*title change based on Testbed/NWS/NHC feedback re: priorities

# The Impact of the G-IV and Non-Standard G-IV flight patterns on TC Forecasts in HAFS*

PI: Sarah Ditchek[1,2]

Collaborators: Ryan Torn[3] & Lisa Bucci[4]

Testbed POCs: Wallace Hogsett[4] & Jason Sippel[2]

NWS-Transition POCs: Wallace Hogsett[4]

[1]Cooperative Institute for Marine and Atmospheric Studies (CIMAS) | University of Miami (UM)

[2]Hurricane Research Division (HRD) | Atlantic Oceanographic and Meteorological Laboratory (AOML)

[3]Department of Atmospheric and Environmental Sciences | University at Albany, SUNY

[4]National Hurricane Center (NHC)

**Funding:** NOAA Award NA22OAR4590534

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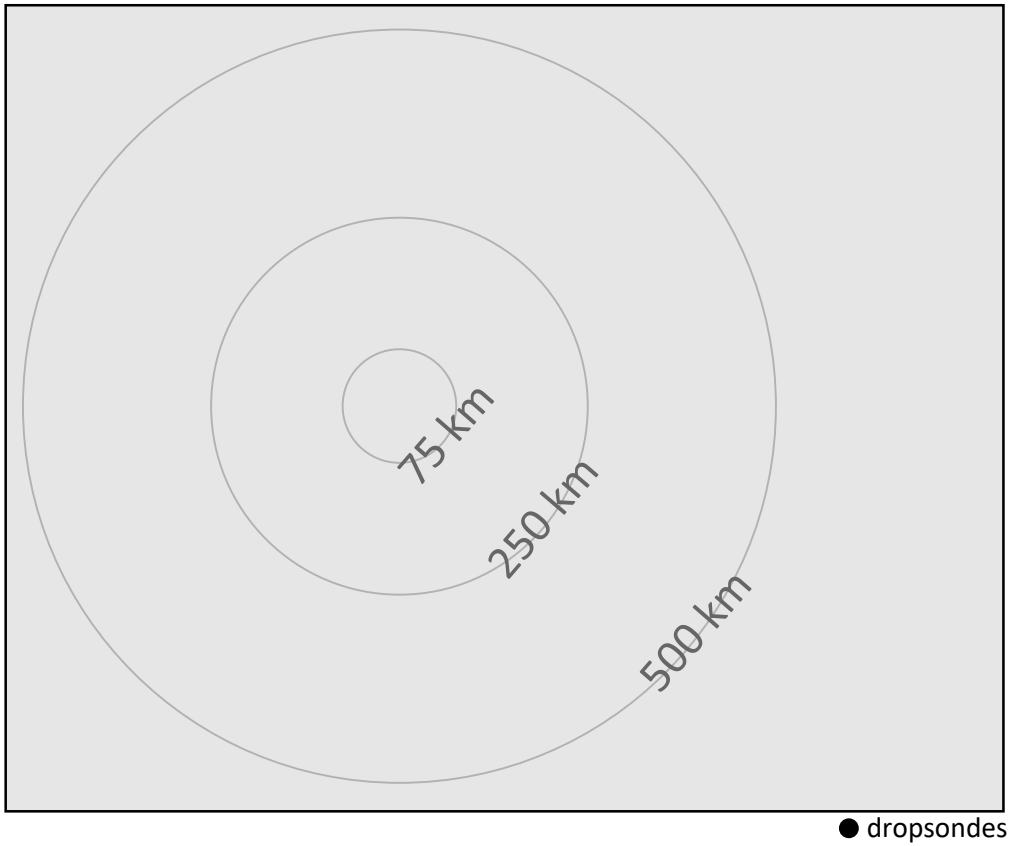

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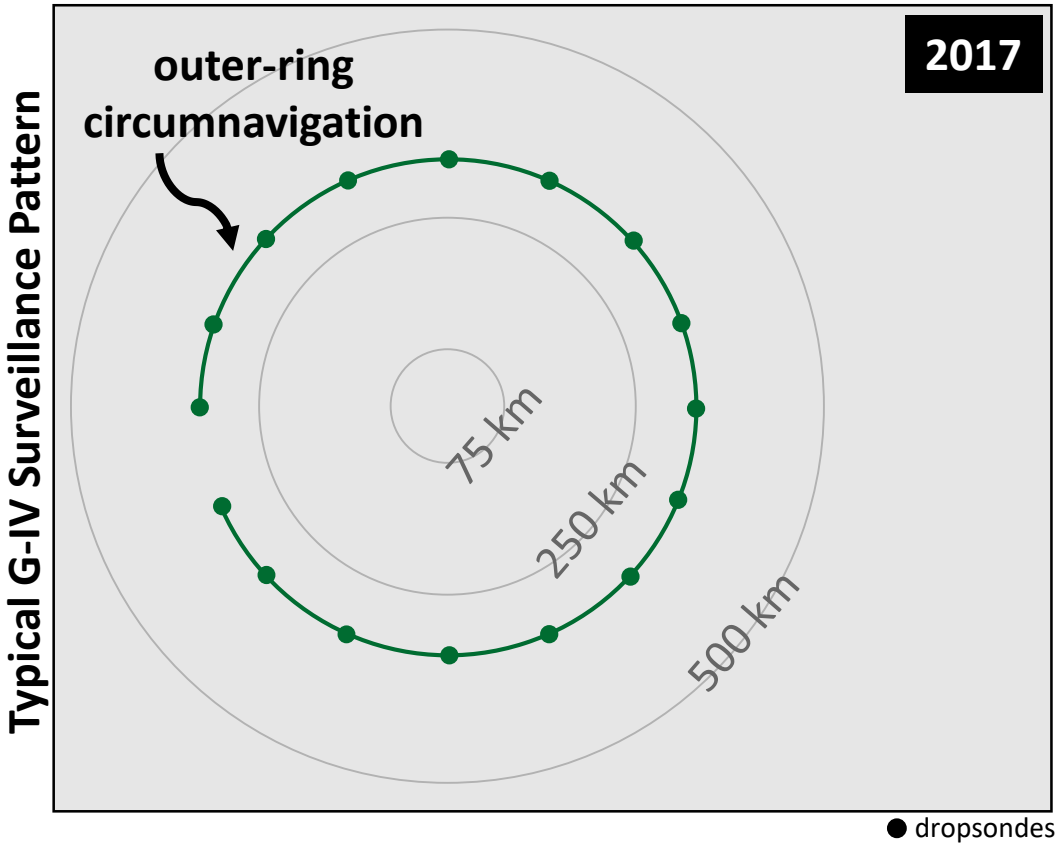

