Reanalysis for COPS – Overview and Strategy

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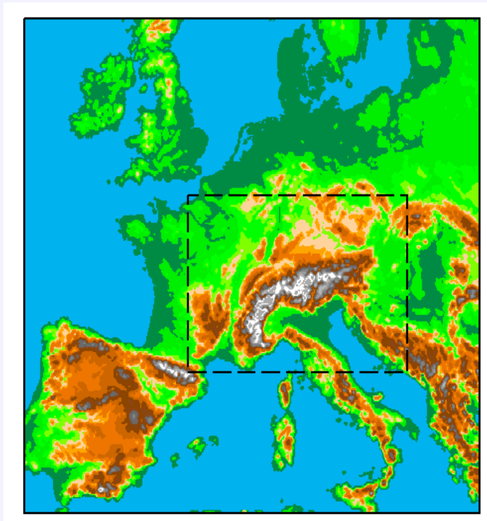
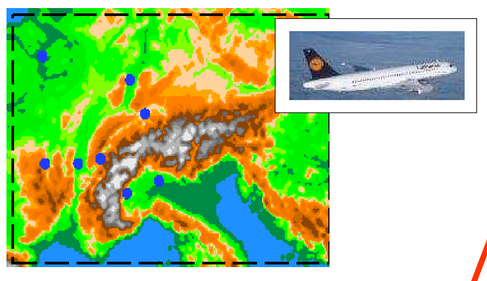
1.Motivation

The Convective and Orographically - induced Precipitation Study was an intensive measurement campaign which lasted three months from 1st June to 31st August 2007 and took place in the area of the Black Forrest. During this time many new measurement techniques like ground based GPS receiver measuring zenith path delay which is converted into integrated water vapor or radars measuring radial winds were used. In addition some already operational techniques like radiosondes or aircrafts gathered data in a higher frequency.
To see the impact of the additional and the not yet assimilated data it is important to reanalyse the three month with the newest version of the small scale model COSMO-DE (version 4.10, more information http://www.cosmo-model.org) of the German Weather Service in collaboration with other institutes in Germany.
A reanalysis can be very helpful for validating field measurements. It shows a four dimensional field which is consistent in space and time and which is the result of the best available model and data assimilation scheme. So this analysis is more suitable than the operational analysis. It is for example possible to validate independent observations (in this case not yet operational or additional data) and detect errors in the measurement. Furthermore it can be proved if the precipitation forecast in an area affected by mountains (windward – lee - effect) is getting better with additional or new data.
It might also be interesting to see the impact of the different measurement systems on their own on a weather forecast. For that reason there will be reanalysis runs based on the operational data base plus the ground based GPS or the radial wind measurements.

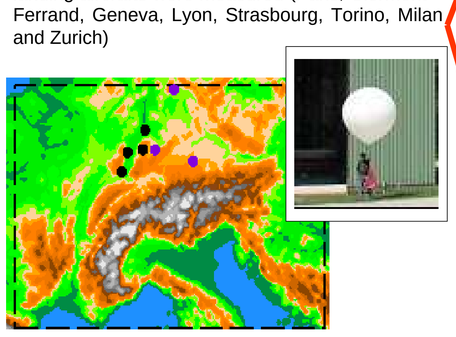


2. Setup of the reanalysis

- Using COSMO version 4.10 (plus changes for reanalysis purposes)
- Domain covers COSMO-DE, COPS and MAP-DPHASE
- Computing a 24 hour forecast every 6 hours
- Boundary conditions are taken from operational COSMO-EU analysis



Airports, at which more profiles of starting and landing aircrafts were measured (Paris, Clermont – Ferrand, Geneva, Lyon, Strasbourg, Torino, Milan and Zurich)



Operational radiosondes (purple), which measured in a higher frequency (Munich, Stuttgart, Meiningen) and additional radiosondes (black)

3. Reanalysis runs

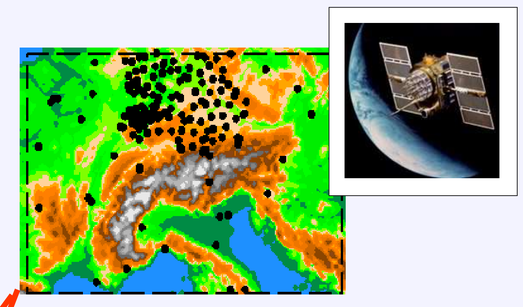
3.1. Operations (ope)
All in the operational data base of the German Weather Service available data is used. That means additional aircraft and radiosonde measurements are taken into account. No integrated water vapor or radial winds are used.

