

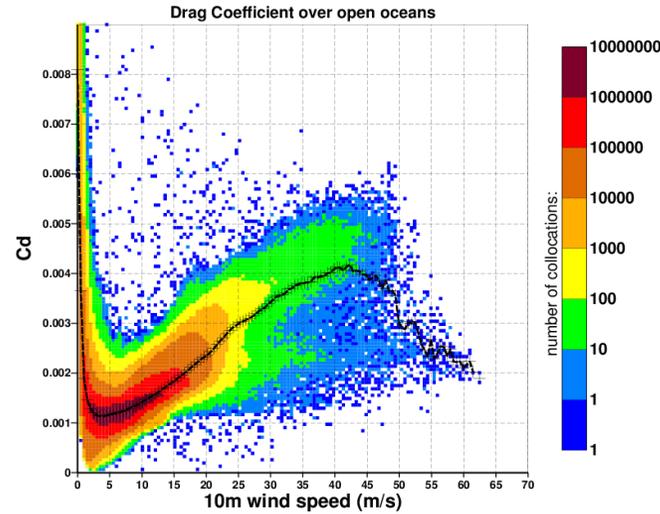
ECMWF Progress in Tropical Cyclone Forecasts

Linus Magnusson, Fernando Prates & Sharan Majumdar

Cycle 47r1: Changes in the Drag Coefficient

See <https://www.ecmwf.int/en/newsletter/164/meteorology/enhancing-tropical-cyclone-wind-forecasts>

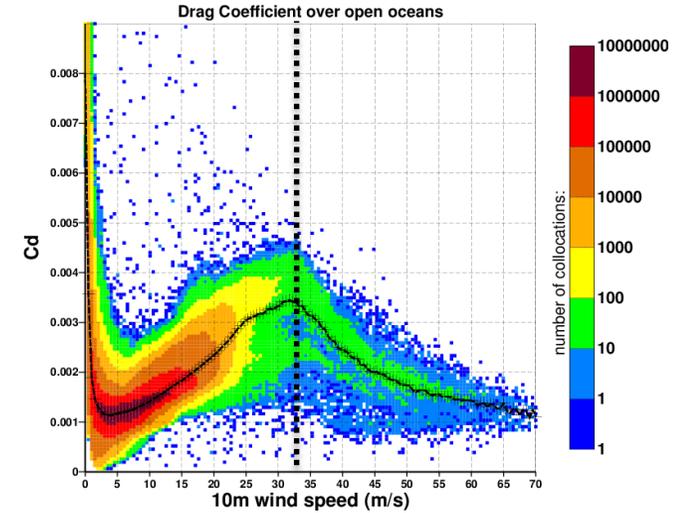
46r1



TCo1999 forecast
h5jx from 20170904 step 6 to 240 by 6

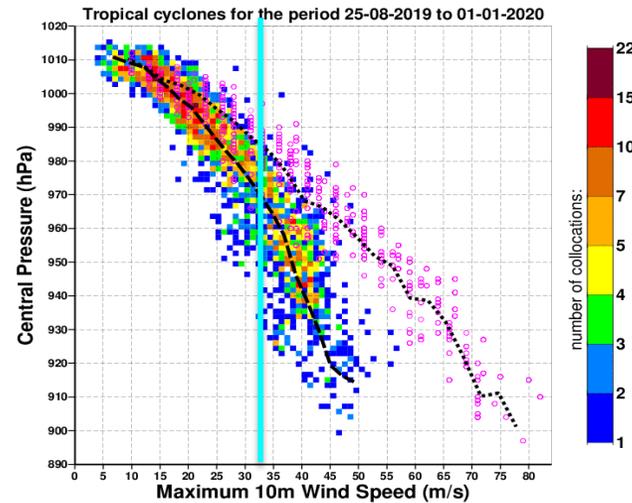
Drag Coefficient & 10 m winds
Tco1999 2017-09-04 00Z +240h
during Hurricane Irma

47r1



TCo1999 forecast
h517 from 20170904 step 6 to 240 by 6

46r1

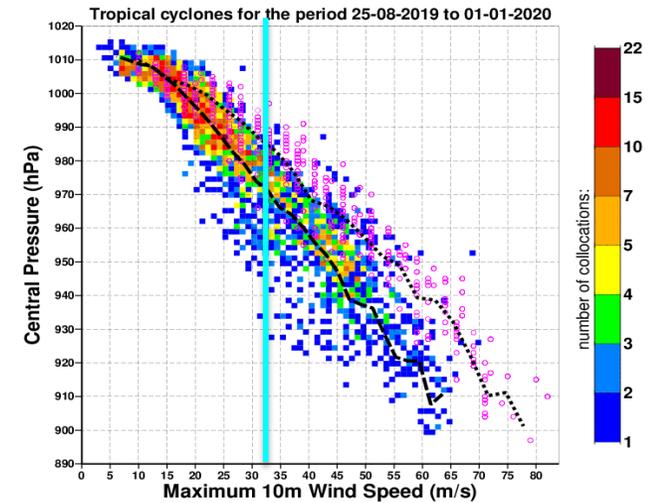


Colour shading and dashed line: TCo1279 forecasts (h9s0), all forecasts initialised from 0 UTC.
Pink symbols and dotted line: Best Track data.

Minimum mslp & Max 10m winds
Tco1279; 25 Aug 2019 to 1Jan 2020

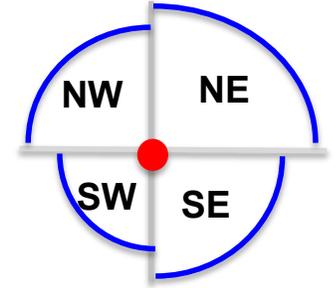
pink squares: Best track data
other colour squares: Tco1279 +240h

