Met Office

Met Office Perspectives on 2020 Atlantic Hurricane Season

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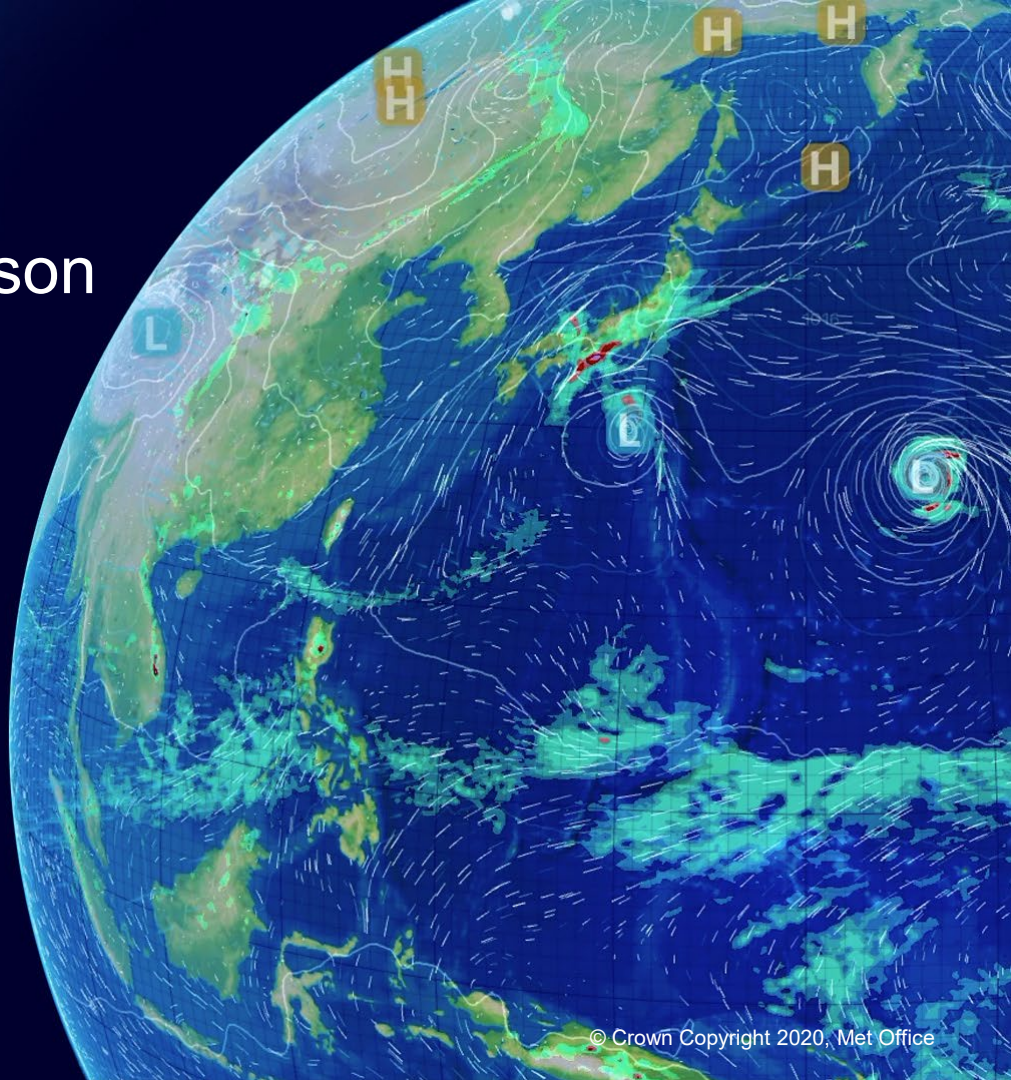
18 November 2020

HFIP Annual Review Meeting



Met Office

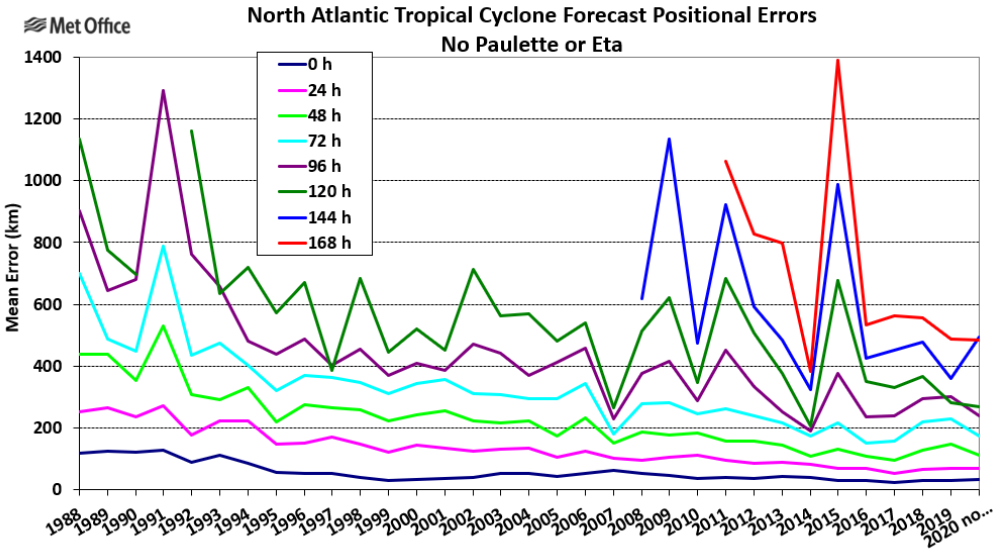
Outline

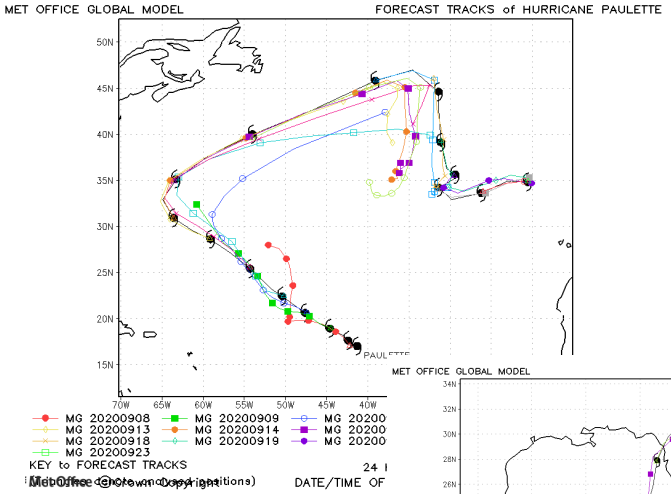
- Met Office Models Performance in 2020 (Paulette, Eta, Laura)
- Cyclogenesis (Gulf/Caribbean v. open Atlantic)
- Rapid intensification (Laura, Delta)
- Wind-Pressure relationship and drag over the ocean (Paulette)
- Atmosphere-Ocean coupled model trial (Teddy)

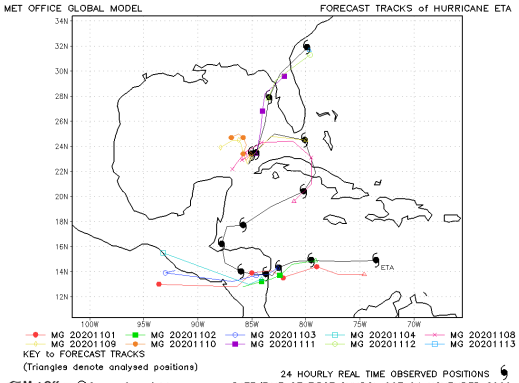
- Additional slides including GloSea Seasonal Forecast 2020

Track Forecasts

- 2020 Atlantic track errors good at short lead times, but large at longer lead times.
- Active season, but dominated by relatively short storms – except Paulette and Eta.
- Paulette and Eta dominated longer lead time errors (as Joaquin did in 2015)

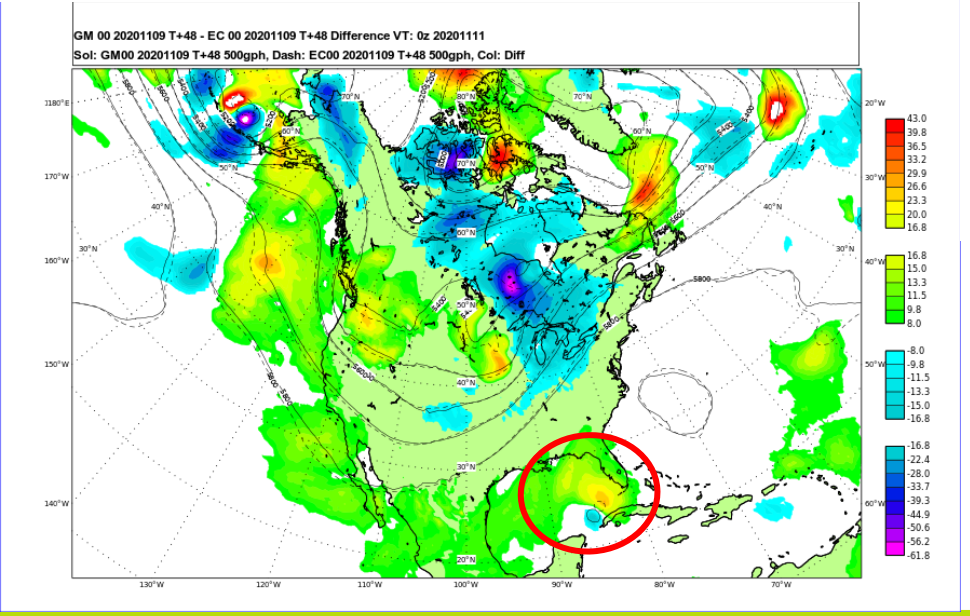


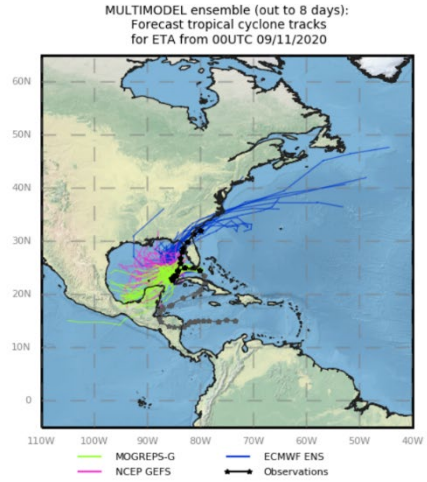


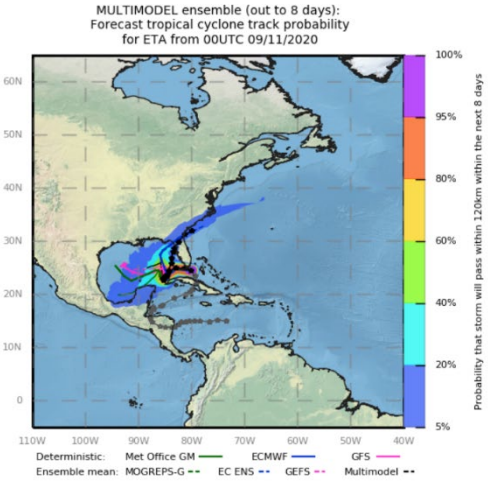


Track Forecasts - Hurricane Eta

- Met Office models poor handling in the Gulf
- 00UTC 9 Nov 48h MOGM-ECMWF difference plot
- Initial investigation into small differences in position/depth of low near Cuba and handling of trough which lifts Eta northwards

