Caase study 1: Rig location study

Summary

Earth observation (EO) technologies can be really useful in the characterization of mesoscale oceanographic feature. EO can capture imagery over a broad geographic area as well as revisit the same areas at reliable intervals for frequent repeat captures.

The combination of several EO products can lead to a very well documented study which can be of a great help for O&G companies during the different phases of their lifecycle project.

Issues & Needs

During the exploration phase, one of the concerns is to select the right location to place the drilling rig. It is primary to know all the characteristics of the site selected to make sure the drilling will be effective. It can represent a significant money and time saving to be able to select the drilling rig and its location with the less uncertainty as possible.

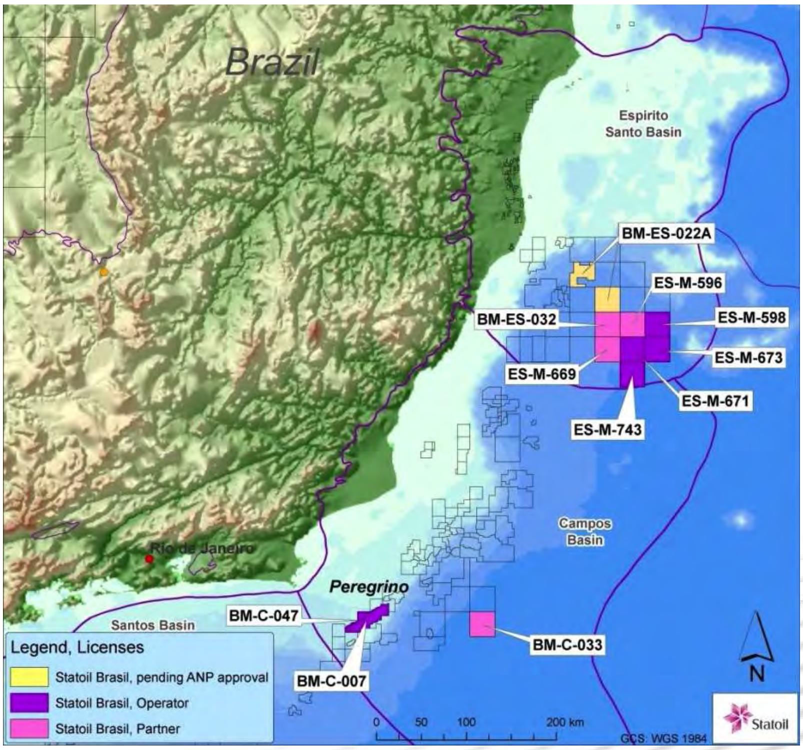


Figure 1: ES-M-598, ES-M-671, ES-M-673, ES-M-743 Blocks. Espírito Santo Basin

To be able to select the right location, the main information needed is on the local metocean features existing. If an O&G company decides to install a drilling rig on an area, it has to know perfectly well the location and the phenomena happening in this zone.

Solution

The EO technology proves to be of a great help in studying the local oceanic phenomena.
Some features like eddies, can be deeply characterized thanks to satellite products and provide a full description of the feature (Frequency, area impacted…)
To do so, two EO products were chosen :

- **Altimetry**

The multisatellite altimetry, technique that combines altimetry data from multiple satellites to fill data gaps, both in time and in space, left by sampling system separately for each satellite, is one of the tools of interest for monitoring ocean circulation, especially given the dynamic topography.

- **Sea Surface Temperature**

Sea surface temperature (SST) is the temperature of the ocean near the surface. Knowing the temperature of this part of the ocean is absolutely essential for many reasons. For oceanographers, meteorologists and climatologists, it is one of the signs/results of the exchange of energy between the ocean and the atmosphere

Results & Perspective

A study of a characterization of ocean mesoscale circulation was done at Espirito Santos Basin (Figure 1). The main goal of the study could be to support the definition of the best locations for installing the drilling rig.

In order to achieve this goal an extensive data analysis is performed, including hydrodynamic models, oceanic drifters and satellite data.

1. **Altimetry**

- **Dynamic topography**

The analysis of two years of data of absolute dynamic topography and geostrophic current, comprised in the period from 01/01/2009 to 31/12/2010 allowed to observe that the Brazil Current, flows southwest, with a meandering pattern, behaving as a train of waves of vorticity permeating the centers of successive high and low pressure, as shown by CALADO (2006), which refers to the positioning of the centers of high and low pressure (**Erreur ! Source du renvoi introuvable.**).

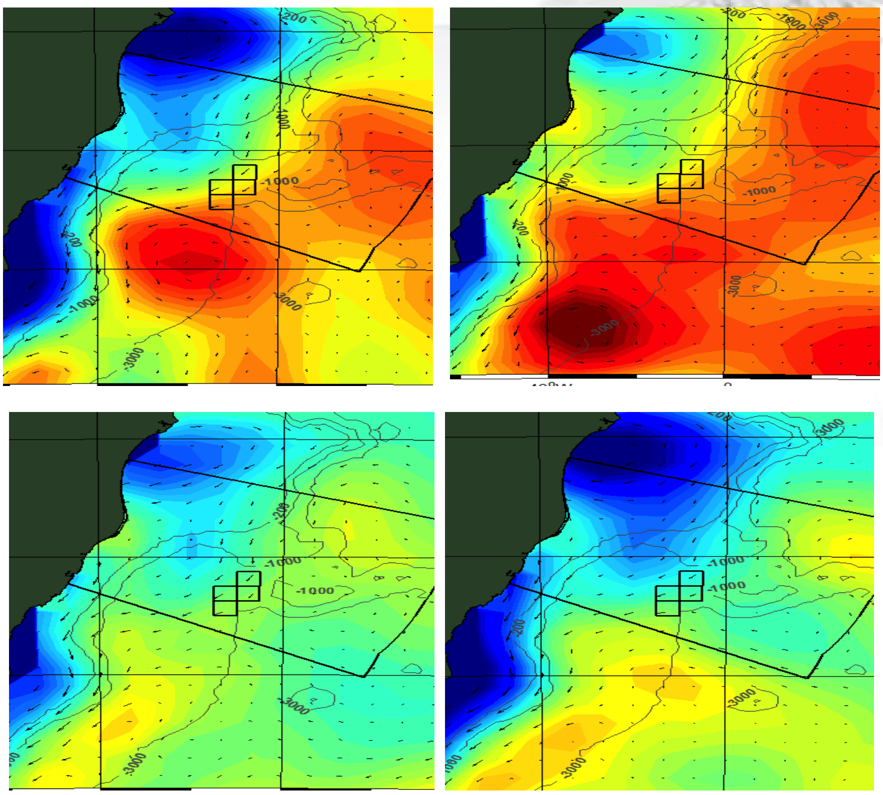


Figure 2: Climatological dynamic topography and geostrophic current for four seasons. The gray lines represent isobaths 200m, 1,000 m and 3,000 m, and the highlighted area in the Espirito Santo Basin. Figure generated from AVISO data.

- **Relative vorticity**

From the geostrophic current from AVISO data it was possible to obtain the relative vorticity fields for the region of Espírito Santo Basin. This parameter indicates the presence of eddies and identifies the direction of the rotation, as well it is possible determine more accurately some characteristics such as the diameter and position of the center.

In the Espírito Santo Basin region, a center of negative vorticity was identified, representing the Vitoria Eddy at Tubarão embayment. This center can be observed at all seasons of the year, centered at approximately 20.3° S and 39° W, but had become more intense in summer and autumn, decreasing in intensity in winter and spring (Figure 3).

In the northeastern portion of the basin, a center of positive vorticity (anticyclonic turning anti-clockwise) was identified, probably representing the Abrolhos Eddy. This can also be observed in both annual and in seasonal period centered approximately at 19.5° S and 37° W, also with variations of intensity. In the months of summer and autumn were more intense and the months of winter and spring, less intense.

Erreur ! Source du renvoi introuvable. illustrates this pattern described with the two vorticity centers for the region of Espírito Santo Basin, confirming the observations of Silveira *et al. (*2006).

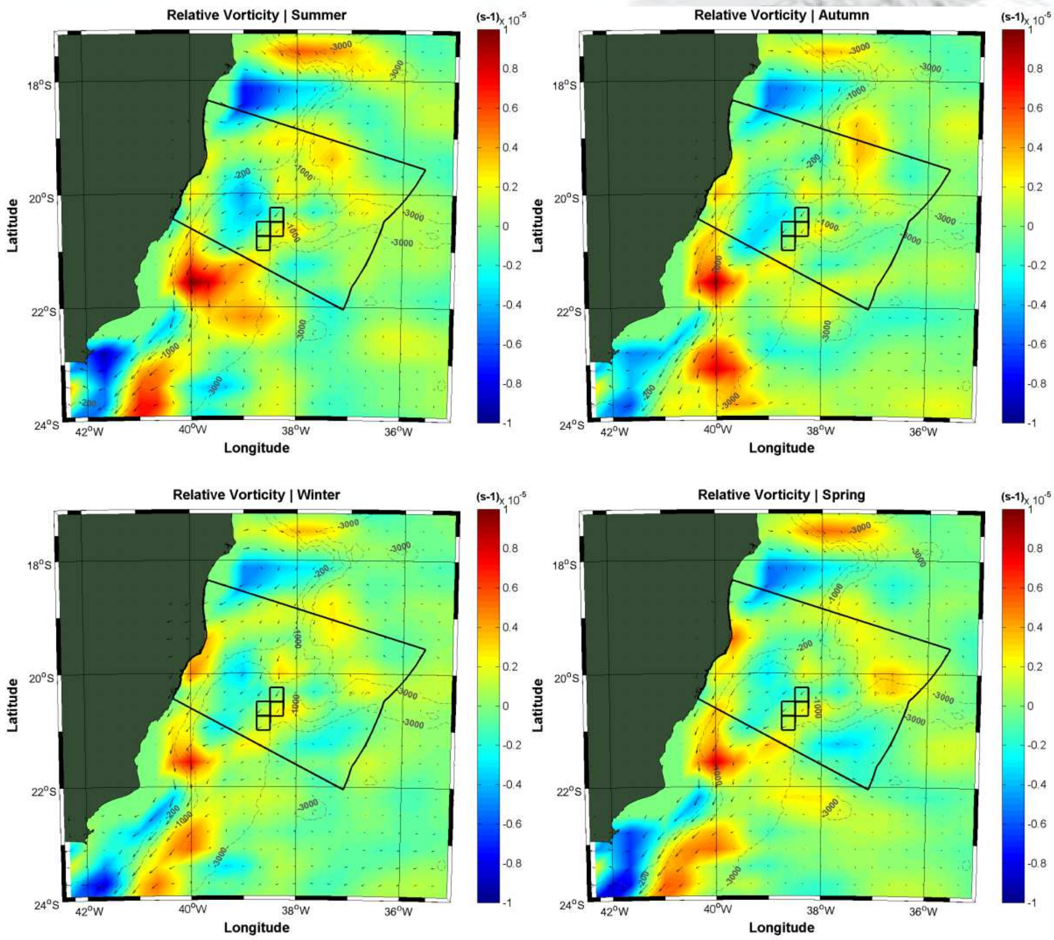


Figure 3: Climatological relative vorticity and geostrophic current for all seasons. The gray lines represent isobaths of 1,000 m and 3,000 m, and the highlighted area in the Espirito Santo Basin. Figure generated from AVISO data.

the database of the GDP (Global Drifter Program) which was captured by Vitoria Eddy, superimposed on the annual relative vorticity map.

The fact that a synoptic data (drifter) is in agreement with climatological data shows that the signal observed in the statistical analyzes corresponds the Vitoria Eddy. The core observed in the negative vorticity annual weather has a diameter of approximately 110 Km.

