Sensibility of GPS measurements and estimates during extreme meteorological events: the case study of mesoscale convective systems in West Africa

S. Nahmani & O. Bock
1. IGN/LAREG, Université Paris Diderot, GRGS, 35 rue Hélène Brion, Bâtiment Lamark B, 75013 PARIS
e-mail: samuel.nahmani@ign.fr

Six permanent GPS stations have been deployed in West Africa within the framework of the African Monsoon Multidisciplinary Analysis (AMMA) project in order to monitor precipitable water vapor (PWV). This quantity is indeed widely employed to compute water budgets and study atmospheric processes. But in Sahel, 90% of annual rainfalls are produced by Mesoscale Convective Systems (MCSs) and PWV estimates tend to be less accurate during these extreme meteorological conditions: temperatures fall, GPS PWV estimates reach a local maximum and GPS phase residuals show strong variations that are spatially and temporally correlated. We observed that GPS phase residuals, which give insight into anomalies of the air refractivity, clearly reveal the passage of MCSs similarly as reflectivity measurements from MIT C-band Doppler radar.

The aim of this study is to evaluate the quality of the GPS PWV estimates during these events and possibly improve their estimation process. We carried out methodological and sensitivity tests on the parameterization of atmospheric delays and especially on the Gauss-Markov process which constrains the temporal variability of the GPS PWV estimates. During MCSs events, differences between GPS PWV estimates from GAMIT (2 $cm.h^{-1/2}$ random walk for zenith tropospheric delays) and GIPSY (5 $mm.h^{-1/2}$ random walk for zenith tropospheric delays) standard processing can for instance reach +/- 3.8 $kg.m^{-2}$. Standard GPS PWV estimates are thus subject to caution during these intense events. We therefore investigate an improved PWV estimation process which considers both zenith tropospheric delays and GPS phase residuals in order to account for the asymmetry of the air refractivity. This method leads to high-frequency PWV estimates for each GPS satellite which we compare with PWV estimates from a collocated microwave radiometer.