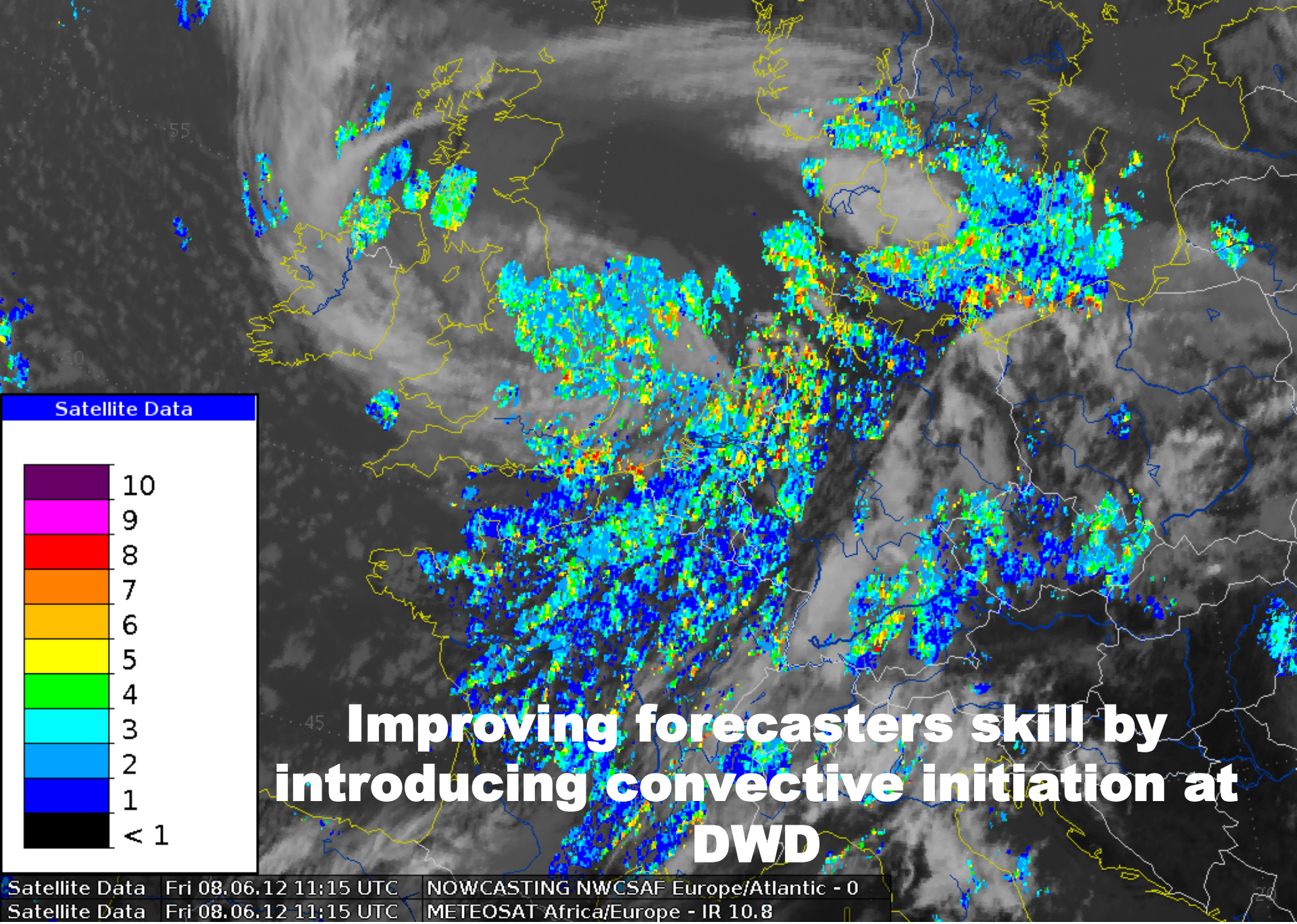


Improving forecasters skill by introducing convective initiation at DWD

Gap Analysis

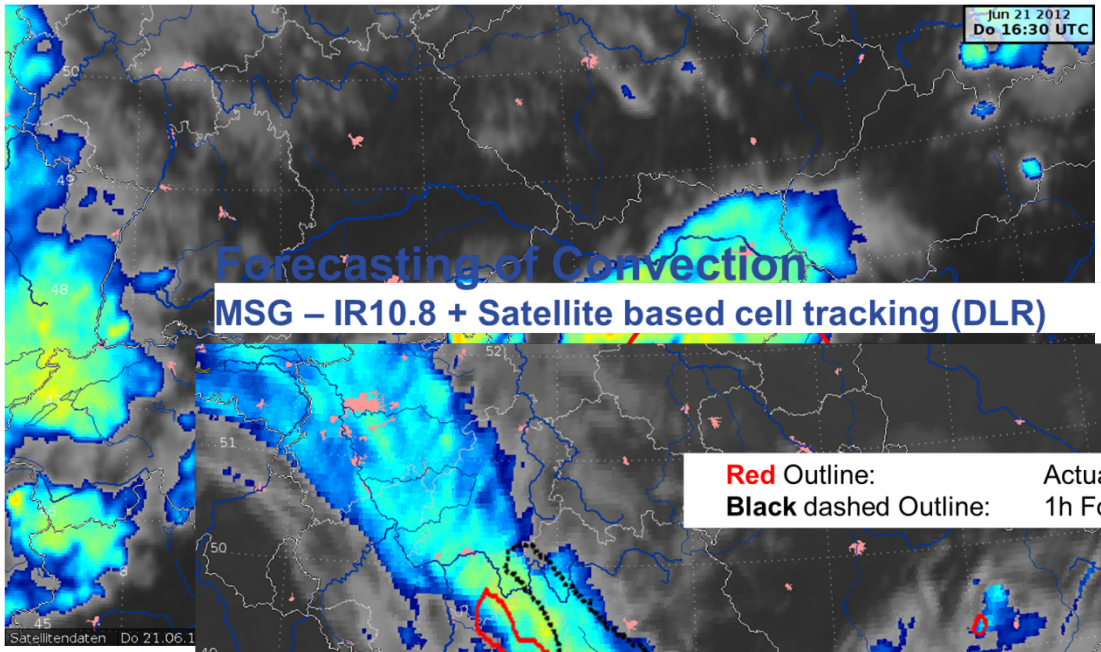
(Heavy) Thunderstorm

- Potential danger
- Difficult to detect before Radar echo occurs
- Spatial distribution

Goal: Early detection of potential convective cells

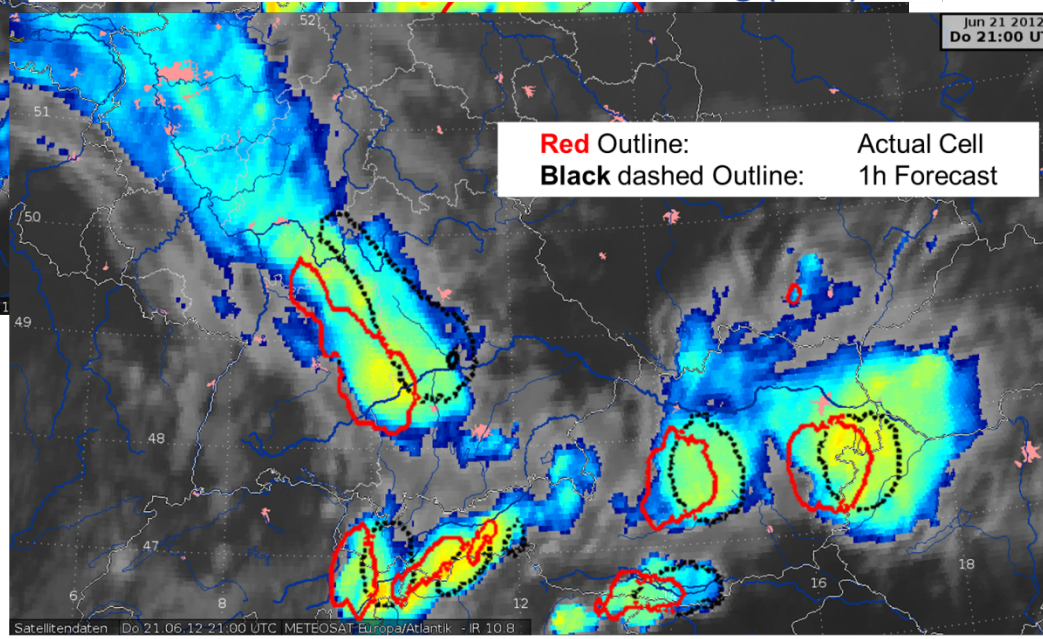
Monitoring Convection – Thread Potential