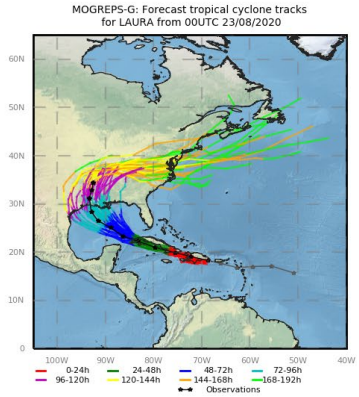


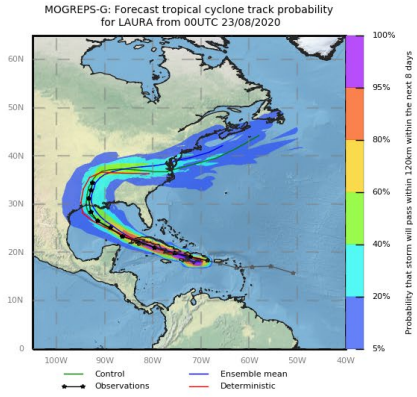


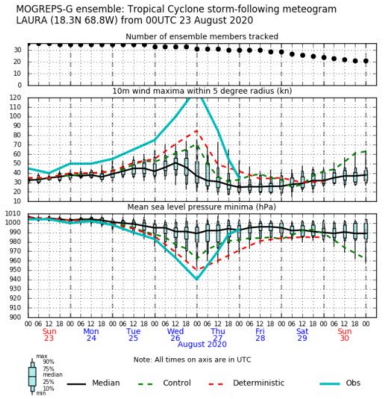


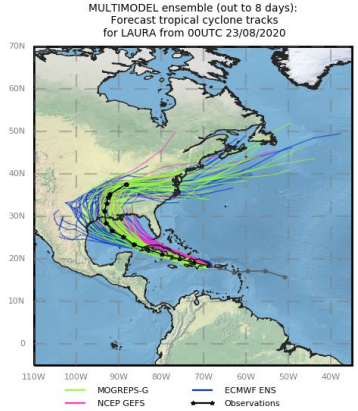
- MOGEPS-G ensemble spread did not capture second Florida landfall
- Feeding into wider research work into the ensemble being underspread

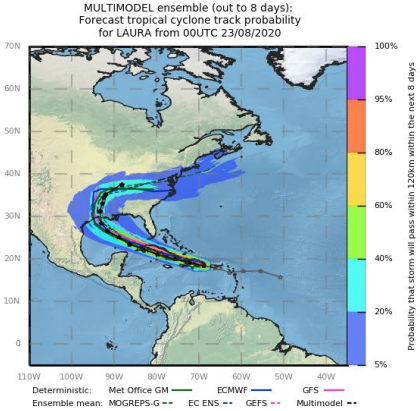
Ensembles – Hurricane Laura

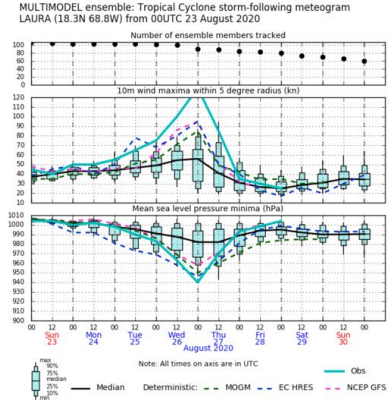






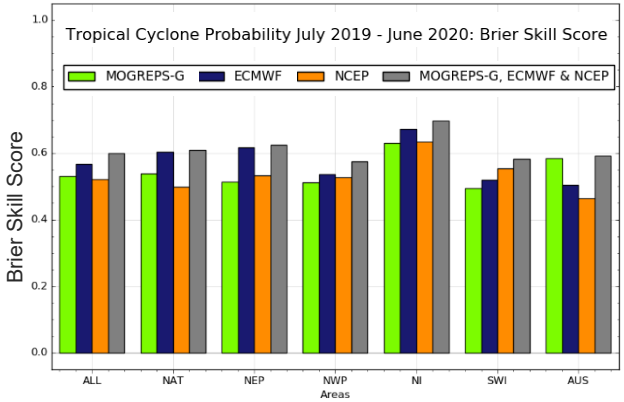






Good forecast of track in MOGREPS-G:

- following the observed track just to the south of Cuba
- US landfall location close to the ensemble mean.
- Good forecast of timing of landfall and timing of peak intensity.

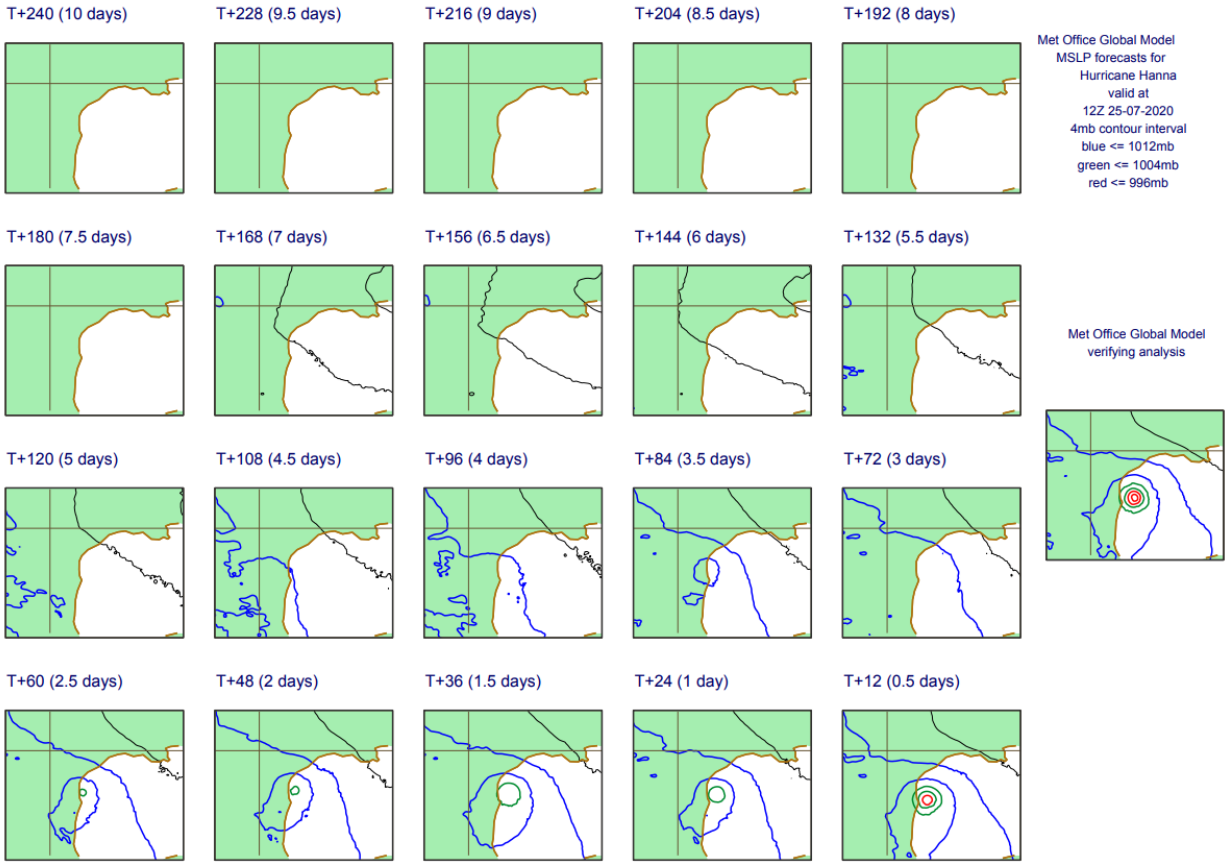


- The most skilful individual ensemble can vary from storm to storm and basin to basin
- Additional skill can be gained by using a multi-model ensemble

Titley and Bowyer (2019)

