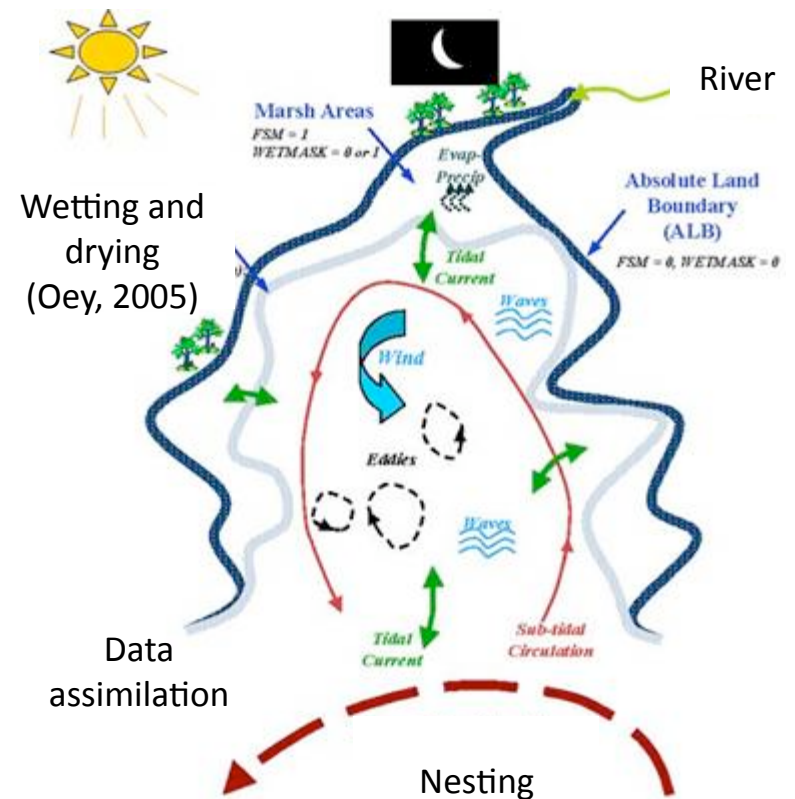


The MPI-PROFS

A Fujisaki* and L Oey
Princeton University

Princeton Regional Ocean Forecast System

- Modeling system for a specified ocean region.
- POM as a core engine.
- Schemes for detailed processes.
- Applications
 - Gulf of Mexico (Yin and Oey 2007, Oey et al. 2007)
 - Oil spill of 2010 in GOM (Chang et al. 2010)
 - Cook Inlet, Alaska (Oey et al. 2007)



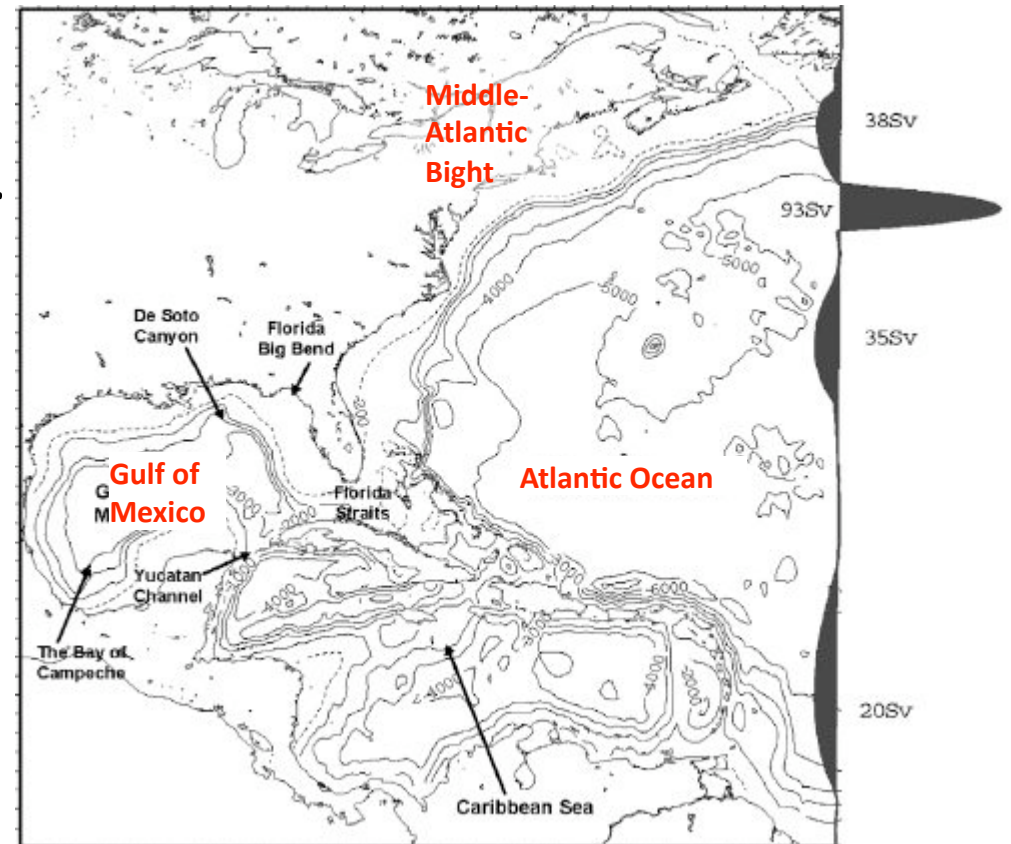
PROFS URL : <http://www.aos.princeton.edu/WWWPUBLIC/PROFS/>

