

Medium-Range Weather and Subseasonal-to-Seasonal Application Team



Co-chairs:

Fanglin Yang, EMC

Cristiana Stan, George Mason U

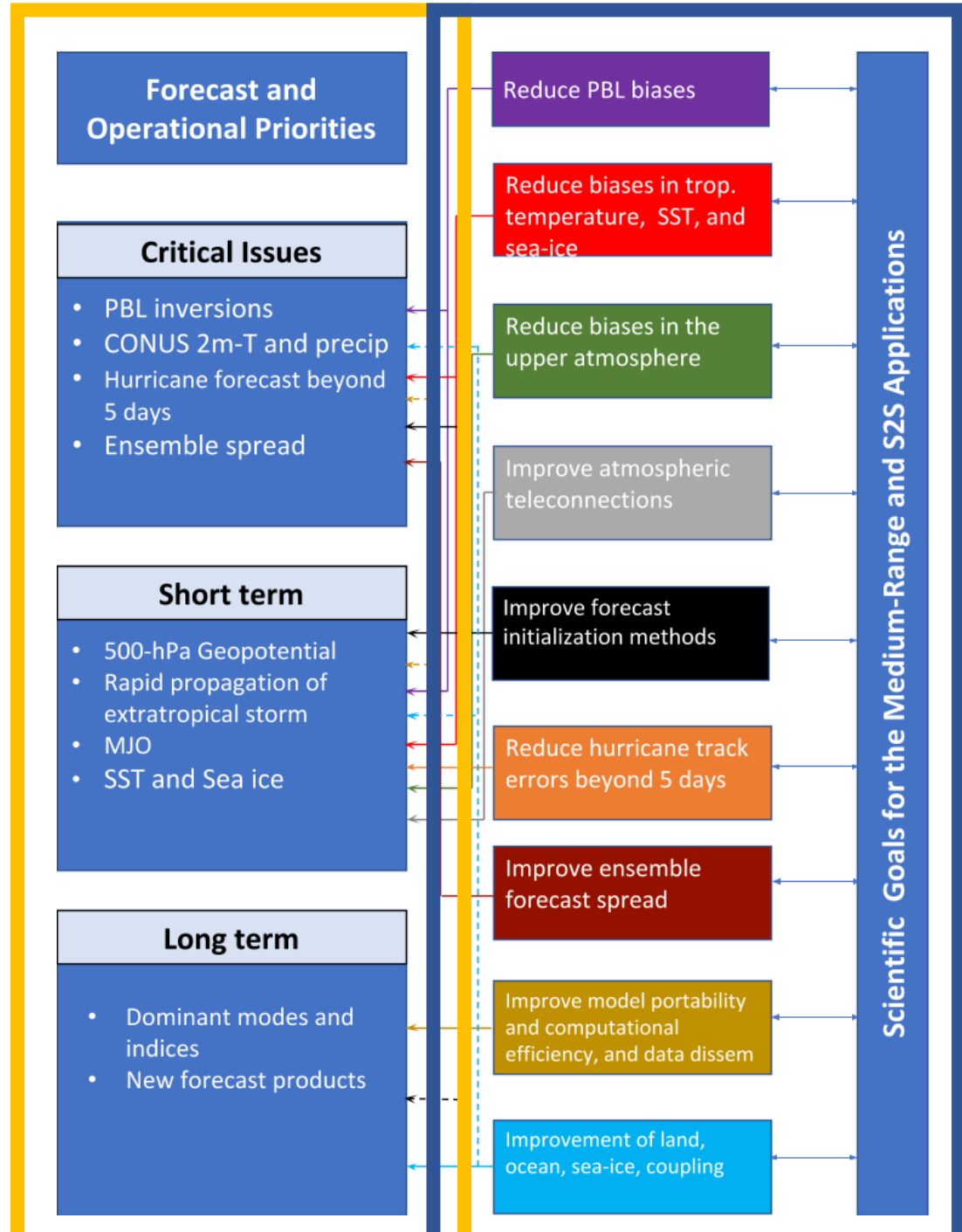
Lucas Harris, GFDL

UFS Users' Meeting

27 July 2020

MRW + S2S Application Team

Lead times of 5 days (medium-range) to one year (seasonal)



MRW + S2S Team Science Goals

- Reduce PBL, cloud, and radiative biases
- Reduce tropospheric temperature biases
- Reduce middle-atmosphere biases
- Reduce SST and sea-ice biases
- Improve atmospheric teleconnections
- Improve model initialization
- Skillful TC tracks beyond 5 days
- Improve ensemble spread
- Improve model portability and efficiency, including I/O
- Improve data dissemination
- Implement effective atmosphere-ocean coupling
- Develop land/ocean/ice DA
- Weakly coupled DA (MRW)
Strongly coupled DA (S2S)

