Operational Global Modeling at NCEP: Plans and Advances

NATIONAL WEATHER SERVICE

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Outline

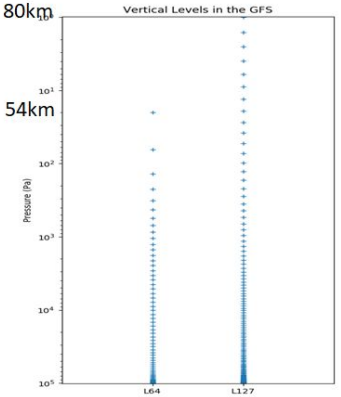
- **2021: Successful year of TC predictions from GFSv16**
  - Implemented in March 2021
  - Best track forecast skill for the North Atlantic Basin
  - Competitive intensity forecasts from Global Models
- **Intermediate Upgrades for GFSv16 in 2022**
  - Satelite DA and other Obs upgrades
  - Possibly run in parallel for 2022 summer and available in real-time
- **GFSv17/GEFSv13 in 2024**
  - Next major upgrade using UFS Coupled Modeling for MRW/SubX
  - Physics finalized for GFSv17
  - GEFSv13 reforecasts planned in 2023

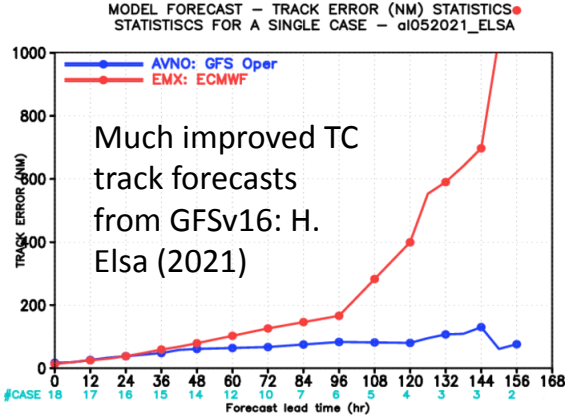
GDAS/GFSv16.0 implemented on March 22, 2021

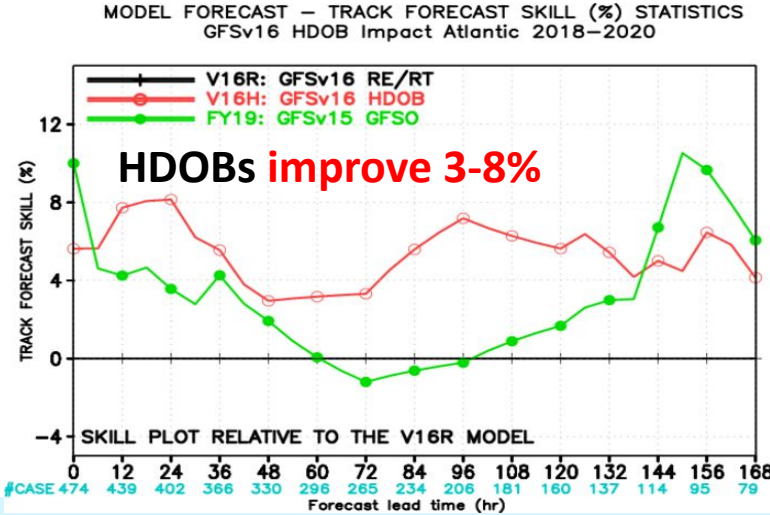
Highlights of GDAS/GFSv16:

- Increase the vertical resolution from 64 to 127 and raise the model top from 54 to 80km
- Advanced physics to enhance the model representation of the atmosphere
- Improved DA algorithms (LETKF and IAU)
- Include more observations (satellite and in-situ, HDOBS)
- Couple the deterministic global wave model with the atmospheric model using the UFS coupling framework (simplification of production suite)

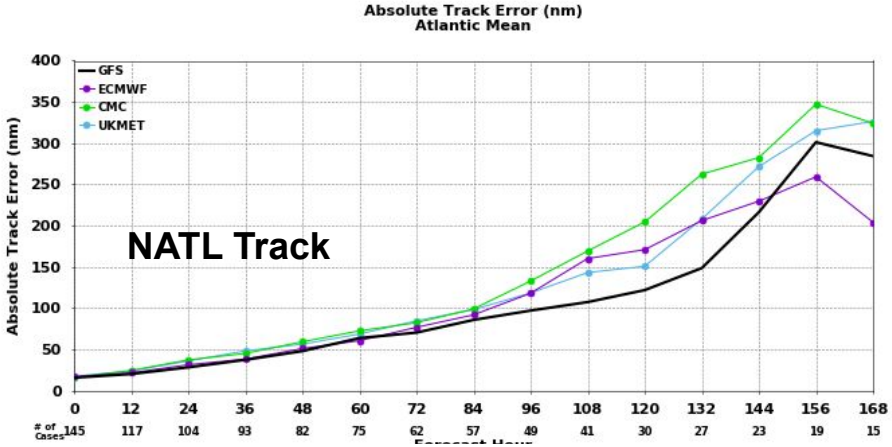
GFSv16.1: Implemented on May 20, 2021 with inclusion of Commercial Radio Occultation Data

