Real-time Eddy-resolving Ocean Prediction in the Caribbean

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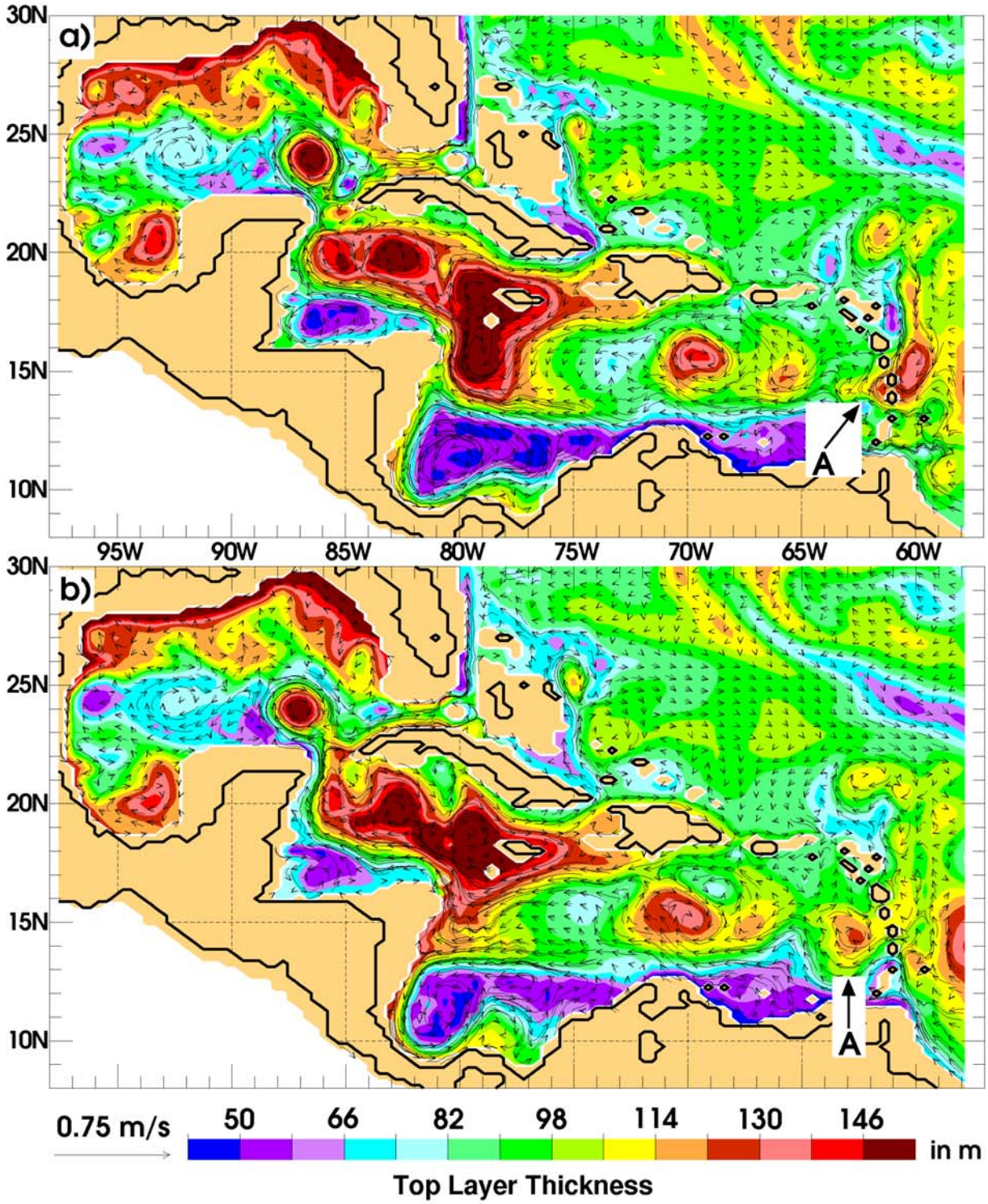
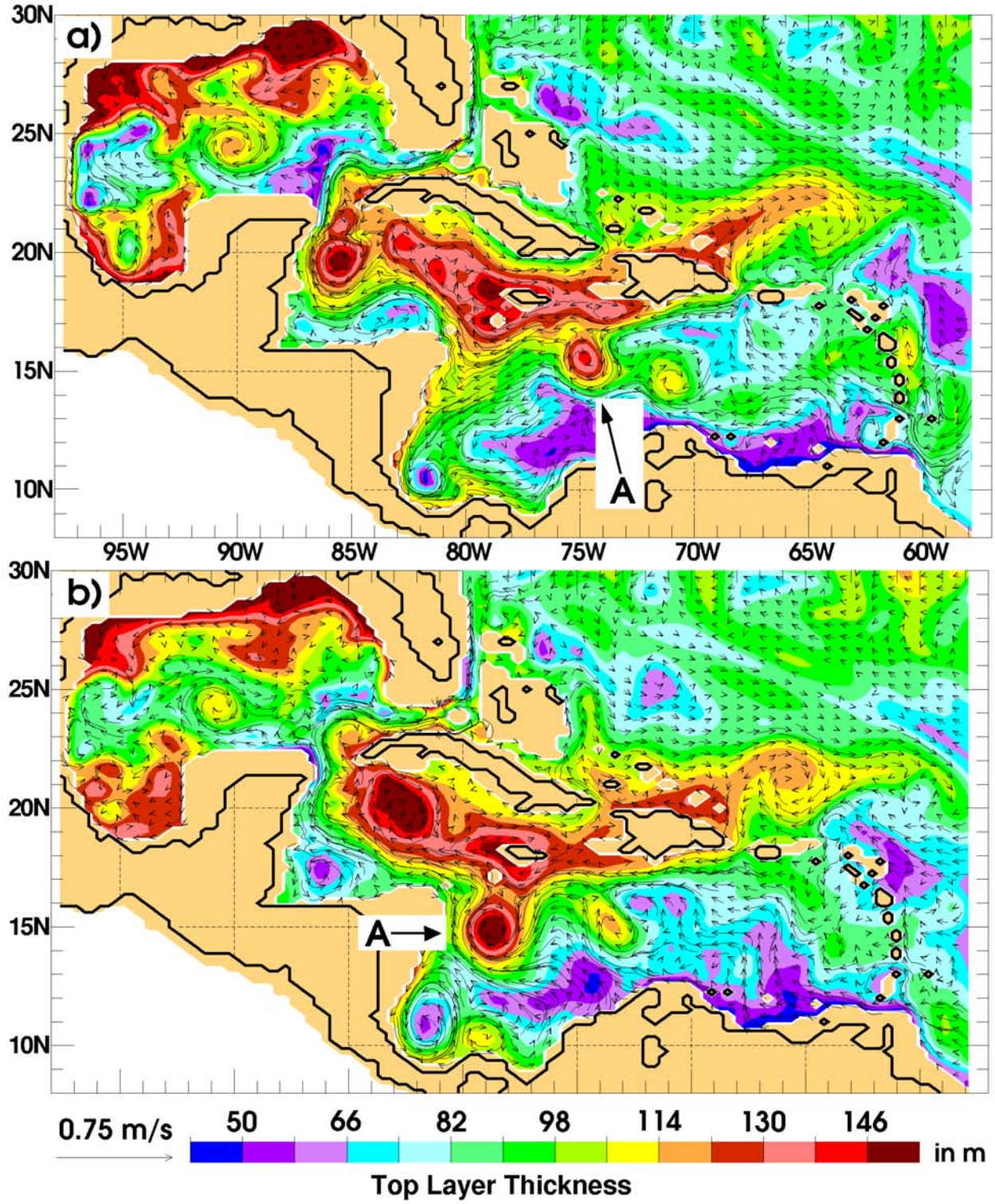
An eddy squeezes through the Lesser Antilles but with diminished amplitude



