

## Meeting of WG 4 Data Assimilation and Predictability (DAP)

### Participants:

Matthias Grzeschik (IPM Hohenheim, grz@uni-hohenheim.de)  
Florian Zus (IPM Hohenheim, zusflori@uni-hohenheim.de)  
Evelyne Richard (LA Toulouse, rice@aero.obs-mip.fr)  
Volker Wulfmeyer (IPM Hohenheim, wulfmeyer@uni-hohenheim.de)  
Volker Küll (U Bonn, vkuell@uni-bonn.de)  
Christian Keil (DLR Oberpfaffenhofen, Christian.Keil@dlr.de)  
Hans Volkert (DLR Oberpfaffenhofen, Hans.Volkert@dlr.de)  
Marco Arpagaus (MeteoSwiss, marco.arpagaus@meteoswiss.ch)  
Stefan Schneider (U Vienna, stefan.schneider@univie.ac.at)  
Romi Schnitter (IMK Karlsruhe, romi.sasse@imk.fzk.de)  
Takuya Kawabata (MRI/JMA, Japan, tkawabat@mri-jma.go.jp)  
Janette Onvlee (KNMI, De Bilt, onvlee@knmi.nl)  
Jean-Pierre Chaboureau (LA, Toulouse, jean-pierre.chaboureau@aero.obs-mip.fr)  
Pierre Brousseau (CNRM, Toulouse, pierre.brousseau@meteo.fr)  
Olivier Caumont (CNRM, Toulouse, olivier.caumont@meteo.fr)  
Stefan Klink (EUCOS, Offenbach, Stefan.Klink@dwd.de)  
Hans-Joachim Koppert (DWD, Offenbach, Hans-Joachim.Koppert@dwd.de)  
Claudia Wunram, M&D, MPI, Hamburg, cops@zmaw.de)  
Hans-Stefan Bauer (IPM Hohenheim, hsbauer@uni-hohenheim.de)

The meeting was started with a brief summary of the results of a data meeting that took place before the workshop on 27.02.2008. It was mentioned that the harmonization of the datasets for the different instruments is essential for allowing an efficient use of the data for assimilation purposes. For the creation of reanalyses, which needs to use the data in an operational framework, this is even more important than for case studies. Furthermore, each provider of observations must also provide an estimation of the observation error (at least an rms error) also necessary for data assimilation. For the lidar systems, the participating groups already developed a common lidar format to be used for all lidar observations. Furthermore, a common format for radiosonde data for the data base is already available and will be applied (refer to M. Dorninger for more details). In this connection, it was pointed out that COPS radiosonde data, which were ingested in GTS, should be stored separately, as in GTS only a subset of the profiles is used, which may be suboptimal for high-resolution data assimilation.

During the COPS workshop intensive discussion of Claudia Wunram and Andreas Behrendt took place with the PIs of the different observing systems to harmonize the data format of the different instruments as much as possible.

During the data meeting the following table of data sets was compiled that will be used for assimilation studies. This table needs to be endorsed by the WG in order to fix the preparation of the data sets.

Provider	Dataset	Period available	Data archive
IMK	Drop up sondes	IOPs	WDCC
U Leeds, U Hohenheim, UNIBAS, Susi V	Radiosondes	IOPs	WDCC
ARM	AMF soundings	continuous, GTS	ARM
EUCOS	Additional radiosondes, AMDAR	GTS	GTS
GFZ	GPS (IWV, ZPD, SPD)	continuous	WDCC
DWD, Meteo France, DLR, ...	Radar radial velocity, reflectivity	continuous	Met. Centers, WDCC
DLR Falcon aircraft	Water-vapor and Doppler lidar, in-situ meteorology	IOPs	WDCC
UHOH	Water-vapor and temperature lidar	IOPs	WDCC
UNIBAS	Water-vapor and temperature lidar	IOPs	WDCC
Safire Falcon aircraft	In-situ meteorology, water-vapor lidar	IOPs	WDCC
IMK DO-128	Aircraft in-situ data	IOPs	WDCC
various	Surface observations	continuous	WDCC
EUMETSAT, WISC, SSEC	Satellite data	continuous	EUMETSAT, SSEC

Table 1: Datasets interesting to be assimilated for case studies and reanalyses.

