UNIVERSITY OF TRENTO - Italy
Department of Civil, Environmental and Mechanical Engineering

High-resolution forecasts of the thermal comfort in the urban area of Trento

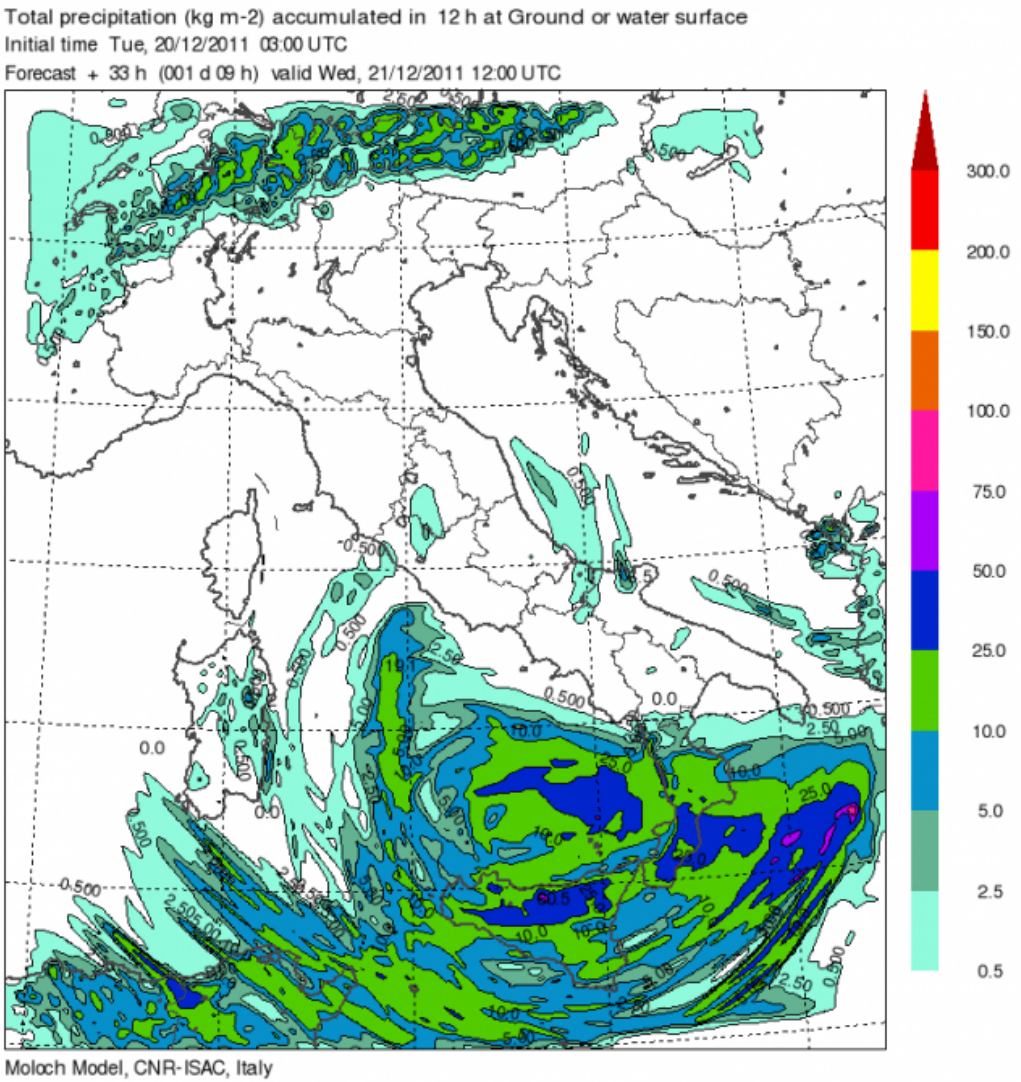
Lorenzo Giovannini, Dino Zardi
lorenzo.giovannini@unitn.it

Atmospheric Physics Group, Departiment of Civil, Environmental and Mechanical Engineering, University of Trento, Trento

Trento, 5 November 2015
First International Conference on Anticipation

Numerical weather forecasts

Weather forecasts are based on the results of numerical meteorological models



Numerical weather forecasts

Vilhelm Bjerknes (1904):

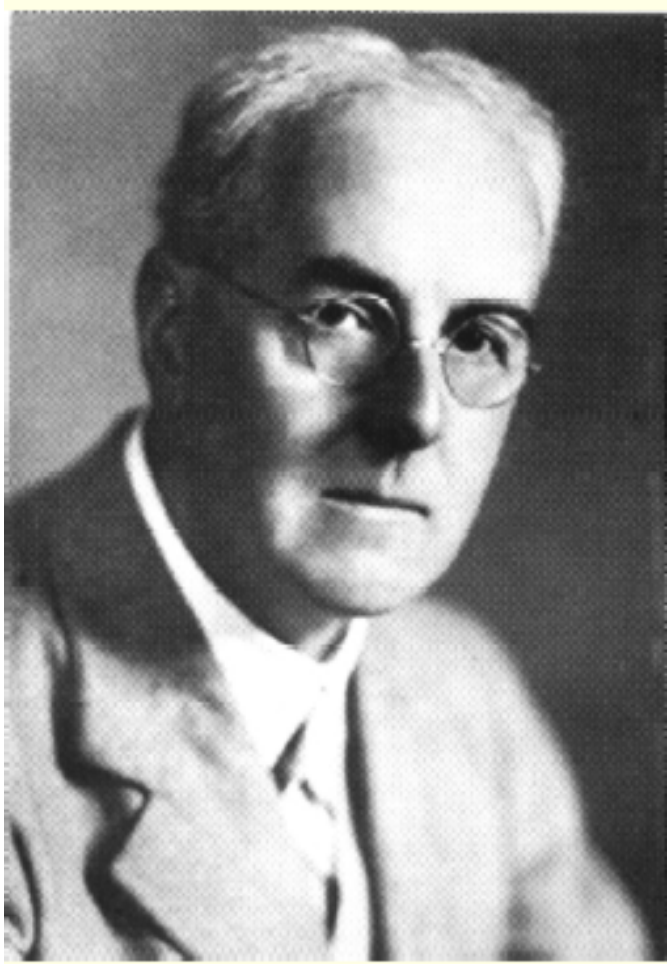
Atmospheric evolution controlled by physical laws.

To predict atmospheric evolution we need to know:

- initial conditions
- physical laws

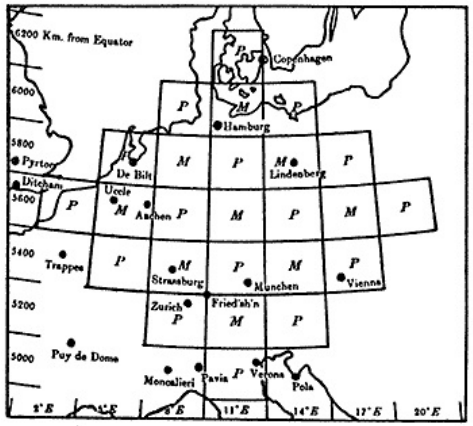
Numerical weather forecasts

Lewis Fry Richardson



First attempt of a weather forecast (1910):

6-h forecast of the pressure, no success.



