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Wind induced errors on solid precipitation measurements: an evaluation using time-dependent turbulence simulations

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Among the different environmental sources of error for ground based solid precipitation measurements, wind is the main responsible for a large reduction of the catching performance. This is due to the aero-dynamic response of the gauge that affects the originally undisturbed airflow causing the deformation of the snowflakes trajectories. The application of composite gauge/wind shield measuring configurations allows the improvements of the collection efficiency (CE) at low wind speeds (U_w) but the performance achievable under severe airflow velocities and the role of turbulence still have to be explained.
This work is aimed to assess the wind induced errors of a Geonor T200B vibrating wires gauge equipped with a single Alter shield. This is a common measuring system for solid precipitation, which constitutes of the R3 reference system in the ongoing WMO Solid Precipitation InterComparison Experiment (SPICE). The analysis is carried out by adopting advanced Computational Fluid Dynamics (CFD) tools for the numerical simulation of the turbulent airflow realized in the proximity of the catching section of the gauge. The airflow patterns were computed by running both time-dependent (Large Eddies Simulation) and time-independent (Reynolds Averaged Navier-Stokes) simulations. on the Yellowstone high performance computing system of the National Center for Atmospheric Research.
The evaluation of CE under different U_w conditions was obtained by running a Lagrangian model for the calculation of the snowflakes trajectories building on the simulated airflow patterns. Particular attention has been paid to the sensitivity of the trajectories to different snow particles sizes and water content (corresponding to dry and wet snow). The results will be illustrated in comparative form between the different methodologies adopted and the existing infield CE evaluations based on double shield reference gauges.