



---

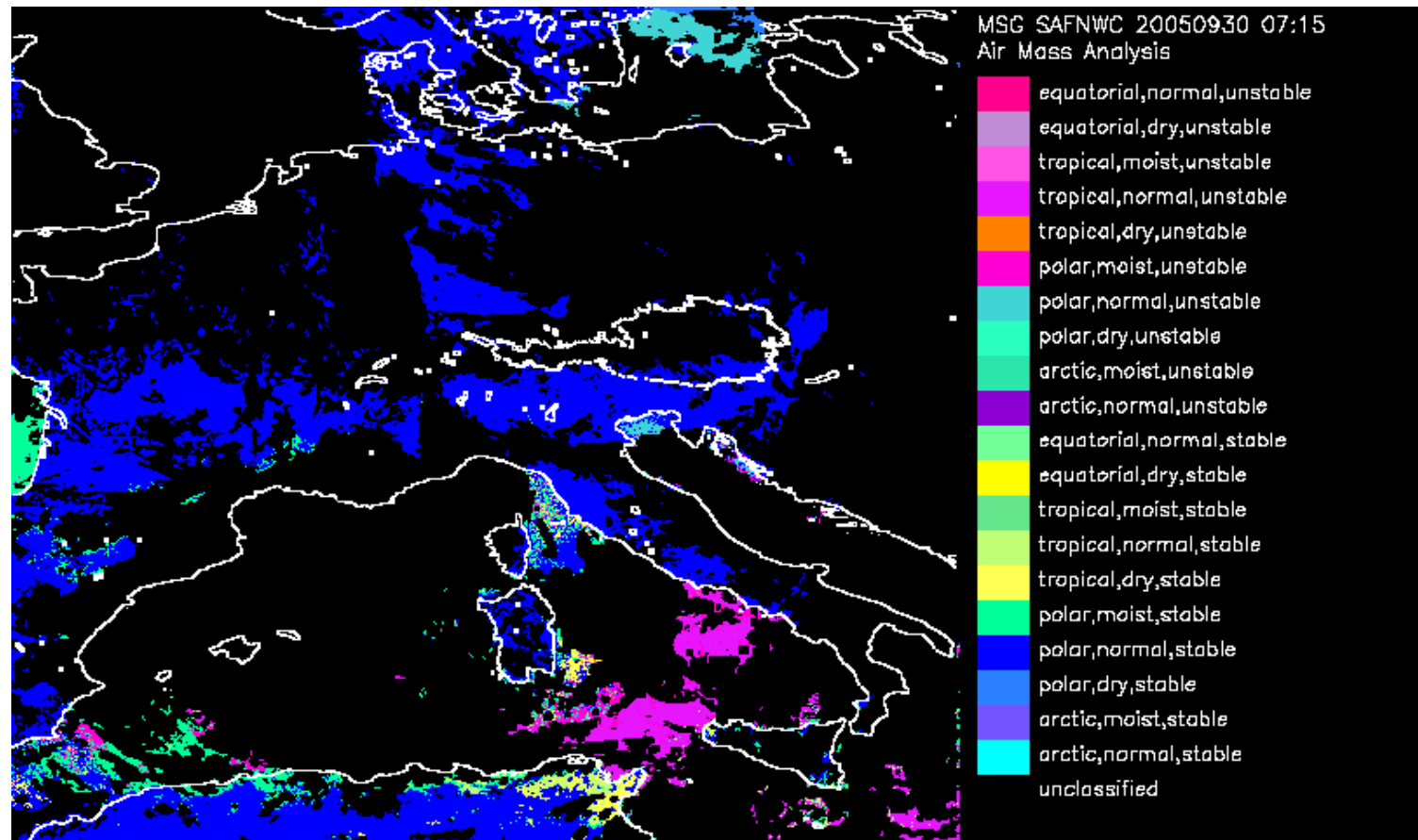
# Validation and tuning of PGE 12 – Air Mass Analysis

**Alexander Jann  
ZAMG Vienna, AUSTRIA**

**PAR Workshop, 17 – 19 October 2005, Madrid**

---

# Air mass classification product



# Air mass classification product

---

- **The key problem of the validation: “There is no unique or optimal way for classifying air masses or weather types” (Bejarán and Camilloni, TAC, 74, 93-103)**
- **Not only is there a multitude of methodologies, but also no consensus on classes (#: 4 – 19)**

# Air mass classification product

---

## Constraints on the selection of the AMC method:

- **MSG-based (which basically eliminates all trajectory-type methods naming air masses after their point of origin)**
- **Large-scale European (approaches based e.g. on cluster analyses with validity of results for just a town cannot be reasonably envisioned)**
- **Selected since apparently the most readily implementable: Temperature – TPW threshold decision trees following Baum et. al (1997, JAM, 1519-1540)**

# One and only general rule (consensus?)

---

- **"The only foundation is that significantly different air masses should not be designated equally and air masses without a significant difference should not be designated with different namings". (Geb, 1981, Meteorologische Abhandlungen, Institut für Meteorologie der Freien Universität Berlin, Serie B, Band 31, Heft 4, SO 7/81.)**
- **Significantly different air mass? We can be certain about that at fronts!**

