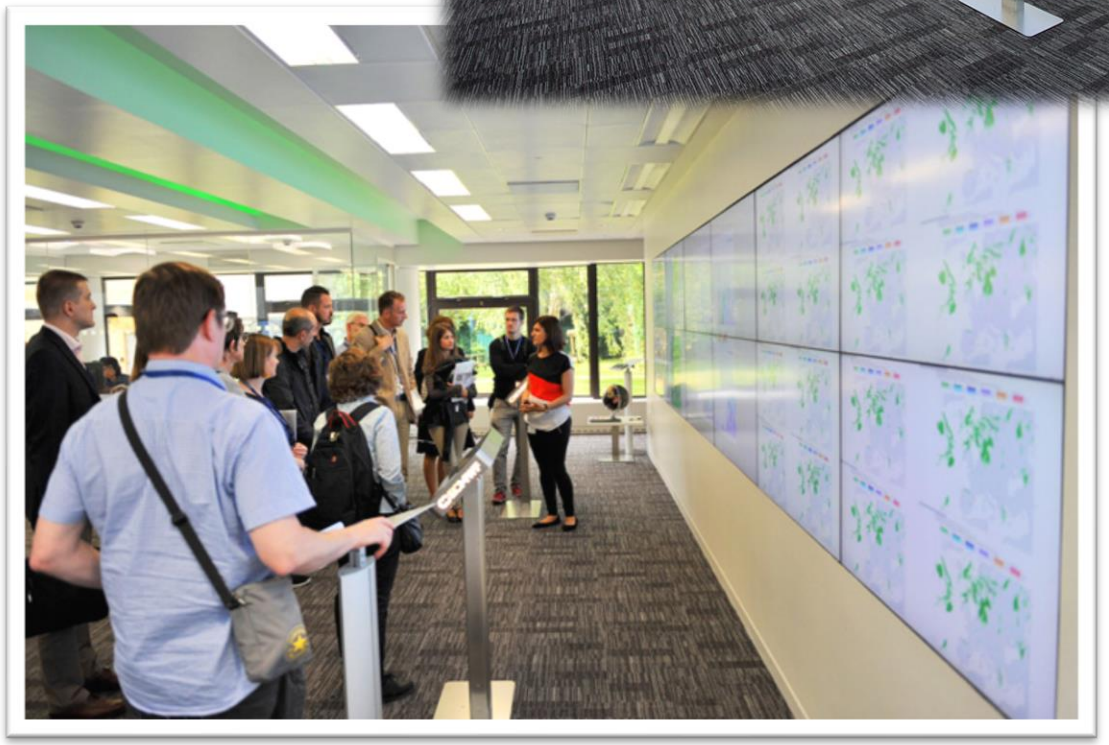
ECMWF Daily Monitoring

Estibaliz Gascon, ECMWF Evaluation section
estibaliz.gascon@ecmwf.int

UEF 2021, 1-4 June 2021



ECMWF

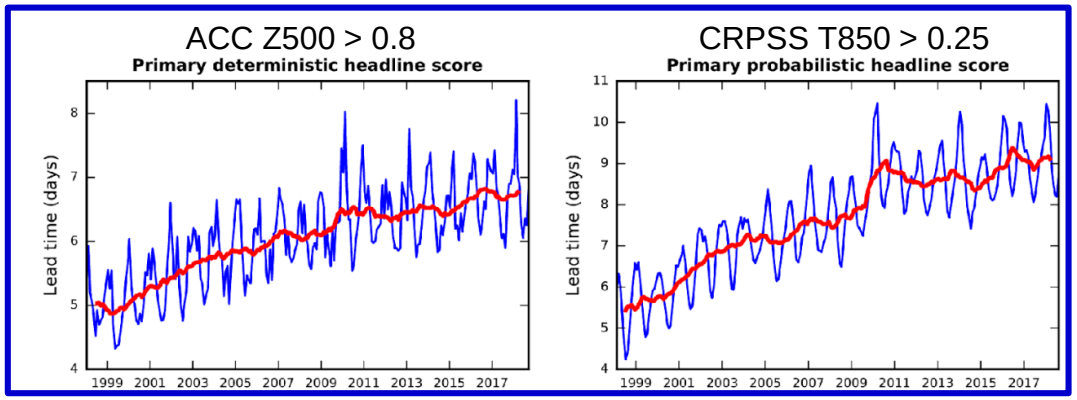
Basic motivations for forecast evaluation

- Monitor the evolution of forecast performance - **management**
- Evaluate new model versions – **avoid future problems**
- Scout for error – **direct future improvements**
- Quickly understand reported errors – **firefighting**
- Learn about the forecast performance in general – **Battlespace awareness**

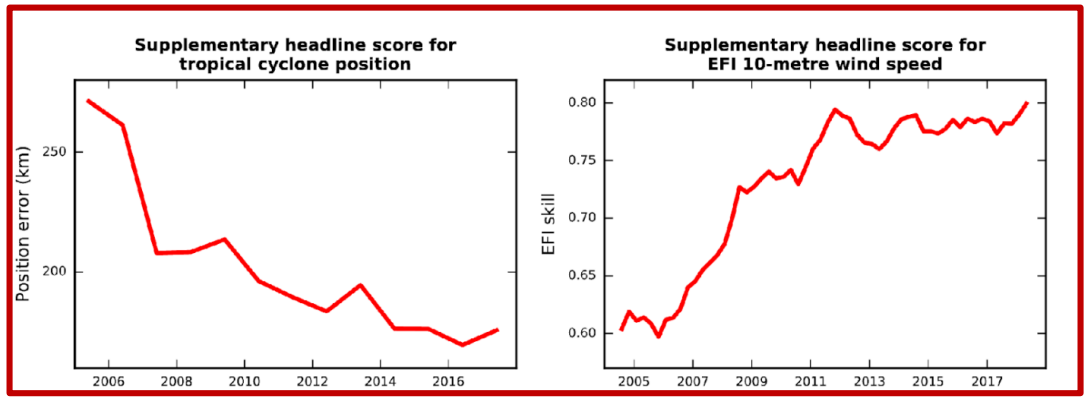
For this one need a wide range of diagnostic tools, verification metrics and a broad understanding of the forecasting system

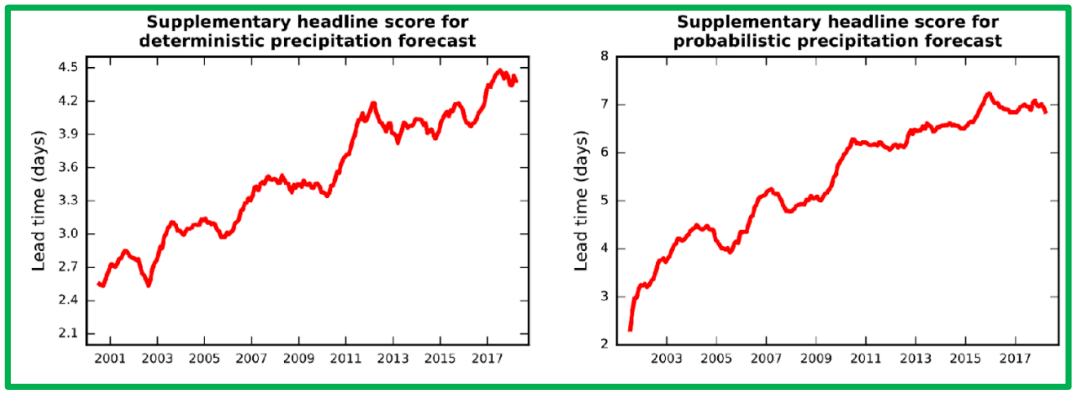
ECMWF headline scores

Upper-air (HRES and ENS)

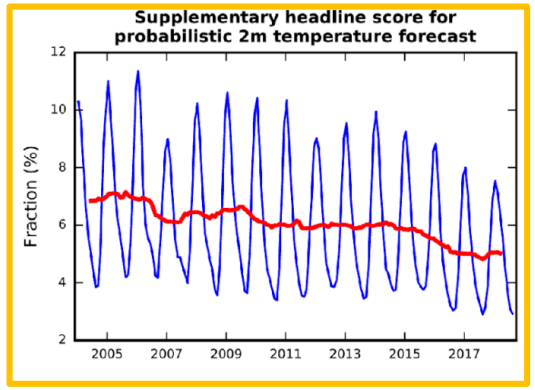


TC position (HRES) and strong winds (ENS)

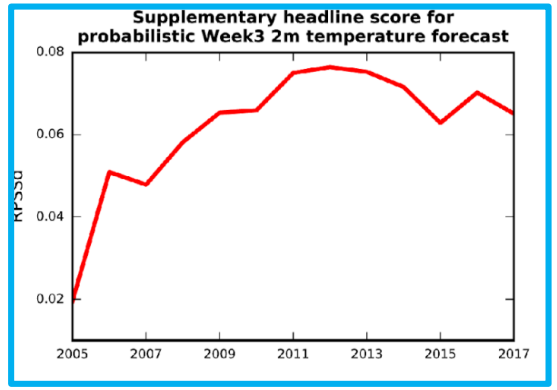




Precipitation (HRES and ENS)



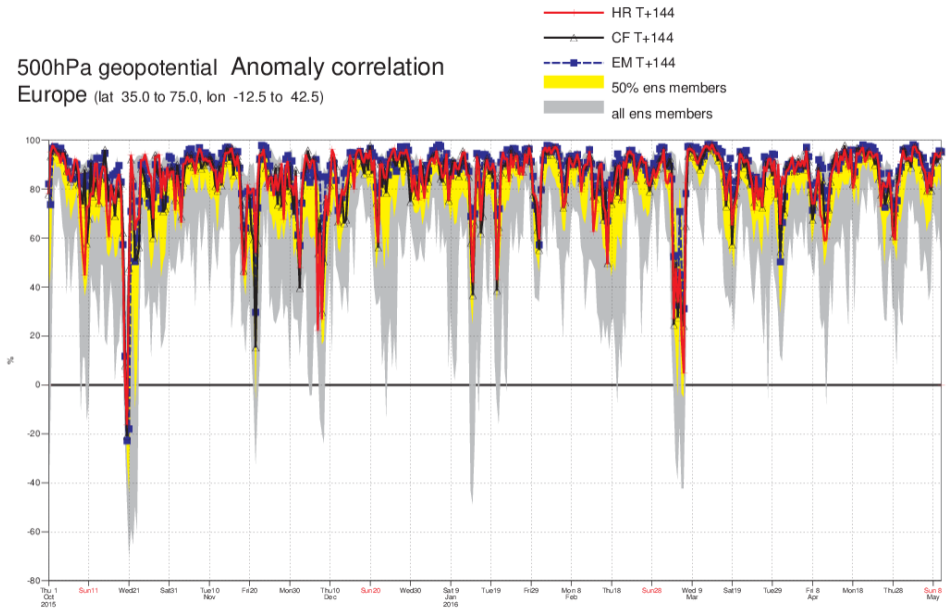
New: Number of large T2m errors (ENS)



