IFS Cycle 50r1 and AIFS v2

Evaluation, new products and technical aspects

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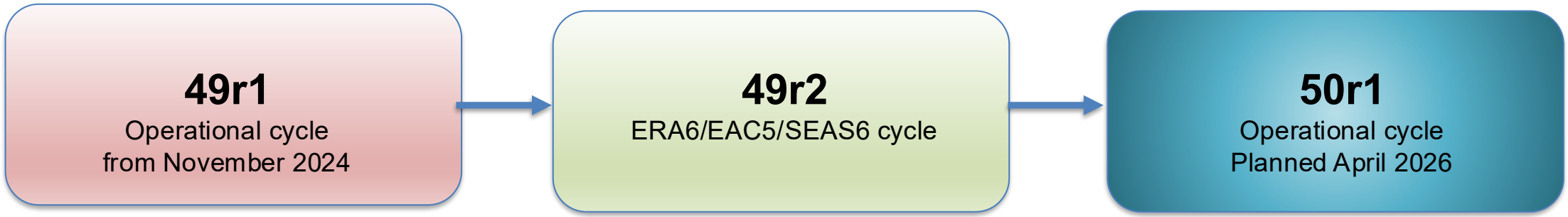
Introduction to IFS Cycle 50r1

Meteorological and technical aspects

Configuration changes
New parameters and products
Verification – evaluation

ECMWF

Science evolution: From IFS 49r1 to IFS 50r1



- ERA6/EAC5 historical reanalyses
- SEAS6 seasonal forecast system
- Output in GRIB2

- All science from 49r2 + additional science upgrades
- Output in GRIB1

IFS Cycle50r1 timeline

Initial announcement
10 September

Cycle declared ready for implementation
September 2025

Start Release Candidate Phase
19 February 2026

Implementation of 50r1 (NWP & CAMS)
April 2026

Jun 25 | July 25 | Aug 25 | Sep 25 | Oct 25 | Nov 25 | Dec 25 | Jan 26 | Feb 26 | Mar 26 | Apr 26 | May 26

15 September
Science webinar

26 February 2026
Meteorological /technical webinar

12 March 2026
Data access / testing and practicalities webinar

Alpha phase (scientific and technical testing)

Beta phase (e-suite catch up + real time running)

Release Candidate Phase (~2 months)

What IFS configurations are affected

Operational Analysis (initial conditions to both IFS and AIFS models)

Medium-range Ensemble Forecast (including Control Forecast): **IFS-ENS** / **IFS-CF**

Sub-seasonal Ensemble Forecast: **IFS-SUBS**

Atmospheric Composition Forecast: **IFS-COMPO** (CAMS)

Greenhouse Gases Forecast: **IFS-GHG** (CAMS)

Not affected: Seasonal forecasts, Reanalysis

Summary of IFS Cycle 50r1 content – NWP

Data assimilation changes

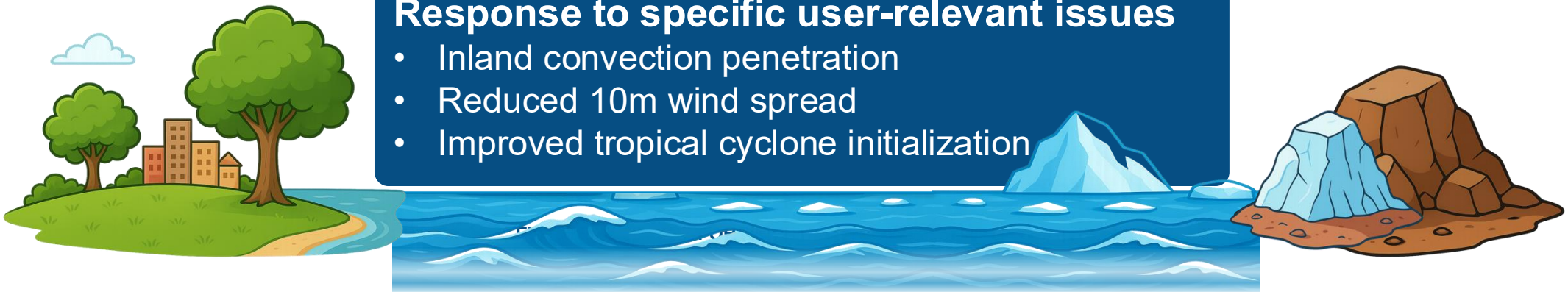
- Outer loop coupling (more exchange of information between atmosphere and ocean within the data assimilation cycle)
- Weak constraint 4D-Var in the boundary layer allowing assimilation of all 2 metre temperature observations
- Unified moisture and temperature analysis in the land DA system
- Numerous enhancements to the use of upper-air observations

Model changes

- New ocean and sea-ice model (NEMO4-SI^3)
- Waves and sea-ice interaction
- Reduced vertical diffusion in the stratosphere (better QBO) and convection and microphysics modifications

Response to specific user-relevant issues

- Inland convection penetration
- Reduced 10m wind spread
- Improved tropical cyclone initialization



Summary of IFS Cycle 50r1 content – CAMS

IFS-COMPO (Aerosols and Reactive Gases)

- Anthropogenic emissions CAMS-GLOB-ANT M1 (composite data set of global and regional inventories from Europe, China and North-America)
- On-line Biogenic VOC emissions (replacing climatology)
- Revised ozone dry deposition (reduced ground-resistance)
- Revised and tuned AC background error statistics
- Modified aerosol removal leading to an increased sea salt burden
- Sentinel 3 AOD retrievals actively assimilated

IFS-GHG (Greenhouse Gases)

- Assimilation of Sentinel 5P methane retrievals (in addition to GOSAT and IASI)
- Revised carbon dioxide and methane background errors based on EDA

Atmosphere Monitoring Service

atmosphere.copernicus.eu

GFAS (Global Fire Assimilation System) wild-fire emission update (using VIIRS FRP to prepare for loss of MODIS)

ECMWF

Configuration changes with IFS Cycle 50r1

- No change in vertical and horizontal nor steps in Atmospheric model
- No change in vertical and horizontal nor steps in Wave model
- No change in Sub-seasonal range forecasts configuration
- No change in reforecasts' configurations (ensemble size, initialization dates)

Important update with IFS-ENS Control forecast

IFS Cycle 49r1: the former High-Resolution forecast (ex-HRES) and 'control' member of medium range ensemble forecast (ENS Control) were made identical.
IFS Cycle 50r1: we will stop running both separately and produce **only one which we refer as the ENS Control (IFS-CF)**.

- IFS-ENS Control forecasts will be disseminated and archived with **stream=oper, type=fc**, rather than stream=enfo, type=cf
- IFS-ENS Wave Control forecasts will be disseminated and archived with **stream=wave, type=fc**, rather than stream=waef, type=cf

Updates to the 06/18 UTC runs

The **06UTC and 18UTC (6-day) runs** from:

- Atmospheric forecasts will be archived and disseminated with **stream=oper** instead of stream=scda
- Wave model will be archived and disseminated with **stream=wave** instead of stream=scwv

New parameters added to 06/18 UTC runs

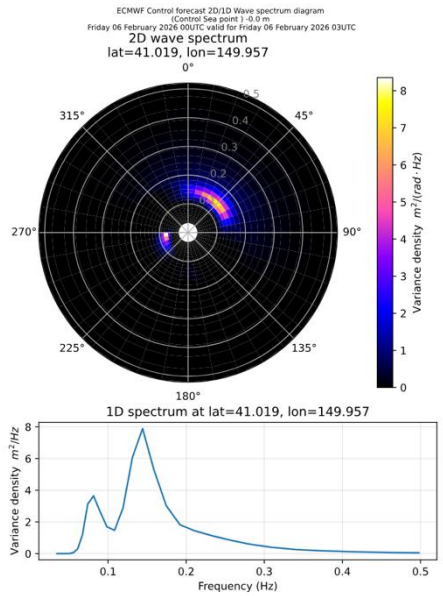
- Heat and cold indices, mean radiant temperature and globe temperature
- Simulated Satellite Data
- EFI and SOT
- Ensemble mean and spread parameters
- Event probabilities parameters
- Cluster means parameters
- Cluster representative parameters

06/18 UTC forecast will be available on **ecCharts/OpenCharts**

New parameters and outputs

- Wet-bulb temperature
- Fraction of snow cover
- Urban cover (replacing Vegetation fraction difference, deprecated)
- New ocean parameters
  - 2 new level types: o2d and o3d with 75 vertical levels
- New sea ice parameters (including snow on sea ice)
- New graphical products (e.g. Ocean wave spectra diagram)
- Additional parameters/outputs (watch the Implementation pages)