# Slight modification in moisture thresholds

---

***Air mass type - Precipitable water (cm), used literature:***

- ***Equatorial: > 6***
- ***Tropical: between 3 and 6***
- ***Polar: between 1 and 3***
- ***Arctic: < 1***

**A classification was considered acceptable when the air masses on the two sides of a front differed in either of the parameters temperature or moisture → slight adaptation of the TPW thresholds:**

- ***Equatorial: > 6***
- ***Tropical: between 2.5 and 6***
- ***Polar: between 0.8 and 2.5***
- ***Arctic: < 0.8***

# Temperature issue

---

- **Surface temperature turned out to be no good air mass descriptor... (but is the primary variable in AMA)**
- **(As so many other MSG products) jumps at coastlines as permanent feature**
- **Diurnal changes in classification not in agreement with air mass notion**
- **Even though there is no absolute reference classification it is possible to predict that tuning of temperature thresholds will not resolve the problem → inspection of alternative concepts**

# Envisaged alternative parameters

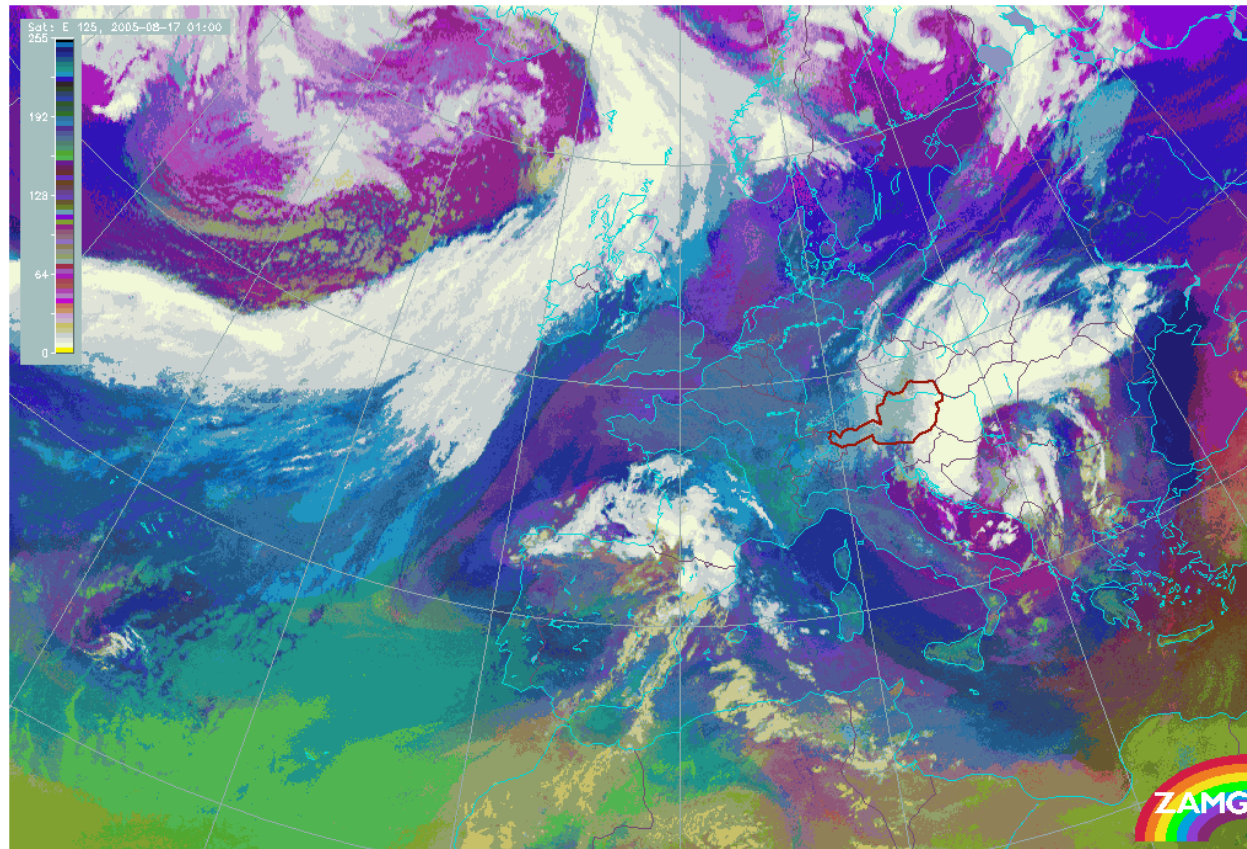
---

- **Vertically integrated/averaged temperature: Tropopause height / ozone content**
- **Air-mass RGB:**
  - **Red component: channel 5 - channel 6;**
  - **Green component: channel 8 – channel 9 (most interesting one for separating warm from cold air masses)**
  - **Blue component: channel 5[inverted]**



