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Verification of the COSMO 7 km model and new developments for the 2.2 km model with a special emphasis on precipitation

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MeteoSwiss

3rd International Verification Methods Workshop
29 January - 2 February 2007, ECMWF

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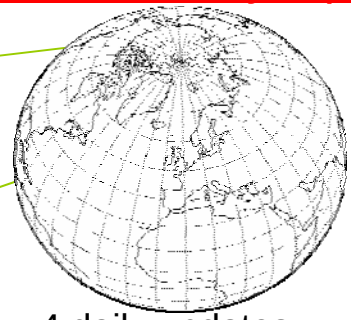
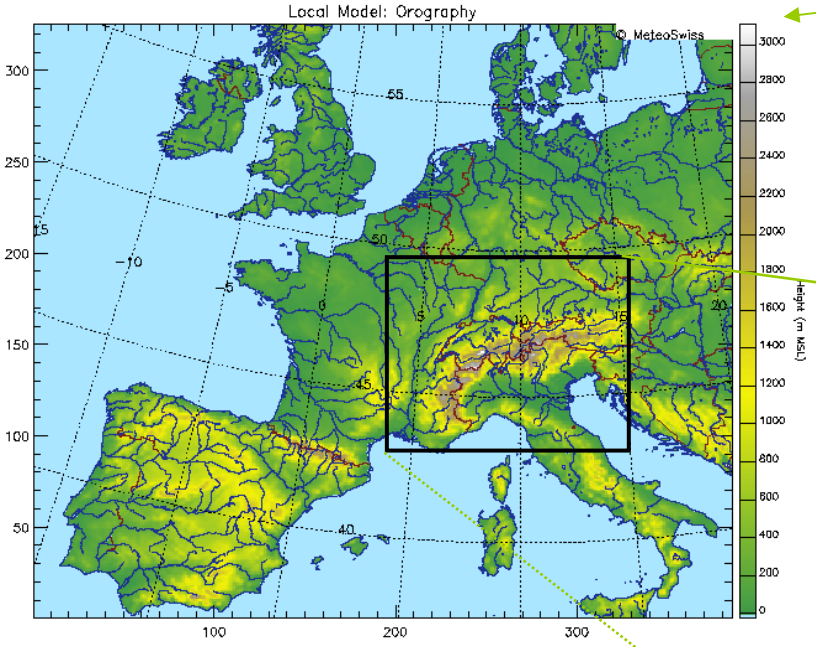
Configuration of COSMO 7 km and 2.2 km

IFS/ECMWF, 20km, synoptic scale



4 daily updates

COSMO 7km, regional scale



Own assimilation cycle

2 daily 72h forecast

COSMO 2.2km, local scale
pre-operational in 2007

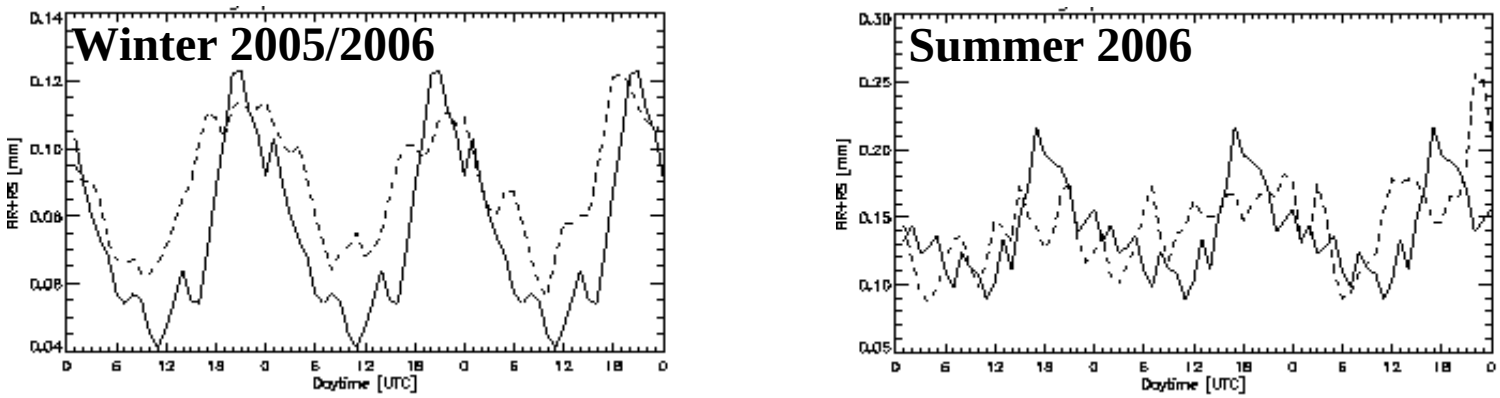
Own assimilation cycle

8 daily 18h forecast

Coarse scale verification (for precipitation)

- Verification with surface observations
- (as mean of 5 gridpoints of COSMO 7km model)
  - categorical verification (scores of 6h-sums)
  - diurnal cycle (hourly resolution)

