SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year	2019
Project Title:	Analysis of the Urban Heat Island over Torino with COSMO model at 1km
Computer Project Account:	spitmil2
Principal Investigator(s):	Massimo Milelli (mcy), Valeria Garbero (mcy0)
Affiliation:	Arpa Piemonte
Name of ECMWF scientist(s) collaborating to the project (if applicable)	
Start date of the project:	2019
Expected end date:	2020

Computer resources allocated/used for the current year and the previous one

(if applicable)

Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	900000	234000	1600000	
Data storage capacity	(Gbytes)	600	95	600	

Summary of project objectives (10 lines max)

- Test of urban parametrization in COSMO model with different configurations (analysis, forecast, domain, physical schemes);
- calibration of the tuning parameters;
- analysis of the external parameters (update, improvement);
- test of the IFS skin temperature formulation (Viterbo & Beljaars, 1995) that was adapted and implemented in TERRA, the soil module of COSMO model;
- feasibility study for implementation of the scheme in the ICON model for NWP applications.

Summary of problems encountered (10 lines max)

No problems so far.

Summary of plans for the continuation of the project (10 lines max)

No plans, the project will end in 2020.

List of publications/reports from the project with complete references

E. Bucchignani, P. Mercogliano, V. Garbero, M. Milelli, M. Varentsov, I. Rozinkina, G. Rivin, D. Blinov, A. Kirsanov, H. Wouters, J.-P. Schulz, U. Schaettler, "Analysis and Evaluation of TERRA_URB Scheme: PT AEVUS Final Report", COSMO Technical Report n°40, DOI: 10.5676/DWD_pub/nwv/cosmo-tr_40, available online at http://www.cosmo-model.org/content/model/documentation/techReports/docs/techReport40.pdf

Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

This is a short summary of the work performed, the full analysis is available in the publication listed above.

This study uses COSMO runs over a domain that includes the Piemonte region with a 1 km grid step (480x320 grid cells), driven by initial and boundary conditions provided by the ECMWF Operational Analysis at 9 km horizontal resolution every 6 hours. Simulations were conducted by activating or not the urban scheme TERRA_URB and by using different schemes to calculate the surface temperature, the canopy scheme or the skin conductivity scheme respectively. The urban scheme needs new external parameters, ISA (impervious surface area) and AHF (anthropogenic heat flux), while the conductivity scheme requires the skin conductivity field (SKC).
Two test cases have been considered until now in hindcast mode:

- 1-7 July 2017
- 23-29 October 2017

		SKIN T scheme	
		OFF	ON
TERRA_URB scheme	OFF	CC1	CC2
	ON	UC1	UC2

Tab. 1. Scheme of the simulations

Tab. 1 describes the tested configurations, which have been evaluated by calculating the mean bias (MB) and the root mean square error (RMSE) for the 2 meter temperature (T2m) and the 2 meter relative humidity (RH2m) using the Arpa network. In addition, the averaged diurnal evolution of the Urban Heat Island (UHI) intensity, i.e. the temperature difference between urban and rural areas, has been calculated and compared to observations.

The introduction of TERRA_URB (UC1 and UC2) generally reduces the T2m and RH2m mean bias with respect to CC1 and CC2 for urban stations, while differences among the different configurations are negligible if we consider the whole domain. This is what we expected since the impact of TERRA_URB should be limited to urban areas, and urban stations are much less than rural ones. Improvements provided by TERRA_URB are particularly evident during the night, catching the positive peaks of UHI.

Moreover, the usage of the skin temperature formulation improves the UHI representation slightly during night time (UC2 vs UC1). In general, it can be stated that the skin temperature scheme provides an explicit representation of the vegetation canopy as a component of the surface energy balance and leads to a more efficient decoupling between the surface and the air temperature. The scheme allows for a more efficient overnight cooling, particularly in the rural areas, and therefore corrects an important systematic model error of TERRA. As a result, the UHI should be simulated more accurately.

Further improvements are expected from a more accurate calibration and tuning of the latest model version. In particular, an optimized namelist setting for an improved COSMO model performance will be specified. In addition, the impact of more accurate urban external parameters will be tested and evaluated.