FINE-MESH (1/12 DEGREE) NUMERICAL SIMULATION OF THE NORTH ATLANTIC: AN OVERVIEW

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ABSTRACT

The Miami Isopycnic Coordinate Ocean Model (MICOM) was configured for the North Atlantic (28°S–65°N) with a horizontal resolution of 1/12° (mesh size on the order of 6 km) and 16 layers in the vertical. Such a set-up demands the latest in high performance computing, and the model is presently integrated on the 706 processors T3E at NAVOCEANO (Stennis Space Center). In this configuration, a good result for the Gulf Stream separation is achieved. This result supports the view that an inertial boundary layer (which results from the fine resolution) is an important factor in the separation process. The modeled sea surface height variability compares well with satellite observations.

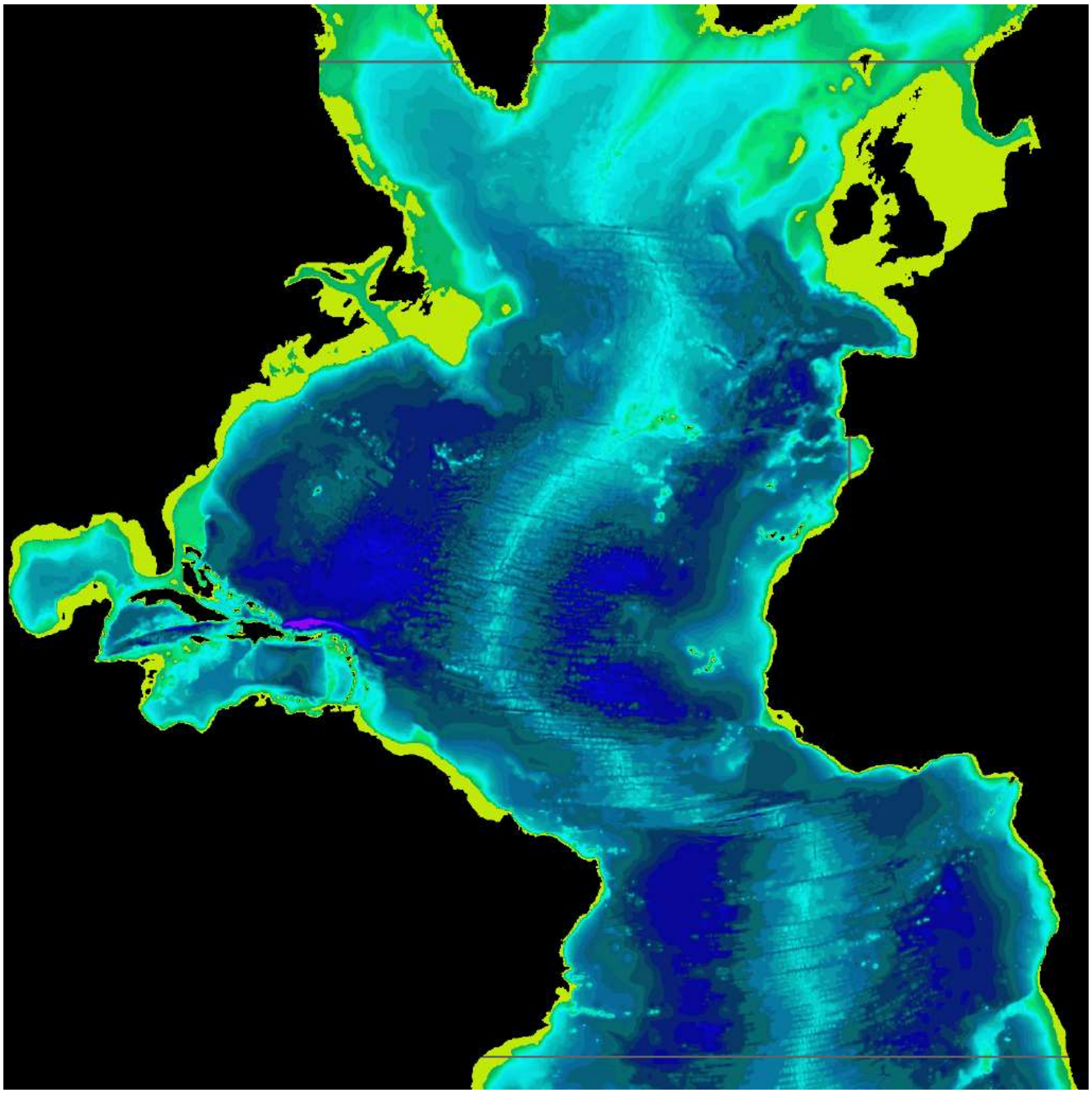
MODEL CONFIGURATION

- **MICOM (Miami Isopycnic Coordinate Ocean Model)**
- **Horizontal grid: 1/12°**
- **28°S to 65°N**
- **16 vertical layers (σ_θ)**
- **Bathymetry: Quality controlled ETOPO_2.5**
- **Surface forcing [COADS climatology from Da Silva (1994)]**

  wind stress
  u-star^3
  heat flux [Q_{net} + dQ/dT (T_{model} - T_{obser})]
  E - P