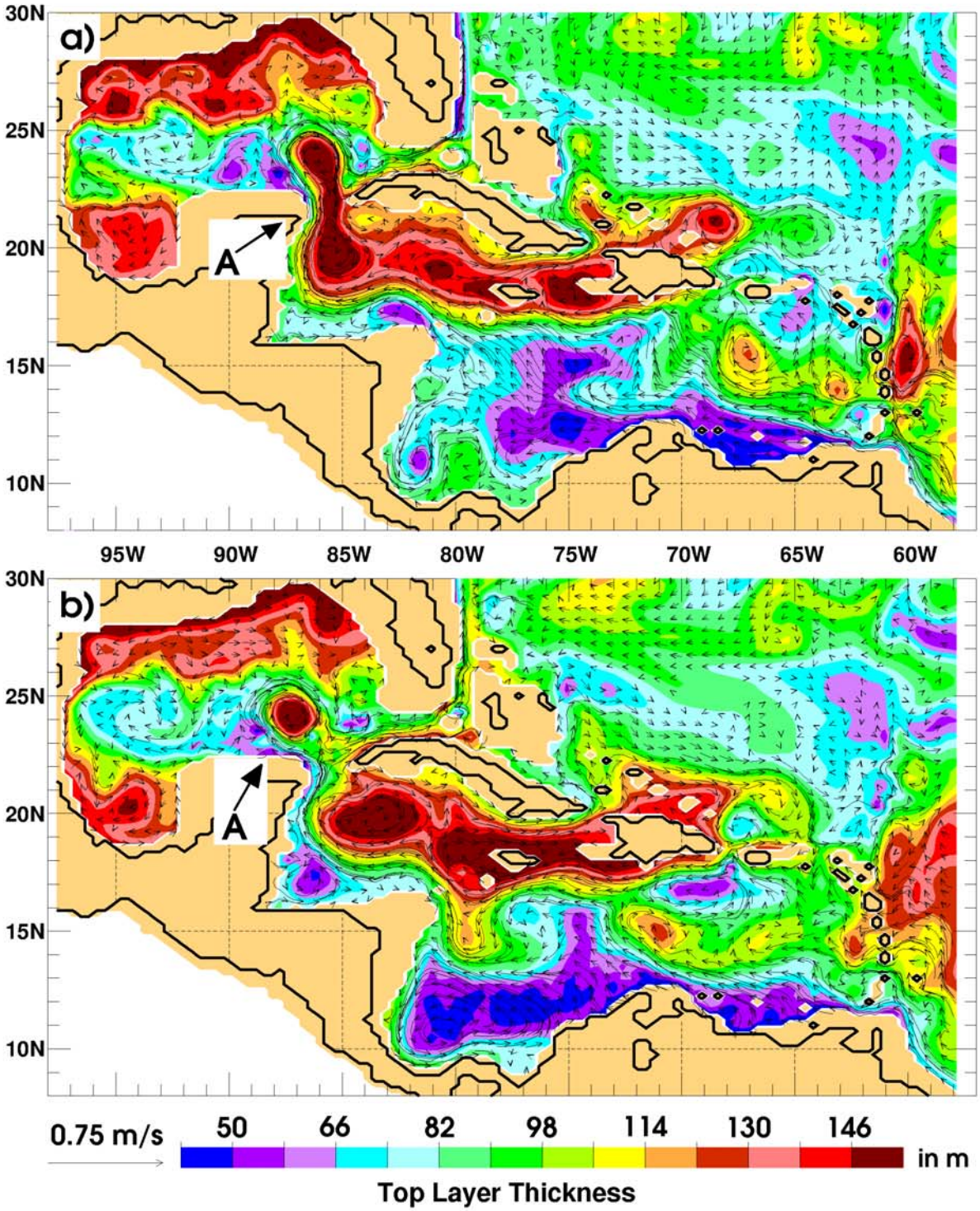
Simulated by a 1/4˚ global 5.5 layer reduced gravity model forced by daily ECMWF 1000 mb winds with the long-term mean replaced by the Hellerman and Rosenstein (1983; JPO) annual mean

