Course offered for the PhD program
in Civil, Chemical and Environmental Engineering
a.y. 2024/2025 (XL cycle)
(course is open for participation of students from other PhD cycles or programs)

1. Title
Fluid-dynamic aspects in precipitation measurements: accuracy and data interpretation

2. Course Objectives and Description
The course provides an in-depth description of the main factors acting as sources of systematic errors (biases) in precipitation measurements and focuses on the associated calibration techniques and adjustment procedure. Fluid-dynamic aspects are addressed since among the environmental factors, wind is the main influencing variable for precipitation measurements. Any precipitation gauge, indeed, presents an obstruction to the prevailing wind and the incoming airflow is deformed when wind overtakes the precipitation gauge. This aerodynamic effect induced by the gauge body deflects the hydrometeors (liquid/solid particles) away from the collector. The other main factors of influence are the wind speed, and the characteristics of precipitation, including the particle size distribution and precipitation intensity. Wind-induced errors were studied in the literature using different approaches – field measurement campaigns, numerical simulation, and wind-tunnel (WT) experiments – with the aim of formulating correction curves to calculate the actual precipitation falling to the ground. In field measurement campaigns, precipitation collected by a gauge installed in operational conditions is compared with a suitable reference. The numerical approach, based on computational fluid dynamics (CFD), reduces the time and resources needed to investigate different configurations by varying the wind speed, type of precipitation and gauge geometry. The validation of numerical models can be obtained by comparison with WT measurements, obtained in controlled laboratory conditions. After validation, the numerical simulation of precipitation particles trajectories leads to estimate the collection efficiency and to quantify the wind-induced errors.

3. Course Organization
Frontal lectures and exercises: methods and instruments for atmospheric precipitation measurements, sources of measurement bias and uncertainty, wind-induced bias of catching and non-catching type gauges (concepts and modelling), fluid-particle interactions, adjustments, and modelling aspects. Wind tunnel and field tests.

4. Teacher
Arianna Cauteruccio

5. Duration and credits
10 hours – 2 credits

6. Activation mode and teaching period
January 2025 – Course is offered on the Teams platform for remote attendance.

7. Deadline for registration
TBD – registration by e-mail (arianna.cauteruccio@edu.unige.it)

8. Final exam
In-depth report on one topic of the course.