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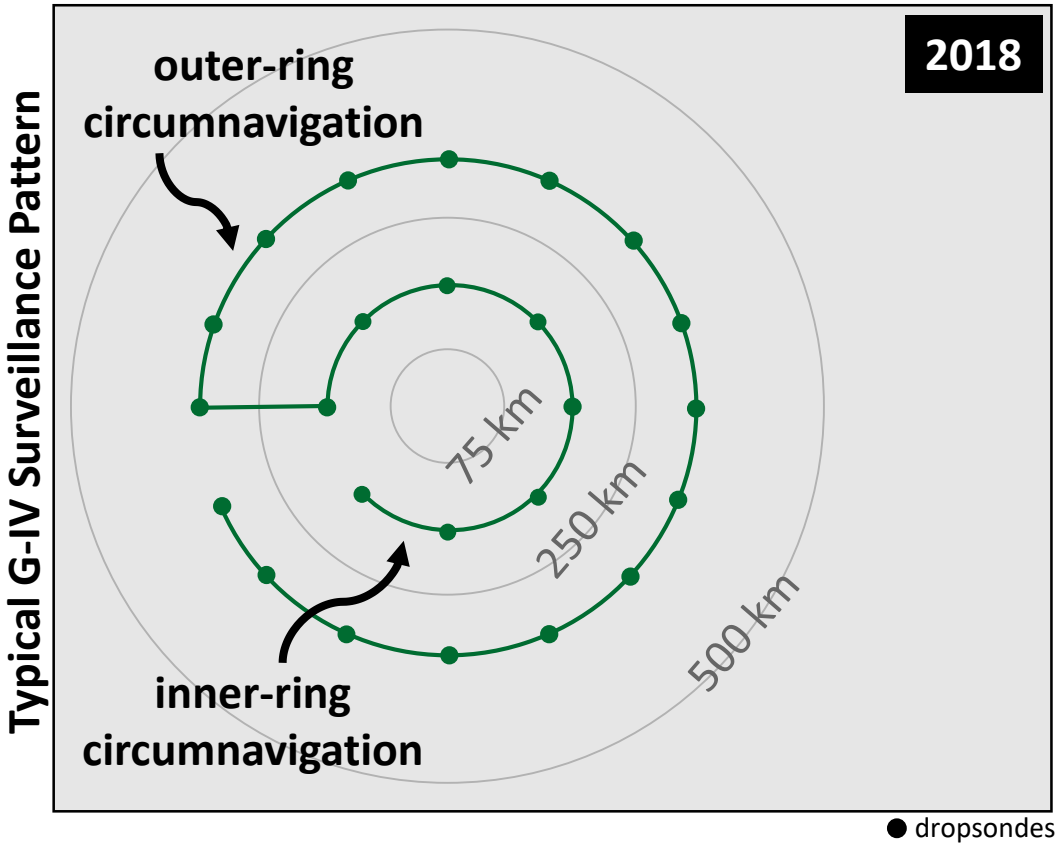

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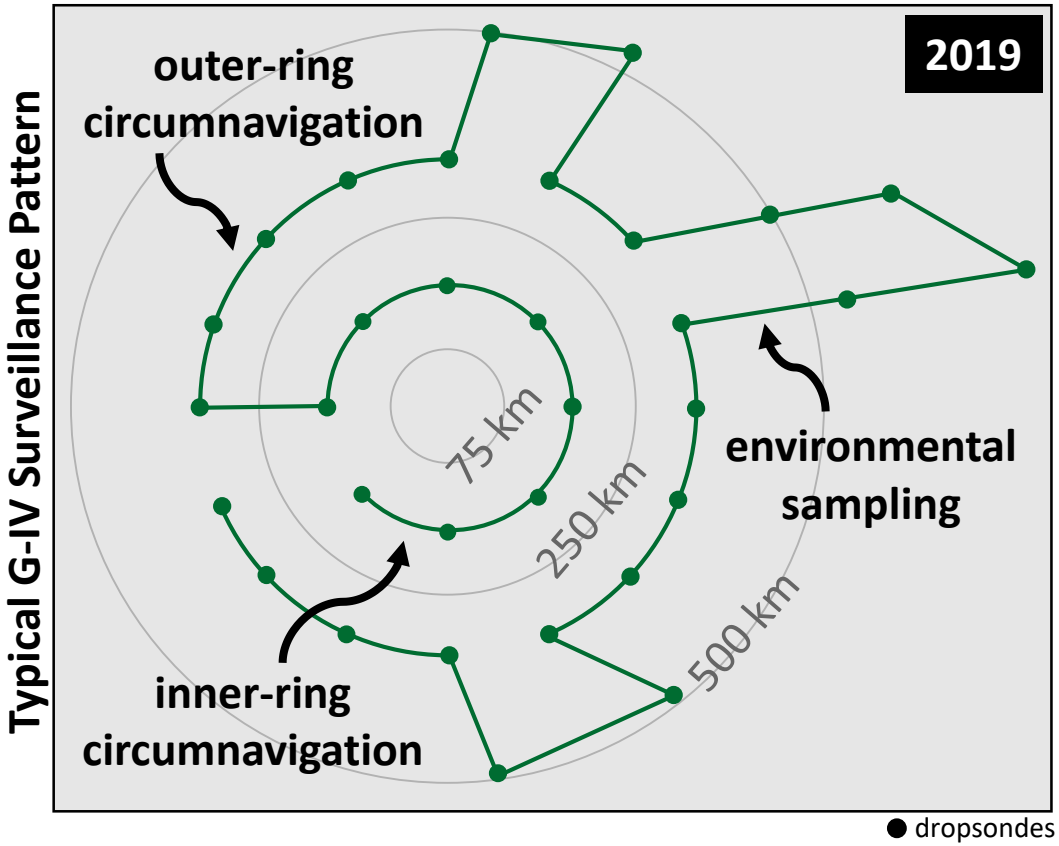

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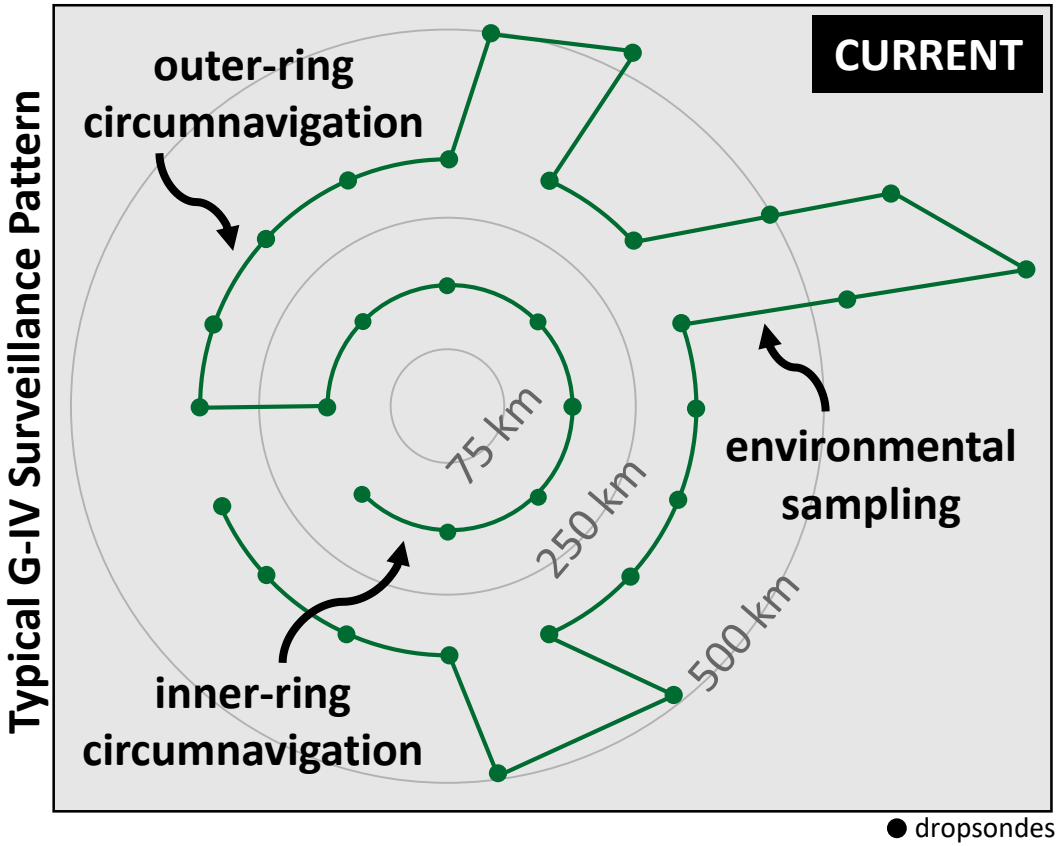

