

Estimating CYGNSS vector winds applying a variational analysis method to simulated CYGNSS ocean surface wind speed retrievals

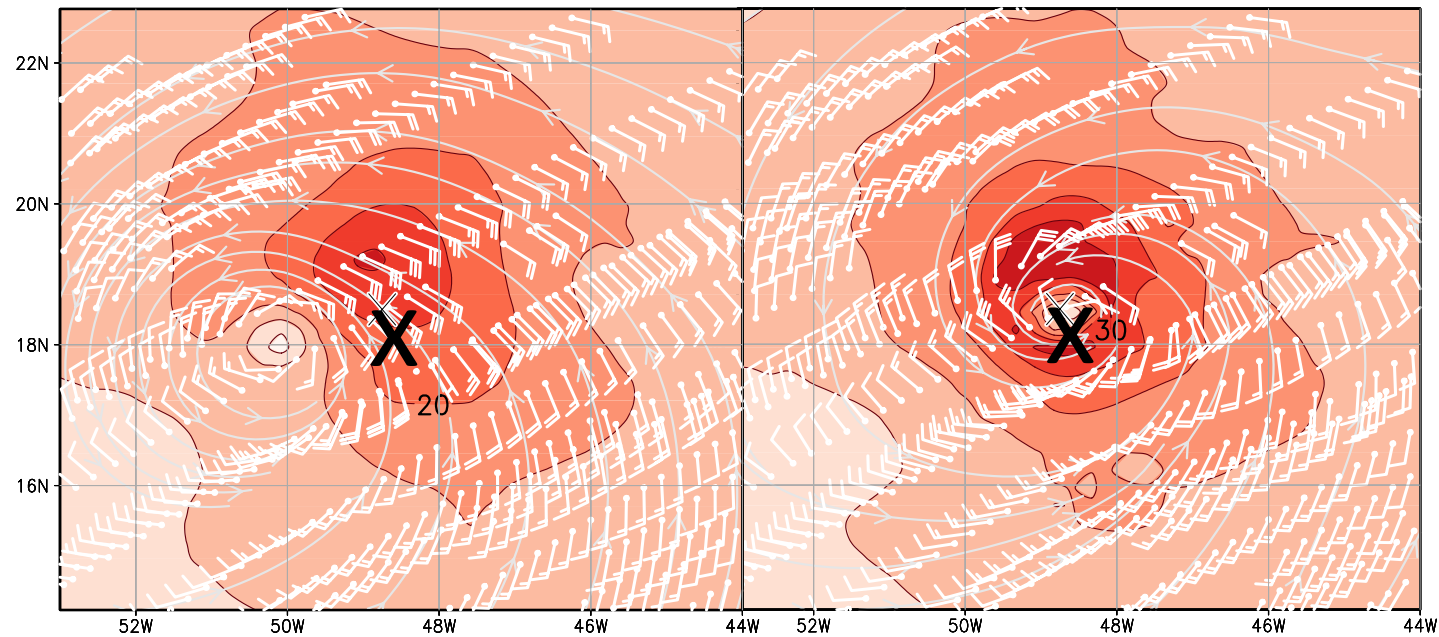
Ross Hoffman, S. Mark Leidner, Robert Atlas and B. Annane

May 4, 2017

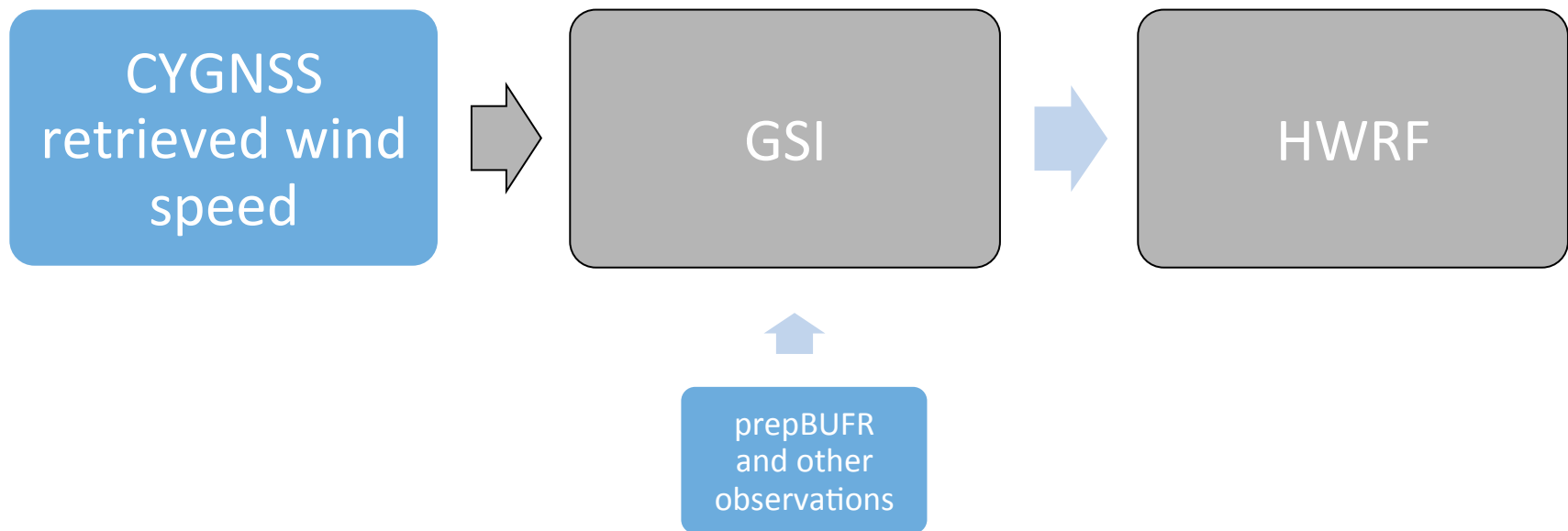
Take-aways:

★ Better results obtained with better priors.

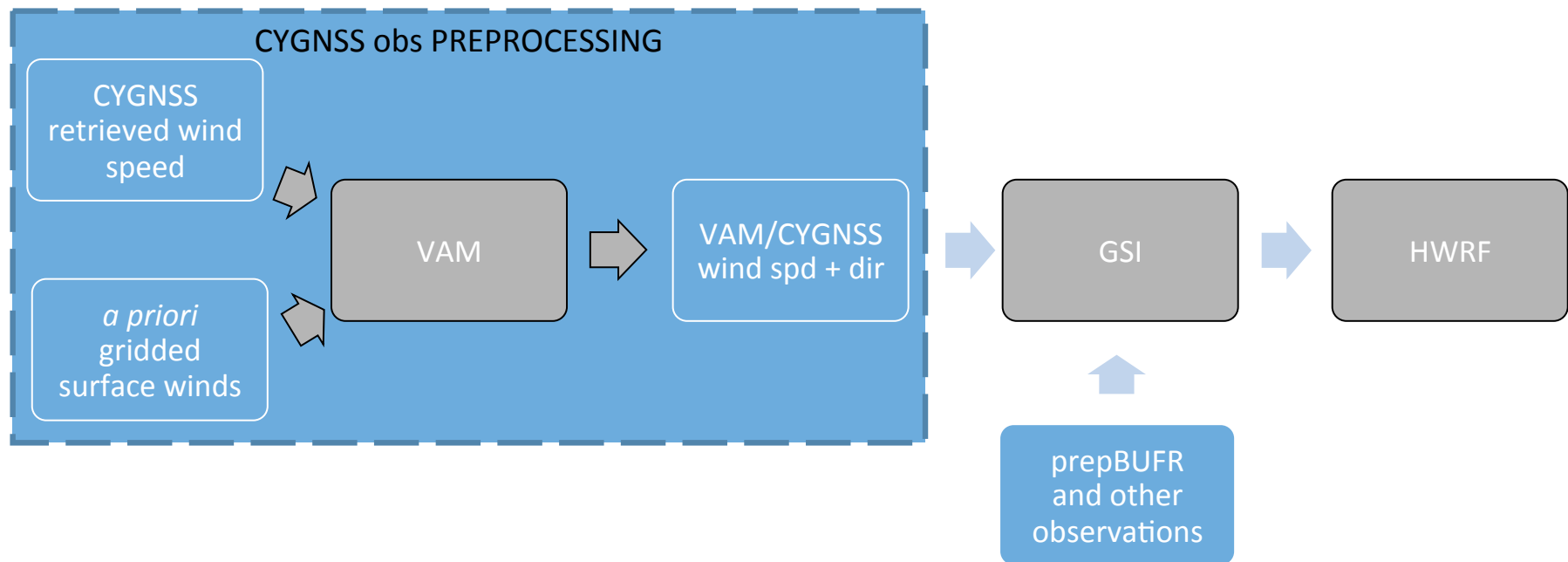
➔ Now working on integrating the VAM in the operational HWRF.