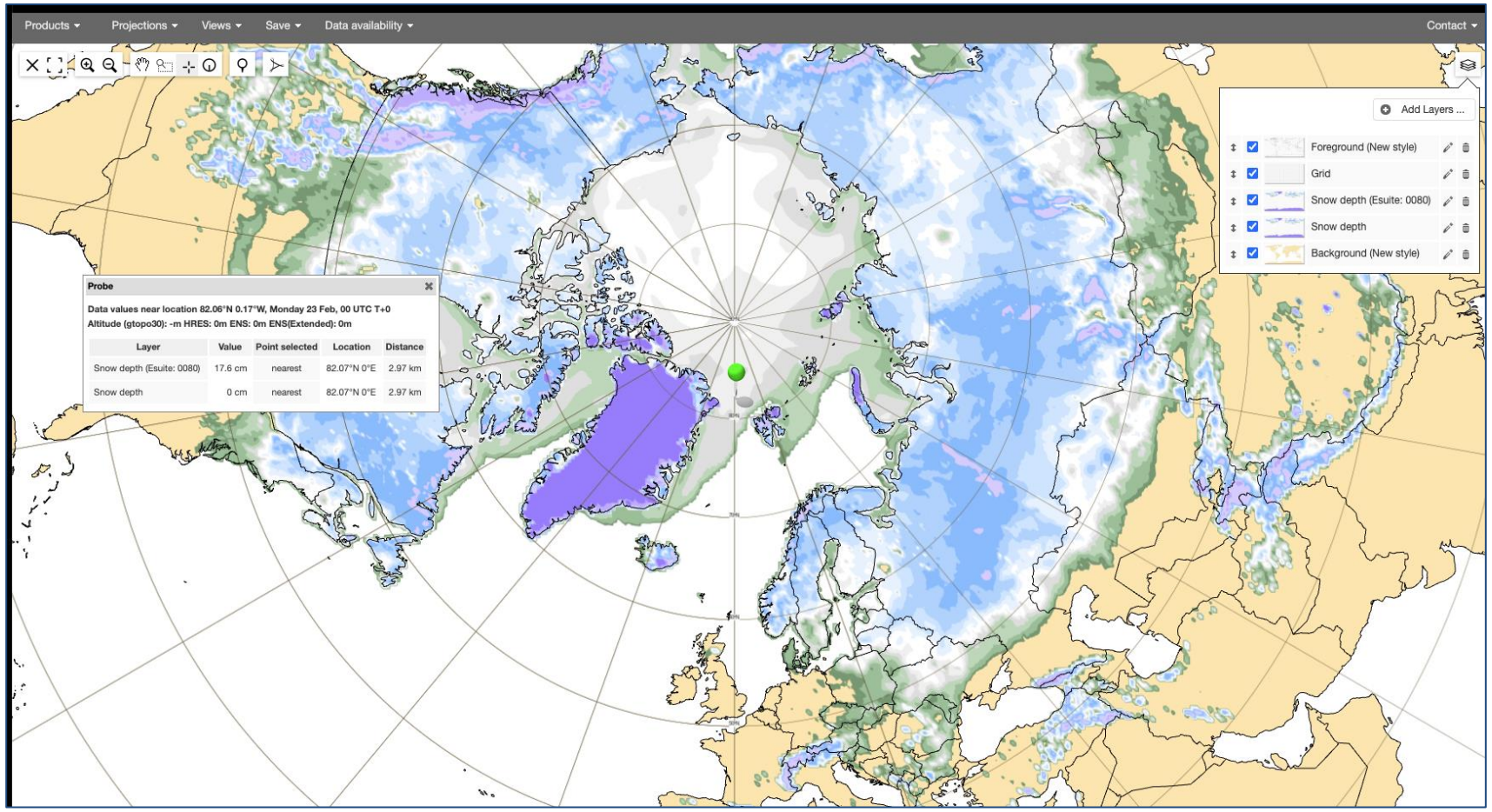
Ocean wave spectra diagram



NWP

CAMS

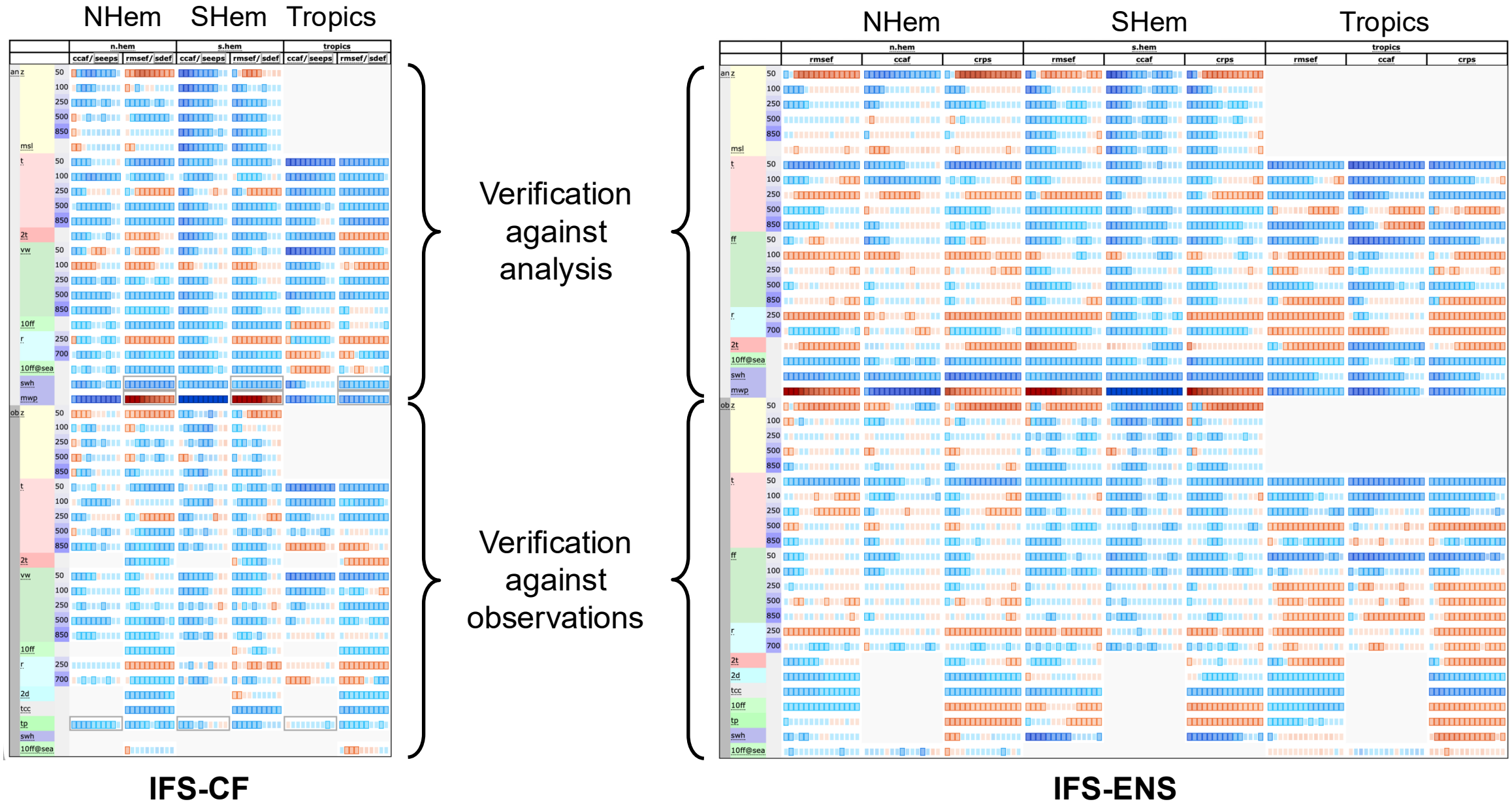
Snow over sea-ice



Evaluation of IFS Cycle 50r1

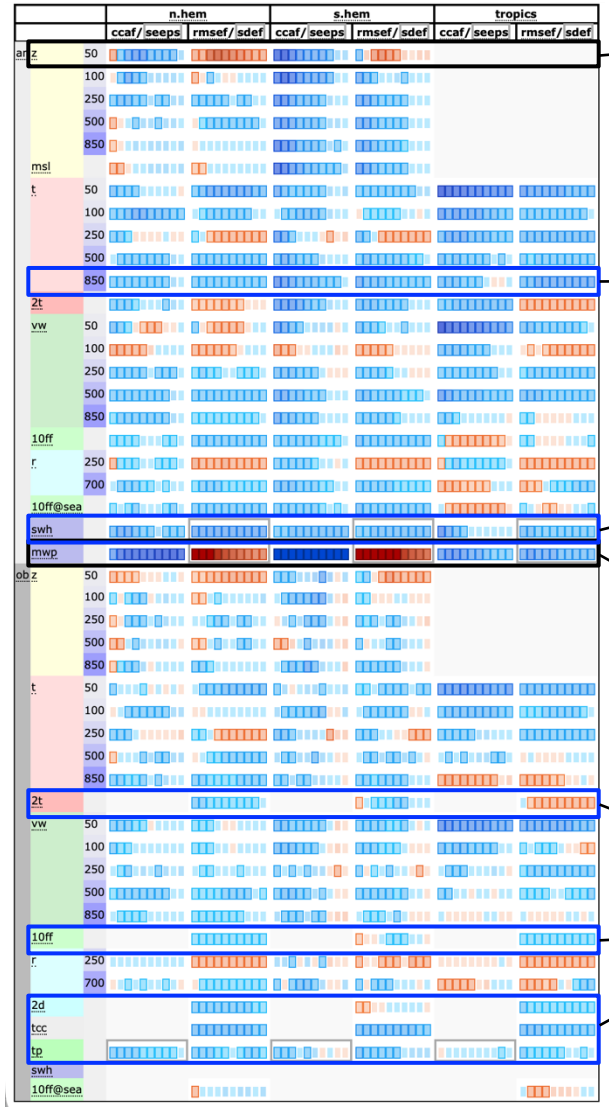
ECMWF

Cycle 50r1 IFS-CF and IFS-ENS scorecards



Cycle 50r1 IFS-CF scorecard

NHem SHem Tropics



50 hPa geopotential has slightly (0.5-1%) increased RMSE due to small mean temperature change in troposphere, but correlation improved (1%)

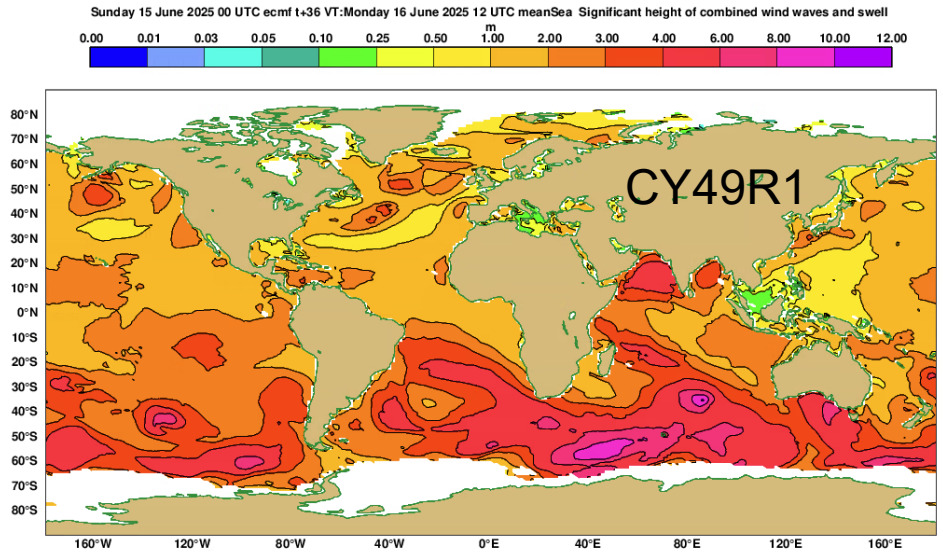
850 hPa temperature improved due to convection changes and aerosol climatology update

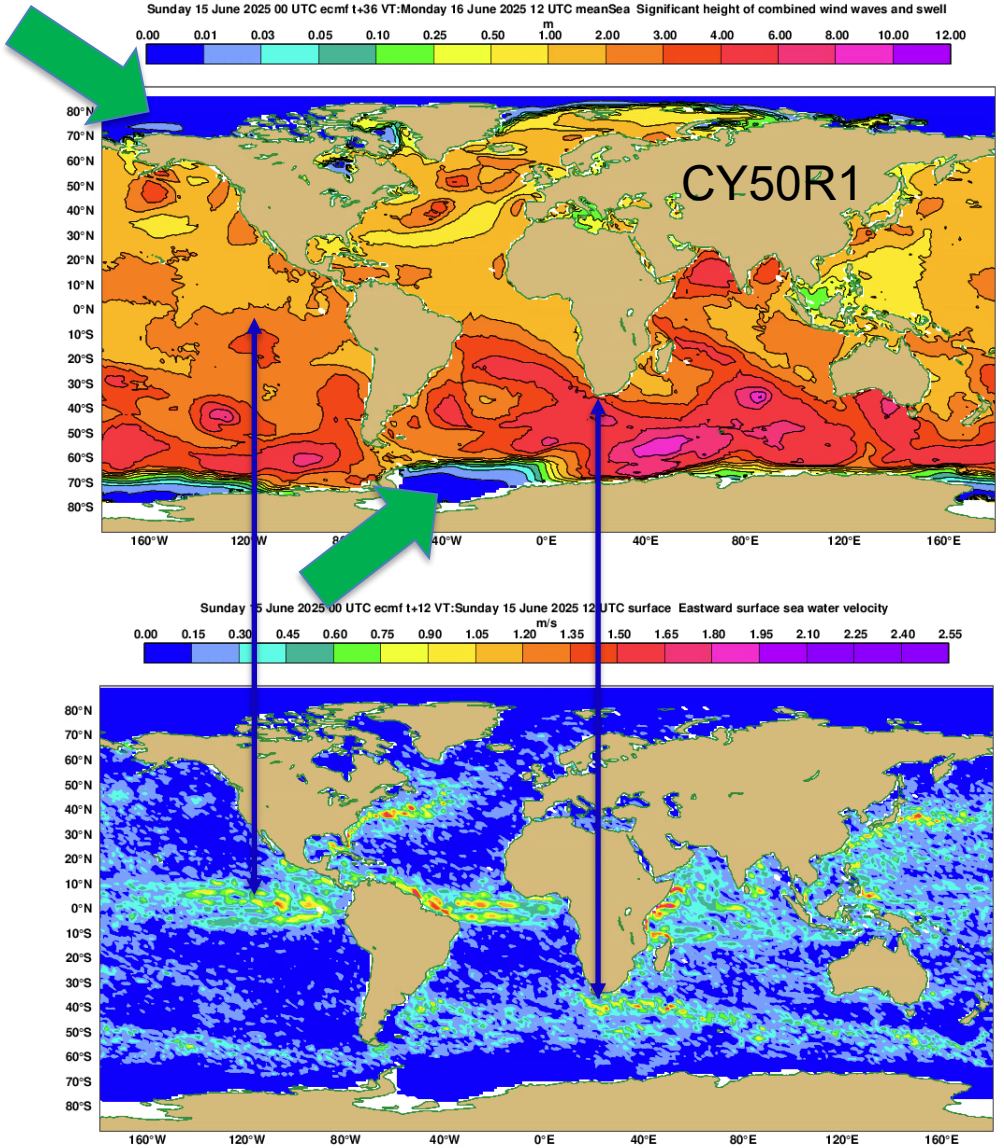
Wave height improved due to surface currents being taken into account in the wave model