MSG – IR10.8 (Cold Rings)



Forecasting of Convection

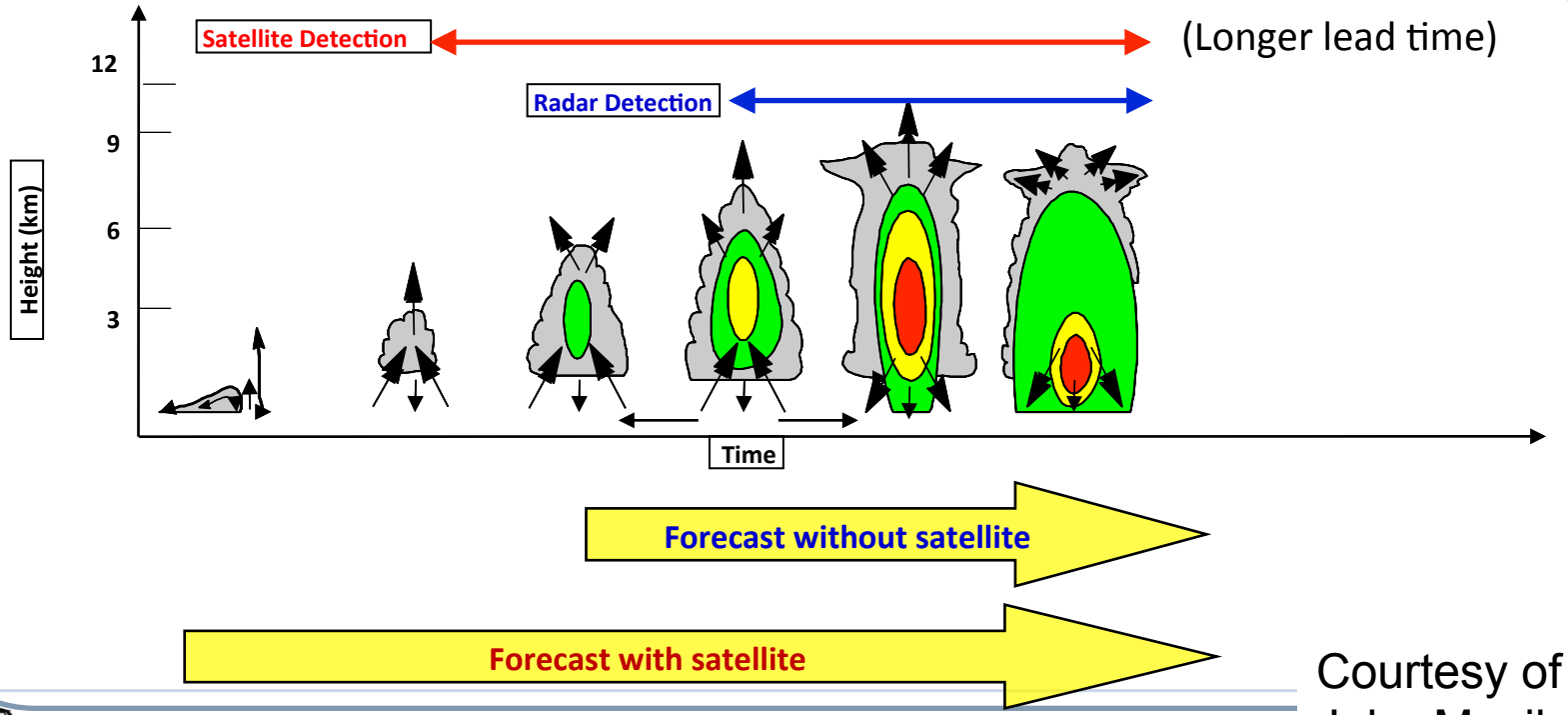
MSG – IR10.8 + Satellite based cell tracking (DLR)



History & Scientific Research/Development

- Mecikalski & Bedka (2006) – Initial methodology
- Bedka and Mecikalski (2005); Bedka et al. (2009) – Mesoscale AMVs
- Mecikalski et al. (2008, 2010a,b, 2011, 2012a,b); Mecikalski (2012); Jewett et al. (2012) – New methods
- Walker et al. (2011) – ATDB for GOES-R AWG
- Siewert (2008); Harris et al. (2010) – First lightning flash initiation
- Siewert et al. (2010); Walker et al. (2012) – Object tracking
- Iskenderian et al. (2012) – Aviation convective nowcasting applications

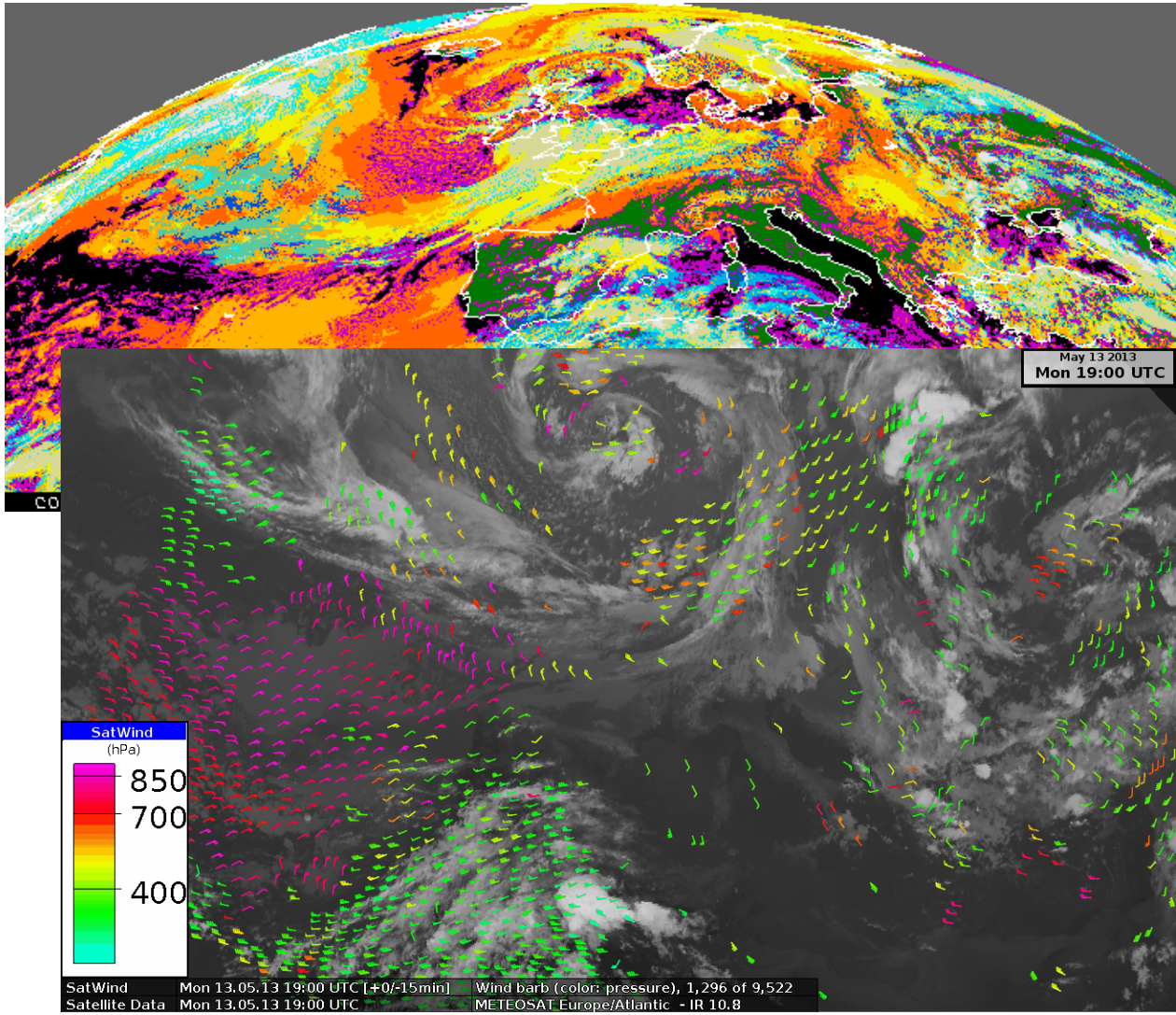
Satellites "see" cumulus before they become thunderstorms!



