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Numerical downscaling at very high resolution of wind extreme events on tall buildings

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The current trend of climate change has many implications in a variety of aspects that heavily impact human activities and society. These include an increase in the intensity and frequency of extreme weather events, including highly energetic storms with highly energetic winds, which can damage economic, social or health-critical structures and activities. Although the probability of structural damage to buildings is very low, the loss of functionality represents a real risk that is currently underestimated in risk management plans.

This work presents an operative methodology for estimating the impact of very strong wind on tall buildings, based on up-to-date numerical simulation techniques for environmental fluid dynamics. The methodology proposed is applied to a real case study in the framework of the Horizon Europe RISKADAPT project. A downscaling strategy is implemented to coupling a meteorological model at the regional scale (i.e. the Weather Research and Forecast model) with high-resolved numerical simulations of the type of Computational Fluid Dynamics (i.e. RANS and LES approaches). The former provides realistic information on the key atmospheric variables during an extreme event; the latter will be set up with these variables to reproduce the wind flow around and at the building with high accuracy. Hence, the output is a high-fidelity reproduction of the local wind circulation and the atmospheric load on buildings, along with the turbulent content of wind. The method is applied to the case study of the public Hospital of Cattinara (Trieste, Italy) which, due to its peculiarity, is particularly exposed to strong Bora winds, typical of the region.

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