In order to further analyze the seasonal pattern of Vitoria Eddy, a temporal analysis of the integrated relative vorticity in the region of occurrence of the Vitoria Eddy was performed. For this, an eddy occurrence area was demarcated and the values of relative vorticity were integrated for each instant in time. The delimitation of the area was made based on the literature and on seasonal variations described. Thus, the area was centered at 20.3° S and 39° W with 0.5° on each side, comprising a square of 1°.

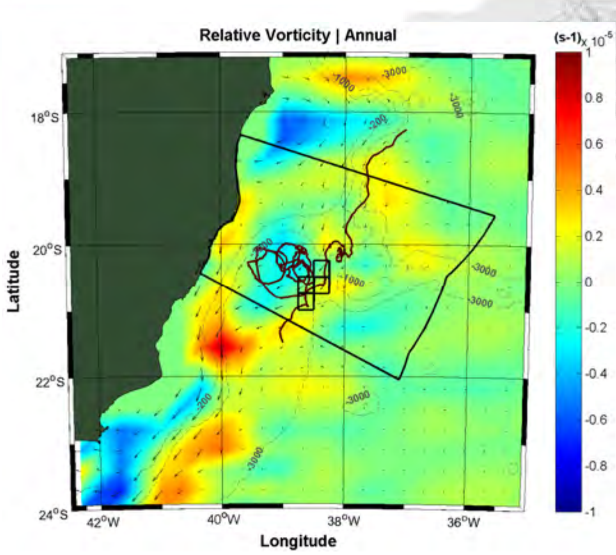


Figure 4: Trajectory of a drifter caught by Vitoria Eddy superimposed on the climatological annual relative vorticity. The gray lines represent isobaths 200m, 1,000 m and 3,000 m, and the highlighted area in the Espirito Santo Basin. Source of data to drifter: GDP. Source of data vorticity: AVISO.

2. Sea Surface Temperature

The region of Espírito Santo Basin shows higher temperatures in the northeastern portion and lower temperatures in the southwest portion, with a gradient of about 1° C (Figure 5). This fact may be associated with the positioning of the centers of positive and negative relative vorticity, corresponding to the Abrolhos and Vitoria eddies.

To assist in evaluating the structure of the Vitoria Eddy a climatological and seasonal variability of sea surface temperature (SST) analysis from satellite data provided by NCOF (National Center for Ocean Forecast) was performed. The analysis was conducted for the period of two years of data, the same range of AVISO data used.

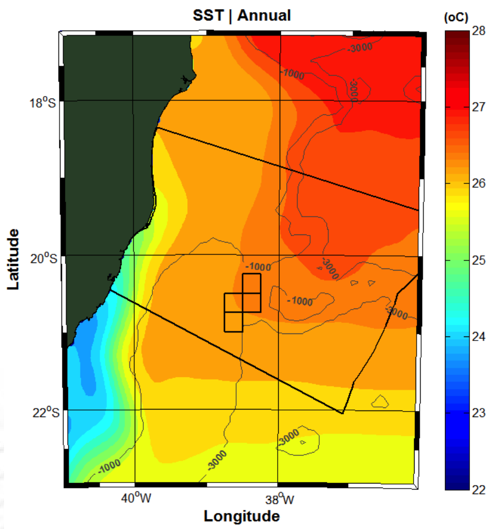


Figure 5: Climatology of Sea Surface Temperature for the entire period analyzed. The gray lines represent isobaths of 1,000 m and 3,000 m, and the highlighted area in the Espirito Santo Basin. Figure generated with OSTIA data.

Case study 2 : Ocean Model validation

Summary

In this case study, the EO data is used to validate Ocean General Circulation Models in order to determine which one is better capable of representing the real ocean in a given area of the world.Daily Sea Surface temperature data and Sea Surface height data are to perform the comparisons.

Issues & Needs

Numerical models are routinely used to try and get a grip on the circulation dynamics of a given region, in this particular case, the Indonesian Seas with a particular focus on the Banda sea in the south eastern part of the archipelago.

The lack of in situ data means that often, it is difficult to gauge the quality of the model representation of 2D structures. As a result, it is often difficult to decide which model to use in a given region in order to get the best representation possible of the ocean. Here, two models are proposed for the representation of the same region, ITF025_G70 LEV, a regional model at ¼ degrees resolution and ORCA12, a global model at 1/12° resolution

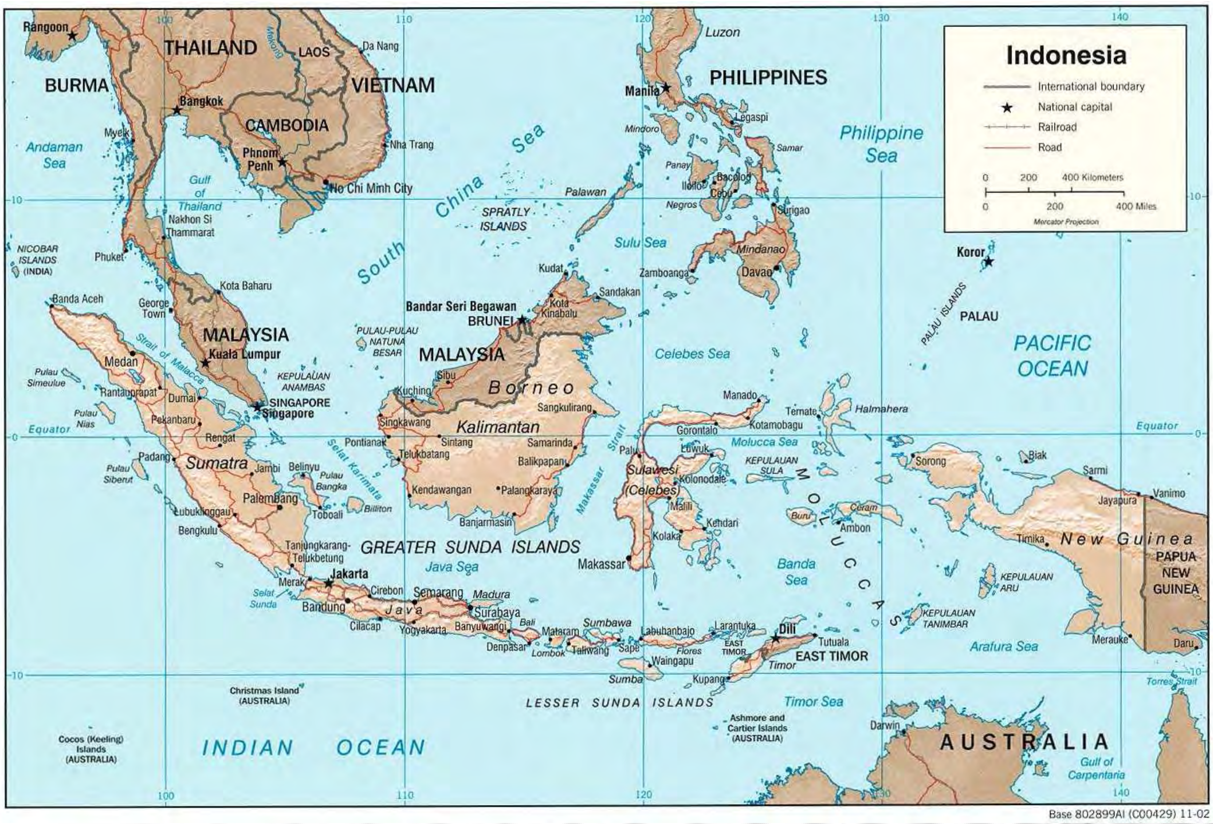


Figure 1: Map of the Indonesian seas

Solution

EO offers a unique possibility of evaluating the quality of models by comparisons with ocean observations at the Sea Surface. Here, 10 years worth of data is used to determine the mean monthly difference and the standard deviation for sea surface temperature fields and sea surface height fields (not shown). Monthly maps are then plotted as well as climatological year time series in a specific area, namely the Banda sea

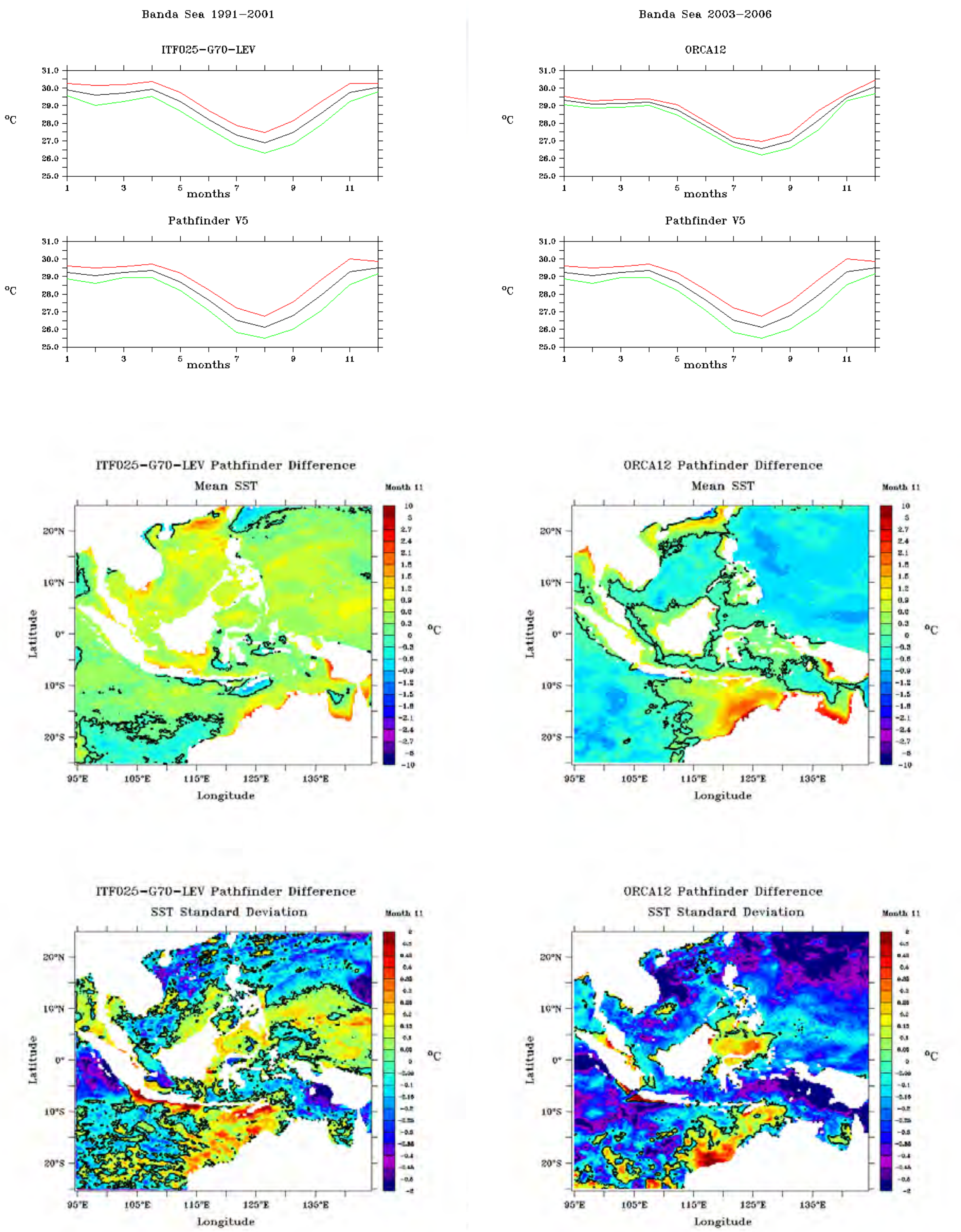


Figure 2: Upper panel: Yearly cycle Middle panel November mean difference, Lower panel: November standard deviation for ITF_025 (left hand and orc12 right hand side for surface tempertaure.

