

Validation and analysis of the 1/4-deg global NEMO-CONCEPTS* ocean model

*Canadian Operational Network of Coupled Environmental Prediction Systems

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A partnership of EC, DFO, DND, GOAPP and MERCATOR-OCEAN

Presentation topics

1- General goal of CONCEPTS

2- CMC global $\frac{1}{4}$ deg model setup: preliminary experiments

3- Yearly simulations:

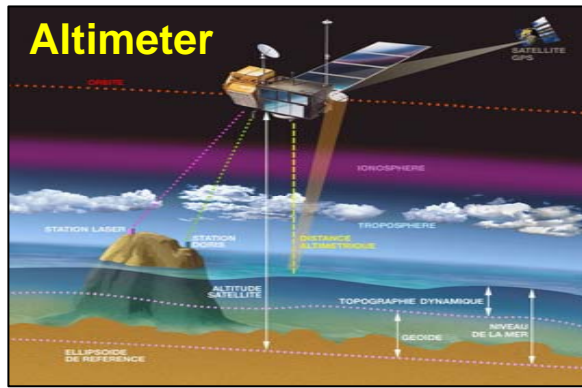
Verification with CMC analysis

Sensitivity tests to atmospheric forcing

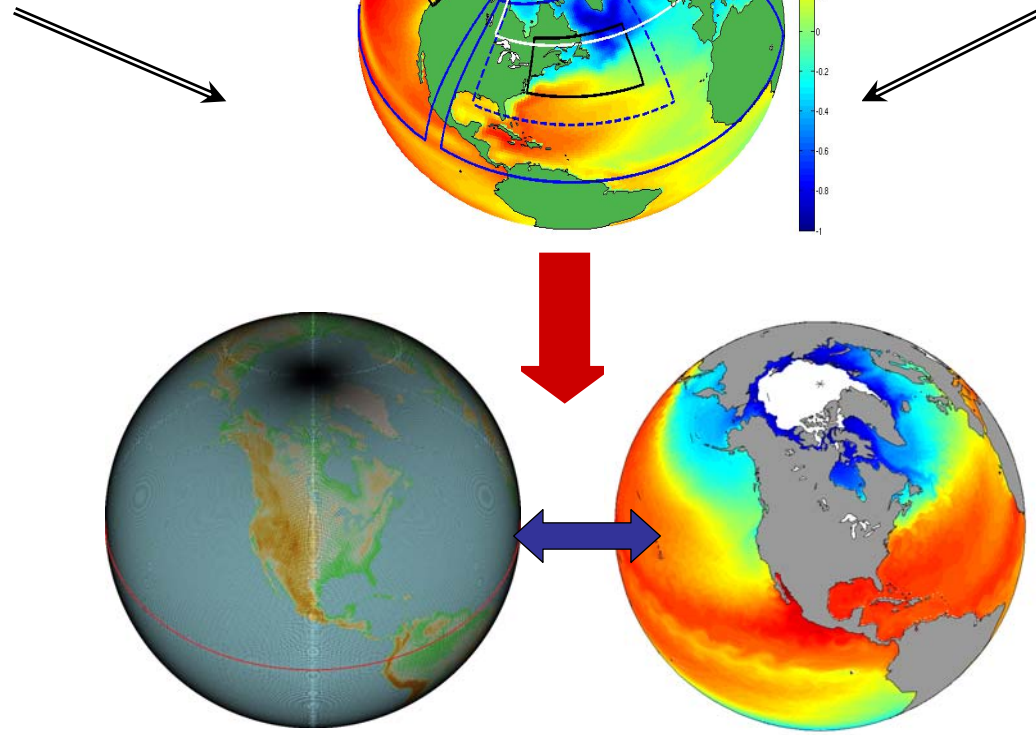
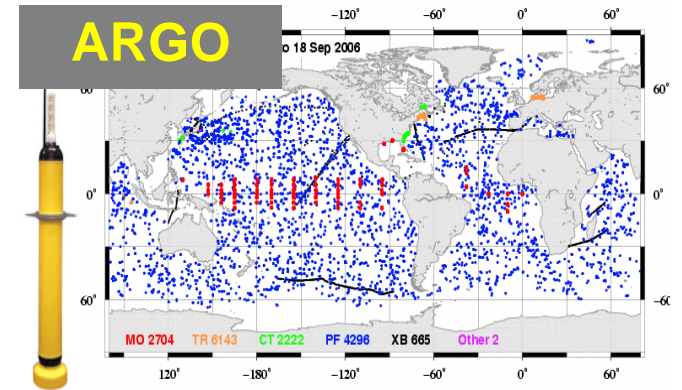
Energy flux from wind to near inertial motions: initial estimates

4- Future work

General goal of CONCEPTS



Ocean modelling &
Data Assimilation



Coupled Global NEMO/GEM

General goal of CONCEPTS...

Focus :

Prediction at time scale from hours to months

Two global ocean configurations:

¼-deg; 1-deg

Status:

¼-deg tested for 6-yr spin-up; 10-day forecast; 1-yr simulation

1-deg model tested for multi-decade simulations;

1-deg model being coupled to 100km GEM;

Validation and process studies

Preliminary experiments: CMC global $\frac{1}{4}$ deg model setup

Yearly simulation configuration:

NEMO3-LIM2 $\frac{1}{4}$ deg resolution on ORCA025 grid (MERCATOR)
50 vertical levels (1 m thick at the surface)

Atmospheric forcing from global GEM at 35 km resolution
($U_a, V_a, T_a, H_a, SW, LW$)

CORE bulk formulas from Large and Yeager (2004)

Initial conditions: MERCATOR-OCEAN data assimilation system
(T, S, U, V , April 18, 2007)

SSS restoring to yearly climatology
No SST restoring

Yearly simulation 1 (**S3**): 3-hourly forcing linearly interpolated in time

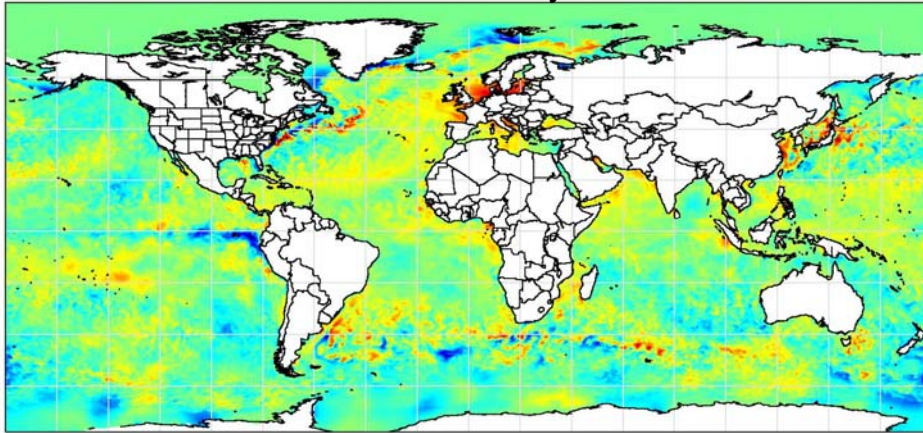
Yearly simulation 2 (**S24**): 24h-averaged forcing (no interpolation in time)

