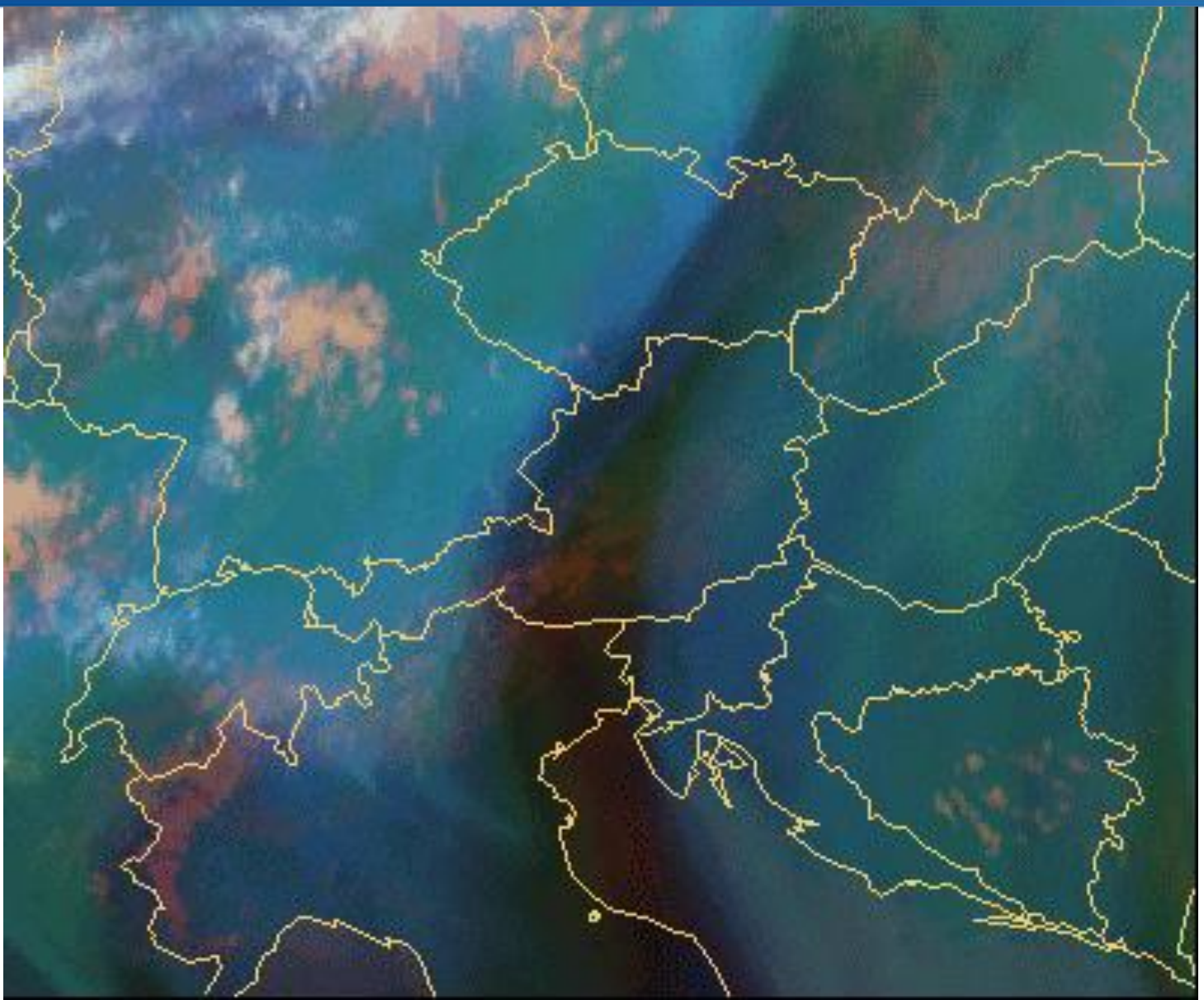
SYMMETRIC INSTABILITIES IN DMC INITIATION - FORECASTER POINT OF VIEW

Thomas Krennert
ZAMG – Central Institute for Meteorology and Geodynamics, Vienna, Austria
t.krennert@zamg.ac.at

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

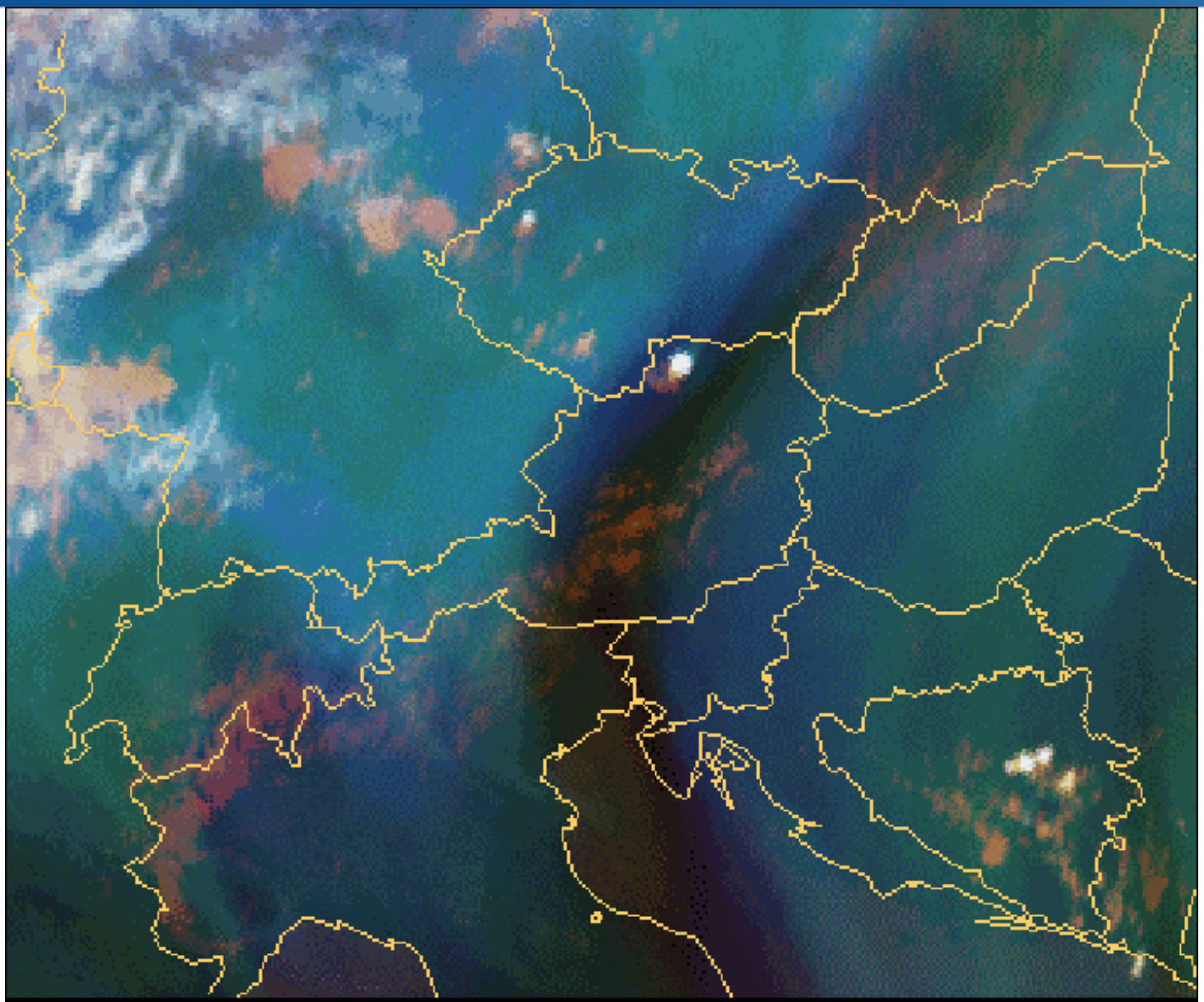
CASE STUDY: 28 July 2005, 1100 UTC, MSG RGB Image loop



