Title

Glider impacts on HAFS Hurricane Fiona (2022) Forecasts using Weakly Coupled Data Assimilation

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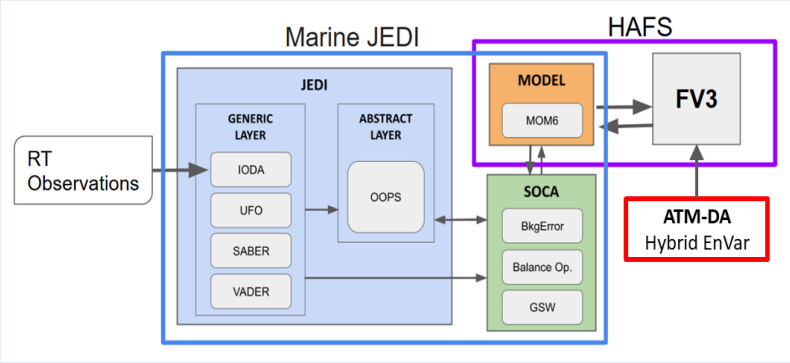
I. Introduction

a) Objective:

Glider data impact study for Hurricane Fiona (2022) predictions using WCDA-HAFS

b) System:

UFS-Hurricane Analysis and Forecast System (HAFS)



c) Experiments:

Marine JEDI - 3DVar DA

Control (**HA2M**); w/ all data (**H2MD**); w/o gliders (**H2MG**).

II. Marine JEDI - 3DVar

a cost function (Courtier et al. 1998):

$$J(x) = \underbrace{\frac{1}{2}\delta x^T B^{-1} \delta x}_{J(x)_b} + \underbrace{\frac{1}{2}(H\delta x - d)^T R^{-1}(H\delta x - d))}_{J(x)_o}$$

Increment, $\delta x = x - x_b$, where the background estimate x_b

Innovation, $d = y - H(x)$, where observation y

Observation operator, H

Observation-error covariance, R

Static Background error covariance, B

II. Marine JEDI - 3DVar

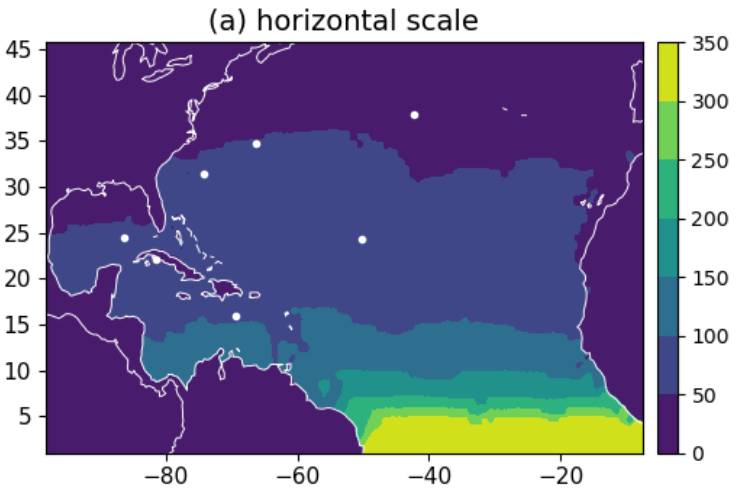
static "B-matrix" $\mathbf{B=KDCD^TK^T}$,

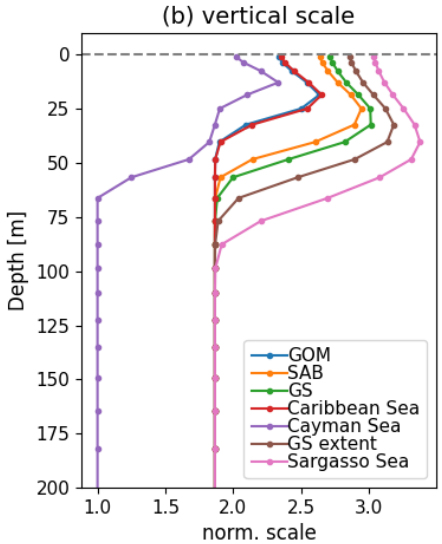
where **K** is **the balance operator**,