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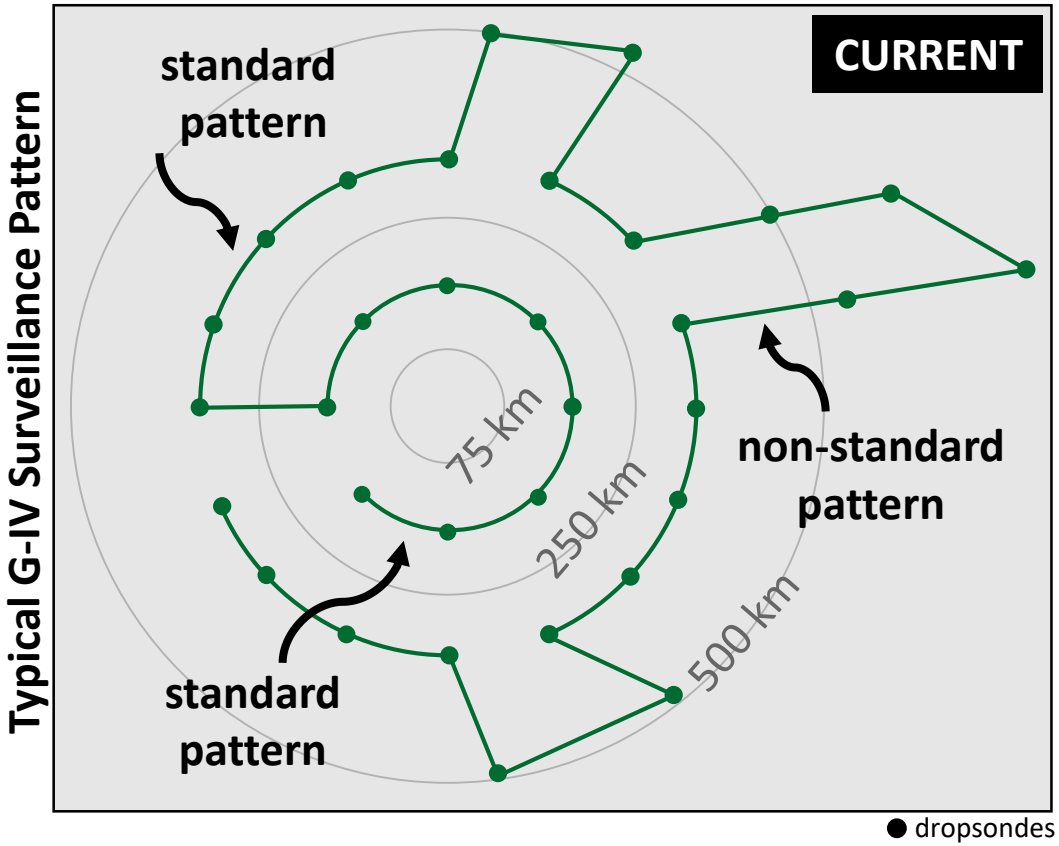

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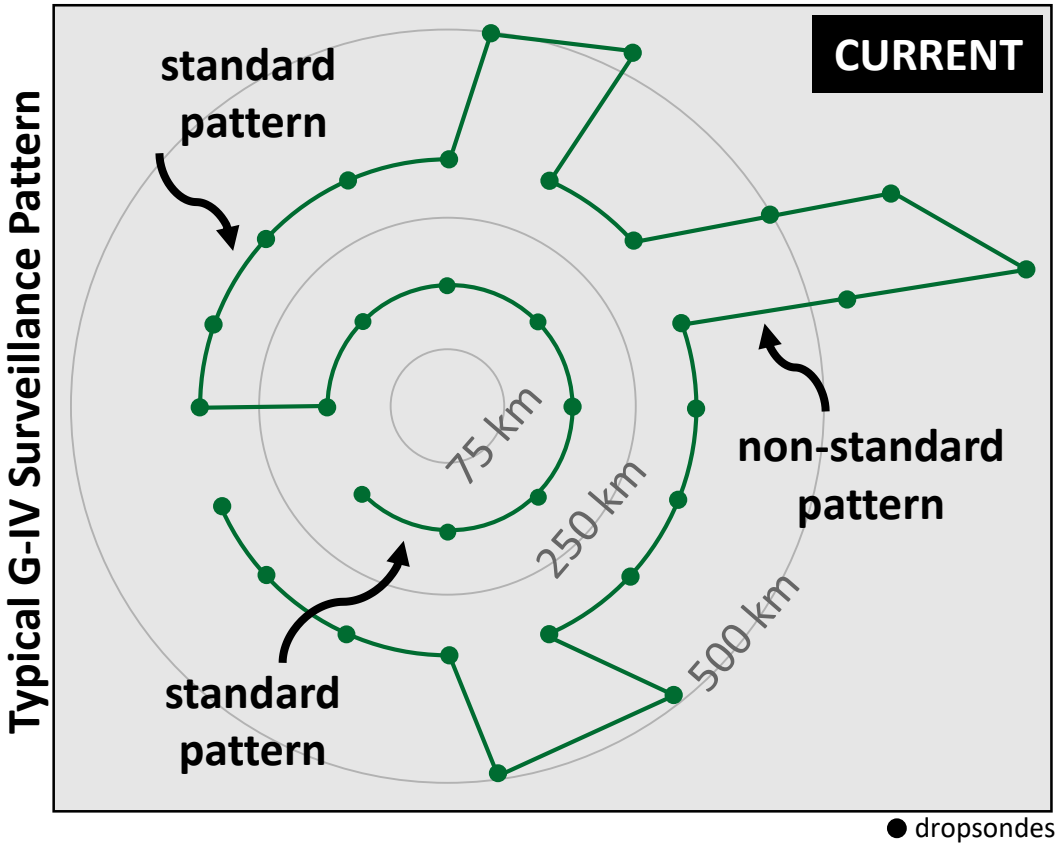


**The impact of these changes on TC forecasts need to be quantified and ways to further optimize the strategy should be assessed!**