Courtesy of John Mecikalski

Work done by EUMETSAT

- Translation to Fortran
- Final consolidation to MSG SEVIRI
- Implementation of a different AMV method (i.c. to SATCAST)
- Introducing box method
- MSG channels: WV6.2, WV7.3, IR8.7, IR10.8, IR12.0.



See also Poster 61

Operational Interest Fields

1. 15-minute cooling rate in IR10.8 between time 3 and time2
   (between -50 °C and -7.5 °C)
2. 30-minute cooling rate in IR10.8 between time 3 and time 1
   (< 15-min cooling)
3. IR10.8 temperature at time 3
   (between 253 K and 273 K)
4. Temperature difference WV6.2 – WV7.3 at time 3
   (between -6 °C and -15 °C)
5. Temperature difference WV6.2 – IR10.8 at time 3
   (between 0 °C and -20 °C)
6. Temperature difference IR8.7 – IR10.8 at time 3
   (between -3 °C and -10 °C)
7. 15-minute trend of IR8.7 – IR10.8 between time 3 and time 2
   (between 0.4 °C and 10 °C)
8. 15-minute trend of tri-channel difference(*) between time 3 and time 2
   (between 0.5 °C and 10 °C)
9. 15-minute trend of WV6.2 – WV7.3 between time 3 and time 2
   (between 0.2 °C and 10 °C)
10. 30-minute trend of WV6.2 – WV7.3 between time 3 and time 1
    (between 0.6 °C and 10 °C)

(*):"tri-channel difference" is the temperature difference
(IR8.7-IR10.8) – (IR10.8-IR12.0)

- Not weighting
- No order

Counting number of Hits

Implementation DWD

Goal:

- Run time stable and optimized code
- Improved Error management
- Decrease run time

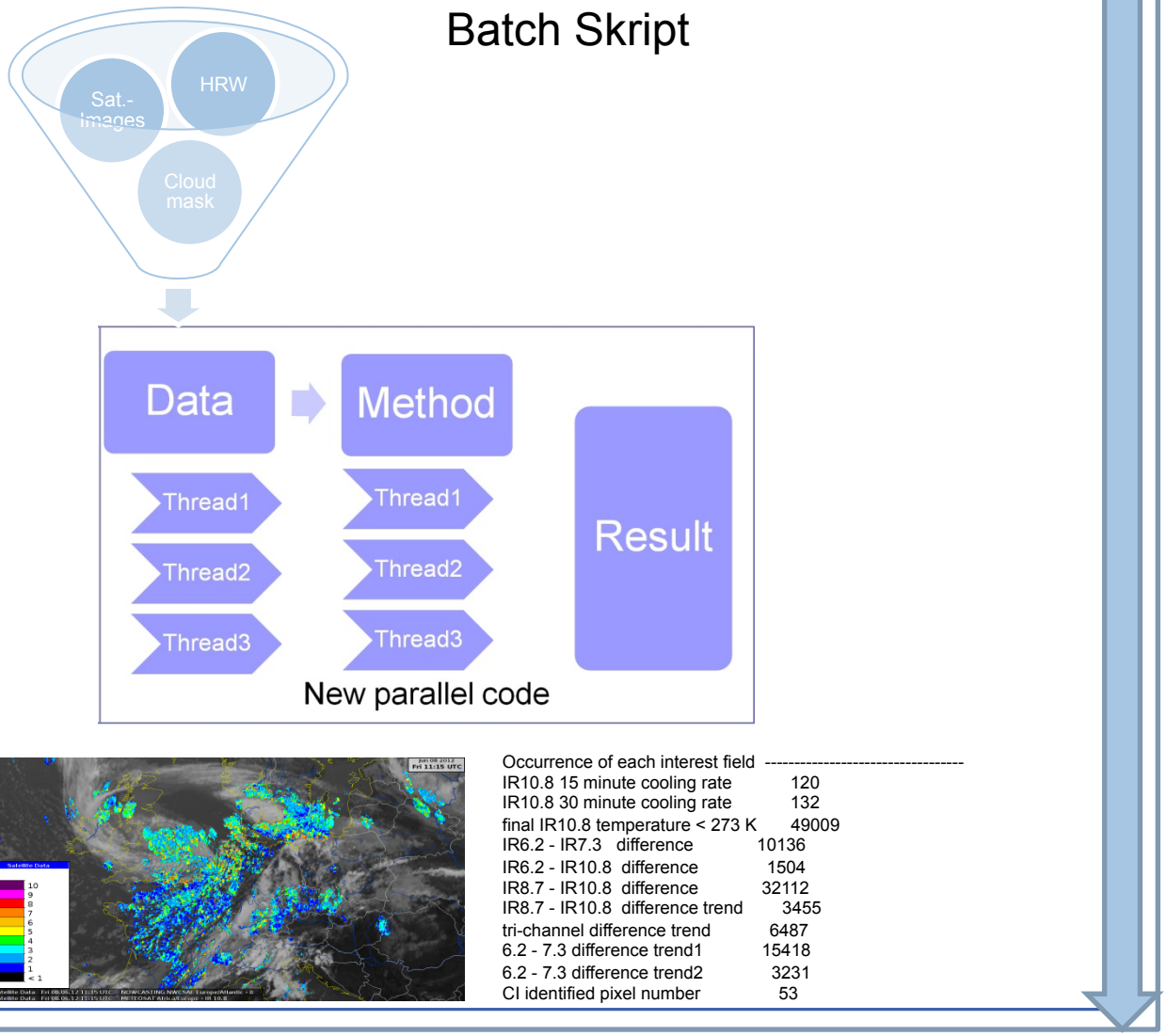
→ Implementation at DWD infrastructure

Input
- METEOSAT Full disk
- NWCSAF PGE09 HRW , if needed: 10.8 AMV‘s

Technical environment
- OpenSource XEN Cluster with SuSe Enterprise 11
- Standardconfiguration: 8 CPU (Intel Xeon X5680) 16 GB RAM
- Running from EUMETCAST to CI (with NWCSAF, H-RIT compilation etc.)

