Role and Goals of COPS within the Priority Program 1167 “QPF”

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1. Role of precipitation in agriculture

2. Logics for the preparation of IOP COPS

3. Vision and expectations

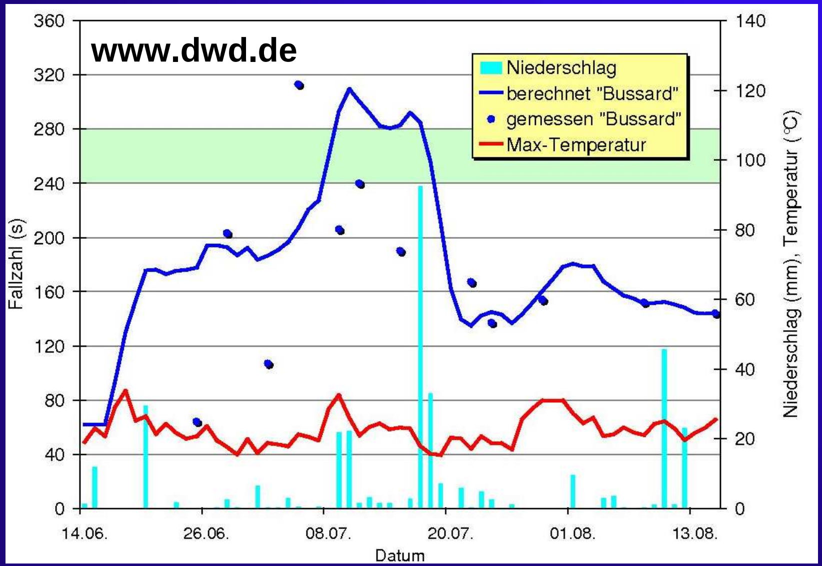
1. Precipitation in agrometeorology

- **Protection from diseases:**

  - Apple scab (Venturia inequalis)

  - Strength of infection depends on global radiation, interception of precipitation

  - Crop protection: Fungizide Trifloxystrobin



- **Optimal harvest time (wheat, rye):**

  - Friction of hot water-flour mixture, 240 s < F < 280 s

  - Enyzme activity strongly dependent on humidity and temperature

2. Logics: Why better observations?

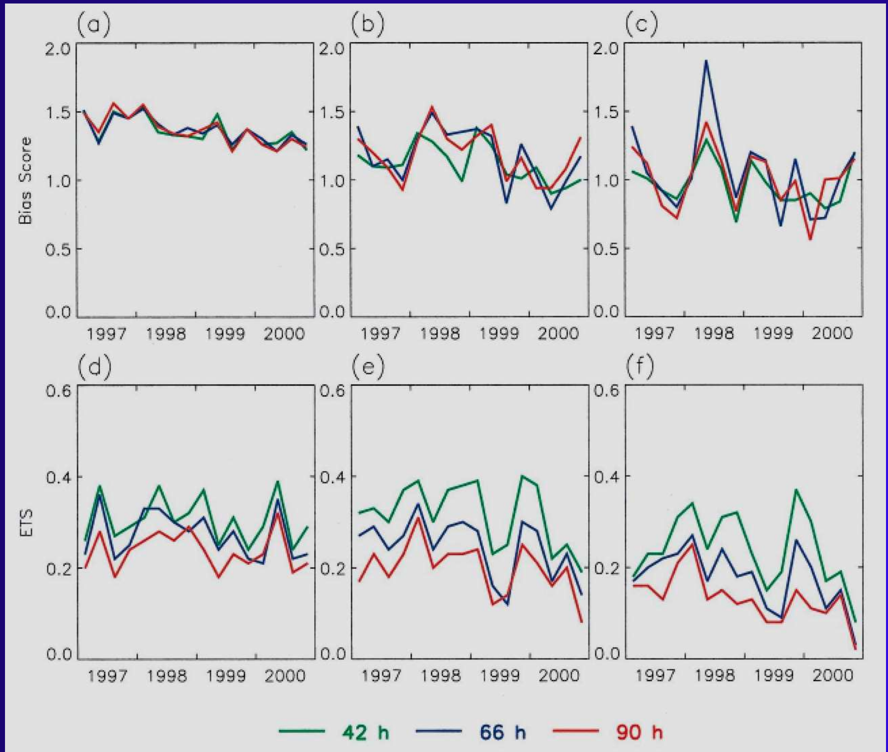
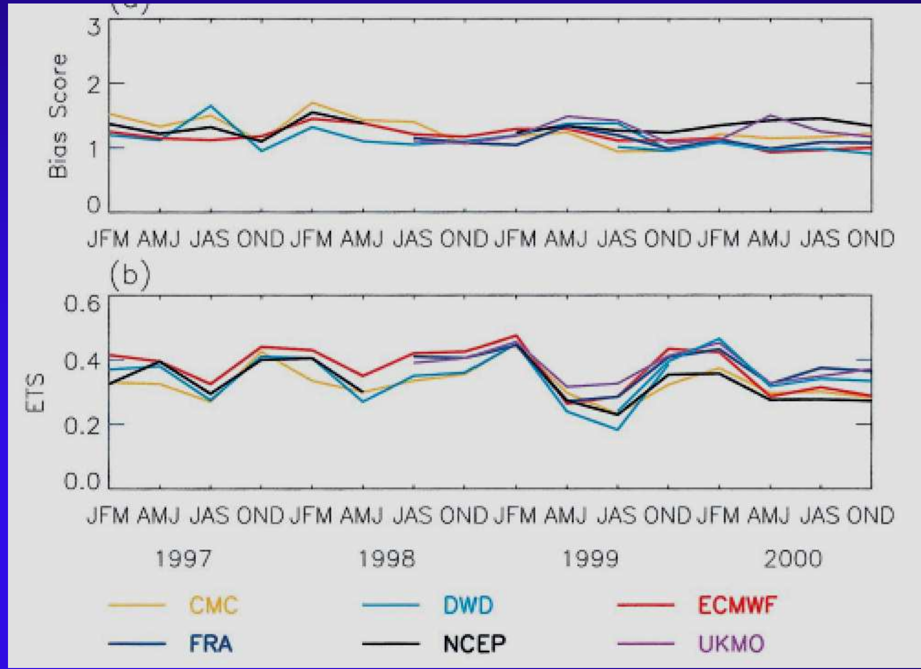