Yearly simulations: verification with CMC analysis

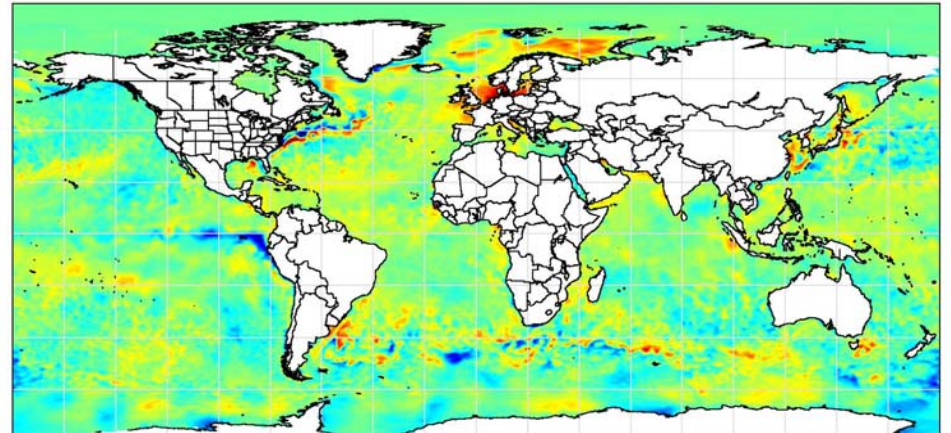
Initial condition: April 18 2007

SST anomaly based on Levitus monthly climatology

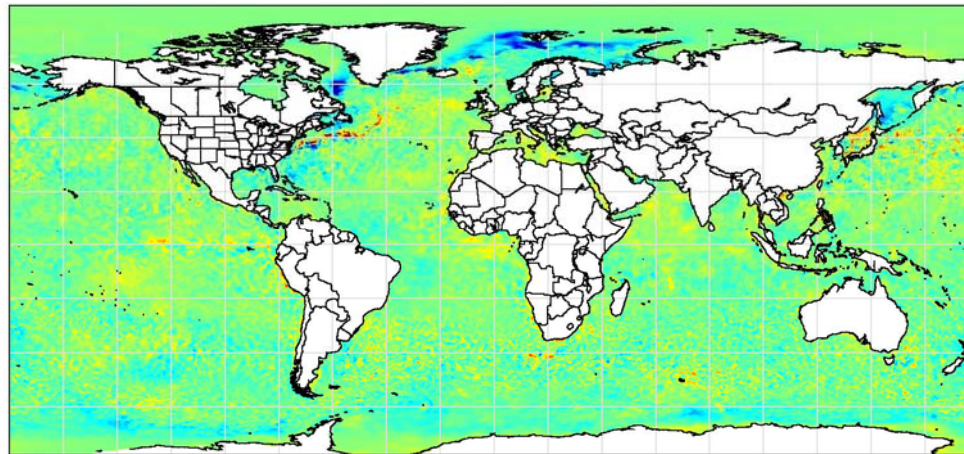
Ocean model: MERCATOR analysis



CMC analysis



Difference: MERCATOR - CMC



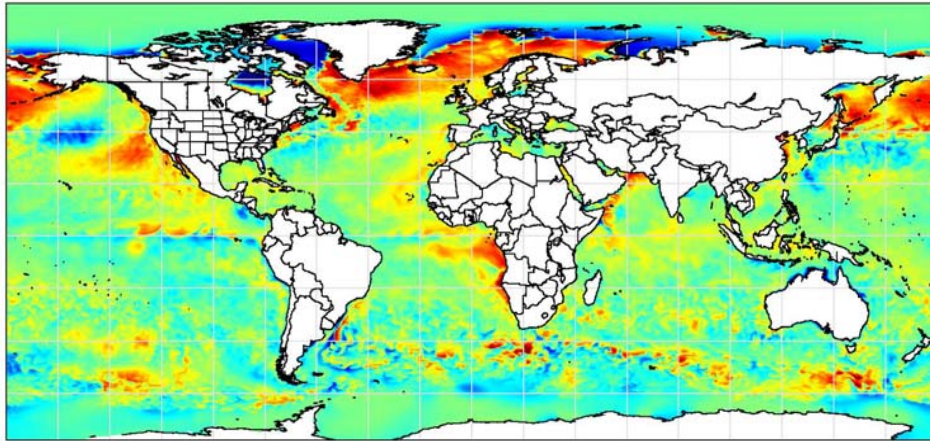
Yearly simulations: verification with CMC analysis

After 3 months: July 15 2007

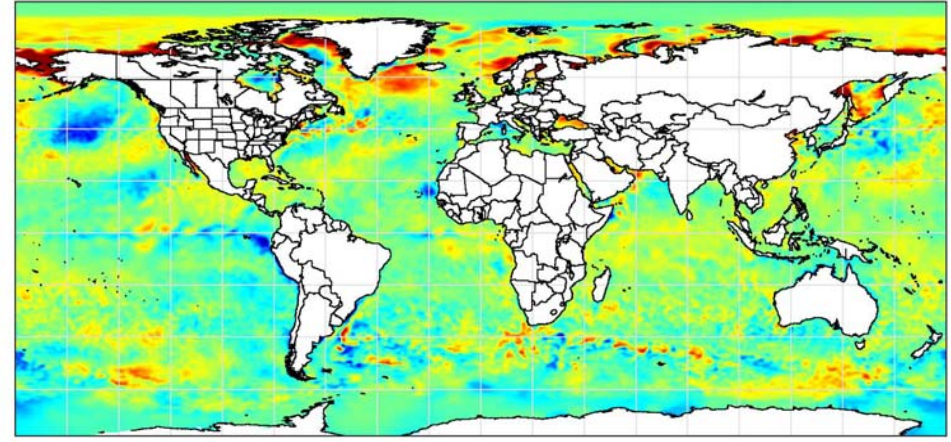
SST anomaly based on Levitus monthly climatology



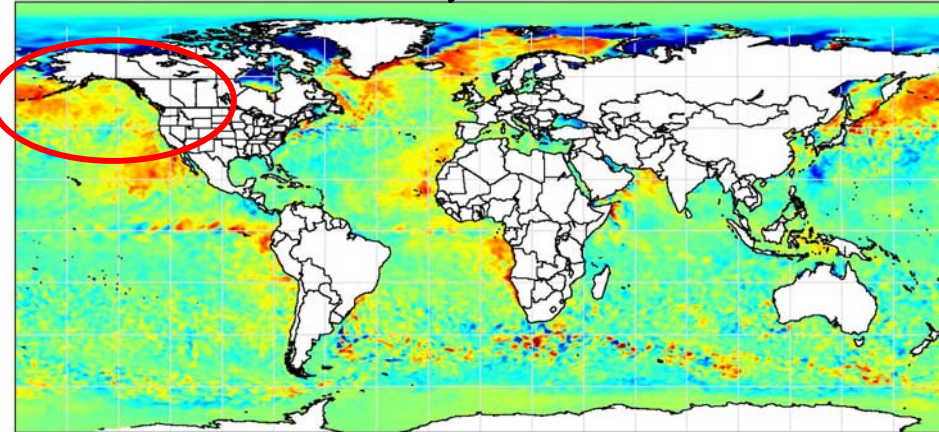
Model (S3)



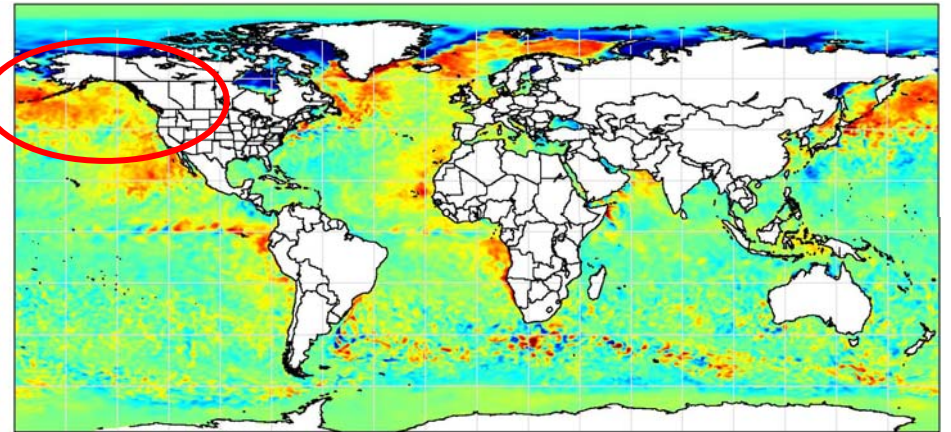
CMC analysis



Difference: S3 - CMC analysis



Difference: S24 - CMC analysis



Warm bias appearing in the northern hemisphere (northern summer)...