# Project Plan Snapshot

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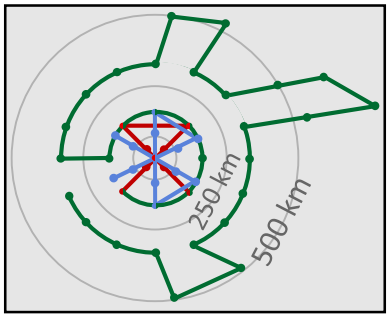


C-130 "Alpha" Pattern
P-3 "Butterfly" Pattern
G-IV Surveillance Pattern
dropsondes

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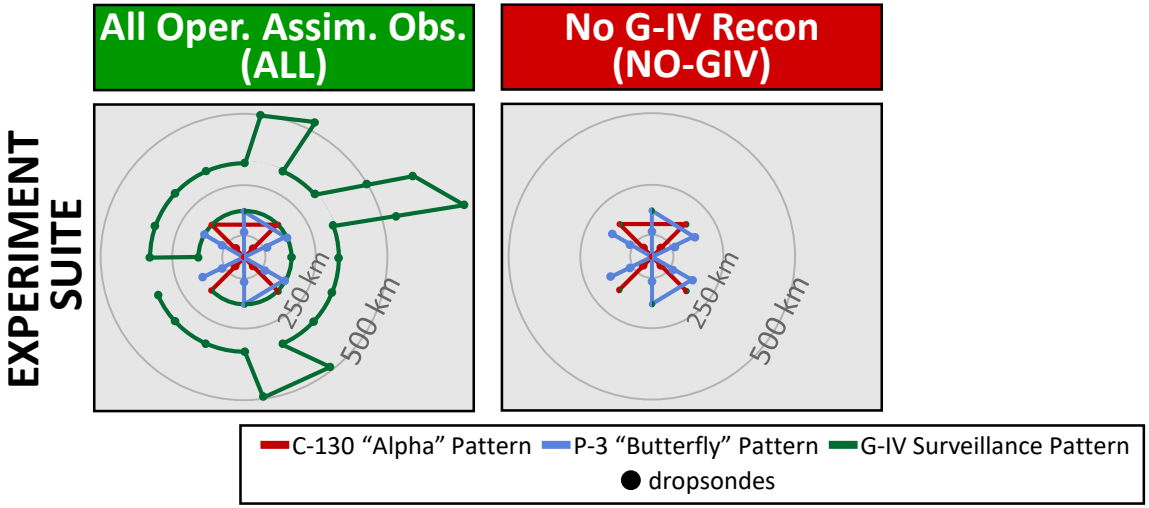

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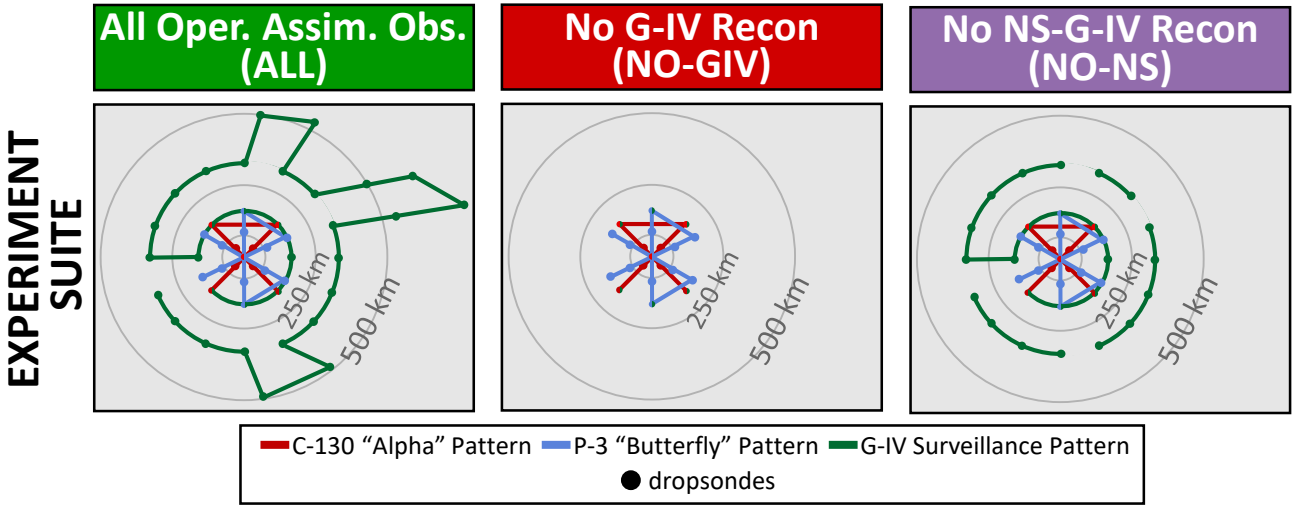

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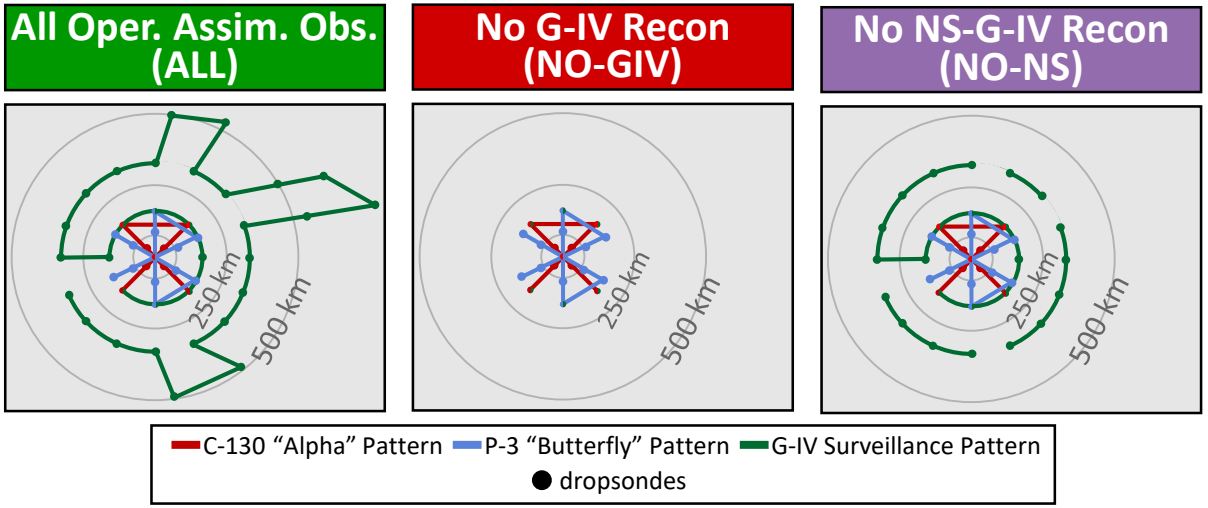


