An Update on the 1/12° Global HYCOM Effort

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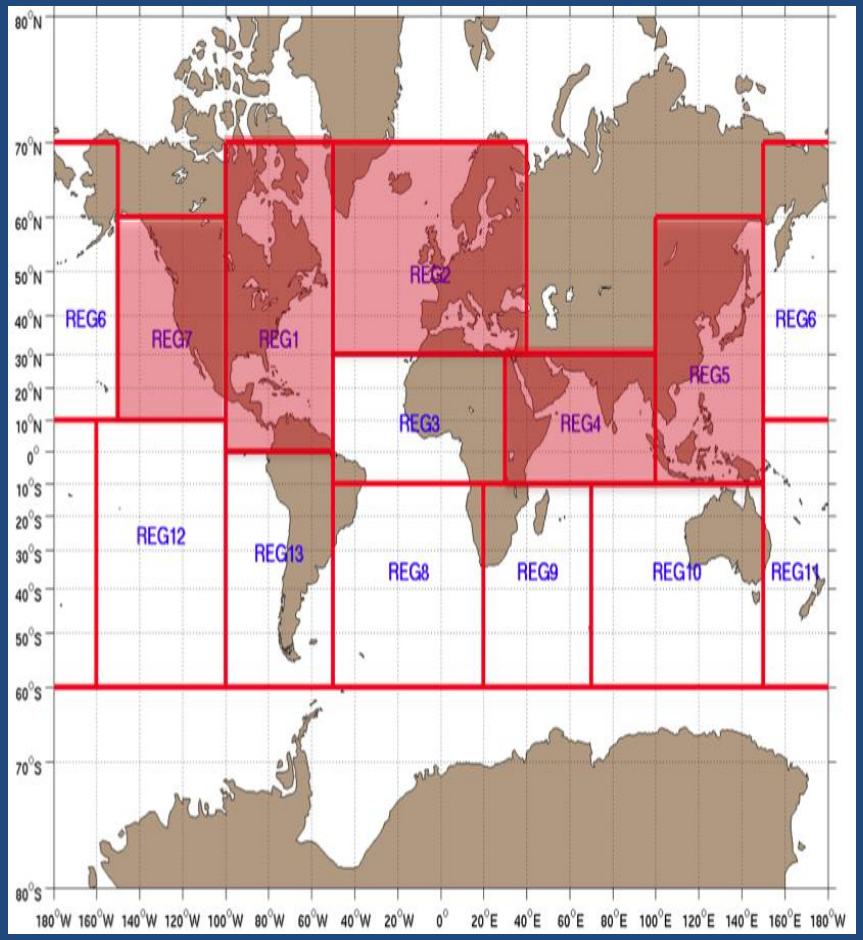
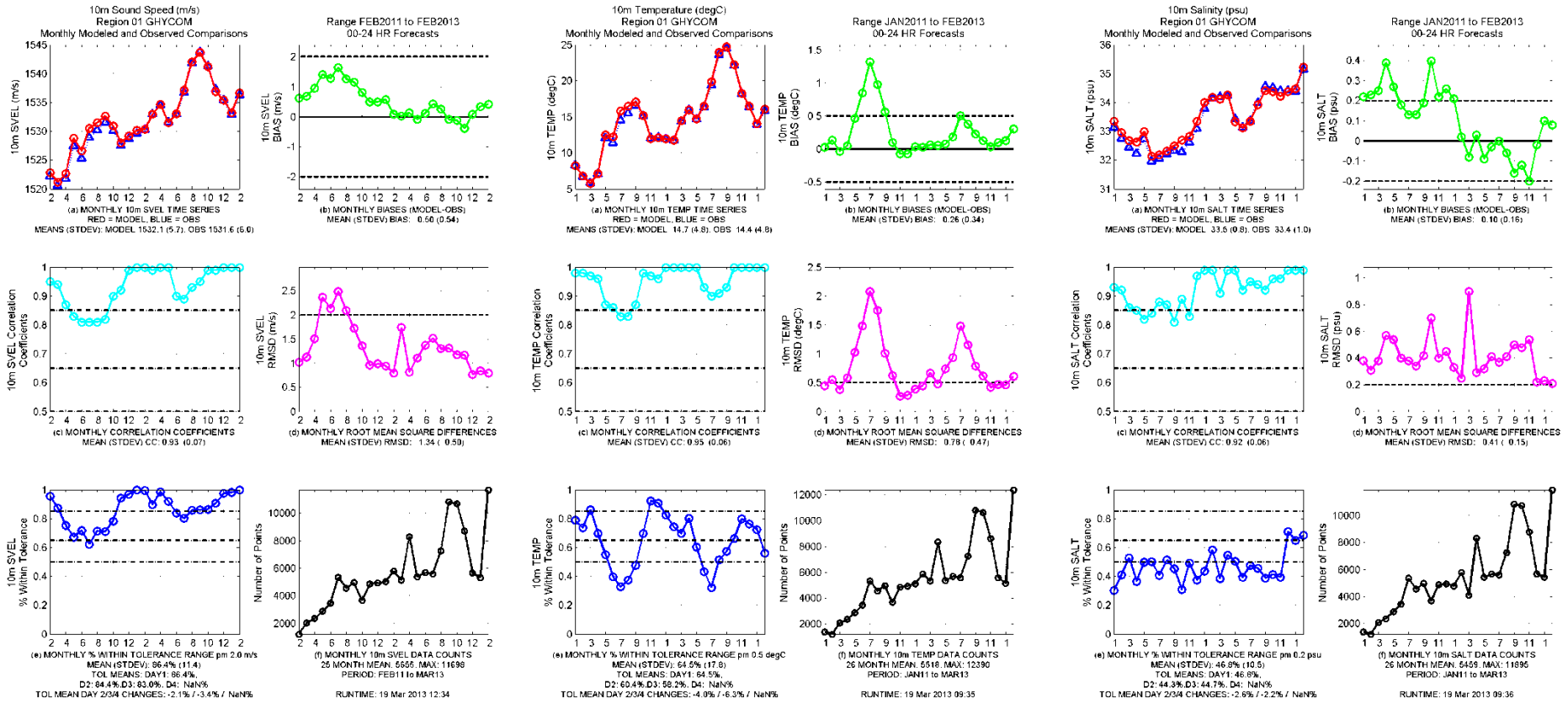
NAVOCEANO OPTEST Results