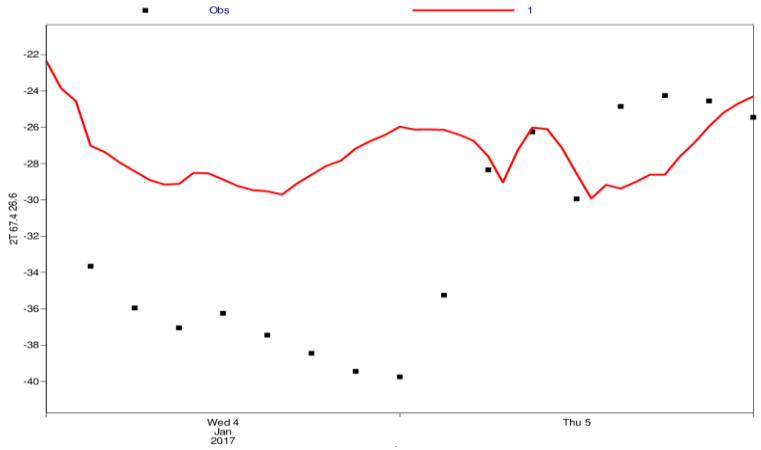
New: Week3 T2m anomalies (ENS)

But the performance is much more than seasonal average RMSE for z500…

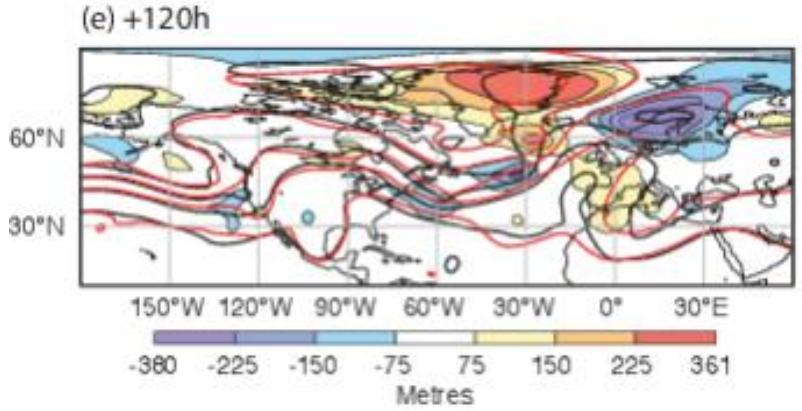
Daily Z500 scores over Europe



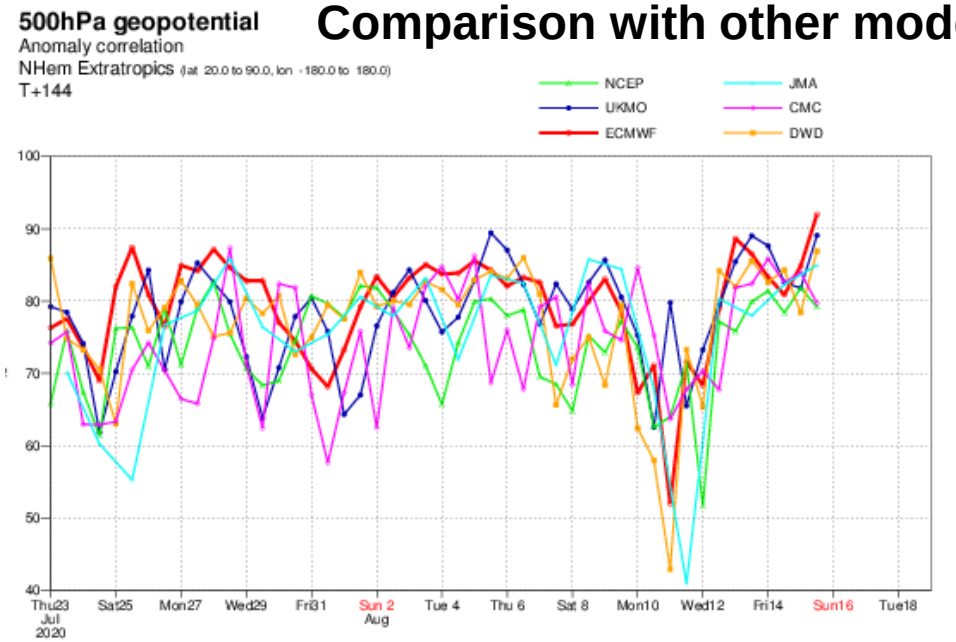
2-metre temperature a winter day over Sodankyla



Example of large error ("bust")



