Data Assimilation Survey:

BACY = Basic Cycling
A Data Assimilation Testbed for Research and Development

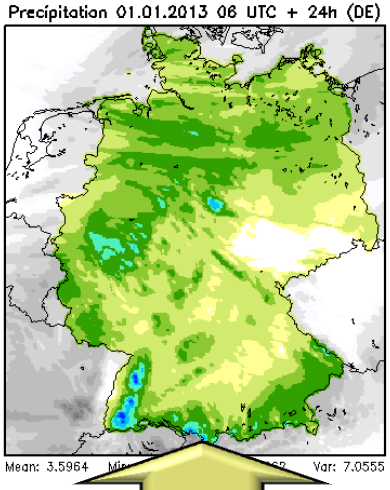
University of Reading
Nov 12, 2014

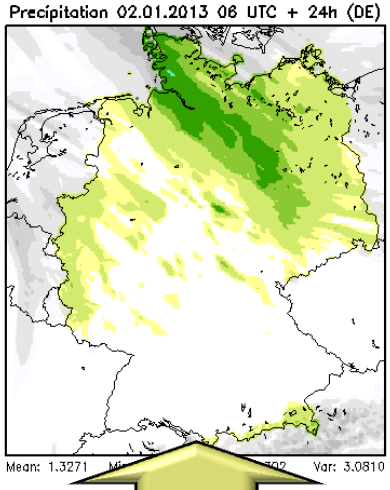
Roland Potthast

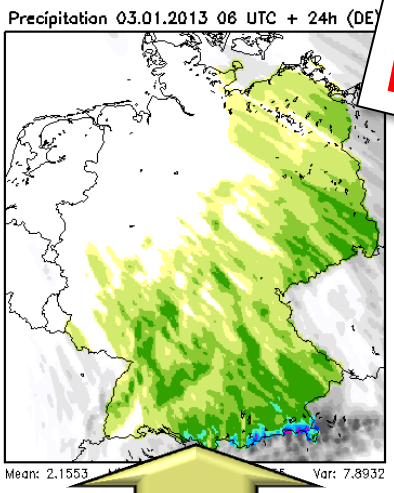
Full NWP System – Integrates Cycled Model and Data Assimilation

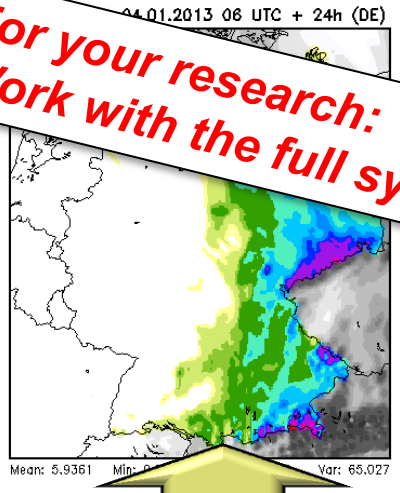
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Model → Data → Model → Data → Model → Data → Model

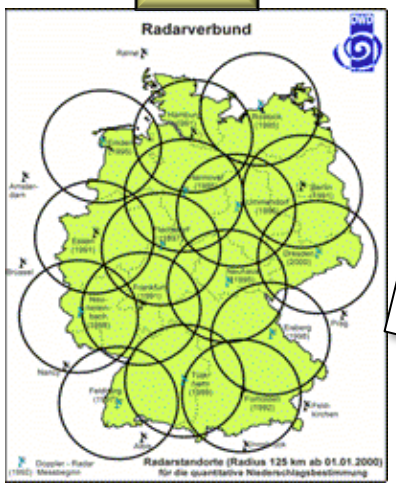


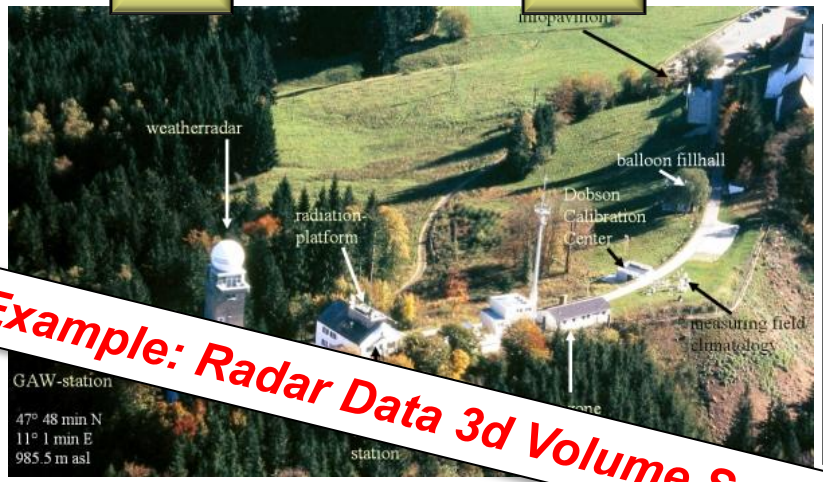




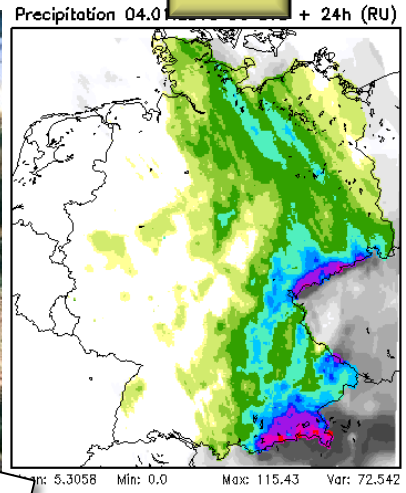


For your research: Work with the full system!