- 26 month evaluation of real-time GOFS 3.0 (Jan 2011 – Feb 2013)
- Evaluated sonic layer depth (SLD), temperature, salinity, sound speed at various depths:
  - 0, 10, 50, 100, 150, 250, 500m
- Skill standards:
  - SLD = ±5.0 m
  - temperature = ±0.5 ºC
  - salinity = ±0.2 psu
  - sound speed = ±2.0 m/s
- Used Autometrics for computation of all statistics



Courtesy of Frank Bub, NAVOCEANO

Figure 7.1.b. Region 01 – Western Atlantic
10m Sound Speed, Temperature, Salinity



	10m Sound Speed	**10m Temperature**	**10m Salinity**
Bias:	+0.5 m/s	+0.10ºC	+0.26 psu
CC:	0.93	0.92	0.95
RMSD:	1.7 m/s	0.41ºC	0.78 psu
Tolerance:	66% (±2.0m/s)	47% (±0.50ºC)	64% (±0.20 psu)

21 May 2013

Courtesy of Frank Bub, NAVOCEANO

NAVOCEANO OPTEST Results

- An “excellent – good – fair – poor” scoring system was devised, Table 1. Overall, HYCOM scored “Excellent” two-thirds of the time.
- Table 2 helps us understand why the surface scores are low – HYCOM is not doing well with its SLD forecasts, with 60% of the scores at poor.
- The 90%, or excellent, result for sound speed might indicate that the 2 m/s standard could be tightened. Having 85-90% of the temperature and salinity scores in the good to excellent range suggests that HYCOM does well forecasting basic ocean properties.
- HYCOM’s forecast skill is good for operational use throughout its forecast period.

Table 1. Summary of scores by level (all properties, all regions).

Scores:	Excellent	Good	Fair	Poor
Surface Totals:	29	13	5	13
10m Totals:	47	9	3	1
100m Totals:	45	9	2	4
Sums:	121	31	10	18
Percent of the total:	67%	18%	5%	10%

Table 2. Summary of scores by property (all levels).

Scores:	Excellent	Good	Fair	Poor
SLD:	10%	20%	10%	60%
Sound Speed:	90%	10%	0%	0%
Temperature:	68%	23%	2%	7%
Salinity:	70%	15%	12%	3%

