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	2022
Project Title:	Short-range re-analysis and forecast to investigate extreme weather events using COSMO and ICON model
Computer Project Account:	SPITGARB
Principal Investigator(s):	Valeria Garbero (mcy0), valeria.garbero@arpa.piemonte.it
Affiliation:	Arpa Piemonte, Italy
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Massimo Milelli (mcy), massimo.milelli@cimafoundation.org
Start date of the project:	January 2022
Expected end date:	December 2024

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)			900.000	257.651
Data storage capacity	(Gbytes)			300	280

Summary of project objectives (10 lines max)

The aim of the project is to use the most advanced numerical modelling to analyse case studies from the recent past, in order to identify critical issues and improve the forecast of future events, not only in case of strong precipitation, but also in case of heat waves, strong wind, etc. The COSMO and ICON models will be used at high horizontal resolution to re-analyse and re-forecast past extreme events. Different model configurations will be tested using new physical parameterization schemes and different initial and boundary conditions to find out which is the best configuration representing the severe events on rather small time and space scales. Temperature, relative humidity and wind will be compared with the observations provided by meteorological stations and radiometers using standard statistic indices (MB, RMSE, etc.). Precipitation will be verified using the innovative fuzzy technique that compares the data estimated by the national radar mosaic with the simulated maps.

Summary of problems encountered (10 lines max)

None.

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

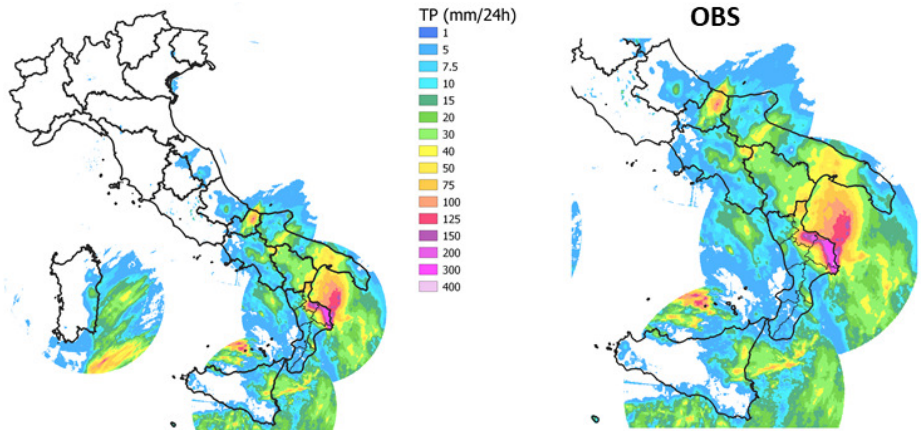
The project will be continued by analysing other case studies using the 2 available NWP models, ICON and COSMO, at very high resolution. Both heavy precipitation events over Italy and heat waves over Turin will be investigated and different model configurations will be used to figure out which configuration best reproduces the events.

List of publications/reports from the project with complete references

Paper in preparation.

Summary of results

Re-analysis and re-forecast of an extreme event that affected the Campania region between November 21 and 22, 2020, have been carried out using COSMO and ICON in different configurations. The event was characterized by very heavy and persistent rainfall, localized mainly on the Ionian-Northern slope; the province of Crotone was the most affected with many stations recording cumulative rainfall exceeding 300 mm. In the figure the precipitation estimated by the merging of radar national composite and rain-gauges (Dewetra).



Runs were performed using COSMO, varying initial and boundary conditions, and ICON at 2 km resolution:
- COSMO run with initial and boundary conditions provided by IFS at 9 km (COSMO);
- COSMO run with initial and boundary conditions provided by ICON at 13 km (CO-ICO);
- COSMO run with initial conditions provided by COSMO-2I analysis (letkf+latent heat assimilation) and boundary conditions provided by IFS at 9 km (COSMO LHN);
- ICON run with initial and boundary conditions provided by ICON at 13 km (ICON).

Precipitation was verified through the fuzzy technique. As an example, in the following figure the FSS calculated for the first 24 hours of forecast (D0, 20201121) by using the 3D fuzzy is shown. The scores point out similar performance for low thresholds for all the simulations and improvement for medium to high thresholds for COSMO runs adopting ICON's initial and boundary conditions but especially those performed with the operational initial and boundary conditions (LHN). CO-ICO and COSMO-LHN configurations reach the FSS_{useful} for the highest threshold of 40 mm/3h at 143 km and COSMO-LHN reaches the FSS_{useful} for the 20 mm/3h threshold at 37 km. ICON doesn't reach any FSS_{useful} any for both 40 and 20 mm/3h thresholds.