Parallelization of PROFS ocean model

- For a further high-resolution forecast system.
- We have alternatives of distributed memory parallel ocean models.
 - Stony Brook Parallel Ocean Model : sbPOM (Dr. A Jordi and Dr. D-P Wang).
 - Parallelized POM (Dr. Y Miyazawa).
- Benefits
 - Shortening of calculation time.
 - Higher-resolution.
 - Higher-order advection scheme.

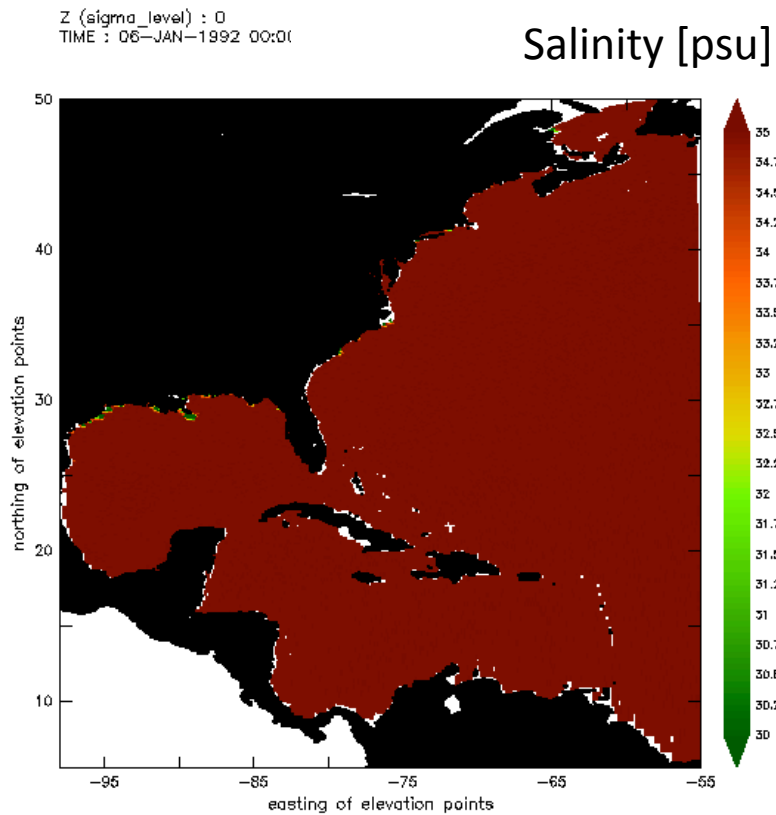
MPI-PROFS

- Configured for simulating the Gulf Stream and the Middle Atlantic Bight shelf circulation.
 - grid number : 402 x 252 x 25
 - Horizontal resolution : ~10km
- Original system will be transplanted to sbPOM.
- Realistic forcings