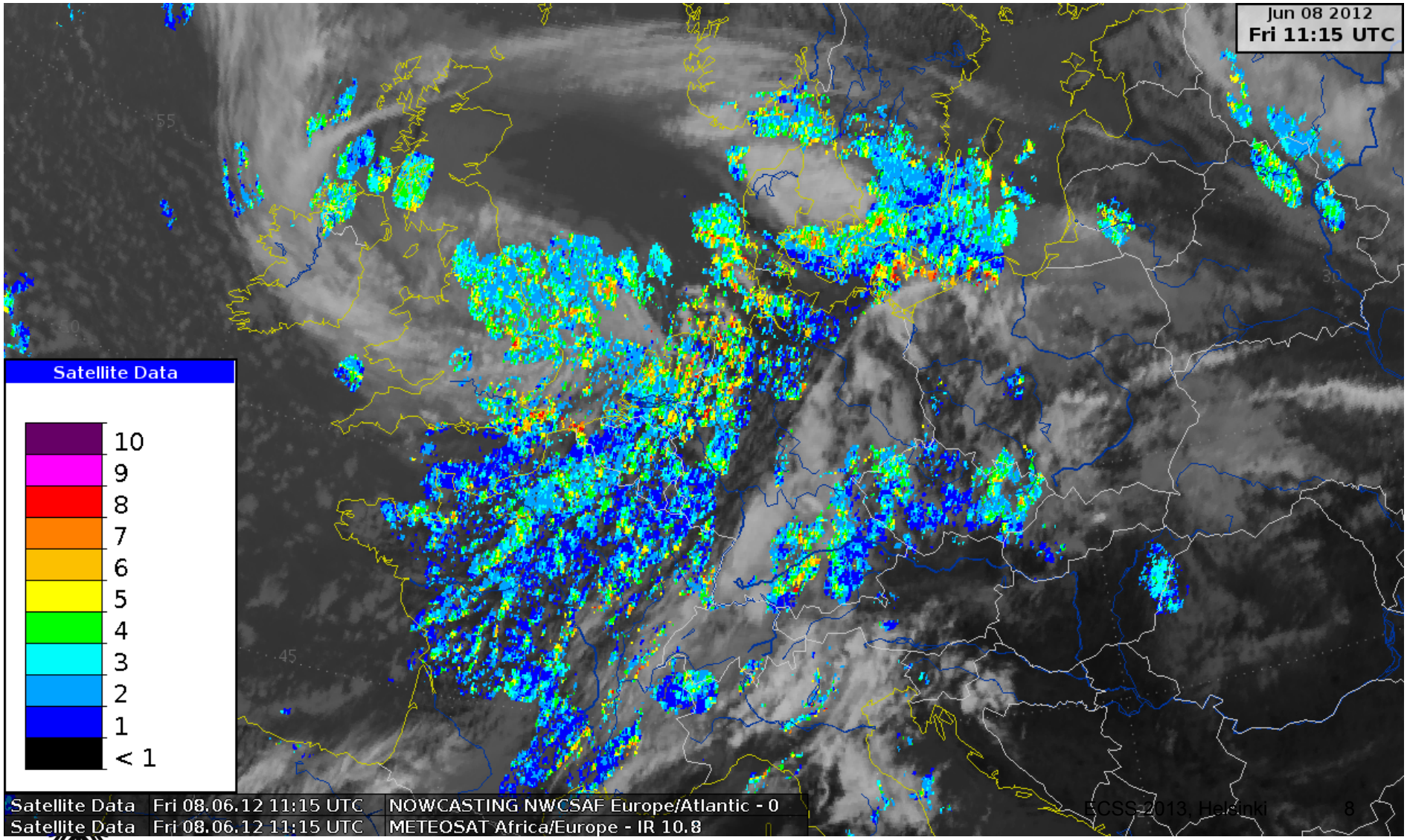
Operational Implementation

- Improvement of elapsed run-time of ~30%, at constant quality and stability
- Production chain to NinJo Visualisation
  - NinJo
  - Other outputs possible
- NinJo: display of 6 or more IF hits

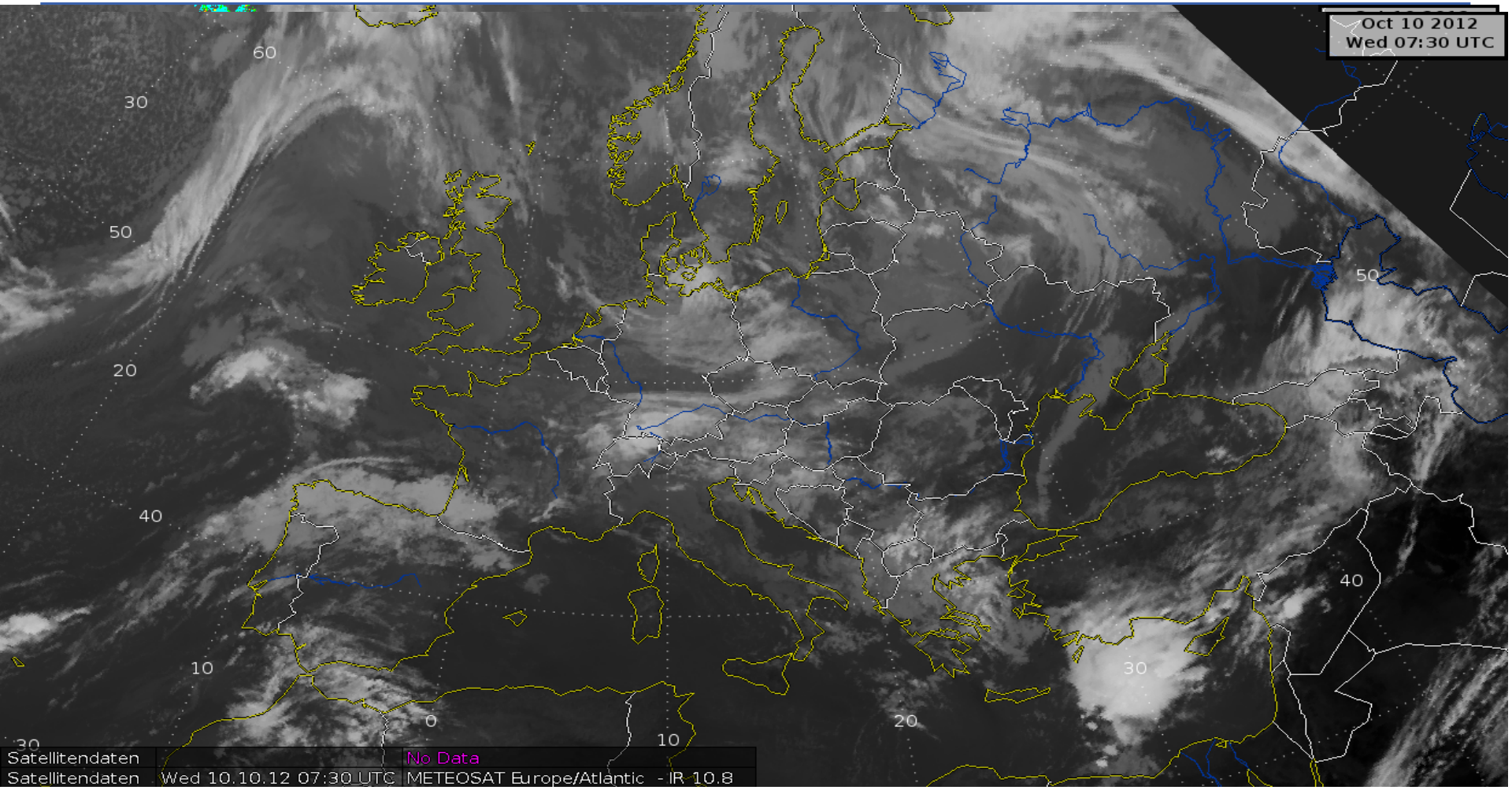


Occurrence of each interest field ----------
IR10.8 15 minute cooling rate 120
IR10.8 30 minute cooling rate 132
final IR10.8 temperature < 273 K 49009
IR6.2 - IR7.3 difference 10136
IR6.2 - IR10.8 difference 1504
IR8.7 - IR10.8 difference 32112
IR8.7 - IR10.8 difference trend 3455
tri-channel difference trend 6487
6.2 - 7.3 difference trend1 15418
6.2 - 7.3 difference trend2 3231
CI identified pixel number 53

Example: 08.06.21012 11:15 UTC
Legend: Number of Interest Fields hits



Implementation - Visual constraints



Known Limitations

CI: convective cloud development in advance of thunderstorm formation

Known science problems

- High cirrus clouds (compare Mecikalski,2012)
- flow winds (Horvath & Davies, 2001)
  - height assignment (Lonitz & Horvath, 2011)
  - Make use of new cloud properties techniques (e.g. (Dybbroe et al., 2005b; Mecikalski, Watts, & Koenig, 2011)
  - day and night (Bedka, 2011; Sieglaff et al., 2011)
- POD/FAR (compr. Walker, 2012)
- Thresholds (compr. Dietsch,2012; Mecikalski,2010)