47r1

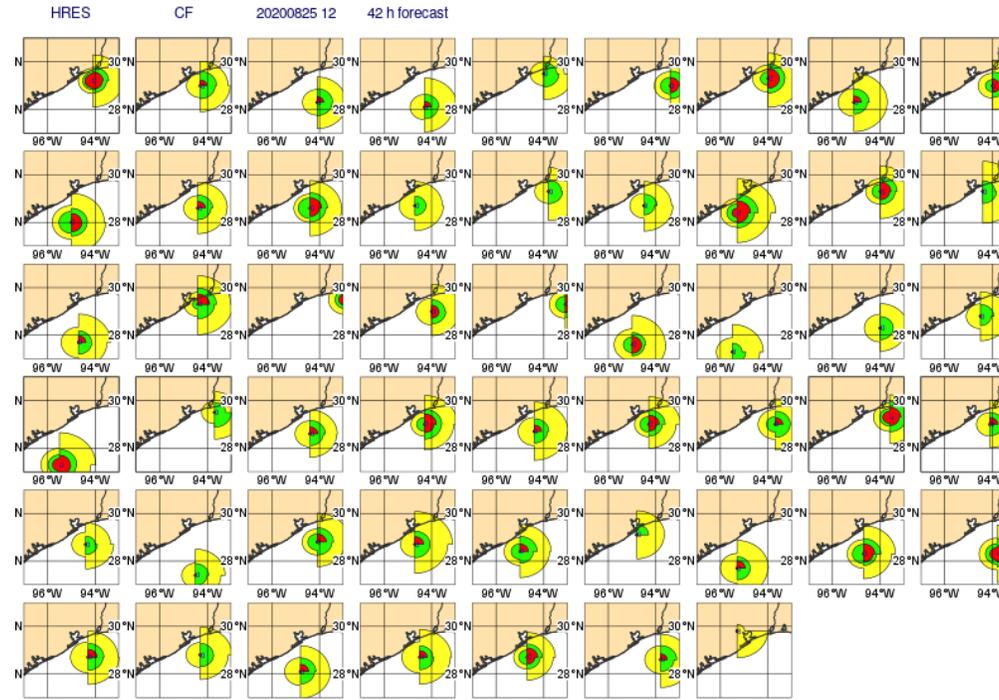


Colour shading and dashed line: TCo1279 forecasts (h9s3), all forecasts initialised from 0 UTC.
Pink symbols and dotted line: Best Track data.

NEW Tropical Cyclone Size: Wind Radii (34-, 50- & 64-kts)



- Radii: maximum extent of 10-m wind thresholds (34-, 50- & 64-kn) in each quadrant (NE, SE, SW & NW) from the TC centre.



w radii (nmi)

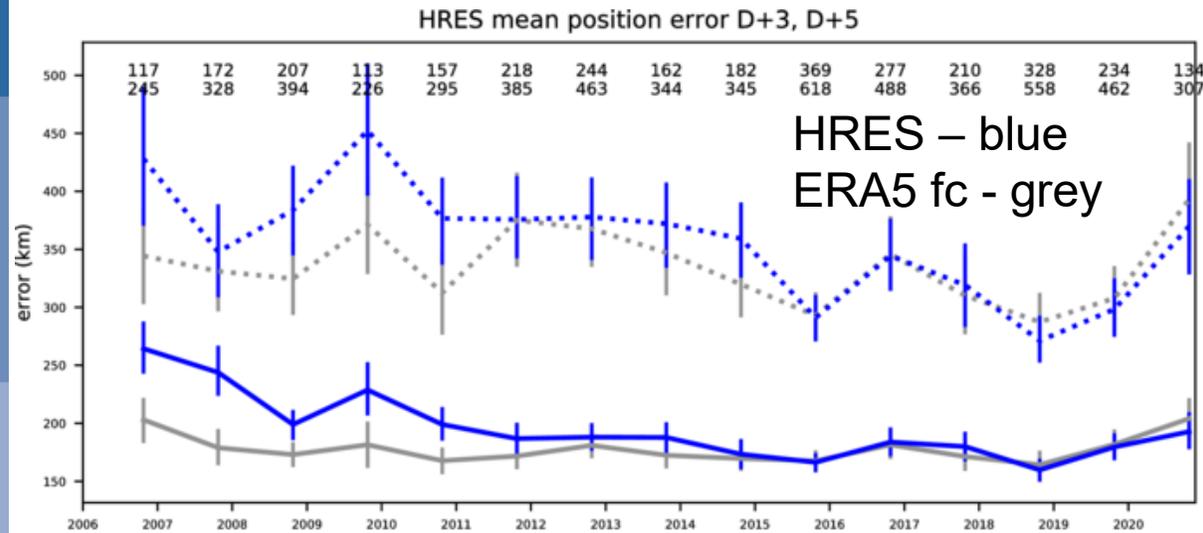
64-kn

50-kn

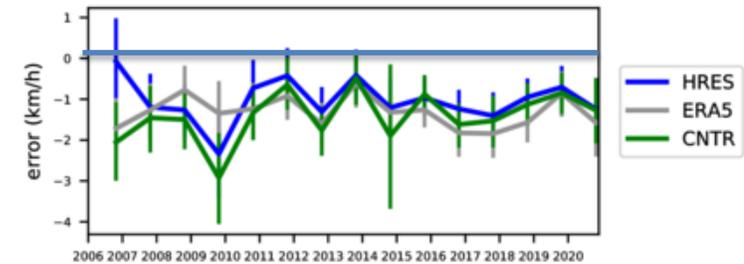
34-kn

- Product available for the HRES and ENS (all TCs in analysis and those that develop during the forecast –'genesis')
 - **BUFR message for dissemination** <https://confluence.ecmwf.int/display/FCST/Implementation+of+IFS+Cycle+47r1> (under "WMO essential")
- More information in <https://confluence.ecmwf.int/display/FCST/New+Tropical+Cyclone+Wind+Radii+product>

Operational tropical statistics by year (Nov-Nov), preliminary figure

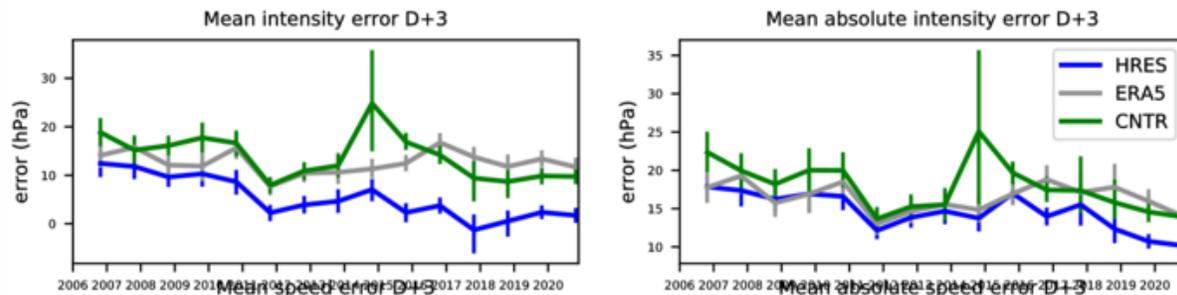
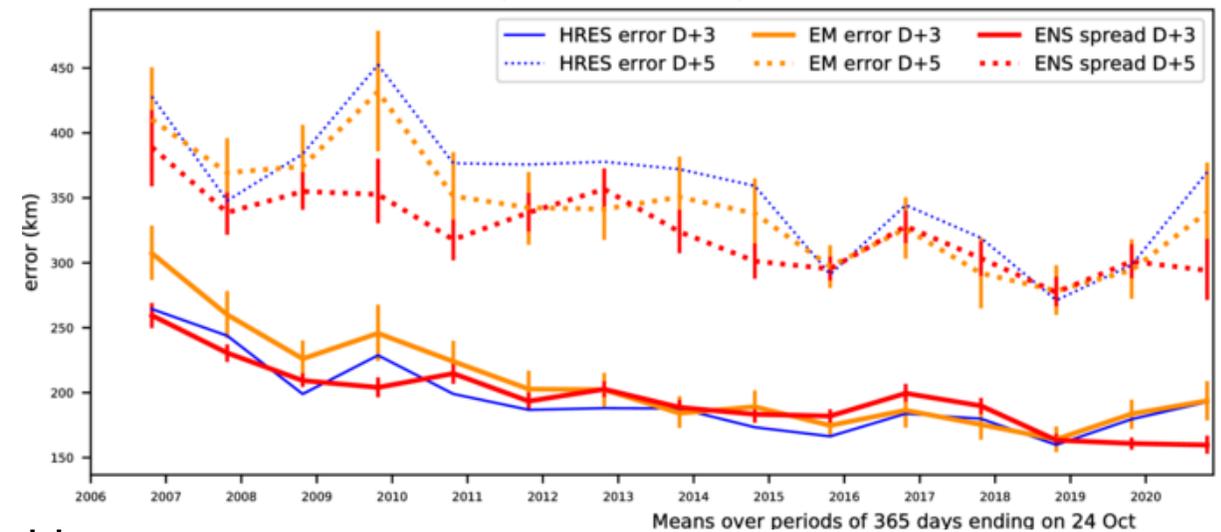


