Using the scale-and aerosol-aware Grell- Freitas convective parameterization in FV3GFS at C768

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Additional ideas from DTC folks

Overview

- DA was not available on jet till late in the game, following results all without DA (cold start)
- Spare cycles were used for a detailed look at 2017 Atlantic and EPAC hurricane season (Keren Rosado)
- Started using DA on Theia in September
- Evaluation done using GFDL tracker (Mike Fiorino)
- Where to go next – what is waiting to be tested in GF

Grell-Freitas Convective Param

- **Scale-aware/Aerosol-aware (Grell and Freitas, 2014, ACP)**
  - Allows CAPE, vertical velocity and moisture convergence closures
  - Scale awareness through Arakawa approach (2011)
    - Evaluated with MPAS (Fowler et al. 2016, GEOS-5 Freitas et al. 2018, BRAMS and WRF (ACP2014)

NOT USED

  - Aerosol awareness is implemented with empirical assumptions based on a paper by Jiang and Feingold
  - Stochastic approach adapted from the Grell-Devenyi (2002) scheme, but changed to include temporal and spatial perturbation patterns

Recent implementations into GF scheme that were used in these runs

- Momentum transport (as in GFS/SAS and/or ECMWF)
- Additional closure for deep convection: Diurnal cycle effect (Bechtold)
- PDF approach for normalized mass flux profiles was implemented
- Mixed phase physics impact in convective parameterization
- Third type of cloud (congestus type convection)
- Changed cloud water detrainment treatment
- Changed conversion of cloud-water to rainwater
- Impacts of memory (downdraft strength, vertical mass flux PDF's)

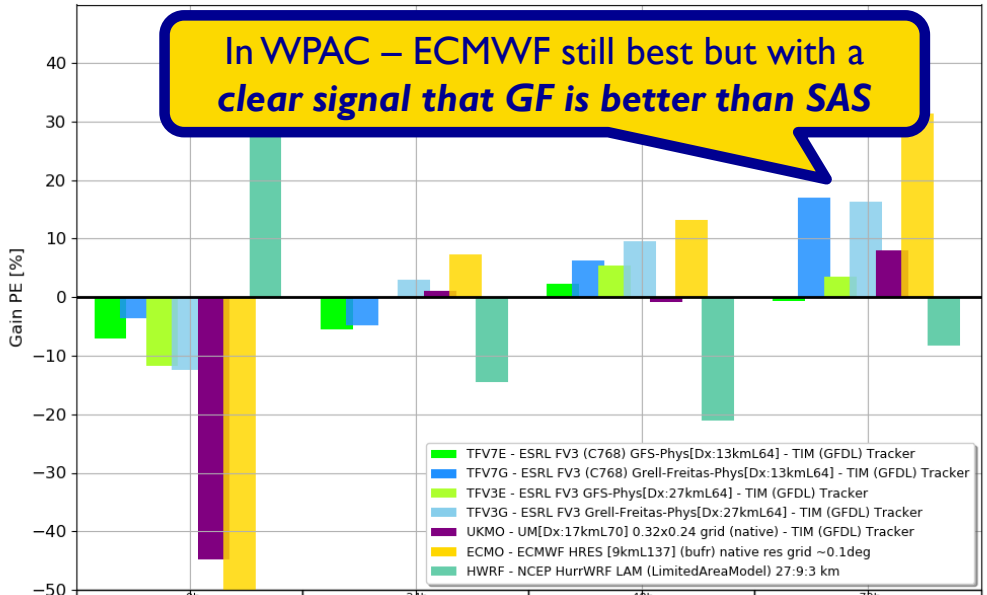
ESRL FV3 runs for HFIP

- 4 versions:
  - FV7E – C768 + SAS (GFS)
  - FV7G – C768 + GF
  - FV3E – C384 + SAS (GFS)
  - FV3G – C384 + GF
- FV3GFS physics, only convection parameterization was touched

