A Fear-Inspiring Intercomparison of Monthly Averaged Surface Forcing

Mark A. Bourassa, P. J. Hughes, and S. R. Smith

Center for Ocean-Atmospheric Prediction Studies, and Department of Meteorology

Florida State University

FSU FLUXES

Center for Ocean-Atmospheric Prediction Studies

SEAFLUX

Why Fear?

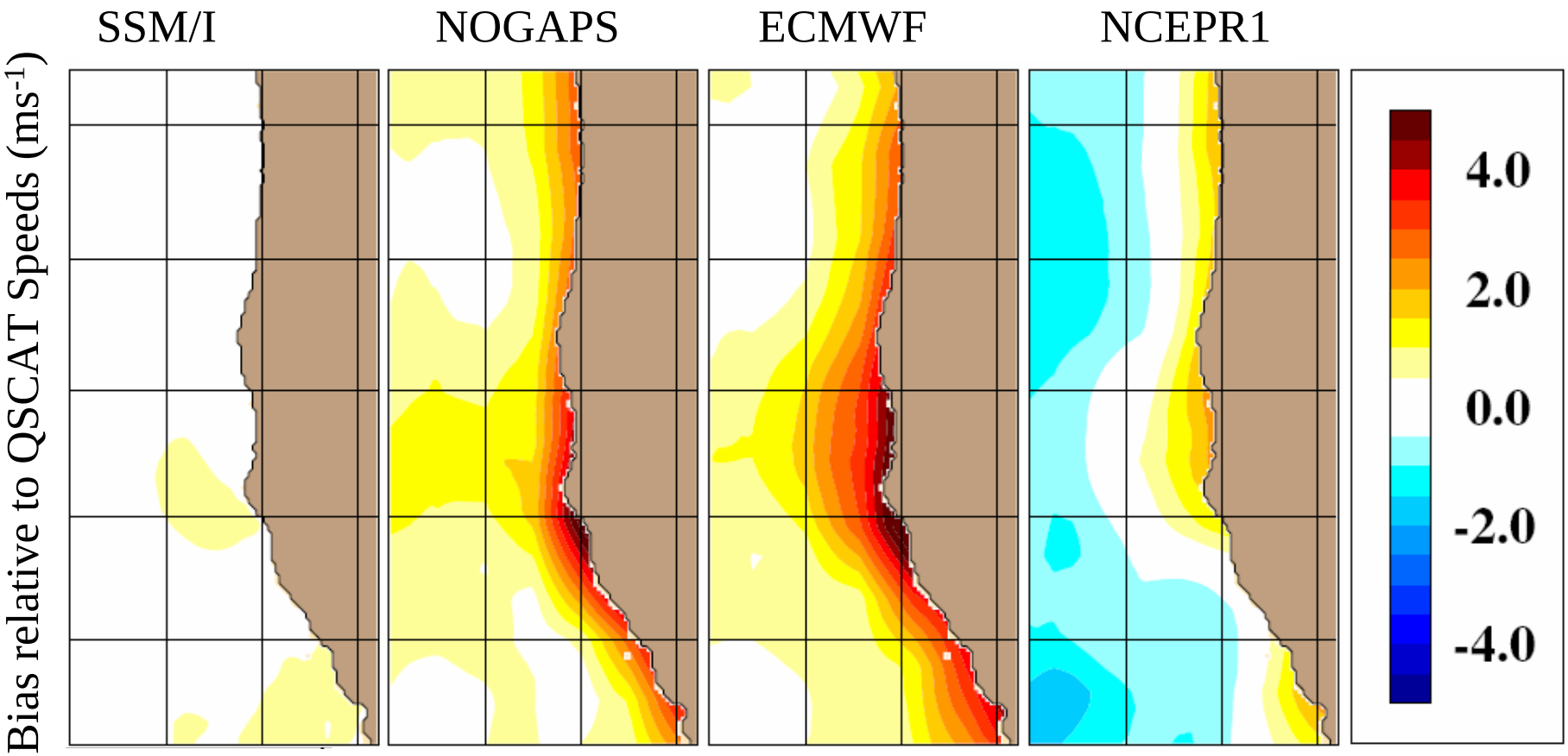
- I get many phone calls and emails asking which product should be used.
- The nine, easily obtained, products that we examined are inconsistent.
  - Different magnitudes, patterns, and distributions
  - Different input data
    - Different spatial and temporal sampling characteristics
    - Different constraints, quality control, and bias correction
  - Different flux parameterizations

Products in Our Comparison

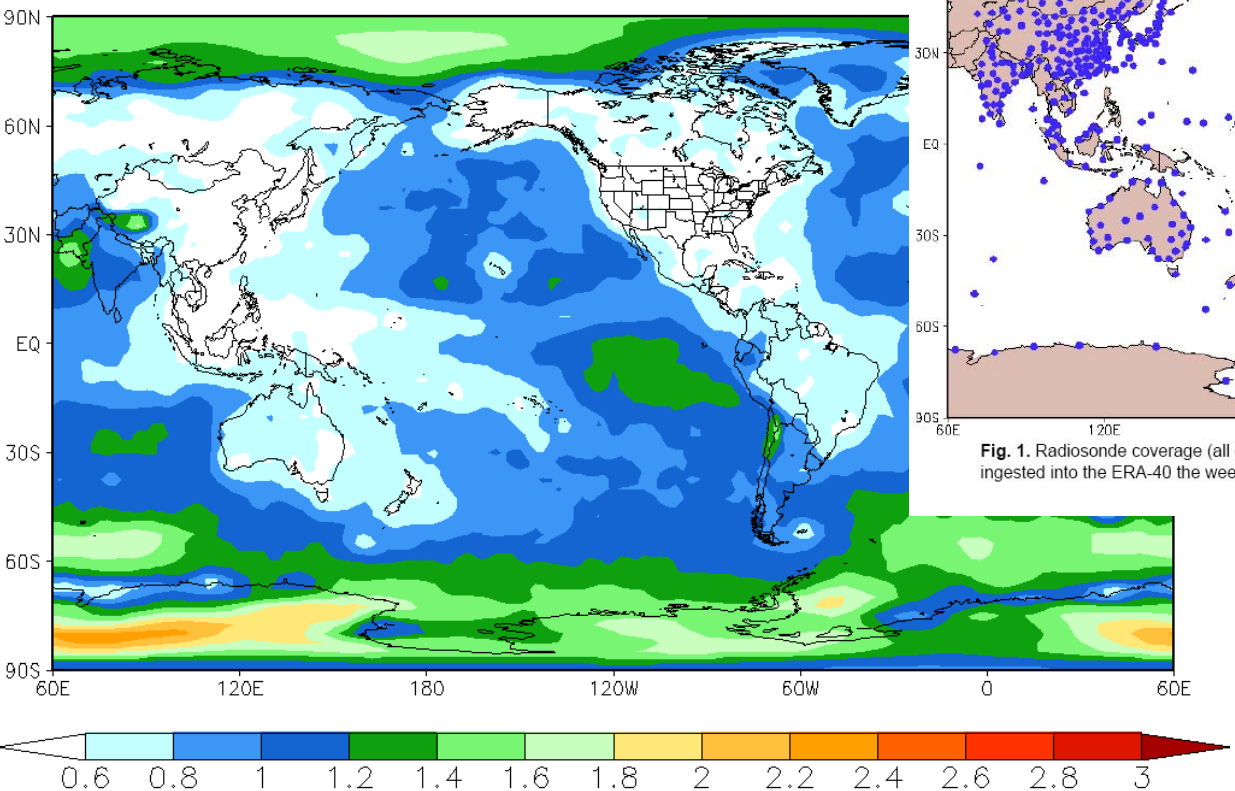
Product	LHF	SHF	Stress (x,y)	Wind Speed	u wind	v wind	Tair	Qair	SST	Product Type	Grid Spacing
NCEPR2	x	x	x		x	x	x	x	x	Reanalysis	Gaussian (T62, 194x94)
JRA25	X	x	x		x	x	x	x	x	Reanalysis	(T106) ~120km
ERA40	x	x	x		x	x	x	x	x	Reanalysis	1 1/8 degrees
WHOI	x	x								Hybrid	1 x 1 degree
GSSTF2	x	x	x	x				x		Hybrid	1 x 1 degree
IFREMER	x	x	x	x	x	x	x	x	x	Satellite	1 x 1 degree
HOAPS2	x	x		x				x	x	Satellite	0.5 x 0.5 degree
FSU3	x	x	x	x	x	x	x	x	x	In-situ	1 x 1 degree
NOC1.1	x	x	x	x			x	x		In-situ	1 x 1 degree

- All these products are regridded (if necessary) on to a similar 1x1° grid.
- A common land mask is applied.
- A common period: March 1993 to Dec. 2000

Land Mask



- Figures show differences in 10m wind speed, relative to QSCAT, adjusted to non-neutral values.
- In our comparison, we mask out all values within 2° of land.