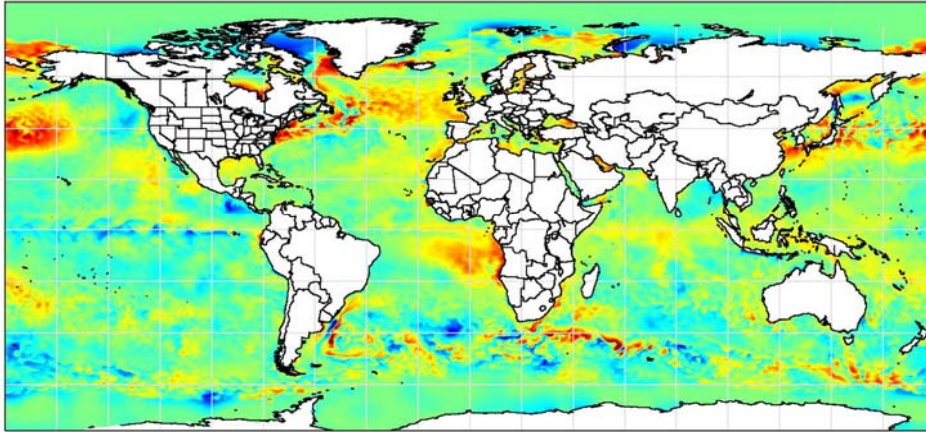
Yearly simulations: verification with CMC analysis

After 6 months: October 15 2007

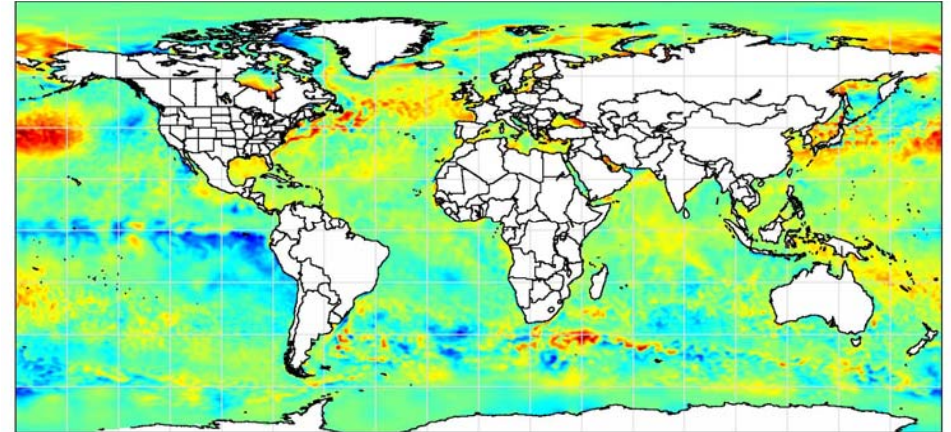
SST anomaly based on Levitus monthly climatology



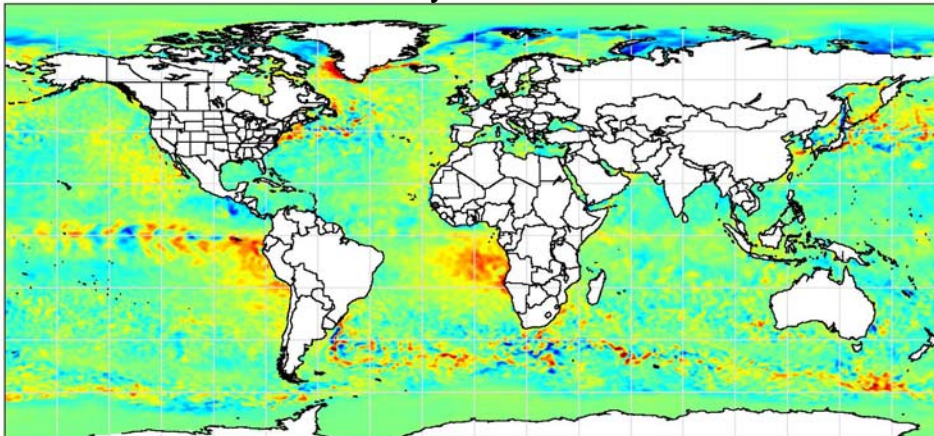
Model (S3)



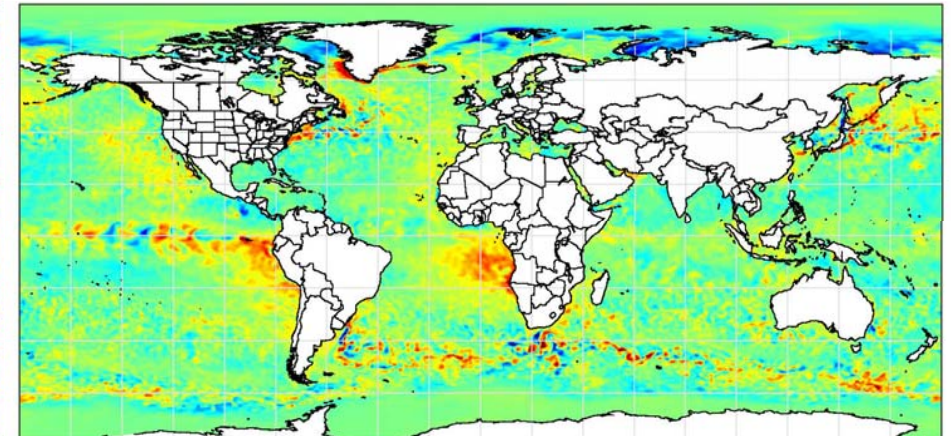
CMC analysis



Difference: S3 - CMC analysis



Difference: S24 - CMC analysis



Warm bias disappearing from the northern hemisphere, starting to appear in south...