# Air mass - RGB

---

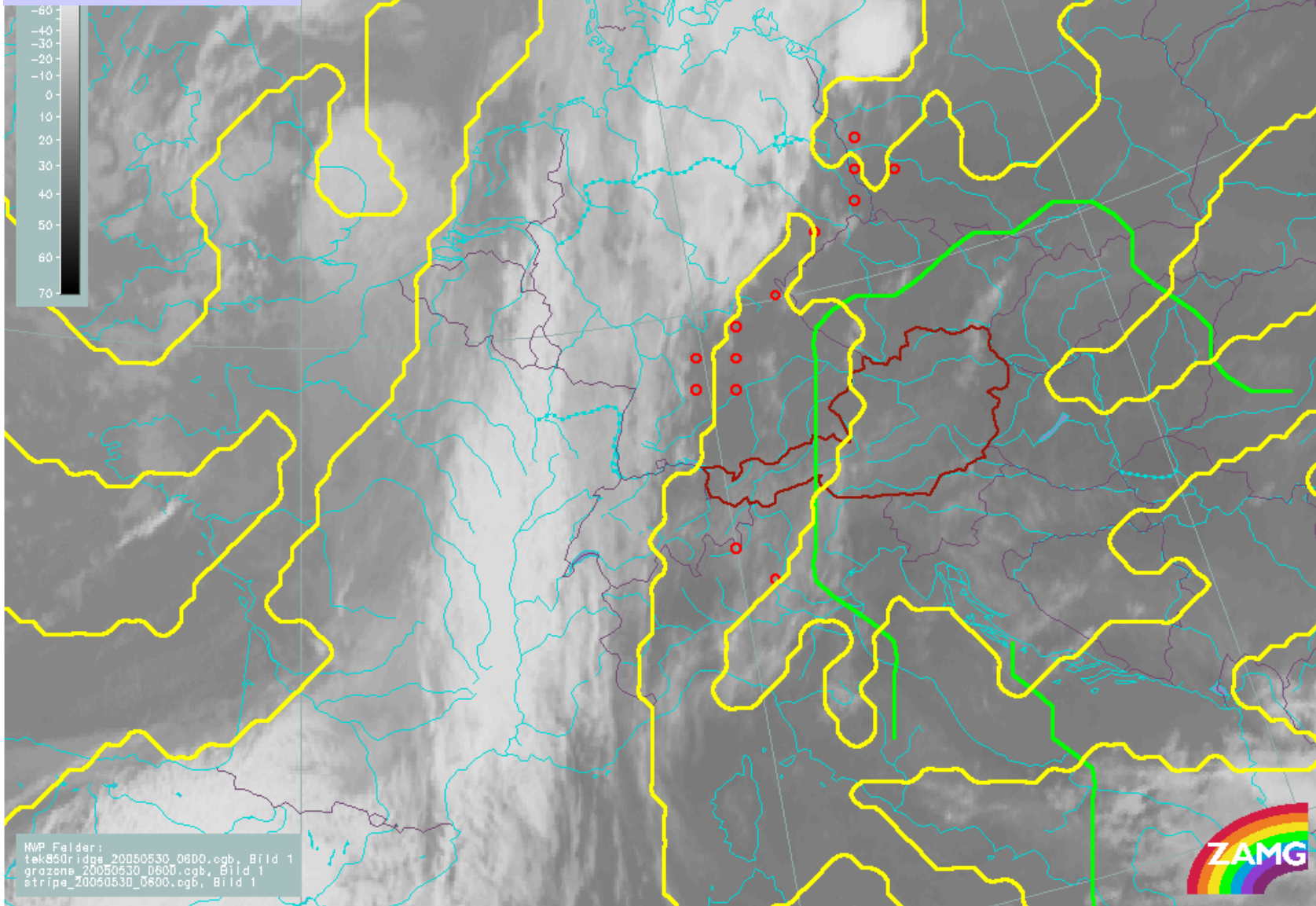


# BUFR products

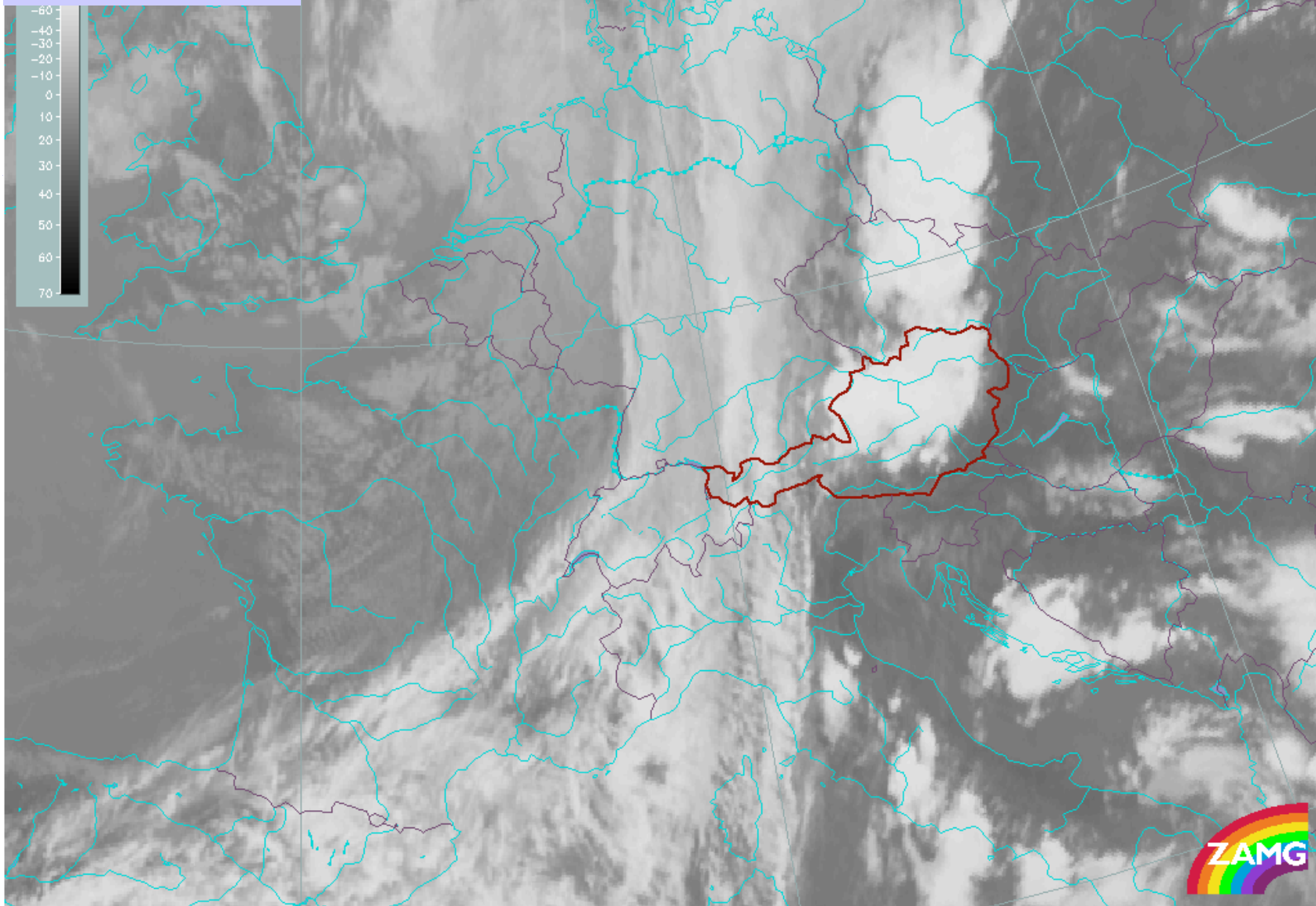
---

- **Dark stripes in WV (ch.5) imagery**
- **Ridge lines of equivalent-potential temperature (purely NWP-based)**
- **Pre-frontal temperature gradient zones (much NWP, some IR 10.8 influence)**

06:00 UTC



16:00 UTC



# Validation and tuning?

---

- **Generally, these are patterns (!) whose connection to triggering of convection is proven – yet without a stringent “if....then...”-relationship....**
- **Hence, objective validation of the type “pattern! → convection?” will yield enormous false alarm rates...**
- **...not reflecting the usefulness to forecasters who have learned to handle such information.**
- **But then...what remains for validation and tuning?**



# Validation and tuning!

---

- **Verify / improve objective recognition through comparison with subjective analyses of patterns, consideration of temporal continuity**
  - ✓ To a large degree work of the development phase – behind us!
- **Validate the completeness of the product catalogue**
  - ✓ Done in 2005. Approach: 1) convection! → pattern? 2) If not, what could be the missing complement?

# Process

---

- **Case studies during warm season of 2005**
- **Selected on the basis of SYNOP reports of thunderstorm activity**
- **Consideration of the AMA BUFR products + stability information some hours before convection took place**
- **If no explanation was found, submission to a second analyst for thorough synoptic evaluation (2 out of 40)**

