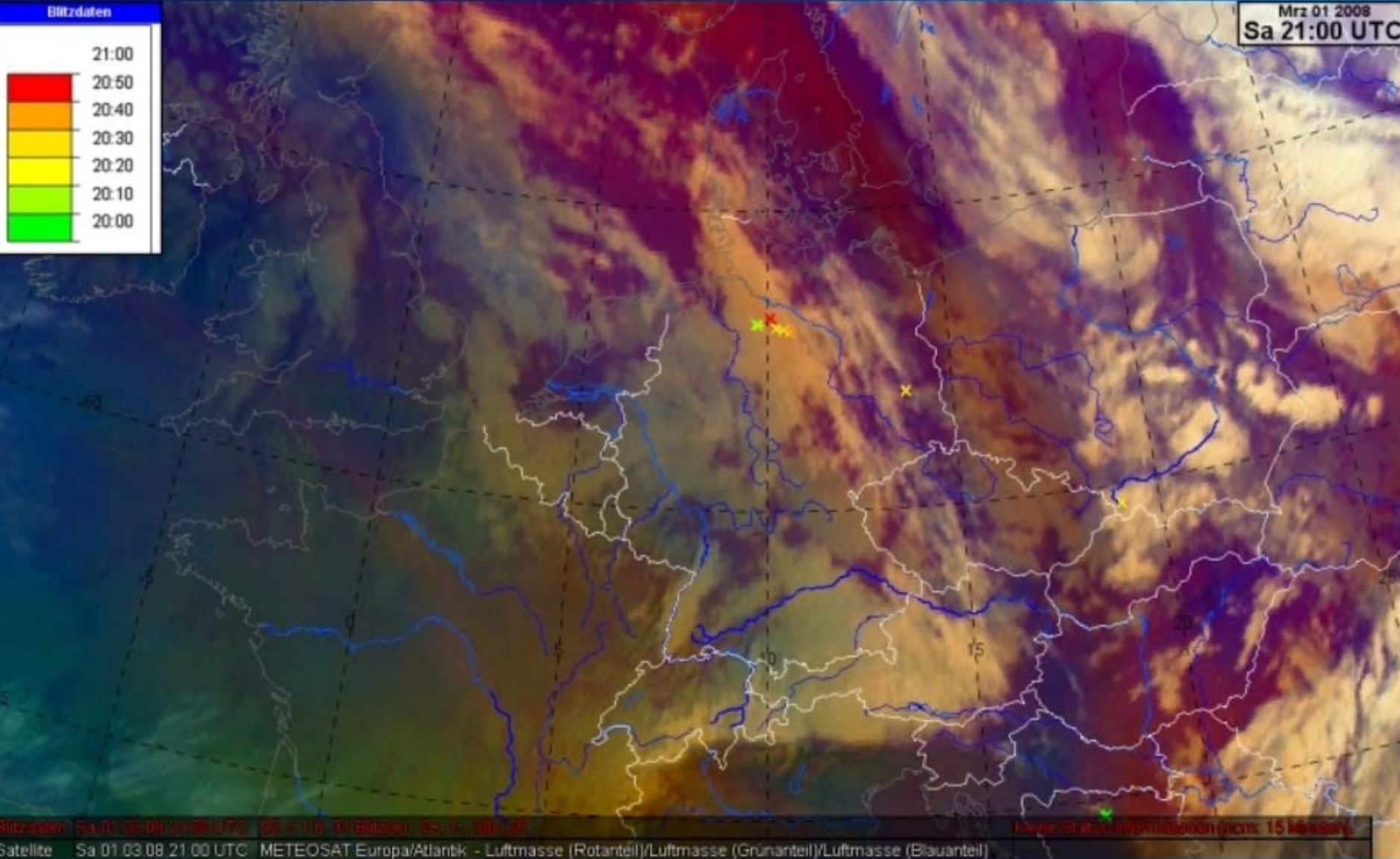
Storm Emma - 1 March 2008



Storm Emma - 1 March 2008



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 windgusts.

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?