D is the diagonal matrix of standard deviation,

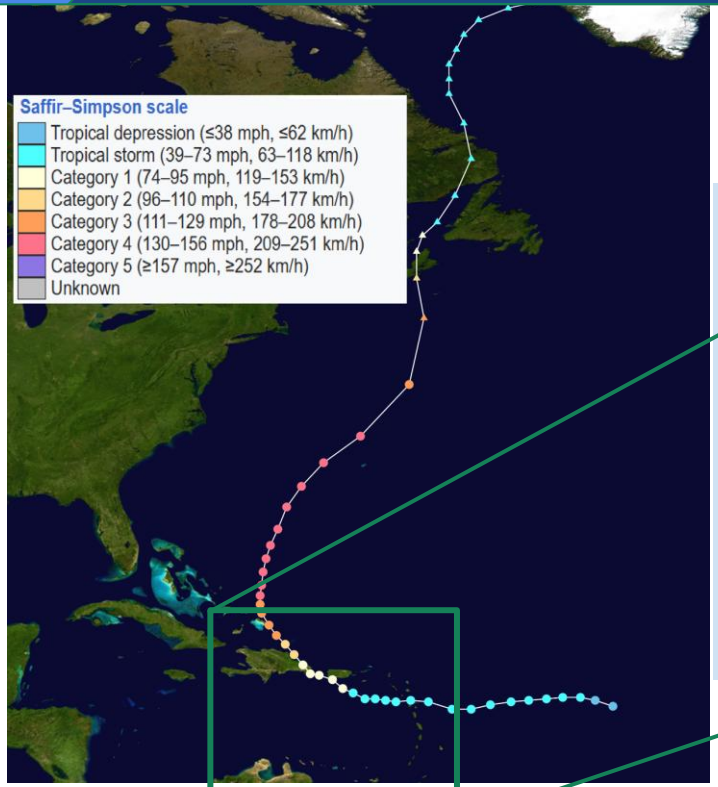
C is the 3D covariance operator, ***Explicit Diffusion model*** (weaver et al., 2005) and

T denotes transpose.