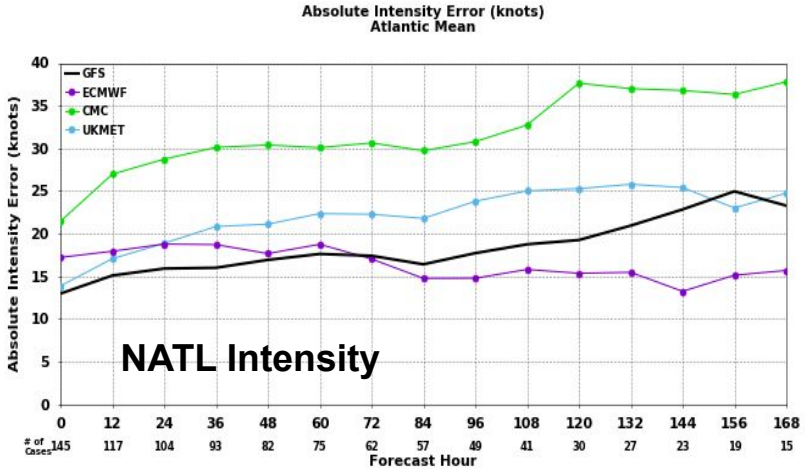


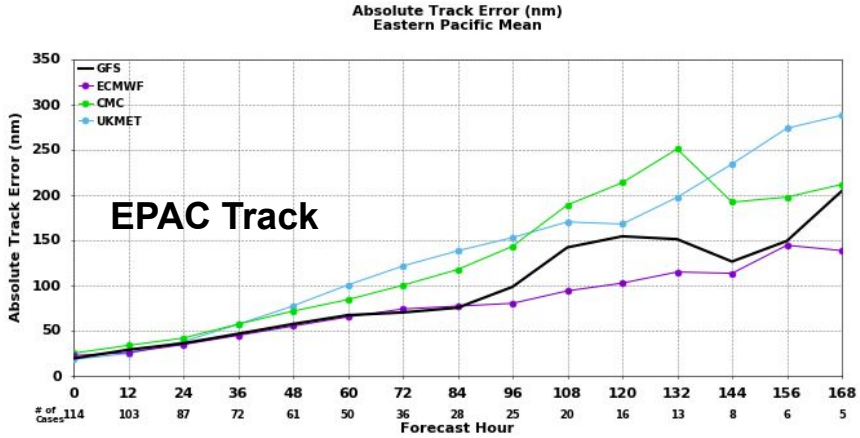


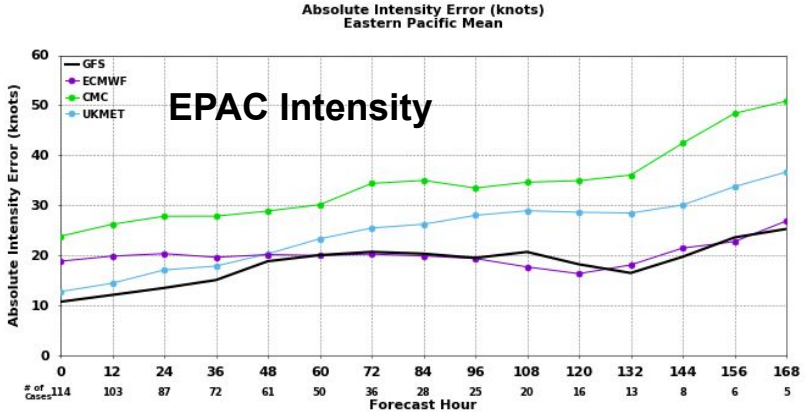


Global Deterministic Models TC Forecast Performance in 2021

