

Atlantic Ocean Forecast System

Ocean Forecast System Project Overview

Carlos Lozano

Desiraju B. Rao

MMAB/NCEP

HYCOM-NOPP workshop at Miami

Outline

- Goals for the Atlantic Ocean Forecast System
- Approach
- Status
- Work ahead

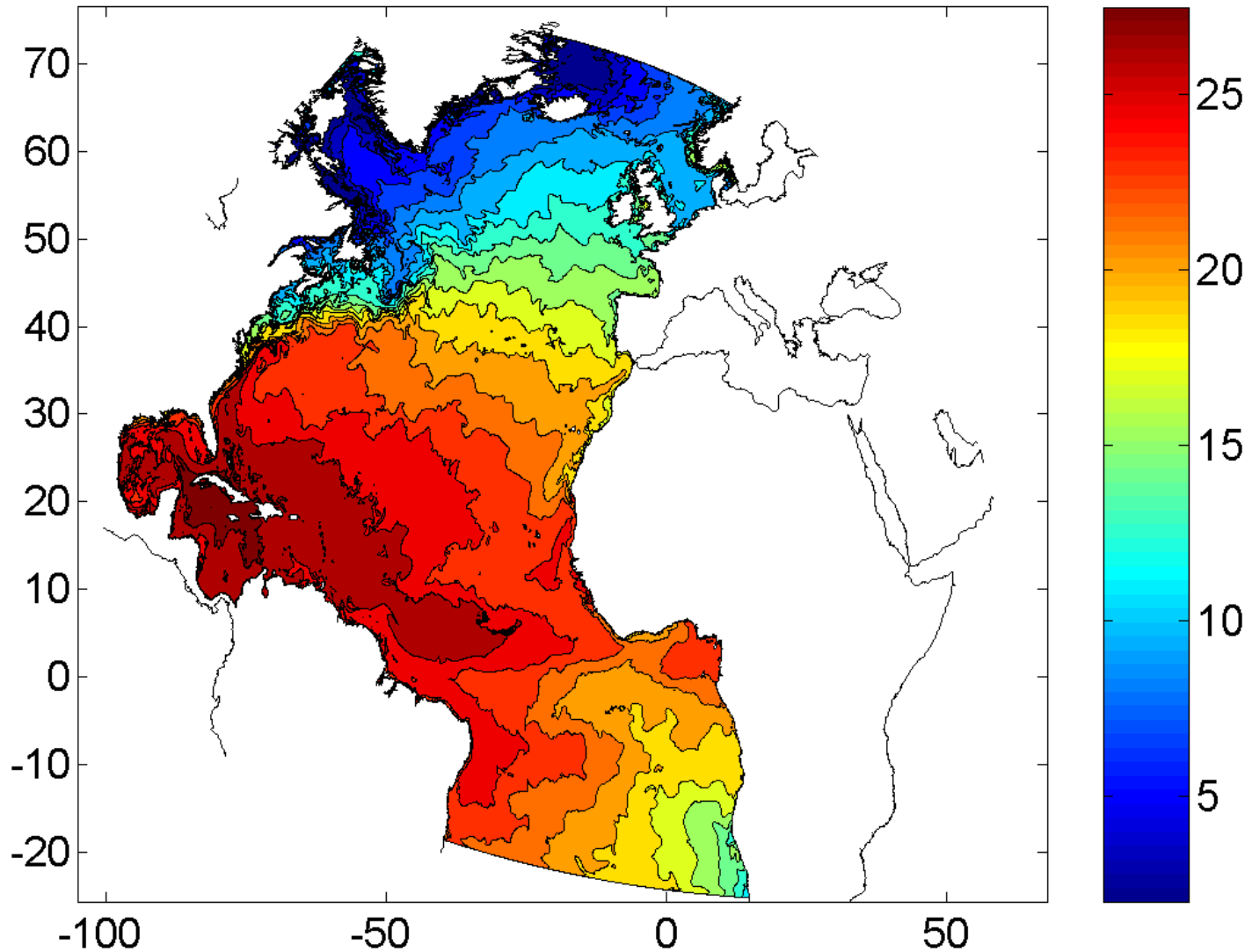
Goals and Objectives

- Establish operational high resolution (*eddy resolving*) ocean forecast systems for short term forecast (*order 1 week*) in the **Atlantic** ocean with US deep and coastal waters well resolved.

