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:	Very high resolution simulations of past flood events with COSMO model and ERA5
Computer Project Account:	spitmile
Principal Investigator(s):	Massimo Milelli, Valeria Garbero
Affiliation:	Arpa Piemonte
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Gianpaolo Balsamo
Start date of the project:	March 2019
Expected end date:	November 2019

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)			500000	204000
Data storage capacity	(Gbytes)			600	345

Summary of project objectives (10 lines max)

The reanalysis of past flood episodes is necessary to understand the dynamics of the events and to get proxies of the reality, especially when the observations are scarce. In particular the aim is to reproduce the November 1994 flood in Piemonte, also because of its 25th anniversary. Arpa Piemonte will run the operational model COSMO (www.cosmo-model.org) at very high horizontal resolution (about 1 km), using the initial and boundary conditions given by ECMWF analysis, then there will be runs in forecast mode to understand the importance of some physical scheme.

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 this year.

List of publications/reports from the project with complete references

No publications up to now, since the project started only in March.

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.

The case of the November 1994 flood on Piemonte was analyzed. A series of simulations were carried out at the spatial resolution of about 1 km (0.01 °) from 3 to 7 November starting from the ECMWF reanalysis, testing the sensitivity of the model with respect to the convection parameterization and with respect to the assimilation of non-GTS data of the regional network of the time; the table below summarizes the simulations.

	Deep convection (Tiedtke)	**Shallow convection (Tiedtke)**	**Assimilation of T2m and RH2m (non-GTS)**
exp0	N	Y	N
exp1	N	Y	Y
exp2	Y	Y	Y

The convection in the models is calculated taking into account its two aspects, the "deep" part and the "low" part. The 2m temperature and humidity data provided by the regional (non-GTS) network have been added. The figure below shows the maps of the cumulative rainfall over 24 hours for November 5, which was the one characterized by the most significant precipitation. The observed rainfall map was obtained with the kriging interpolation method starting from the pluviometric data available at that time. It can be seen how the intense values on the north-western area have been correctly simulated, even if there is an overestimation in the northern part. The values on the Apennines areas on the border with the Ligurian Alps are underestimated by the model, which

instead sees the most intense values shifted to the west. It seems that there is a slight deviation in the direction of the moist flow, which was predominantly from southeast, but which in the model has a more southern component. This explains both the underestimation on the Apennines and the overestimation on the Verbano. It has to be underlined also a slight underestimation on the southern plain that is a direct consequence of the southern flow, which impacts the Ligurian Alps (higher than the Apennines) and does not affect the plains. Qualitatively speaking, however, it can be said that the event was fairly well represented. Considering the different configurations tested, it can be noted that “exp0” represents the observations slightly better, having a more limited overestimation on the Verbano and minor underestimation on the southern part. It is therefore correct to exclude the "deep" part of convection (present in "exp2"), while the assimilation of non-GTS data (in "exp1") does not lead to clear improvements in the precipitation field.
The project will be completed with the following steps:

- test with ERA5 IC/BC
- test with different nested domains
- test to determine the best configuration (IFS → 1km or IFS → 5km → 1km)
- test with Bechtold convection scheme