Eddy propagates westward through the Caribbean and amplifies due to flow instabilities of the Caribbean Current



Simulated by a 1/4˚ global 5.5 layer reduced gravity model forced by daily ECMWF 1000 mb winds with the long-term mean replaced by the Hellerman and Rosenstein (1983; JPO) annual mean

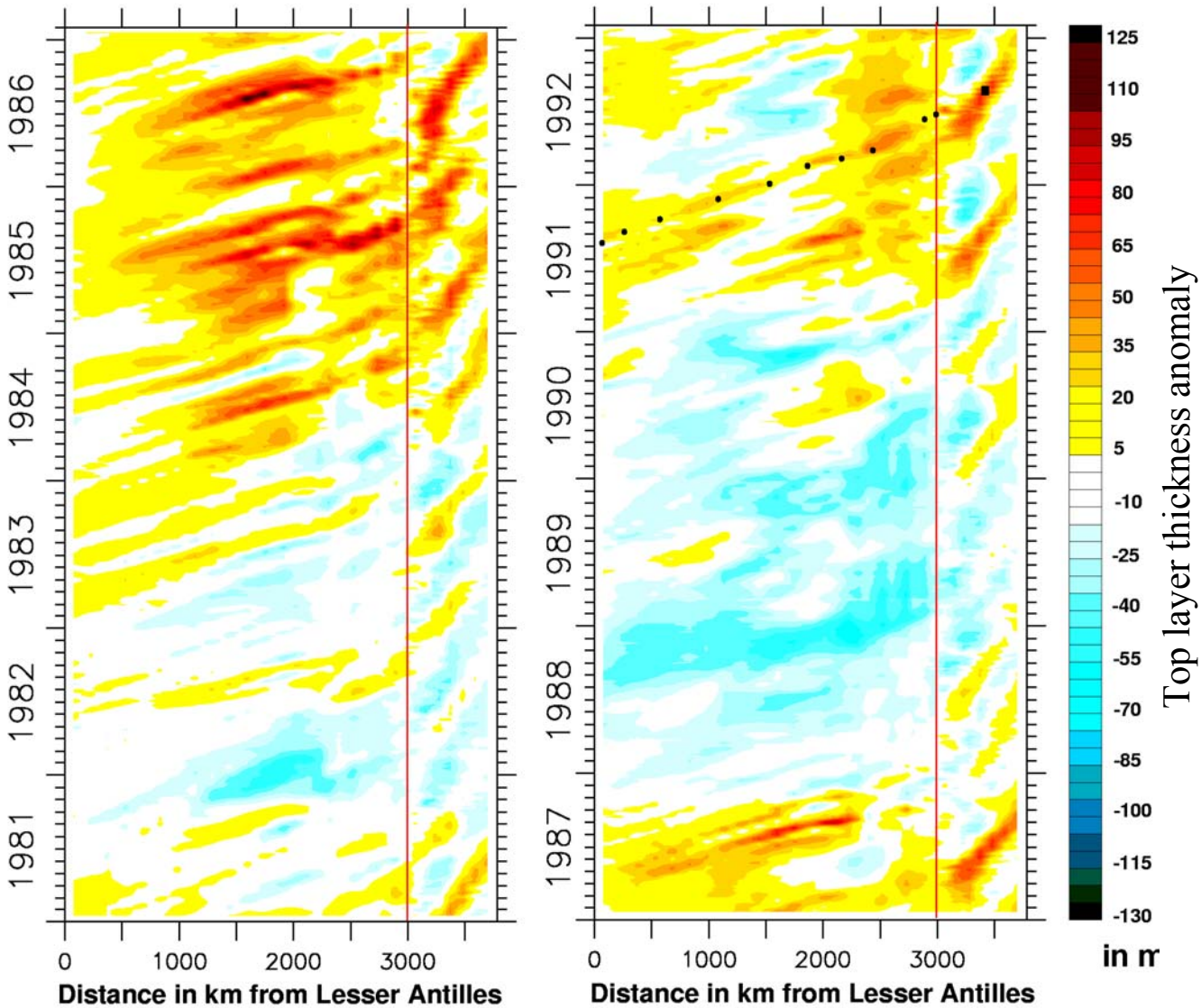
Eddy squeezes through Yucatan Channel and contributes to Loop Current eddy-shedding event