R 8.7µ
G 7.3µ
B 6.2µ

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

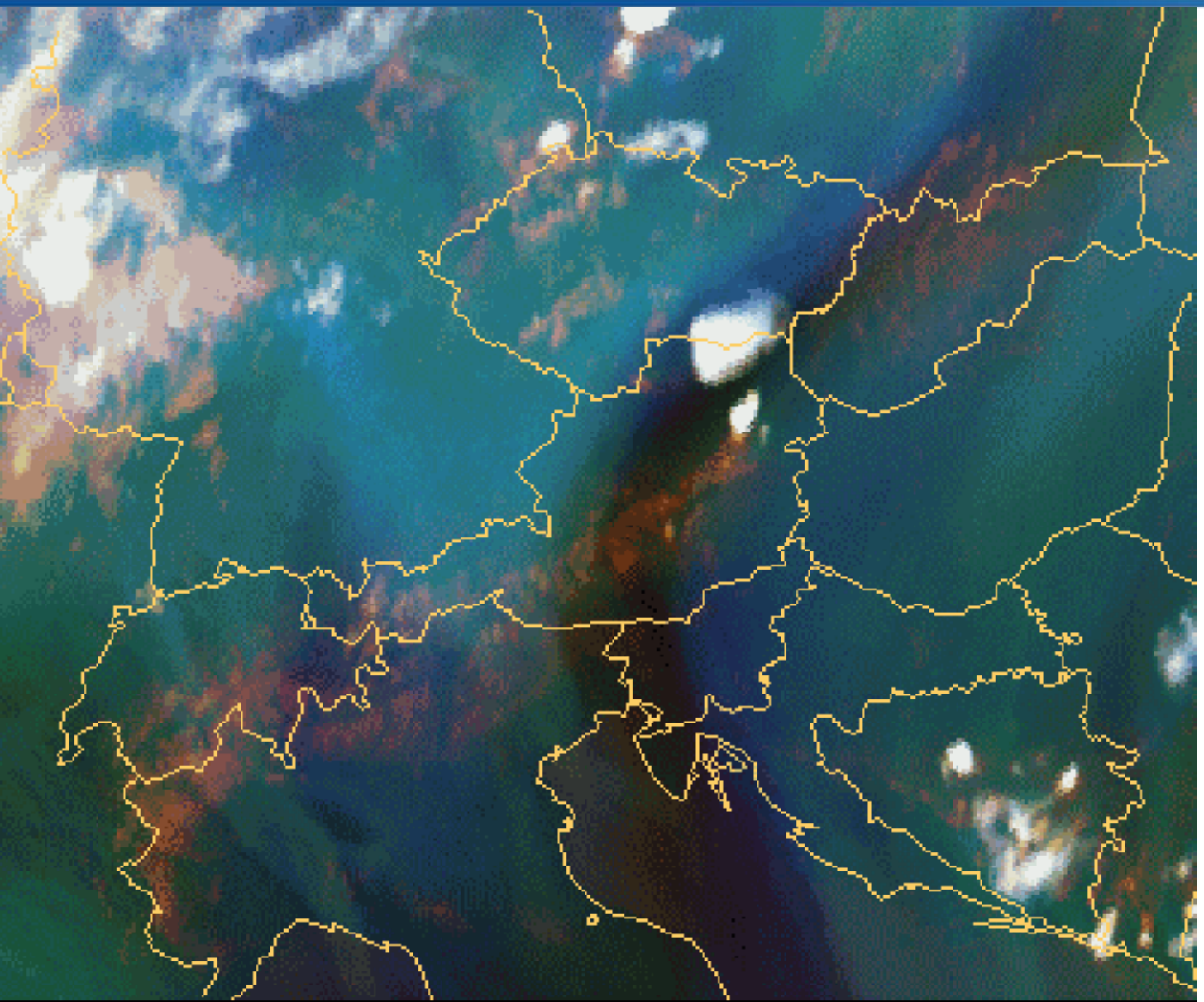
CASE STUDY: 28 July 2005, 1100 UTC, MSG RGB Image loop



R 8.7µ
G 7.3µ
B 6.2µ

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

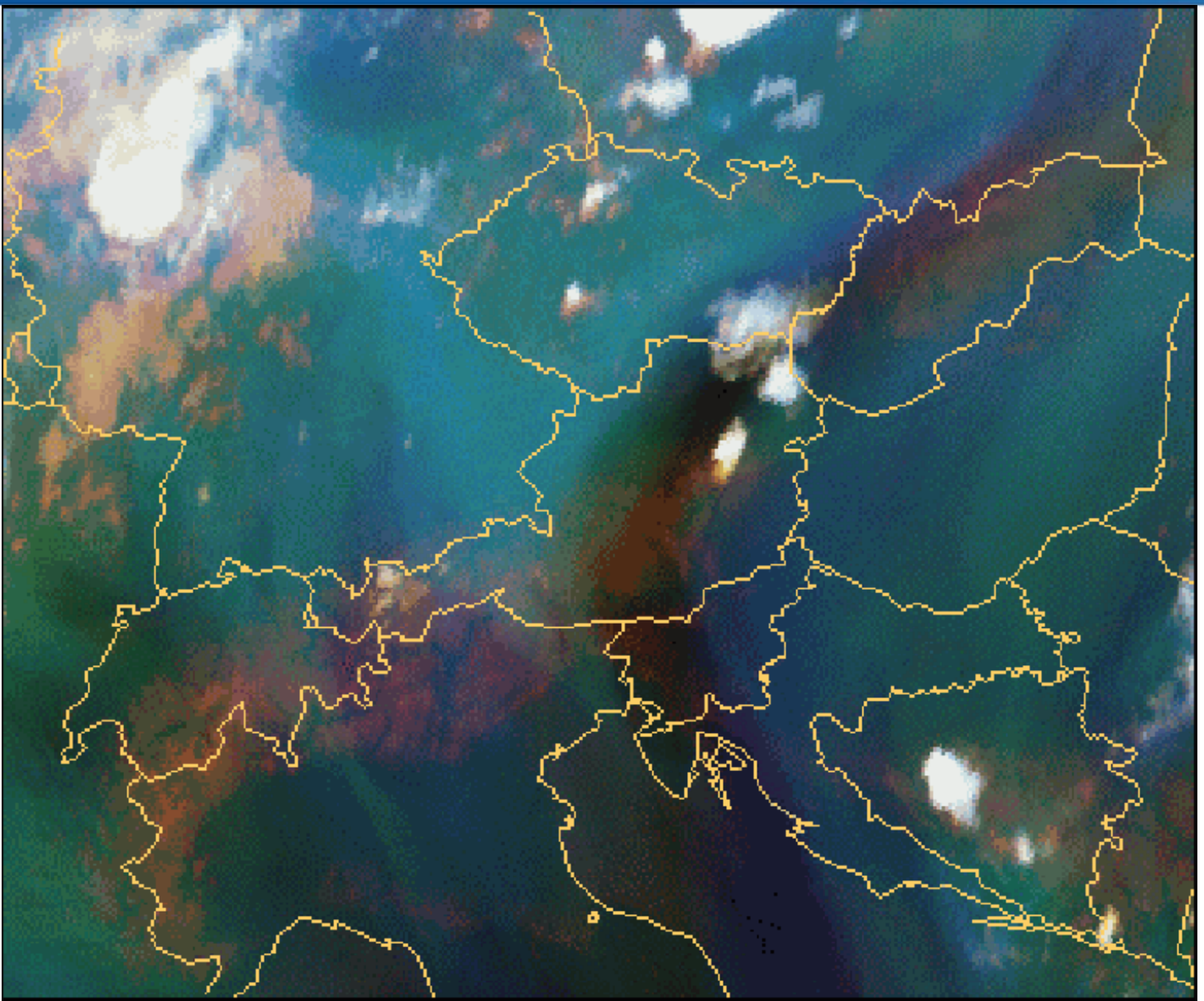
CASE STUDY: 28 July 2005, 1100 UTC, MSG RGB Image loop



