

Modeling of mesoscale phenomena using WRF-BEP-BEM-CIM in a complex region

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November 22, 2022

Abstract

Because of the global warming, urban planning strategies must be investigated to reduce the building energy consumption and increase the thermal comfort in cities. In the framework of Energy Strategy 2050 of Switzerland, it is important to highlight the impact of future climate change on urban planning and proposes strategies to help urban planners and policymakers face this new challenge particularly in a future where heat waves are going to become common at mid-latitudes. However, to do so in the best possible way, the models currently used have to be robust enough in complex regions (with lakes, mountains and urban areas) to evaluate future planning scenarios. Simulations are performed over Switzerland at high resolution using a mesoscale numerical weather prediction system. The results from the simulations are compared with multiple meteorological stations located in the domain and is also used to evaluate the urban heat island. We demonstrate that the models performs well in plateaued regions but some important deviations are noted in particularly complex region with complex topography. The importance of Lake Geneva in the mesoscale dynamics in the region is also highlighted

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Context

Urban planning strategies must be investigated to reduce the building energy consumption and increase the thermal comfort in cities. The evaluation of the impact of **future climate change** on urban planning strategies are needed to help **urban planners and policymakers** face this new challenge particularly in a future where heat waves are going to become common at mid-latitudes.

Objectives

Models currently used have to be robust enough in **complex regions (with lakes and mountains)** to evaluate future planning scenarios.

Simulations are performed over Switzerland at **high resolution** using the Weather Research and Forecast model (**WRF V3.6**).

Climate
change



Urban
Planning



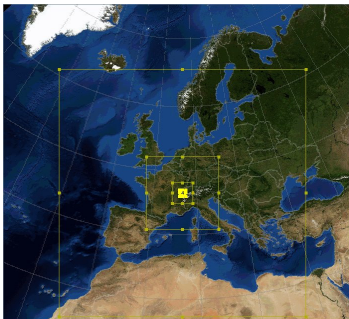
Heat
waves



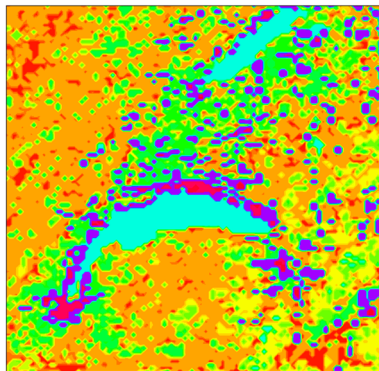
CO₂
emissions



Case study : Lemanic region



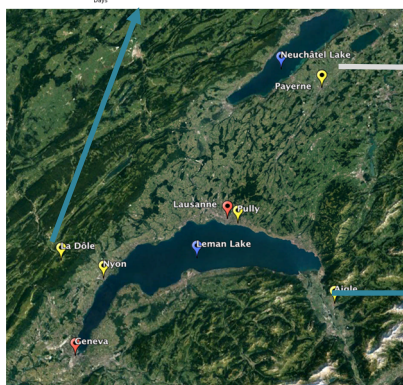
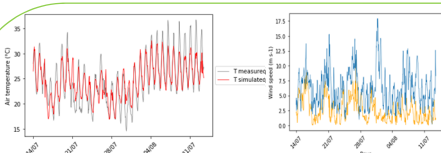
Domains centred over Lemanic region:
4 domains : 45km, 15km, 3km, 1km
Time:
14 July 2003 to 14 August 2003



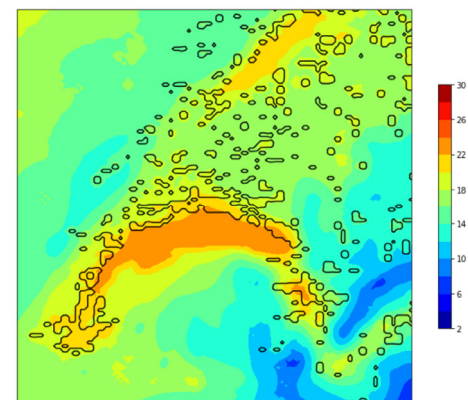
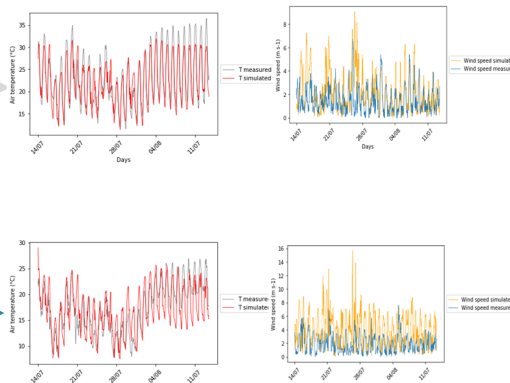
Land use: 33 categories (Global Land Cover - MODIS)

Value	Label
0	Water
1	Evergreen Needleleaf forest
2	Evergreen Broadleaf forest
3	Deciduous Needleleaf forest
4	Deciduous Broadleaf forest
5	Mixed forest
6	Closed shrublands
7	Open shrublands
8	Woody savannas
9	Savannas
10	Grasslands
11	Permanent wetlands
12	Croplands
13	Urban and built-up
14	Cropland/Natural vegetation mosaic
15	Snow and ice
16	Barren or sparsely vegetated

Results



Mountain → Rural



Mean monthly 2m air
temperature (°C) at 05.00

Discussions

- Model performs well over rural areas ($r^2=0.81$, $\sigma = 0.1$)
- Accumulation of heat over the lake during summer nights
- Significant deviation for mountainous regions ($r^2=0.56$, $\sigma = 0.5$)

Conclusions / Perspectives

- Improve the representation of the surface in atmospheric model
- Canopy Interface Model (Mauree et al., 2018) can be used
- Decrease overestimation of the wind in urban areas and increases air temperature.

Acknowledgements

The research is part of the Swiss Competence Center for Energy Research – Future Energy Efficient Buildings and Districts (SCCER FEEB&D).