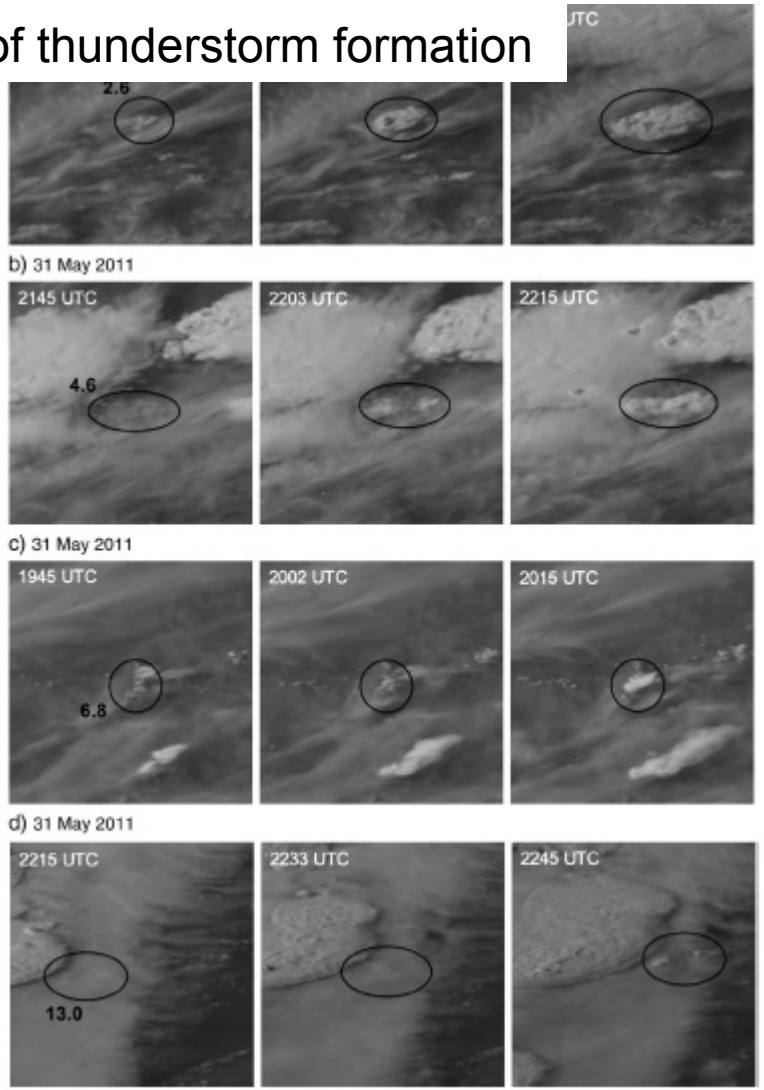


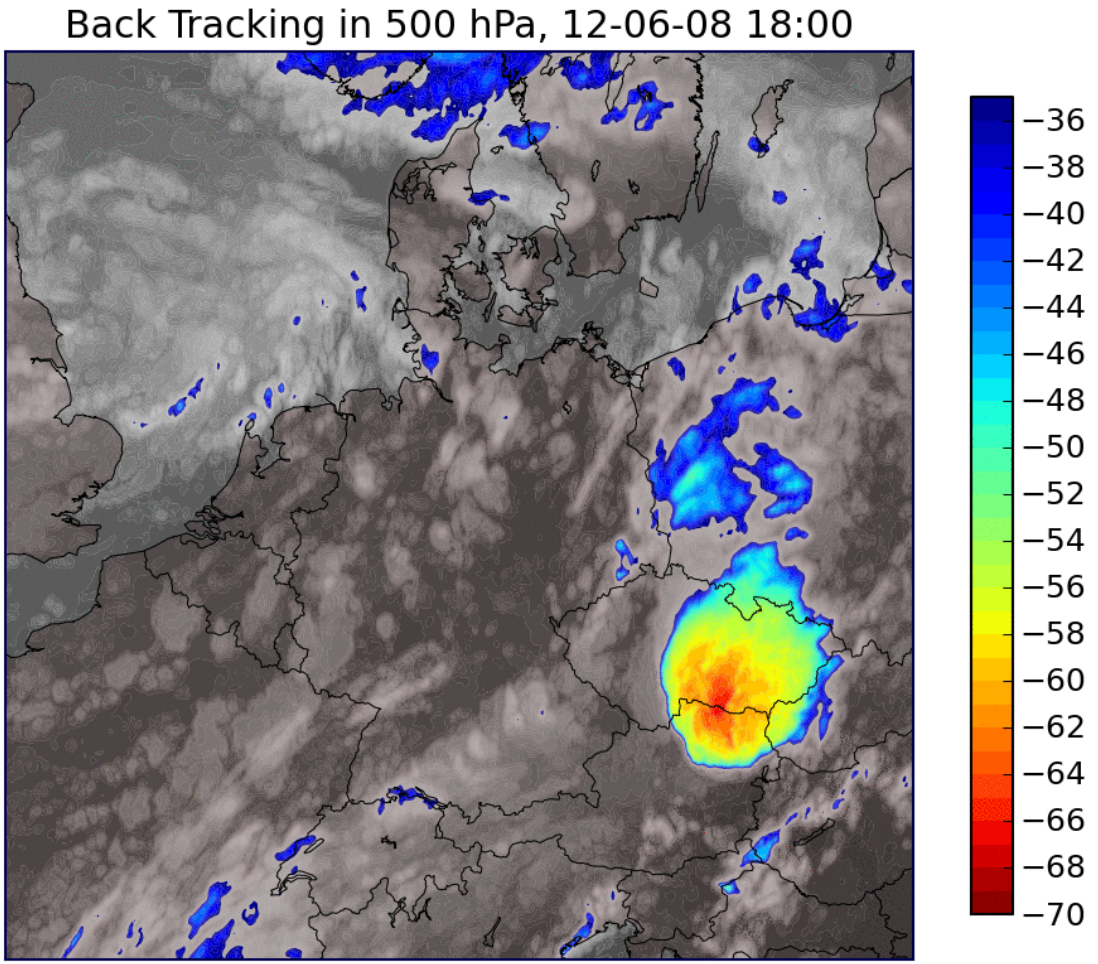
Image from Mecikalski,2012

How to evaluate?

Backtracking

Discrepancy between model and real vertical wind

Temporal disagreement due to 3h model cycle



Back Tracking using ECMWF reanalysis data

© Felix Dietzsch, TROPOS

See also Poster: 164

How to evaluate?

CI-Kriterium	Superzellen		MCS			orogr.	frontal		
Fall Nr.	3	8	1	2	9	7	4	5	6
10,8 µm	ja	ja	ja	ja	ja	ja	ja	ja	ja
6,2 µm − 10,8 µm	ja	ja	ja	ja	ja	ja	ja	ja	ja
7,3 µm − 10,8 µm	ja	nein	ja	ja	nein	nein	nein	nein	nein
13,4 µm − 10,8 µm	ja	ja	ja	ja	ja	ja	ja	ja	ja
6,2 µm − 7,3 µm	ja	ja	ja	ja	ja	ja	ja	ja	ja
12,0 µm − 10,8 µm	ja	ja	ja	ja	ja	nein	ja	ja	ja
$\Delta T_{10,8}\,(15\,\mathrm{min})^{-1}$	ja	ja	ja	ja	ja	ja	ja	ja	ja
$\Delta T_{10,8}\,(30\,\mathrm{min})^{-1} < \Delta T_{10,8}\,(15\,\mathrm{min})^{-1}$	ja	ja	ja	ja	ja	ja	ja	ja	ja
$\Delta T_{6,2-10,8}\,(15\,\mathrm{min})^{-1}$	ja	ja	ja	ja	ja	ja	nein	ja	ja
$\Delta T_{7,3-10,8}\,(15\,\mathrm{min})^{-1}$	ja	nein	ja	ja	nein	ja	nein	ja	ja
$\Delta T_{12,0-10,8}\,(15\,\mathrm{min})^{-1}$	nein	nein	ja	ja	nein	nein	nein	nein	nein
$\Delta T_{13,4-10,8}\,(15\,\mathrm{min})^{-1}$	ja	nein	ja	ja	ja	ja	nein	ja	ja
beschl. Wachstum	ja	ja	nein	nein	ja	nein	ja	ja	ja

How to evaluate? Energy?