R 8.7µ
G 7.3µ
B 6.2µ

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

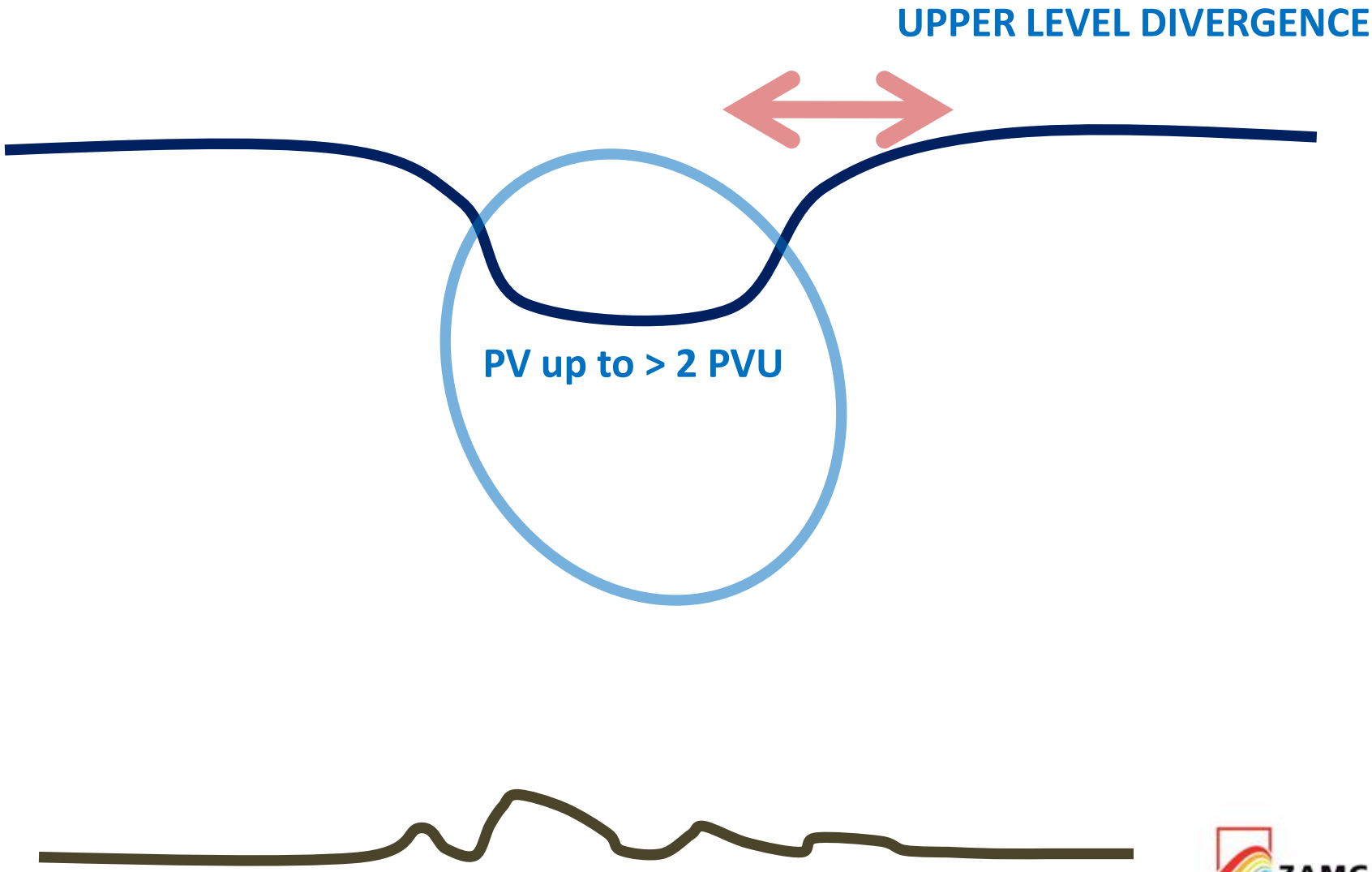
CASE STUDY: 28 July 2005, 1100 UTC, MSG RGB Image loop



R 8.7µ
G 7.3µ
B 6.2µ

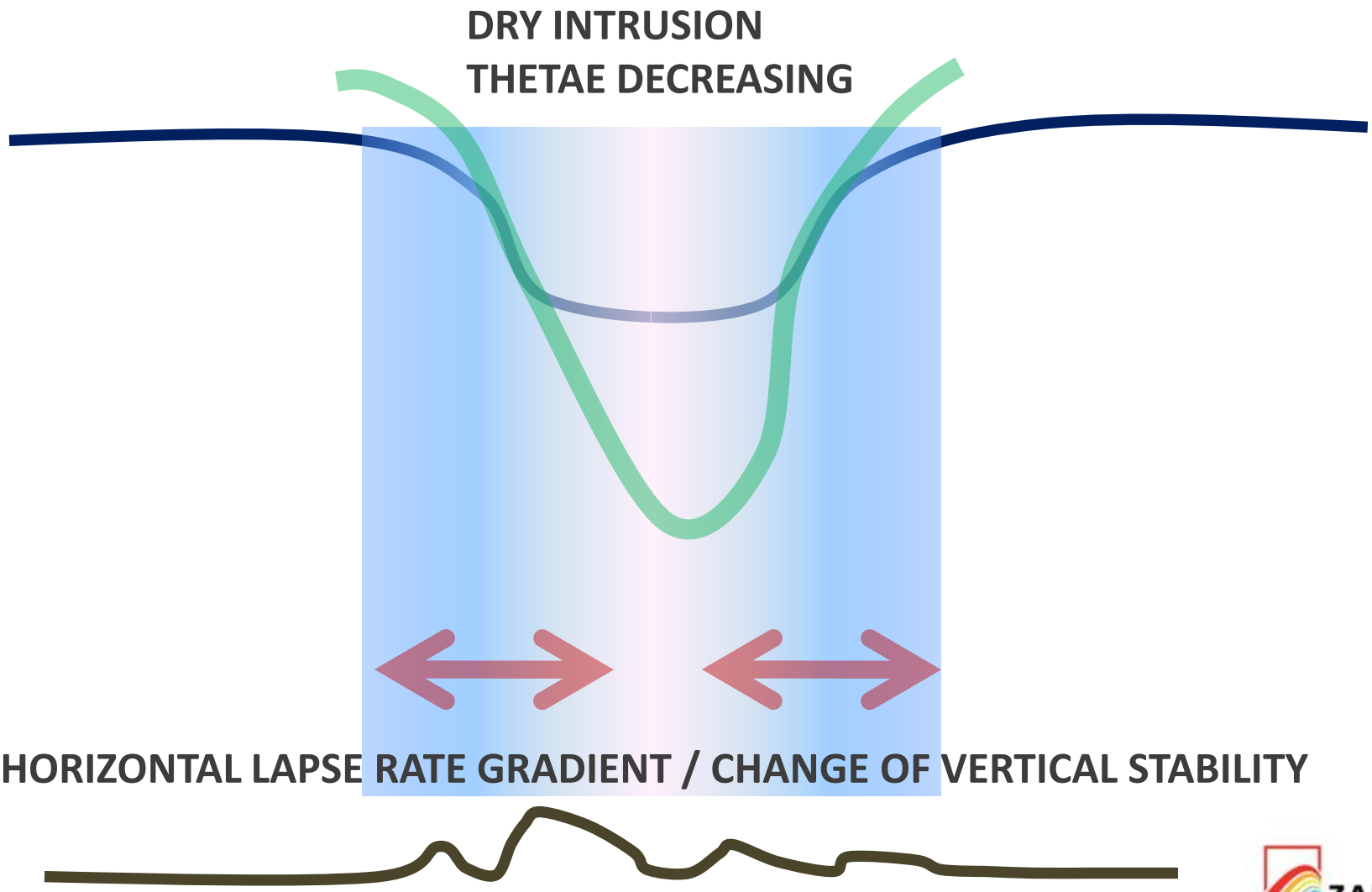
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