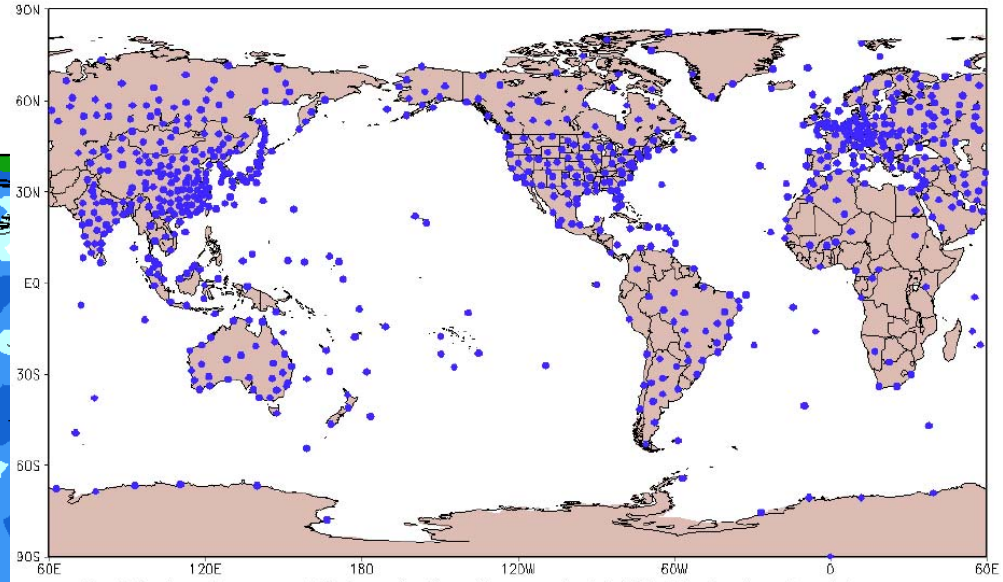
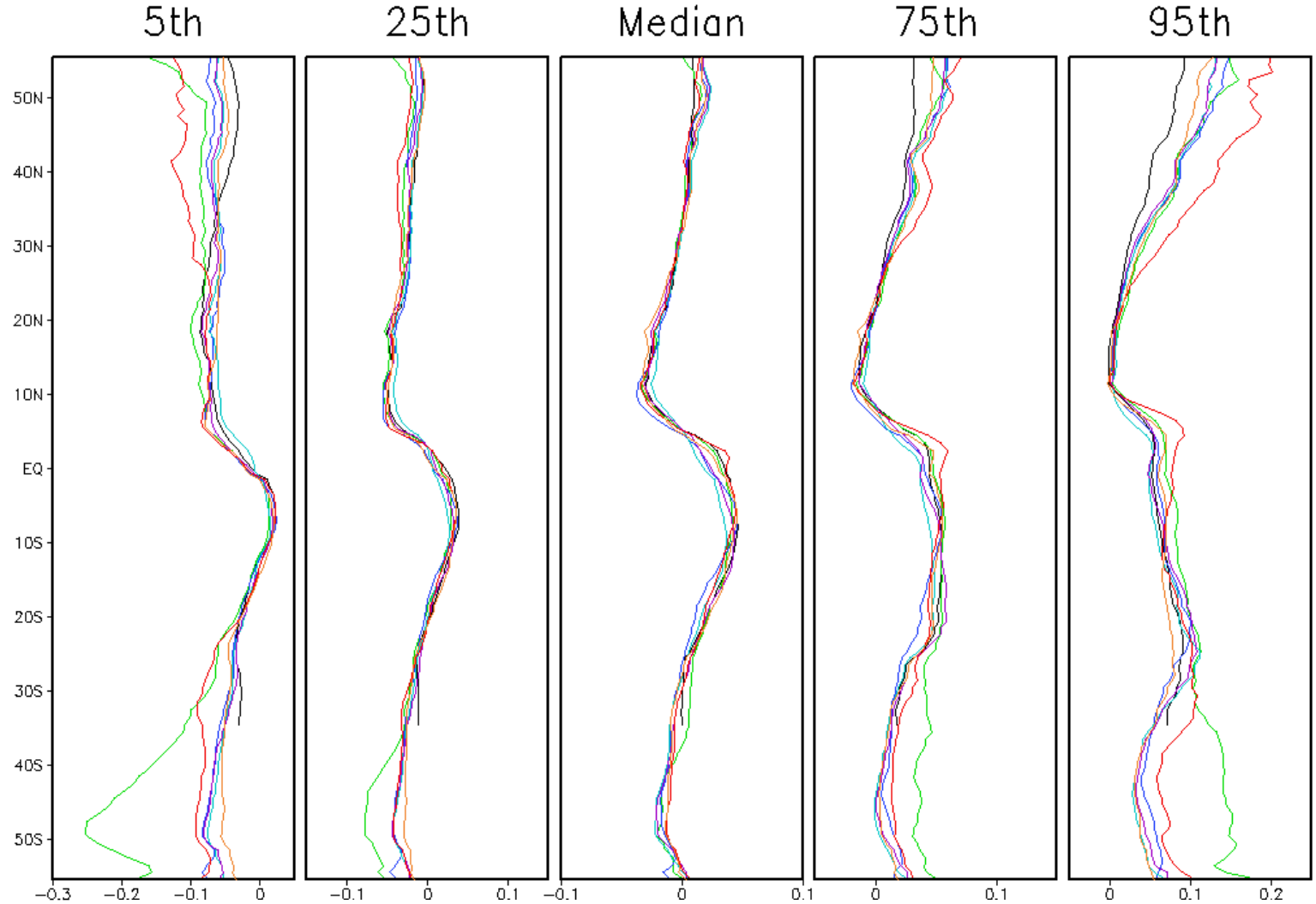


Fig. 1. Radiosonde coverage (all observation times) for approximately 700 station locations, from data ingested into the ERA-40 the week of January 1, 2001.

