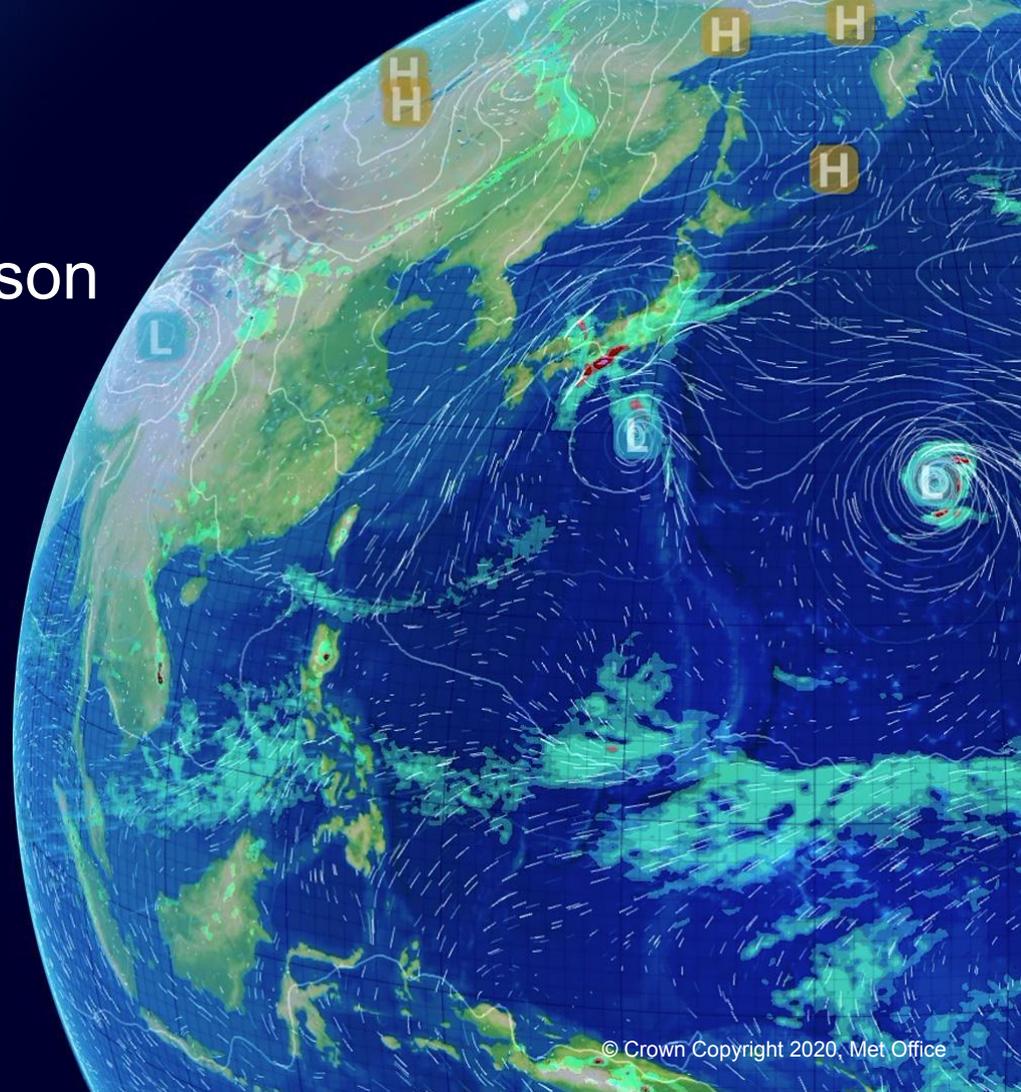


Met Office Perspectives on 2021 Atlantic Hurricane Season

Julian Heming

16 November 2021

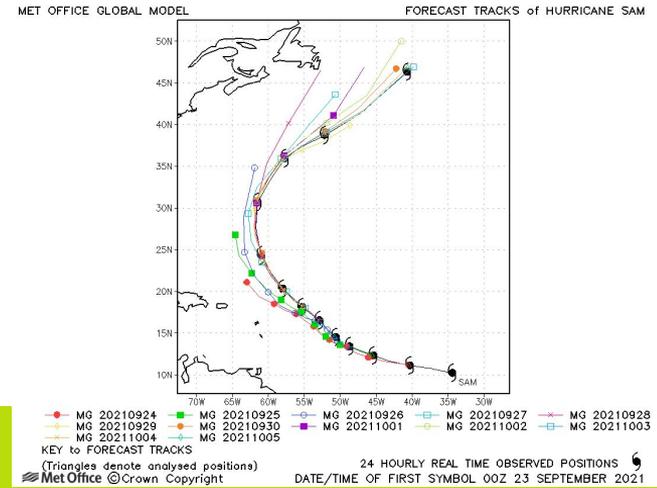
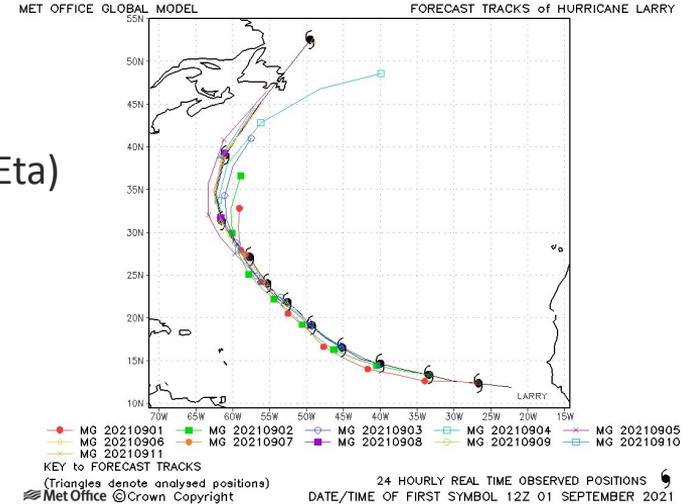
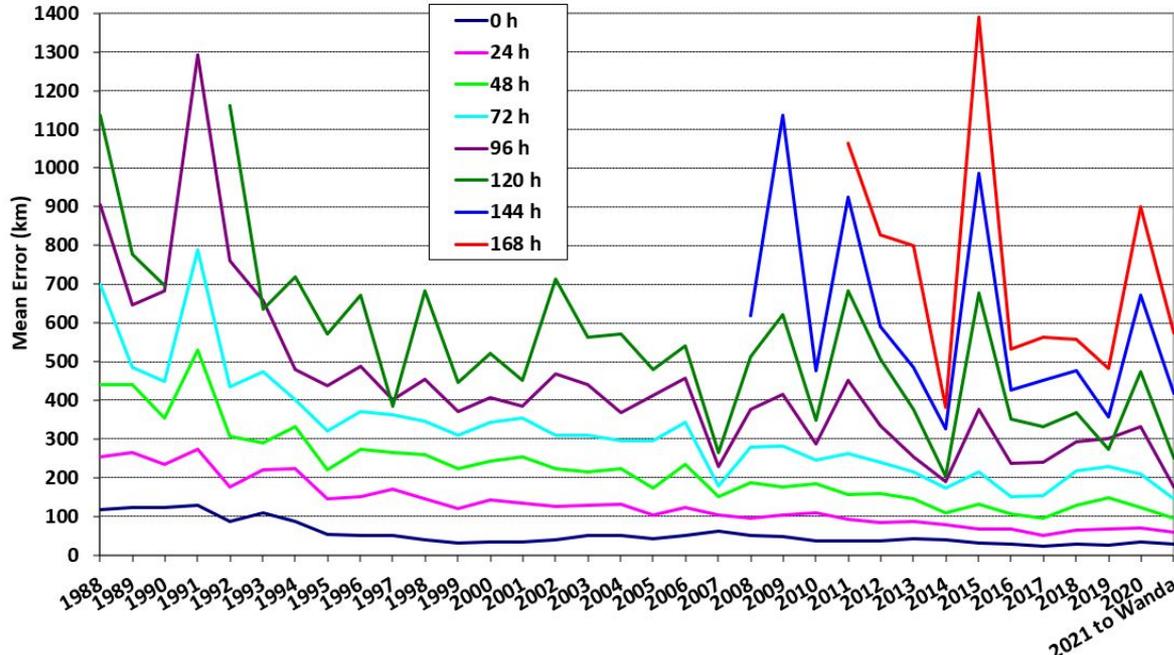
HFIP Annual Review Meeting