Propagation speed bias



HRES, EM and ensemble spread

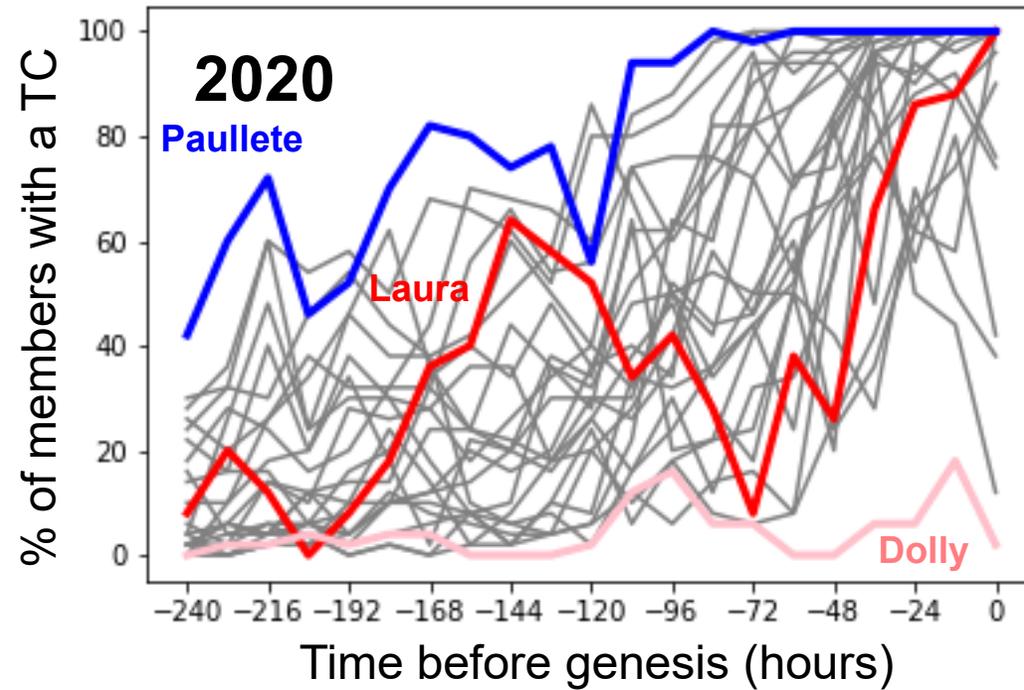
EM mean position error and ENS spread D+3, D+5



Key messages:

- Last year more difficult – not captured by ensemble
- Persistent slow propagation bias
- Intensity steadily improves

Diagnostics of TC genesis probabilities

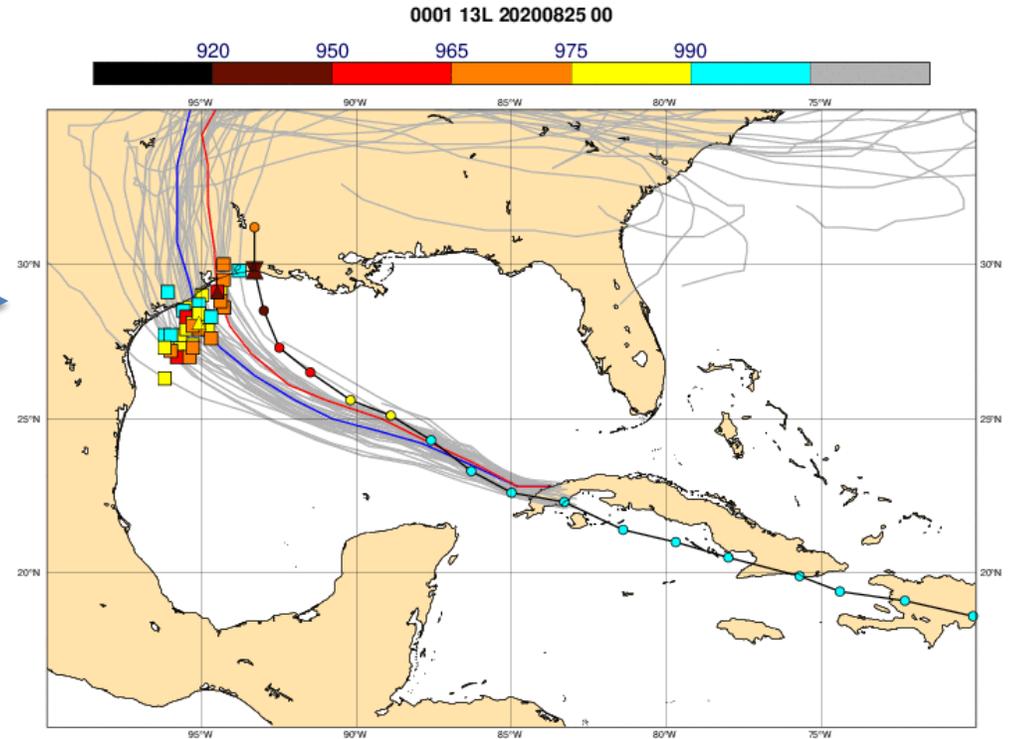
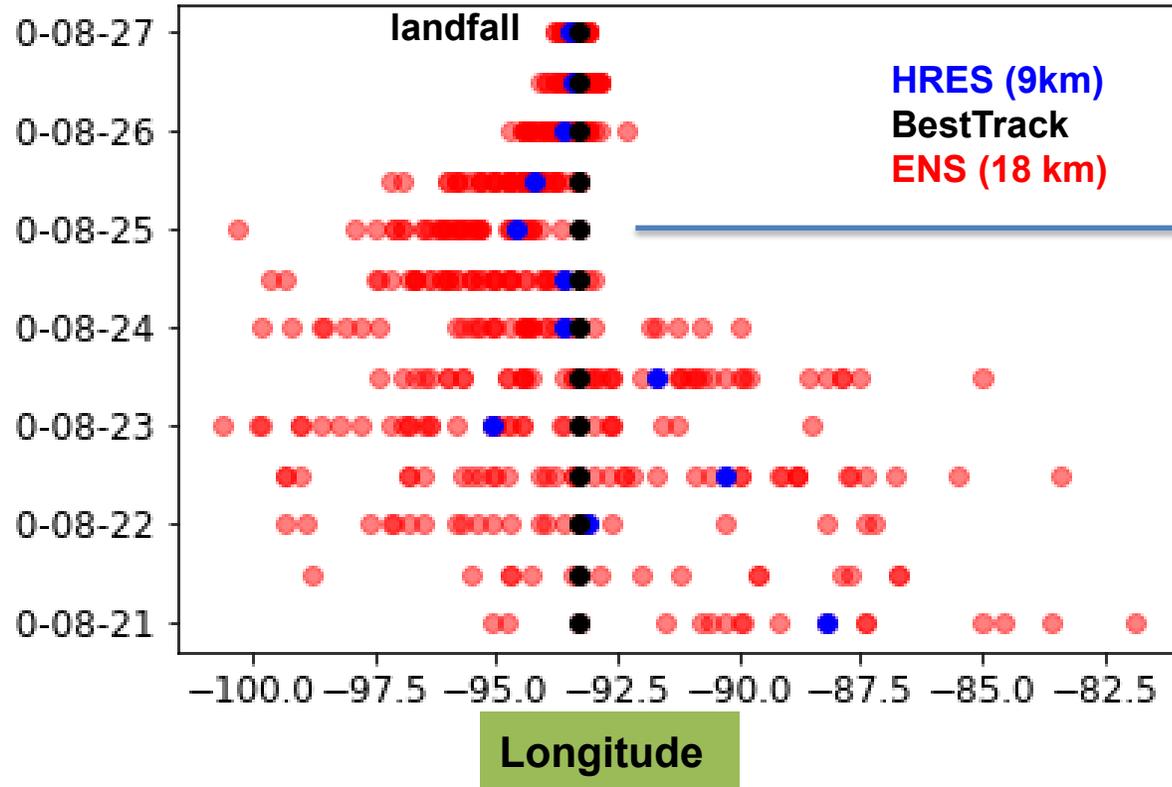