Results and perspectives

The analysis shows that the global model presents some marked biases in coastal areas even though generally, the differences with the satellite data are less than for the regional model. In the particular cases of the band sea, the yearly cycle is better represented in the regional model with similar amplitudes and standard deviation. Similar results are found for the sea surface height data. The conclusion is that the regional model is of better quality over the Banda sea.

EO offers thus a simple an effective way of providing zero order validation for numerical models. The can thus be used also in the tuning of such models, to insure that the parameters used allow the best possible representation of the oceanographic circulation in the region of interest.

Finally, these type of diagnostic can also be produced on a daily basis when a model is used for day to day operations.

Case study 3 : Current vein location

Summary

In this study, a more accurate positioning of the Agulhas current is obtain through the use of along track sea surface height data.

Issue and needs

Operations in high intensity and high variability environments are particular difficult. In particular, ROV operations require a good understanding of the local dynamics and an accurate positioning of high intensity dynamic feature such as the Agulhas current.

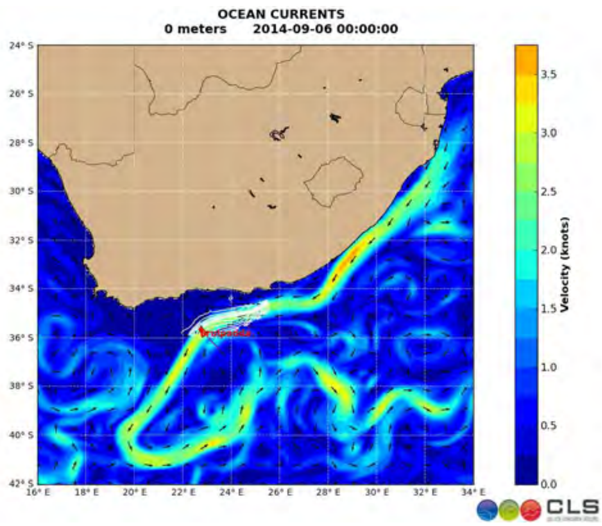


Figure 1: Southern Africa Model Surface Current map

A present, Ocean models are unable to properly position these features. As a result, it is necessary to improve their positioning in order to insure that operations are conducted in a safe environment.

Solution

EO altimetry data is used to provide an accurate picture of the position of highly dynamic features.

To this end, every day, the along track altimetry data is downloaded and plotted over maps of the currents as provided by model data in order to check the position of the Agulhas current. Across track geostrophic estimation are computed from the data which is then super imposed on the model surface velocity data.

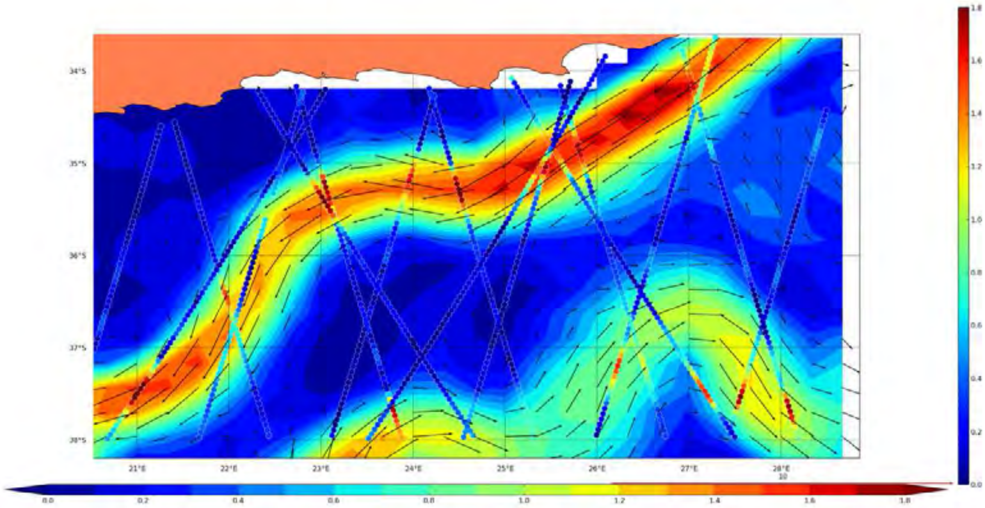


Figure 2 : Across-track geostrophic velocities computed from 2008, Feb 5th until 2008, Feb 21st along Envisat and Jason-1 mission track (vertical colorbar: ||Ucrosstrack||)) overimposed on to Ocean Model data (horizontal colorbar : sqrt(U2+V**2))**

Results and perspective

The along track data shows that the Agulhas current representation is often too wide and that the velocities at the core are sometimes underestimated. In particular, the strength of the Agulhas retroflection in the southern part of the domain is much weaker in the model compared to the values obtained from the EO data.

These maps are produced on a daily basis and allow the operation manager to determine the level of accuracy of the model and hence the confidence in the model estimates. It is thus possible to determine with a great level of accuracy whether the point of interest is in the vein or not.

Case study 4 : Congo River Plume Localization

Summary

In this study, the localization of the Congo river plume is determine through the use of Ocean Colour data and the statistical calculation of a threshold value enabling a differentiation between water within and outside the plume. This leads to a monthly climatology of the river extent and position.

Issue and needs

The Congo River plume is unique in that the low salinity river water form a very shallow layer that extend well beyond the river mouth. The end result is the creation of a very strong current shear at the interface that can be problematic for operation in the area such as the loading of tankers.

A good understanding of the spread of the plume and its variability allows a better planning of all operations.

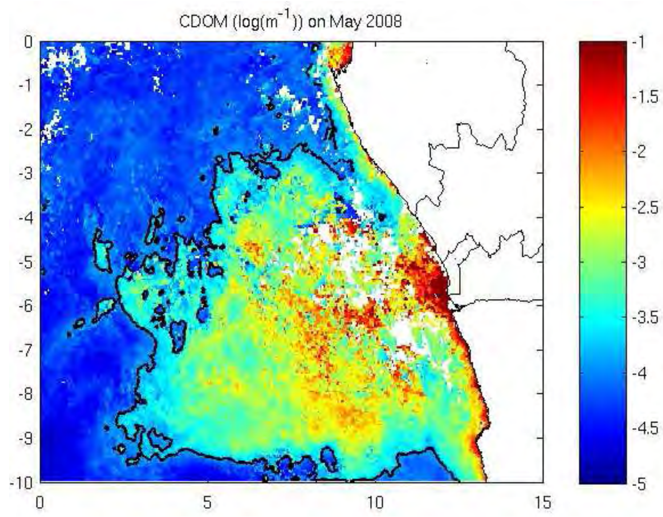


Figure 1: Congo plume CDOM signature

Solution

Daily EO Ocean color images which contain chlorophyll, total suspended matter and concentration of dissolved organic matter are processed using an algorithm that determines a threshold value that differentiates plume waters and open ocean waters. This produces daily maps of the plume extent. These maps can be then be averaged over a month to get monthly extent maps of the plume extent.

This can be done for successive years and hence create a monthly climatology of the plume extent.

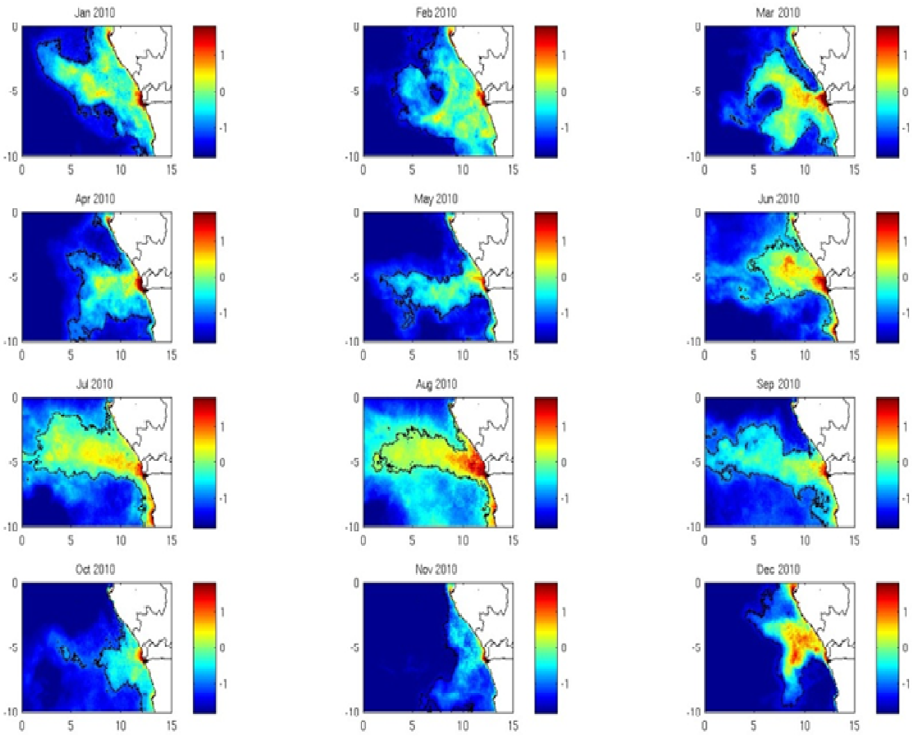


Figure 2: Monthly maps of the plume extent for 2010

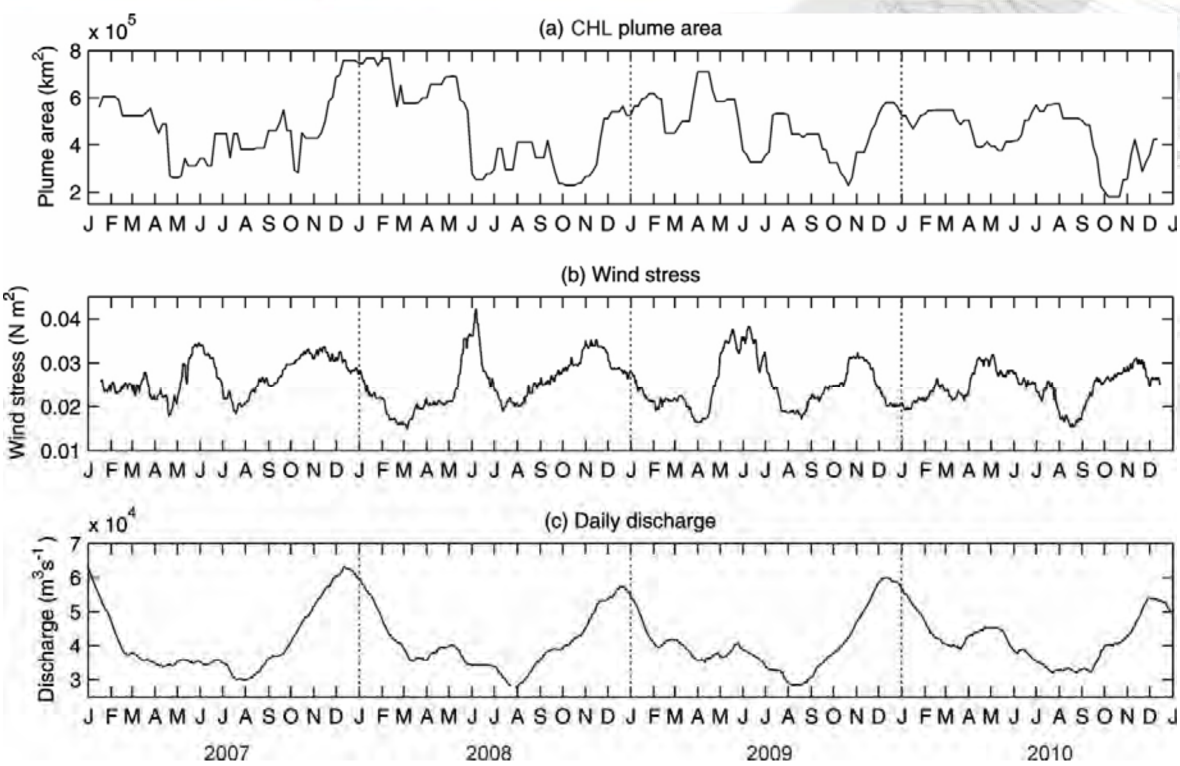


Figure 3: Time series of plume area, wind stress and daily discharge

Results and perspectives

EO data allows the production of daily maps mapping the Congo River plume.