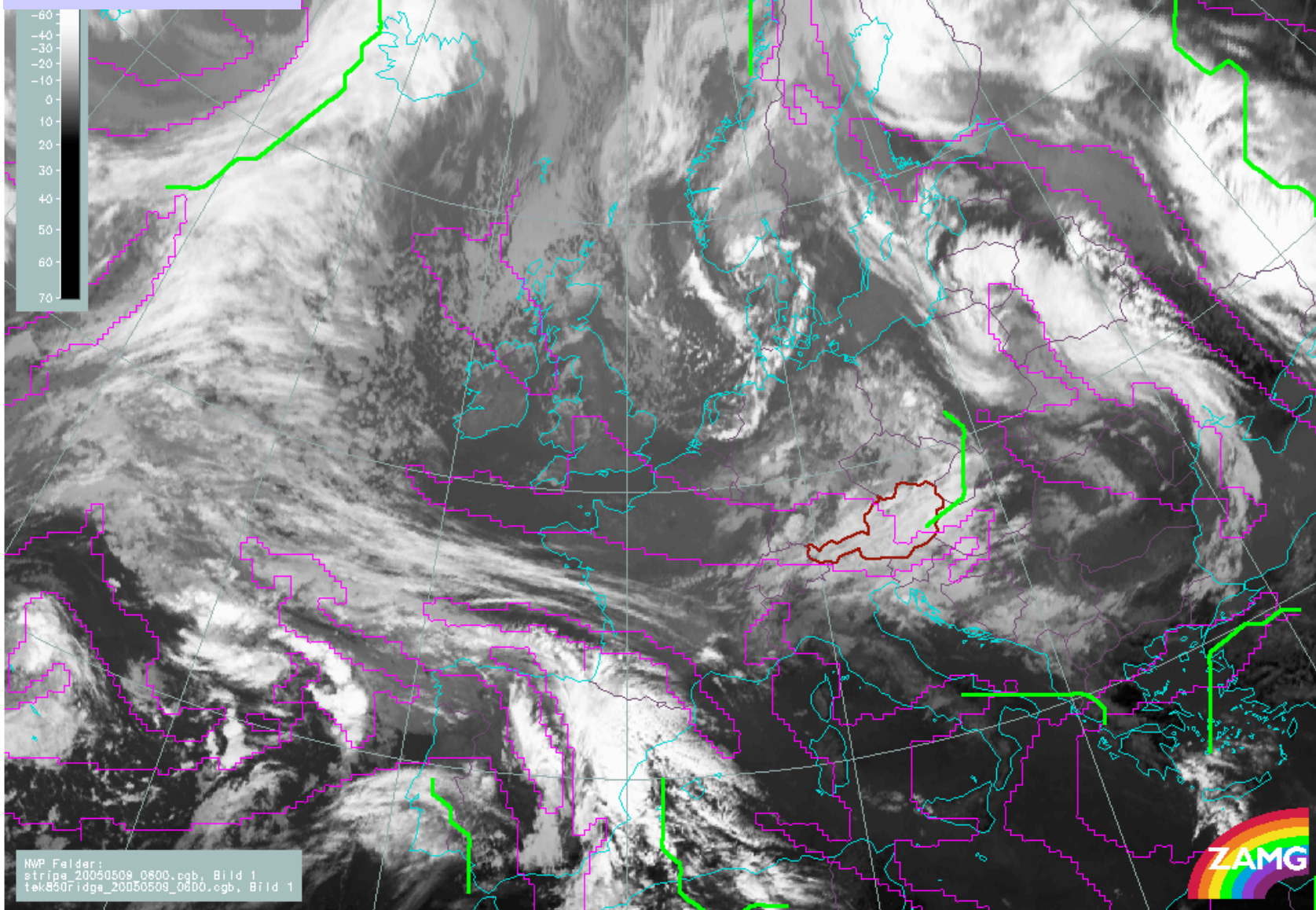
# The „unusual“ case(s)

---

- **Similar situation on two consecutive days (9 -10 May 2005):**
- **Pool of cold air (no ridge lines)**
- **Abundant moisture (no WV stripes)**
- **Diurnal cycle of cloud formation and decay over land**
- **Unstable according to ECMWF, but difficult to catch that fact from MSG (cloud cover → no SAI and no clear alternative air mass quantity imaginable)**
- **Only loops (history, a couple of cloud free slots) as remedy (?)**



