SPECIAL PROJECT PROGRESS REPORT

Reporting year 2024

Project Title: Globo Ensemble Reforecast 2023 – GLEREF23

Computer Project Account: spitmast

Principal Investigator(s): Daniele Mastrangelo

Affiliation: CNR-ISAC

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

Start date of the project: 1 September 2023

Expected end date: 31 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)			20.000.000	~6.848.000
Data storage capacity	(Gbytes)			13.500	~13.600

Summary of project objectives (10 lines max)

This project aims at creating a new dataset of 35-days, 8-member ensemble reforecasts with an updated version of the atmospheric general circulation model Globo developed at CNR-ISAC. The same institute runs operationally an S2S forecasting system participating, for instance, into the S2S Prediction Project and its database. The reforecast dataset is used to calibrate the real-time forecasts and is therefore the preliminary step to update the CNR-ISAC S2S forecasting system.
Also, covering a climatologically significant period, this dataset will be the basis to perform research studies on the model performance and its forecasting skill on the subseasonal scale.

Summary of problems encountered (10 lines max)

No relevant issues were encountered.

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

As reported at the end of 2023, the production phase started later than planned but, once the model was installed and tested in its new upgraded version on the S2S scale, the production of the planned reforecasts got started. The resources initially allocated for this project would have expired on 31 Dec 2023, when about 20% of the whole dataset had been created. Thanks to a partial renewal of the project, it was possible to go on with the planned simulation activity in the first months of 2024.
Currently, after the whole dataset has been completed, more tests are performed, especially to fix some of the minor problems detected from a partial analysis of the produced simulations.

List of publications/reports from the project with complete references

No publication is available for this project yet.

Summary of results

The reforecast dataset has been produced, completing the planned simulations: reforecasts are initialized on fixed dates, every 5 days from 1 Jan to 27 Dec, over the 2001-2020 reference period, with initial conditions based on the ERA5 reanalyses. Since every ensemble is made up of 8 members, a total of 8 members * 20 years * 73 calendar days = 11680 35-days simulations was run.
For each reforecast, 2 output files were produced and converted into grib2 files: the S2S outputs, at 1.5x1.5° lat-lon resolution, and the original-resolution files where a subset of variables are stored on the 360x512 lat-lon points of the model regular grid. The S2S outputs have been successfully uploaded on the S2S database and are now publicly available (https://apps.ecmwf.int/datasets/data/s2s-reforecasts-daily-averaged-isac/levtype=sfc/type=cf/; model version 2023-10-16).
Reforecast files produced in this project have been used for testing the updated real-time S2S forecasting system based on the same Globo version used for the reforecasts. Figure 1 shows the same forecast products (41-member ensemble forecasts initialized on 27 June 2024) obtained by the still operational CNR-ISAC forecasting system (left panels) and the new forecasting system in test phase (right panels): the 2-m temperature week-3 anomalies predicted over the Eastern Europe show some difference that can be in part due to the different reference period used to calibrate the ensemble forecast; being warmer than the 1981-2010 period used in the still operational forecasting system, the 2001-2020 period of the new reforecast dataset leads to lower positive anomalies (Fig. 1b). The area-averaged geopotential height anomaly forecast over Italy for the 35 days of the new forecast system is shown in Fig. 1d and can be compared to the 32-day forecast of the operational forecasting system.
New tests are now being performed to fix some minor issue observed in the reforecasts produced in the framework of GLEREF23. The main issue, affecting the temperature evolution in the stratosphere, slightly impact the average bias and occurs mainly in the last days of simulations featuring an already cold stratospheric vortex. The goal of this testing phase is to re-run the few affected simulations and to prepare the model for a next major update. As an example, Fig. 2 shows the effects of tuning a parameter affecting the excessive cooling in the stratosphere occurring in a January run.

