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Wind-tunnel measurements of the airflow pattern above the collector of different shielded and unshielded precipitation gauges

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Wind is the first environmental source of precipitation undercatch for catching-type precipitation gauge. This work presents an aerodynamic investigation on different precipitation gauge geometries and on a wind shield by means of wind tunnel tests. Experiments have been jointly performed by University of Genoa, DICCA, and Politecnico di Milano within the Italian project PRIN 20154WX5NA "Reconciling precipitation with runoff: the role of understated measurement biases in the modelling of hydrological processes".

The airflow, around precipitation gauges, was measured employing two different experimental techniques: a traversing system equipped with "Cobra" multi hole pressure probes and the Particles Image Velocimetry PIV. Cobra probes allow to measure the three components of the local flow velocity in the measuring points, while PIV technique provides two-dimensional velocity fields on the investigated planes.
The airflow velocity and direction were investigated for different wind speed values and different precipitation gauge geometries: the "chimney", the "cylindrical" and the "inverted conical" shapes. The effect of a traditional Single Alter windshield was also assessed on the cylindrical shape.
These experiments allow to detect qualitatively and quantitatively the main features of the flow, speed-up and updraft, above the collector which influence the particle trajectories and their collection. Results confirm the dependency of the airflow disturbance on the gauge geometry, especially in terms of maximum local velocity and distribution of the upward and downward components of the vertical velocity. PIV velocity fields and Cobra velocity profiles show the expected attenuation of the flow velocity above a gauge located inside the windshield due to the break of the flow induced by the shield slats.

The experimental campaign provided a wide dataset suitable for the validation of numerical Computational Fluid Dynamics simulations. This work is propaedeutic to the quantification of the precipitation undercatch and the elaboration of correction curves to obtain the actual precipitation in windy conditions.