- Met Office Models Performance in 2021
- Selected storms showing biases in track and intensity
 - Elsa, Grace, Henri, Ida, Larry, Sam
- PS45 – coupled model and prognostic entrainment
- High resolution simulations

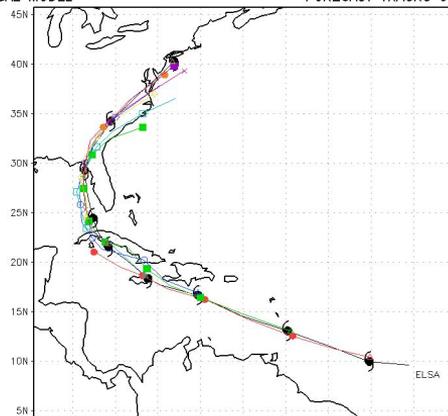
- 2021 Atlantic track errors much lower than 2020.
- In 2020 the two longest lived TCs poorly forecast (Paulette and Eta)
- In 2021 the two longest lived TCs well forecast (Larry and Sam)
- Skill against CLIPER fairly static in last 8 years

Met Office North Atlantic Tropical Cyclone Forecast Positional Errors



- Met Office models good for track
- MOGREPS-G ensemble captured northwards turn a little earlier than deterministic
- Intensity forecasts mostly poor
- Intensification phases not captured

MET OFFICE GLOBAL MODEL FORECAST TRACKS of HURRICAN

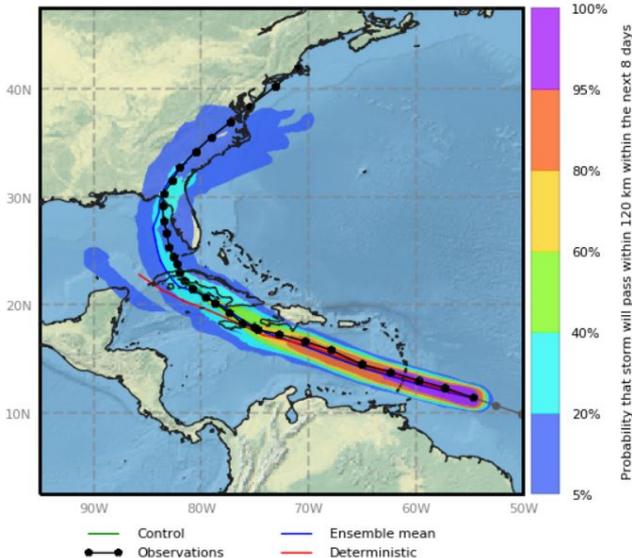


● MG 20210701 ■ MG 20210702 ○ MG 20210703 □ MG 20210704 ✱ MG 20210705
● MG 20210706 ■ MG 20210707 ○ MG 20210708 □ MG 20210709

KEY to FORECAST TRACKS
(Triangles denote analysed positions)

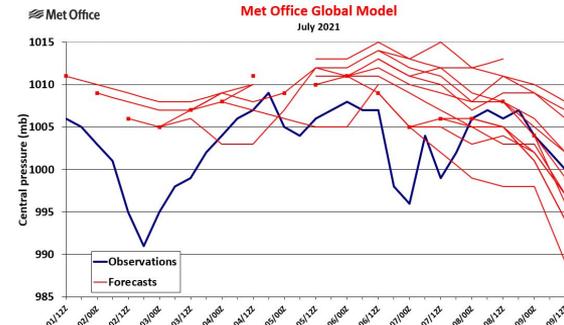
24 HOURLY REAL TIME OBSERVED POSITIONS
DATE/TIME OF FIRST SYMBOL 12Z 01 JULY 2021