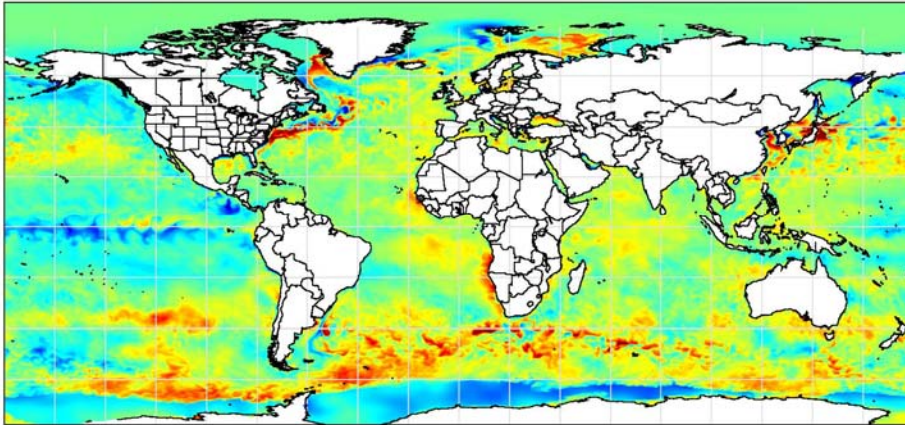
Yearly simulations: verification with CMC analysis

After 9 months: January 15 2008

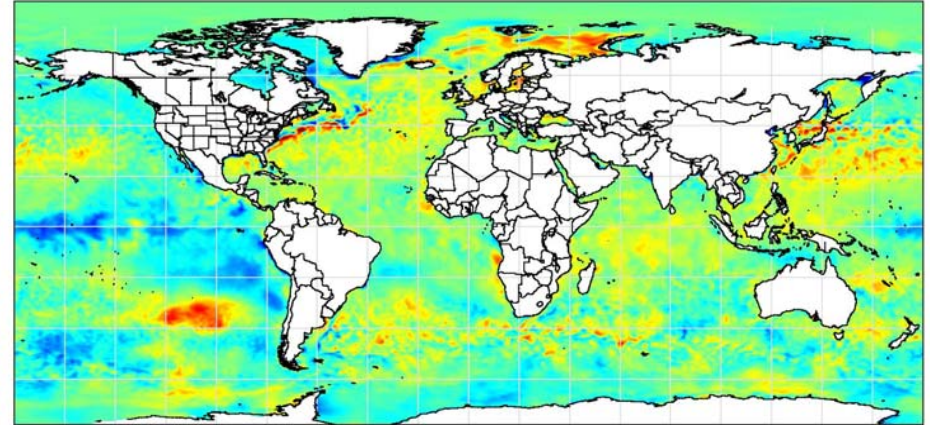
SST anomaly based on Levitus monthly climatology



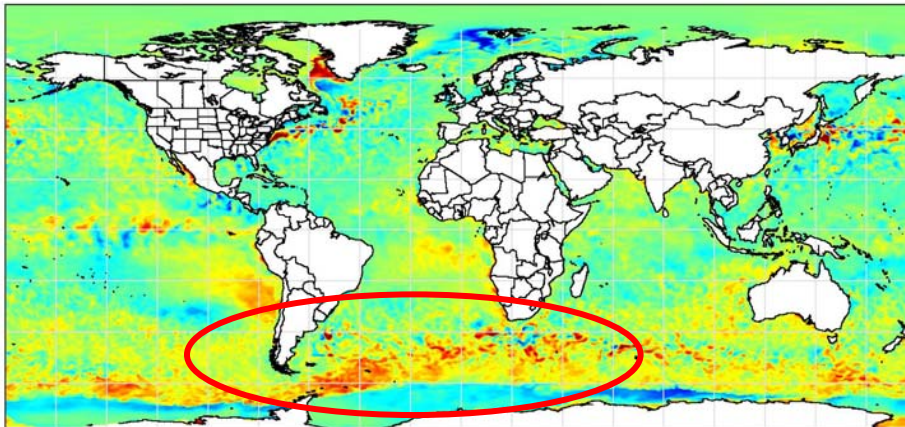
Model (S3)



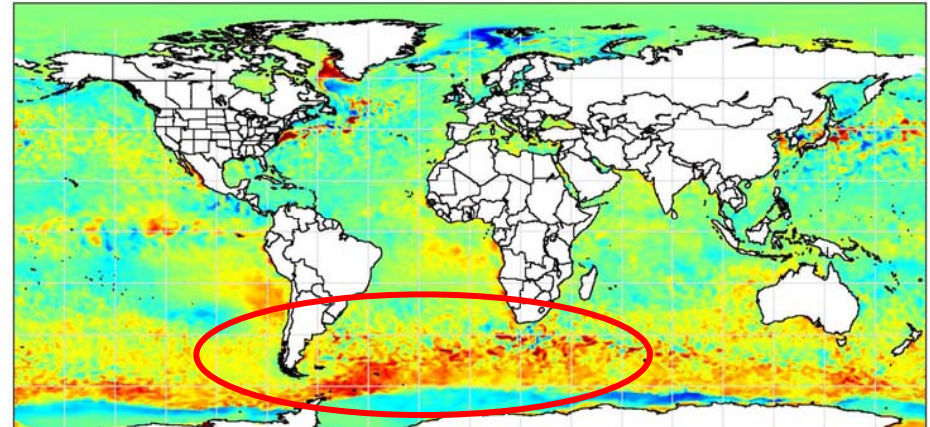
CMC analysis



Difference: S3 - CMC analysis



Difference: S24 - CMC analysis

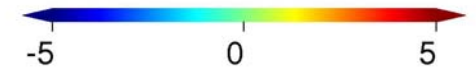


Warm bias appearing in the southern hemisphere (southern summer) ...

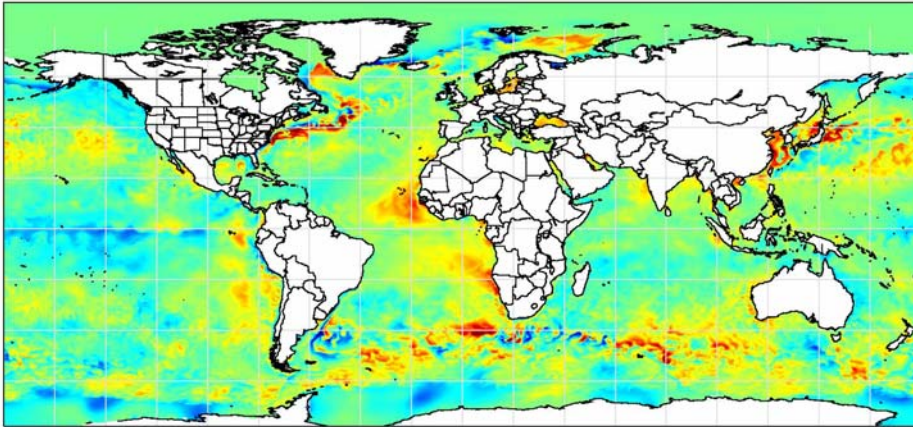
Yearly simulations: verification with CMC analysis

After 1 year: April 18 2008

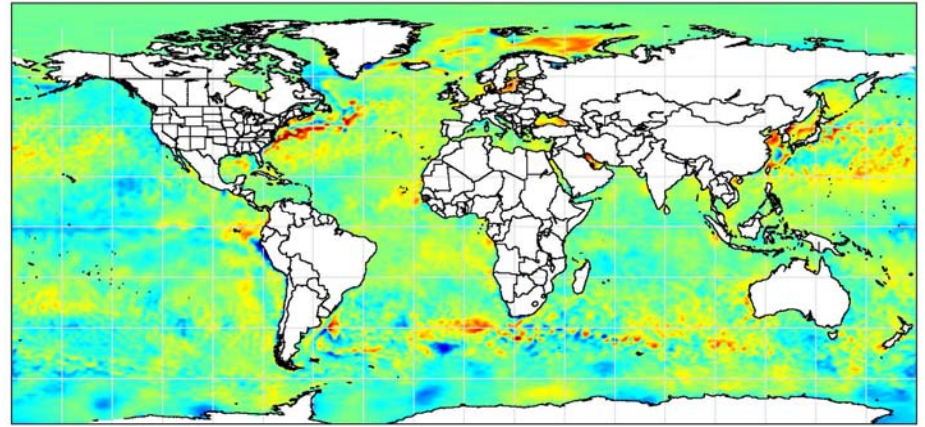
SST anomaly based on Levitus monthly climatology