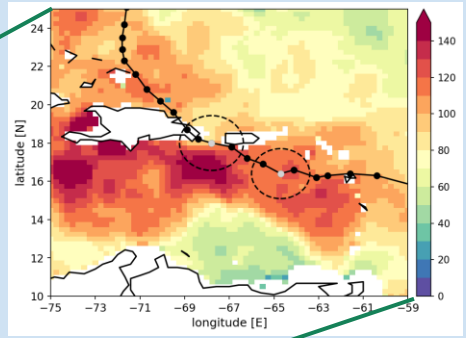


II. Hurricane Fiona (2022)

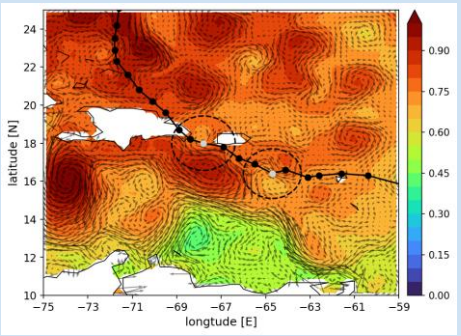


The Pre-Storm Conditions

(a) NESDIS - OHC



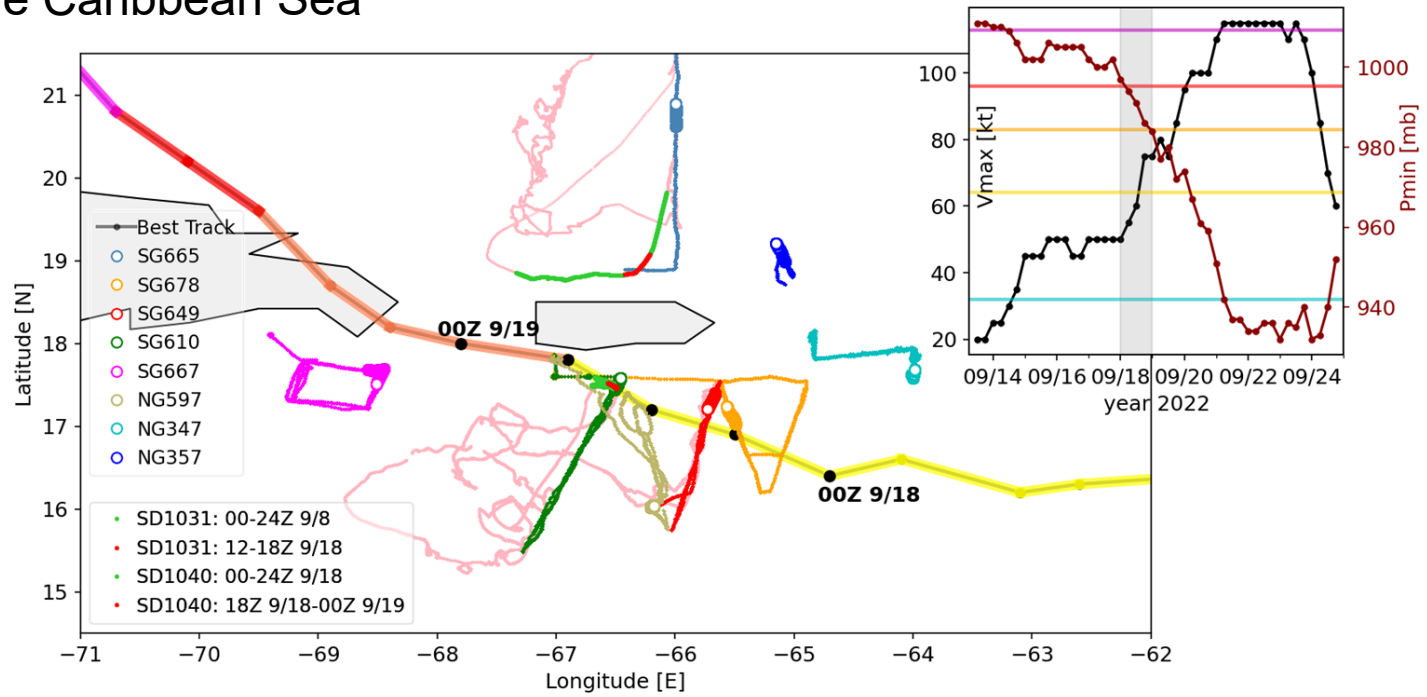
(b) AVISO - SSH & SSC



By MarioProtIV - Created by MarioProtIV using Wikipedia:WikiProject Tropical cyclones/Tracks. The background image is from NASA. Tracking data is from the National Hurricane Center[1]., Public Domain, https://commons.wikimedia.org/w/index.php?curid=139871533