Diurnal cycle of precipitation over Switzerland for gridpoints < 800 m



full line: obs (ANETZ) ; dashed: COSMO

Coarse scale verification (for precipitation)

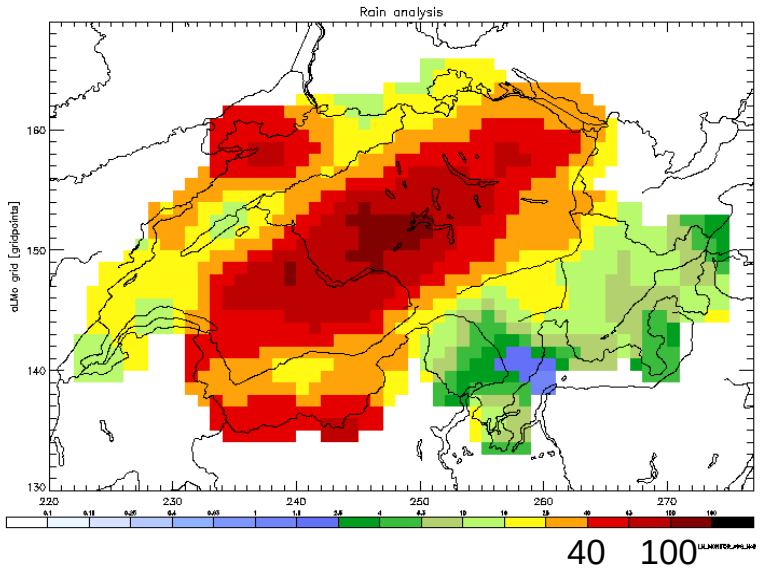
- Verification with surface observations
  (as mean of 5 gridpoints of 7km model)
  - categorical verification (scores of 6h-sums)
  - diurnal cycle

- Verification with raingauges (24h sums)
  - Gridded analyses vs model forecast

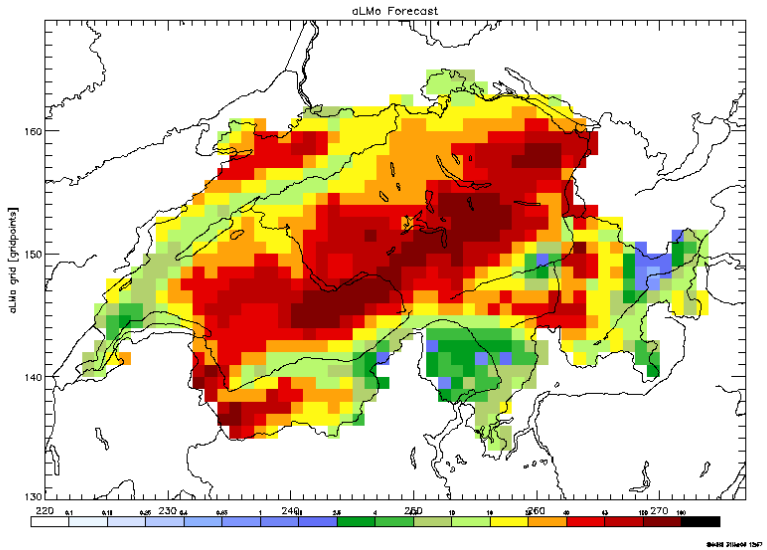
Flash flood August 2005

24h precipitation sums [mm] (21-22.8.2005, 06-06 UTC)

gridded observations
(Christoph Frei, Climate Services)



COSMO forecast of
20.8.2005 00 UTC (+30 to +54h)



Coarse scale verification (for precipitation)

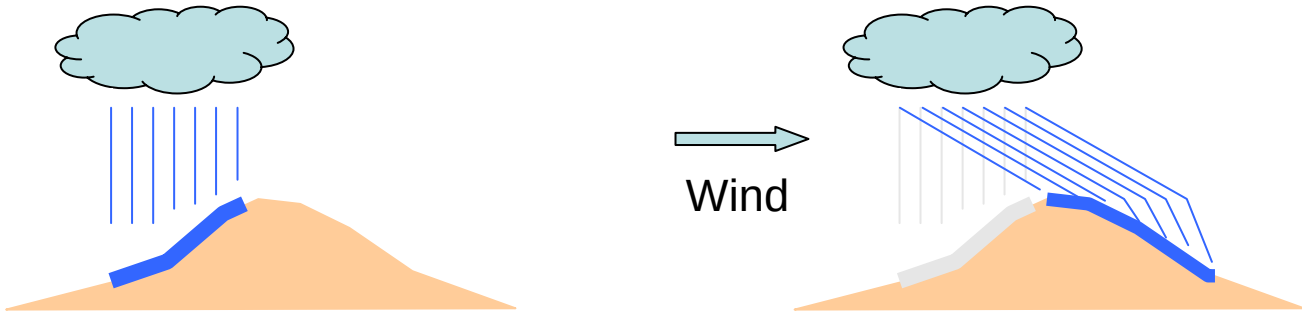
- Verification with surface observations
  (as mean of 5 gridpoints of 7km model)
  - categorical verification (scores of 6h-sums)
  - diurnal cycle

