Convection Initiation – Nowcasting by data fusion and its Verification

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Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

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Outline

Motivation & general idea

Cb-TRAM (**C**umulonim**b**us **TR**acking **A**nd **M**onitoring)

CI-Verification

Additional data sources

Motivation

Aviation purposes

Cb-TRAM as basic tool

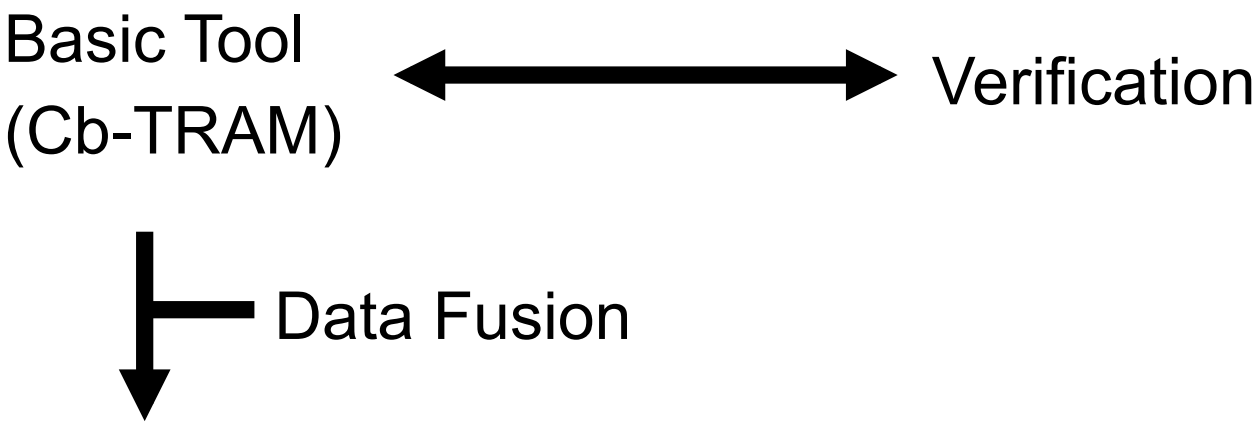
Adding non-satellite fields for further development

General idea

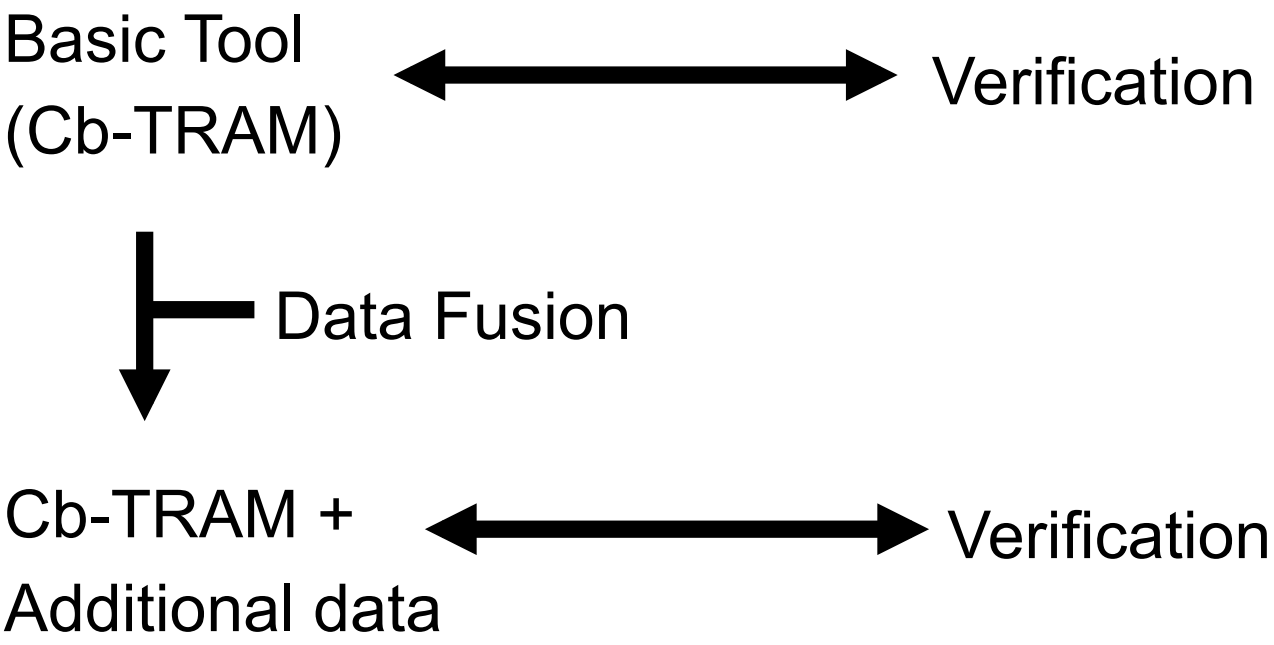
Basic Tool
(Cb-TRAM)

