Statistical Postprocessing of Surface Weather Parameters

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Example of Convective Precipitation

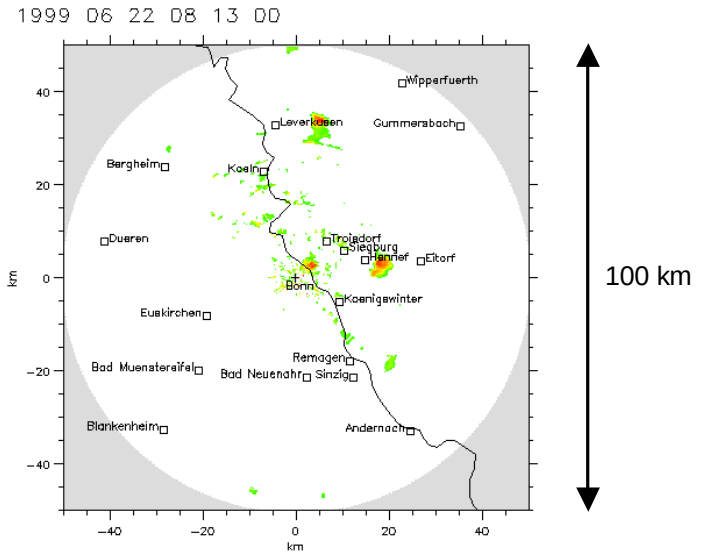
OUTLINE

Motivation

Experimental Ensemble

Statistical Postprocessing

Conclusion



Limits of Deterministic Predictability

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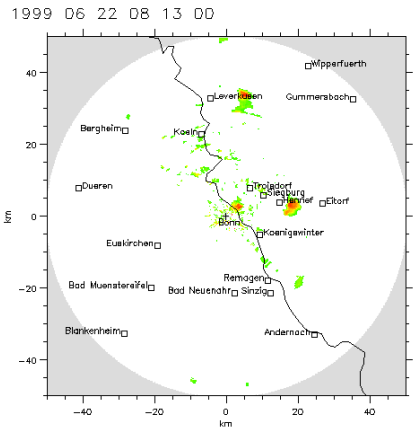

The NWP Model LM:

grid size: 7 km

lead time: 48h

The DMO of the LM might contain a considerable amount of noise!

From the Model to the User

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model + autom. postprocessing

user

judgment by an expert

Automatic Forecast Product

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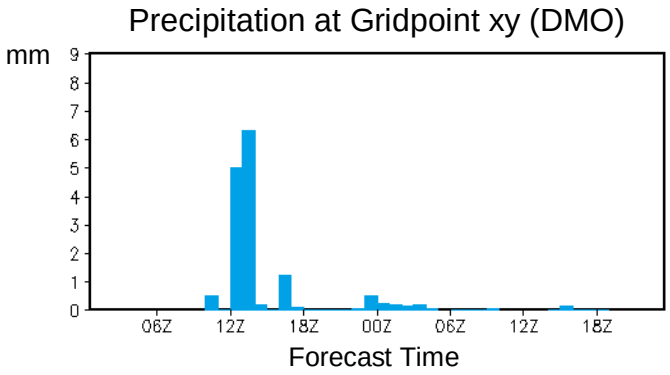

Automatic Forecast Product

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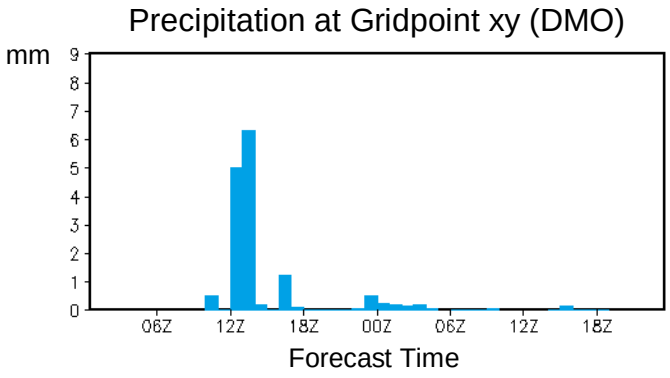

The uncertainty inherent in forecasters‘ judgments is not reflected – the forecast is not consistent!

