



Nowcasting of convection initiation by analysis and fusion of multiple data sources

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Outline

Motivation

Cb-TRAM (Cumulonimbus TRacking And Monitoring)

CI- Verification

Next steps

Summary





Motivation

Aviation purposes

Lead time: satellite vs radar

Cb-TRAM as basic tool

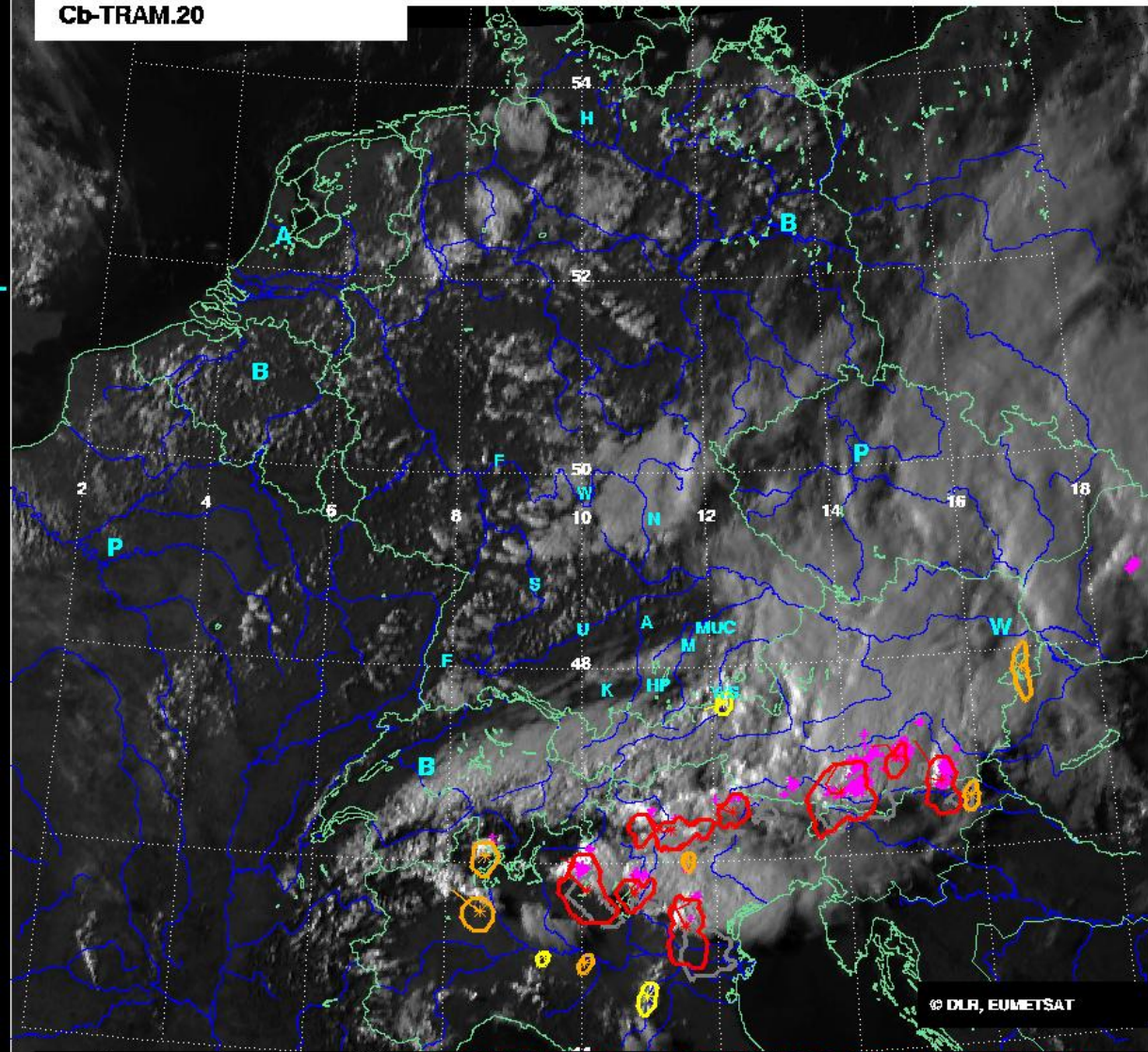
Adding non-satellite fields for further development

