Data assimilation and Predictability Results and Visions

Hans-Stefan Bauer
Institute of Physics and Meteorology, Hohenheim University

Content:

- Review of the last meeting
- First results
- Data assimilation & COPS
  - Plans
  - Requirements
  - Visions

Scientific Questions

What will be the relative improvement in forecasts resulting from better large-scale and local forecasts ?

→ This is likely to depend strongly on the meteorological situation and the nature of the different data sets.

How should high-resolution data assimilation be done ?

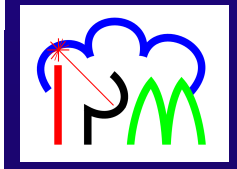
→ Here it is important to involve a variety of models and assimilation methods to benefit their different advantages.

How should limited computing power be allocated between resolution, complex parameterizations, data assimilation, ensemble size, ... ?

→ Need to evaluate performance of the entire DA/NWP chain

What improvements can be transformed to operational practice ?

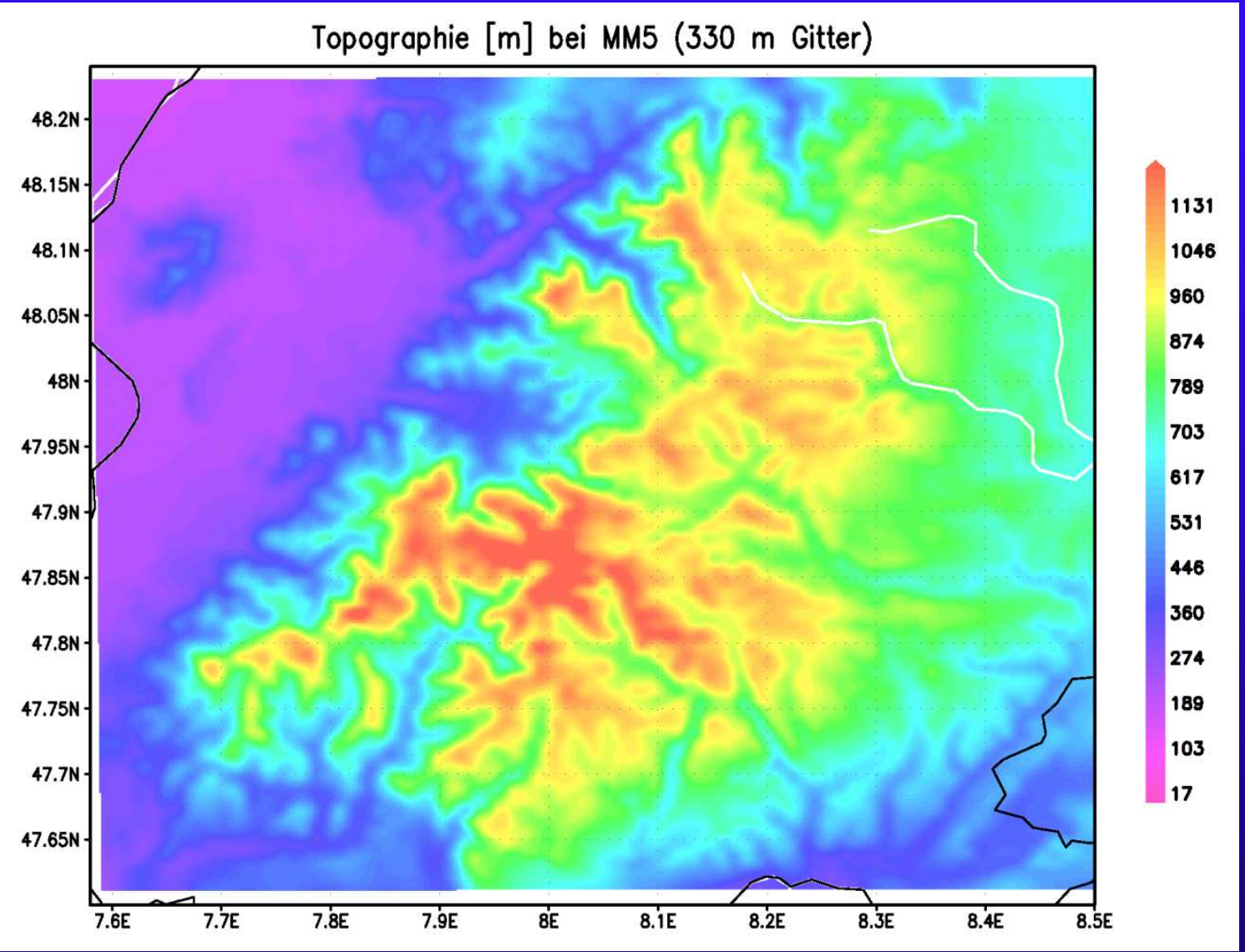
→ This is an important question but it should not restrict the ideas involved in the project.