*-Nowcast and forecast of sea levels, current temperature, salinity. **Emphasis in costal ocean, Loop & Gulf Stream***

*-Provide **seamless** boundary and **initial conditions** to regional ocean physical and bio-geo-chemical models.*

Temperature ($^{\circ}\text{C}$) for day 287 in 2003. Cl: 1.5



Resolution: 4-5km US coast; 7km Gulf Stream

HYCOM dynamical model

- **Primitive equation with free surface.**
- **Sub-grid scale parameterizations. Vertical and horizontal eddy viscosity and mixing. Diapycnal mixing.**
- **Tide and sea surface pressure.**
- **River outflow and run-off**
- **Ice dynamics and thermodynamics.**

Central Setup Specifications

Dynamical Model: HYCOM 2..01.3+; GISS; [FCT-2]. In-house adaptations for tide; river outflow; ice model

Initialization: Cold Start: coastal/deep climatologies; followed by assimilation of historical data

Surface forcing: GFS (NCEP) & MODIS (water type)

Central Setup

2

Tides: Eight constituents(+12). Body force and open boundaries [data for open boundaries: Goddard, OSU]; Ports at Bay of Fundy & selected inlets

River outflow/runoff: blend of observations, climatology and hydraulic model (NOAH) nowcast and forecast estimates

Open boundaries: Derived from World ocean fields (ESMF coupler). *Initially from climatology.*

Bathymetry: ETOPO2(NGDC) + corrections + minimal smoothing

Coastal boundary: blend of bathymetry and coastline data sets (NGDC)

