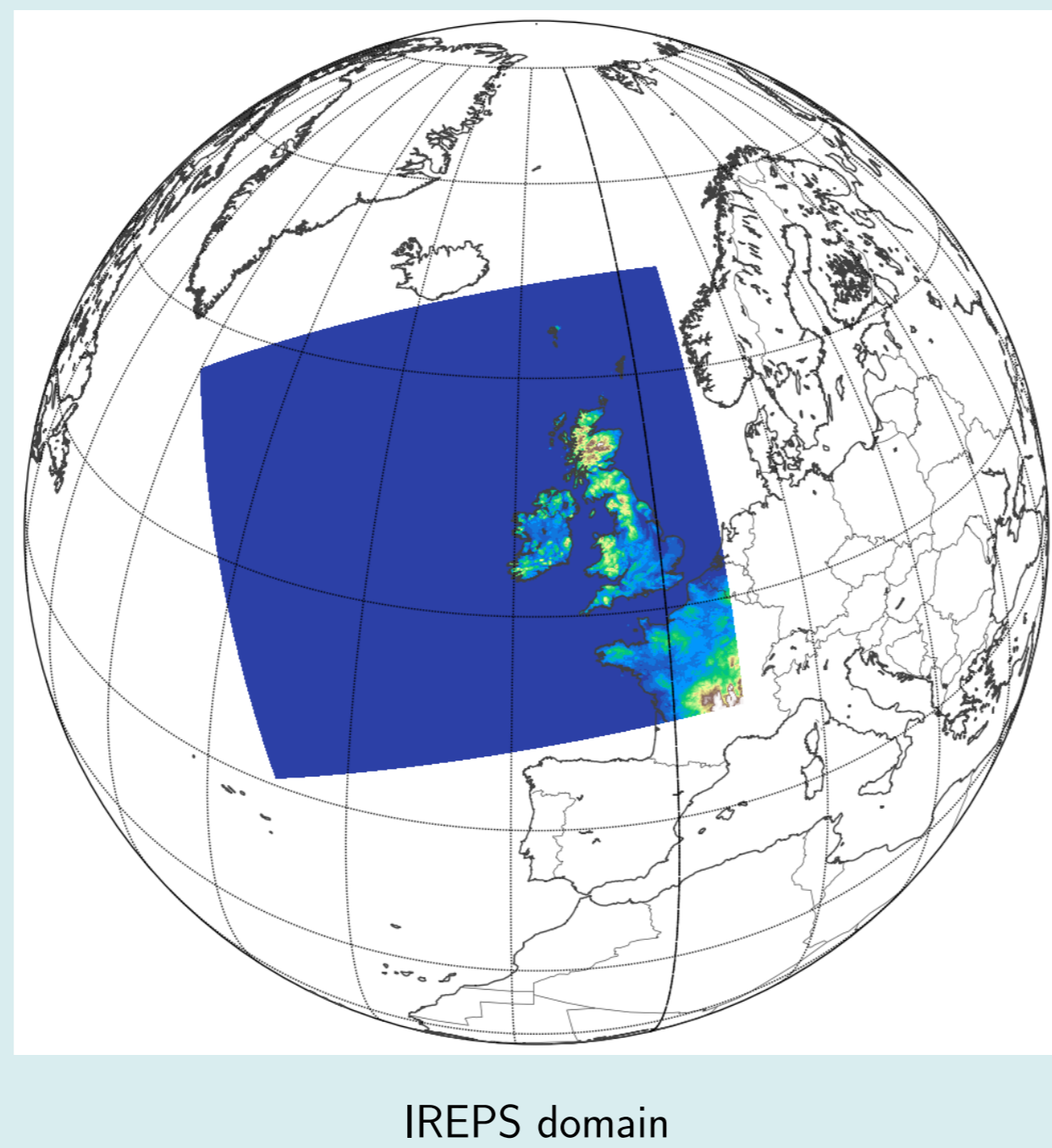


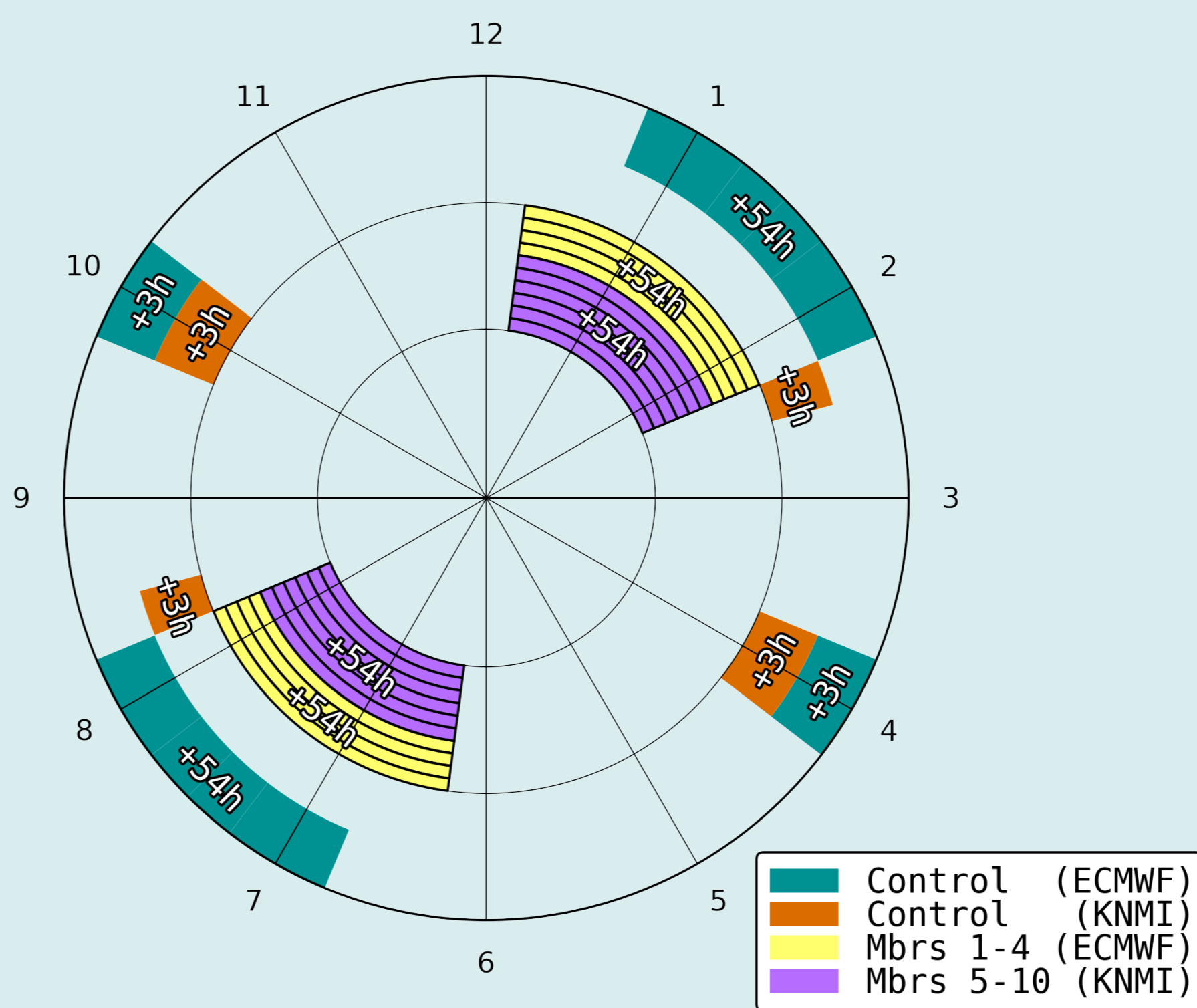
NWP Overview

The HARMONIE-AROME configuration of cy40h1.1 is the basis of Met Éireann's operational NWP suite, called IREPS (Irish Regional Ensemble Prediction System). The IREPS configuration is summarised in the table below.