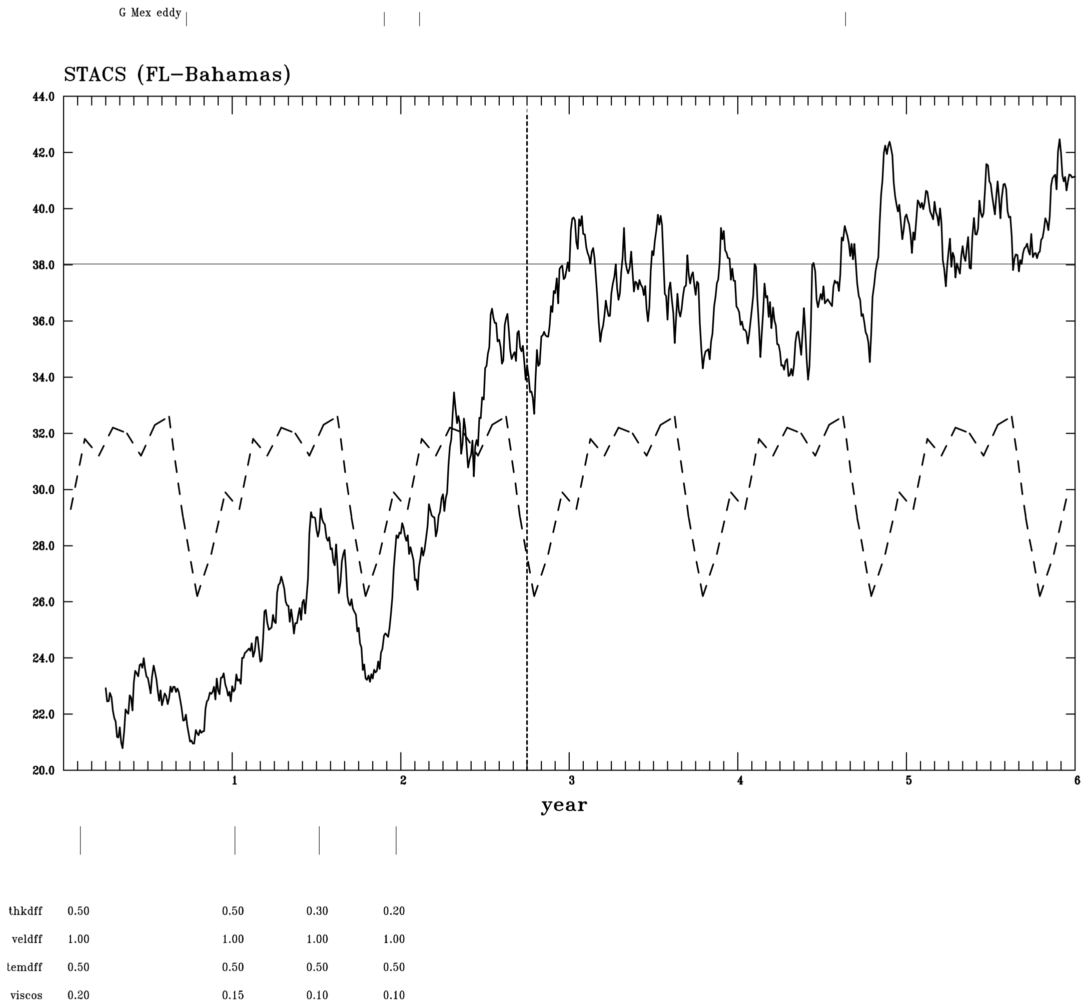
- **River runoff**
- **Buffer zones:**
  3° buffer zones with relaxation to monthly climatological T and S (Levitus)

- **Viscosity:**
  momentum mixing: the greater of:
  (i) 1.0 cm/s $\times$ mesh size
  (ii) 0.1 $\times$ (mesh size)^2 $\times$ velocity deformation
  temp./salin. mixing: 0.5 cm/s $\times$ mesh size
  thickness diffusion: 0.2 cm/s $\times$ mesh size
  diapycnal diffusivity: 0.001 cm^2/s^2 $\times$ (buoyancy frequency)$^{(-1)}$