Central Setup

3

Assimilation Scheme: Multi-variate 2D OI & 2DVar with vertical extension

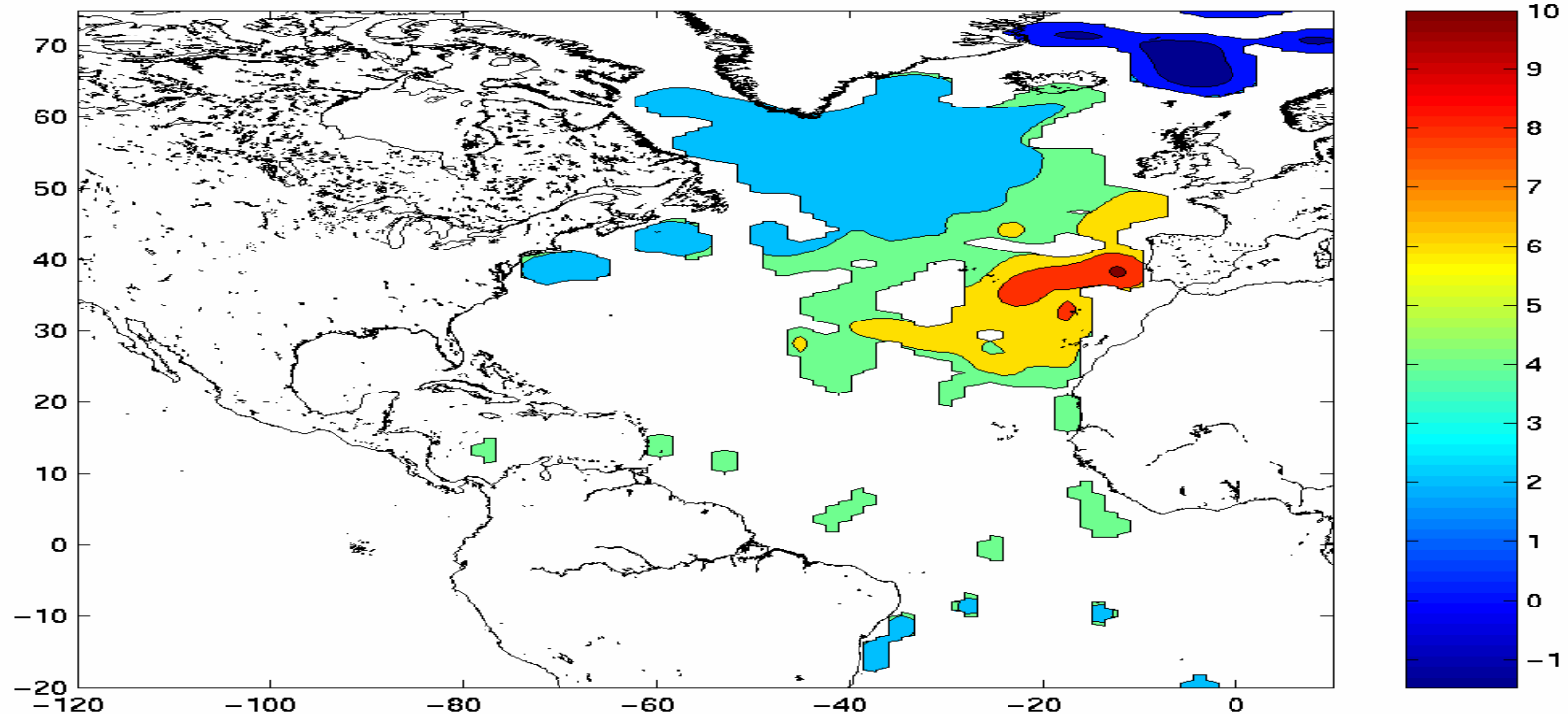
Data Types: SST, SSH, in-situ T,S, ice concentration

Extensions: Prepare $(T(z), S(z))$ profiles from $T(z)$; and SSHA.

Covariance error: Decomposed 3D to 2DX1D.

Hydrography (2D-OI)

Sub-surface T ($^{\circ}\text{C}$) at 1200m for April 2003



639 observations (World oceans)

213 observations in the Atlantic Sector shown.

OI decorrelation length scale 400km.