Data flow for CYGNSS wind speeds



Data flow for CYGNSS VAM vectors



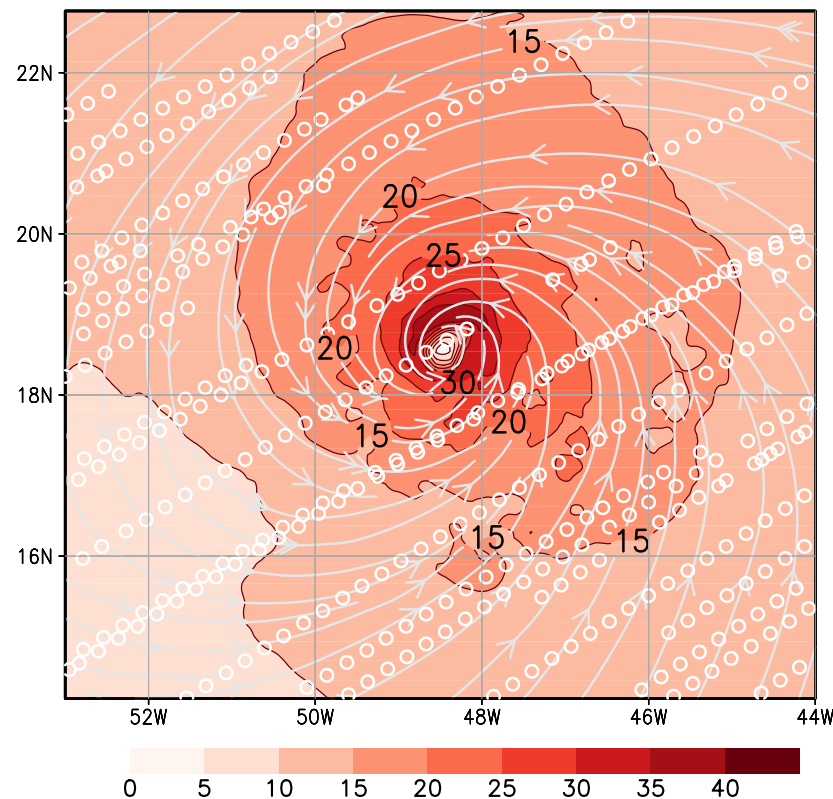
Simulation of CYGNSS wind retrievals

UM/AOML Nature Run 10-meter winds (Nolan et al. 2013)

Simulated using the
CYGNSS Science Team
End-to-End Simulator
(E2ES).

Uses the Univ. of Miami/
AOML WRF-ARW hurricane
Nature Run (UM/AOML NR).

Expected CYGNSS
observation errors
are applied.



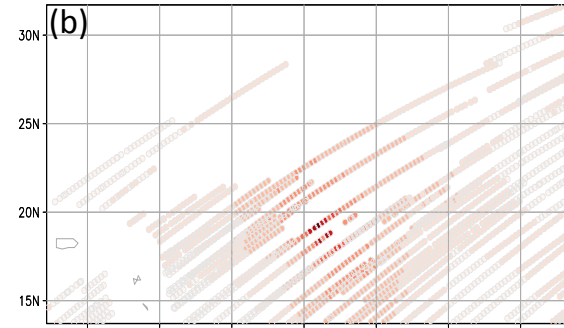
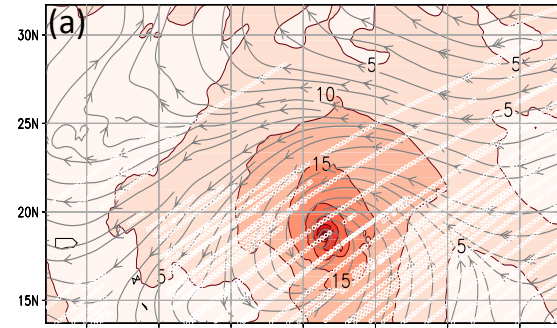
Variational Analysis Method (VAM)

- VAM creates gridded 2D surface wind analysis by minimizing an objective function, J , which measures the misfit of the analysis to the background (J_b), the observations (J_o), and a priori constraints (J_c)... the analyzed dynamical balance must be close to that of the background.

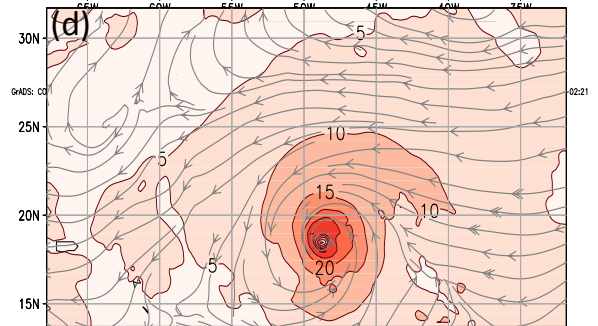
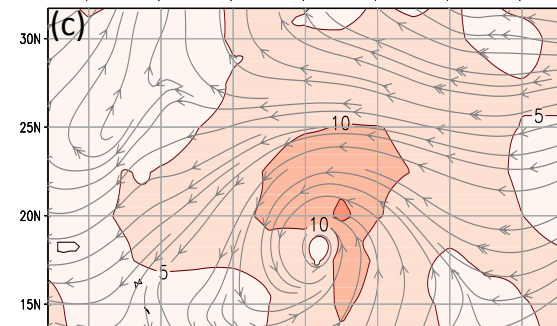
$$J(x) = J_b(x) + J_o(x) + J_c(x)$$

- Used to create 30+ years of high-quality global, ocean surface wind datasets (CCMP).