Code	HARMONIE-40h1
Domain	1000×900 ×65
Model top	10 hPa
Grid spacing	2.5 km
Cut-off	20 mins, 45 mins (control)
Observations	SYNOP, SHIP, AIREP, BUOY, TEMP, ASCAT, AMSU-A, MHS & IASI
Data assimilation	Surface OI & 3D-Var
Configuration	HARMONIE-AROME
Cycle	3-hourly: 54 hour forecasts at 00Z, 06Z, 12Z, 18Z
LBCs	IFS-HRES
EPS	1+10 members
Perturbations	SLAF and surface



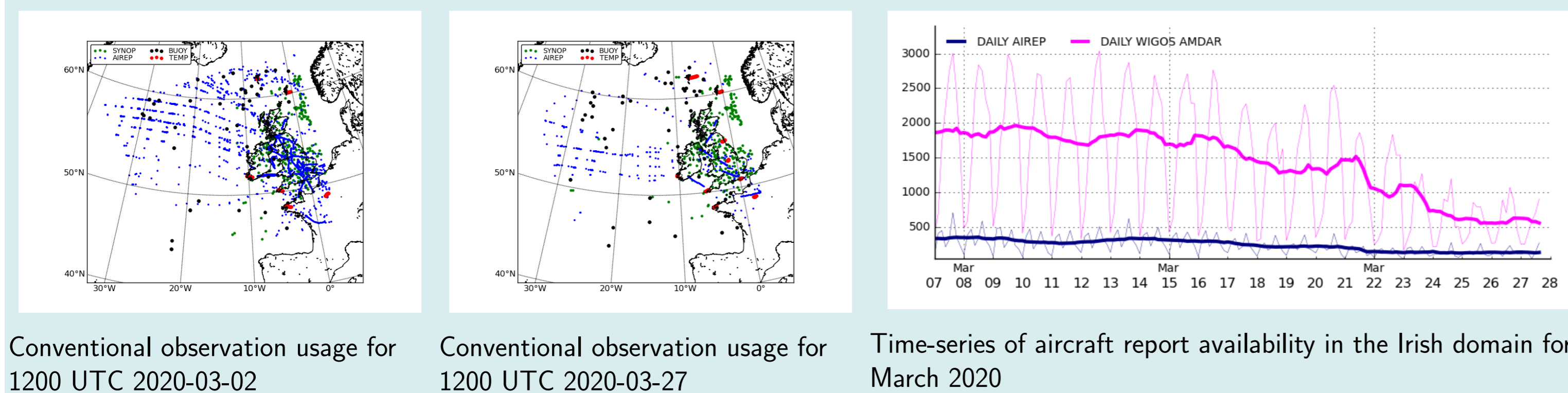
Operational Clock



- From Q2 2020, Met Éireann will split its 1+10 ensemble between HPC resources at both KNMI and ECMWF.
- As the ensemble members assimilate conventional observations only, it is possible to begin these forecasts approximately 25 minutes earlier than the control member, which must wait for non-conventional observations such as radiance data. This allows us to reassign HPC resources to produce longer forecasts while still completing by T+2:15.
- The control member at ECMWF will produce 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 will produce a 3 hour assimilation cycle by default. This will start after the ensemble members complete to maximise HPC resources.