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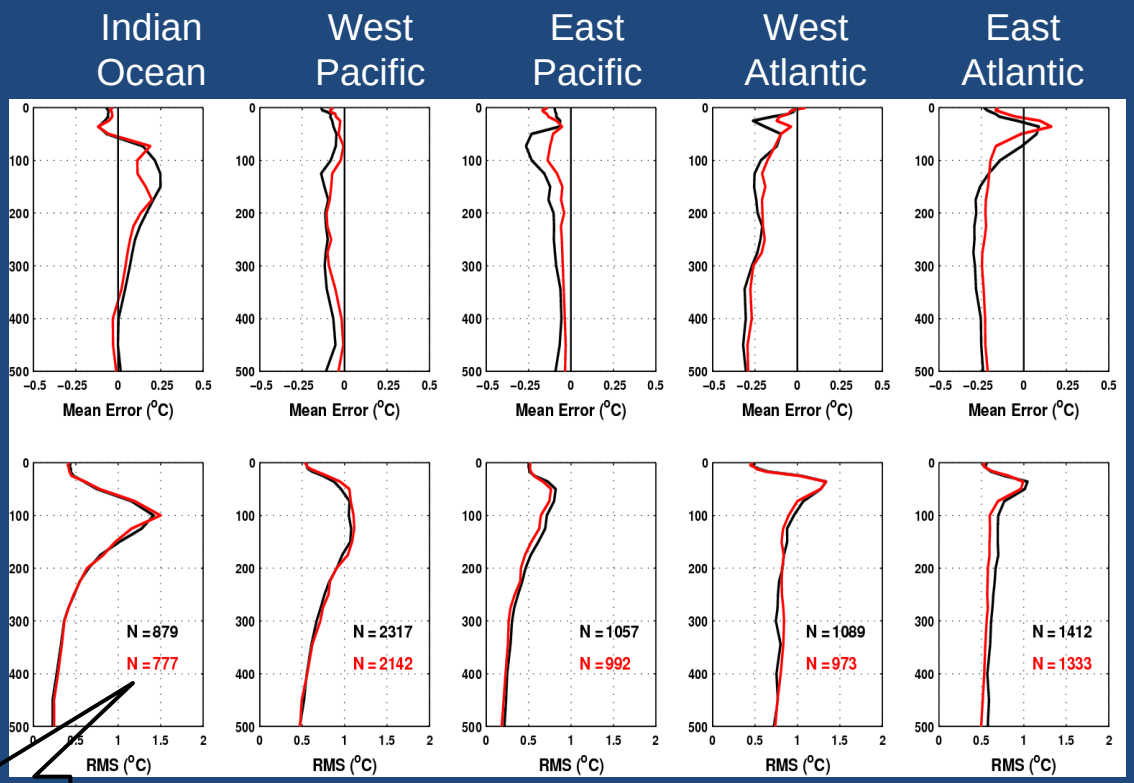
NCODA-MVOI vs. 3DVAR Testing

Hindcast using NCODA-MVOI is compared against hindcast using NCODA-3DVAR, both use MODAS synthetics for downward projection of surface data. Error analysis examining temperature as a function of depth over June - August 2010 for several geographic regions.



N = number of unassimilated profiles used in the analysis

Black curves: NCODA-3DVAR
Red curves: NCODA-MVOI

99% confidence interval

As expected, there are not large differences depending upon the NCODA scheme used.