Verification

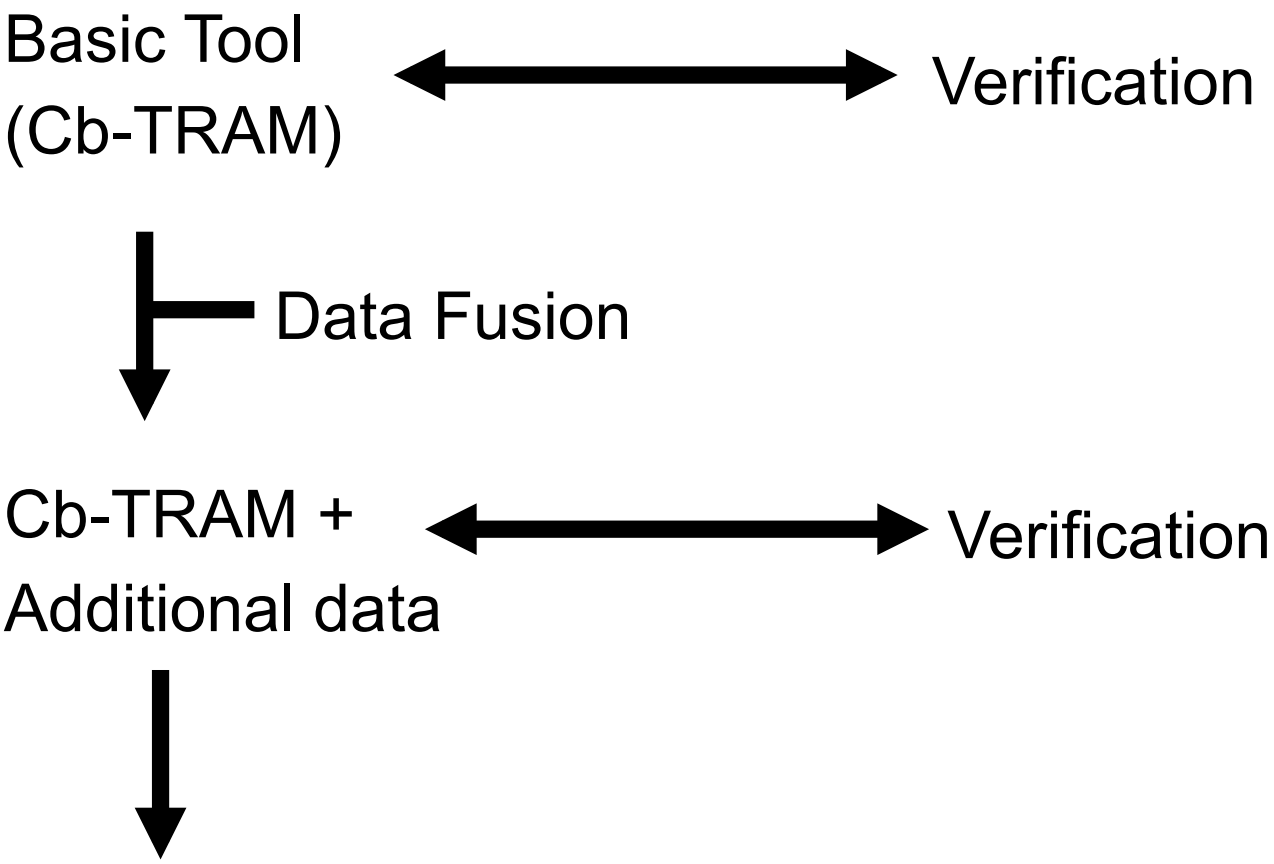
General idea



General idea

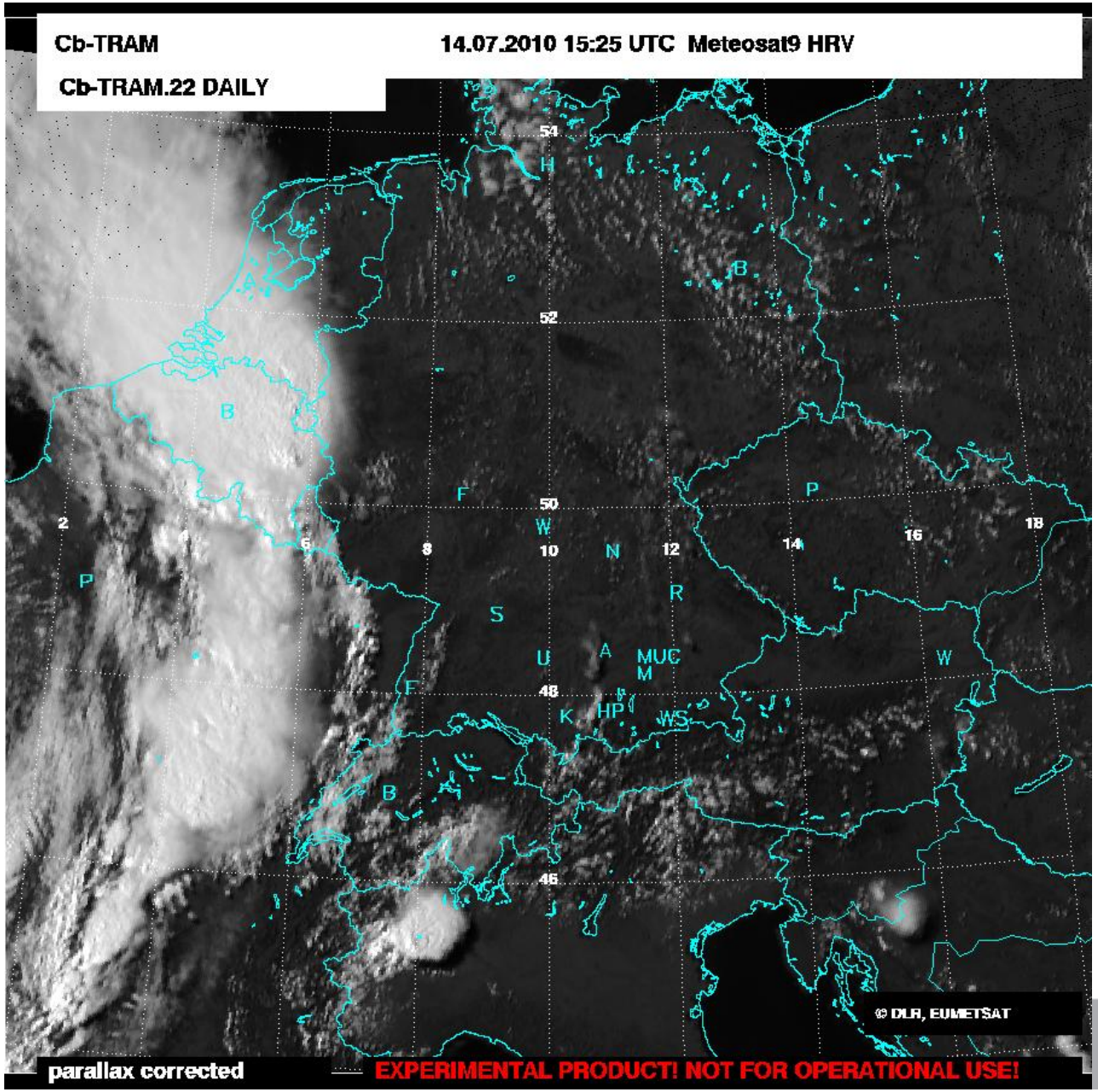


General idea

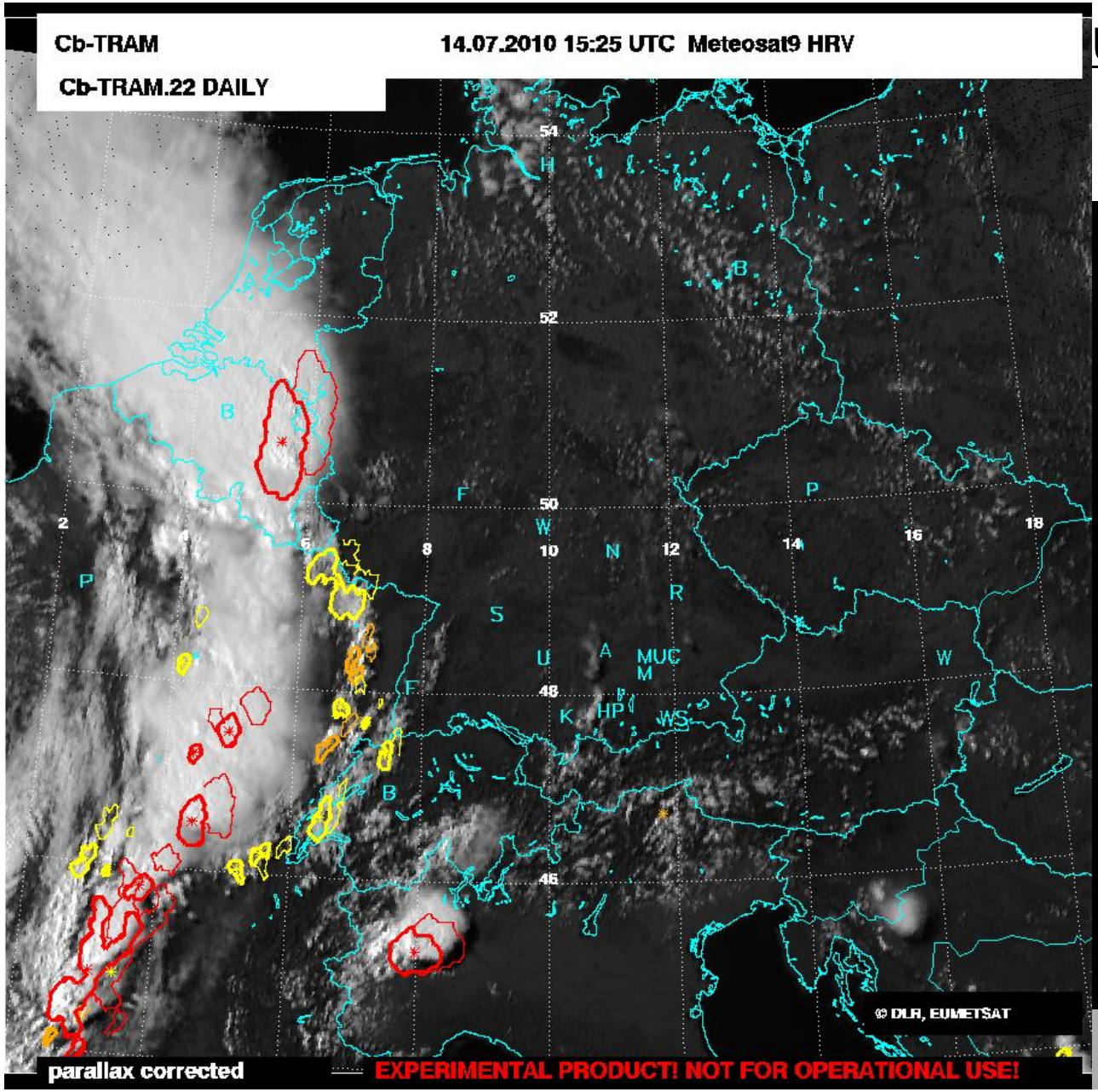


CI-NOW – a CI detection and nowcasting tool

Cb-TRAM - Cumulonimbus TRacking And Monitoring



Cb-TRAM - Cumulonimbus TRacking And Monitoring



Used MSG (rapidscan) data:

WV 6.2	IR 10.8
IR 12.0	HRV

Detection stages:

1: Convection Initiation (CI)
- development in HRV
- IR 10.8 cooling

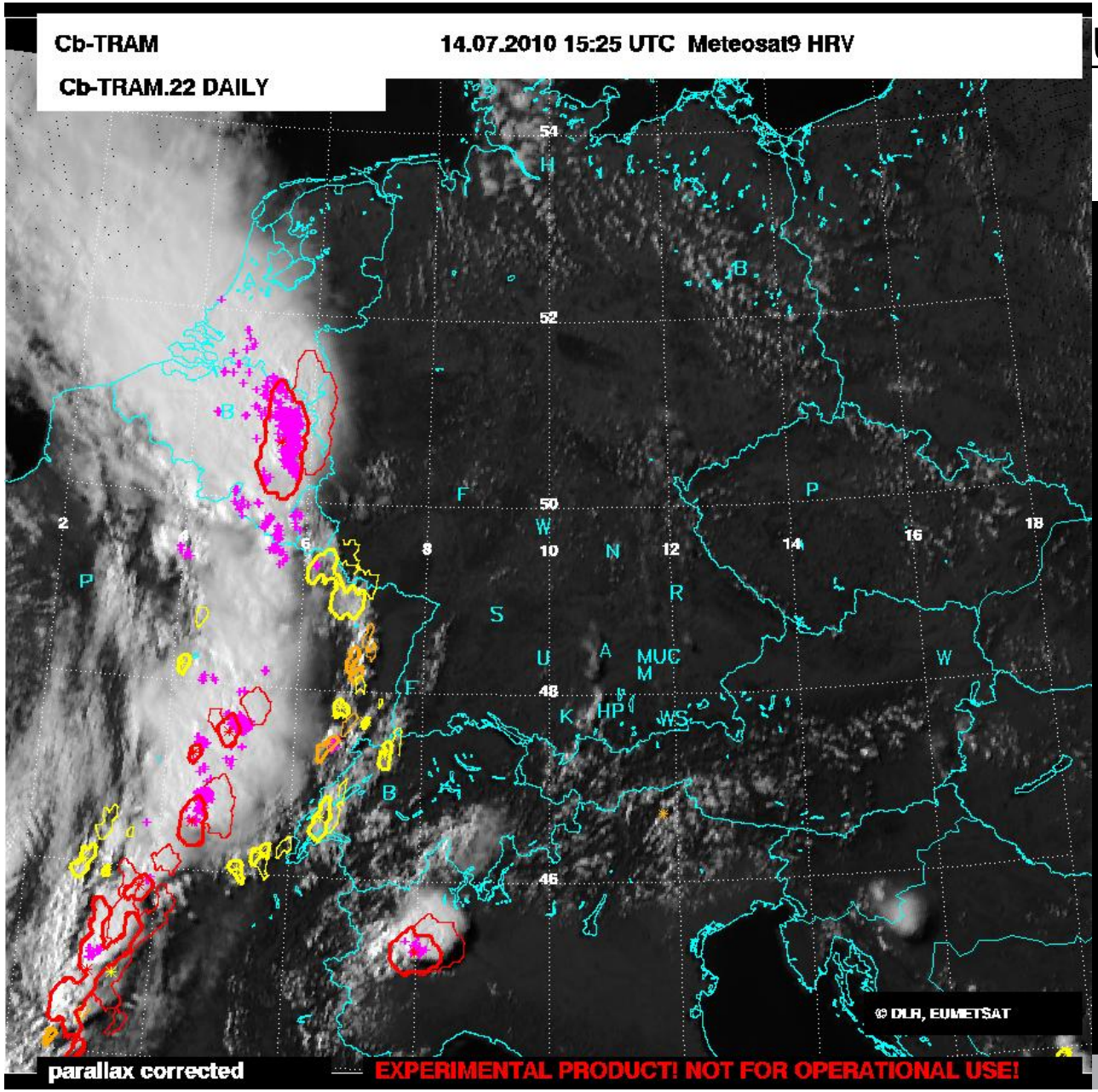
2: Rapid development
- WV 6.2 rapid cooling (> 1K/15min)

3: Mature storms
- T 6.2 - T 10.8
- HRV texture

Extrapolation up to 60 min
(here 30 minute nowcast plotted)

Description: Zinner et al., 2008

Cb-TRAM - Cumulonimbus TRacking And Monitoring



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Lightning (LINET)

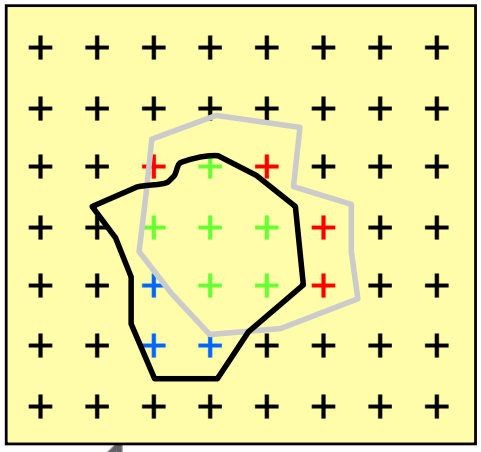
Extrapolation up to 60 min
(here 30 minute nowcast plotted)

Description: Zinner et al., 2008

CI-Verification

Contingency table		Observed	
		yes	no
Forecast	yes	hit	false alarm
	no	miss	correct negative

Cb-TRAM analysis used for comparison with the 15, 30, 45, and 60 minutes CI-stage nowcasts



Pixel based

Requires perfect matching!

CI-Verification

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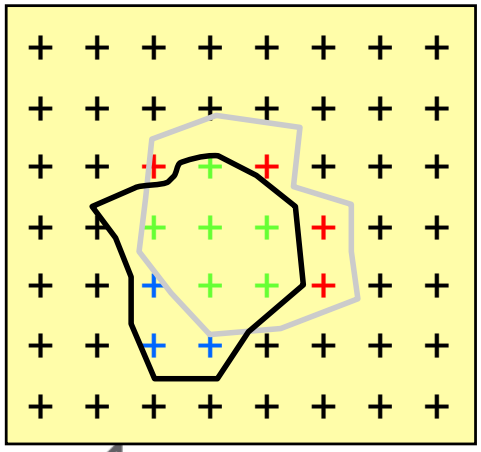

