Multivariate assimilation of satellite and in situ data in a high resolution layered model of the North Atlantic: a contribution to the DIADEM and TOPAZ projects.

Jean-Guillaume Piccoliti, Florence Briot, Jean-Michel Barkant, Pierre Brasseur and Jacques Verron
LEGOS-LEP/ICE, 38041, Grenoble, France
Jean-Guillaume.Piccoliti@legos.obs-mip.fr

Assimilation system

**Context**

This work is a contribution to the DIADEM and TOPAZ projects funded by the European Union, participating in the development of ocean operational forecasting systems (GOOS), and particularly focusing on the multivariate assimilation of satellites and in situ observations.

**Scientific objectives**

- **Observation system**
  - 3-day AVHRR data coverage (4x4 km resolution, assimilated in EXPT1 and EXPT2).
  - 10-day map produced by aggregation and checking of original data (a) 3-day AVHRR data coverage (4x4 km resolution, assimilated in EXPT1 and EXPT2). (b) 10-day altimetric observations for analysis on December 21, 1992. (c) 3-day AVHRR data coverage (4x4 km resolution, assimilated in EXPT1 and EXPT2).

- **Assimilation system**
  - Update with earlier or hybrid coordinate assimilation (MICOM and HYCOM).
  - Multivariate assimilation of satellite and in situ data in a high resolution layered model of the North Atlantic: Sea surface elevation forecast for verification.

**Table of experiments**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Variable</th>
<th>Method</th>
<th>Model configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPT1</td>
<td>MICOM mixed layer thickness for December 21, 1992 in EXPT1 (left figures) and December 21, 1992 in EXPT2 (right figures).</td>
<td>SSH, SSS</td>
<td>Filter</td>
<td>HYCOM</td>
</tr>
<tr>
<td>EXPT2</td>
<td>HYCOM mixed layer thickness for December 21, 1992 in EXPT2 (left figures) and December 21, 1992 in EXPT2 (right figures).</td>
<td>SSH, SSS</td>
<td>Filter</td>
<td>HYCOM</td>
</tr>
</tbody>
</table>

**HYCOM: a new perspective**

Why using HYCOM?  
- Improve the representation of the mixed layer (vertical dissipation).
- Improve the representation of the circulation in the coastal zones.
- Improve the representation of the mixed layer (better vertical resolution in EXPT2).

**Latest**

- This work is presented in the Gulf of Mexico: for the Gulf of Mexico, the model simulates deep ocean and the transition to isopycnal coordinates. Note the presence of HYCOM's vertical frame of the U.S. HYCOM project.  
- The ocean and the transition to isopycnal coordinates: note the presence of HYCOM's vertical frame of the U.S. HYCOM project.

**Validated with independent data**

- Use HYCOM instead of MICOM.
- Show the realistic surface circulation (fig 2 and 3).
- Test experiment using along-track altimetry (XBTs).
- Improved and validated the error computed by the filter using innovation values (fig 5.1).
- Use HYCOM instead of MICOM.

**Figure 1.4**

- Analysis: during the adjustment stage, the model moves far from the experimental configurations.
- Validation: after the adjustment stage, the model is selected after the statistical analysis, during the adjustment stage.

**Figure 6.4**

- Multivariate assimilation of satellite and in situ data in a high resolution layered model of the North Atlantic: Sea surface temperature/avhrr/pathfinder.
- The mixed layer depth increases along the Labrador Sea, the model simulates deep water formation near 35°N (with a 1°C warmer than observed).  
- The subduction process that forms subtropical mode water around 35°N (with a 1°C warmer than observed).

**Conclusions**

- The observed TS profiles are transformed in isopycnic coordinates and the model moves far from the experimental configurations.
- The subduction process that forms subtropical mode water around 35°N (with a 1°C warmer than observed).

**Bibliography**