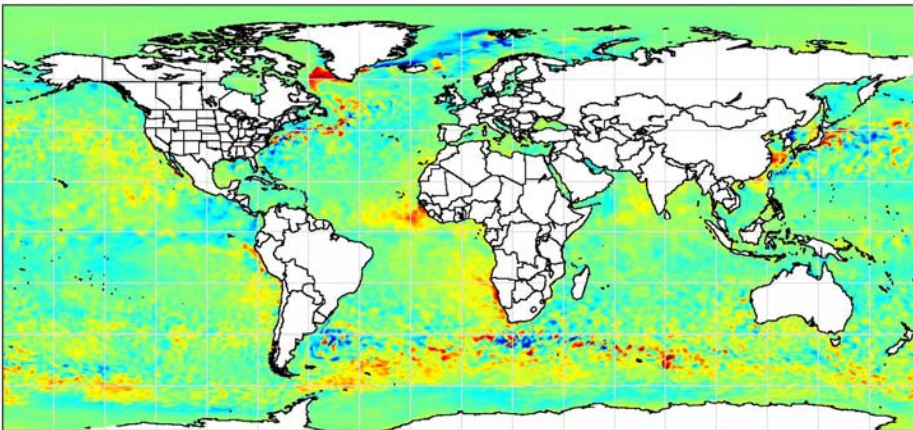
Model (S3)



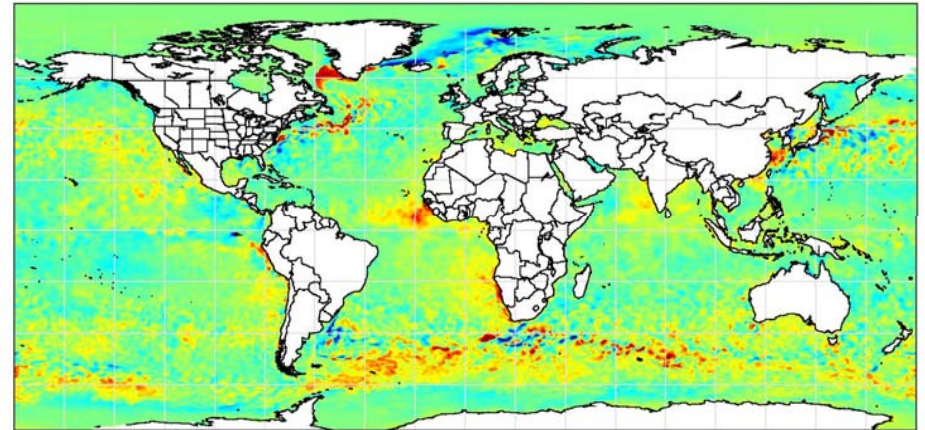
CMC analysis



Difference: S3 - CMC analysis



Difference: S24 - CMC analysis

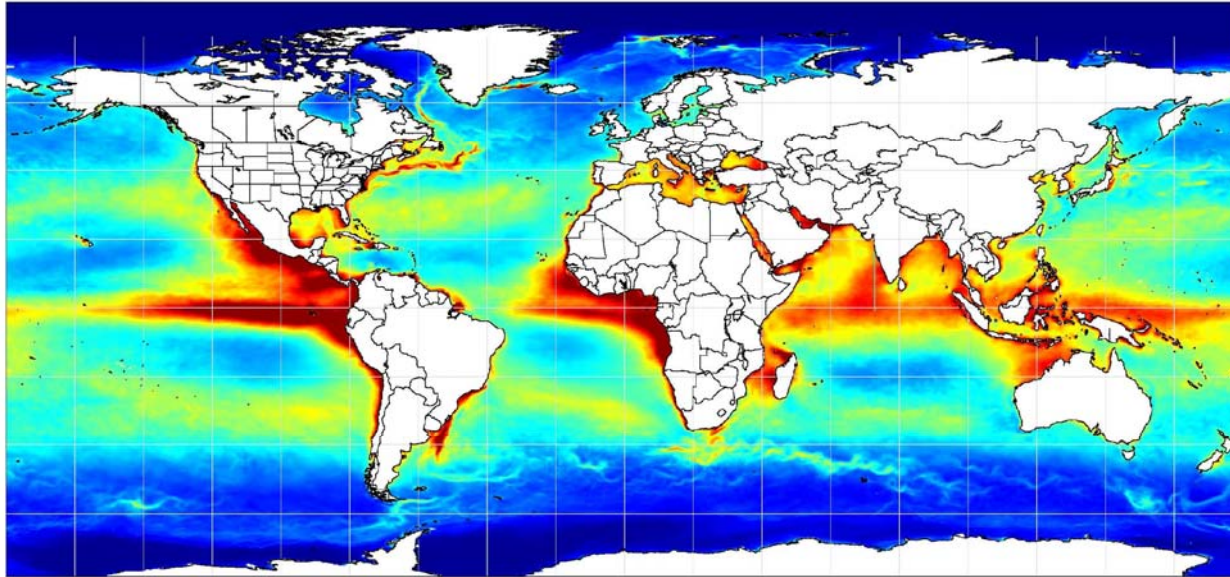


Warm bias decreasing in the southern hemisphere ...

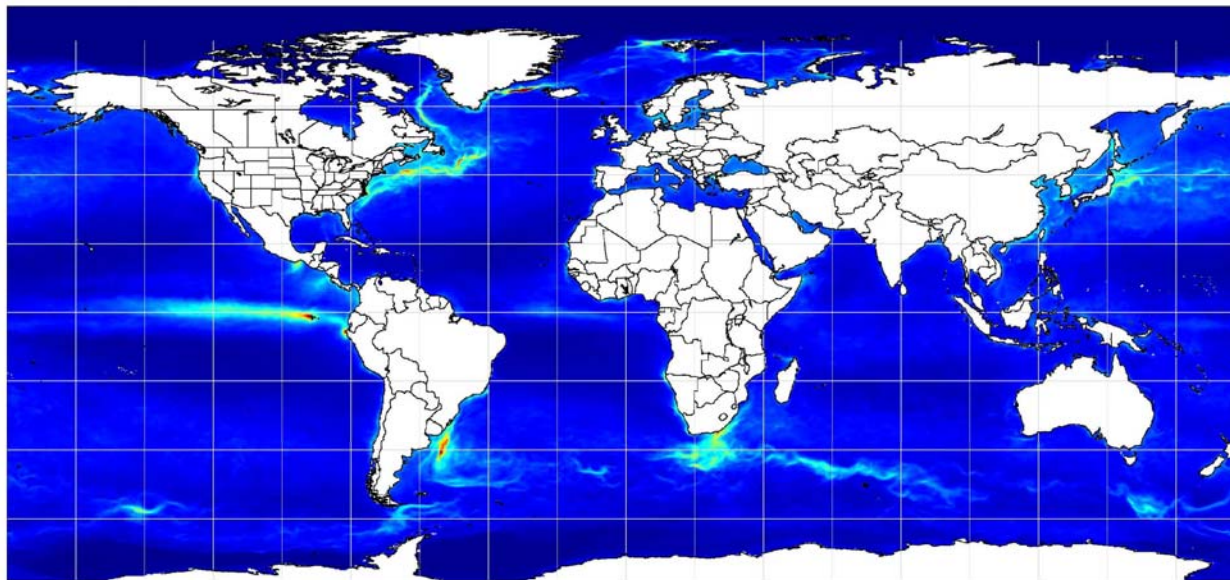
Yearly simulations: sensitivity to atmospheric forcing

Daily standard deviation of SST, yearly averaged (effect of diurnal cycle)

Model (S3)