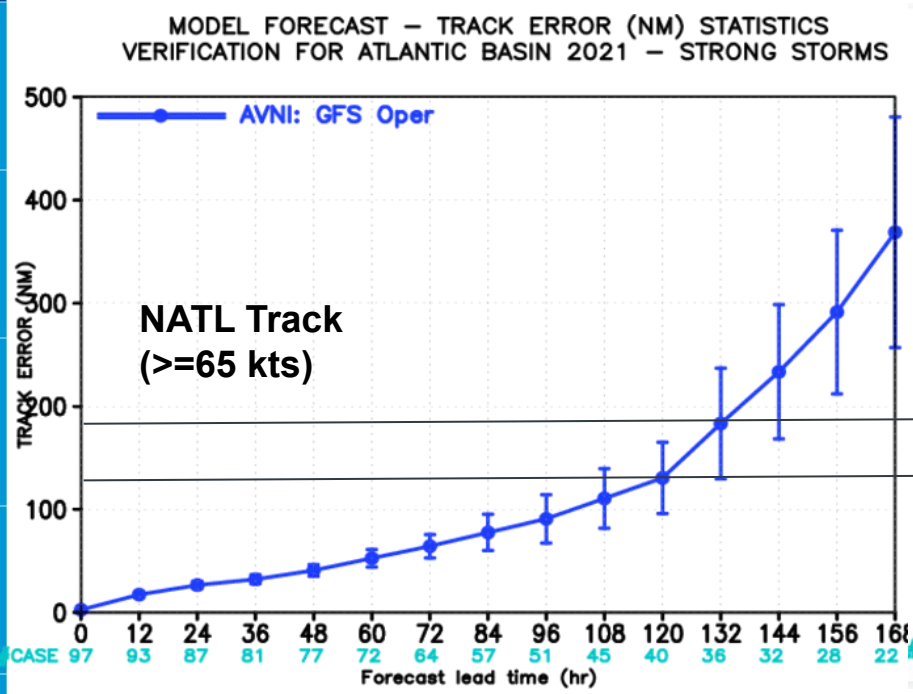


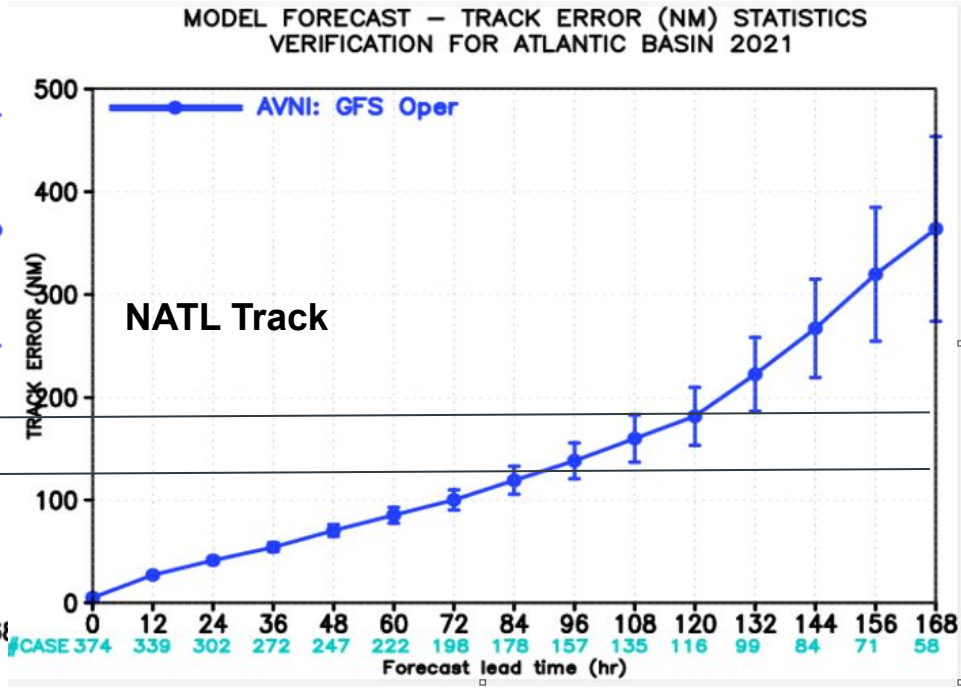






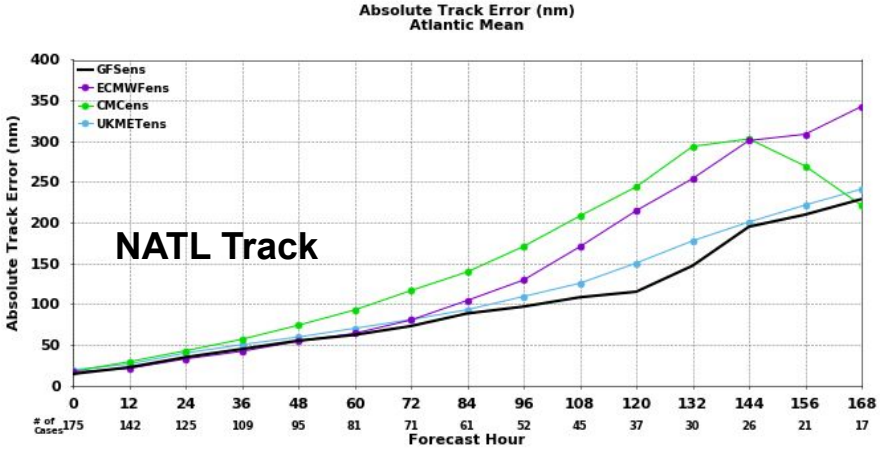
GFS TC Forecast Performance in 2021: Strong vs. Weak Storms