MOGREPS-G: Forecast TC track probability for ELSA from 00 UTC Fri 02 Jul 2021

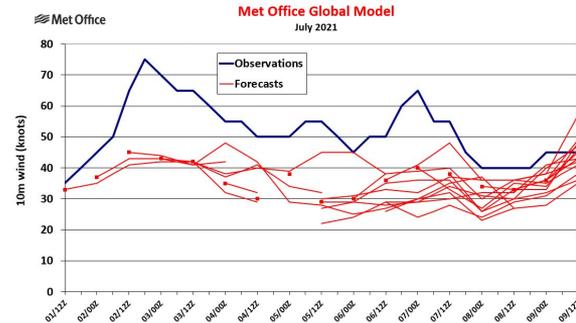


— Control — Ensemble mean
● Observations — Deterministic

Hurricane Elsa Central Pressure Predictions

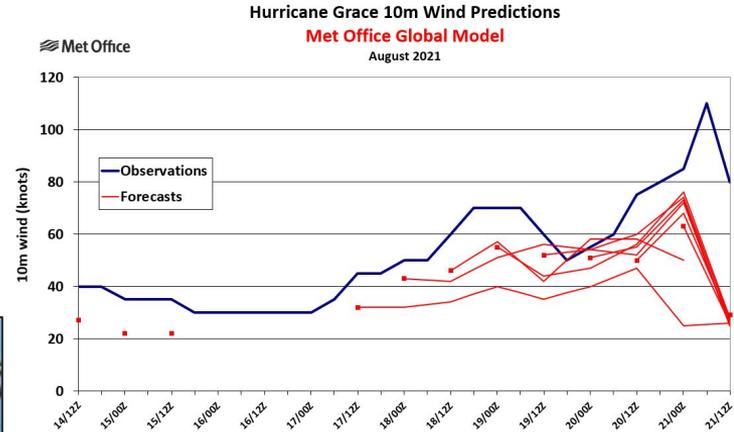
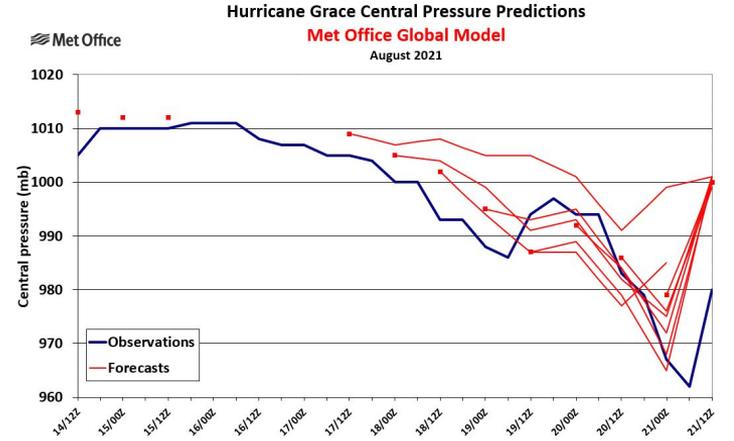
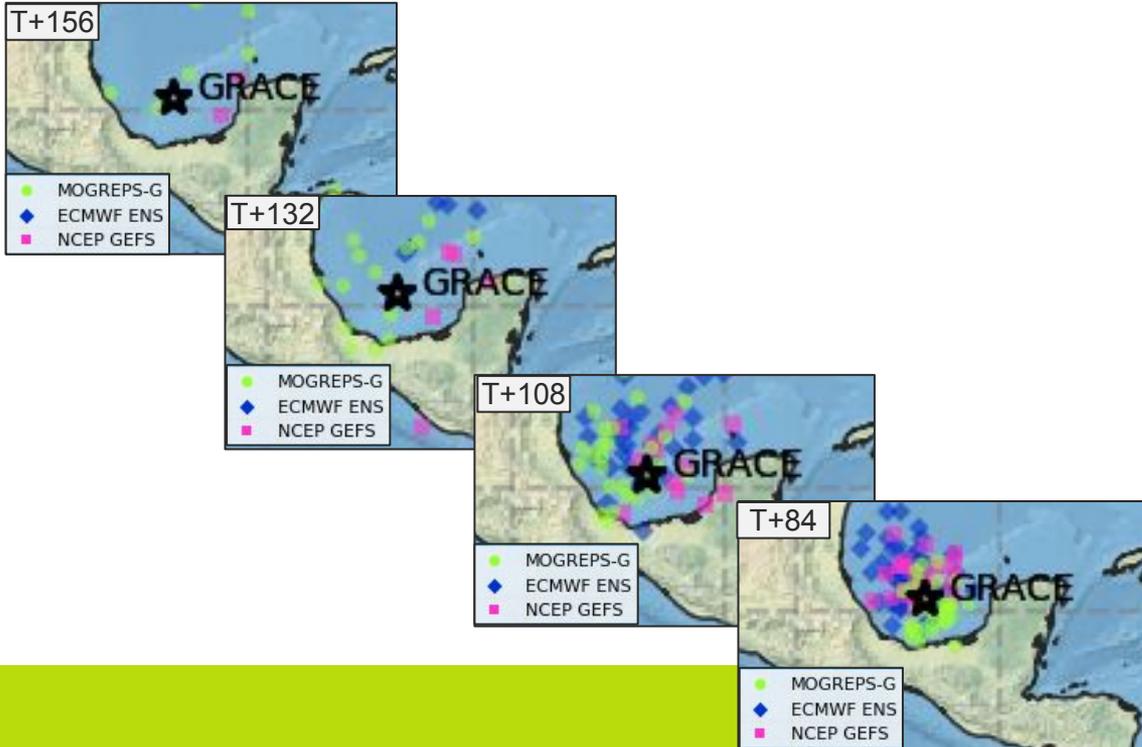


Hurricane Elsa 10m Wind Predictions



Hurricane Grace

- Several MOGREPS-G ensemble members correctly predicted path across Yucatan into Bay of Campeche out to 6+ days, with confidence increasing over subsequent runs
- Intensification in Gulf of Mexico well predicted a couple of days ahead

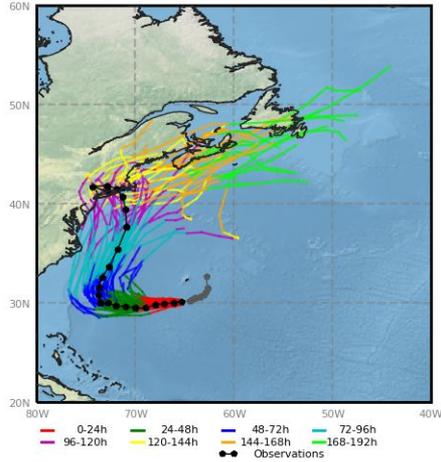


Hurricane Henri

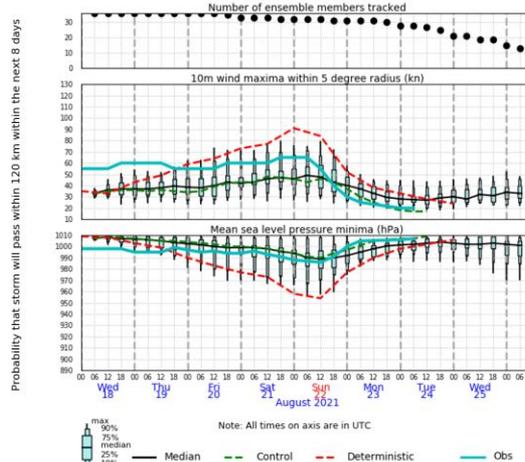
- Uncertainty in track captured by ensemble spread
- Over-intensification by deterministic model