DMC @ ULMG – FAVOURABLE INGREDIENTS 1



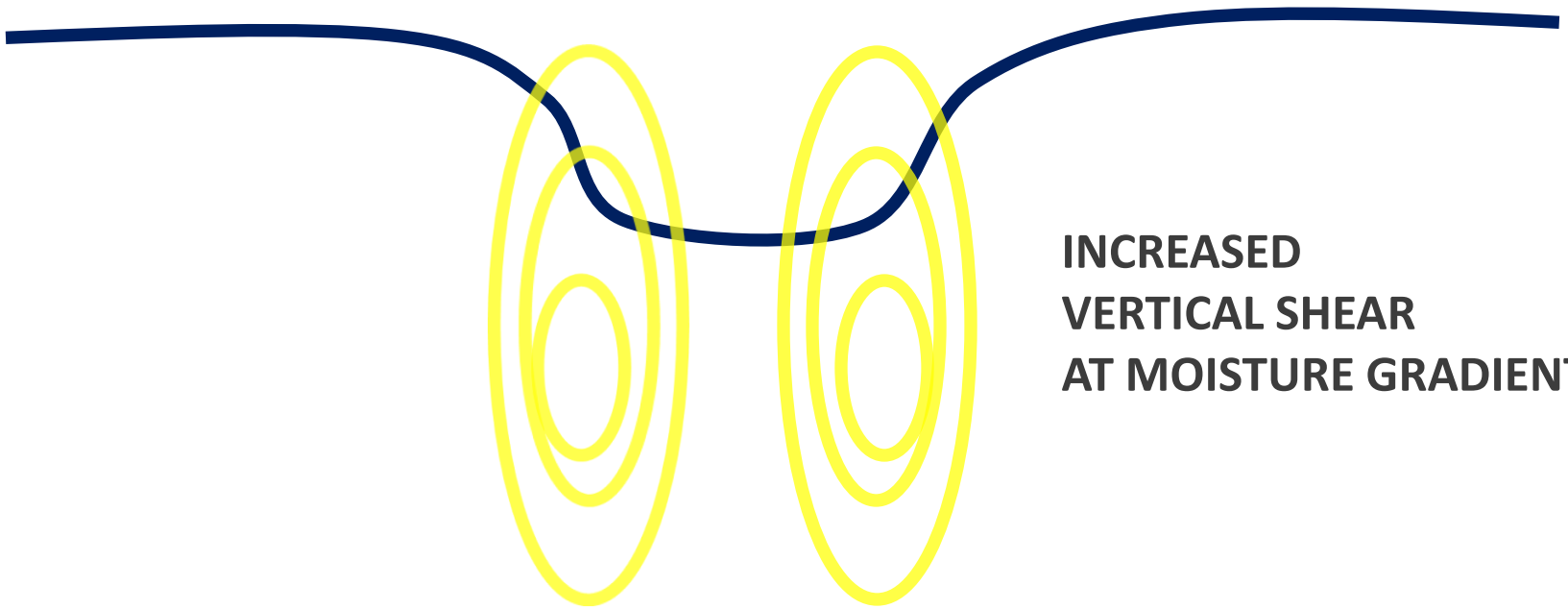
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

DMC @ ULMG – FAVOURABLE INGREDIENTS 2



ZAMG
Zentralanstalt für Meteorologie und Geodynamik

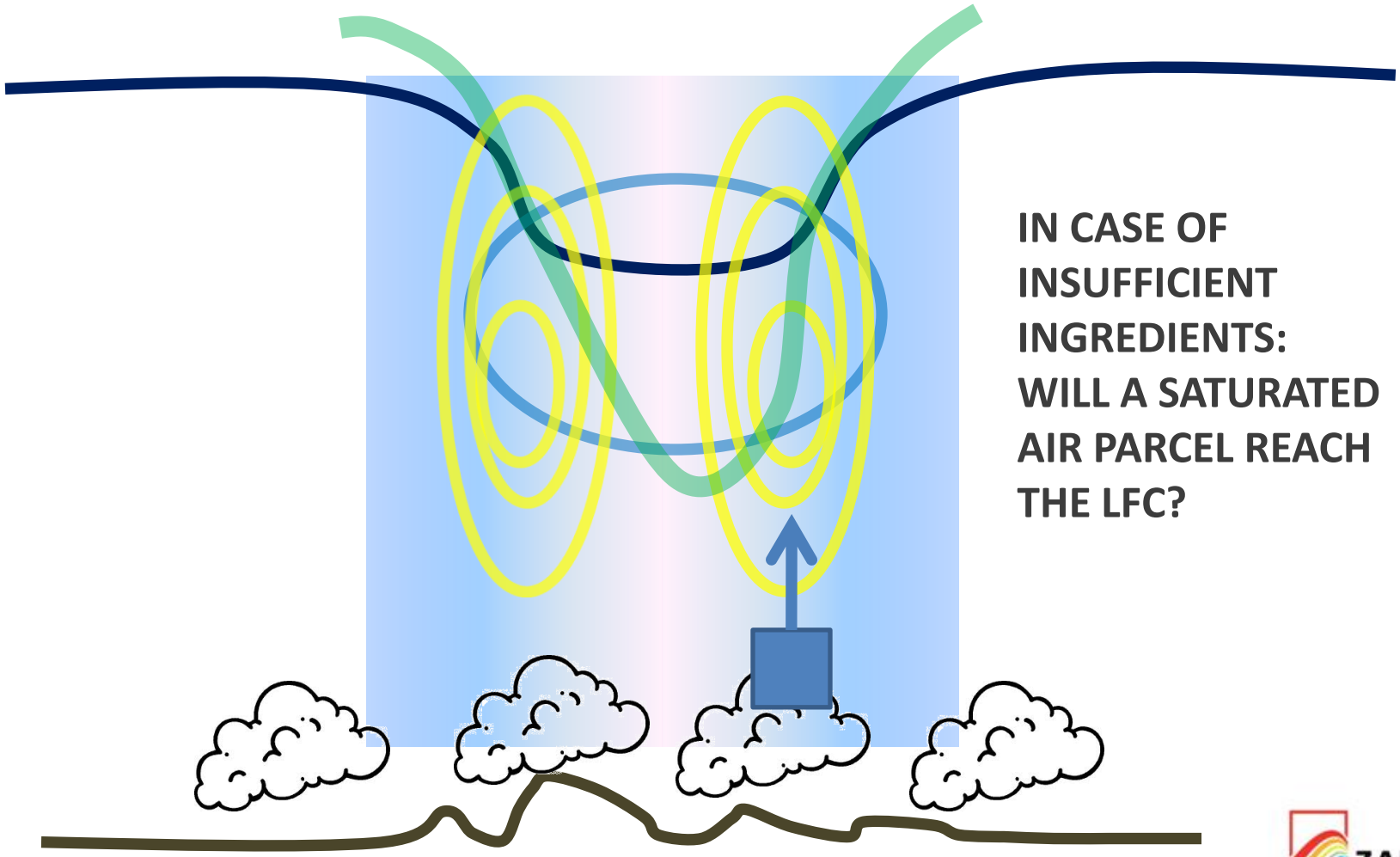
DMC @ ULMG – FAVOURABLE INGREDIENTS 3



INCREASED
VERTICAL SHEAR
AT MOISTURE GRADIENTS

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

DMC @ ULMG – FAVOURABLE INGREDIENTS



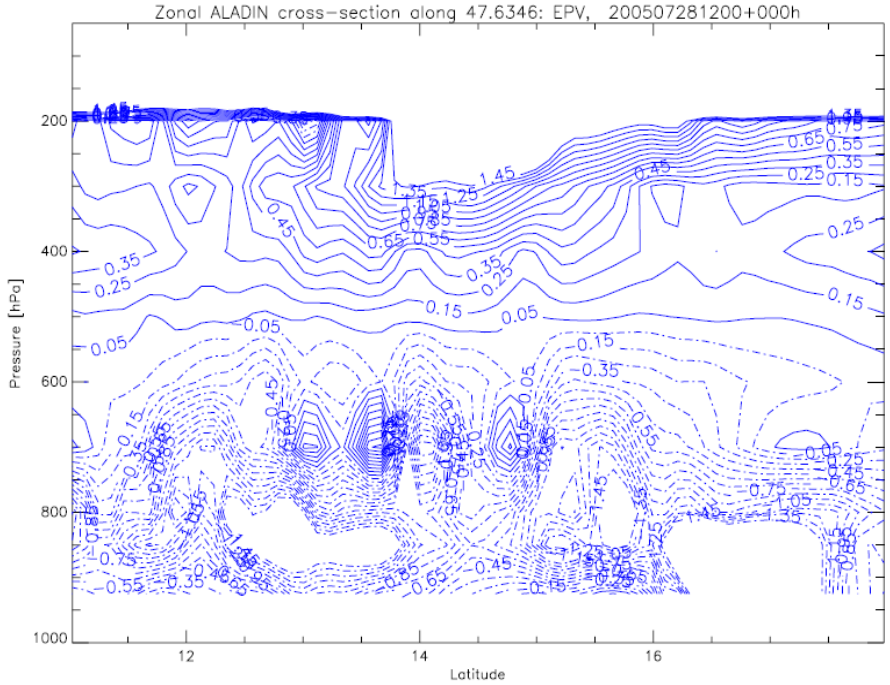
IN CASE OF INSUFFICIENT INGREDIENTS: WILL A SATURATED AIR PARCEL REACH THE LFC?