- Verification with raingauges (24h sums)
  - Gridded analyses vs model forecast

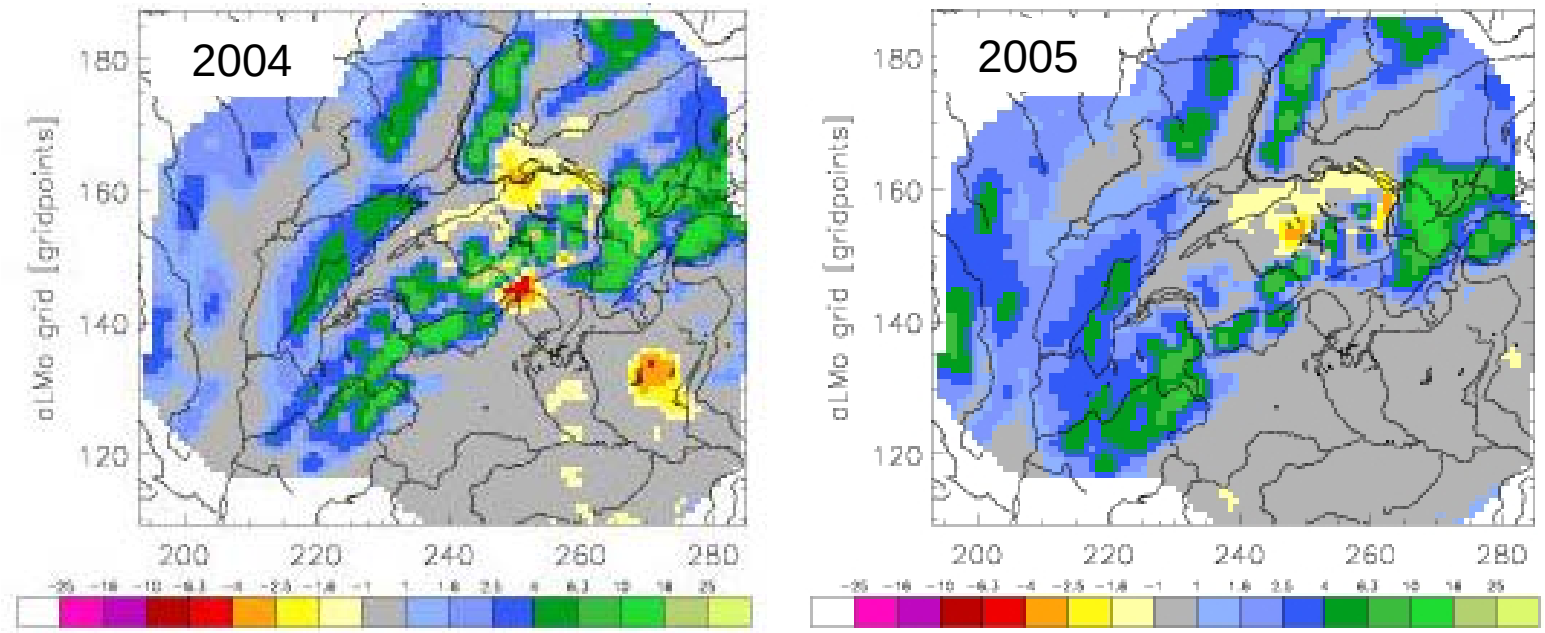
- Verification with radar precipitation estimates
  - categorical verification
  - Weather-type dependant verification

Impact of prognostic precipitation

(introduced on 16 November 2004)



COSMO – Radar; northwesterly flow

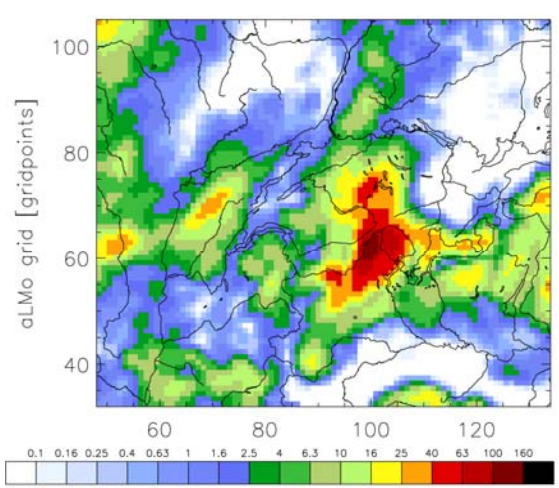


Emanuele Zala, MeteoSwiss

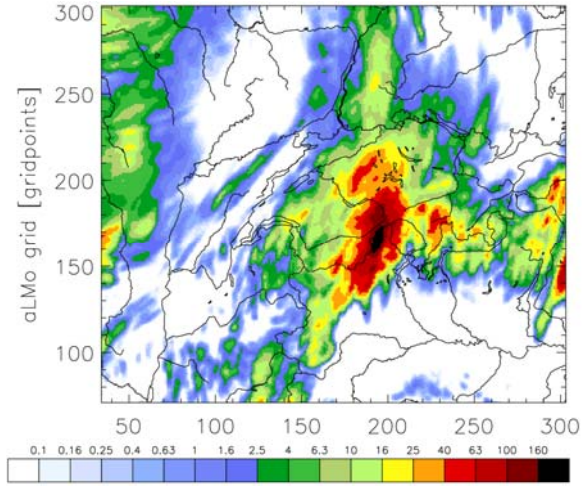
Precipitation in COSMO 7 km and 2.2 km

Experiments in Project Preview (flash floods)

