From COPS to HyMeX: Assimilating ground-based remote sensing data into high-resolution atmospheric models to predict extreme precipitating events

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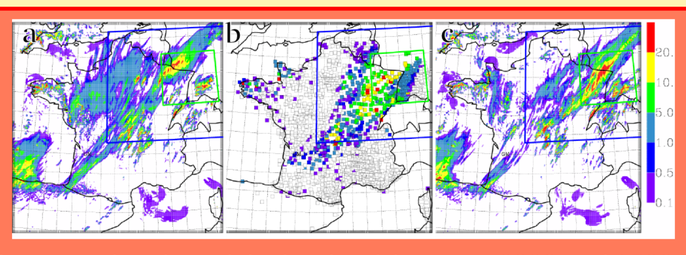
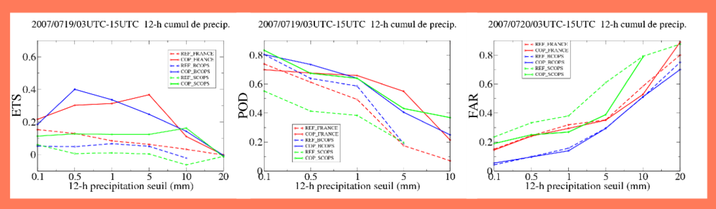
Introduction

Ground-based remote sensing instruments are central to observe the atmosphere, and therefore contribute directly to the comprehension of atmospheric processes. They can also contribute to this comprehension indirectly through their use in data assimilation to improve initial conditions of atmospheric simulations. From an operational point of view, the assimilation of data collected by such instruments can also potentially improve weather forecasts.

Achievements from the COPS campaign

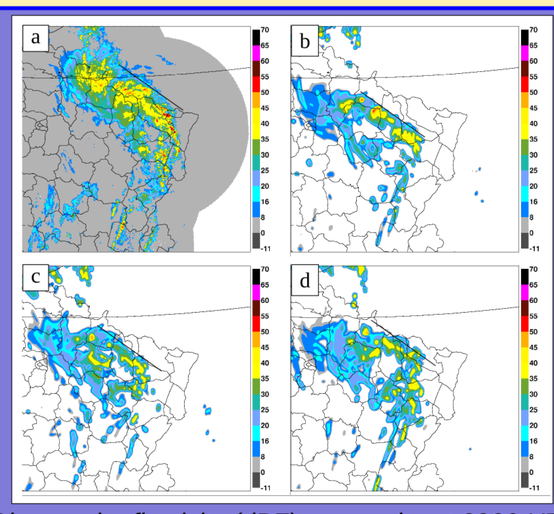


12-h accumulated precipitation (mm) between 0300 and 1500 UTC on 19 July 2007. (a) Arome forecast without ZTD assimilation, (b) raingauges, and (c) AROME forecast with ZTD. In the latter case, precipitation maxima at the French-German border are better positioned, and weak precipitation over northern France is eliminated.



Skill scores over 3 domains: red (AROME domain), blue, and green (COPS region). Solid lines: with ZTD assimilation; dashed lines: without ZTD assimilation. Scores are improved when ZTD are assimilated.

The Convective and Orographically induced Precipitation Study (COPS) campaign that took place in the Summer 2007 in an area including the Vosges and Black-Forest aimed at "advanc[ing] the quality of forecasts of orographically-induced convective precipitation by four-dimensional observations and modeling of its life cycle" (Wulfmeyer et al. 2008). For that purpose, a large number of remote sensing instruments have been deployed during this campaign. First results from assimilation experiments of data collected during the COPS campaign, like GPS Zenith Total Delay (ZTD) or radar data, have shown positive impacts at high resolution, especially for convective events (Yan et al. 2009, Caumont et al. 2009). Since then, the assimilation of GPS and radar Doppler velocity has even been included in the first operational version of Arome, in December 2008. The COPS campaign has thus contributed to show the potential of remote sensing data for assimilation and paved the way for their inclusion in operational convective-scale assimilation systems.



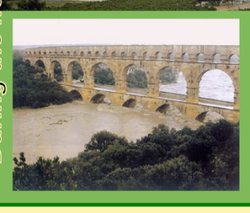
(a) Observed reflectivity (dBZ) composite at 0900 UTC on 20 July 2007; and simulated reflectivity (dBZ) at 700 hPa with (b) no reflectivity assimilation, (c) assimilation of reflectivity data from 1 radar, and (d) assimilation of reflectivity data from 11 radars, at the same time. The solid, black line denotes the leading edge of the MCS, which is better predicted when reflectivity is assimilated.

Towards the HyMeX campaign

Before the flood

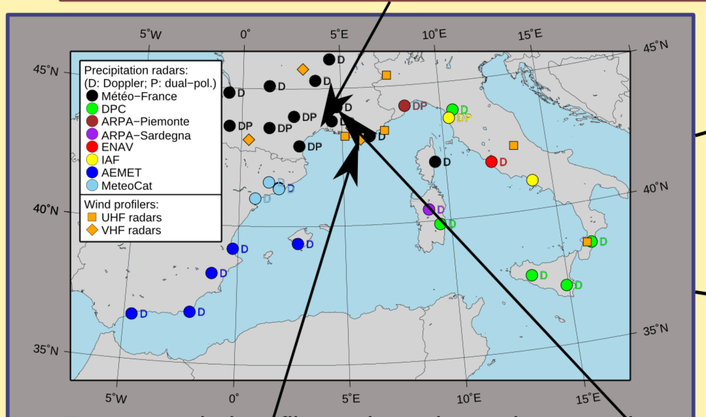
Flash flood in southeastern France (Gard region, 8-9 September 2002)

During the flood



As for the COPS area, the region covered by HyMeX is prone to heavy precipitating events, which can lead to even more severe damage. Improving the comprehension and prediction of such specific events in one of HyMeX's primary goals. Therefore, during the HyMeX campaign, similar ground-based remote sensing instruments will be deployed. As for COPS, our aim is to assimilate reflectivity and Doppler velocity into the Arome model running on the HyMeX domain at a horizontal resolution of 2.5 km, and assess the impact of these observation types in meteorological situations different from those that occurred during COPS. In addition, we plan to assimilate new observation data types like dual-polarization observations and refractivity from ground-based weather radars, as well as wind from vertical profilers. Contributions and/or collaborations on this topic are welcome so as to collect more data and/or do model intercomparisons.

Degreane PCL 1300 mobile UHF wind profiler (1274 MHz)



Foreseen wind profiler and weather radar network

VHF wind profiler (45 Mhz)

Météo-France operational S-band precipitation radar located in Bollène

Assimilation into the Arome numerical weather prediction (NWP) system

Intercomparison

Assimilation into other NWP systems

References

Caumont, O., É. Wattrelot, G. Jaubert, and V. Ducrocq, 2009: Assimilation of weather radar reflectivity in the AROME model for the COPS-IOP9. *Proc. Int. Conf. on Alpine Meteorology (ICAM 2009)*, Rastatt, Germany, Annalen der Meteorologie, **44**, 80-81.

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Yan, X., V. Ducrocq, P. Poli, M. Hakam, G. Jaubert, A. Walpersdorf, 2009: Impact of GPS zenith delay assimilation on convective scale prediction of Mediterranean heavy rainfall. *J. Geophys. Res.*, **114**.

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