Other discussed topics

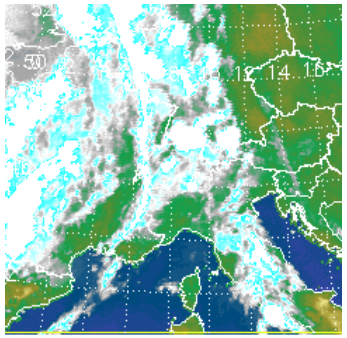
- Agree on common case studies → list created, work on certain cases started
- Trial simulations should be attempted at least a year before the campaign
  → LAUNCH campaign, VERTIKATOR cases
- A strong cooperation between the modelers and experimentalists is necessary to find the best measurement strategy and to ensure that the experiment produces a good validation data set.
- The influence of high-resolution orography is not well understood. Therefore careful experiments using different horizontal resolutions are necessary
  → example model topographies from VERTIKATOR case
- There is a need for new measures of skill → SPP Verification Strategy
- Data issues → format, exchange, policy, ...
- Ongoing discussion of how assimilation should be done during the campaign.

The Southern Back Forest



Model	Provider	Resolution	Data assimilation
IFS	ECMWF	T511 (40 km), global	4DVAR
EPS, 50 members	ECMWF	T256 (80 km), global	
GME	DWD	60 km, global	3DVAR
LM, LME, LMK	DWD	7 km and 2.8 km	Nudging
aLMo, aLMo2.2	MeteoSwiss	7 km and 2.2 km	Nudging
MM5	NCAR/PennState	Variable, down to 1 km	Nudging, 3DVAR, 4DVAR
WRF	NCAR	Variable, down to 1 km	3DVAR, 4DVAR under development
MC2	Met. Service Canada	Variable, e.g. 3 km during MAP	
AROME	MeteoFrance	Variable, pre-op tests with 2.5 km	4DVAR