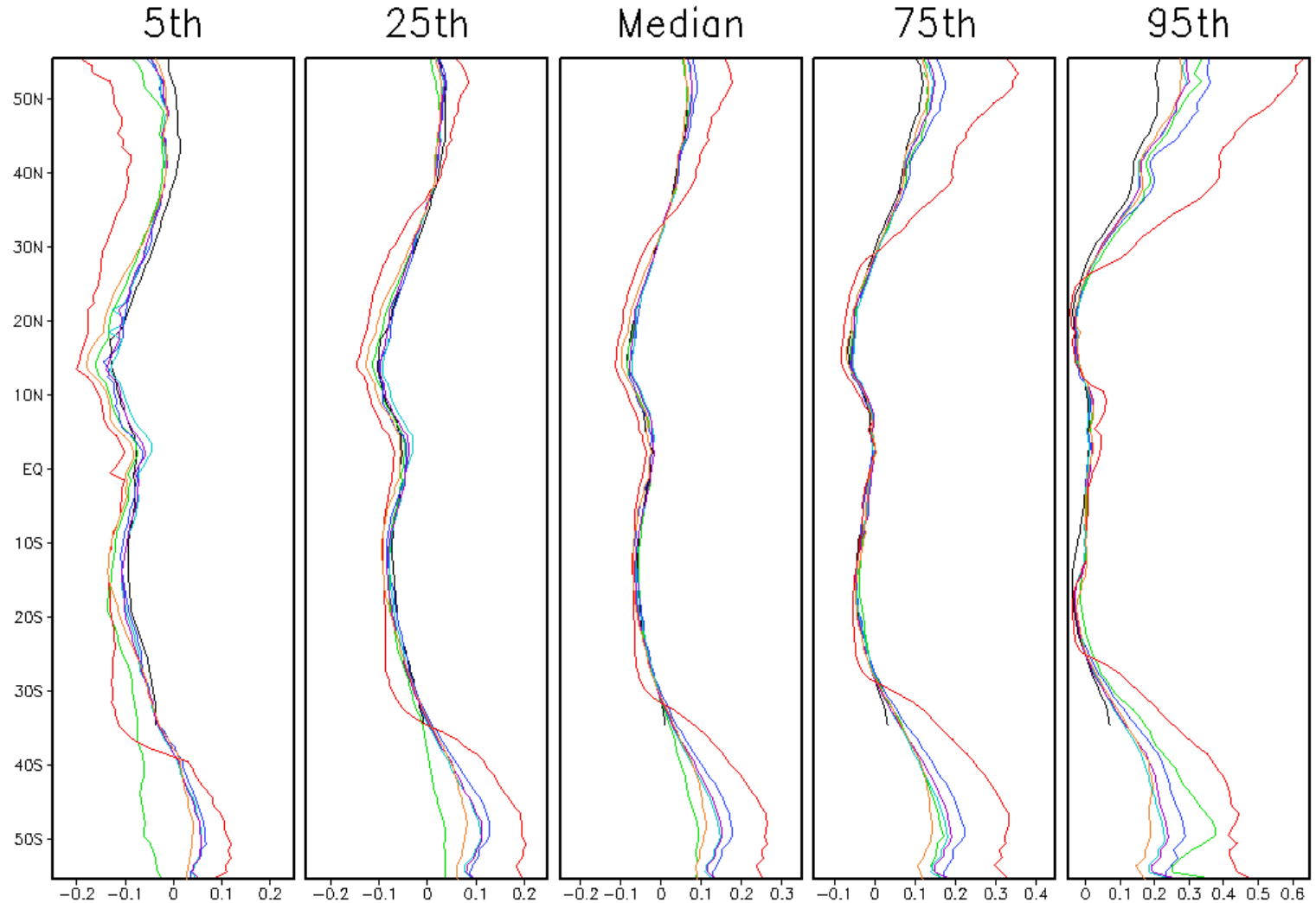
JRA25 – ERA40 Root Mean Square differences (using only 00Z and 12Z times) for Calendar year 2001: 500 mb temperature (K)

Langland, Maue, and Bishop, (submitted to Science) – Temperature Uncertainties Collaboration part of NRL summer internship (2007).