EPAC 2018 00Z only -- %improve over GFS

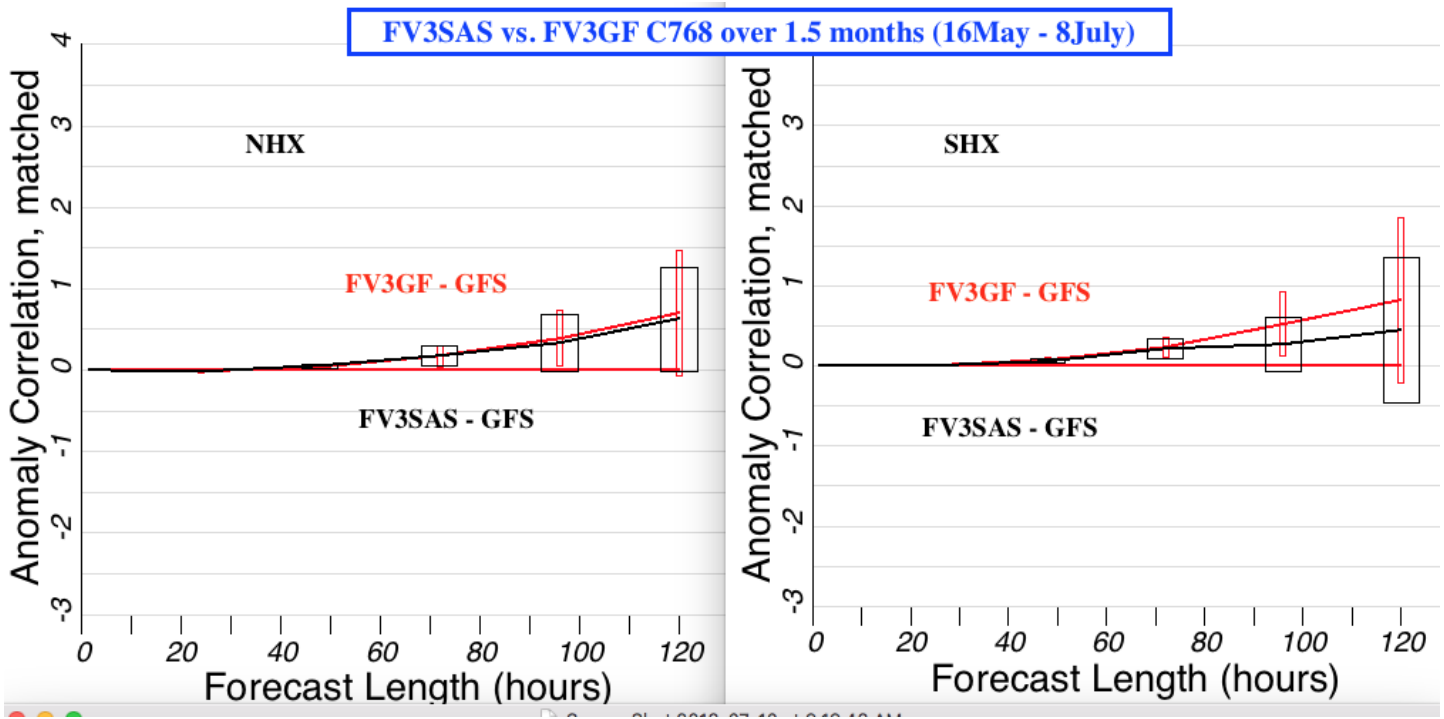
WPAC (05-31W) 2018 00Z only -- %improve over GFS
thru 20181023

Storms[N] [27]: 05W.18 06W.18 07W.18 08W.18 09W.18 10W.18 11W.18 12W.18 13W.18 ... 23W.18 24W.18 25W.18 26W.18 27W.18 28W.18 29W.18 30W.18 31W.18



	0h	24h	48h	72h
TFV7E	-7[158]	-6[129]	2[105]	-1[81]
TFV7G	-4[151]	-5[123]	6[99]	17[74]
TFV3E	-12[164]	-0[133]	5[107]	3[79]
TFV3G	-13[161]	3[130]	10[103]	16[80]
TUKM2	-45[155]	1[130]	-1[105]	8[81]
EMDT	-55[156]	7[136]	13[108]	31[84]
HWRF	28[147]	-14[134]	-21[110]	-8[86]