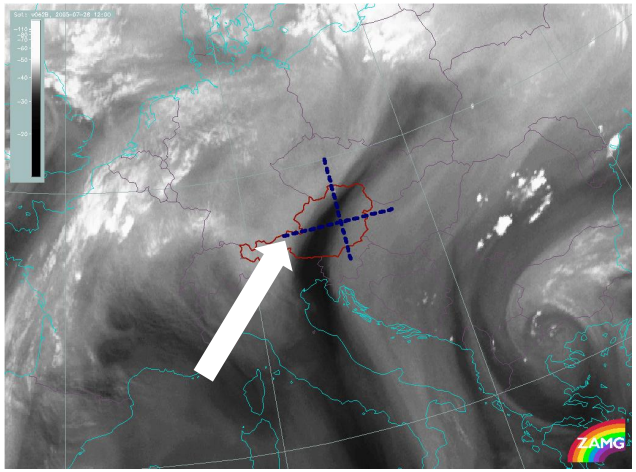
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

DMC @ ULMG – DISCUSSION

- Upper level ingredients will not cause DMC per se
- "Dry streaks" with cyclonic curvature and significant propagation will induce lift on a scale larger than MESO ("upper fronts", ULL, pre-frontal TS)
- Convective initiation within a high pressure environment depends on the formation of shallow clouds from elevated grounds
- Shallow, humid clouds will stay that way without further increase of lift or instability
- Counter indicators:
  - Capping inversion (summer morning, orography)
  - Insufficient ground moisture to reach LFC

DMC @ ULMG – THE MISSING LINK ?



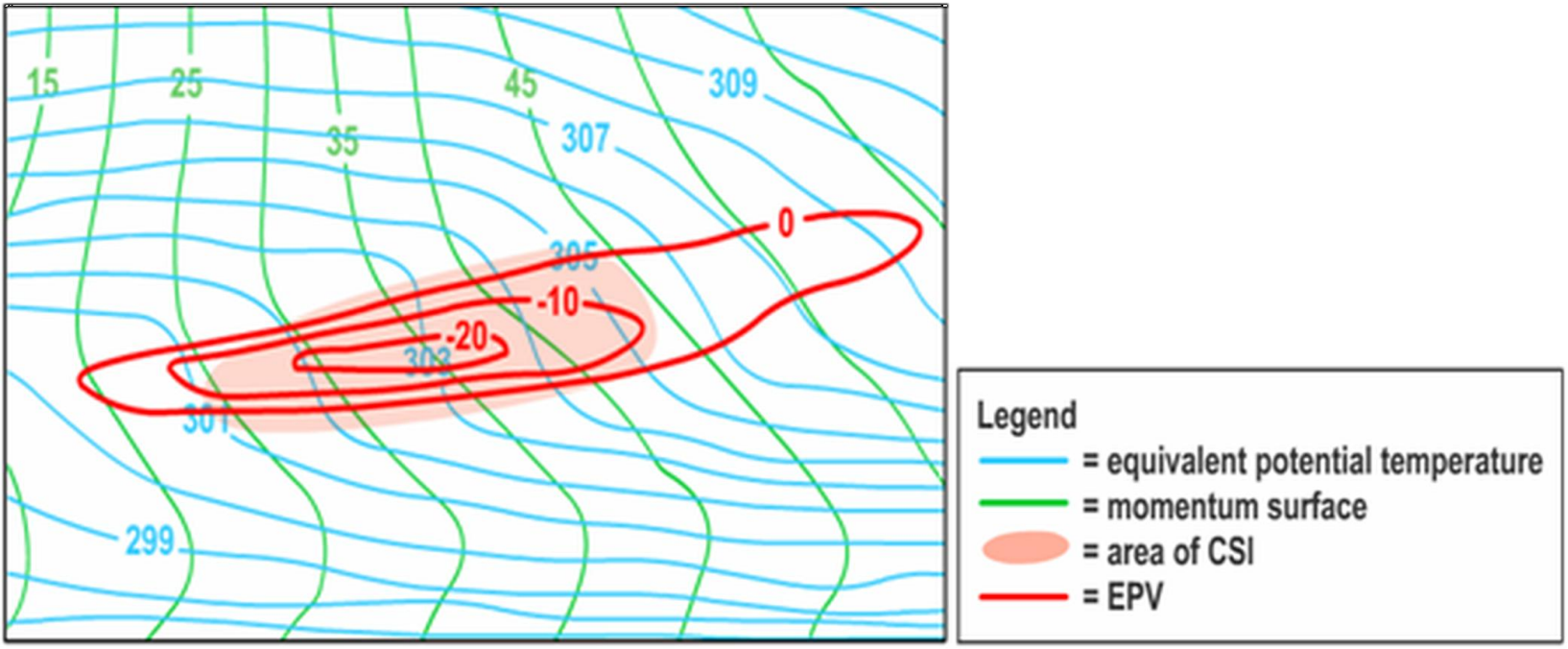


- Distinct pattern of negative Equivalent Potential Vorticity EPV up to 600 hPa
- EPV < 0 can be seen as an indicator for symmetric instabilities SI (Mc Cann, 1995; Hoskins, 1974)

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

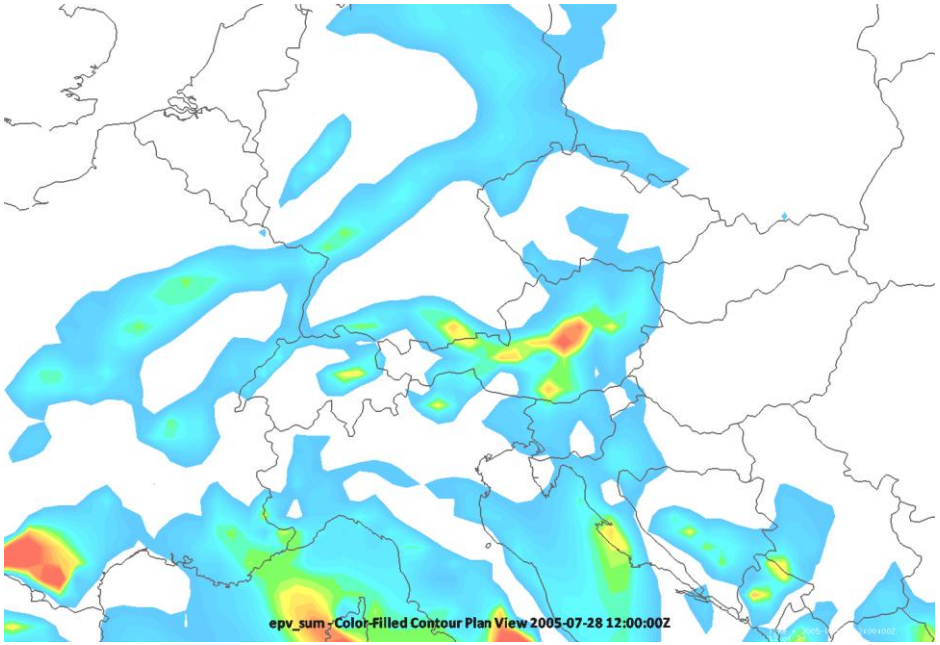
INDICATORS FOR SYMMETRIC INSTABILITIES – NEGATIVE EPV

- Convection can possess characteristics of slantwise convection, gravitational convection, or both (Schultz and Schumacher, 1999; Fantini et al., 2011)
- Coexistence of: CSI/PSI, CI/PI, adequate moisture / lift
- Limitations: identifying regions with PVg / EPVg and slantwise convection might also indicate PI / CI and gravitational convection