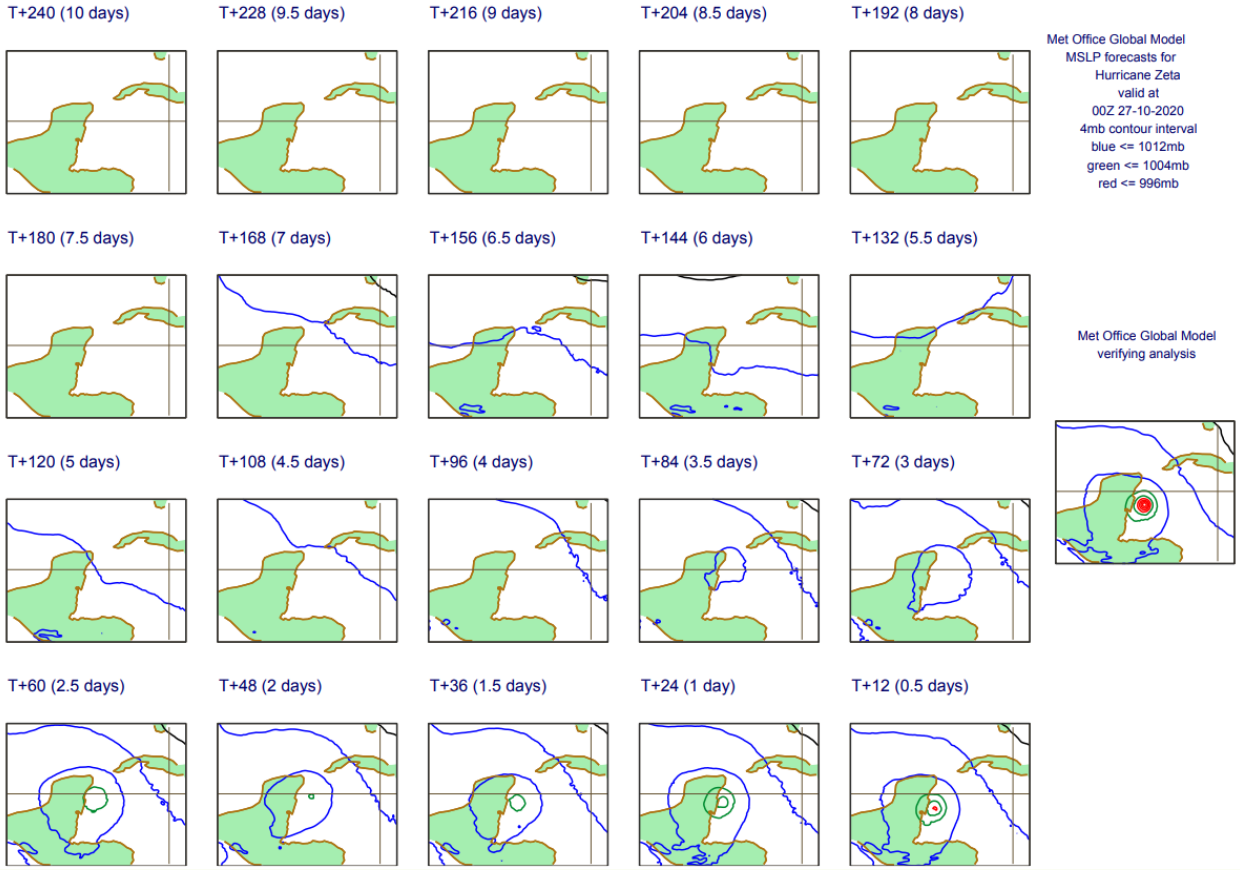
Cyclogenesis – Hurricane Hanna

- All forecasts verifying just before landfall as a hurricane shown
- Little indication of formation until 60 hours before landfall
- Very little to suggest hurricane intensity possible



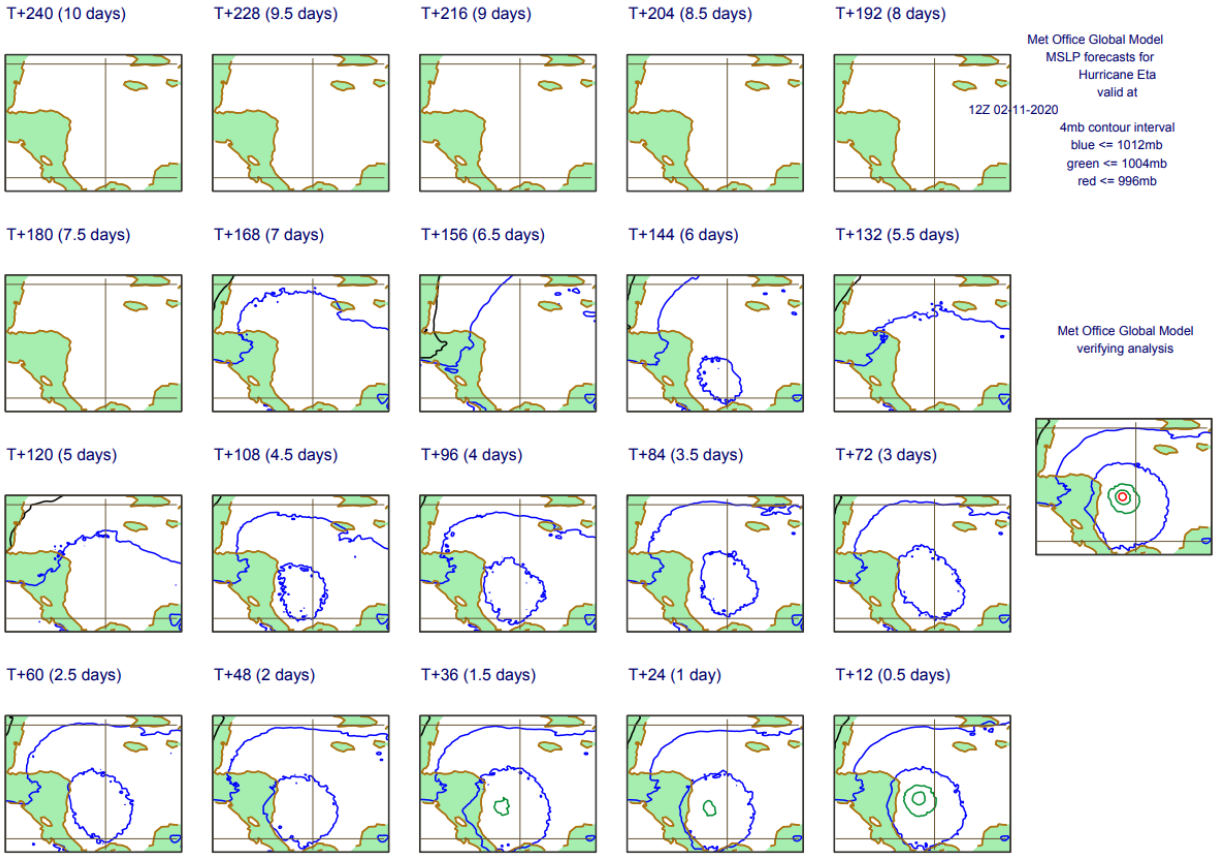
Cyclogenesis – Hurricane Zeta

- All forecasts verifying at time just before landfall over Yucatan
- Hint of formation 84 hours in advance, but still weak up to 24 hours ahead.



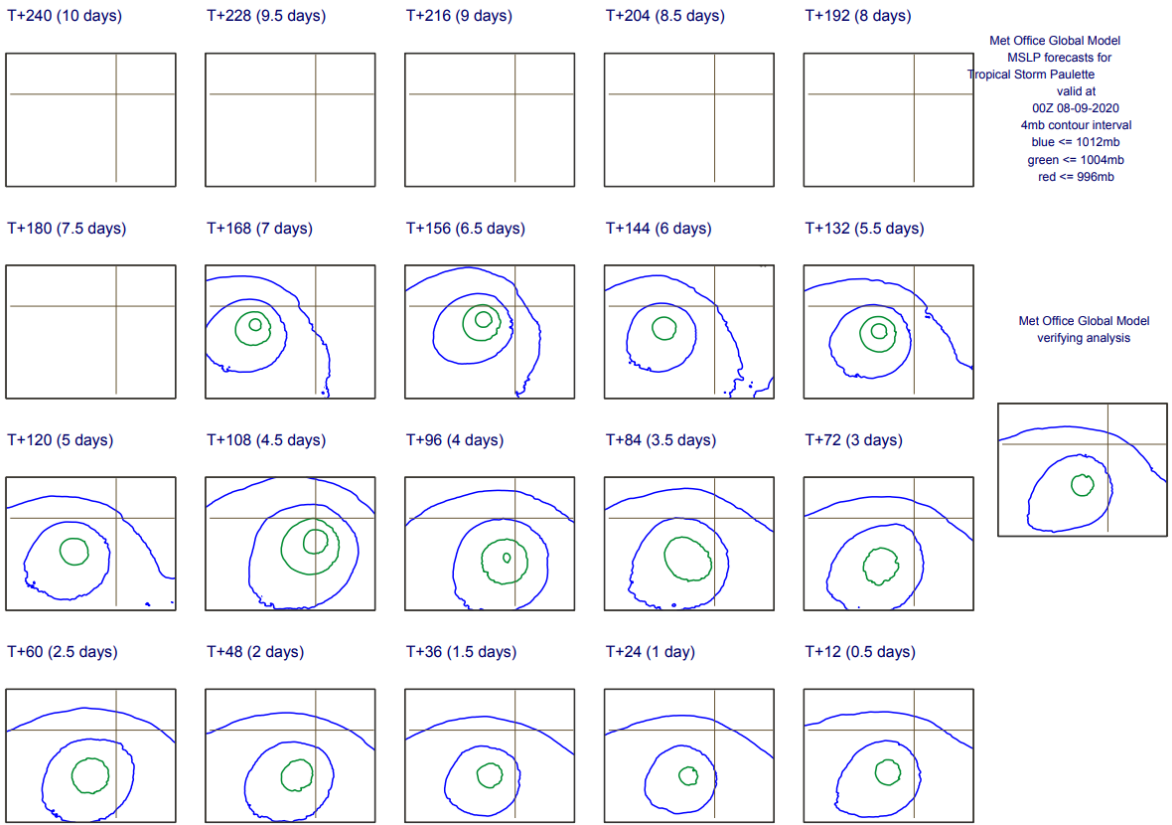
Cyclogenesis – Hurricane Eta

- All forecasts verifying at time just after Eta became a hurricane
- An indication of formation 108 hours ahead, but very weak circulation.
- Other cases of poor cyclogenesis prediction (see additional slides): Marco, Nana, Delta



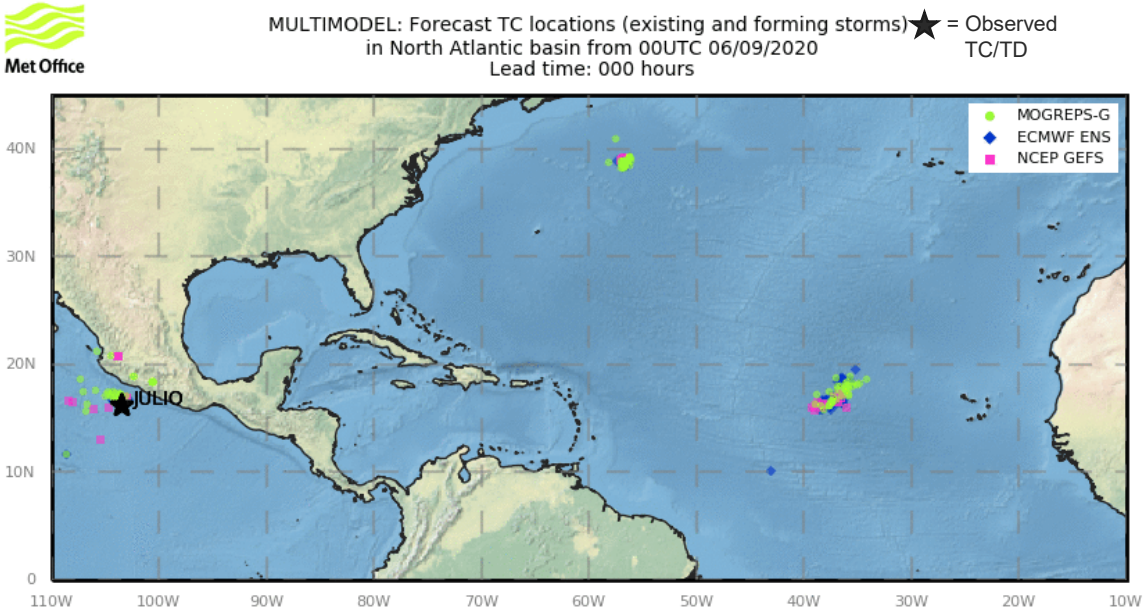
Cyclogenesis – Tropical Storm Paulette

- All forecasts verifying at first main hour after storm formation
- Good forecast of tropical storm formation at least 7 days ahead
- Cyclogenesis handled better for larger storms and those in the MDR/open ocean
- Possible research: impact of observations on the periphery of TC development in western Caribbean and Gulf of Mexico.