The surface of the plume extent area can then calculated and a clear relationship between wind strength and plume area is established (fig 3): maximum in wind stress coincide with reduction in the plume area, suggesting that the wind induced mixing is one of the main drivers of plume extent.

Case study 5 : Ocean Model Circulation Operational Validation

Summary

In this study, an ocean general circulation model velocity fields are validated on a daily basis through the uses of Ocean color data.

Issues and Needs

Marine operation such as drilling or seismic surveying can strongly benefit from a good knowledge of local currents to plan deep intervention or flute deployment and behavior. In some region of the world, this is particularly important due to the strong dynamics found there. On such region is the northern coast of South America which is subject to the very strong currents and eddies found in the North Brazil Current system.

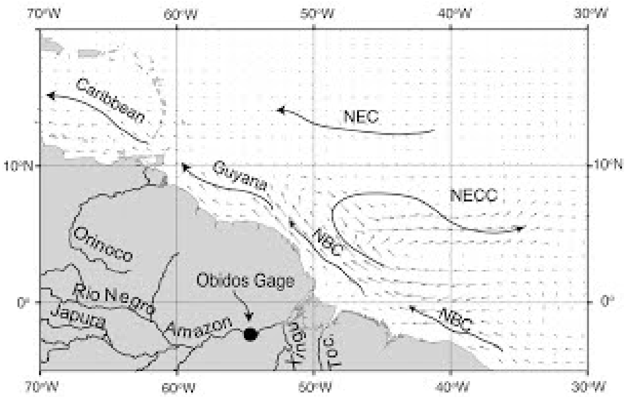


Figure 1: North Brazil Current System

Generally speaking, current data can only be provided by ocean general circulation models when information on more than s ingle point of data is required. In particular, a 2D/3D vision in necessary when a synoptic understanding of the dynamics is required.

However, the fields produced by the model can sometimes differ greatly from what is observed on board the vessels. It is therefore necessary to quickly determine how accurate the model currents are.

Solution

EO ocean color data is to a certain extent a passive tracer. The qualitative information contained in the data allows user to trace the principle dynamic features in some region of the world where the open productivity is low. This is the case in the North Brazil current system, where primary productivity is predominantly coastal.

This data is used as a passive tracer. When model streamlines are superimposed, it is possible to see if the large scale circulation within the model is in keeping with the dynamic observed through the use of ocean colour.

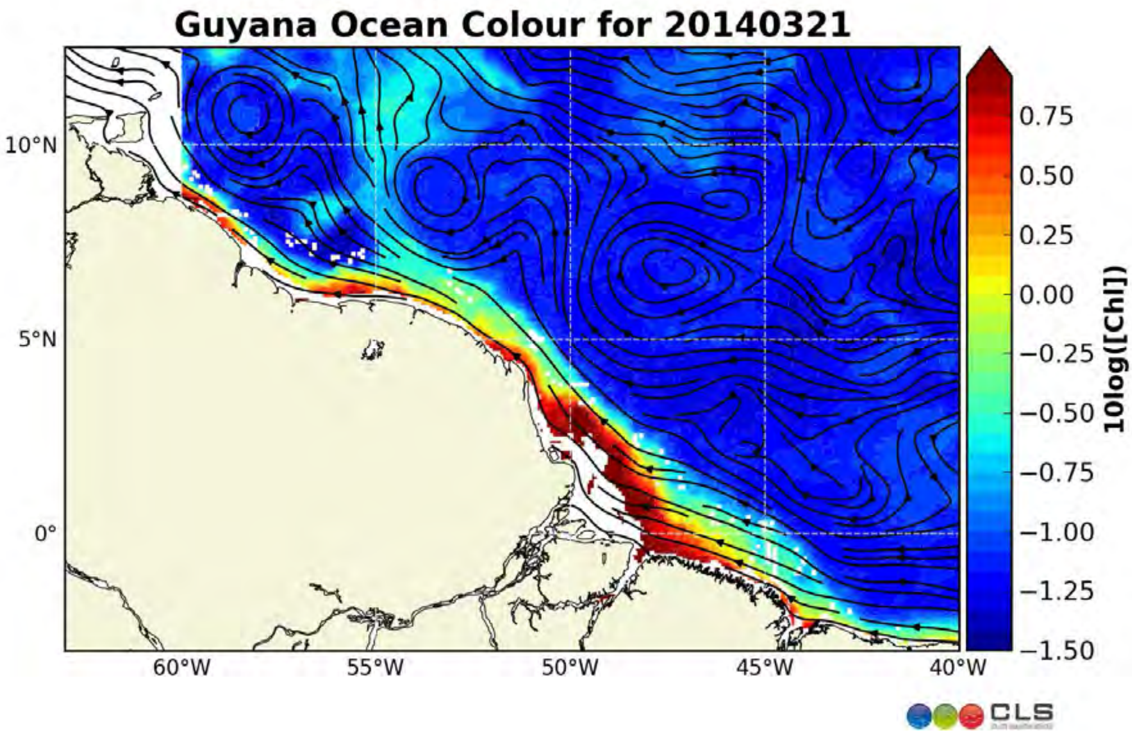


Figure 2: Ocean model current streamlines overaid on EO ocean colour data

Results and perspectives

Maps are produced on a daily basis allowing operation manager to gauge the quality of the model currents

These show whether or not the export of coastally produced Chlorophyll match the flow fields calculated from model data.

With at least a year worth of data, it is possible to have an indication of the seasonal variability in the model quality.

Case study 6 : Wave hindcasts calibration report

Summary

MetoceanPro is a global wave hindcast and several regional wave hindcast created by MeteoGroup to provide long and continuous time series to the Oil&Gas industry. Before running 20 years of hindcast, each model has been calibrated over one year: 2010. The purpose of this document is to present the calibration results for each domain. Calibrations have been performed using altimeter and in situ data when available. CFSR surface winds and ice (hourly, 0.3°) have been used as forcing.

It is important to highlight the importance of the use of altimetry data to be able to calibrate and validate the accuracy of the climatology worldwide. Without those data and limiting our verification to only a couple of available buoys could lead to an inaccurate hindcast.

Results & Perspective

1 Global coverage

1.1 Configuration

Spatial grid: 1°x1°, 80°S; 78°N; 0°E 360°E
Forcing: hourly surface winds and ice from CFSR (0.3° -> 2010 and 0.2° from 2011)

1.2 Altimeters data

Overall boxes statistics (over 2010):

RMSE (Root Mean Square Error):0.39 m
NRMSE (Normalized RMSE) : 13.17 %
BIAS: 0.06 m
Correlation: 0.971

Results from the global 1° with CFSR gives slightly better results than with ERA INTERIM (NRMSE of 13.17% against 12.89 %).

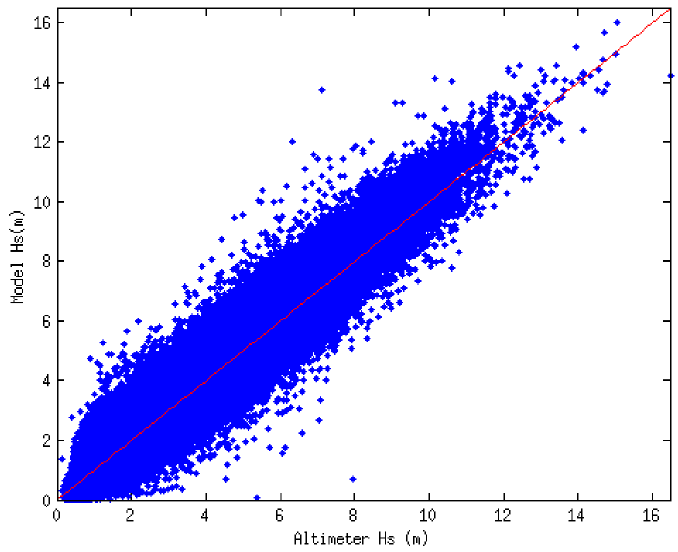


Figure 1 : Significant wave height scatter plot for the global domain (2010)

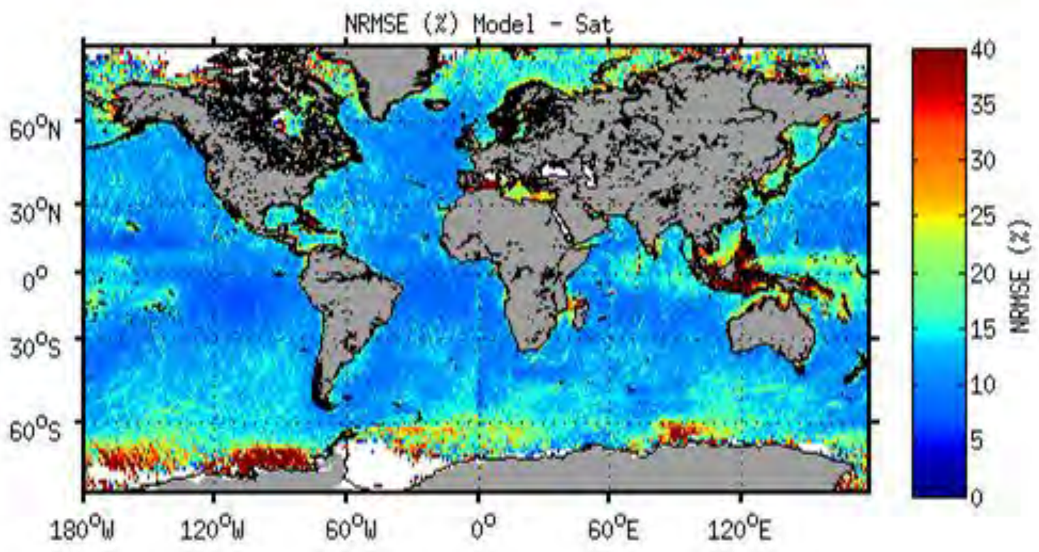


Figure 2 : Significant wave height error (%) (2010)

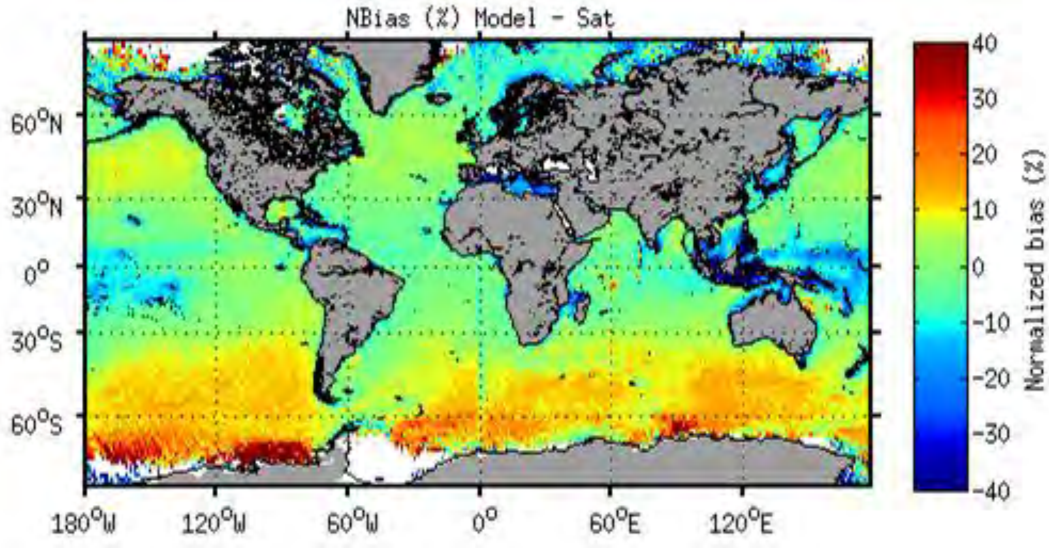


Figure 3 : Significant wave height bias (%) (2010).