Within the project COPS-GRID, DWD will perform reanalyses for the COPS period using radio soundings, GPS, and radar radial velocities (see poster DAP 1 for more details). For this purpose, the data, as it is stored in the data base, has to be re-structured into synoptic batches. So far, the data are stored as instrument and parameter based time series. However, all variables from one instrument are needed in 3h batches (daily possible but re-processing necessary). DWD offered to provide the re-structured data to the assimilation groups in the DWD data base. Whether and how the data is then re-mirrored to the COPS database in Hamburg is under discussion.

In this context DWD noted that data from the GTS is also available in the DWD database for the COPS participants. This is also true for additional EUCOS radiosondes not available in the GTS. Furthermore, Manfred Dorninger (U Vienna) is collecting GTS and non-GTS data to prepare „European“ data sets from the different data sources, which will be available soon in the data archive. First versions of some of the data sets are already available directly from the University of Vienna.

The COPS data shall be uploaded to the COPS database until the end of March. However, first studies will focus on some few IOPs. Although already selected during the preparation meeting for the third phase of PQP in Langen, it was briefly discussed about interesting IOPs. The list shall cover all convection types, defined before COPS (non-forced, forced non-frontal, forced-frontal). As golden days from a synoptic point of view the following IOPs were selected:

- IOP 4 (forced non-frontal)
- IOP 8b (surface driven, non-forced)
- IOP 9c (forced-frontal)
- IOP 13 (cyclogenesis over France, Saharian dust outbreak)

For these IOPs the observations shall be processed and stored to the database with priority. The investigations shall first focus on IOPs where an as large as possible observational dataset is available. From the selected IOPs this is fulfilled by the IOPs 8b, 9c and 13. For IOP 4 no aircraft data is available.

During some of the IOPs targeting flights within the European THORPEX Regional Campaign 2007 (ETReC07) were carried out by the DLR Falcon aircraft. The following table summarizes the ECTeC07 Upstream Observation Periods (UOPs) performed during the COPS period.

UOP	Date	AMDAR	Radiosonde	DLR Falcon
1	26 June 2007	X	X	
2	3 July 2007	X	X	
3	8 July 2007	X	X	X
4	15 July 2007	X	X	
5	19 July 2007	X	X	X
6	29 July 2007	X	X	
7	1 August 2007	X		X

On the next meeting of the WWRP working group on Mesoscale Weather Forecasting, COPS will be proposed as a WWRP data assimilation test bed. This contains coordinated model forecasts using different assimilation systems to investigate their performance. To work out the differences induced by using different assimilation methods, it is necessary that the different assimilation groups agree as much as possible about model configuration, domain configuration, initialization time and assimilation window for the planned experiments. Furthermore, the different cut-off times used in the different assimilation schemes of operational and research assimilation experiments have to be considered for comparisons.

Afterwards, every participant briefly introduced him/herself, their work and plans for the future, summarized with the following list of keyword.

**Volker Küll**

- Development of a hybrid convection scheme during PQP phases 1 and 2
- Now data is needed to validate the new scheme and tune the used free parameters

- Interested to use the best initial state from DWD (reanalysis)

### **Hans Volkert, Christian Keil, George Craig**

- Performed larger scale, upstream aircraft missions within ETReC07 during COPS with the DLR Falcon aircraft
- Data assimilation with the COSMO – LEPS system
- Assimilation of radar products, Physical Initialization (PI) product (case studies) LIDAR from Falcon (wind, water vapor) using COSMO nudging system
- Comparison of forecasts with and without assimilation

### **Marco Arpagaus**

- D-PHASE coordinator
- D-PHASE forecast demonstration project containing the COPS period
- No assimilation activities planned from D-PHASE side
- Data base with model results and visualized products available
- First analyses of the D-PHASE ensemble about the performance of the participating models (see presentation on the COPS workshop on the COPS webpage at <https://www.uni-hohenheim.de/spp-iop>)

