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## Near real-time water vapour monitoring with shipborne GNSS for numerical weather prediction

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MAP-IO (Marion Dufresne Atmospheric Program Indian Ocean) is a research project that aims to collect long-term atmospheric, biological and marine observations to document the under-instrumented areas of the Indian and Southern Oceans. To achieve this, the French Research Vessel (R/V) Marion-Dufresne, based in Réunion Island in the Indian Ocean, has been equipped with around twenty autonomous instruments to take measurements along its route.

Among the instruments deployed on this R/V, a GNSS antenna has been in operation since autumn 2020, providing unique and continuous measurements of atmospheric water vapour in this part of the world. The data were initially transmitted daily to shore for ultra-rapid (day +1) and rapid (day +3) routine analysis. The quality of the retrieved tropospheric delays and integrated water vapour contents was highlighted in a previous study. With more reliable transmission facilities, raw GNSS data are now transmitted hourly and can be analysed with a latency of less than 30 minutes.

In this study, we provide an initial assessment of the near real-time (h+20min) processing performed as part of this project. This evaluation is based on GNSS raw data collected in August 2023 during a rotation of the R/V Marion-Dufresne in the French Austral Islands (Crozet, Kerguelen, Saint-Paul and Amsterdam Islands). Processing is performed every hour over a 24-hour window, using the raw hourly data transmitted by the R/V and the cumulative real-time ephemerides and clocks provided by JPL / GDGPS. Only the last hour of each analysis is then considered. Over this period, the estimated tropospheric delays are in good agreement with the rapid routine solution, with differences of less than 1 cm RMS. The comparison with the analysis and the 6h forecast of the Météo-France's global numerical weather prediction model Arpège highlight the benefits of these shipborne GNSS measurements for numerical weather prediction.

The medium-term objective of this work is to establish an operational procedure for the assimilation of these near real-time GNSS tropospheric solutions into numerical weather prediction models.