Mean wave period has improved correlation.
Increased RMSE due to waves in areas of sea-ice (new feature)

Surface parameters (against SYNOP, except T2m in tropics) improved by 1-4% due to weak-constraint 4D-Var and model physics changes

Waves



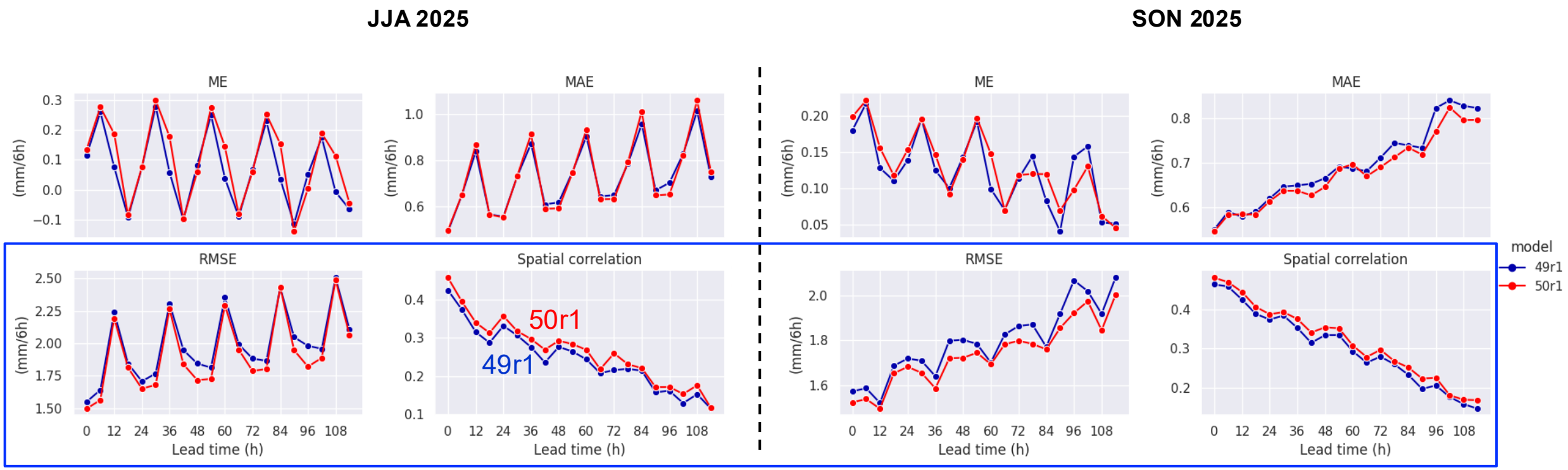


Waves now **attenuated** in the presence of sea ice

Wave refraction in the presence of **ocean surface currents** more consistent across analysis and forecast

ECMWF

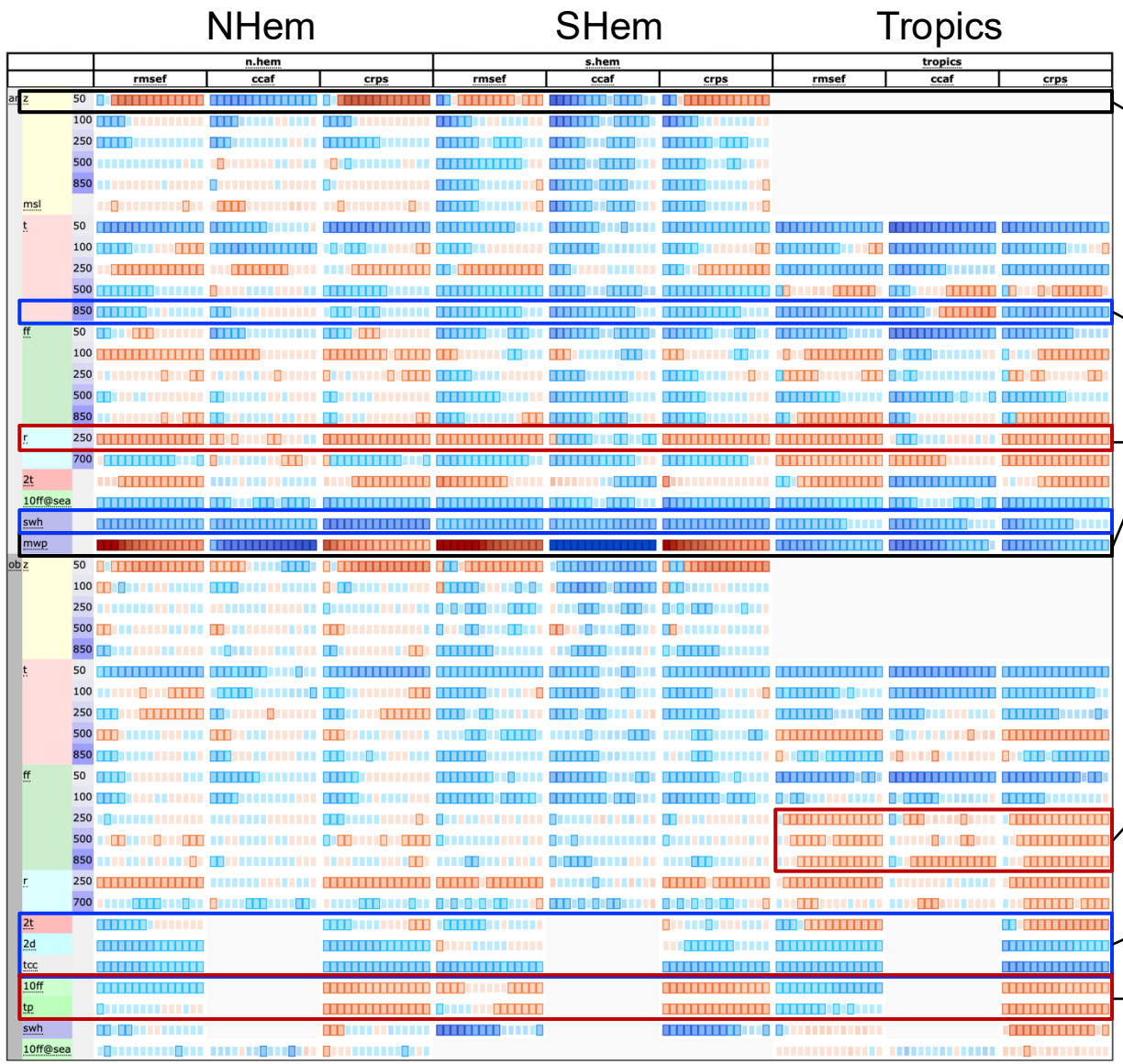
IFS-CF precipitation scores against radar data (Northern Central Europe)



Reduced RMSE and increased spatial correlation
due to improved handling of convective precipitation

Reference: OPERA (Eumetnet)

Cycle 50r1 IFS-ENS scorecard



Similar signals as in deterministic scorecard

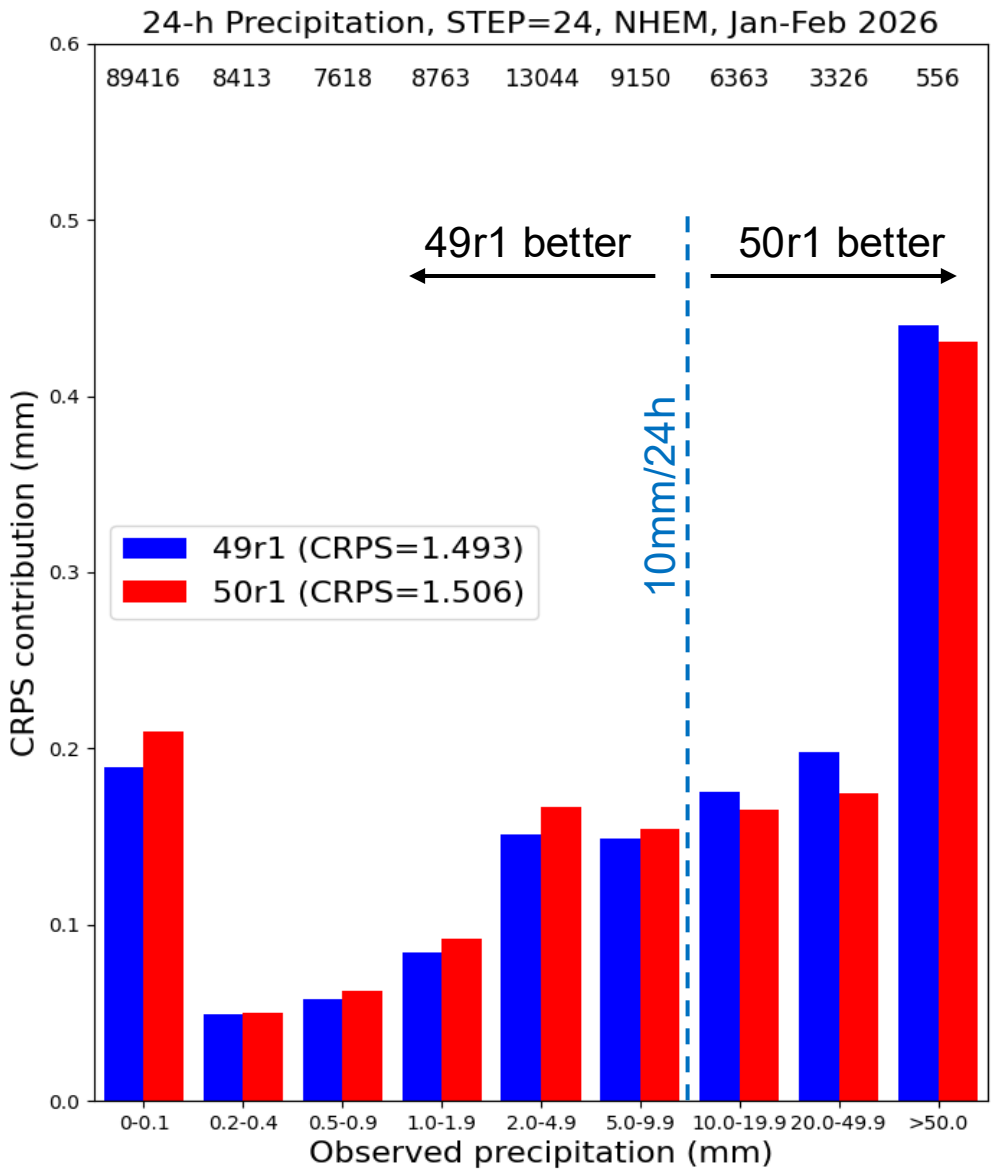
Convection changes improve T850 but degrade RH250

1% degradation of tropical upper-air wind due to slightly reduced spread

2m temperature, 2m dewpoint, and total cloud cover improved by 1-5%, but 2m temperature in tropics degraded 1-5%

10m wind speed and precipitation 1-3% degraded, partly due to reduced spread, but ensemble mean slightly improved (1%)

