1st COPS Workshop
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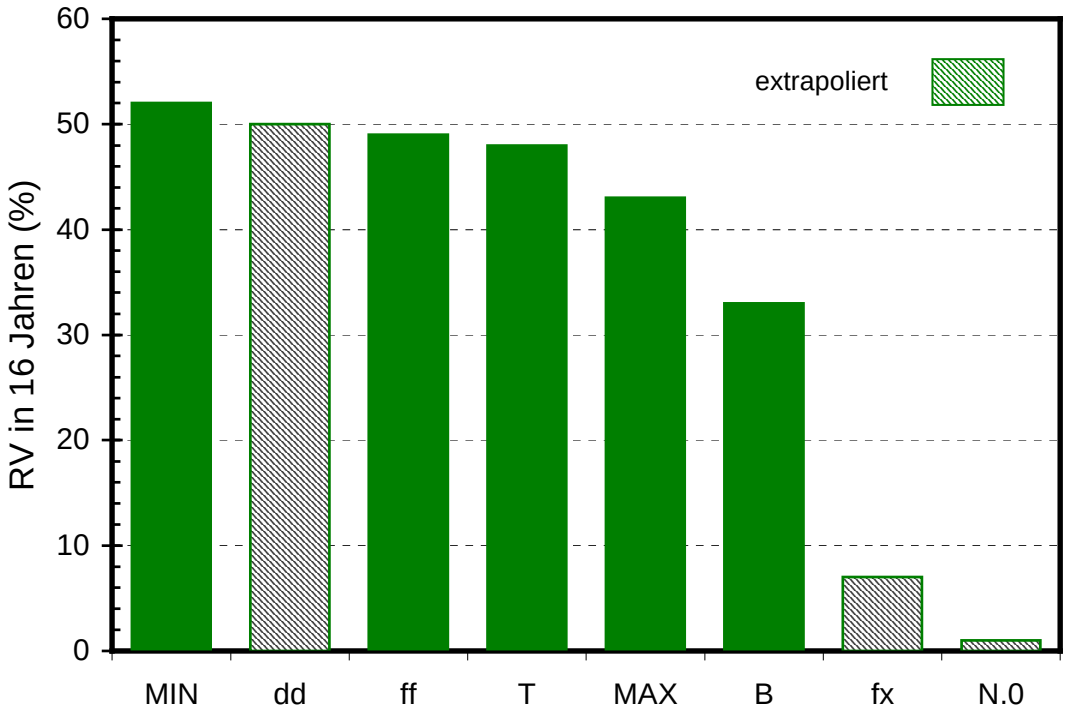
The precipitation process in NWP: skills, problems, and data requirements

Erdmann Heise
German Weather Service

Outline

- Skill of precipitation prediction compared to other results of NWP
- The precipitation process in NWP
- The problem of convection
- Data requirements in COPS
- Conclusions