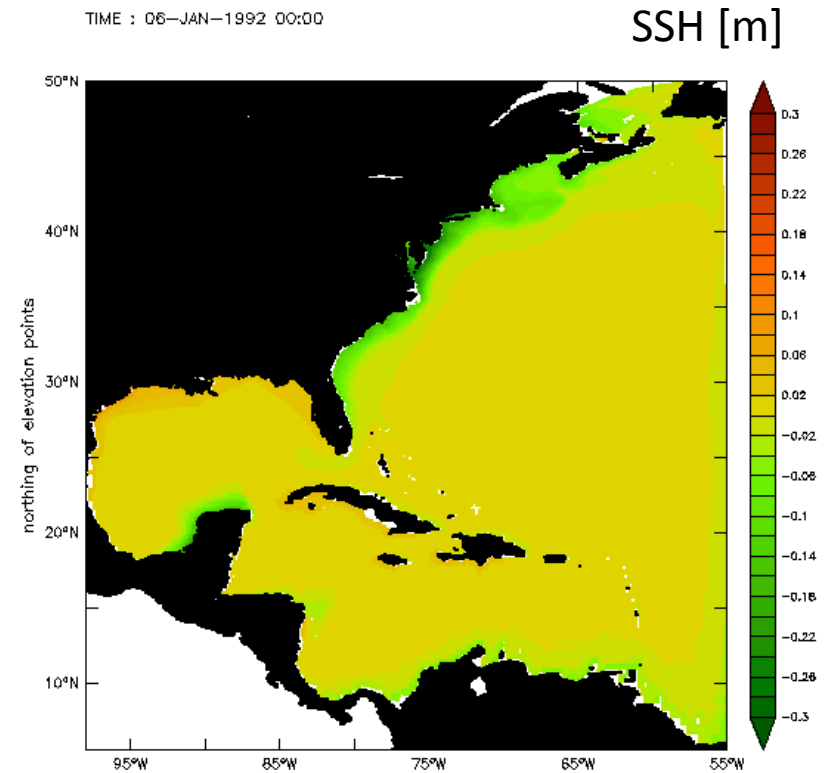


Domain for the simulation.