MOGREPS-G: Forecast TC tracks for HENRI from 06 UTC Wed 18 Aug 2021

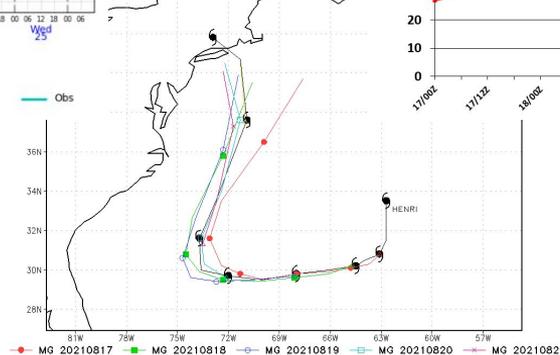


MOGREPS-G ensemble: TC-following meteorogram HENRI (30.1N 65.3W) from 06 UTC Wed 18 August 2021



Probability that storm will pass within 120 km within the next 8 days

MODEL FOREC



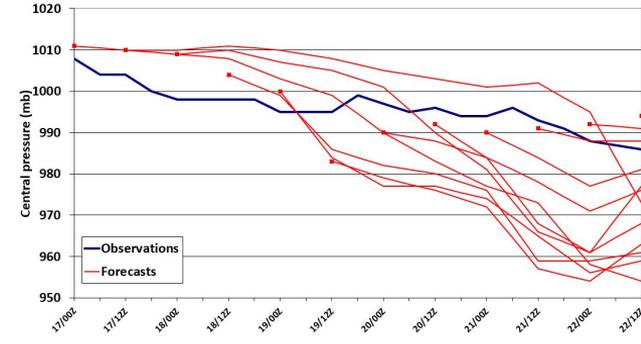
KEY to FORECAST TRACKS (Triangles denote analysed positions)
 24 HOURLY REAL TIME OBSERVED POSITIONS
 DATE/TIME OF FIRST SYMBOL_00Z_18 AUGUST 2021
 Met Office © Crown Copyright

Met Office

Hurricane Henri Central Pressure Predictions

Met Office Global Model

August 2021

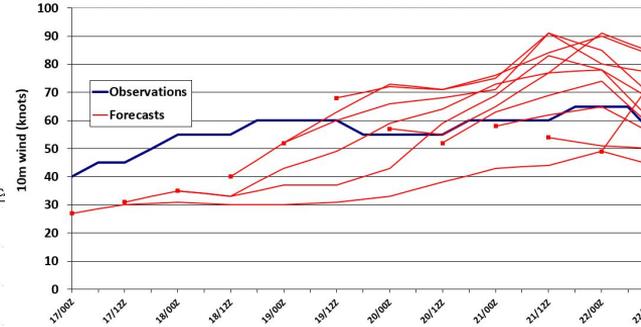


Met Office

Hurricane Henri 10m Wind Predictions

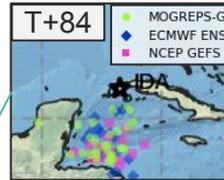
Met Office Global Model

August 2021

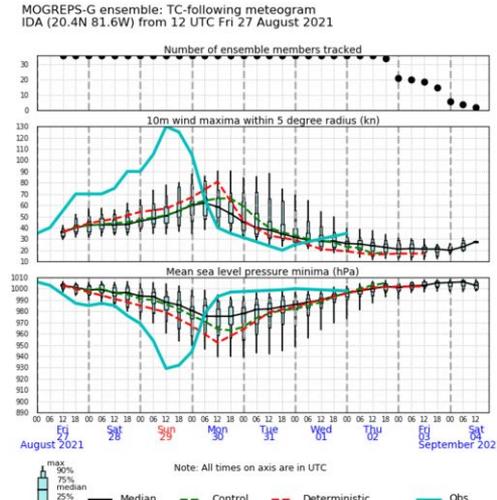
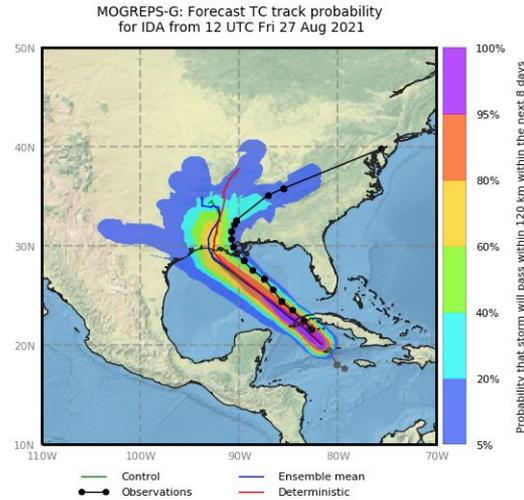
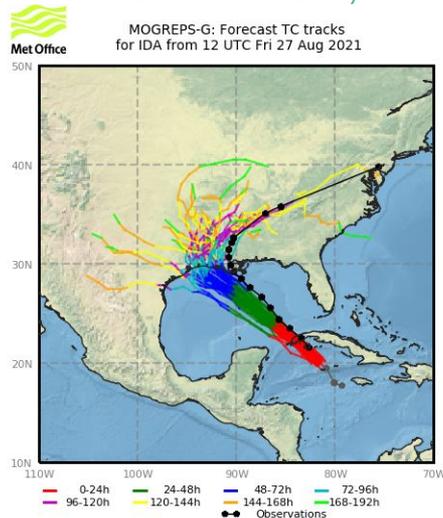
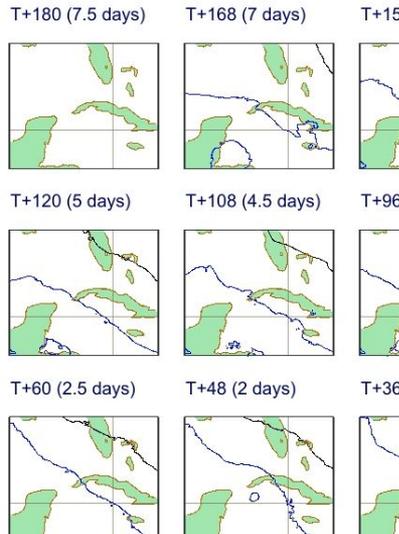
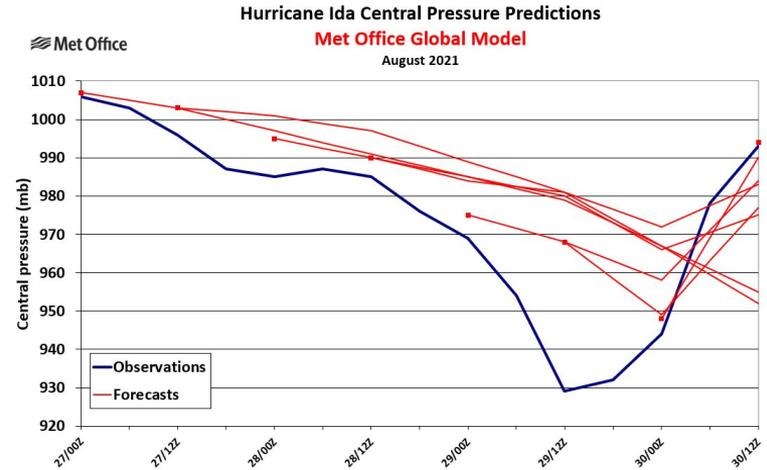