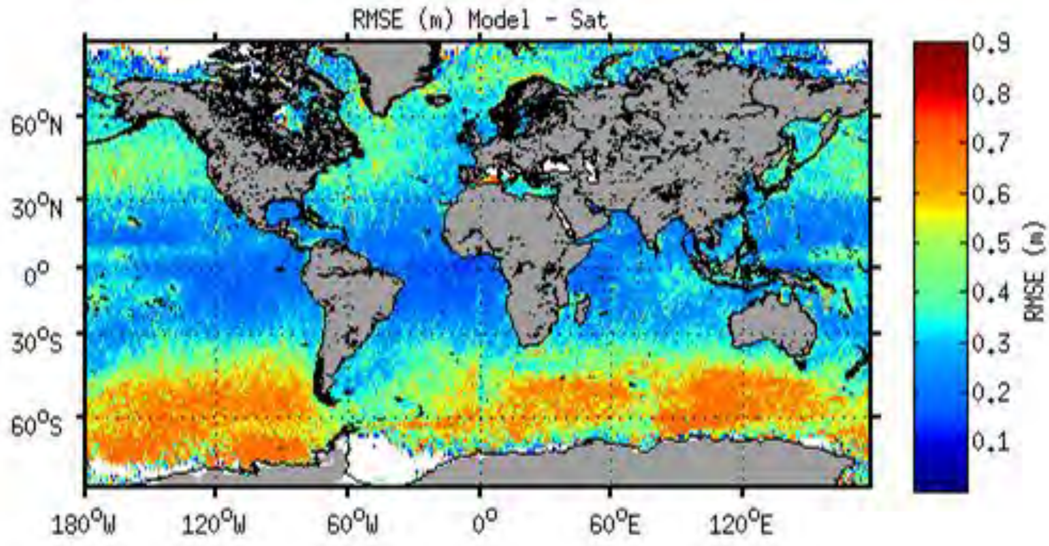


Figure 4 : Significant wave height error (m) (2010).

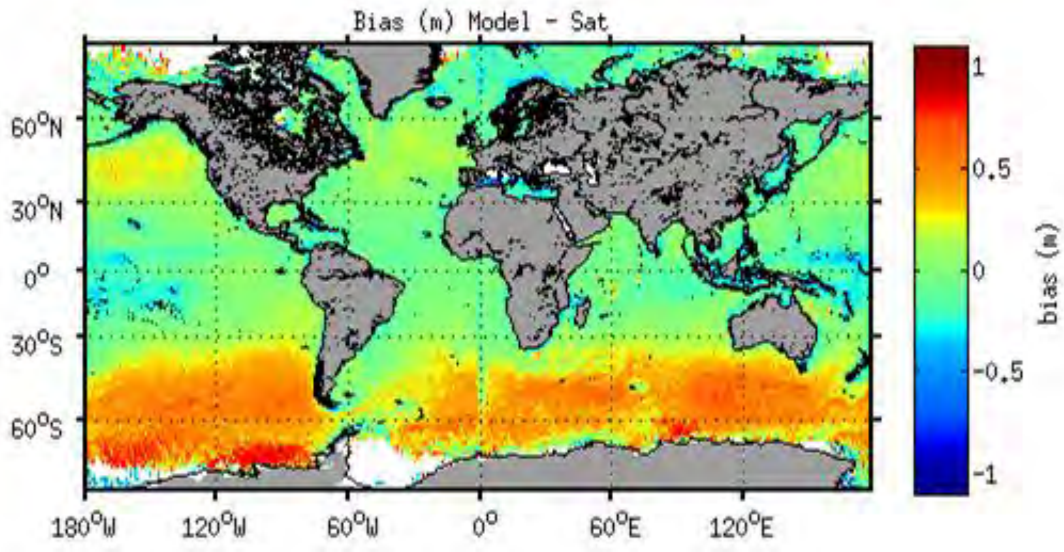


Figure 5 : Significant wave height bias (m) (2010).

1.3 In situ data

In situ data have been extracted from the MeteoGroup archive which represents more than 200 weather buoys. Results against in-situ data should thus be considered with care.

Figure 7: In situ stations

All buoys statistics over 2010:

RMSE (Root Mean Square Error): 0.26 m
NRMSE (Normalized RMSE) : 16%
BIAS: 0.02 m
Correlation: 0.91

Results against in situ data are less good than against satellites data. There are two reasons for this. The quality of the in situ data is not perfect, which adds errors. Moreover

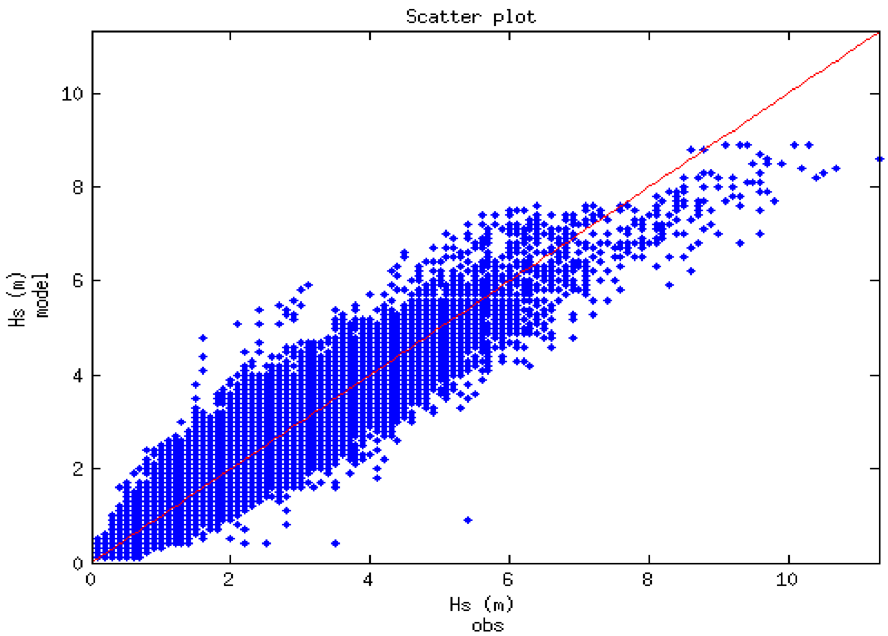
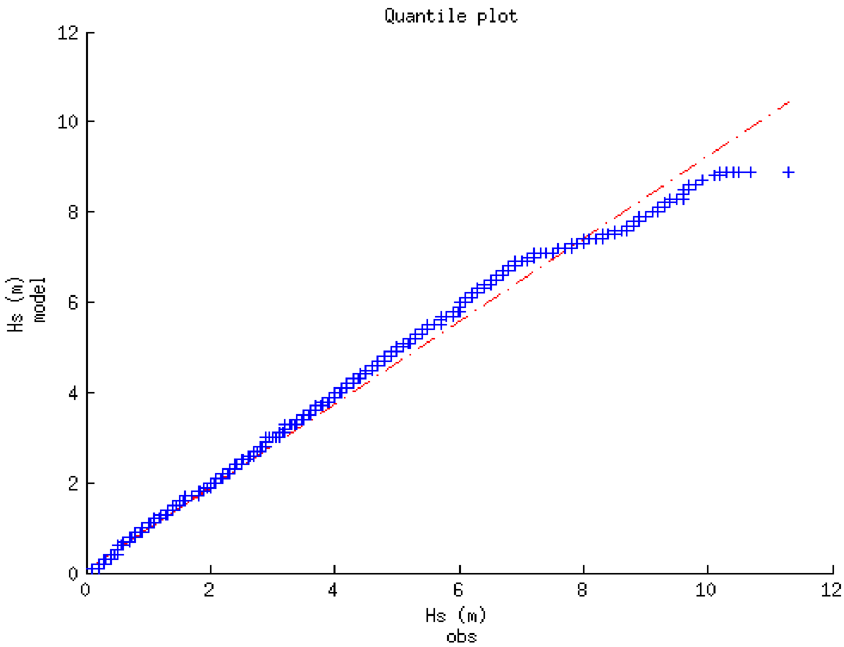


Figure 6 : Significant wave height scatter plot for the global domain (2010)



Case study 7: Bering Sea Project

Summary

Earth observation (EO) technologies are useful in providing environmental context while conducting marine studies. For ship-based studies in particular, EO can help make day-to-day decisions as to when and where to collect samples, and especially when trying to understand more ephemeral ecosystem features such polynyas, the ice edge, eddies, or predator-prey hotspots.

Being able to review these data as they are relayed in near-real time to the ship allows for safer and more efficient research operations and thus represents a critical tool many researchers have come to rely on.

Project Background

The Bering Sea Project (http://www.nprb.org/bering-sea-project) was funded by the North Pacific Research Board in Alaska and the National Science Foundation (NSF). The aim of this $52 million Project, which took place between 2008-2013 on the Bering Sea shelf and involved over a hundred investigators from over 30 institutions, was to understand the interplay between climate forcing, key physical and biological ocean features, marine resources (particularly fish, birds and mammals), and the people that live and use this region. Part of the work was focused on better understanding the relationship between spring sea ice dynamics, pelagic and benthic productivity, and its implications for walrus and spectacled eiders. For this purpose, the project conducted research cruises aboard the USCG ice-breaker Healy in March of 2008 - 2010.

Issues & Needs

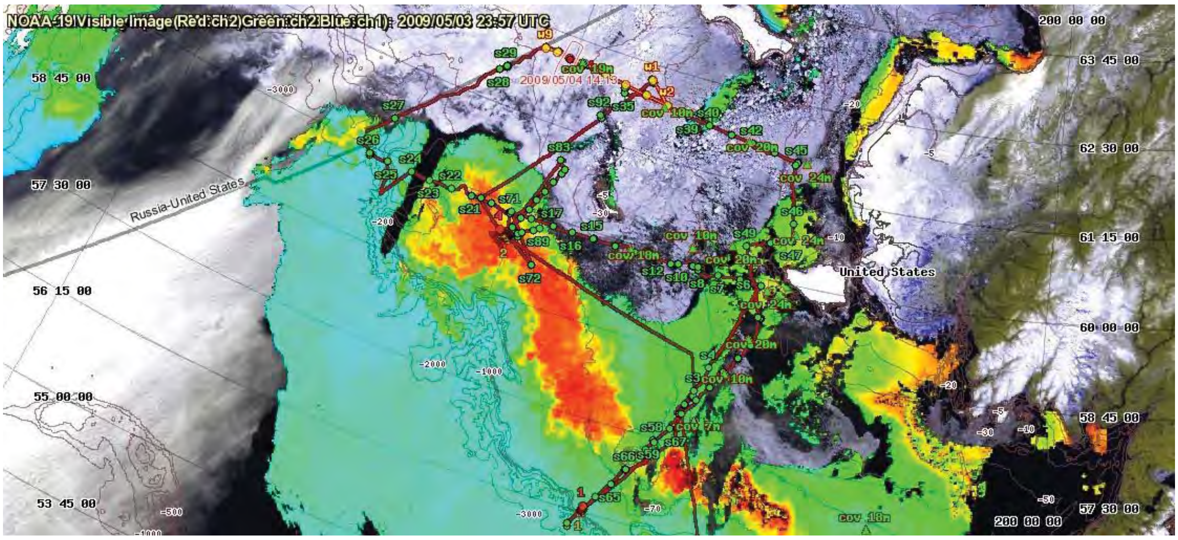
An important part of this project was to study the benthos underneath polynyas, in locations where spectacle eiders were feeding, as well as to carry out ice stations (i.e. drill ice cores, take snow measurements, measure primary production in and underneath the ice, etc.). Some local reconnaissance was carried out with a helicopter, but a broader scale search pattern was needed to direct the ice breaker within the ice field in the northern Bering Sea and thus efficiently accomplish these goals.