Test cases



River only

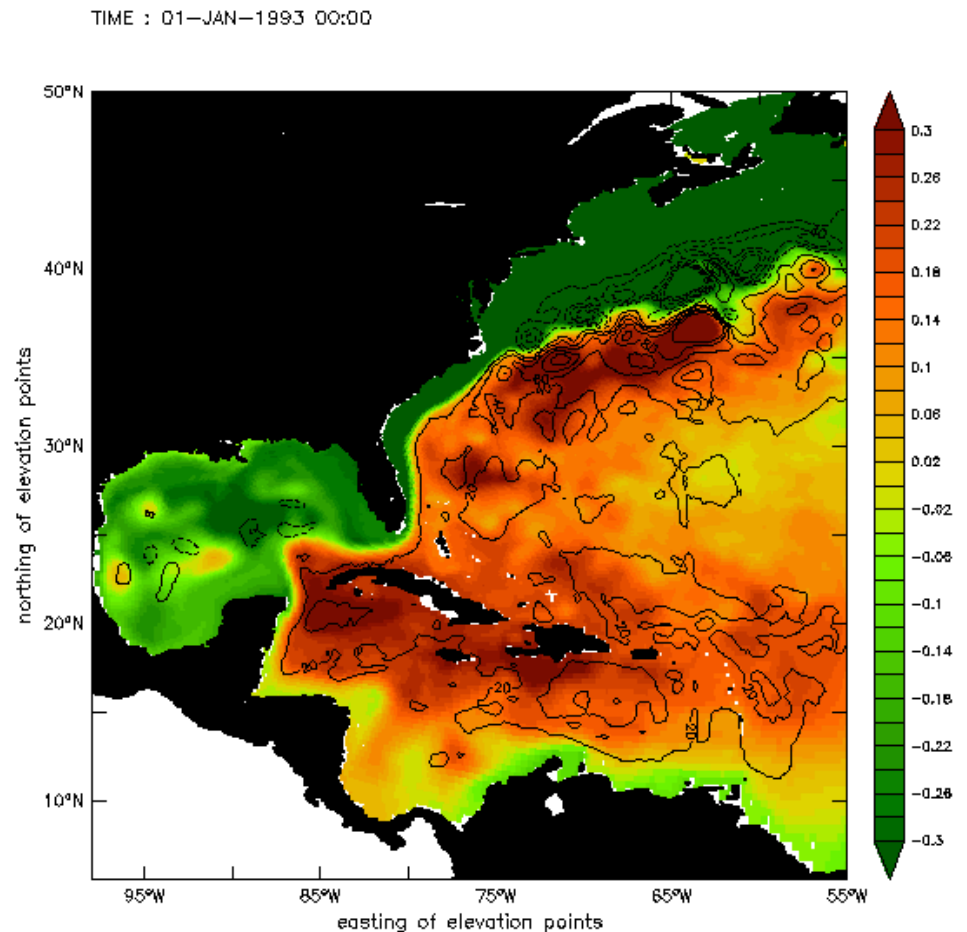


Wind stress curl only
(Sinusoidal $\langle w'u' \rangle$)

Eastern boundary is closed.

Hindcast 1992-2008

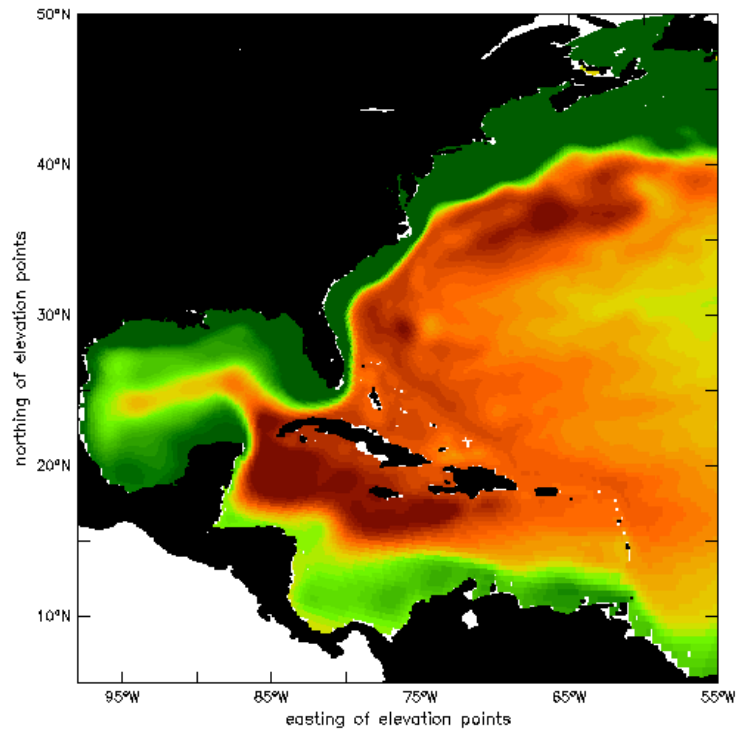
- CCMP ocean surface wind components
 - Rivers (33 in GOM and 17 in MAB)
 - SST/SSS relaxation
 - Specified transport at the Eastern boundary.
- boundary.
- Started from the original PROFS model result.
 - No data assimilation (so far).



SSHA [m] and stream function [Sv]