Atlantic Meridional Stress

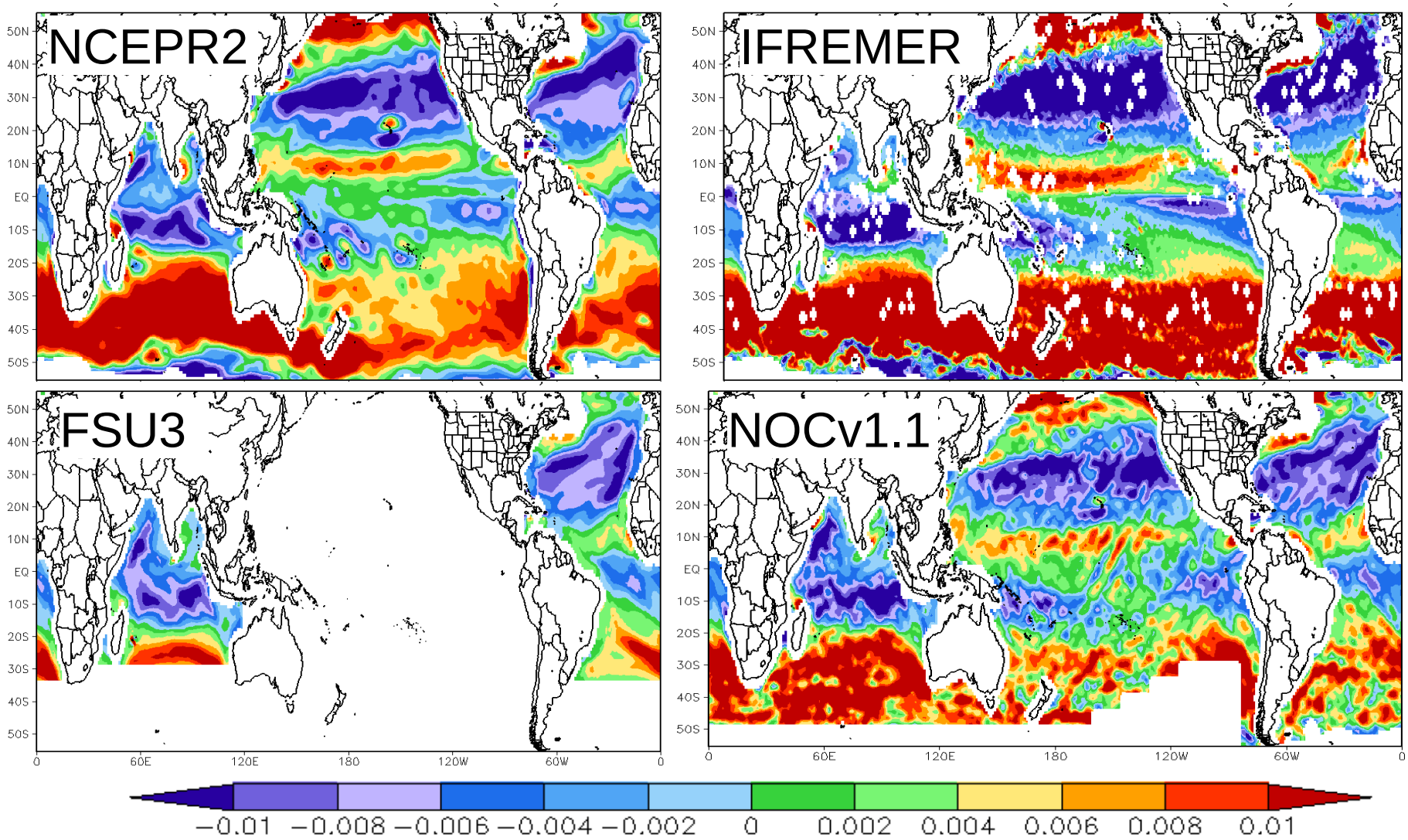


Atlantic Zonal Stress



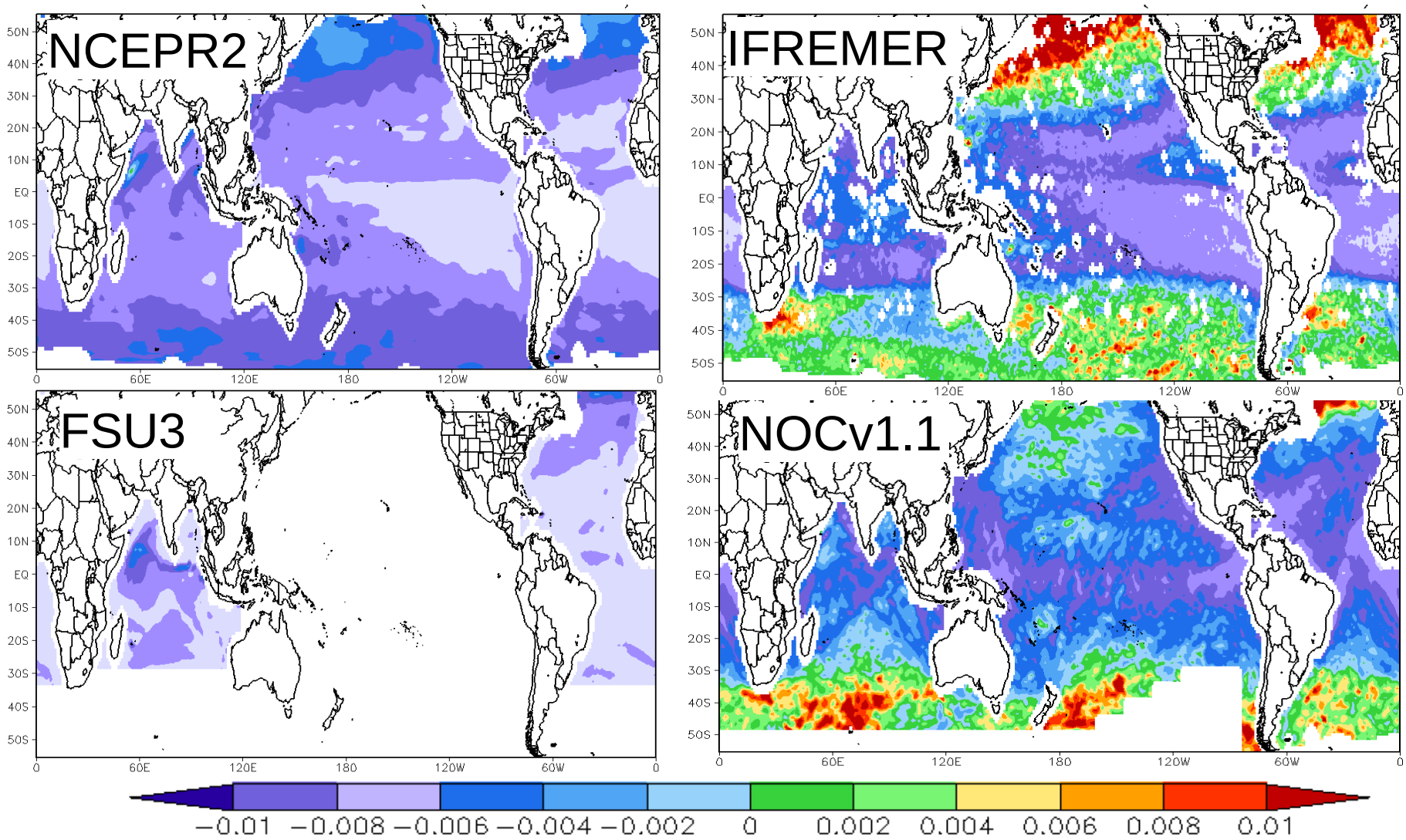
FSU3 WHOI NOC NCEPR2 JRA ERA40 IFREMER GSSTF2 HOAPS

Curl of the Stress



- Ship tracks are apparent in many products, as are TAO buoys

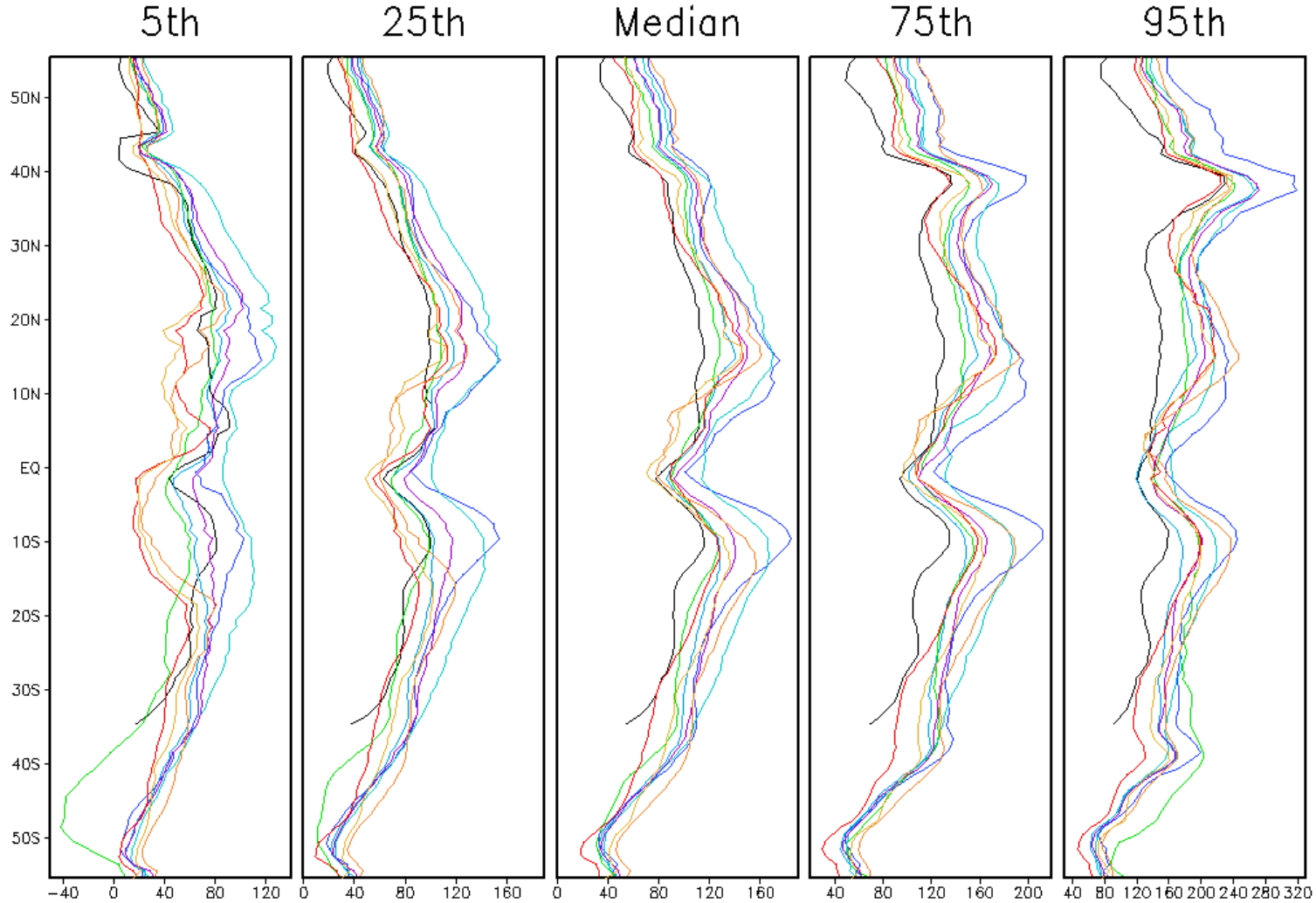
Standard Deviation of the Curl of the Stress



