SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year	2018 (first semester)
Project Title:	Study of different configurations of the RAMS model for precipitation and lightning forecast over Italy at high horizontal resolution.
Computer Project Account:	…………………….SPITFEDE……………..……
Principal Investigator(s):	……………Stefano Federico……….
	……………………………………………………………..……
Affiliation:	ISAC-CNR (Institute for Atmospheric Sciences and Climate - National Research Council)
Name of ECMWF scientist(s) collaborating to the project (if applicable)	……………………………………………………………..…… ……………………………………………………………..……
Start date of the project:	1 January 2018
Expected end date:	31 December 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)	/	/	6,000,000	2,100,000
Data storage capacity	(Gbytes)	/	/	3TB	1.2 TB

Summary of project objectives

(10 lines max)

The aim of this project is to test several configurations of the RAMS (Regional Atmosheric Modeling System) model for the one-day precipitation forecast and for the lightning forecast. The verification of the lightning forecast will be performed during the third (last) year of the project, after finding the best configuration of the RAMS model for the simulation of rainfall. The precipitation forecast will be verified using a dense raingauge network available over Italy for twenty moderate-intense precipitation events occurred over Italy during HyMeX-SOP1 (5 September-5 November 2012). The sensitivity of the forecast to the microphysical scheme (WSM6 and Thompson) and to the radiative scheme (Harrington, and Chen Cotton) will be considered. Also, the performance of the CSU-RAMS model will be assessed in comparison with the RAMS model developed ad ISAC-CNR.

Summary of problems encountered (if any)

(20 lines max)

In this part of the project no particular problems were encountered. The compilation of the model was done in the first two weeks of the project. Then some training was necessary to use the cca batch system and to configure the batch geometry. I use the gfortran compiler, the gcc compiler, the ncl/6.1.2 package and the hdf5 libraries.

Summary of results of the current year (from July of previous year to June of current year)

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

In this first semester of the project, the attention was focused on the compilation and settings of the RAMS model at the ECMWF computing facilities and on the setting of the meteorological model for the project. At the end of the semester, the configuration of the model to be used for the whole project was decided. We will use two domains, shown in Figure 1, and main parameters of the domains are shown in Table 1. The first domain (R10) has 301 by 301 grid points in the horizontal directions, with 10 km grid spacing, and extends over the Central Europe and Mediterranean Basin, the second domain has 631 by 631 grid-points, with 3 km grid spacing, and extends over Italy. The nesting between the two domains is one-way.
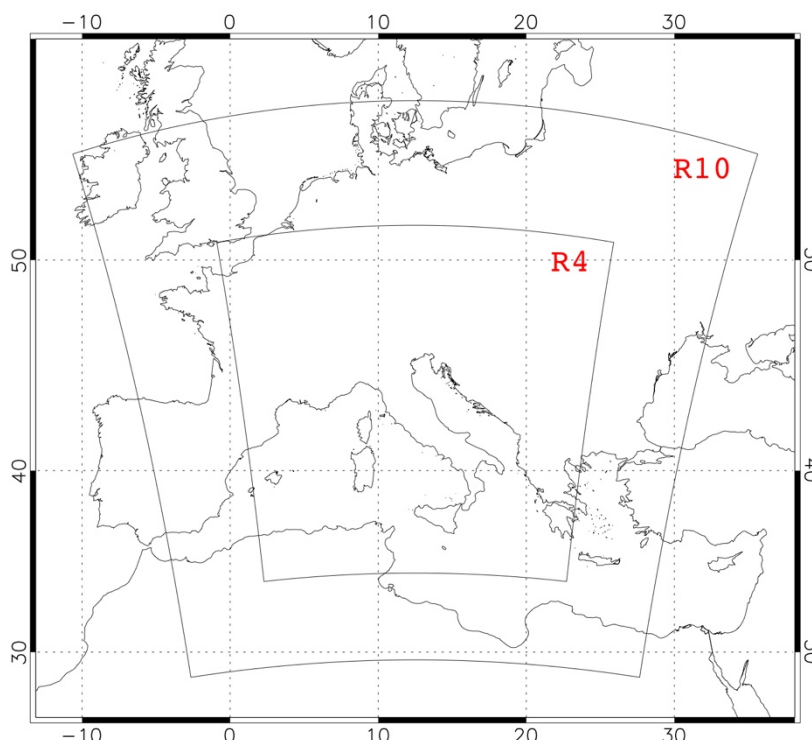