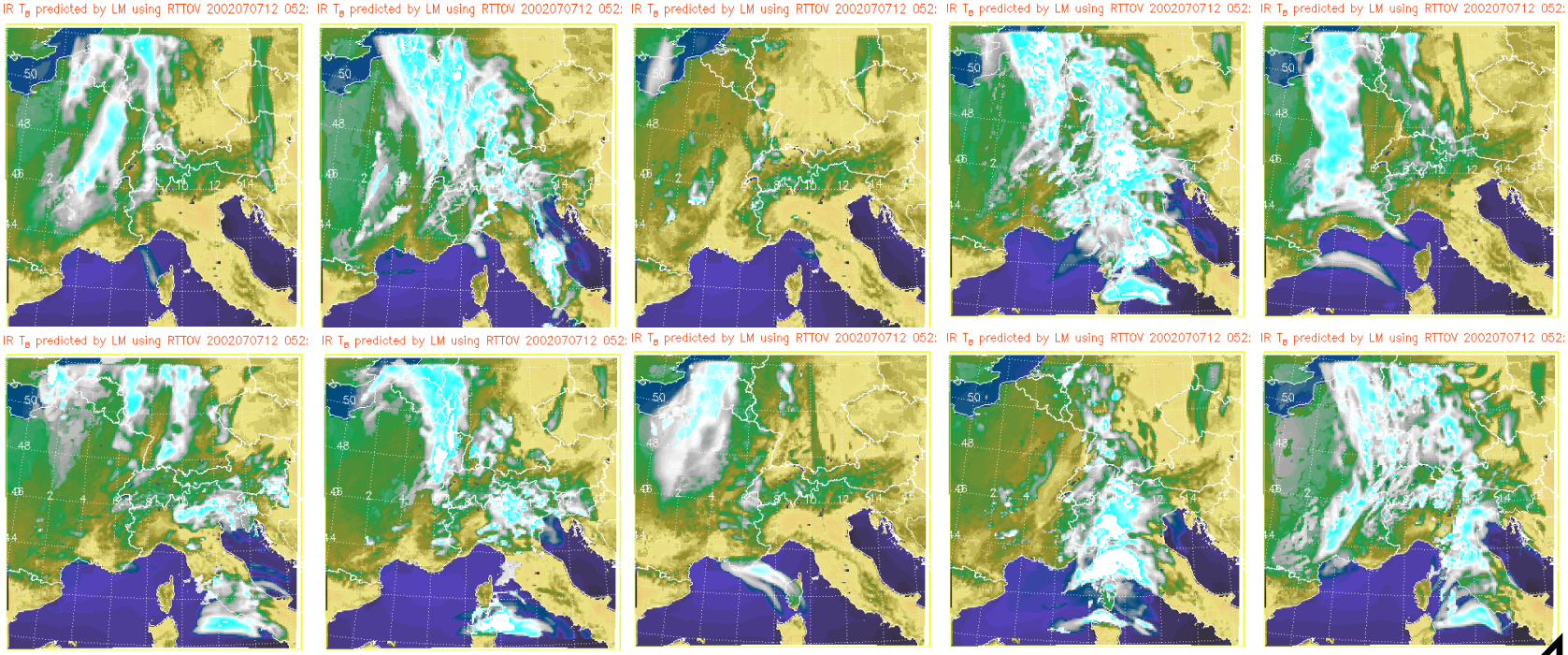
Results: Predictability



Meteosat IR 16:00 UTC 9 July 2002

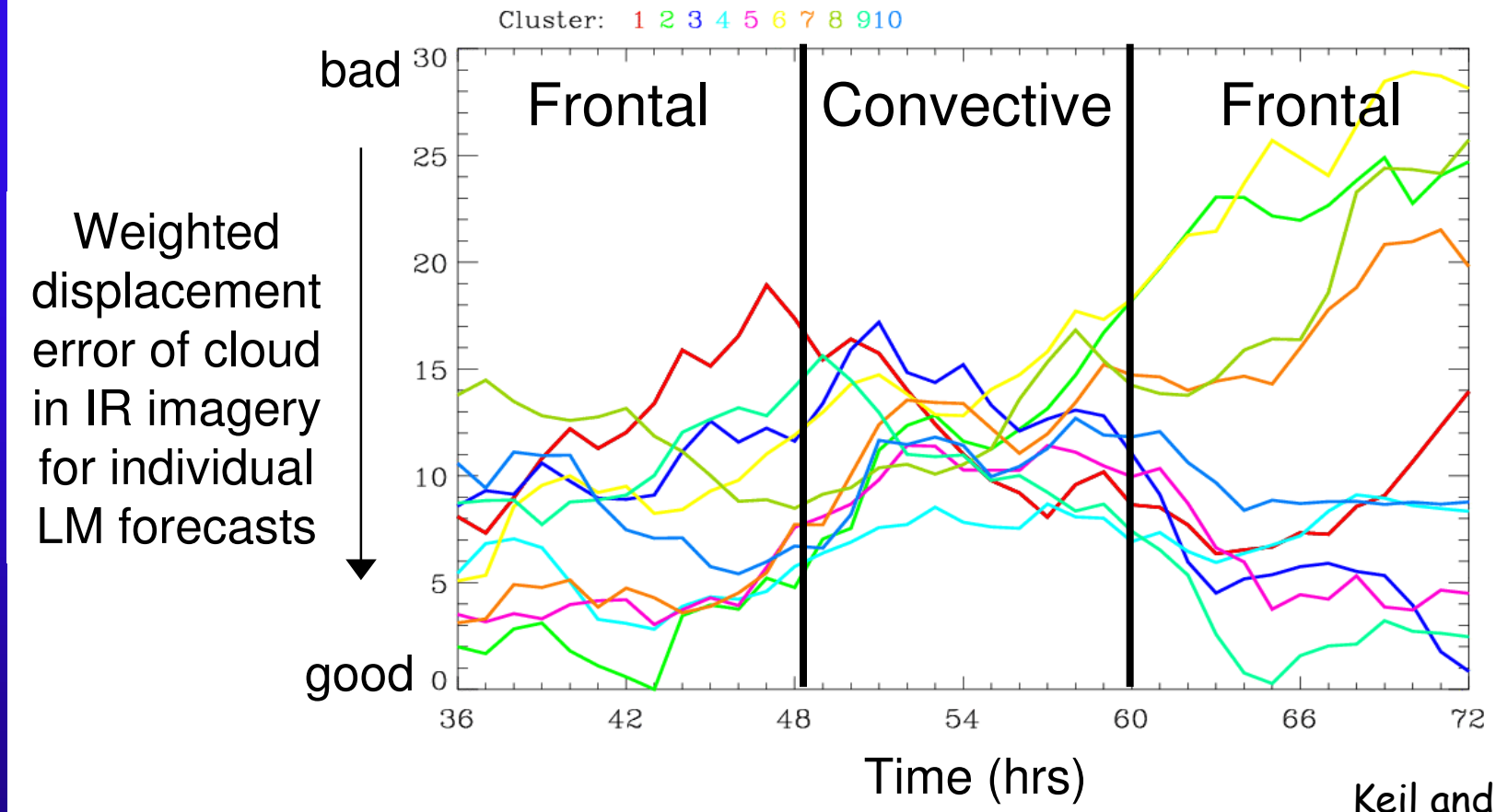
Forecasts of convection are very sensitive to the synoptic situation (boundary conditions for a limited area model)