NCODA analysis using 3DVAR ran ~35% faster than MVOI

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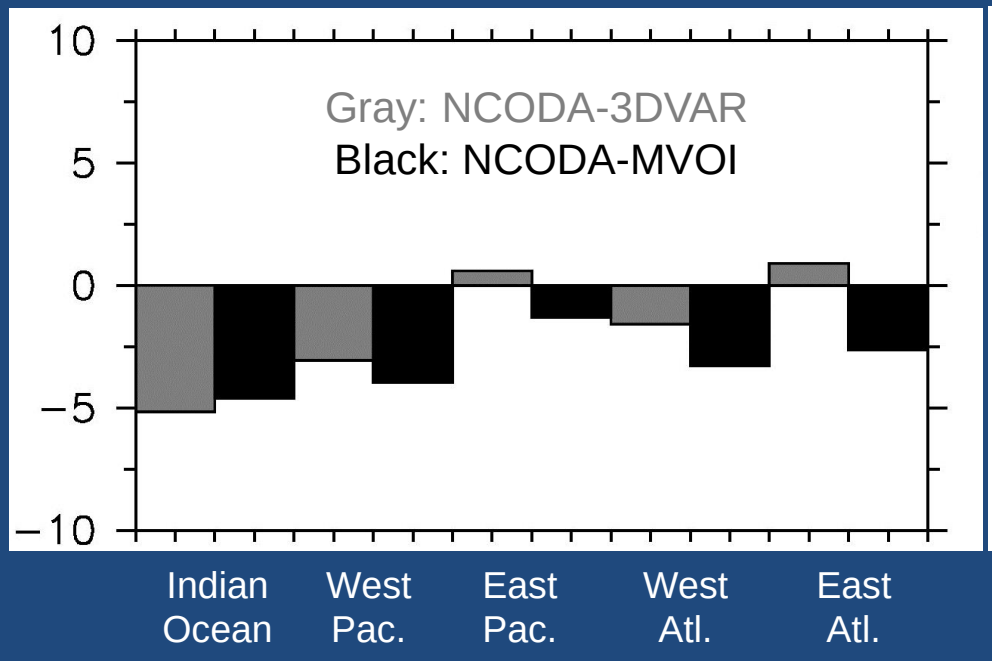
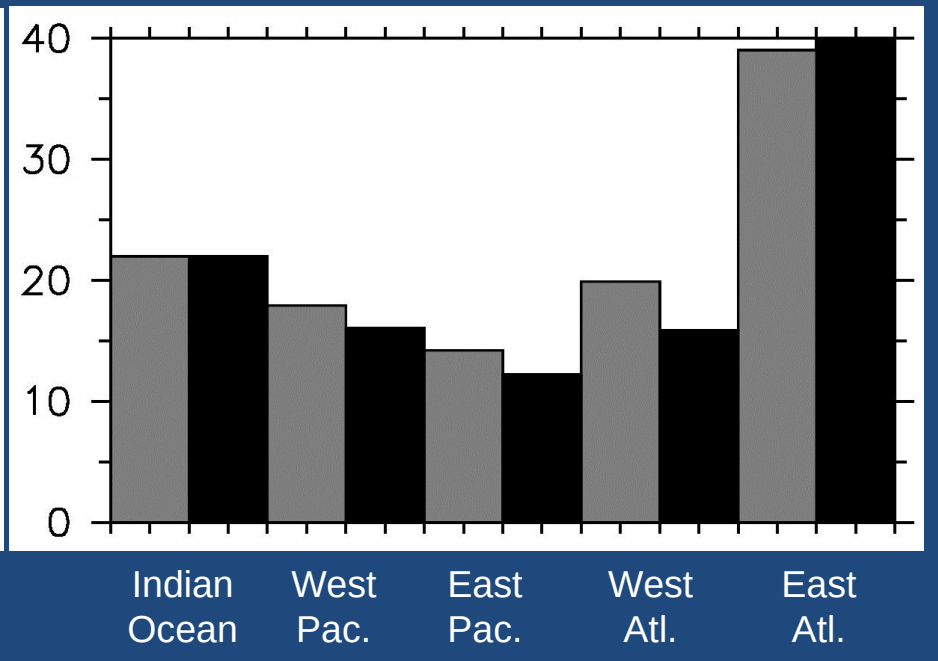
Mean Error



RMSE



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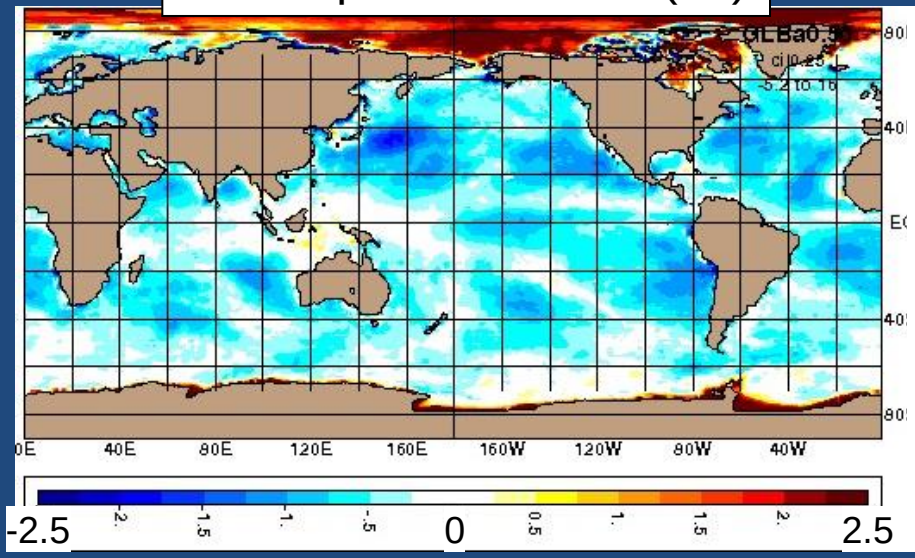
NAVGEM to replace NOGAPS in GOFS

- NAVGEM = NAVy Global Environmental Model
  - declared operational on 13 Mar 2013
- NOGAPS decommission date: 31 Aug 2013
  - output still being sent to NAVOCEANO and hycom.org
- Analysis shows the two atmospheric models are different enough to cause different upper ocean model response
- Two calibrations must be performed on NAVGEM output to assure the underlying ocean model response will be consistent across the decommission time boundary
  1. Calibrate NAVGEM winds to scatterometer winds
  2. Calibrate heat flux relative to forecast SST error