Example: Radar Data 3d Volume Scan



and.potthast@dwd.de

Full NWP System – Integrates Cycled Model and Data Assimilation

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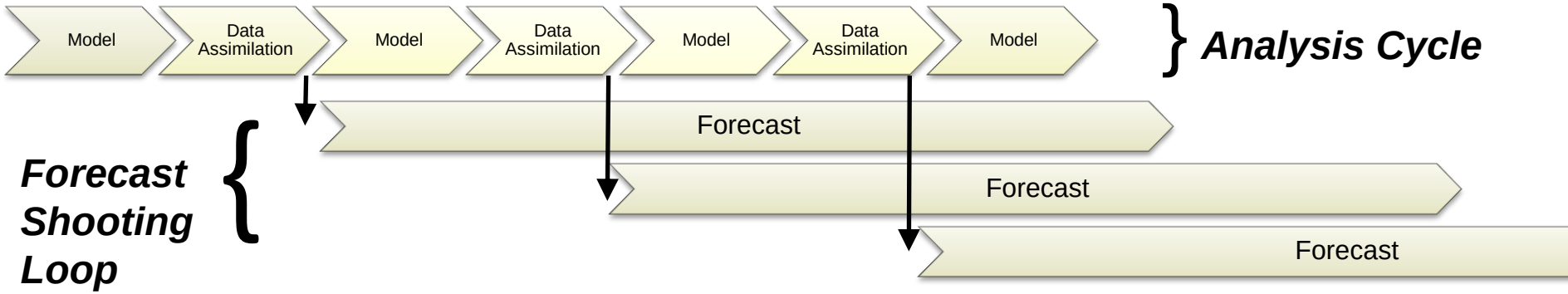

Some Arguments:

- Test model developments and forecasts in a realistic „small“ or „baby“-cycling environment (BACY)
- Model developments will strongly influence the behaviour of the cycled system and the corresponding forecasts (feedback loops!)
- *Just testing changes of forecasts when model developments are carried out is only a part of what really happens*
- Observe and treat realistic development of biases which often arises by multiplyer effect of cycling
- Test the influence of new observations and rather easily integrate them into an NWP environement (without running the whole DB System)

Regional Model needs Boundary Conditions from Global Model

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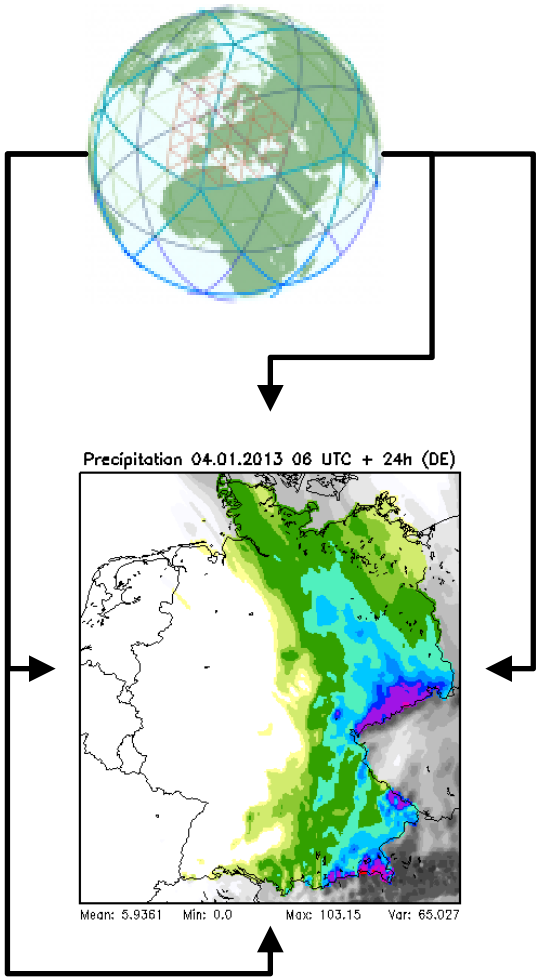
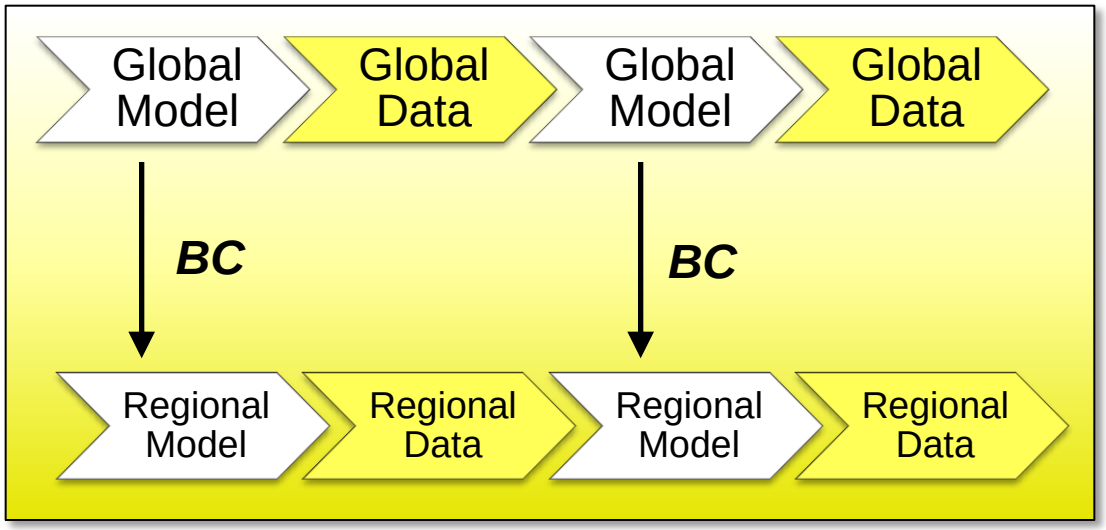
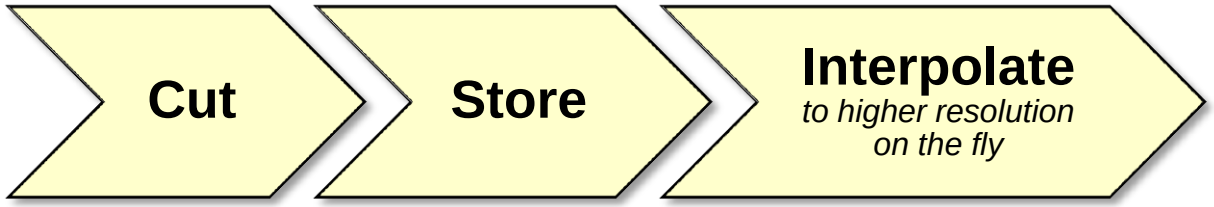
Wetter und Klima aus einer Hand