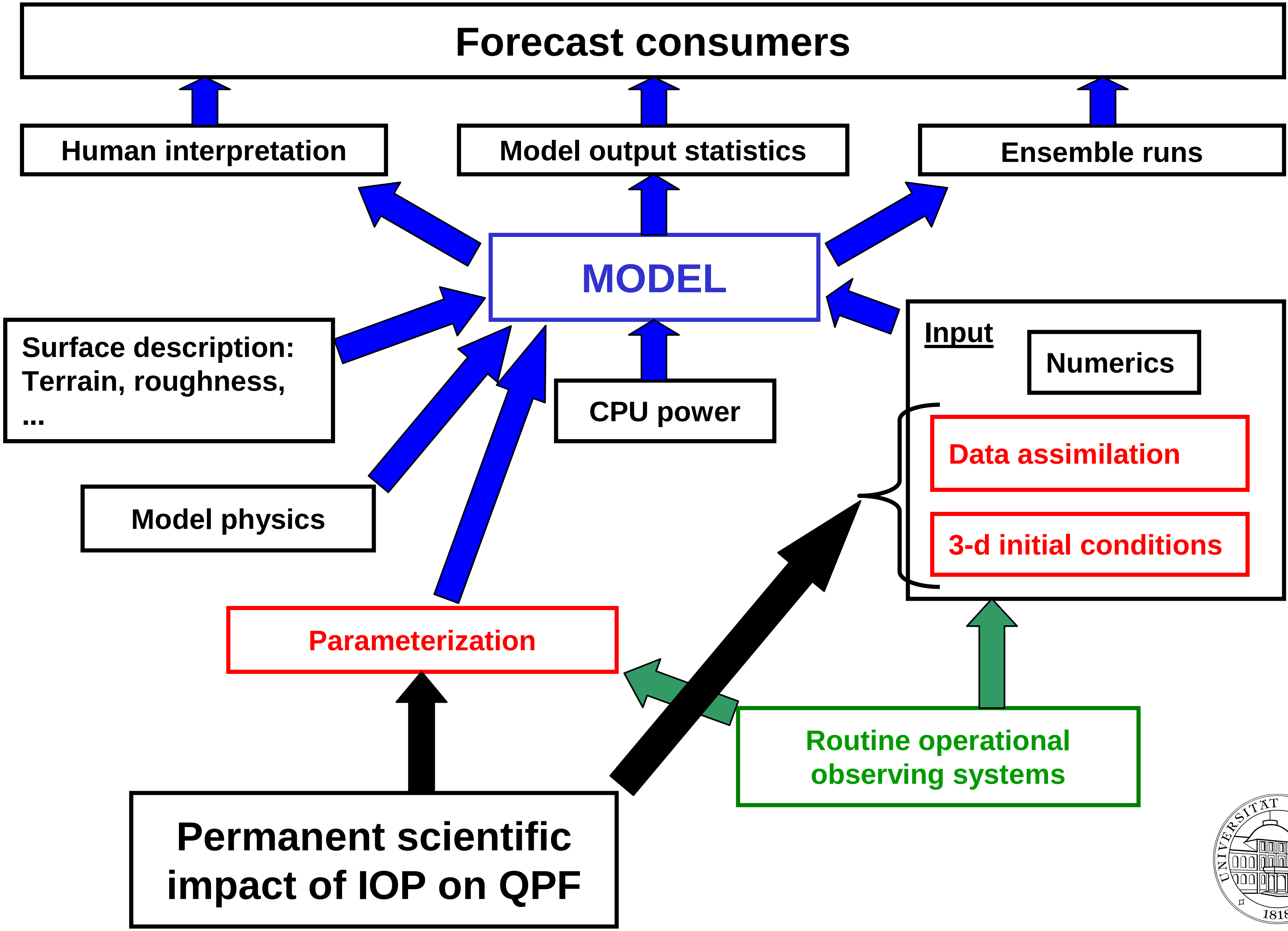
FIG. 6. (a)–(c) Bias score and (d)–(f) equitable threat score over Germany for three different thresholds (left to right, respectively, 0.1, 4, and 8 mm d^{-1}) and for three forecast periods (42: green; 66: blue; 90 h: red) for the ECMWF model.