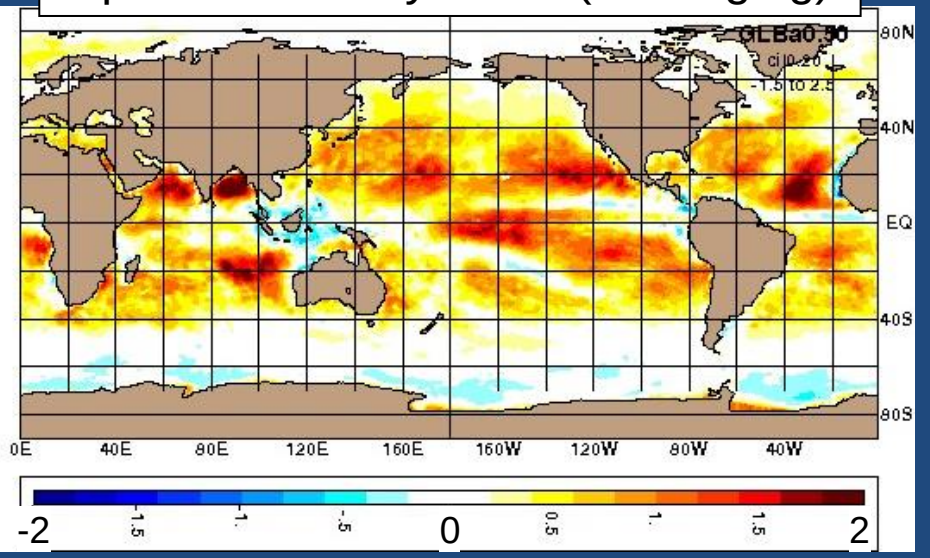
NAVGEM minus NOGAPS

Mean over 8-31 Dec 2012

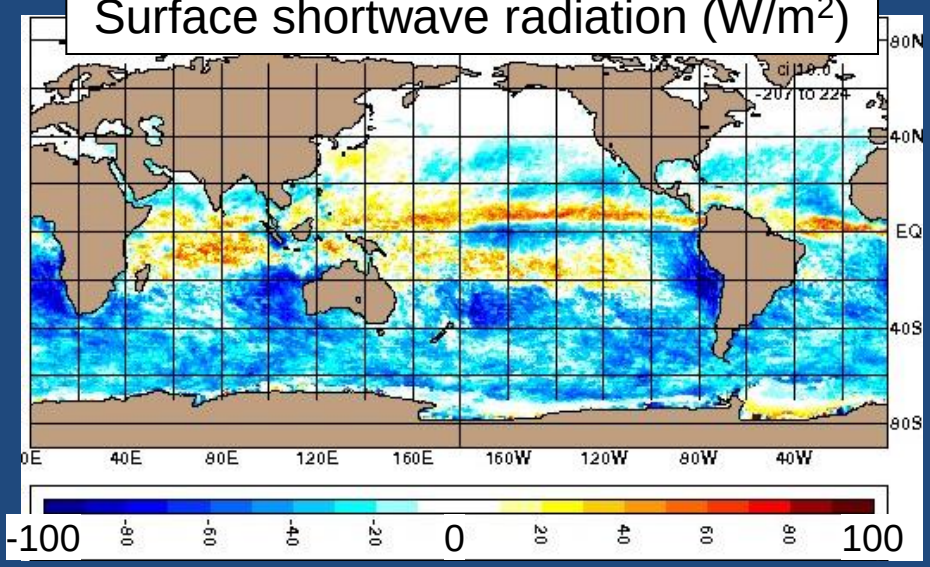
Air temperature at 2m (°C)



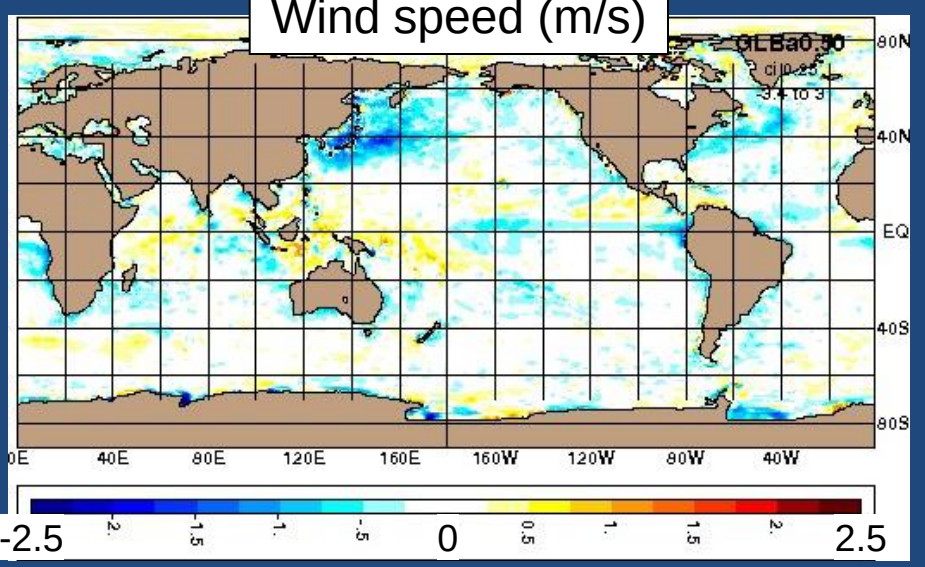
Specific humidity at 2m (x10^3 kg/kg)