Global Model provides Boundary Conditions



Efficient Treatment of Boundary Data



`gme_sub` … `int2lm`
`icon_sub`

Take Part in DA + full NWP Development

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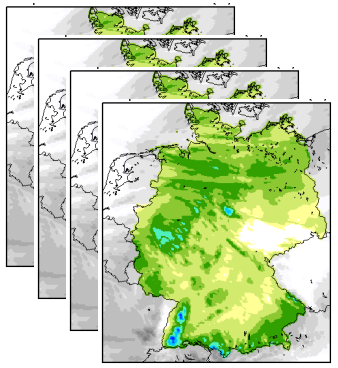
NWP Development

ICON DA

COSMO DA



ICON Bacy

ICON VarEnKF Bacy

KENDA Bacy

Kilometer Scale Ensemble Data Assimilation

Hendrik Reich

Variational (3dVar) Deterministic Data Assimilation for ICON

Harald Anlauf

Hybrid Variational Ensemble Kalman Filter (VarEnKF) for ICON

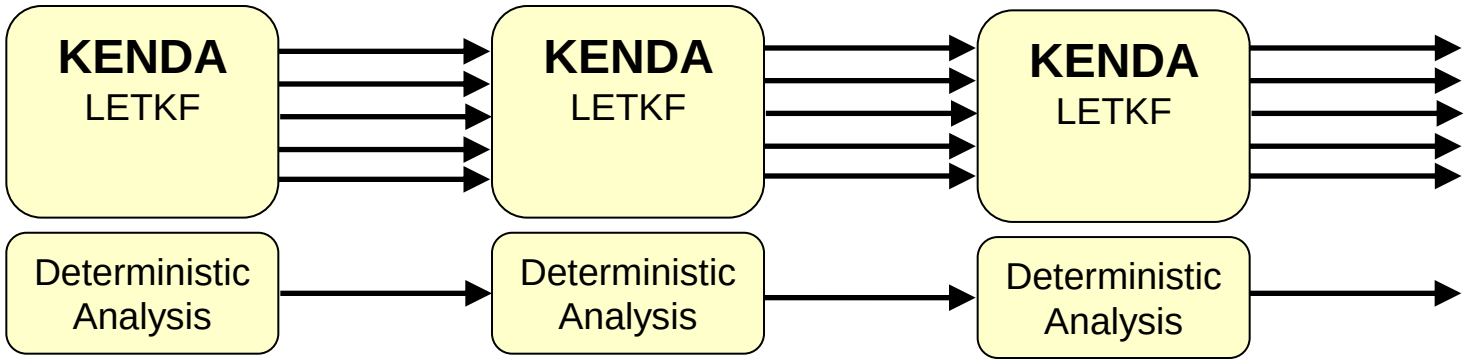
Ana Fernandez, Alex Cress

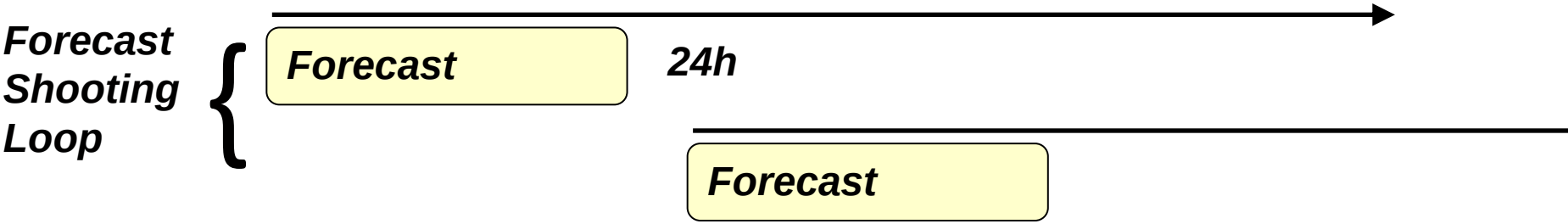
Boundary conditions (repository)

BACY Experiments: KENDA versus Nudging

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Experiments carried out by Hendrik Reich





- COSMO-DE Domain, 2.8km resolution
- Standard operational configuration of DWD
- Bacy Speed 1.2 i.e. 1.2 simulations days per day
  (6 Days Experiment in 5 days)
- Four Experiments with different Setup carried out (adaptivity)