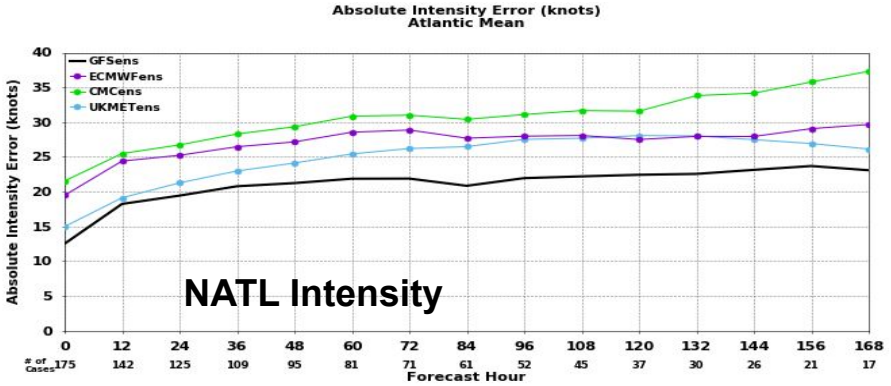


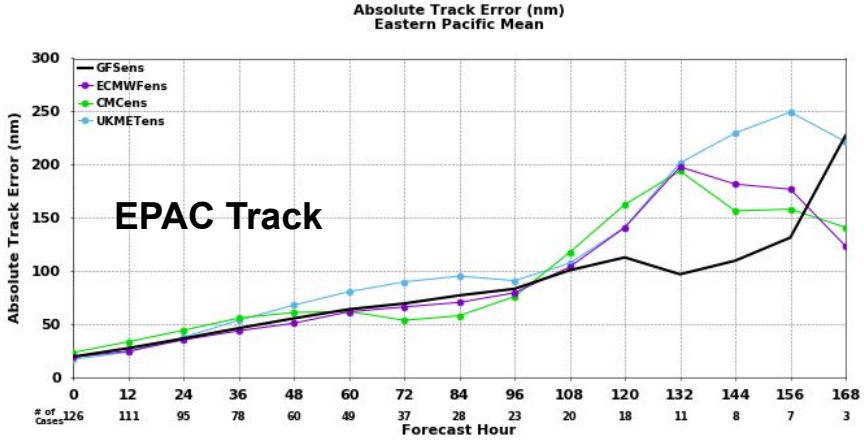


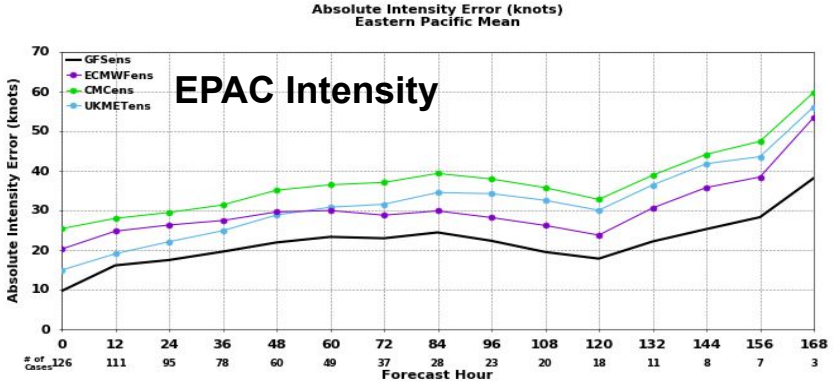
Improved forecast skill for strong storms