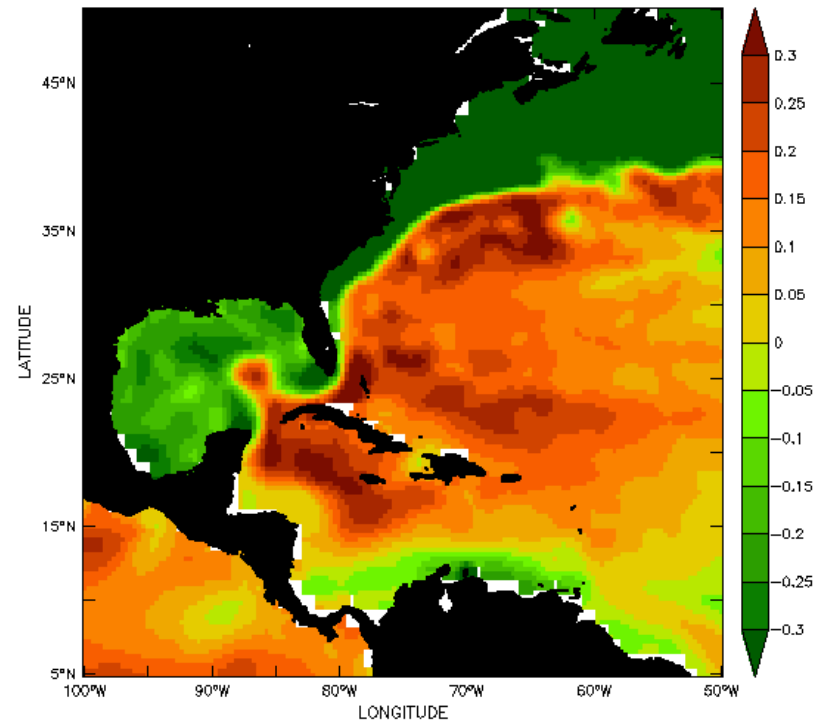
Comparison with observation

Averaged through Sep. 2003 – Aug. 2004.



SSHA [m]

MPI-PROFS Hindcast



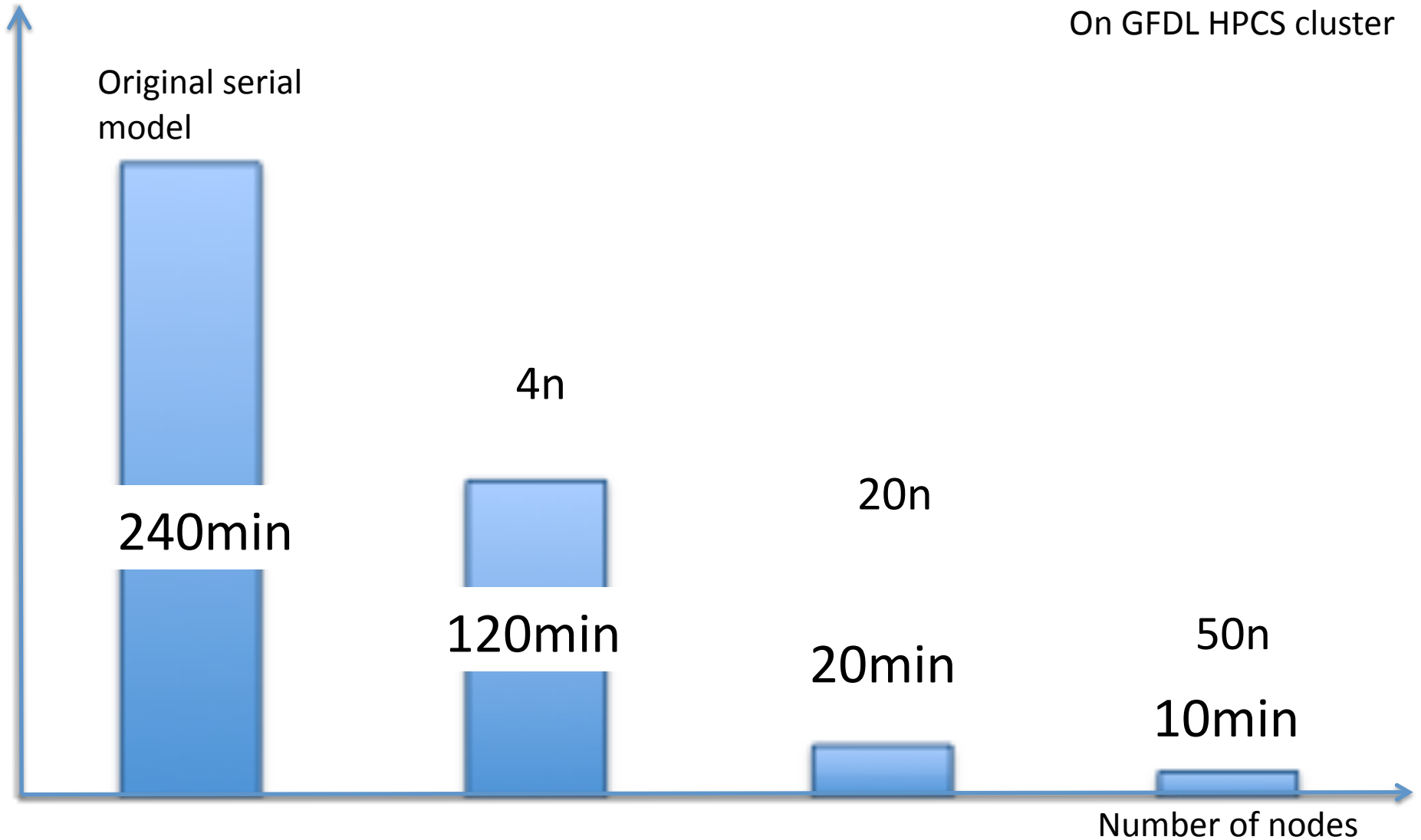
Dynamic topography (anomaly) [m]

