BEAUFORT REGIONAL ENVIRONMENTAL ASSESSMENT

Distribution and Thickness of Different Sea Ice Types and Extreme Ice Features in the Beaufort Sea: 2012 Field Report

Canada

July 2012

DISTRIBUTION AND THICKNESS OF DIFFERENT SEA ICE TYPES AND EXTREME ICE FEATURES IN THE BEAUFORT SEA

BEAUFORT SEA REGIONAL ENVIRONMENTAL ASSESSMENT (BREA)

Low lying fog banks over newly formed large leads. Photos were taken during thickness survey on April 22, 2012.

FIELD REPORT AIRBORNE ICE THICKNESS SURVEYS AD BUOY DEPLOYMENTS

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Summary

This report summarizes the buoy deployments and airborne ice thickness surveys performed as part of the BREA sea ice project "Distribution and thickness of different sea ice types and ice features in the Beaufort Sea". A buoy deployment flight was performed in close collaboration with Canatec Associates Inc. (Calgary) on April 15 using an Aklak Air Basler BT67 aircraft. 10 GPS beacons were successfully deployed on extreme ice features, four of which were provided through the BREA project and whose data are available to project partners. Ice thickness surveys took place between April 21 and 23, 2012, and used the German Basler BT67 aircraft "Polar 5" operated by the German Alfred Wegener Institute. The plane was based in Inuvik. Due to surface fog on two days which was invisible on satellite imagery but prevented low-level flying, ice thickness data were only successfully obtained on April 22. However, that flight was very successful and included overflights of several multiyear hummock fields and ice islands which were previously marked by GPS beacons. Unfortunately the main multiyear ice zone of the Beaufort Sea was located very far north and was out of range from Inuvik. Flights could not be performed from Sachs Harbour due to a shortage of fuel at the local airfield.

The field program was affected by the failure of the Envisat satellite, which resulted in the lack of frequent radar imagery which would have been used to track some ice features on which no GPS beacons were deployed. Radarsat imagery, which could have compensated for the loss of Envisat, were not available in sufficient numbers .Tracking of those ice features instead had to rely on MODIS imagery (see Figure 2 below).

The processed data are already uploaded to the Polar Data Catalogue at

http://www.polardata.ca/whitesnow/downloads/pdc/brea/11470/CCIN11470_20120627_20120422_noII_readme.txt

and

http://www.polardata.ca/whitesnow/downloads/pdc/brea/11470/CCIN11470_20120613_20120422_noII.txt ,

and are provided for the SEARCH sea ice outlook activity

http://www.arcus.org/search/seaiceoutlook/ice-thickness-data#BREA_Airborne_Electromagnetic-induction_EM_Ice_Thickness_Survey

A data report with analyses of the data will be delivered in December 2012.

1. Objectives

- Observe the regional distribution of the thickness of different ice types, including extreme ice features.
- Track the drift paths of ice islands and multiyear hummock fields, means of air-droppable GPS beacons.

2. Main study region

Southern Beaufort Sea, region upstream of the oil and gas leases (i.e. east of -132°W), within 450 km of Inuvik (Figure 1).