- Ship tracks are apparent in many products, as are TAO buoys

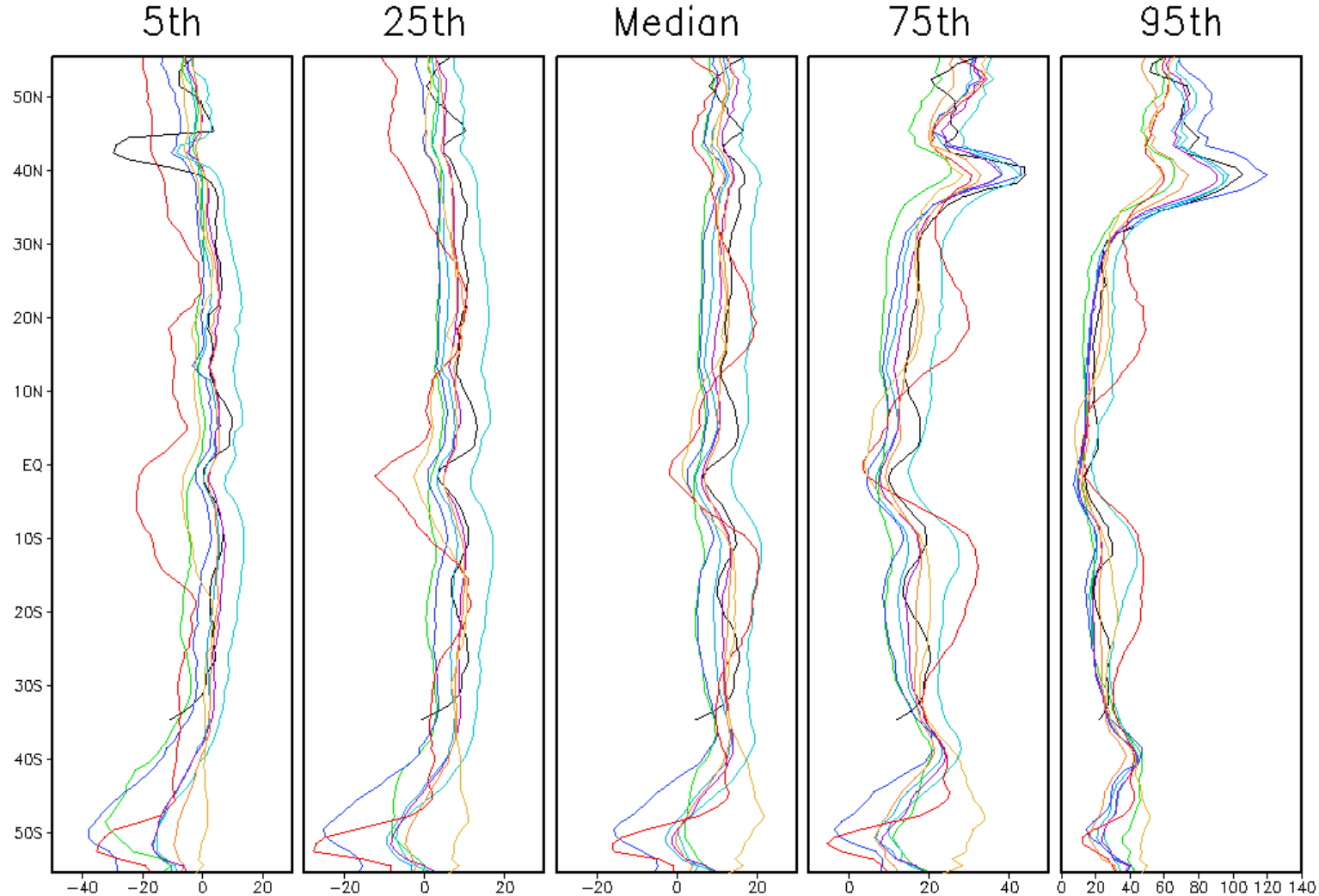
bourassa@met.fsu.edu

Atlantic Latent Heat Flux



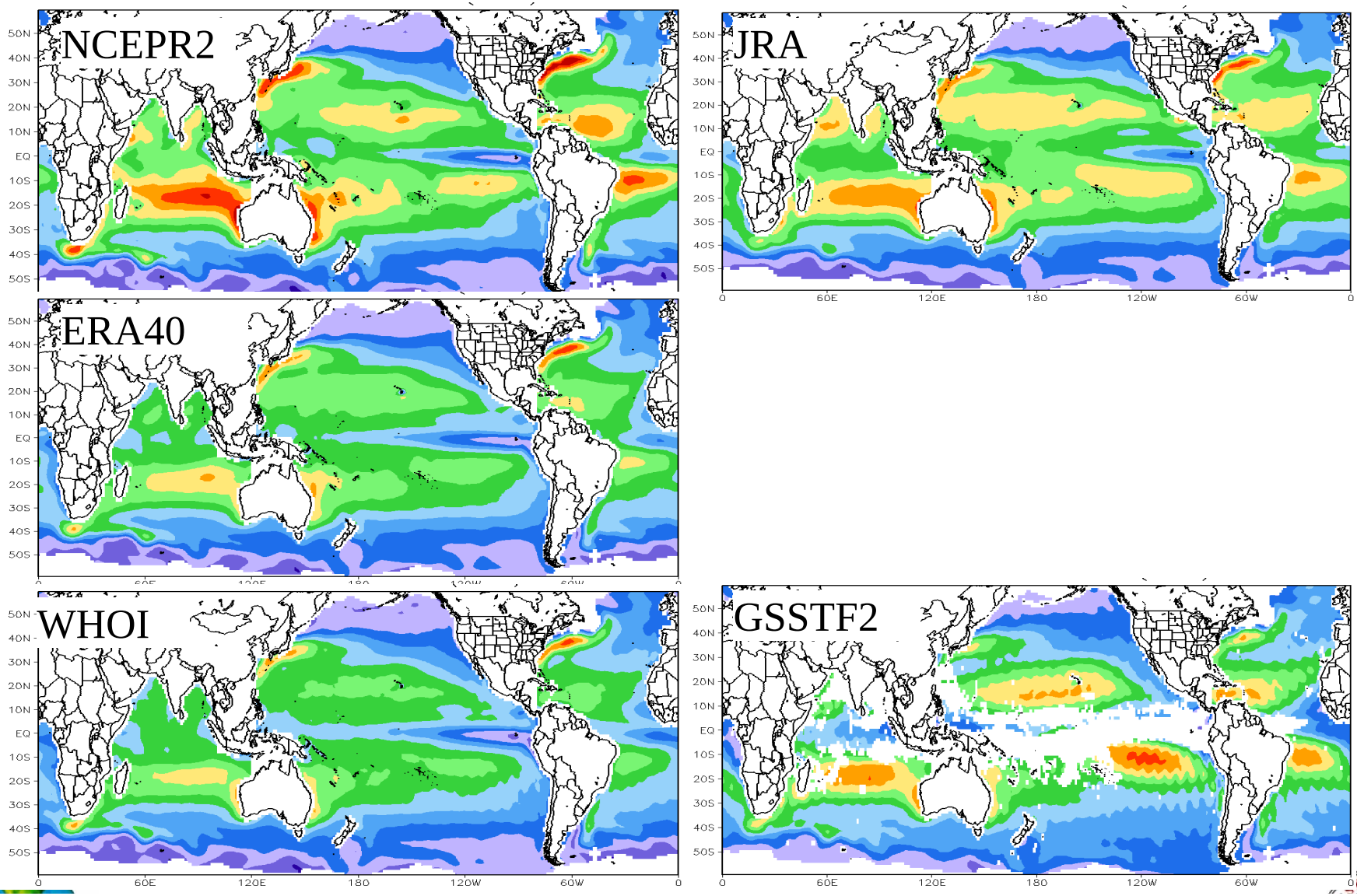
FSU3 WHOI NOC NCEPR2 JRA ERA40 IFREMER GSSTF2 HOAPS