Simulated by a 1/4˚ global 5.5 layer reduced gravity model forced by daily ECMWF 1000 mb winds with the long-term mean replaced by the Hellerman and Rosenstein (1983; JPO) annual mean

Caribbean eddy influence on Loop Current eddy-shedding in the Gulf of Mexico

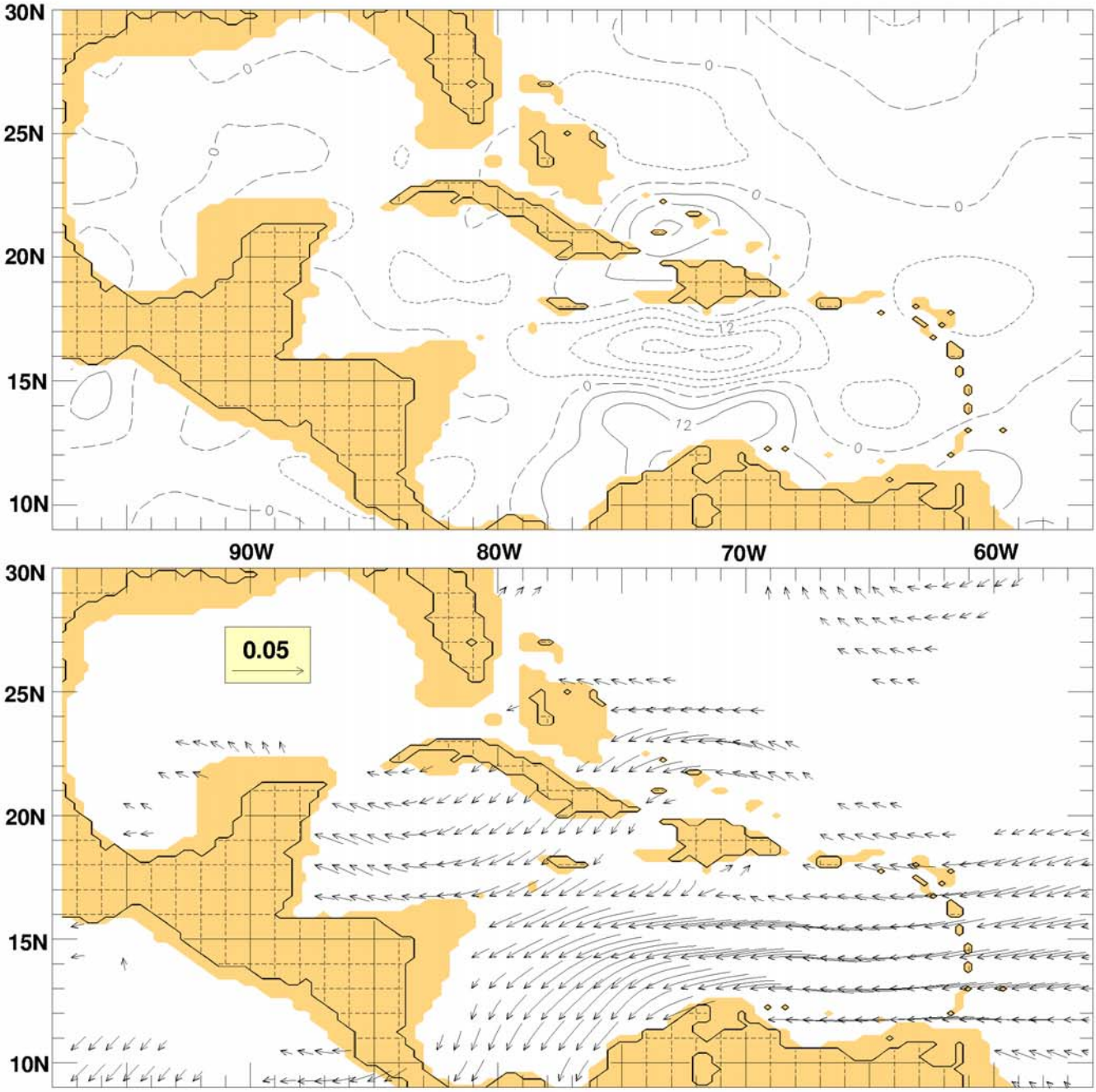
Eddy propagation vs time from the Lesser Antilles (0 km), through the Yucatan Channel (red line at 3000 km) to the western Gulf of Mexico