Hurricane Ida

- Cyclogenesis poorly forecast in deterministic (> 48 h) and ensembles (> 72 h)
- Left bias in model forecasts, but spread covered track
- Forecast intensity too weak



Met Office Global Model MSLP forecasts for Hurricane Ida valid at 00Z 28-08-2021
4mb contour interval
blue <= 1012mb
green <= 1004mb
red <= 996mb

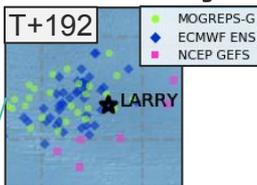
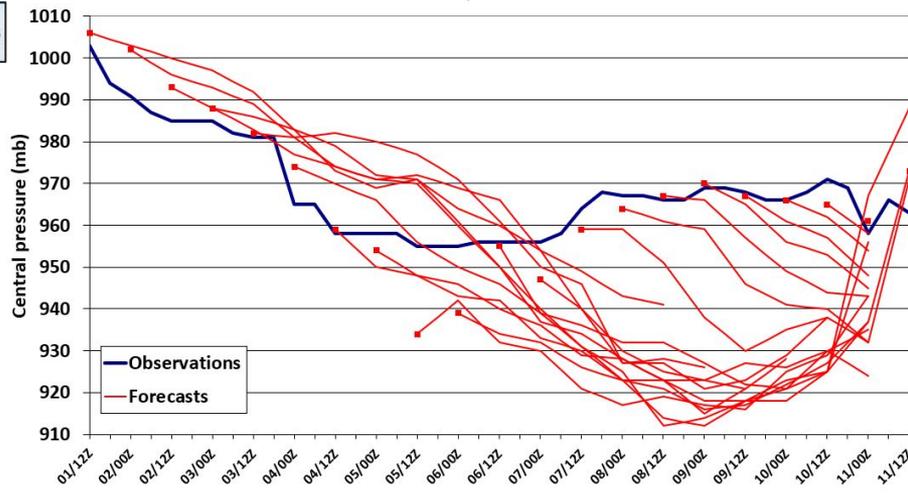


Hurricane Larry

Hurricane Larry Central Pressure Predictions

Met Office Global Model

September 2021



Met Office Global Model
MSLP forecasts for
Hurricane Larry
valid at
12Z 02-09-2021
4mb contour interval
blue <= 1012mb
green <= 1004mb
red <= 996mb

Met Office Global Model
verifying analysis

MOGREPS-G: Forecast TC tracks
for LARRY from 18 UTC Fri 03 Sep 2021

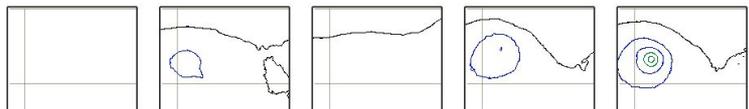
MOGREPS-G: Forecast TC track probability
for LARRY from 18 UTC Fri 03 Sep 2021

MOGREPS-G ensemble: TC-following meteogram
LARRY (14.8N 41.5W) from 18 UTC Fri 03 September 2021

T+240 (10 days) T+228 (9.5 days) T+216 (9 days) T+204 (8.5 days) T+192 (8 days)



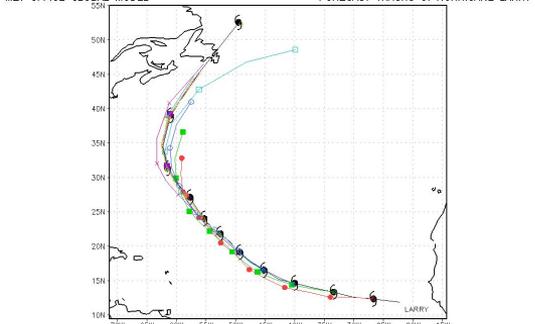
T+180 (7.5 days) T+168 (7 days) T+156 (6.5 days) T+144 (6 days) T+132 (5.5 days)



T+120 (5 days) T+108 (4.5 days) T+96 (4 days) T+84 (3.5 days) T+72 (3 days)