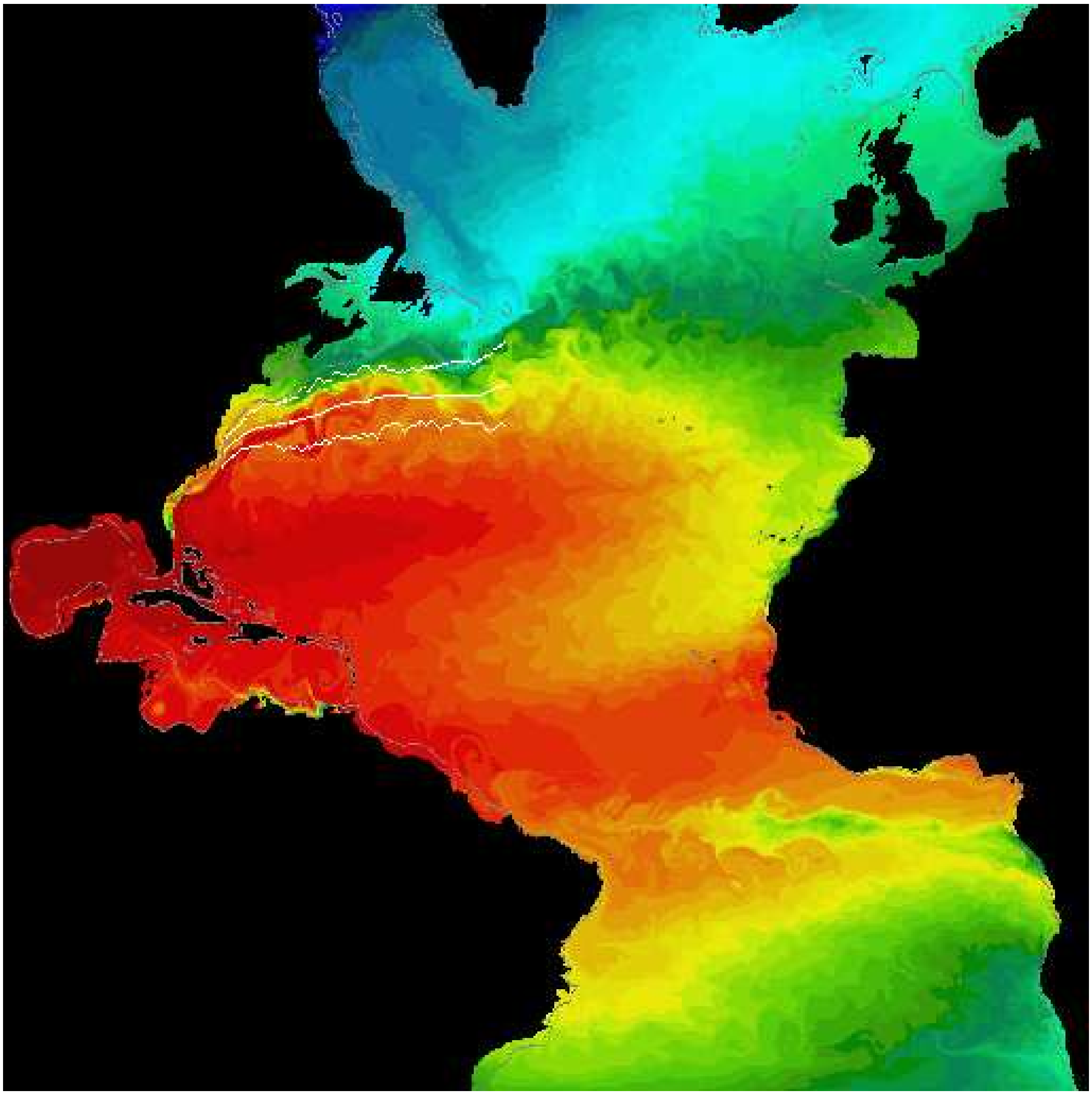
0 m to 8000 m

Topography in meters. The extent of the buffer zones is indicated by the gray lines at the northern and southern boundaries and in the Gulf of Cadiz near the Mediterranean Sea outflow.