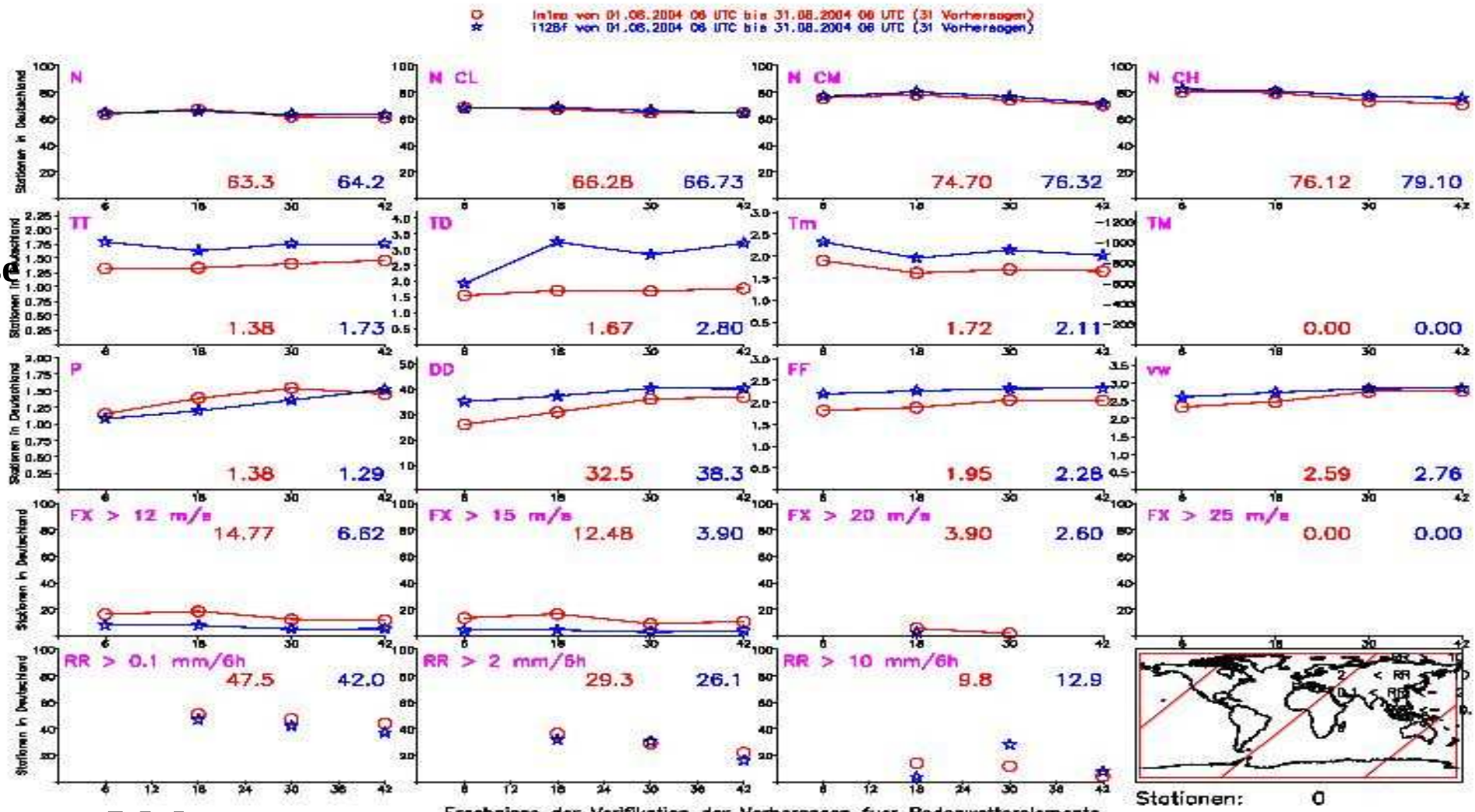
Reduction of variance
in 16 years for

- Temperature (T, MIN, MAX)
- Wind (dd, ff, fx)
- Cloud cover (B)
- Precipitation (ND)

Remark: Verification of quantitative precipitation prediction of all major NWP-centres shows comparable results for the different models