Atlantic Sensible Heat Flux

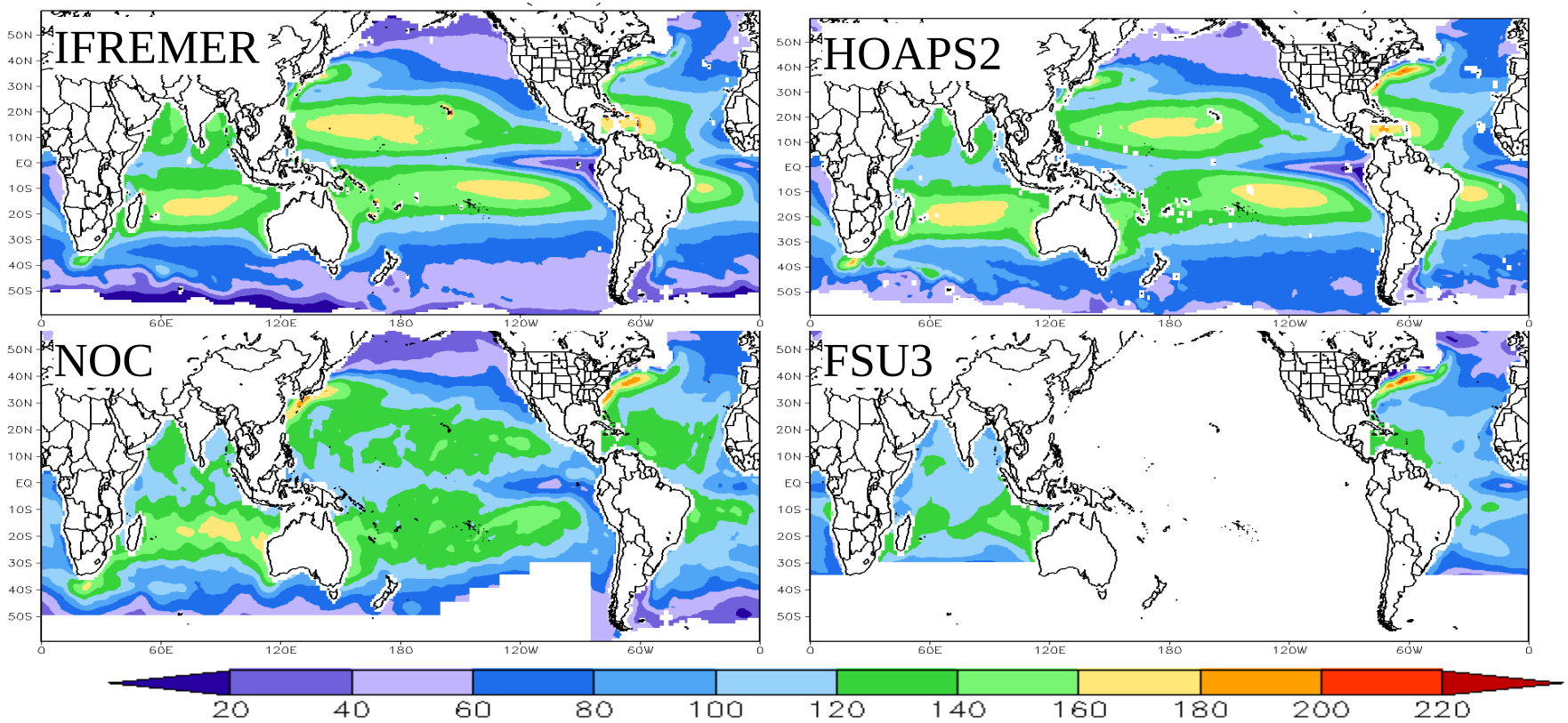


FSU3 WHOI NOC NCEPR2 JRA ERA40 IFREMER GSSTF2 HOAPS

Latent Heat Flux

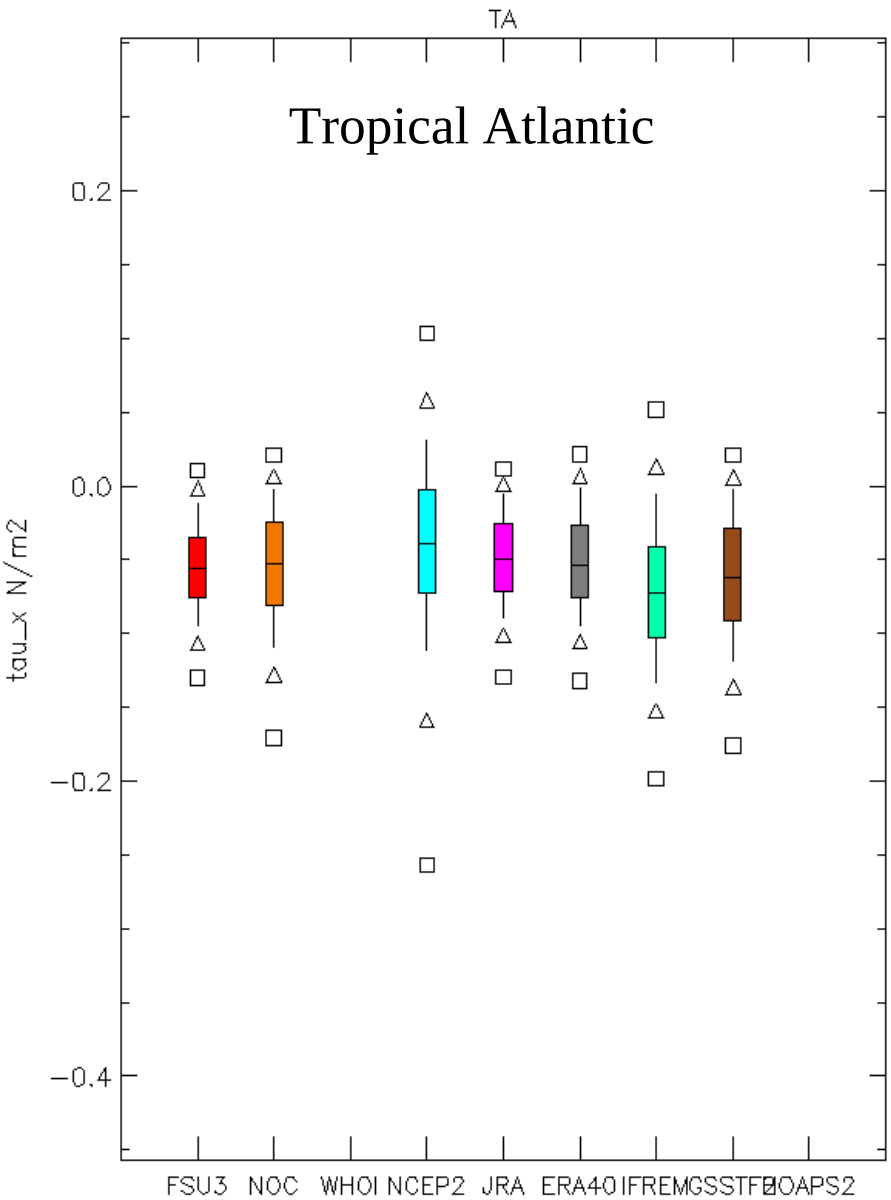


Latent Heat Flux