(Fraction of ensemble with cyclone within 300 km of the genesis position, +/-2 days)

Verification of landfall forecasts for TC Laura

Longitude for crossing 30N
0001

Forecast start dates

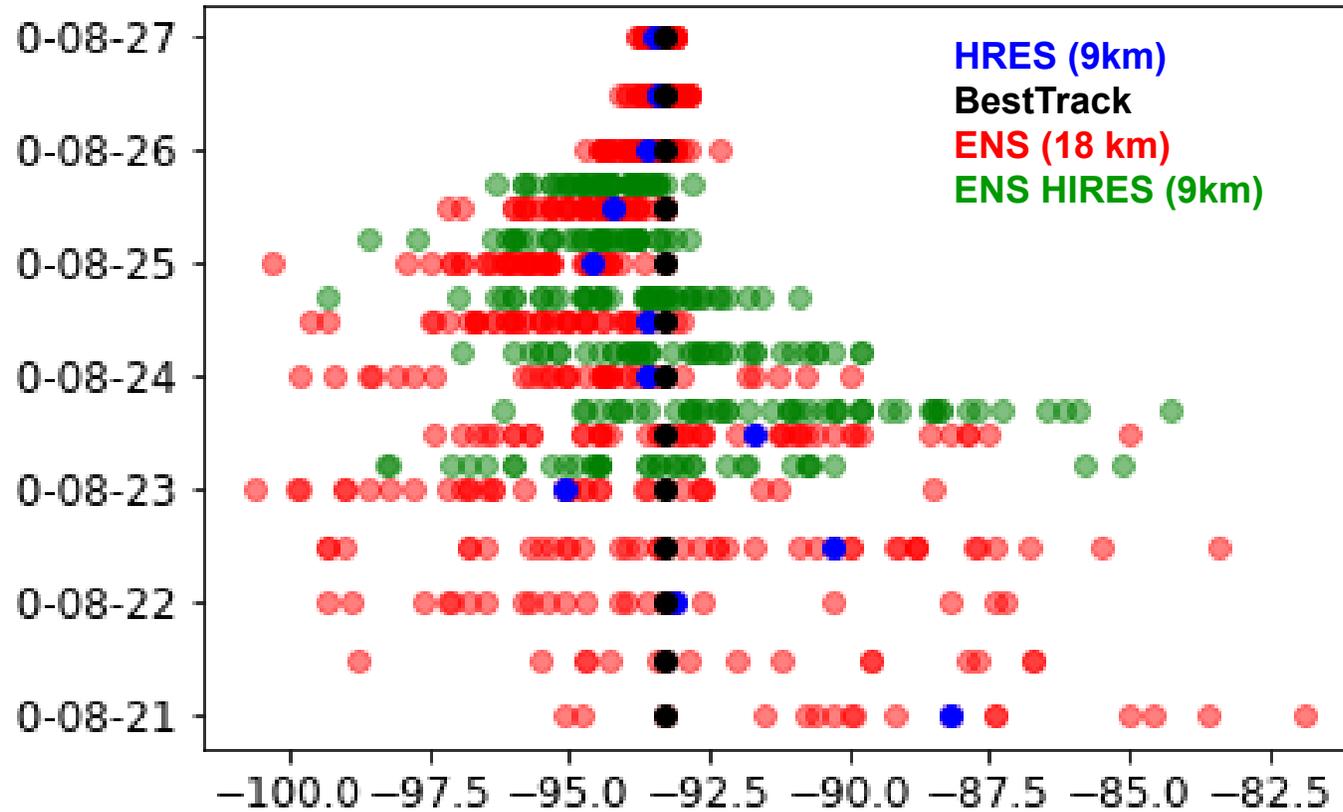


symbols: ENS positions VT: 27@00

- Flip-flop from 22 Aug to 24 Aug
- Too far west 24 Aug – 25 Aug 12UTC

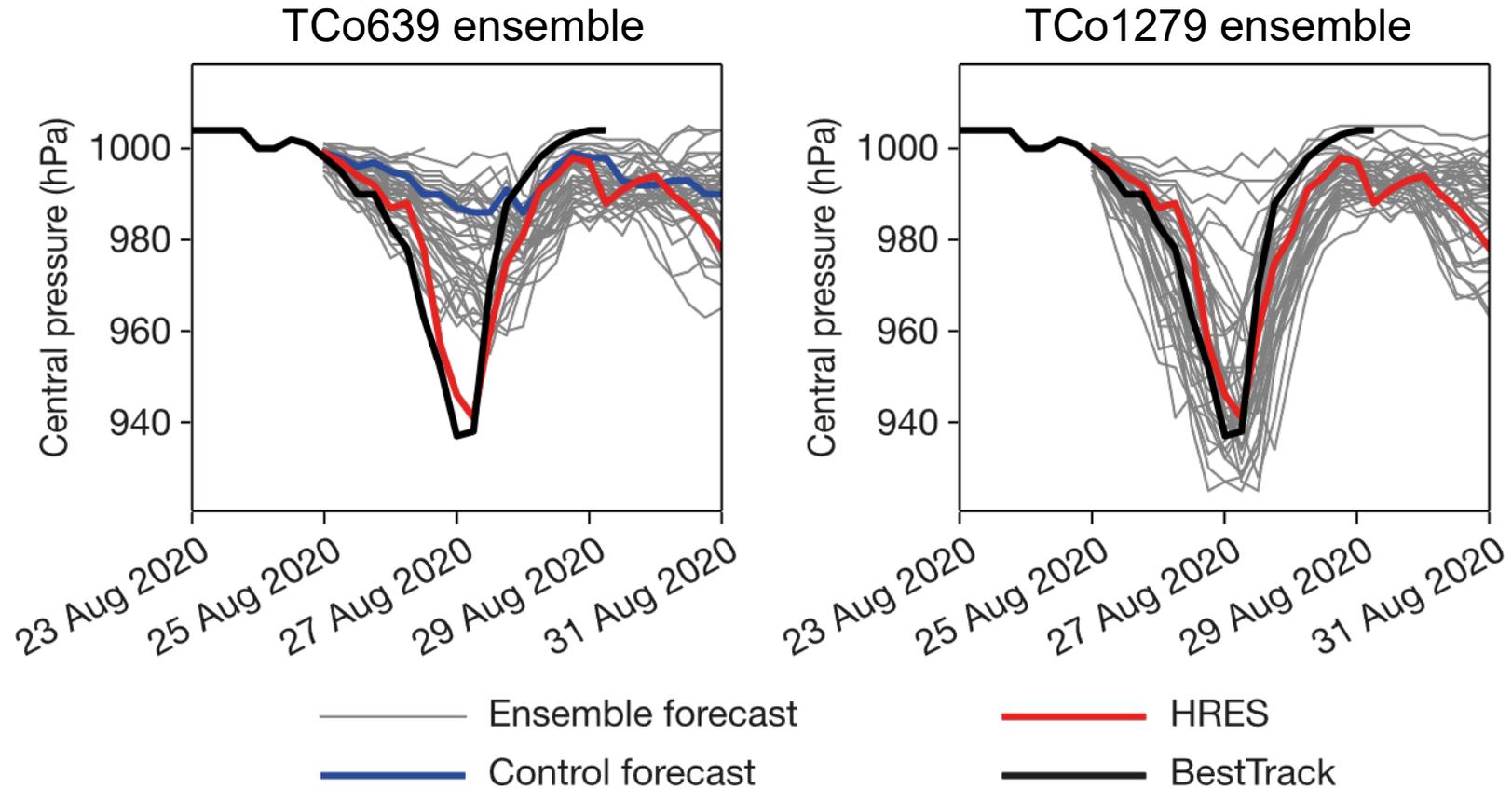
Summary **EC OPER** (T639) / **EC HIRES** (T1279) ensemble

Thanks to Simon Lang



Interesting systematic shift to the right in few model runs

Intensity forecasts for TC Laura



Summary

- Improve wind-pressure relation this year
- Propagation speed still an issue (Isaias example this year)
- TC Laura challenging, ECMWF has archived full vertical resolution to facilitate further investigation
- A lot of open questions around genesis predictability

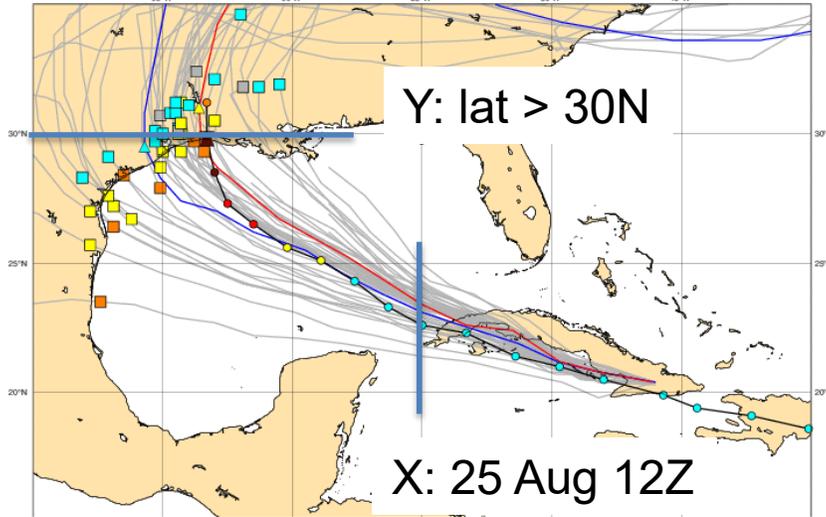
- Increased vertical resolution for the ensemble planned for 2021

- Research to determine how to spend new computer resources in 2022 – high-resolution ensemble an option