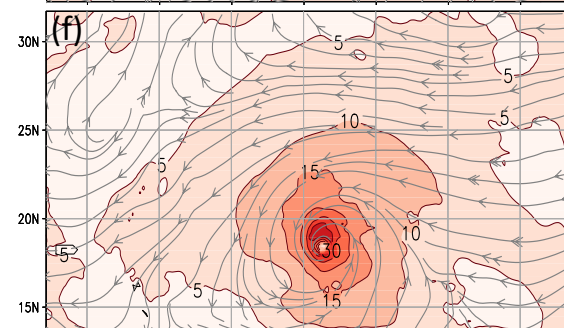
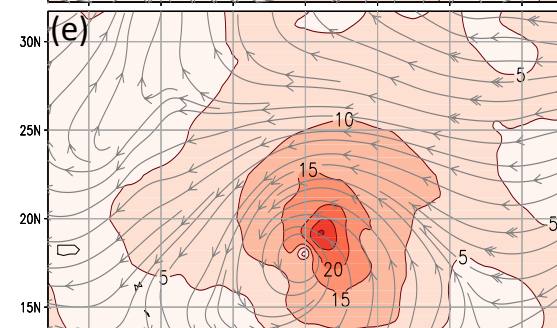
UM/AOML NR
10-m winds and
Simulated CYGNSS obs

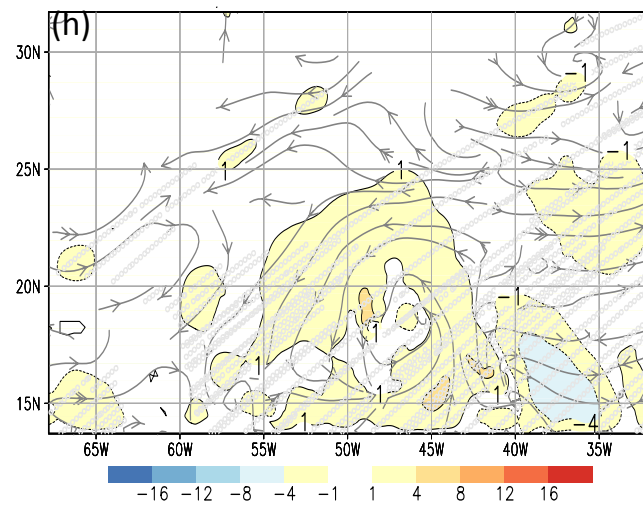
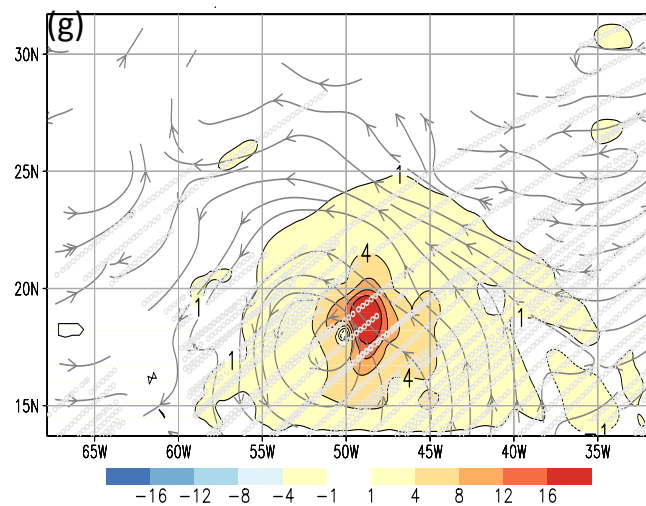
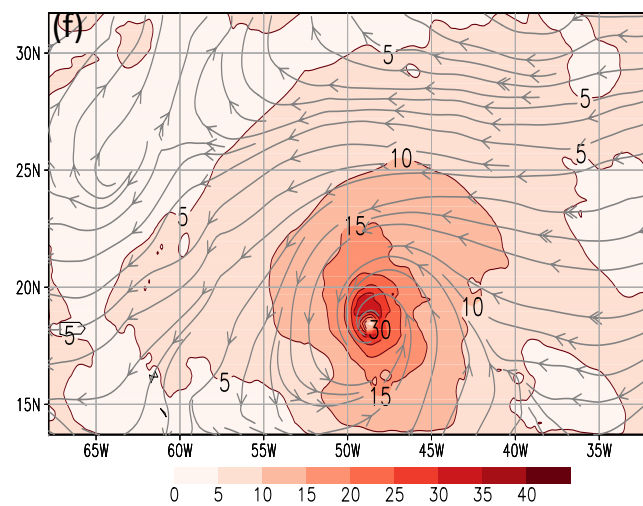
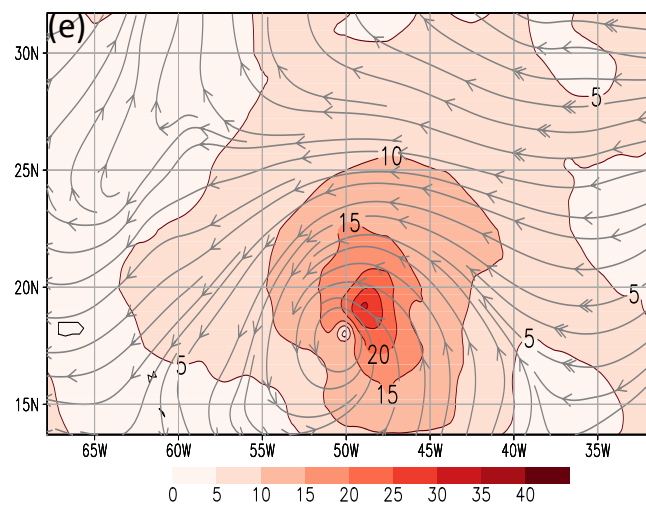