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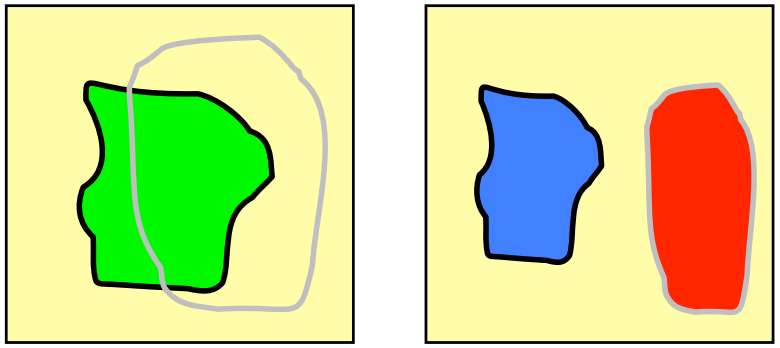
Object based



double penalty problem

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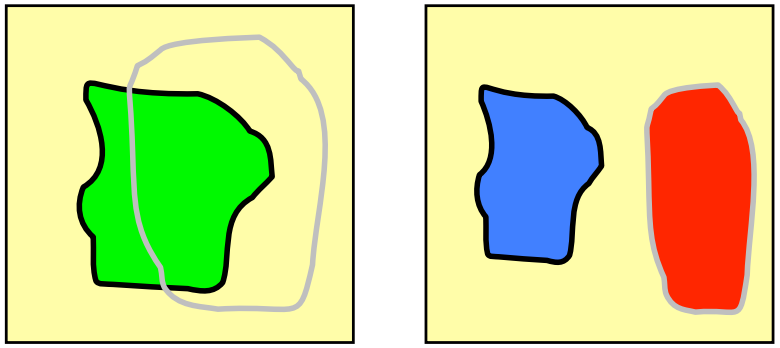

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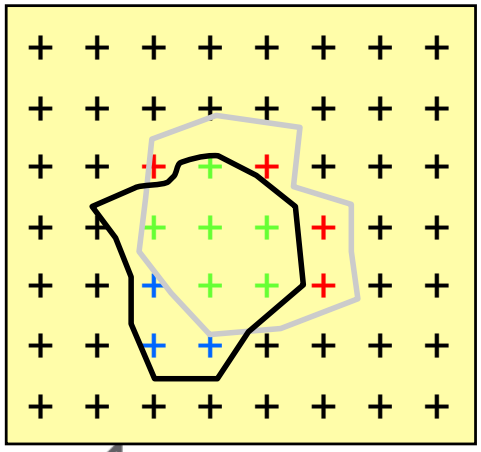
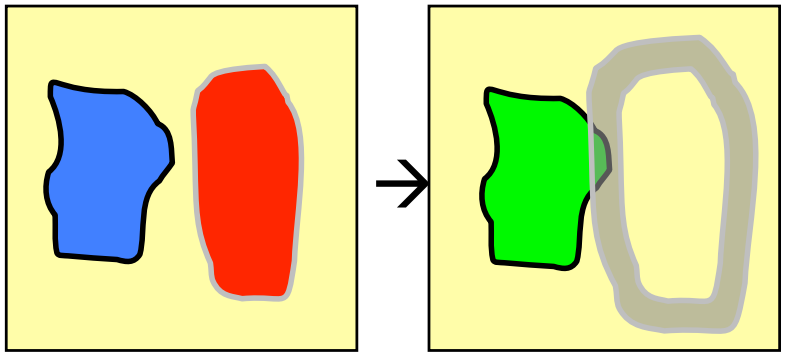


Pixel based

Requires perfect matching!

Fuzzy + Object based



CI-Verification

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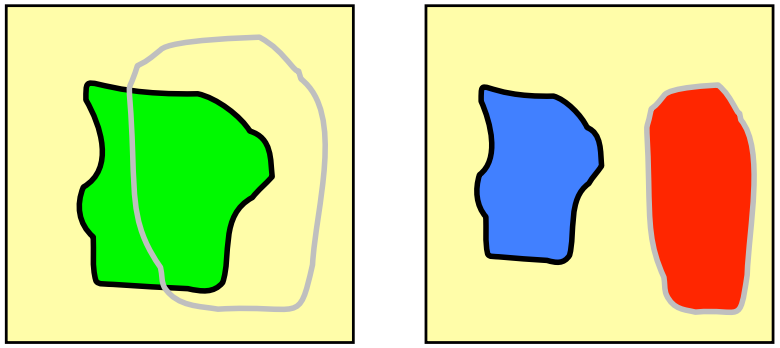


CI-Verification

Different versions shown:

Object based
with Cb stage 1 analysis objects for the nowcast overlap

Developing Object based
without Cb stage 1 analysis objects for the nowcast overlap
→ just developing cells

Results for the summer 2009, 15 May to 31 August			
	15 min	30 min	acc 15-60 min
Object based POD	0,5919	0,4212	0,4093
Object based FAR	0,6109	0,7545	0,5448
Dev Object POD	0,2281	0,1992	0,1697
Dev Object FAR	0,8853	0,8841	0,8176

POD = hits / (hits + misses)

FAR = false alarms / (hits + false alarms)
CSI = hits / (hits + misses + false alarms)

