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Tomography sensitivity tests and comparisons of water vapor fields with radar data.

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As part of the OHM-CV (Observatoire Hydrométéorologique Méditerranéen Cévennes-Vivarais), a project dedicated to the study of heavy precipitation occurrences and hydro-meteorology in Southern France, an extensive GPS project has collected data during the autumn period of 2002, located in the south of France. In particular, a dense GPS network (16 stations over a 30 km by 30 km area) was deployed in the Cévennes-Vivarais region.

In order to retrieve the 3-D water vapor distribution, we have developed a GPS tomographic inversion software based on the LOFTT-K algorithms from LDL. This software is divided into two part: first to produce the inputs of the tomography and secondly to invert these data. Thus using the GPS data, we derive information on the propagation delay through the atmosphere. The ZTD (zenith tropospheric delay) is the GPS observable corresponding to the delay induced by the troposphere above the station. This delay (ZTD) has two components: a hydrostatic delay (ZHD) and a wet delay (ZWD). Using the atmospheric pressure and coordinates at each station, we can calculate the ZHD. Hence, the resulting ZWD can provide the corresponding IWV (integrated water vapor, i.e. the height of an equivalent column of liquid water). Afterward we derive the integrated water vapor and estimate the slant integrated water vapor (SIWV) that is the primary input for the tomographic inversion.

Using synthetic data, we study the effect of the network geometry (number of voxels) as well as the numbers of inputs (SIVW) in order to test the sensitivity of the tomographic algorithm and better understand its limits. We can already assume that a small number of voxels has a less precision in space than a large number. Hence, we have an underestimation of the water vapor density for the lower voxels and an overestimation for the higher voxels. It also seems that we reach a limit in the resolution when the size of the voxels corresponds to the distance between two GPS ground stations (2 Km). Further testing is underway.

Rain data are provided by the Bollène Météo France radar operated in a 3-D volume scan mode. The resulting data (after an interpolation of the reflectivity given by 8 different elevations angles) display the rain reflectivity over the same area that the GPS network for comparison and further correlations. However since this radar is distant from our network, we have a lack of information for low altitude (0 up to 1000 m) due to the curve of the beams. Thus, to complement the radar data on the ground, we also use rain gauges data. Our objective is to link the water vapor distribution and its dynamics to the occurrence of sustained precipitations.