Altimetry research with Jason-1 at SOC

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Altimetry is a key component of the remote-sensing work at Southampton Oceanography Centre. We have used data from most previous missions, and those from Jason-1 are an integral part of our future plans. We will make use of all the geophysical parameters obtainable over the ocean — sea surface height, wave height, wind speed and rain rate, both separately and in combination. Our proposed work with Jason-1 will focus on four main areas — CALVAL, global climatologies, long-term monitoring and comparison with other datasets and models.

CALVAL

In order to make the best possible use of the data, their quality must be evaluated by comparison with other measurements. This is especially critical when studying long-term climate change involving data from many different satellites. First, for wind and wave validation, we will use data from the large set of wave buoys, as well as comparisons with other altimeters. This work will also evaluate new algorithms giving wave period as well as the latest wind speed algorithms. Second, in combination with colleagues in La Spezia, we will be deploying tide gauges on the island of Capraia (in the Corsica Channel), which lies close to both the TOPEX/Jason and ERS/ENVISAT ground tracks.

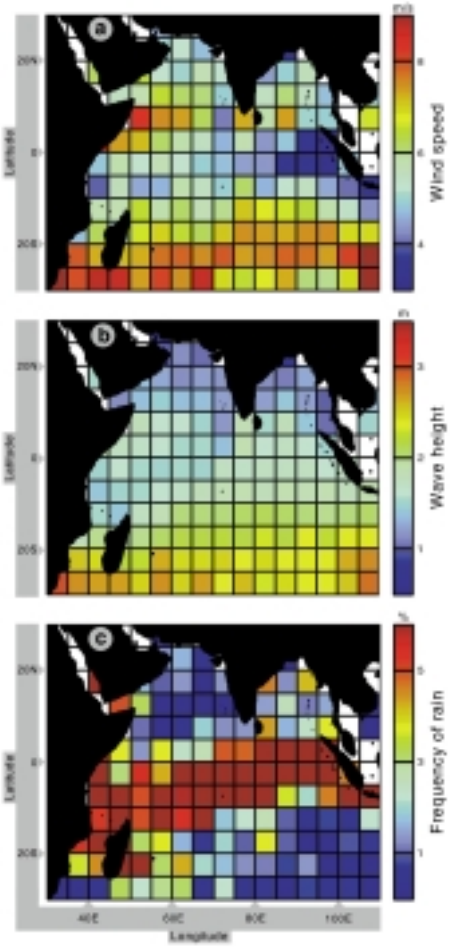

Figure 1: Climatologies of a) wind, b) wave and c) rainfall from TOPEX data for January-February 1998. A dual-frequency altimeter enables us to study correlations between simultaneous observations of these three variables [Quartly et al., 2000b].

Third, we hope to position a number of acoustic rain gauges under the satellite track to assess the dual-frequency rain algorithm.

Global climatologies

With suitable averaging of the data, we can form global or regional maps of wave height, wind speed and rain rate (see figure 1). We will be examining changes in these on seasonal-to-decadal time scales. Analysis of weather-ship data by Bacon and Carter [1991] has shown a trend to increasing wave height in the northeast Atlantic, possibly related to the high state of the North Atlantic Oscillation, that is, the large wintertime north-south pressure difference that has been prevalent in the 1990's. The rain rate data from TOPEX have shown that the 1997-98 El Niño was marked by an increase in the surface area and intensity of the Pacific rain belt [Quartly et al., 2000c]. Jason-1 will probably give us the opportunity to observe another El Niño, and also to continue our analysis of the spatial scales of rainfall. The climatologies of all three parameters will be compared to those derived from other datasets.

Long-term monitoring of ocean features

The Jason track close to Capraia is ideal for monitoring the height difference between the two basins at either end of the Corsica Channel. Flows inferred from TOPEX/POSEIDON data for 1993-98 compare favorably with current meters in the channel [Vignudelli et al., 2000], demonstrating how Jason-1 could be used in monitoring critical flows.

The Agulhas region to the south of South Africa is an active area, with many eddies contributing to the fluxes of heat and salt-water between the Indian and Atlantic Oceans. The translation of eddies across altimeter tracks allows us to estimate their number and size, through the changes in sea surface height profile (see figure 2).