IFS-ENS precipitation scores: CRPS decomposition



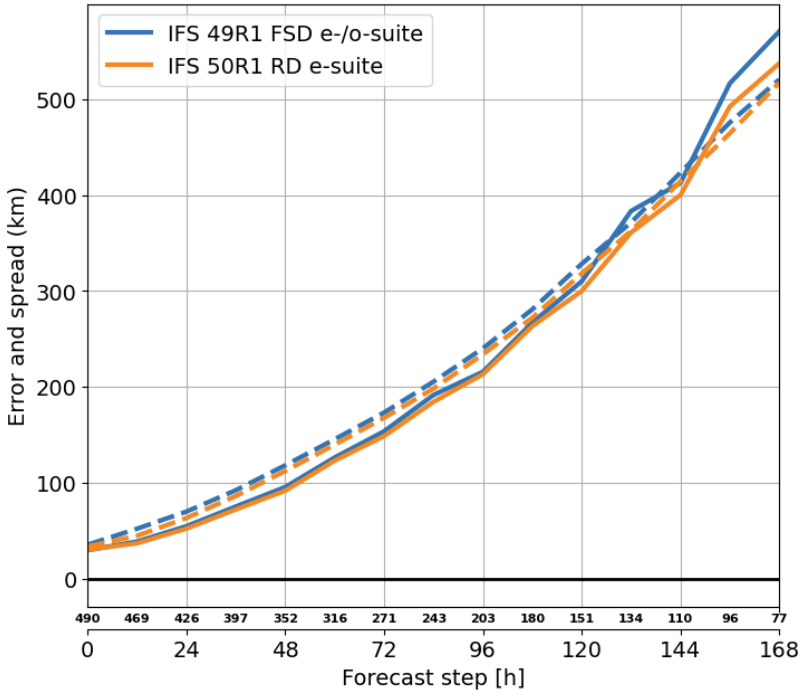
Cycle 50r1 has slightly worse overall CRPS due to increase in frequency of light precipitation

Cycle 50r1 improves moderate to heavy precipitation (>10mm/24h)

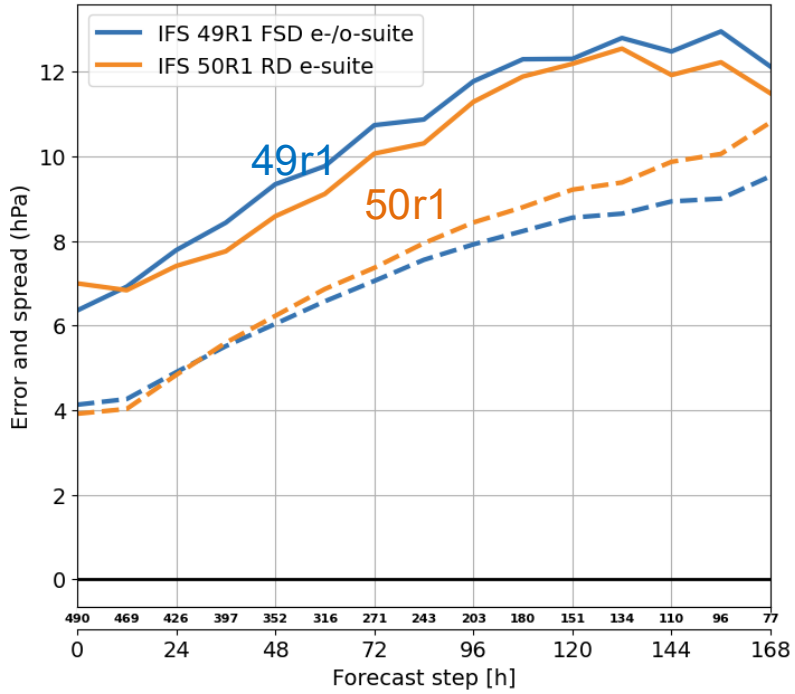
Tropical cyclone verification: IFS-ENS

Verification period June 2024-January 2026 – all basins – reference: IBTrACS (version 04r01)

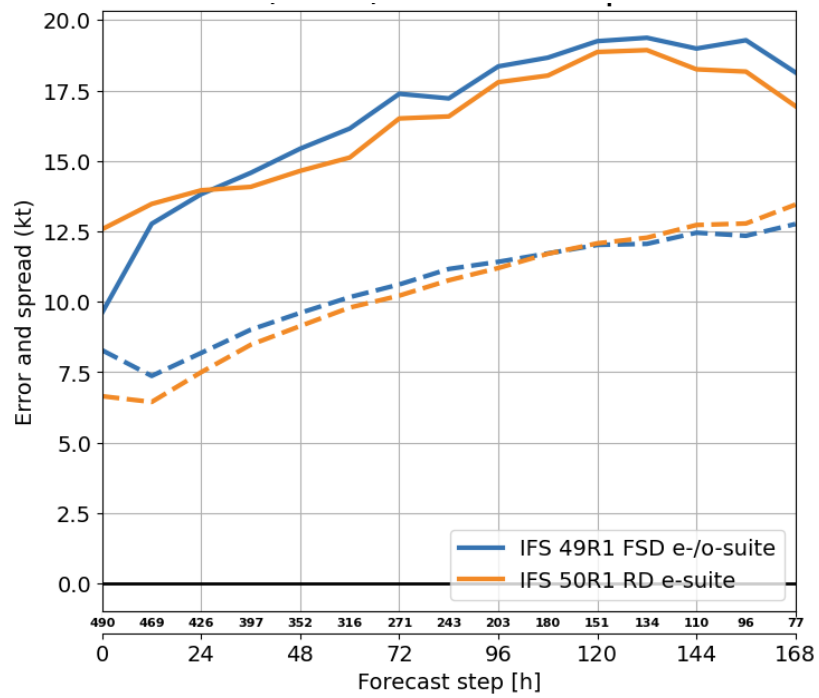
Position



Central pressure



Maximum wind speed



- Neutral for position error
- Central pressure and max wind speed improved

Error

Spread

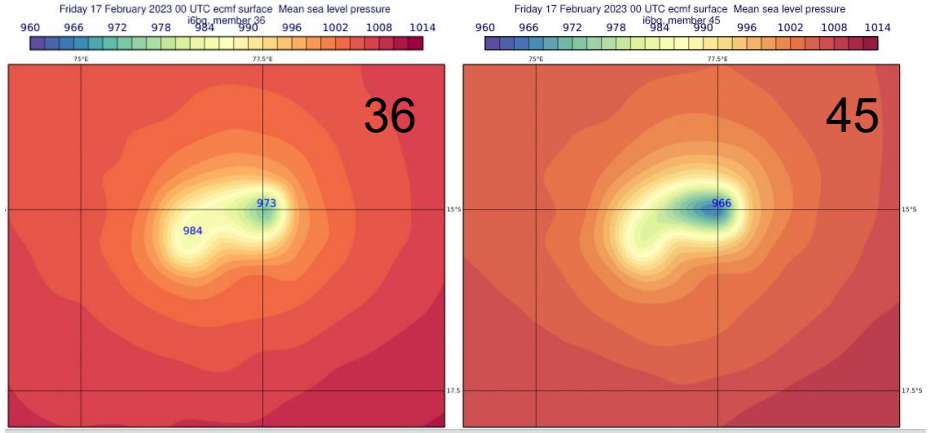
Change in construction of ensemble initial conditions in 50r1

Known Problem: In 49r1, increasing EDA resolution to TCo1279 led to deeper tropical cyclones in the EDA, which sometimes resulted in unrealistic initial conditions after re-centring.

- Scale-dependent re-centring introduced in 50r1 preserves ensemble skill without degrading small scales.

re-centred EDA

49r1



scale-dependent re-centring of EDA

(50r1)

TC Freddy, 17 Feb 2023, 0UTC,

mean sea level pressure t=0h

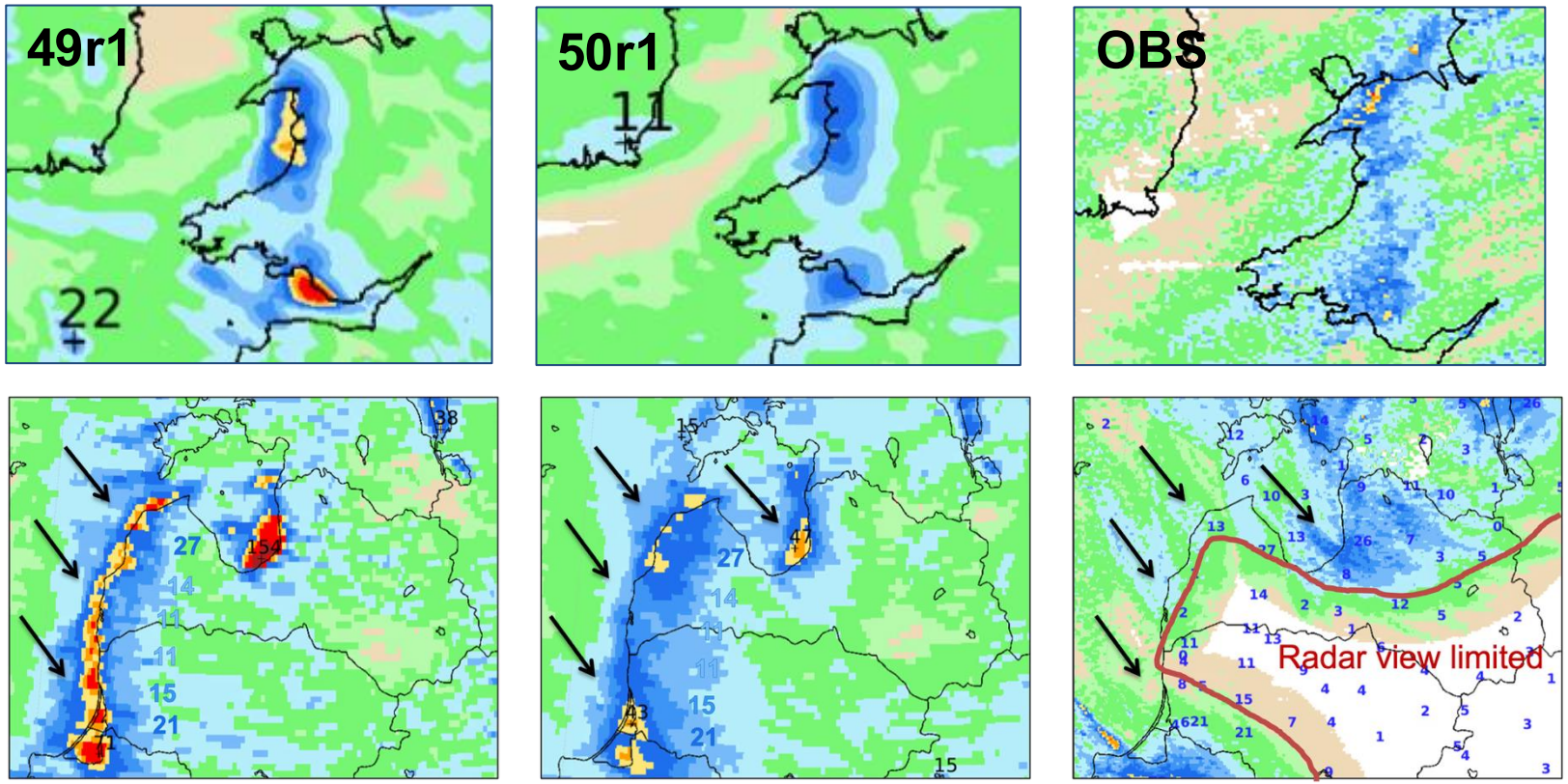
ECMWF

50r1 e-suite case studies – precipitation inland

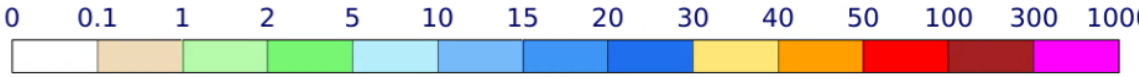
- Some of the convective precipitation now handled prognostically by the cloud scheme and advected
- Mitigates known bias of excessive offshore convective precipitation with onshore wind
- Inland penetration of precipitation improved in convective situations