rmse

tss

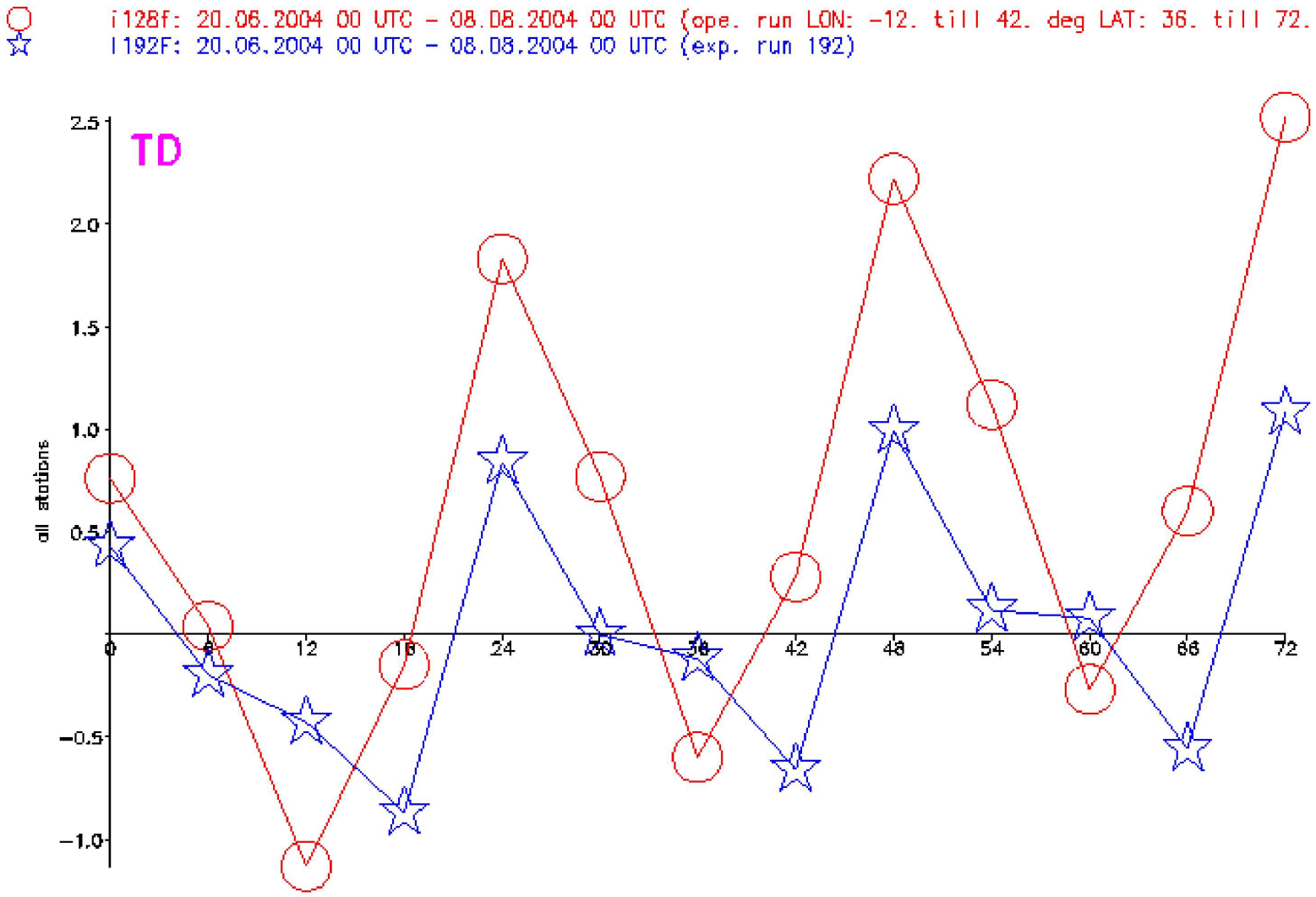


Ergebnisse der Verifikation der Vorhersagen fuer Bodenwetterelemente
TSS fuer Niederschlag T-6 bis T, ETS fuer Boeen, Treffer fuer Bedeckungsgrade, RMSE fuer andere Elemente
Mittelwerte ueber alle Vorhersagezeitraeume als Ziffern, horizontal: Vorhersagezeit
Verifikation fuer den Zieltermin