(everywhere on Earth, all in one model configuration)

MRW + S2S Forecast Priorities

Critical Issues

- PBL Inversions
 - Surface temperature, temperature profile, PBL mixing, stratocumulus
- CONUS Temperature & Precip
 - Heat waves, cold waves
- Hurricane Tracks, beyond day 5
- Ensemble Forecast Spread

Significant progress has been made by EMC and partners towards these goals for GFSv16 and GEFSv12

See Fanglin Yang's presentation (Tuesday, 2pm) and Vijay Tallapragada's presentation (Tuesday, 12:30pm)

MRW + S2S Forecast Priorities

Short-Term Priorities

- 500-mb ACC (duh)
- Too-fast extratropical cyclones
- Improve the MJO and tropical waves
- Tropical and high-latitude variability

Long-Term Priorities

- Improve S2S alphabet soup
 - NAO, PNA, SSW, QBO, ETC.
- Cool new forecast products
 - CONUS river hydrology
 - Ocean wave forecasts
 - S2S severe weather and hurricane forecasts!

Future Operational Implementations

GEFS v13 (FY24)

UFSATM (FV3 + GFS Physics + GOCART) +
MOM6 + CICE5 + WWW3

- First NCEP coupled system for sub-seasonal predictions
- DA for each component
- GFS.v16 physics
- Extensive reanalysis and reforecasts for bias calibration and research

GFS v17 (FY24)