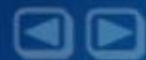


**Where do we typically find
maxima of PVA?**

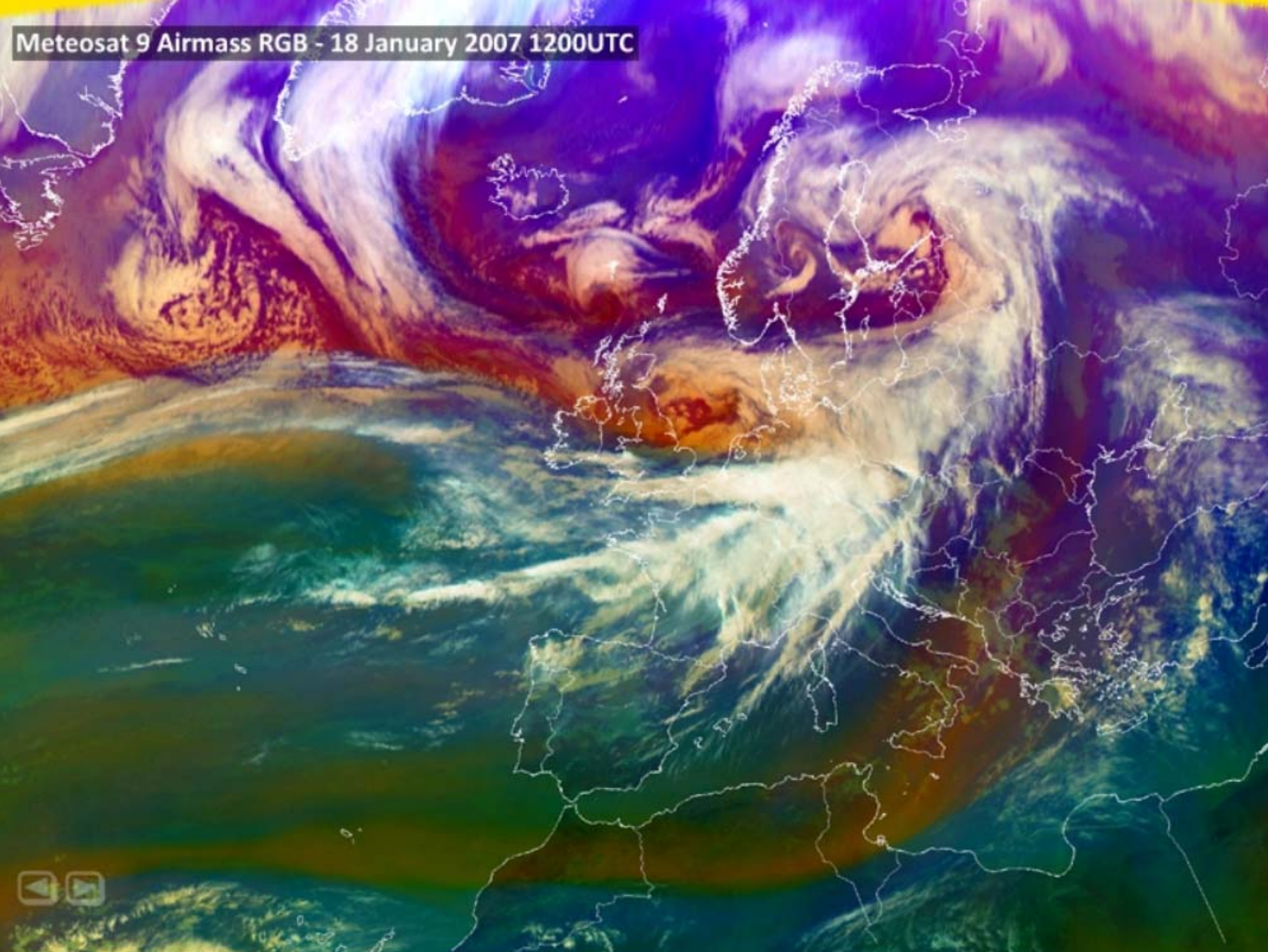


Line convection and downburst winds

From a satellite point of view the Forecasters should monitor the Airmass image closely. The forecaster can identify the position and orientation of the jet¹ 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).