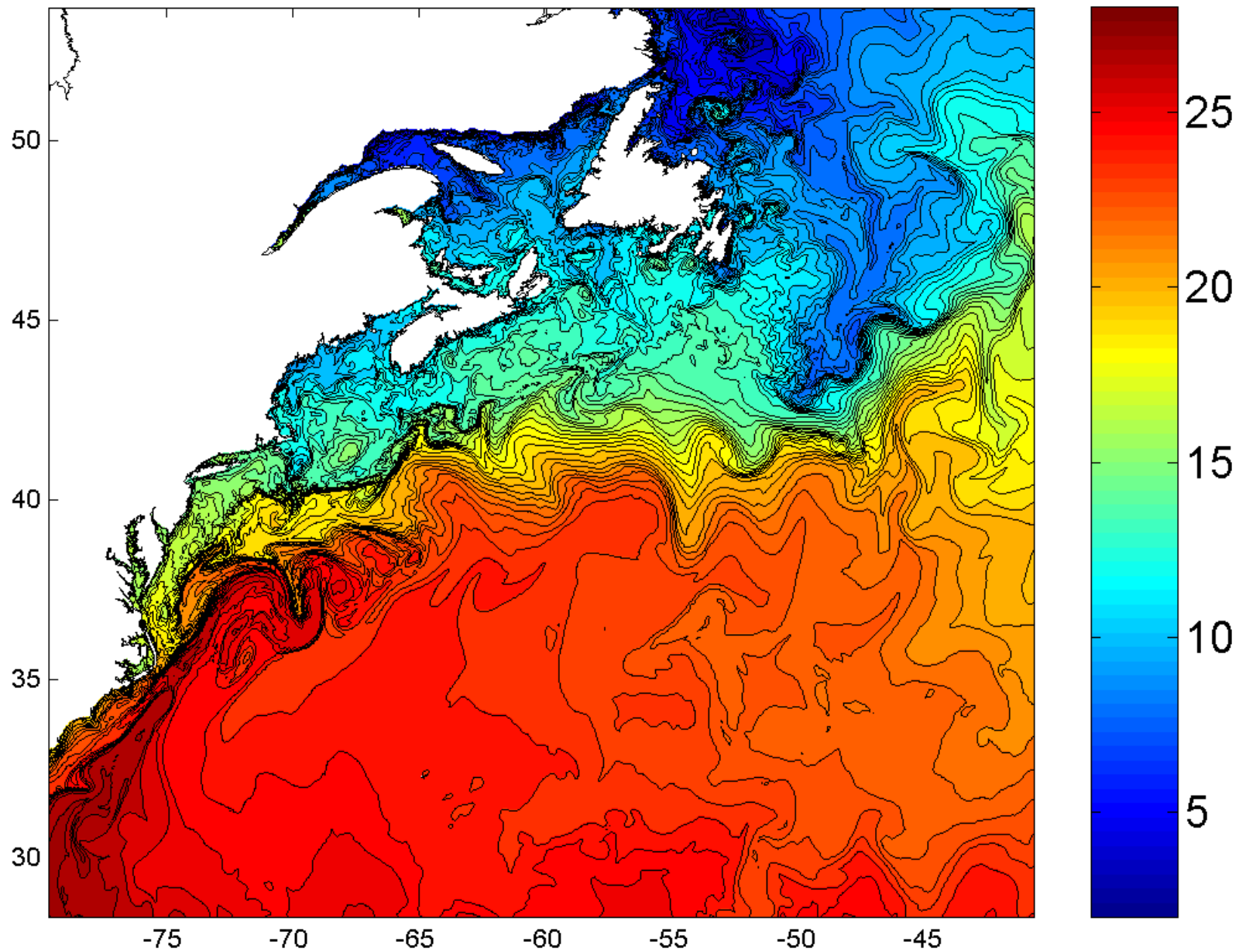
Ocean forecast system elements

- » Data retrieval & acquisition (real-time & historical)
- » Data archive (MODS-BUFR)
- » QC, analyses & data composites
- » Data Assimilation (MV2DOI; MV2DVar)
- » Dynamical Model (HYCOM)
- » Nowcast-forecast monitoring and skill metrics
- » Nowcast-forecast products and distribution
- » Analyses, diagnostics & re-analyses
- » Data and model visualization