Global Ensemble Models TC Forecast Performance in 2021

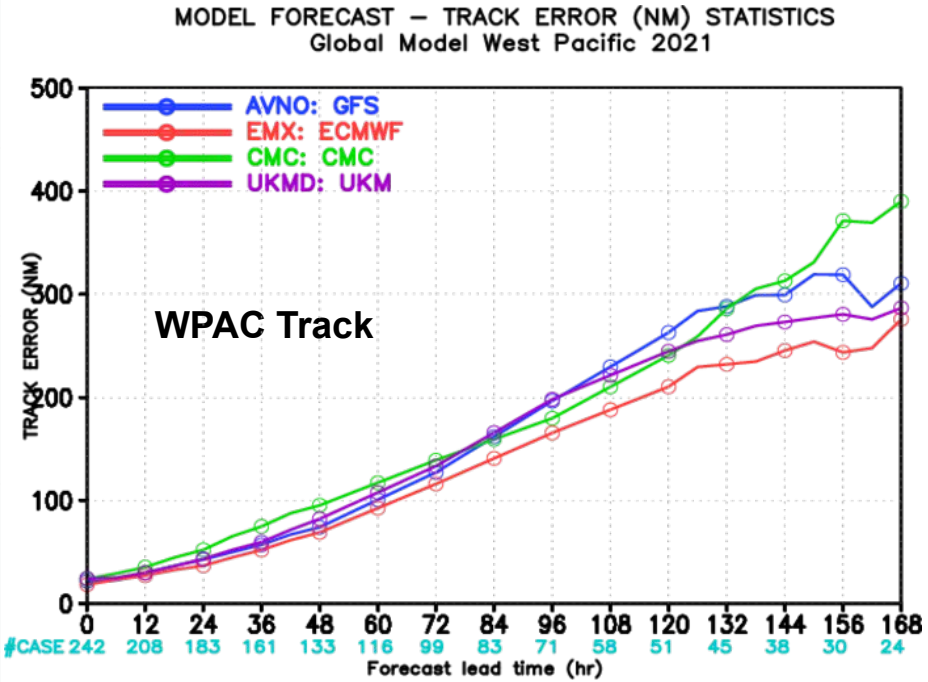


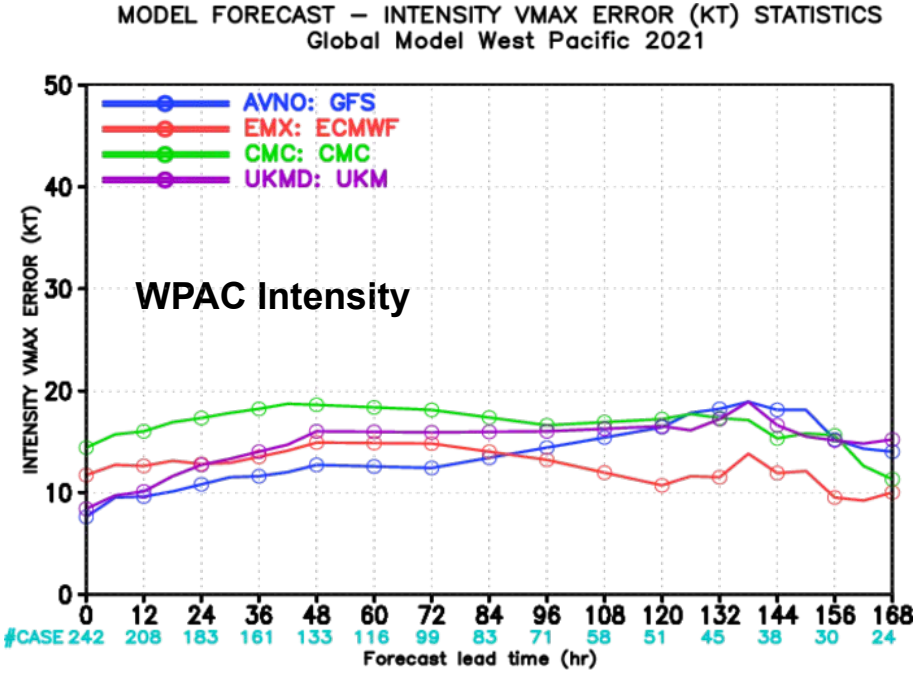




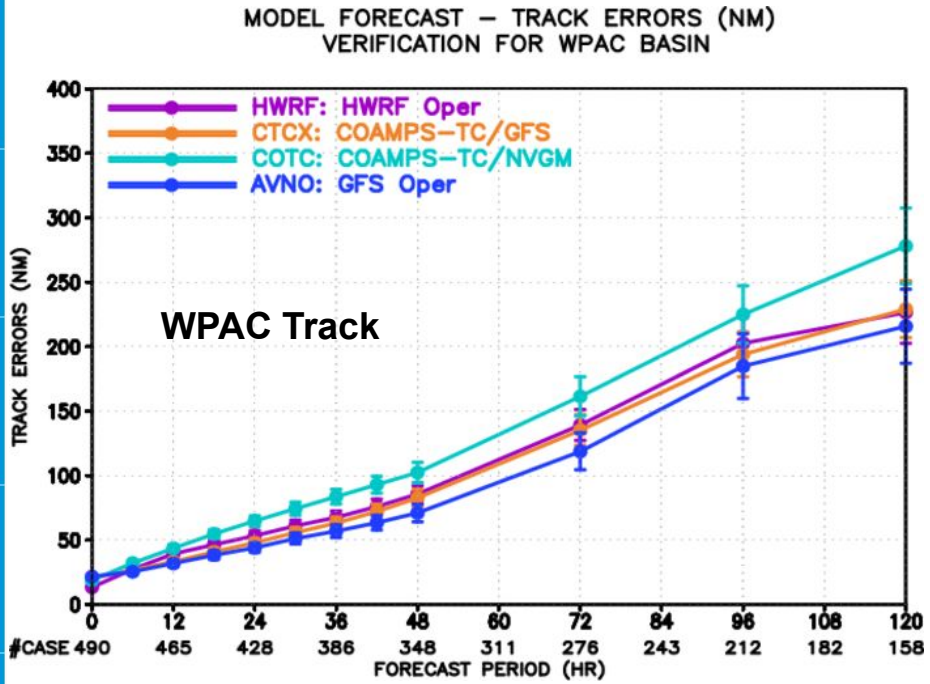


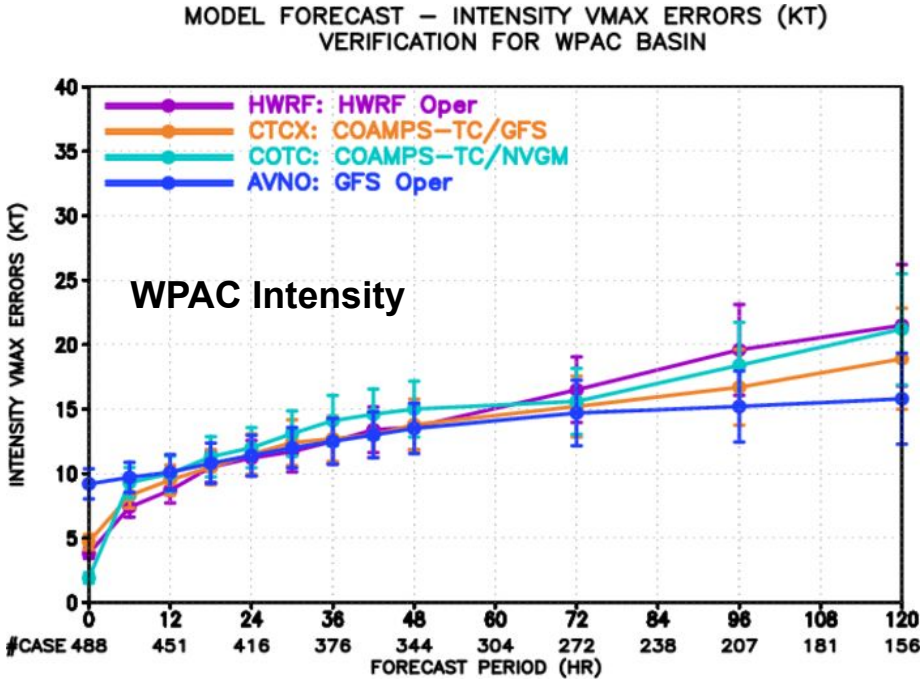