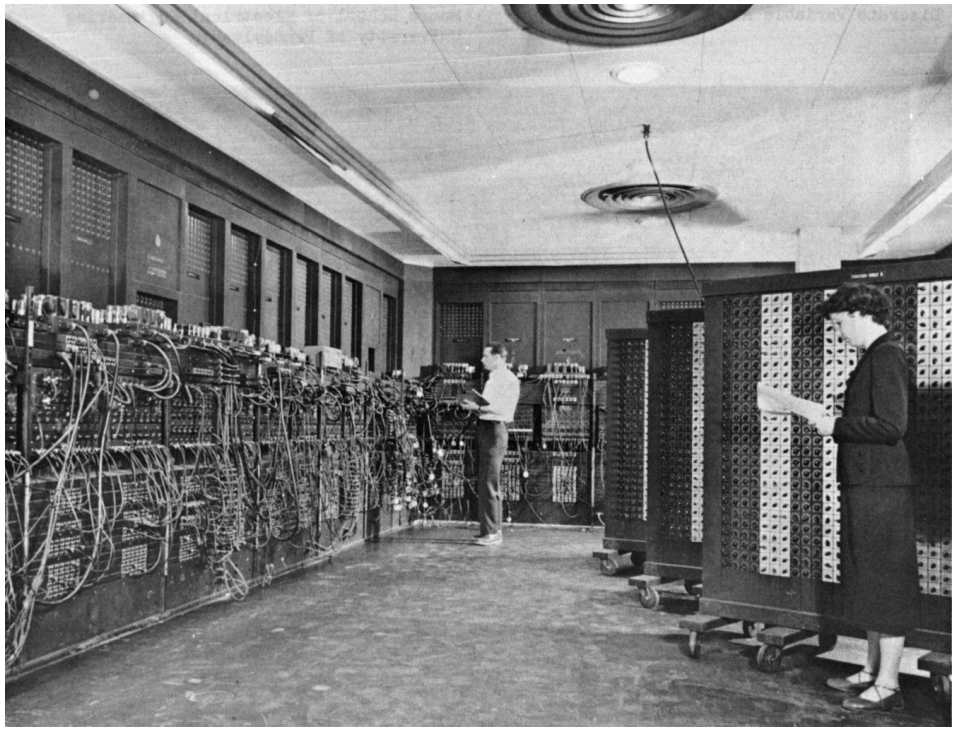
Weather Prediction by Numerical Process (1922)

Numerical weather forecasts

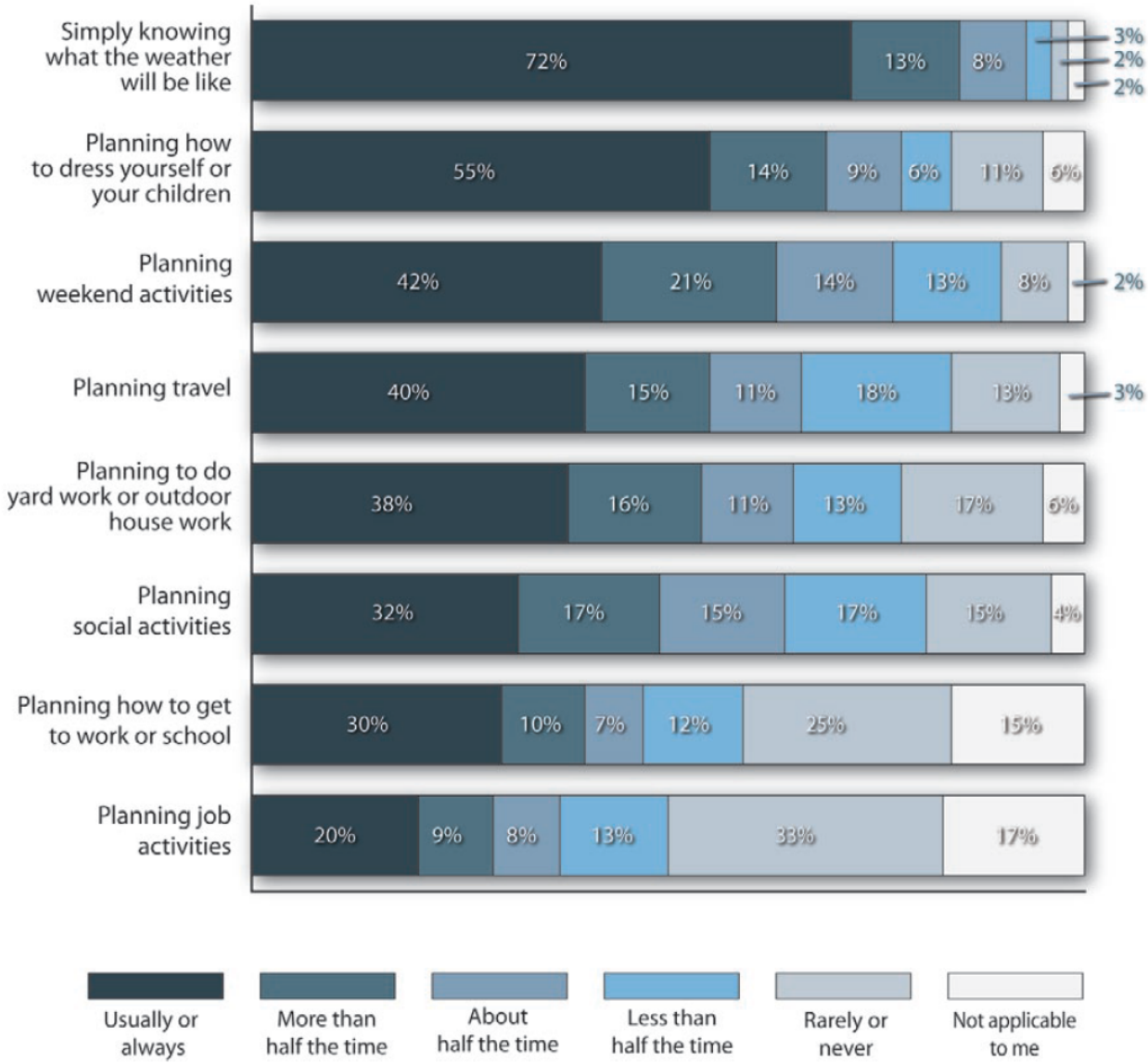
The first numerical weather forecast: march 1950 in Princeton.

- grid over the United States

ENIAC: Electronic Numerical Integrator And Computer

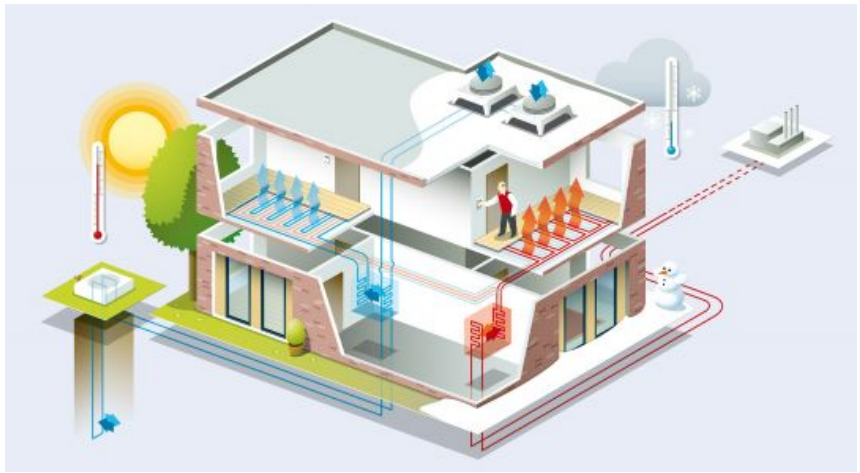


How can meteorological forecasts be used?