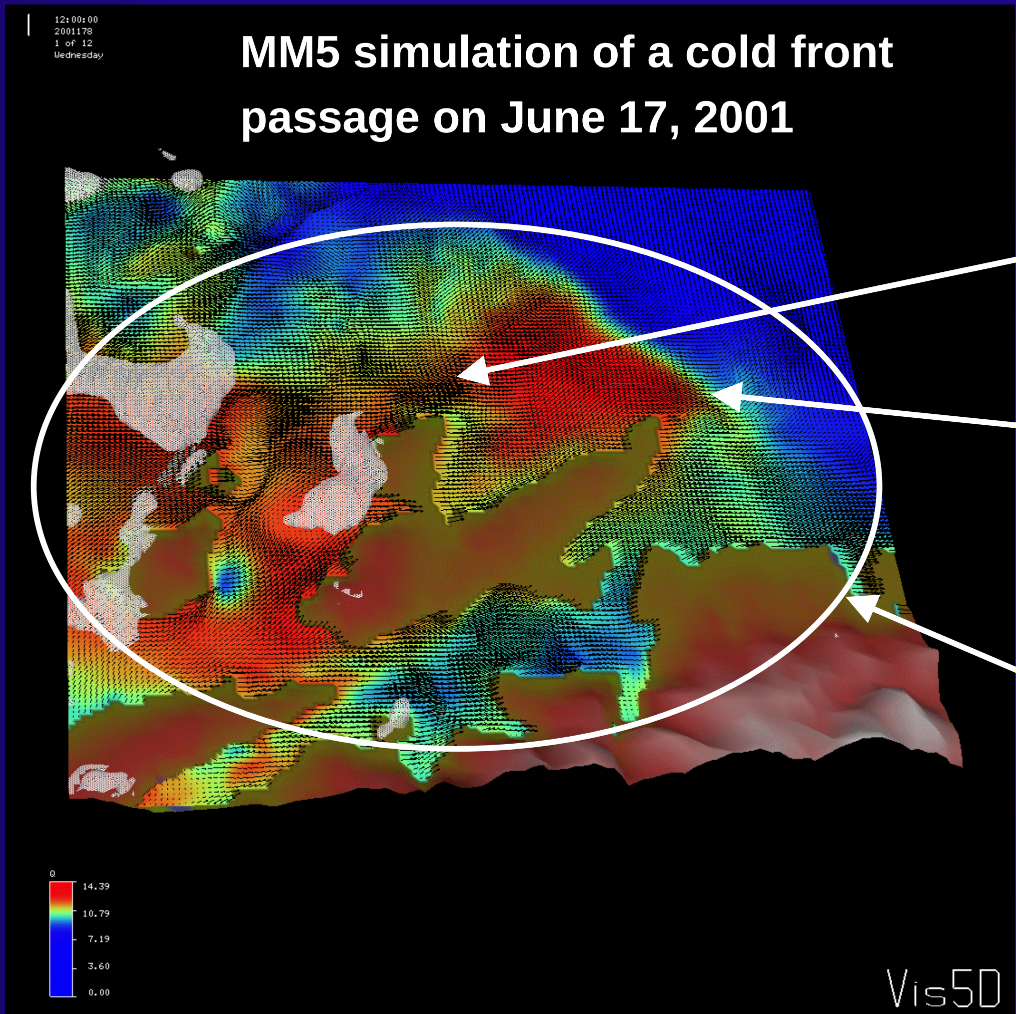
Analyses of global NWP models over Germany, Ebert et al. BAMS 2003

Skill low, particularly in summer, decreasing with rain amount. Light rain predicted too often. On mesoscale, comparable data as well as analyses of orographic effects lacking.

What is the expected impact of observations?



What kind of observations?



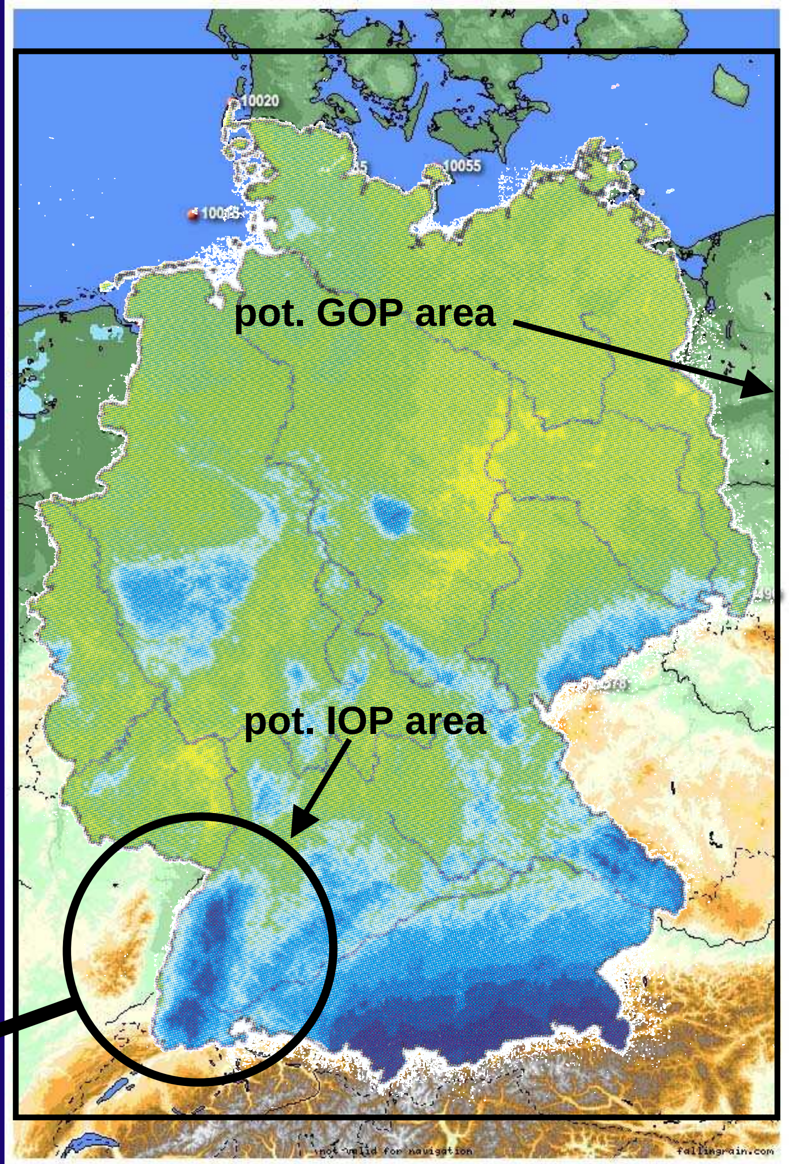
Sub-grid scale processes (e.g. turbulence and convection)

Inhomogeneities in initial fields (particularly water in all its phases and dynamics)

Suboptimal or lacking assimilation of existing data

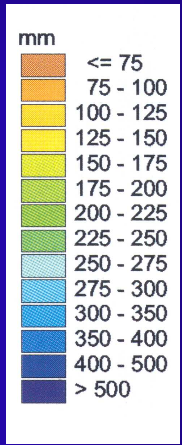
High-resolution, large-range, 4-d observations of key atmospheric variables crucial for improving QPF

Where and when observations?