Ensembles Cyclogenesis

Tropical cyclone genesis in 2020 Atlantic hurricane season

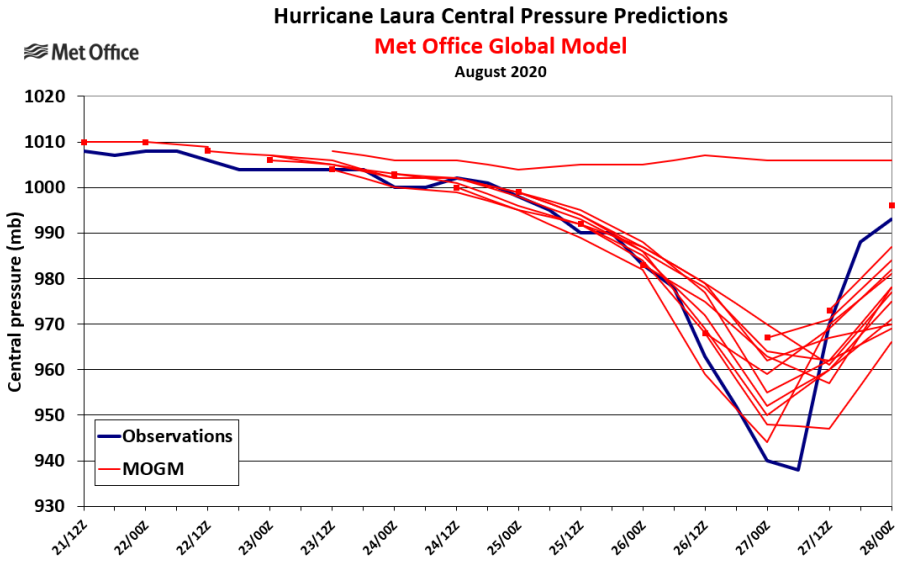


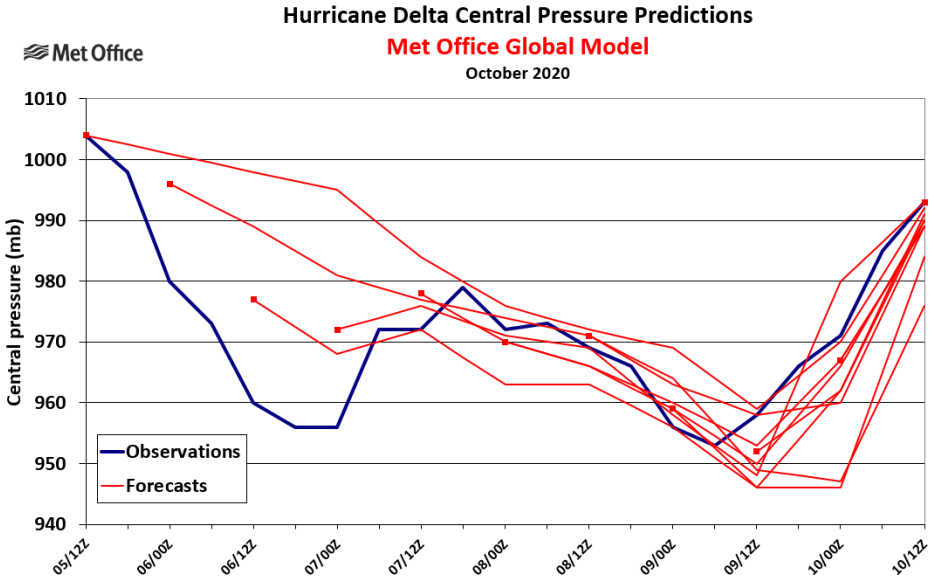
- The storms that developed from African Easterly Waves were generally well forecast by MOGREPS-G, and the other global ensembles.
- The formation of some of the storms that formed in the Caribbean and Gulf were less well predicted by the global ensembles.

- Forecast from DT 00UTC 6th September.
- Formations of Paulette, Rene and Teddy in open ocean all well predicted.
- Formation of Sally near Florida not well predicted

Rapid Intensification

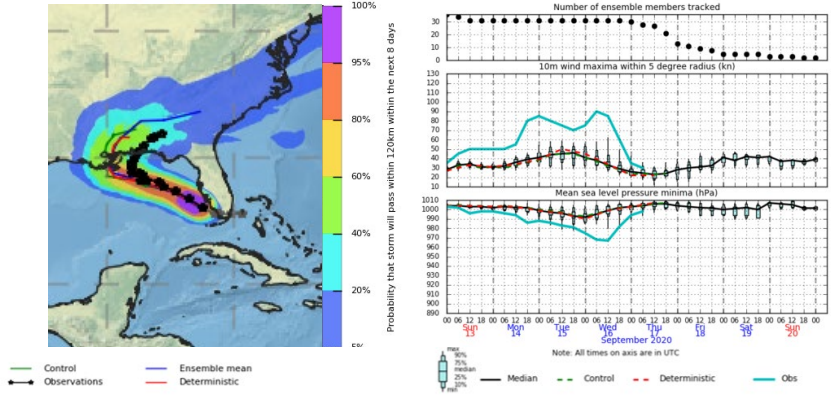
- Rapid intensification of Laura reasonably well captured
- Rapid intensification of Delta not captured
- Second peak in intensity of Delta handled well



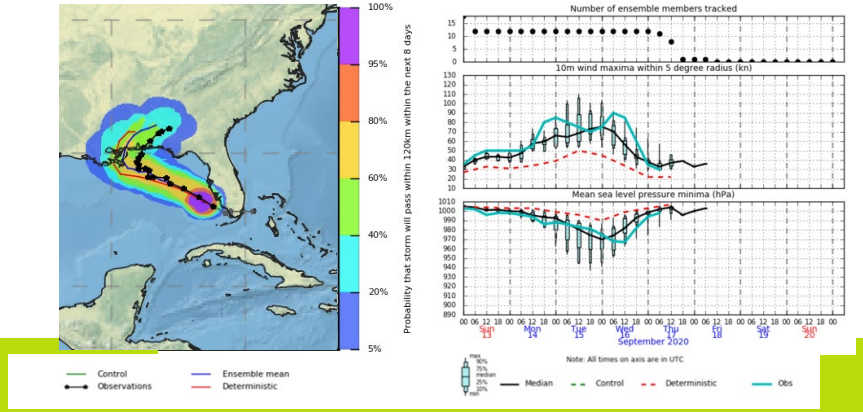


Convection Permitting Ensemble (4.4 km) – Hurricane Sally

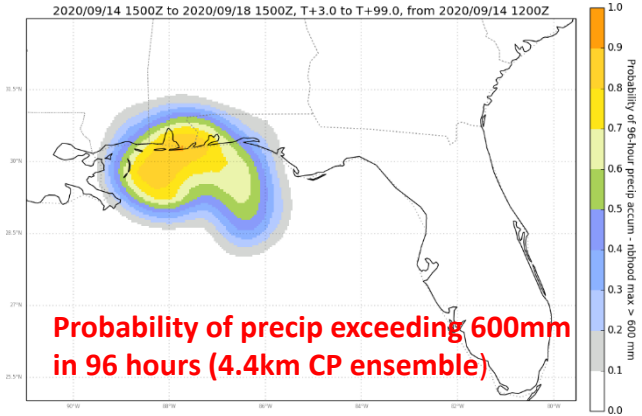
MOGREPS-G



4.4km CP ensemble



- CP ensemble tracks similar to MOGREPS-G
- CP ensemble much better for intensity

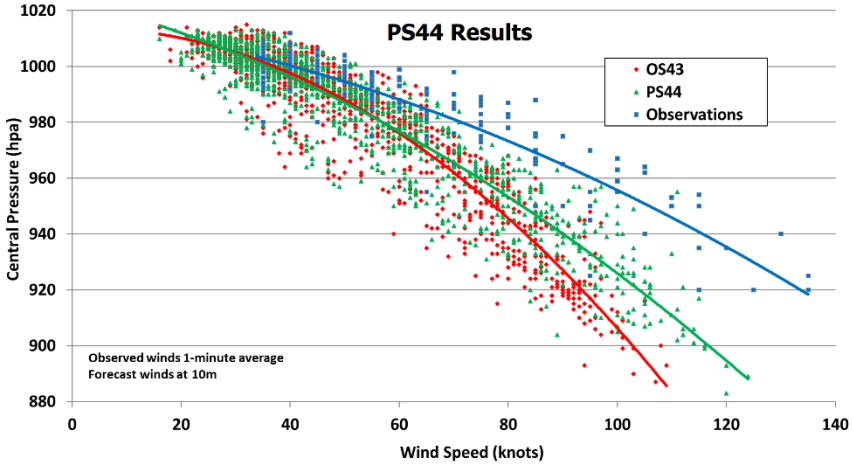


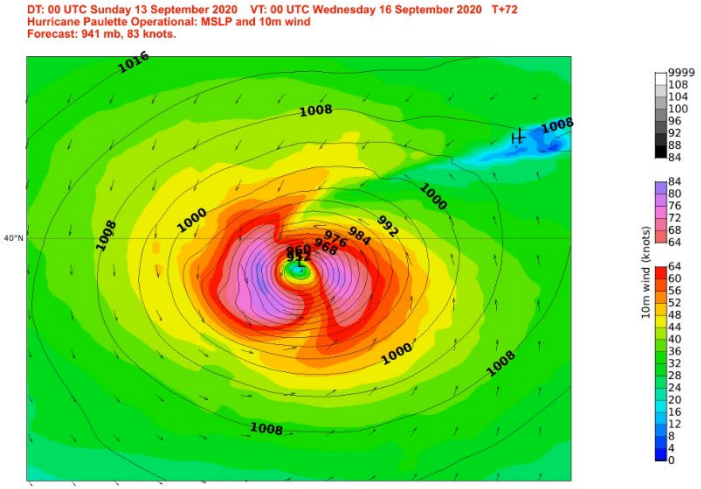
- Forecast 80-90% prob of 600 mm in 96h
- Observed:
  - Pensacola 610 mm
  - AL/FL border 750 mm