Figure 1: The two RAMS domains. R10 has 10 km horizontal grid spacing and R4 has 4 km horizontal grid spacing.

The larger domain, R10, gives the initial and boundary conditions to the nested grid. R10 uses, as initial and boundary conditions, the ECMWF analysis/forecast cycle issued at 12 UTC by ECMWF on the day before the actual forecast day. The simulations on both domains lasts 36 h, starting at the 12 UTC of the day before the actual forecast day. The first 12 h of simulation are spin-up time and are discarded from the analysis.

	R10	R4
NNXP	301	631
NNYP	301	631
NNZP	36	36
Lx	3000 km	1890 km
Ly	3000 km	1890 km
Lz	~22400 m	~22400 m
DX	10 km	3 km
DY	10 km	3 km
CENTLAT (°)	43.0 N	43.0 N
CENTLON (°)	12.5 E	12.5 E

Table 1: Parameters of the RAMS domains. NNXP, NNYP and NNZP are the number of grid points in the WE direction, in the NS direction and the number of levels, respectively. L_x, L_y and L_z are the extension of the domains in the three spatial directions, WE, NS and vertical. DX and DY are the spacing of the grid in the WE and NS directions. CENTLAT and CENTLON are the coordinates of the grid center.

Figure 2 shows the topography of the second RAMS domain, where the statistics of the project will be considered. Interestingly, the 3km horizontal resolution resolves several structures and deep valleys over the Alps, giving the possibility to take into account for fine-scale interactions between the atmospheric flow and the Alpine orography. This consideration applies also for the Apennines.
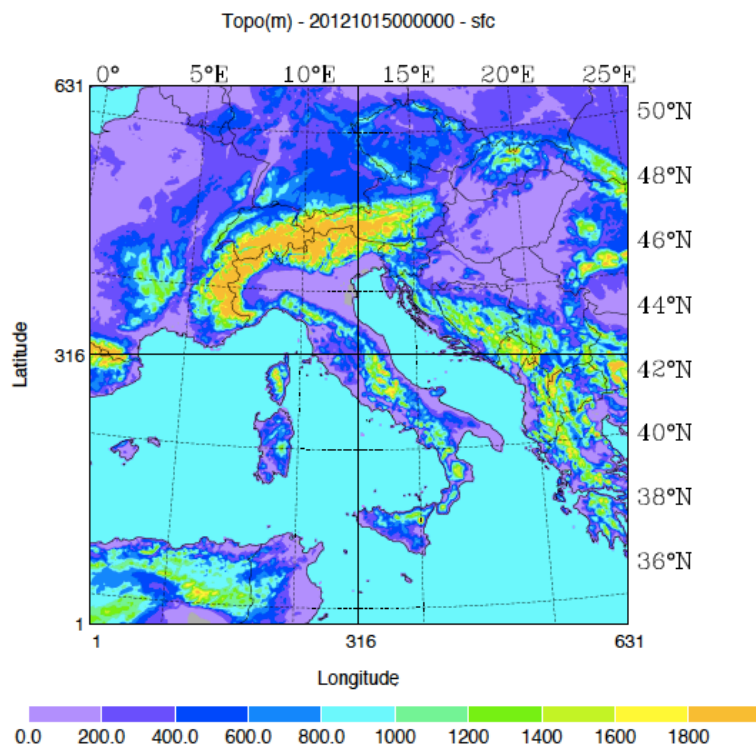