Orography in Germany.

Overlay: Mean precipitation amounts in summer, average between 1901 and 2000 (DWD Klimastatusbericht 2001)



IOP COPS (Convective and Orographically-induced Precipitation Study):

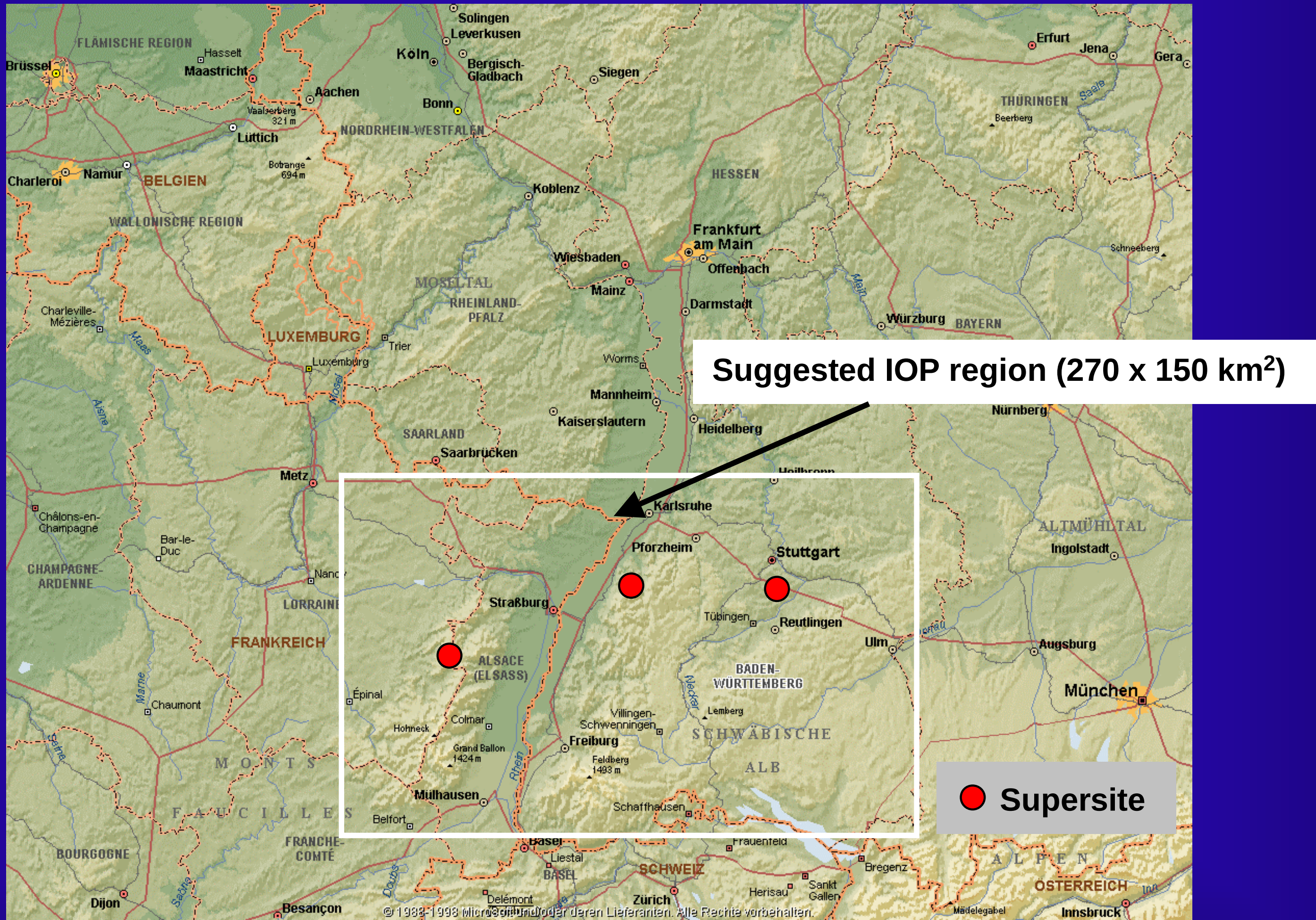
Region: Southwestern Germany

Duration: 3 months

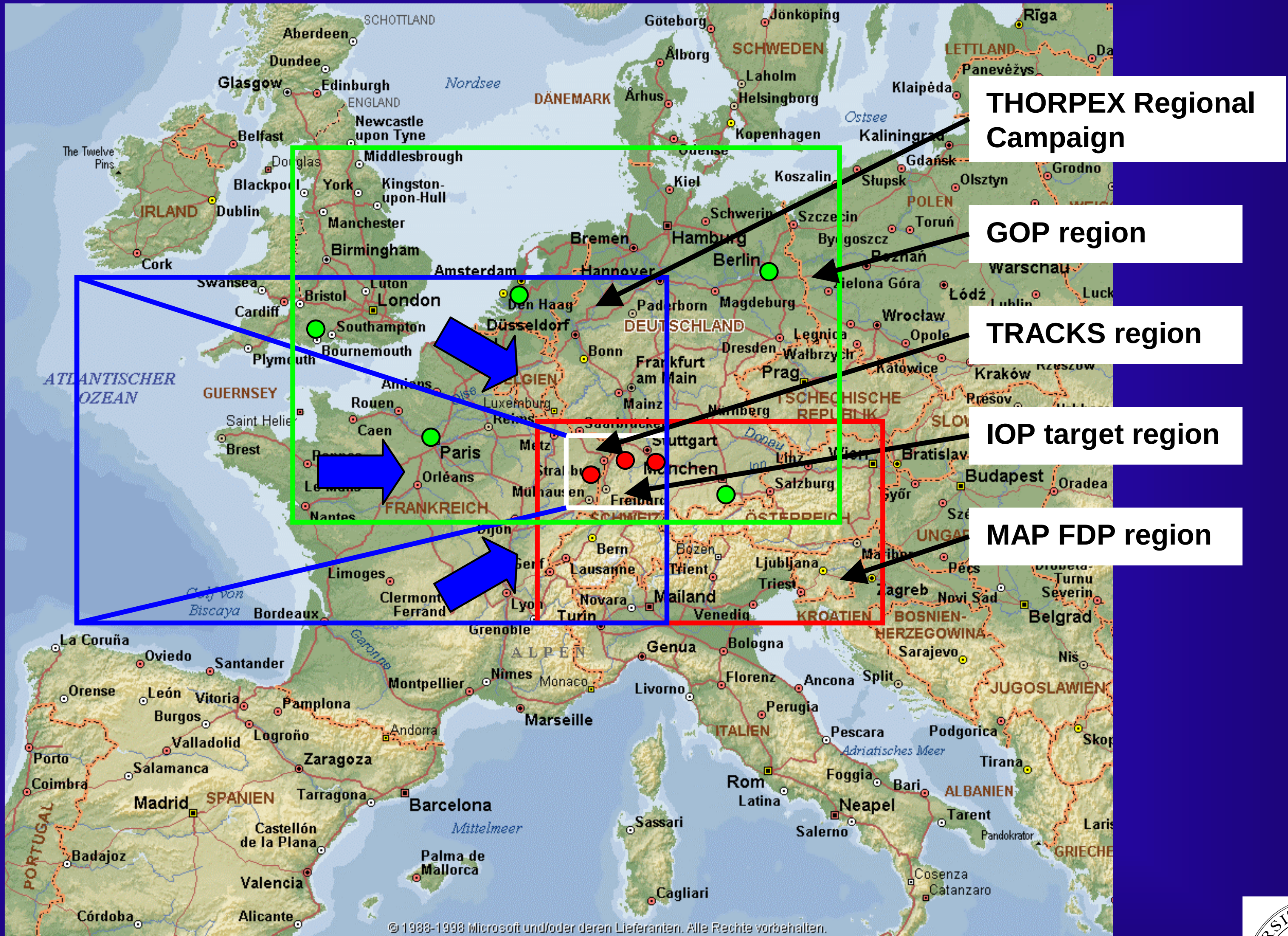
Date: Summer 2007

Coverage: about 200 km x 200 km

COPS (Convective and Orographically-induced Precipitation Study) region:



Exciting international collaboration possible:



First international QPF field campaign in low-mountain region

How?

1. Previously unachieved data sets:

Synergy of 3-d scanning, airborne and satellite instrumentation

2. High-resolution, advanced models

3. Data assimilation, ensemble forecasts

Big picture approach:

Initiation of convection

⇒ Formation of clouds

⇒ Formation of precip.

