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LONG-RANGE FORECASTING OF THE ICEBERG POPULATION ON THE GRAND BANKS

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1 Introduction

Icebergs pose a severe threat to shipping and offshore oil and gas activities on the Grand Banks of Newfoundland because of the risk of impact with vessels and fixed platforms, and the risk of bottom scouring on pipelines and wellheads. These risks in turn pose a threat to the safety of personnel and the marine environment.

Long-range forecasting of the iceberg population on the Grand Banks is needed by the offshore oil and gas industry for logistic planning. Because more iceberg-towing vessels and supply vessels are required in heavy iceberg years, a long-range forecast would help offshore operators procure and commit the appropriate number of vessels and level of manpower.

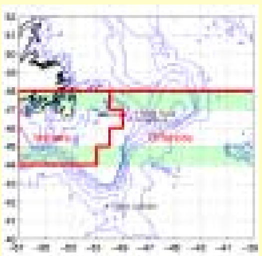

Figure 1: Map of Grand Banks area.

2 Icebergs and Sea Ice

A 2-month iceberg population forecast system is being developed using a statistical model based primarily on the strong relationship between iceberg numbers on the Grand Banks and prior sea ice extent on the Newfoundland and Labrador shelves. The statistical model consists of multiple regression equations developed for each month using data from the International Ice Patrol Iceberg Sightings Database (1960-2002) and digital ice charts from the Canadian Ice Service (1963-2002).

Sea ice is normally present off southern Labrador and Newfoundland from December to June, while icebergs drift south of 48°N primarily between mid-March and mid-July (Fig. 2). Annual iceberg severity and spring sea ice extent off Newfoundland are highly correlated (Fig. 3), primarily because ice extent is a good indicator of the spatial extent of cold water (<0°C) where iceberg deterioration is negligible. Because of the high persistence of ice extent, annual iceberg severity is also highly correlated with ice extent 1-2 months prior to the iceberg season.

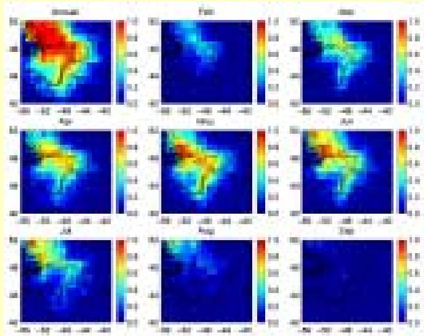

Figure 2: 40-year frequency of non-zero iceberg sightings in each 1°latitude by 1°longitude square (1963-2002) from the International Ice Patrol Iceberg Sightings Database.

Figure 3: Annual number of icebergs south of 48°N, spring sea ice extent east of Newfoundland, and inverted mean air temperature at Cartwright, Labrador (November-May).

3 Iceberg Data Normalization

Since the accuracy of statistical models depends on the quality of the data on which they are based, it is important to assess and possibly improve the accuracy of the iceberg population estimates. Periodic normalization of the iceberg data is necessary because of changes in methodology over time.

Because resighted icebergs were not identified in the database prior to the late 1970's, iceberg numbers before 1979 were reduced using a factor derived from the "Number of Icebergs South of 48°N" data set (Fig. 5). A second normalization is needed for the years prior to 1993. Since then, the number of icebergs near 48°N is high when compared with (a) sea ice extent and air temperature anomalies (Fig. 3), (b) iceberg numbers reported farther south (Fig. 4) and (c) the length of the iceberg season. This appears to be due to a larger fraction of the true iceberg population near 48°N being counted in recent years. Since 1993 (for February and March) and since 1995 (for April, May and June), there has been an increase in both the number of sightings per flight, and the total number of flights on which icebergs are reported (Fig. 6).

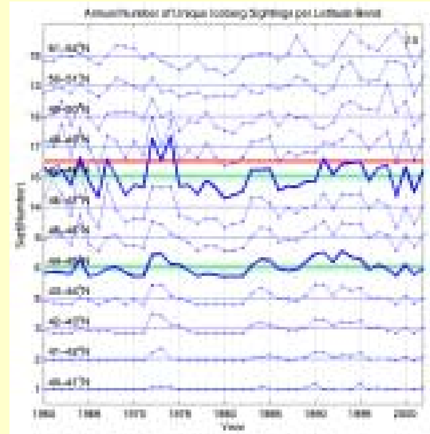

Figure 4: Annual number of unique iceberg sightings in each latitude band.

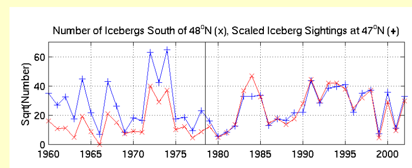

Figure 5: Comparison of number of unique iceberg sightings at 47-48°N and "Icebergs South of 48°N" data set.

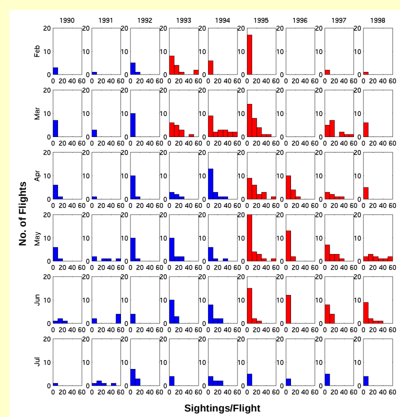

Figure 6: Monthly histograms showing the number of flights at 47-48°N as a function of the number of sightings per flight.

4 0-2 Month Iceberg Forecast

Regression coefficients derived from the monthly iceberg and sea-ice extent data were used to prepare a 0-1 month and a 1-2 month iceberg forecast at the beginning of each month. A first-year trial of the system was performed in 2003 for the offshore area of the Grand Banks.

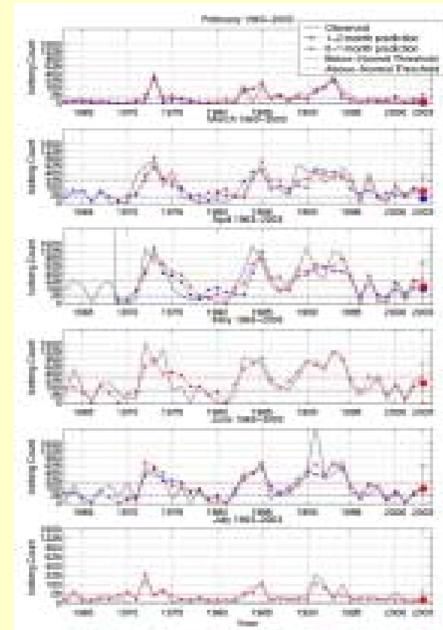

Figure 7: The observed monthly number of offshore icebergs for 1963-2003 (grey line), the fitted number based on prior sea ice extent for 1963-2002, and the forecast number for 2003.

5 Discussion

Iceberg data normalization is not only important for developing a forecast model, but is also needed for accurate risk analyses concerning offshore oil and gas facilities, and for assessing the effects of climate change.

Future work will include adding a forecast for the inshore area of the Grand Banks.

Acknowledgement

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