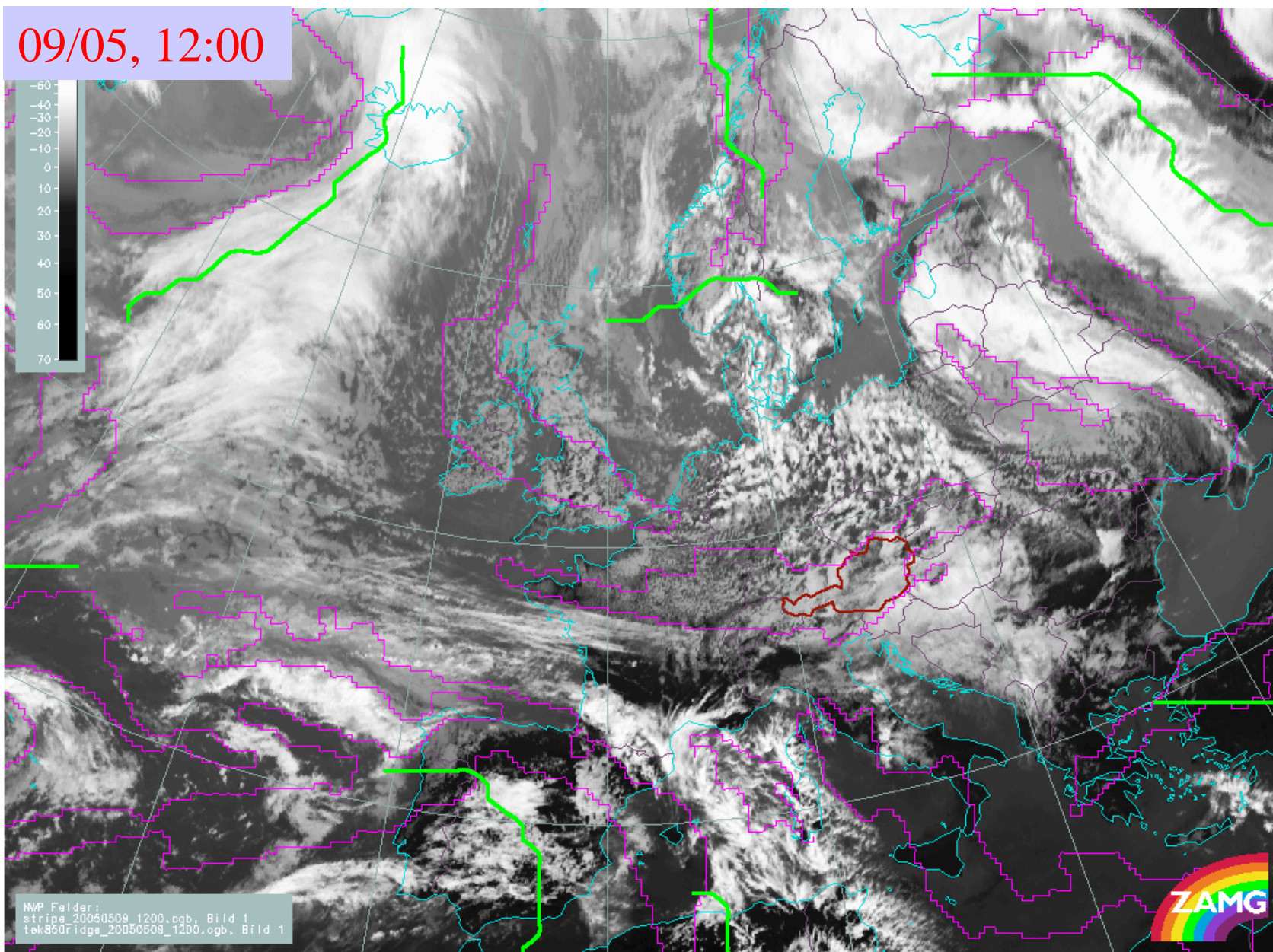
09/05, 06:00



NWP Falder:  
striga\_20050509\_0600.egb, Bild 1  
tek850ridge\_20050509\_0600.egb, Bild 1