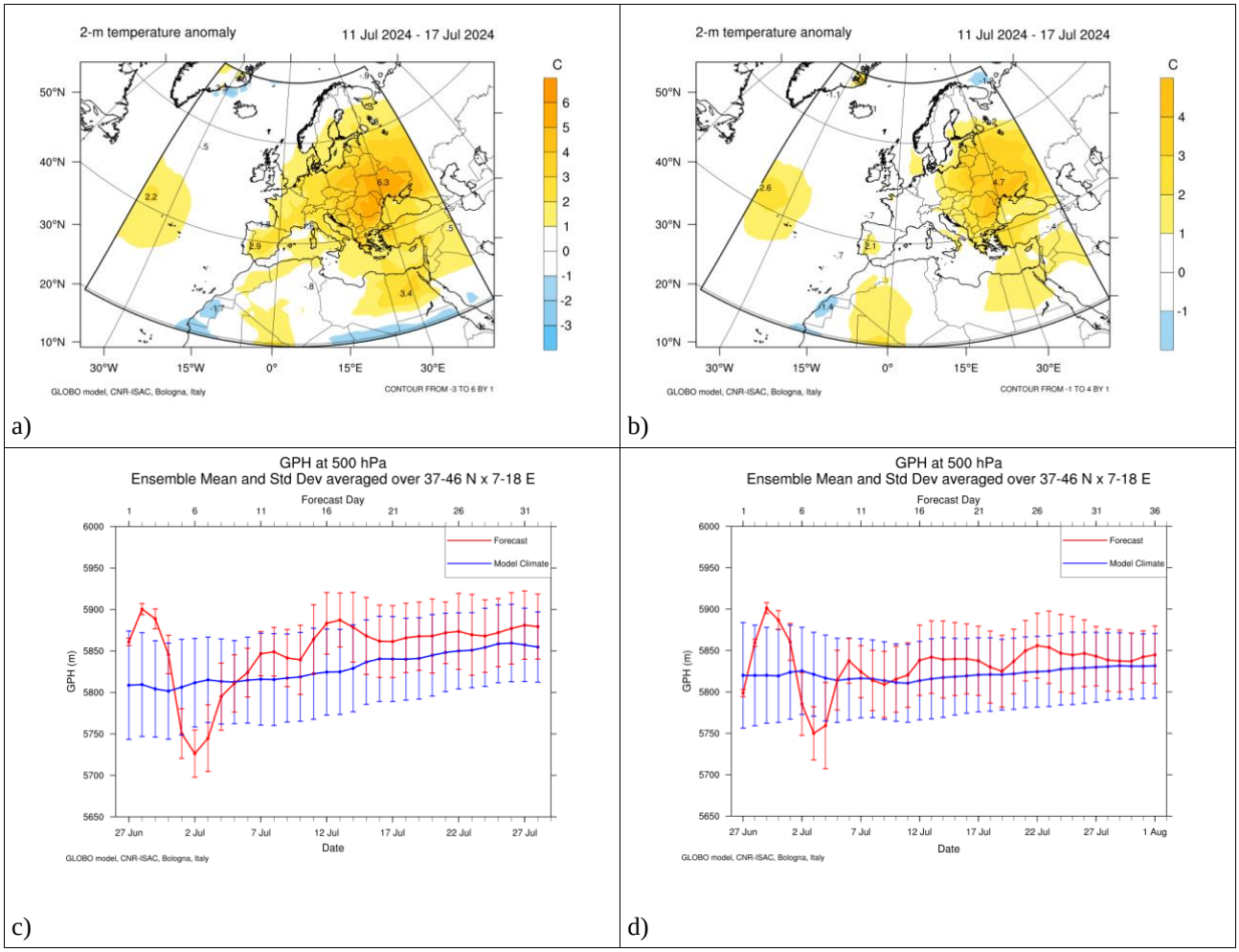

Fig. 1: 2-m temperature week-3 anomaly predicted with the currently operational CNR-ISAC S2S forecasting system (a) and the updated forecasting system (b), in test phase, based on the reforecast dataset produced with GLEREF23 SP. Area averaged Z500 ensemble mean forecast over Italy from the operational (c) and test (d) forecasting systems. Both forecasts are initialized on 27 June 2024.

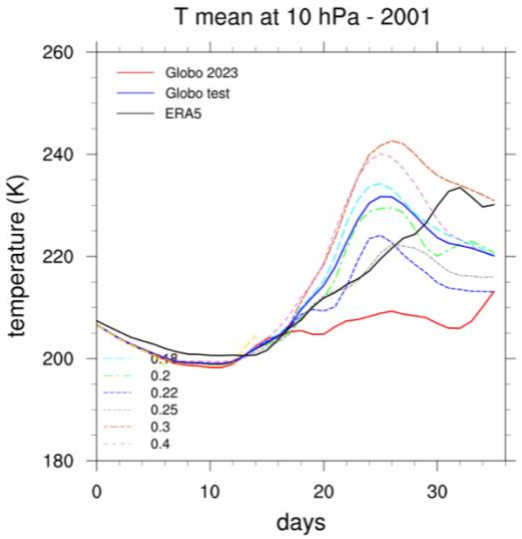

Fig. 2: Temperature at 10 hPa averaged over the Northern Hemisphere polar cap (lat > 60 °N) for the reforecast initialized on 1 Jan 2001. The blue curve indicates the average of the test simulations (dashed curves) and is compared to the ERA5 curve (black curve) and to the reference simulation obtained with the GLEREF23 SP *(red curve).*