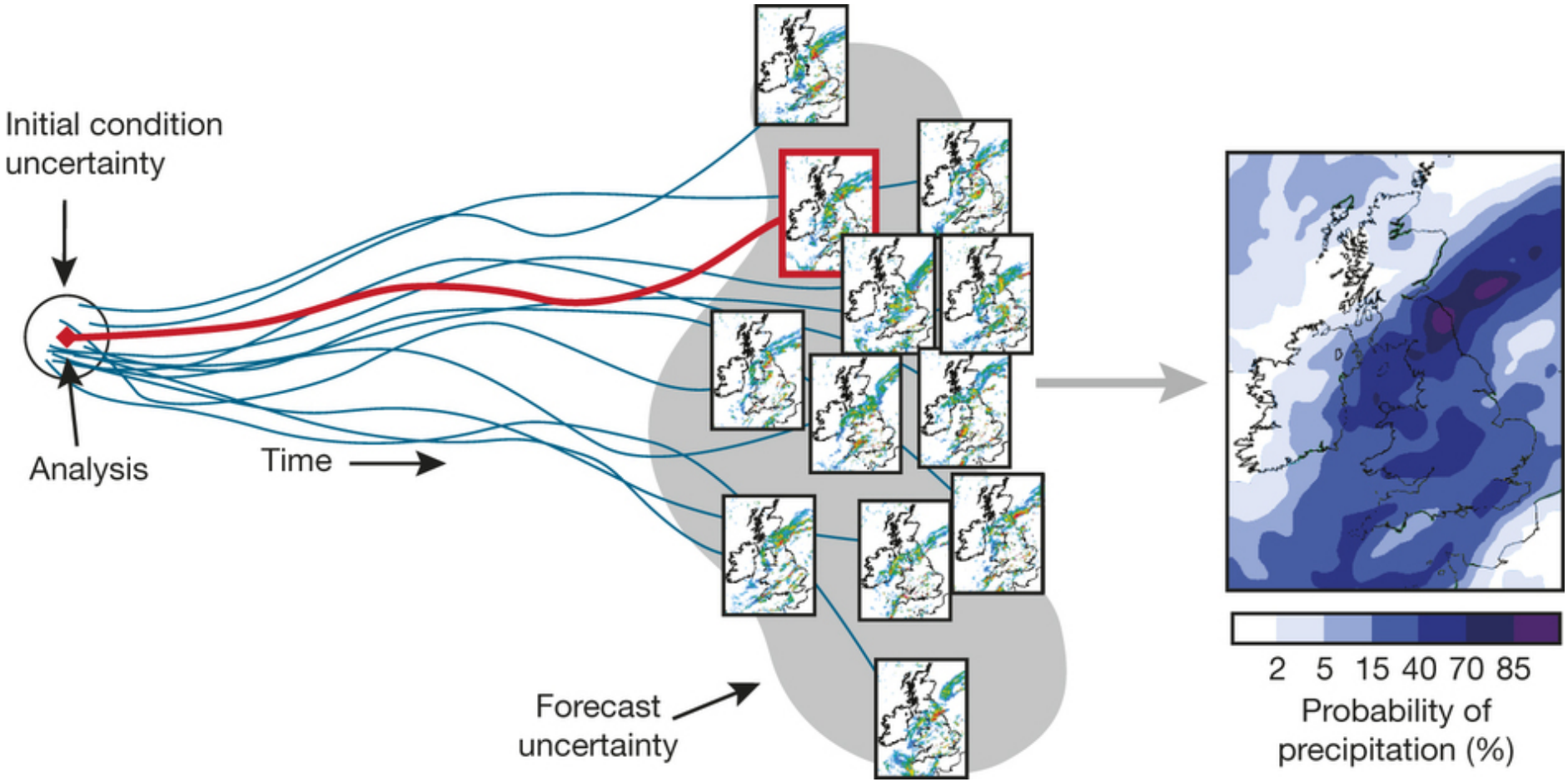


Lazo et al. (2009)

How can meteorological forecasts be used?