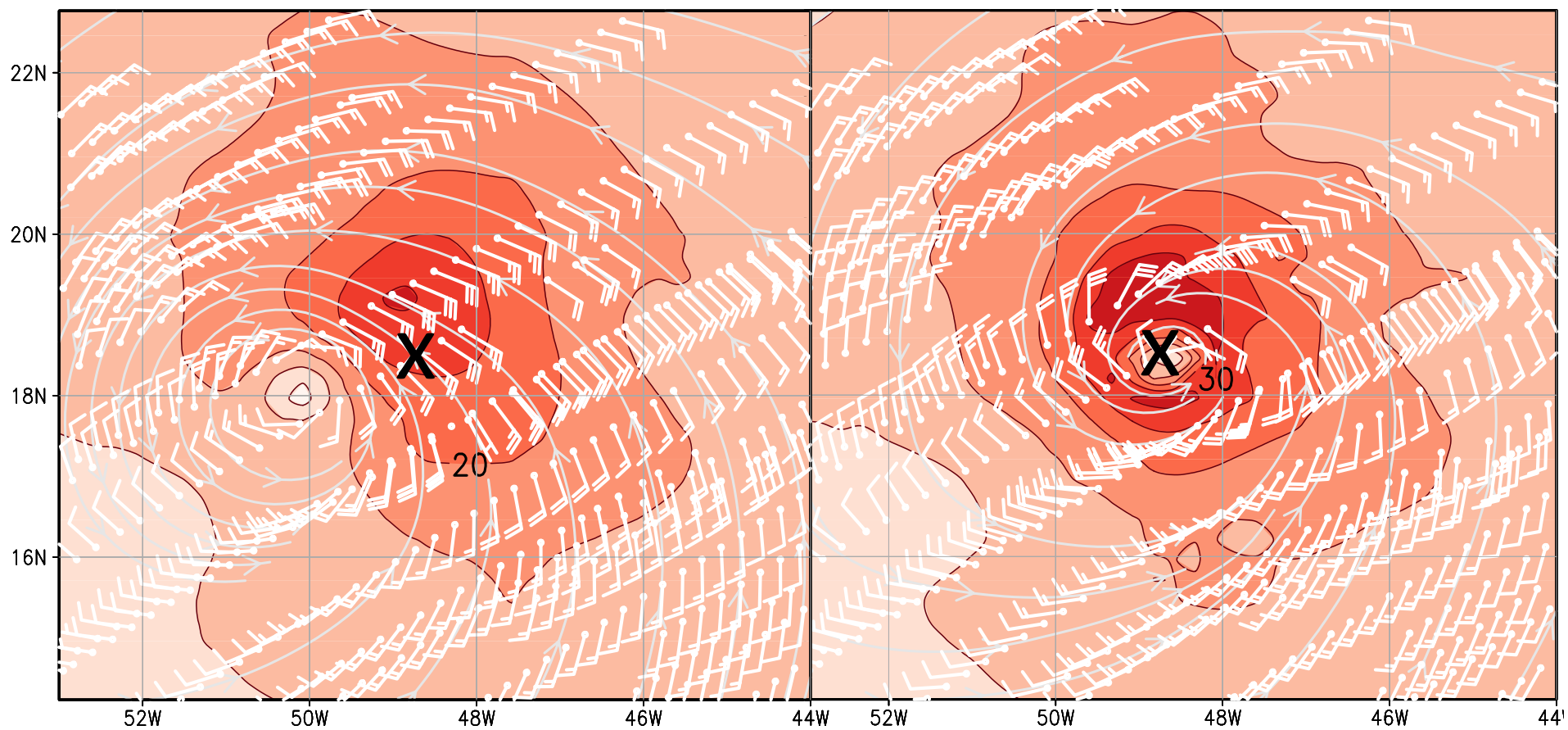
VAM Backgrounds
GFS and HWRF
(6-hour forecasts)



