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	2021
Project Title:	Optimisation of Cycling Strategies for a Nowcasting configuration of HARMONIE-AROME for Ireland
Computer Project Account:	spieharn
Principal Investigator(s):	Eoghan Harney
Affiliation:	Met Éireann
Name of ECMWF scientist(s) collaborating to the project (if applicable)	n/a
Start date of the project:	Start 2021
Expected end date:	End 2021 (I will be submitting an application to extend project).

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)			9.5M	1.5M
Data storage capacity	(Gbytes)			5TB	0[1]

1: National allocation (ienwp) is being used.

Summary of project objectives (10 lines max)

The objective of the special project is test Nowcasting type configurations of the HARMONIE-AROME model. This will include investigating cycling strategies (Rapid Refresh and Rapid Update Cycling), data assimilation algorithms (3D-Var and 4D-Var), techniques that can reduce model spin-up (Incremental Analysis Updates) and the assimilation of observations with higher spatial and temporal resolutions (radar reflectivity, Doppler winds, Mode-S, GNSS). Testing of these different aspects will provide the basis for a NWP Nowcasting configuration for Ireland which will be run on a smaller domain and higher model resolution than Met Éireann's current operational limited area EPS system IREPS.

Summary of problems encountered (10 lines max)

Initial test short runs commenced in late April with investigation into the length of observation cut-off and window, and testing of Rapid Refresh and Rapid Update Cycling strategies. Problems have been encountered in two areas: Firstly initial Rapid Refresh setup is using incorrect first guess files and so longer runs in this area have yet to begin with further investigation of code required. Secondly, a number of longer run experiments crashed in surface analysis after a number days all for the same initial time, this was due to local BUFR file for the hour missing all SYNOP reports. Investigation showed similar issues in local BUFR files in the proposed test period, only solution was rerunning experiments using observations from MARS.

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

- Resolution of issues with Rapid Refresh setup, with longer runs to follow.
- More two week runs comparing Rapid Refresh and Rapid Update Cycling, using local BUFR files and choosing period to avoid issue with missing SYNOP observations with emphasis on spring/summer time.
- Testing of hi-res observations starting with radar reflectivity.

List of publications/reports from the project with complete references

None.

Summary of results:

Initial short test runs commenced in late April with investigation into the length of observation cut-off and window, and testing of Rapid Refresh and Rapid Update Cycling strategies. Results for shorter tests were inconclusive and so longer tests comprising 10 days of forecasts began in late May to cover Storm Aidan in late October and early November 2020, results for 5 day of forecats are shown below.

To produce a nowcast within one hour of initial time requires reducing observation cut-off and window, this reduces the number of observations available for assimilation. It is thought that 30 minutes is longest cut-off which will ensure nowcasts are available inside an hour and testing of 20/25/30 minute cut-off with symmetric windows was done to investigate effect of the reduction in the amount of observations. Use of a 20 minute cut-off results in no TEMP reports and an approximate 20% loss in SYNOP and AIREP reports being available. Results shown in figure below show no significant difference in RMSE or bias for 1hr Precipitation or T2m, in forecasts with 20/25/30 minute cut-off with symmetric windows using hourly cycling.
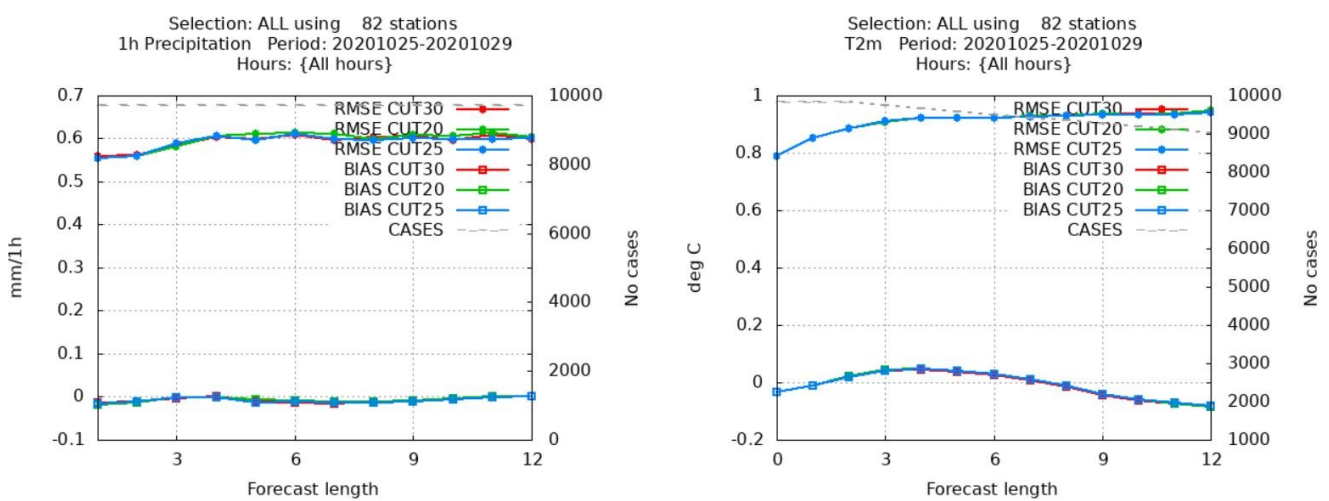
Hourly cycling can be achieved with two main cycling strategies, Rapid Refresh (nowcasting setup takes first guess files come from another model eg IFS or IREPS) and Rapid Update Cycling (hourly runs using 1/2/3 hourly cycling with parallel suites for 2/3 hour cycling). Technical testing of Rapid Refresh is ongoing due to issues described above. Results from 1/2/3 hour Rapid Update Cycling below show slightly better error and bias for T2m (right) using 1 hour cycling, whereas 2/3 hour cycling has lower error for 1hr Precipitation (left).