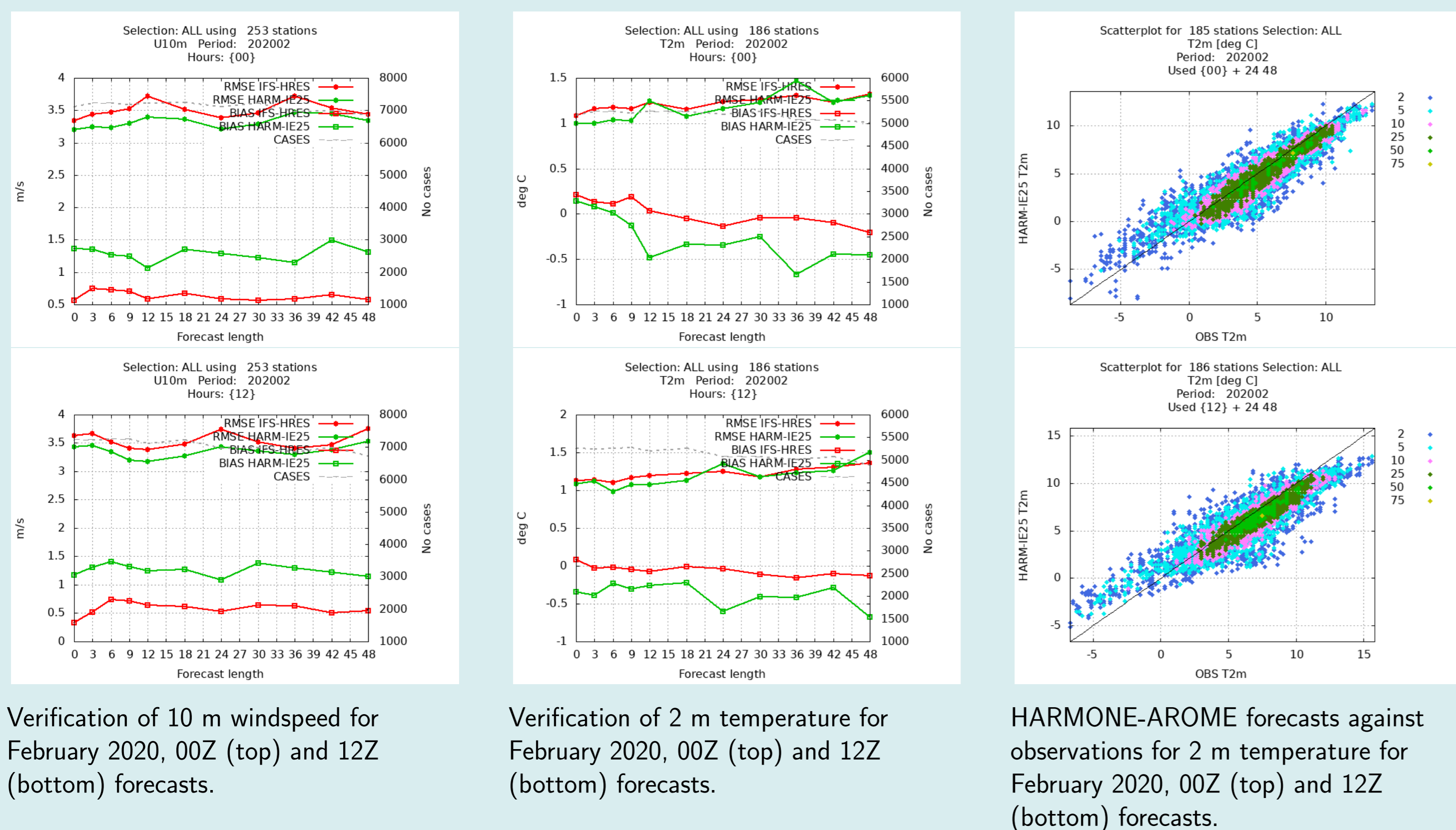
Observation Usage

3D-Var data assimilation is applied by the control member of IREPS. Typical conventional observation usage plots are shown below for 2nd March 2020 and 27th March 2020 at 1200 UTC.