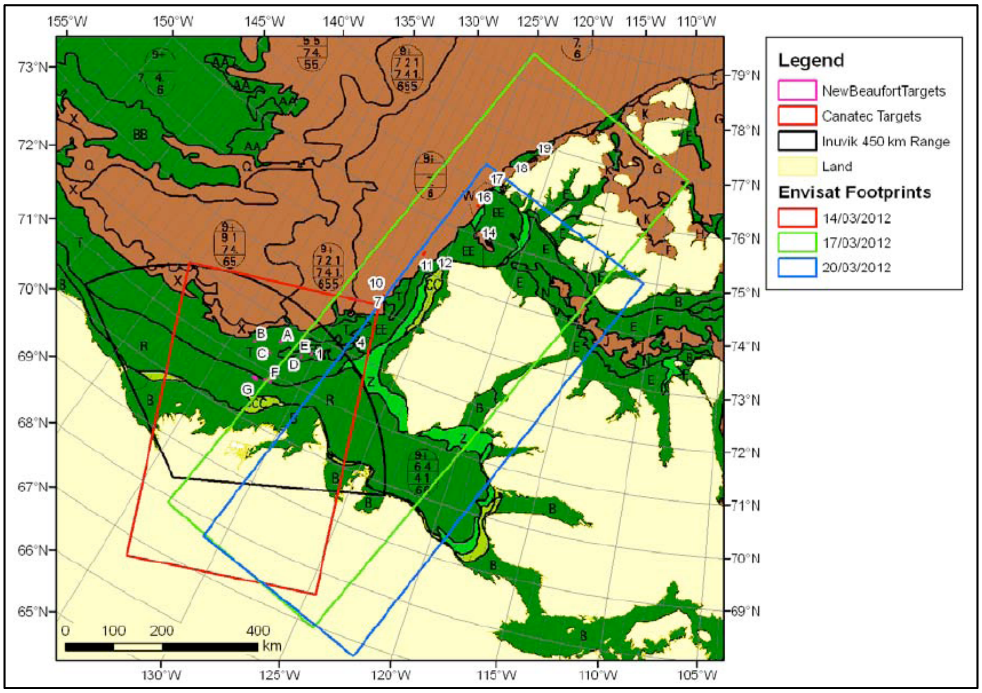

Figure 1: Ice chart of the Southern Beaufort Sea provided by the Canadian Ice Service, showing the distribution of first- and multiyear ice on March 19. The 450 km operating radius of the airborne thickness surveys, as well as the locations of some thick ice features derived from SAR imagery are also shown.

3. Ice and weather conditions

The sea ice cover in the Southern Beaufort Sea was mostly stable and immobile during early April. However, the ice started to break up and move soon after the buoy deployment flight on April 15. Ice motion was very rapid, leading to the opening of many large leads. The four panels in Figure 2 show typical ice conditions during the April 21 to 23 flying period. Many of the extensive lead systems are well visible. The imagery was also used to track some of the deformed ice features identified on earlier Envisat radar imagery. Due to a technical failure Envisat produced no data after April 8. Figure 2 shows how MODIS imagery was used to track some of these features. However, the accuracy of this tracking was poor and it was not clear if the features would have been hit. However, due to adverse, foggy conditions there was no possibility to survey them during the April 23 flight which led into this area.

The opening of extensive lead systems and the presence of air still well below -10°C cold resulted in the widespread formation of surface fog (see photos on title page). Although not very thick, this fog reduced the horizontal visibility significantly and did not allow the airplane to fly at an altitude of 200 feet which is required for the thickness surveys. Due to its small thickness, the fog layer was not well visible on MODIS and AVHRR imagery (Figures 2 and 3), which led to two failed flights on April 21 and 23. Luckily fog was mostly absent on April 22 and a successful flight could be performed.