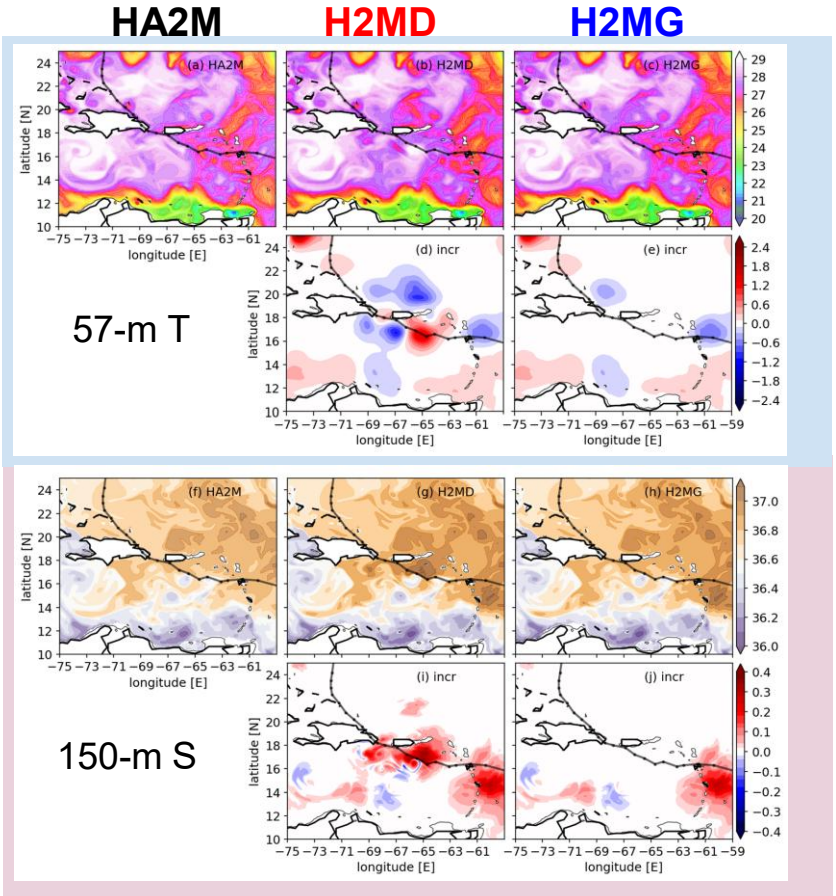
II. Hurricane Fiona (2022) - Obs Assets

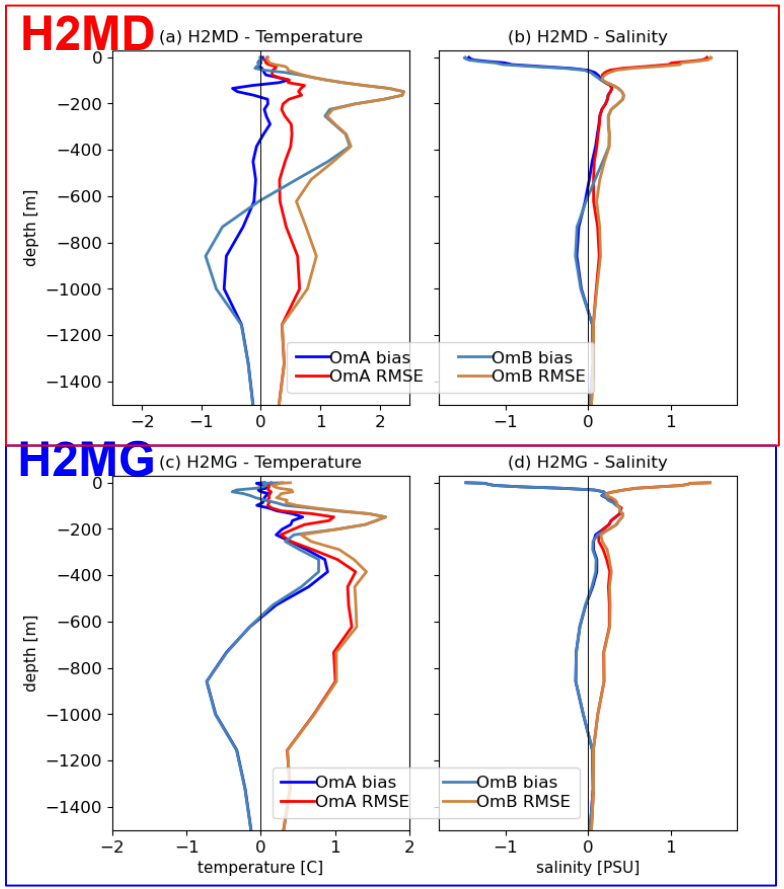
The Caribbean Sea



2 saildrone (pink-green-red)
8 gliders (open circle valid at 15Z September 18)

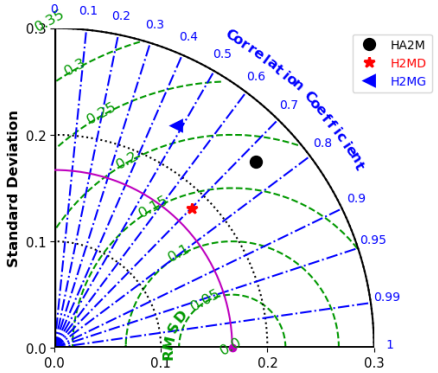
III. Results - 1. Analysis



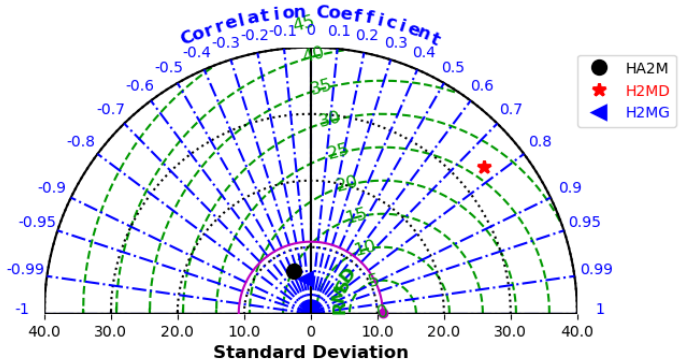


III. Results - 2. Ocean Forecast

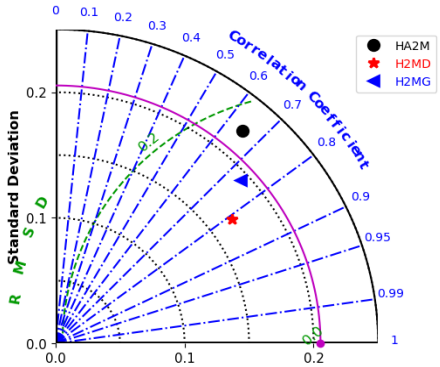
(a) 24-h forecast MLD
(2022092618)