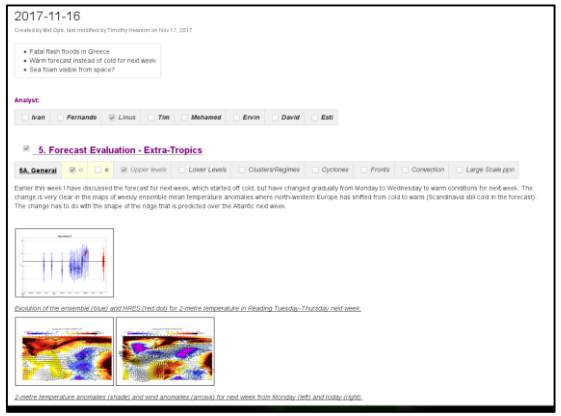
Comparison with other model centres



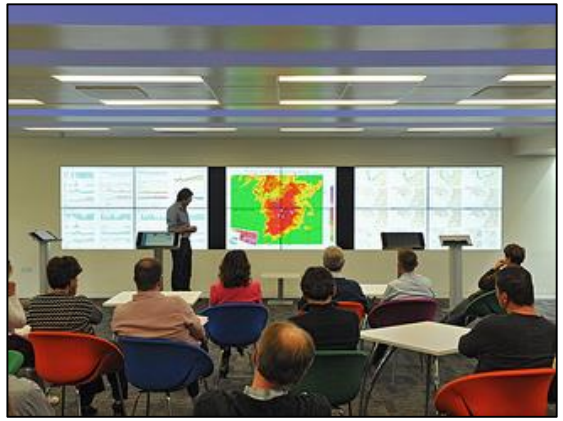
Questions from users

Forecast quality monitoring at ECMWF

Daily report

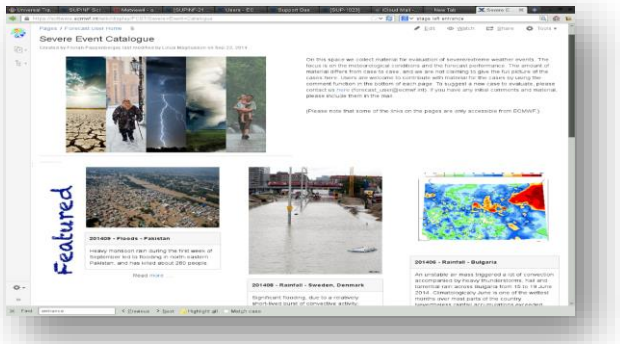


Weekly weather discussions



Quarterly evaluation and development meeting

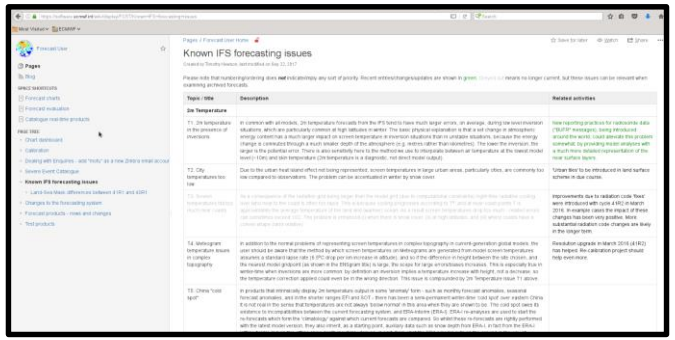
Severe event catalogue



New model cycles

Research activities

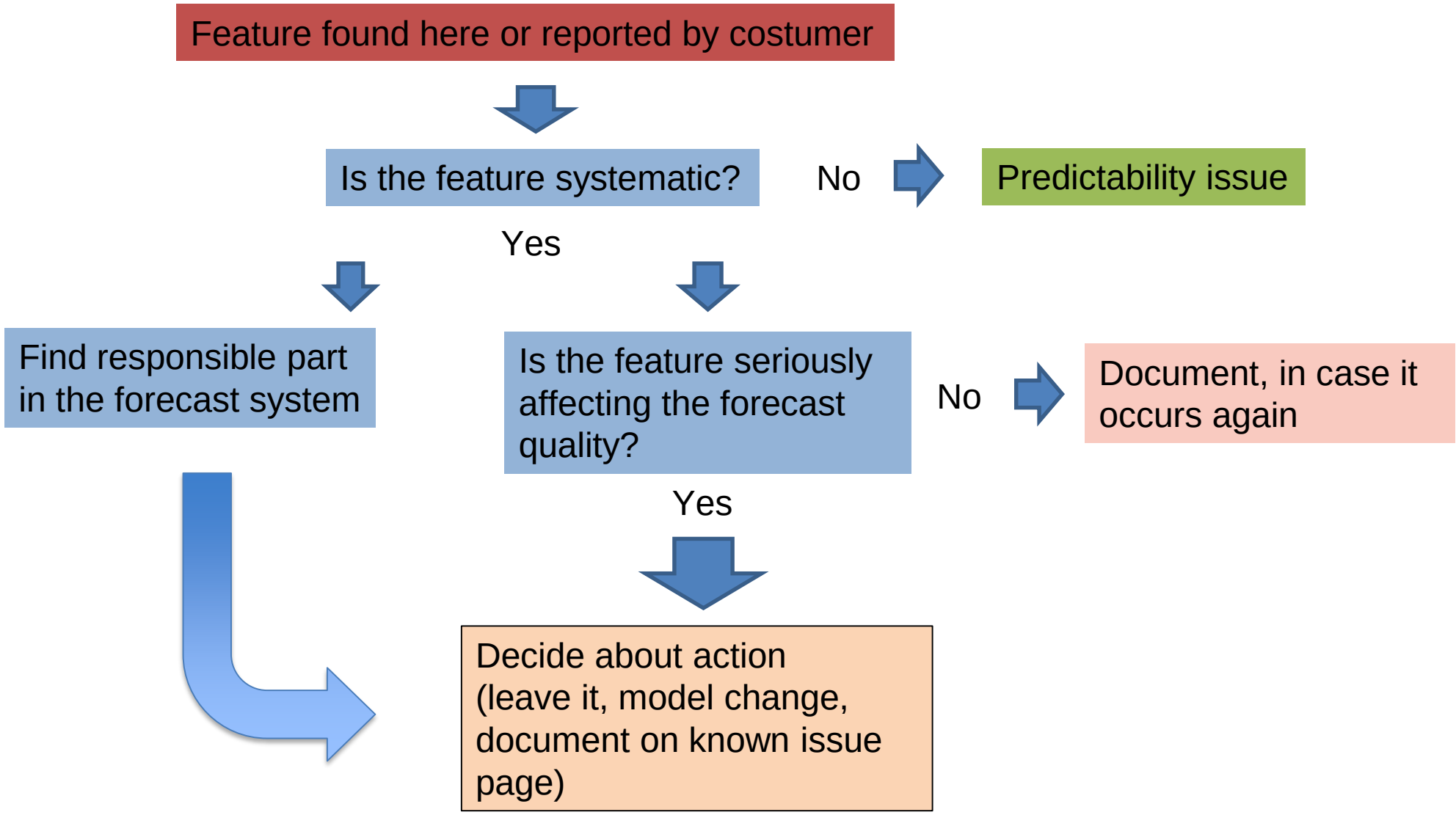
Known forecast issues



ECMWF

Know the Daily Report analysts

Workflow for investigating forecast issues



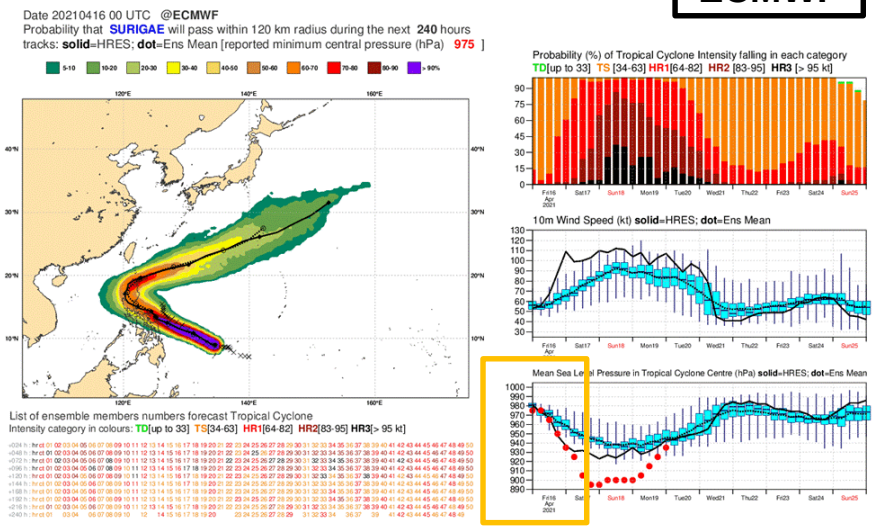
An example of a daily report topic:

Surigae Tropical Cyclone
April 2021

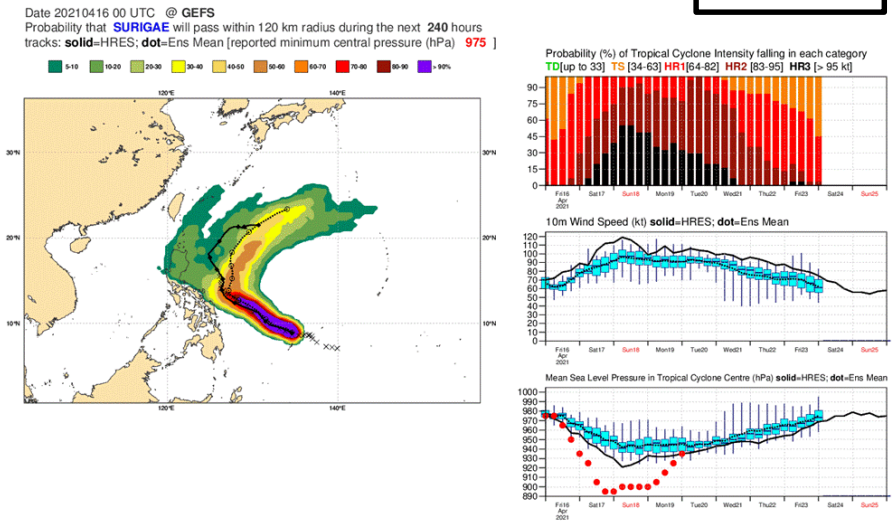
Comparing different Centres

1) Best Rapid intensification (Friday) - HRES
2) Best track forecast - GFS

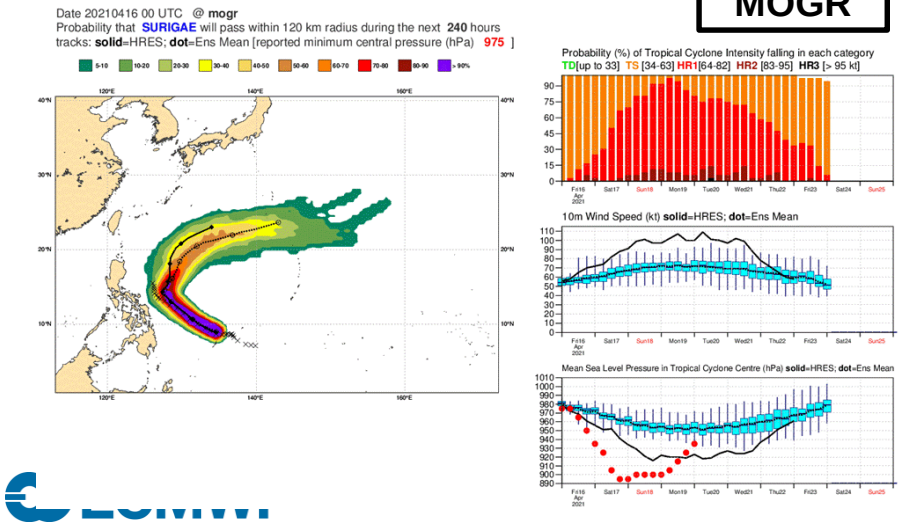
ECMWF



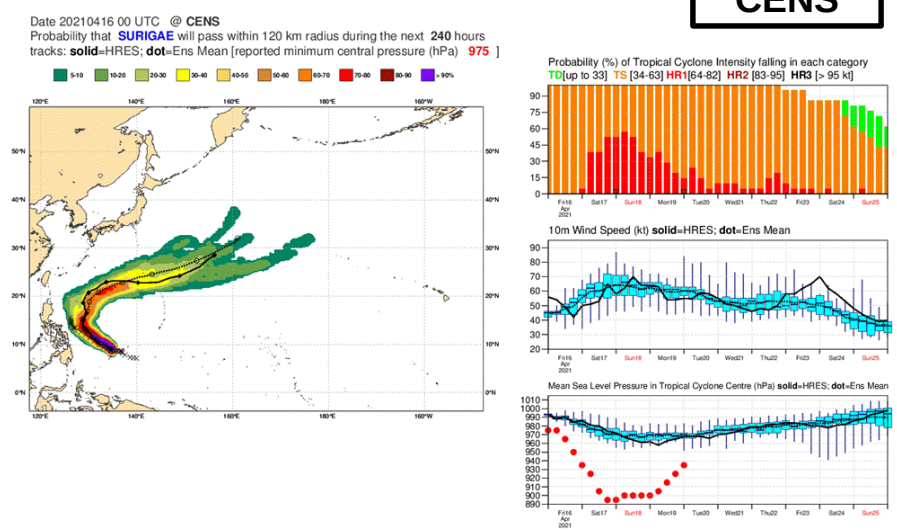
GEFS



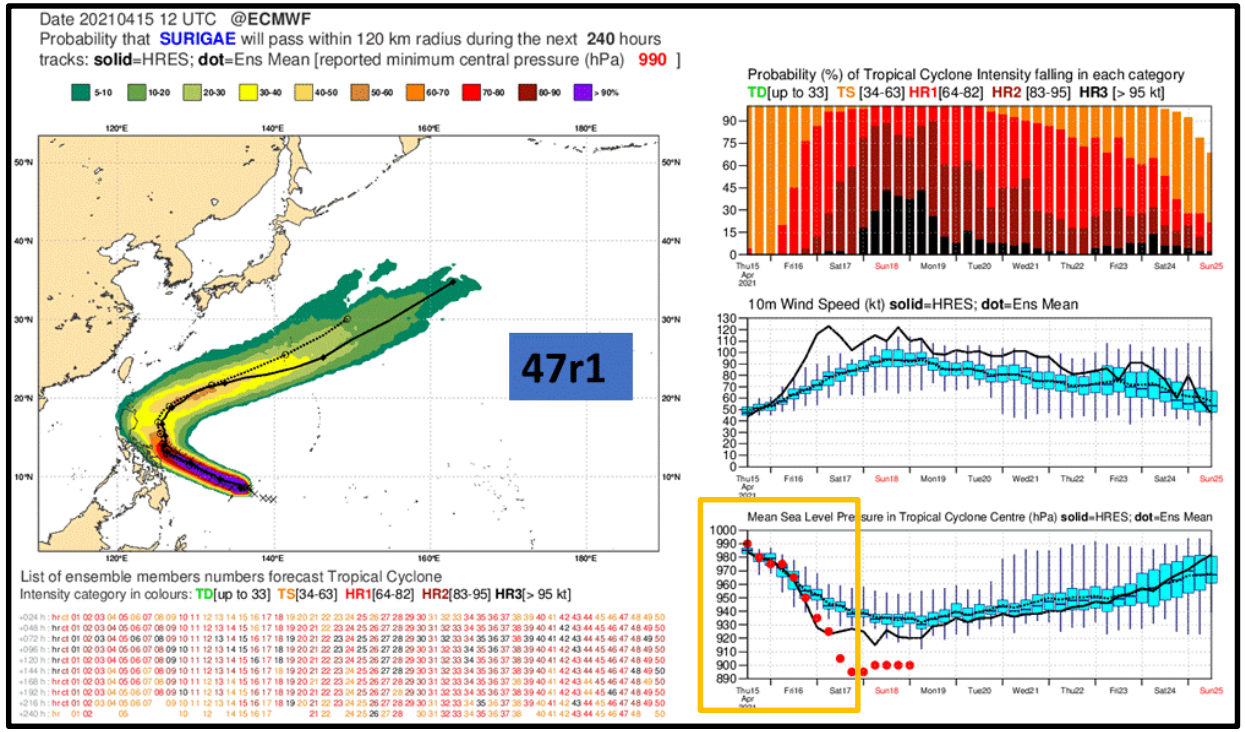
MOGR

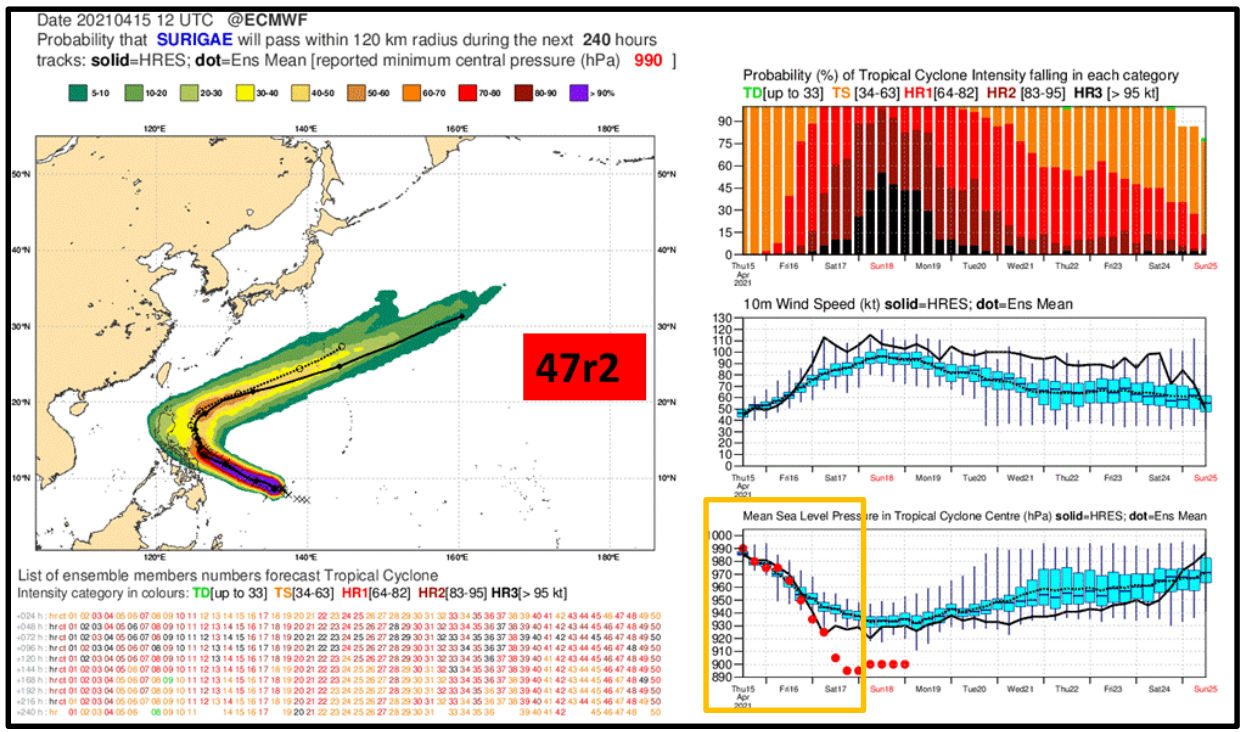


CENS



Comparing different cycles (if available). Base time Thursday, 14 April 2021 12 UTC

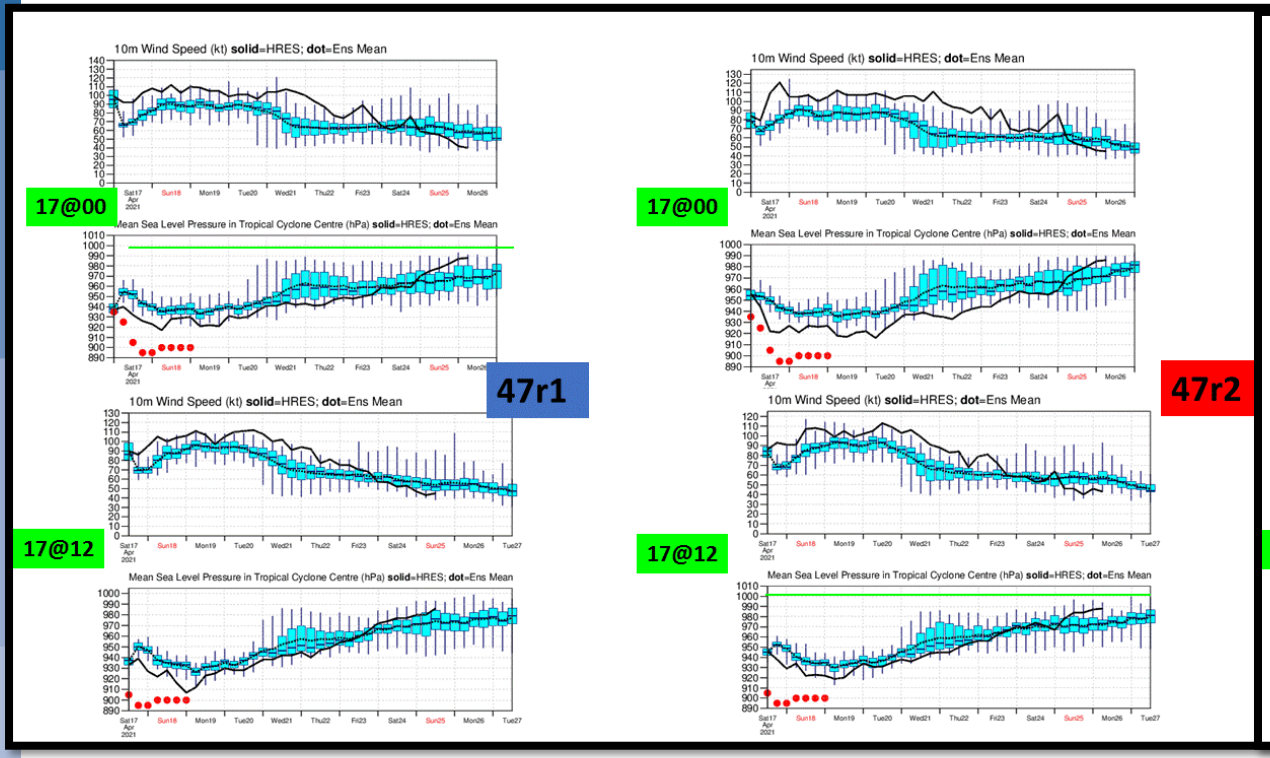


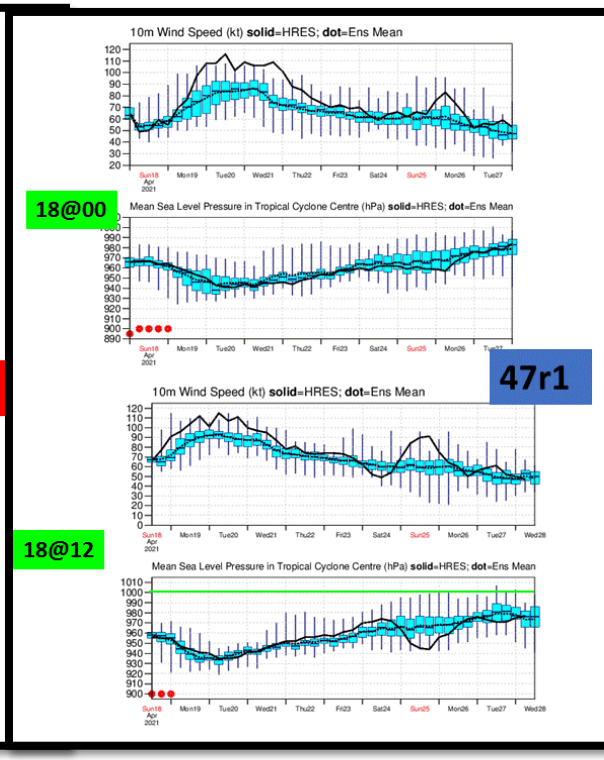


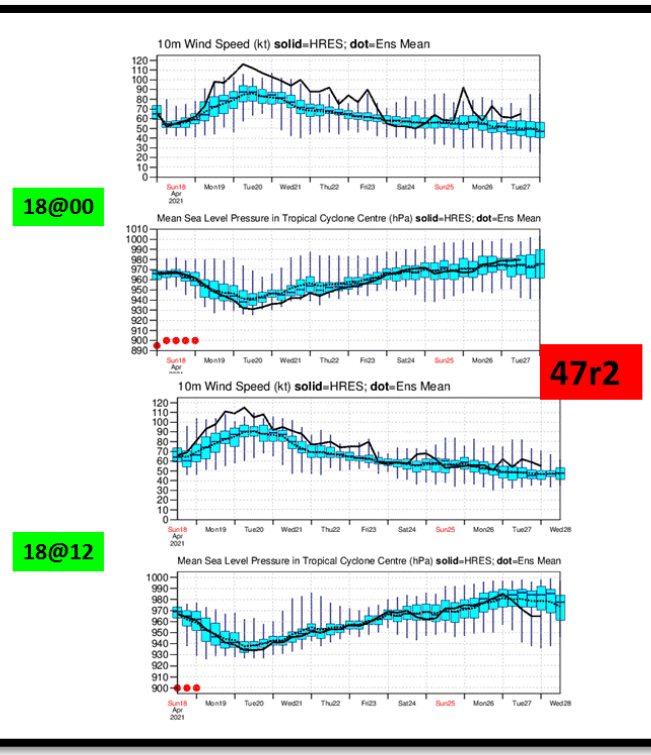
- Both IFS model versions (pre-oper & 47r2) shows the rapid intensification during Friday although 47r2 is better by the end of Friday begin of Saturday with few ENS members deepening the TC (the gap between the HRES and the ENS most extreme is quite obvious in oper).

- The probabilities of HR3 (>95kts) are slightly higher in 47r2 than 47r1 for last Sunday- this is consistent with the verification results for 47r2 (the positive bias and Mean absolute error is smaller). In the 47r1 the HRES tends to be slightly deeper (mslp) with stronger max wind.