3.2. Baseline (bas)
All COPS related observations are left out. That means, the aircraft and radiosonde data is thinned and no ground based GPS (integrated water vapor) or radial wind data is used. For the radiosonde stations Stuttgart (10739), München (10868) and Meiningen (10548), which measured in a higher frequency, only the operational measurements at 00 UTC and 12 UTC are used. The measurements of the mobile radiosonde stations (FKB, LFPW, FRBUR, DLFZK) are totally left out. The aircraft data was thinned, i. e. only the same number of profiles as in the operational case are used. The single - level aircraft data is not thinned. The considered airports are Paris, Clermont – Ferrand, Geneva, Lyon, Strasbourg, Torino, Milan and Zurich.

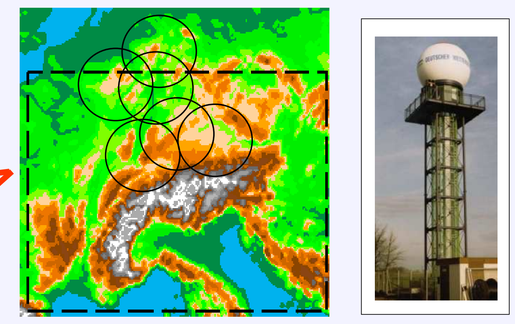
3.3. GPS (gps)
This run is built of the conventional data (baseline, see 3.2.) and ground based GPS integrated water vapor. The German Research Centre for Geosciences Potsdam reprocessed the measured data, so that we use COST - 716 V2.0 files.

3.4. Radar (rad)
Like the run before, baseline data and instead of integrated water vapor radial wind data is used.

3.5. All (all)
All data sources are used. That means additional radiosonde and aircraft data, GPS integrated water vapor and radial wind data are taken into account beside the conventional data.



Ground based GPS receiver in the area of interest. This data is reprocessed by the German Research Centre for Geosciences Potsdam.