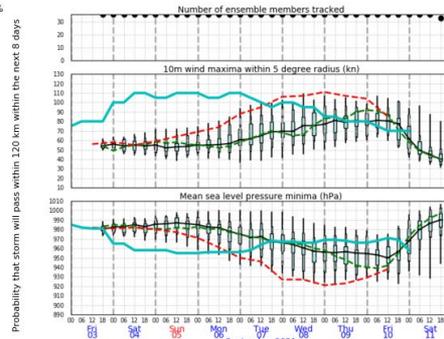
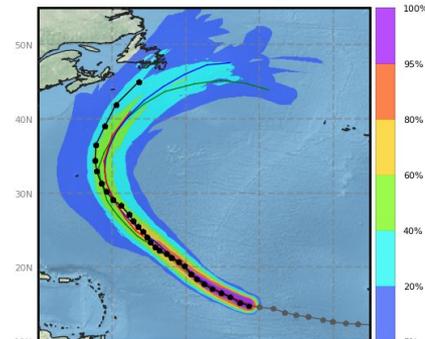
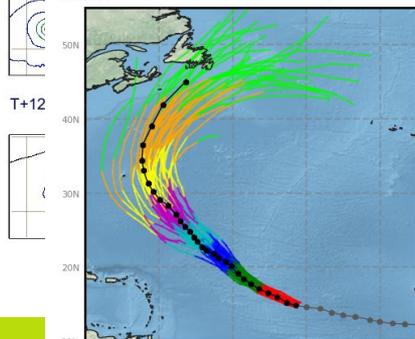
MET OFFICE GLOBAL MODEL FORECAST TRACKS OF HURRICANE LARRY



KEY TO FORECAST TRACKS
(Triangles denote analysed positions)

24 HOURLY REAL TIME OBSERVED POSITIONS
(Triangles denote analysed positions)

DATE/TIME OF FIX AT SPONSORSHIP 2021



max 90%
median 75%
25%
min 10%

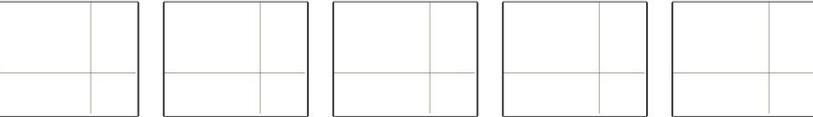
Note: All times on axis are in UTC

— Median — Control - - - Deterministic — Obs

Hurricane Sam

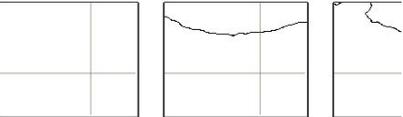
- Small TC – weak cyclogenesis
- Left-of-track bias in models, but captured by ensemble spread
- Weak bias even into higher latitudes

T+240 (10 days) T+228 (9.5 days) T+216 (9 days) T+204 (8.5 days) T+192 (8 days)

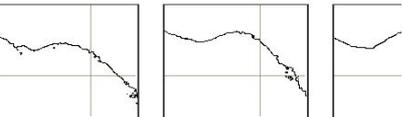


Met Office Global Model
MSLP forecasts for
Hurricane Sam
valid at
12Z 24-09-2021
4mb contour interval
blue <= 1012mb
green <= 1004mb
red <= 996mb

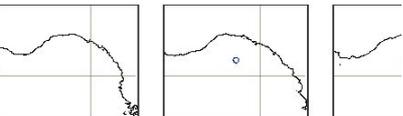
T+180 (7.5 days) T+168 (7 days) T+156 (6 days)



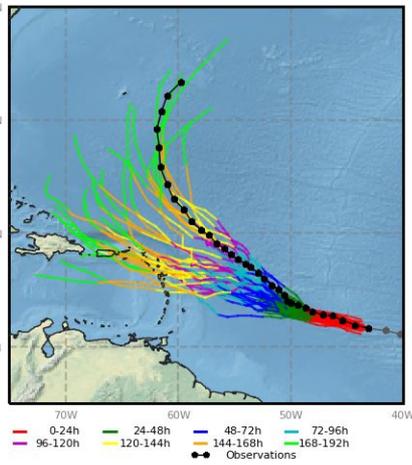
T+120 (5 days) T+108 (4.5 days) T+96 (4 days)



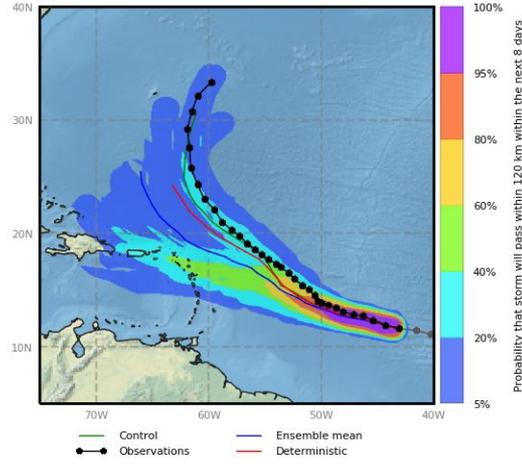
T+60 (2.5 days) T+48 (2 days) T+36 (1.5 days)



MOGREPS-G: Forecast TC tracks
for SAM from 12 UTC Fri 24 Sep 2021



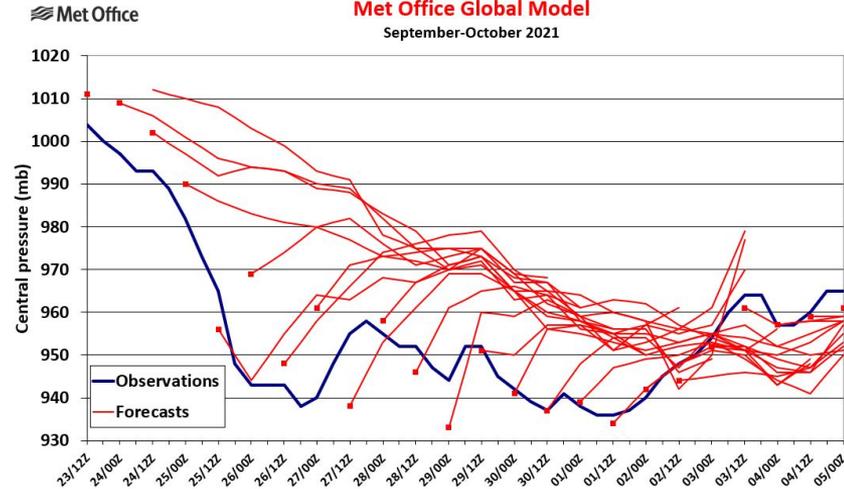
MOGREPS-G: Forecast TC track probability
for SAM from 12 UTC Fri 24 Sep 2021