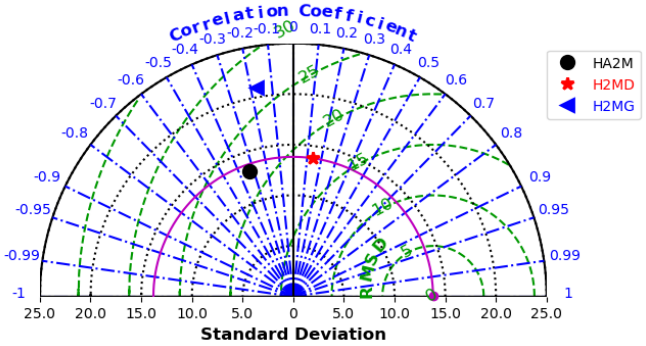
(c) 24-h forecast Z26
(2022091618)



(b) 24-h forecast T100
(2022091618)

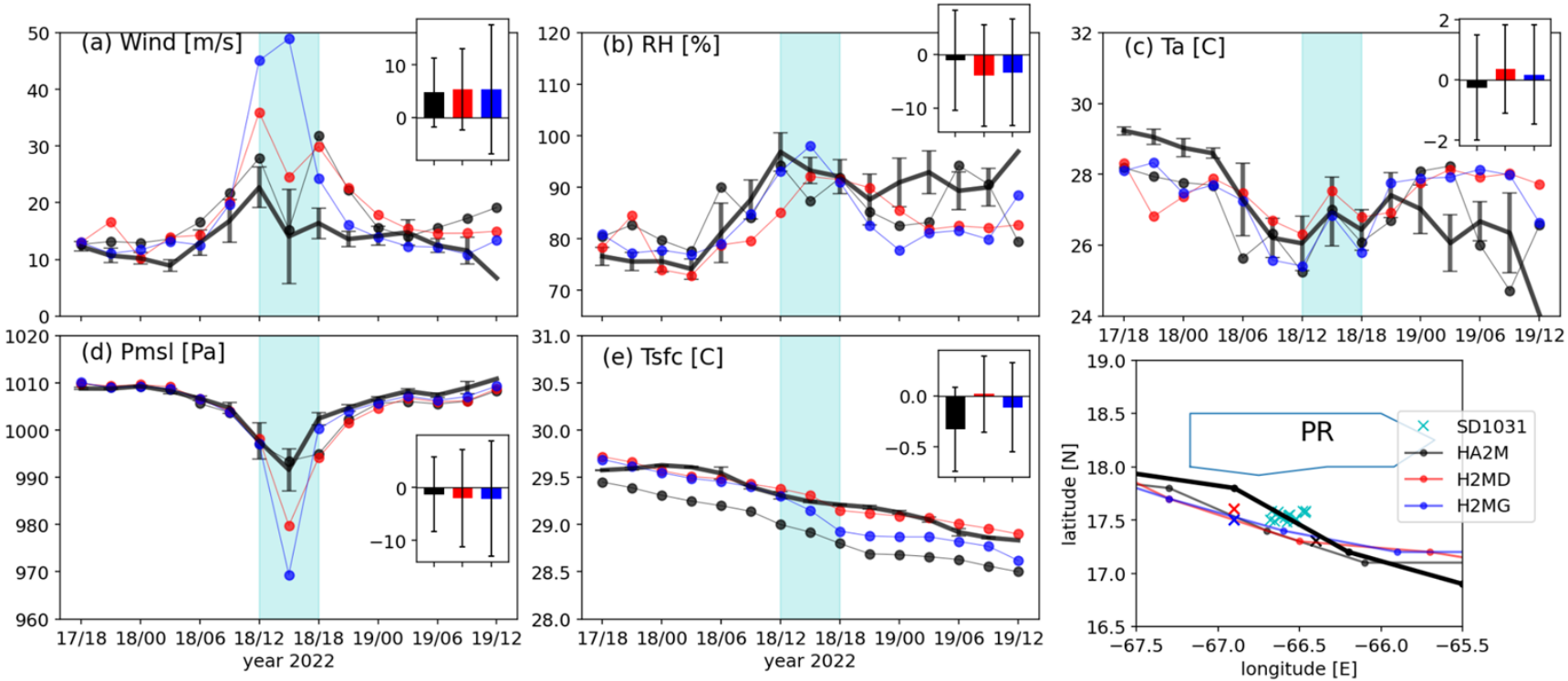


(d) 24-h forecast Smax Depth
(2022091618)