Aims of the Project

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- detection of cases with limited predictability
- optimal interpretation of the DMO in such cases (automatic method!)

The Experimental Ensemble

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Perturbation of sub-grid scale processes:

- parametrized tendencies (ECMWF)
- solar radiation flux at the ground
- roughness length

The Experimental Ensemble

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Perturbation of parametrized tendencies:

Unperturbed simulation:

$$e(t) = \int_{t=0}^{t} \frac{\partial e}{\partial t}\, dt = \int_{t=0}^{t} \{\, \mathrm{A}(e;t) + \mathrm{P}(e;t) \,\}\, dt$$

Ensemble member:

$$e_j(t) = \int_{t=0}^{t} \left\{ \mathrm{A}(e_j;t) + \mathrm{P}(e_j;t) \cdot \langle x_j(\mathrm{r};t) \rangle \right\} dt$$

The Experimental Ensemble

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Structures of a few gridboxes in size are very sensitive to the perturbations

- 1-hr sum of precipitation (conv and gsc) — xx
- cloud cover (esp. conv) — xx
- net solar radiation — xx
- 2m-temperature — x
- net thermal radiation — x
- 10m-wind (gusts and mean) — o

Statistical Postprocessing

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- Verification

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DMO of a single simulation → noise-reduced QPF and PQPF

Basic Assumption

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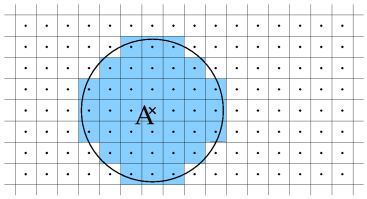
random variability
=
variability in space & time



Forecasts within a neighbourhood in space & time constitute a sample of the forecast at grid point A

Products of Postprocessing

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- Mean Value and Expected Value
- Quantiles (10%, 25%, 50%, 75%, 90%)
- Probability of Precipitation (several thresholds)

Example of a Forecast Product

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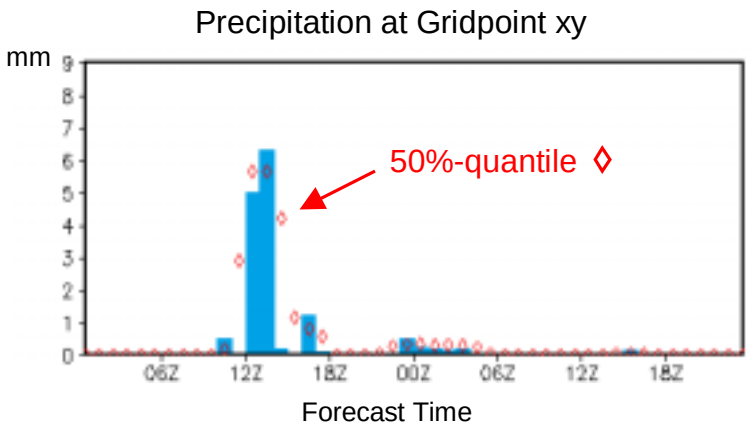

Example of a Forecast Product

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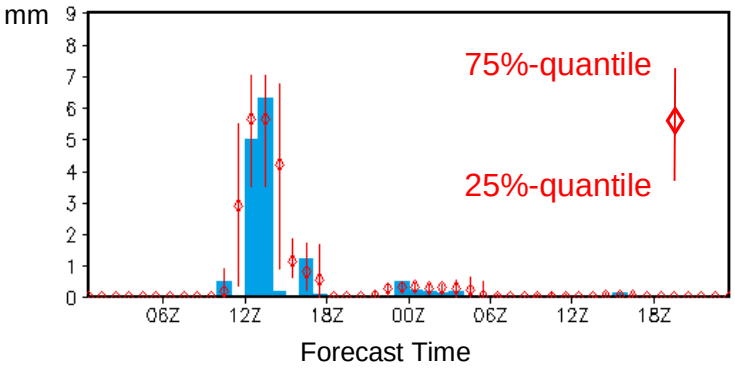
Precipitation at Gridpoint xy