Simulated by a 1/4° global 5.5 layer reduced gravity model forced by daily ECMWF 1000 mb winds with the long-term mean replaced by the Hellerman and Rosenstein (1983; JPO) annual mean

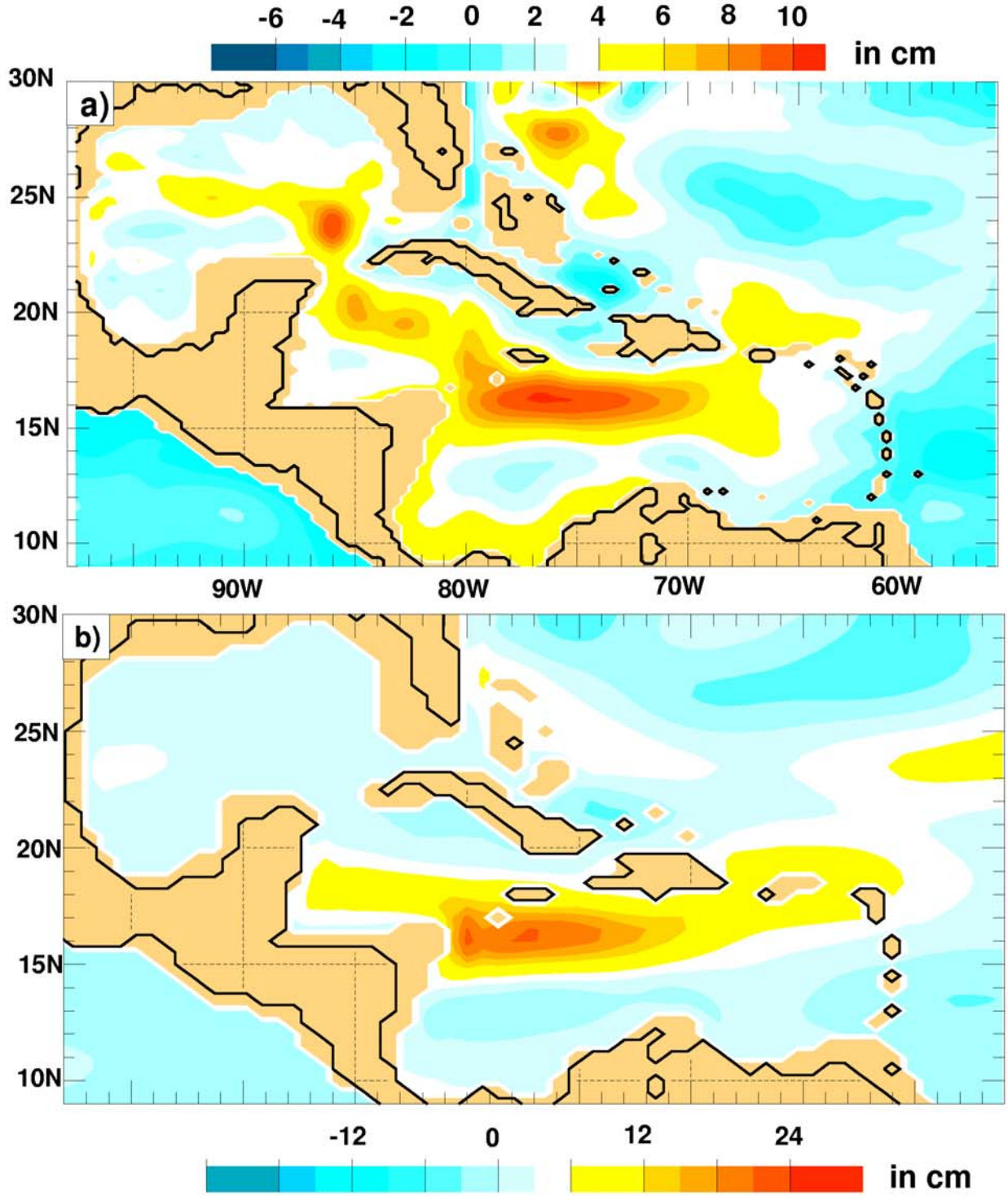
An intradecadal anomaly in the ECMWF wind forcing over the Caribbean as seen in the wind stress curl (top panel) and the wind stress vectors (bottom panel).

1985-1986 Mean minus 1981-1991 Mean



Wind Curl contour interval is 6 Pa/m x 10^{-8}, wind stress in newtons/m^2

An intradecadal anomaly is confined to the Caribbean in a 1/2˚ linear simulation (bottom panel), but in a 1/4˚ nonlinear simulation the anomaly is propagated all the way into the western Gulf of Mexico via eddies from the Caribbean (top panel).



1985-1987 mean minus 1981-1991 mean sea surface height. Both the 1/2˚ 1.5-layer linear and the 1/4˚ 5.5-layer nonlinear global reduced gravity model simulations were forced by daily ECMWF 1000mb winds with the long-term mean replaced by the Hellerman and Rosenstein (1983; JPO) annual mean.