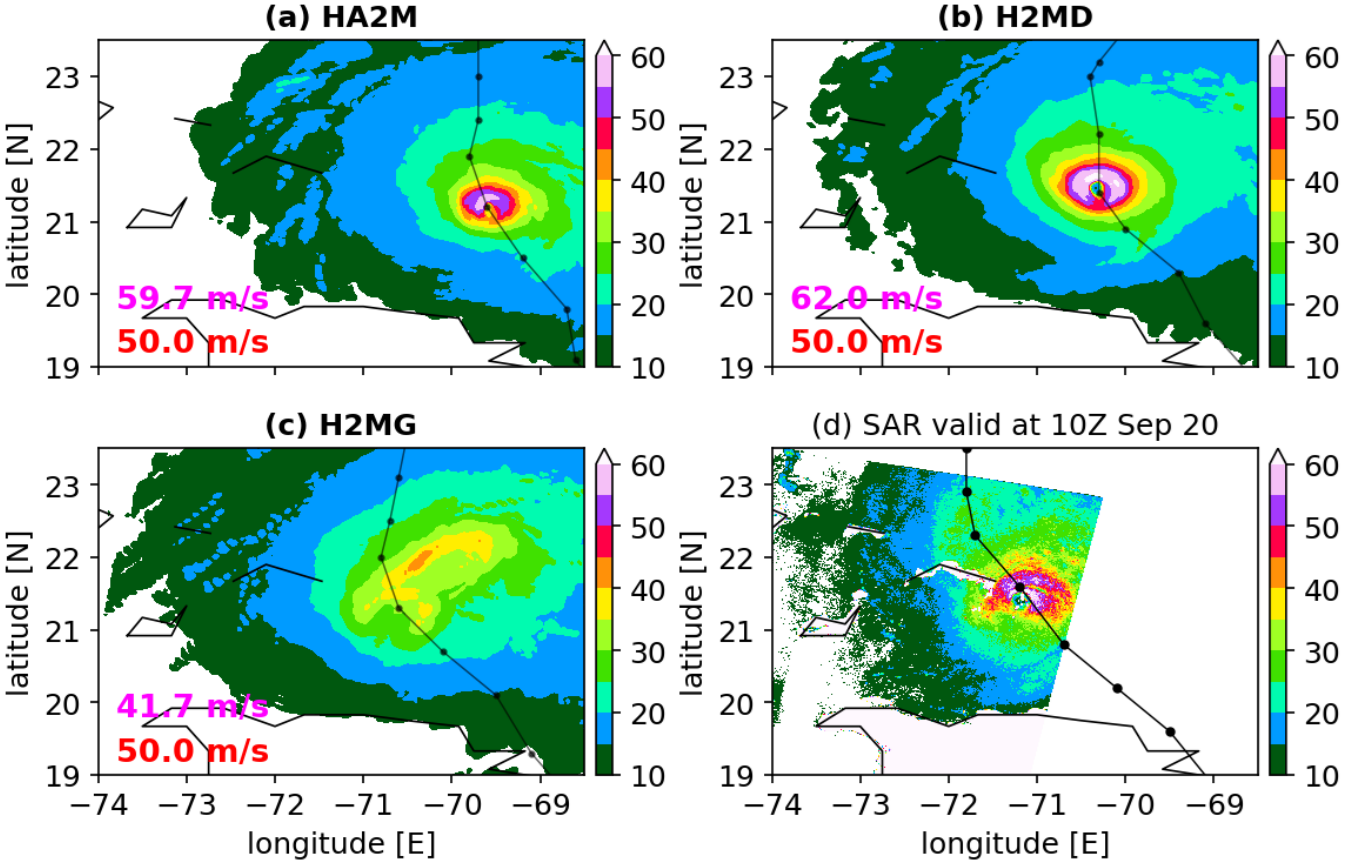


III. Results - 3. Air-Sea forecast

48-hrs from 66-h forecast lead time for 2022091618

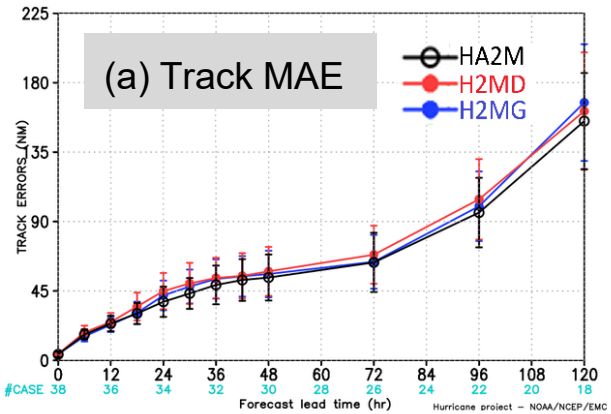


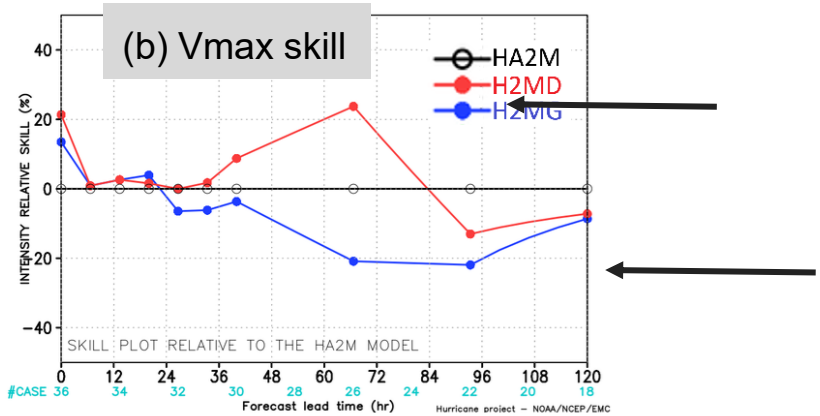