Comparing different cycles at different base times (forecast initialization)





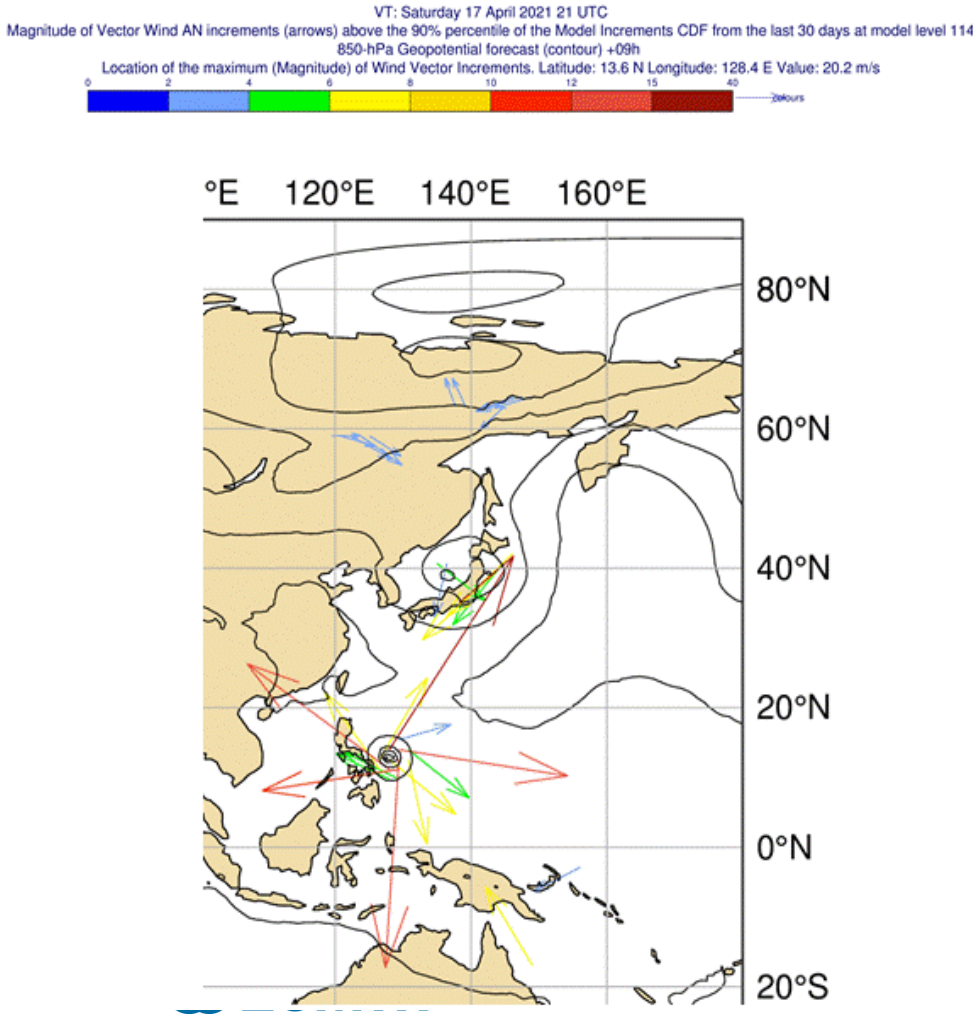


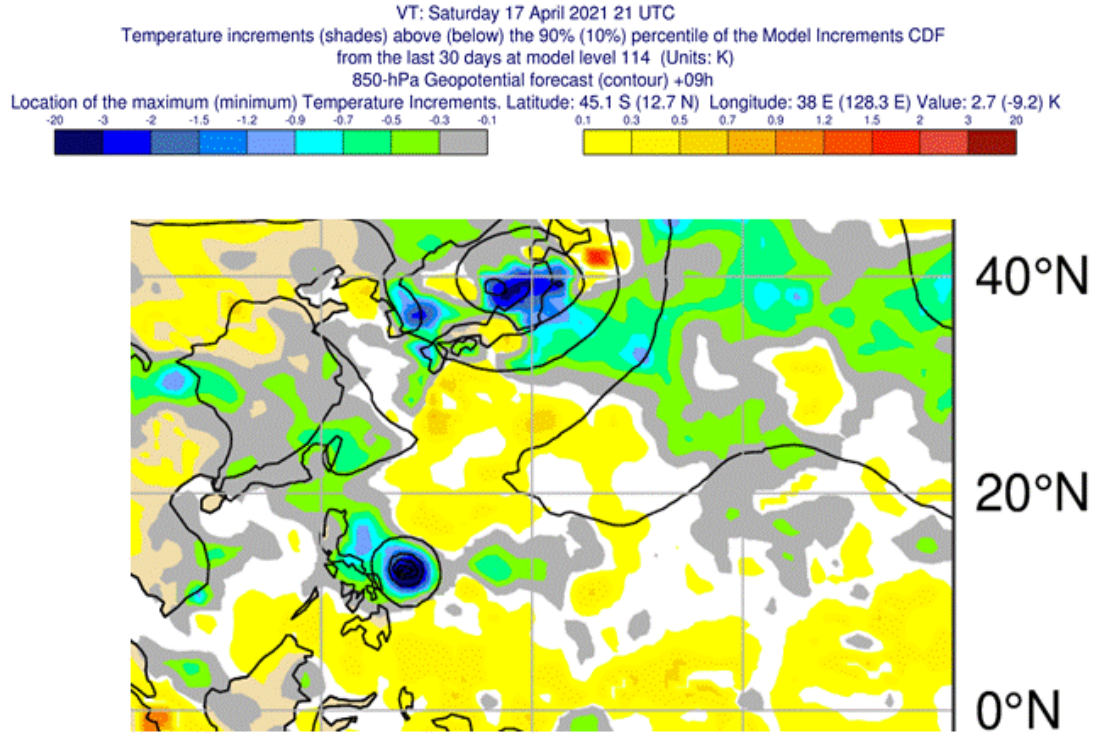
- Meteograms of the MSLP and maximum wind speed for 47r1 and 47r2 are displayed starting on 00Z of 17 April.

- Slight differences between both cycles: HRES in 47r2 more rapid intensification on 17@00 than 47r2. Later, quite similar.

Wind vector and Temperature increments:

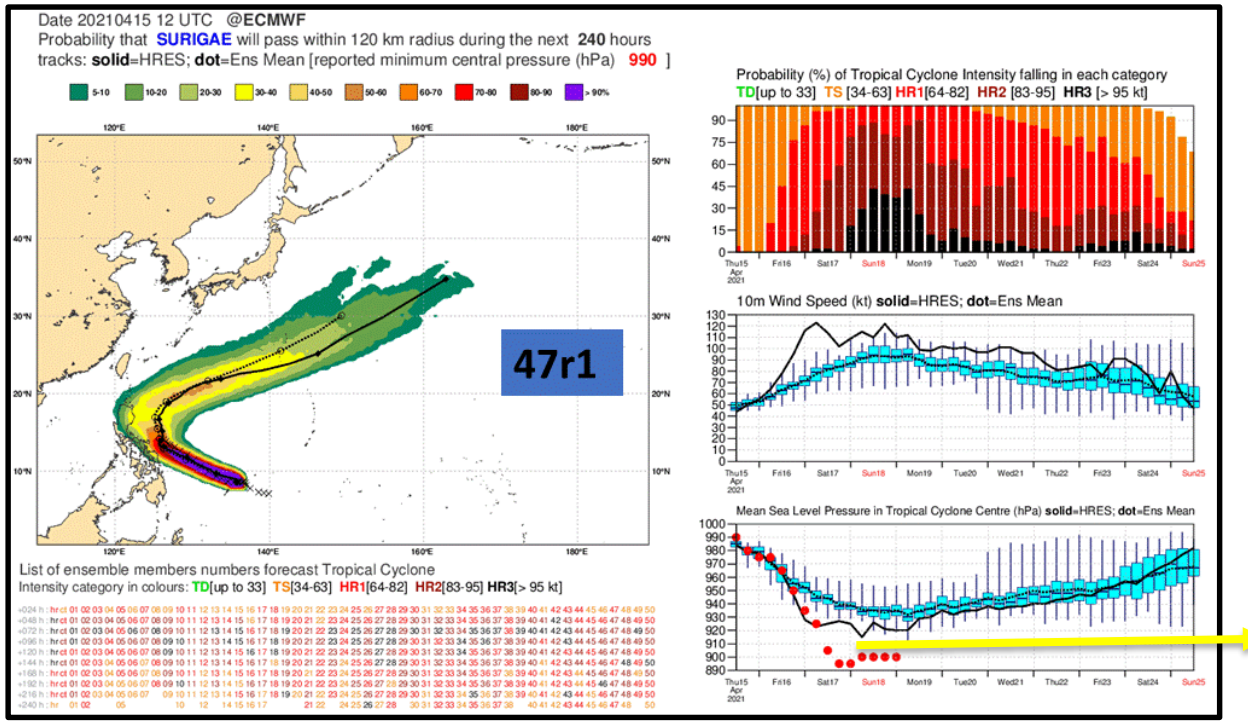
The magnitude of the wind vector and temperature increments (just the one > 90% of the increment CDF of the last 30 days) or how the analysis has adjusted to observations. It shows "massive" values near the typhoon in particular to spin down the storm (& cooling it). It is particularly notorious during the **LWDA for the 18 April at 00 UTC.**





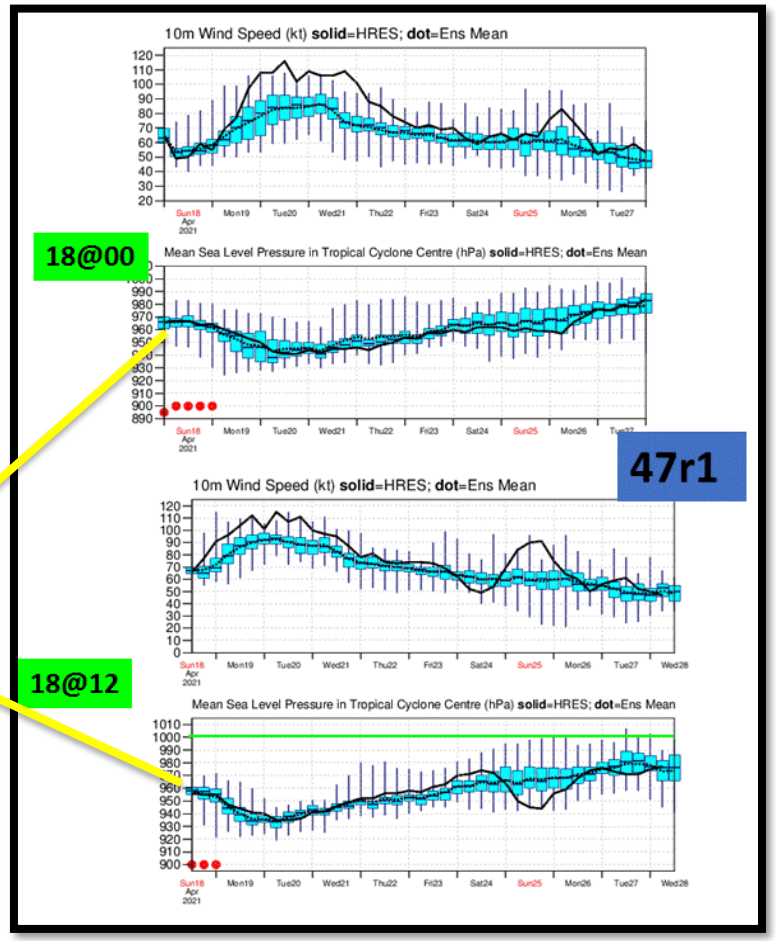
<u>Increments applied at the begin of the LWDA window 17@21</u>