01 Sep 2025
Wales/UK
+114h forecast

24 Aug 2025
Latvia & Lithuania
+30h forecast



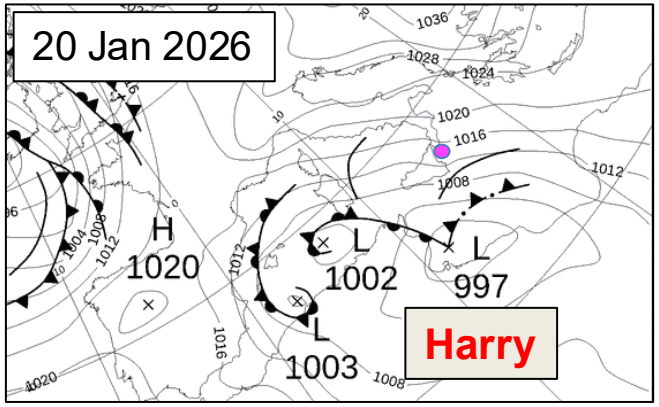
↘ = wind direction



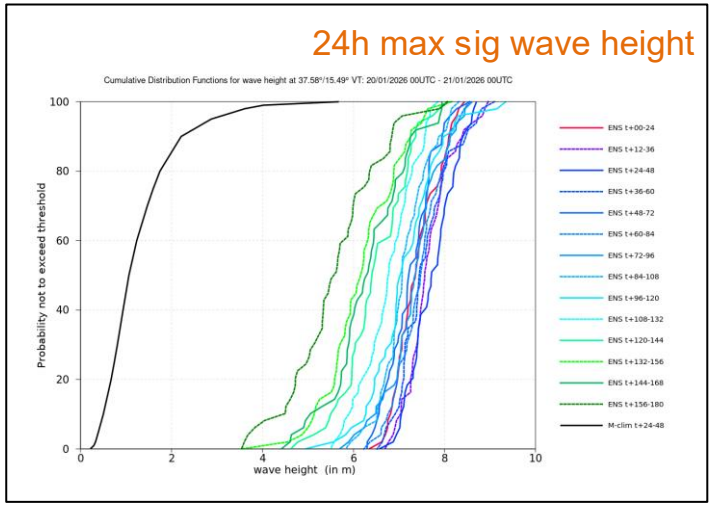
Accumulated precipitation over 24 hours (mm)

50r1 e-suite case studies – impact of the revision of SPP

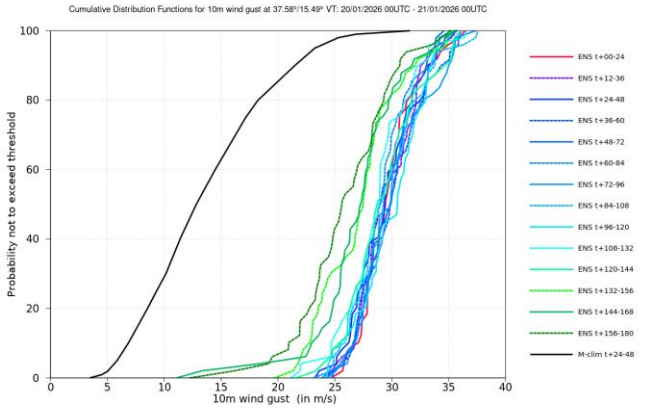
First Example: Storm Harry (January 2026)
Successive forecasts (CDFs) for sea point near Taormina, Sicily
49r1 vs 50r1 alternating (50r1 e-suite = fewer lines).



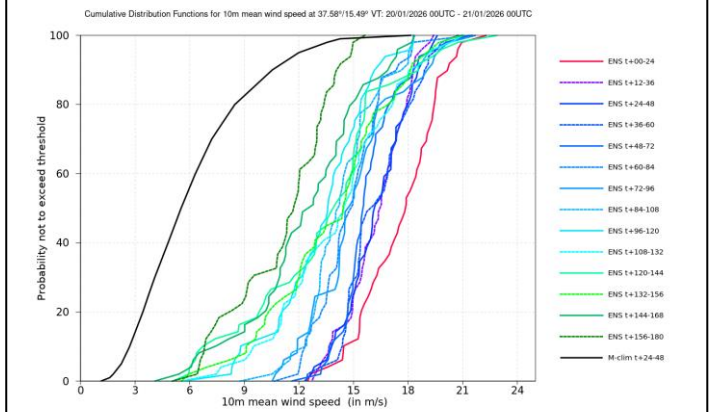
24h max sig wave height



24h max 10m wind gust

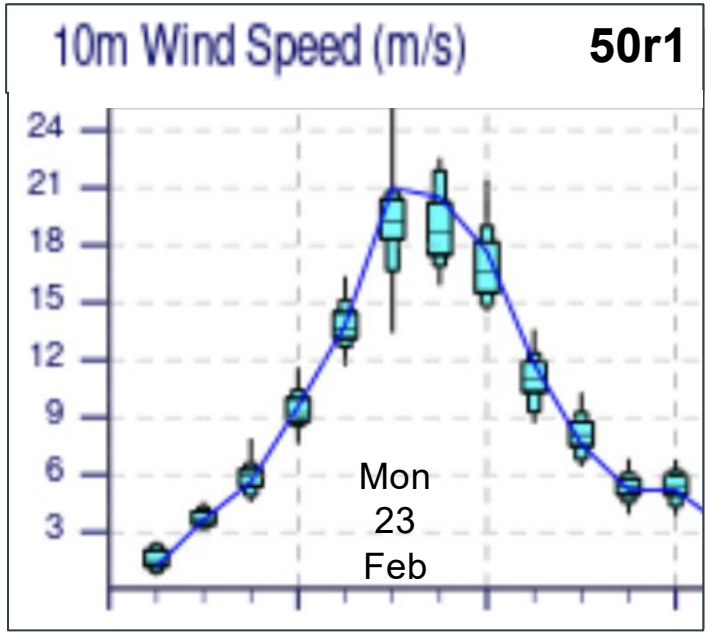


24h mean 10m wind speed



Second Example: US snowstorm (22-23 February 2026)

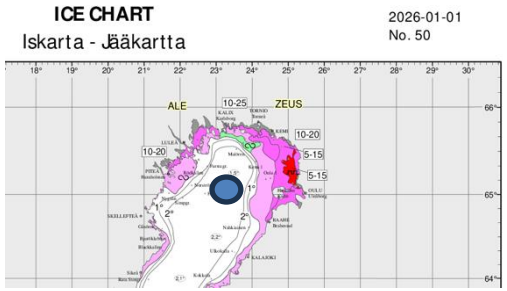
Wind speed forecasts, for land point on Cape Cod (MA, USA), for T+6-72