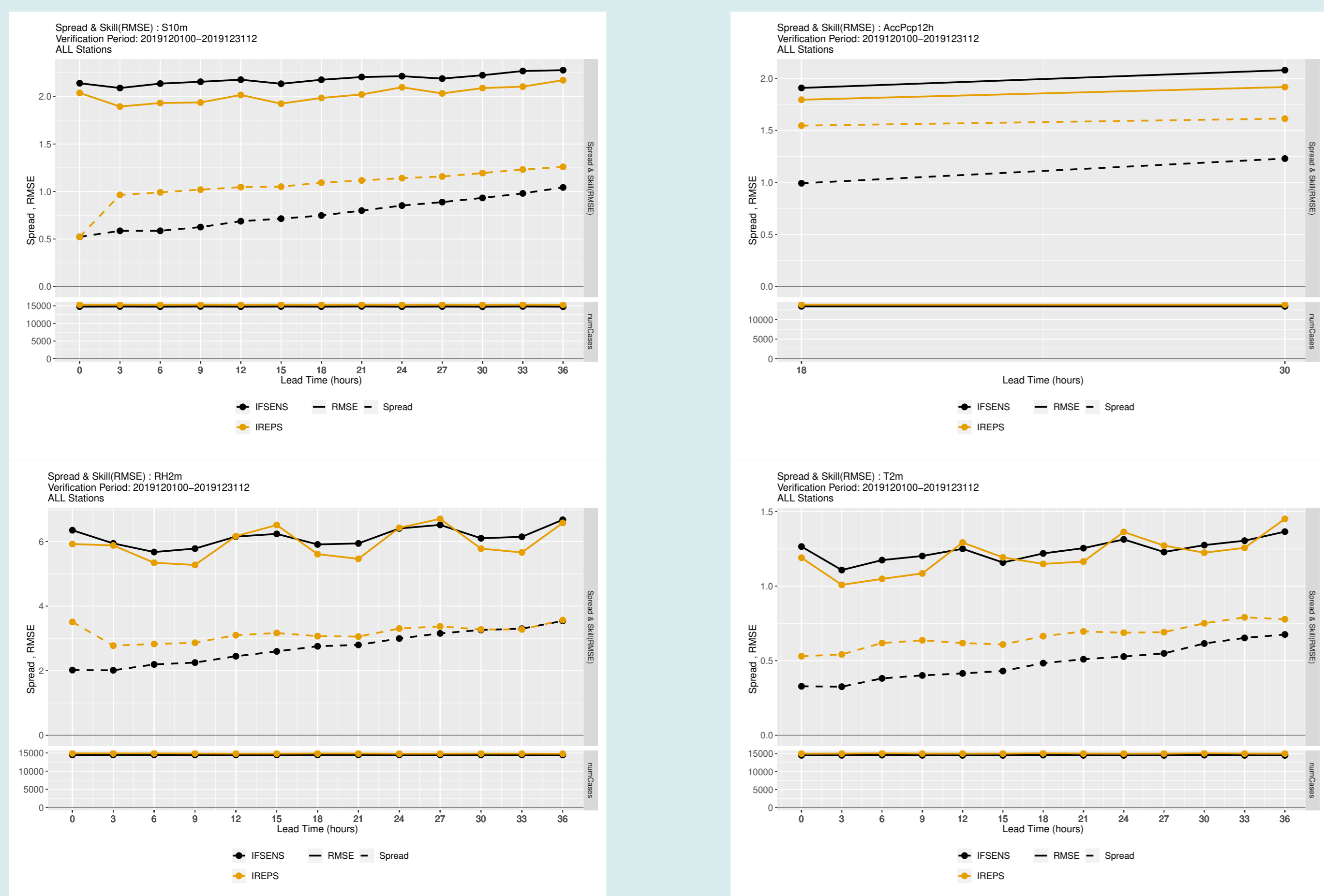
Deterministic Verification

Point verification of the operational HARMONIE-AROME forecasts for February 2020 are shown below, and compared with IFS-HRES. The model continues to exhibit a cold bias, particularly noticeable at night.



IREPS

In October 2018, Met Éireann implemented the Irish Regional Ensemble Prediction System (IREPS). IREPS is an 11 member high-resolution ensemble prediction system. The Scaled Lagged Average Forecasting (SLAF) method is used to create perturbed 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. IREPS is run twice daily at 0000 UTC and 1200 UTC out to +36 hours.



