Satellite ocean front maps reveal dynamic surface currents: improved metocean for offshore oil and gas

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1 Introduction

We have developed novel Earth observation (EO) methods for visualising and inferring the spatio-temporal distribution of dynamic oceanic fronts, in order to provide additional information on physical oceanography pertinent to the offshore oil and gas industry. For instance, this analysis may reveal if there is more eddy activity at particular locations or times of year, or predictable seasonal changes in the width of the slope current. EO front maps from a 30-year time-series can be integrated with other metocean information, for instance current meters or ADCP that reveal physical processes at depth but are restricted to small regions and limited time span.

Examples will be shown for regions of interest to oil and gas industry, such as the Faroe-Shetland Channel and the Gulf of Mexico. Potential applications include site selection and design, real-time operations and spill management. It may also address conservation concerns by incorporating information on marine mammal and seabird usage of fronts into detailed site selection.

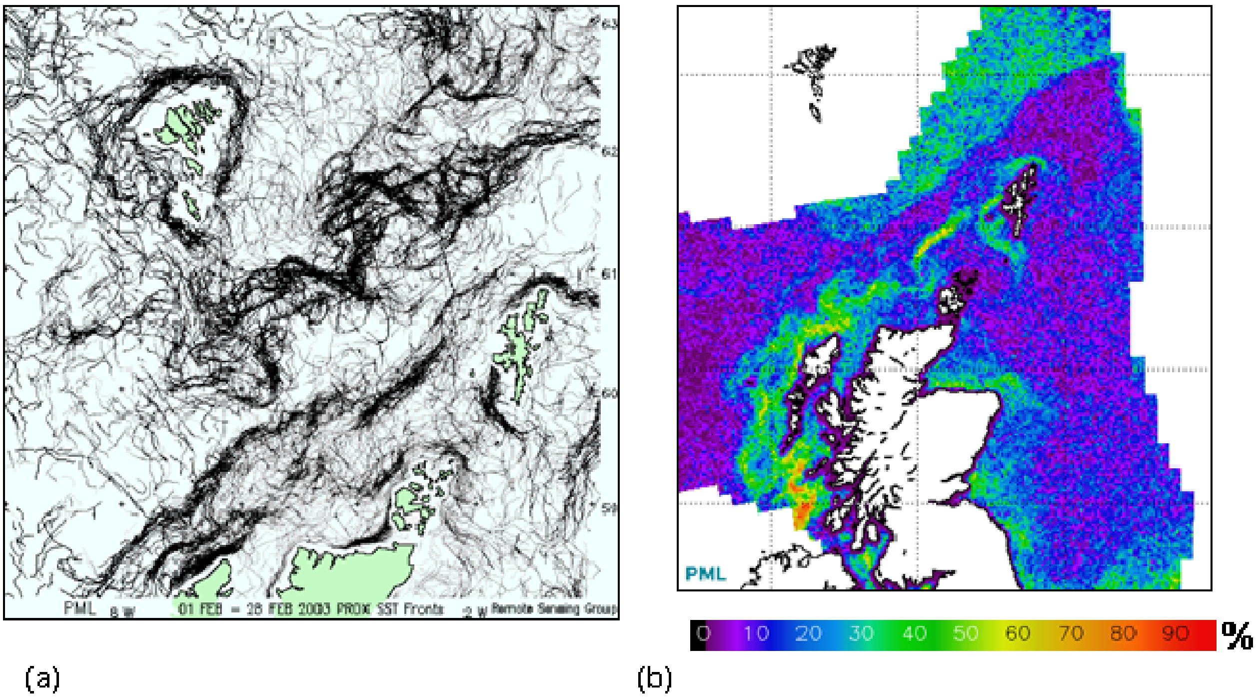

Figure 1. (a) Sample monthly thermal front map for February 2003, visualising mesoscale features of the shelf-break current in the Faroe-Shetland Channel. (b) Example of a seasonal frequent front map for spring at 4km resolution, indicating the percentage of time a strong front was observed at each location. This previous analysis was performed at a lower spatial and temporal resolution than proposed, for a different time period, and only covered part of the Faroe-Shetland region.

Oceanic fronts are formed at the boundary between water masses of different temperature or density, and are often associated with enhanced mixing. Fronts that extend to the sea surface may be observed by satellite if the water masses differ in temperature or colour, and such observations may allow interpretation of the location and dynamics of mesoscale processes including meanders and eddies. We are even able to detect major fronts when completely obscured by cloud cover. Ocean colour may reveal additional physical processes even if there is no SST signal. This research is based on the *composite front map* approach, which is to combine the location, strength and persistence of all fronts observed over several days into a single map, improving interpretation of dynamic mesoscale structures (Miller, 2009). These techniques are robust and applicable to any geographic area.

2 Methodology

This research is based on the *composite front map* approach, which is to combine the location, strength and persistence of all fronts observed over several days into a single map, improving interpretation of dynamic mesoscale structures (Miller, 2009). These techniques are robust and applicable to any geographic area (Figure 1a).

Frequent locations of thermal fronts in UK shelf seas were identified using an archive of 30,000 satellite images acquired between 1999 and 2008. This was the first study of UK shelf-sea front locations to use a 10-year archive of full-resolution (1.1 km) AVHRR data, revealing new aspects of their spatial and seasonal variability. The next stage of analysis was to aggregate the monthly front maps into seasonal front climatologies to identify strong, persistent and frequently occurring features (Miller et al., 2010). These front maps can reveal the spatial distribution of dynamic surface currents (Figure 1b).

Acknowledgements

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References

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