First Operational Eddy-Resolving 1/16° Global Ocean Prediction System

- **Developed** by the Naval Research Laboratory at Stennis Space Center, MS
  - Uses NRL Layered Ocean Model (NLOM)
    - ♦ 1/16° x 45/512° (Lat x Lon) resolution
      - ◊ 7 layers in vertical including bulk mixed layer & SST
      - ◊ free surface and bottom topography

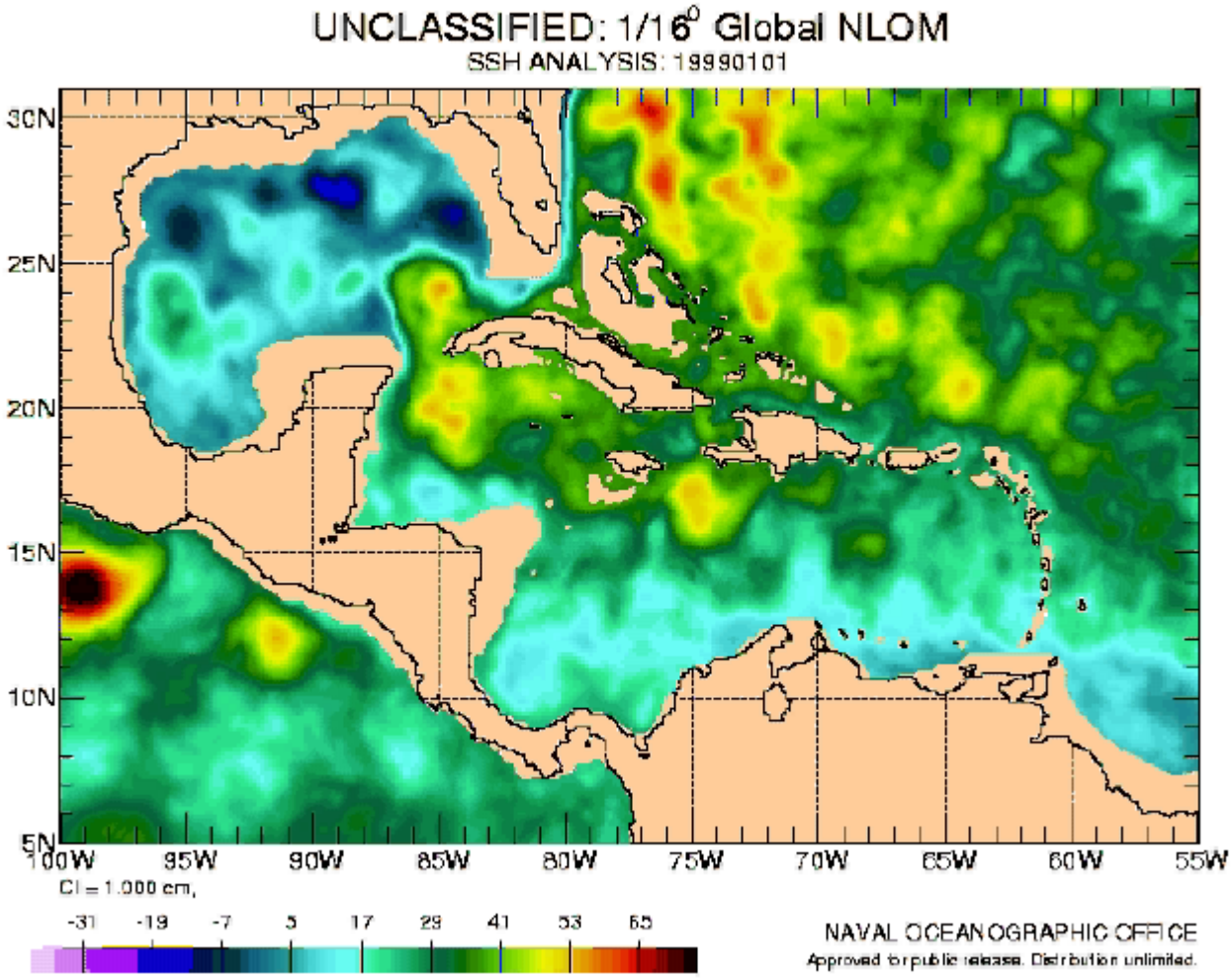
- **Operational** at Naval Oceanographic Office since 27 Sept 2001
  - Run daily by NAVO in real time since 18 Oct 2000 on Cray T3E and IBM SMP
  - ~7 km resolution at mid-latitudes
  - 30-day forecasts every Wednesday, 4-day forecasts daily

- **Real-time web site**:
  http://www7320.nrlssc.navy.mil/global_nlom/index.html