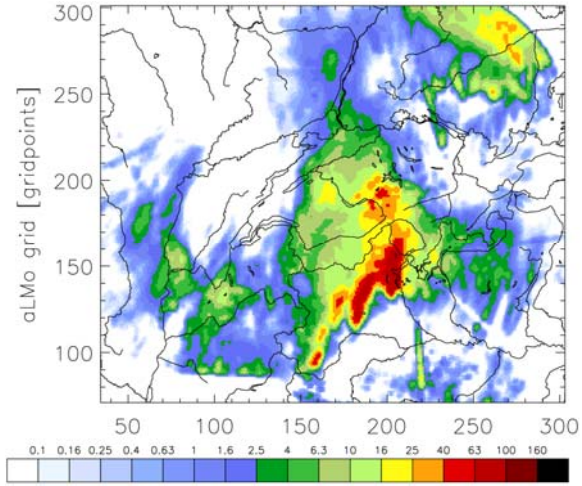
12h-precipitation sums (+12 to +24h) of COSMO forecast of 05.06.2002 00 UTC



COSMO 7 km



COSMO 2.2 km



Radar

COSMO 2.2 km show much more finescale structures: are they realistic?

Towards fine scale verification (for precipitation)

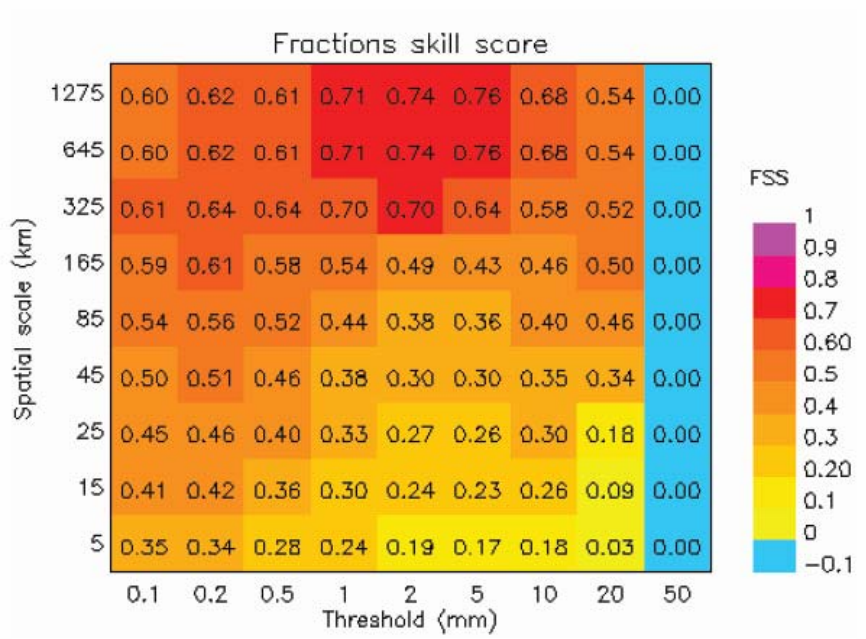
- point-based verification ➔ double penalty problem
  - consider non-localized statistics: frequency distribution, autocorrelation length
  - consider fuzzy-localized statistics: looking at various spatial scales, apply different interpretation strategies

    ➔ Fuzzy verification

- COSMO Priority Project “Advanced interpretation and verification of very high resolution models”
  - Goal is to find the smallest area in which the benefit of running a very high resolution model is present (reliable scale)
  - Products for end-users (forecasters) designed for this scale

Fuzzy verification

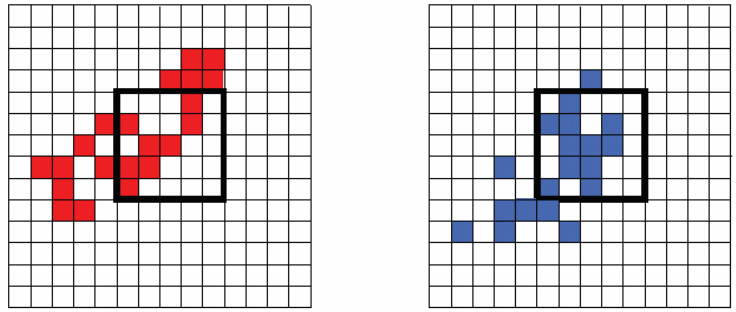
- define scales of interest; consider “average” features within each box
- Beth Ebert build up a collection of existing fuzzy forecasting verification scores in a toolbox



(© Beth Ebert)