Track for TC Laura – 24 August 00UTC

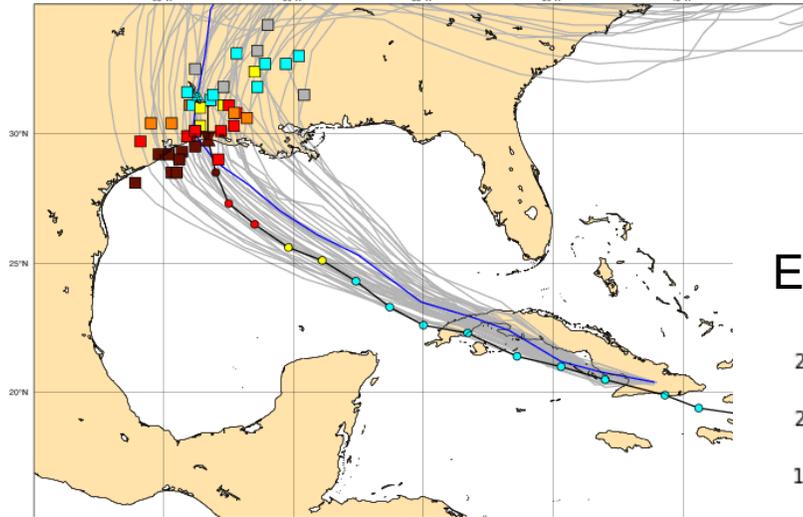
EC OPER

0001 13L 20200824 00



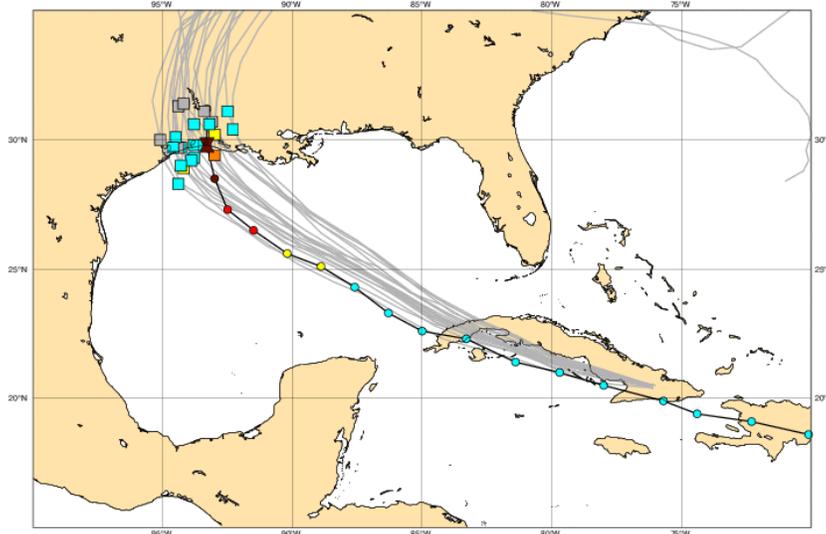
EC HIRES (thanks to Simon Lang)

