Geophysical Research Abstracts
Vol. 13, EGU2011-4222, 2011
EGU General Assembly 2011

Impact of GPS ZTD on Rainfall Estimates in an Hourly Update Cycle of a Numerical Weather Prediction Model

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Short range forecasting or nowcasting using a numerical weather prediction (NWP) model has become feasible with the growing number of rapid available observations and increase of computation capacity. These runs are updated with an hourly frequency and are nested in a larger NWP run which has a three hour cycle.

In the fast update cycle, the initial wind and temperature field is adjusted by assimilation of AMDAR (and Mode-S) aircraft observations. The surface pressure field is corrected using surface observations from synoptic stations, mainly concentrated to land. All these observations are available within 10 minutes of observation time, however upper humidity information is lacking. Generally in NWP, radiosondes provide this information, however this data is only available with a latency of at least 45 minutes.

In this paper, it is shown that GPS Zenith Total Delay (ZTD) estimates from a network of groundbased GPS receivers can fill this lack of information. Estimation of GPS-ZTD by processing a network of around 30 stations around the Netherlands in real time (in meteorological sense) provides ZTD values 5 minutes after observation time. The impact of this data is shown using two simultaneous runs in a semi-operational setting; one run without GPS-ZTD and one with GPS-ZTD assimilated. The run with GPS-ZTD data assimilated shows good agreement with rainfall rates observed by radar, while the run without GPS-ZTD largely underestimates the rainfall rates.