III. Results - 4. SAR Surface Wind Comparisons

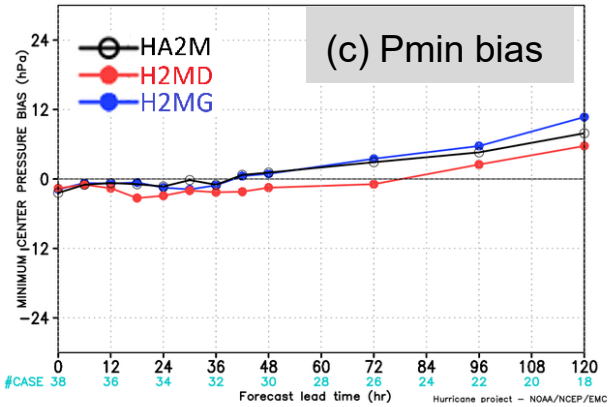


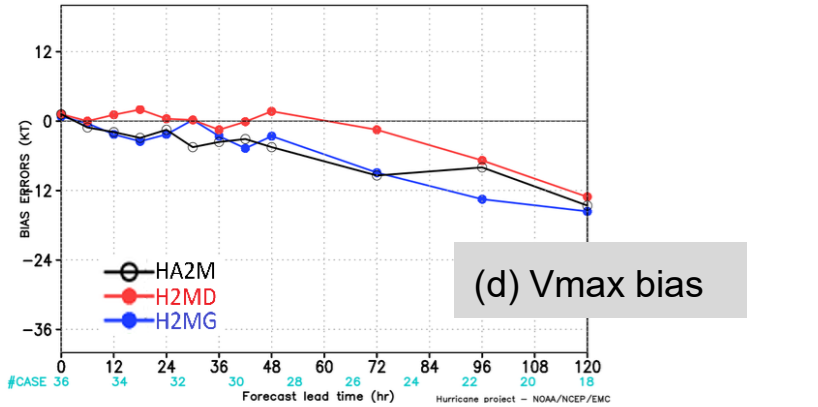
III. Results - 5. Track and Intensity Forecasts