09/05, 12:00

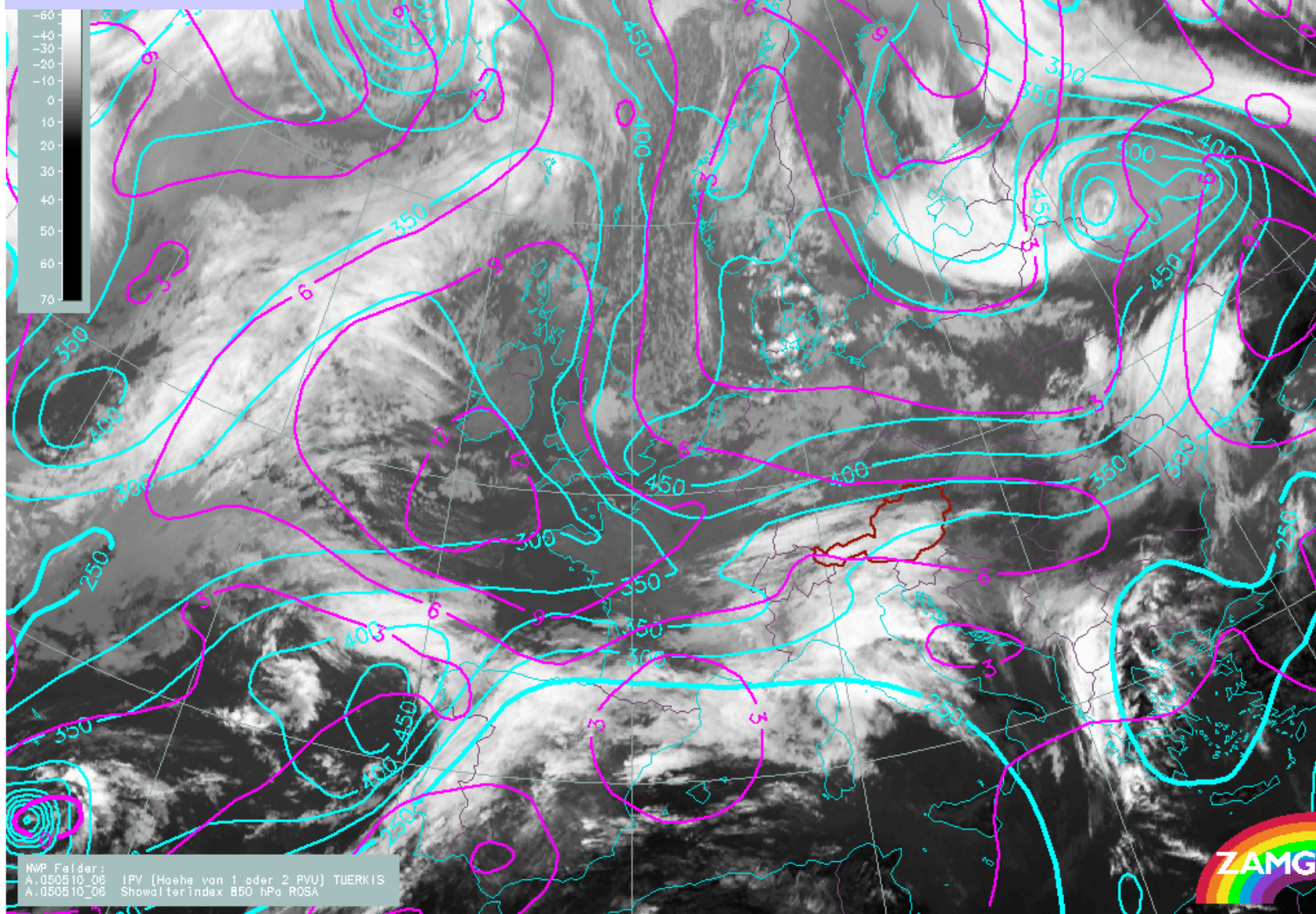


NWP Falder:  
striga\_20050509\_1200.egb, Bild 1  
fek850ridge\_20050509\_1200.egb, Bild 1