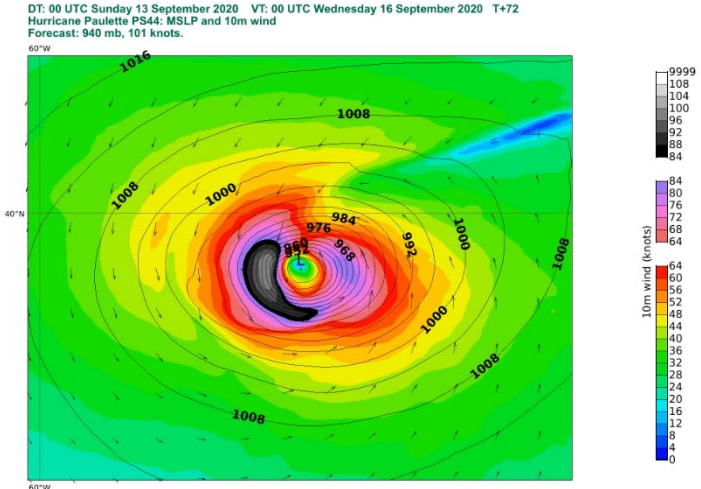
- CP ensemble also captured second intensification of Delta well (additional slides)

Wind-Pressure Relationship Update

- Capped drag at high wind speeds to be introduced in Global Model in December
- Trials show improvement in wind-pressure relationship (Control red, Trial green)
- Example forecast for Hurricane Paulette
- Control left, Trial right
- Winds 18 knots stronger with no difference in central pressure

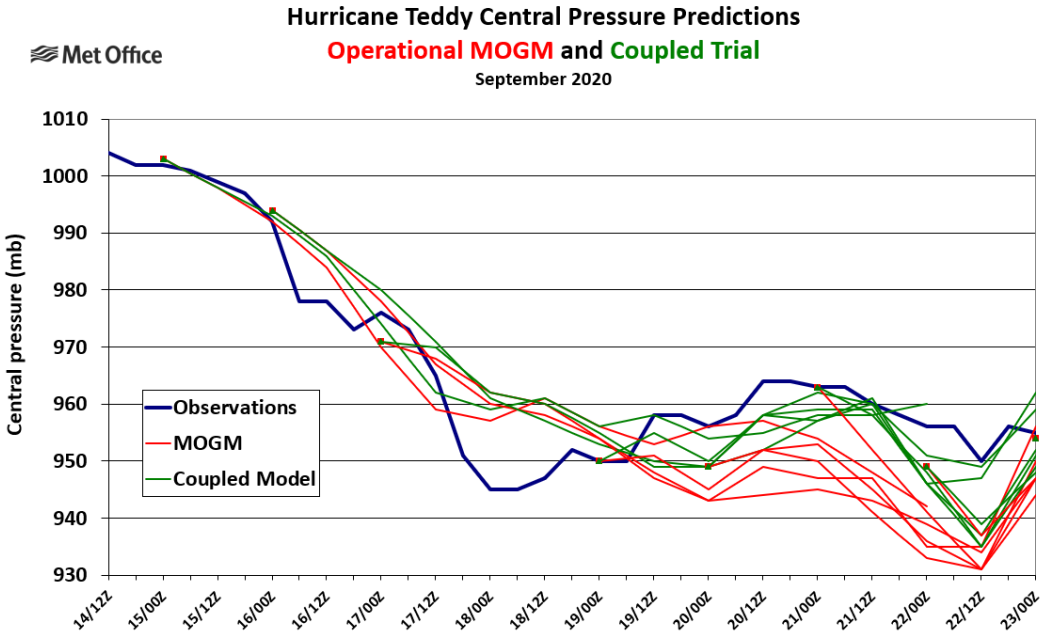


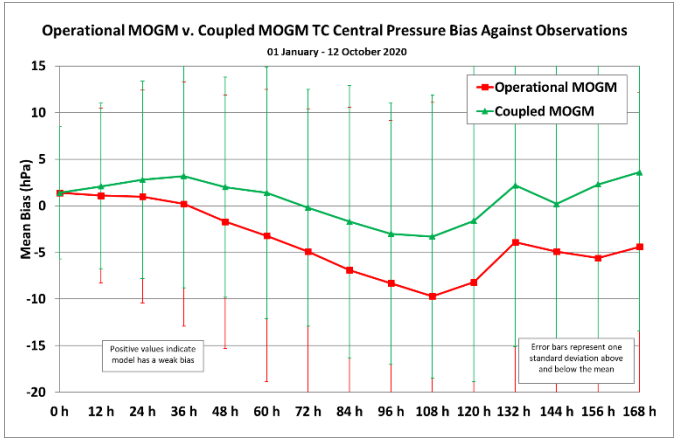


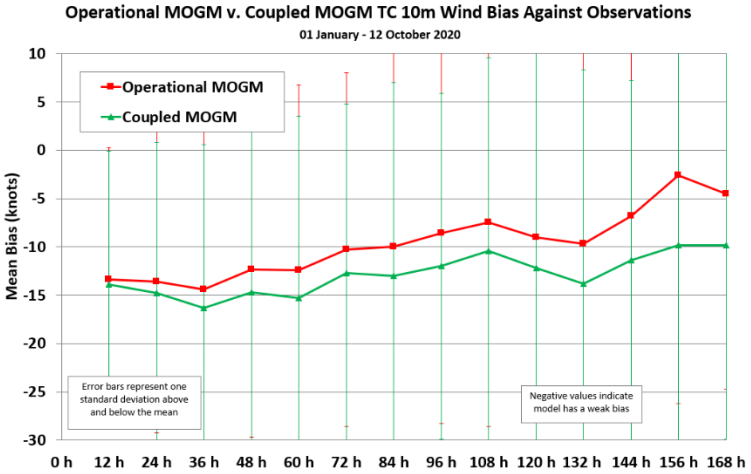


Atmosphere-Ocean Coupled MOGM

- Planned introduction 2021
- Central pressure over-deepening bias much reduced
  - Hurricane Teddy example
- Low bias in 10m winds made worse
- Combined impact of drag over the ocean and coupling yet to be tested.







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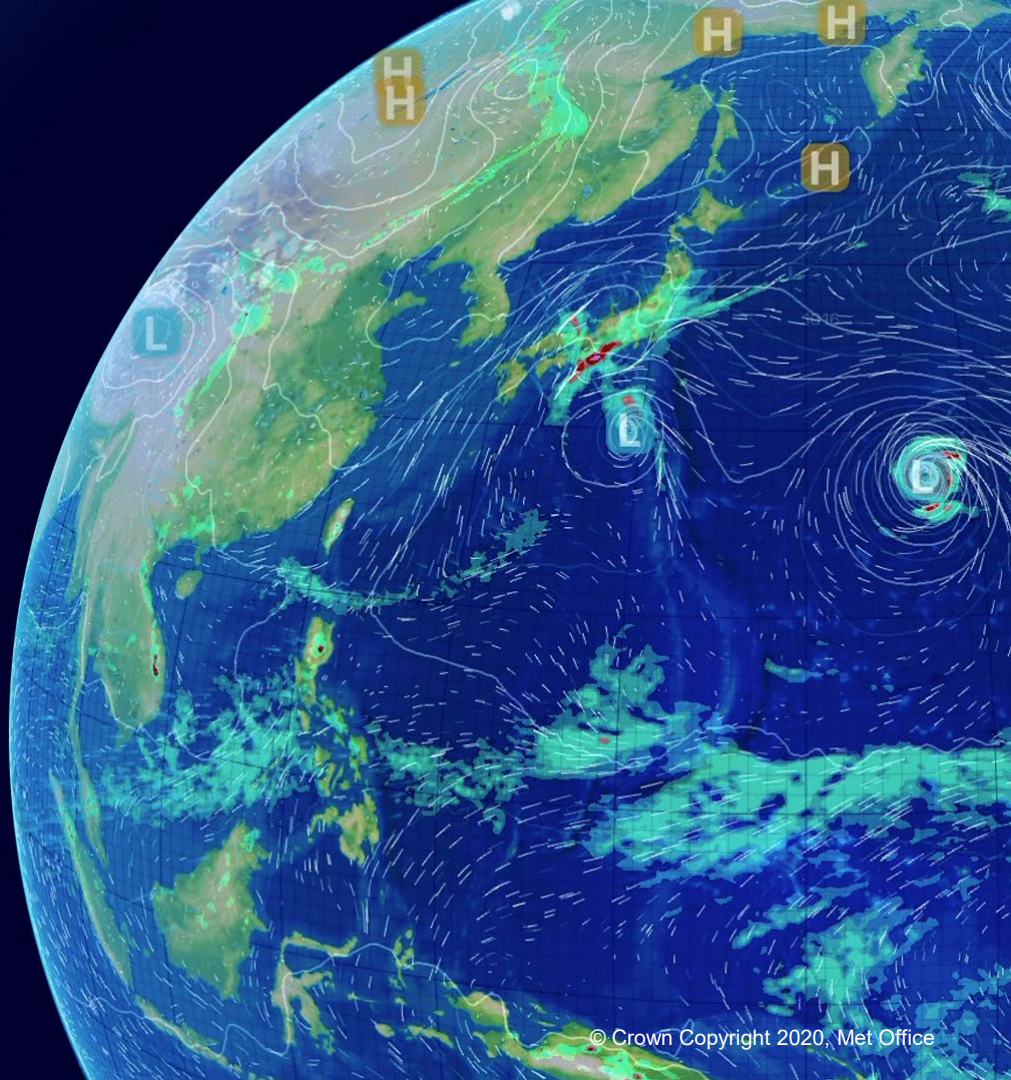
The End

