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## IWV observations from a network of ground-based GNSS receivers during EUREC4A

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IWV data were retrieved from a network of nearly fifty Global Navigation Satellite System (GNSS) stations distributed over the Caribbean arc for the period 1 January–29 February 2020 encompassing the EUREC4A field campaign. Two of the stations had been installed at the Barbados Cloud Observatory (BCO) during fall 2019 in the framework of the project and are still running. All other stations are permanent stations operated routinely from various geodetic and geophysical organisations in the region. High spatial and temporal Integrated Water Vapour (IWV) observations will be used to investigate the atmospheric environment during the life cycle of convection and its feedback on the large-scale circulation and energy budget.

This paper describes the ground-based GNSS data processing details and assesses the quality of the GNSS IWV retrievals as well as the IWV estimates from radiosoundings, microwave radiometer measurements and ERA5 reanalysis.

The GNSS results from five different processing streams run by IGN and ENSTA-B/IPGP are first intercompared. Four of the streams were run operationally, among one was in near-real time, and one was run after the campaign in a reprocessing mode. The uncertainties associated with each of the data sets, including the zenith tropospheric delay to IWV conversion methods and auxiliary data, are quantified and discussed. The IWV estimates from the reprocessed data set are compared to the Vaisala RS41 radiosonde measurements operated from the BCO and to the measurements from the operational radiosonde station at Grantley Adams international airport (GAIA). A significant dry bias is found in the GAIA humidity observations with respect to the BCO sondes ( $-2.9$  kg/m<sup>2</sup>) and the GNSS results ( $-1.2$  kg/m<sup>2</sup>). A systematic bias between the BCO sondes and GNSS is also observed ( $1.7$  kg/m<sup>2</sup>) where the Vaisala RS41 measurements are moister than the GNSS retrievals. The HATPRO IWV estimates agree with the BCO soundings after an

instrumental update on 27 January, while they exhibit a dry bias compared to GNSS and BCO sondes before that date. ERA5 IWV estimates are overall close to the GAIA observations, probably due to the assimilation of these observations in the reanalysis. However, during several events where strong peaks in IWV occurred, ERA5 is shown to significantly underestimate the IWV peaks. Two successive peaks are observed on 22 January and 23/24 January which were associated with heavy rain and deep moist layers extending from the surface up to altitudes of 3.5 and 5 km, respectively. ERA5 significantly underestimates the moisture content in the upper part of these layers. The origins of the various moisture biases are currently being investigated.