Operational NWP at Met Éireann

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NWP Overview

The HARMONIE-AROME configuration of cy40h1.1 is the basis of Met Éireann's operational NWP suite, called IREPS (**I**rish **R**egional **E**nsemble **P**rediction **S**ystem). The suite runs four times each day at 0000 UTC, 0600 UTC, 1200 UTC and 1800 UTC producing 54 hour forecasts. IREPS is summarised in *Table 1* with the extent of the operational domain shown in *Fig. 1*.

Code	HARMONIE-40h1
Domain	$1000 \times 900 \times 65$
Model top	10 hPa
Grid spacing	2.5 km
Cut-off	20 mins, 45 mins (control)
Observations	CONV, ASCAT, AMSU-A, MHS & IASI
Data assimilation	Surface OI & 3D-Var
Configuration	HARMONIE-AROME
Cycle	3-hourly
LBCs	IFS-HRES
EPS	1+10 members
Perturbations	SLAF and surface

Table 1: IREPS summary

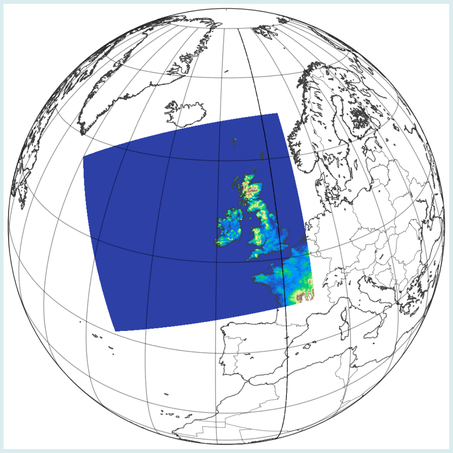

Figure 1: IREPS domain

Data Assimilation & Observation Usage

The control member of IREPS uses 3D-Var data assimilation with a three hour cycle. The control and perturbed members use OI to produce the surface analysis. Typical conventional observation usage plots are shown for March 2nd 2020 (*Fig. 2*) and March 27th 2020 (*Fig. 3*) at 1200 UTC. The assimilation system saw a sharp reduction in the availability of aircraft observations due COVID-19 in March. This was ameliorated at the time with the assimilation of AFIRS and TAMDAR observations.

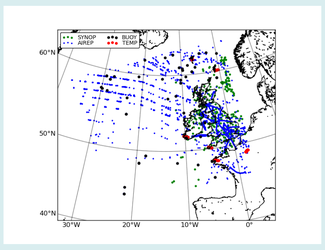

Figure 2: Conventional observation usage for 1200 UTC 2020-03-02

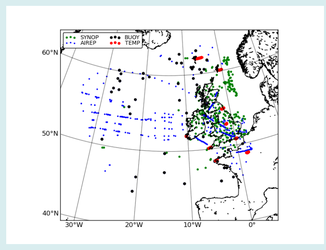

Figure 3: Conventional observation usage for 1200 UTC 2020-03-27

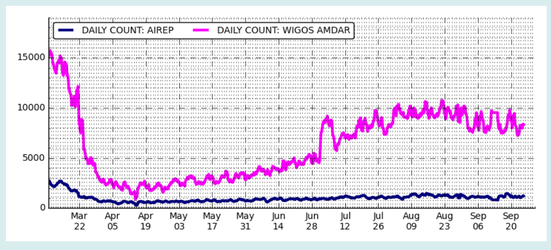

Figure 4: Time-series of aircraft report availability in the Irish domain March – September 2020

Deterministic Verification

Point verification of the operational HARMONIE-AROME forecasts for December 2019 and June 2020 are shown in *Fig. 5,Fig. 6 and 7*. HARMONIE-AROME statistics are compared with IFS-HRES. The model continues to exhibit a cold bias, particularly noticeable at night.

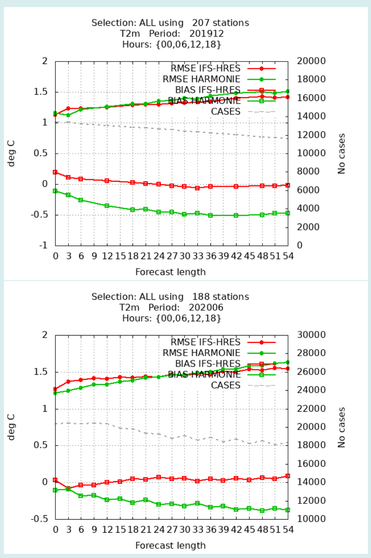

Figure 5: Verification of 10 m wind-speed forecasts for December 2019 (top) and June 2020 (bottom).