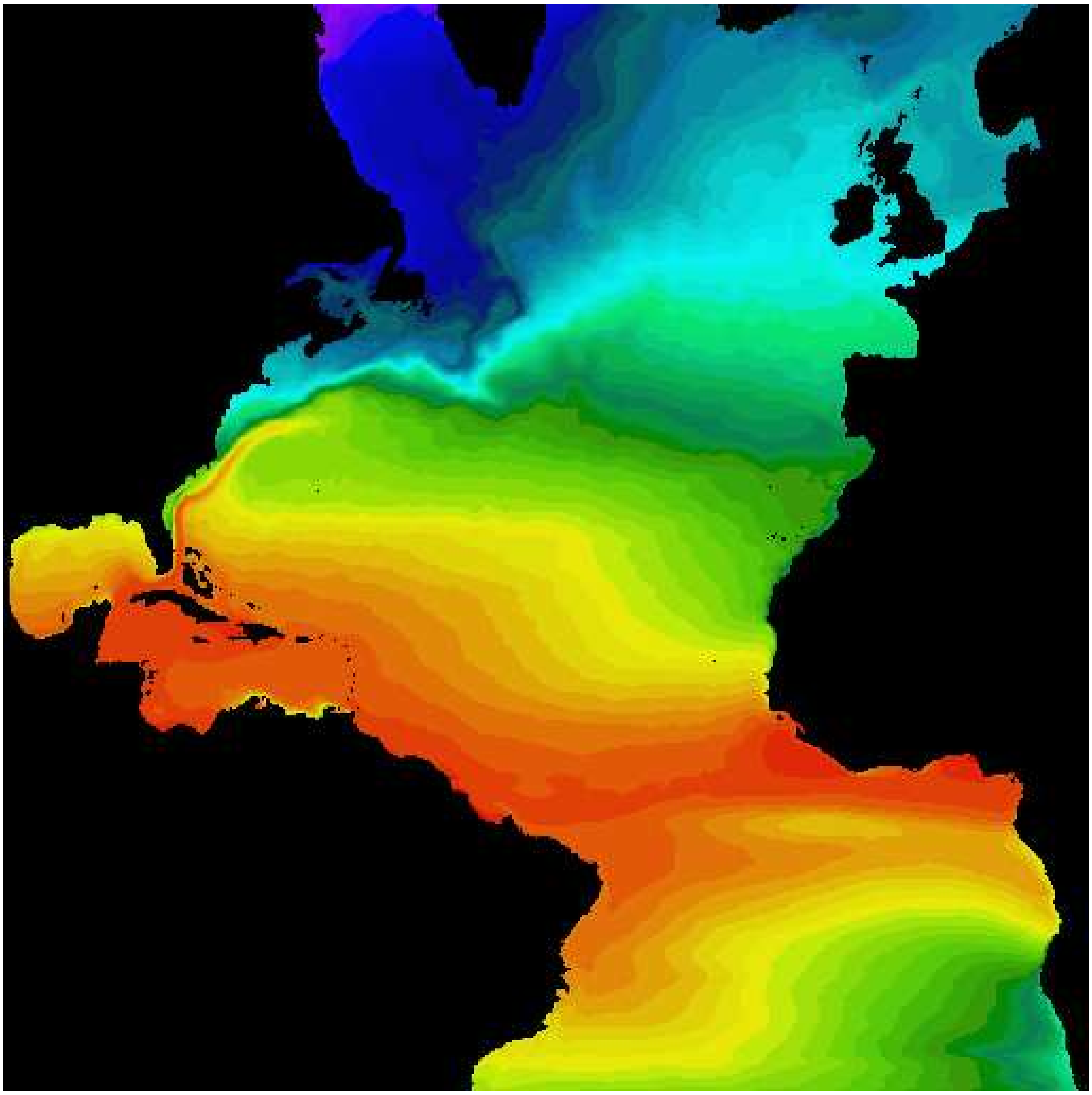
The modeled Florida Current transport (at 26.9°N – solid line) has a mean value of 38 Sv (years 4–6) and is, on the average, stronger than observed (Schott et al., 1987 – dashed line). A good spearation for the Gulf Stream was achieved after 2.7 years of integration (vertical dashed-dotted line). Four Gulf of Mexico Loop Current eddies were formed during the 6-year integration (tick-marks at the top of the figure) with an average time between eddies of 15-18 months.

Sea surface temperature (Sep 15, year 6)



