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:

High-impact precipitation events prediction with convection-permitting models nested in the ECMWF ensemble: new tests with the MOLOCH and Meso-NH models

Computer Project Account:

SPITCAPE

Principal Investigator(s):

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Affiliation:

LaMMA Consortium - Environmental Modelling and Monitoring Laboratory for Sustainable Development

Name of ECMWF scientist(s) collaborating to the project
(if applicable)

Start date of the project:

2019

Expected end date:

2021

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)	/	/	2 900 000	4000
Data storage capacity	(Gbytes)	/	/	20000	19465

Summary of project objectives (10 lines max)

The SPITCAPE 2019-2021 Special Project (SP) is intended to be the continuation of the activities carried out during the SPITCAPE 2016-2018 SP. The goal is to re-forecast the high-precipitation events addressed previously by using two additional mesoscale models (the Moloch and Meso-NH models) for the convection-permitting ensemble simulations. The global ensemble produced during the years 2016-2018 using the IFS model cycle 41r2 at the spectral resolution TCo639, will provide the initial and boundary conditions for the regional simulations. The comparison between results obtained with these two models and those obtained with the WRF model will contribute to the debate regarding the reliability of these regional models and their strengths and weaknesses with respect to: (i) the accuracy of the results for the three events considered, (ii) the integration with ECMWF products, (iii) the ease of implementation and (iv) the computational costs in view of a potential use for operational forecasting activities.

Summary of problems encountered (10 lines max)

None

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

In the second part of 2019, the plan is to re-forecast the high-precipitation event that flooded the Cinque Terre (north-western Italy) on the 25th of October 2011. High-resolution (grid spacing about 2.5 km) and convection-permitting ensemble forecasts will be produced using both the Moloch and Meso-NH model. The inter-comparison these models and the WRF model will be carried out by looking at the probability of precipitation (ie the probability of cumulated rainfall exceeding predefined thresholds in a 24-hour period) at different forecast ranges. Furthermore, coherently with what has been done in the past, a standard verification statistics will be performed using the available rain-gauges in the area of interest. This will be achieved by computing the RMSE (root-mean-square) of the ensemble QPF (quantitative precipitation forecast) given by the ensemble mean of both Moloch and Meso-NH. Finally to evaluate the probabilistic skills, the relative operating characteristic area will be computed.

List of publications/reports from the project with complete references

None

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.

During the first part of 2019, the Moloch and Meso-NH models were successfully compiled on cca. The Moloch source code is available upon request to the ISAC/CNR staff (the model developers). The Meso-NH software is freely available on line under the CeCILL-C license agreement. The version 19 (March 2019) of the Moloch model was compiled using the Intel compiler in the $PERM directory. The version 5.4.2 (April 2019) of the Meso-NH model was compiled using the Intel compiler in the $PERM directory. The compilation of the Meso-NH model takes a lot (about 7000 seconds) if compared to the compilation of the Moloch model (less than 600 seconds). Nevertheless, it has to be stressed that the Meso-NH model has several modules implemented and it is intended for a broader use than the numerical weather forecasting. In fact, it is also used for a wide range of applications such as air quality, optical turbulence for astronomy, wild-land fire forecasting, volcanic plume modeling, electric activity within precipitating convective clouds, LES simulations, etc…

The ISAC/CNR staff provides a full online support for the compilation of the Moloch model. The compilation of the Meso-NH model is well documented and a specific procedure for the compilation on cca is provided with the master distribution of the software.

On the basis of the SPITBRAN 2018-2020 Special Project, a 24-hour period simulation at 2.5 km grid spacing with 50 vertical levels and 500X600 grid points costs about 700-800 SBUs. A preliminary test performed this year showed that the cost of a 24-hour long simulation with the Meso-NH model with similar domain settings is about 10000-11000 SBUs.

Thus a full re-forecasting job for one of the high precipitation event listed in the SP proposal, will have the following cost (50_members X model_cost_1_day X number_of_days):

	72-hour fcst len	60-hour fcst len	48-hour fcst len	36-hour fcst len	24-hour fcst len	Estimatedt otal cost
Moloch	120000	100000	80000	60000	40000	**400000**
Meso-NH	1620000		1080000		540000	**3240000**
						3640000

Furthermore, the cost of the pre-processing of the ENS data needs to be added to the above bill. This cost is estimated relevant for the Meso-NH model (at least 100000 SBUs).

It has to be noted that during the test cases, one of the main difference arisen from the comparison of the Moloch and Meso-NH is the time step value: this is 30 seconds for the Moloch and 8 seconds for the Meso-NH model (in fact, tests performed with higher values ended with a CFL condition error).

Finally, we underline the fact that the data amount currently stored in ECFS is due to the numerical experiments produced during the SPITCAPE 2016-2018 SP (ie data produced with the WRF model).

Considering the estimated total cost shown in the previous Table and the needs to storage data from the WRF, Moloch and Meso-NH models, a request for additional resources will be forwarded during this year.