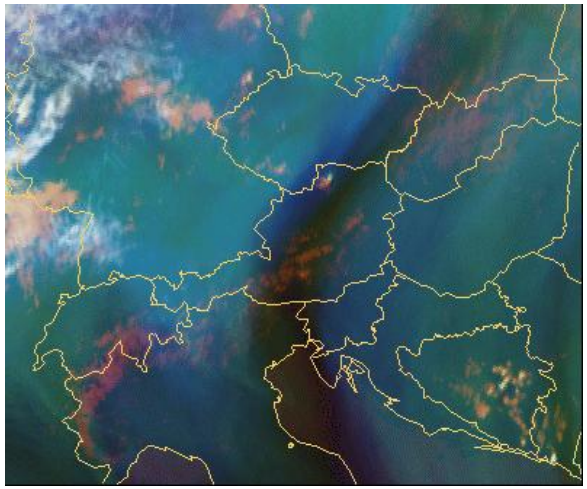


ZAMG
Zentralanstalt für Meteorologie und Geodynamik

INDICATORS FOR SYMMETRIC INSTABILITIES – NEGATIVE EPV



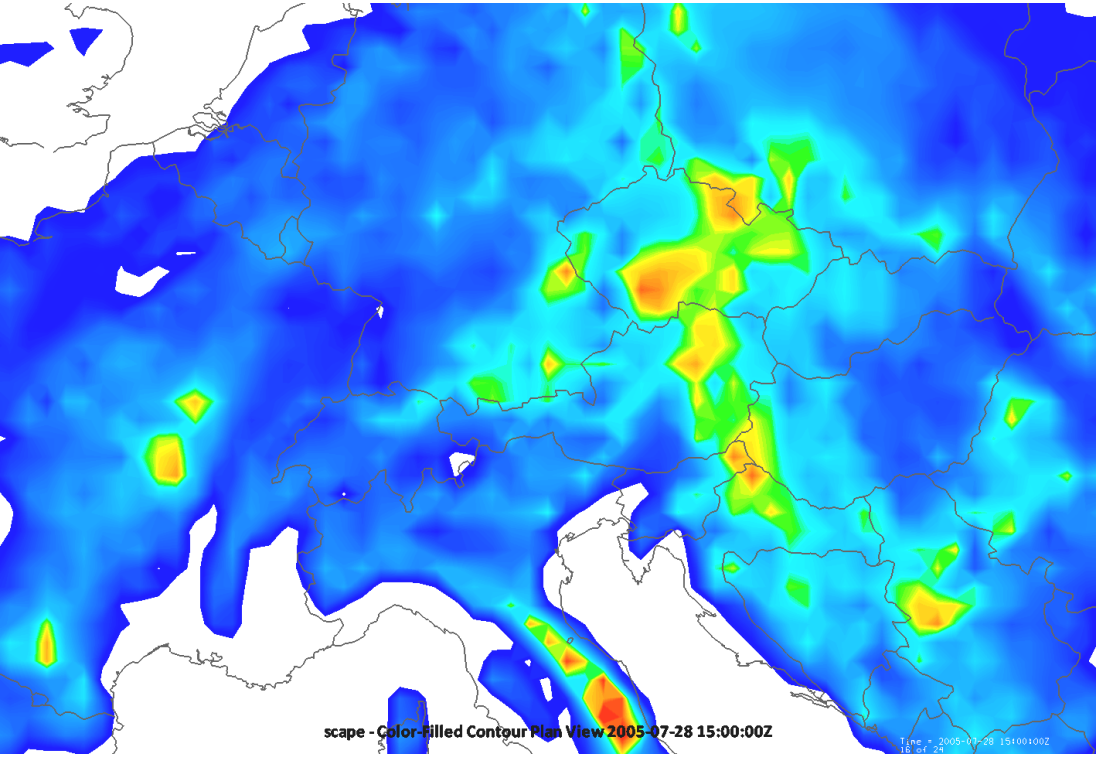
28 July 2005, 1200 UTC,
NEGATIVE Eqivalent Potential Vorticity, EPV
[|-5| (blue) to |-30| (red)10^{-6} K*m^2/kg*sec],
850 – 500 hPa,
WRF-model



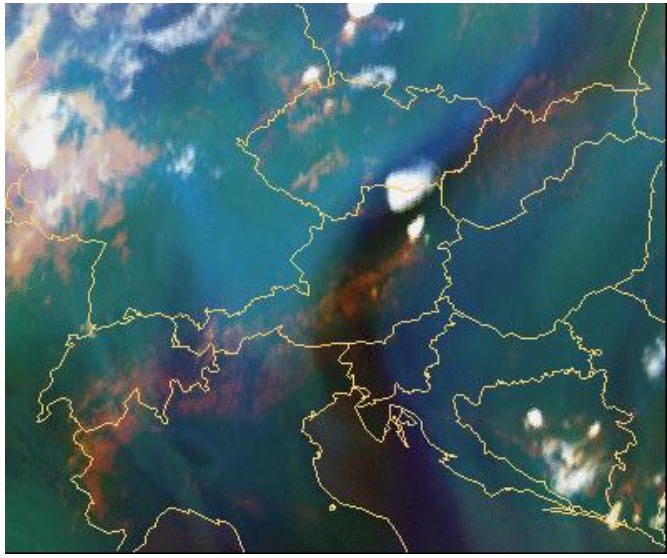
- **Saturated buoyant air parcel reaches a zone of distinct negative EPVg**
- **A possible release of SI leading to slantwise convection supports convective lift (cms-1)?**
- **Provides sufficient lift for the air parcel to reach LFC?**

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

INDICATORS FOR SYMMETRIC INSTABILITIES – SCAPE



28 July 2005, 1200 UTC
Symmetric Available Potential Energy, SCAPE above 950 hPa, (Dixon, 2000)
500 (blue) to 3000 (red) J/kg
WRF-model