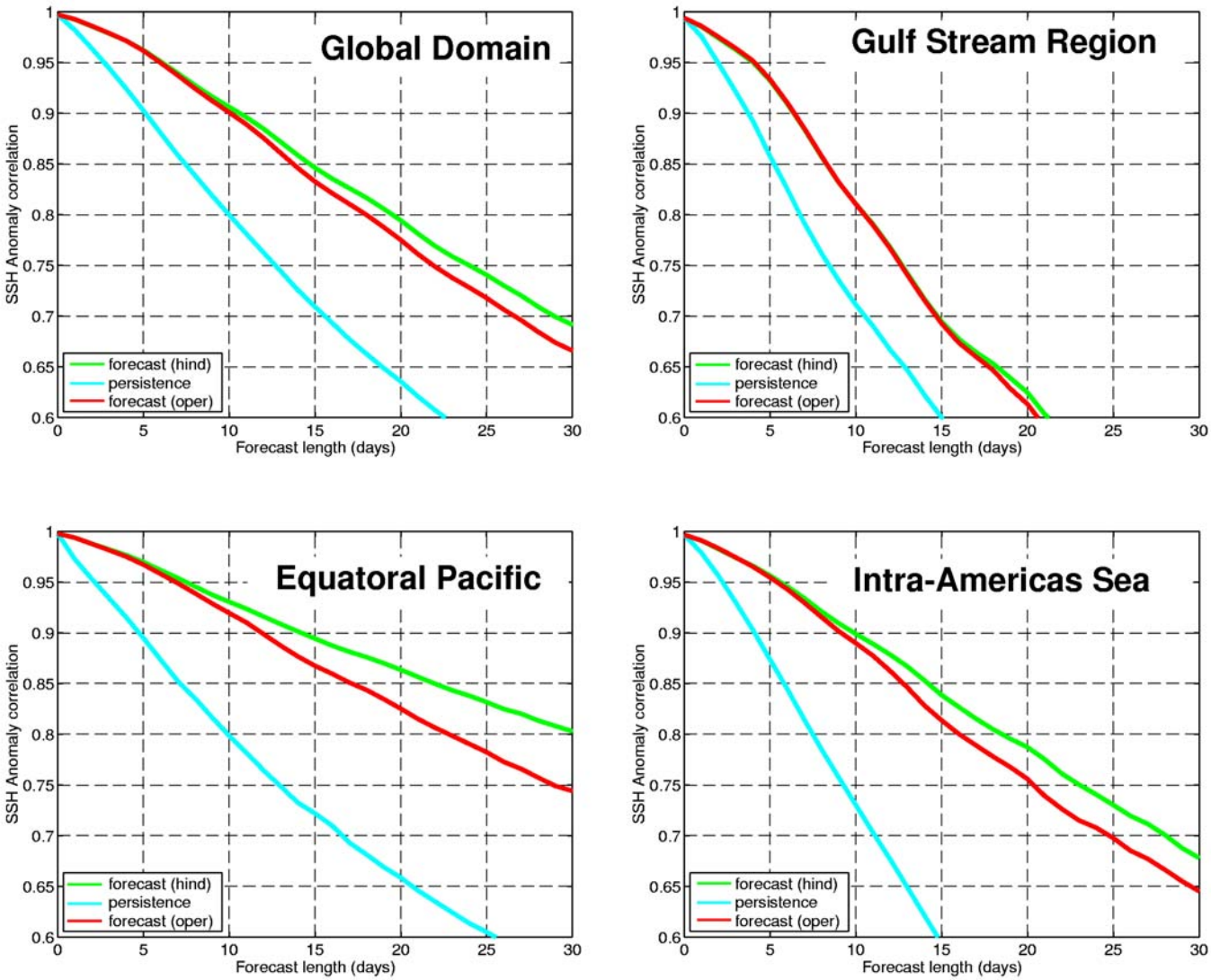
- **Assimilates real-time sea surface height data from the ERS-2, GFO, T/P satellite altimeters**
  - The essential available data source for eddy-resolving global ocean circulation monitoring and prediction

- **Assimilates Sea Surface Temperature from satellite IR**

- **Atmospheric forcing from Fleet Numerical Meteorology and Oceanography Center**
  - forcing for forecasts reverts toward climatology after 4 days
    - ♦ not a serious detriment for many ocean features


UNCLASSIFIED: 1/16° Global NLOM
SSH ANALYSIS: 19990101
30N
25N
20N
15N
10N
5N
100W
95W
90W
85W
80W
75W
70W
65W
60W
55W
CI = 1.000 cm,
-31
-19
-7
5
17
29
41
53
65
NAVAL OCEANOGRAPHIC OFFICE
Approved for public release. Distribution unlimited.