VAM Analyses
VAM(G) and VAM(H)

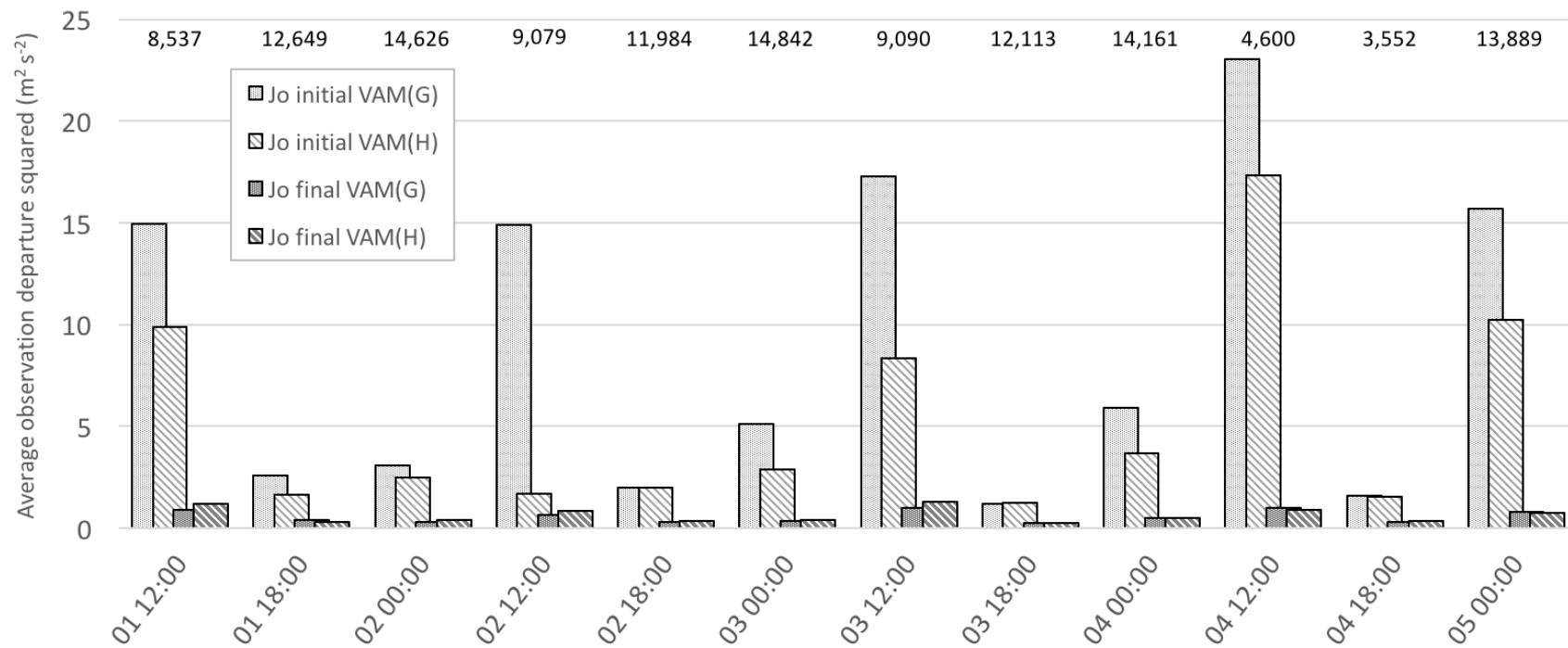




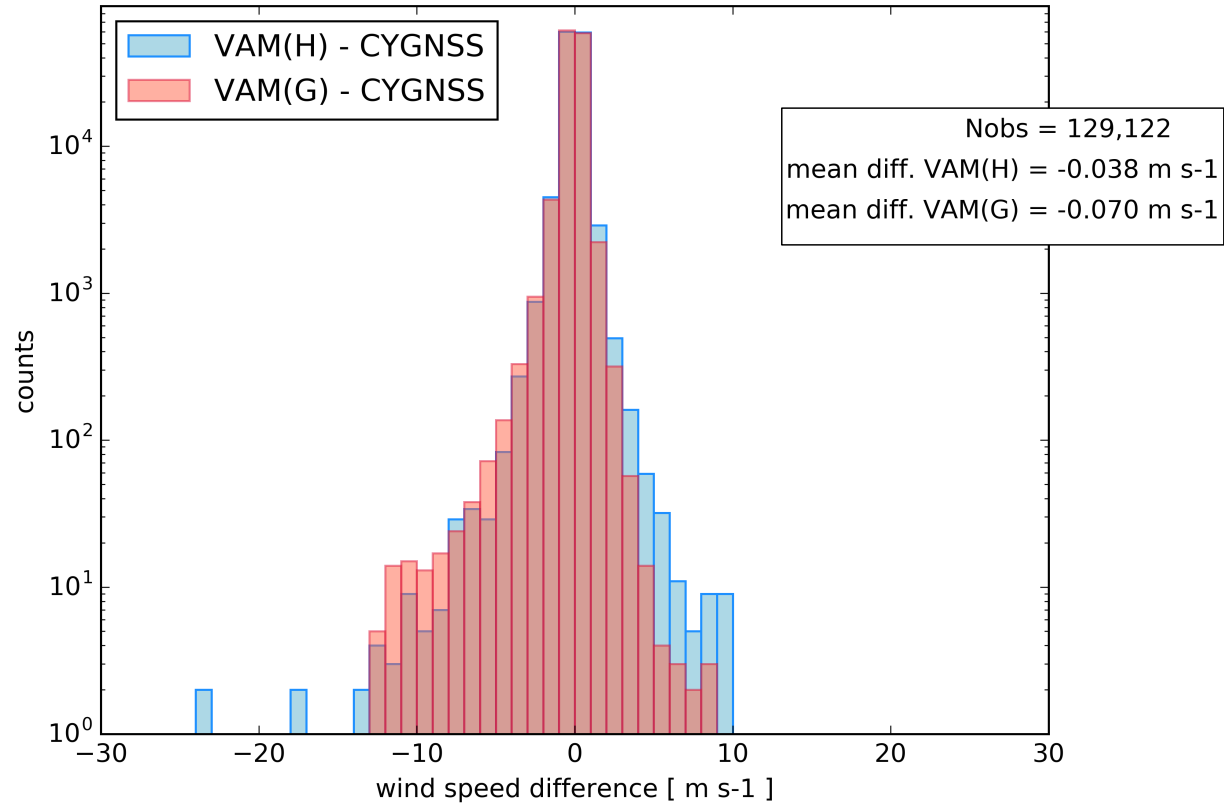


<i>Overall statistics</i>	GFS backgrounds	HWRF backgrounds
