Set Up and Operation of the AMF Site in the Black Forest During COPS

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1) COPS and AMF science

Quantitative precipitation forecasting (QPF) is a key issue in atmospheric science. Accurate predictions of precipitation, particularly of extreme events, are of extraordinary value for economy and society.
QPF problems are related to deficiencies in the representation of the whole life cycle of precipitation events from the preconvective environment, to the development of clouds, to the onset, development, and decay of precipitation. Corresponding errors are interwoven and propagate in a non-linear cascade in the model system. As model physics and spatial scales in weather and climate simulations are becoming more and more similar, improved simulations of precipitation will contribute to forecast skills on all time scales.
Particularly in complex terrain, two prominent QPF problems have been identified:

1. Windward/lee effect

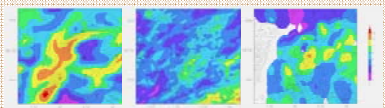

Figure 1. *Comparison of observations with 24-h precipitation forecasts in mm/day using the MM5 model driven by ECMWF analyses. 13 representative cases with significant precipitation in the Black Forest region during summer 2005 have been averaged. The black lines indicate the orography of the region. Left panel: 7-km MM5 simulation with convection parameterization. Middle panel: 1-km MM5 simulation without convection parameterization. Right panel: Corresponding observations. Using high-resolution simulations without convection parameterization, the windward/lee effect is clearly reduced.*

2. Diurnal cycle of precipitation

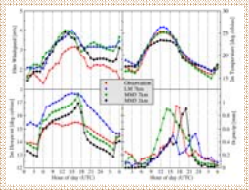

Figure 2. *Diurnal cycle of surface variables simulated for the same 13 cases as in Fig.1. LM: Lokalmodell of the German Weather Service (DWD). Strong deviations from observations are found in all variables. Increasing model resolution and shutdown of convection parameterization results in an improvement of the simulation of precipitation.*

2) European summer experiments 2007

To address these topics, a series of research programs has been initiated, which is coordinated by the World Weather Research Program (WWRP). Process and predictability studies are strongly related to World Climate Research Program (WCRP) and Atmospheric Radiation Measurement (ARM) Program research activities.

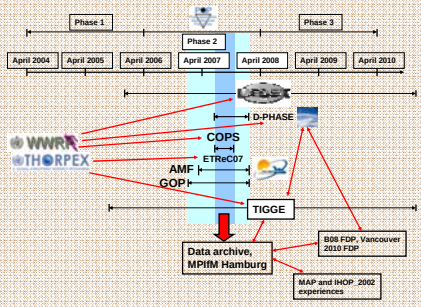

Figure 3. *Coordination of weather research programs during this decade. PQP: German QPF program funded by the German Research Foundation (DFG); MEDEX: World Weather Research Program (WWRP) Research and Development Project (RDP) for studying cyclones in the mediterranean area; D-PHASE: WWRP Forecast Demonstration Project (FDP). COPS: Convective and Orographically-induced Precipitation Study, a WWRP RDP; GOP: 1-year General Observations Period; COPS and GOP and strongly supported by operation of the AMF; ETReC07: First summertime European THORPEX Regional Campaign; TIGGE: THORPEX Interactive Grand Global Ensemble; MAP: Mesoscale Alpine Programme; IHOP_2002: International Water Vapor Project.*

Within these research programs, intense global and mesoscale modeling activities are coordinated with a series of experiments providing a unique data set.

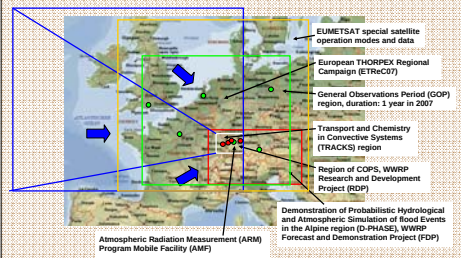

Figure 4. *Spatial overlap of research areas.*

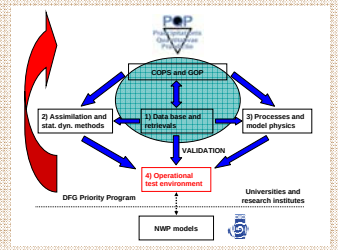

Figure 5. *Set up of German QPF program PQP.*

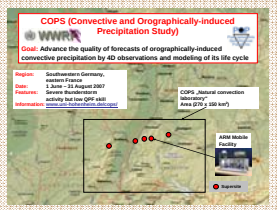

Figure 6. *COPS region and science goal. The location of the AMF is also indicated.*