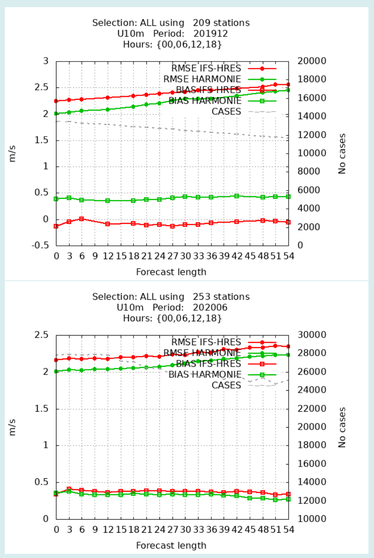

Figure 6: Verification of 10 m wind-speed forecasts for December 2019 (top) and June 2020 (bottom).

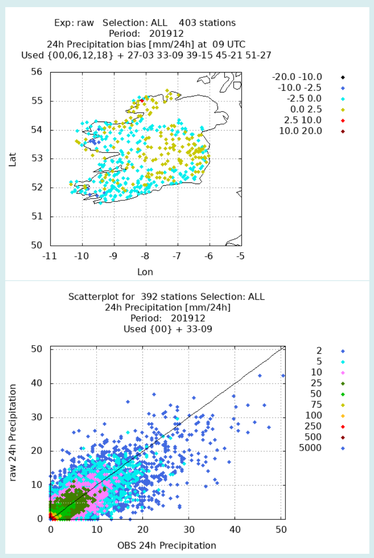

Figure 7: Verification of 24 hour of accumulations of precipitation using rainfall network observations for Decemeber 2019.

IREPS

IREPS is an 1 + 10 member high-resolution ensemble prediction system. The Scaled Lagged Average Forecasting (SLAF) method is used to perturb boundaries for each of the members. Uncertainties related to the surface physics are represented through perturbations applied to certain parameters in the surface physics code.