RMS o-b [m/s]	1.48	1.14
RMS o-a [m/s]	0.41	0.43

RMS (O-B) and (O-A) for VAM(G) and VAM(H)

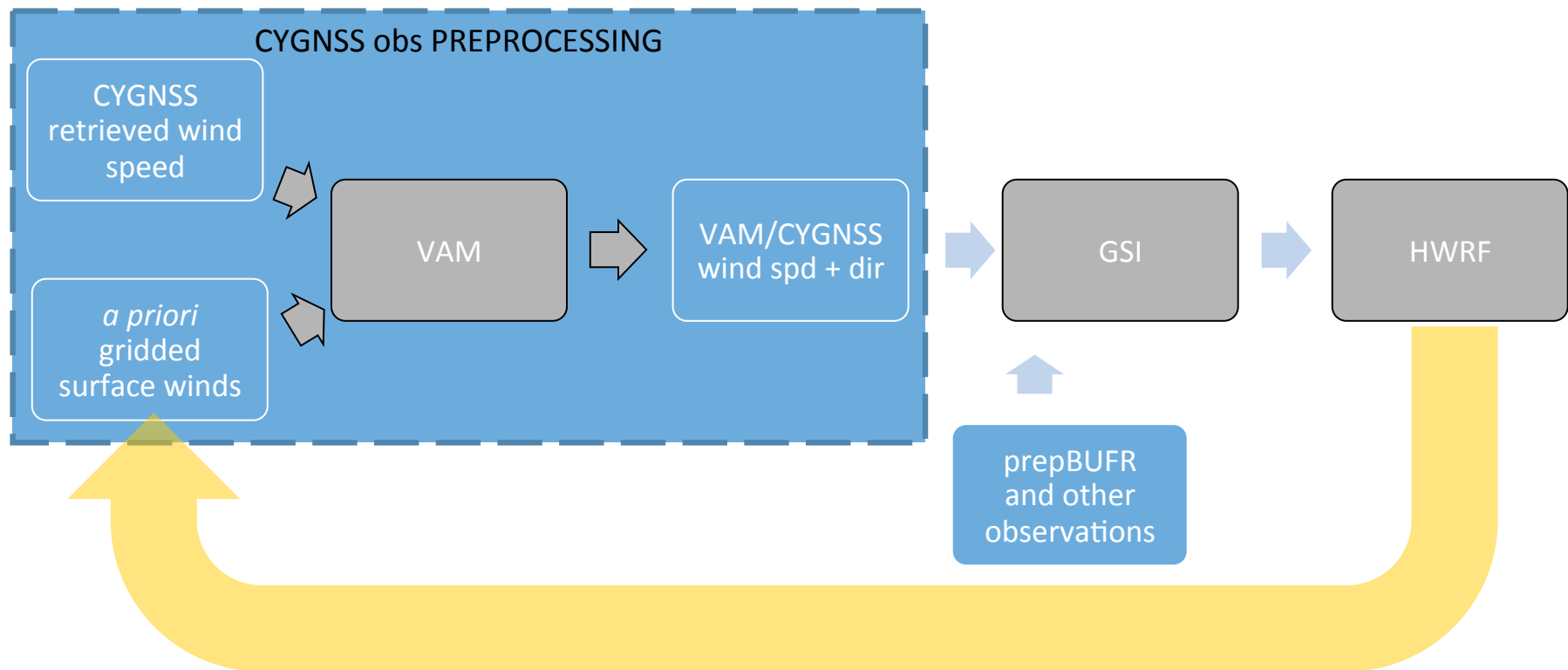


$(O-B)^2$ and $(O-A)^2$ for VAM(G) and VAM(H)