ACC comparison for c768 resolution runs, no cycling

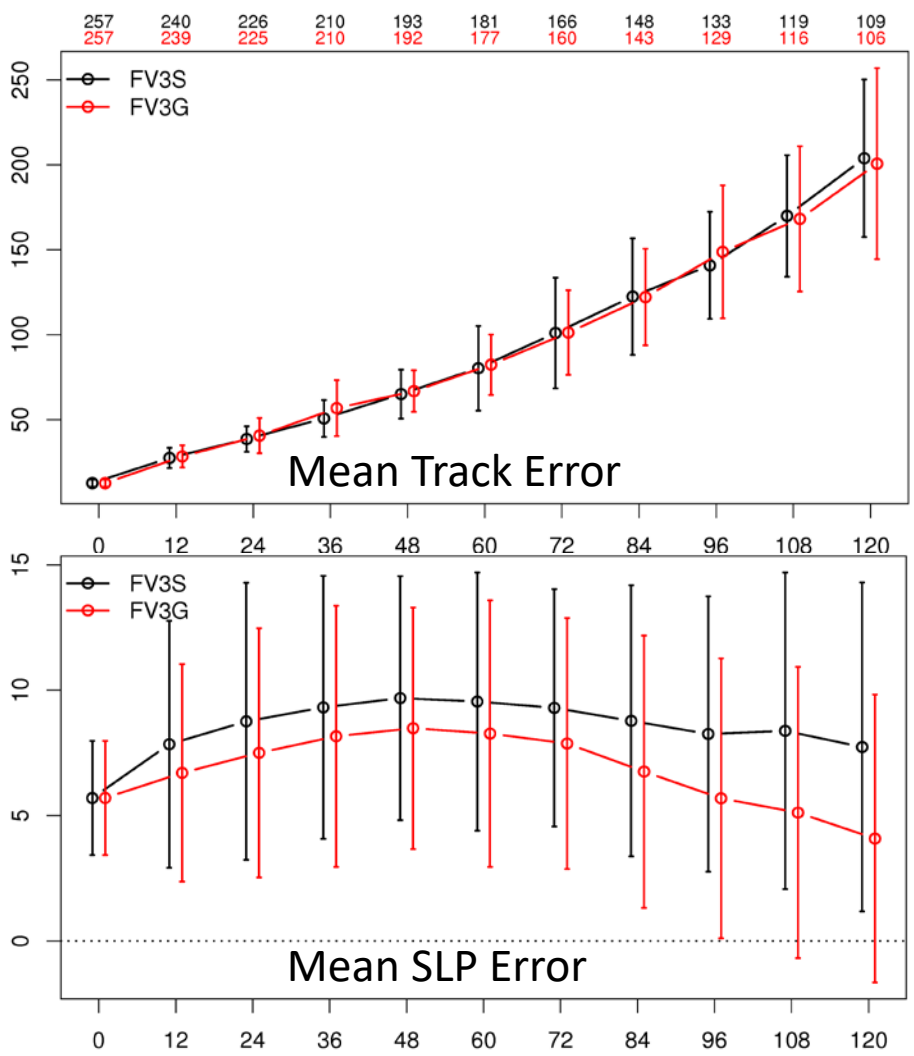


Ongoing work! – ***by October both runs are almost identical!!***

2017 Hurricane evaluation experiments

- Evaluation of C768 (13km) resolution
  - Ongoing, East Pacific and Atlantic
  - Comparison with FV3GFS
  - All FV3 forecasts with GF started from GFS initial fields (cold start)
  - GFDL Microphysics used in FV3-GF runs