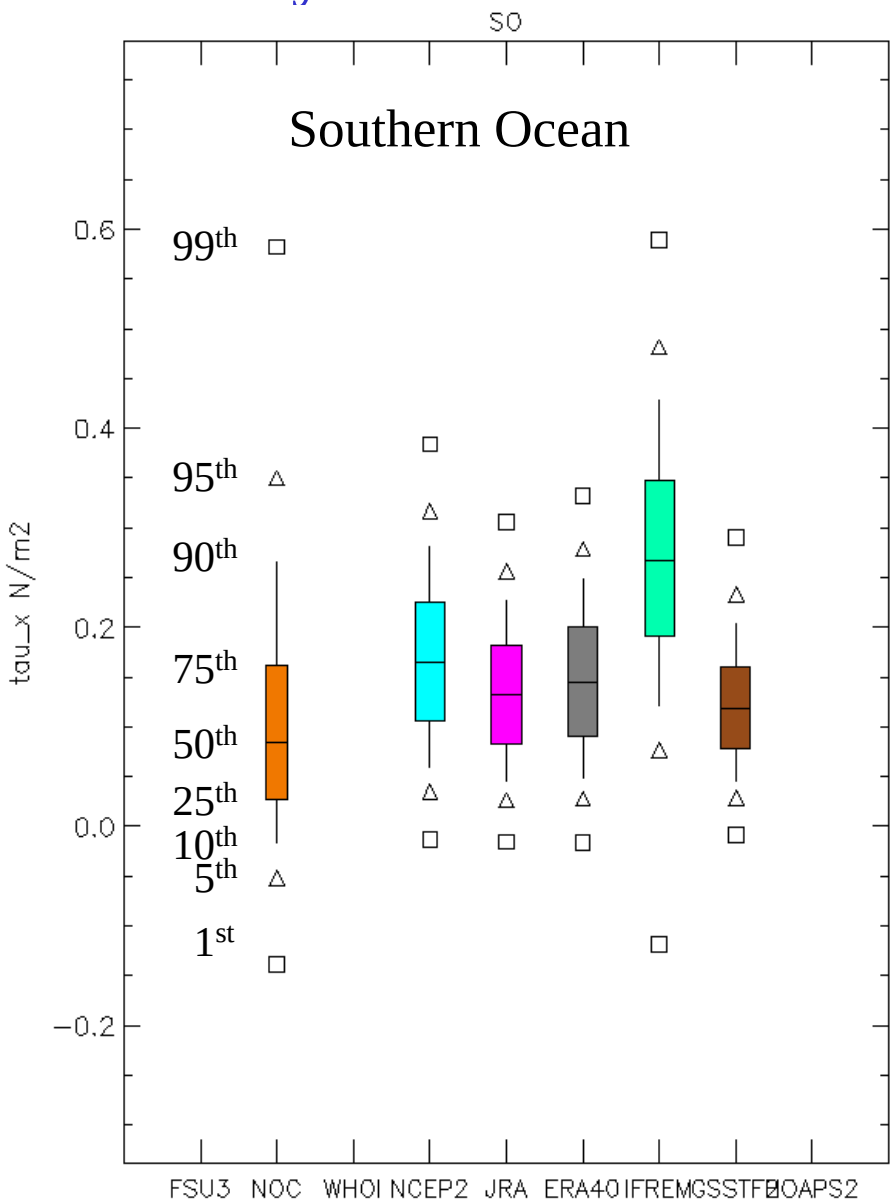


- Satellite and In situ products

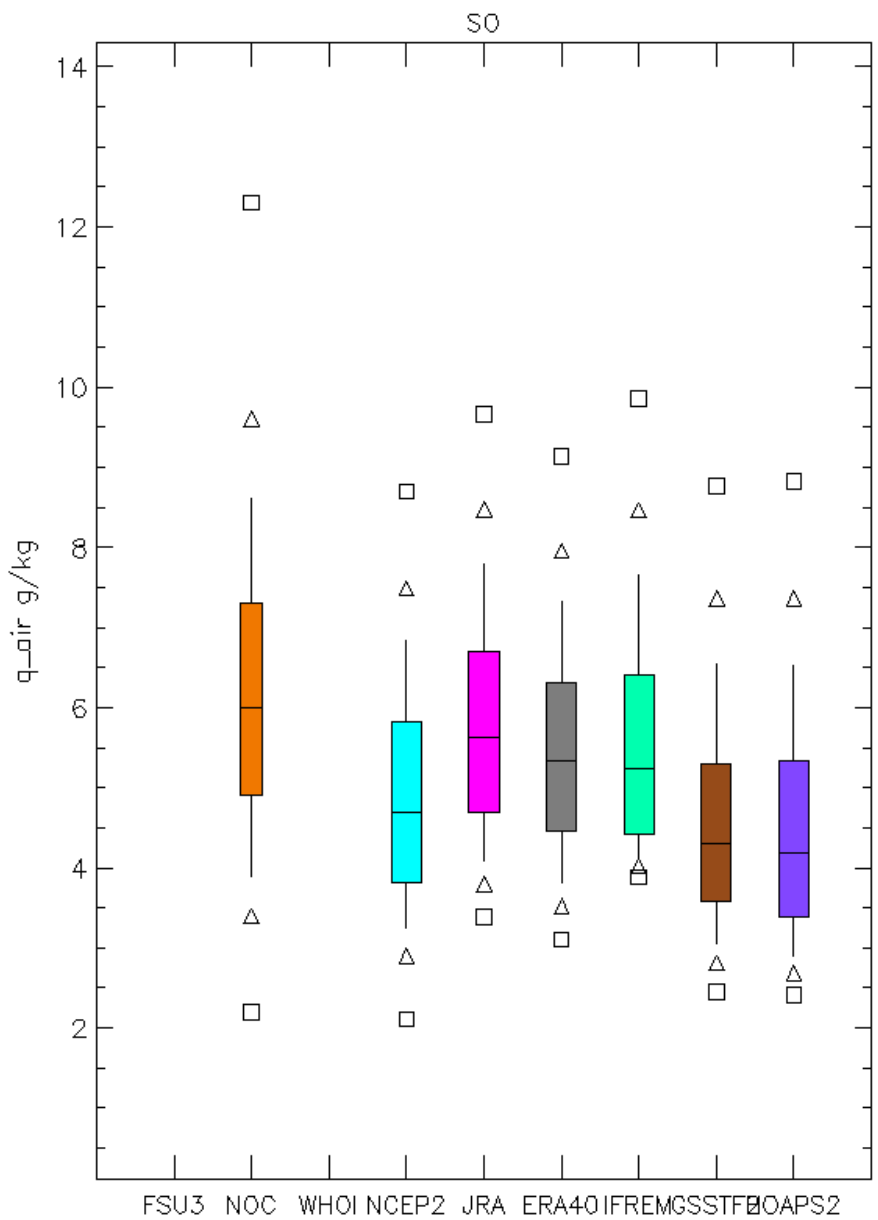
Reanalysis Products Have Differing Means and Distributions
- Even Zonal Stress on a Monthly Scale -

