The new real-time measurement capabilities of the profiling TARA radar

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In the past 10 years, the S-band FMCW TARA (Transportable Atmospheric RAdar) provided in real-time vertical profiles of the Doppler moments. It was also possible to acquire raw data. Based on them, new algorithms were developed using spectral polarimetry and the multi-beam capabilities of this radar. They have been tested during the COPS (2007) and EUCAARI-IMPACT campaigns (2008).

To measure in real-time the Doppler moments of three beams, the differential reflectivity, the linear depolarization ratio, the horizontal wind and the vertical mean Doppler velocity, it became necessary to upgrade TARA. This resulted in a new design of the radar control unit and a new processing based on spectral polarimetry. This major upgrade took place in 2011. TARA can now deliver multi-parameters profiles and raw data in real-time. They are stored with the Netcdf format. Furthermore, detailed quick-looks are available in real-time at http://ftp.tudelft.nl/TUDelft/irctr-rse/tara/index.html.
Because TARA stays a research radar, the main requirements of the new design of the radar control unit and processing, are flexibility of the system and the ability to directly use developed Matlab codes. Parts of the new design are a PXI, Labview software, a DDS (Direct Digital Synthesizer) and Matlab codes. The signal is defined by user input (range resolution, measurement cycle, …) and generated by the DDS. The main tasks of the PXI are timing and synchronization in the radar control unit, and the analog to digital conversion of the received signal. The Labview software is employed for the radar control unit and the graphical interface. It uses Matlab codes for the data processing and the data storage in Netcdf files (processed data, noise data, raw data).
The processing is mainly carried out on the spectrograms (Doppler spectra for every range bin). New techniques of clutter and noise suppression, and de-aliasing, using spectral polarimetry are real-time implemented for the radar main beam. Classical techniques are developed for the two other beams, not polarimetric. TARA has a single receiver channel. Most of the time, the measurement sequence is VV, HV, HH, OB1, OB2, where OB1 and OB2 are measurements performed by the offset beams. One measurement is obtained each 0.5 ms and the sequence each 2.5 ms. This leads to an unambiguous maximum Doppler velocity of 9 m s^{-1}, which is not sufficient for all the atmospheric events to be measured. The spectral polarimetric dealiasing of the main beam supplies a maximum Doppler velocity of 45 m s^{-1}. The mean Doppler velocity profile of the main beam is going to be used to enhance the de-aliasing of the offset beams in case of strong horizontal wind. With this sequence, the time resolution of the profiles is 5.12 s.