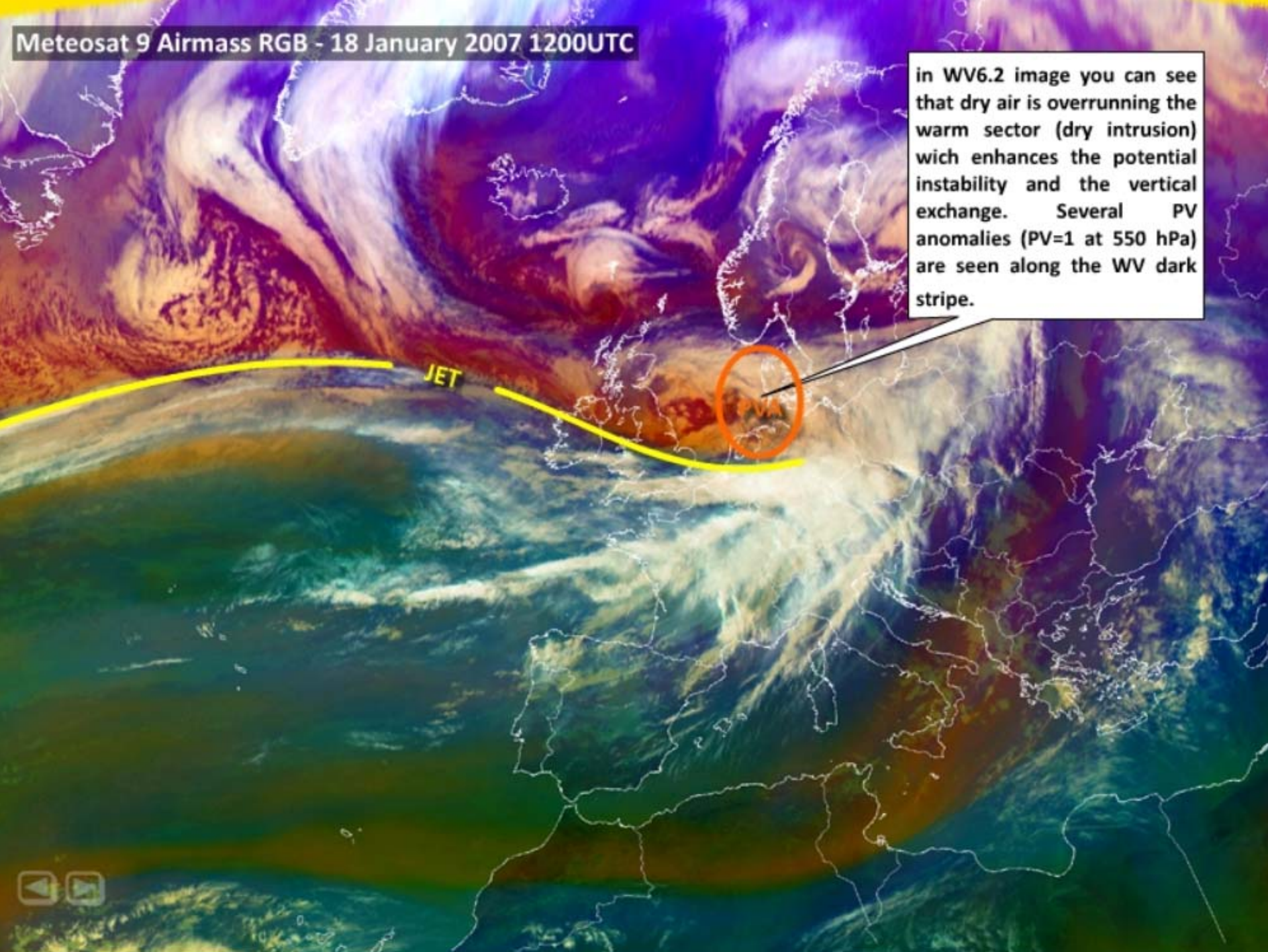


Meteosat 9 Airmass RGB - 18 January 2007 1200UTC

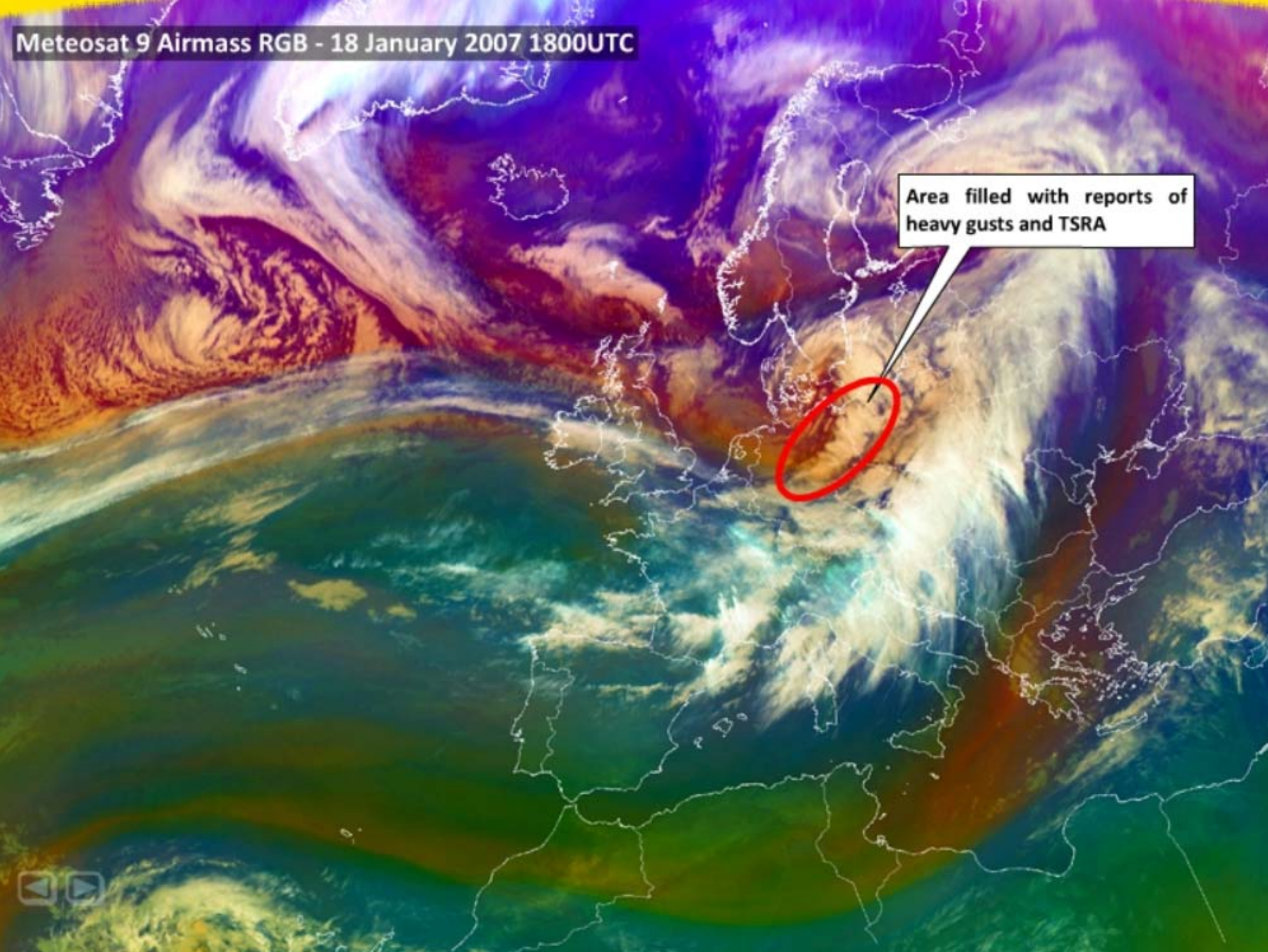


Meteosat 9 Airmass RGB - 18 January 2007 1200UTC

in WV6.2 image you can see that dry air is overrunning the warm sector (dry intrusion) which enhances the potential instability and the vertical exchange. Several PV anomalies ($PV=1$ at 550 hPa) are seen along the WV dark stripe.



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?