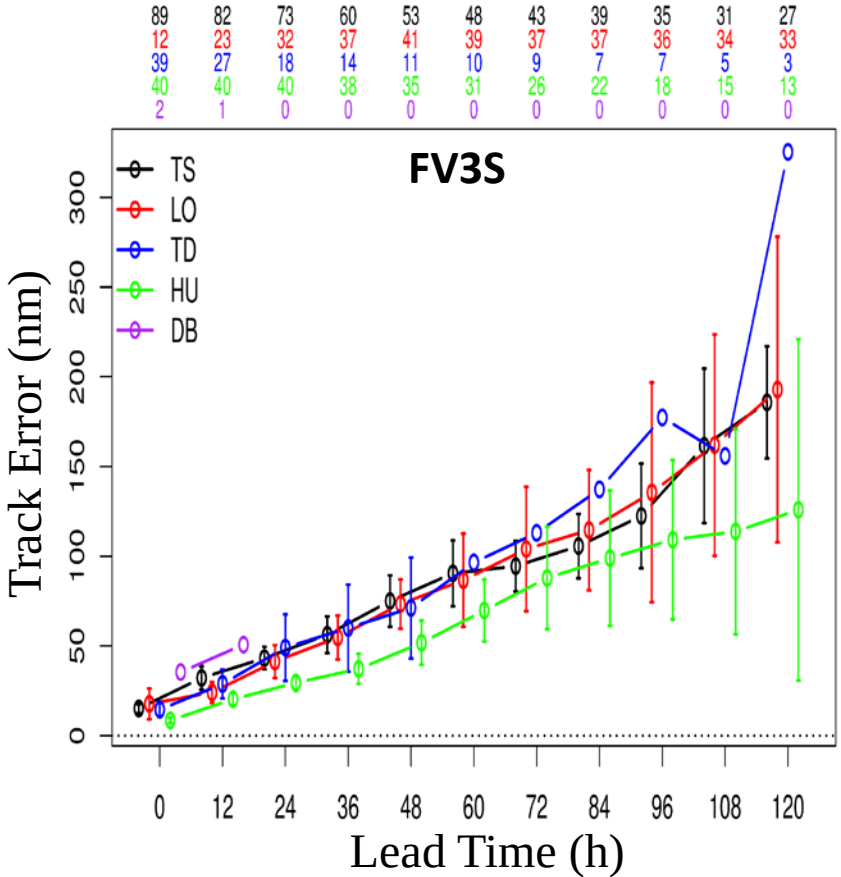
Model runs produced and evaluated by Keren Rosado