Minimizing the gap between models and data

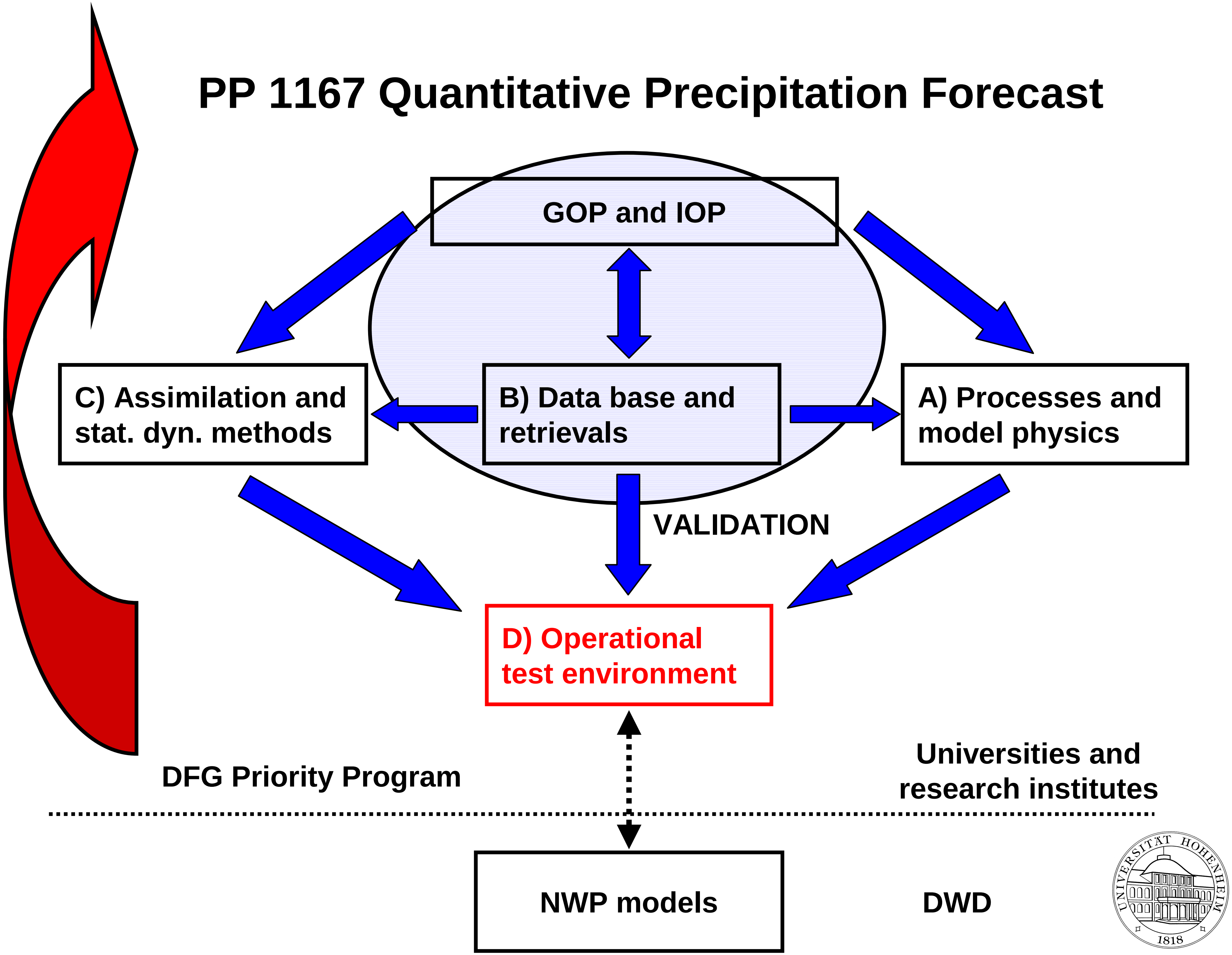
3. COPS vision

If these tools are available during the campaign, we can:

- **Improve the skill of short-range QPF, e.g. for applications in hydrology**
- **Investigate the predictability of convective precipitation**
- **Understand the 3-d development of convection**
- **Separate model errors due to initialization and parameterization**

Significant step forward for the understanding of precipitation processes

PP 1167 Quantitative Precipitation Forecast



Goals of the PP 1167

Improve QPF by the

- **identification of the physical and chemical processes responsible for deficits**
- **exploration and application of existing and new data sets for improved representation of relevant processes**
- **determination of the predictability of precipitation using stat. dyn. analyses**

PP 1167 Information

- **Acceptance: May 2003**
- **Start: April 2004**
- **Duration: 6 years**
- **Funding periods: 3 x 2 years**

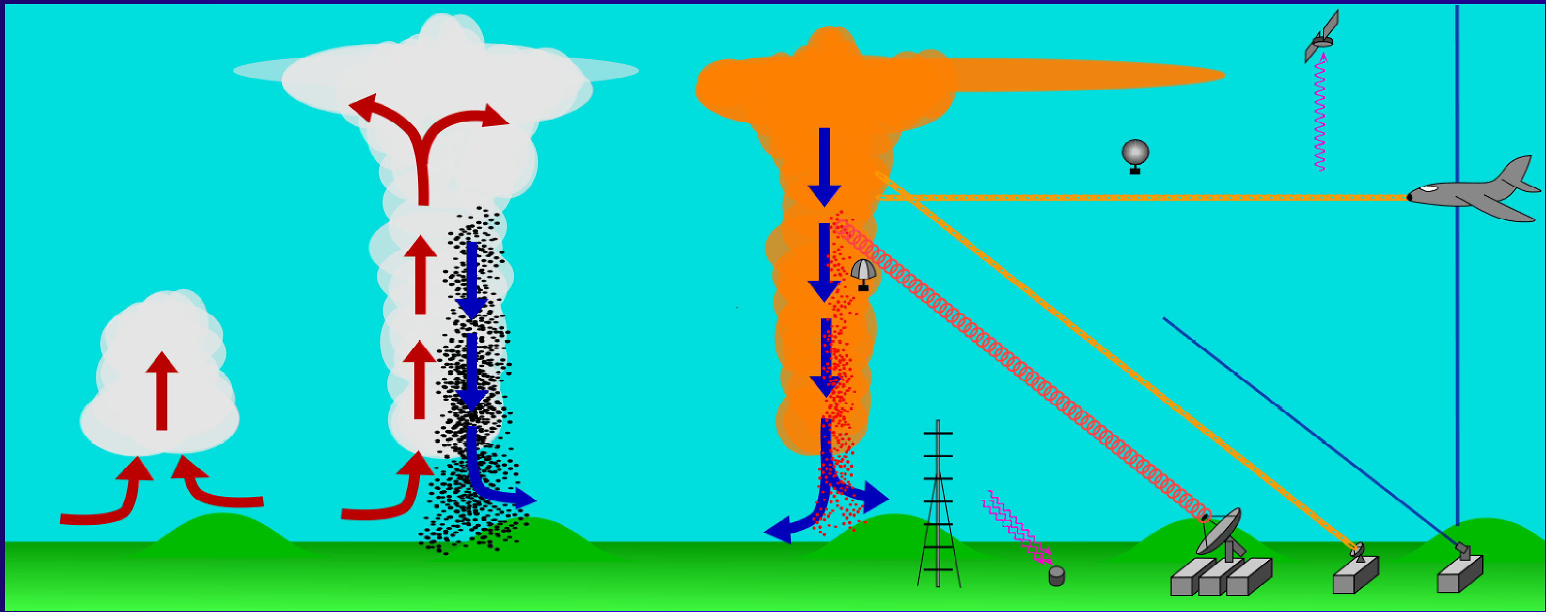
Year	1	2	3	4	5	6
Staff	2 M€	2 M€	2 M€	2 M€	2 M€	2 M€
Exp.			0.2M€	1.2M€	0.2M€	

COPS visions:

If these tools are available during the campaign, we can:

- **Suggest future observing strategies, e.g. targeting**
- **Suggest advanced parameterizations**
- **Investigate the role of aerosol and cloud microphysics in QPF in low-mountain regions**