### **Stefan Schneider**

- Analysis of surface observations
- Compilation of gridded fields of GTS and non-GTS surface observations combining sources from different forecast agencies

### **Romi Schnitter**

- Analysis of the water cycle in the COSMO model
- Interested in GPS data assimilation into COSMO

### **Takuya Kawabata**

- Developed a high resolution 4D-Var based on the non-hydrostatic version of the MRI-JMA forecast model
- Interested in the assimilation of the COPS data
- Cooperation with IPM to improve the performance of both systems (MM5/WRF 4DVAR and NHM-4DVAR)

### **Jeanette Onvlee**

- Performs reanalyses assimilating different observing systems with the HIRLAM model (3DVAR and 4DVAR)
- Priority on GPS and radar radial velocity data
- Interested in the design of an optimal mesoscale observational network

### **Jean-Piere Chaboureau**

- Performs case studies using the MesoNH model
- No assimilation studies planned
- Needs data for model validation (as e.g. radar, radiosondes, ...)

### **Pierre Brousseau**

- Performs observing system experiments (OSEs) and reanalyses over long periods with the AROME Rapid Update Cycle (3DVAR).

- Priority on GPS, surface and radar radial velocity data.

#### **Olivier Caumont**

- Assimilation of radar reflectivities and GPS zenith total delays (ZTD) data with the AROME 3DVAR assimilation system.
- Needs observation for model validation (AROME)

#### **Evelyne Richard**

- Interested in case studies using the MesoNH model
- Therefore, the best possible initial state is needed
- Interested in using COPS data for model validation

#### **Stefan Klink**

- Provides data of additional radiosondes
- Interested in the projects of this working group

#### **Hans-Joachim Koppert, Werner Wergen**

- Representative of the DWD part of the COPS-GRID project
- Re-structuring of COPS observations needed for the reanalysis project
- DWD reanalyses using different observations
- Observing System Experiments (OSEs) using research data from COPS

#### **Hans-Stefan Bauer, Volker Wulfmeyer, Florian Zus, Matthias Grzeschik**

- MM5 4DVAR of high-resolution observations (COPS-GRID within DFG SPP1167)
- D-PHASE project within DFG SPP1167 containing process studies with the D-PHASE ensemble and predictability studies
- Operational assimilation of GPS slant path delay data during COPS
- High-resolution process and impact studies for selected COPS IOPs using MM5 / WRF assimilating data collected during COPS.
- Development of forward operators for scanning lidar systems and radar radial velocities
- Interested in import routines for the different data sources

After the introduction session a discussion was started about possible beneficial cooperations of the participating groups. An important point mentioned by Hans Volkert was that the reanalysis of the COPS period with the COSMO-DE model (DWD, COPS-GRID) will be an important basis for many assimilation studies. Therefore, it is important to release the baseline reanalysis as soon as possible. The same is true for the provision of the synoptically-sorted observations. Within COPS-GRID, DWD planned to provide the baseline experiment and the observations 6 months after the start of the project. However, the change to a new supercomputer and the necessity to hire a scientist for this project might delay the schedule. Further beneficial cooperations are summarized as follows:

- Preparation of initial conditions using different assimilation schemes for case studies and validation of parameterizations
- Coordinate case study experiments
- Coordinated ensemble studies with e.g. different models starting from the same ECMWF ensemble members (e.g. predictability studies)

- Coordinated data preparation to avoid double work
- Develop methods to compare the results of the different groups
- Sharing knowledge and observation operators
- Joint publications

The following table summarizes the planned assimilation activities.

Institution	Model	Assimilation Method	Data to be used
IPM U Hohenheim	MM5/WRF	3/4DVAR	Lidar Radiosondes GPS slant total delay Radar radial velocity
DWD	COSMO-DE	Nudging	Radiosondes GPS slant total delay Radar radial velocity Lidar for case studies
Météo-France	AROME	RUC 3DVAR	radiosondes surface (T2m, Hu2m, V10) radar radial velocity ground-based GPS ZTD
Météo-France	AROME	3DVAR	Radar reflectivities and denser GPS ZTD data for case studies