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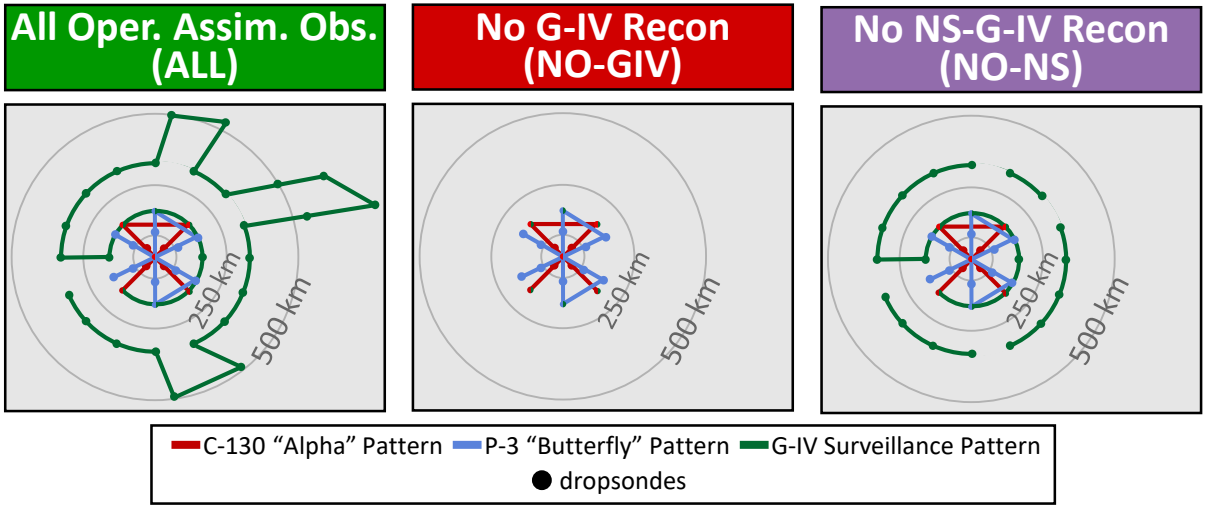


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| 3 years | 13 TCs | 531 cycles | 45 missions |

all TCs with *tasked* G-IV missions

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*Available early/mid Feb 2023 – run by Andy Hazelton using GROOT

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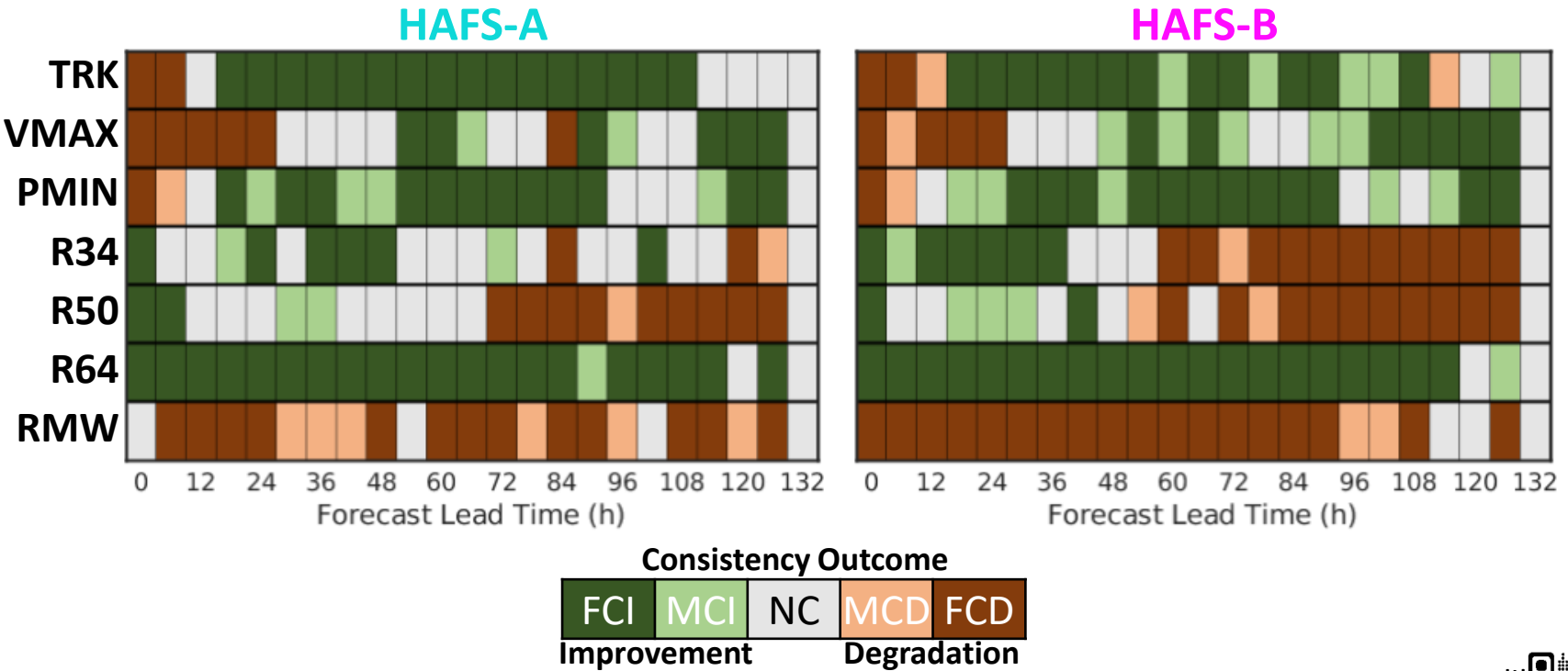


README

Sample Sizes @ 0/126 h: 1050/217 *(TRK, VMAX, PMIN, RMW)*, 1808/430 *(R34)*, 987/376 *(R50)*, & 630/245 *(R64)*

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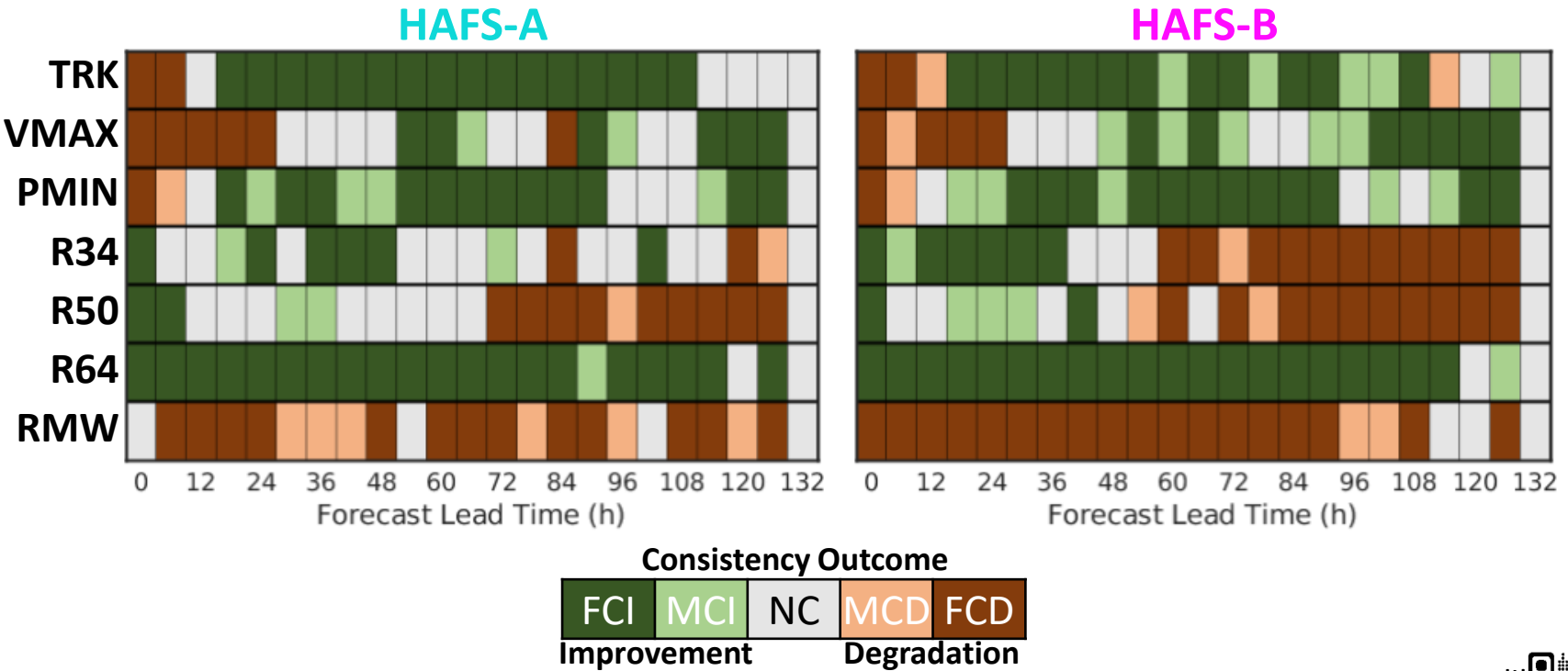