10 LM Forecasts from COSMO-LEPS



Keil and Craig

Persistence of Forecast Skill

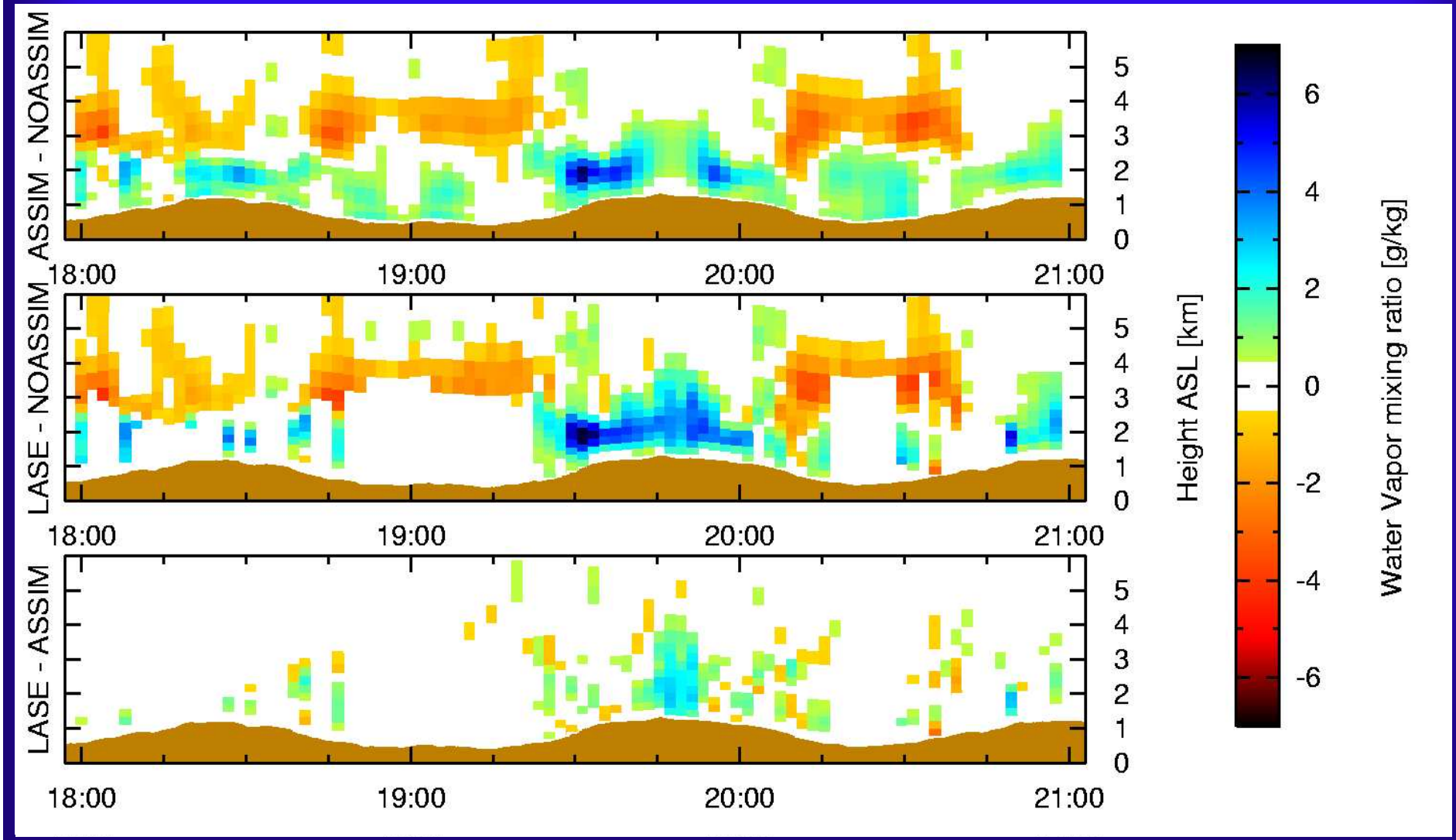


Keil and Craig

A good forecast continues to be good only as long as the synoptic situation persists - in this case, about 12 hours