hgap 13L 20200824 00



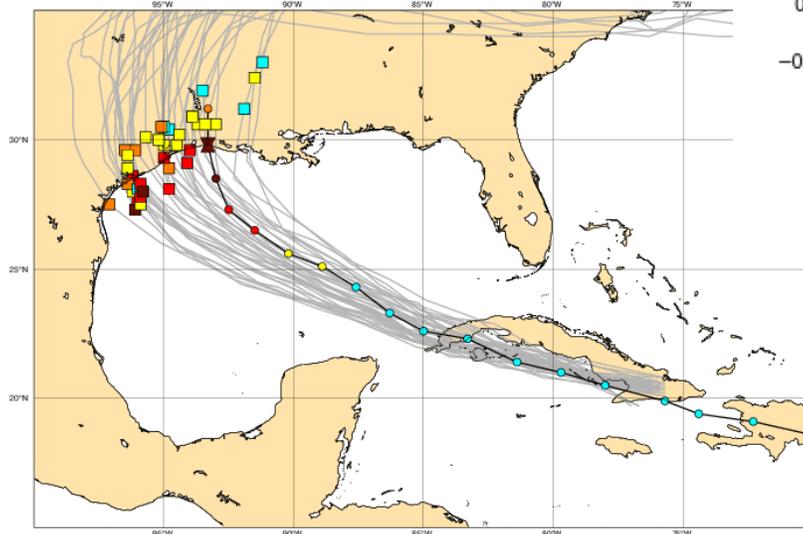
NCEP

GEFS 13L 20200824 00

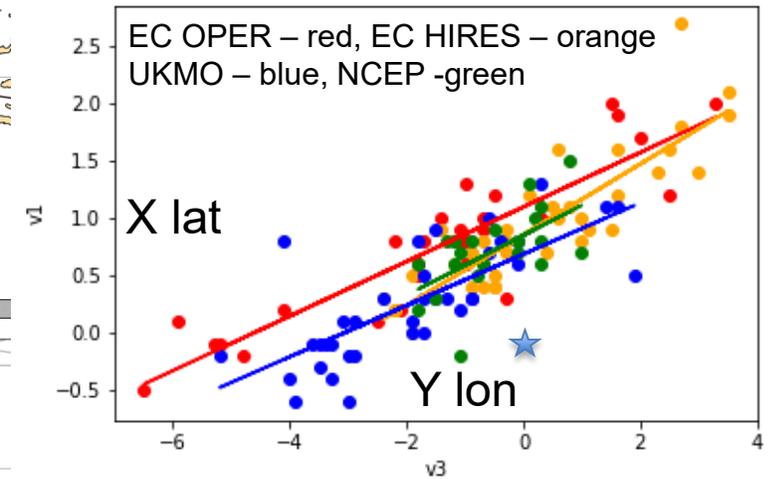


UKMO

mogreps 13L 20200824 00

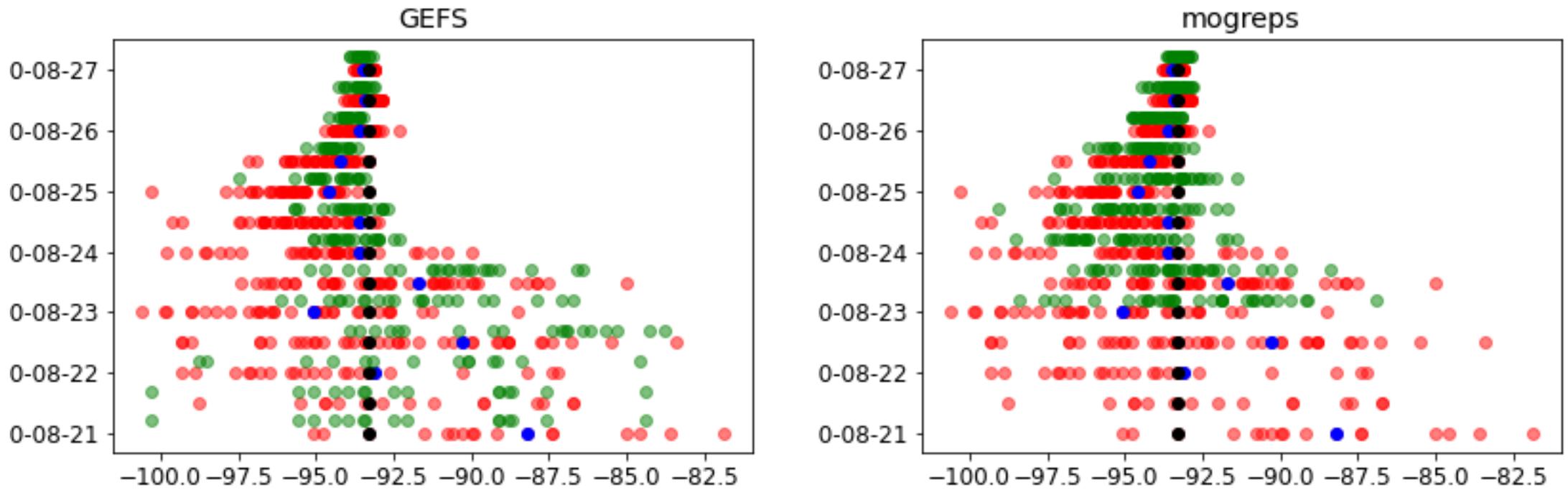


Errors for two points along the tracks



NCEP and UKMO
ensembles from TIGGE-Tc
thanks to Fernando

Forecasts for TC Laura

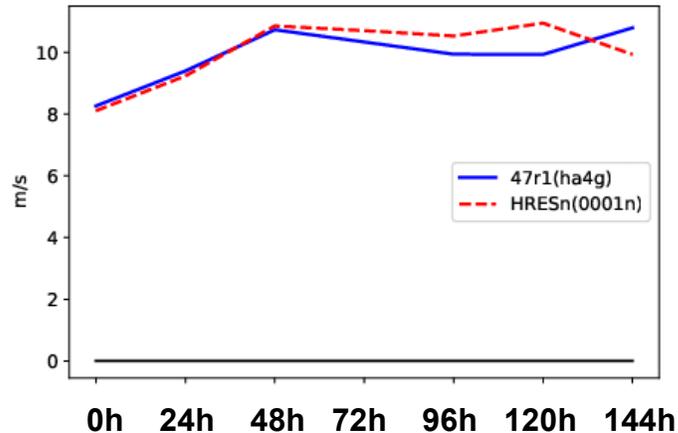


(ECMWF ENS – red, ECMWF HRES - blue)

Cycle 47r1: Impact on the Maximum wind speed in TC forecast (HRES)