**HAFS-A will be used for this assessment.**

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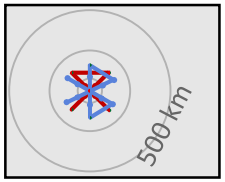

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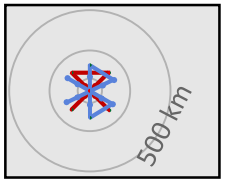

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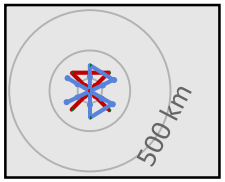


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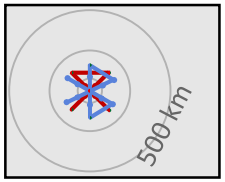


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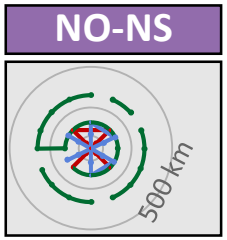

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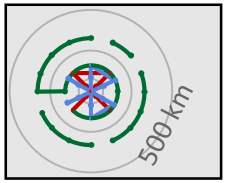

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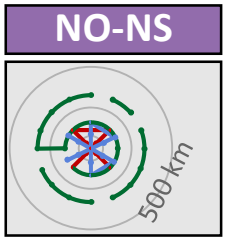

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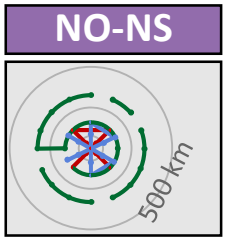

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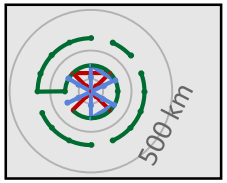

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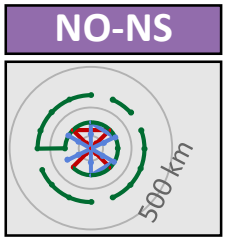

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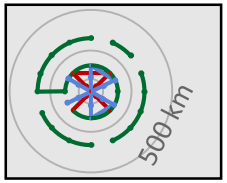


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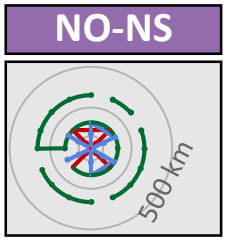


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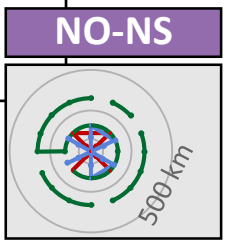


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**THANK YOU FOR LISTENING!**

**Dr. Sarah D. Ditchek**

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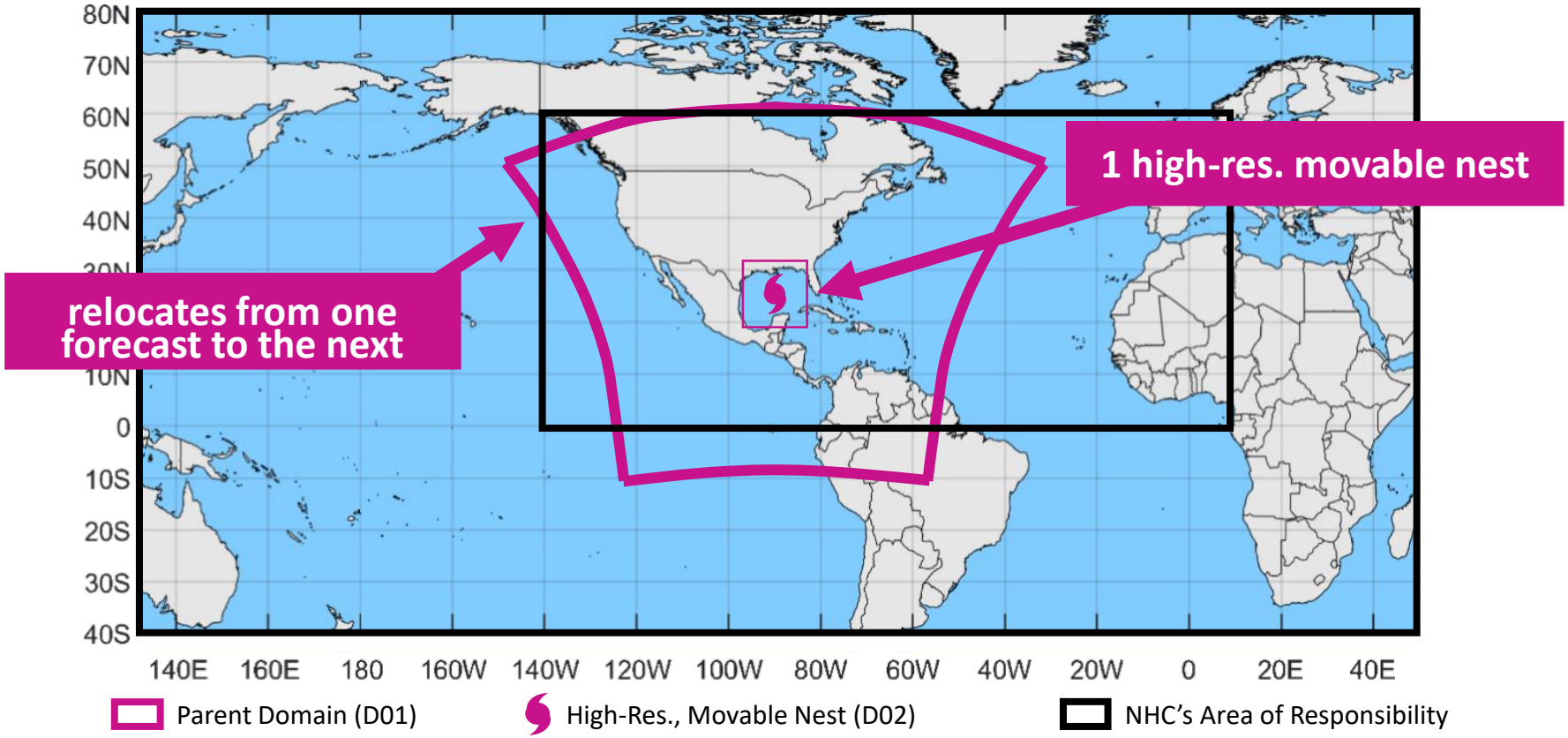
WPO FY22 HOT Project Progress

