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Stratospheric and mesospheric wind measurements from the new WIRA-C wind radiometer and comparison to the Doppler lidar on La Réunion island

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Measurements of wind speeds in altitudes between 30 and 70 km are surprisingly rare. Passive microwave radiometry and Doppler lidar techniques provide two methods for covering this gap region. With the Rayleigh-Mie Doppler wind lidar of CNRS/INSU (Guyancourt, France) and OSUR (La Réunion, France) and the passive microwave radiometer WIRA-C of the IAP (Bern, Switzerland) two such instruments are collocated in the Maïdo observatory on the tropical island La Réunion (21° South, France). Both instruments participate in the ARISE2 project that is funded by the European Commission Horizon 2020.

The Rayleigh-Mie Doppler wind lidar is an active sounder, measuring the Doppler shift of backscattered visible light and can provide wind profiles from 5 up to 50 km with a vertical resolution of up to 100 m and an accuracy better than 1 $\frac{\mathrm{m}}{\mathrm{s}}$ up to 30 km. On the other side, WIRA-C is a passive microwave radiometer that measures the Doppler shift of the ozone thermal emission line at 142 GHz. The radiometer has a high spectral resolution of 12.2 kHz and a band width of 200 MHz and can thus exploit the pressure broadening of the ozone line to retrieve an altitude resolved wind profile. The retrieval is based on a model of the atmosphere and optimal estimation techniques implemented by ARTS and Atmlab/Qpack, but in contrast to previous versions the atmospheric model is three-dimensional. Meaningful wind speeds can be retrieved for an altitude range of 30 to 70 km with a vertical resolution of up to 4 km. WIRA-C is able to measure continuously, independent of daylight and clouds.

WIRA-C has been installed on the Maïdo observatory in August 2016 and has measured since then whenever the optical thickness of the atmosphere was low enough. The Doppler lidar at Maïdo was operated on a campaign basis since 2013 and routinely twice a week since September 2015.

We present the WIRA-C instrument and its measurement results for the tropical summer 2016/17 and compare them to coincident measurements of the Rayleigh-Mie Doppler wind lidar. Further, we compare the measurements to ECMWF model data and, on the lower domain around 30 km altitude, to balloon soundings.