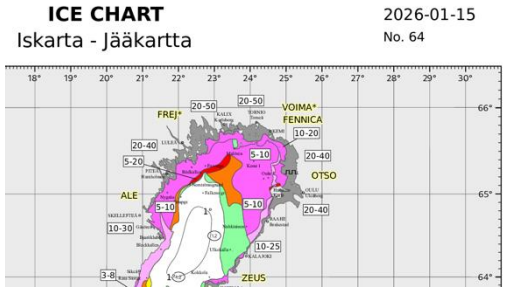


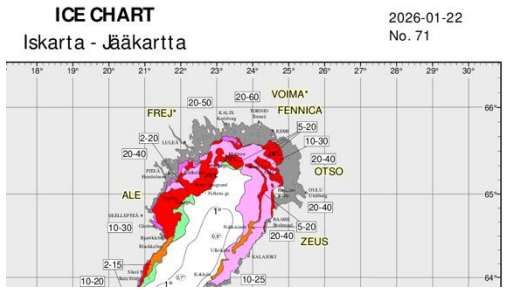
Ocean and sea ice in IFS Cycle 50r1

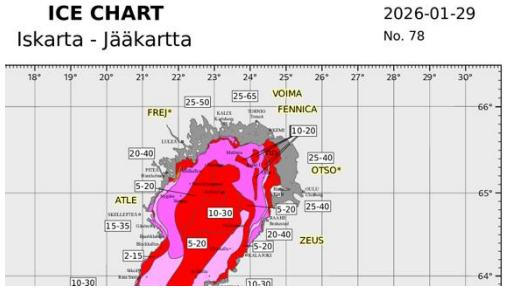
ECMWF

50r1 e-suite case study – sea ice in the Baltic Sea – January-February 2026

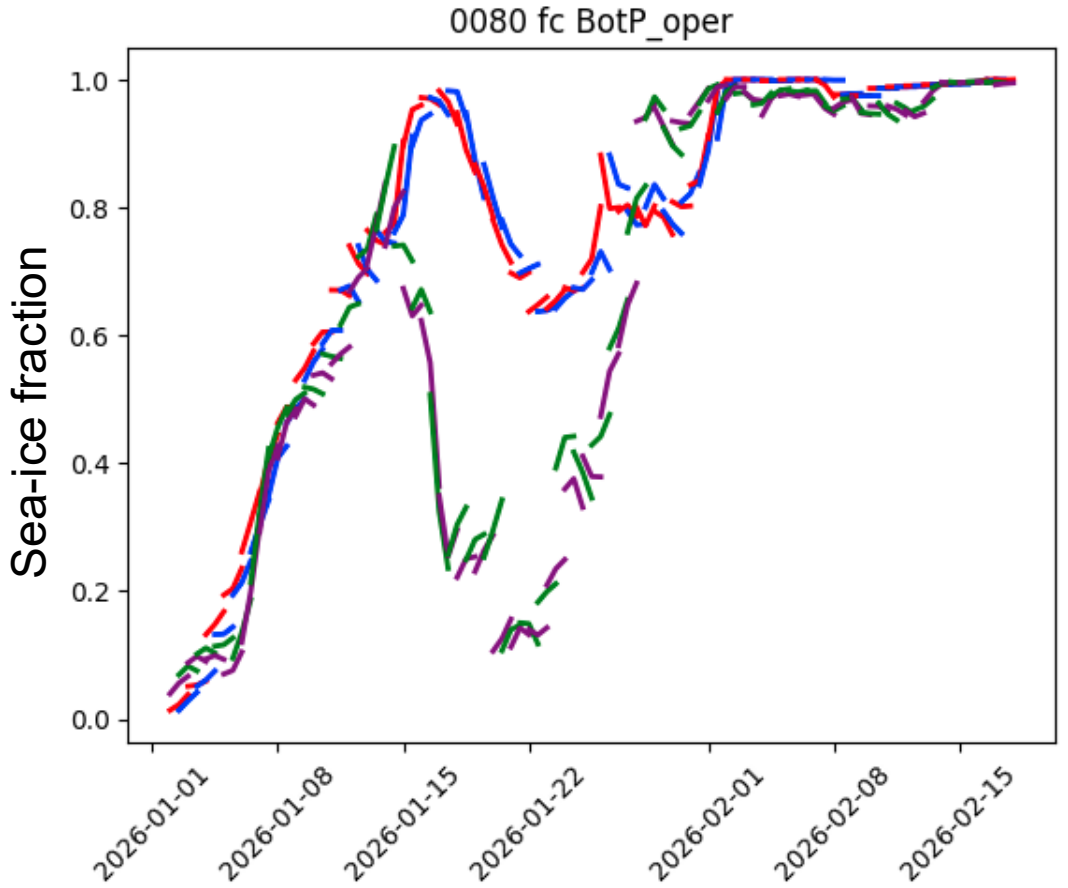








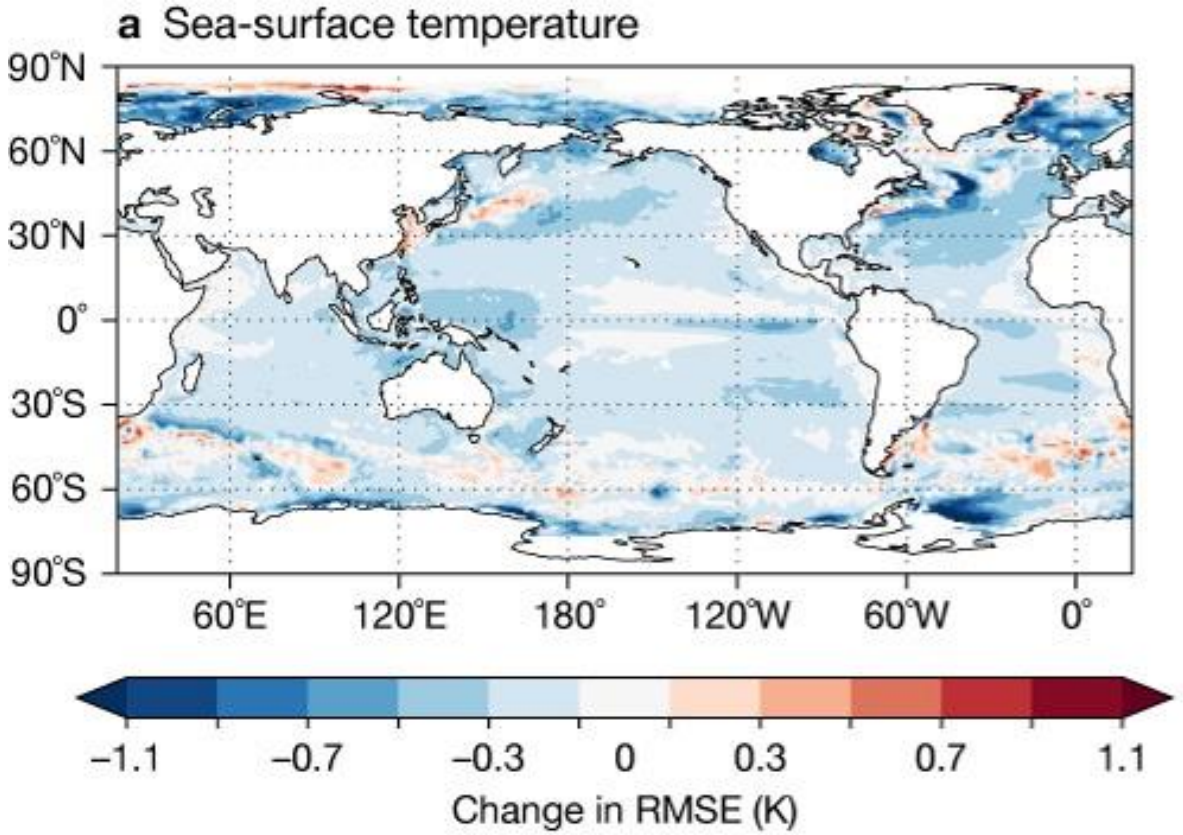
49r1 o-suite – red/blue
50r1 e-suite – green/purple

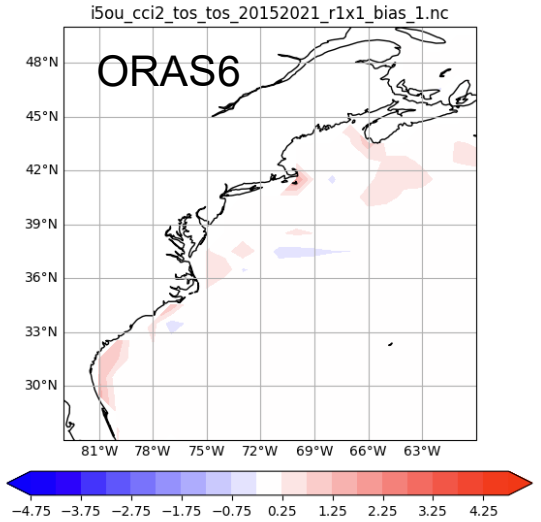


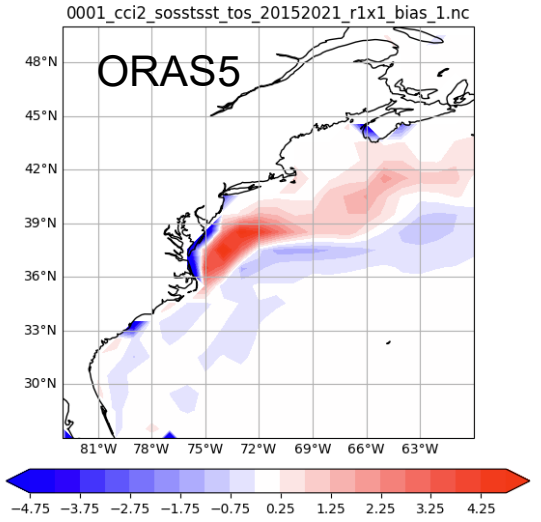
- Faster sea-ice growth in 50r1
- More responsive sea-ice evolution

Impact of new ocean model in IFS Cycle 50r1

Annual mean changes in RMSE (1999-2019) for NEMO4 vs NEMO3.4 (analysis)





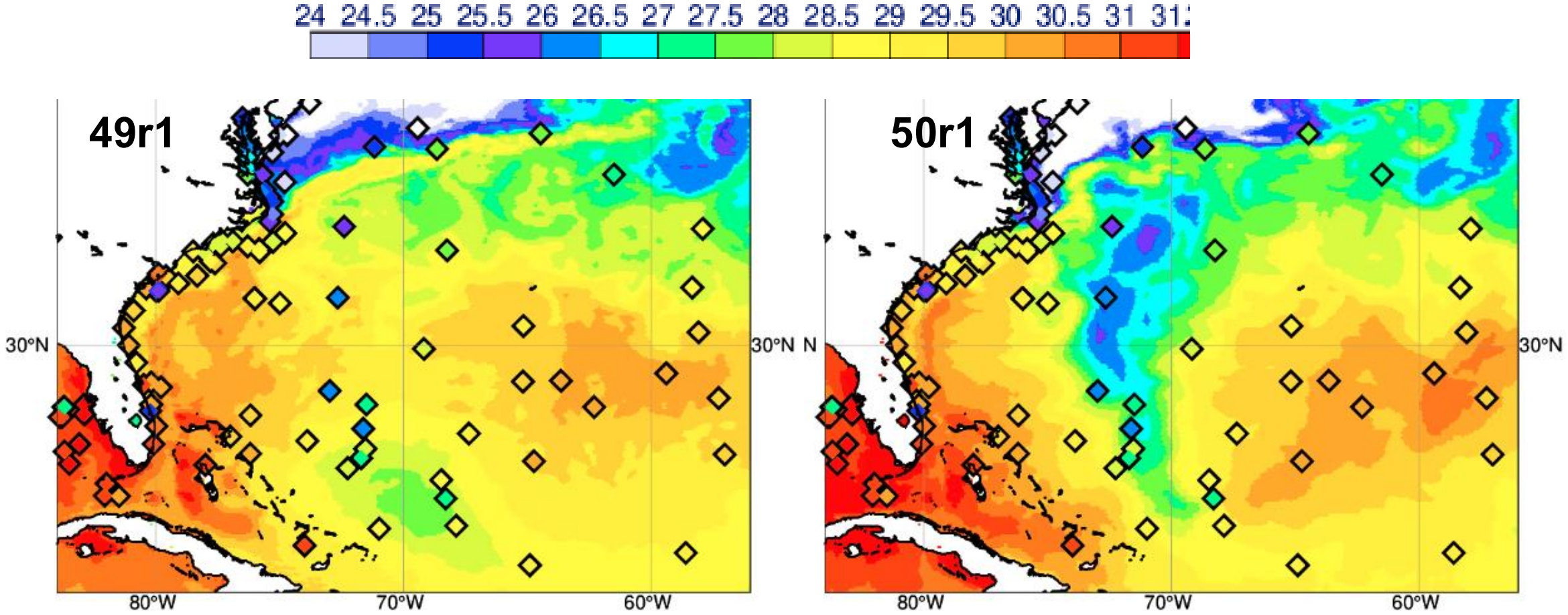


Mean SST biases (2015-2021)

Verf. CCIv2 SST

50r1 e-suite case study – Tropical Cyclone Erin, August 2025

Tropical Cyclone Erin – 22 August 2025 00UTC



- Better match of SSTs with observations. More realistic variability.
  - Removal of partial coupling procedure facilitated by model and DA improvements (incl SST)

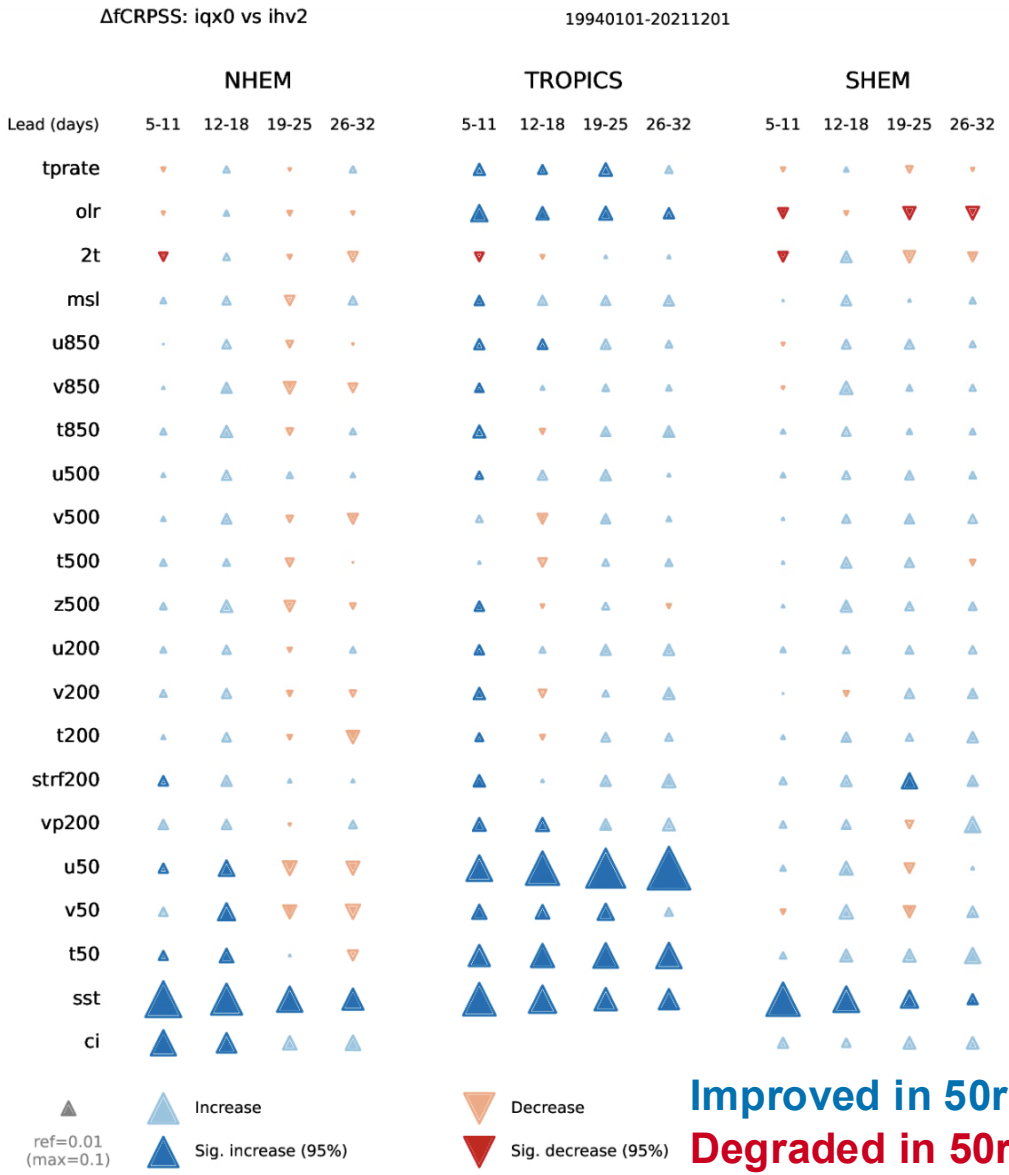
IFS Sub-seasonal (up to 6 weeks)

ECMWF

IFS 50r1 Sub-seasonal forecast evaluation (reforecasts)

Reforecast configuration
- Tco319L137 ORCA025_Z75
- 9+1 members
- Initialized 1st of each month.
- 1994-2021.