Example: Fractions skill score

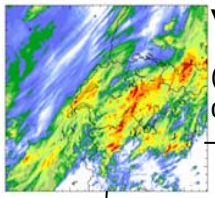
Compare fractional coverage in a box



(© Beth Ebert)

- score depends on considered scale and threshold (defining an event)

A (Fuzzy) Verification testbed

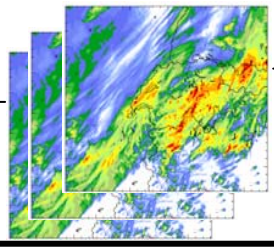


Virtual truth

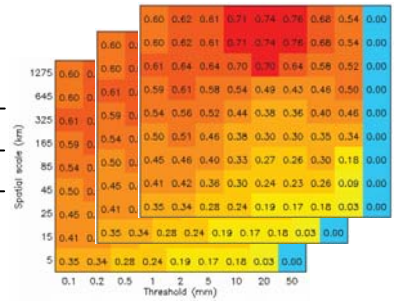
(Radar data, model data, **synthetic field**)

Perturbance Generator

Realizations of virtual model forecasts

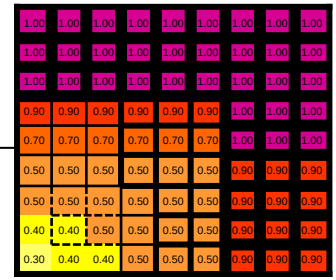


Fuzzy Verification Toolbox



Realizations of verification results

Analyzer



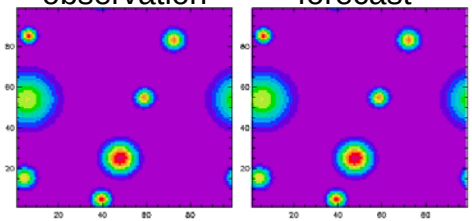
Assessment of

- sensitivity
- sharpness

Perturbation	Description
SCALE	Multiply field by constant factor
WNOISEMULT	Multiply by white noise
XSHIFT	Translation in space
TSHIFT	Translation in time
SMOOTH	Smooth the field
…	…