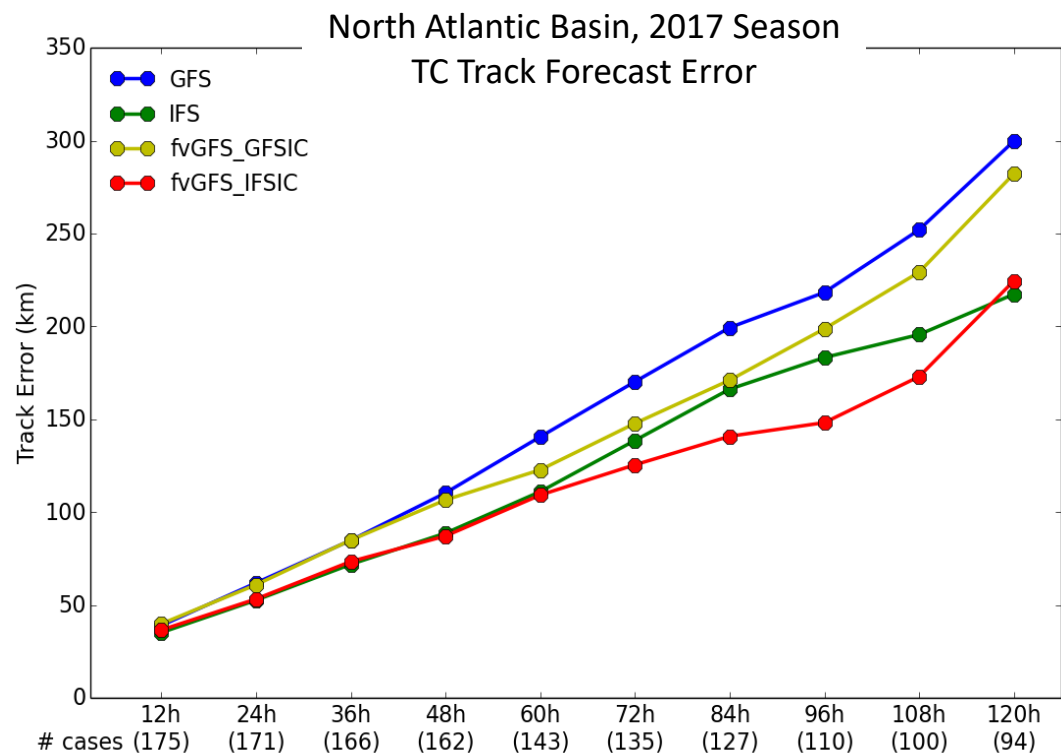
UFSATM + MOM6 + CICE5 + WWW3

Integrated GEFS and GFS system

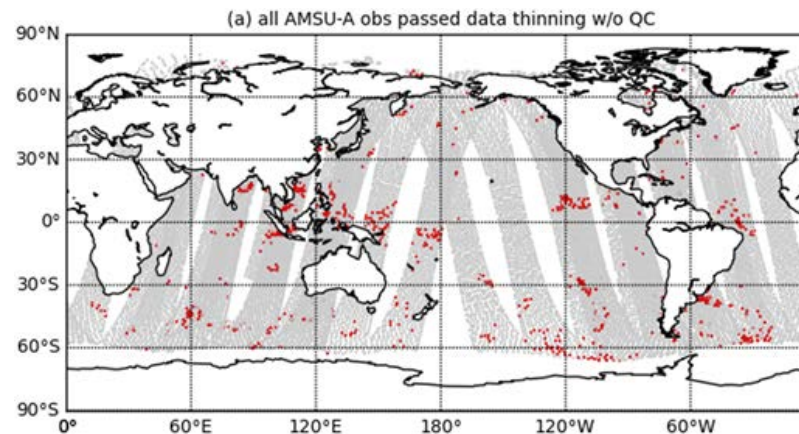
- Weakly coupled JEDI DA
- 9km deterministic resolution
- Advanced physics
 - Integrated microphysics and aerosols, improved TKE PBL and surface layer, better SGS convection + orography
- Updated LSM: Noah-MP, LM4

See Jessica Meixner's presentation, Wednesday 12:30pm
and many many coupled DA presentations

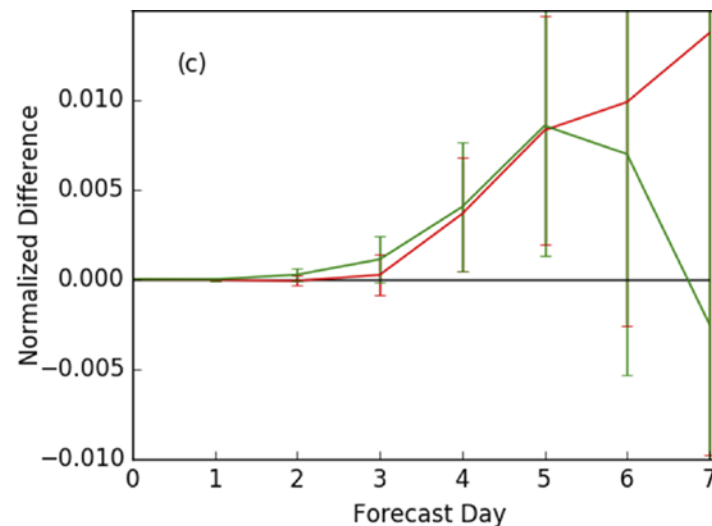
Better forecasts? Better ICs!



Collaborations with ECMWF
J-H Chen et al. 2019, GRL
Ongoing Dimosic Project



New radiances
assimilated in all-
sky assimilation



**New All-Sky
Assimilation**

**... plus Cycling of
Hydrometeors**

M Tong et al.
2020, MWR

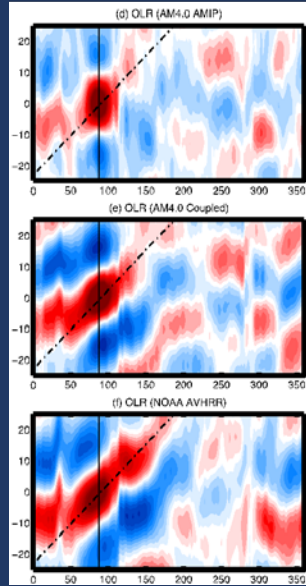
Warning: It's a long way from a research result to operational implementation!

Seamless Modeling in the UFS

CMIP-class Earth-System models
(GFDL CMIP6 collection in JAMES)

AM4 Atmosphere
(FV3 + GFDL Climate Physics)
+ MOM6 + LM4

100-km CM4 Coupled Climate
100-km ESM4 Coupled-
Carbon Cycle

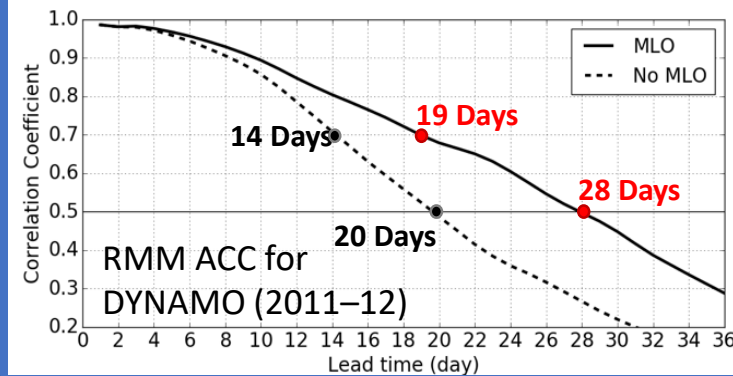
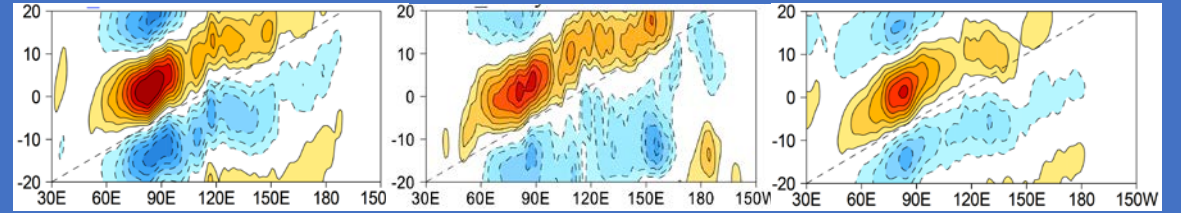