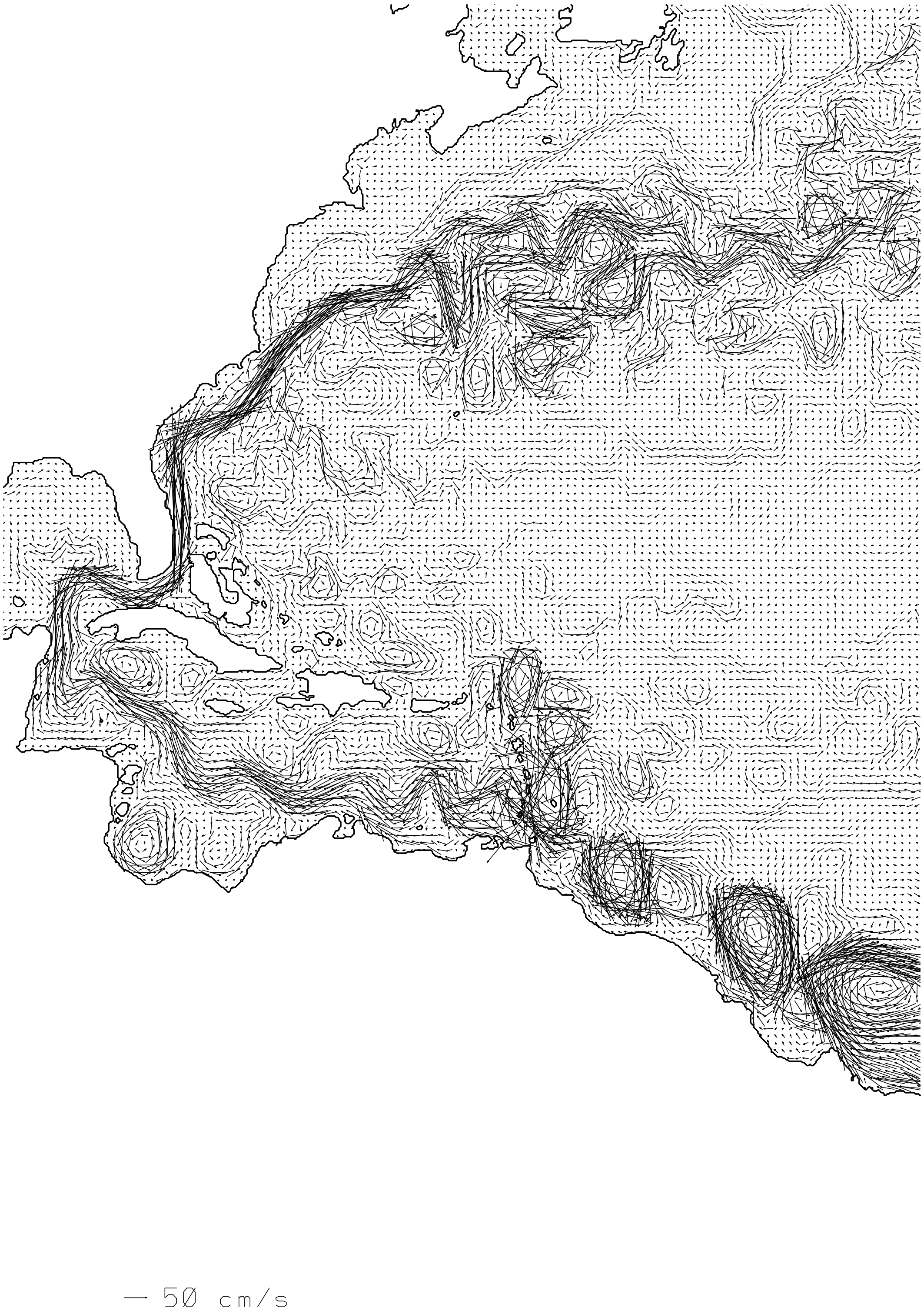
min: 0°, max: 32°C

Sea surface temperature (3-year average)