Figure 2: topography of the second domain.
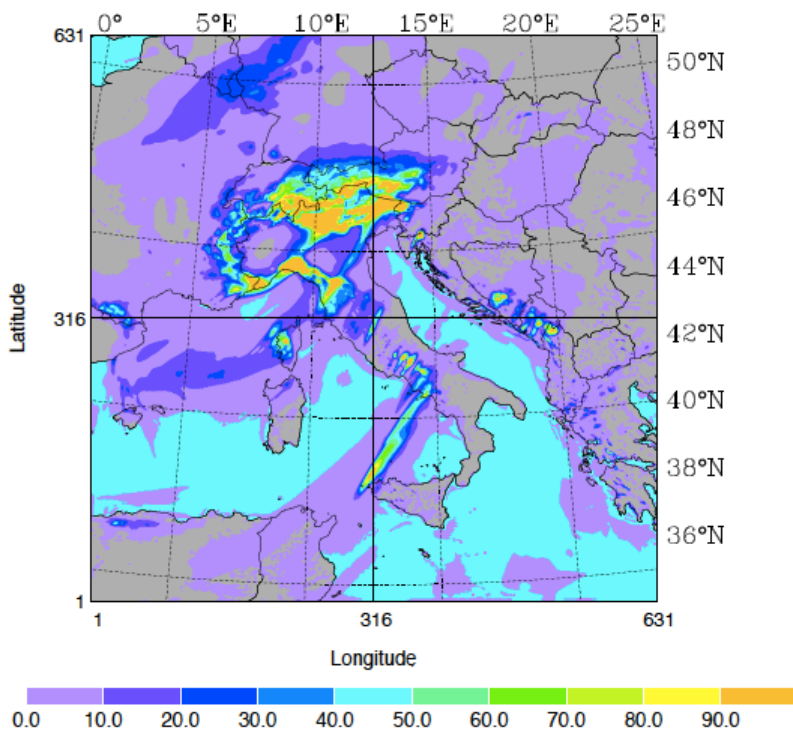
Figure 3: precipitation accumulated for the 15 October 2012.

The period selected for this study is composed by 20 days of the HyMeX-SOP1 (HYdrological cycle in the Mediterranean Experiment - Special Observing Period 1; Table 2). HyMeX (Drobinski et al., 2014; Ducroq et al., 2014) is an international experimental program that aims to advance scientific knowledge of water cycle variability in the Mediterranean basin. This goal is pursued through monitoring, analysis, and modelling of the regional hydrological cycle in a seamless approach.

In HyMeX, special emphasis is given to the topics of the occurrence of heavy precipitation and floods, and their societal impacts, which were the subjects of the SOP1. One of the products of the HyMeX SOP1 is a database of hourly precipitation available for 2944 raingauges over Italy belonging to the Italian DPC (Department of Civil Protection; Davolio et al., 2015; Figure 4). This database extends behind the period of the HyMeX SOP1 and contains all the events considered in this paper. The raingauges available for the HyMeX-SOP1also extends outside of the Italian territory and will be considered if available.
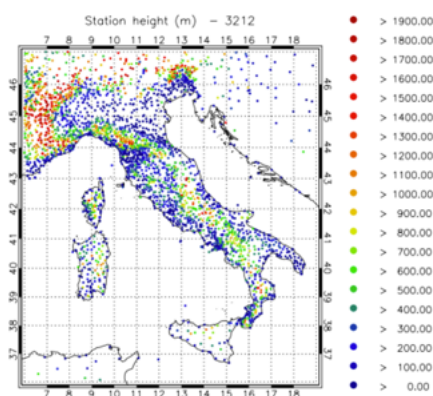
Figure 4: Raingauges available for the HyMeX-SOP1. The database extends over the Italian raingauge network.

The days selected to test the rainfall forecast (this period could eventually change for the verification of the lightning forecast) are shown in Table 2.

Month	Days
September 2012	12, 13, 14, 24, 26, 30
October 2012	12, 13, 15, 26, 27, 28, 29, 31
November 2012	4, 5, 11, 20, 21, 28

Table 2: The twenty case studies.