30-Day SSH Forecast Sensitivity to Atmospheric Forcing and SST
Metric: SSH Anomaly correlations vs. Forecast Length



1/16˚ Global NLOM Nowcast/Forecast System

Mean of 6 forecasts initialized 3 Jan - 14 Feb 2001

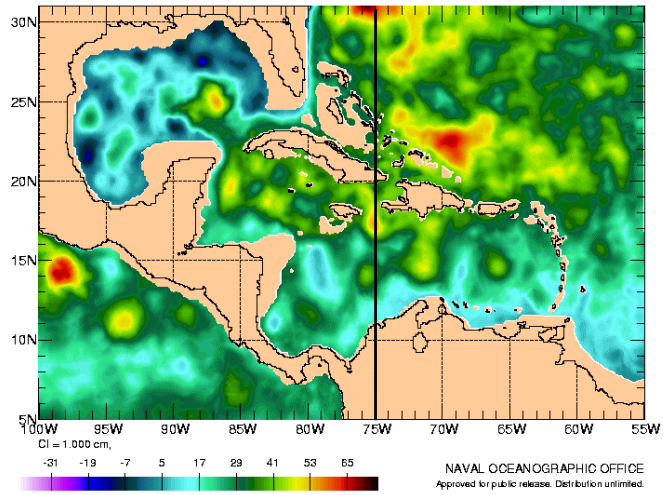
— Analysis quality atmospheric forcing and SST during hindcast

— Atmospheric forcing reverts toward climatology and SST is relaxed toward climatologically - corrected persistence

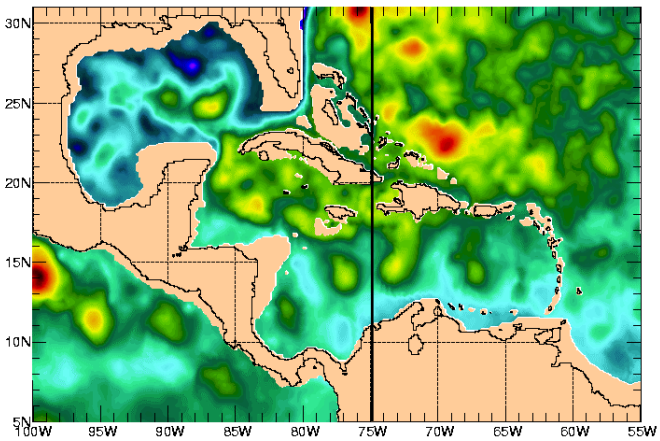
E-folding time scale for SST relaxation is 1/4 forecast length in both cases.

Real-time 1/16º Global NLOM

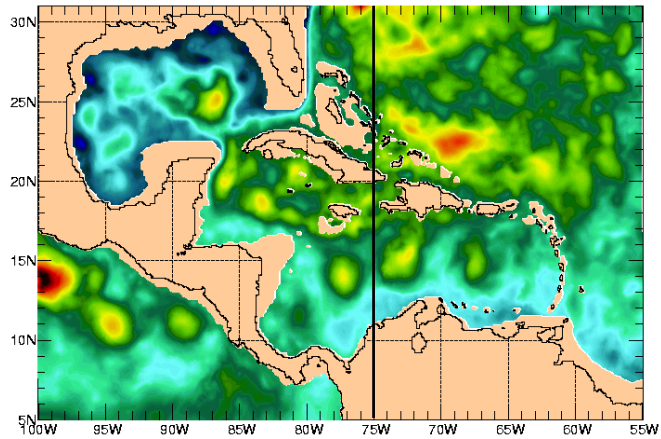
Forecast Verification in Intra-Americas Sea Region



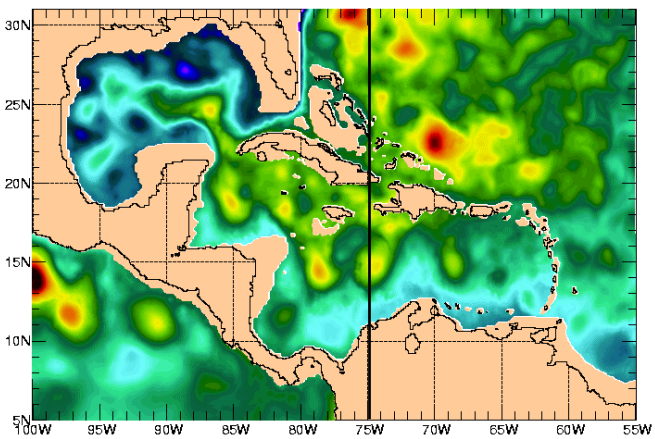
NLOM SSH analysis January 3, 2001



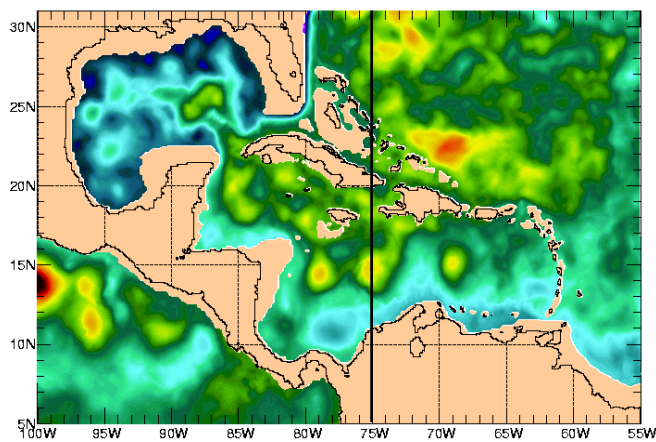
15-day NLOM SSH forecast valid January 18,2001



NLOM SSH analysis valid January 18, 2001



30-day NLOM SSH forecast valid February 2, 2001



NLOM SSH analysis valid February 2, 2001