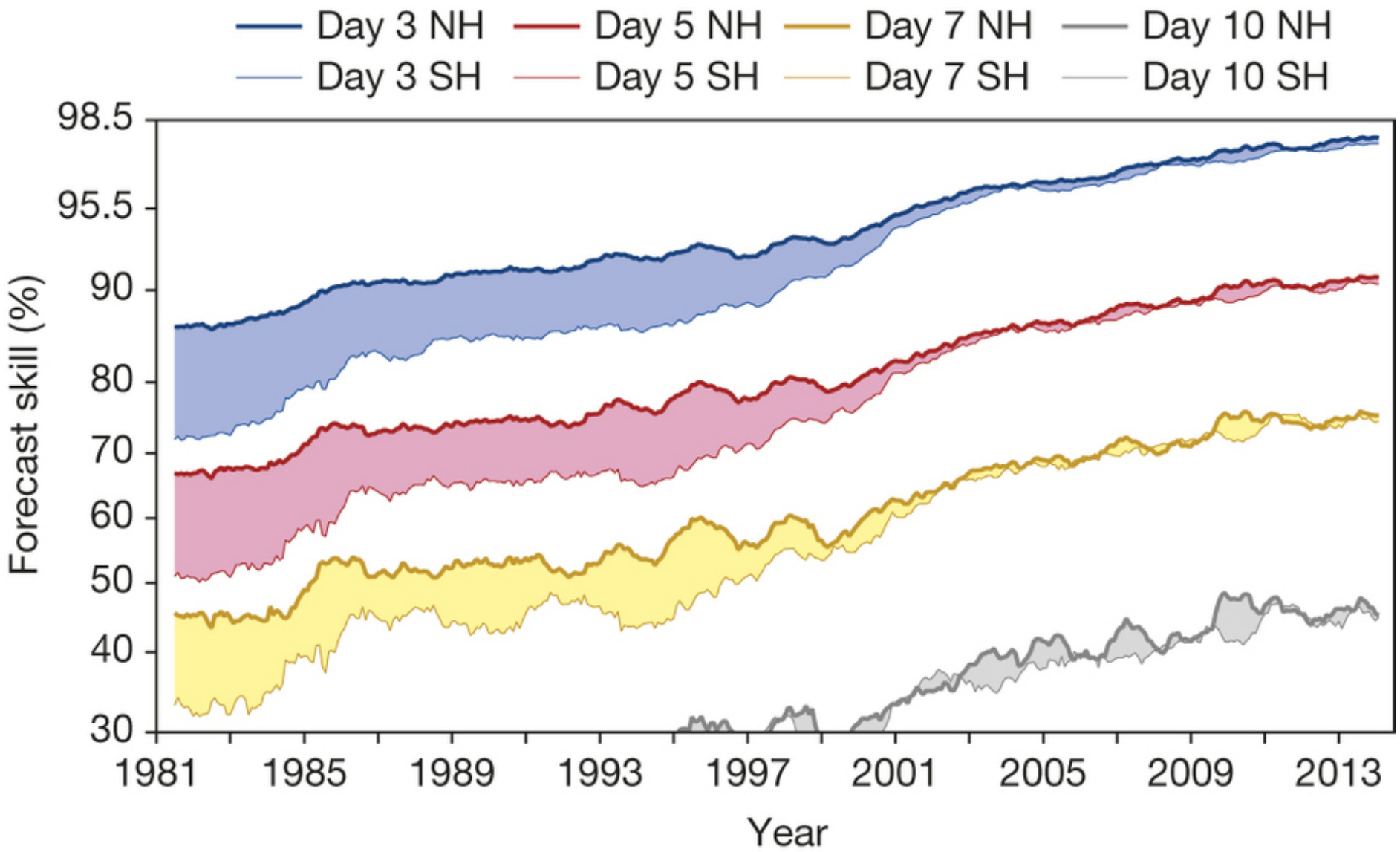


Numerical weather forecasts: uncertainty



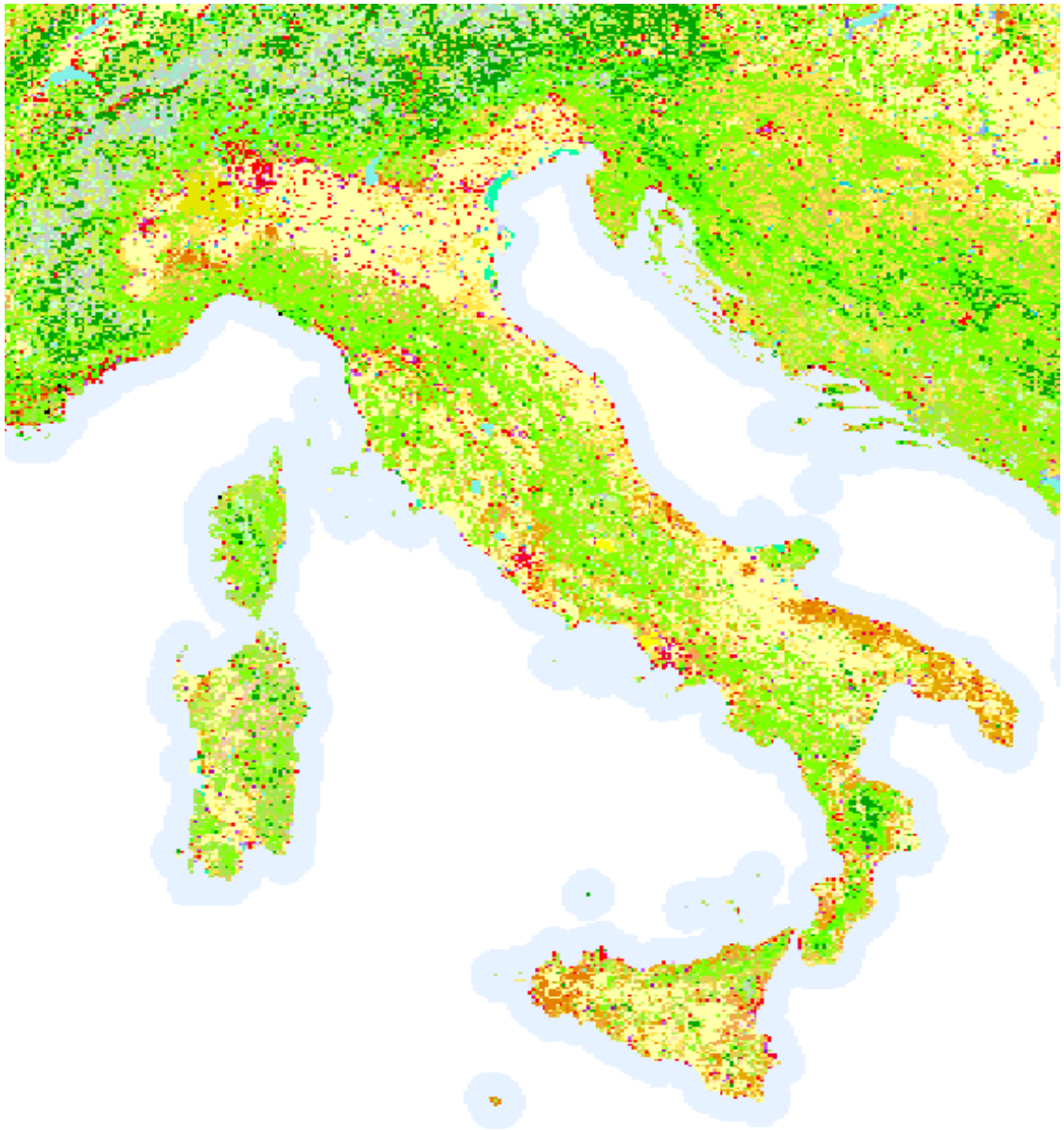
P Bauer et al. Nature 525, 47-55 (2015) doi:10.1038/nature14956

Numerical weather forecasts: uncertainty



P Bauer et al. Nature 525, 47-55 (2015) doi:10.1038/nature14956

Why urban meteorology?



Urban heat island

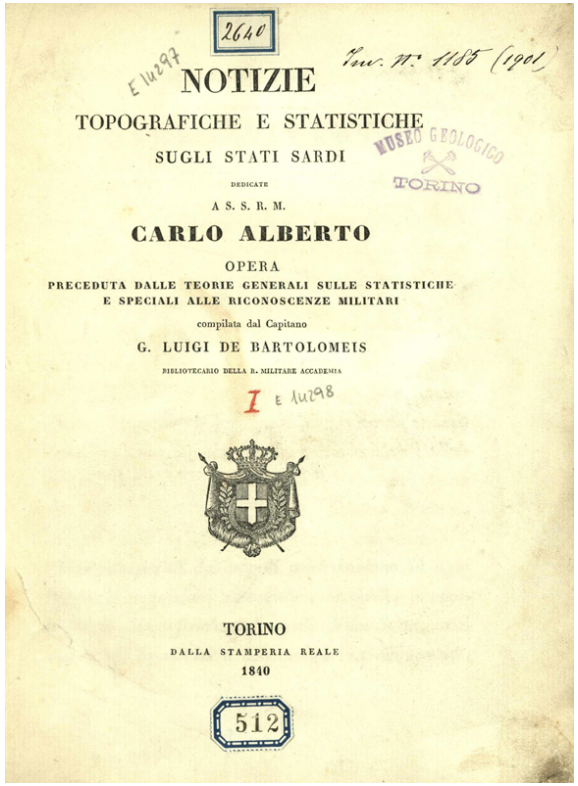
Temperature inside cities is generally higher than in surrounding rural areas.

