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Meso-scale simulations of tropical cyclone ENAWO (2017) and impact on hydration of the tropical tropopause layer

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Stratospheric water vapor variations play an important role on the climate. Predictions of changes in stratospheric humidity are uncertain because of gaps in our understanding of physical processes occurring in the Tropical Tropopause Layer (TTL), between 14 and 20 km altitude. In particular, climate models have great difficulties in modeling water vapor variations in the TTL due to a poor representation of tropical convection, which largely controls the vertical transport of water vapor to UTLS, among other things.
One of the scientific objective of the CONCIRTO[1] program is to understand the role of marine deep convective systems, and tropical cyclones in particular, on the hydration of TTL in the South-West Indian Ocean. In March 2017, the tropical cyclone Enawo passed off the coast of Reunion with a straight trajectory. The progressive intensification of the cyclone to the intense tropical cyclone stage makes it an ideal case study to analyze the transport of water vapor and hydrometeors in the TTL according to the intensity phase of the cyclone.
We will present results based on the Meso-NH meteorological mesoscale model and observations. Precipitation fields and the height of convective clouds simulated by Meso-NH are compared to the Global Precipitation Measurement (GPM) data and Meteosat-7 brightness temperatures. The simulations are further compared with in-situ measurements of water vapor, wind speed and the altitude of the convective outflow from radiosondes modem and Cryogenic Frostpoint Hygrometer (CFH). The hydrometeorological evolution of the TTL above the tropical cyclone in the model suggests 3 main hydration phases as a function of the ENAWO intensity. We will present the characteristics for each of them, and estimates of the total water transport into the TTL.

[1] Effects of convection and cirrus clouds on the Tropical Tropopause Layer over the Indian Ocean