Surface shortwave radiation (W/m^2)



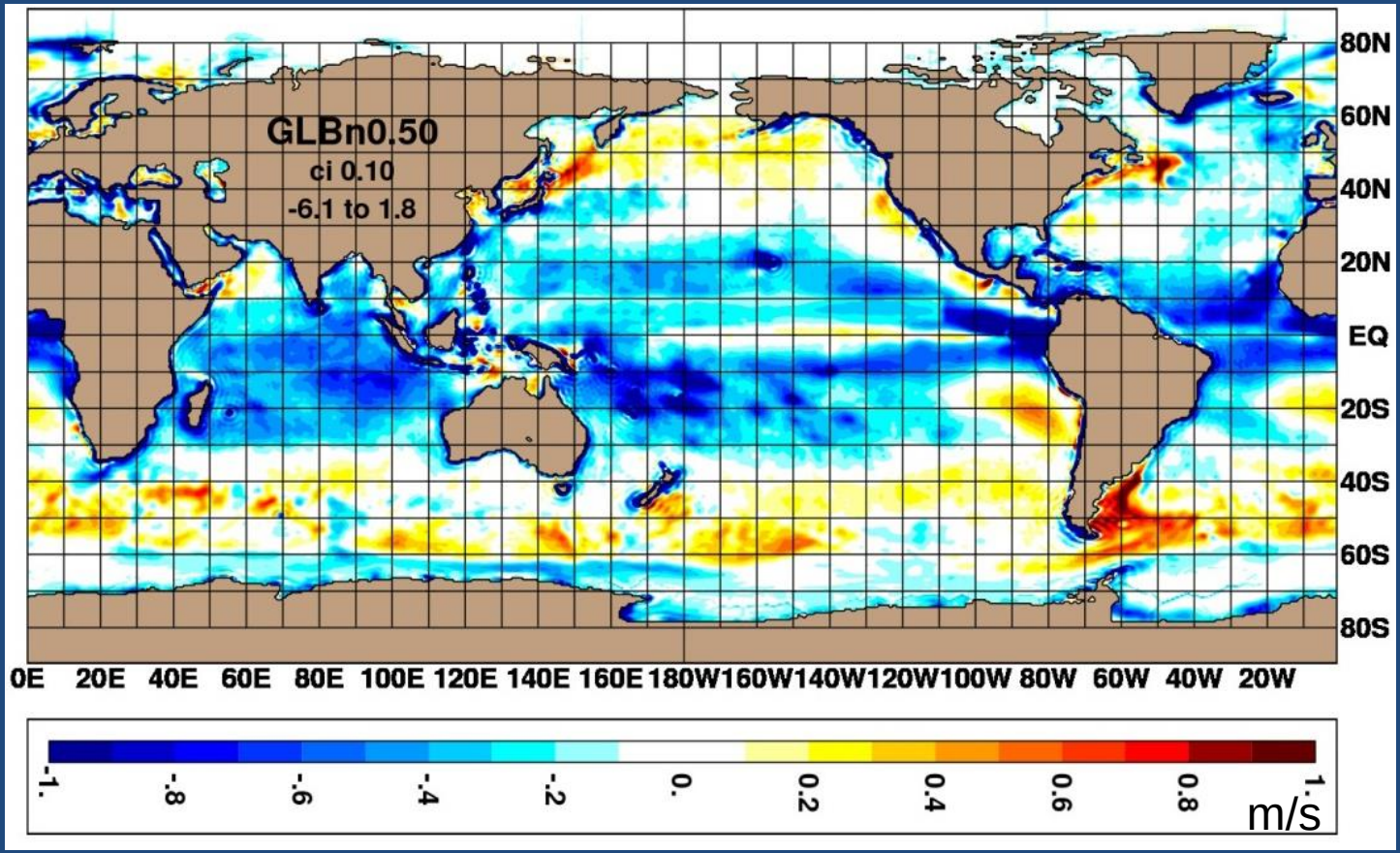
Wind speed (m/s)