LM

GME

August 2004

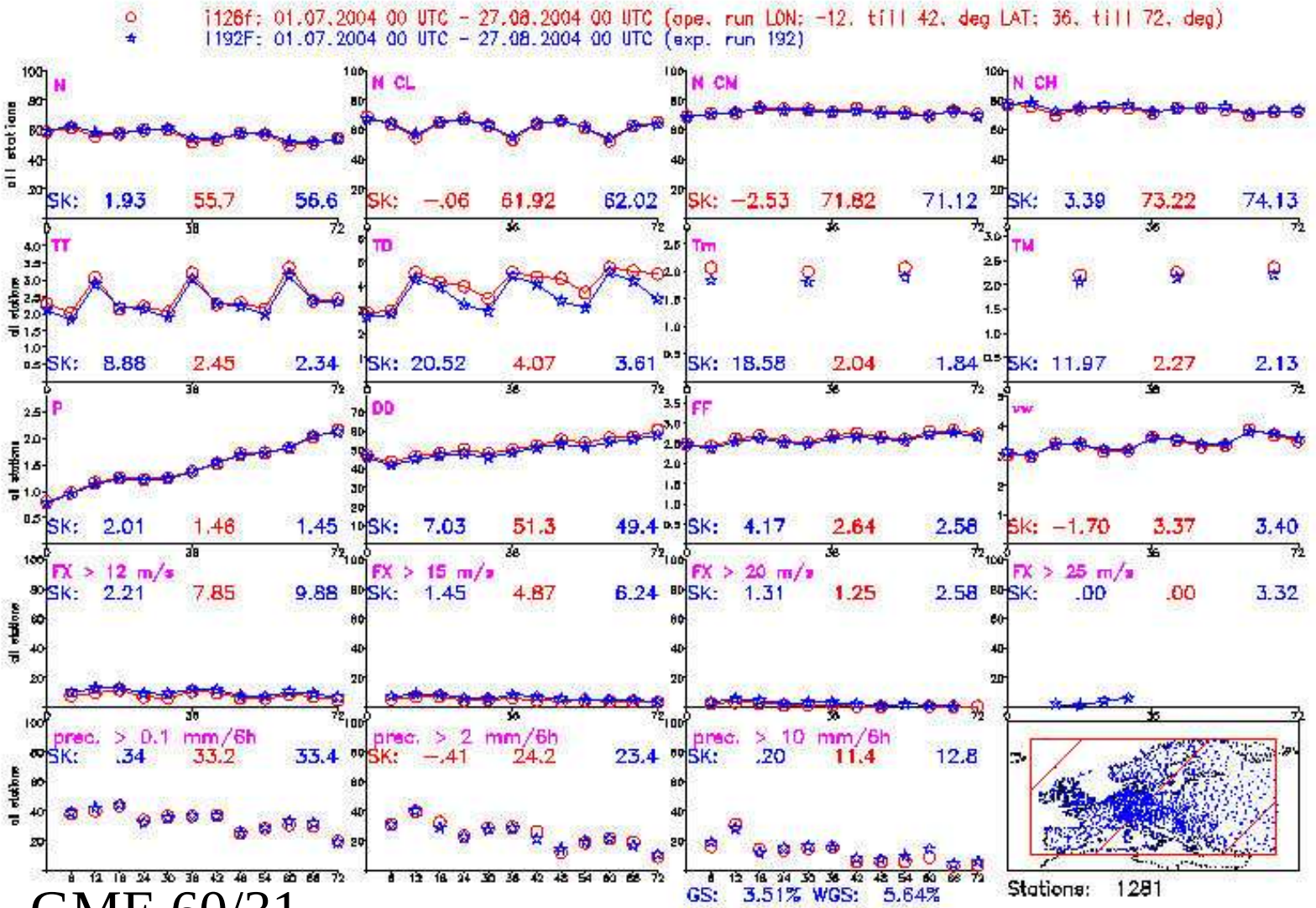


Mean error (K) of dew point at 2 m in Europe for GME 60 km/L31 and 40 km/L40

Deutscher Wetterdienst

rmse

tss

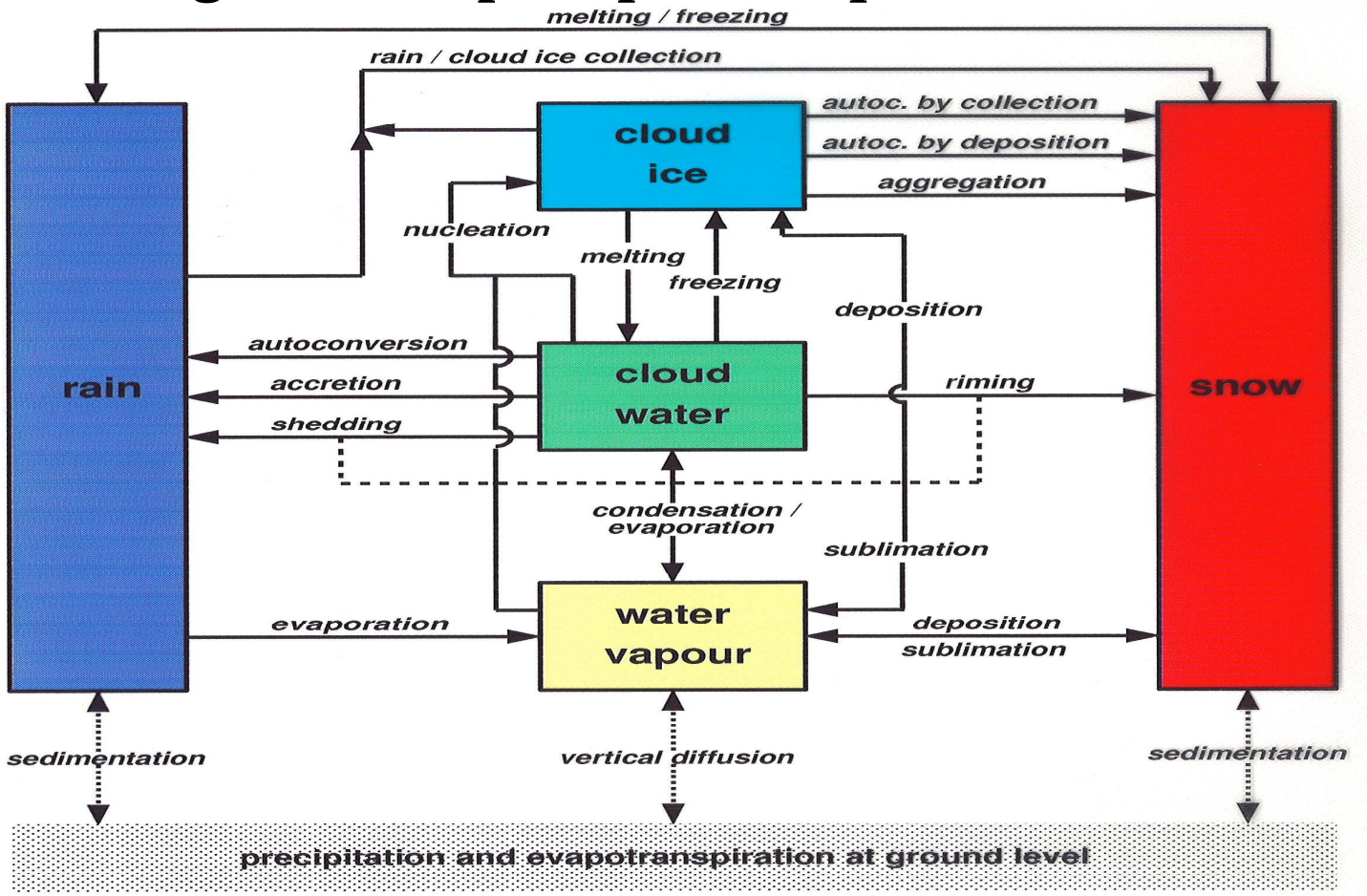


GME 60/31

GME 40/40

01 July - 27 Aug. 2004

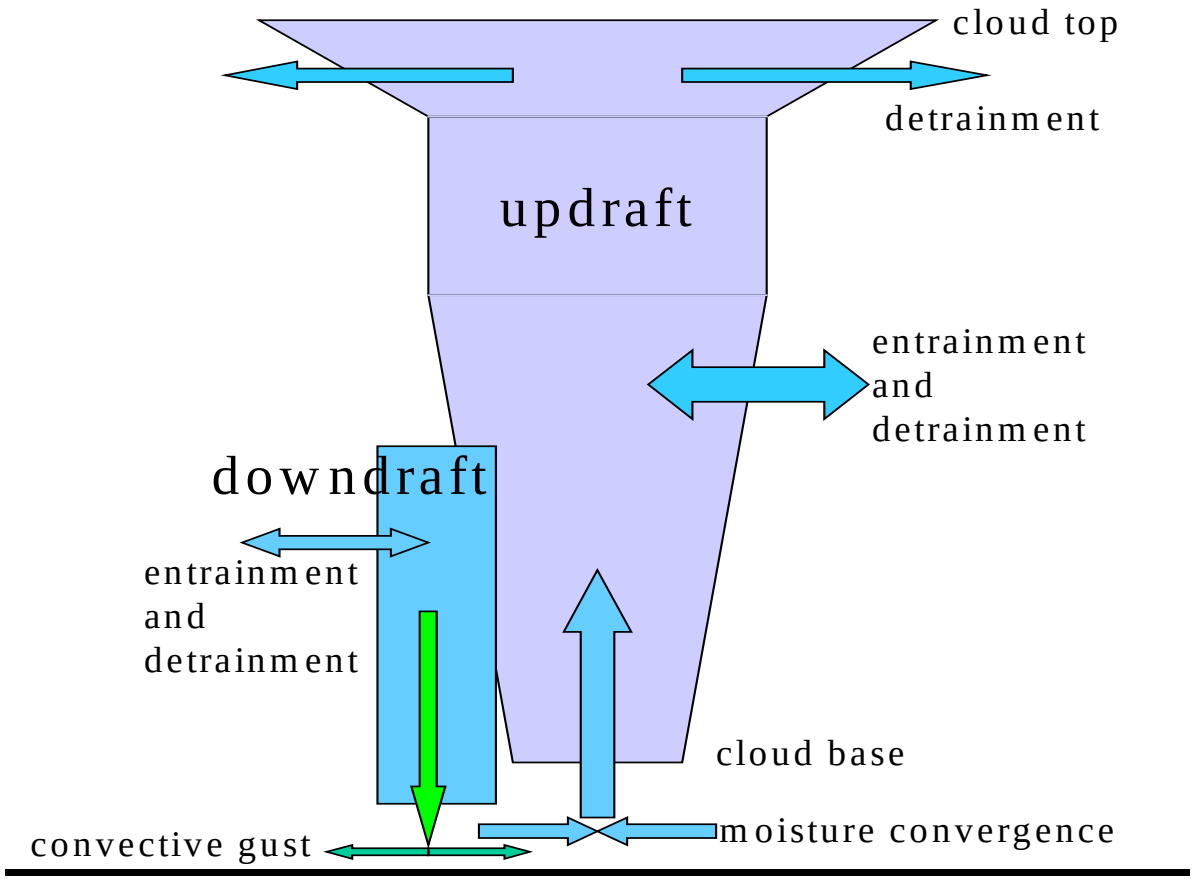
grid-scale precipitation process



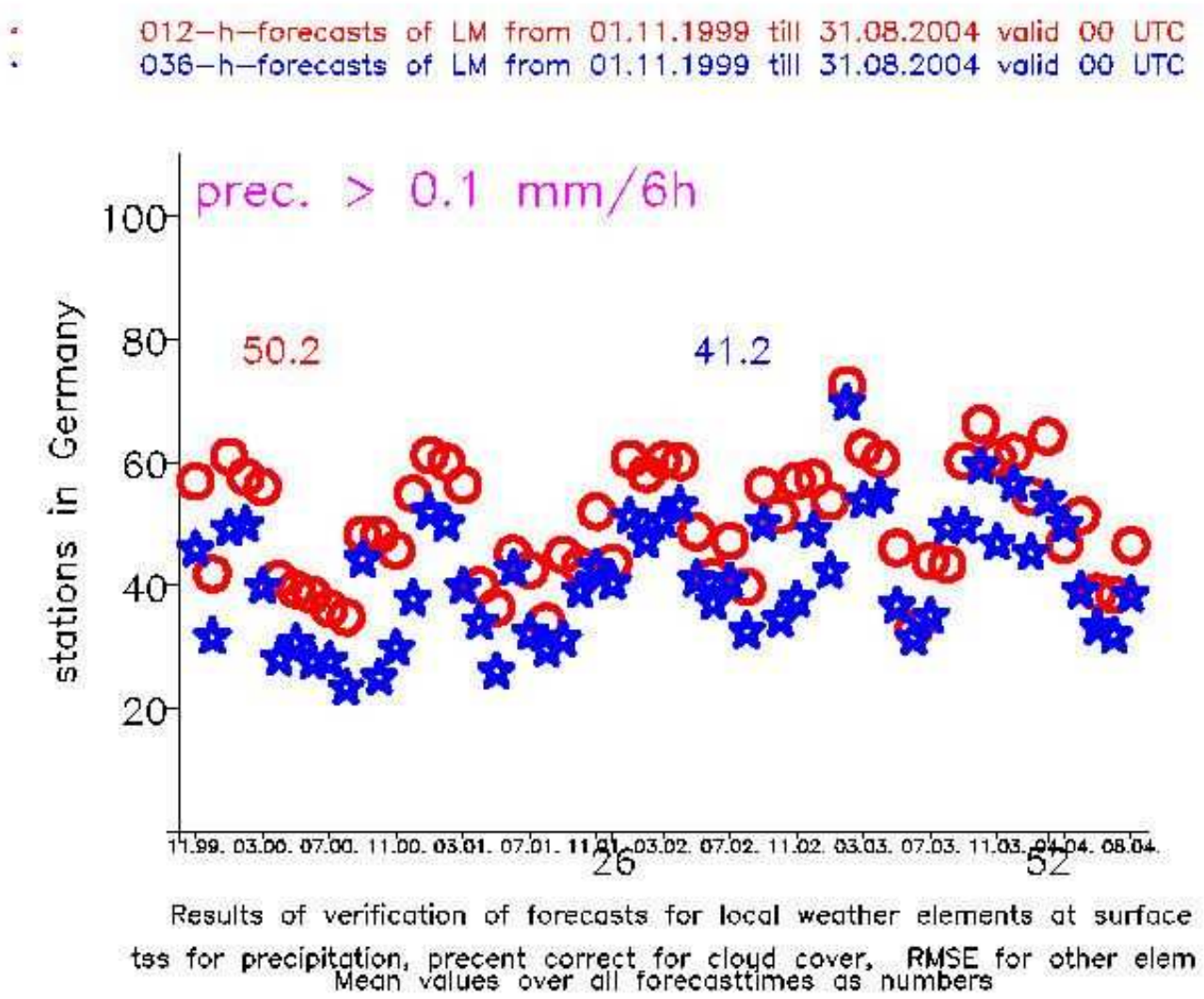
Processes considered in the cloud-ice scheme.

Much of the process is resolved by the model, only the conversion terms have to be parameterised (in LM prognostic precipitation)