DLR

Results: Local scale

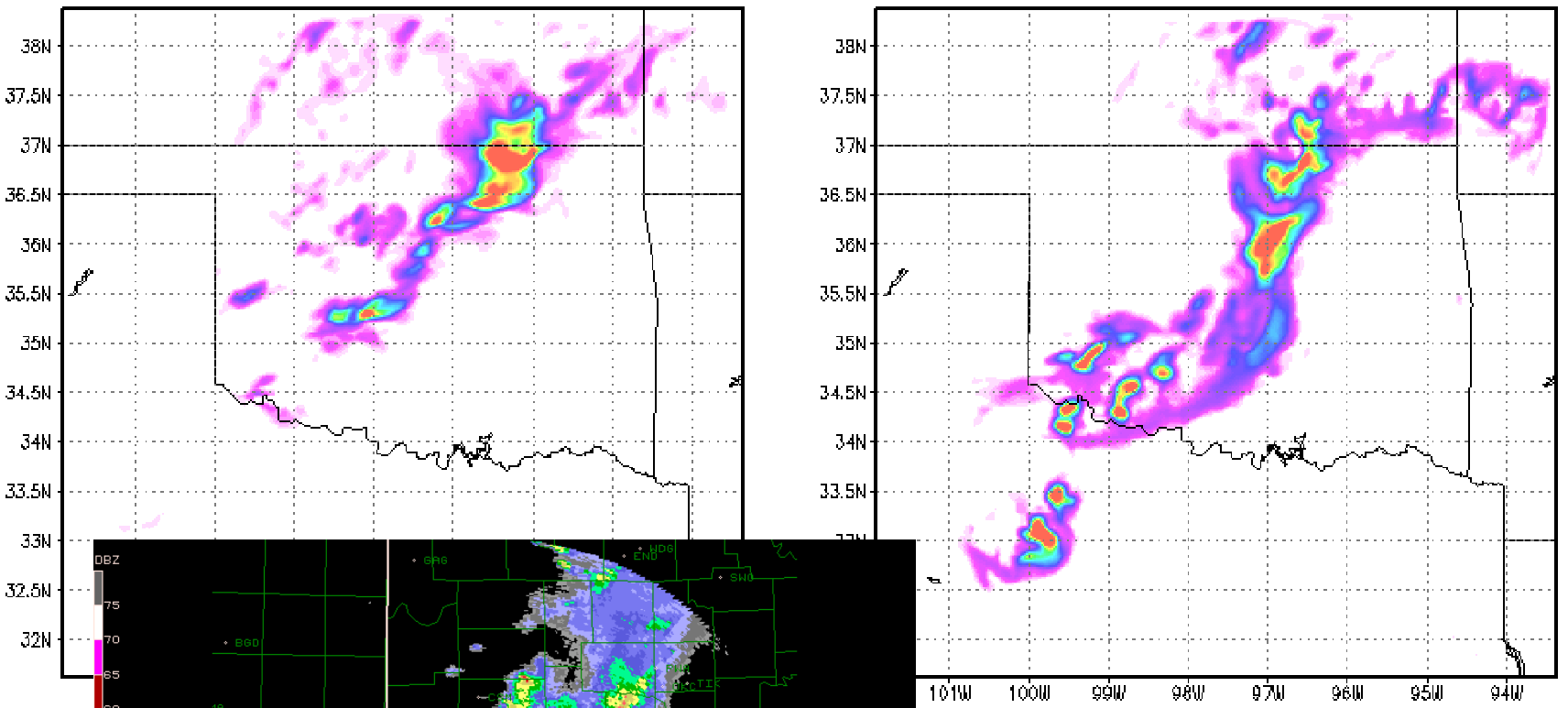


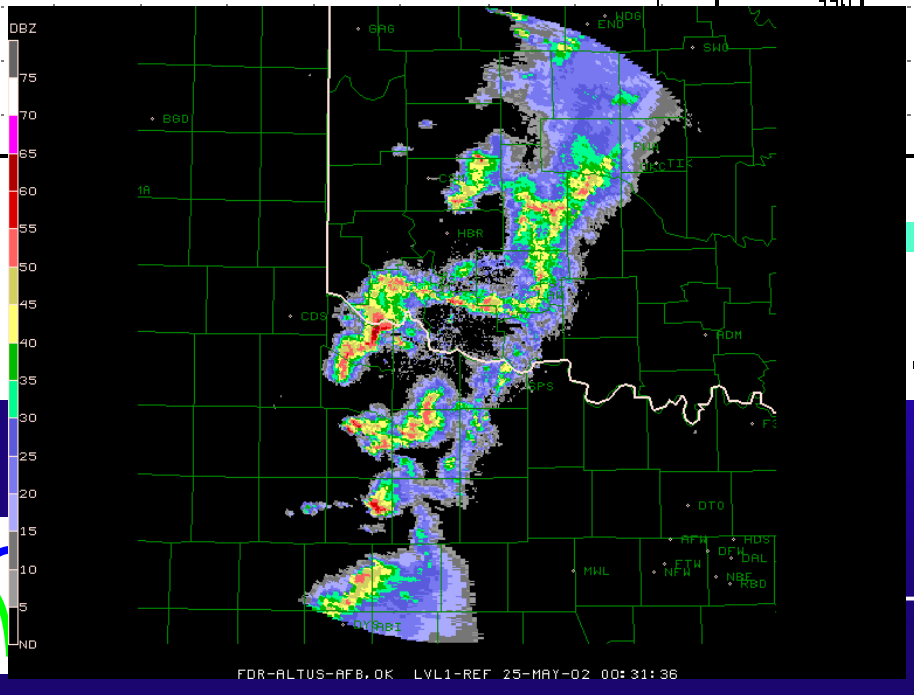
Wulfmeyer et al, 2005

Total Precipitation (3.3 km accumulated over 30 min)