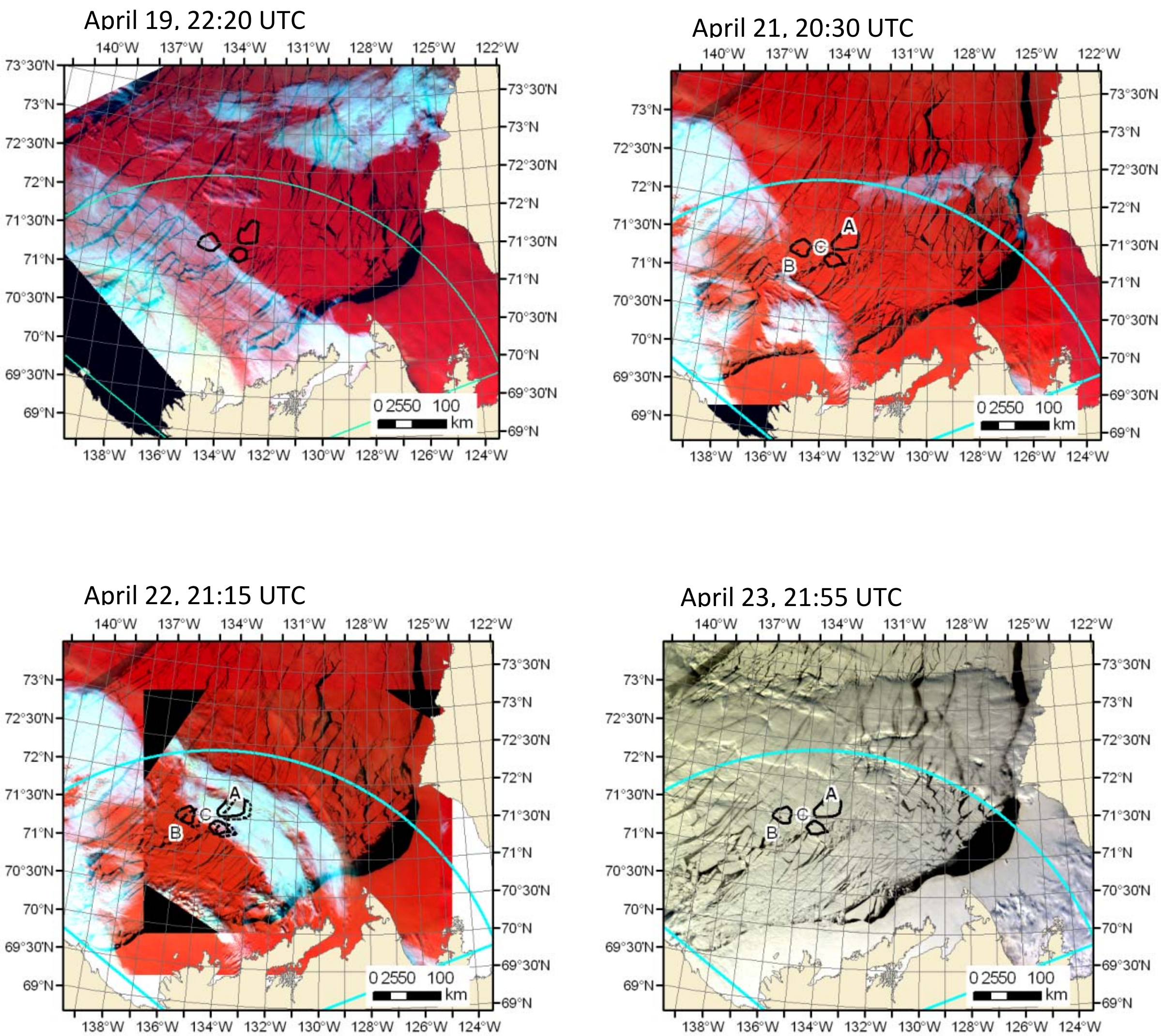

Figure 2: MODIS images showing typical ice and cloud conditions during the campaign between April 19 and 23. Note that low-level fog is mostly invisible in these images. Polygons A, B, and C indicate locations of deformed hummock fields which were identified on SAR imagery and then tracked with these MODIS images (Figures courtesy Alec Casey, University of Alberta).

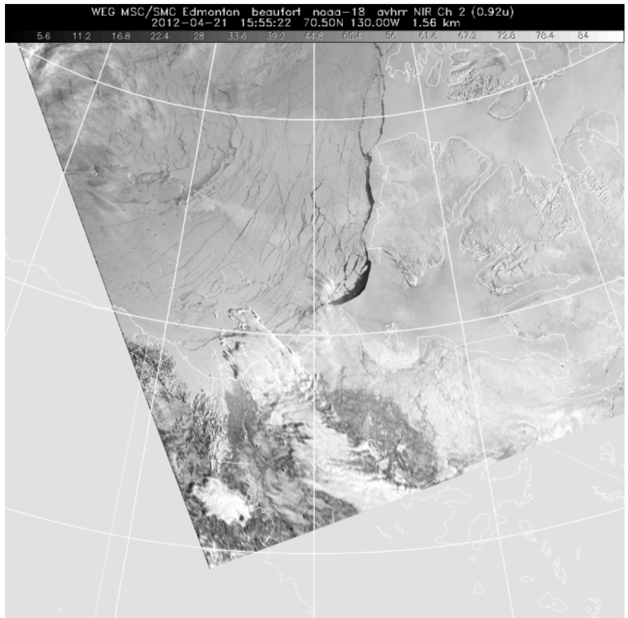

Figure 3: AVHRR channel 2 image of the southern Beaufort Sea showing cloud and ice conditions on April 22, the day of the successful thickness survey.

4. Buoy deployments

On April 15, personnel of Canatec Associates Inc. from Calgary air-dropped 10 Canatec GPS beacons using a Basler BT67 aircraft operated by Aklak Air in Inuvik. These beacons included 4 BREA beacons, and we contributed to the flight charter with BREA funds. Data from the other 6 beacons are not made available in real time, but will be provided to the project eventually.

All beacons were deployed on multiyear hummock fields identified in SAR imagery a few days before the deployment. Two beacons were also deployed on a prominent ice island, the same feature which was visited by the University of Manitoba group in early April, who also deployed a beacon on it.

Figure 4 shows the initial positions of all beacons. All are still transmitting valid as of the writing of this report (July 10, 2012), well into the melt season.

Figure 4: Initial locations of all 10 GPS beacons air-dropped on April 15. Map taken from non-disclosed Canatec beacon web site.

5. Ice thickness survey

The map in Figure 5 shows flight tracks of the three ice thickness surveys performed on April 21, 22, and 23. None of these flights reached into the main multiyear ice zone whose boundary was unusually far north and out of range of the aircraft. Due to low-lying fog only the April 22 flight produced useful data. This flight followed a straight path north-northeast from Inuvik to a turning point chosen as the location of one of the GPS beacons marking a multiyear hummock field. From there, the survey led northwest, towards other multiyear hummock fields marked by beacons as well as to a prominent ice island. The map shows the involved flight tracks in the region of these ice features which was chosen to best overfly each.