Questions to investigate:



HRES Sunday, 18 April
~ 920 hPa

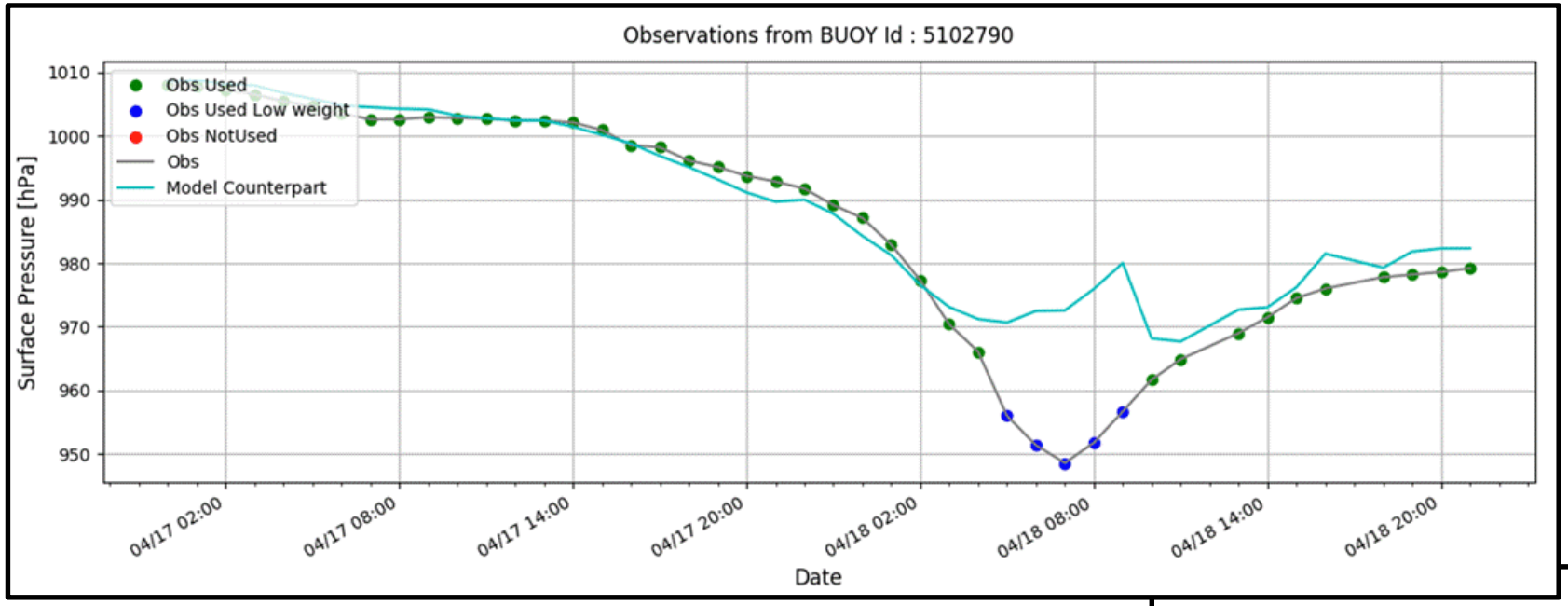
Analysis Sunday 18 April (00 and 12 UTC)
~ 960 hPa



What went **wrong with the analysis for 18 April at 00 UTC** when the very short-range forecast (**HRES**) predicts core pressure **of ~910-920 hPa (15 April 12 UTC**)? The region is not abundant in conventional observations (no Islands to east of central Philippines). Only **remote sensing and a lonely drifting buoy.**

The meteograms shows little variation (at analysis time) of the MSLP between 18 April 00 UTC and 12 UTC at the peak of strength. The question is what went "wrong" with the analysis at 18 April 00 UTC. What observation(s) had a detrimental effect?

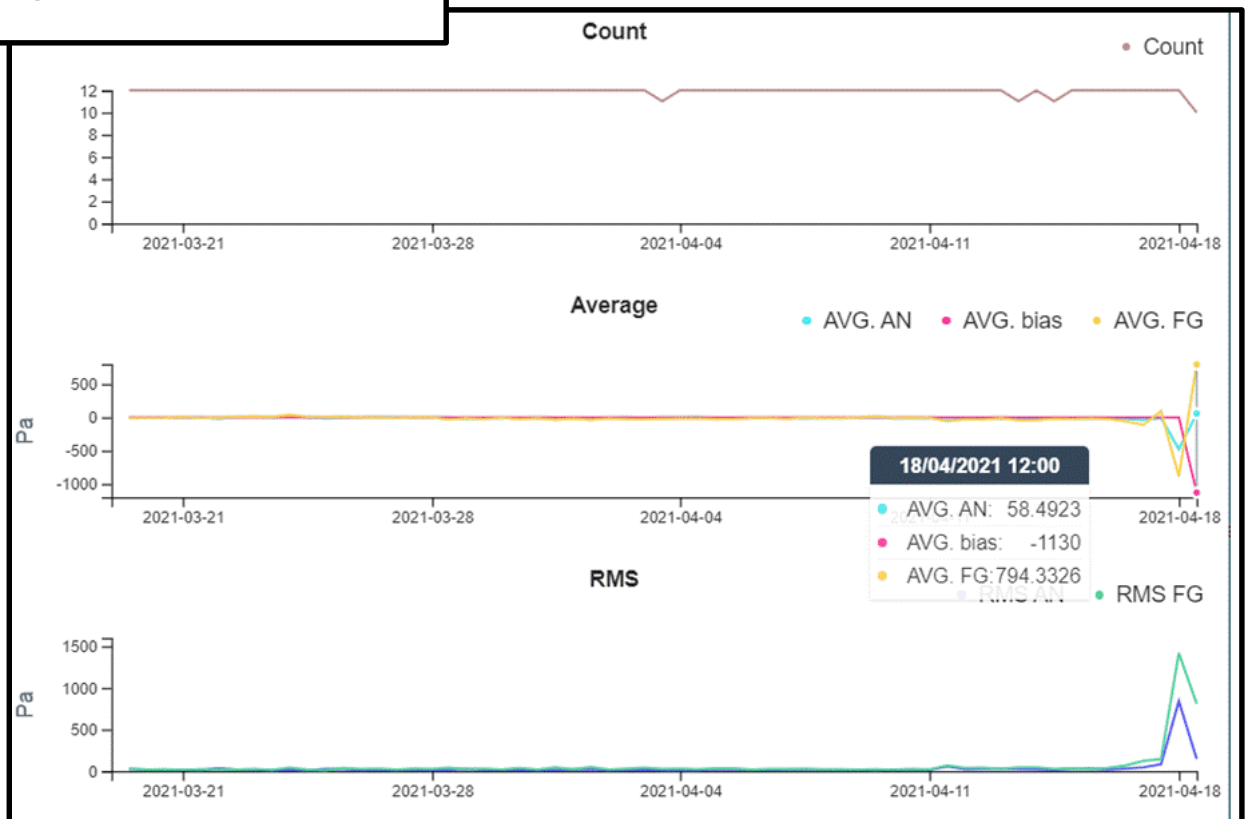
ECMWF



The time series above show the **background forecast and the MSLP reported by the buoy** (ID 5102790).

- Until 17 April, both values (fcst & obs) are quite similar.
- **Things start to deteriorate during the first hours of 18 April** and at one point the **observations were used with a low weight**.

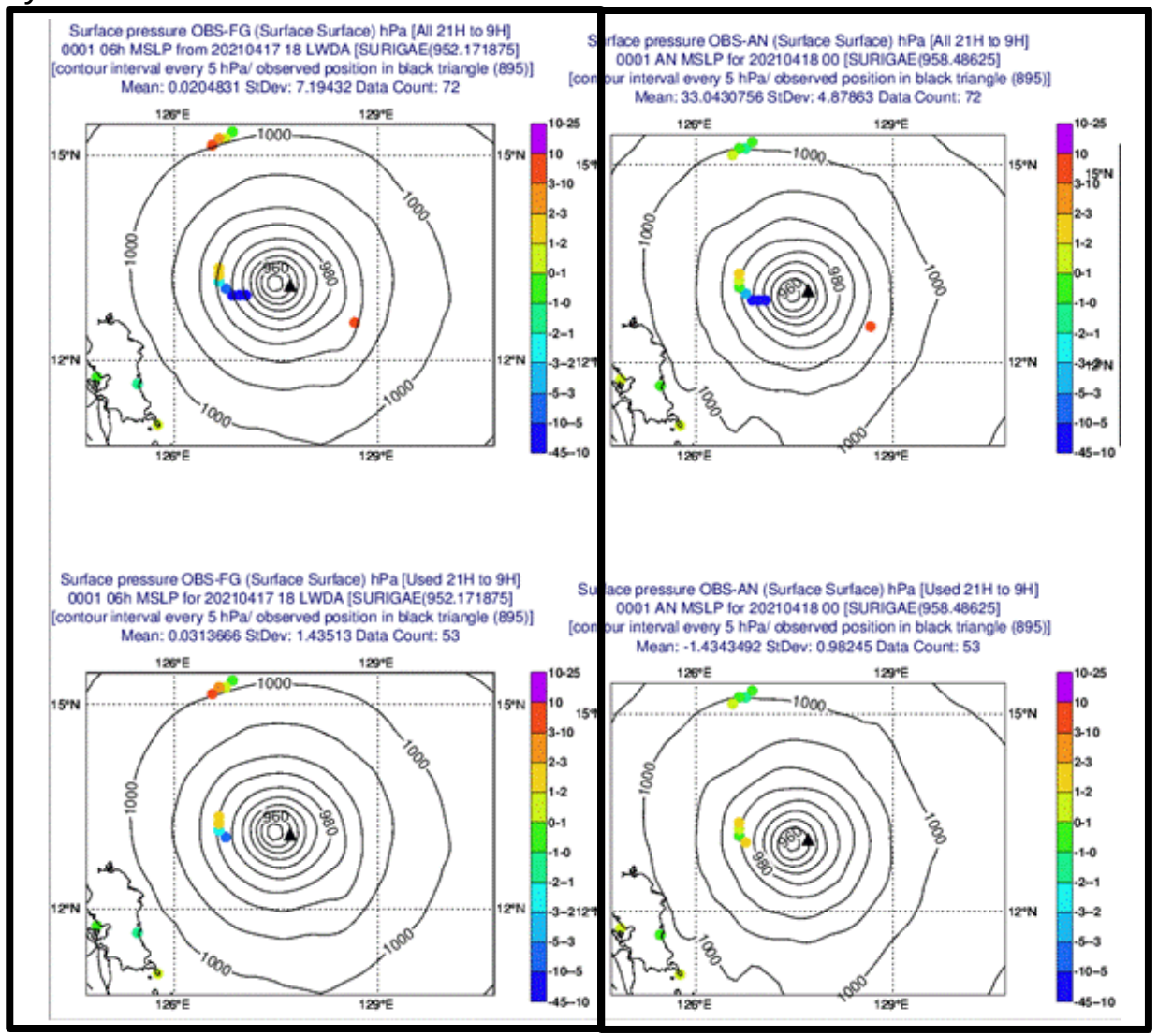
- Time series of the **average OBS-AN, OBS-FG** provides an alternative way of looking to the evolution of the errors. Again the "problems" stand up between the 18 April 00 UTC and 12 UTC.