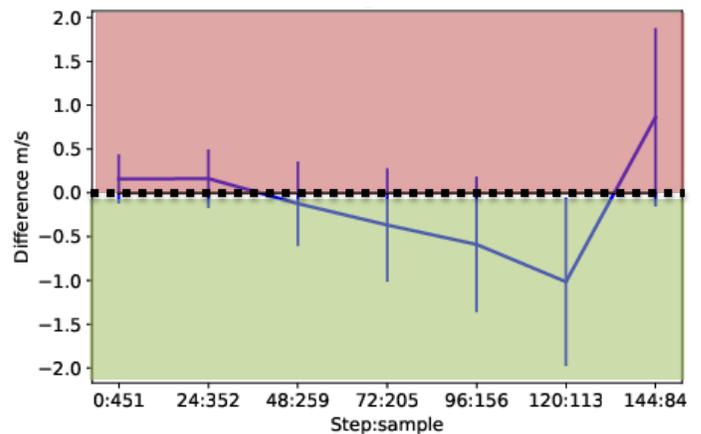
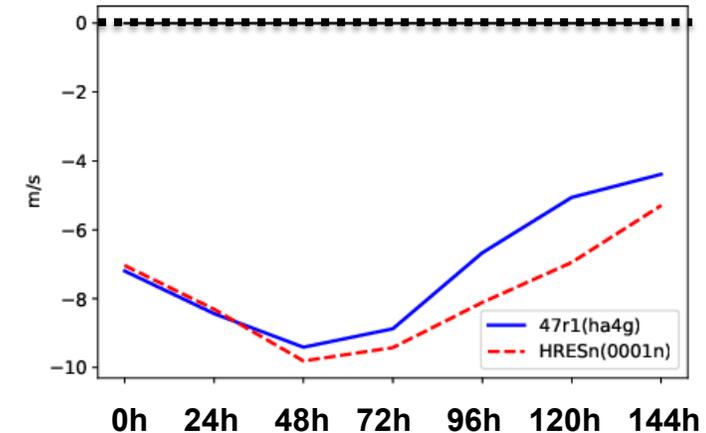
units: m/s

Mean Absolute Vmax error



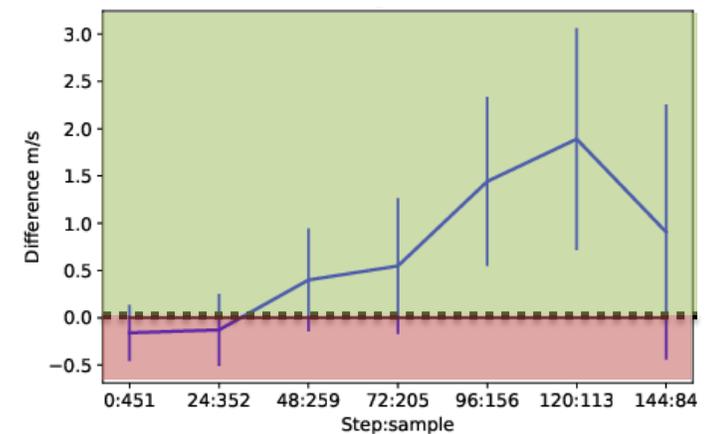
**Verification period
15 July - 31 Oct 2019
47r1 & 46r1**

Mean Vmax error (bias)



47r1 better than 46r1
 47r1 worse than 46r1

**homogeneous sample
Vertical bars : 95% CI**

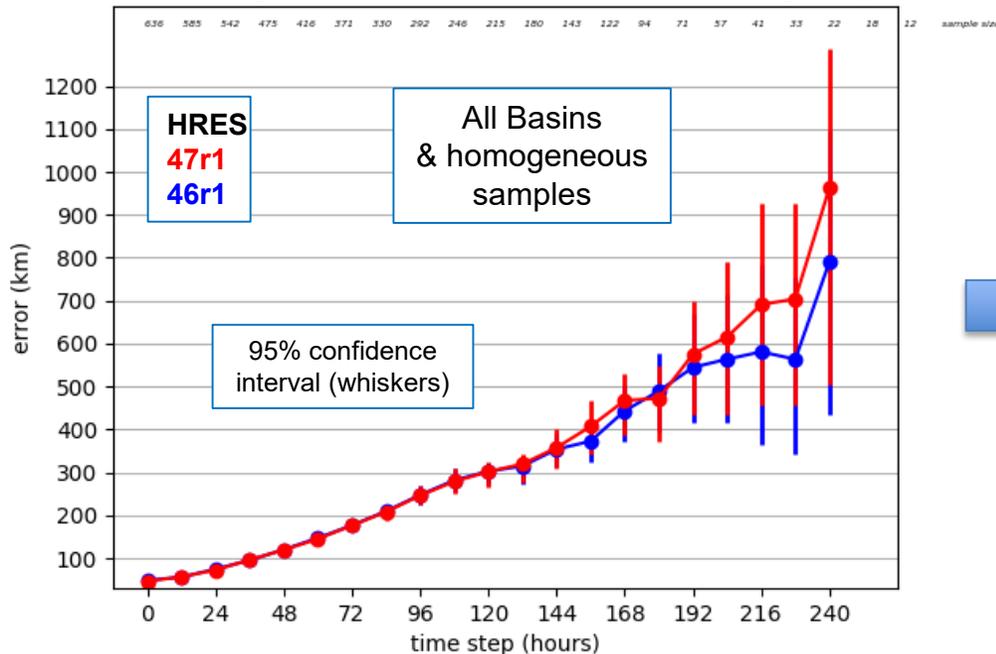


Cycle 47r1: Meteorological impact (HRES)