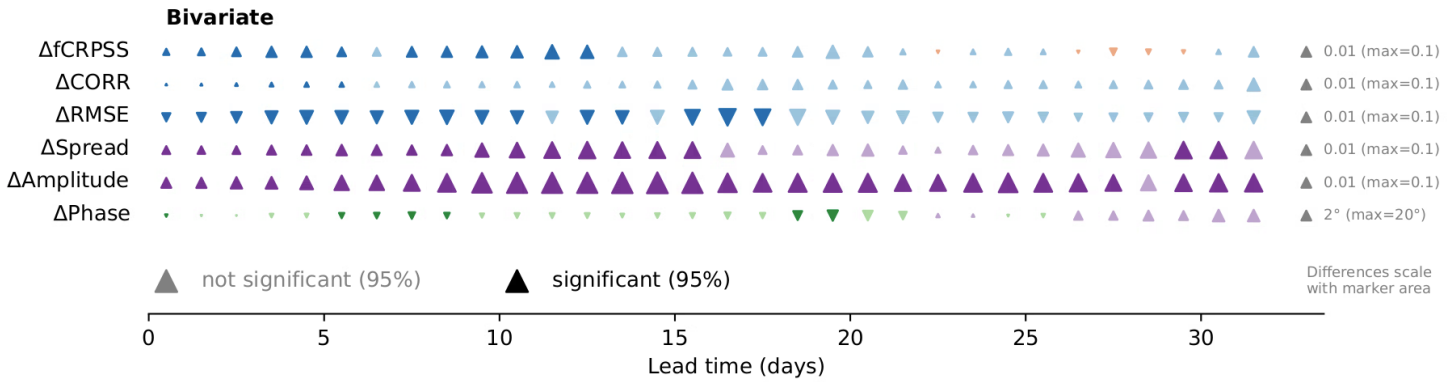
Weekly anomalies improved in ocean/stratosphere



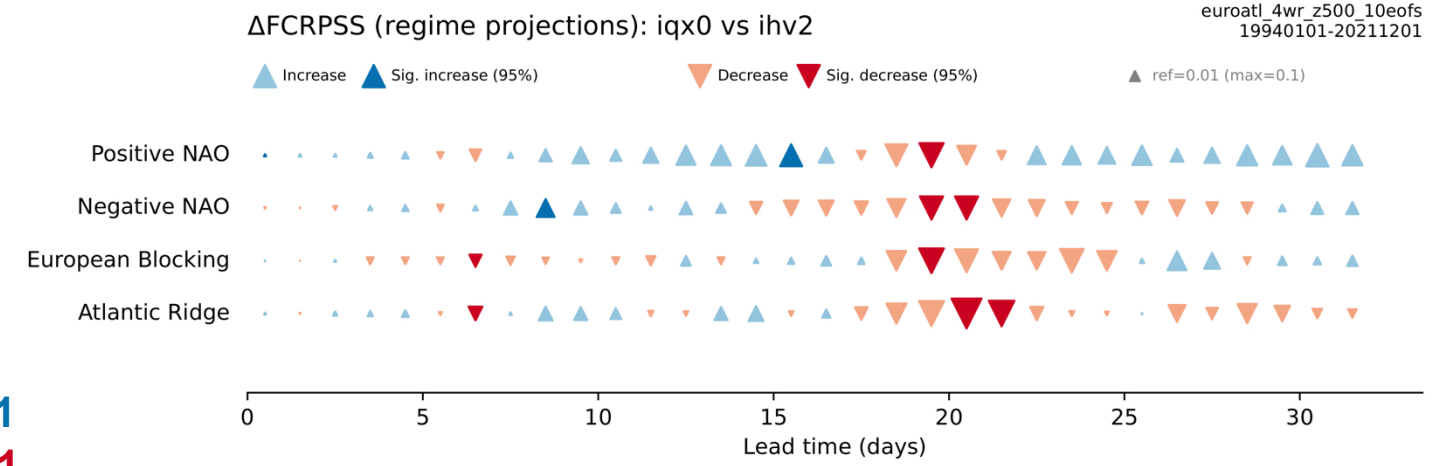
Improved in 50r1

Degraded in 50r1

Small improvements to MJO index skill at days 1-15



Limited impact on Euro-Atlantic regimes



CAMS forecasts – IFS-COMPO

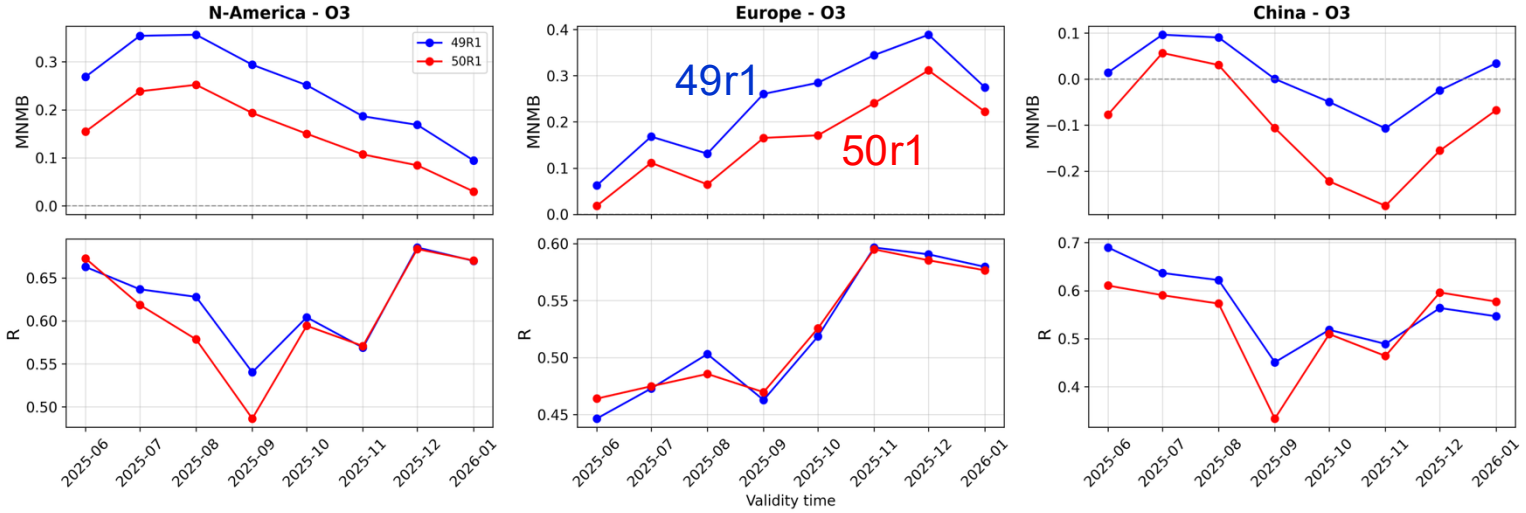
ECMWF

IFS-COMPO: Scores of reactive gases – O_3, NO_2, SO_2, CO

Atmosphere Monitoring Service
atmosphere.copernicus.eu

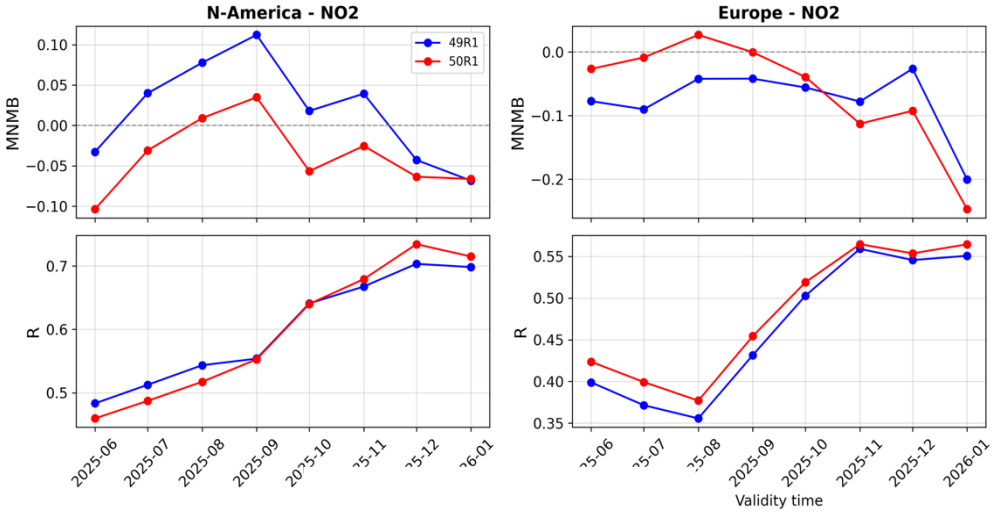
+24h forecasts

O_3

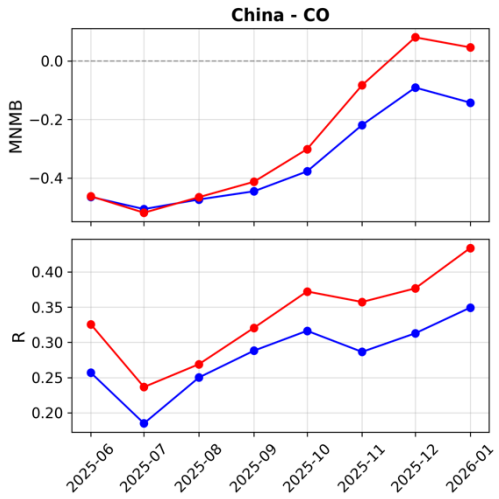


- Lowered surface O_3 concentration with the upgrade in ozone deposition scheme, leading to overall improvement in biases except in China
- General improved correlations for primary species (NO_2, SO_2, CO) with updates in anthropogenic emissions, except high biases of NO_2 in China during summer