Solution

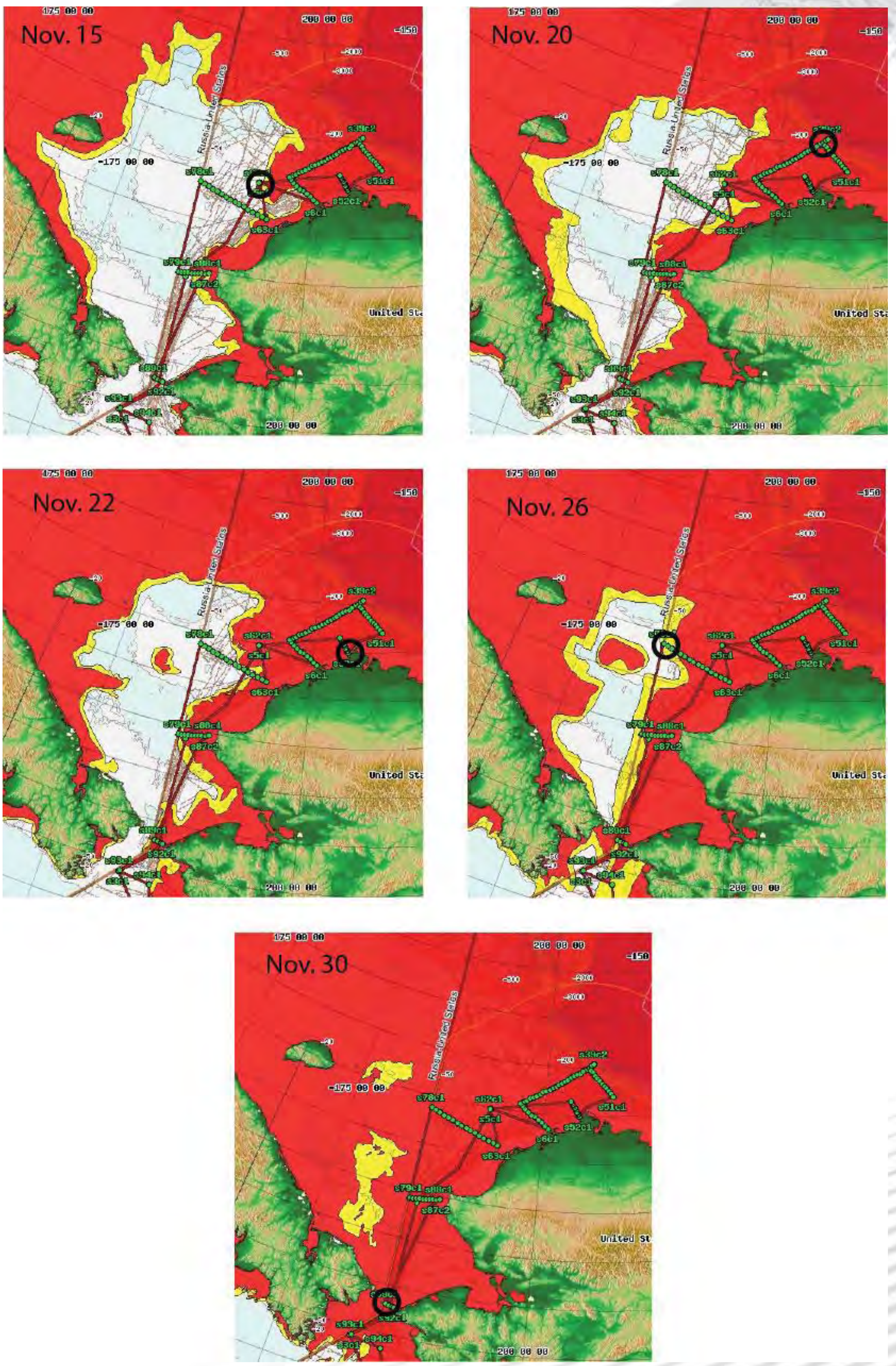
The solution came from the ability of the US Coast Guard Cutter Healy to receive near-real time satellite observations of key parameters while at sea, and from the partnership of the project and NSF with the Earth Observing Laboratory (EOL). Formed in 2005, EOL is one of the five laboratories of the National Center for Atmospheric Research (NCAR), the US National Science Foundation's Federally Funded Research and Development Center. As the successor of NCAR's Atmospheric Technology Division (ATD), the mission of EOL is to provide leadership in observing facilities and field project support, as well as research and data services needed to advance the scientific understanding of the Earth system.

Results & Perspective

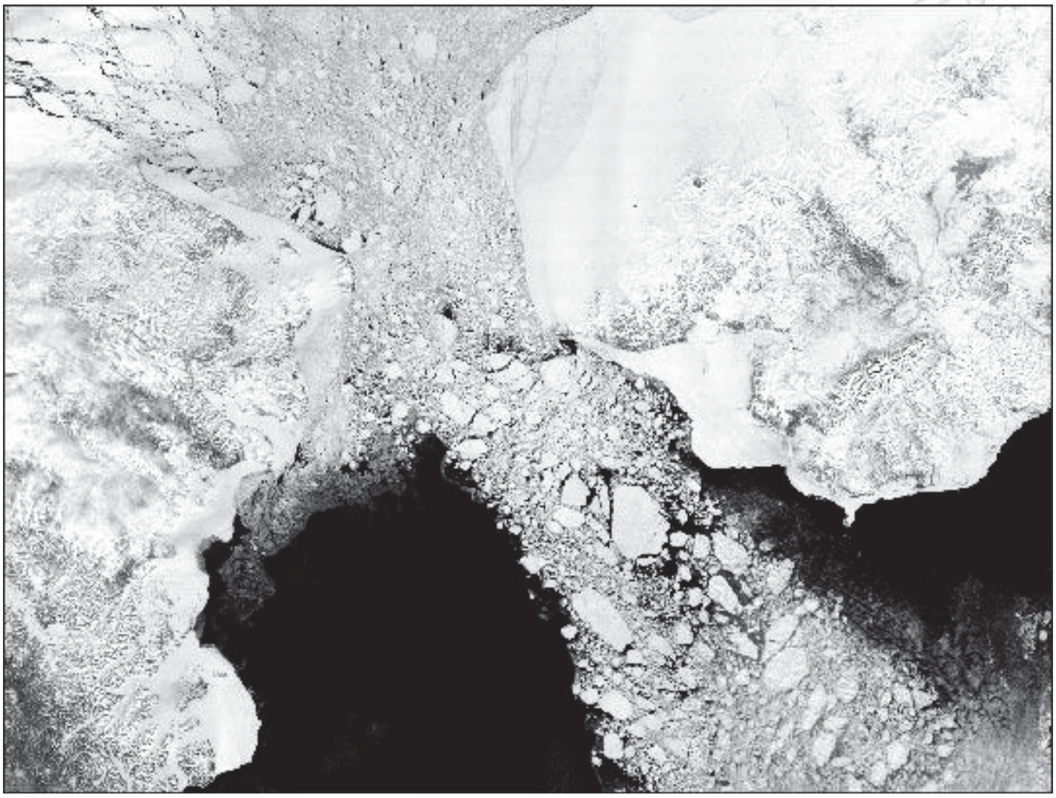
During all spring and summer Healy cruises between 2008 and 2010, EOL made available on the Healy MapServer as much useful satellite imagery as possible, including AVHRR sea ice, National Ice Center ice extent for the various dates, ocean colour and ARGOS telemetered spectacle eider and walrus locations, all overlaid with the real-time ship track (see example images below). RadarSat imagery was also imported where available through one of the university researchers.



Sea ice from AVHRR, ocean colour and the ship track.


Nov. 15
Nov. 20
Nov. 22
Nov. 26
Nov. 30

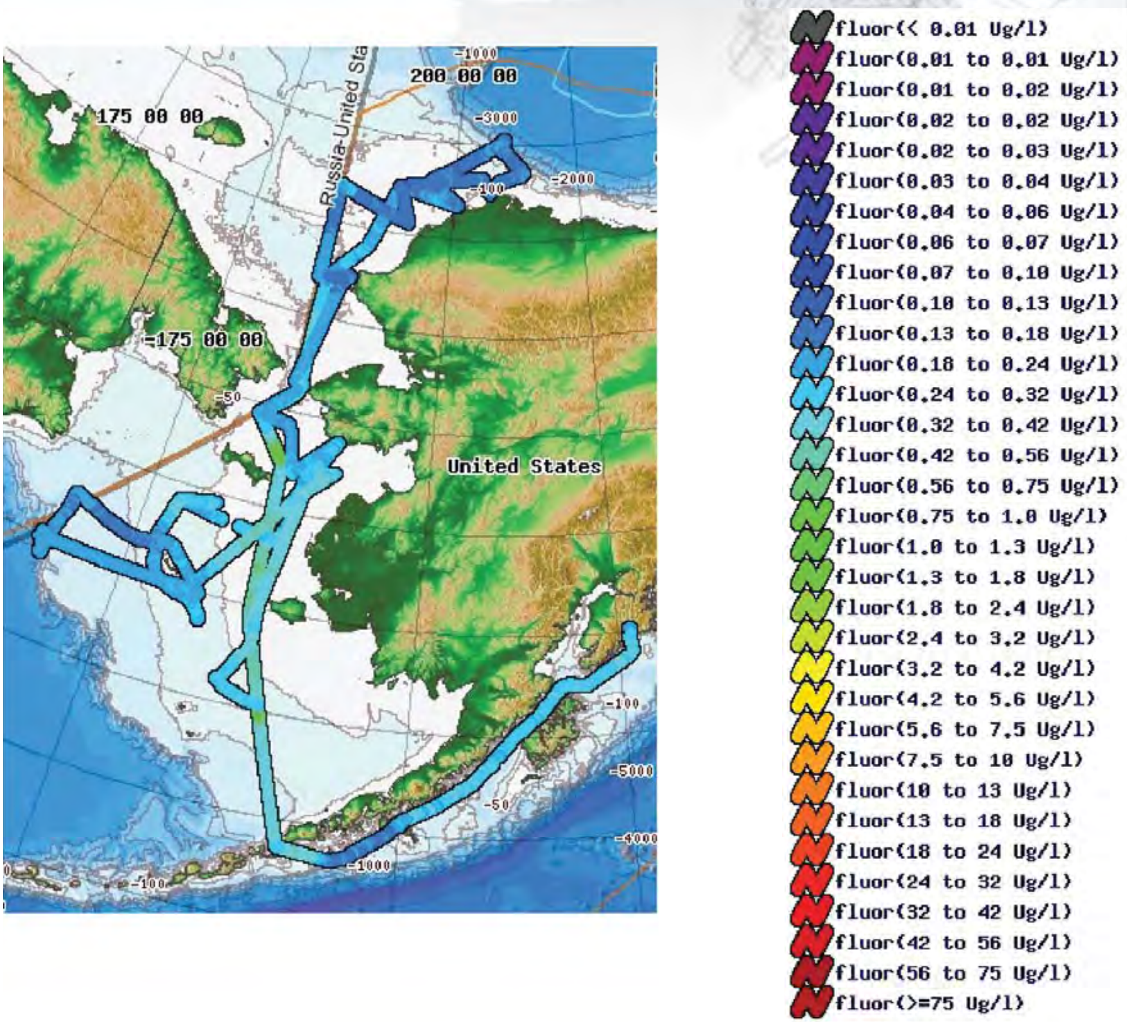
National Ice Center ice extent for the various dates. The location of the ship at the time of the ice extent map is circled. The cruise track of Healy is shown (these maps were generated by Steve Roberts, UAF).