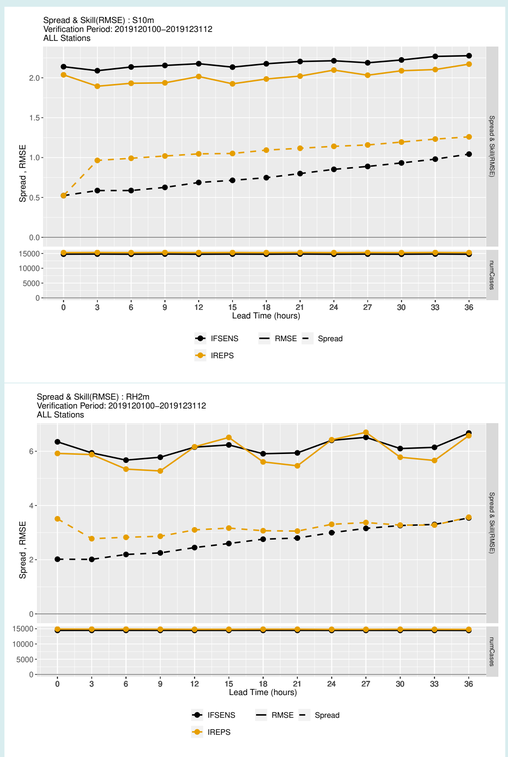

Figure 8: Spread/Skill for 10 m wind speed and and 2 m relative humidity

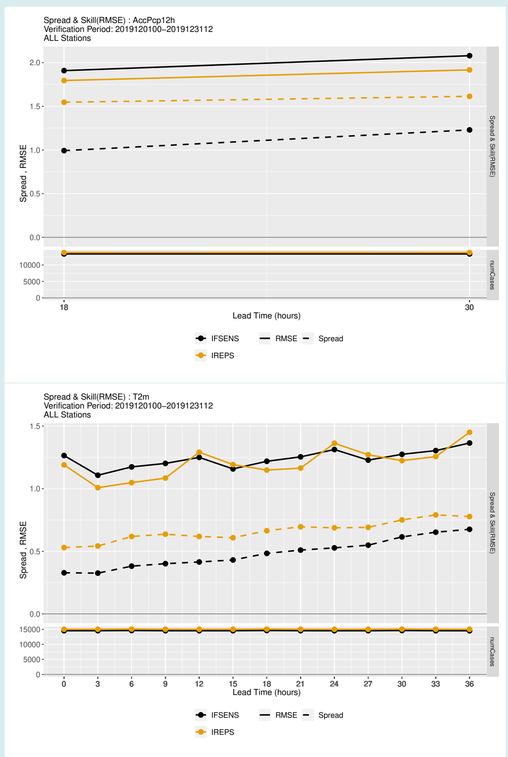

Figure 9: Spread/Skill for 12 h accumulated precipitation and 2 m temperature

Operational Suite

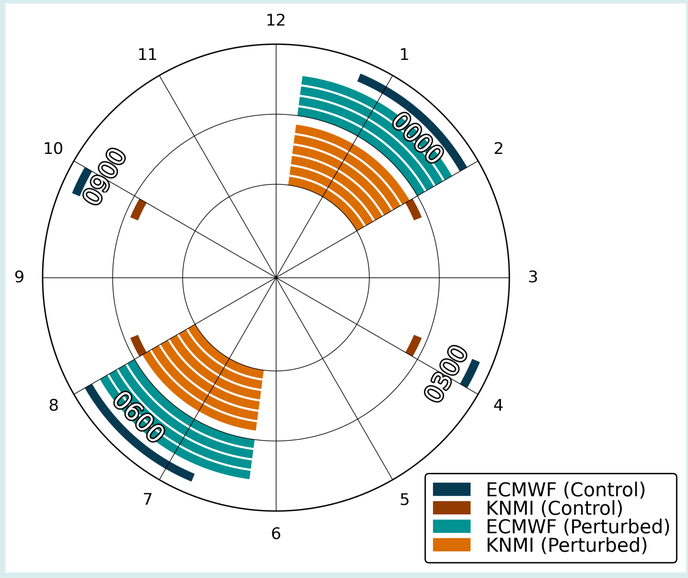

Figure 10: Operational clock showing forecast length, start time, duration, and HPC centre

- IREPS is run at KNMI and ECMWF HPCFs.
- As the perturbed members only assimilate (SYNOP) screen level observations (for the surface OI), it is possible to begin these members approximately 25 minutes earlier than the control member, which must wait for a more complete set of observations. This allows us to reassign HPC resources to produce longer forecasts while still completing by T+2:00.
- The control member at ECMWF produces a 54 hour forecast by default. This can be switched to KNMI in the event of an outage at ECMWF.
- The control member at KNMI produces a 3 hour assimilation cycle by default. This starts after the ensemble members complete to maximise HPC resources.

Planned Upgrade

HIRLAM-C released Harmonie-43h2.1 at the end of July. The new version of the NWP system brings updates to the turbulence and micro-physics schemes and a new version of the surface model, SURFEX 8.1. For data assimilation the new release allows the assimilation of new observation types and incorporates ECMWF's conventional blacklists. Met Éireann has commenced initial tests of Harmonie-43h2 with operational implementation planned to be completed before the end of 2020. Some of the planned changes to Met Éireann's operational implementation are itemized in *Table 2*.

EPS	Use semi-continuous configuration
EPS	Perturbed parametrizations
EPS	Enable EDA
Obs	Assimilate radiances from Metop-C
Obs	Assimilate ATMS and MWHS2 obs
Obs	Assimilate EMADDC Mode-S obs

Table 2: Upgrade summary

A new configuration will involve moving to a semi-continuous setup. 1 (control) + 4 (perturbed) members will continue to run at ECMWF, however with the 0000/0600/1200/1800 UTC cycles running to 57 hours. At KNMI 1 + 5 members will run out to 57 hours for 0300/0900/1500/2100 UTC cycles with 6 perturbed members running at 0000/0600/1200/1800 UTC. With this configuration IREPS will effectively produce a 1 + 15 member ensemble updated every three hours.

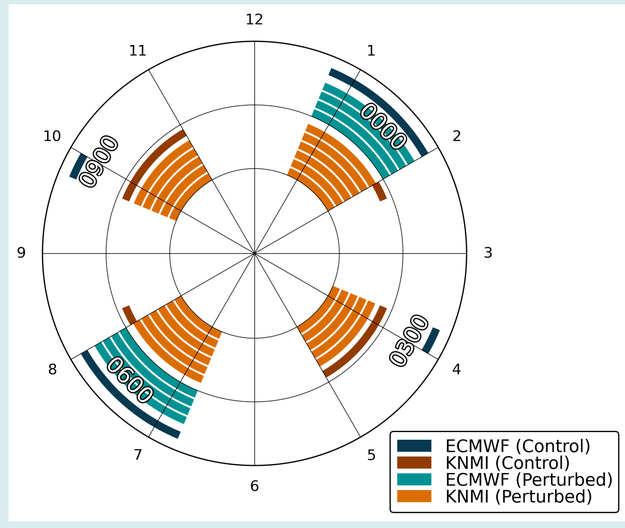

Figure 11: New operational clock showing forecast length, start time, duration, and HPC centre

The assimilation of ATMS and MWHS2 observations is in preparation for operational use with Harmonie-43h2.1. It is hoped that the assimilation of these observations will improve early morning assimilation cycles.