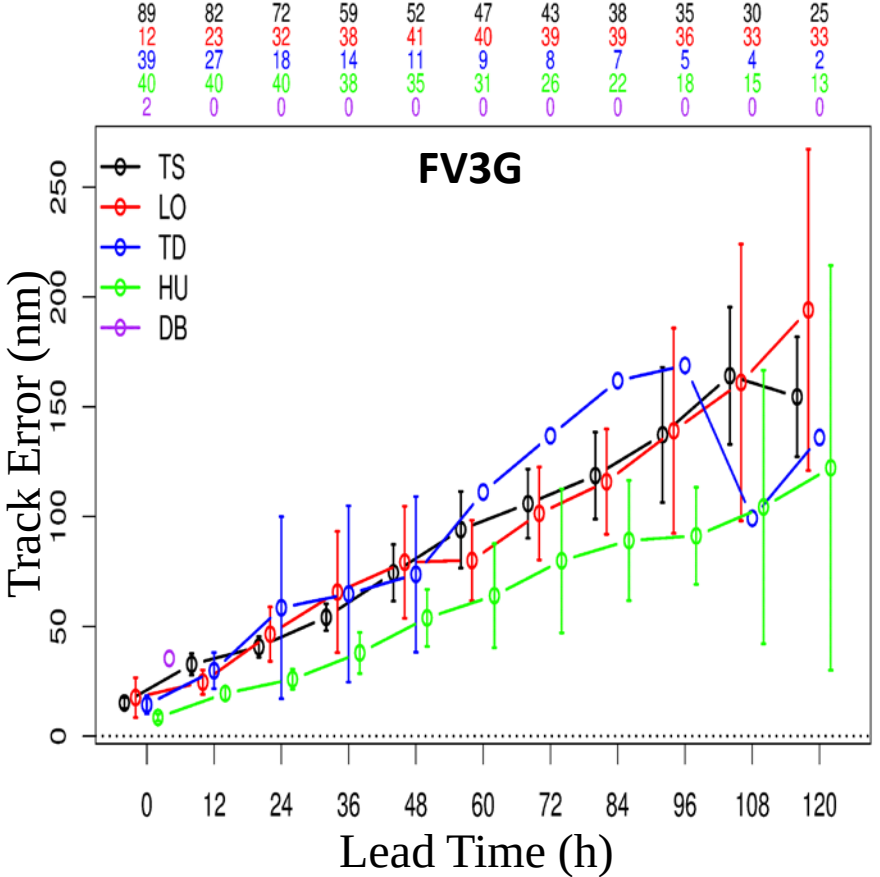


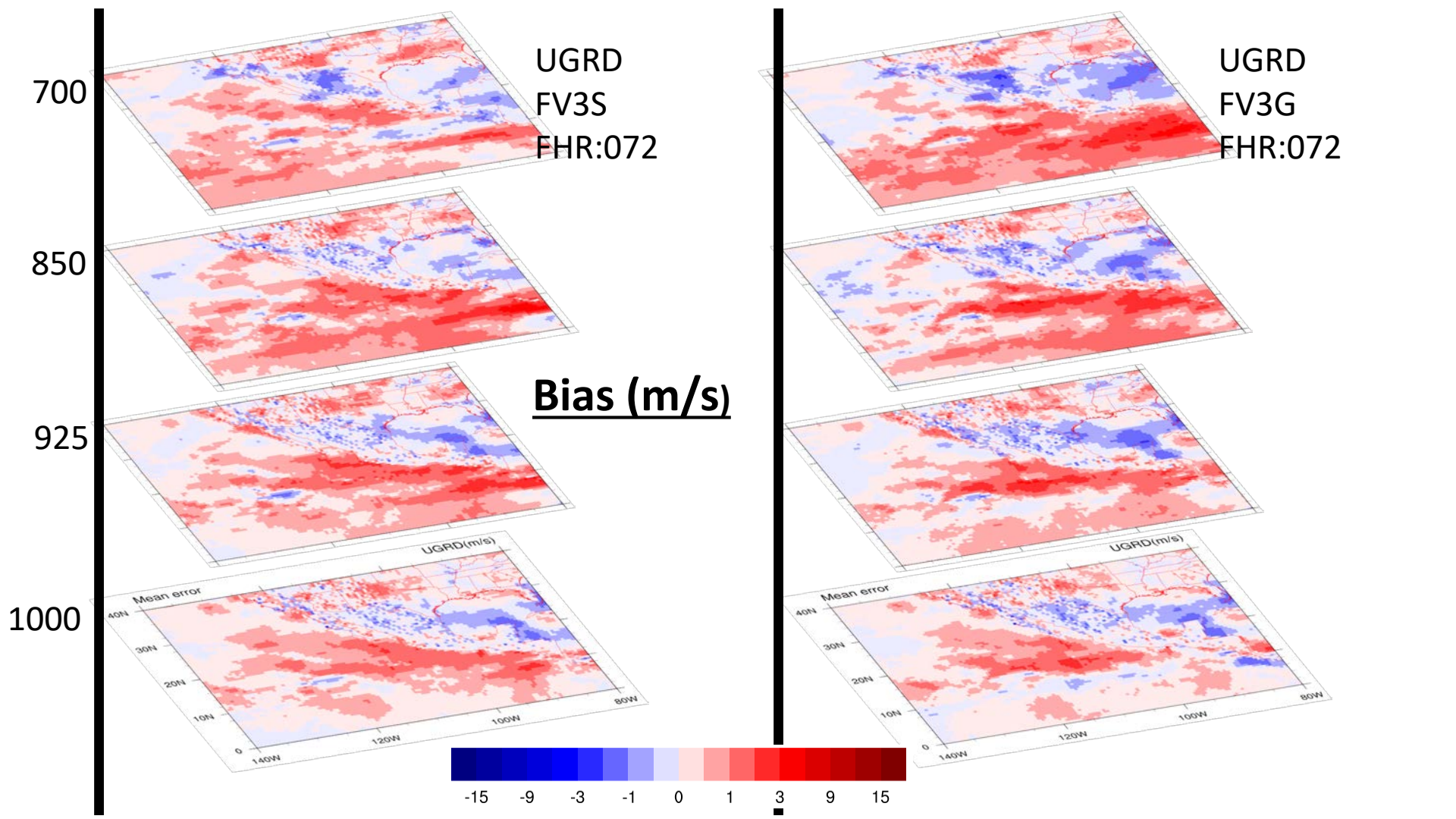
2017 Atlantic Hurricane Season
(~13km resolution)

