Geophysical Research Abstracts
Vol. 19, EGU2017-16058, 2017
EGU General Assembly 2017


# Wind tunnel validation of the aerodynamic performance of rain gauges simulated using a CFD approach.

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Wind is recognized as the primary cause for the undercatch of solid and liquid precipitation as experienced by catching type gauges. The airflow pattern above the collector, modified by the presence of the gauge body, influences the particle trajectories and reduces the collection of precipitation. Windshields are employed in the field to reduce the impact of wind. As an alternative, measured data are corrected in post-processing using correction functions derived from field data or numerical simulations. Aerodynamic rain gauges have been also developed, with their outer shape designed to reduce the aerodynamic impact of the gauge body on the surrounding airflow.

In a previous work, CFD simulations of aerodynamic gauges were performed and the performance of different shapes were compared. The aim of this work is to validate the airflow pattern around the gaugeas predicted by improved CFD simulations by performing wind tunnel tests both in smooth and turbulent conditions. The airflow in the proximity of the gauge was simulated using the Unsteady Reynolds Average Navier-Stokes (URANS) equations approach. Advantages of the URANS method include the possibility of describing accurate time-varying patterns of the turbulent air velocity field while maintaining acceptable computational requirements.

The simulations were performed under two different turbulence conditions in order to assess the role of the base-flow turbulence on the calculated flow pattern. In the first case, the free stream velocity profile is assumed steady and uniform. Under these conditions the time varying pattern of the airflow around the rain gauge collector is due to the instrument aero-dynamics alone. The second case includes a free-stream turbulence intensity approximately equal to 13%, generated by introducing a fixed solid fence upstream the gauge. Validation of the CFD results was provided by realizing the same airflow conditions in the DICCA wind tunnel and measuring the air velocity components in different fixed positions around the collector of the gauge. Results are presented in comparative terms, based on the time-averaged air velocity, the amplitude of the oscillating components and the turbulent kinetic energy.