BACY Experiment 4: KENDA versus Nudging

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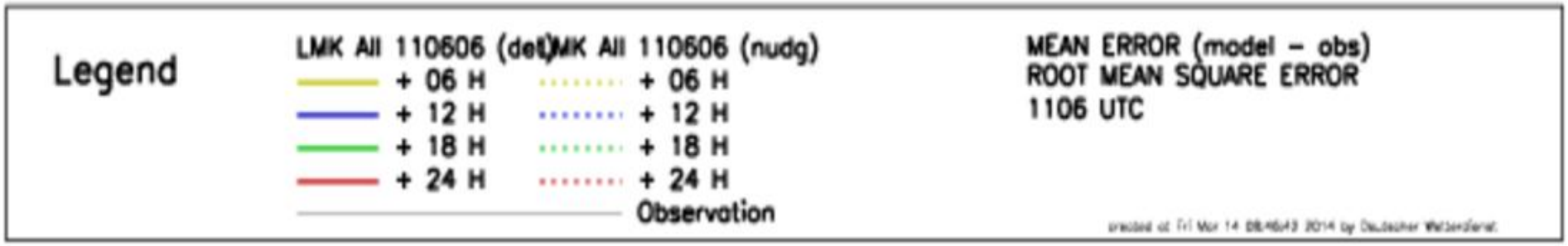
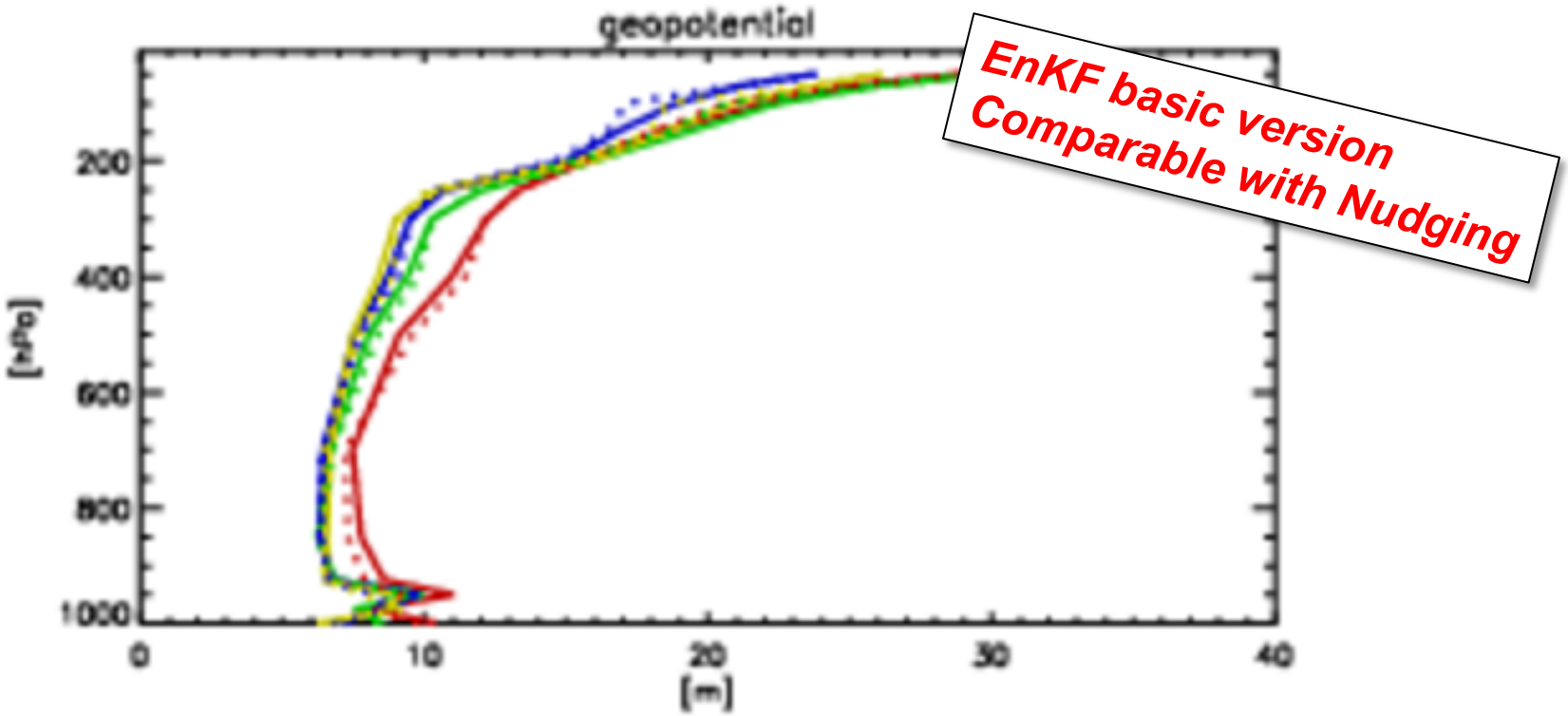
Wetter und Klima aus einer Hand





EnKF basic version
Comparable with Nudging

BACY Experiment 4: KENDA versus Nudging

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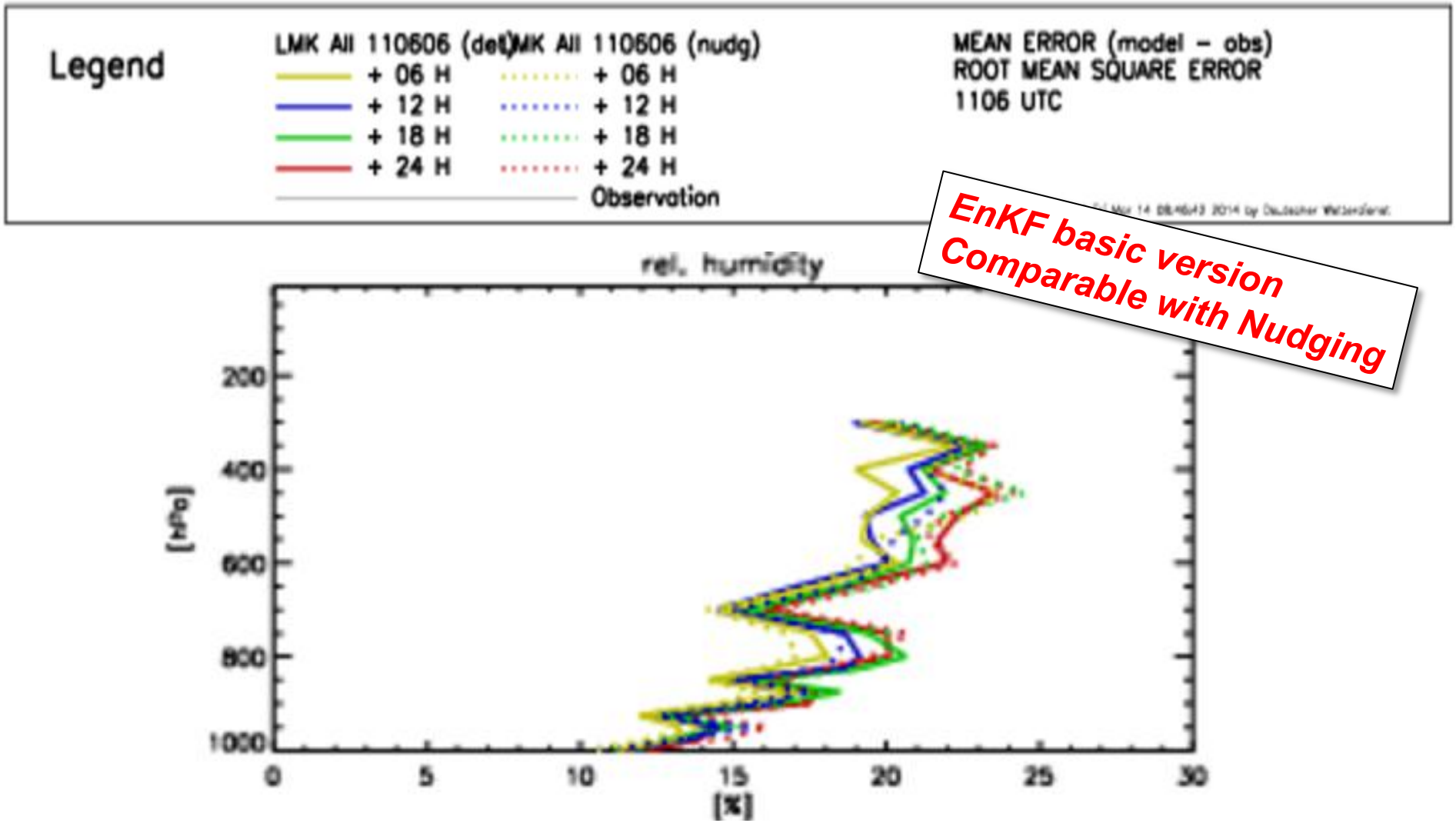