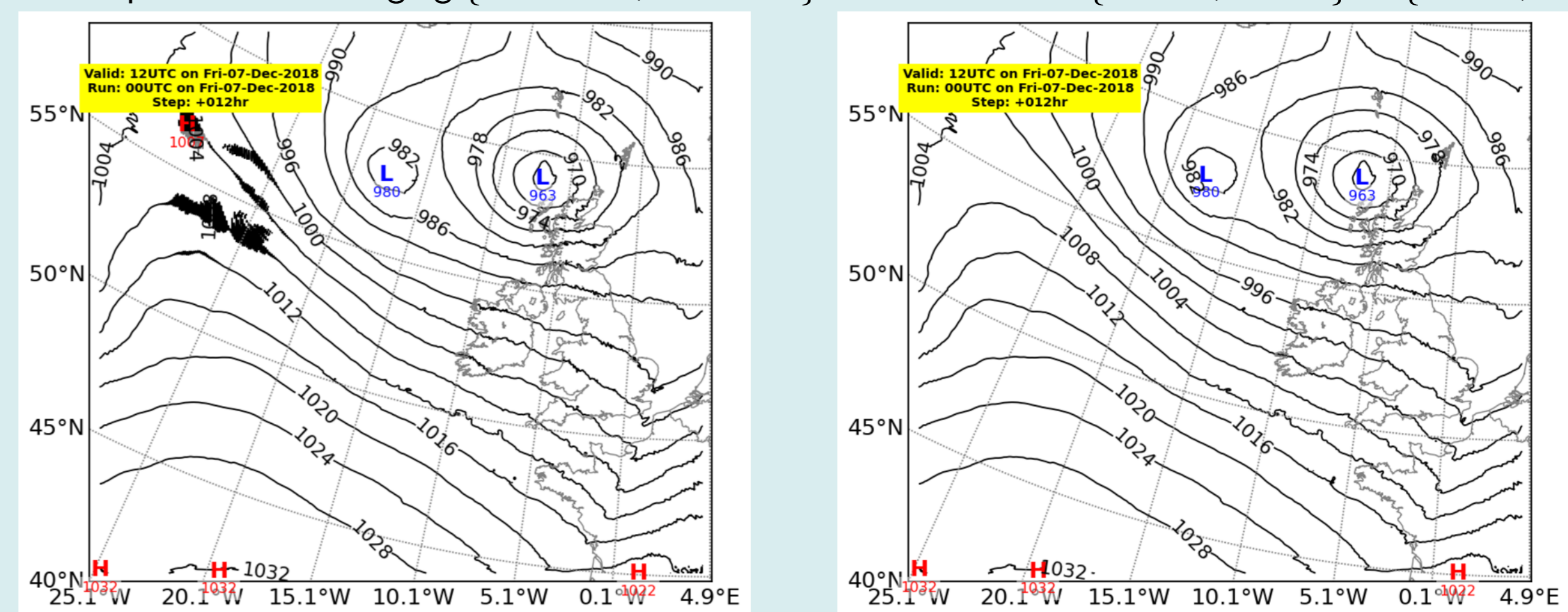
Spread/Skill for 10 m wind speed and 2 m relative humidity