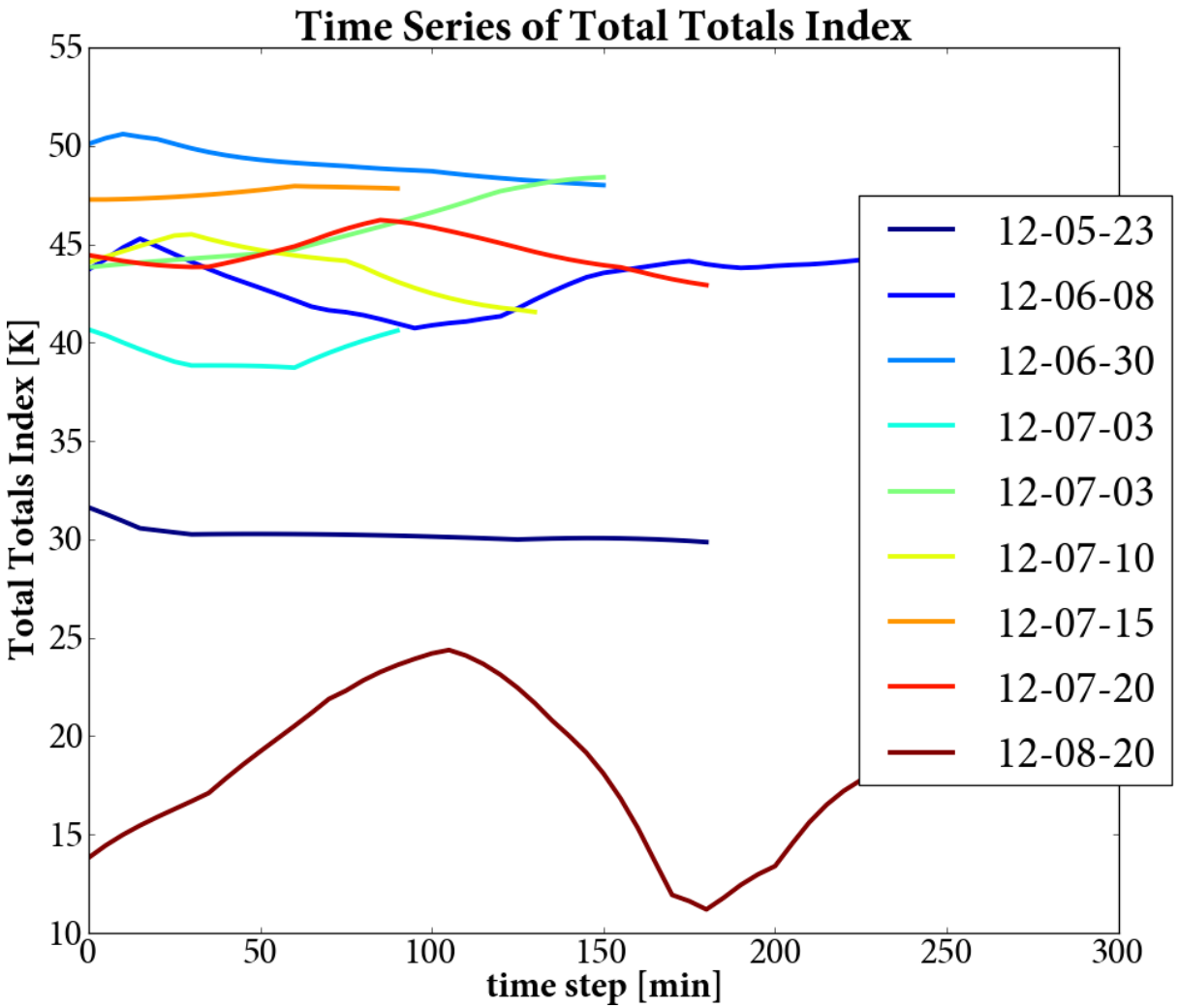
Cape Values

Frontal cases (03.07.12)

Prefrontal TS (cyan)
Postfrontal TS (green)

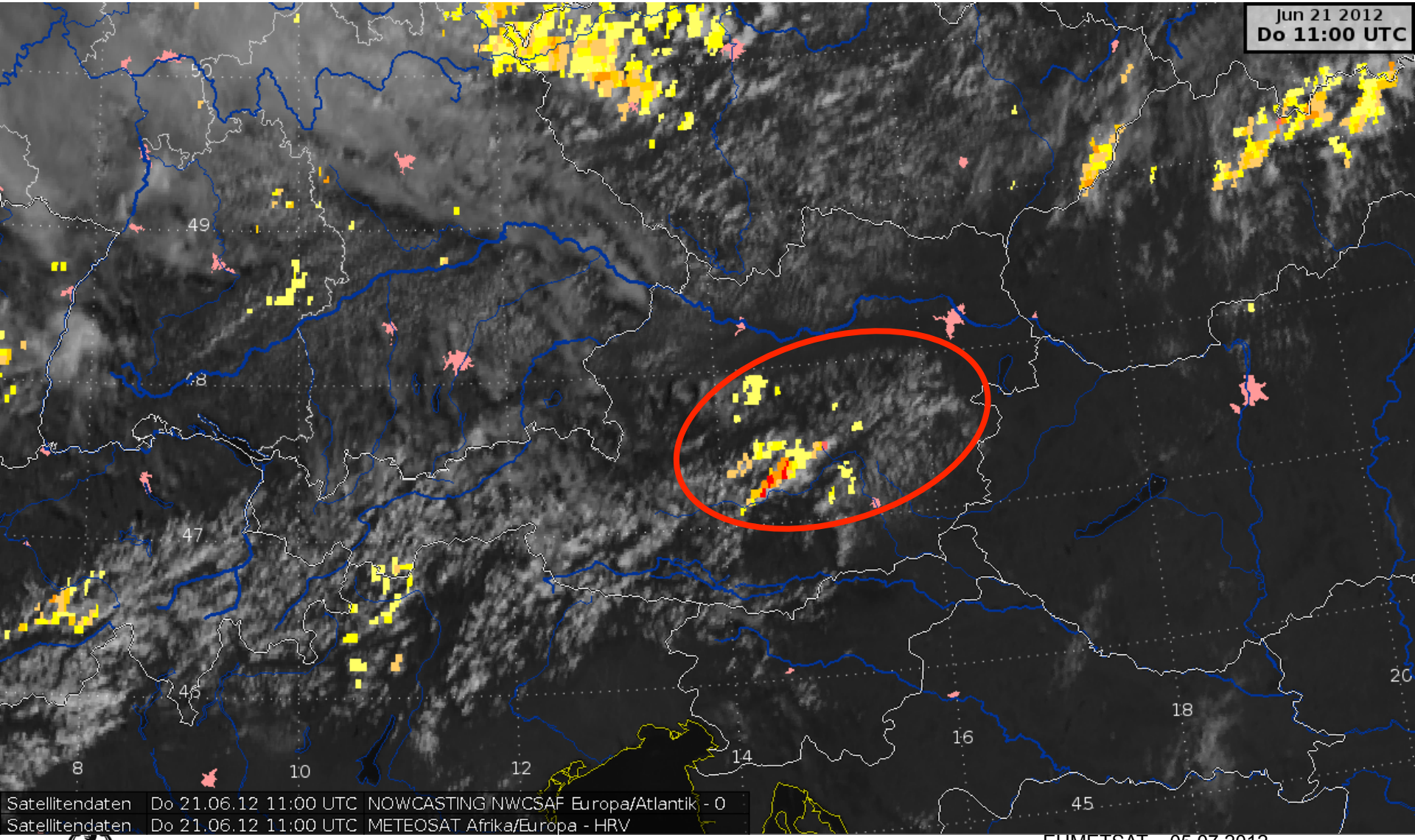
Meso-scale (MSC)
Dark blue & brown

Super cell
30.06.12 (light blue)

