Nesting the Gulf of Mexico in Atlantic HYCOM: Oceanographic Processes Generated by Hurricanes Ivan, Katrina, and Rita

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RSMAS, University of Miami, FL.
1/12° ATL HYCOM provides boundary conditions for the 1/25° GOM HYCOM Simulations
BCS are updated every 1-day
Barotropic and Baroclinic modes in BCS
20 grid-point wide relaxation zone
1-10 day relaxation e-folding time
Sea Surface Temperature (°C)

- 30.09°N, 88.77°W
  - r = 0.96
  - r = 0.99
- 29.25°N, 94.41°W
  - r = 0.96
  - r = 0.99
- 25.84°N, 89.66°W
  - r = 0.97
  - r = 0.97
- 26.94°N, 96.70°W
  - r = 0.98
  - r = 0.98

Observations (black) are from the National Data Buoy Center

1/12° ATL (NOGAPS–KPP)
1/25° GOM (NOGAPS–KPP)
Sea Surface Temperature (°C)

Observations (26.01° N, 85.91° W)
1/12° ATL (NOGAPS-KPP)
1/25° GOM (NOGAPS-KPP)
1/25° GOM (NOGAPS-GISS)
1/25° GOM (NOGAPS-MY)
1/25° GOM (NOGAPS-PWP)
1/25° GOM (NOGAPS-KT)
1/25° GOM (NOGAPS-NML)

Observations are from the National Data Buoy Center

r = 0.89
r = 0.83
r = 0.84
r = 0.90
r = 0.83
r = 0.82
r = 0.55

Sea Surface Temperature

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec 2004
Sea Surface Temperature

August 2005 - September 2005

Observations (25.84° N, 89.66° W)
1/12 ATL (NOGAPS-KPP)  r = 0.85
1/25 GOM (NOGAPS-KPP)  r = 0.83
1/25 GOM (NOGAPS-GISS) r = 0.82
1/25 GOM (NOGAPS-MY)  r = 0.81
1/25 GOM (NOGAPS-KT)  r = 0.82
1/25 GOM (NOGAPS-PWP) r = 0.73

Katrina

Rita
The blue experiment includes correction in heat fluxes

Observations (25.84° N, 89.66° W)
1/12° ATL (NOGAPS–KPP) $r = 0.85$
1/25° GOM (NOGAPS–KPP) $r = 0.82$
1/25° GOM (NOGAPS–KPP–WC) $r = 0.84$
Transport (Sv)

Yucatan Channel
Key West–Cuba

Frances → Ivan

1/25° GOM (NOGAPS–KPP)
1/12° ATL HYCOM SSH Anomaly (cm)

Sep-12-2004
CTW

Sep-13-2004
CTW

Sep-14-2004
CTW

Sep-15-2004
CTW
From Florida to Yucatan along the coast of the GOM
Deterministic versus Nondeterministic variability of the GOM

In order to assess the degree of determinism in the experiments, an ensemble of seven simulations was integrated over the year 2004. These simulations differed only in their initial states (one day apart).

Since these simulations differ only in initial state, any differences between them can be attributed to nondeterministic differences in both the initial conditions and the evolution of the simulations.

Metzger et al. [1994] developed a technique to separate the variability of a variable into two components:

The deterministic component is a direct response to atmospheric forcing.

The nondeterministic component is due to nonlinear mesoscale flow instabilities.
Sea Surface Temperature (°C)

Observations (26.01° N, 85.91° W)

- 1/12° ATL (NOGAPS-KPP)
- 1/25° GOM (NOGAPS-KPP)
- 1/25° GOM (NOGAPS-GISS)
- 1/25° GOM (NOGAPS-MY)
- 1/25° GOM (NOGAPS-PWP)
- 1/25° GOM (NOGAPS-KT)
- 1/25° GOM (NOGAPS-NML)

Observations are from the National Data Buoy Center

r = 0.89
r = 0.83
r = 0.84
r = 0.90
r = 0.83
r = 0.82
r = 0.55