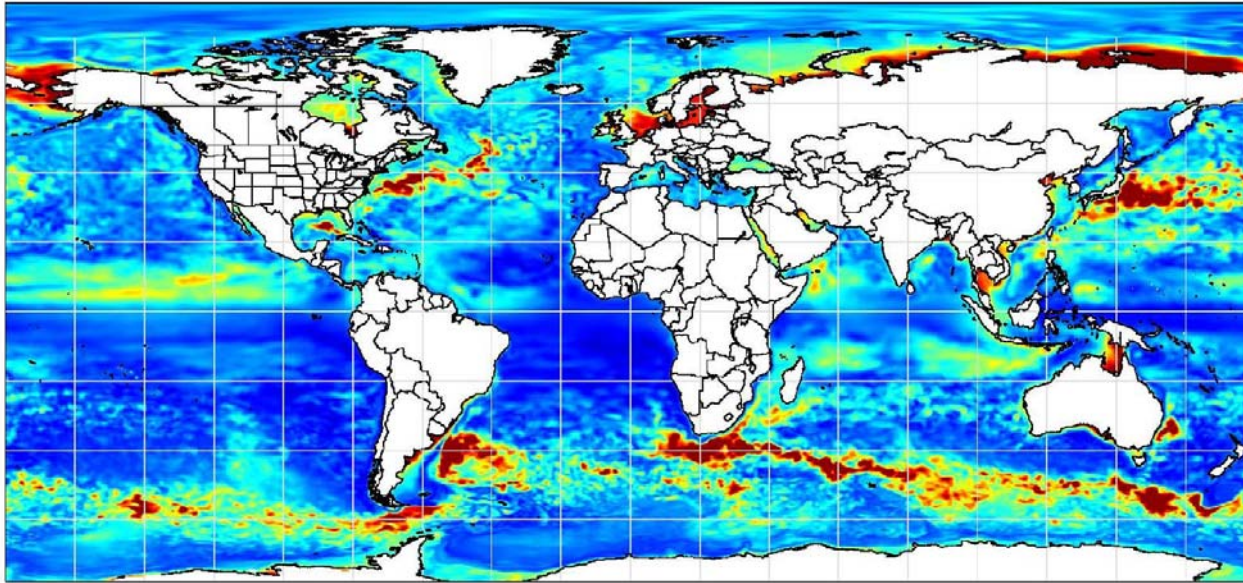


Model (S24)

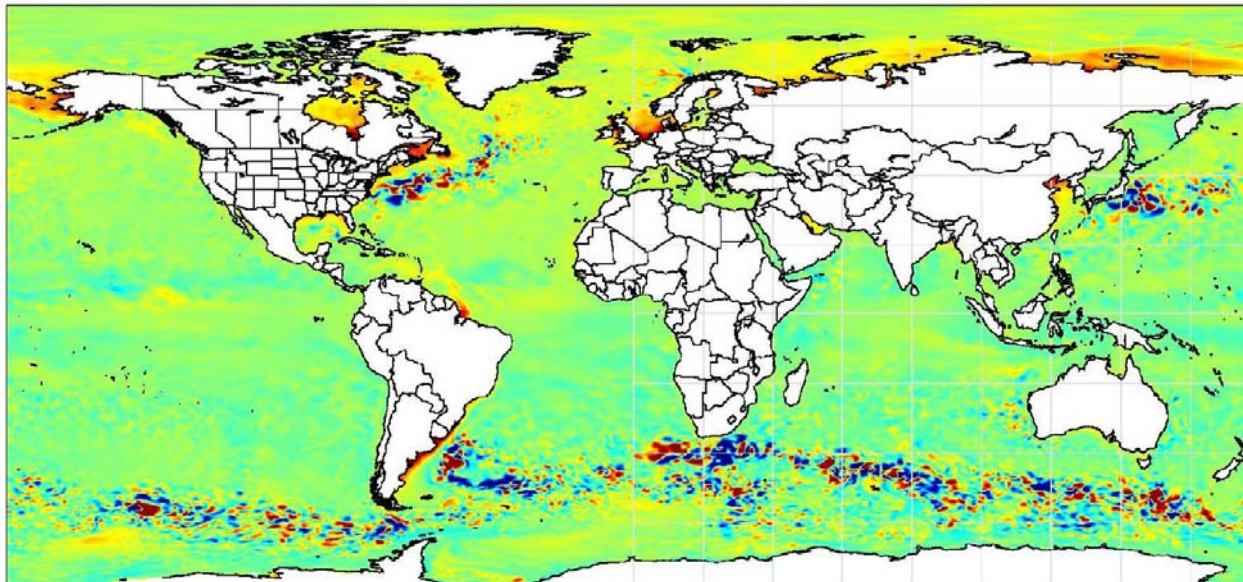


Yearly simulations: sensitivity to atmospheric forcing

SSH yearly standard deviation (using 20 outputs per day, close to hourly)