Merged satellite data (AVISO)

Performance of parallelization

Calculation time for 60 days

On GFDL HPCS cluster



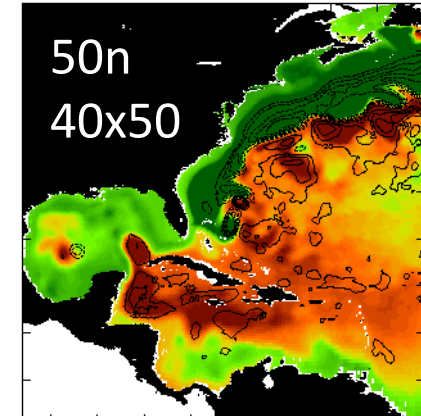
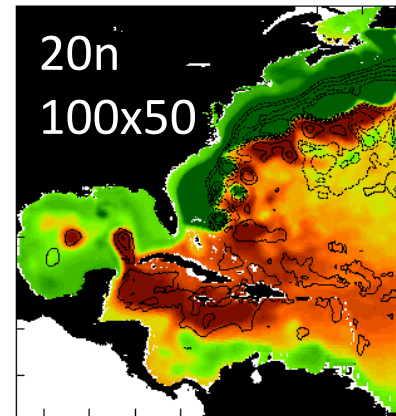
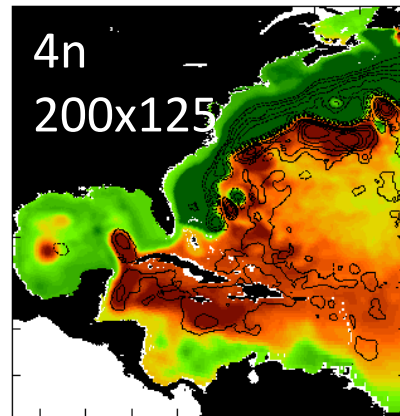
Fluctuation due to parallelization

4n vs 50n

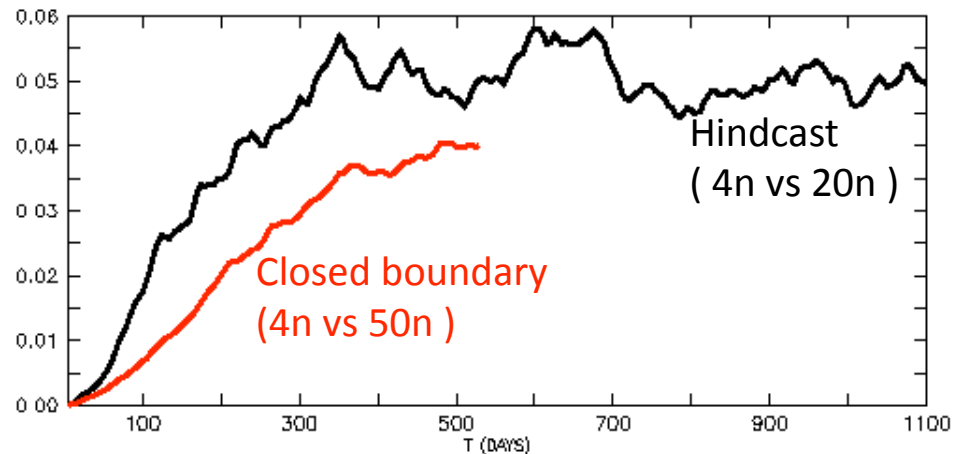
→ velocity RMS = 0 after 40days (closed boundary, and low optimization level -O2).

- Error by high-level optimization, reduction calculation over nodes, and so on.

Hindcast snapshot
after 3 years, SSH



RMS for depth averaged velocity
(high-level optimization -O3)



Summary

- MPI-PROFS is configured for simulation the Gulf Stream and the Middle Atlantic Bight.
- Future works
 - Model validation
 - Data assimilation
 - Higher-resolution
 - Higher-order advection scheme