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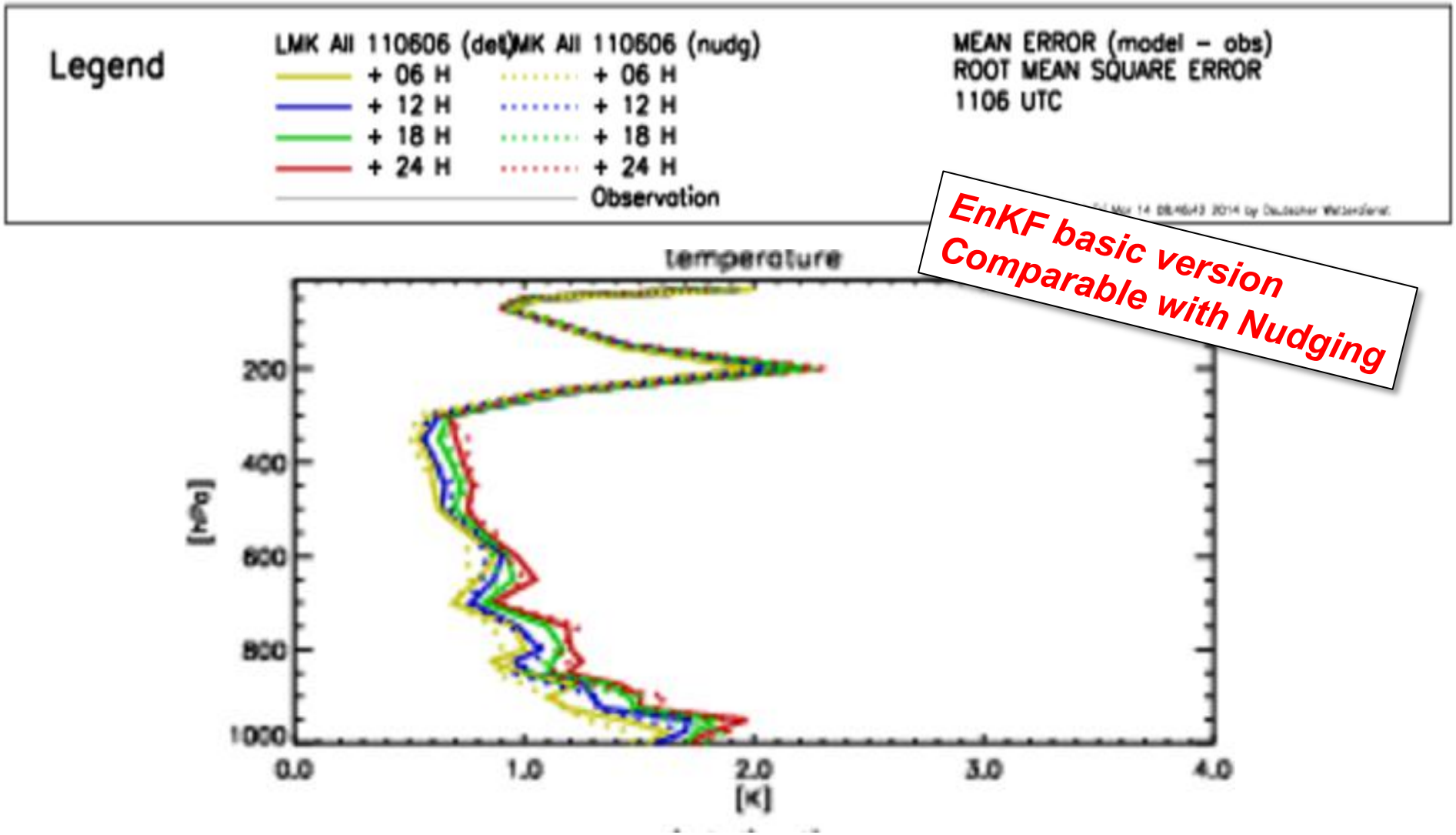