M. Zhao et al. JAMES 2018a,b

Observations

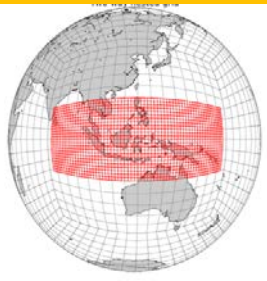
25-km SHIELD
Atmos. w/ MLO

50-km SPEAR
Coupled S2D



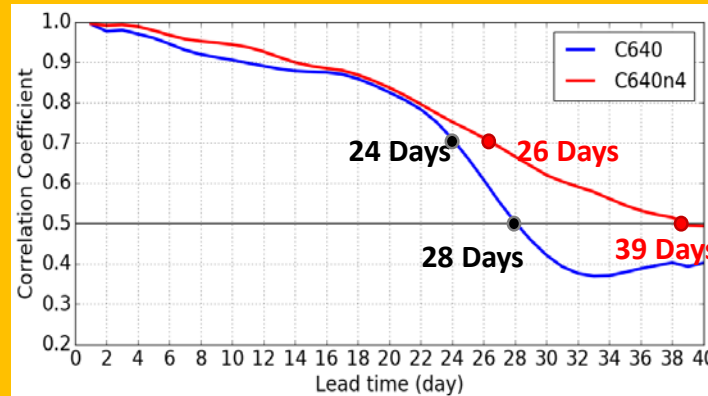
Courtesy
Baoqiang Xiang
(UCAR/GFDL)

Harris et al.,
submitted to JAMES

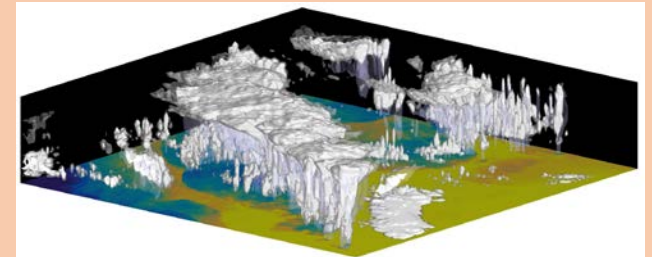


T-SHIELD
(GFS-like + MLO)
16-km Global
with 4-km Maritime
Continent Nest

RMM ACC for 34 Cases during
DYNAMO (MJO phase 3 or 4)



Courtesy Kun Gao, Princeton Univ.



Nested, doubly-periodic and regional domains
See RCEMIP, Wing et al. JAMES 2020
and LAM presentations by Jacob Carley and
many others

Global Cloud-Resolving Modeling

- GFDL and NASA submitted FV3-based GCRMs to DYAMOND
- Vulcan Inc. and GFDL are developing a hybrid Machine Learning-Dynamical Model: GCRM input in, new moist physics out
- Public-Private-Academic partnership to port UFSATM (FV3 + physics + land) into GridTools DSL to take advantage of new computing platforms

See Mark Cheeseman's presentation at 2:40pm Wednesday and Rhea George's presentation at 2:50pm Wednesday



Stevens et al., 2019, PEPS; Satoh et al., CCCR

| GFS-like C3072 L79 | | |
|--------------------|------------|------------|
| Gaea c4 | 13482 CPUs | 75 min/day |
| Orion (MSU) | 12288 CPUs | 68 min/day |
| Courtesy | 27648 CPUs | 33 min/day |
| Rusty Benson | 36864 CPUs | 26 min/day |

(Timing does not include I/O)



Medium-Range Weather Application

- v1.0 released 11 March 2020

<https://ufscommunity.org/news/medrangeweatherapp/>

- New updates forthcoming

- FV3 201912 Update w/ technical note GFDL2020001

<https://www.gfdl.noaa.gov/fv3/fv3-documentation-and-references>

- New updates to FMS, FV3, and Inline GFDL Microphysics in testing

https://github.com/NOAA-GFDL/GFDL_atmos_cubed_sphere

<https://github.com/NOAA-GFDL/FMS>

See Tom Robinson's presentation at 2:10pm Wednesday

Acknowledgements

- UFS and NGGPS Leadership
- Major science and software leadership from EMC and DTC
- MRW Application Release Team
- GFDL FV3, MOM6, and FMS Teams
- CPC and other NCEP centers
- ESRLs and NCAR
- University Partners