(Voogt 2000)

Urban heat island: history

Luke Howard

The climate of London (1833)



Luigi de Bartolomeis

Notizie topografiche e statistiche sugli stati sardi (1840-47)

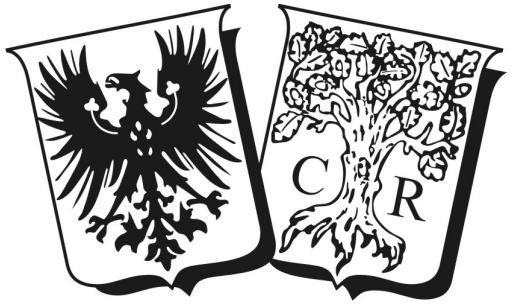
Thermal comfort in urban areas

Thermal comfort in urban areas

COM4CAST

"High-resolution forecasts of the thermal comfort in the major urban areas of the Province of Trento"

Project funded by



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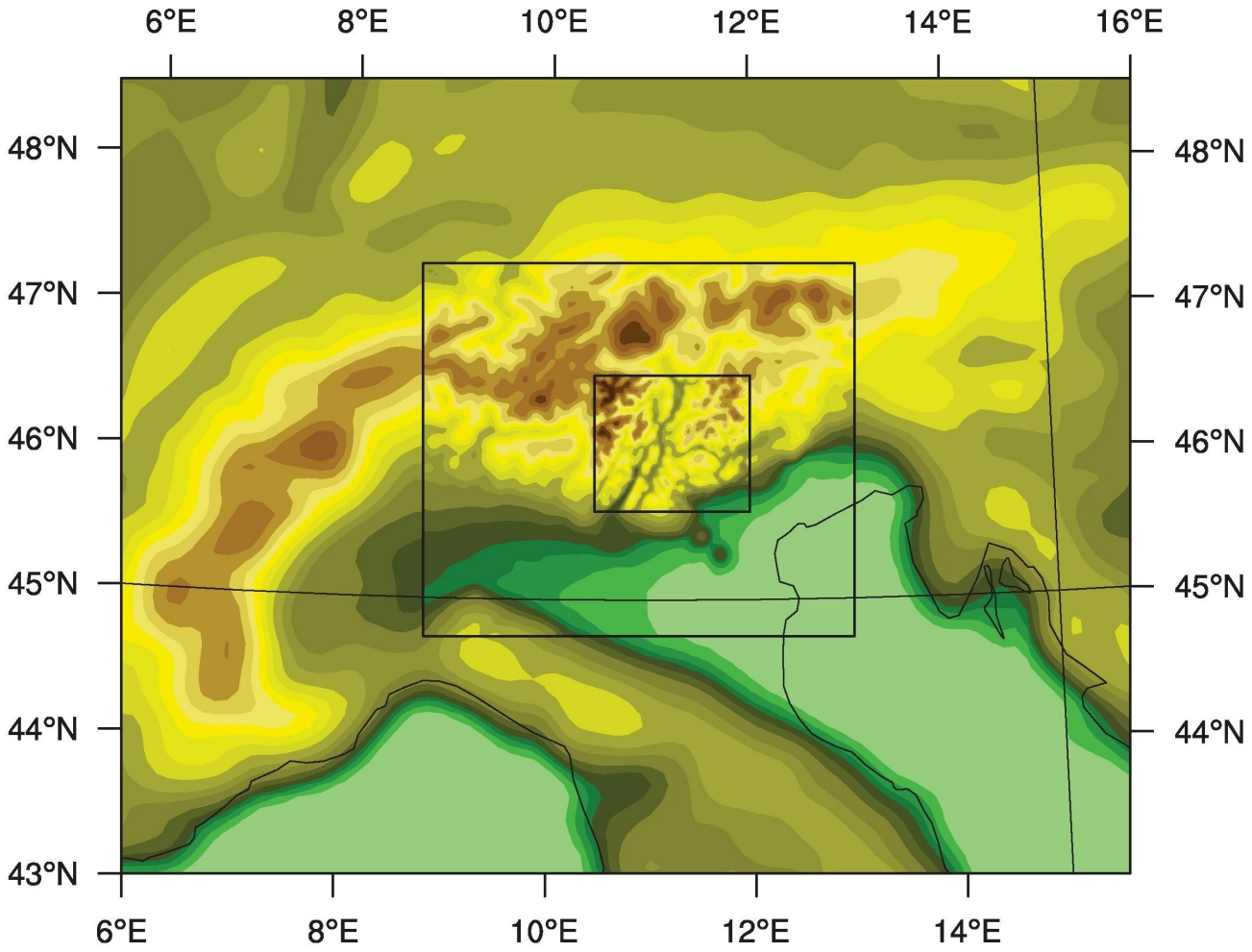
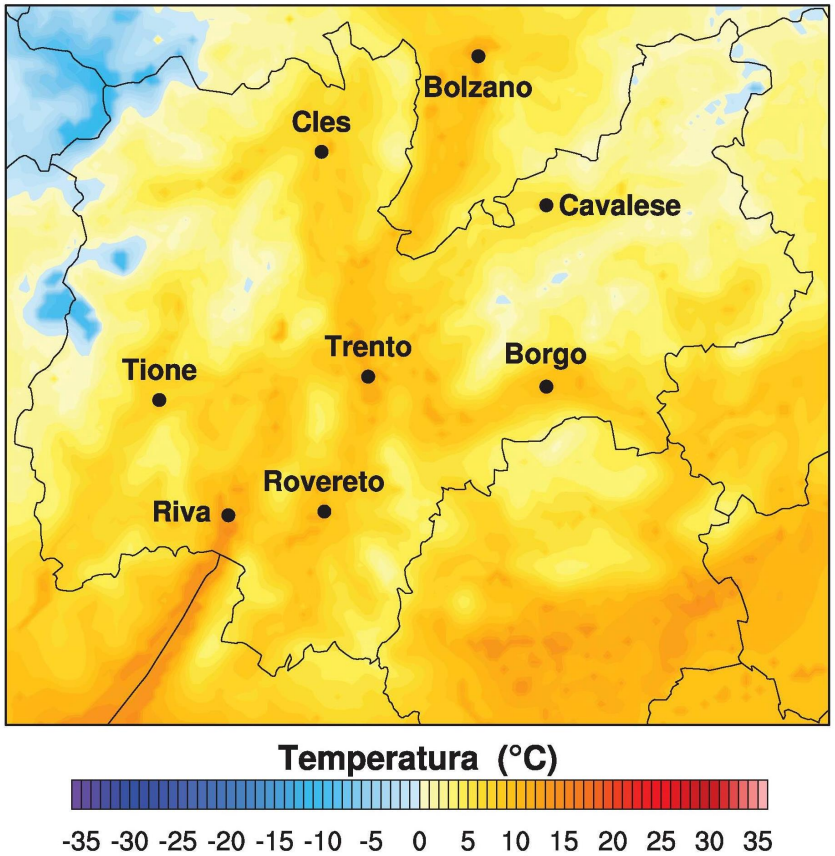
CASSA DI RISPARMIO
DI TRENTO E ROVERETO