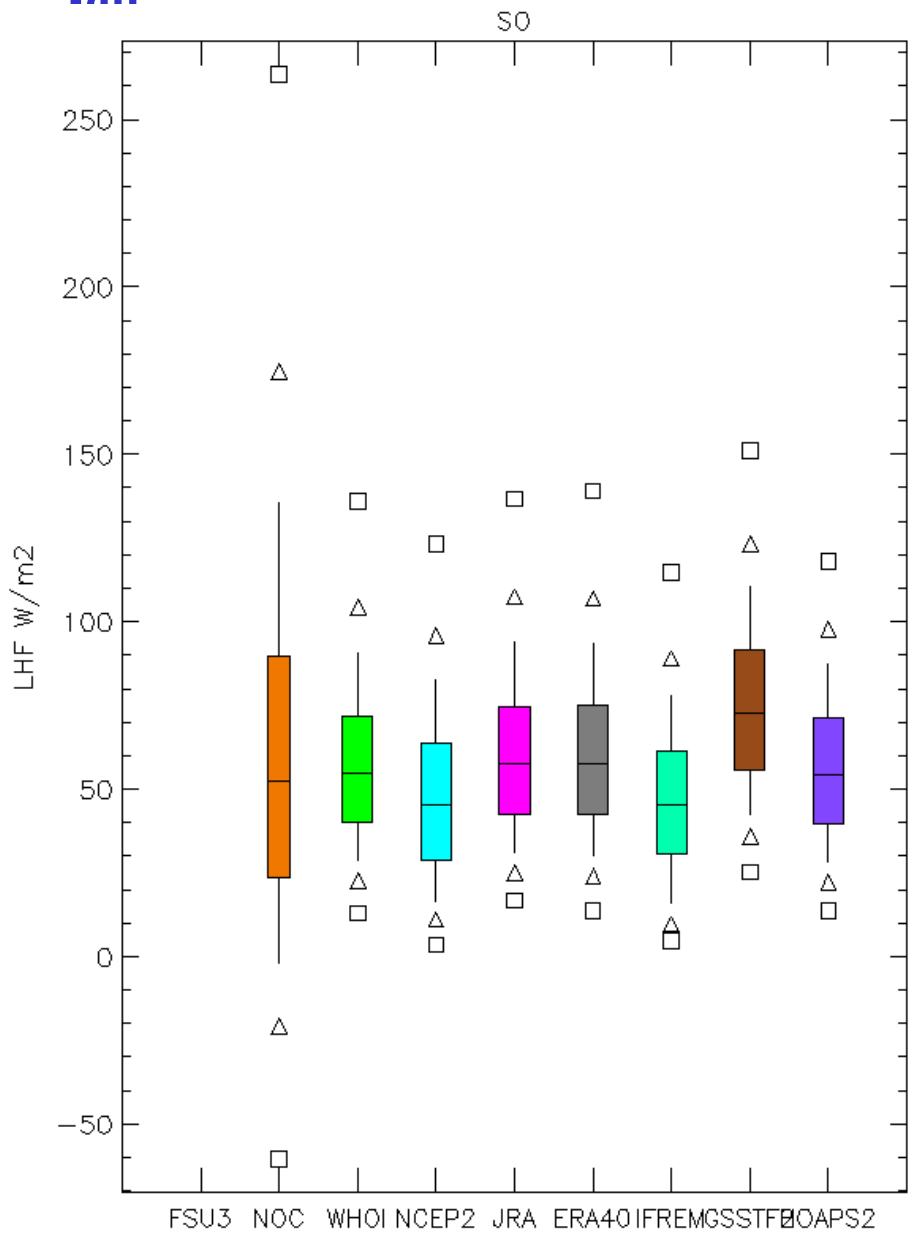


la Sta

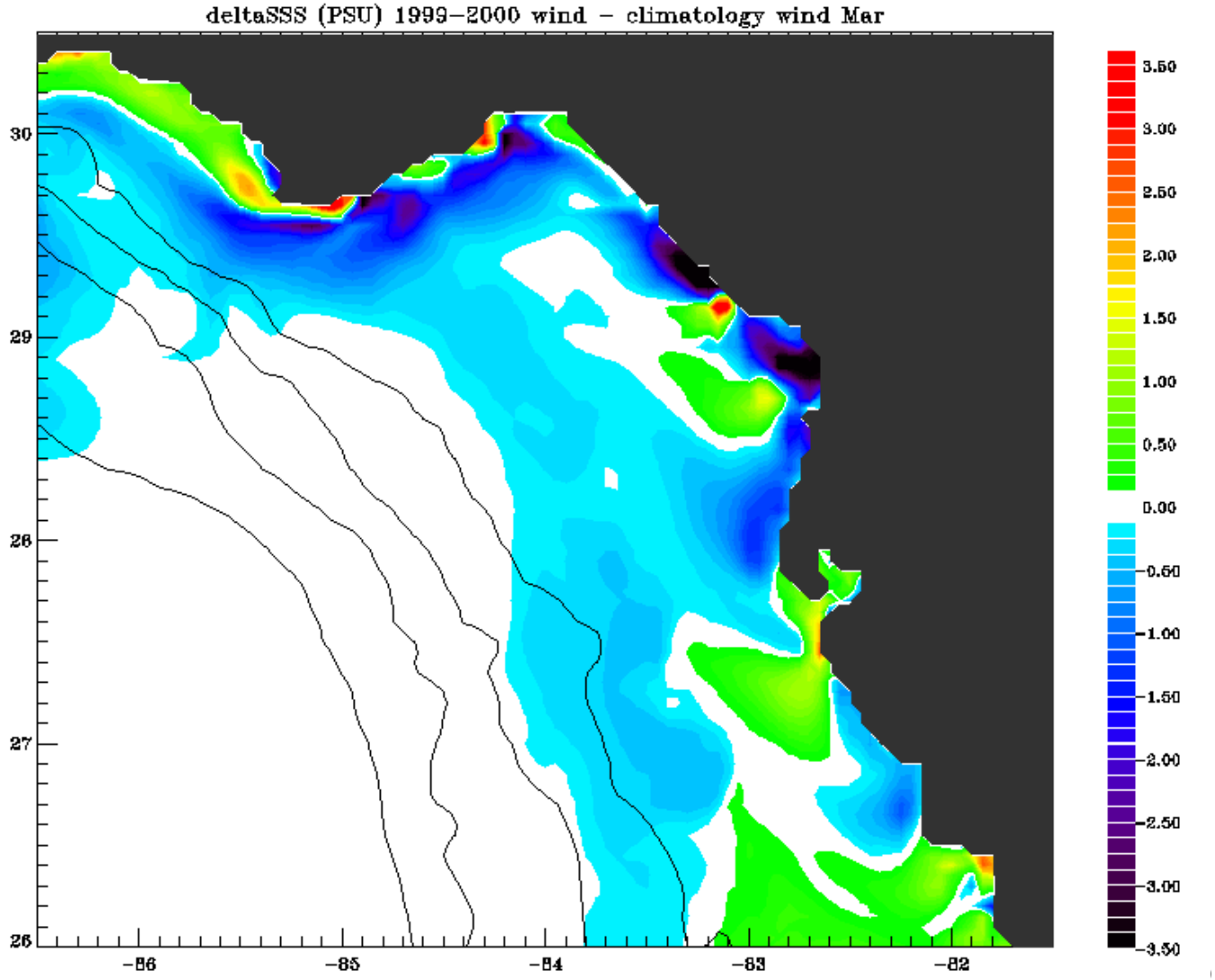


Southern Ocean q_{air} and LHF





March average salinity difference between a model forced by climatology wind stress and a model forced by 12-hourly scatterometer-derived wind stresses. The high-frequency winds force intermittent offshore transport of low salinity water which results in freshening over the middle shelf.

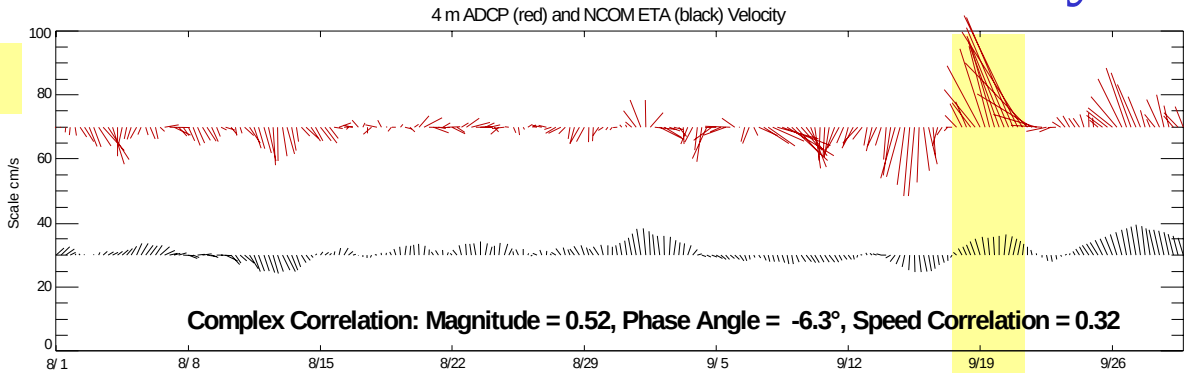


bo

NCOM vs. COMPS ADCP 4m Velocity

T.S. Harvey

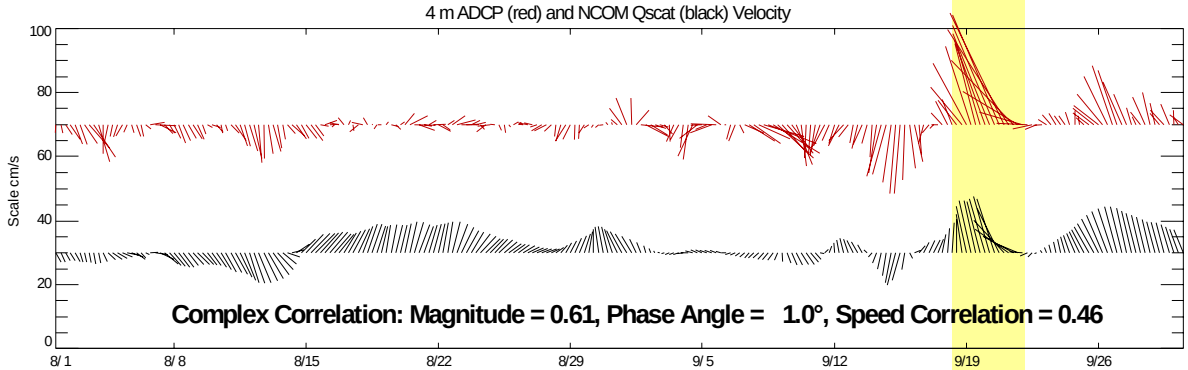
Eta



Observed

Modeled

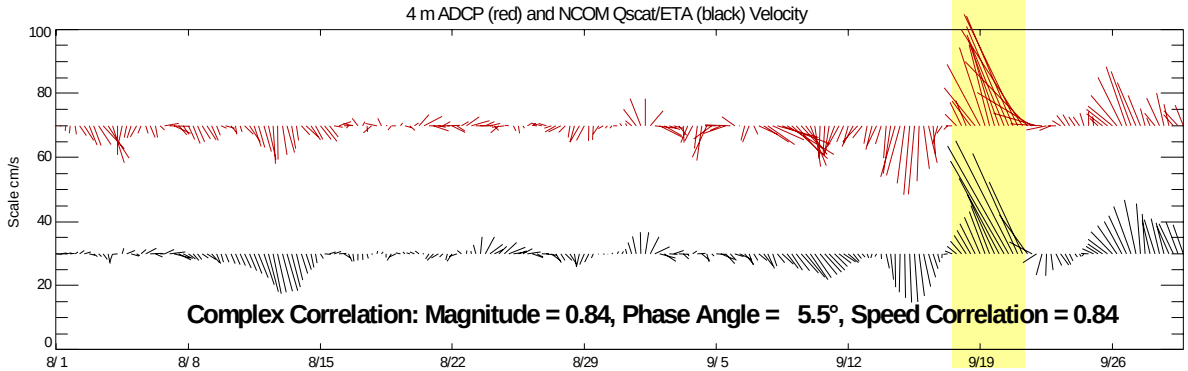
QuikSCAT



Observed

Modeled

QuikSCAT/Eta



Observed

Modeled

Conclusions

- Each flux product has it's strengths and weaknesses.
  - The choice of which one is best is dependent on the application.
- There are large differences in atmospheric humidity and scalar wind speed (and air temperature in one product) that contribute to differences in surface fluxes.
- There are many applications for which temporal resolution must be much better than monthly.
  - NWP products do not assimilate satellite data as well as would be desired, and
  - In situ products do not have sufficient spatial/temporal resolution over much of the global oceans.