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CHC CANADIAN HYDRAULICS CENTRE

Improved Iceberg Forecasts and Bergy Bit Guidance

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ABSTRACT

The Program of Energy Research and Development (PERD) has been funding development of the Iceberg drift and deterioration model in two areas: Improved Iceberg forecasts and Improved bergy bit guidance. The focus of the Improved Iceberg forecasts project is to develop improved iceberg information for the marine community in general and more specifically to the energy production sector. This will be accomplished by developing an improved operational iceberg modelling system running at the CIS. The focus of the Improved bergy bit guidance project is to develop improved understanding of iceberg calving mechanisms and bergy bit drift and deterioration and develop a stand-alone model that end-users can use. The information will be presented to interested tanker captains during training sessions or through training focused reports.

Canadian Ice Service (CIS) has contracted Canadian Hydraulics Centre (CHC) to develop an Iceberg drift and deterioration model and provide upgrades and maintenance to the model. The aim of this reports is to summarize what has been achieved 2009/2010, what is remaining, and identify key issues and practical way forward.

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Improved Iceberg Forecasts and Bergy Bit Guidance

1.0 INTRODUCTION

An iceberg forecasting model has been under development by the Canadian Ice Service (CIS). The development addresses iceberg drift, deterioration and calving, as well as the fate of the calved small ice masses. The model is intended for operational use by CIS to forecast iceberg conditions along the East Coast of Canada. Knowledge of the deterioration of iceberg size is essential for forecasting the drift. Iceberg size is also an important factor in making decisions concerning iceberg management (e.g. towing) and evaluating the risks to offshore installations. Calving of small ice pieces presents an additional hazard to shipping. The small pieces are difficult to detect, and can inflict considerable damage if collisions occur. For these reasons, an operational iceberg forecasting model requires reliable modeling of deterioration processes. One of the main features of the new model is the utilization of detailed environmental forcing input, such as the vertical profile of water current. The model runs on the CIS main computer system, where it is linked to an ocean model and databases for other environmental inputs.

The output of the model has been in operational use by some end users (e.g. Provincial Aerospace Ltd.) to predict the iceberg drift tracks over the Grand Banks. A number of end-users have indicated an interest in the development of a version of the model that can be directly operated in a stand-alone mode, without a need to link to the large ocean model and databases at CIS. The idea is that the end user will have the ability to input iceberg and environmental data into the model and could produce the output about the iceberg drift whenever needed. Such model will be advantageous to the end-users as a great tool in predicting the iceberg drift and drift of bergy bits.

The Program of Energy Research and Development (PERD) has been funding development of the model. A number of papers have been published describing iceberg deterioration (Kubat et al. 2007), the drift component (Kubat et al. 2005), the modeling of the size distribution and fate of calved ice (Savage et al. 2001, and 2000) and local forecasting issues (Kubat, 2004). The aim of this reports is to summarize what has been achieved in 2009/2010, what is remaining, and identify key issues and practical way forward. The document is divided into two parts: 1) Improved Iceberg forecasts and 2) Improved bergy bit guidance.

2.0 ICEBERG FORECASTS

The focus of this 4-year project is to develop improved iceberg information for the marine community in general and more specifically to the energy production sector. This will be accomplished by developing an improved operational iceberg modelling system running at the CIS. Wherever possible, existing research results will be adapted for this application. It is also expected that new techniques will be developed for the model.

2.1 CHC Work in 2009/2010

The tasks identified for 2009/2010 were:

a. Parameterization of iceberg deterioration: review and revise existing parameterization of wave erosion and calving in light of new Norwegian studies.
b. Collaboration with CIS on the testing and validation of the ice force formulation.

Delivered:

The code dealing with sea ice forces on icebergs was tested and verified; code was sent to CIS. Report on Validation of iceberg model at met.no was obtained from Norwegian Meteorological Institute (Broström et al., 2009), However, the report does not contain data that could be used to validate ice force formulation.