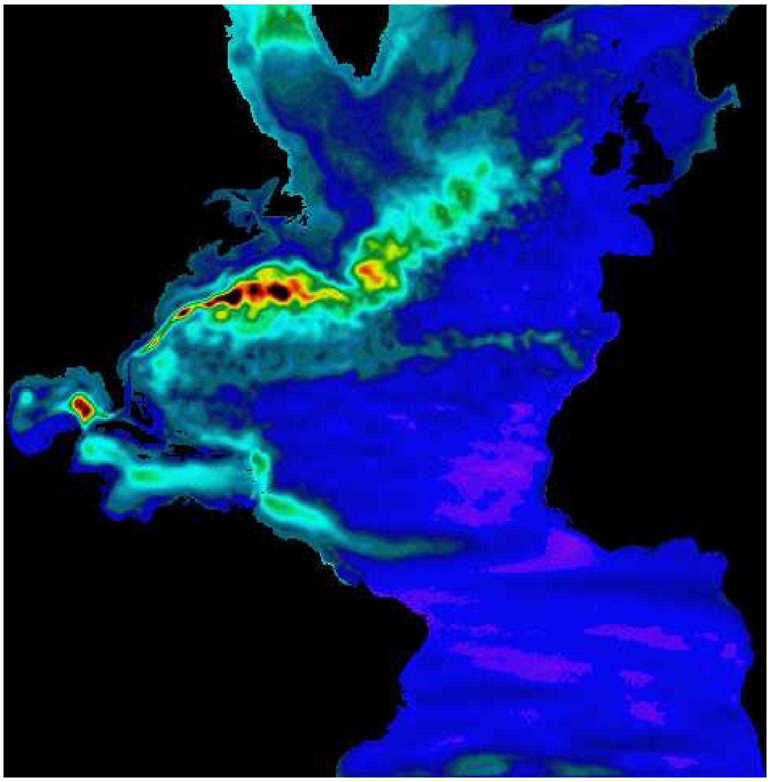


min: 0°, max: 32°C

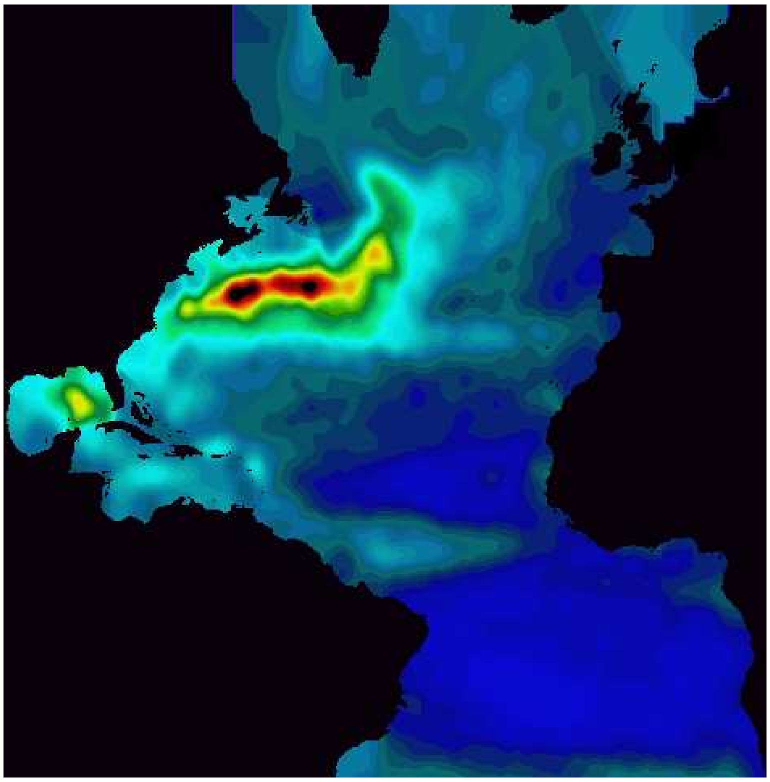
Surface velocity (Sep 15, year 6)



MICOM Sea surface height variability (3-year average)



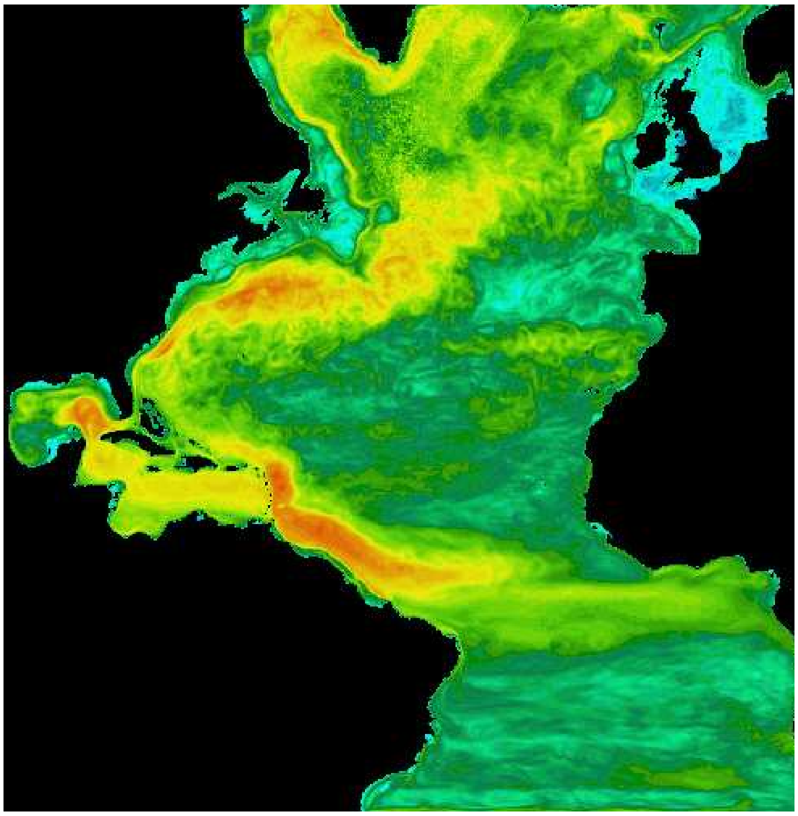
TOPEX (from NASA/JPL, courtesy of G. Goñi)