Additional data sources

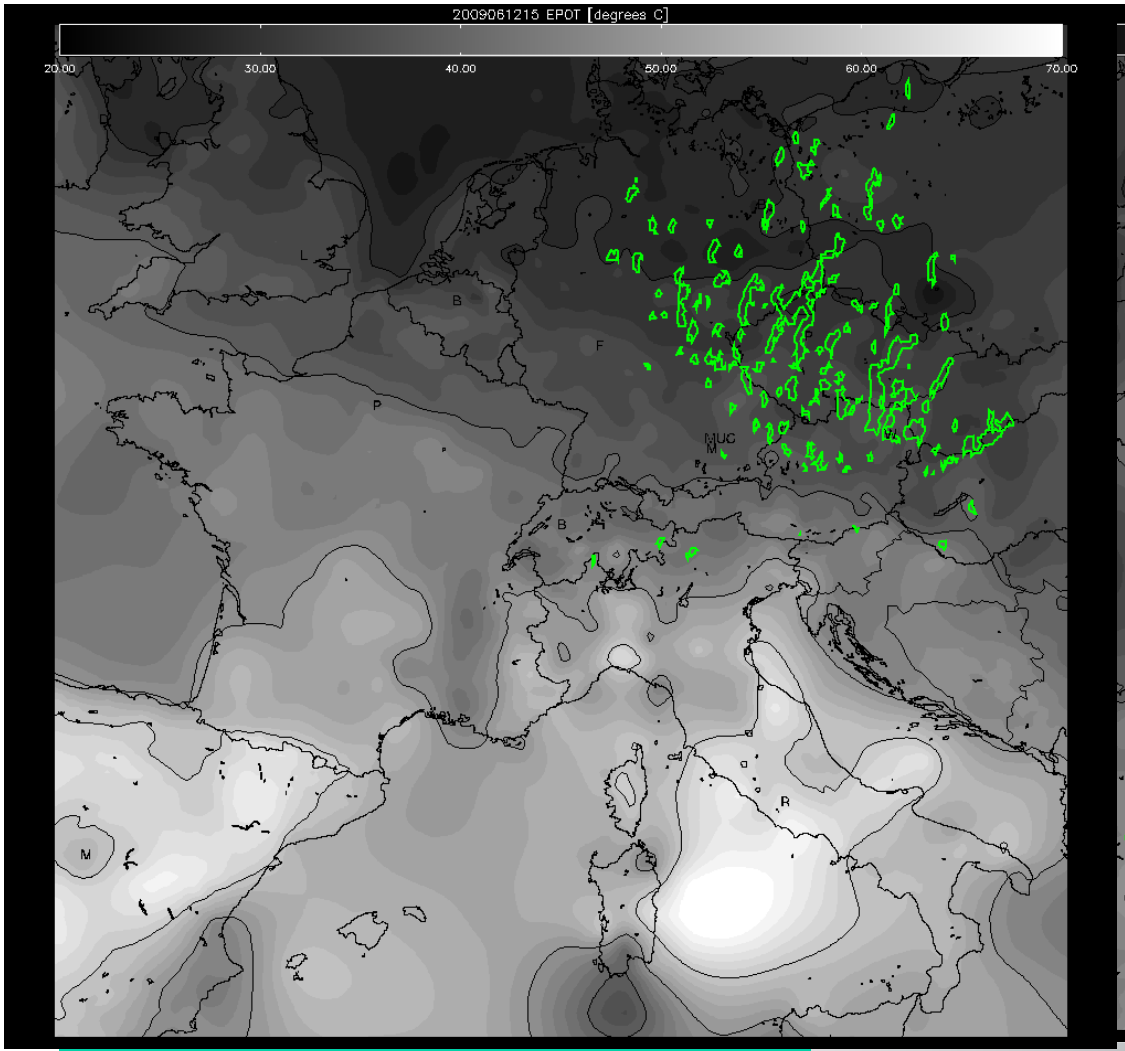
Testing the additional information provided by:

- more satellite channels (SATCAST IFs)
- VERA data (e.g. MFC, equivalent potential temperature)
- COSMO-EU data (e.g. updraft, an instability measure)
- COSMO-DE data (e.g. thunderstorm probability)
- LINET data

