Urban Heat Island in Lyon metropolitan areas

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Presentation of Lyon metropolis



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Presentation of Lyon metropolis



Lyon metropolis is the second metropolitan area in France with 1 300 000 inhabitants.

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Presentation of Lyon metropolis



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The main part of this study is based on the model developed by he Laboratory of Aerology and National Centre of Meteorological Research (CNRM) in Toulouse.



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Meso-NH: is a non-hydrostatic mesoscale atmospheric model. To assess the surface impacts, the SURFEX model is integrated in Meso-NH.



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Model description

SURFEX is the externalized land and ocean surface platform using the tile approach.



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TEB - TOWN ENERGY BALANCE model, which simulates exchanges between an artificial surface and the atmosphere.



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Land cover database

A new database was created to characterize the Greater Lyon land cover with a horizontal resolution equal to 250 m.

- SPOT Thema which is based on the SPOT images' classification (2010),
- Local Development Plan (PLU in French),
- Building construction date, developed in Morphological approach to urbanization (N.Ferrand, 2010),
- Material building characteristic developed in MUSCADE research program (Lemonsu A. et al., 2012).

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- Methods

Land cover database

Land cover database for Lyon metropolis



Three fractions: TOWN, VEGETATION, WATER. GARDEN and BUILDING fractions.

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Methods

-Land cover database

Land cover database. GARDEN and BUILDING fractions.



The mean value of GARDEN fraction is 0.57, and for BUILDING 0.14, but the urban vegetation is changing from 0.0 to 0.996. In industrial area we can have mesh grids without urban vegetation.

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Urban Heat Island in Lyon metropolitan area └─ Methods

Land cover database





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Urban Heat Island in Lyon metropolitan areas

Meteorological conditions during the simulation.

17 - 23 August 2012



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Urban Heat Island in Lyon metropolitan areas

Meteorological conditions during the simulation.

21th August 2012



Vertical profiles for three hours 7p.m., 11p.m., 3a.m UTC.



Atmospheric dynamic: kinetic energy.

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Temperature at 2 m for three hours: 7p.m., 11p.m., 3a.m UTC

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Nighttime minimal temperature and the nighttime mean temperature



Minimal and mean nighttime temperatures at 21th August 2012.

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Correlations between the temperature and the geographic's conditions; and between the temperature and fractions: $R^2 = 0.5076$



Parameters	latitude	longitude	altitude	garden	building	building's height	road	bld+road	_
T _{min}	-0.4766	0.1743	-0.3112	-0.1427	-0.0259	0.0854	0.2175	0.1427	=
Tnight	-0.5972	0.3174	-0.4022	-0.1520	-0.0638	-0.0023	0.2548	0.1520	
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Conclusion

- The warmest areas in Lyon metropolis are : the activities areas and the major roads.
- At the beginning of the night the temperature differences between the center and the warmest areas are about $+3^{\circ}C$.
- The old town and the Lyon center are about 1-2°C cooler than the activities areas at the end of the night.
- In the valley the temperature inversion is predominant.
- The residuals analyse shows that the altitude is significant.
- The mean night temperature is the most correlated with the geographic's parameters.
- The road fraction is highly correlated with the temperatures compared to the other land cover fractions.
- The minimal temperature is more correlated with the building height than the mean nighttime temperature.

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Thank you for your attention





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