Cloud model of the Tiedtke convection scheme



The whole process is parameterised



Monthly means of skill (TSS) in precipitation forecast
November 1999 - August 2004

Main problem: Convection

Different reasons:

- In present operational models convection has to be parameterised, without a convection parameterisation the results deteriorate
- Each parameterisation requires simplifications of the process and assumptions (tuning)
- Convection is a process with a horizontal scale of > 10 km and a time scale of ca. 1 hour ➡ strictly speaking **convection is not subgrid-scale** and therefore ‚not parameterisable'

The role of COPS in the Priority program 1167 „Quantitative Precipitation Forecast“

- The priority program 1167 of the German Research Foundation aims at improving the quantitative precipitation forecast
- COPS specifically concentrates on the convective part of the precipitation process in NWP models and on orographically forced precipitation
- The data produced in COPS have to be used in different kinds of numerical models (for initialisation, forcing, validation, etc.)
- This leads to **special data requirements** (only the modelling part is considered here, not the requirements of assimilation)

Data requirements

Remark: It is obvious that the following requirements can be met only partially

- Profiles of turbulent vertical fluxes (heat, moisture, momentum) over the whole boundary layer
- 3D-fields of temperature, moisture and wind components
- Cloud microphysical parameters (total water content, ice content, precipitation, droplet spectra)
- 3D mass and energy budgets of a developing cumulus and of the environment
- Radiative fluxes at the surface, soil temperature and water content