Many other diagnostics available

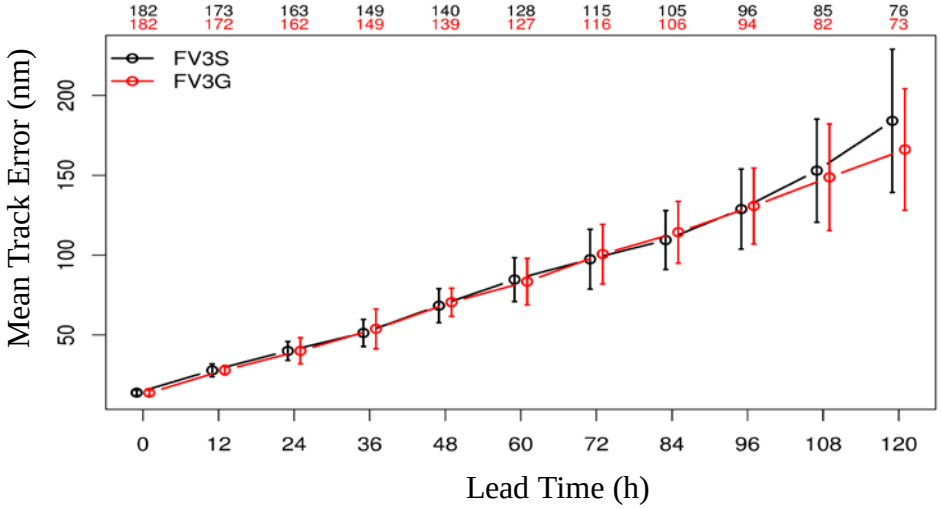
Track Error by Storm Severity

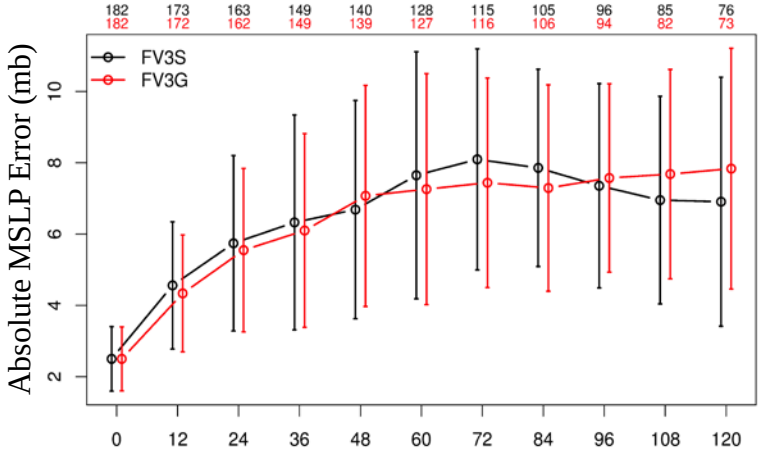





700
850
925
1000
UGRD
FV3S
FHR:072
UGRD
FV3G
FHR:072
Bias (m/s)
UGRD(m/s)
Mean error
40N
30N
20N
10N
0
140W
120W
100W
80W
-15
-9
-3
-1
0
1
3
9
15