NAVGEM Wind Calibration

- NWP products are generally weaker than scatterometer winds

NOGAPS minus QuikSCAT-scaled NOGAPS – 2012 mean



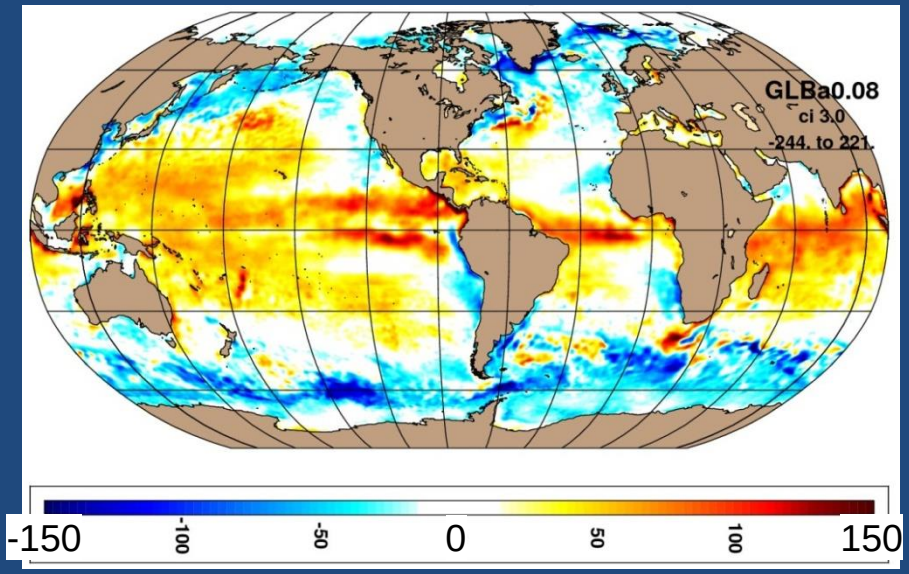
NAVGEM Wind Calibration

- Obtaining one year of NAVGEM output: Jun 2012 through May 2013
  - Hindcast output (Jun 2012 → Jan 2013) processed and in HYCOM-ready format
  - Pre-OPS/OPS output (Dec 2012 → present) processed daily and in HYCOM-ready format
- Regression analysis vs. contemporaneous scatterometer data (SSMI/S and WindSAT)
- Calibrate NAVGEM wind speed

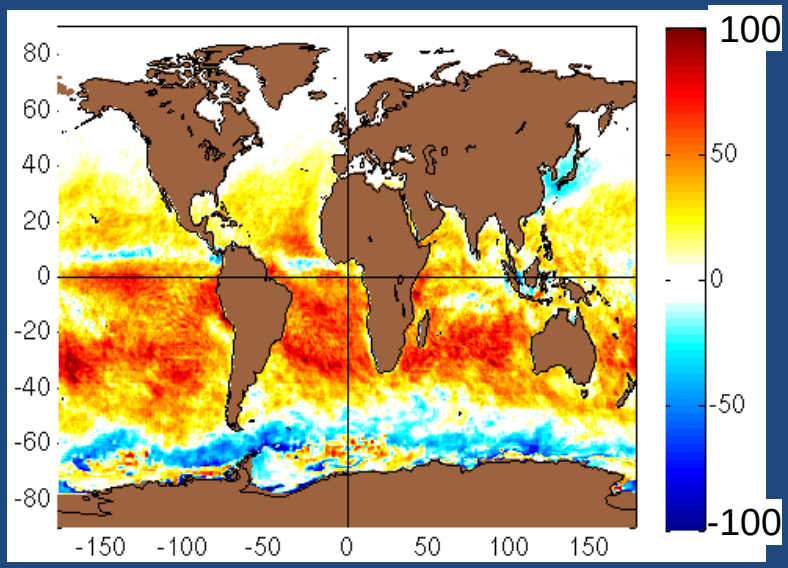
NAVGEM Heat Flux Calibration

- Attribute SST bias to inaccuracies in NWP heat fluxes

Heat flux offset currently used in GOFS 3.01



FLASHFlux minus NAVGEM surface shortwave radiation (W/m^2) averaged over 8-31 Dec 2012



FLASHFlux - NAVGEM differences in shortwave radiation of comparable magnitude to existing heat flux offset used in GOFS

NAVGEM Heat Flux Calibration

- Using calibrated NAVGEM winds, integrate a year-long GOFS hindcast
- From this hindcast, integrate a series of 5-day forecasts and compare against the 5 day later nowcast as the truth
- 5 day forecast SST error is used to compute heat flux offset, where 1°C error = 250 W/m^2 heat loss or gain
- Create a monthly varying heat flux offset
  - GOFS currently uses an annual offset