Global Deterministic Models TC Forecast Performance in 2021 (WPAC)



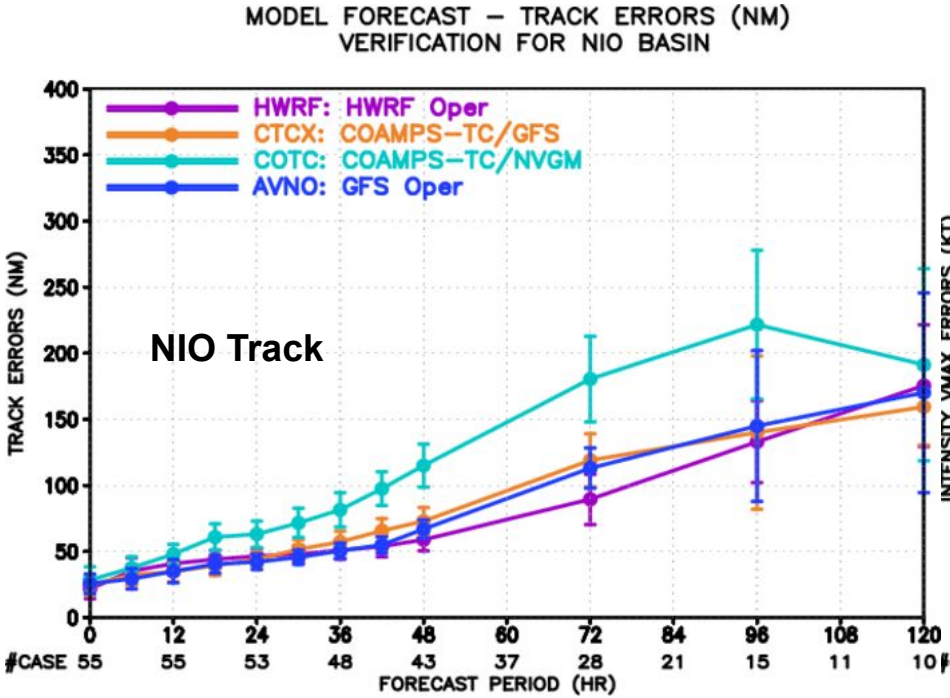


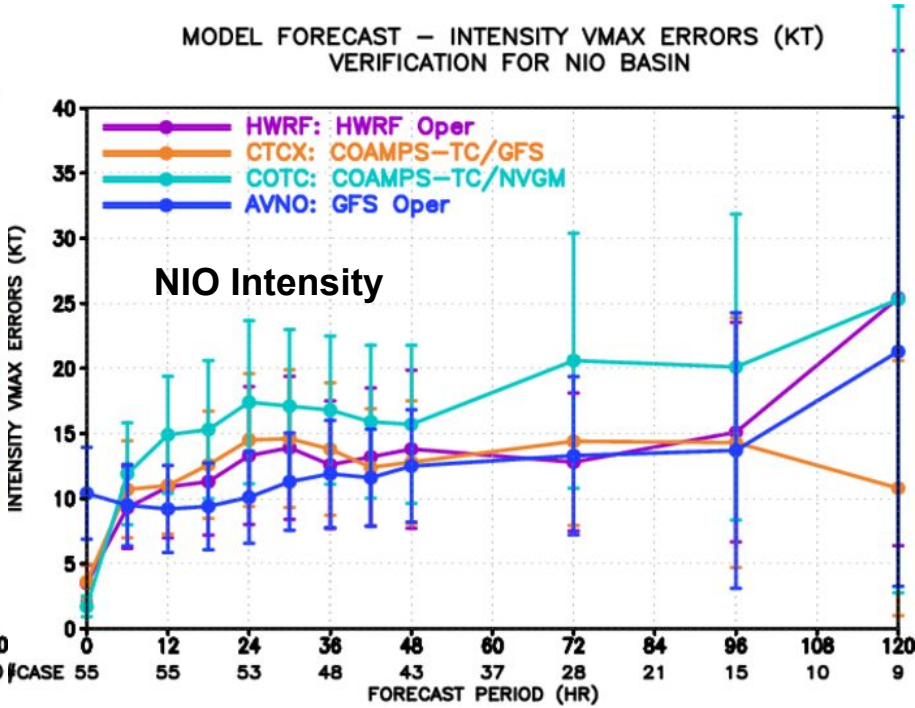
TC Forecast Performance in 2021 (WPAC)