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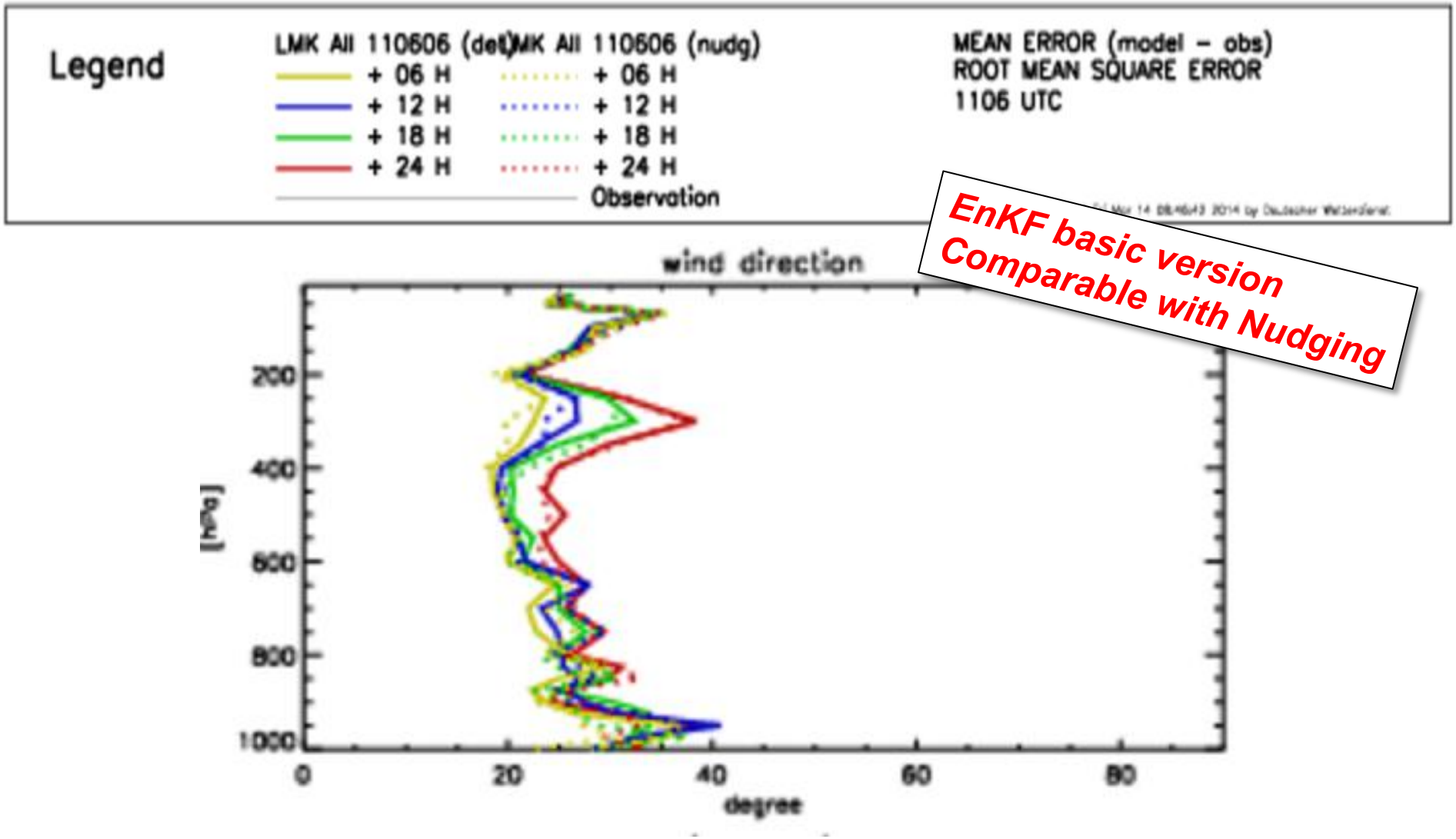

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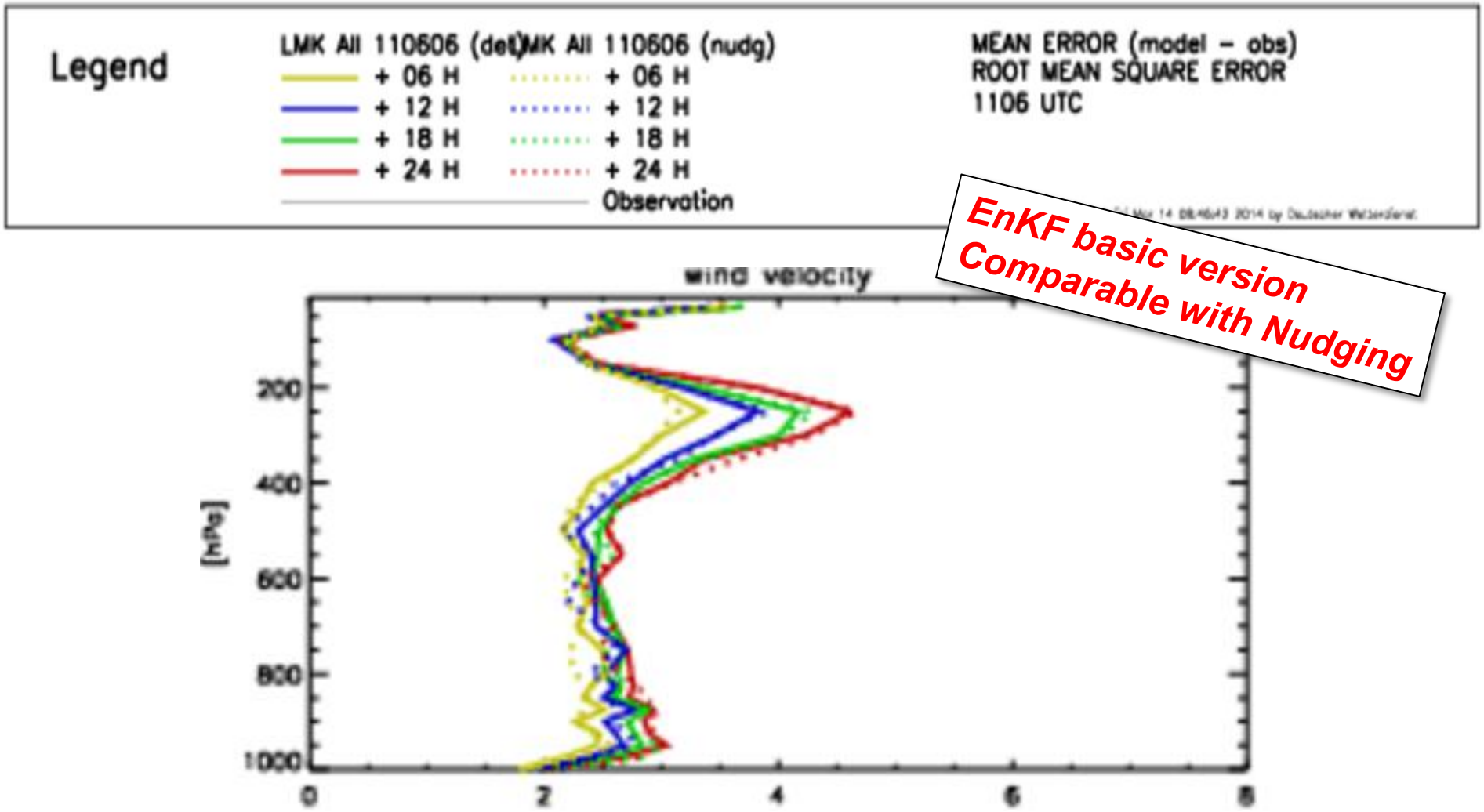

See more in Hendrik's Talk in the afternoon workshop!