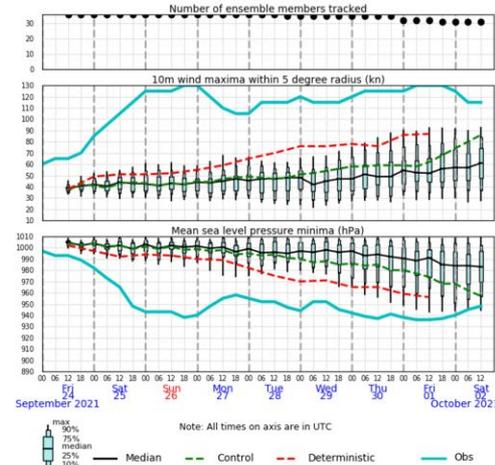
Hurricane Sam Central Pressure Predictions

Met Office Global Model

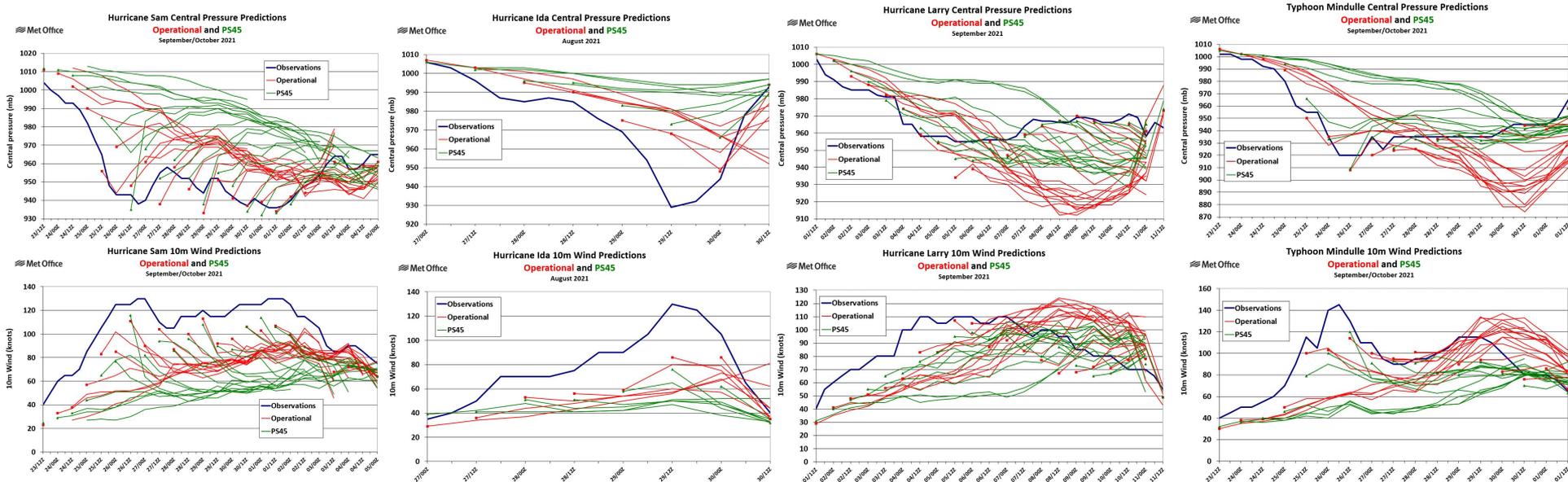
September-October 2021



MOGREPS-G ensemble: TC-following meteorogram
SAM (11.6N 43.1W) from 12 UTC Fri 24 September 2021



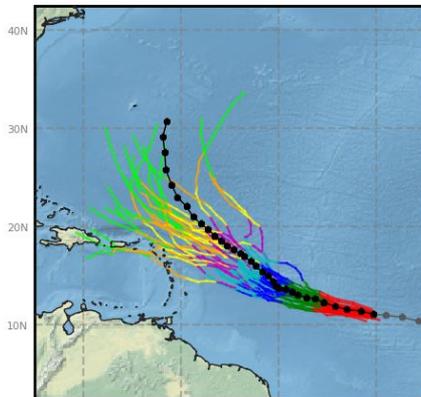
- Package of changes including ocean coupling and prognostic entrainment (convective memory)
- TCs systematically weaker, but reduces over-deepening in subtropics
- Impact on track is variable
- To be implemented February 2022 due to overall positive impact on model forecasts
- Options being investigated to counter systematic weakening of TCs



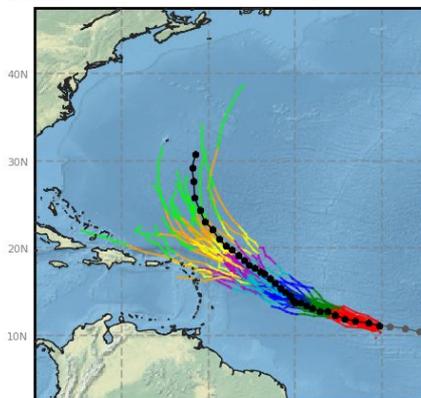
- Loss of intensity spread in MOGREPS-G ensemble, thought to be largely due to systematic weakening in the model
- Research project starting shortly to investigate enhancing IC perturbations by perturbing depth and position of TC pressure obs



MOGREPS-G: Forecast TC tracks for SAM from 00 UTC Fri 24 Sep 2021



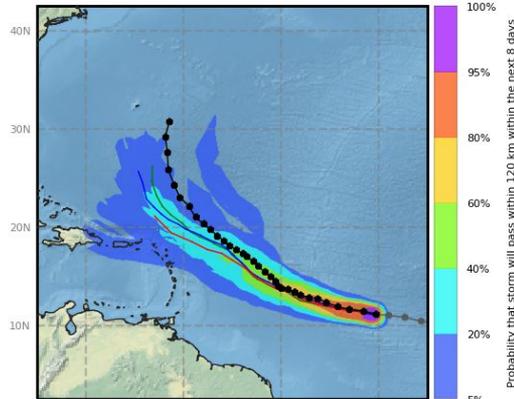
MOGREPS-G-PS: Forecast TC tracks for SAM from 00 UTC Fri 24 Sep 2021