# HAFS IOC Version Differences

| HAFSv1 | HFSA | HFSB |
|---|---|---|
| Grid | Storm-centric regional Extended Schmidt Gnomonic (ESG) grid based storm-following moving-nest configuration | |
| | Parent: 6-km (1320x1200, ~78x75 degree) | Parent: 6-km (1200x1200, ~75x75 degree) |
| | Nest: 2-km (600x600, ~12x12 degree | |
| Vertical Levels | L81 with a 2-hPa model top | |
| Physics Timestep | 90s time step | |
| | Parent: k/n_split of 2/4 | |
| | Nest: k/n_split of 4/10 | Nest: k/n_split of 4/9 |
| IC/BC | GFSv16 \| LBC blending with nrows_blend of 20 | |
| Vegetation | VIIRS | |
| VI/VR/VM | Modernized VI including VR & automatically determined VM based on intensity, where warm-cycling intensity threshold is | |
| | 50 kt | 40 kt |
| DA | High-resolution inner-core DA with 3-h FGAT \| 4DEnVar with 3-h 80 member GDAS ensembles<br>Updated adaptive observation error coefficients for flight recon data \| Assimilates all obs ingested by HWRF & GFS/GDAS | |
| Dynamics | hord_mt/vt/tm/dp/tr=6/6/6/6/-5 \| kord_mt/wz/tr/tm=11/11/11/-11<br>Damping: tau=5, n_sponge = 24 \| rf_cutoff = 50.e2, sg_cutoff = -1. \| d2_bg_k1=0.20, d2_bg_k2 = 0.15 \| vtdm4 = 0.04, delt_max=0.008<br>full_zs_filter=.true. \| max_slope=0.15,0.15 for both parent and nest | |
| MP | GFDL | Thompson |
| Radiation | RRTMG (720s time step) | RRTMG (1800s time step) |
| PBL | Modified TKE-EDMF GFS PBL (sfc_rlm=1, d02 elmx/rlmx=250) | Modified TKE-EDMF GFS PBL (tc_pbl=1, d02 elmx/rlmx=75) |
| CP | upgraded sa-SAS | |
| LSM | Noah | |
| Surface Model | GFS SFC with HWRF exchange coefficients | |
| ---- | Unified UGWPv1 | |
| Air-Sea Interaction & Coupling | ESMF/CMEPS based HYCON ocean coupling with extended ocean domain<br>ATM → OCN: air-sea momentum, SH & LH fluxes, net SW & LW radiation fluxes, surface pressure, & precipitation \| OCN → ATM: SST<br>1/12-degree grid spacing with L41 vertical levels \| Ocean IC from RTOFSv2 with persistent oceanic LBC<br>Atmospheric forcing from GFSv16 grib2 files for non-overlapping area | |
| | One-way WW3 wave coupling for NHC/CPHC basins (AL, EP, CP) | No wave coupling |
| Post-Processing & Products | Latest UPP \| Upgraded GFDL Vortex Tracker | |

# HAFS IOC Domain



# Model Choice (1)

**Consistency Outcome**

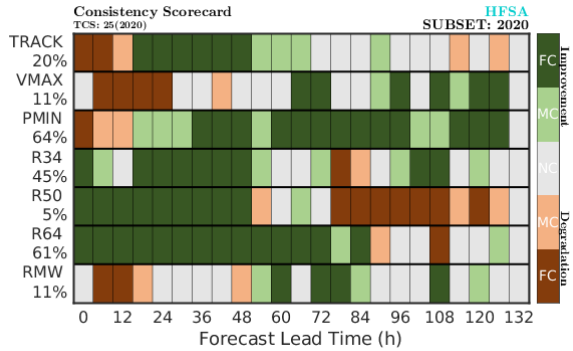
| FCI | MCI | NC | MCD | FCD |
|---|---|---|---|---|