2017 EPAC Hurricane Season



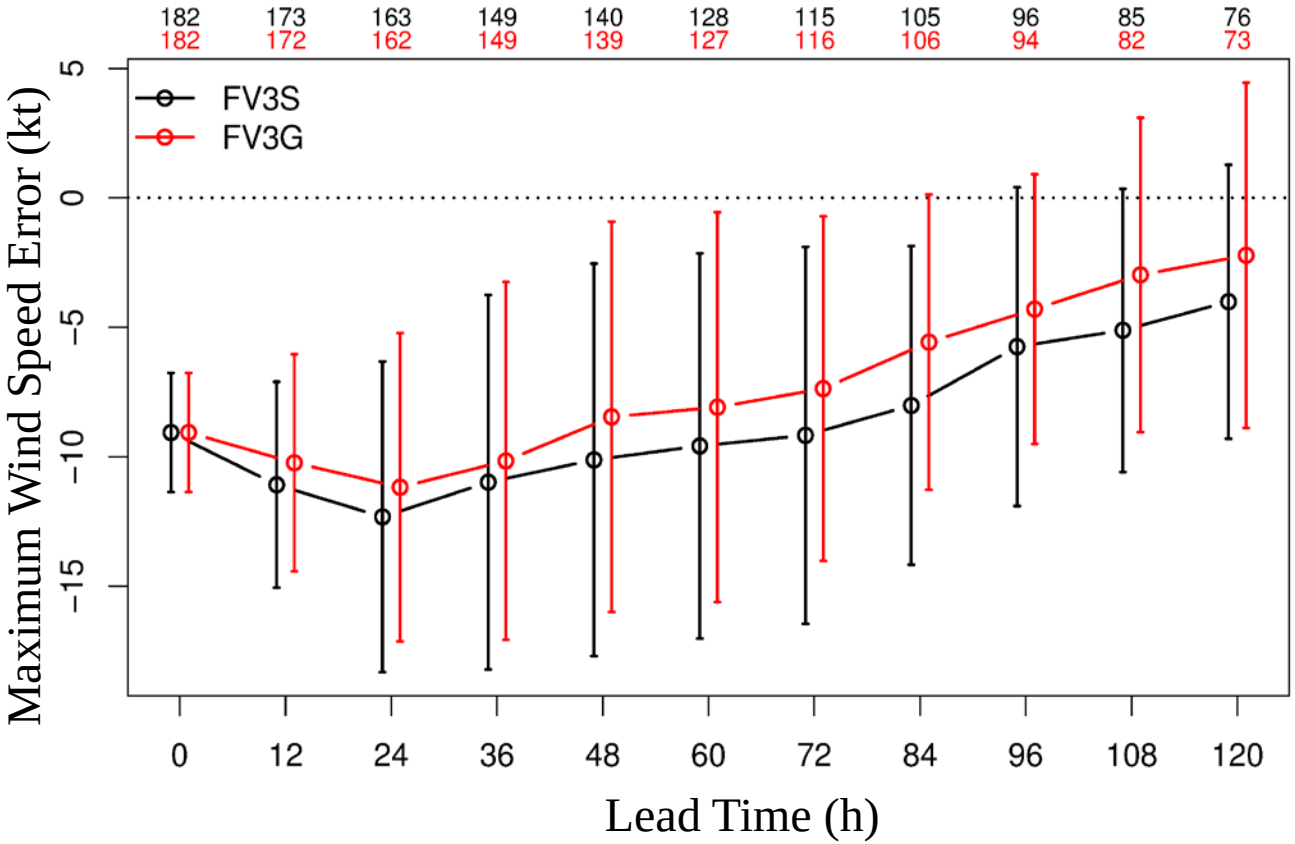


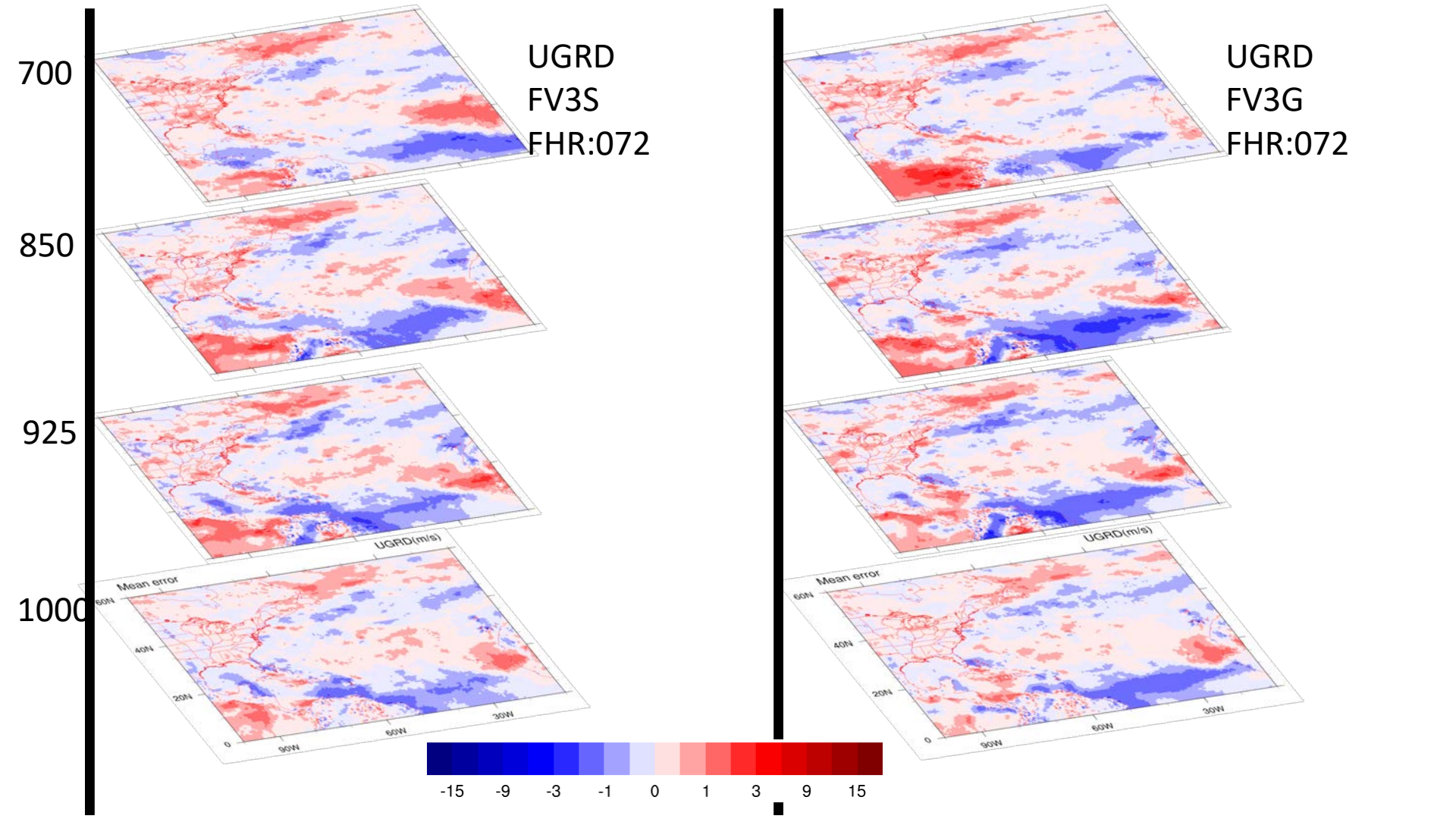
Most important recent ongoing development work

- Consistency with microphysics
  - New implementation into GF is treatment of number density variables to be more consistent with double moment microphysics schemes (appears to have largest impact on cloud ice) – Hannah Barnes, PostDoc
- Impact of cold pool movements
- Momentum transport needs a look (tuning may be appropriate..)
- Isolating parameters that need to be retuned for different physics (FV3GFS versus RAP/HRRR versus HWRF)
- Retuning aerosol awareness
- *Would like to test stochastics*

Additional material

2017 EPAC Hurricane Season




700
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UGRD
FV3S
FHR:072
UGRD
FV3G
FHR:072
Mean error
UGRD(m/s)
60N
40N
20N
0
90W
60W
30W
-15
-9
-3
-1
0
1
3
9
15