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Investigation in GNSS ground-based tropospheric tomography: benefits and perspectives of combined Galileo, Glonass and GPS constellations.

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Water vapour plays a key role in the balance of planetary radiation, influences and accounts for the atmospheric motions and is involved in the decomposition of the ozone layer and in the greenhouse effect. Consequently, the distribution of water vapor as well as its spatial and temporal behaviour, is important for climate predictions and weather forecasts. But it is difficult to quantify its spatial-temporal distribution due to its high variability.

For some years, GPS-based tropospheric tomography is considered a promising technique that allows to determine the spatial distribution and temporal variation of the water vapor content, starting from GPS measurements. In fact electromagnetic signals are refracted by the water vapour present in the troposphere. The magnitudes of these signal slant delays, directly related to the water vapour content, may be estimated in the routinely geodetic processing of GPS data.

So far, several feasibility studies have demonstrated the practicability of this new technique but considering only data acquired by GPS permanent stations; recently, dedicated field experiments of GPS tomography were conducted in Switzerland [*Troller*, 2004] and Germany [*Bender & Raabe*, 2006]. Their results were undoubtedly encouraging, but also highlighted that a remarkable present limitation of the technique is the low number of in-view satellites, forcing to introduce a significant amount of regularization equations to make tomographic inversion stable and computable.

Nevertheless, in the next future, the full functionality of Glonass and the deployment of the European GNSS Galileo and the Chinese BeiDou System will increase remarkably the number of available (about 100) and in-view (probably more than 20, in the average) satellites, so that much better horizontal, vertical and temporal resolutions are expected if multi-constellation receivers will be available.

In order to exploit the benefit of a triple constellation (Galileo, Glonass, GPS) for a GNSS-based tomography, we developed a research for carrying out a tomography simulation over the central part of the Rome municipality (about 200 km^2), hypothesizing to use a GNSS permanent network including 7 receivers approximately located on the vertices of a hexagon and on its center. This simulation is based, at first, on GNSS observation generated by Bernese GPS software version 5.0 with true GPS and Glonass orbits and Galileo orbit simulated by Galileo System Simulation Facility (ESA product), for the 1472 GPS-week; moreover, synthetic tropospheric fronts were generated with an ancillary implemented software. The tropospheric tomography with different constellations (only GPS, GPS+Glonass, triple constellation) were carried out by the original software **SofTT** (Software for Troposphere Tomography), designed and implemented at the Area di Geodesia e Geomatica (AGG-DITS). The results of the different tropospheric tomographies are compared and discussed.