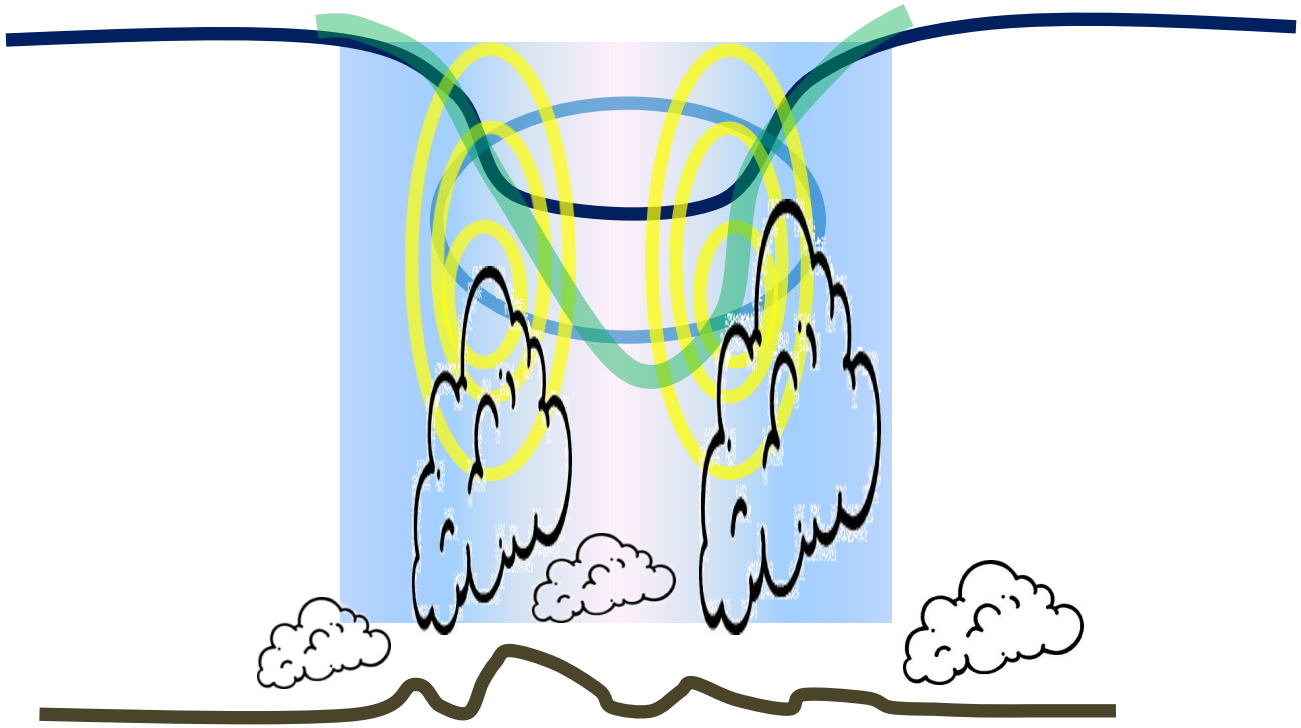


Symmetric Available Potential Energy SCAPE

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

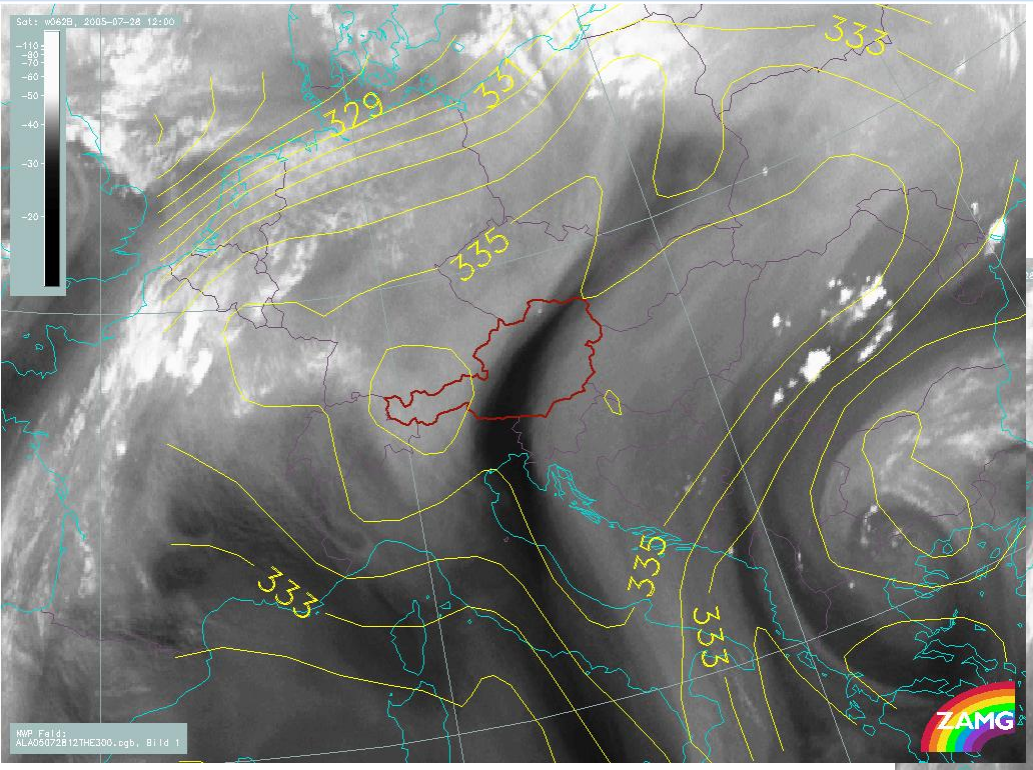
DMC @ ULMG – OPERATIONALLY APPLICABLE ?

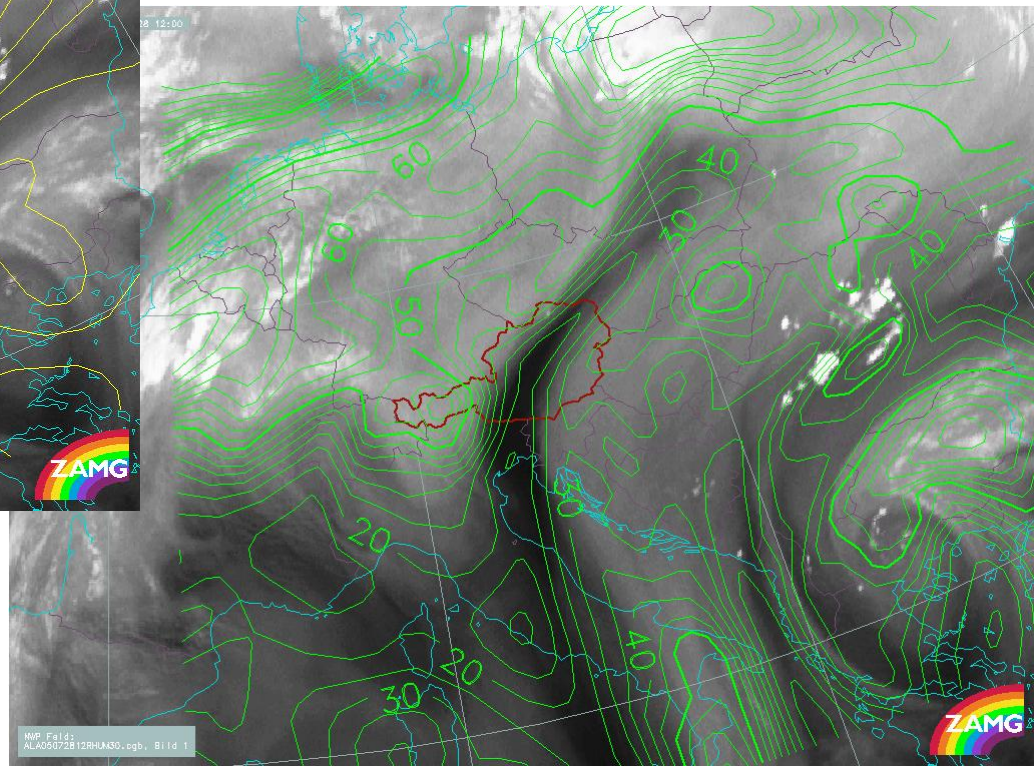
- First efforts for operational usage at ZAMG – higher probability for DMC ?
  - Mid-tropospheric SCAPE / EPV<0 as indicators for additional lift - > LFC
  - RGB Loops for NOWCAST purposes
- Providing additional information in connection to orographically induced “fair weather” pulse convection



