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:	RAIN -Reflectivity Assimilation for an Innovative Nowcasting approach
Computer Project Account:	spitlaga
Principal Investigator(s):	Martina Lagasio
Affiliation:	CIMA Research Foundation
Name of ECMWF scientist(s) collaborating to the project (if applicable)	…… ……
Start date of the project:	March 19 2021
Expected end date:	Dec 2022

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)	950000	950000	950000	950000
Data storage capacity	(Gbytes)	2160	1000	2160	1000

Summary of project objectives (10 lines max)

This project aims to build up a nowcasting system with a NWP model (WRF) using a 3-hour rapid update cycling 3DVAR of radar reflectivity observations with a new postprocessing algorithm able to take into account the timely and spatial uncertainty in the convective field simulation. The main aim is to take into account the spatial and temporal uncertainties of the meteorological model, also considering that the most recent simulation is not necessarily the best one due to, for example, the spin up process. Performing a 3-hour cycling 3DVAR with 12 hours of forecast each time it is possible to guess that, for each time instant (dt=3 h in this case) starting from a given time, the nowcasting scheme allows to have 3 simulations providing a 6 hour forecast covering the same time window. The final product will be a rainfall hazard scenario map for the following 6 hours based on all the simulation considered.

Summary of problems encountered (10 lines max)

No problems encountered during the project development.

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

The project simulations end in 2022 as all the SBU have been consumed and all the necessaries simulations have been run. However the post processing and the simulation validations will continue until Dec 2022.

List of publications/reports from the project with complete references

SWING, the Score-Weighted Improved NowcastinG algorithm: description and application. By Lagasio et al., 2022 is currently under review on Water (MDPI) journal.

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.

……

Heavy rainfall events are responsible for numerous casualties and several millions euros of damages every year. Because of the ongoing climate change, extreme rainfall events frequency at global scale is expected to increase, resulting in higher social and economic impacts. Thus, improving the forecast accuracy and the risk communication is a fundamental goal to limit social and economic damages. The adoption of high-resolutions meteorological forecasting approaches, possibly combined with data assimilation, became essential to provide timely and accurate short-range forecast in the latest years. Both Numerical Weather Prediction (NWP) and radar-based nowcasting still have open issues, mainly in terms of predictability of the correct time/space localization of precipitation systems and rapid decay of the forecast accuracy respectively. Trying to overcome these issues, this work aims to present a nowcasting system combining NWP model (WRF), using a 3-hour rapid update cycling 3DVAR of radar reflectivity, with the radar based nowcasting system PhaSt through a blending technique. Moreover, an innovative post processing algorithm named SWING (Score-Weighted Improved NowcastinG) has been developed, in order to take into account

the timely and spatial uncertainty in the convective field simulation. The overarching goal is to pave the way for an easy and automatic communication of the heavy rainfall warning derived by the nowcasting procedure. The results obtained applying the SWING algorithm over a case study of 24 days suggest that the algorithm could improve the predictive capability of a traditional deterministic nowcasting forecast system, keeping an useful forecast timing and thus integrating the current forecast procedures. This would bring to an automatic warning of people with an overall good performance also in case of hardly predictable extreme events. Eventually, the main advantage of the SWING algorithm is also its very high versatility, since it could be used with any meteorological model in a multi-model forecast approach.

The work titled “SWING, the Score-Weighted Improved NowcastinG algorithm: description and application.” by Lagasio et al., is currently under review on Water (MDPI) journal.