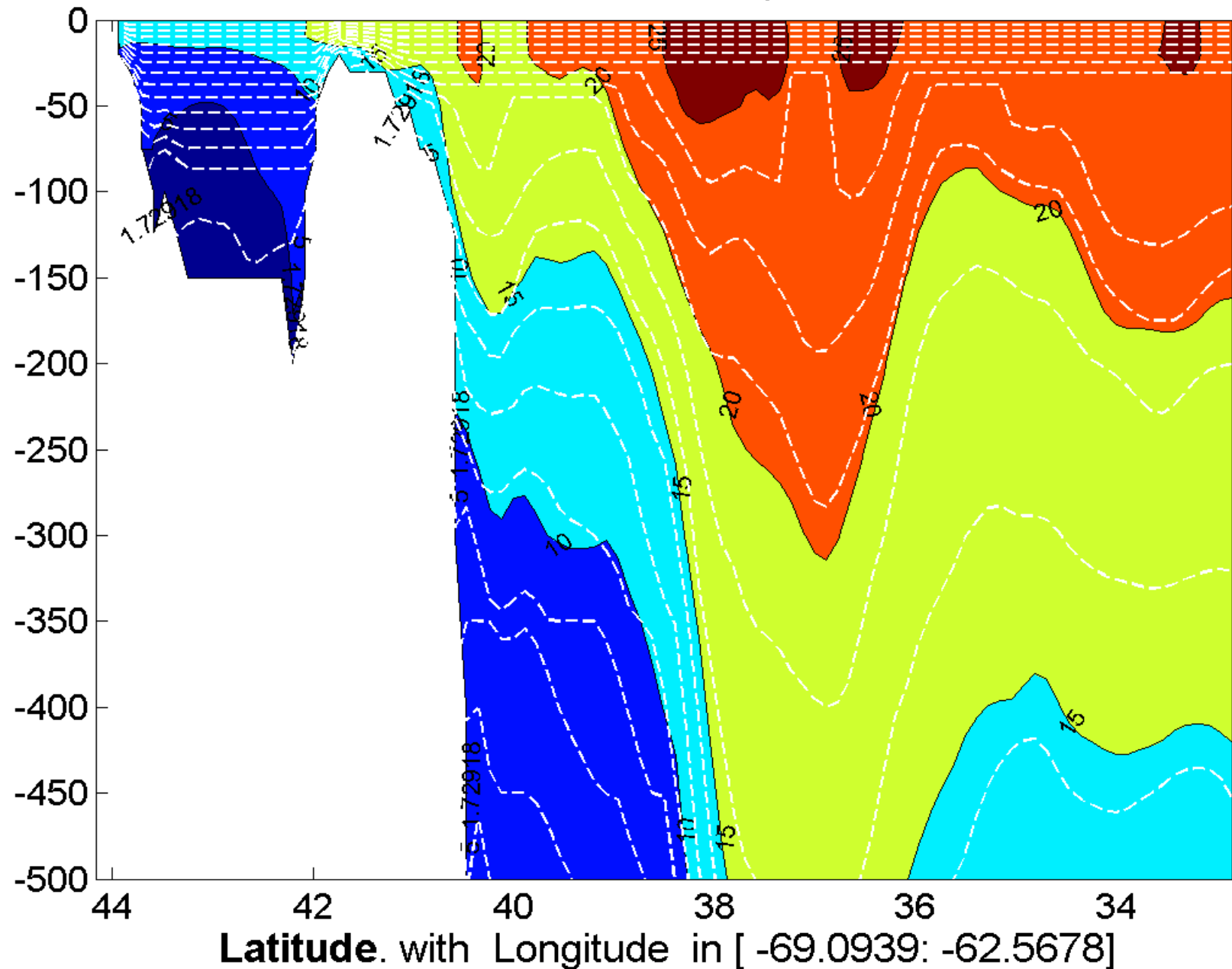
North Atlantic experiments and setups in NCEP orthogonal

- sigma2*; 25 levels
1/12 deg. Initialization and assimilation.
Response to a hurricane
1/3 deg. Calibration of atmospheric forcing
Seasonal mixed layer variability
Calibration of tides
Simulated end-to-end
operational system