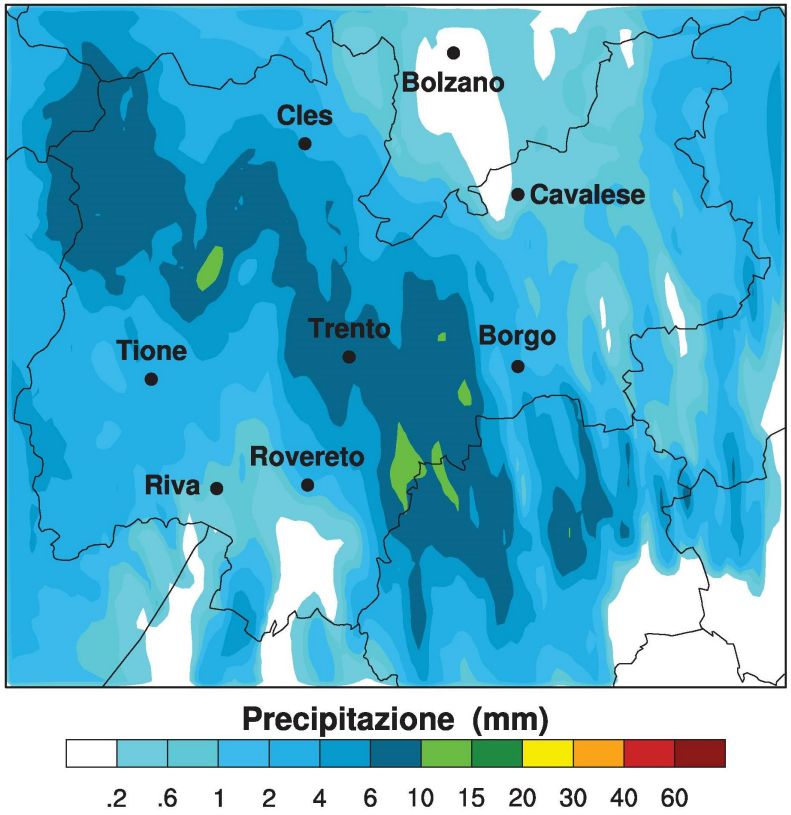
Thermal comfort in urban areas

High-resolution (1 km) forecasts with the WRF model in the Province of Trento



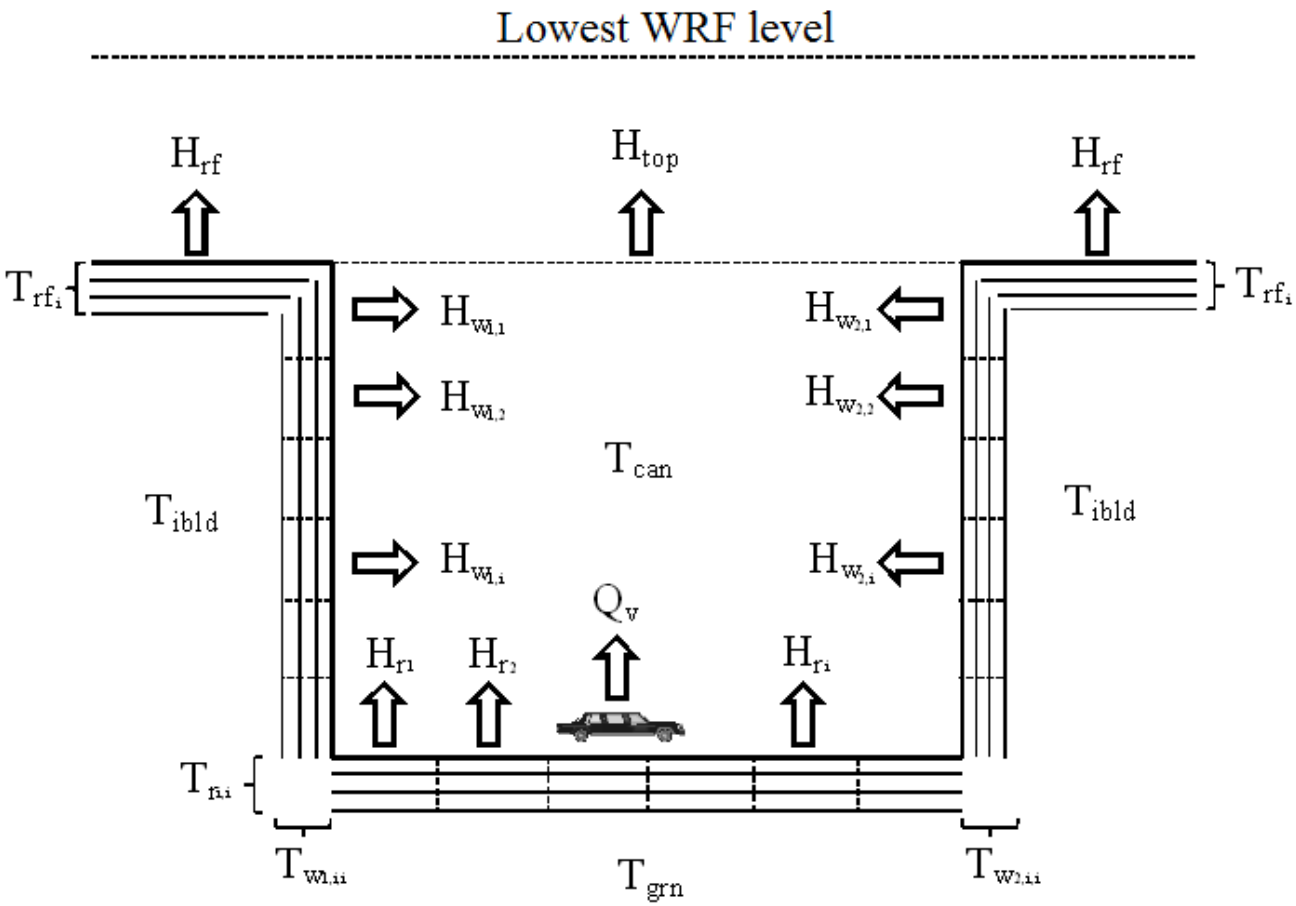
Weather forecasts: Province of Trento





Thermal comfort in urban areas

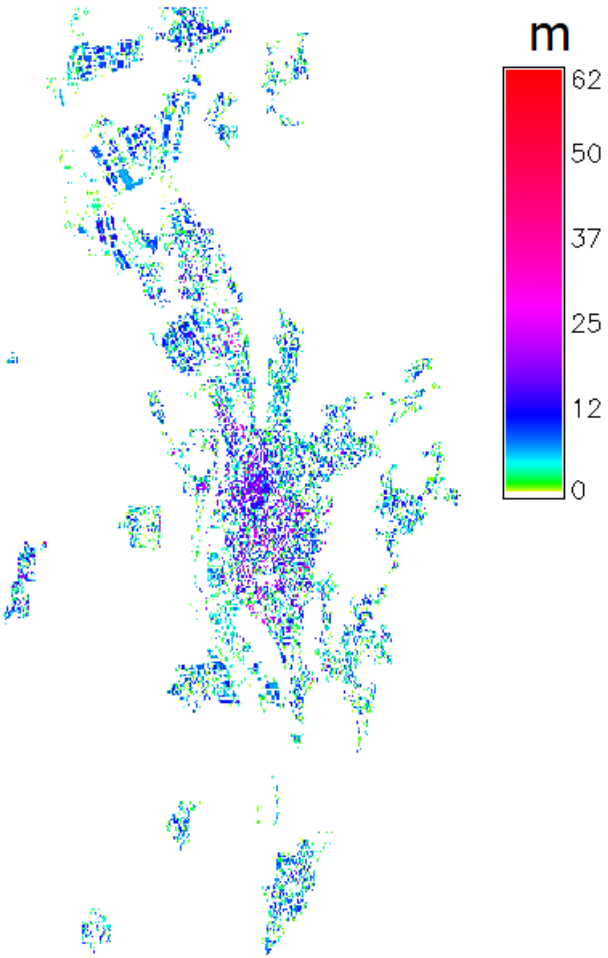
Downscaling to 100 m on the major urban areas of the Province of Trento



Giovannini et al. (2013)