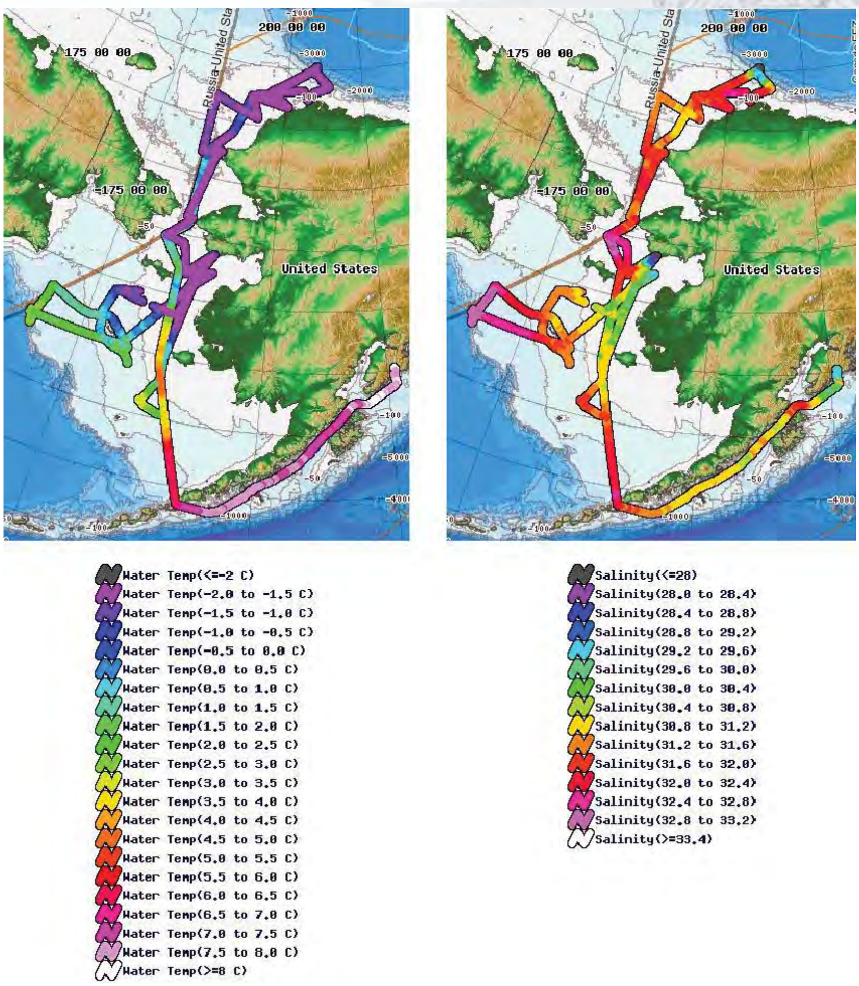


MODIS sensor on Terra sending images of sea ice distribution in the Bering Strait between Siberia and western Alaska.

Although not satellite imagery, researchers could also graphically display the following during the cruise (see figure below):

- Location – present, future, past occupied stations
- Cruise track
- Underway seawater temperature, fluorescence, salinity, etc.
- Multibeam data, both historic and real time
- Meteorological data
- pCO_2, oxygen
- ADCP data
- Bottom depth


175 00 00
200 00 00
-175 00 00
Russia-United Sta
United States
-1000
-3000
-2000
-100
-50
-5000
-4000
fluor(< 0.01 Ug/l)
fluor(0.01 to 0.01 Ug/l)
fluor(0.01 to 0.02 Ug/l)
fluor(0.02 to 0.02 Ug/l)
fluor(0.02 to 0.03 Ug/l)
fluor(0.03 to 0.04 Ug/l)
fluor(0.04 to 0.06 Ug/l)
fluor(0.06 to 0.07 Ug/l)
fluor(0.07 to 0.10 Ug/l)
fluor(0.10 to 0.13 Ug/l)
fluor(0.13 to 0.18 Ug/l)
fluor(0.18 to 0.24 Ug/l)
fluor(0.24 to 0.32 Ug/l)
fluor(0.32 to 0.42 Ug/l)
fluor(0.42 to 0.56 Ug/l)
fluor(0.56 to 0.75 Ug/l)
fluor(0.75 to 1.0 Ug/l)
fluor(1.0 to 1.3 Ug/l)
fluor(1.3 to 1.8 Ug/l)
fluor(1.8 to 2.4 Ug/l)
fluor(2.4 to 3.2 Ug/l)
fluor(3.2 to 4.2 Ug/l)
fluor(4.2 to 5.6 Ug/l)
fluor(5.6 to 7.5 Ug/l)
fluor(7.5 to 10 Ug/l)
fluor(10 to 13 Ug/l)
fluor(13 to 18 Ug/l)
fluor(18 to 24 Ug/l)
fluor(24 to 32 Ug/l)
fluor(32 to 42 Ug/l)
fluor(42 to 56 Ug/l)
fluor(56 to 75 Ug/l)
fluor(>=75 Ug/l)



All together, the in situ observations at select stations, the underway data from the ships sensors and the large scale satellite imagery for context complemented each other perfectly to provide the researchers the proper and necessary physical and biological context to interpret their data and address their research goals.

It is clear from this project and other efforts like it, that EO information plays a critical role in helping us understand the marine ecosystem. Marine researchers around the world will continue to use the available data streams; and likely increasingly so, as the bandwidth of ships improves and is able to receive increasing amounts of data like the ones shown, and as more EO sensors come online to provide new, higher resolution and more frequent imagery of the physical and biological environment that surrounds us.

Related Info

See http://www.nprb.org/bering-sea-project for more information on this project and related publications.

Case study 8: Use of EO to determine metrological and oceanographic conditions

Summary

For designers and engineers of coastal and off-shore equipment and for operators, whether from the shipping or resource extraction industries, knowledge of the metrological and oceanographic (metocean) conditions for a region in which they have an interest is essential. Earth observation (EO) technologies are a crucial component, both directly and indirectly, in acquiring and generating metocean data.

Sample Project Background

In early 2013, following a campaign of data collection and analysis, the discovery of three newly defined hydrocarbon basins in the Labrador Sea (the Henley, Chidley, and Holton Basins) and expanded the extent of the Hawke Basin. Results from the campaign are being made available to industry in order to generate interest in undertaking exploration activities in this region. As part of this effort C-CORE were requested to produce a metrological and oceanographic study to help define the risks associated with marine operations in the offshore environment and compare these conditions with other regions around the world. Specifically the objectives were as follows:

- Characterize metocean conditions (pack ice, icebergs, ice islands, waves, currents, wind, fog and vessel icing) in the specified area of interest; and
- Compare these conditions to those in other analogous internationally-explored regions (i.e. Grand Banks, Orphan Basin, East and West Greenland, North Sea, Barents Sea, Canadian Beaufort Sea, Chukchi Sea, Kara Sea, Caspian Sea and Sakhalin Island).

Without EO data the breadth, depth, and quality of the datasets used in the characterization exercise would have been significantly compromised.

Sample Results & Perspective

The following sample metocean results are derived from datasets that employ EO data, either as a primary data source, or as a data source that is used conjunction with other data types and methodologies.

Example 1 presents a dataset were EO data plays a direct role. **Erreur ! Source du renvoi introuvable.** shows the average number of days of open water (i.e., the number of days when less than 1/10th concentration of sea ice is present) during the period 1999-2008 in the southern portion of the Labrador Sea. Ice free days are an important metocean parameter as they allow shipping and other operations to be carried out without a need for ice class vessels or structures. The dataset from which this plot was made was generated through the acquisition, aggregation and processing of hundreds of Canadian Ice Service charts, an example of which is show in **Erreur ! Source du renvoi introuvable.**.

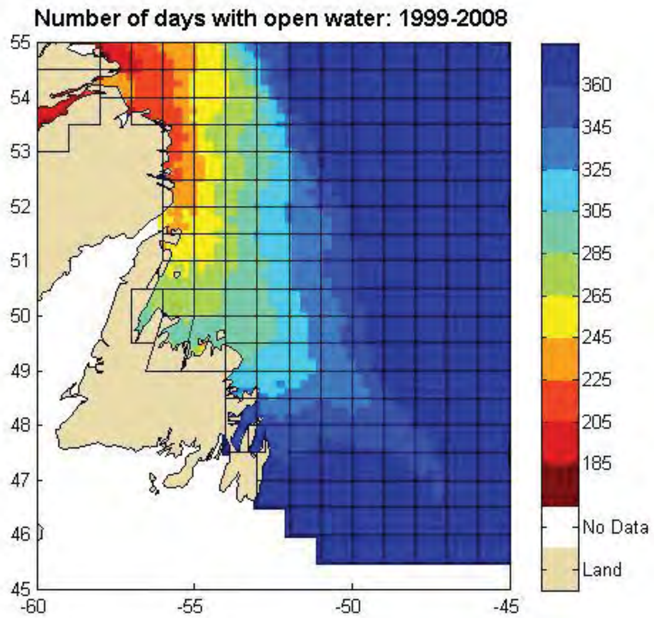


Figure 1: EO derived dataset showing number of days with open water determined from a 10 year average of ice charts

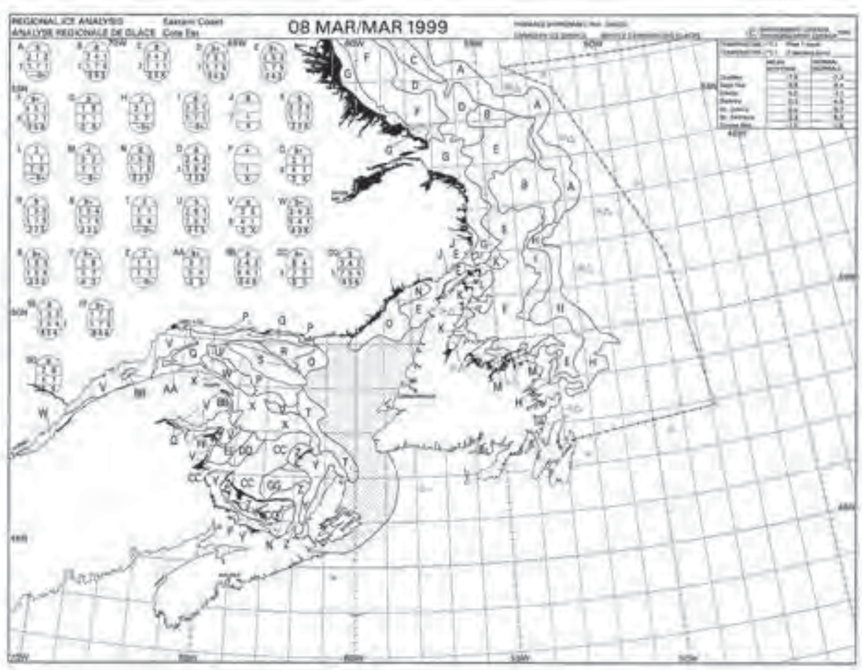


Figure 2: Sample Canadian Ice Service chart derived from EO data (© CIS 2014).