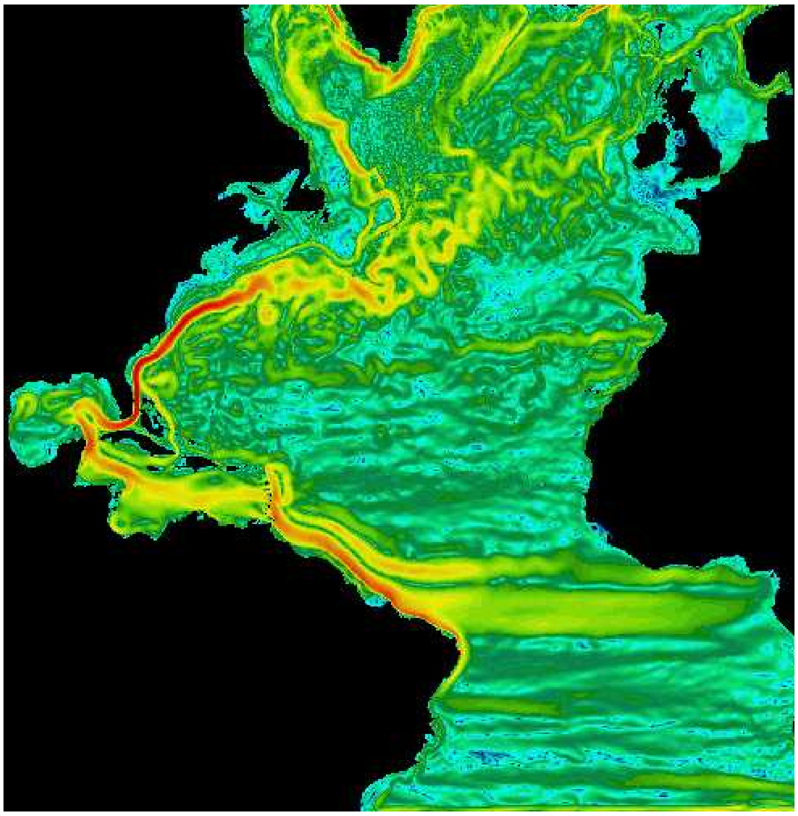
min: 0 ; max: 35 cm

MICOM kinetic energy, layer 1, year 5

Eddy



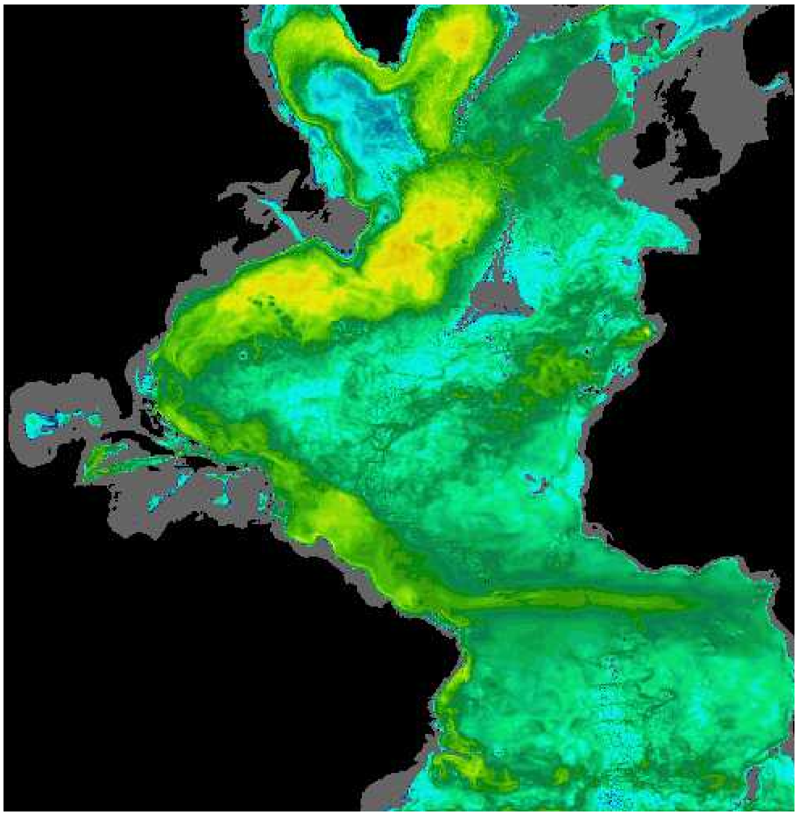
Mean flow



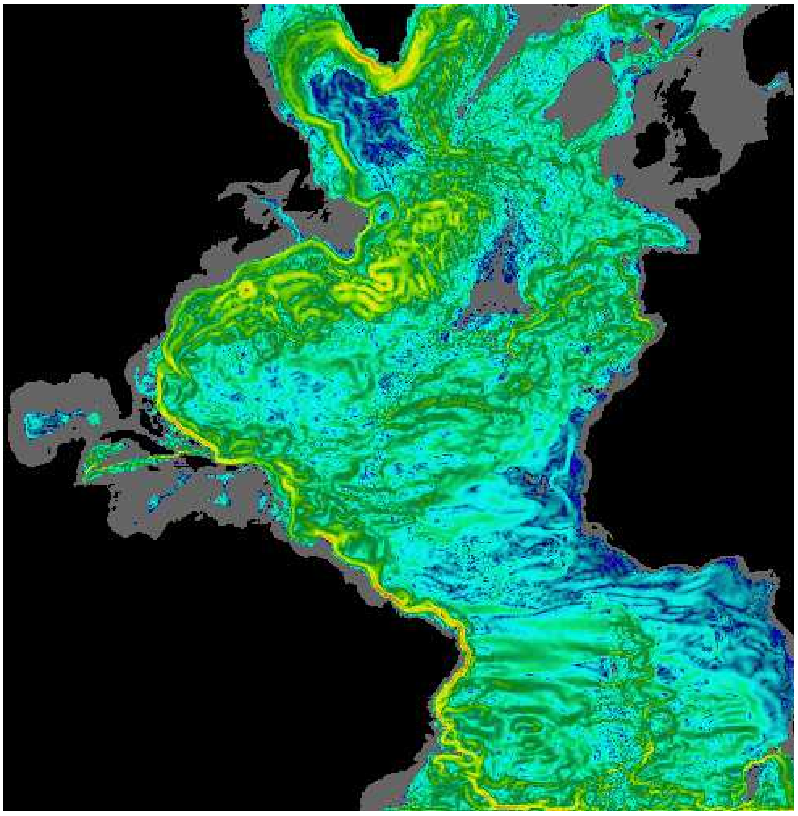
log10 energy (m^3/s^2), min: -6 ; max: 3