Increments

The maps show the position of the drifting buoy for few model cycles. Two distinct features stand out; how close the buoy is from the cyclone and trajectory of the buoy during the passage of the typhoon across the region. As expected with the previous results the departures are large in both background and analyses.

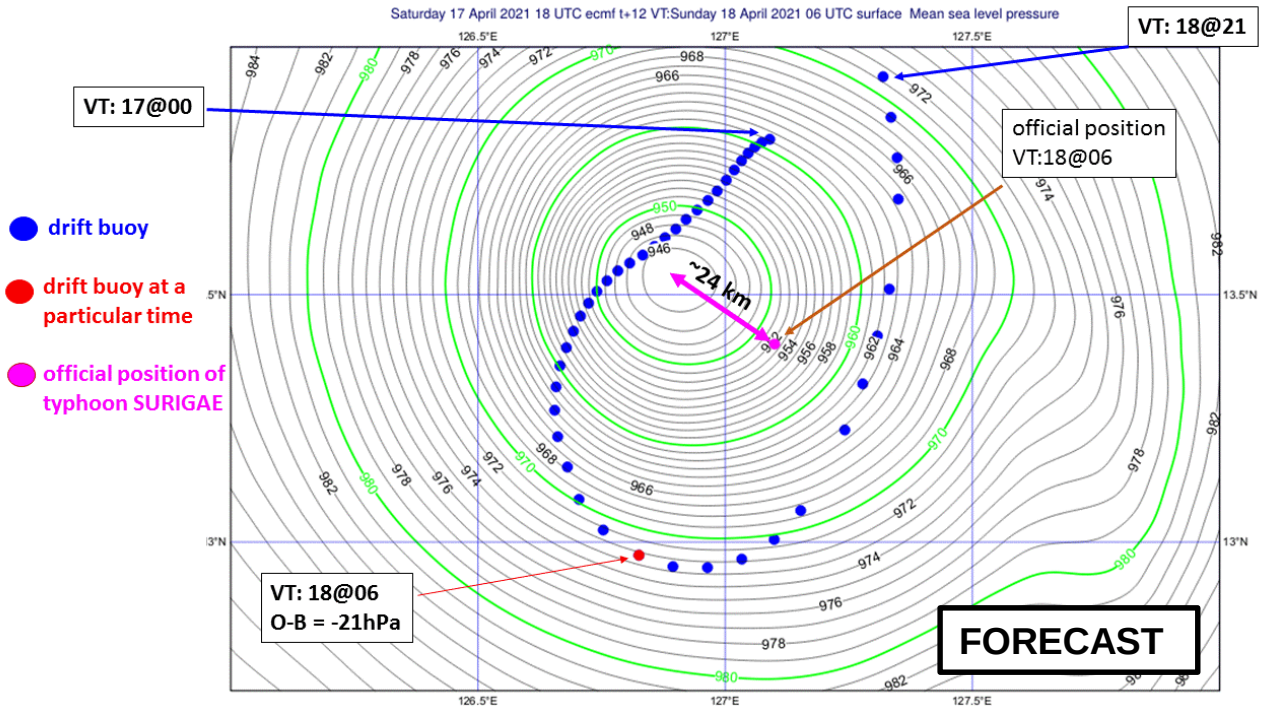
Departures
OBS - forecast

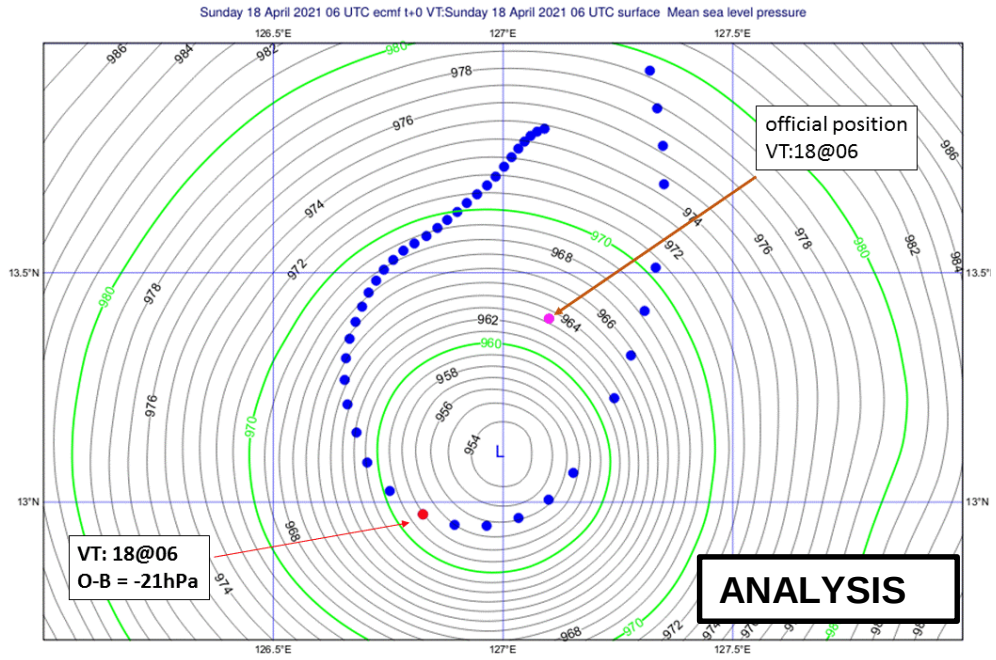


Departures
OBS - analysis

Buoy trajectory

- Left: Buoy trajectory (blue dots); official position of SURIGAE on 18 April 06 UTC (magenta dot) and **MSLP** (1hPa contour interval) of **+12h LWDA forecasts**.
- Right: same but for **analysis mslp**





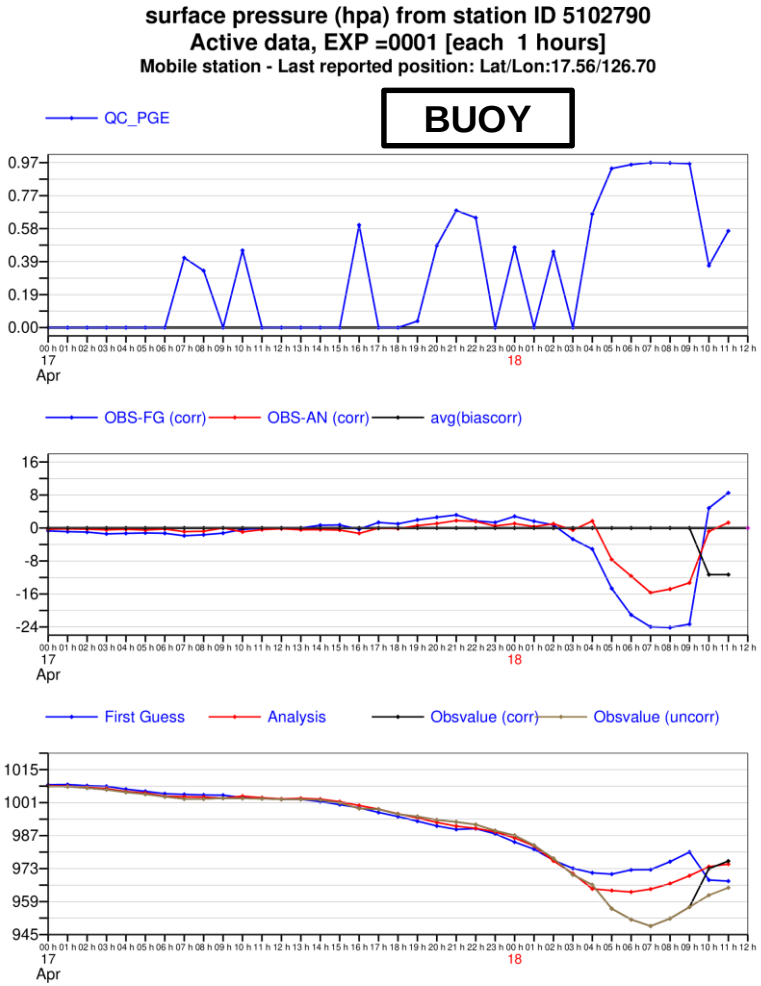
- The trajectory (blue dots) is valid between 17 April 00 UTC and 18 April UTC and clearly shows the **effect of the currents due to Coriolis force**, in particular, induced by the typhoon SURIGAE strong winds almost ending in the same position where it started ~2 days ago (pendulum turn).