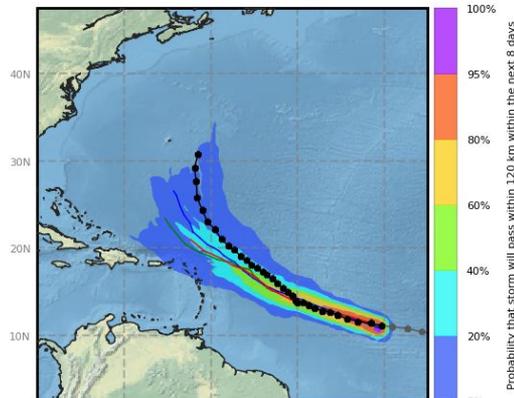
80W 70W 60W 50W 40W

— 0-24h — 24-48h — 48-72h — 72-96h
— 96-120h — 120-144h — 144-168h — 168-192h
●— Observations

MOGREPS-G: Forecast TC track probability for SAM from 00 UTC Fri 24 Sep 2021

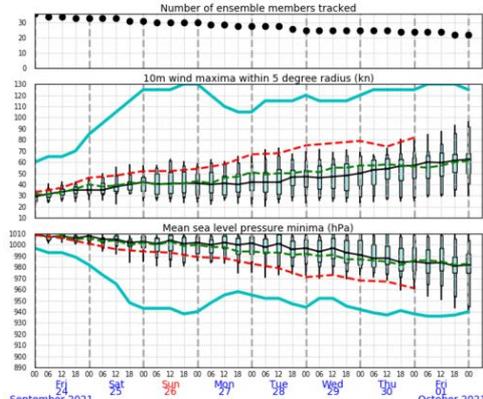


MOGREPS-G-PS: Forecast TC track probability for SAM from 00 UTC Fri 24 Sep 2021

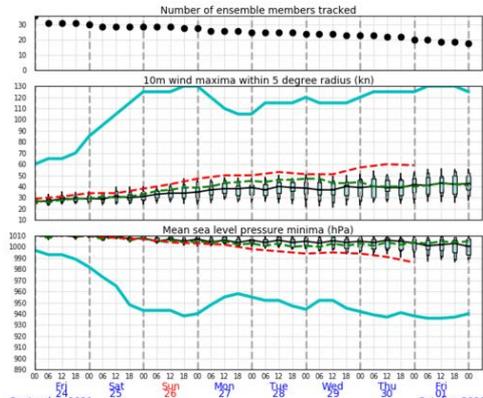


— Control — Ensemble mean
●— Observations — Deterministic

MOGREPS-G ensemble: TC-following meteorogram SAM (11.1N 40.3W) from 00 UTC Fri 24 September 2021



MOGREPS-G-PS ensemble: TC-following meteorogram SAM (11.1N 40.3W) from 00 UTC Fri 24 September 2021



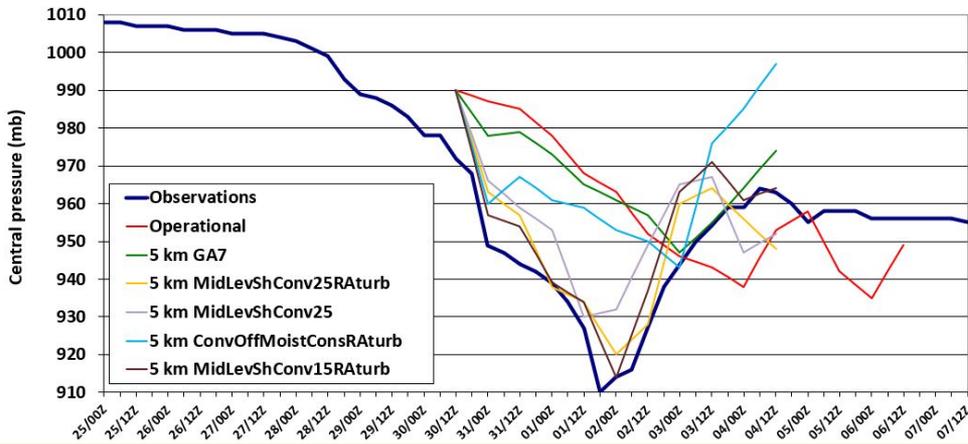
Note: All times on axis are in UTC

— max
— 90%
— 75%
— median
— 25%
— 10%
— min
— Median — Control — Deterministic — Obs

- Long term plans to run a 5 km resolution global model
- Experimenting with various science settings
- Hurricane Dorian and Typhoon Goni cases run
- Horizontal resolution not the biggest factor for intensity
- Adjustments to mid-level and shallow convection schemes and turbulence have bigger impact
- A new scale aware convection scheme also being developed – good initial results for TC track and intensity

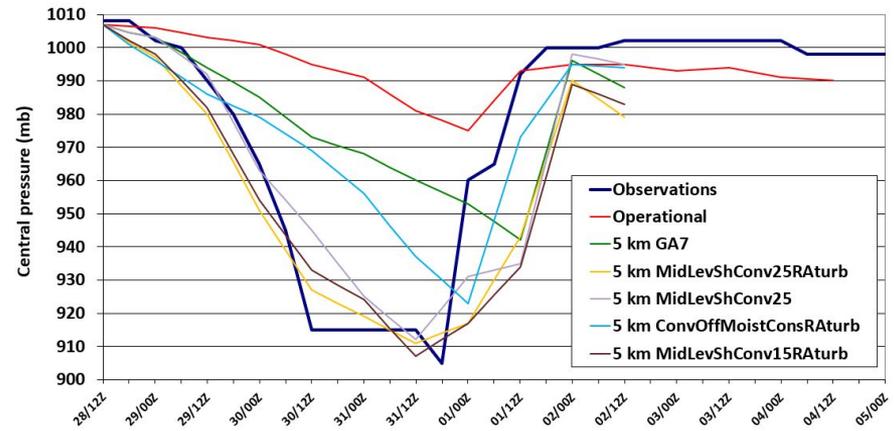
Hurricane Dorian Central Pressure Predictions
Operational and 5 km Global Trials
August-September 2019

Met Office



Typhoon Goni Central Pressure Predictions
Operational and 5 km Global Trials
October-November 2020

Met Office



Summary

- Track forecasts good for longest lived TCs (Larry and Sam)
- Ensembles mostly captured tracks even for uncertain cases.
- Intensification not well captured for small TCs and those in deep tropics
- As found in 2020, cyclogenesis better predicted in main development region than in the Caribbean and Gulf of Mexico
- Upcoming model change will make TCs weaker – better in subtropics, but not in tropics
- Experiments with 5 km resolution global model with revised physics show some good results for capturing rapid intensification

The End