We are also interested in further regional studies in the northeast Atlantic and western Mediterranean, where the altimeter data will be used in combination with ship and satellite observations of temperature, current velocity and chlorophyll content. Application of the technique developed by Challenor et al. [1996] will allow us to determine absolute velocities for all altimetric repeats of a surveyed track. We will use this, in combination with models, to investigate the effects of physical variability on phytoplankton growth.

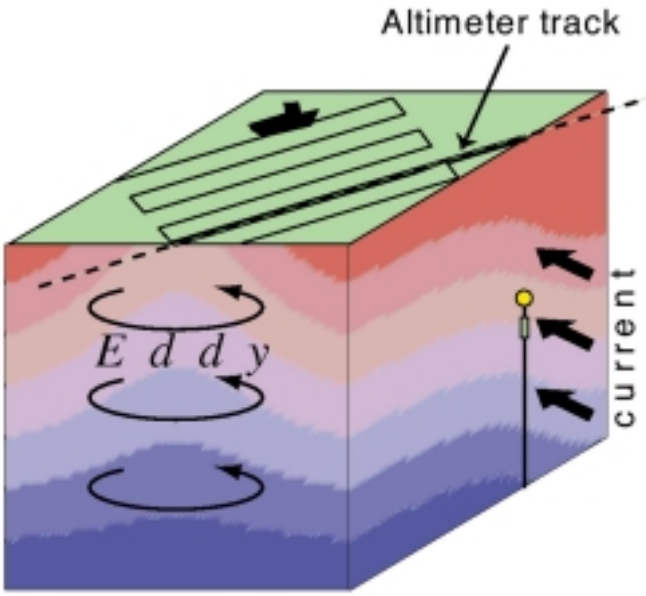

Figure 2: Using repeated altimeter tracks for monitoring eddies and inter-basin flows, in combination with ship surveys and current meters. [Here shifts in constant density layers (colored) illustrate the position of an eddy and a strong current].

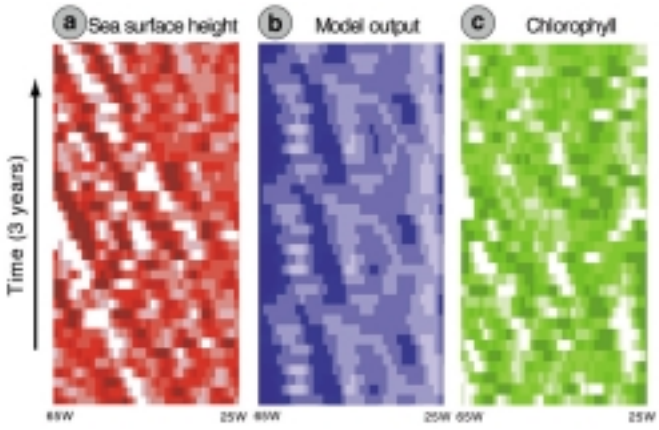

Figure 3: Contrasting Rossby waves in models and data. All three datasets are from 29˚N in the North Atlantic, although not for the same time periods. Westward-moving features are present in sea surface height from TOPEX/ POSEIDON (a), and the AIM model (b), and also in chlorophyll measured by SeaWiFS (c).

Comparisons between datasets

Although altimeter data are a major resource on their own, there are important gains to be made from using them in combination with data from other sensors. Rossby waves are an important process by which the ocean transmits information from east to west, possibly affecting the strong Western Boundary Currents. Cipollini et al. [2001] have shown that Rossby waves, as well as having a sea surface height signature detectable by altimeters, are detectable in ocean color data (see figure 3), and we have begun to look at the phase relationship of the height, temperature and color signatures [Quartly et al., 2000a] in order to understand the mechanisms involved.

Altimeter data will also be compared to models to test how well they represent reality. Differences in location of features and/or in the timing of events can lead to large errors in simple root-mean-square comparisons, with little insight gained. Instead, we will apply spatial analysis techniques that ascertain the common modes of variability. An important test of models is the strength and speed of their Rossby waves [see Cipollini et al., 2000], for they indicate how well and how fast a system responds to changes elsewhere.

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