Cb-TRAM - Cumulonimbb TRacking And Monitoring

Cb-TRAM

22.08.2009 16:10 UTC Meteosat9 HRV

Cb-TRAM.20



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

Lightning

parallax corrected

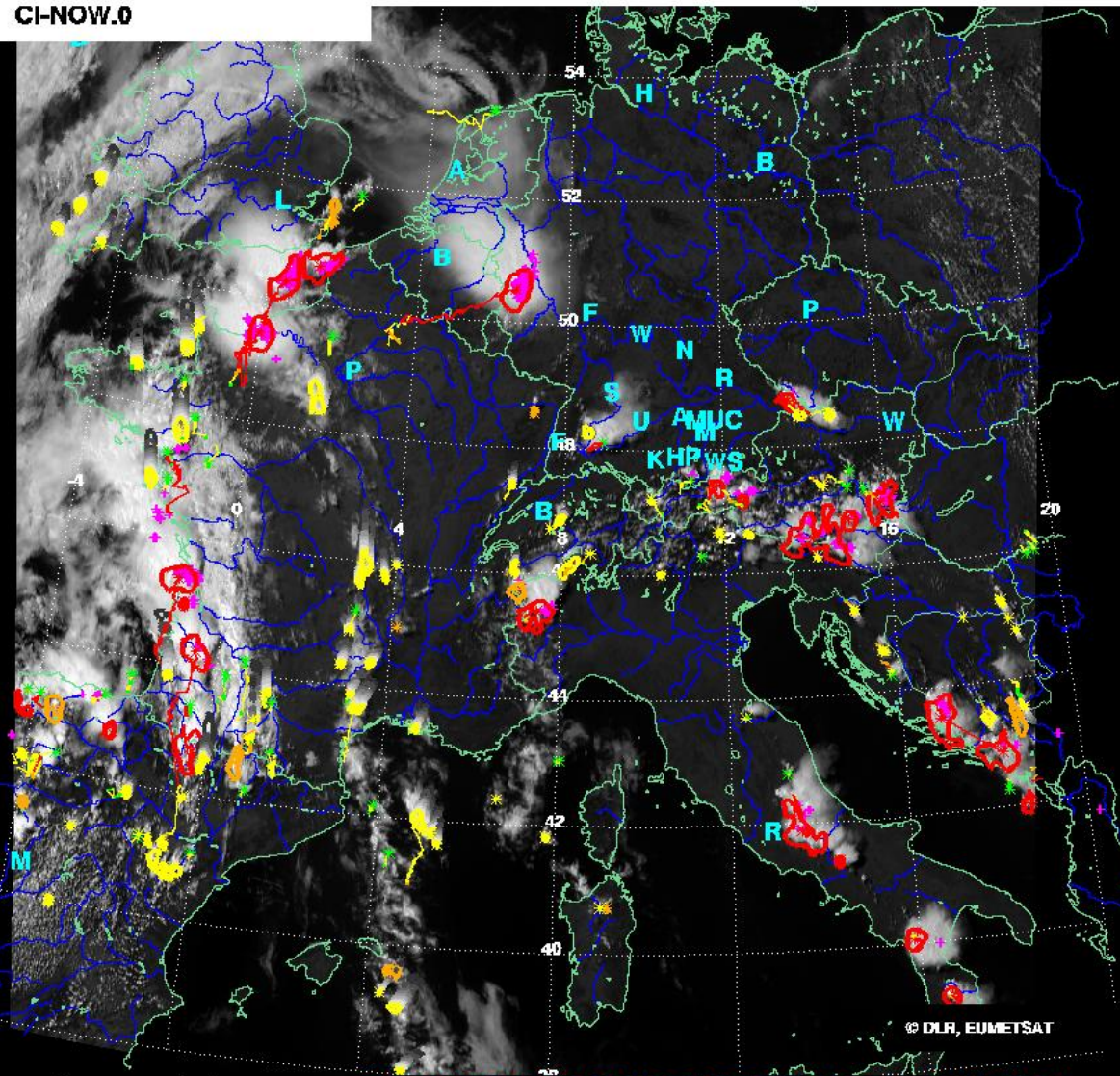
EXPERIMENTAL PRODUCT! NOT FOR OPERATIONAL USE!

