High-Resolution Forecasts of the Thermal Comfort in the Urban Area of Trento

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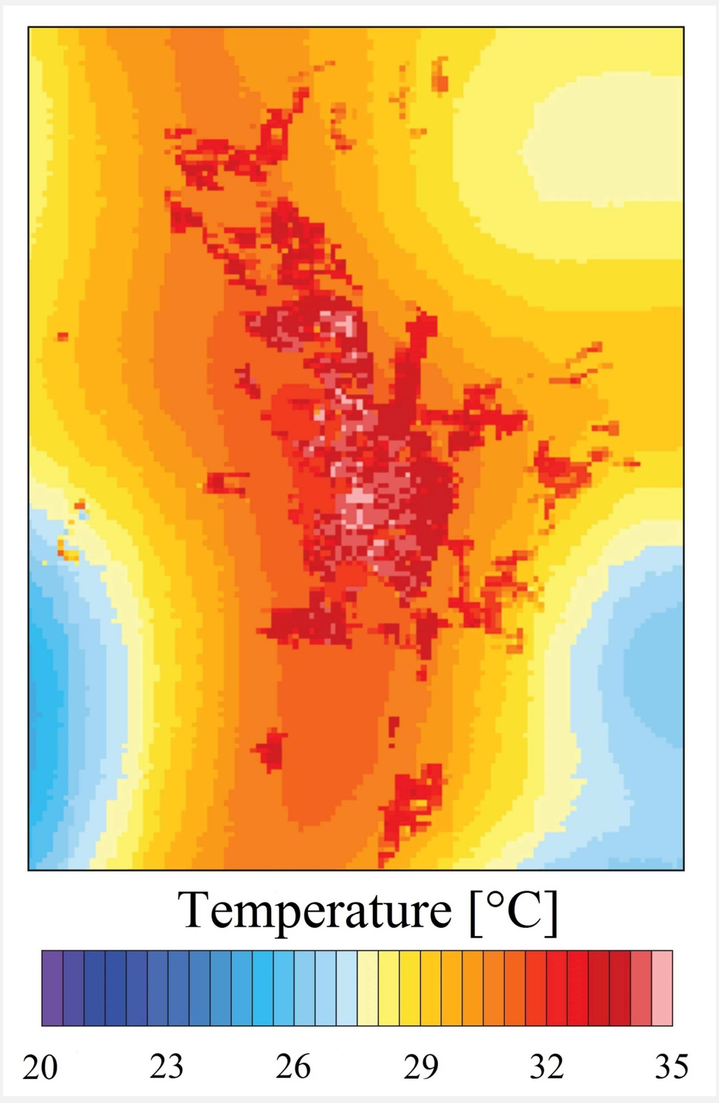
FONDAZIONE CASSA DI RISPARMIO DI TRENTO E ROVERETO

Introduction

A forecasting system composed of the Weather Research and Forecasting (WRF) model coupled with a single-layer urban canopy parameterization scheme is implemented to perform high-resolution forecasts of the thermal field inside the urban area of Trento, a medium-sized city located in the Italian part of the Alps. Simulations with the WRF model are routinely performed at 1-km resolution, to provide suitable meteorological upper boundary conditions to the urban canopy model. The single-layer urban parameterization scheme is used to downscale the WRF forecasts inside the urban area, taking into account the local characteristics of the city. Gridded maps of urban canopy parameters (UCPs) are utilized as input for the urban canopy model. Results from the modeling system are validated against measurements performed in the city center.

Model Results

Temperature field in the urban area simulated by the model at 1200 UTC 15 July 2015.

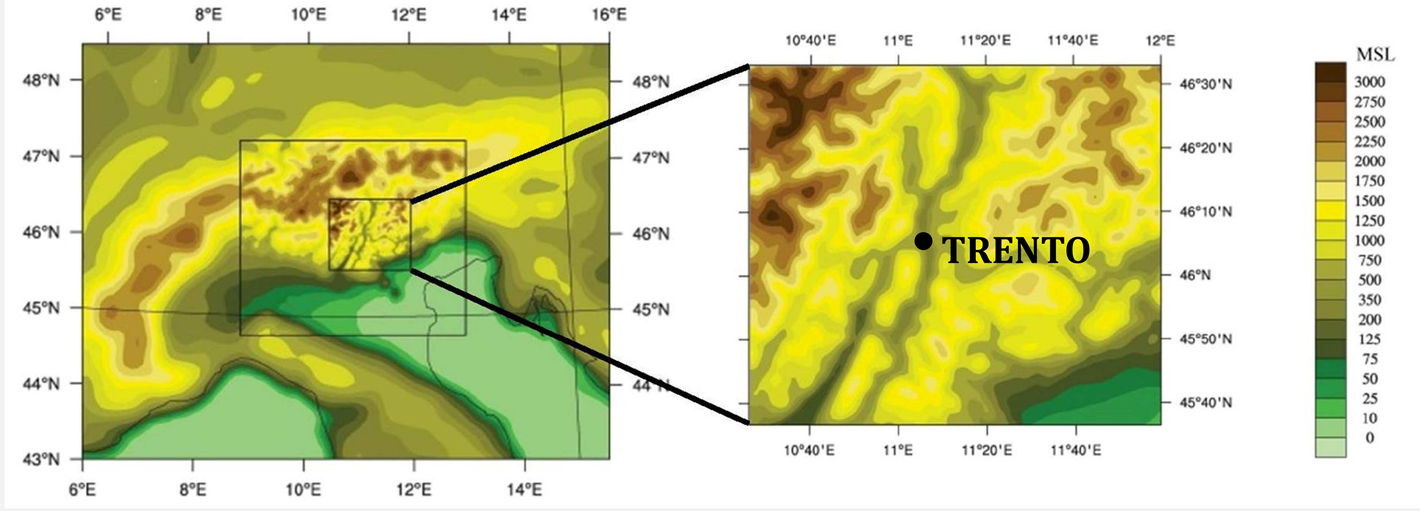


Methods

WRF model

48-h forecasts with the WRF model:

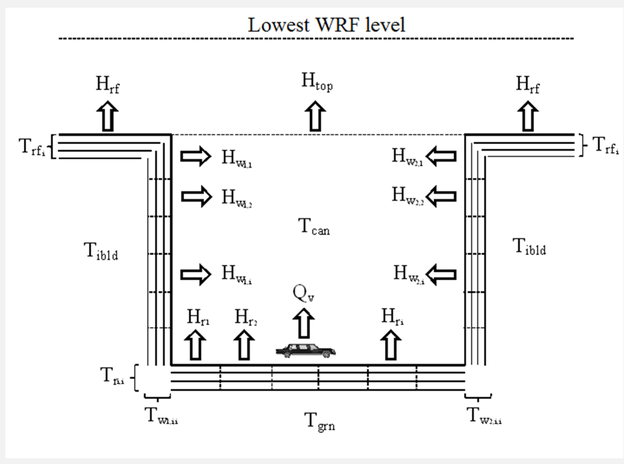
- 3 two-way nested domains with a resolution of 9-3-1 km and 27 vertical levels.



Canyon model

WRF forecasts are downscaled to a resolution of 100 m in the urban area of Trento using a single-layer urban canopy model (Giovannini et al. 2013):

- surface energy balance for walls, roads and roofs;
- shadowing inside the street;
- multiple reflections of short- and long-wave radiation;
- heat conduction through surfaces;
- anthropogenic heat flux.



Urban morphology

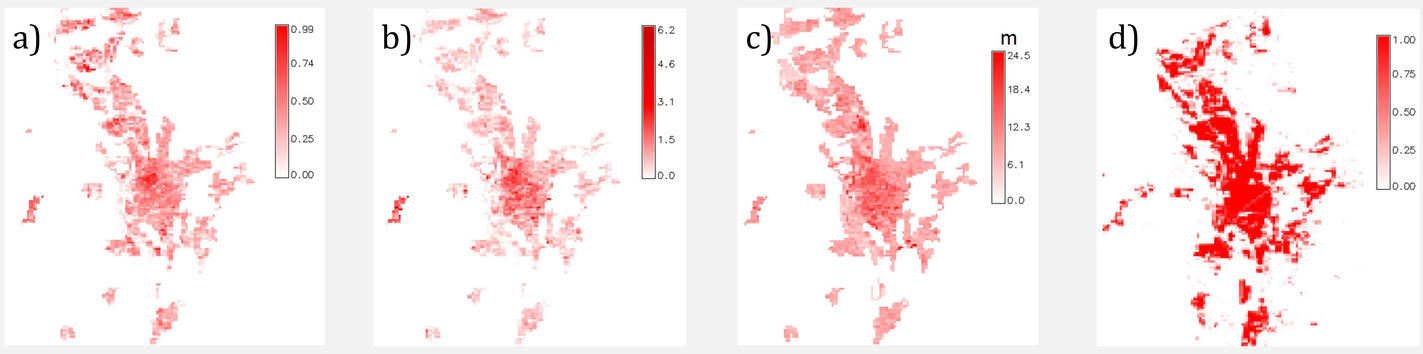
Detailed information on urban morphology from 1-m resolution lidar data.

a) $\lambda_p = \frac{A_{roofs}}{A_{tot}}$

b) $\lambda_b = \frac{A_{roofs}+A_{walls}}{A_{tot}}$

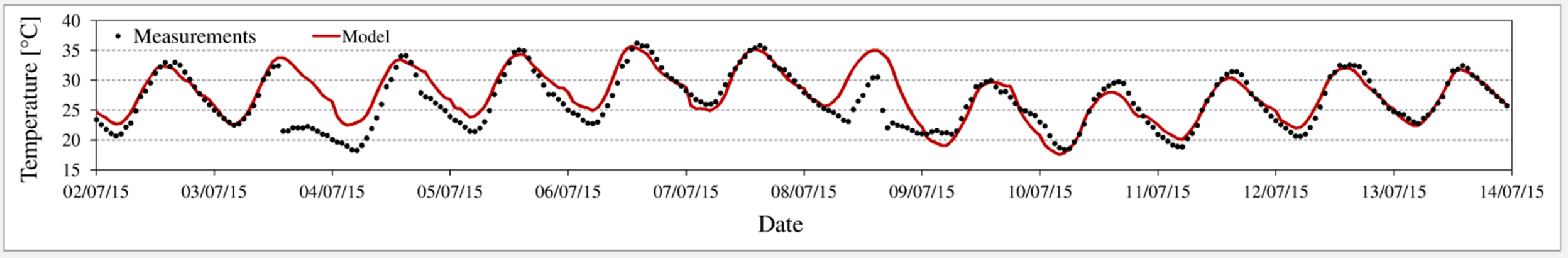
c) average building height

d) urban fraction



Model Validation

Validation of model results against measurements performed in the city center.



References

Giovannini L., D. Zardi, M. de Franceschi, 2013: Characterization of the thermal structure inside an urban canyon: field measurements and validation of a simple model. *Journal of Applied Meteorology and Climatology*, **52,** 64-81.

Acknowledgements

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Future Work

Calculate, from the meteorological parameters provided by the forecasting system, indexes for the bio-meteorological assessment of the thermal environment in the urban area.