Additional slides available including seasonal forecast assessment



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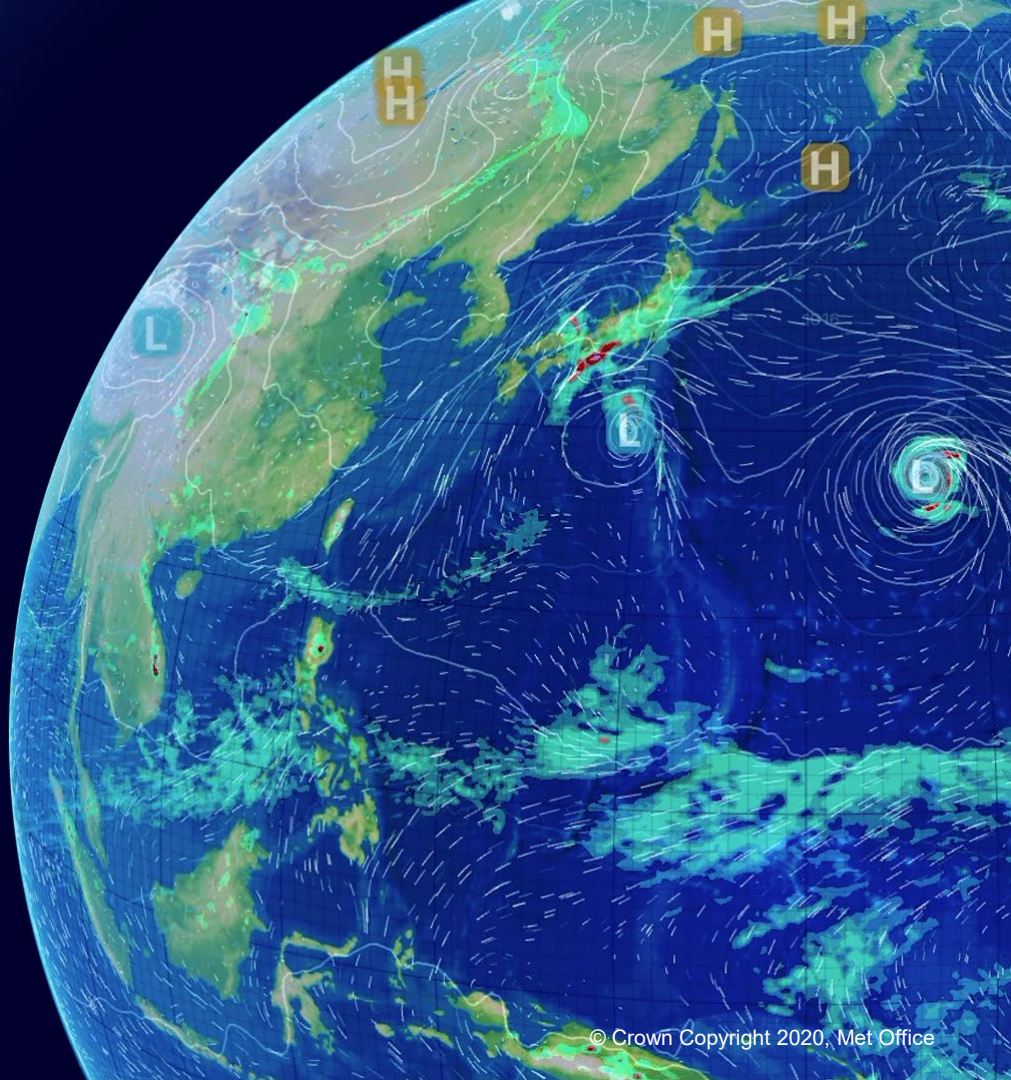
Additional slides



Met Office

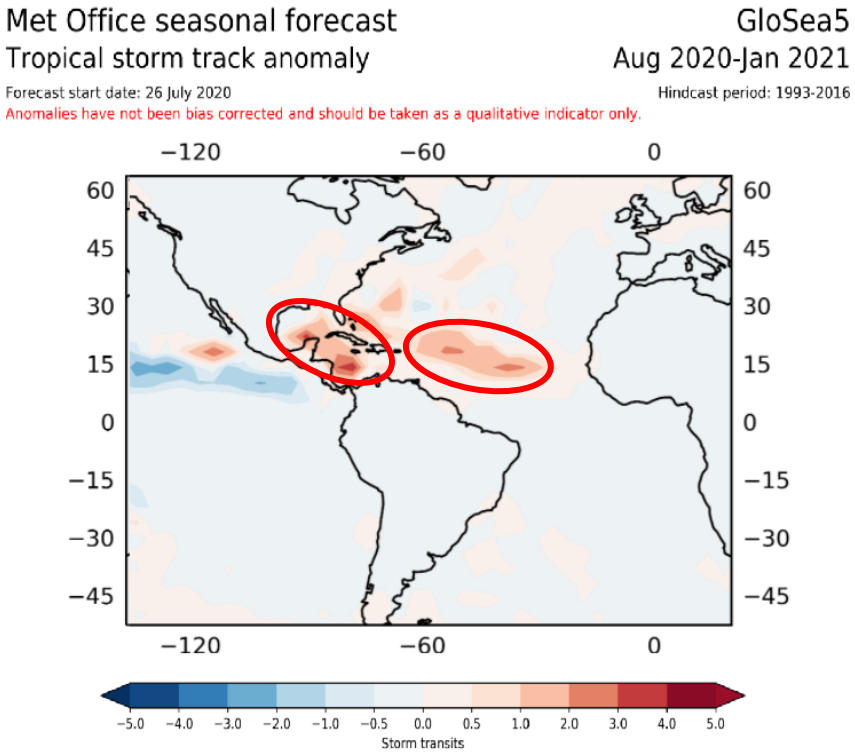
Atlantic Seasonal Forecast 2020

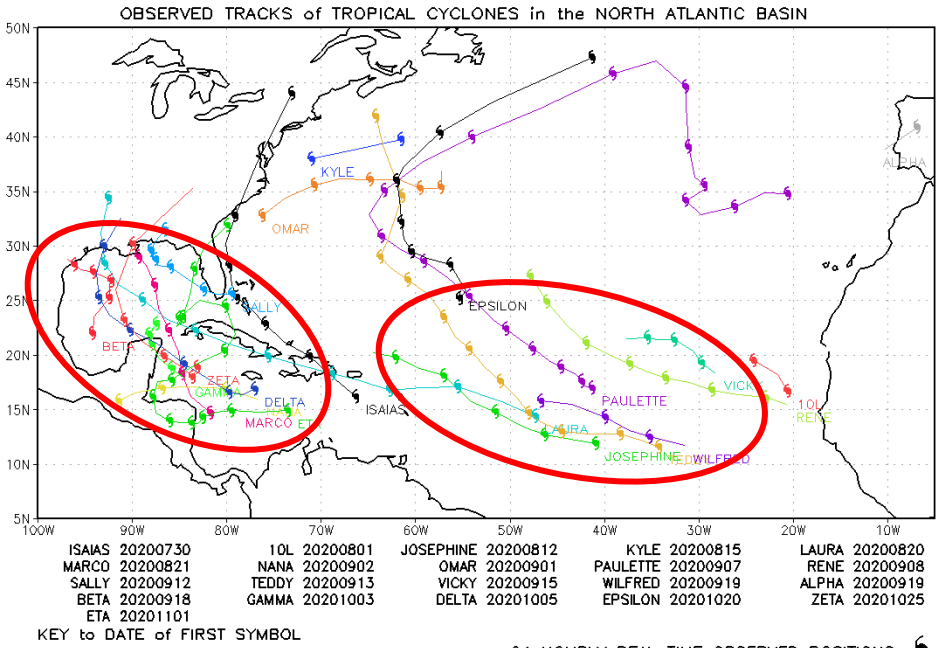
	Forecast for May-October (issued late April)		Forecast for June-November (issued late May)*‡		Forecast for July-December (issued late June)*		Forecast for August-January (issued late July)*		Observed to 17 November	1981-2010 average
Tropical storms	13	9-17	15	11-19	19	15-23	23	19-27	30	12.1
Hurricanes	7	5-9	7	5-9	8	5-11	9	7-11	13	6.4
Major hurricanes	3	2-4	3	2-4	4	3-5	4	3-5	6	2.7
ACE index	115	66-164	112	68-156	150	108-192	165	117-213	179	106

* Forecast values include data for storms which occurred before the forecast start date.
‡ Public forecast

Atlantic Seasonal Forecast 2020

- Forecast track spatial anomaly from August onwards gave good guidance





Met Office

Atlantic Seasonal Forecast 2020

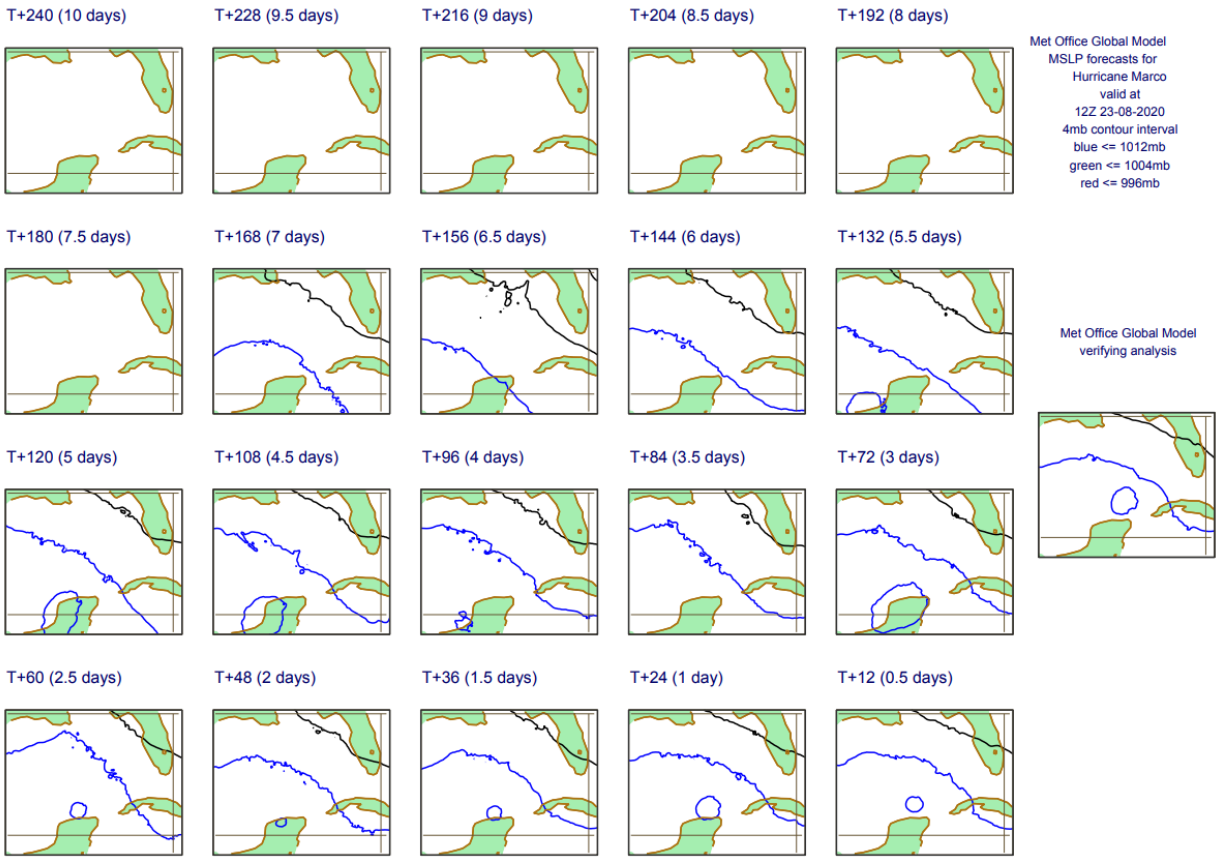
- Forecasts late March to early April called for high activity
- Forecast activity reduced mid-April to late May when public forecast issued
- From June onwards forecast activity increased again