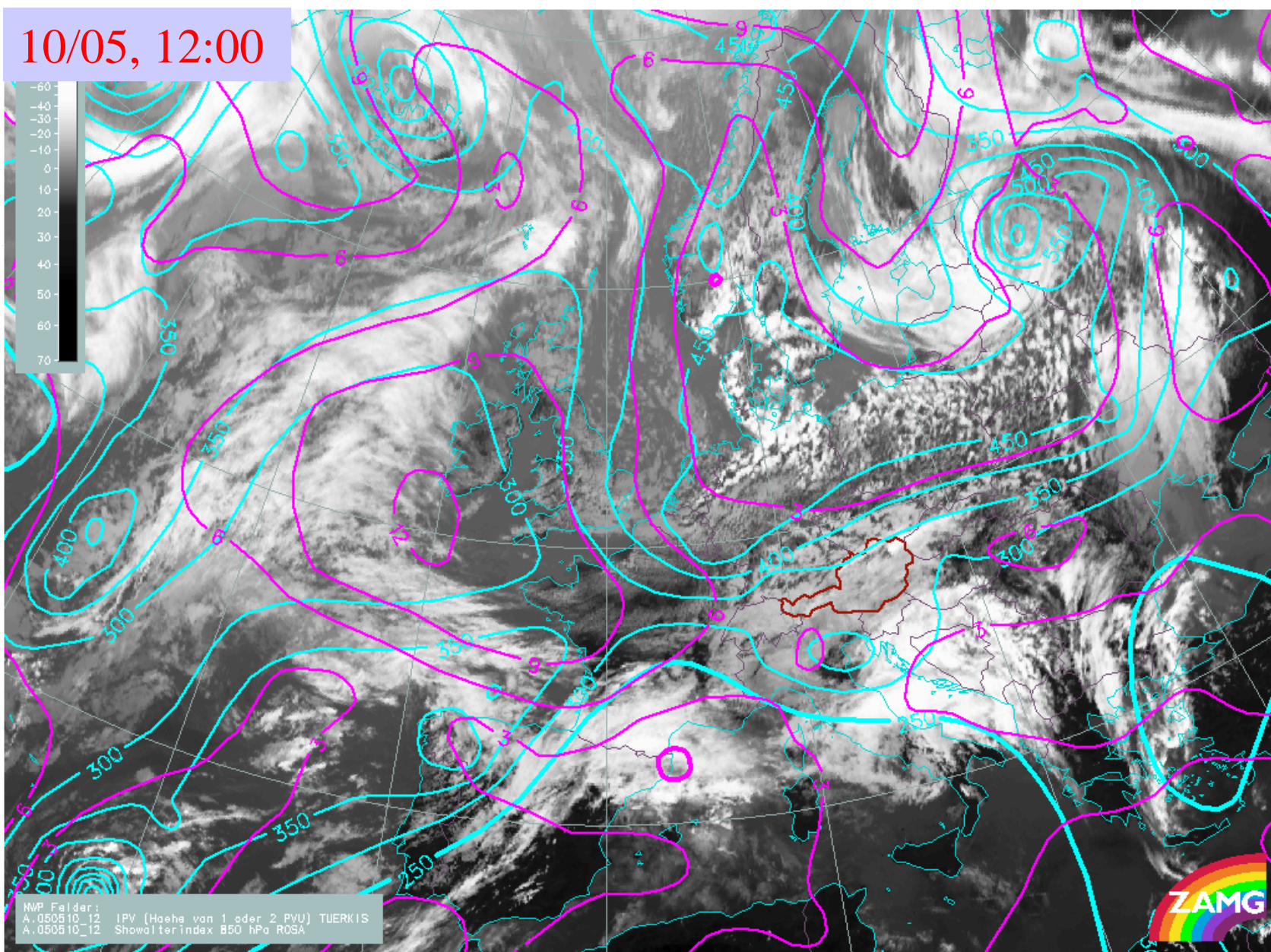


10/05, 06:00





10/05, 12:00



# Lessons learned

---

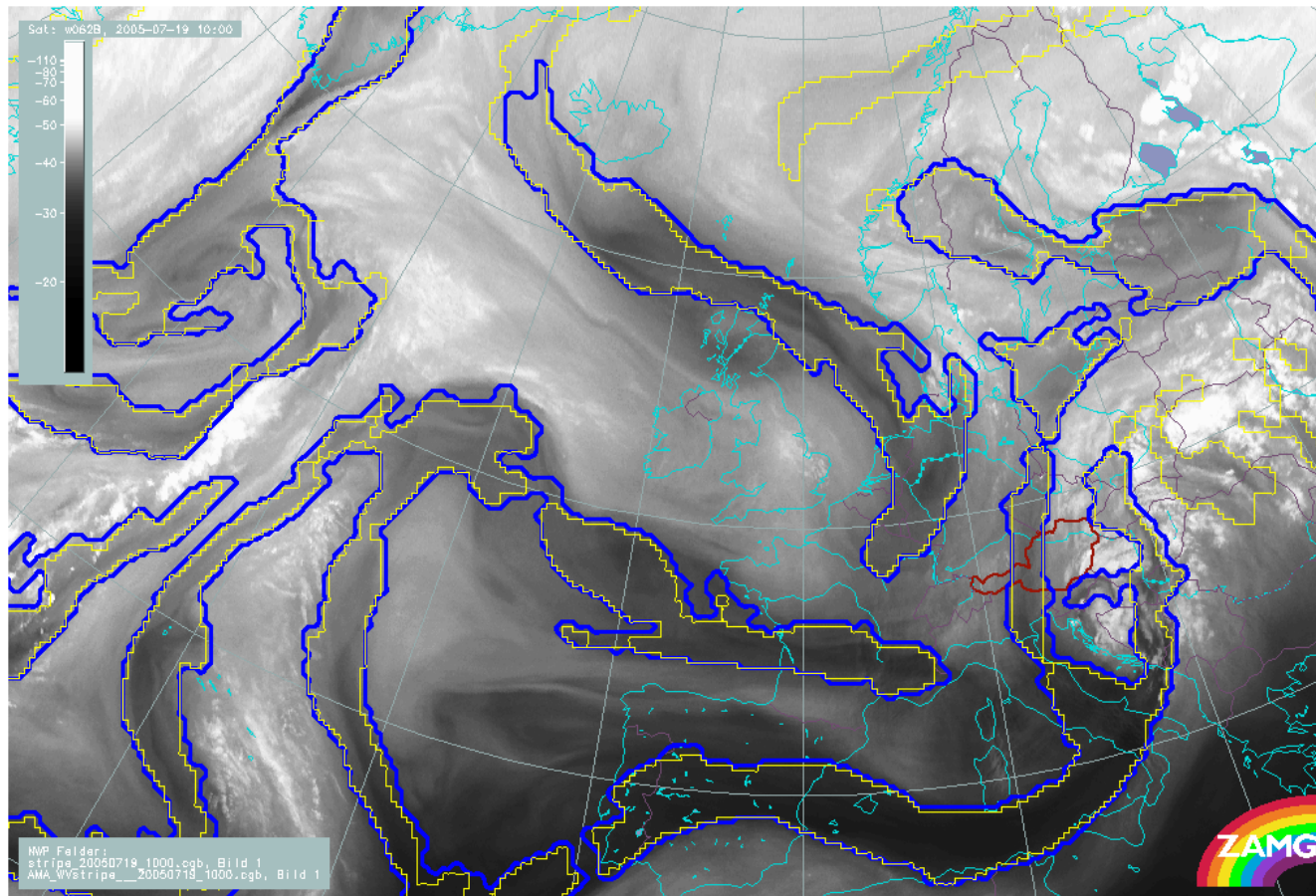
- **Lability is frequently THE predictor (a fact that made investigations unproductive in the high summer season, therefore under-represented)**
- **Excellent examples of convection triggering at the edge of WV dark stripes and ridge lines**
- **“Pre-frontal gradient zone” product clearly lagging behind in terms of usefulness**

# Lessons learned

---

- **WV stripe recognition was so far almost solely been based on pattern recognition alone (“darker than surrounding”). A more stringent brightness temperature criterion (threshold  $-43,5^{\circ}\text{C}$ ) will be introduced in the next version to focus on the relevant dark structures**
- **Some algorithmic changes will eliminate spurious branchings and yield smoother (=easier-to-interpret) outlook**

# “Dark stripe” product, v2.0





# Future priorities (ZAMG's ranking prior to the PAR

## workshop)

---

- **Substitute surface temperature by a more suitable air mass descriptor**
- **Use the rule “a) significantly different air masses should not be designated equally; b) air masses without a significant difference should not be designated with different namings” as an ingredient in production (image segmentation?)**
- **Ridge lines and WV stripes by and large frozen since 😊**
- **Effort in better definition of “prefrontal” probably large, await PAR's assessment of the gradient zone product**



# Finally....a website of reference BUFR products

---

<http://www.zamg.ac.at/satweb/SAF/SAF2/ASII.htm>

**(providing the most recent Postscript graphics files)**

# Backup slide

---

# User response

---

- **Proposal by the Portuguese Met. Service: categories „arctic“, „polar“, „tropical“, „equatorial“ with sub-classification „maritime“ vs. „continental“ → 8 air masses**
- **Information on cloud-contaminated area desired**
- **(Though originally stated for PGE10, equally applicable here): allow 3-hourly NWP data as input**