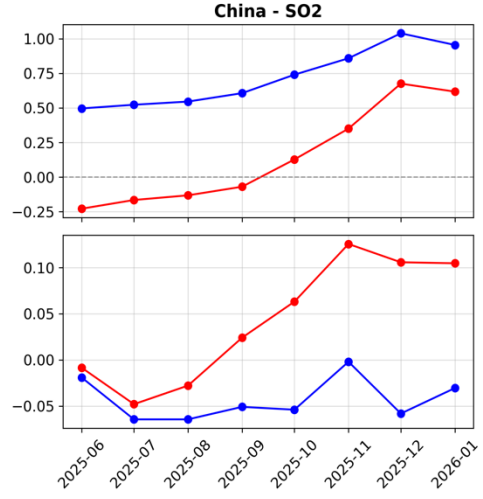
NO_2



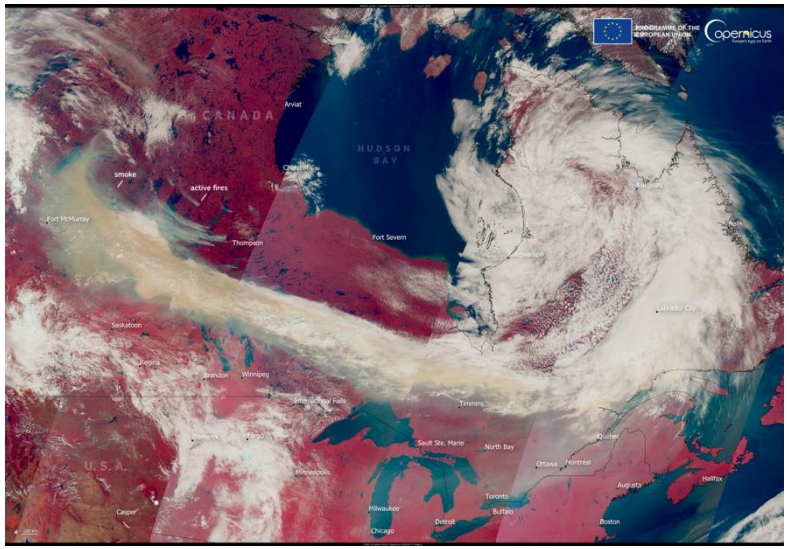
CO



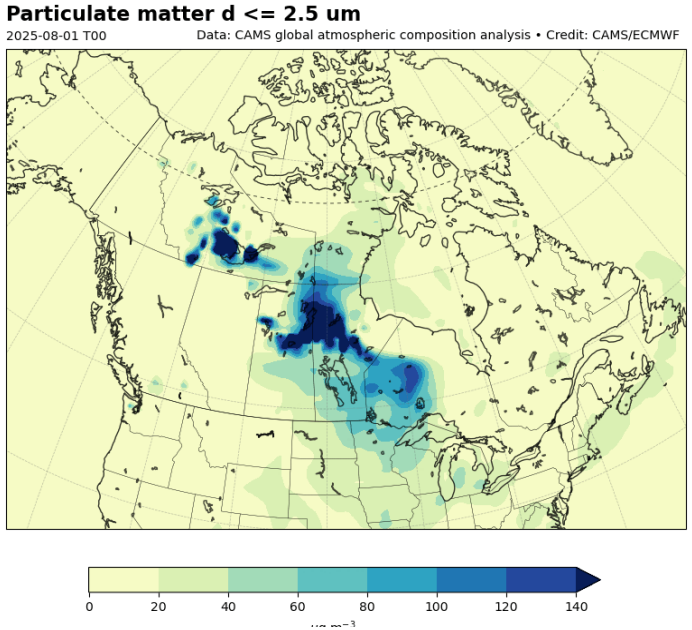
SO_2



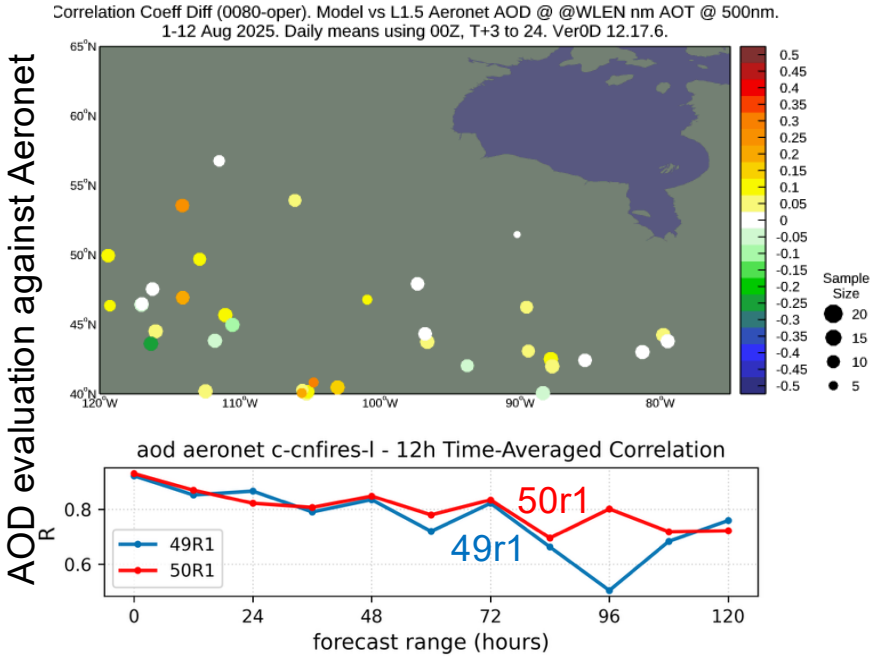
IFS-COMPO case study – North America wildfires on 1-12 August 2025

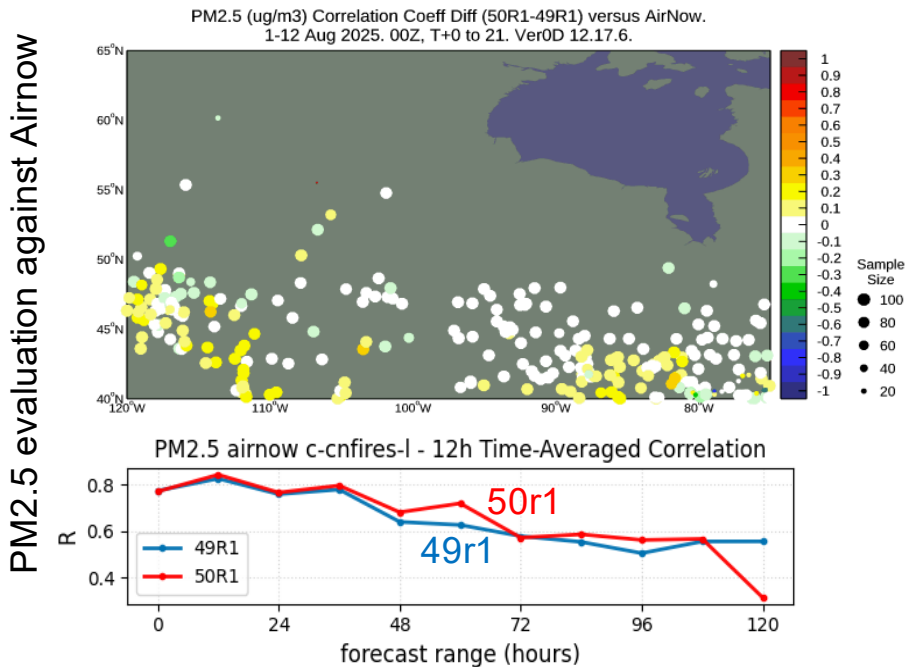


Credit: European Union, Copernicus Sentinel-3 imagery



Improved correlation in AOD and PM2.5 for the first 4 forecast days when forecasting the fire event





Improvement in correlation

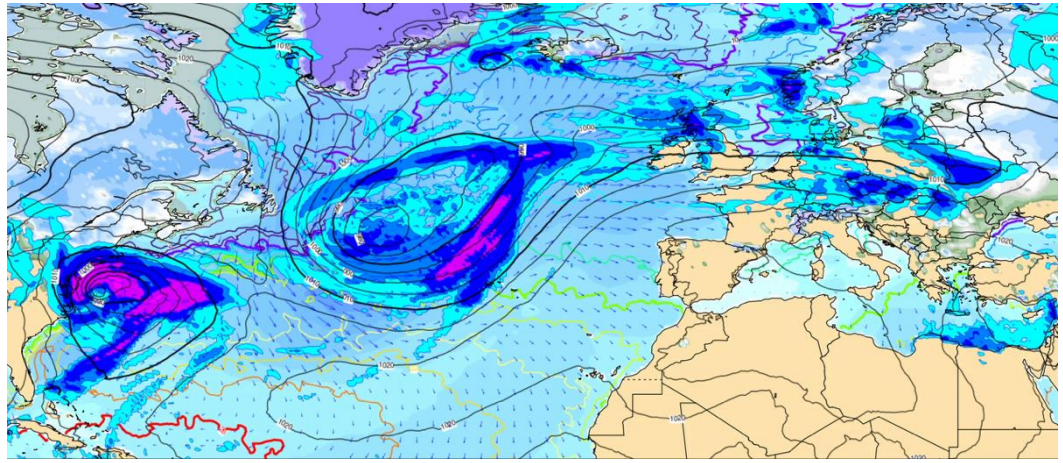
Degradation in correlation

Conclusion

Summary – IFS Cycle 50r1

- New science: Earth System, coupling, more observations, responding to known issues
- Configuration changes and new products: IFS-ENS Control forecast, updates to 06/18UTC runs, new parameters
- Wave in sea ice, snow over sea ice, ocean current impact on waves, full ocean-atmosphere coupling…
- Improvements in convection, precipitation (still issues with light precipitation), surface parameters, reduced excessive wind spread, slightly improved tropical cyclone (intensity)… in medium-range IFS-ENS.
- Reduced SST biases, including Western Boundary Currents
- Improvements in ocean, stratosphere, and MJO in sub-seasonal IFS-SUBS.
- Improved scores for ozone and primary species in IFS-COMPO (CAMS); reduced bias in IFS-GHG (not shown).

NWP CAMS



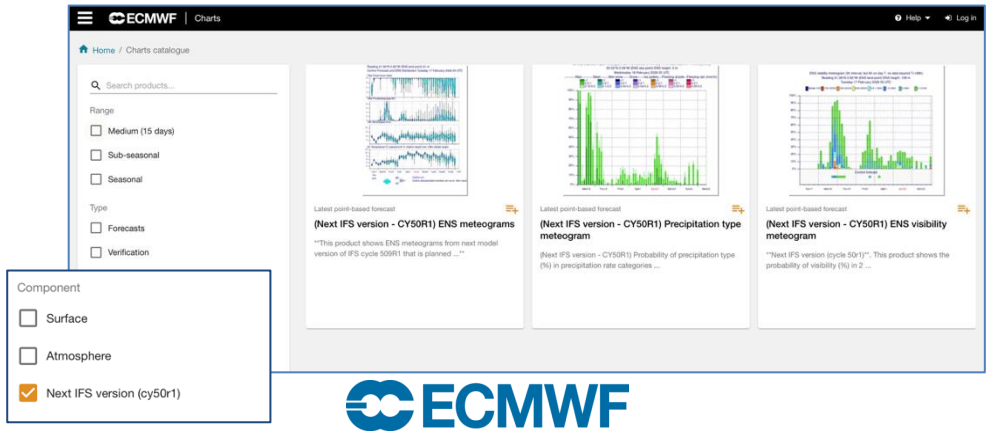
Release candidate phase just started !

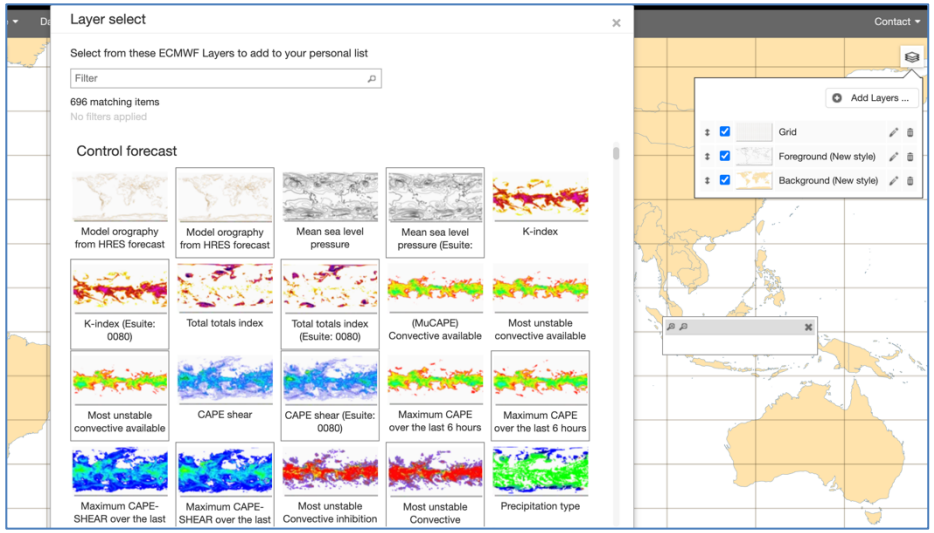
Accessing IFS Cycle 50r1 e-suite forecasts

NWP

CAMS

- Study the IFS 50r1 Implementation pages
- Datasets available for now: IFS-ENS (no EFI/SOT & Tropical Cyclones yet)
- Experiment version **80**
- Registered users can get e-suite data via dissemination - details on Implementation page
  - Contact Data Support if help needed (https://support.ecmwf.int).
- Non-registered users can access e-suite in OpenData (https://data.ecmwf.int/forecasts/testdata/)
- Graphical products available on OpenCharts and ecCharts
- **Data webinar on 12 March 2026**





Please provide feedback or report issues via the ECMWF Support Portal

Thank you for your attention !

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