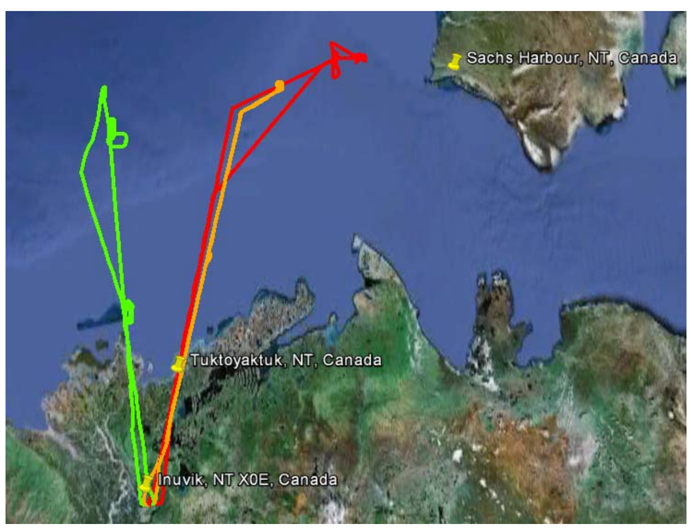

Figure 5: Flight tracks flown on April 21 (orange), April 22 (red), and April 23 (green), 2012. Ice thickness data were only obtained on April 22 due to unfavourable weather conditions on the other days.

One of the major goals of this flight was to survey the deformed ice features marked by the GPS beacons. However, due to the ice drift this was very challenging. Most recent beacon positions were downloaded from the data web site just before the flight, and used as way points. However, in the 2 to 3 hours between data upload and flight, and the several hours between the last message transmission and data download, the ice had drifted significantly. Therefore, and although the pilots searched the area visually, the southwestern-most ice feature (JIP3 in Figure 6) was not hit well and no increased thicknesses were measured. However, the ice features in the northeastern survey region drifted more slowly and their GPS beacons reported more closely, such that they were successfully surveyed. Thicknesses between 6 and 10 meters were measured over these features.

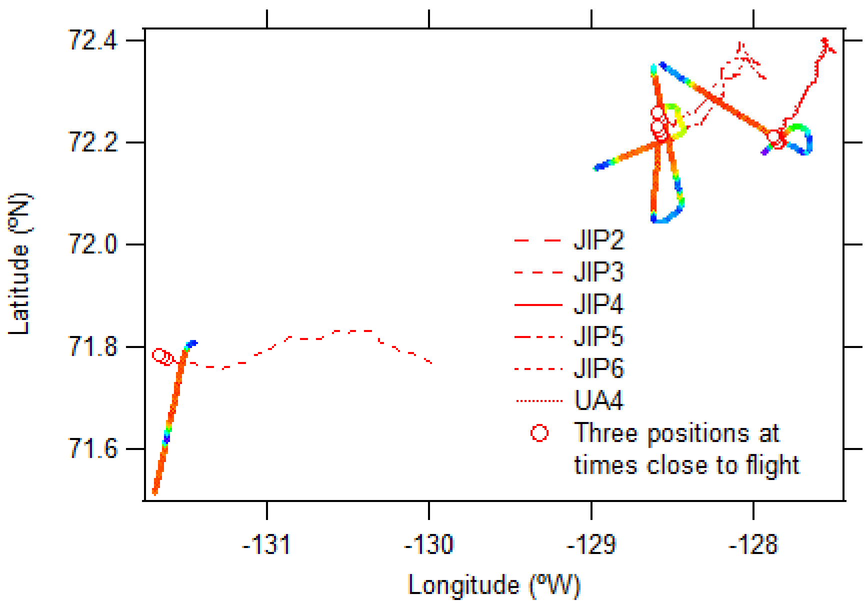

Figure 6: Ice thickness flight tracks on April 22 (thick lines; color code indicates flying altitude – red: low; blue: high) and buoy drift tracks between April 15 and 22 (stippled lines). Circles indicate the three positions closest before and after the overflight time.

Finally, the flight led twice across a prominent ice island which was well visible to the pilots (Figures 7 and 8). Incidentally we also surveyed this ice island in May 2011, when it was still in Viscount Melville Sound and reached by helicopter from Resolute Bay. Preliminary analyses showed that the thickness of this ice island reduced from 35 m to just over 25 m within a year.

Figure 7: Photo of ice island, taken on April 22 at 21:19:37 at 72.2264°N -127.8988°W from an altitude of 1250 m.

Figure 8: Nadir photograph of ice island, taken on April 22 at 21:28:14 at 72.2233°N and -127.8515°W from an altitude of 2600 m.