PhD in CIVIL AND ENVIRONMENTAL ENGINEERING

Research Title: Atmospheric Boundary Layer Dynamics over Urban Environments

Funded by	ARPA Piemonte

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Context of the research activity	Urban effects on macro- and micro-climate have recently received significant attention. Many observational and numerical studies have been implemented to understand atmospheric phenomena peculiar of urban areas and to recognize the physical processes that are involved. These phenomena include urban heat islands, urban breezes, precipitation, and turbulent flows over cities. Regional mesoscale atmospheric models are essential tools in a variety of meteorological applications For the reliable prediction of weather and climate in urban areas, the physical processes occurring at and near urban surfaces should be included properly in models. Current mesoscale atmospheric models cannot explicitly take into account urban canopies (e.g. urban canyons and buildings) and therefore parameterized physical processes are inherently subgrid-scale processes. The easiest tool for including urban effects in a mesoscale model is the slab models. Slab models do not resolve an urban canopy but solely surface properties such as albedo, roughness length, surface moisture, thermal conductivity, and heat capacity. Nevertheless, these models are known to

	fail in simulating some basic features such as, for example, nighttime energy balance, and the city ventilation. In particular, quantifying the external air supplied to an urban environment, (i.e. City ventilation) is fundamental in estimating the urban heat balance and quantifying the ability of a city to remove heat and airborne pollutants.

Objectives	The main objectives are: • a better understanding of the fundamental processes such as urban heat islands, urban breezes and ventilation, and turbulent flows over cities. • To design, implement and use a new experimental set-up for studying the basic physical processes that govern the exchange of momentum and heat between the urban surface and the atmosphere. • To develop, based on the results from the experiments and previous field measurements, a new slab model capable to estimate the main surface properties such as albedo, roughness length, surface moisture, thermal conductivity, and heat capacity. • To integrate the new model in a the Regional mesoscale atmospheric models (COSMO-CLM model or similar).

Skills and competencies for the development of the activity	The following abilities are preferable in the Candidate and they will be enhanced during the PhD: - Basic-science field (physics and math), engineering principles(continuum mechanics, experimental data processing, statistics). - Fundamental knowledge related to hydraulics and hydrology is required. Knowledge of as proficiency in numerical modelling are preferred skills. - Ability to carry out analysis and synthesis on the state of the art of technologies and methods - Ability to design and perform an experiment