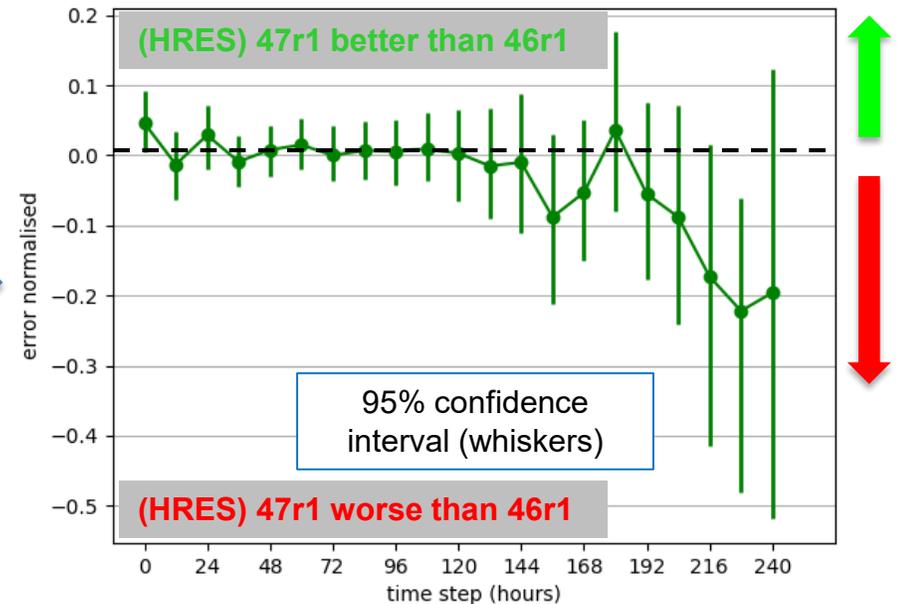
<https://confluence.ecmwf.int/display/FCST/Implementation+of+IFS+Cycle+47r1#ImplementationofIFSCycle47r1-Meteorologicalimpact>

- “Verification against observations shows that upper-air changes in the tropics are overall neutral”

Mean position forecast error (km)

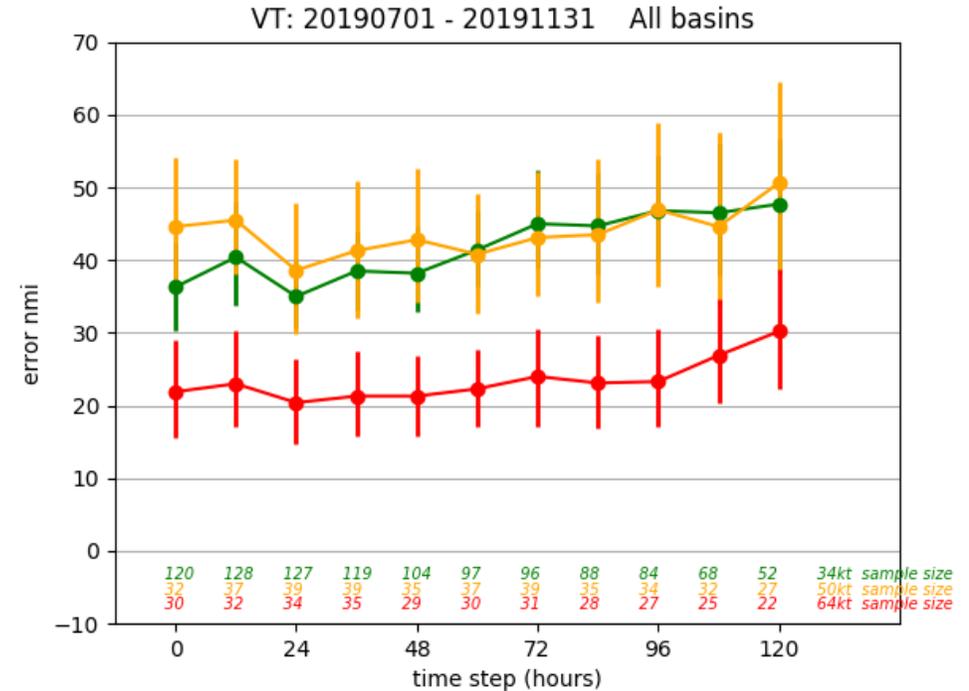
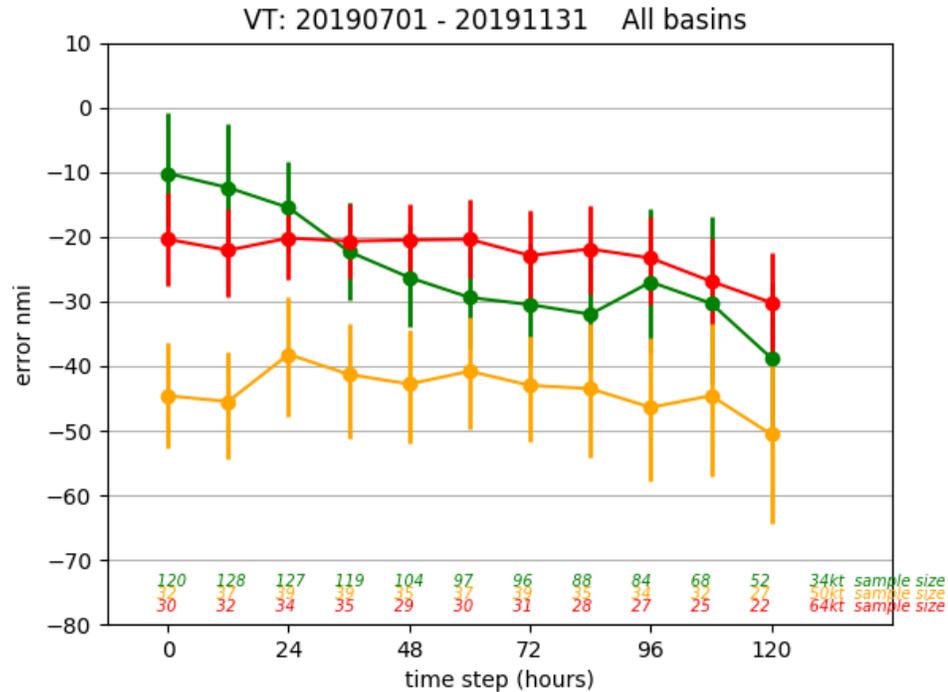


Normalised mean error difference (%)



Wind Radii Forecast performance – preliminary results

basins: N Atl/ E Pac/ W Pac



HRES mean error (bias)
error (nmi) of 34-, 50- & 64-kt wind thresholds

HRES mean absolute error
error (nmi) of 34-, 50- & 64-kt wind thresholds

34-kt (W Pac/ E Pac/ N Atl)
50- & 64-kt (E Pac/ N Atl)

See the article in the Newsletter last summer