

## SPECIAL PROJECT FINAL REPORT

All the following mandatory information needs to be provided.

<b>Project Title:</b>	Analysis of the Urban Heat Island over Torino with COSMO model at 1km
<b>Computer Project Account:</b>	spitmil2
<b>Start Year - End Year :</b>	2019 - 2020
<b>Principal Investigator(s)</b>	Massimo Milelli (mcy), Valeria Garbero (mcy0)
<b>Affiliation/Address:</b>	Arpa Piemonte
<b>Other Researchers (Name/Affiliation):</b>	

The following should cover the entire project duration.

## **Summary of project objectives**

(10 lines max)

1. Test of urban parametrization in COSMO model;
2. calibration of the tuning parameters;
3. analysis of the external parameters (update, improvement);
4. test of the IFS skin temperature formulation (Viterbo & Beljaars, 1995) that was adapted and implemented in TERRA, the soil module of COSMO model;
5. feasibility study for implementation of the scheme in the ICON model for NWP applications

## **Summary of problems encountered**

(If you encountered any problems of a more technical nature, please describe them here.)

The debugging of the code was longer than expected, because the interaction of TERRA\_URB with some existing parameterization (turbulence basically) was problematic.

## **Experience with the Special Project framework**

(Please let us know about your experience with administrative aspects like the application procedure, progress reporting etc.)

The experience acquired so far is positive and the administrative procedure is clear enough.

## Summary of results

(This section should comprise up to 10 pages, reflecting the complexity and duration of the project, and can be replaced by a short summary plus an existing scientific report on the project.)

The whole project, focused on COSMO model, produced two publications and two presentations at SRNWP Meetings (in 2019 and 2020, listed below). Therefore only the main achievements will be listed here.

The work was embedded into a COSMO Priority Task: Analysis and Evaluation of TERRA\_URB Scheme (ÆVUS). This PT (one year duration) started in spring 2018 and was followed by PT ÆVUS2. TERRA\_URB (Wouters et al, 2016) was implemented in a parallel and non-operational branch of COSMO, tested in different conditions and different areas. The results showed a general improvement of T2m in urban areas and a consequent better representation of UHI (defined as T2m\_urb-T2m\_rur). Anthropogenic Heat Flux (AHF) and Impervious Surface Area (ISA) had to be included into the COSMO pre-processor (EXTPAR). Test of the Schulz and Vogel (2017) land surface scheme, adaptation of the Viterbo and Beljaars (1995) scheme, was performed. Results were positive, but some calibration of parameters was necessary. Also in this case an external field (Skin Conductivity, SKC) had to be included into EXTPAR. The possibility to use Local Climate Zones (LCZ, Demuzere et al., 2019) was also explored, together with the possibility to calibrate some model parameter such as building height, building fraction and ratio H/W, where H is the height of the building and W is the width of a urban canyon. Now these parameters are tuneable from the namelist (before they were hardcoded) and will be studied in the prosecution of the project.

Wouters, H.; Demuzere, M.; Blahak, U.; Fortuniak, K.; Maiheu, B.; Camps, J.; Tielemans, D.; Van Lipzig, N. The Efficient Urban Canopy Dependency Parametrization (SURY) v1.0 for Atmospheric Modelling: Description and Application with the COSMO-CLM Model for a Belgian Summer. *Geosci. Model Dev.* 2016, 9, 3027–3054.

Viterbo, P., and Beljaars, C.M., 1995: An improved land surface parametrization scheme in the ECMWF model and its validation. *J. Climate*, 8, 2716-2748.

Schulz, J.-P., and Vogel, G., 2017: An improved representation of the land surface temperature including the effects of vegetation in the COSMO model. *Geophys. Res. Abstracts*, 19, EGU2017-7896.

Demuzere, Matthias; Bechtel, Benjamin; Middel, Ariane; Mills, Gerald (2019): European LCZ map. figshare. Dataset. <https://doi.org/10.6084/m9.figshare.13322450.v1>

## List of publications/reports from the project with complete references

Presentation @ 41st EWGLAM and 26th SRNWP Meeting in 2019:

[http://srnwp.met.hu/Annual\\_Meetings/2019/download/wednesday/ewglam2019\\_milelli.pdf](http://srnwp.met.hu/Annual_Meetings/2019/download/wednesday/ewglam2019_milelli.pdf)

E. Bucchignani, P. Mercogliano, V. Garbero, M. Milelli, M. Varentsov, I. Rozinkina, G. Rivin, D. Blinov, A. Kirsanov, H. Wouters, J.-P. Schulz, U. Schättler, “Analysis and Evaluation of TERRA\_URB Scheme: PT AEVUS Final Report”, COSMO Technical Report n°40, 2019. DOI:10.5676/DWD\_pub/nwv/cosmo-tr\_40. Available online at <http://www.cosmo-model.org/content/model/documentation/techReports/docs/techReport40.pdf>

Presentation @ 42nd EWGLAM and 27th SRNWP Meeting in 2020:

[http://srnwp.met.hu/Annual\\_Meetings/2020/download/thursday/AM/EWGALM2020\\_mercogliano.pdf](http://srnwp.met.hu/Annual_Meetings/2020/download/thursday/AM/EWGALM2020_mercogliano.pdf)

Garbero, V.; Milelli, M.; Bucchignani, E.; Mercogliano, P.; Varentsov, M.; Rozinkina, I.; Rivin, G.; Blinov, D.; Wouters, H.; Schulz, J.-P.; Schättler, U.; Bassani, F.; Demuzere, M.; Repola, F. Evaluating the Urban Canopy Scheme TERRA\_URB in the COSMO Model for Selected European Cities. *Atmosphere* 2021, 12, 237. <https://doi.org/10.3390/atmos12020237>

## Future plans

(Please let us know of any imminent plans regarding a continuation of this research activity, in particular if they are linked to another/new Special Project.)

The spitmil2 project continues with a new SP (but still spitmil2): Implementation and test of a urban parameterization module in ICON Model. Its first semester report has been submitted. This new work is embedded into a COSMO Priority Project named CITTA' (City Induced Temperature change Through A'dvanced modelling), starting officially in fall 2021 for three years.