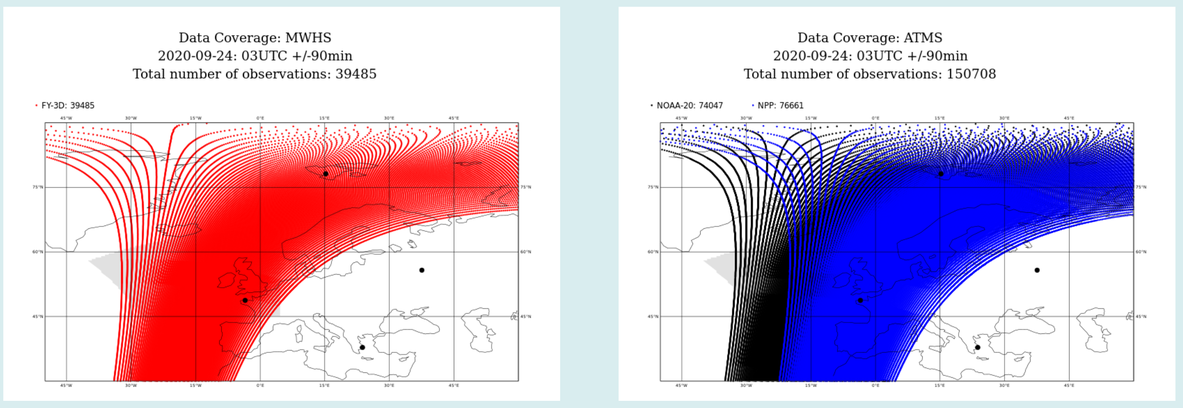

Figure 12: MWHS2 (left) and ATMS (right) observations for 0300 UTC 24th September 2020.

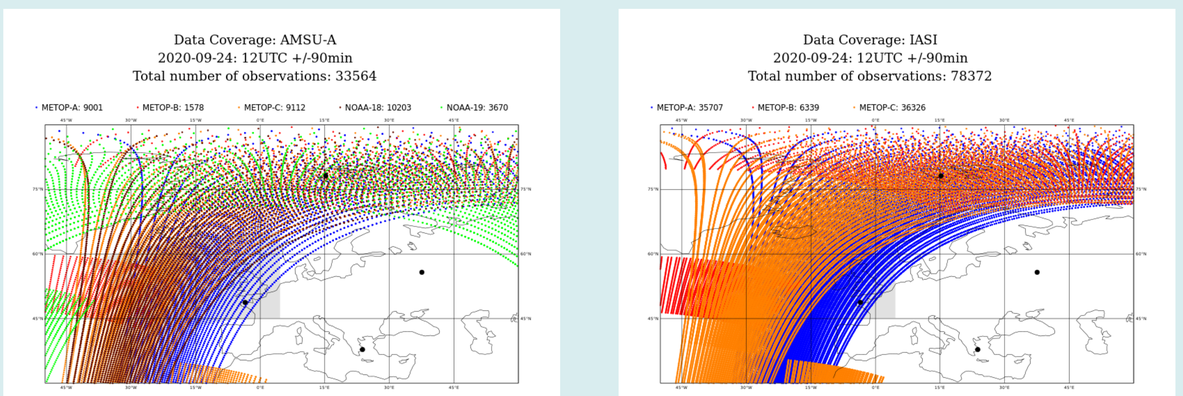

Figure 13: AMSU-A (left) and IASI (right) observations for 1200 UTC 24th September 2020.

Other developments

- A dedicated NWP-based Nowcasting system is being developed with implementation planned for the end of 2020.
- Met Éireann is a member of the United Weather Centres West (UWC-West) consortium whose main goal is to achieve common operational NWP with DMI, IMO and KNMI by the end of 2022. Preparations are ongoing. (See session on "Link with Applications").
- Work on model physiography and best use of national databases
- Three data science internships during summer 2020 exploring pressing topics in NWP. (See breakout session on "Surface Aspects").