Operational monitoring of the mesoscale ocean

**L. Kerleguer [1], P. Bahurel [1],
R. Baraille [1], E. Dombrowsky [2],
M. Gavart [3], S. Giraud [2], D. Jourdan [1]
[1] (SHOM/LEGOS, France)
[2] (CLS, France)
[3] (Michel Gavart Consultant, France)**

**Our investigation aims to study how Jason altimetry data can benefit the SOAP mesoscale ocean forecasting system developed by SHOM, the French Navy's hydrography and oceanography department.
The investigation will focus on three areas:**

1. **study and adaptation of Jason-1 altimetry data (accuracy, condi tioning, etc.) for assimilation into an ocean prediction model;**
2. **improvement of techniques used to assimilate altimetry data into real-time operational models;**
3. **definition and distribution of oceanography products derived from altimetry data.**

Main objectives

This investigation aims to assimilate Jason-1 and ENVISAT altimetry data to constrain a high-resolution operational ocean model.

The underlying principle relies on routine assimilation of real-time altimetry data into one or more high-resolution ocean models.
Our objective is to conduct routine analyses and predictions in real time of the three-dimensional ocean at regional scale. For this purpose, we intend to develop methods for processing, assimilating, and modeling data, and for implementing them on a routine basis in real time.

This investigation follows on from exploratory work undertaken on the SOAP project since 1991 by the French Navy's hydrography and oceanography department (SHOM) in collaboration with CLS. It is focused chiefly on representing mesoscale circulation and, therefore, on the use of high-resolution regional models.
It is closely tied to the MERCATOR investigation [Bahurel et al, this issue], which aims to make global ocean forecasting a reality and supply real-time boundary-forcing data for high-resolution regional systems (interleaved models).
The SOAP regional system is a potential user of the global MERCATOR system, as both exploit altimetry data.

Our work is therefore geared towards developing operational applications as described in the SWT Announcement of Opportunity.

Activities (1998, 1999, 2000) and results

Altimetry data acquisition and processing

The objective here is to prepare the systems used to acquire and process input altimetry data. The period during the run-up to the launch of Jason-1 has given us time to optimize the DUACS system (Developing Use of Altimetry for Climate Studies) operated by CLS, which acquires, processes, validates, and merges TOPEX/POSEIDON and ERS-2 data before assimilation.
Two main actions were pursued during the 1998-2000 period:

• upgrading of DUACS real-time systems in readiness for the future integration of data from Jason-1, GFO and ENVISAT; these new systems have been in routine operation since fall 1999;
• calculation of a mean sea surface (MSS) over a regular 1/16° global grid merging mean sea surface heights derived from the ERS-1 space geodesy mission, and from Geosat, ERS-1 and TOPEX/POSEIDON repeat cycles; calculation of this MSS has been optimized for ocean applications with a view to using it as a reference surface when merging new altimetry data from current or future missions.

Assimilation and Modeling

The objective here is to develop and test advanced techniques for assimilating altimetry data into ocean models. Over the 1998-2000 period, the main research effort has concentrated on adaptive filtering. An adaptive filter, the underlying theory of which was conceived by Son Hoang [Hoang 99], lets us estimate certain unknown or empirically specified parameters in data assimilation schemes by minimizing the mean prediction error. This filter can be most simply and cheaply applied to identify the vertical correlation coefficients of the error covariance matrix in an optimal interpolation scheme.
This technique has been employed successfully with a 1/3° configuration of the North Atlantic. Results show

that it offers a significant improvement in the prediction error at the surface compared to more conventional assimilation schemes.

Generation and distribution of oceanography products derived from altimetry

Routine real-time regional analysis and prediction

Routine exploitation in real time of model/assimilation configurations is one of the investigation's chief aims.
We will consider two configurations:
• The SOPRANE configuration, consisting of a 1/10° quasi-geostrophic model covering the North-East Atlantic (from 24°N to 54°N and from 35°W to the European and African coasts) and the SOFA optimal interpolation assimilation scheme (developed by LEGOS), capable of routine real-time assimilation of altimetry data from DUACS. This configuration has been used routinely since April 1998, generating weekly ocean bulletins that provide ocean analysis and forecasts covering a two-week period. This information is used in operational mode by the French Navy (CELENV) to predict the acoustic environment, and by French and European researchers on campaigns of opportunity to acquire measurements in this zone.
• The POMME configuration, consisting of a 1/20° regional model covering 15°W-21°W and 38°N-45°N. This configuration is based on a primitive-equation model (OPA, LODYC) that uses an optimal interpolation scheme capable of assimilating DUACS altimetry data, surface temperature, and in-situ hydrological observations (T,S,P) derived from point soundings or drifting profiling floats. The initial conditions of this regional model can be set and evolutive boundary forcing can be performed using predictions from the MERCATOR basin model (see figure 1) or from fields derived from analyses of hydrological networks.

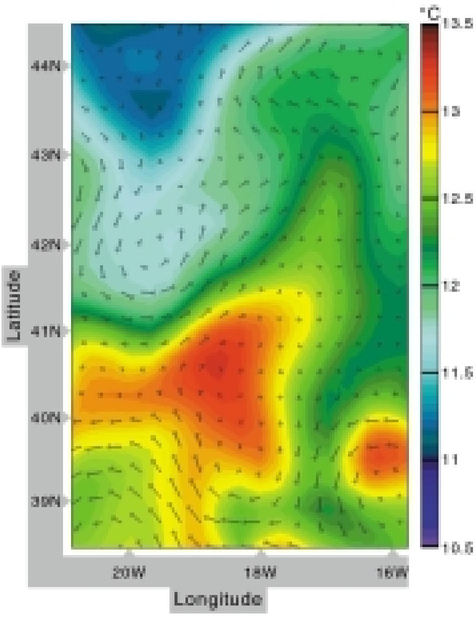

Figure 1: POMME model initialized and forced at its boundaries by MERCATOR. Temperature and currents at 400 metres on January 28, 2001.

These two configurations will be used routinely in real time throughout 2001 to support a multi-organization scientific campaign.

Independent data exploitation

We have studied the ability to exploit altimetry data independently from a numerical prediction model, based chiefly on the use of image processing techniques.
In 2000, our efforts focused on merging multisensor data (altimetry, sea surface temperature from AVHRR, and ocean color). Preliminary studies have been completed and we plan to develop a model in 2001.

Corresponding author:
Laurent Kerleguer
SHOM/LEGOS
14, avenue Edouard Belin
31400 Toulouse - France
E-mail: laurent.kerleguer@cnes.fr