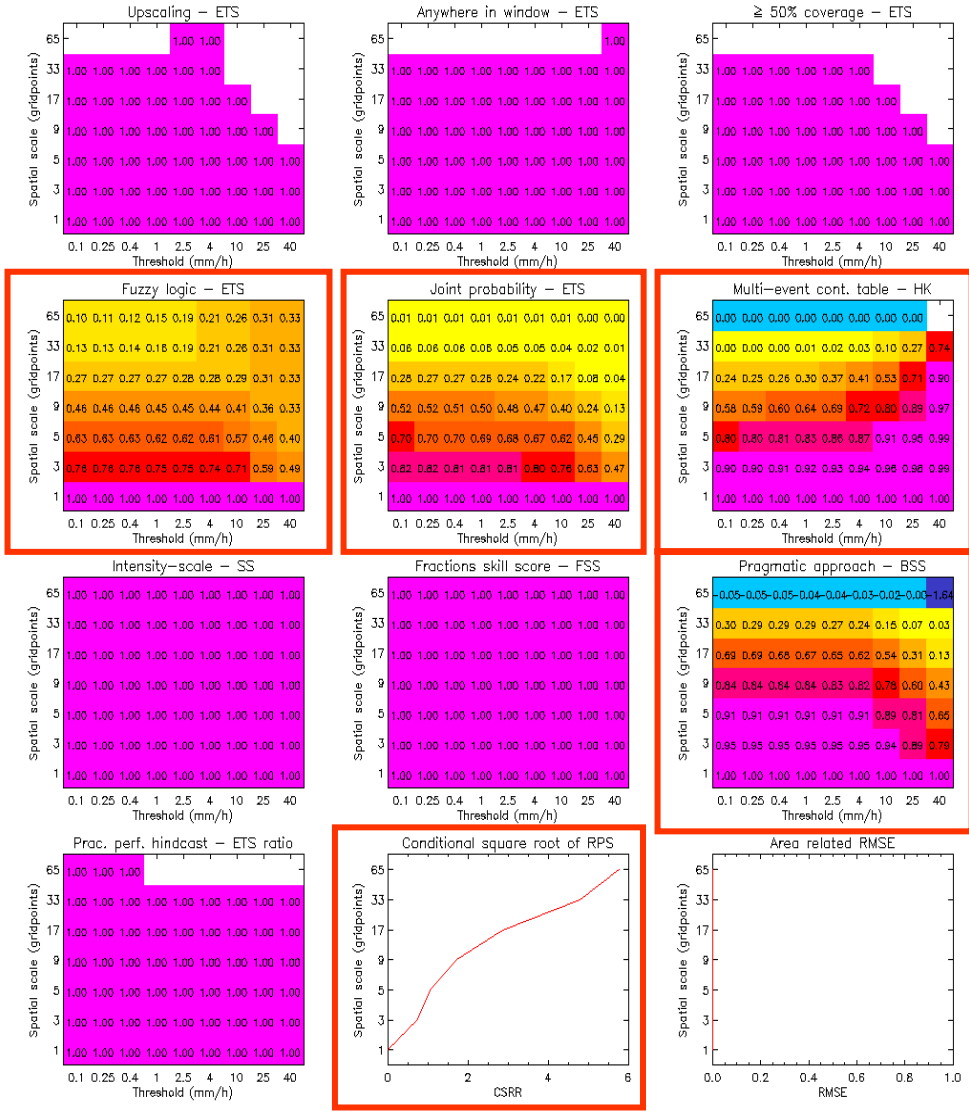
Perfect forecast

observation = forecast



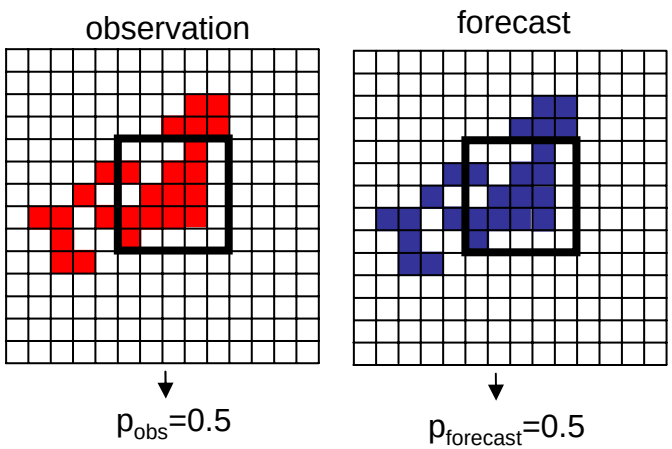
All scores should equal 1.00 **!**

But, in fact, 5 out of 12 do not!

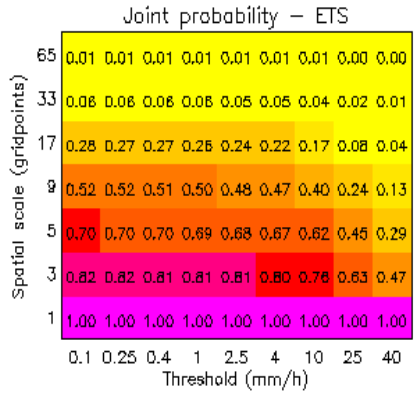


Effect of „Leaking“ Scores

Some methods assume no skill at scales below window size!



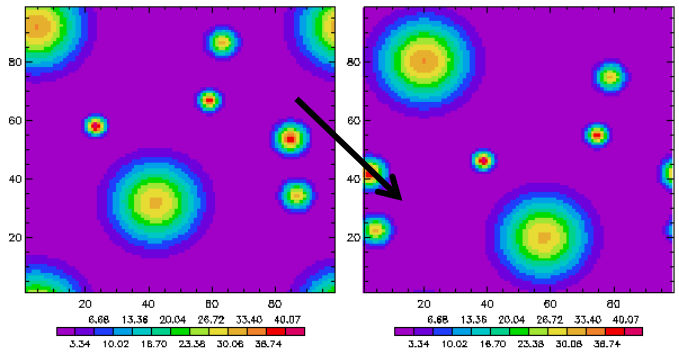
An example:
Joint probability method



OBS	Forecast: yes	Forecast: no
yes	0.25	0.25
no	0.25	0.25

Not perfect!

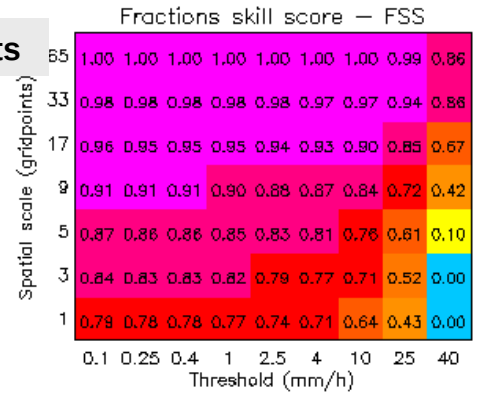
Spatial Translation



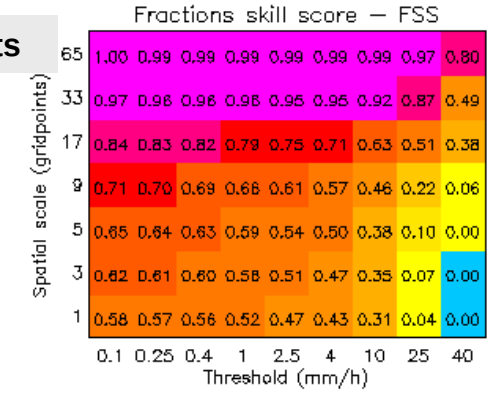
Example:
Fractions skill score (Roberts, N., 2005)

- Fraction skill score shows a very reasonable behavior in case of translations.