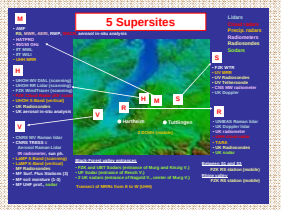

Figure 7. *COPS Supersite equipment. The AMF is located at Supersite M.*

Figure 8. *Airborne platforms participating in COPS / TRACKS.*

3) Set up of AMF site, coordination with COPS and GOP

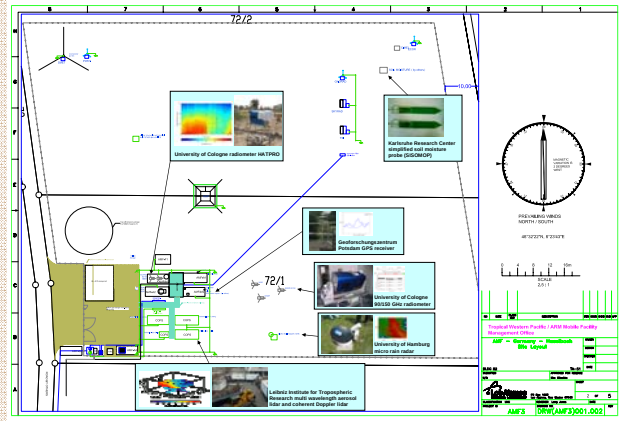

Figure 9. *Result of site preparation and operation planning process, which was organized within a contract between Los Alamos National Laboratory and University of Hohenheim. It comprised the work of the local government and an engineering office and included site rental, building application, site ground work, logistics (power, internet, phone), fence, outreach, etc. The German COPS and GOP contributions are highlighted.*

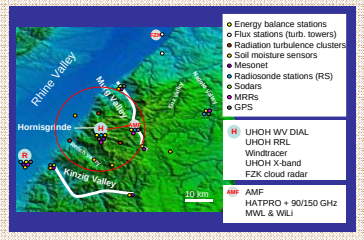

Figure 10. *Zoom in view of Northern Black Forest. Scanning remote sensing systems from Supersite H shall overpass the AMF site for synergetic measurements and for studying the representativeness of AMF measurements.*

Figure 11. *Aerial photo of AMF site in Murg valley.*

Figure 12. *MWRs.*

Figure 13. *Wind profiler.*

Figure 14. *Eddy correlation station.*

Figure 15. *AMF site with aerosol inlet.*

4) Strategy for reaching the science goals

Mission planning is performed by the COPS ISSC and the COPS PIs. Mission preparation and performance is organized at the COPS Operations Center. Particularly challenging is the coordination of the airborne platforms with scanning and mobile ground-based measurements. Long-term statistics of synergetic retrievals will be used for model evaluations.

Figure 16. *COPS OC at Baden Airpark in the Rhine valley.*

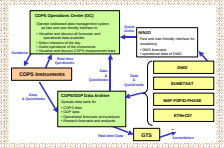

Figure 18. *Mission planning and data management. It is expected that about 10TB of data will be produced.*

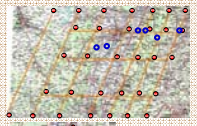

Figure 17. *Forced convection mission plan for German and French Falcons (upper panel) as well as DO 128 aircraft (bottom panel).*

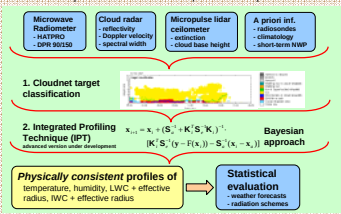

Figure 19. *Planned near real-time data analysis using Cloudnet classification and improved Integrated Profiling Technique (IPT).*

Overarching Science Questions:

- What are the processes responsible for the formation and evolution of convective clouds in orographic terrain?
- What are the microphysical properties of orographically induced clouds and how do these depend on dynamics, thermodynamics, and aerosol microphysics?
- How can convective clouds in orographic terrain be represented in atmospheric models based on AMF, COPS, and GOP data?

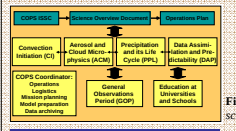

Figure 20. *COPS scientific organization.*

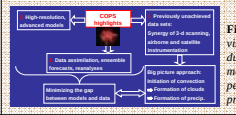

Figure 21. *COPS research vision for separating errors due to initial fields and model physics as well as for performing process and predictability studies.*

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