Proposed synergy of observing systems



Precipitation radars

X-, C- or S-band,
ν = 2 – 10 GHz, $\lambda \approx$ 15 – 3 cm,
⇨ Reflectivity, LOS velocity, refractivity in precipitation

Cloud radars

Ka- or W-band
ν = 35 – 95 GHz, $\lambda \approx$ 9 – 3 mm
⇨ Particle reflectivity factor, depolarization ($\rightarrow$ liquid/ice), LOS velocity in clouds

Lidars

$\lambda \approx$ 0.3 – 2 μm, $\nu = 10^{15} – 1.5 \times 10^{14}$ Hz
⇨ α_{par}, β_{par}, δ ($\rightarrow$ liquid/ice), q, T, LOS wind in clear air, aerosol layers and thin clouds

MW and FTIR radiometers

⇨ LWC, q, T, ...

The full potential of synergetic measurements is not explored yet, e.g.:
- R_{eff} in clouds using lidar and cloud radar (Donovan et al. 2001)
- CCN using lidar, cloud radar and MW radiometer (Feingold et al. 1997)

Collaboration with DWD

- Discussion of region and name
- Development of key science questions
- Collaboration between instrument PIs and modelers
- Support access to instrumentation
- Support collaboration with other QPF programs (CSIP, THORPEX)
- Support logistic preparation as well as performance of campaign

For more details please contact the project office at IPM (Dr. Andreas Behrendt, www.uni-hohenheim/spp-iop, spp-iop@uni-hohenheim.de)

Current Members of ISSC

Prof. Dr. Volker Wulfmeyer, IPM, UHOH, Germany, Chair

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Prof. Dr. Kenneth J. Davis, Department of Meteorology, Pennsylvania State University, USA

Prof. Dr. Hartmut Graßl, MPIfM, Hamburg, Germany

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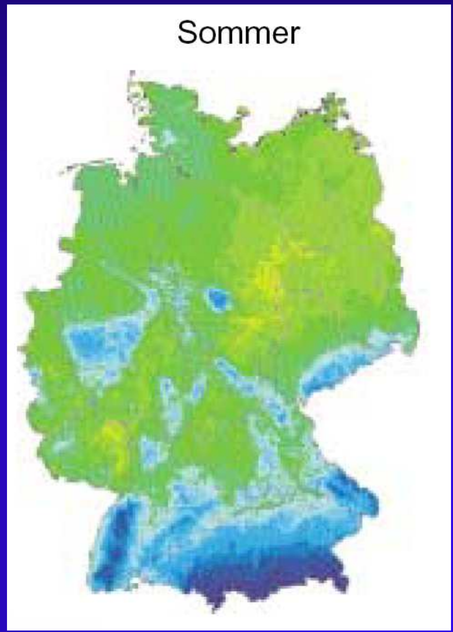
Prof. Dr. Reinhold Steinacker, Department of Meteorology and Geophysics, University of Vienna, Vienna, Austria

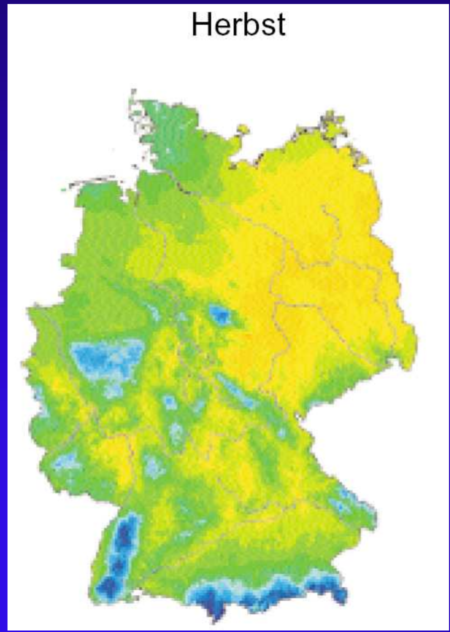
Scientific topics

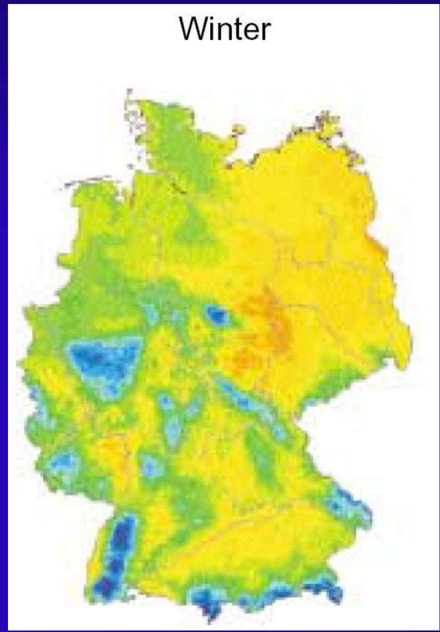
Model deficits largest in regions with significant orography:

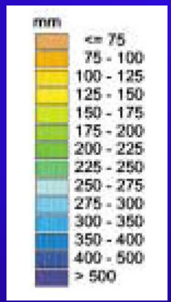
- **Precipitation fields displaced (too much lee side, not enough luv side)**
- **Too often prediction of weak precip**
- **Large errors of strong precip**
- **Diurnal cycle of precip incorrect (onset of convection too early)**
- **Incorrect estimation of convective cloud coverage**