The CIS ice charts are produced from Synthetic Aperture Radar (SAR) Satellite Imagery satellite imagery and supported by ship and aircraft-based visual observations. They represent, on the chart publication date, the best estimate of ice conditions based on the integrated observational data. SAR data is an invaluable tool for this task because of the large spatial areas over which the satellite can obtain imagery and its ability to acquire data day and night in all weather conditions, clouds and fog being particularly problematic along the Labrador Coast.

Example 2 presents an example of where EO observation plays an indirect but essential role. **Erreur ! Source du renvoi introuvable.** shows oceanographic surface current data from the Canadian East Coast Ocean Model (CECOM) model[1]. CECOM is a dynamically and thermodynamically coupled ice-ocean model developed and maintained by researchers at the Bedford Institute of Oceanography. The model has been employed in numerous studies including basin-scale and shelf circulations, operational ocean forecasting, and seasonal variation of ice cover. The spatial resolution of the model is 0.1 x 0.1 ° with a 21 level generalized σ (sigma) co-ordinate grid in the vertical; the data is produced at a 30 min resolution. Crucial to the development of model is the assimilation of the near real time satellite derived sea-surface temperature (SST) data; by incorporating the SST observations the accuracy of the model output is greatly increased improving the quality of the data that operators and designers require and rely on for design, planning, and operational purposes.

Example 3 exploits the output from the Japanese Meteorological Research Institute Coupled General Circulation Model (MRI-CGCM3)[2], a 1.4^o x 1.4^o resolution earth systems model. **Erreur ! Source du renvoi introuvable.** shows the change, predicted by MRI-CGCM3, in the mean number of ice-free days between the period 1980-2010 and the period 2020-2050. The plot show that in the majority of locations the number of ice free days in a season will increase by up to ten days. The MRI-CGCM3 uses satellite derived altimeter data as part of its data assimilation scheme[3]. Again, by employing the satellite derived observational data the uncertainty in the model is greatly reduced, improving confidence in the results. MRI-CGCM3 is one of the models that is used in the Coupled Model Intercomparison Project Phase 5 (CMIP5)[4] experiments which, amongst other objectives, looks to provide a standard set of model simulations to evaluate how realistic the global climate models are in simulating the recent past and to provide projections of future climate change on near term and long term timescales.

The role EO plays in deriving parameters such as sea surface temperature and sea surface height is essential in reducing the uncertainty of models such as CECOM and MRI-CGCM3 that are used to generate metocean datasets and analyses, both short term as operational forecasts and longer term as summaries and predications.

---

[1] http://www.bio.gc.ca/science/research-recherche/ocean/forecasts-previsions/model-eng.php
[2] http://www.mri-jma.go.jp/Dep/cl/cl_4/index_en.html
[3] shttp://ds.data.jma.go.jp/tcc/tcc/products/elnino/move_mricom_doc.html
[4] http://cmip-pcmdi.llnl.gov/cmip5/

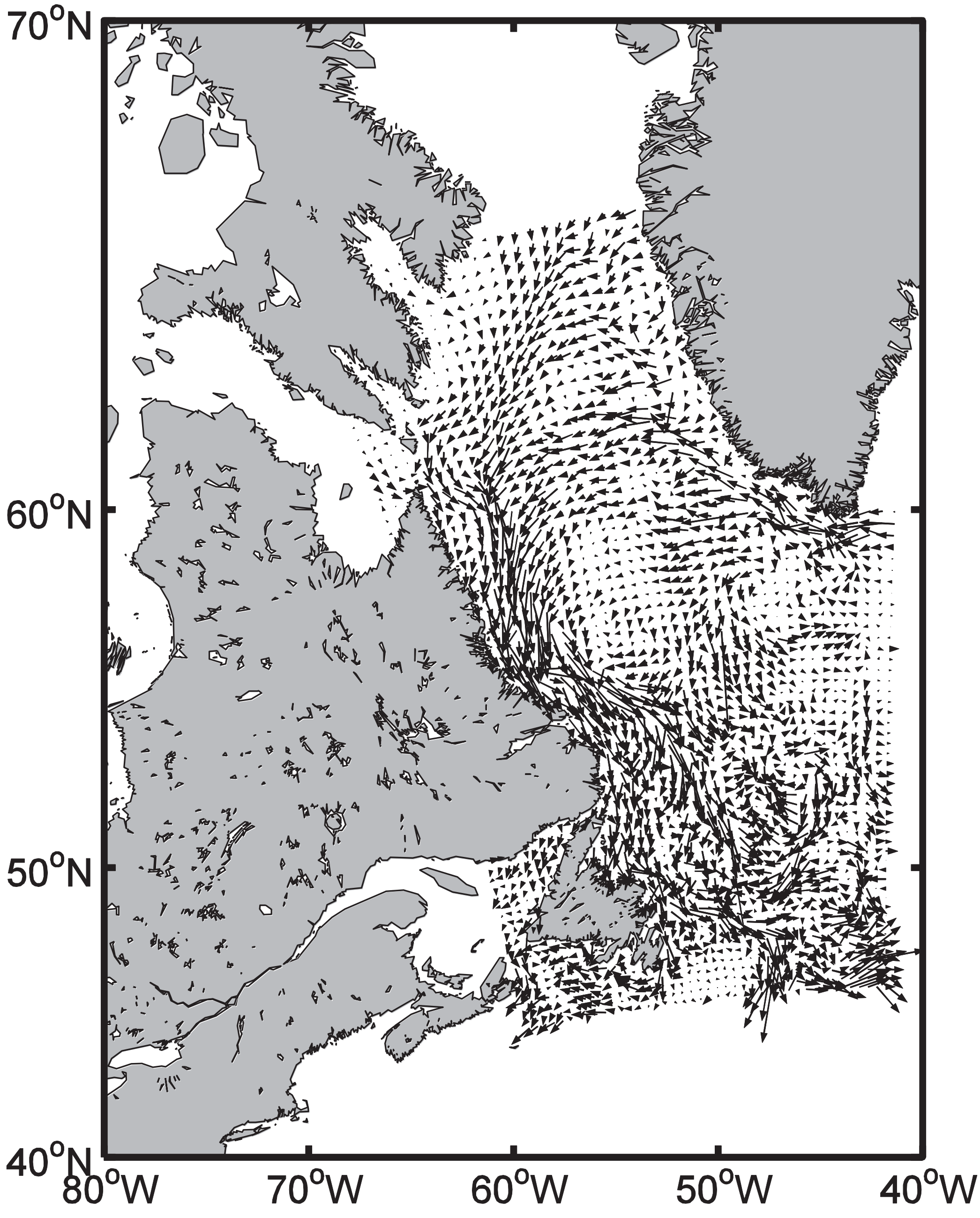


Figure 3: Sample surface current output from the CECOM model for 03/01/2003 at 0200hr (CECOM model data kindly provided by the Bedford Institute of Oceanography)

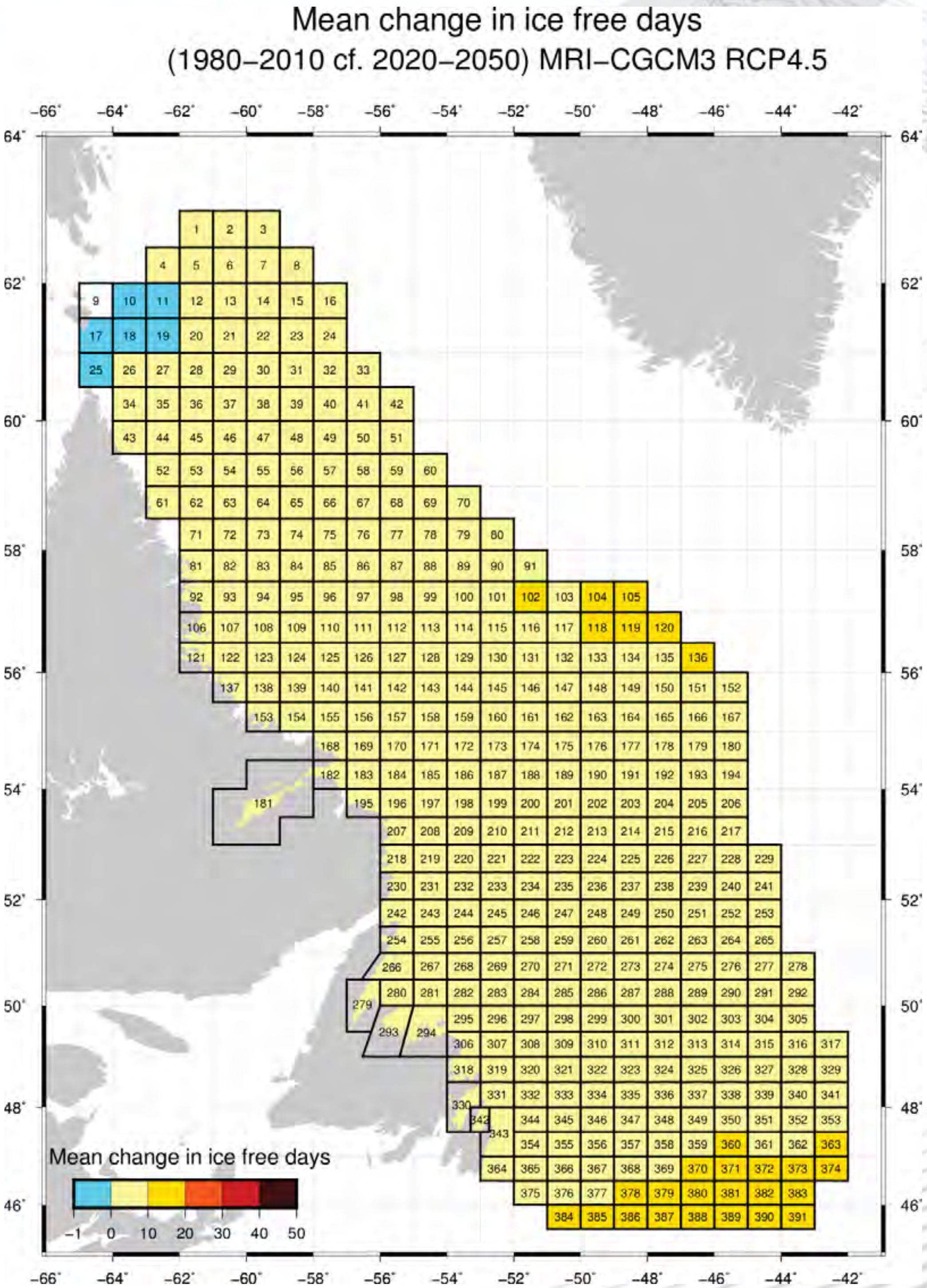


Figure 4: Predicted change in ice free days from MRI-GCM3

Related Info

About C-CORE

C-CORE's mission is to be a world leader in the development and application of advanced engineering principles to solve operational challenges in the natural resource sectors and other target markets. Through responsiveness, excellence in service, continuously advancing technology, and understanding clients' needs, C-CORE will be the organization of choice for providing innovative services and products. C-CORE will conduct applied research and development with a motivated, highly qualified team working in a framework of sound business principles.

Contact: Dr. Rob Briggs

Captain Robert A. Bartlett Building, Morrissey Road, St. John's, NL, Canada A1B 3X5
T: 709-864-8354 / F: 709-864-4706 / e-mail: info@c-core.ca