Experiment of HErZ LMU: KENDA versus COSMO-DE-EPS

Experiments by Florian Harnisch and Christian Keil, LMU

(1) 15 UTC 10 June - 00 UTC 12 June 2012: → 21-h fc at 00 UTC 11 / 12 June

(2) 06 UTC 18 June – 12 UTC 19 June 2012: → 21-h fc at 12 UTC 18 June

KENDA: - 3-hourly LETKF data assimilation of conventional data
- 3-hourly analysis ensemble with **20** ensemble members
- 20 member ECMWF EPS lateral boundary conditions (16 km)
- No physics parametrization perturbations (PPP)
- Multiplicative adaptive covariance inflation

KENDAppp: including 10 physics parametrization perturbations (PPP)

KENDArtpp: relaxation-to-prior-perturbation inflation (α = 0.75)

KENDArtps: relaxation-to-prior-spread inflation (α= 0.95)

KENDArtps40: 40 ensemble members / relaxation-to-prior-spread

Experiments: KENDA versus COSMO-DE-EPS

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Wetter und Klima aus einer Hand

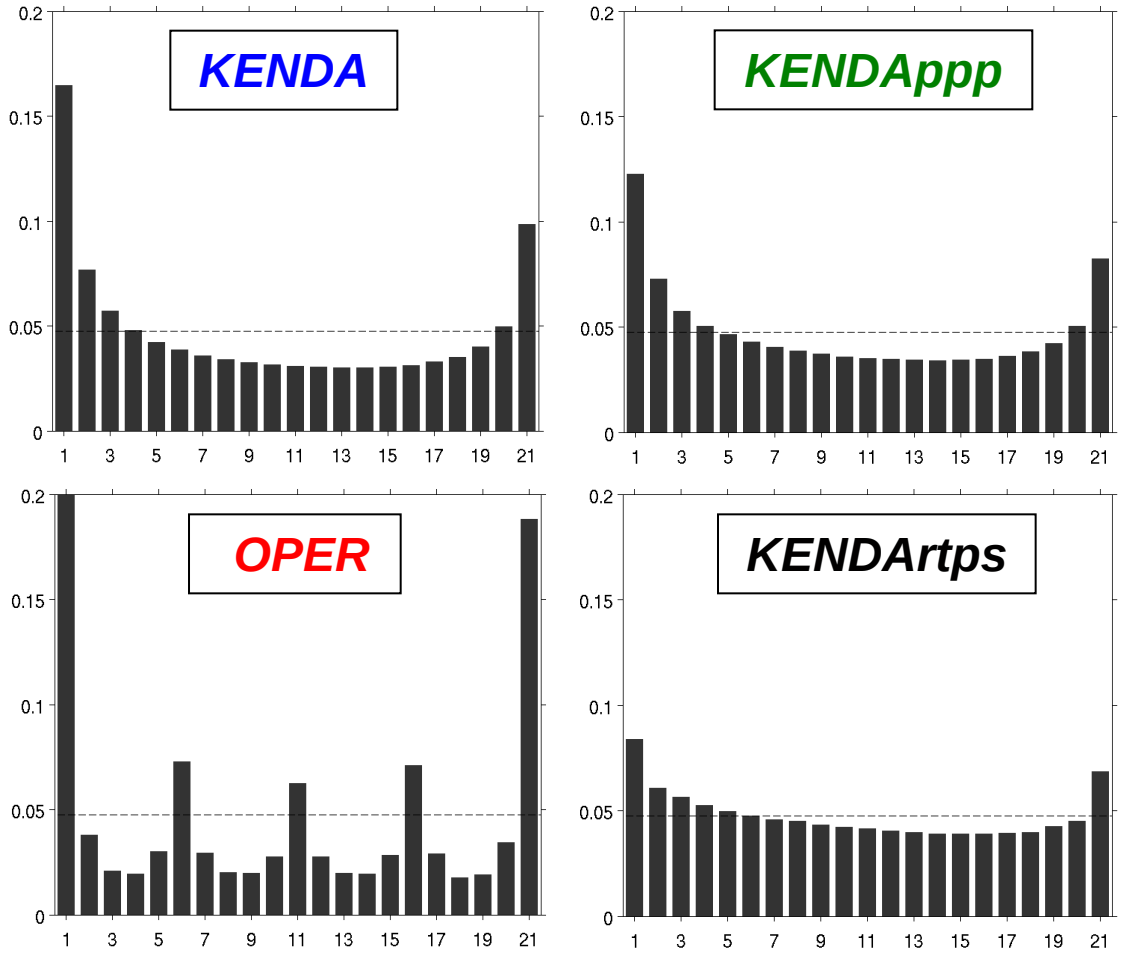
Experiments carried out by Florian Harnisch and Christian Keil, LMU

+3 h forecasts of 10 m wind speed

EnKF improved versions Can improve EPS

Verified against COSMO-DE analysis (similar results against observations)