Distribution and trends of precipitation





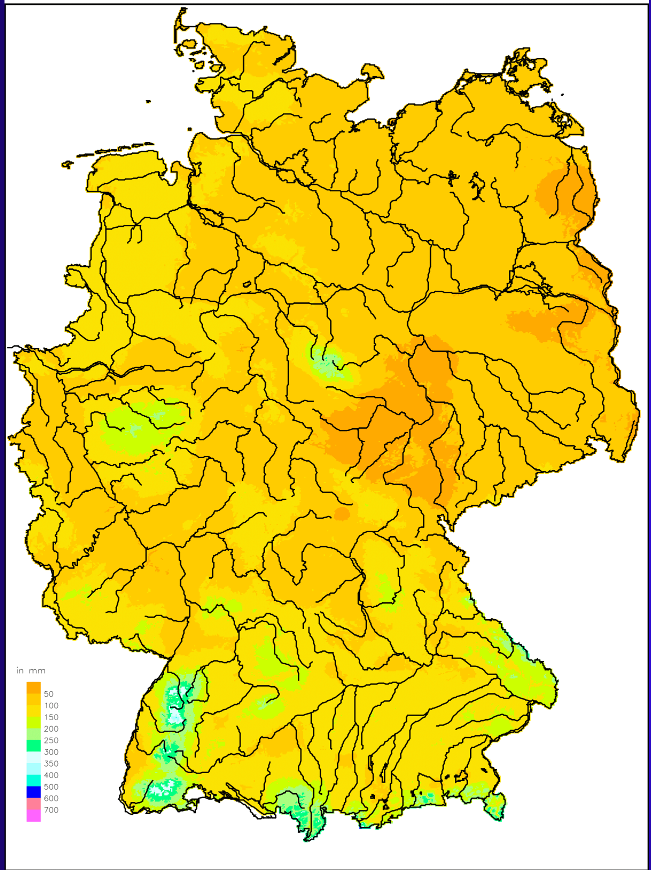




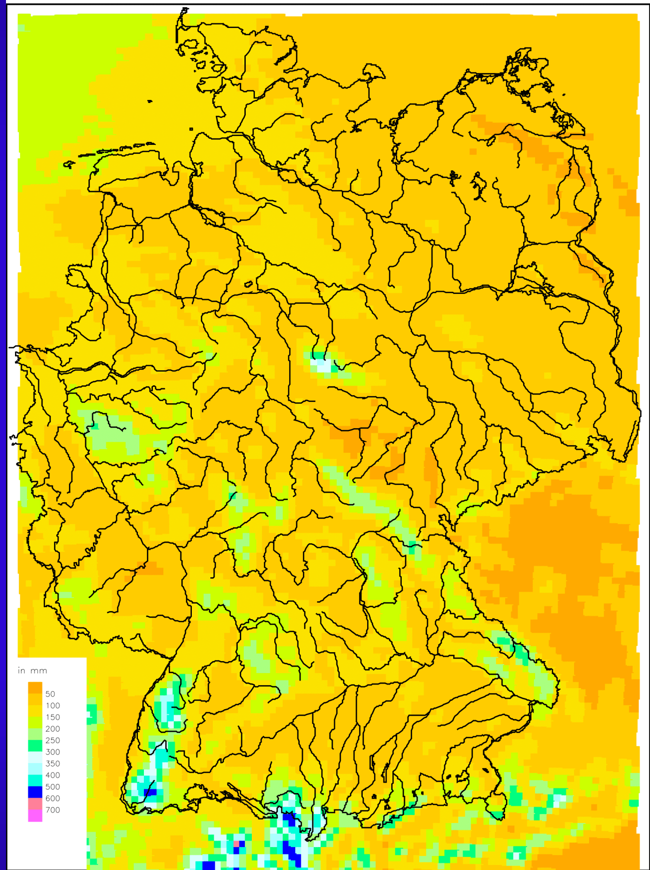
DWD Klimastatusbericht 2001

Scientific analyses of Lokal Model at DWD

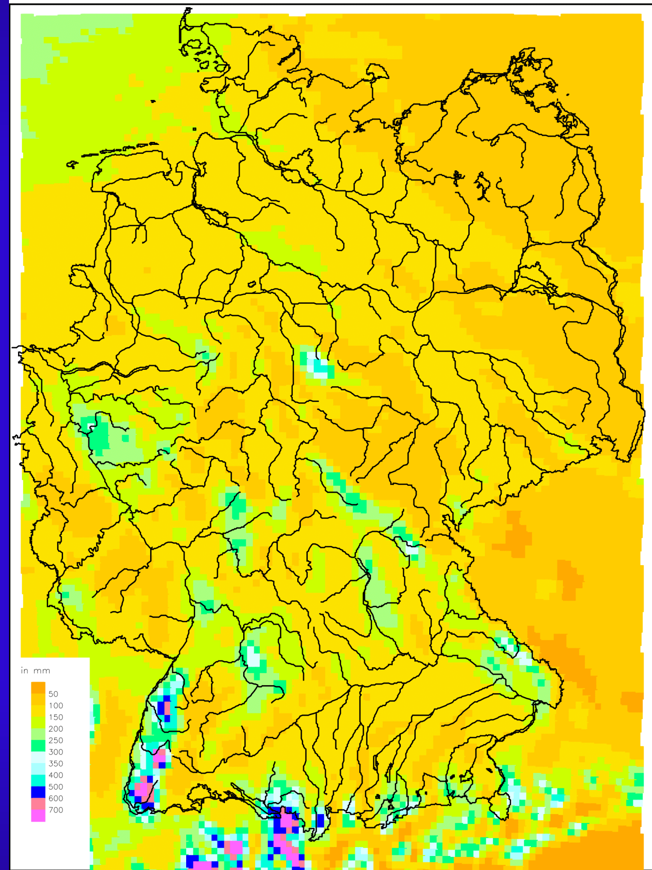
Observation, Jan, 2004



Improved LM, Jan, 2004



Previous LM, Jan, 2004



Courtesy of Prof. Dr. Gerhard Adrian, DWD