EMS Annual Meeting Abstracts
Vol. 14, EMS2017-512, 2017

Low-cost sensors for high resolution water vapor monitoring in Rotterdam

Andreas Krietemeyer (1), Marie-claire ten Veldhuis (1), Eugenio Realini (2), and Nick van de Giesen (1)

(1) Water Management Department, Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, Netherlands (A.Krietemeyer@tudelft.nl), (2) GReD - Geomatics Research & Development srl, Italy

Weather predictions are of particular importance in modern times. In times of climate change, turbulent weather events are more and more frequent. People also put high requirements on rainfall now- and forecasting, so weather prediction models need to improve continuously. One of the most significant input parameters is Precipitable Water Vapor (PWV). There are several possibilities to detect water vapor in the atmosphere. Traditional releases of radiosondes offer rather precise data, but have a poor spatial resolution. The observation trajectory is limited by the wind. Satellite-image-based measurements generally offer a good spatial resolution but have a low temporal resolution and lack representation of small-scale moisture fluctuations. On the other hand, utilizing Global Navigation Satellite System (GNSS) allows to continuously track water vapor following the passing satellites. Existing GNSS networks are, however, sparsely distributed, with at least inter-station distances in the order of tens of kilometers. These networks consist of geodetic dual-frequency receivers and antennas. Driven by economic reasons, a densification with these devices is not possible. Low-cost single-frequency receivers offer an interesting alternative. Still, in contrast to their expensive counterparts, they are prone to errors caused by the Earth's ionosphere. To compensate for this influence, a model is applied that makes use of surrounding dual-frequency stations. The validation is performed by co-aligning a single-frequency receiver to a dual-frequency receiver at the Nederlands Meetinstituut (NMi) in Delft. To investigate the feasibility of monitoring small-scale water vapor fluctuations using single-frequency sensors, we will deploy 4 additional receivers within the urban testbed of Rotterdam to achieve inter-station distances of 4-5 kilometers. This experiment is part of a hydro-meteorological monitoring campaign which links the measurements to a meteorological observation network and modeling outputs. The city features a dense network of weather stations and a high resolution X-band radar providing high quality rainfall estimates. WRF modeling will be performed to test how local rain forecasts are improved by assimilating the PWV datasets into a local rain forecast model.