Cb-TRAM - Cumulonimbus TRacking And Monitoring

CI-NOW

25.05.2009 14:50 UTC Meteosat8 HRV

CI-NOW.0



Tracks:

Colors represent the different detection stages within the track

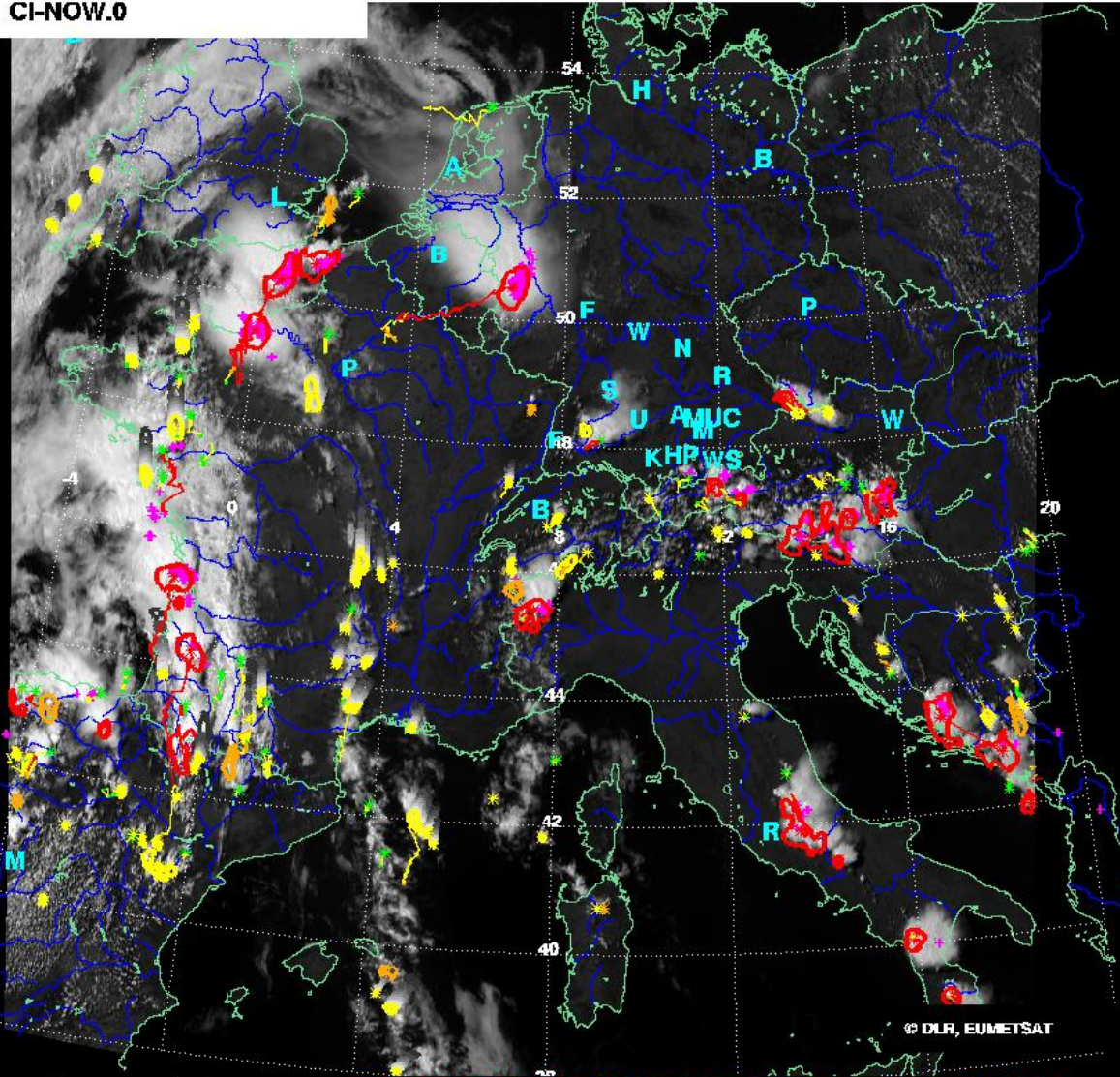
Description: Zinner et al., 2008

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Tracks:

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Nowcasts:

The extrapolation is shown just for the CI stage plotted in grey

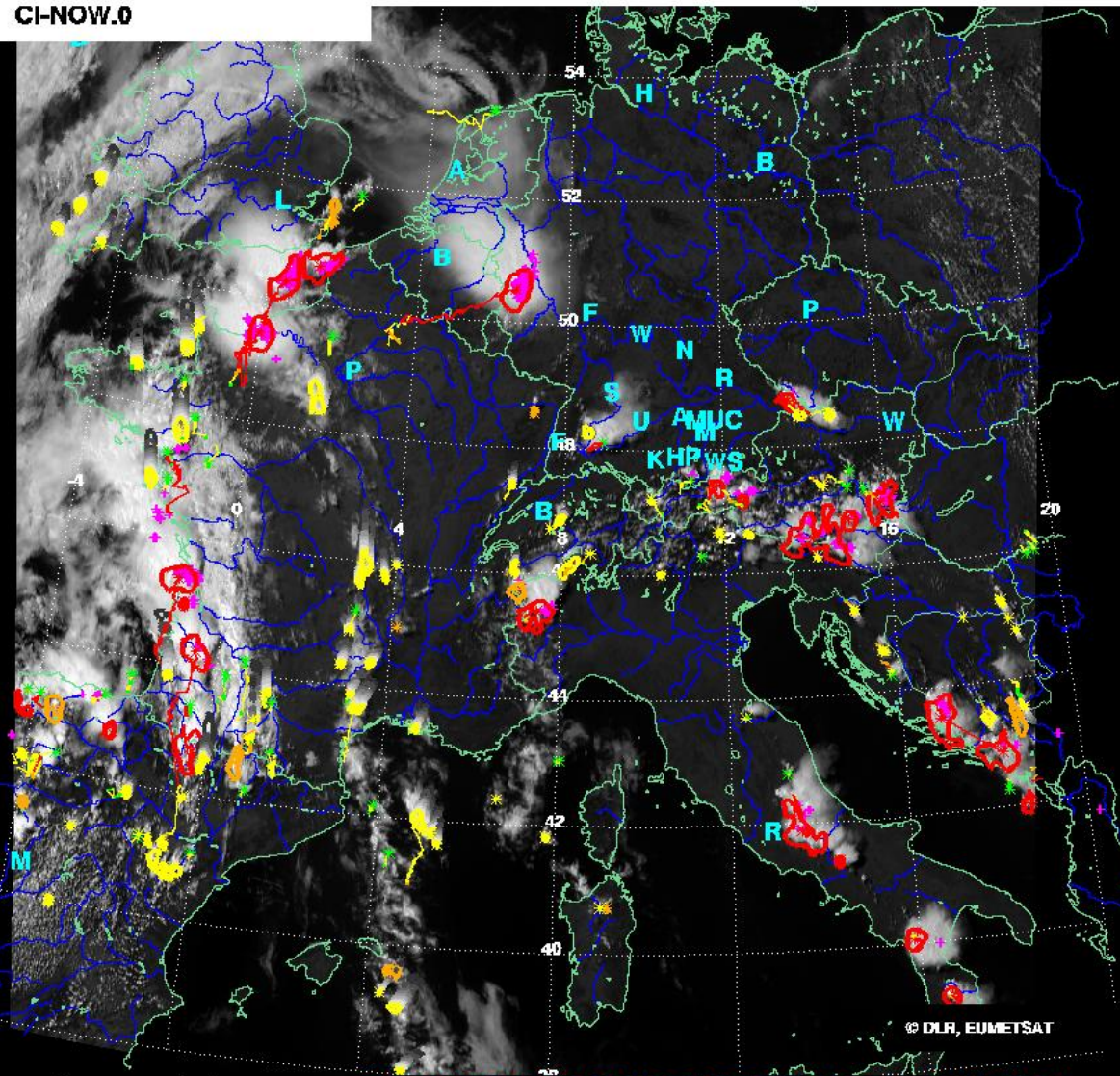
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Tracks:

Colors represent the different detection stages within the track

Nowcasts:

The extrapolation is shown just for the CI stage plotted in grey

Posttracking:

The green stars monitor positions of cells detected within the last two timesteps but not at the current one

Description: Zinner et al., 2008

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parallax corrected

CI-Verification

How to verify CI?

Cutting edge of forecast verification!