Implications of Switching Atmospheric Forcing

- With NAVGEM wind and heat flux calibration in place, re-integrate the GOFS hindcast bringing it up to real-time (under NRL control)
  - Perform a subset of validation metrics and compare against NOGAPS-forced GOFS
  - Hand off NAVGEM-forced GOFS to NAVOCEANO
    - Will be a short time period of dual ops
  - Tight time frame to get this done before NOGAPS decommissioning on 31 Aug 2013

Implications of Switching Atmospheric Forcing

- Because of the short time period for calibrating NAVGEM winds against scatterometer data and computing the heat flux offset, this static recalibration should be performed with each additional year of NAVGEM output
- Additionally, a static recalibration may be needed with every new NAVGEM delivery (T379L50 → T425L60 → T639L70)

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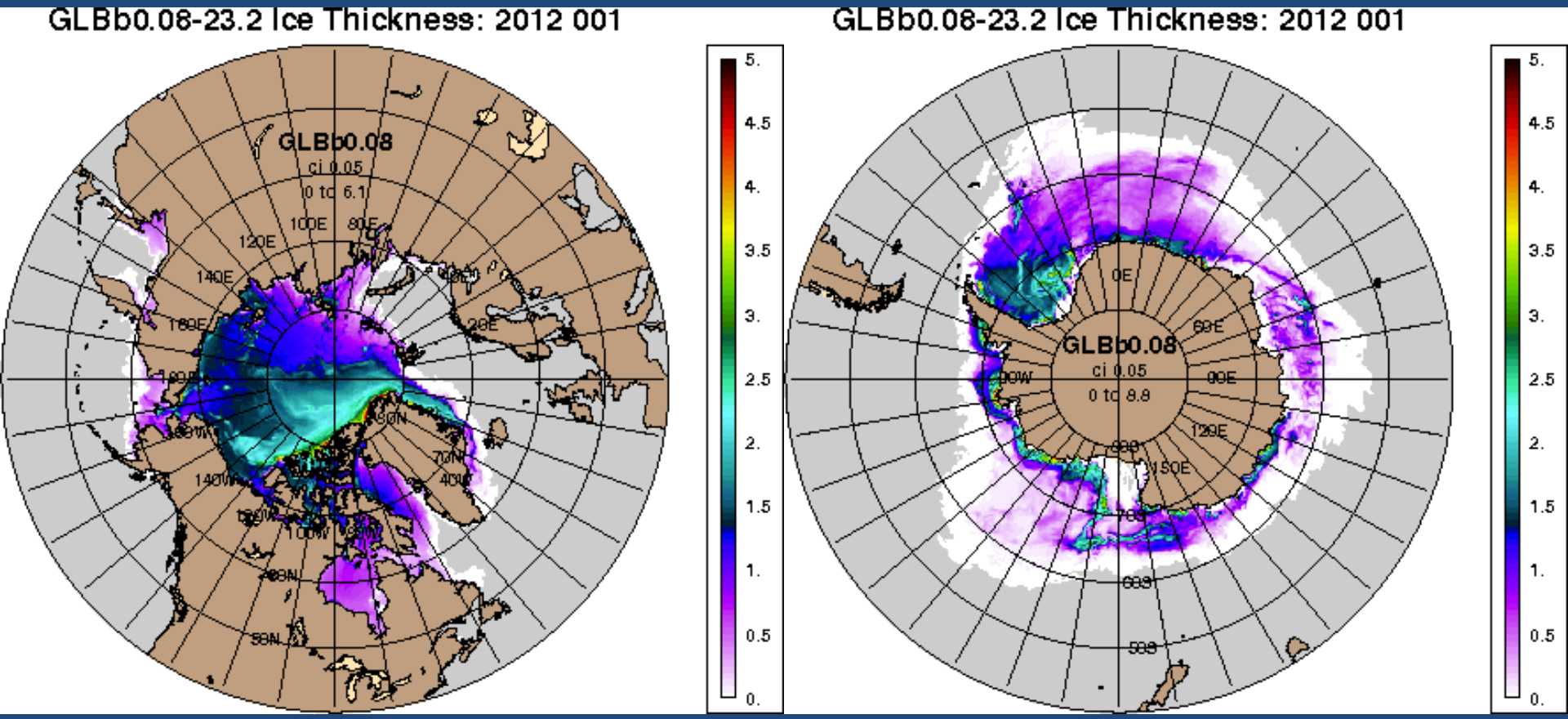
HYCOM/CICE Coupling

Two-way ocean/ice coupling between HYCOM and CICE with 1 hour coupling frequency

2012 ice thickness (m) from non-assimilative spin-up



Currently redefining ice assimilation methodology

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