S3

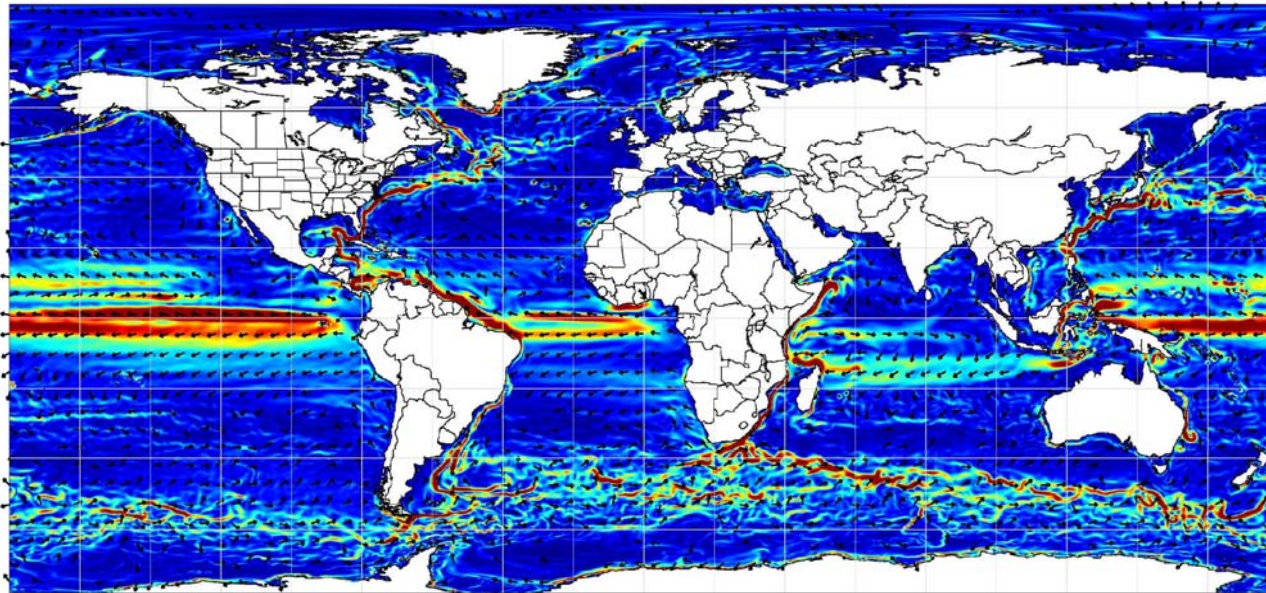


S3 – S24

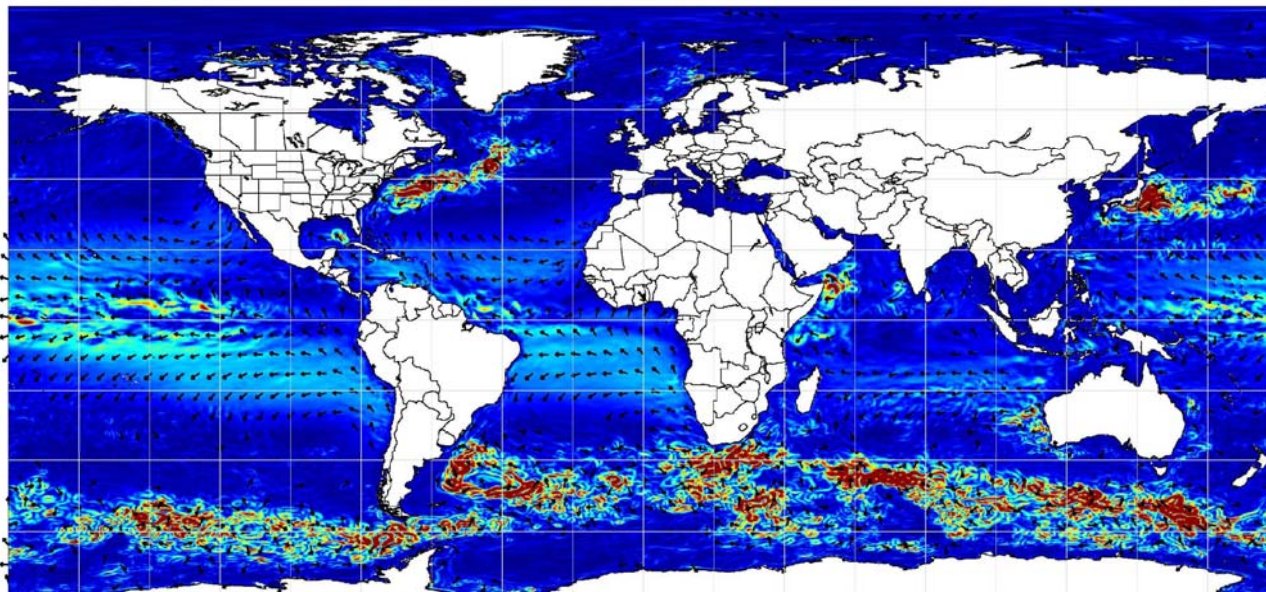
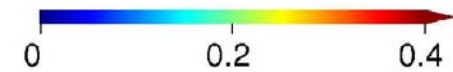


Yearly simulations: sensitivity to atmospheric forcing

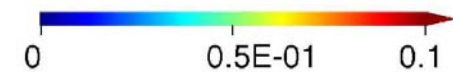
Yearly averaged surface circulation in ms^{-1} (first 5 m)



S3



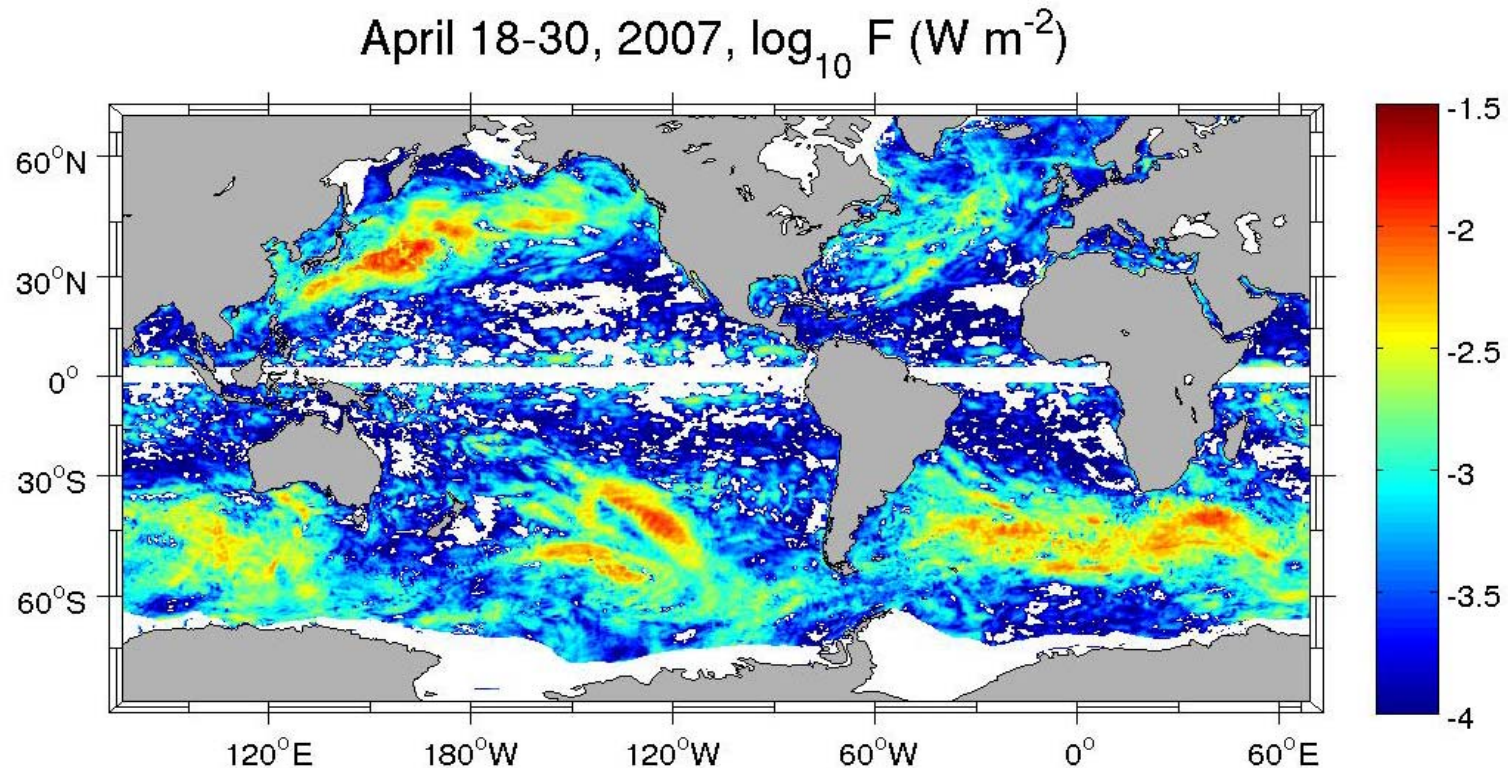
S3 - S24



Wind energy input to oceanic near inertial motions: S3

Initial estimates based for April 18-30, 2007

High energy flux associated with synoptic storms



Future work:

- Further analyses to reveal seasonal cycle
- Comparison to be made with semi-analytic solution

Conclusion

NEMO3-LIM2 with GEM forcing produces a realistic seasonal cycle without major SST drift

A non-persistent warm bias occurs during the summers of the north and south hemispheres (slightly reduced with 3-hourly forcing)

Significant variability in SST is added with 3-hourly forcing (diurnal cycle)

SSH variability is increased in coastal areas with 3-hourly forcing and the distribution of meso-scale eddies is changed

Averaged westerly currents near the tropics are increased with 3-hourly forcing

3-hourly forcing produces high energy flux associated with synoptic storms

Future work

Verification with in situ and satellite derived data

Work to explain the summer warm bias

More global diagnostics

Sensitivity tests to flux parameterization (CORE, GEM physics, ...) and TKE parameters

Importing data assimilation system from MERCATOR

Pseudo-operational 10 day forecasts using GEM forcing

Two-way coupling of NEMO with GEM

EXTRAS ...