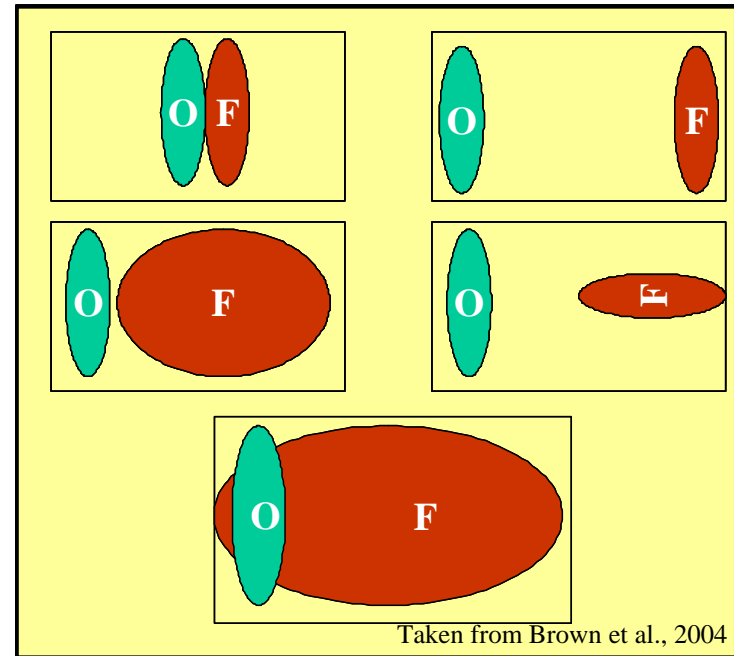
Difficult to match CI satellite indicators to lateron (30 – 60 min) existing storms, detected in radar, lightning or satellite data

Thunderstorms are relatively rare events!

How to deal with close nowcasts?
What is close?

Contingency tables

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



Taken from Brown et al., 2004



CI-Verification

How is a “CI-event“ defined? Or: What’s used as “truth“?

- radar echo ≥ 35 dBZ
(e.g. Roberts & Rutledge, 2003; Mecikalski & Bedka, 2006)
- Lightning density / flash rate
(e.g. Zinner & Betz, 2009; Donovan et al., 2008)
- Cb-TRAM “mature storm“-stage
determined by IR 6.2 – IR 10.8 and HRV texture

CI-Verification

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Cb-TRAM stage 1, 2, and 3 analysis used for comparison with the 15, 30, 45, and 60 minutes CI-stage nowcast

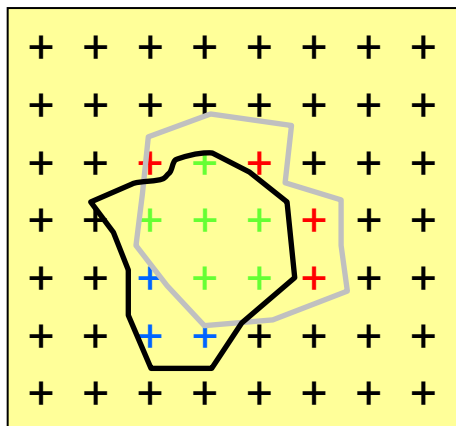
- Cb-TRAM “mature storm“-stage determined by IR 6.2 – IR 10.8 and HRV texture

CI-Verification

Contingency tables

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Pixel based

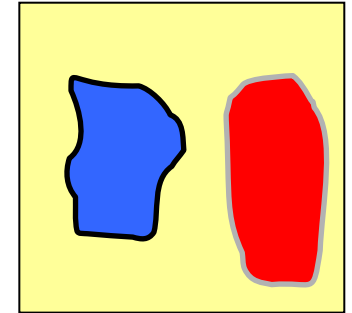
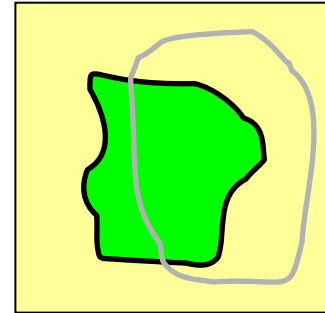
Requires perfect matching!

CI-Verification

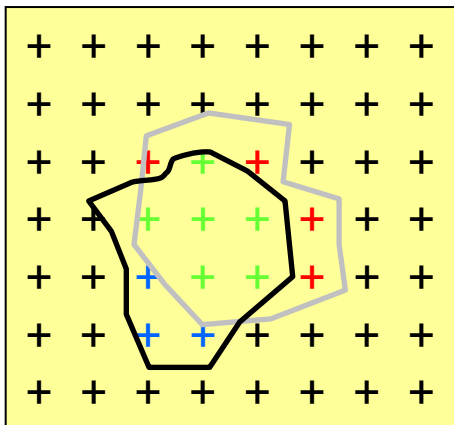
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Object based