MICOM kinetic energy, layer 15, year 5

Eddy



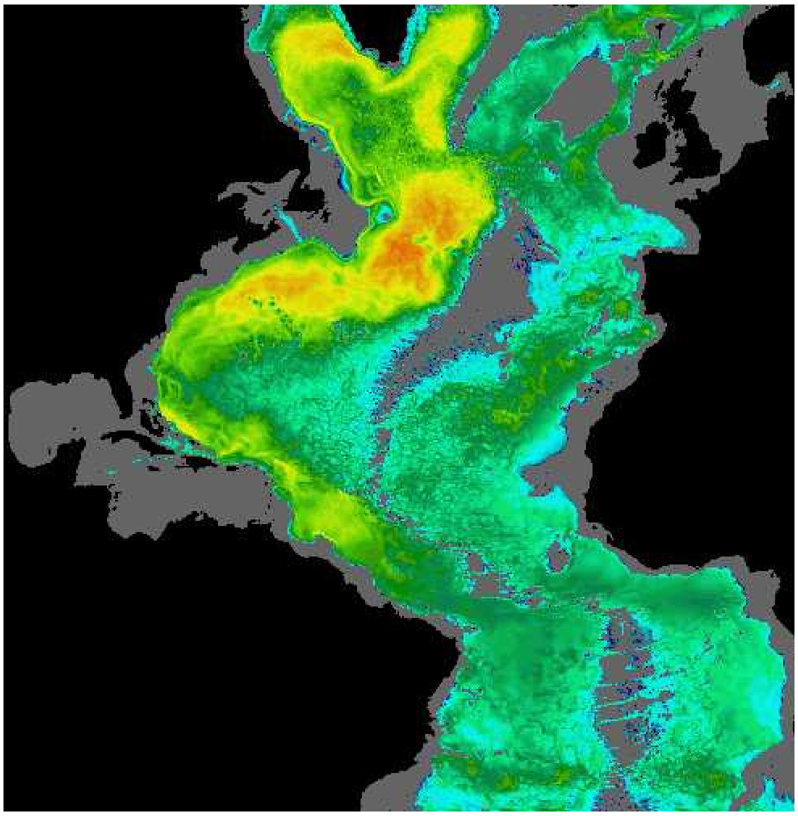
Mean flow



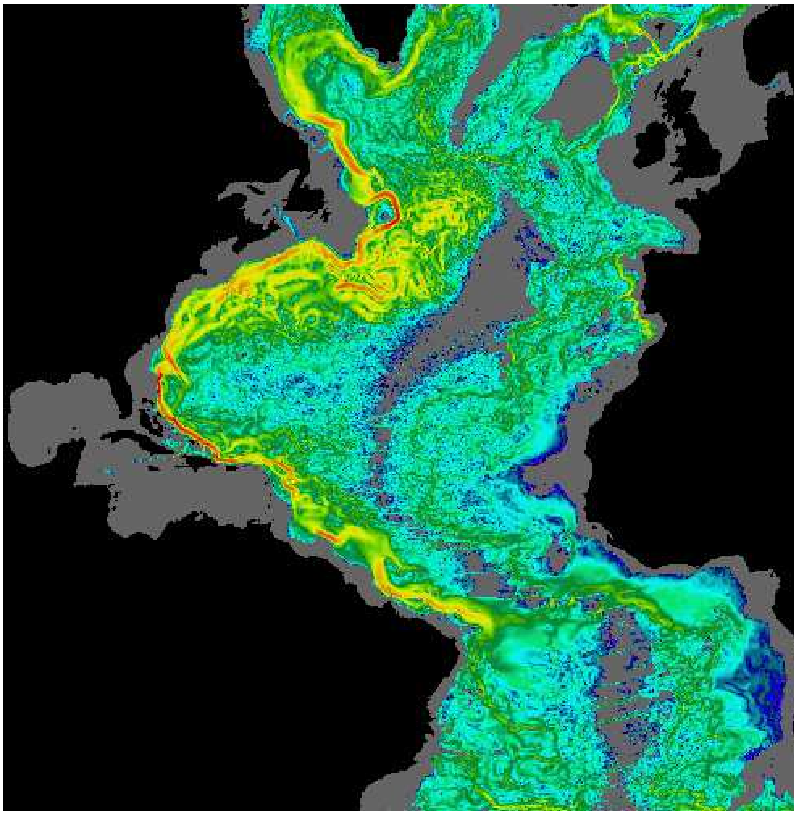
log10 energy (m^3/s^2), min: -6 ; max: 3

MICOM kinetic energy, layer 16, year 5

Eddy



Mean flow



log10 energy (m^3/s^2), min: -6 ; max: 3

Sea surface height, year 5