Example of a Forecast Product

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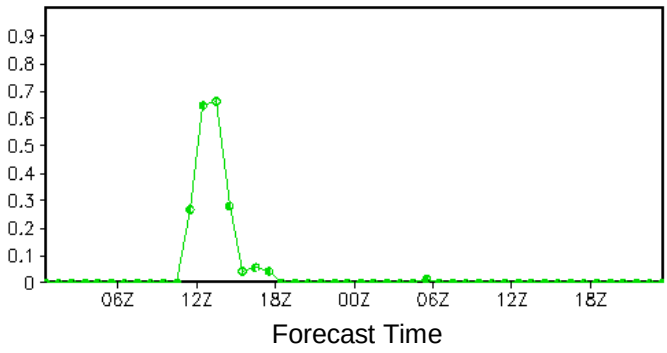
Probability of Precipitation > 2.0 mm at Gridpoint xy



Verification of Postprocessed DMO

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...has been done:

- for 1-hour sums of precipitation and 2m-temperature
- for several periods in the warm season (length: 2 weeks each)
- on the area of Germany

Following example: 10.7.-24.7.2002
1-hour sums of precipitation

Verification of Mean Value

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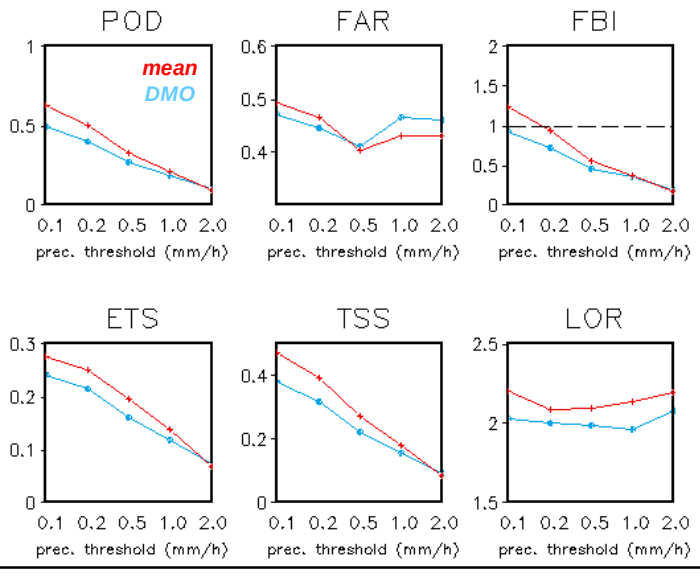

Verification of PoP Forecasts

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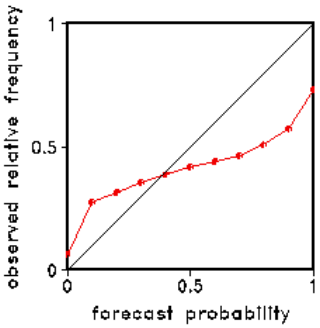
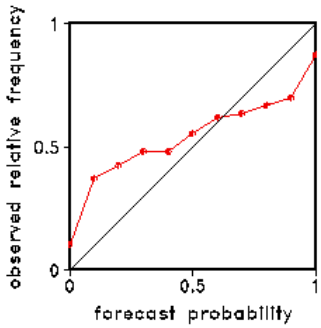
Reliability Diagram

prec. thresh.: 0.1 mm/h



prec. thresh.: 2.0 mm/h



Conclusion

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- small scales of the DMO contain a considerable amount of noise (experimental ensemble)
- postprocessing (smoothing) significantly improves the DMO in some respects
- probabilistic QPF still needs improvement

Outlook

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- make further refinements to the postprocessing method
- can we improve the PQPF?
- another postprocessing method: application of wavelets