double penalty problem



Pixel based

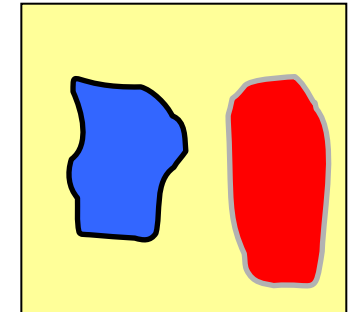
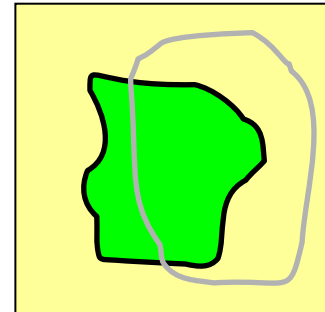
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CI-Verification

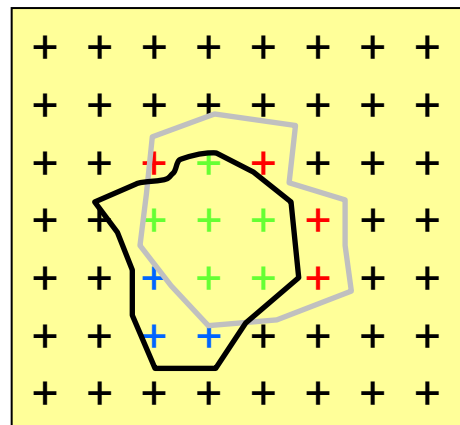
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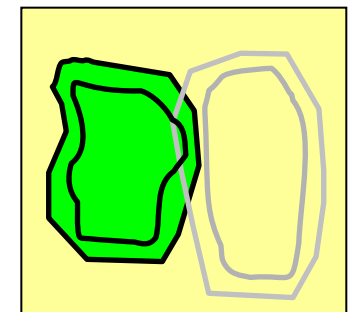
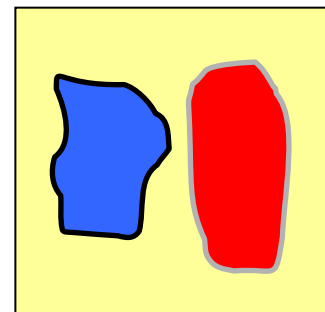
double penalty problem



Pixel based

Requires perfect matching!

Fuzzy + Object based



CI-Verification

Different versions:

Pixel based
& with Cb stage 2 nowcasts

Object based
& with Cb stage 2 nowcasts

Future work:

Fuzzy + Object based
incorporating
tracking uncertainties

Preliminary results for the summer 2009, 15 May to 31 August (30 minute nowcasts)

	POD	FAR	CSI
Pixel based	0.052	0.723	0.032
Pixel based Nowcast1&2	0.084	0.798	0.048
Object based	0.133	0.703	0.090
Object based Nowcast1&2	0.206	0.723	0.128

POD = hits / (hits + misses)

FAR = false alarms / (hits + false alarms)

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



Next steps

Incorporating some more satellite “interest fields“ using existing channels

Testing the additional information provided by:

- Satellite channels
- VERA data (e.g. moisture con- and divergence)
- COSMO-DE data (CAPE, CIN, etc)

Data fusion (e.g. fuzzy logic)

Verify the abilities for the different products and their fusion



Summary

Basic Tool
(Cb-TRAM)



Verification



Summary

Basic Tool
(Cb-TRAM)



Verification



Summary

Basic Tool
(Cb-TRAM) ↔ Verification

↓ Data Fusion

Cb-TRAM +
Additional data ↔ Verification

Summary

Basic Tool
(Cb-TRAM) ↔ Verification

↓ Data Fusion

Cb-TRAM +
Additional data ↔ Verification



CI-NOW – a CI detection and nowcasting tool

References

- Brown, B.G., R.R. Bullock, C.A. David, J.H. Gotway, M.B. Chapman, A. Takacs, E. Gilleland, K. Manning, J. Mahoney (2004): New verification approaches for convective weather forecasts. *11th Conf. Aviation, Range, and Aerospace Meteorology*, 4-8 Oct 2004, Hyannis, MA.
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- Zinner, T., Mannstein, H., and Tafferger, A. (2008). Cb-TRAM: Tracking and monitoring severe convection from onset over rapid development to mature phase using multi-channel Meteosat-8 SEVIRI data. *Meteorology and Atmospheric Physics*, **101**: 191210.

Thank you for your attention! Questions?

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