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GPS tomographic experiment on water vapour dynamics in the troposphere over Lisbon

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Quantification of the water vapour variability on the atmosphere remains a difficult task, affecting the weather prediction. Coarse water vapour resolution measurements in space and time affect the numerical weather prediction solution models causing artifacts in the prediction of severe weather phenomena. The GNSS atmospheric processing has been developed in the past years providing integrated water vapour estimates comparable with the meteorological sensor measurements, with studies registering 1 to 2 kg/m2 bias, but lack a vertical determination of the atmospheric processes. The GNSS tomography in the troposphere is one of the most promising techniques for sensing the three-dimensional water vapour state of the atmosphere. The determination of the integrated water vapour profile by means of the widely accepted GNSS meteorology techniques, allows the reconstruction of several slant path delay rays in the satellite line of view, providing an opportunity to sense the troposphere at tree-dimensions plus time. The tomographic system can estimate an image solution of the water vapour but impositions have to be introduced to the system of equations inversion because of the non-optimal GNSS observation geometry. Application of this technique on atmospheric processes like large convective precipitation or mesoscale water vapour circulation have been able to describe its local dynamic vertical variation.
A 3D tomographic experiment was developed over an area of 60x60 km2 around Lisbon (Portugal). The GNSS network available composed by 9 receivers was used for an experiment of densification of the permanent network using 8 temporarily installed GPS receivers (totalling 17 stations). This study was performed during several weeks in July 2013, where a radiosonde campaign was also held in order to validate the tomographic inversion solution. 2D integrated water vapour maps directly obtained from the GNSS processing were also evaluated and local coastal breeze circulation patterns were identified. Preliminary results show good agreement between radiosonde vertical profiles of water vapour and the correspondent grid columnar profile of the tomographic solution. This study aims for a preliminary characterization of the 3D water vapour field over this region, investigating its potential for monitor small scale air circulation on coastal areas like sea breeze meteorological phenomenon.
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