Data of a great variety of instruments have to be joined in one data-set

What can be expected from using the data

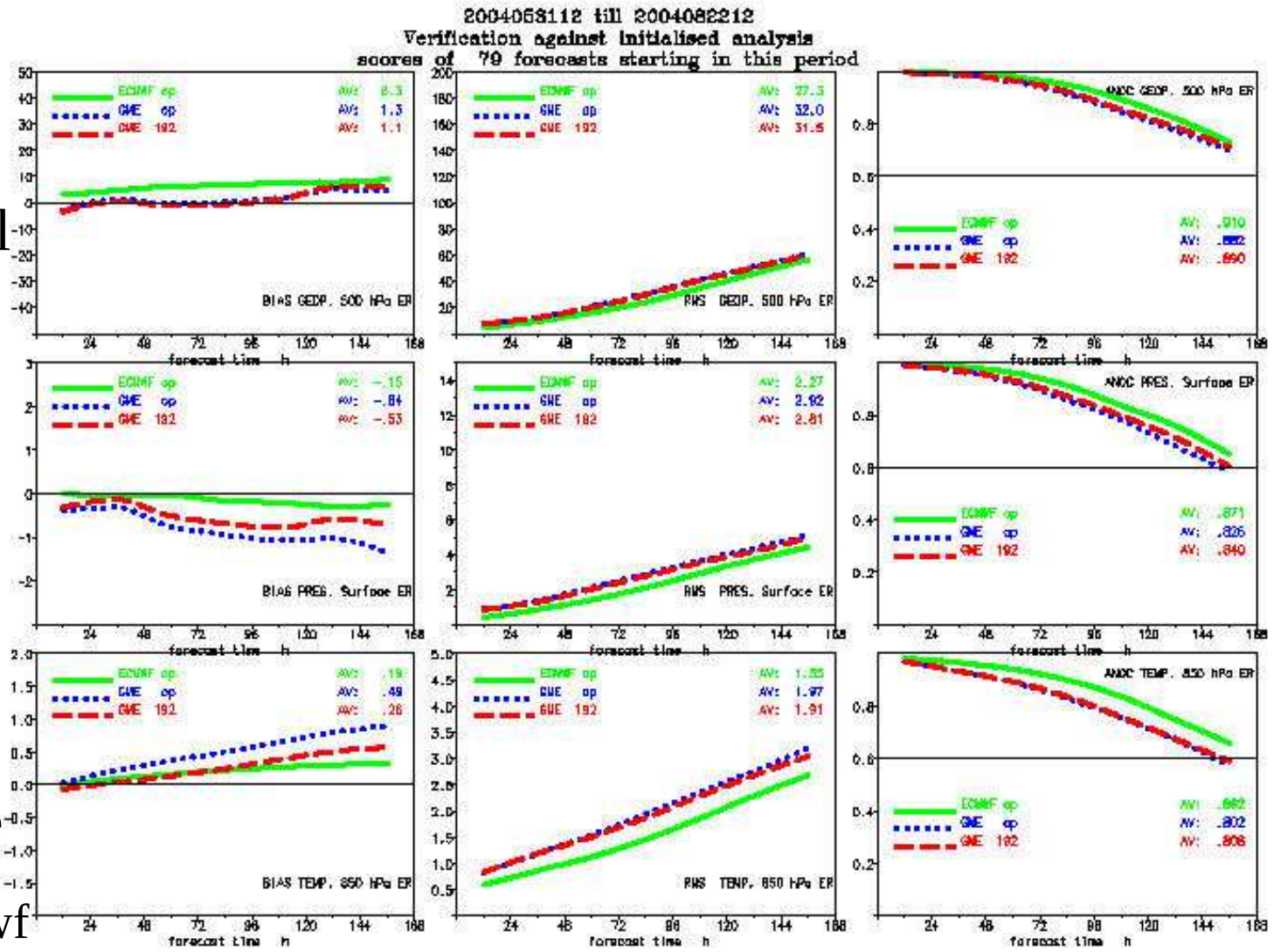
- Validation of high-resolution (1 to 3 km) NWP models with explicit simulation of penetrative convection
- Validation of convection parameterisations in low-resolution NWP models
- Initial conditions for and validation of cloud resolving models
- Forcing and validation of 1D-models
- Improved understanding of the convective process

Conclusions

A successful **COPS** will enable the scientific community to make major **improvements in**

- **understanding,**
- **modelling and**
- **parameterising**

the convection process. This will lead to a significant improvement of quantitative precipitation prediction.



500 hPa geopotential

Surface pressure

850 hPa temperature

ecmwf

gme 60/31

gme 40/40

bias

rmse

anoc