Wind Speed Histogram of (O-A) for VAM(G) and VAM(H)

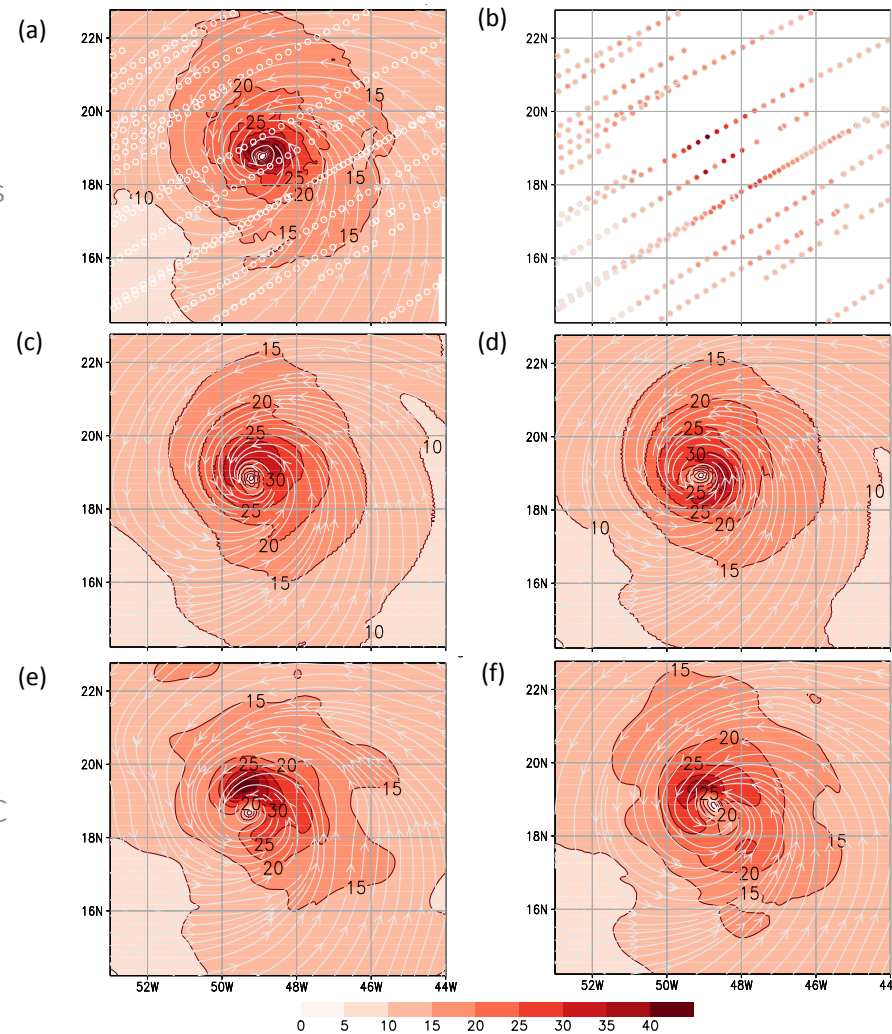
Planned VAM software integration in HWRF



UM/AOML NR
10-m winds and
Simulated CYGNSS obs

GSI Backgrounds
HWRF
(3-hour forecasts)

GSI Analyses
CYG SPD and VAM VEC



OSSE results
comparing the
assimilation of
CYGNSS speeds
vs. VAM vectors

Summary and Conclusions

- CYGNSS will observe tropical cyclones in new ways
- Vector information is more valuable to assimilation systems
- The Variational Analysis Method (VAM) is an approach to generate CYGNSS winds with vector information
- VAM analysis results dependent on the choice of background
 - Higher-resolution backgrounds are more suitable than lower-resolution backgrounds for hurricanes
- OSSE results show the value added by using vector CYGNSS
 - Improved analysis of wind field structure & storm location
 - Improved intensity forecasts (maximum wind speed & min. pressure)
- Pre-processing of CYGNSS winds to VAM-CYGNSS, and assimilation, will occur during the 2017 hurricane season

Take-aways:

★ Better results obtained with better priors.

➔ Now working on integrating the VAM in the operational HWRF.