- Currently only one public forecast issued (late May)
- May consider issuing a late July update as done by other agencies

- GloSea6 to be implemented February 2021 based on GC3.2
- No assessment or hindcasts yet available

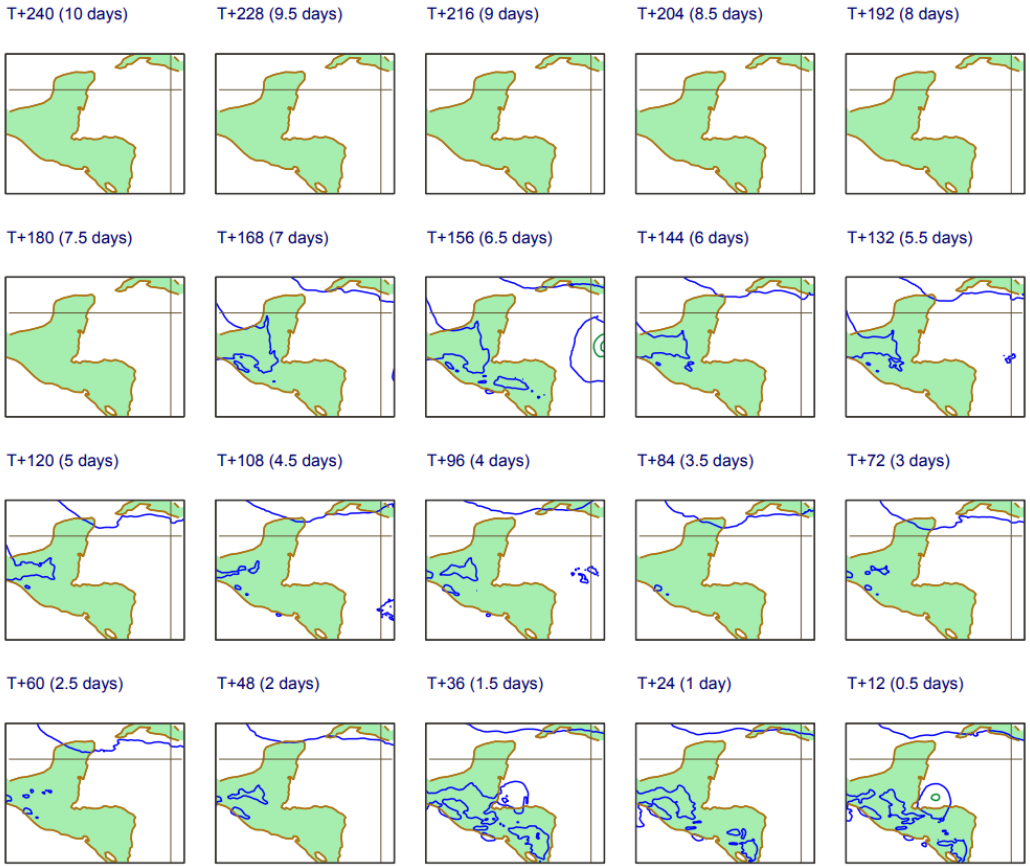
Cyclogenesis – Hurricane Marco

- All forecasts verifying at time Marco became a hurricane
- Very weak circulation forecast on and off from day 5
- Barely discernible even in the analysis



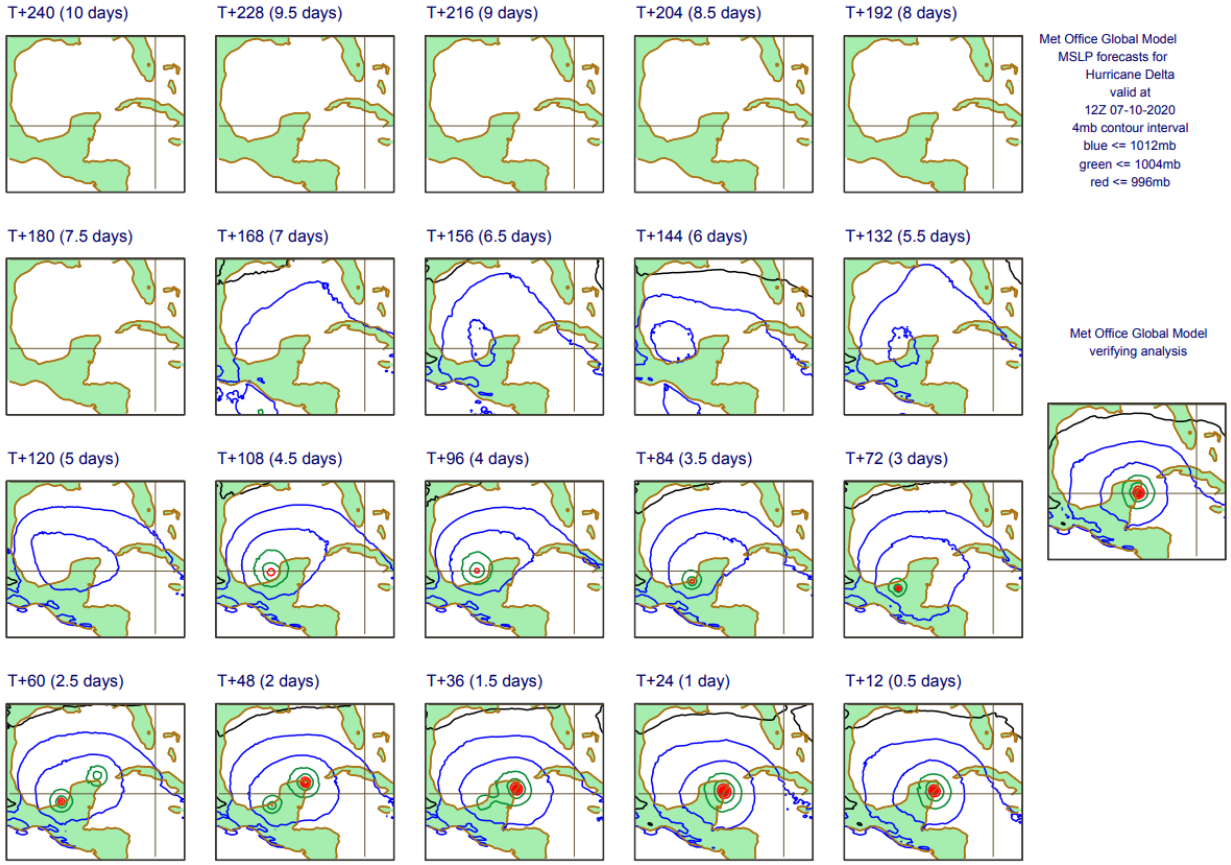
Cyclogenesis – Hurricane Nana

- All forecasts verifying just before landfall as a hurricane shown
- Hint of formation 7 days out, but too far east and lost after that
- Barely discernible even in the analysis



Cyclogenesis – Hurricane Delta

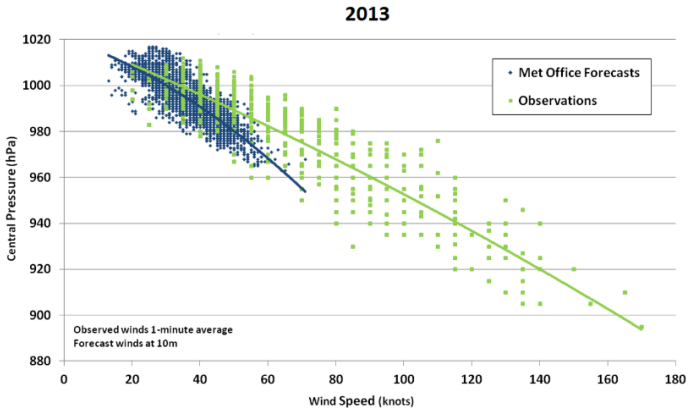
- All forecasts verifying at time of landfall over Yucatan
- Early forecasts too strong for Gamma and missed Delta
- Eventually captured Delta two days before landfall

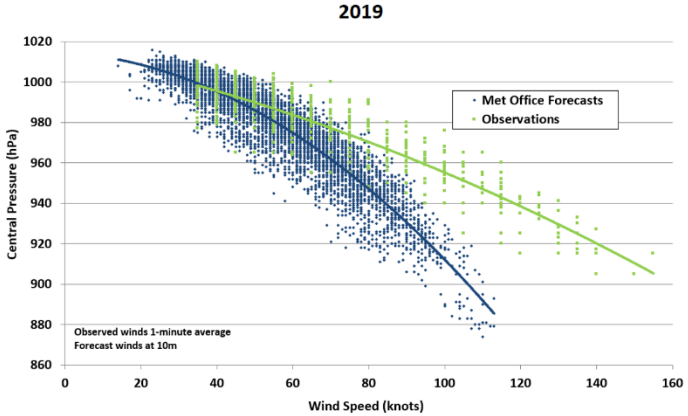


Wind-Pressure Relationship Update

- Prior to implementation of GA6 in 2014, global model rarely simulated tropical cyclones stronger than 65 knots or 960 hPa
- Under GA6/GA7 central pressure can go as low as 880 hPa, but rarely above 110 knots

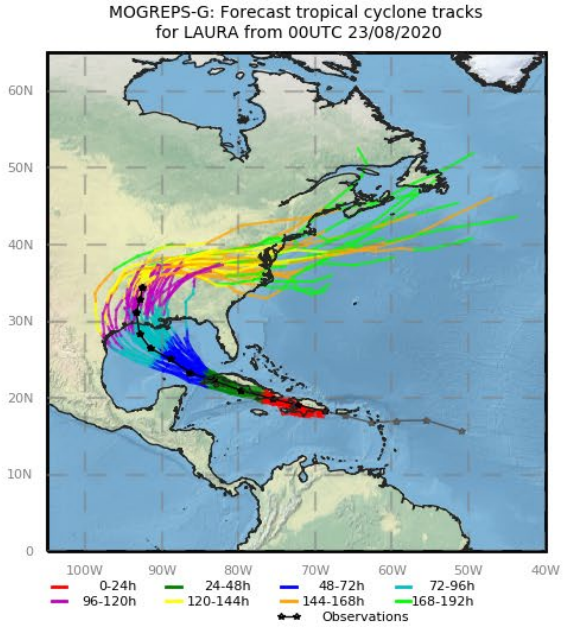
- Contributor to poor Wind-Pressure relationship at high wind speeds is the model's linearly increasing drag over the ocean
- Theory and experimental work suggests drag does not continue increasing at higher wind speeds
- Extensive trials undertaken with drag capped and then reduced at high wind speeds.