Ensemble rank histogram



Experiments:
KENDA versus COSMO-DE-EPS

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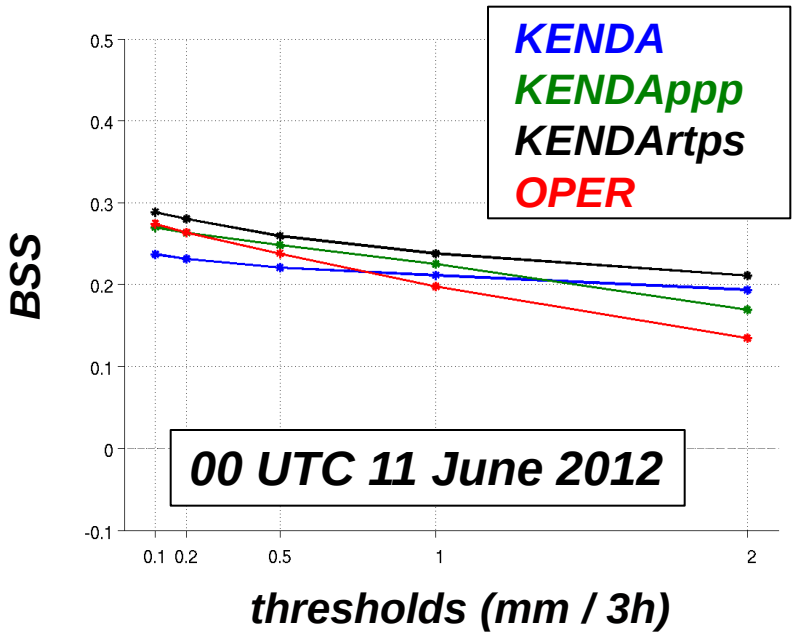
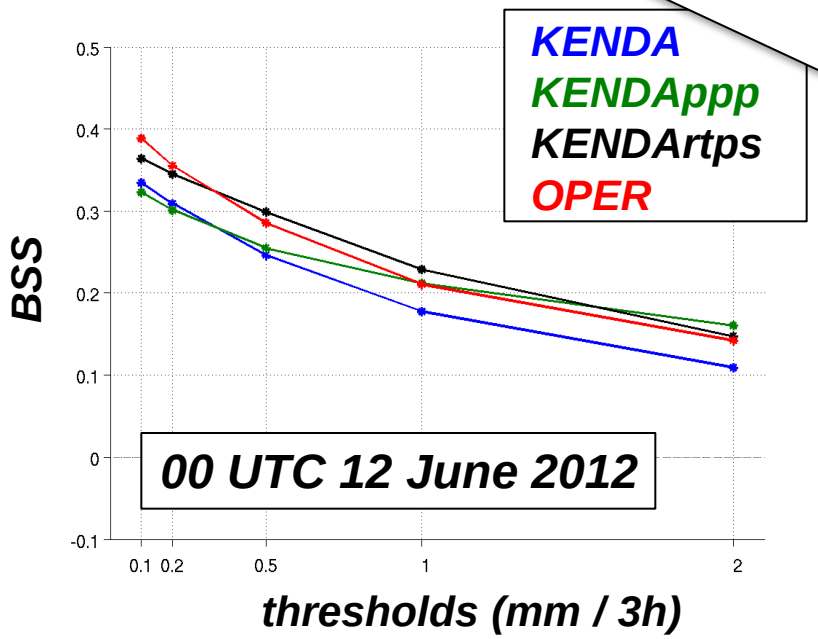
DWD

EnKF improved versions
Can improve EPS

BSS: 21-h ensemble forecasts of precipitation

3-21 h forecasts averaged over Germany

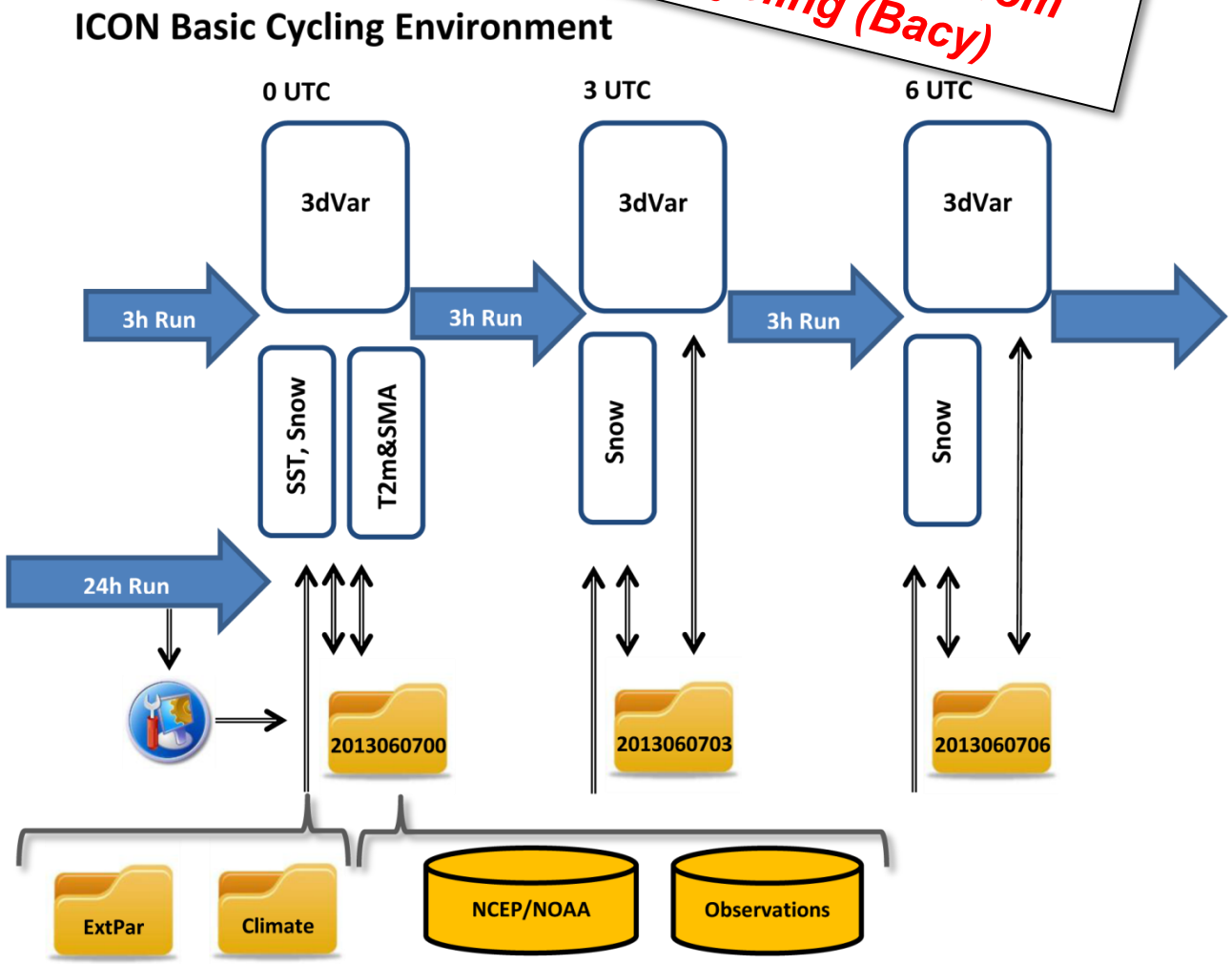




- Brier Skill Score = [resolution – reliability] / uncertainty
- Accounting for model errors with ***PPP*** shows positive impact
- Large impact of ***inflation*** procedure

ICON DA Development

Over the past 8 month ICON development has strongly benefited from Basic Cycling (Bacy)

Basic Cycle

- Elementary Cycling; principle of simplicity
- File Based for Model Fields
- Flexible DB/Files for Observations
- Useful for Debugging
- Basic speed check for DA components
- Needed for efficient NUMEX implementation and test