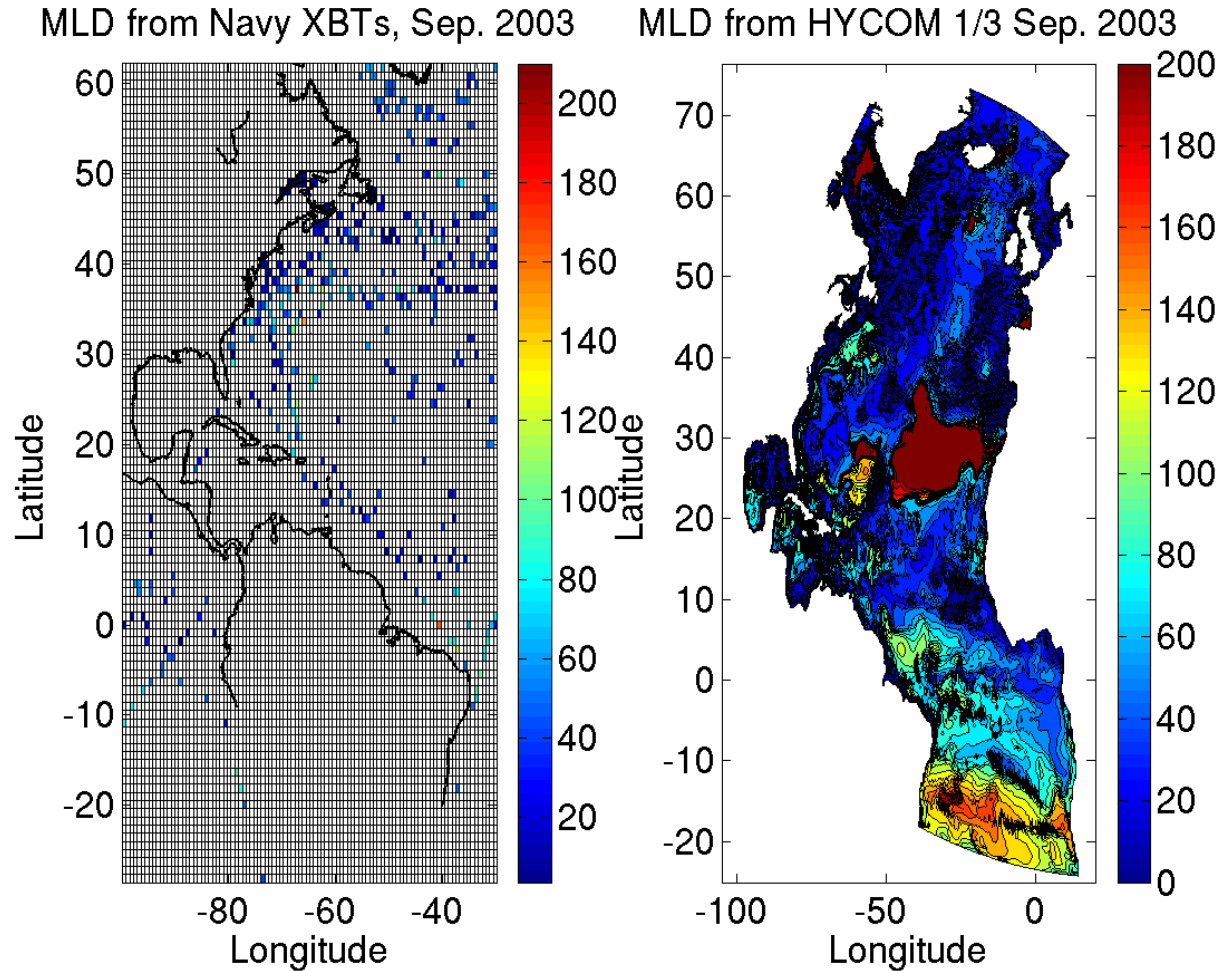
Temperature ($^{\circ}\text{C}$) for day 287 in 2003. Cl: 0.5



NCEP 1/12 05.0: temperature $^{\circ}\text{C}$



Seasonal mixed layer variability



North Atlantic experiments and setups in NRL/RSMAS Mercator

- - 2 deg. (Carlyle, George) ; OI sensitivity studies.
 - 1/3 deg. (Pat); simulated end-to-end operational system.
 - 1/12 deg. (Ole-Martin); response to a hurricane in mixed layer and geostrophic adjustment.
 - 1/12 deg. (Zulema); to be compared with orthogonal NCEP 1/12 deg.

STUDIES

- **Evaluation of GDAS turbulent air-seas fluxes**
- **Response to strong storms**
- **Geostrophic adjustment**
- **Climatology for coastal oceans**

Work Ahead

- Complete calibration of atmospheric and tide forcing.
- Add river and runoff outflows.
- Complete calibration of initialization procedures.
- End-to-end operational in realtime.
- Validation of nowcast and forecast.