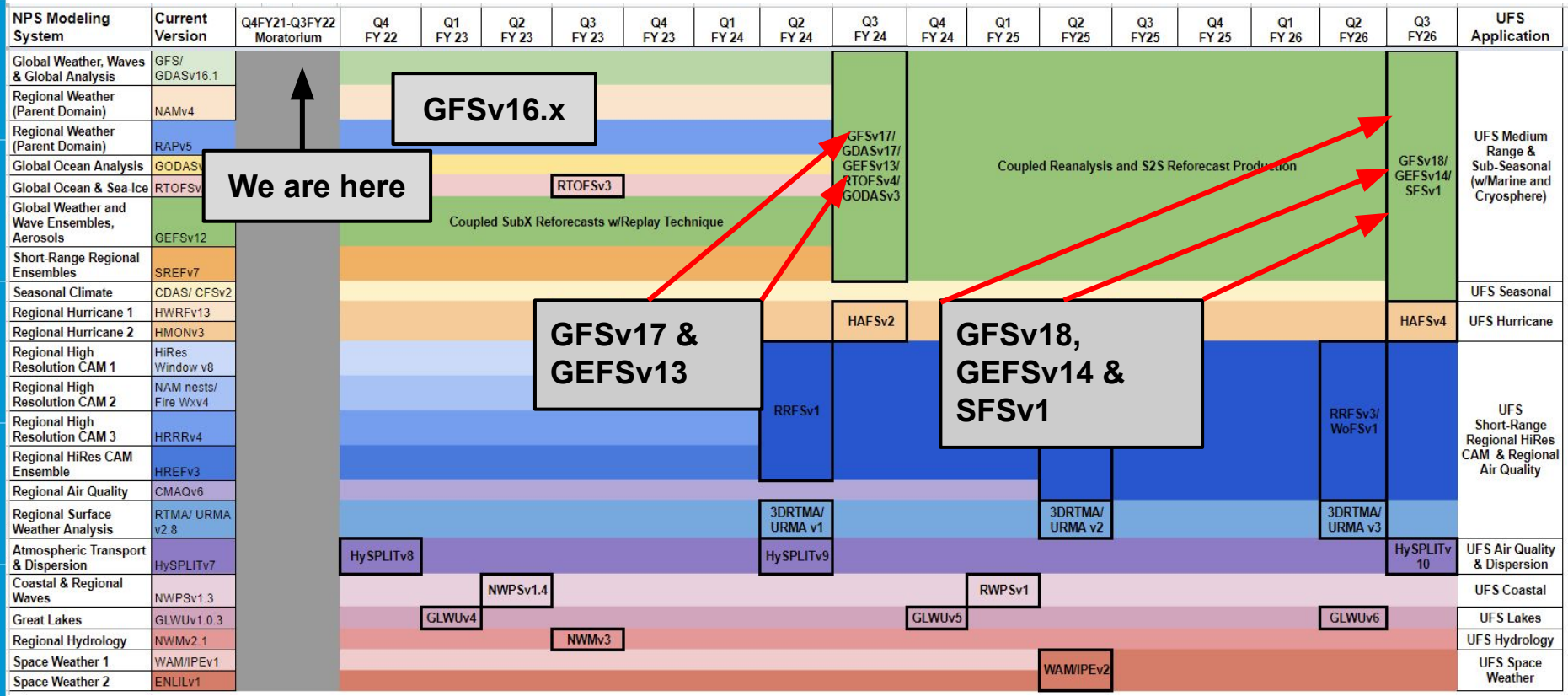


TC Forecast Performance in 2021 (NIO)





Operational Targets for Future Global Systems (GFS/GEFS/SFS) (notional) Timeline to Operations



Proposed Upgrades - v16.x, November 2022
(Real-time parallel planned for summer)

Winds
- Leo-Geo AMVs, GOES-17 mitigated AMVs
- GOES-16/17 & VIIRS AMVs with revised cloud algorithm
- AMVs from MetOp-BC (replacement for MetOp-AB)
- Updated utilization of ASCAT winds