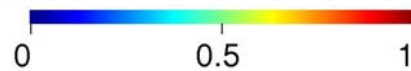
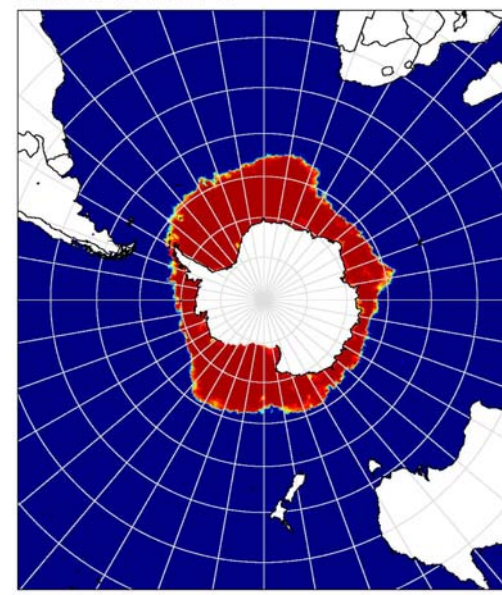
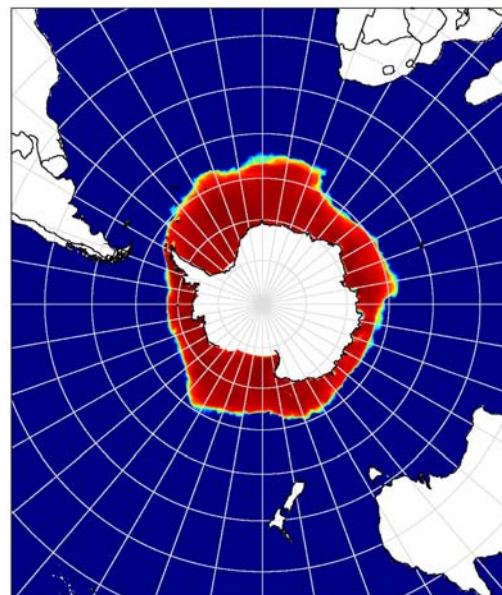
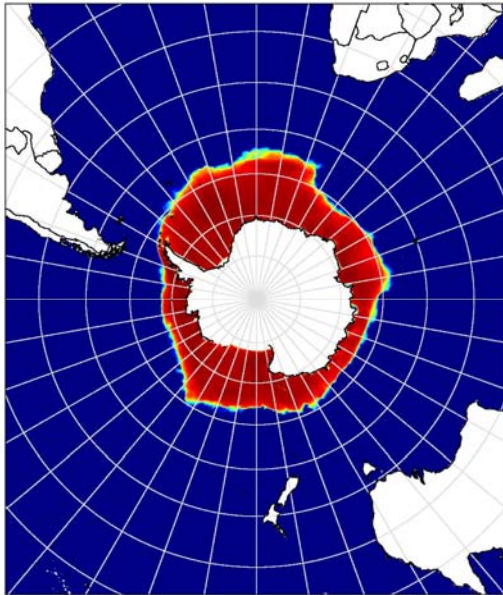
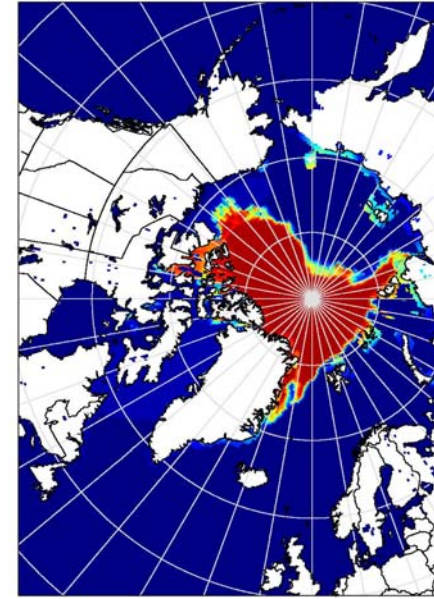
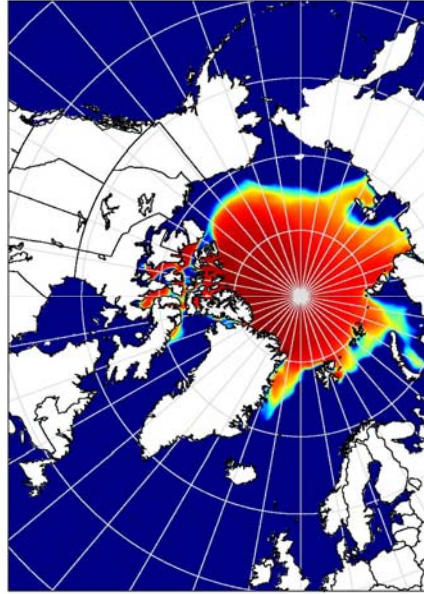
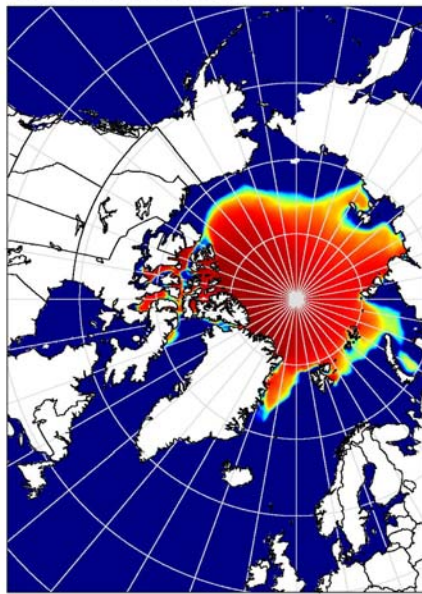
... showing a reasonable seasonal cycle

Verification: Ice fraction (Sept 15 2007 after 5 months of sim.)

S3

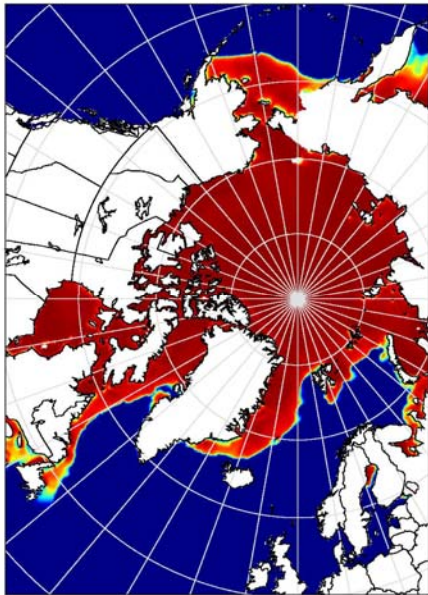
S24

CMC analysis

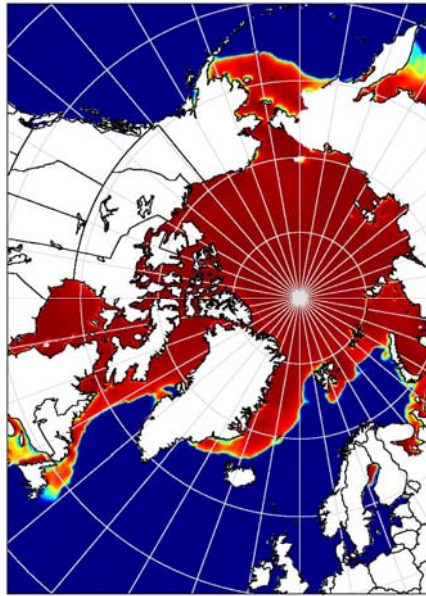


Verification: Ice fraction (April 15 2008 after 1 year of sim.)

S3



S24



CMC analysis