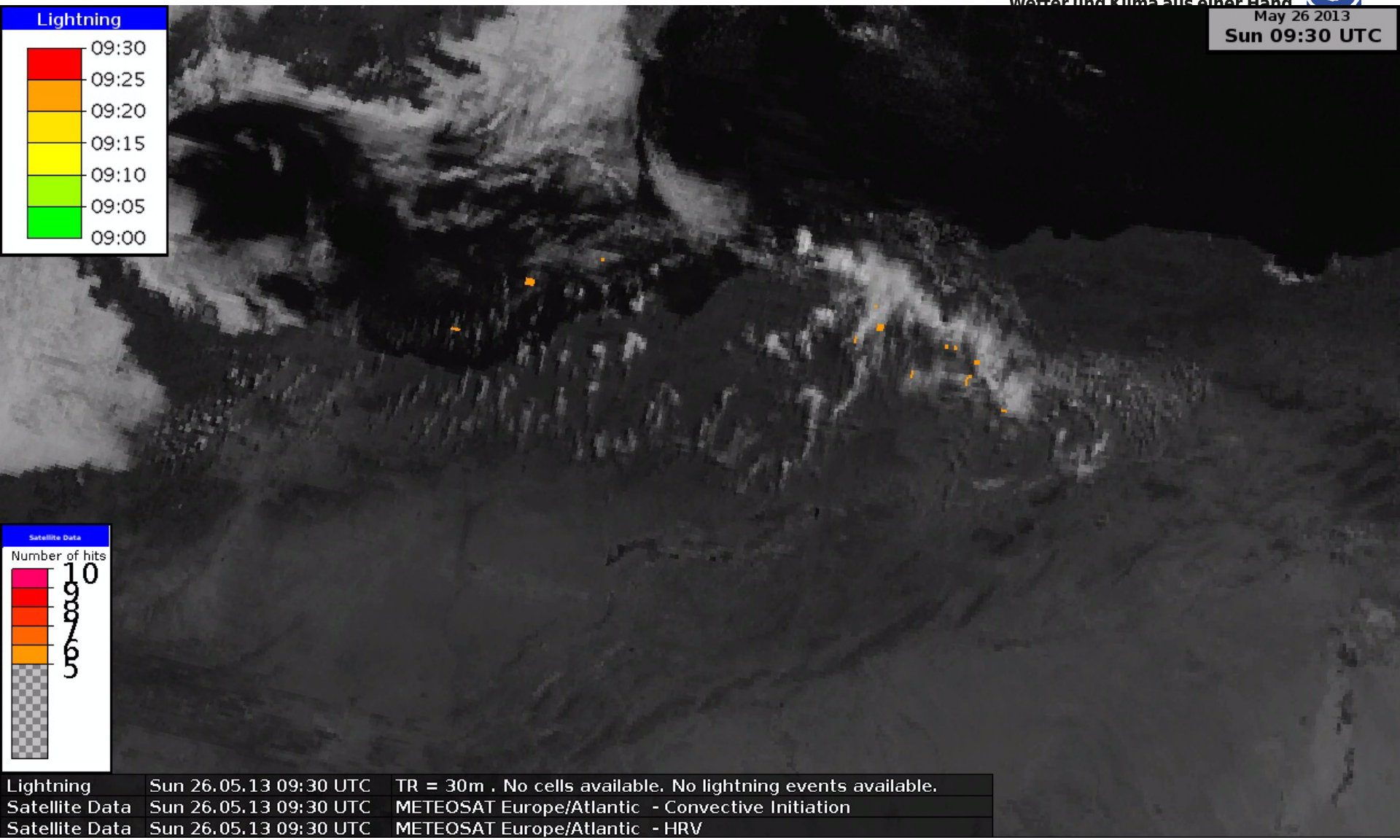


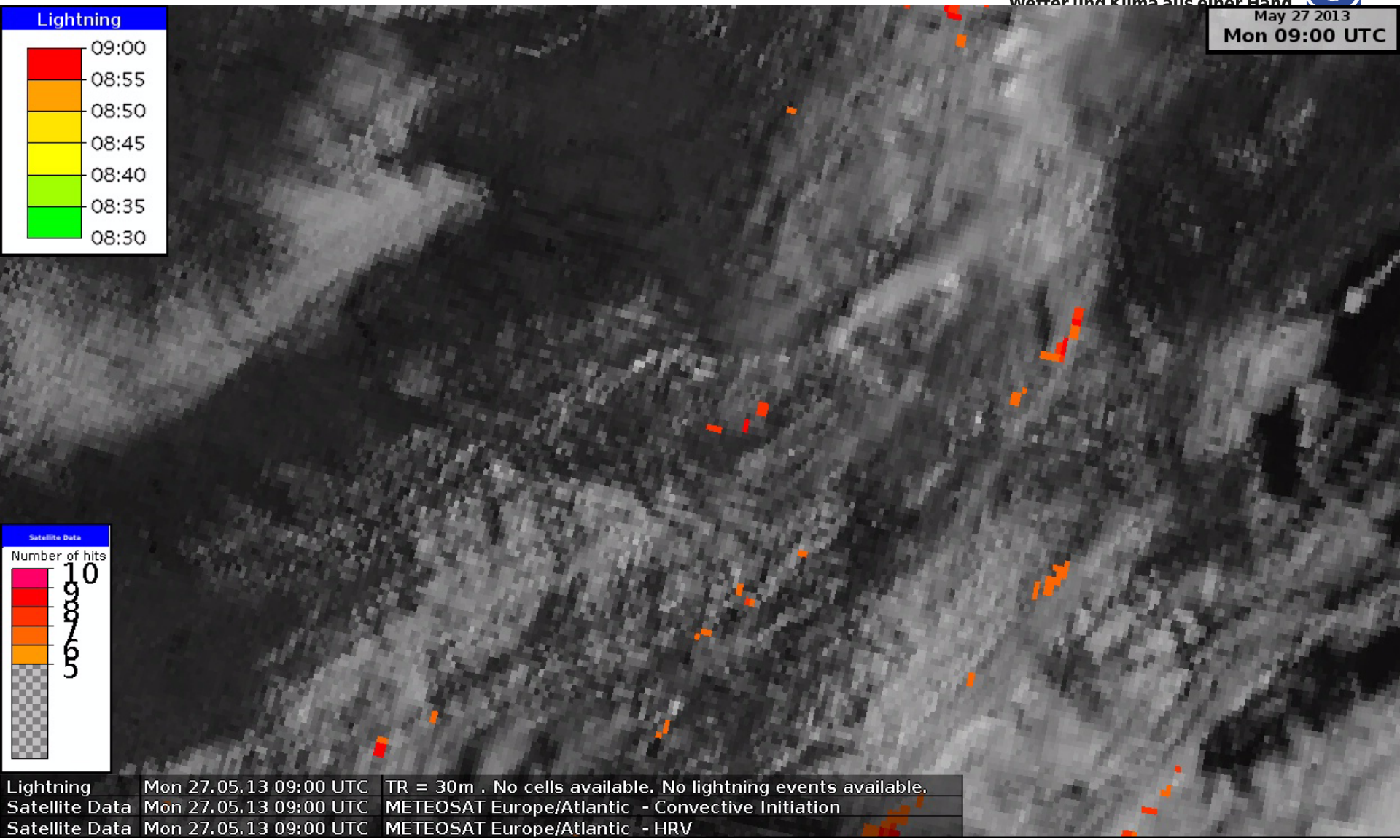
Around Noon: Rapidly growing Cumulus

MSG HRV + CI-Produkt (pre-operationel)