NHC verification for 38/42 homogeneous cases









IV. Summary and Conclusions

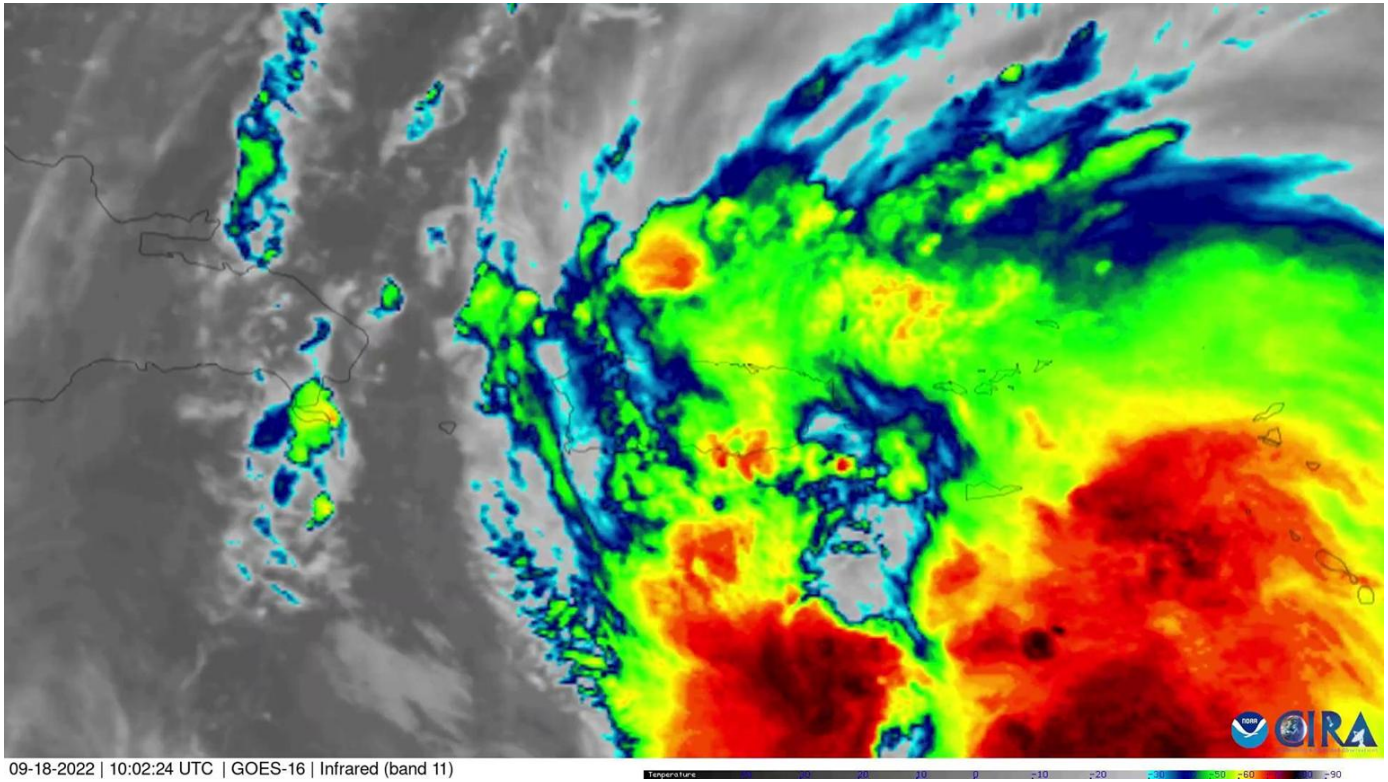
- **OmB & OmA:**
  - **H2MG**, small reduction by < ~1C and <**28%** for T and S, respectively, at 150 m.
  - **H2MD**, RMSE reduction by < **76%** (~2C) for T and < **60%** for S (centered at 180 and 150 m).
    bias reduction by between ~2.5 and 0.5C for T and between 0.12 and 0.19 PSU for S

- **Air-sea interaction variables:**
  - **H2MG**: large RMSE for all variables
  - **H2MD**: Smallest error for Tsfc, large error for Ta and RH

- **Forecast verification:**
  - **H2MG**: degraded Track wrt baseline (HA2M), but improved Track wrt H2MD
    - Vmax skill improved early lead but degraded late lead time (<20%)
    - Worst Intensity bias late lead time.
  - **H2MD**: improved Pmin and Vmax bias (10%), improved Vmax skill up to **20%.**

Q & A

Thank you


09-18-2022 | 10:02:24 UTC | GOES-16 | Infrared (band 11)
Temperature
-90

II. Hurricane Fiona (2022)