ZAMG
Zentralanstalt für Meteorologie und Geodynamik

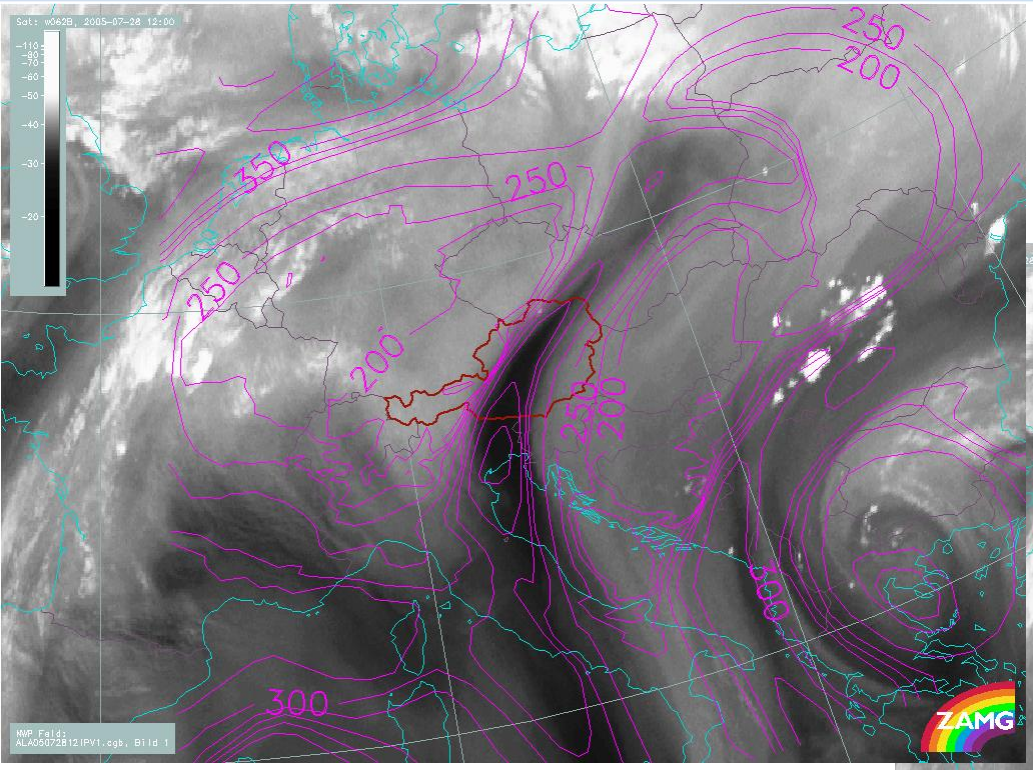
APPENDIX 1: THETA E & RELHUM at 300 hPA

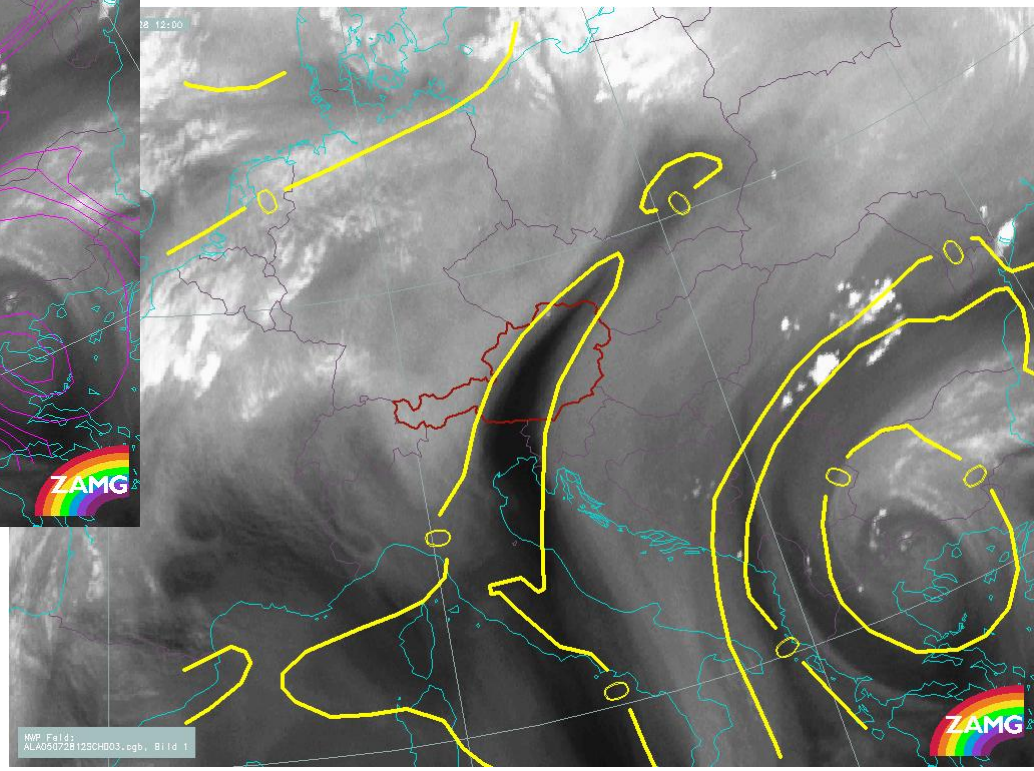




ZAMG
Zentralanstalt für Meteorologie und Geodynamik

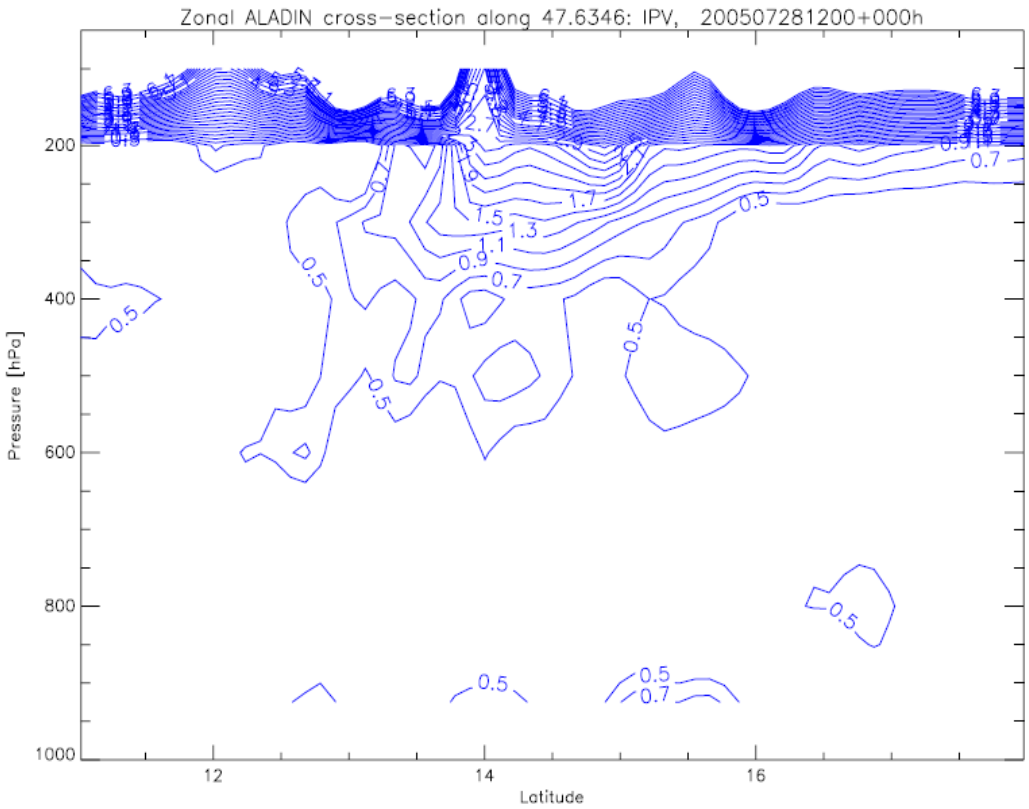
APPENDIX 2: Isophlets 1,5 PVU / Level; SV=0 Jet indicator at 300 hPA

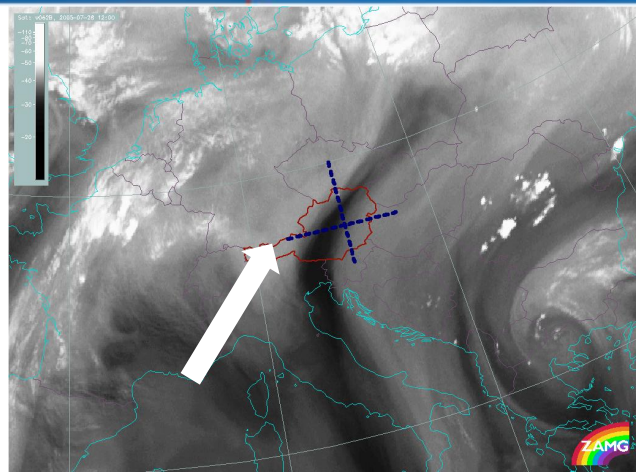




ZAMG
Zentralanstalt für Meteorologie und Geodynamik

APPENDIX 3: VERTICAL CROSS SECTION ISOPHLETS





ZAMG
Zentralanstalt für Meteorologie und Geodynamik