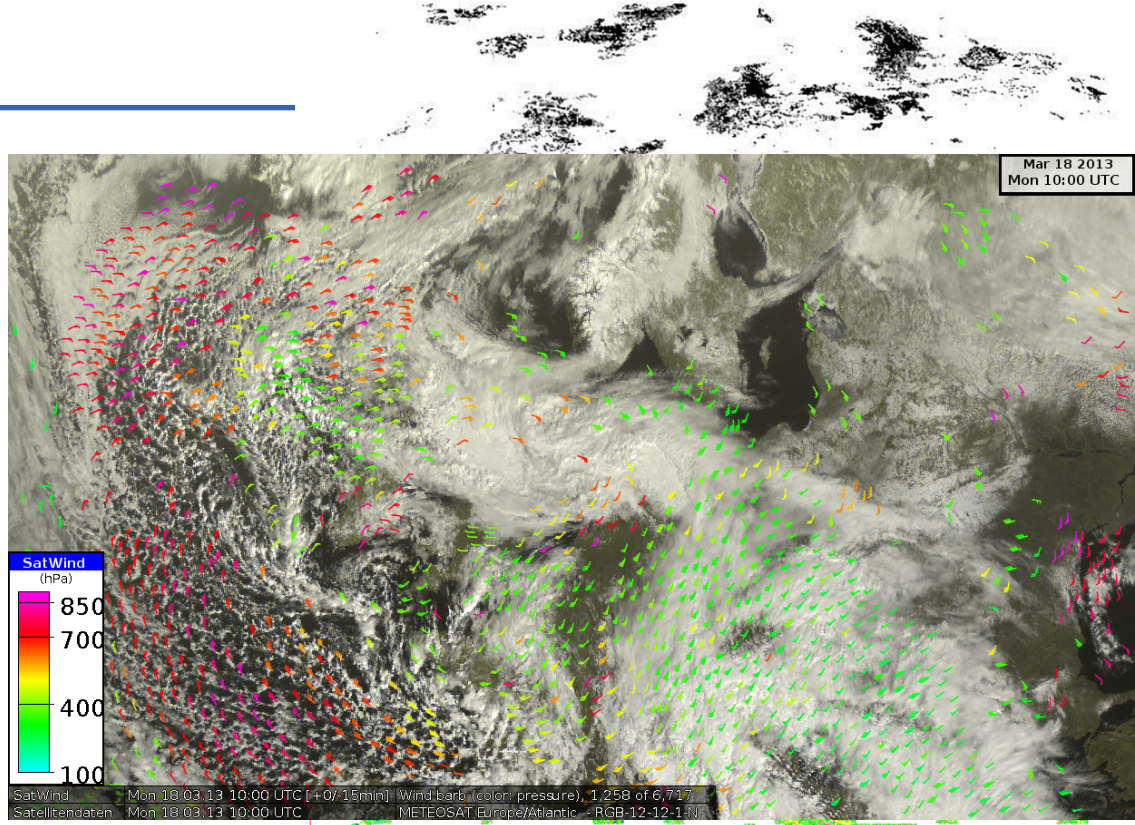
Slide by H.J.Koppert

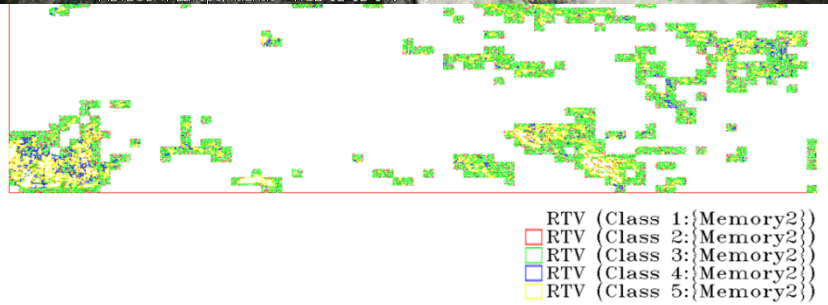

Lightning
09:30
09:25
09:20
09:15
09:10
09:05
09:00
May 26 2013
Sun 09:30 UTC
Satellite Data
Number of hits
10
9
8
7
6
5
Lightning | Sun 26.05.13 09:30 UTC | TR = 30m . No cells available. No lightning events available.
Satellite Data | Sun 26.05.13 09:30 UTC | METEOSAT Europe/Atlantic - Convective Initiation
Satellite Data | Sun 26.05.13 09:30 UTC | METEOSAT Europe/Atlantic - HRV


Lightning
09:00
08:55
08:50
08:45
08:40
08:35
08:30
May 27 2013
Mon 09:00 UTC
Satellite Data
Number of hits
10
9
8
7
6
5
Lightning | Mon 27.05.13 09:00 UTC | TR = 30m . No cells available. No lightning events available.
Satellite Data | Mon 27.05.13 09:00 UTC | METEOSAT Europe/Atlantic - Convective Initiation
Satellite Data | Mon 27.05.13 09:00 UTC | METEOSAT Europe/Atlantic - HRV

Outlook

- Development of a Object-ID based output (polygons or other)
- Advance (day/night) AMV's
- Development/Implementation of a probabilistic output
- Further scientific cooperation (HERZ, TROPOS and other)





First visualisation with for 21 May 2011 10:00 UTC with classified vectors. Additional information can be added to each vector. In this case the information of co-located available profiles or other information for class four and five could be added in order to bundle information.

Summary

- ✓ First pre-operational implementation in Europe
- ✓ Working on “Tweaks” and other improvements
- ✓ Implemented into NinJo Release 1.7
- ✓ First Evaluation going on →going to ESSL Testbed
- ✓ First Master thesis done

To do:

- Evaluation of longer periods and special synoptic situations
- Further development
- Improving skill score

Literature (excerpt)

Dietsch, F. (2013). Validierung satellitenbasierter Früherkennung konvektiver Gewitter mittels Rückwärtstrajektorien Leipziger Institut für Meteorologie Institut für Troposphärenforschung Leipzig. Leipzig, Universität Leipzig. **Master.**

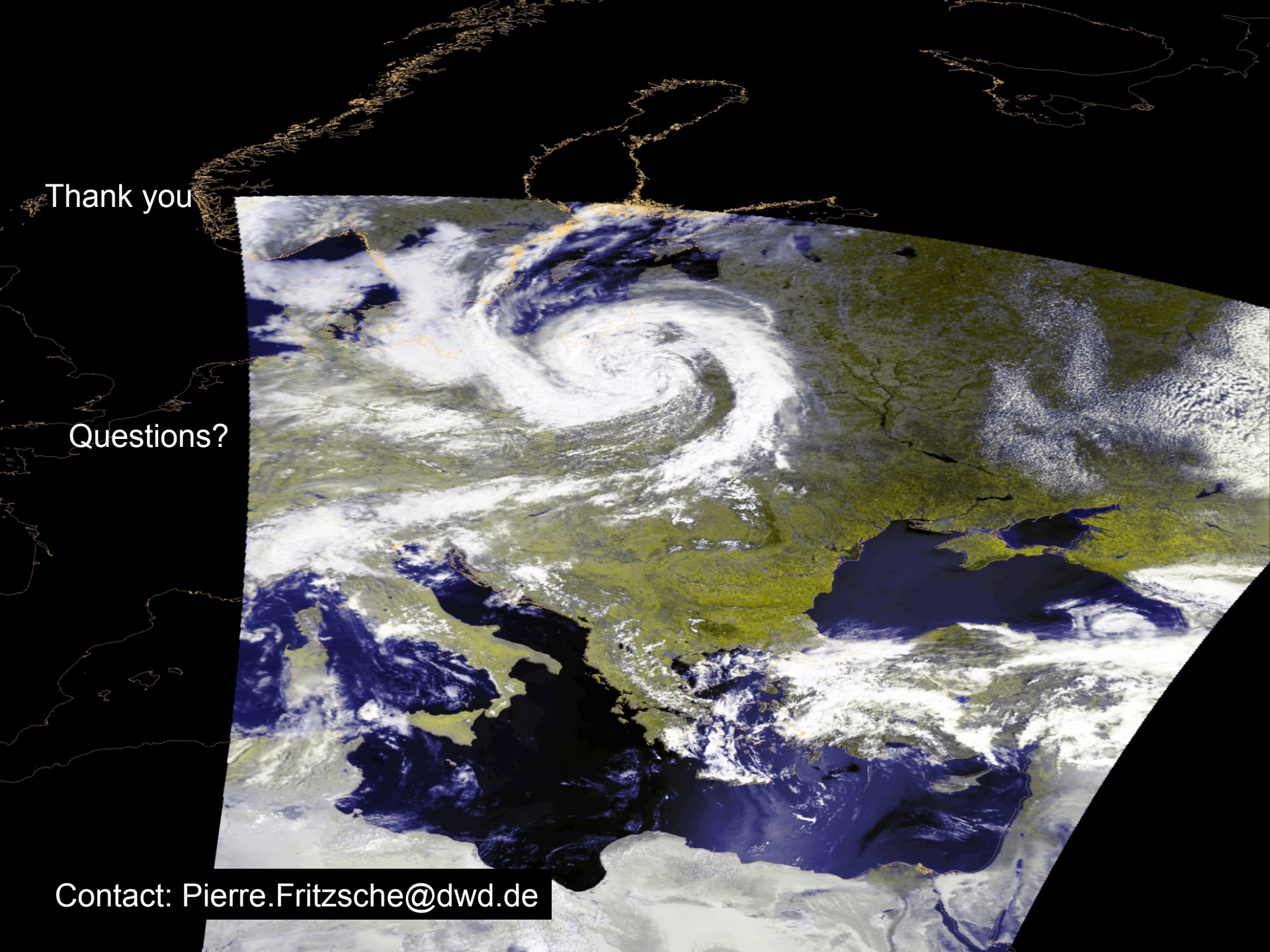
Mecikalski, J. R., P. Minnis, et al. (2013). "Use of satellite derived cloud properties to quantify growing cumulus beneath cirrus clouds." Atmospheric Research **120: 192-201.**

Walker, J. R., W. M. MacKenzie, et al. (2012). "An Enhanced Geostationary Satellite–Based Convective Initiation Algorithm for 0–2-h Nowcasting with Object Tracking." Journal of Applied Meteorology and Climatology **51(11): 1931-1949.**

Mecikalski, J. R., W. M. Mackenzie, et al. (2010). "Cloud-Top Properties of Growing Cumulus prior to Convective Initiation as Measured by Meteosat Second Generation. Part II: Use of Visible Reflectance." Journal of Applied Meteorology and Climatology **49(12): 2544-2558.**

Thank you

Questions?



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