Figure 3 shows, for example, the daily precipitation accumulated on 15 October 2012, one of the case studies selected. It can be seen the high amount of precipitation forecast in different parts of Italy, especially northern Italy.

Both qualitative (FBIAS, ETS, POD and FAR) and quantitative scores (Bias, RMSE) will be considered to evaluate the model performance.

References

Ducrocq, V., I. Braud, S. Davolio, R. Ferretti, C. Flamant, A. Jansa, N. Kalthoff, E. Richard, I. Taupier-Letage, P.A. Ayral, S. Belamari, A. Berne, M. Borga, B. Boudevillain, O. Bock, J.-L. Boichard, M.-N. Bouin, O. Bousquet, C. Bouvier, J. Chiggiato, D. Cimini, U. Corsmeier, L. Coppola, P. Cocquerez, E. Defer, P. Drobinski, Y. Dufournet, N. Fourrié, J.J. Gourley, L. Labatut, D. Lambert, J. Le Coz, F.S. Marzano, G. Molinié, A. Montani, G. Nord, M. Nuret, K. Ramage, B. Rison, O. Roussot, F. Said, A. Schwarzenboeck, P. Testor, J. Van Baelen, B. Vincendon, M. Aran, J. Tamayo, 2014: HyMeX-SOP1, the field campaign dedicated to heavy precipitation and flash flooding 1in the northwestern Mediterranean. Bull. Amer. Meteor. Soc. 95, 1083–1100, doi:10.1175/BAMS-D-12-00244.1

Drobinski, P., V. Ducrocq, P. Alpert, E. Anagnostou, K. Béranger, M. Borga, I. Braud, A. Chanzy, S. Davolio, G. Delrieu, C. Estournel, N. Filali Boubrahmi, J. Font, V. Grubisic, S. Gualdi, V. Homar, B. Ivancan-Picek, C. Kottmeier, V. Kotroni, K. Lagouvardos, P. Lionello, M.C. Llasat, W. Ludwig, C. Lutoff, A. Mariotti, E. Richard, R. Romero, R. Rotunno, O. Roussot, I. Ruin, S. Somot, I. Taupier-Letage, J. Tintore, R. Uijlenhoet, H. Wernli, 2014: HyMeX, a 10-year multidisciplinary program on the Mediterranean water cycle. Bull. Amer. Meteor. Soc. 95, 1063–1082, doi:10.1175/BAMS-D-12-00242.1.

Davolio, S., Ferretti,R., Baldini, L., Casaioli, M., Cimini,D., Ferrario, M. E. Enrico, Gentile, S., Loglisci, N., Maiello, I., Manzato, A., Mariani, S., Marsigli, C., Marzano, F. S., Miglietta, M. M., Montani, A., Panegrossi, G., Pasi, F., Pichelli, E., Pucillo, A., Zinzi, A.: The role of the Italian scientific community in the first HyMeX SOP: an outstanding multidisciplinary experience. Meteorologische Zeitschrift Vol. 24 No. 3**,** p. 261 – 267, 2015.

List of publications/reports from the project with complete references
I published a paper on the verification of the WRF simulation for a heavy precipitation event occurred in Italy. Part of the verification was computed using the resources allocated for this project. This special project is acknowledged in the publication.

Elenio Avolio, Stefano Federico, WRF simulations for a heavy rainfall event in southern Italy: Verification and sensitivity tests, Atmospheric Research, Volume 209, 2018, Pages 14-35, ISSN 0169-8095, https://doi.org/10.1016/j.atmosres.2018.03.009.

Summary of plans for the continuation of the project
(10 lines max)
In this semester, we did several tests on the model configuration and we decided the final configuration for the on going research. In the next semester, we will run the model for at least two configurations for the twenty days selected for the HyMeX-SOP1. For the report due by the end of the year the score of the two settings will be reported for the precipitation.