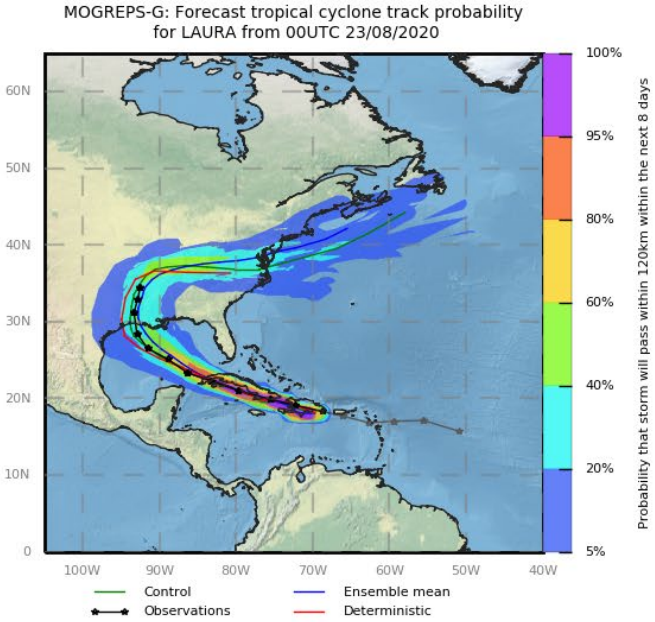


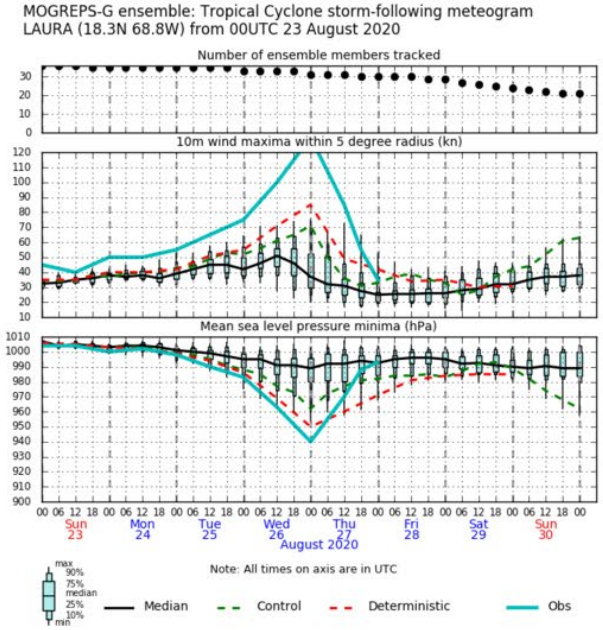


MOGREPS-G - Hurricane Laura

- Laura 00Z forecast tracks (left), 12Z tracks (right)
- A left-of-track bias in some early forecasts (slight wind shield wiper effect)
- Ensembles captured uncertainty as in this example from 00Z 23 August.

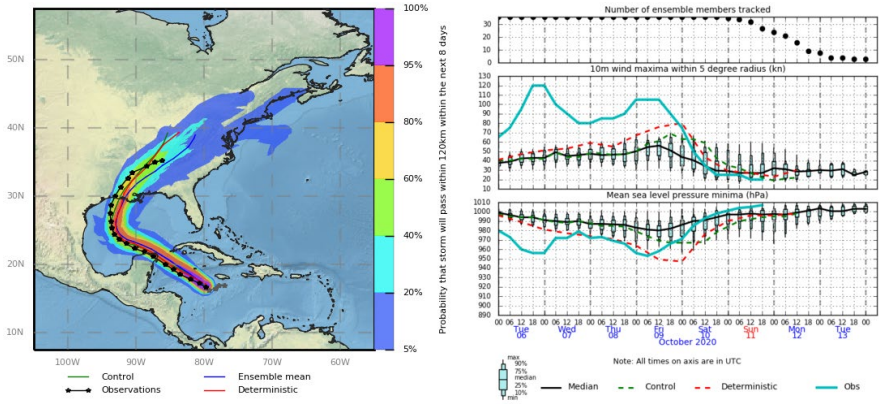




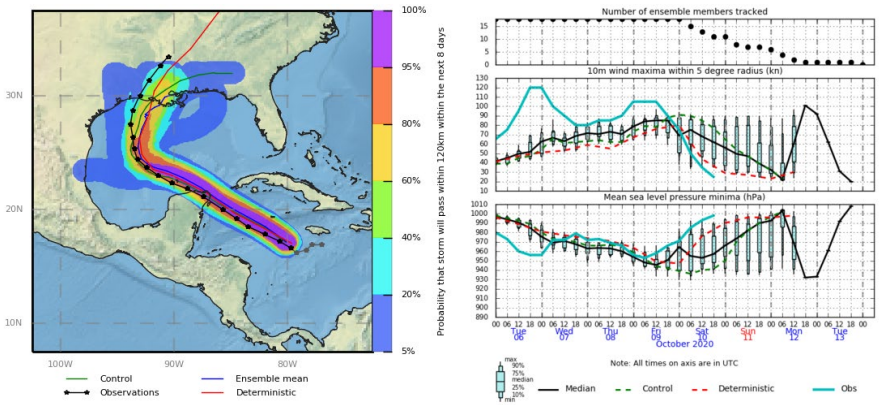


Met Office MOGREPS-G and Convection Permitting Ensemble – Hurricane Delta

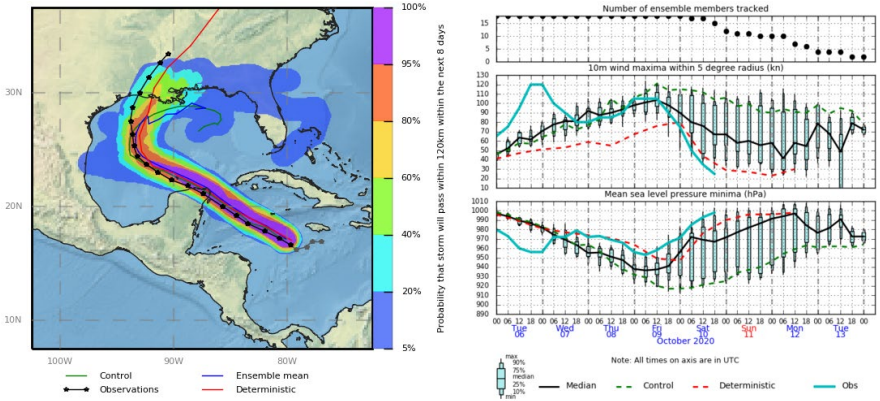
MOGREPS-G



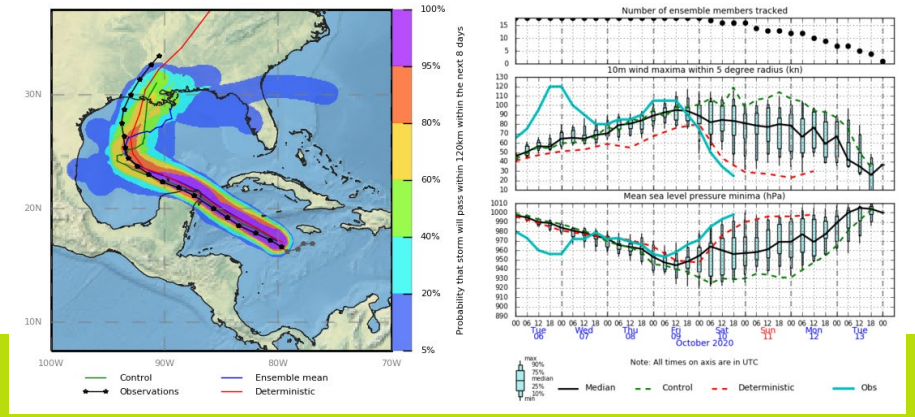
8.8km GA7 ensemble



8.8km CP ensemble



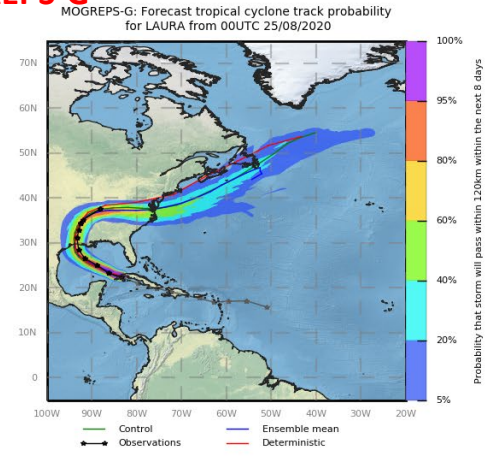
4.4km CP ensemble

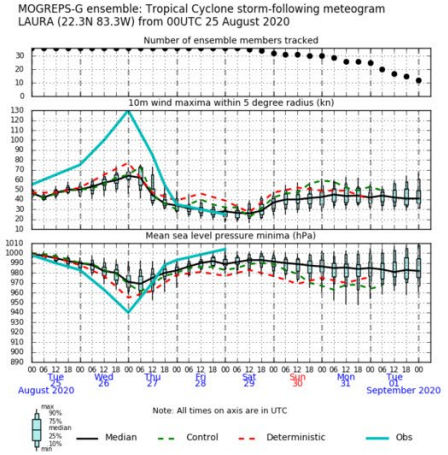


MOGREPS-G and Convection Permitting Ensemble – Hurricane Laura

- MOGREPS-G and 4.4km ensemble both capture track well
- MOGREPS-G good for intensity timing, but not absolute value
- 4.4km ensemble excellent for intensity

MOGREPS-G





4.4km CP ensemble