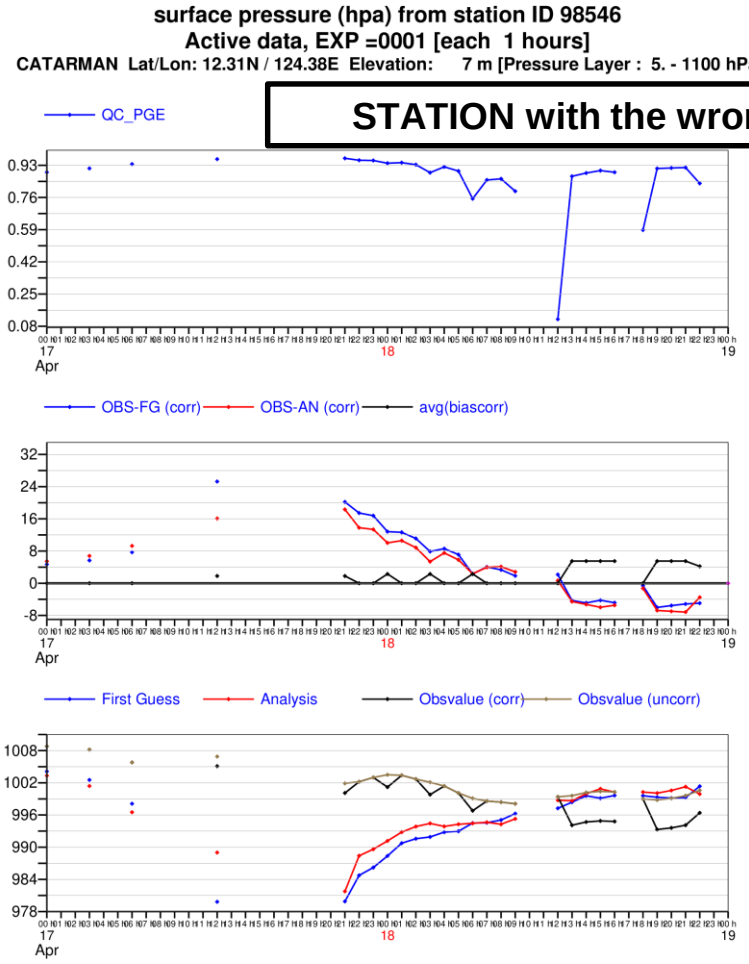
- Background forecast +12h initiated on 17 April 18 UTC. **The background moved the storm faster**, positioning the cyclone to northwest of official position of SURIGAE (usually the storms tend to move slower in the forecast) give by the magenta full circle. The drifting buoy at this time (18@06) was located to the southwest of the official position.

ECMWF

Checking time series from other near obs stations. Buoy was used for the bias correction but with **very low weight**!!!

The LARGE ERRORS of the analysis on the 20210417 12UTC and following days could be due to the **misspecified longitude of island station id 98546,** which appears to be wrong by 4 degrees. This induces O-B increments of around ~26 hPa! The buoy is a false lead, in fact it behaves well until 20210418 12UTC, when the wrong bias correction kicks in.





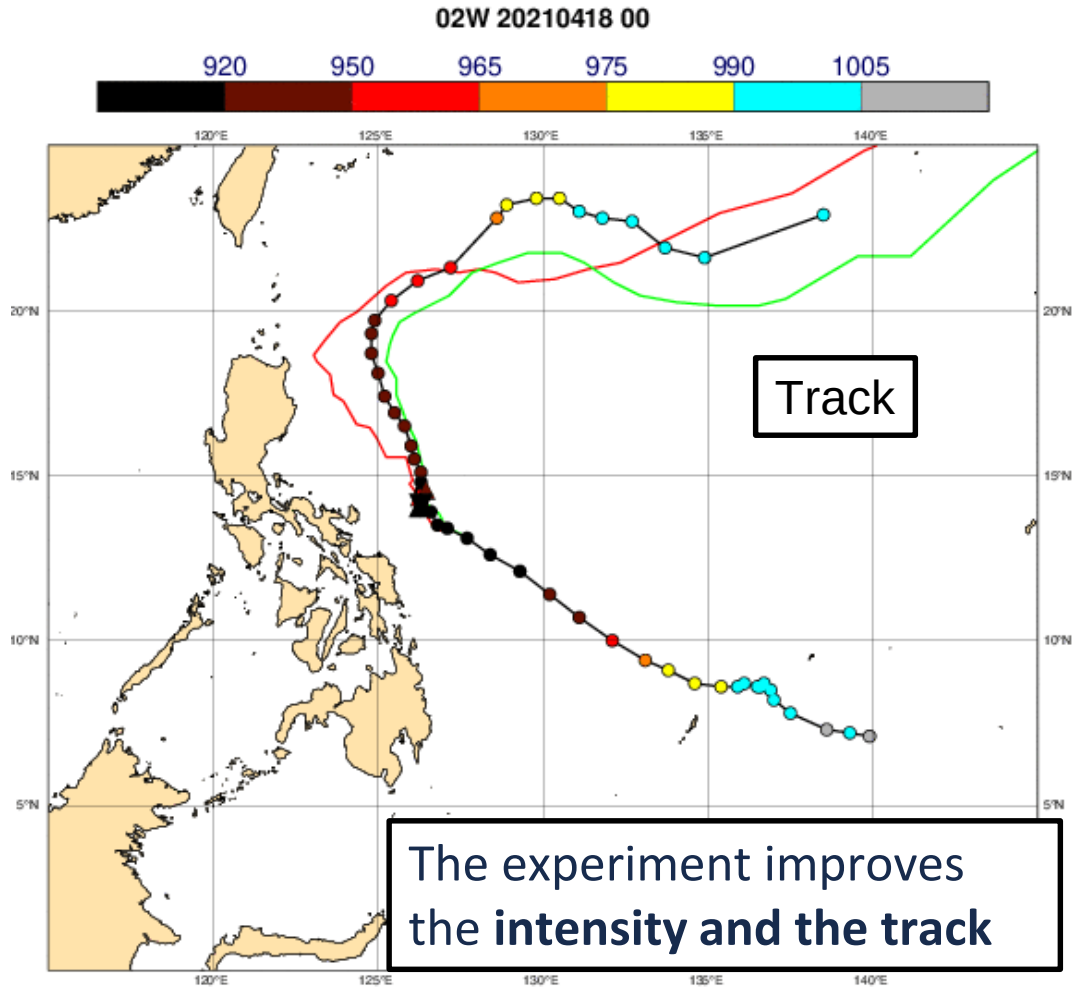
Also, scatterometer data was checked

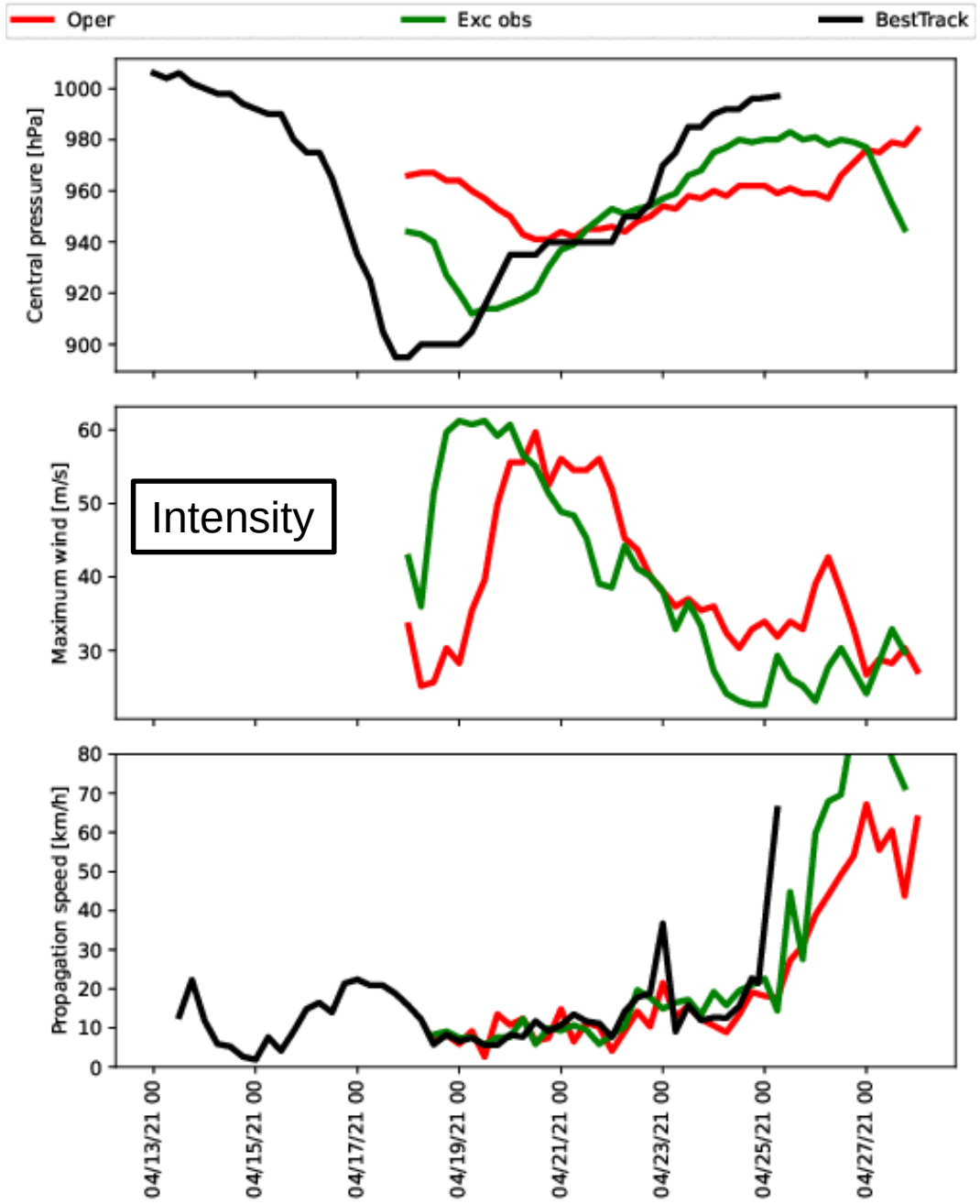
Next step: run model **experiment(s)**:

1. **Excluding the erroneous** positioned **SYNOP**

Experiments: Base time 18 April 00 UTC

- **Excluding the erroneous positioned SYNOP** (**green**), compared to operations (**red**).





Examples of error types

- **Observation related** (missing observations, faulty observations)
  - Automated alarm systems and quality control
- **Boundary conditions**
  - Sea-ice and SST
  - Snow
  - Climate files (land-sea mask, vegetation, ..)
- **Large synoptic errors**
  - Medium-range (forecast busts)
- **Weather parameters**
  - 2-metre temperature, clouds, winds
  - Often systematic errors
- **Severe events**
  - Missing extremes
- **Model climate**
  - Mean
  - Variability

Collaboration between different sections , departments and the users is crucial!

Summary

- Purpose of forecast evaluation
  - Fire fighting (**problems that needs immediate action**)
  - **Detect and document systematic errors** (to be addressed in research)
  - **Learn about the behaviour of the forecast system** (unpredictable situations, extreme weather, …)