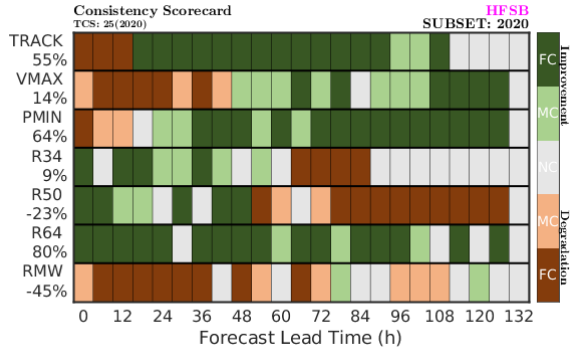
Improvement — Degradation

## CONSISTENCY SCORECARDS

***Stratified By Year***

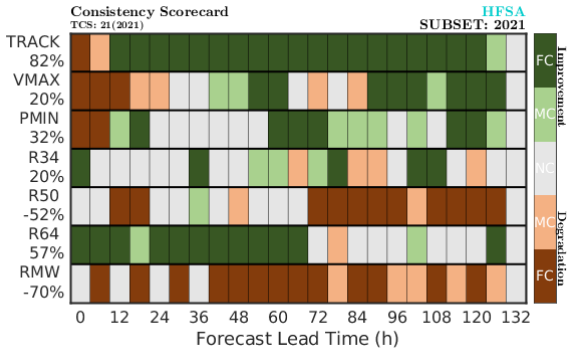
### 2020

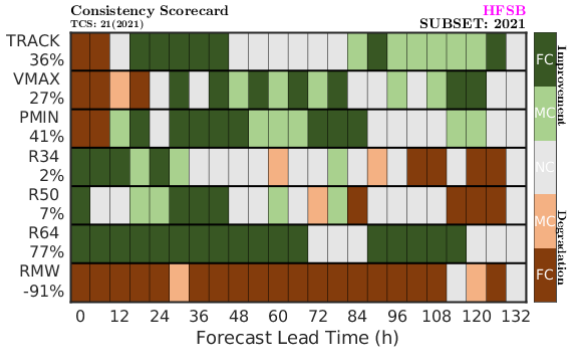



**A** better for R34, R50 & RMW
**B** better for track & R64

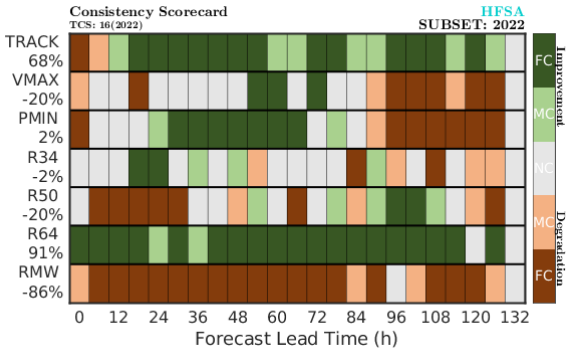
### 2021

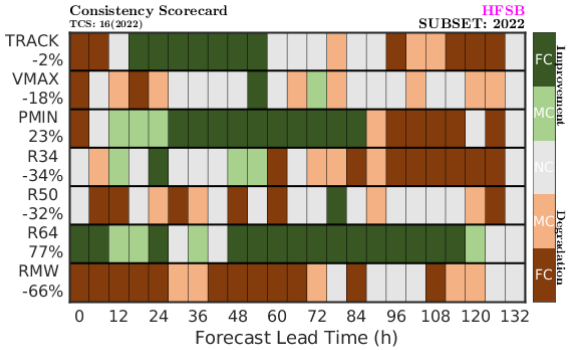



**A** better for track, R34, & RMW
**B** better for R50 & R64

### 2022




**A** slightly better for R50 and better for track, R34, & R64
**B** better for PMIN & RMW

HAFS-A

HAFS-B

Sample Sizes @ 0/126 h for 2020: 451/77 *(TRK, VMAX, PMIN, RMW)*, 779/162 *(R34)*, 384/139 *(R50)*, & 206/65 *(R64)*
Sample Sizes @ 0/126 h for 2021: 349/94 *(TRK, VMAX, PMIN, RMW)*, 602/168 *(R34)*, 379/158 *(R50)*, & 275/125 *(R64)*
Sample Sizes @ 0/126 h for 2022: 250/46 *(TRK, VMAX, PMIN, RMW)*, 427/100 *(R34)*, 224/79 *(R50)*, & 149/55 *(R64)*

# Model Choice (2)

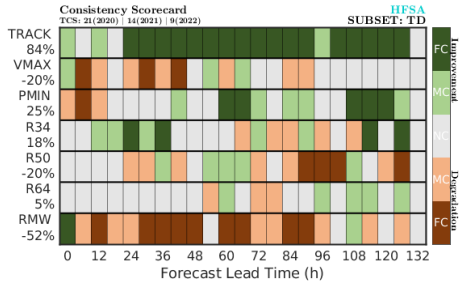
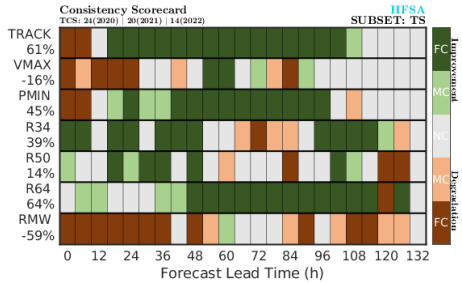
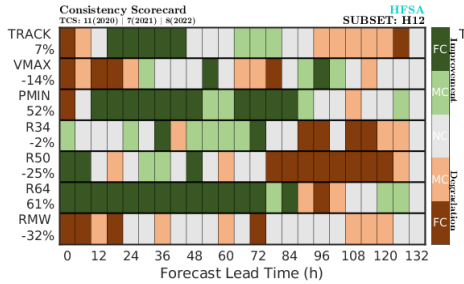
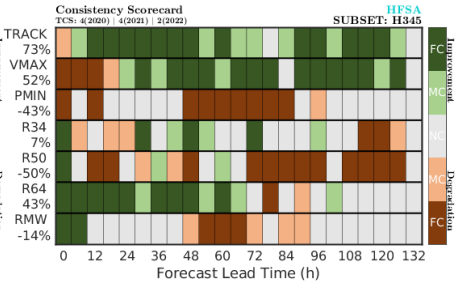
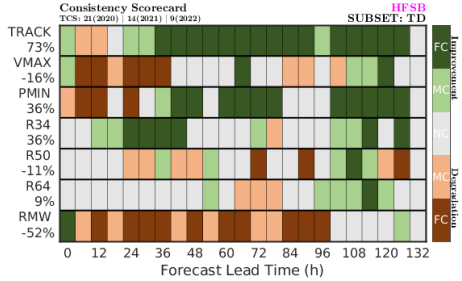
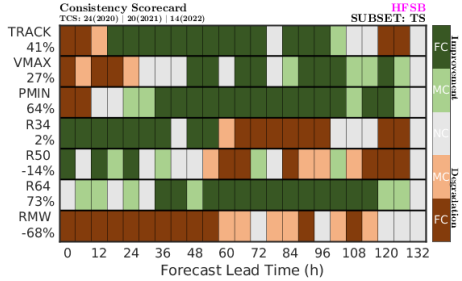
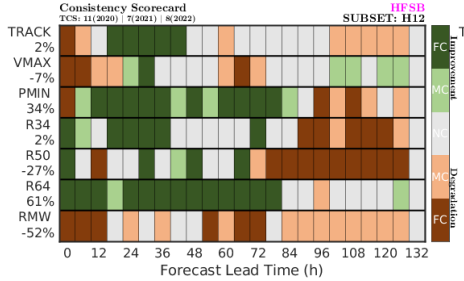
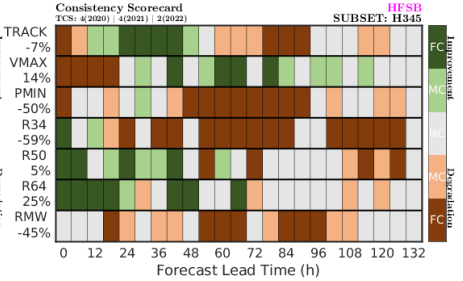
**Consistency Outcome**

| FCI | MCI | NC | MCD | FCD |
|---|---|---|---|---|

Improvement — Degradation

## CONSISTENCY SCORECARDS

***Stratified By Saffir-Simpson Category***

| | TD | TS | H12 | H345 |
|---|---|---|---|---|
| **HAFS-A** |  |  |  |  |
| **HAFS-B** |  |  |  |  |
| | **A** slightly better for track<br>**B** slightly better for PMIN and better for R34 | **A** better for track, R34, & R50<br>**B** better for VMAX & PMIN | **A** slightly better for PMIN & RMW | **A** better for track, VMAX, R34, R64, & RMW<br>**B** better for R50 |

Sample Sizes @ 0/126 h for TD: 170/40 *(TRK, VMAX, PMIN, RMW)*, 0/71 *(R34)*, 0/54 *(R50)*, & 0/30 *(R64)*
Sample Sizes @ 0/126 h for TS: 547/119 *(TRK, VMAX, PMIN, RMW)*, 802/231 *(R34)*, 106/195 *(R50)*, & 0/132 *(R64)*
Sample Sizes @ 0/126 h for H12: 215/25 *(TRK, VMAX, PMIN, RMW)*, 614/68 *(R34)*, 501/67 *(R50)*, & 256/38 *(R64)*
Sample Sizes @ 0/126 h for H345: 96/29 *(TRK, VMAX, PMIN, RMW)*, 380/60 *(R34)*, 380/60 *(R50)*, & 374/45 *(R64)*