without assimilation

with assimilation



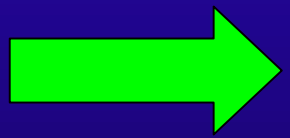


at 00:30Z25MAY2002

Wulfmeyer et al, 2005

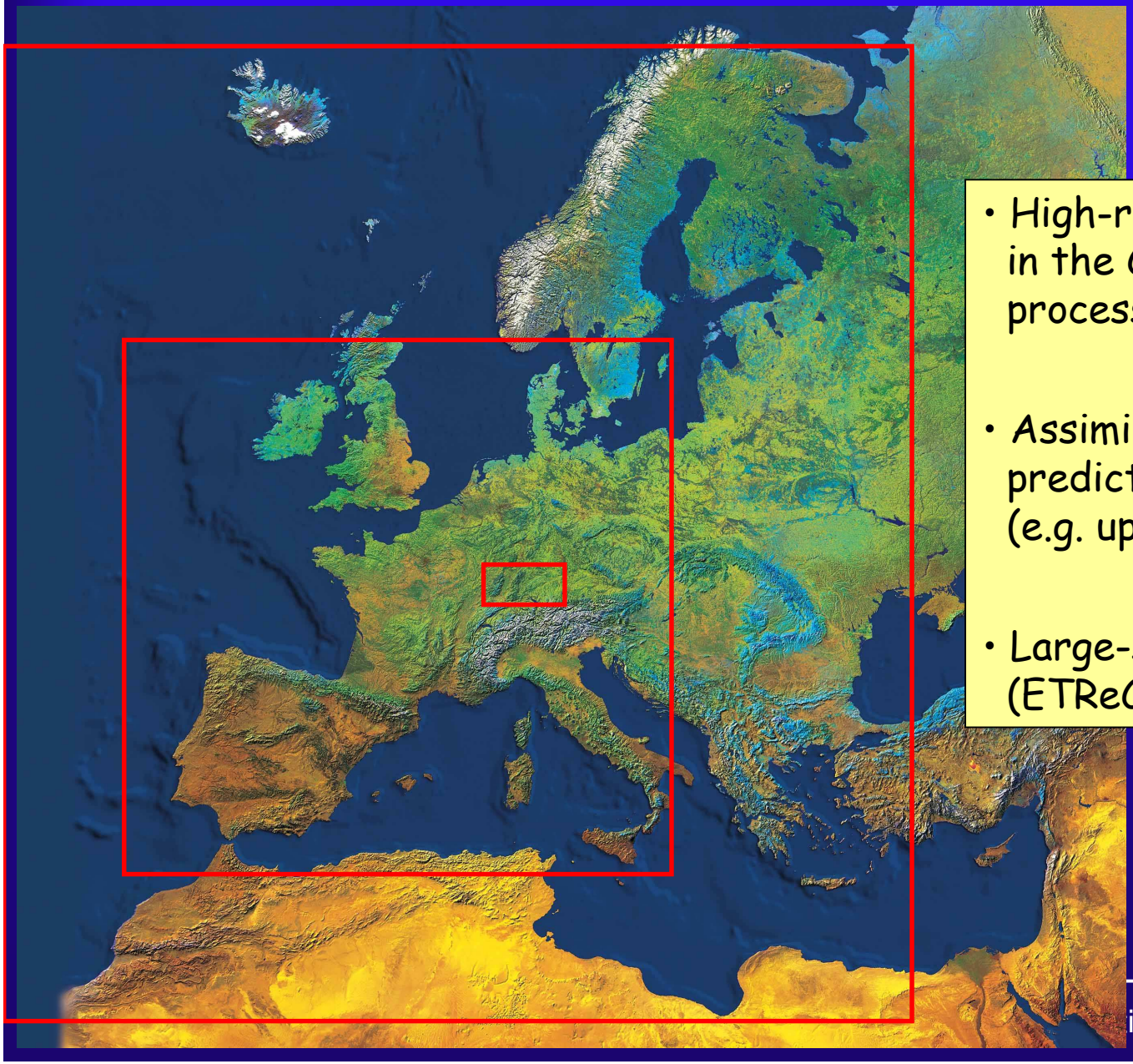
Scientific Meaning of DA during COPS

- Data assimilation provides the link between the observations and the different models used for different purposes during COPS.
- DA allows the investigation of the model sensitivity to the initial conditions
  - Ensemble simulations for predictability investigations
  - Importance of different observing systems
- By providing the models with the best possible initial condition (reduction of the initialization error), DA helps to better relate the model errors to their causes.
- High-resolution reanalyses of selected cases assimilating as much data as possible allows detailed process and parameterization studies (as e.g. Martin and Xue, 2005)