RO
- PAZ polarimetric radio occultation
- Include improved RO data (below 8 km and upper levels) from MetOps

Ozone
- Include top 5 layers retrieved ozone profile
- NOAA-20 OMPS Nadir Mapper (NM)
- NPP OMPS-LP (UV and VIS blended)

NSST
- Include VIIRS & AVHRR radiances for NSST analysis with revised thinning
- New correlation length

Radiances
- Include GOES-18 ABI CSR
- Revised QC and bias correction for hyperspectral IR sounders
- Assimilate antenna-corrected AMSU-A, MHS, and ATMS BT
- Obs Operator Upgrade to CRTM 2.4.0 + GFDL cloud table
- Precipitation-affected AMSU-A & ATMS radiances
- All-sky assimilation of GMI

Minimization
- Limit moisture observation by saturated moisture value; this is especially important when there are many hurricane aircraft (recon) observations at 100% RH
- Apply data thinning and obs error inflation to ASCAT data
- Revised change in updating of bias correction variances

Recon
- Test/evaluate inclusion of P3/G-IV TDR data in GFS, full BUFR dropsonde data w/drift
- Test/evaluate inclusion of sUAS, ARO and balloon data

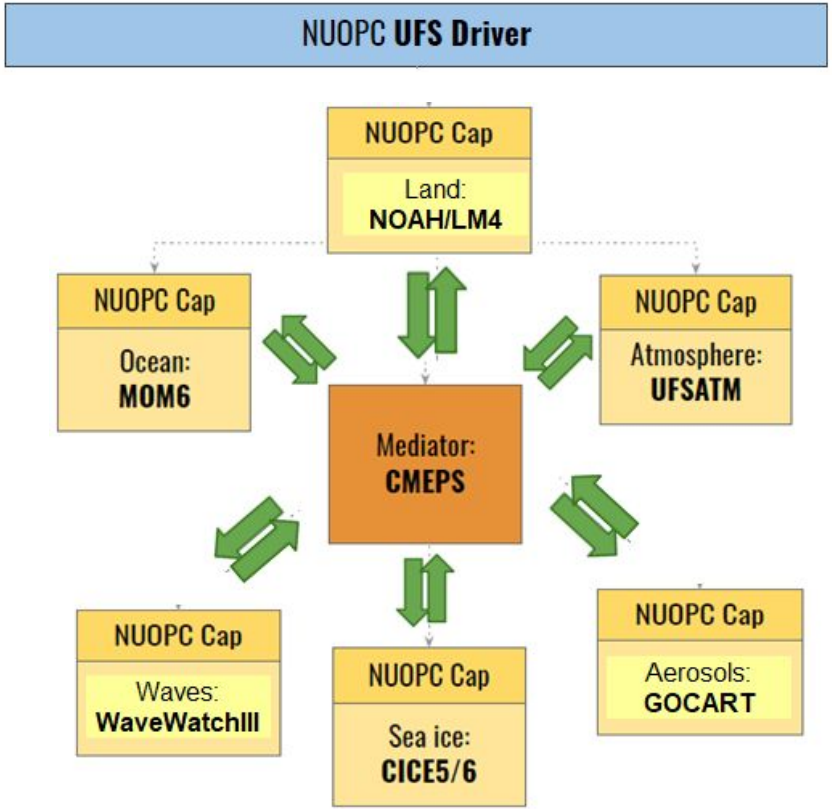
Coupled UFS Applications for global medium range, sub-seasonal and seasonal predictions

GFSv17/GEFS v13: Fully coupled system for medium-range and sub-seasonal predictions

- FV3+MOM6+CICE6+WWW3+GOCART Coupled Model, Advanced Physics, Weakly Coupled DA
- 30-year GEFS reforecasts using ERA5/ORAS5
- FY24: Implement GFSv17/GEFS v13

Seasonal Forecast System (SFS v1.0)

- Fully coupled Unified Forecast System, Seasonal ensemble forecasts with coupled reanalysis and reforecasts, Advanced coupled DA
- FY26/27: Implement SFS v1.0



Physics Planned for GFS.v17 & GEFS.v13

	GFS.v16	GFS.v17/GEFS.v13
Microphysics	GFDL MP	Thompson
Radiation (LW &SW)	RRTMG	RRTMGp
Orographic Gravity Wave Drag Small-scale gravity-wave drag (new) Turbulent Orographic Form drag (new)	Kim & Arakawa (1995)	uGWP.v1 Kim and Doyle (2005),Tsiringakis et al. (2017), Beljaars et al. (2004)
Non-orographic Gravity Wave Drag	uGWP v0 (Yudin et al., 2018)	uGWP.v1 (Yudin et al., 2020)
Land	Noah SLM	NOAH MP
Aerosol	OPAC (5 types, 5x5-deg resolution)	MERRA2
PBL	sa-TKE-EDMF	updated
Surface Layer	GFS	Updated
Cumulus Convection (Shallow & Deep)	sa-SAS	updated
Lake	NSST	FLAKE on top of NSST

Thanks for your attention

Questions?