

Forecasting extreme weather and ocean conditions in the Beaufort Sea

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Environment Canada

Environnement Canada



Défense National nationale Defence



Overview

Research aim:

Improve short-term weather, ocean, ice forecasts in the Beaufort by developing a coupled ocean-wave-ice-atmosphere prediction system.

BREA context:

Contributes to the coupled ocean-ice-atmosphere modelling and forecasting research priority area.

Presentation outline:

Background; the forecast systems; improvements; disseminating forecasts.





Background

Why do we need improved forecasts?

- METAREAS Canada has assumed responsibility for marine forecasts in the Beaufort Sea and other Arctic regions.
- Industry Support for planning and operations (transport safety and efficiency, offloading, evacuation, ice management, infrastructure design, etc.)
- Regulators Support for the environmental review process, and for operational and strategic decision making.
- Emergency response Surface trajectory predictions for oil spill response and for search and rescue.
- Communities Predictions of ice and weather conditions for transport, recreation and other needs.
- Academia Contributes to improved understanding of the Arctic system.





The team

Canada

The prediction systems are being developed as a collaboration between:

- Environment Canada
- Fisheries & Oceans Canada
- National Defence

Collaborations outside of the federal government:

- McGill University (sea ice modelling)
- Université de Québec à Rimouski (ice-wave interactions)

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- Mercator Ocean (ocean modelling)

Links with other BREA projects



🐯 McGill



UOAI

Université du Québec à Rimouski



Prediction systems

- Prediction systems are used for the atmosphere (the weather), for the ocean and for sea-ice.
- But the atmosphere, the ocean and the ice are linked and influence one another.
- Coupled prediction systems reproduce these linkages – with the aim of increasing the accuracy of forecasts.

We are developing a suite of coupled models – global, regional and local.



Source: NOAA





Global system

- Resolution of 1/4° (<10 km in the Beaufort Sea).
- 10 day forecasts.
- Assimilation of sea surface temperature, sea surface height, temperature & salinity profiles, and sea ice conditions.
- Provides the initial and boundary conditions for the regional systems.
- Evaluation of coupled atmospheric forecast trials underway, showing significant improvements.







Regional system

- Regional ice-ocean prediction system.
- 1/12° horizontal resolution (2-3km in the southern Beaufort Sea).
- 2 day ice forecasts.
- Coupled ice-ocean system to be implemented spring 2015.





Ice thickness

Canada



Improvements

Within the BREA project, there have been many areas of research towards forecast system improvements.

Some examples are:

- Ice-wave interaction
- Landfast ice
- Ice-atmosphere interaction
- Ocean physics
- Data assimilation

Other BREA projects are contributing to system improvements – for example improvements to the modeled freshwater flow from the Mackenzie River.





Ice-wave interaction

- Waves break the ice in the marginal ice zone. Improvements include:
- Better representation of the ice-wave interaction in the forecast system.
- Better identification of the MIZ from satellite images.







Landfast ice

- Landfast ice is poorly reproduced in ice models.
- A new parameterization of the stresses of grounded keels has improved the landfast ice.
- Thickness shown here illustrates the improvement along the coast of the southern Beaufort Sea.









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Ocean physics

The ice-ocean model has been used to hindcast the ocean state for 2003-2009, allowing us to identify strengths & weaknesses, and implement improvements to the system.





120°W

5 cm/s

Canadă

SST, Hindcast06, Aug 2008

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160°W



Observations

Data is needed for assimilation into the models (to correct biases), and for verifying the forecasts. Examples of new Arctic observations include:

- Ice buoys.
- Ocean profiling buoys.
- Canadian Rangers.
- A moored ocean observatory.













Disseminating forecasts

Getting forecasts to industry, regulators, government and communities is a key aim.

Dissemination is by:

- Environment Canada marine forecasts
- Conventional Environment Canada weather forecasts
- CONCEPTS webpage (under development)
- Experimental web access via meteocentre.com





CONCEPTS webpage

Operational Atmosphere-Ocean-Ice Forecasting

Concepts

Operational Atmosphere-Ocean-Ice Forecasting

Using CONCEPTS Ocean Data Products and Services

CONCEPTS Development

CONCEPTS Future

Global Ice Ocean Prediction System (GIOPS)

Regional Ice Ocean Prediction System (RIOPS)

Coastal Ice Ocean Prediction System (CIOPS)

Projects and Research under CONCEPTS

CONCEPTS Publications and Documentation

Recent and Upcoming Events

CONCEPTS Team and Partners

Frequently asked Questions



CONCEPTS

Pacific Ocean



Sea Surface Temperature (°C) 2014 12 03 6 7 8 9 10 11 12 13 14 15 "CONCEPTS", (Canadian Operational Network of Coupled Environmental PredicTion Systems) are online oceanographic data services. Observations on the atmosphere, oceans and sea ice are integrated into computer models to deliver automated, real-time descriptions of ocean conditions and behavior. CONCEPTS services are intended to provide Canadians with the best possible environmental forecasts, including improved short-term weather forecasts and more accurate ocean, ice, current, wave, and storm surge forecasts. Enhanced knowledge of ocean conditions leads to better understanding and management of Canadian marine ecosystems, especially under a changing climate.

Arctic Ocean

Atlantic Ocean



-2 -1 -0 1 2 3 4 5 6 7 8 9 10 11







Experimental access



Meteocentre.com/plus

Surface currents





Experimental access



Meteocentre.com/plus

Ice thickness and drift





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Questions and discussion





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