Remaining:

Recent data from ice basin tests of ice action on icebergs became available in 2010. The data can form the basis for validation of the ice force module. Preliminary examination of the data shows that considerable effort will be needed to analyze the data in order to carry out the required validation.

3.0 BERGY BIT GUIDANCE

The focus of this 4-year project is to develop improved understanding of iceberg calving mechanisms and bergy bit drift and deterioration. This is to be accomplished by gathering new field and lab information to create improved parameterizations. The information will be presented to interested tanker captains during training sessions or through training focused reports. Two outcomes were identified in the PERD proposal:

Outcome #1 Improved understanding and parameterization of bergy bit evolution

A series of field and or lab experiments will be conducted to monitor and quantify iceberg calving and bergy bit drift and deterioration. This information will be related to environmental conditions in order to better understand the governing forcing and to improve parameterizations within the CIS iceberg model.

Outcome #2 Bergy bit training

Training material and or training sessions will be prepared using the information discussed above. This training will be focused on providing tanker captains with information that better guides their activities in iceberg infested waters. Computer code will be delivered for direct use on site (e.g. onboard shuttle tankers and by other operators).

3.1 CHC Work in 2009/2010

The tasks identified for 2009/2010 were:

a. Integrate the CIS ensemble model and NRC local models to have a single unified up-to-date version of the model. This will be Version 2, will include sea ice effect on icebergs, and will serve as a basis for future model developments. This model would be used as a basis for the stand-alone local iceberg drift model. Report updating documentation of the iceberg model engine (NRC-CHC code) will be delivered.
b. Hold meetings with end-users (PAL, shuttle tanker captains) to obtain their input and feedback.
c. Provide support to industry to implement the revised unified local iceberg model (Version 2) into their operations.

Delivered:

The CHC code is now similar to the engine of CIS code. Documentation of the ice force subroutine is included in the code. Reports including documentation have been delivered earlier. The ice force subroutine was delivered to CIS. A report would be warranted when there are sufficient upgrades beyond what is already in numerous reports. The CIS code interfaces have not been compiled yet. That would be done when the code will be delivered to end-users.

The following end-users were contacted: PAL (Provincial Aerospace Airline Ltd.), Canship Uglands, Woodward Group of Companies, NEAS (Nunavut Eastern Arctic Shipping Inc), and PetroNav. Canship Uglands and PAL were interested in local version of the model. Captain McCarter from Canship Uglands suggested that shuttle tanker Captains will record data on bergy bits occurrence and will provide CHC with a feedback on local model performance in form of a report. However, the occurrence of bergy bits wasn't the highest priority during the year 2009/2010. The end users will be approached again in the year 2010/2011.

Remaining:

Training will have to be postponed to follow the end-users timeline and priorities. It was not feasible to start training in 2009/2010.

4.0 SUMMARY AND CONCLUSIONS

The report has summarized the efforts carried out by the Canadian Hydraulics Centre (CHC) during 2009/2010 in collaboration with the Canadian Ice Service (CIS) to improve Iceberg forecasts and improve bergy bit guidance.

For the task "Iceberg Forecasts":

- Code of sea ice forces was delivered. Verification through preliminary tests was done.
- Another effort, with partial funded from Norway to provide leverage to PERD, include successful implementation at the Norwegian Meteorological Institute. A report was delivered showing encouraging validation over the Barents Sea.
- The intended revision of the parameterization of the iceberg deterioration was not done because data was not available on time.

For the task "Bergybit Guidance":

- Codes are integrated in one "engine" that account for the dynamics and deterioration. The interface to environmental forces (developed by CIS) remains undocumented.
- The interfaces to environmental forces will be documented as they are delivered to end-users.
- Meetings were held with several potential end-users. There was general interest, but implementing the model aws not a priority in the short-term.

The way forward:

- Validation of the ice force module: a review of the newly available data needs to be done in order to establish a timeline and scope for the work.
- Reach out to end-users and support: Discussions need to continue and the timeline for individual potential end-users has to be accommodated. Implementation, training and support evidently has to be customized to address the needs and circumstances of each end-user.

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