Sites of radial wind measurements

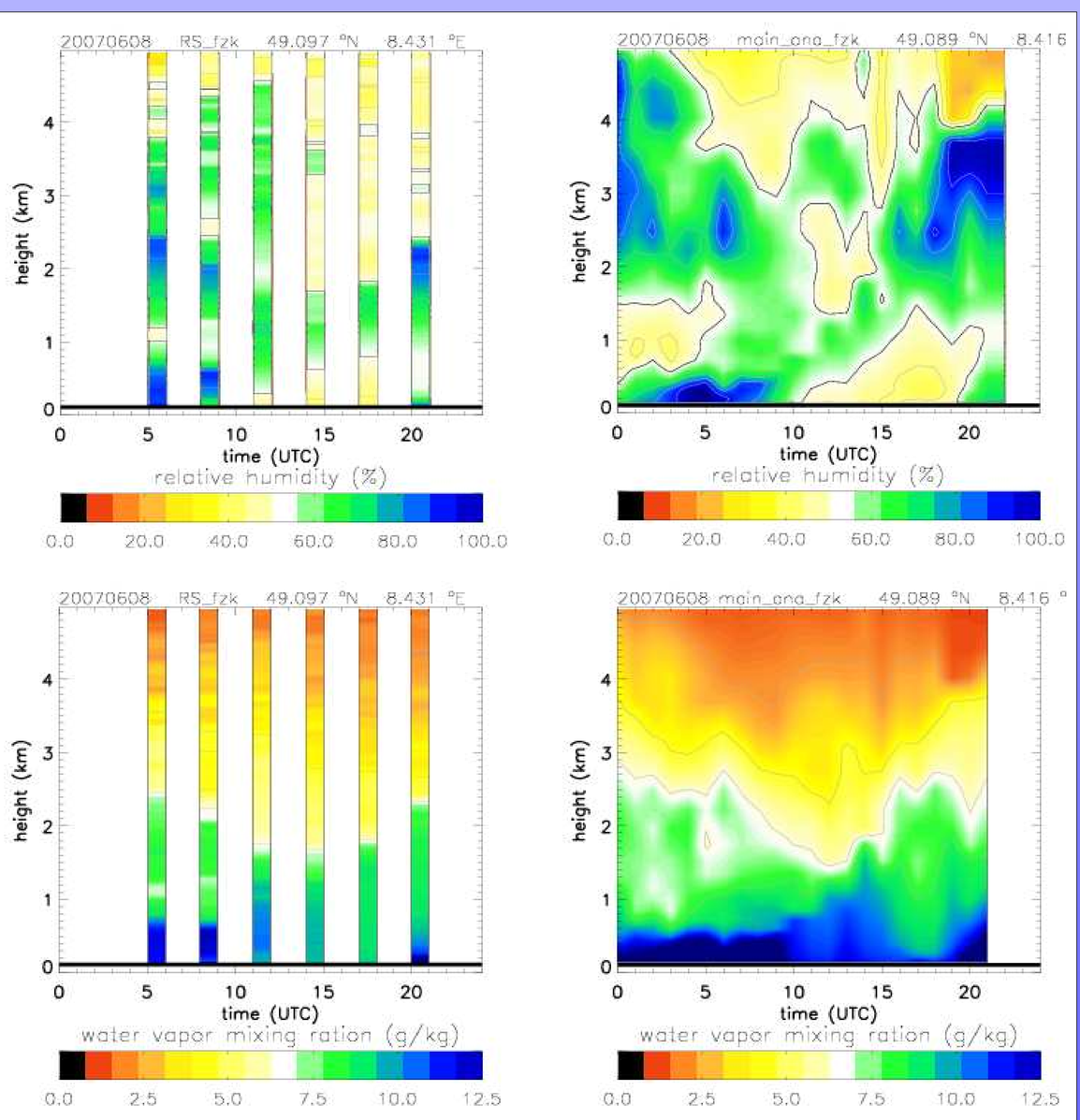
4. Output definitions

Output fields will confirming the TIGGE+ requirements as good as possible and will be given as GRIB1 every 15 minutes for each simulation run. A complete data set covering MAP-DPHASE domain will be stored at the CERA data base (Hamburg). The notation there is: {**time**}_ds_jdc_{**exp**}_{**type**}_{**var**}.grb.gz. That means:

- **time**:
  - Has the format YYYYMMDDHH
- **exp**:
  - Name of the run (ope, bas, gps, rad or all)
- **type**:
  - Type of model run (rean for reanalysis, fore for forecast)
- **var**:

• mu	u-velocity on model levels	[m/s]
• mv	v-velocity on model levels	[m/s]
• mw	w-velocity on model levels	[m/s]
• mqc	specific cloud water content on model levels	[kg/kg]
• mqi	specific cloud ice content on model levels	[kg/kg]
• mqr	specific water content of rain on model levels	[kg/kg]
• mqs	specific water content of snow on model levels	[kg/kg]
• mqg	specific water content of graupel on model levels	[kg/kg]
• mt	temperature on model levels	[K]
• mp	pressure on model levels	[Pa]
• mqv	specific humidity on model levels	[kg/kg]
• mtke	turbulent kinetic energy on model levels	[m²/s²]
• mdbz	synt. radarreflectivity on model levels	[dbz]
• mclc	cloud area fraction on model levels	
• surf	2d surface fields without total precipitation, 2m temperature and synt. satellite images	
• sat	synt. satellite images	
• tpt2	2D surface fields of total precipitation and 2m temperature	
• zlev	upper air fields on altitude levels (500, 1000, 1500, 2000, 3000, 5000m)	
• plev	upper air fields on pressure levels (1000, 975, 925, 850, 700, 600, 500, 400, 300, 250, 200hPa)	
• fix	constant fields	
• out	ASCII output of model information (every 5 minutes)	

The output data for the entire reanalysis domain will be stored at DWD and can be retrieved via the WEB interface of DWD (contact: andreas.roepnack@dwd.de)
On the right side an example of an evaluation between model and observation is shown.



Comparison between COPS radiosonde (FZK) and analysis on 8th June 2007. First row relative humidity, second row water vapor mixing ratio (Courtesy of Kathrin Wapler)

The COPS reanalysis project is founded by DFG (German Research Foundation) as a part of the Priority Program 1167