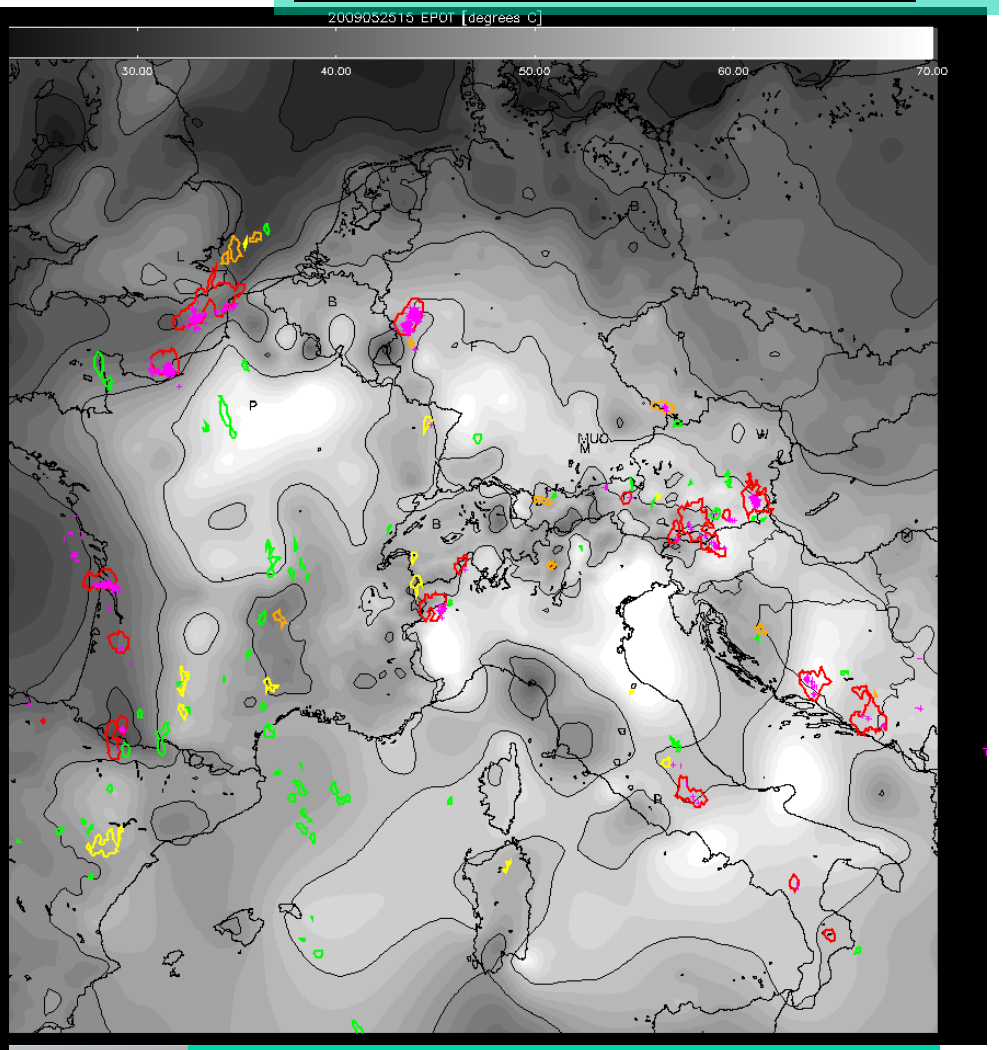
V ienna E nhanced R esolution A nalysis

More information and references:

www.univie.ac.at/amk/vera/

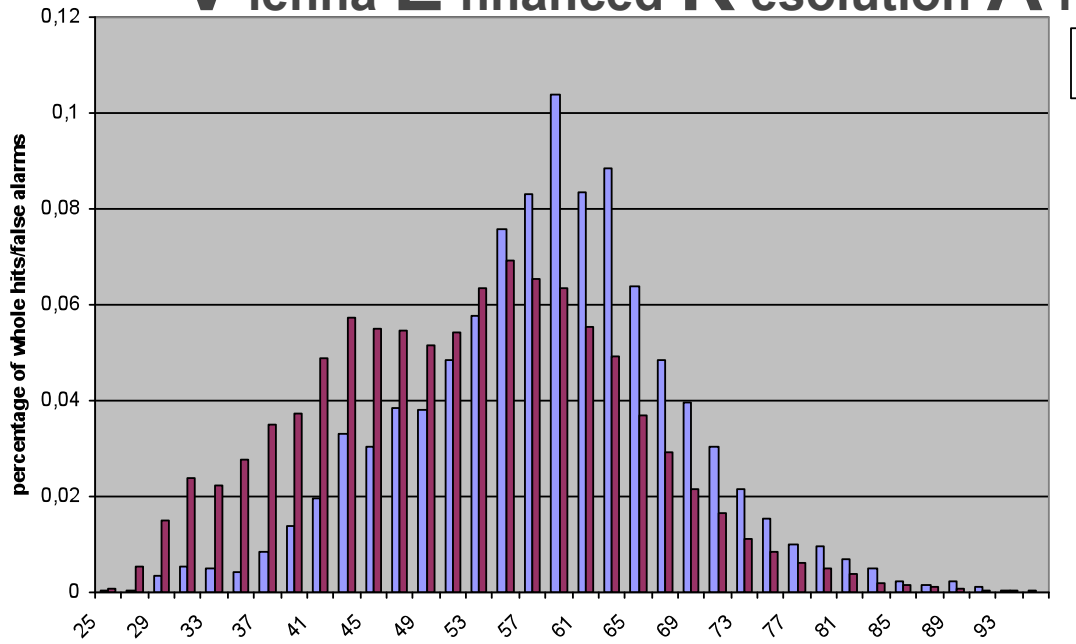


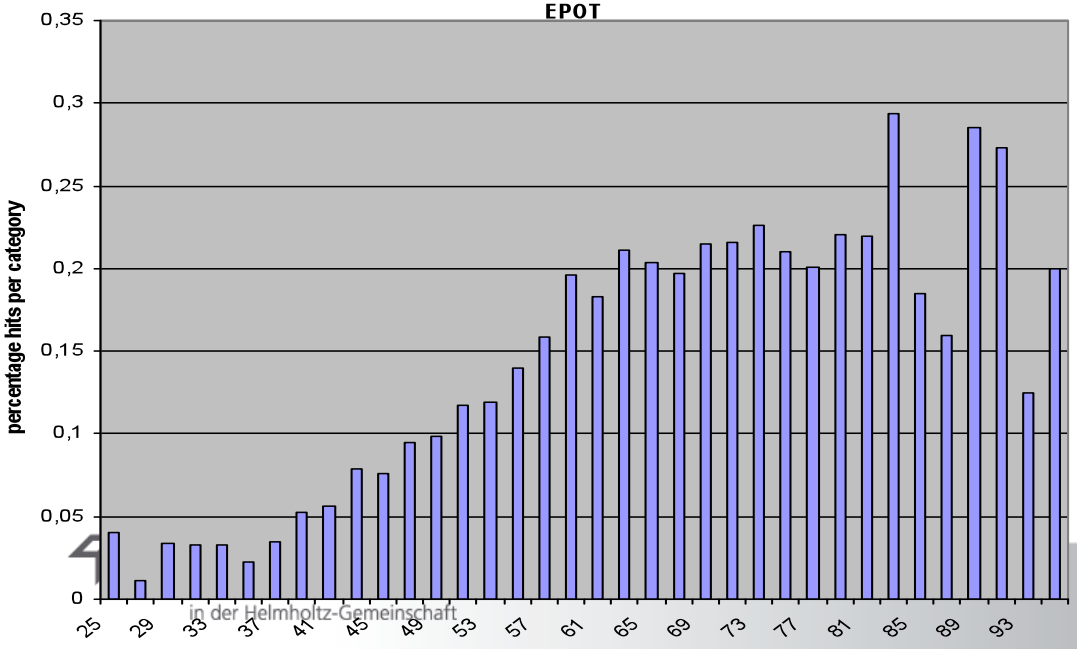
EPOT June 12 2009 15 UTC



EPOT May 25 2009 15 UTC

Vienna Enhanced Resolution Analysis





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Statistics calculated for ~ 35.000 CI cells over 87 days in summer 2009 (May 15 - 31 August)