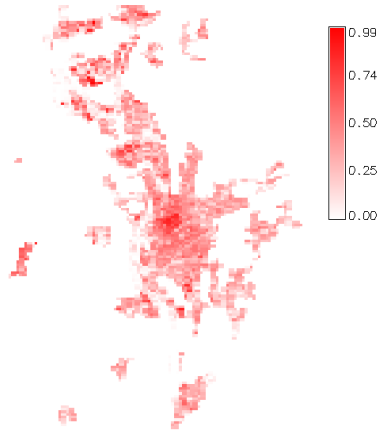
Urban morphology

Lidar data

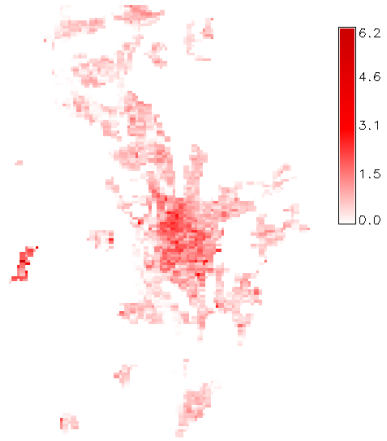


$\Longrightarrow$

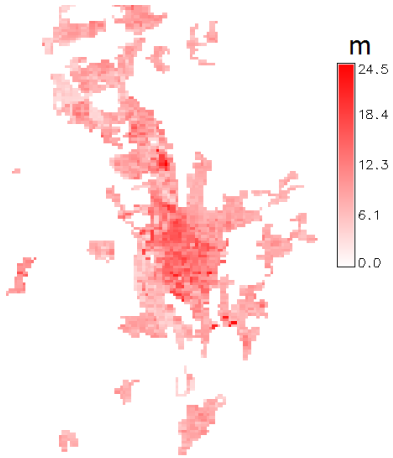
λ_p



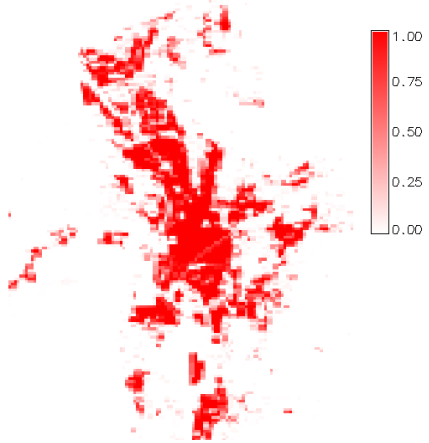
λ_b



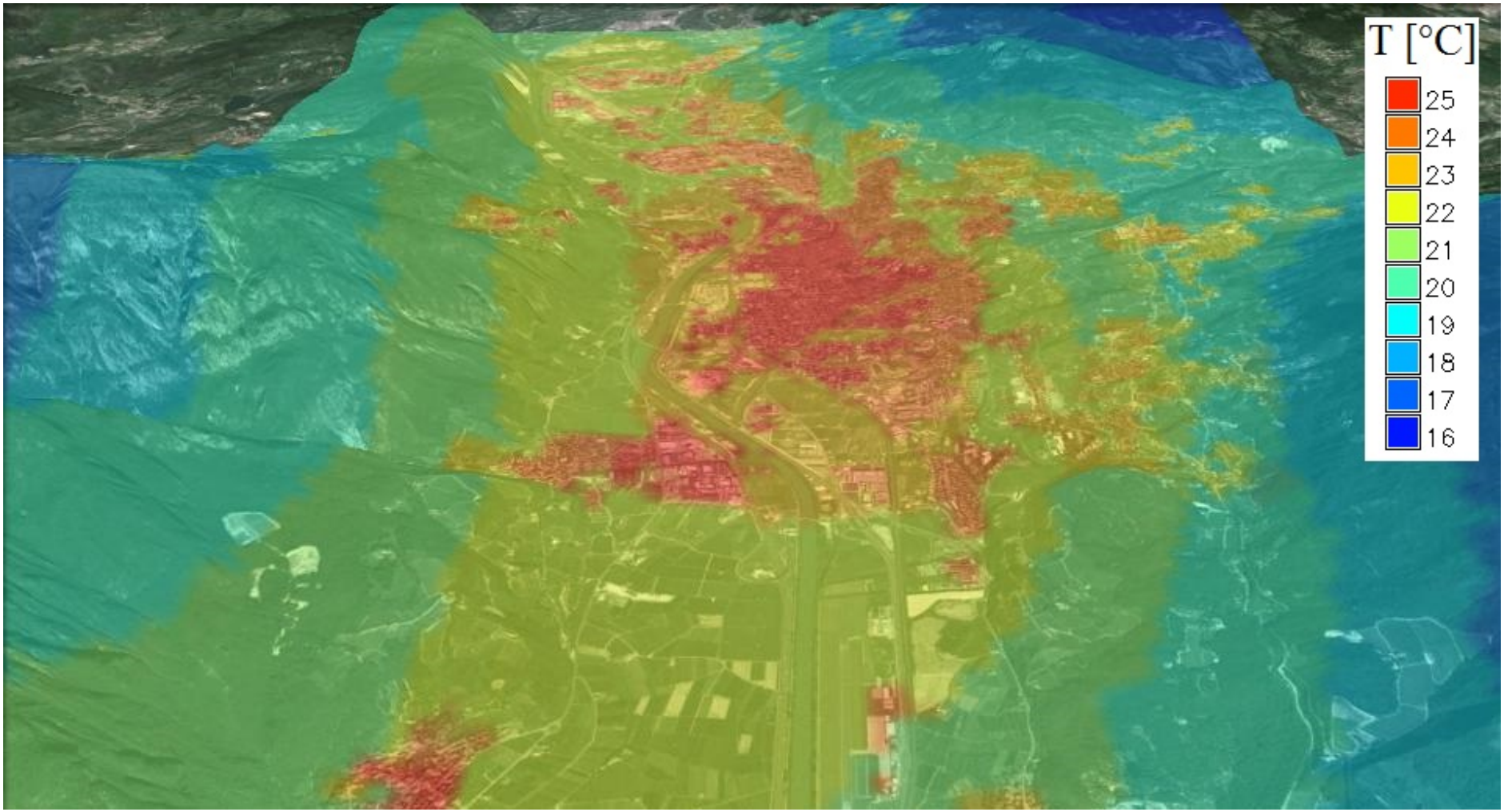
Buildings height



Urban fraction



Thermal comfort in urban areas



Thermal comfort in urban areas

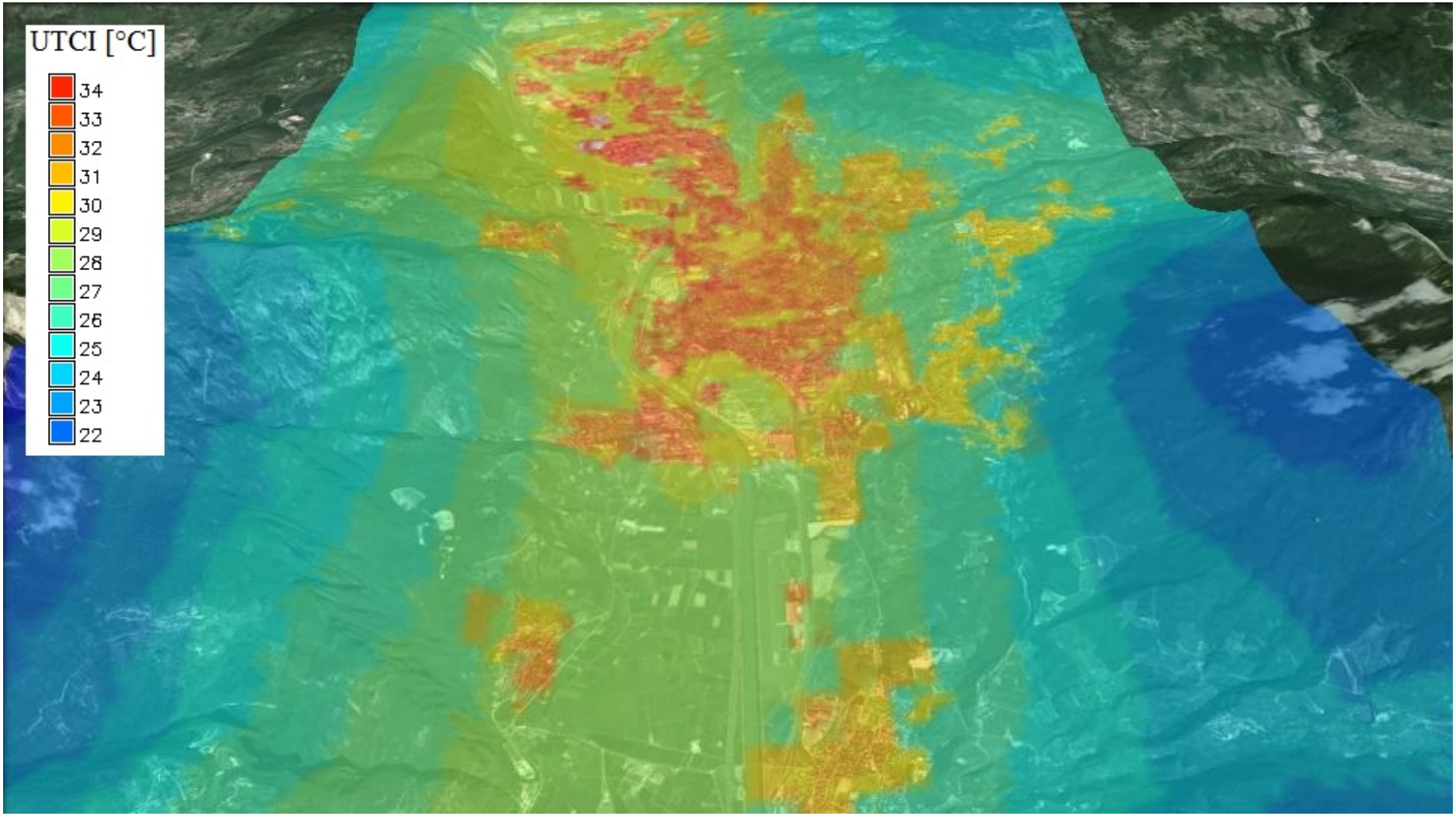
Universal Thermal Climate Index (UTCI)

The UTCI assesses the outdoor thermal environment for biometeorological applications.

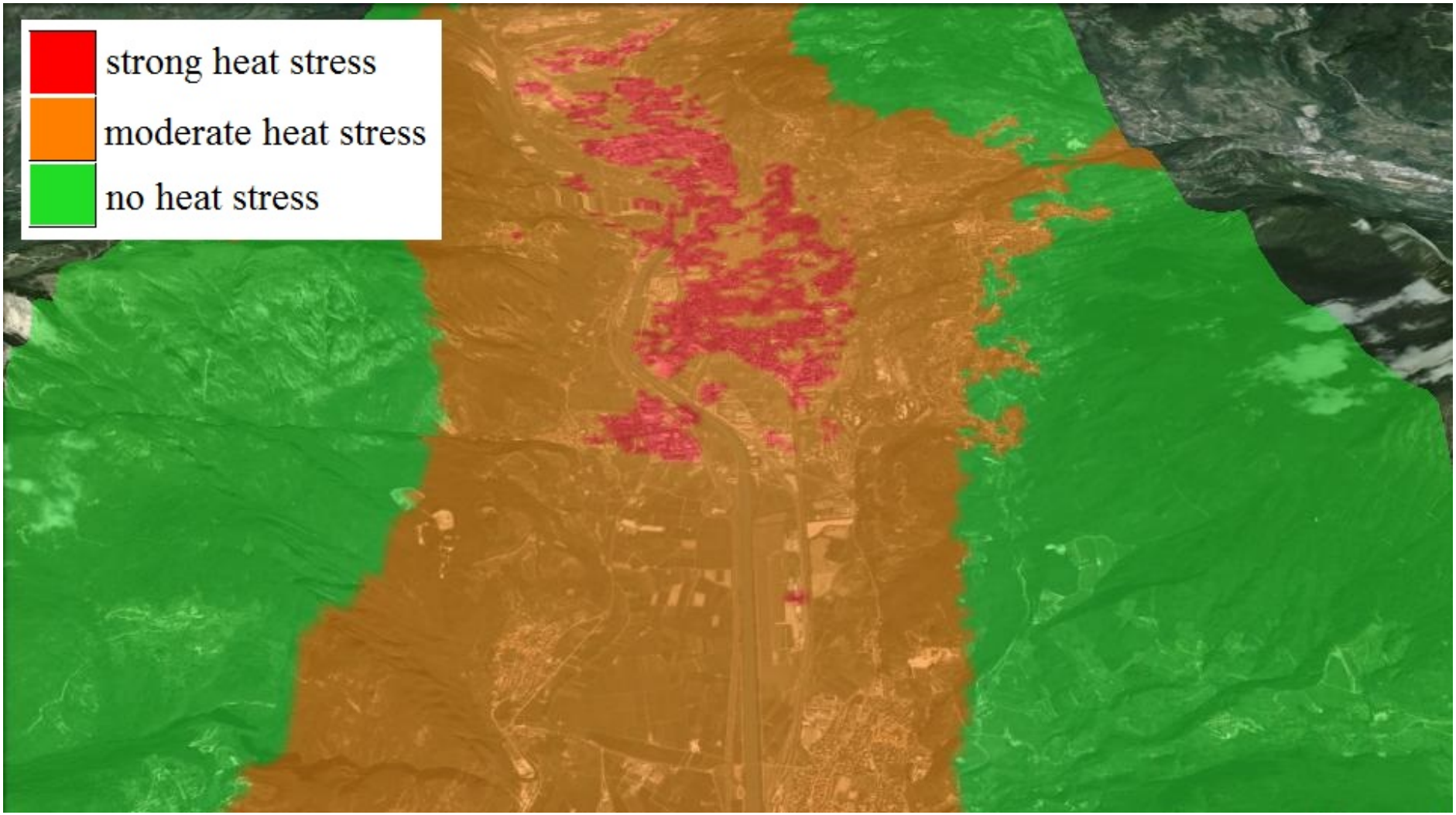
- Dependent on temperature, radiation, humidity and wind
- Accounts for the heat exchange between human body and environment

UTCI (°C) range	Stress Category
above +46	extreme heat stress
+38 to +46	very strong heat stress
+32 to +38	strong heat stress
+26 to +32	moderate heat stress
+9 to +26	no thermal stress
+9 to 0	slight cold stress
0 to -13	moderate cold stress
-13 to -27	strong cold stress
-27 to -40	very strong cold stress
below -40	extreme cold stress

Thermal comfort in urban areas



Thermal comfort in urban areas



Conclusions

Meteorology and weather forecasts:

- Meteorologists try to forecast the future weather
- Weather forecasts can be used to take important decisions
- Be aware of uncertainty

Case study:

- High-resolution forecasts of the thermal comfort in urban areas
- Support decision tool for issuing alerts in critical situations

THANKS FOR YOUR KIND ATTENTION!