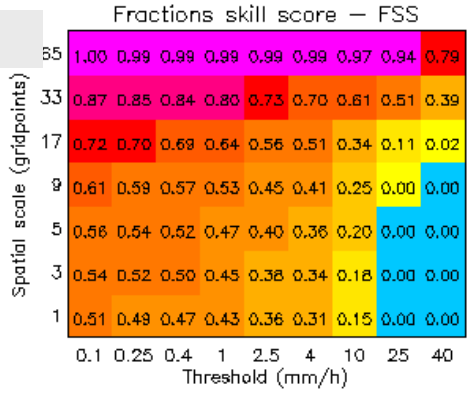
Δx=7.5 points



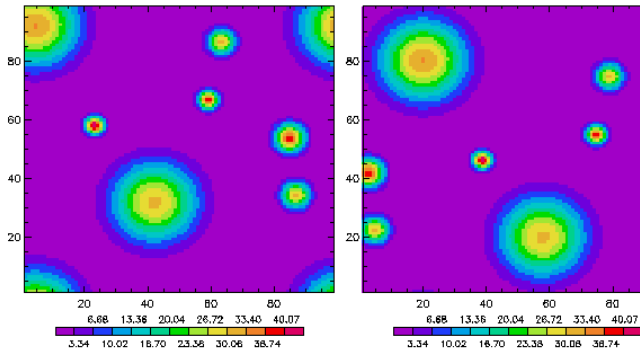
Δx=15 points



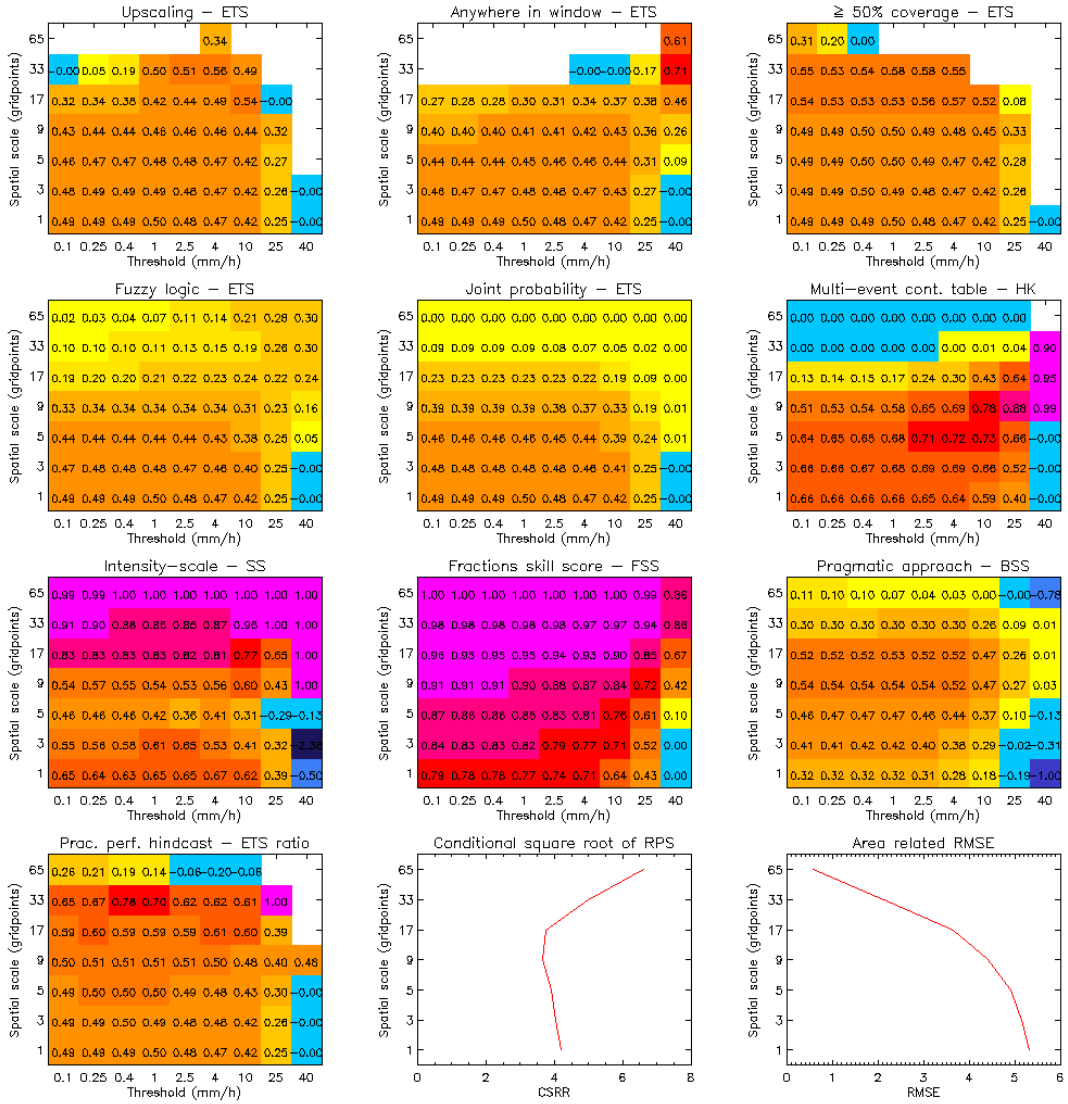
Δx30 points



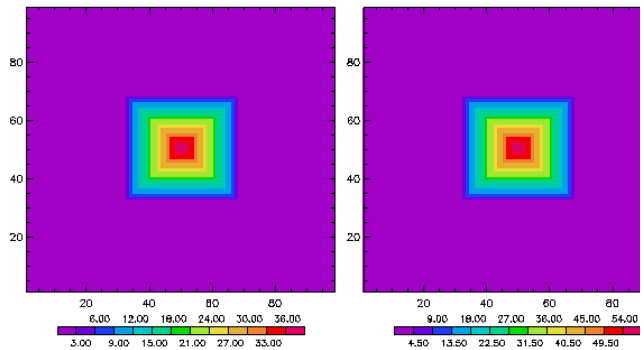
Spatial Translation



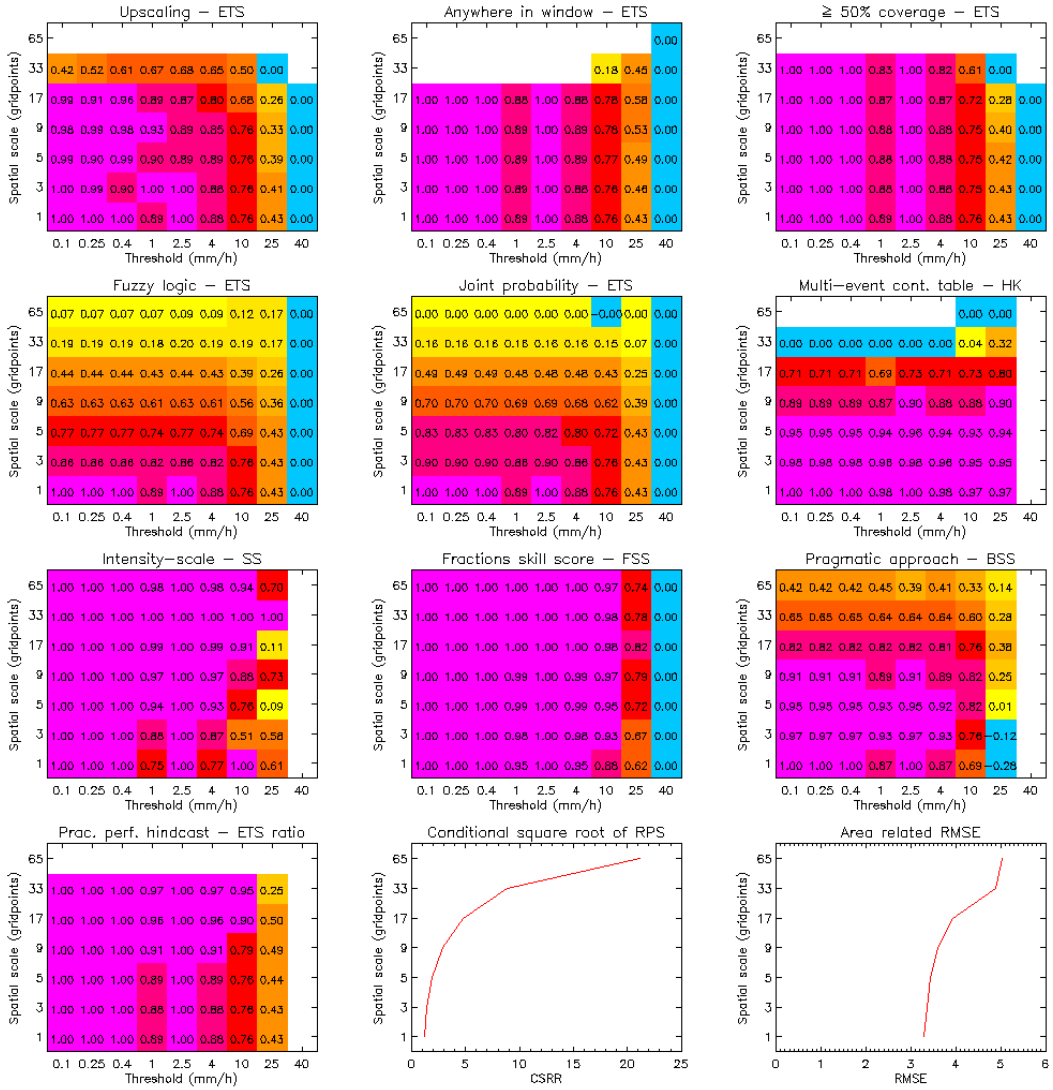
Δx=7.5 points



Scaling



scaling: 1.50



Outlook

- Further study with the fuzzy verification testbed
  - Scaling, smoothing, ...
- Selection of some fuzzy verification methods
  - Fractions skill score, intensity-scale, ...
- Starting verification with real cases
  - Comparison of COSMO: 7 km vs 2.2 km
- Verification of MAP D-PHASE WWRP forecast demonstration project (August-November 2007)
  - Flash floods, ...

Thank you for your attention