UNIVERSITY OF GENOVA
**DICCA**
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# PhD program in Civil, Chemical and Environmental Engineering

## Curriculum in Fluid Dynamics and Environmental Engineering

## Academic year 2020/2021

**1. Title of the course**
Fluid-dynamics aspects in atmospheric precipitation measurements

**2. Contents**
Both instrumental and environmental factors act as sources of systematic errors (biases) in precipitation measurements and can be adjusted by means of correction curves.
Instrumental factors such as the systematic mechanical error of tipping-bucket rain gauges and the dynamic response of weighing gauges can be corrected after dynamic calibration in the laboratory. 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. Wind generally accelerates above the collector of the instrument, while vertical upward velocity components arise upwind of the collector. This aerodynamic effect induced by the gauge body deflects the hydrometeors (liquid/solid particles) away from the collector. The main factors of influence are the gauge geometry, 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. Structure of the course**
2h - Methods and instruments for atmospheric precipitation measurements
2h - Sources of measurement bias and uncertainty
2h - Wind-induced bias of catching type gauges (concepts and modelling)
2h - Wind-induced bias of non-catching type gauges (concepts and modelling)
3h - Exercise on modelling the bluff-body behaviour of various gauge geometries
3h - Fluid-particle interactions, adjustments, and modelling aspects
4h - Exercise on modelling hydrometeors trajectories
2h - Wind tunnel and field tests

**4. Lecturer**
Luca G. Lanza

**5. Duration and credits**
20 hours – 4 credits

**6. Period and registration procedure**
11-22 October 2021 – registration by e-mail (luca.lanza@unige.it)

**7. Deadline for registration**
October 4th, 2021

**8. Final exam**
Oral discussion of the proposed exercises