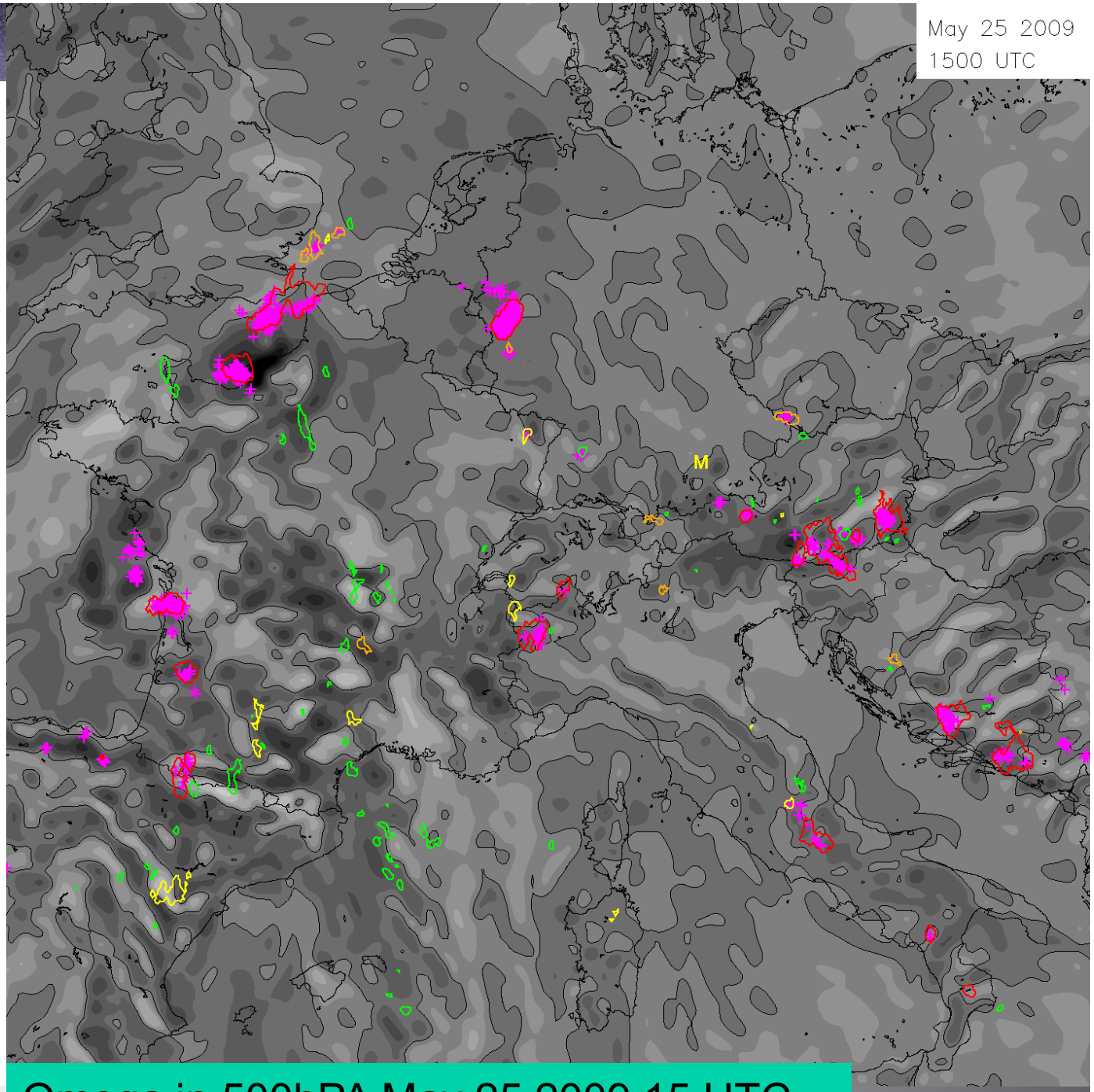
EPOT < 36 °:
2.2 % of all hits
11.2 % of all false alarms

EPOT < 41 °:
6.1 % of all hits
21.6 % of all false alarms

COSMO-EU

Omega in 500 hPa:

Dark shading represents updraft areas, light shading downdraft areas



Omega in 500hPA May 25 2009 15 UTC

VERA & COSMO_EU

First Results for Combinations:

Percentage of CI cells filtered with the additional data sources

	36° < Epot < 41°	false alarms	hits
Epot < 36°		11.2 %	2.2 %
Epot < 36°	MFD > 0	16.0 %	3.5 %
Epot < 36°	ω_{500} > 6	14.5 %	3.0 %
Epot < 36°	$\omega_{400\text{-}600}$ > 0	14.0 %	3.0 %
Epot < 36°	ω_{500} > 0 & MFD > 0	13.7 %	2.9 %
Epot < 36°	$\omega_{400\text{-}600}$ > 0 & MFD > 0	12.5 %	2.5 %

[MFD] = 10^-4 g/(kg s) & [ω] = hPa/h

Additional data sources

Testing the additional information provided by:

- more satellite channels (SATCAST IFs)
- VERA data (e.g. MFC, equivalent potential temperature)
- COSMO-EU data (e.g. updraft, an instability measure)

NEXT STEPS:

- COSMO-DE data (e.g. thunderstorm probability)
- LINET data

Data fusion (e.g. fuzzy logic)

Verify the abilities for the different products and their fusion

Thank you for your attention! Questions?

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