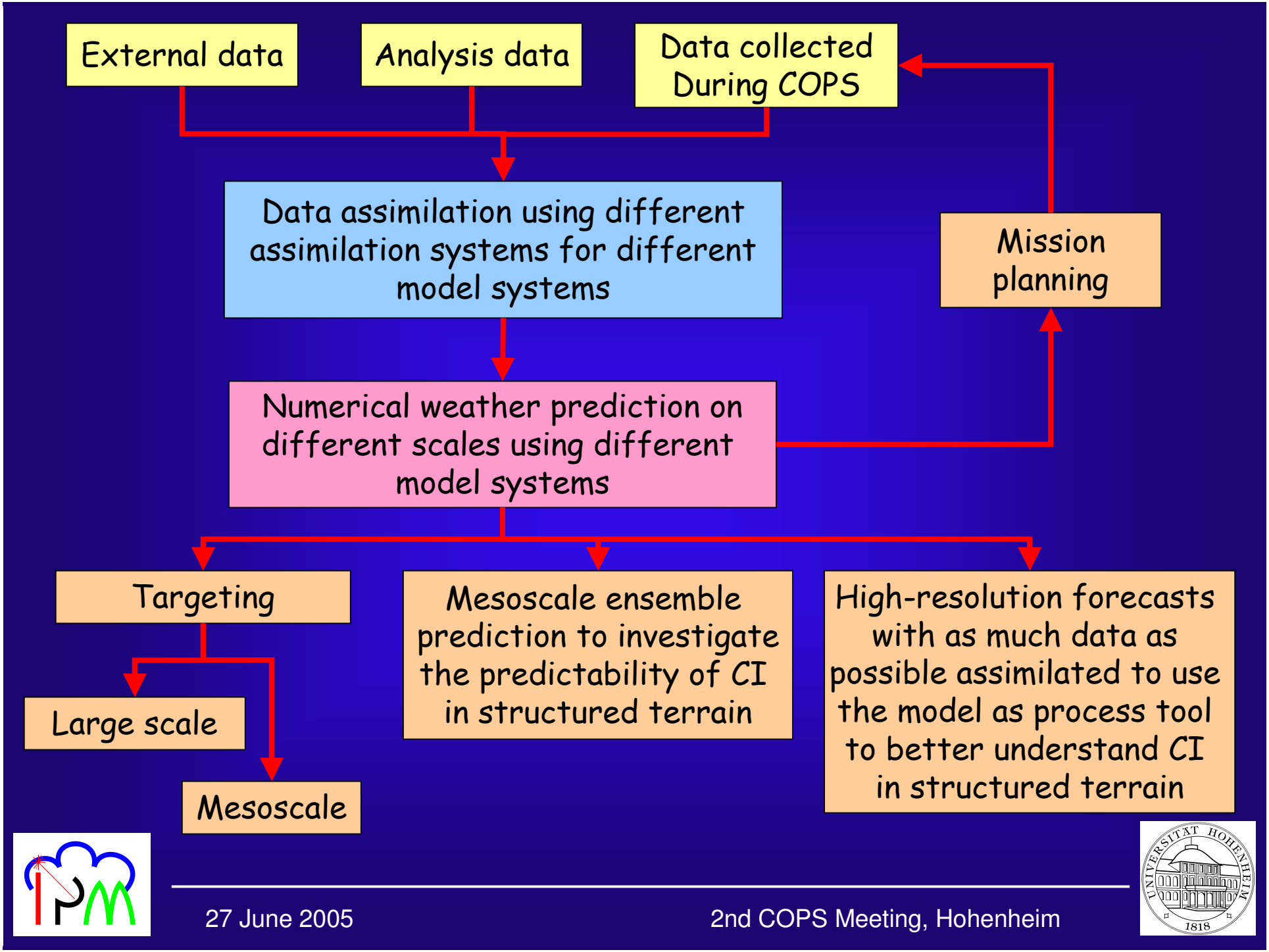


All these arguments push the data assimilation to a central position during COPS.

3 stages of DA during COPS



- High-resolution assimilation in the COPS domain (e.g. for process studies)
- Assimilation and ensemble prediction on the mesoscale (e.g. upstream targeting).
- Large-scale targeting (ETReC, THORPEX)


External data
Analysis data
Data collected During COPS
Data assimilation using different assimilation systems for different model systems
Mission planning
Numerical weather prediction on different scales using different model systems
Targeting
Large scale
Mesoscale
Mesoscale ensemble prediction to investigate the predictability of CI in structured terrain
High-resolution forecasts with as much data as possible assimilated to use the model as process tool to better understand CI in structured terrain

Data Assimilation and Predictability

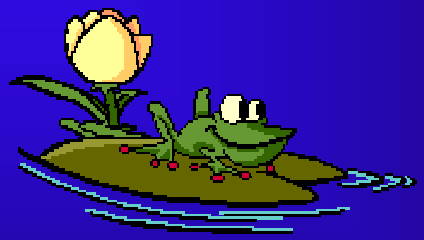
Background Issues:

1. Availability of COPS data in useable form - as much as possible, as soon as possible, to support activities below
2. Availability of operational NWP for BC's and comparison (DWD, PEPS, D-PHASE, ETReC)

Three Levels of DA/NWP Activities in COPS

1. Real time - custom forecast setups - e.g. Hohenheim, Karlsruhe, DLR(NOWVIV), US, MeteoFrance (Arome), ...?
2. Near real time - quick look studies of impact of COPS data
3. After field phase - preliminary studies to be followed up in 3rd phase of SPP

Thank you for your attention !



Data issues

- From a modeling perspective we can decide for each of the available formats. However, it is necessary that all observing groups provide the same format.
- For real-time data assimilation BUFR is the best format (WMO standard for observations, packed, ...) but it requires more effort to reformat the data and create the necessary description tables.
- Free exchange of data is essential to reach our science goals. This should not be a „one-way street" and holds for the model data as well as for the observations collected during the campaign.
- Data policy
- Data quality control
- Data availability
- ...