Spread/Skill for 12 h acc. precipitation and 2 m temperature

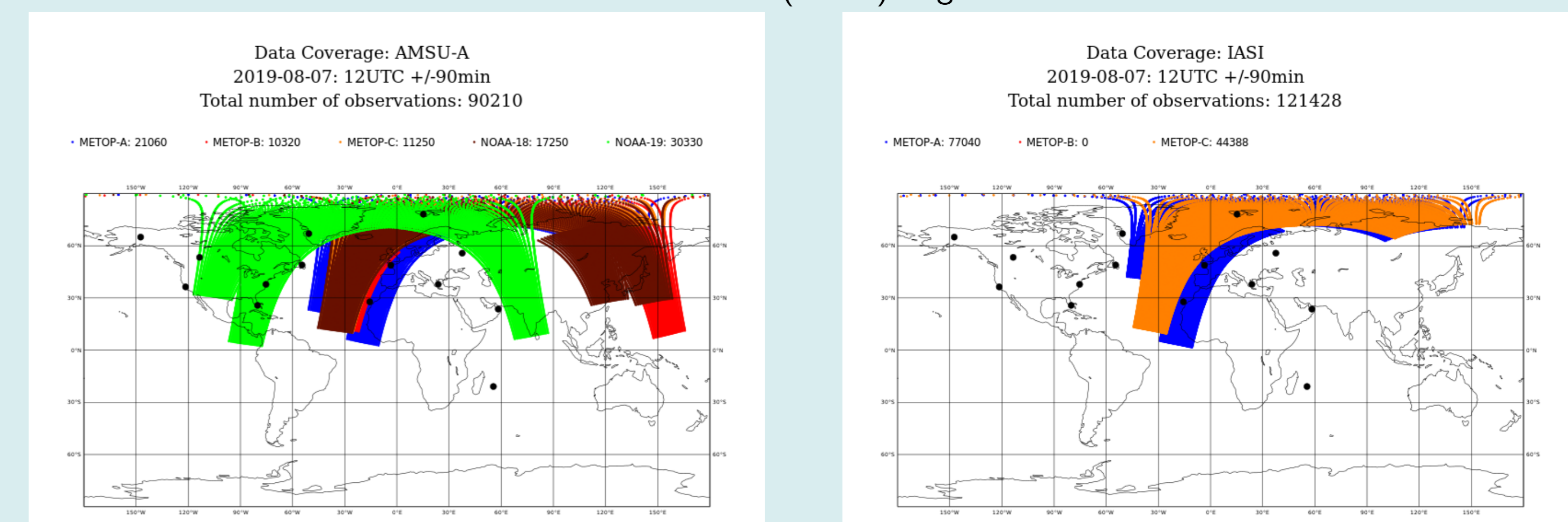
IREPS Technical Upgrade (August 2019)

Model component	Description
Dynamics	Adjust vertical momentum equation
Dynamics	Change spectral grid from linear to quadratic
Data assimilation	Assimilate radiances from AMSU-A, MHS and IASI satellite instruments
Data assimilation	Assimilate METOP-C ASCAT winds
Ensemble	Update SLAF coefficients, SLAFLAG values and surface perturbations

- In 2019 noise patterns were observed in the MSLP forecasts produced by our operational HARMONIE-AROME. Investigations revealed that these could be removed by changing parameters related to the form of the vertical momentum equation: *i.e.* changing {LGWADV, LRDBBC} from the default {FALSE, TRUE} to {TRUE, FALSE}.



- The default linear spectral grid was replaced with the quadratic grid. This results in a saving of approximately 13% in CPU time, which allows for more rapid forecast production with no degradation in forecast quality.
- The technical upgrade also brought the assimilation of radiance data from the AMSU-A, MHS and IASI instruments on board EUMETSAT and NOAA polar orbiting satellites. Met Éireann receives satellite data used in NWP via the EUMETSAT Advanced Retransmission Service (EARS) Regional Service.



AMSU-A (left) and IASI (right) observations for 12 UTC 7 August 2019. The black dots indicate the location of EARS receiving stations.

- METOP-C was launched on the 7 November 2018. Radiance data (AMSU-A, MHS and IASI) have been blacklisted. ASCAT data are assimilated as these data are considered to be unbiased. The assimilation of METOP-C radiances will be introduced at a later date.
- Perturbations of the snow depth parameter, vegetation fraction, leaf area index (LAI) and soil thermal coefficient were deactivated. The mean bias in 2 m temperature, 10 m wind speed and 2 m relative humidity, shows the positive impact of these modifications. The 3 parameters result in a lower mean bias compared to the reference experiment. This is particularly important for 2 m temperature given that HARMONIE-AROME cycle 40h1.1 suffers from a negative 2 m temperature bias over Ireland.



Mean bias in 10 m wind speed (left), 2 m relative humidity (middle) and 2 m temperature (right) for experiments related to modifications in the surface perturbations. The updated surface perturbation set-up is shown in black, a reference experiment is in blue and an experiment with no perturbations to the snow depth parameter is in orange.

Future Plans

- Following on from the upgrade made in Q2 2020, we plan to increase the forecast length of the control member of IREPS from +3h to +54h for the 03Z, 09Z, 15Z, and 21Z cycles.
- We will begin testing the assimilation of GNSS data.
- We will work with United Weather Centres West (UWC-West) with an aim of joint operations by the end of 2022.