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Observing Arctic Pack Ice and Under-lying River Plume Properties with Helicopter-borne Sensors

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Ice thickness and surface ice roughness were measured over the Mackenzie Shelf in the Beaufort Sea with a helicopter-borne electromagnetic (EM) system called the “Ice Pic” during the winter of 2004. The electromagnetic sensor provides the distance from the sensor to the sea surface (the nearest conducting medium) while a laser altimeter provides the distance to the surface of the snow or ice. Together the sensors give the snow-plus-ice thickness over mobile offshore pack ice. However, at river mouths, the freshwater plume layer is also included. The laser altimeter data also provide pack ice surface roughness profiles. The sampling rate for the ice thickness and roughness data is 10 Hz which represents a spatial sampling interval of about 4-5 m. A video/laser system provides overlapping video frames with a width equal to the helicopter’s altitude.

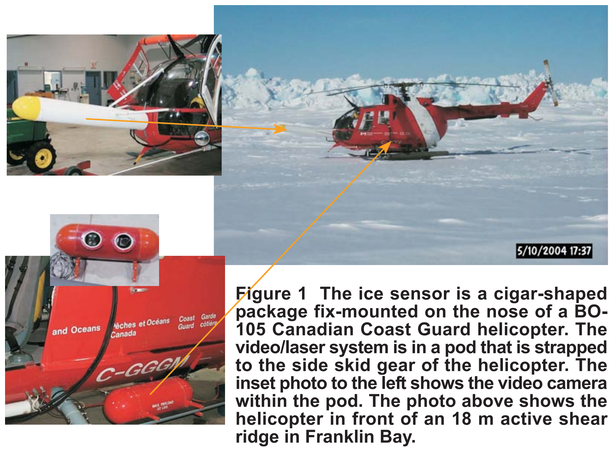


Figure 1 The ice sensor is a cigar-shaped package fix-mounted on the nose of a BO-105 Canadian Coast Guard helicopter. The video/laser system is in a pod that is strapped to the side skid gear of the helicopter. The inset photo to the left shows the video camera within the pod. The photo above shows the helicopter in front of an 18 m active shear ridge in Franklin Bay.

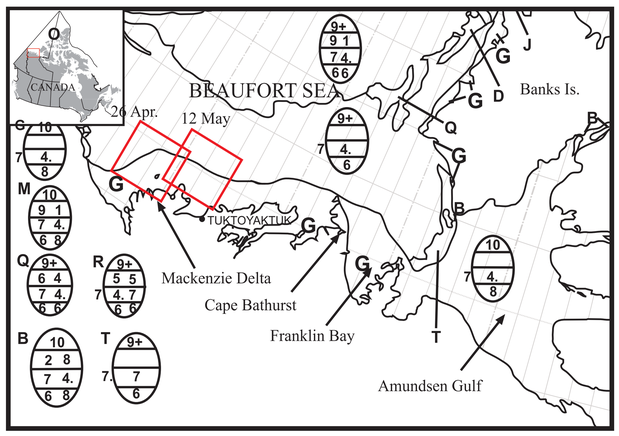
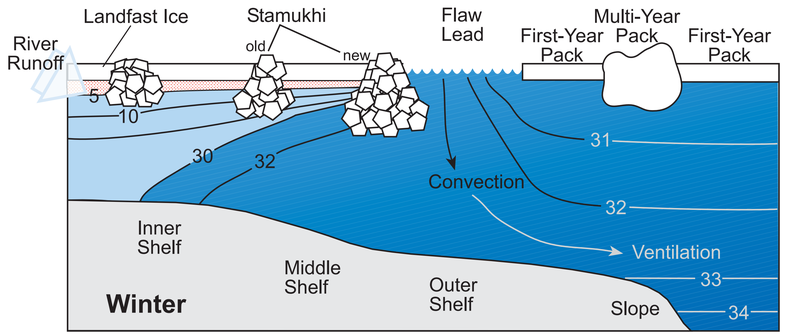


Figure 2 Map showing the survey area in the Beaufort Sea and section of the May 15, 2004 regional ice chart. The red rectangles show the location of the ENVISAT images that are displayed on this poster.

Figure 3 Physical system of ice, plume, and water beneath the ice in winter. The drawing shows the layer of freshwaer runoff from the Mackenzie River that was trapped beneath the land-fast ice and that was trapped by several shear ridges that ran parallel to shore.



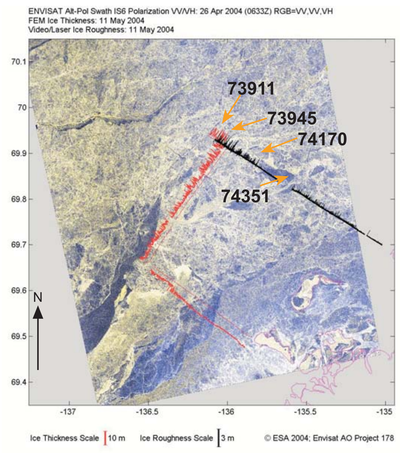
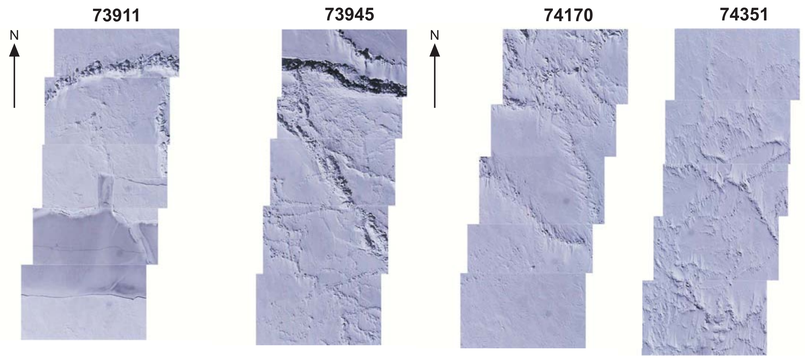


Figure 4 60 km x 80 km ENVISAT image of April 26 overlain with ice thickness observations obtained on May 11. Ice thickness is plotted relative to the thin red line that represents the location of the flight path. Ice roughness is plotted in black. The dark blue regions are relatively flat pack ice regions that were formed when the pack ice moved temporarily offshore. Brighter yellow areas are regions with extensively ridged, deformed ice.

Figure 5 Four mosaics constructed from ~100 m wide overlapping video images that were collected along the inbound flight path while flying at ~100m altitude (black line on Figure 4). Mosaics show a newly refrozen lead with bear tracks (73911), main shear ridge (73945), change-over from rough to flat ice (74170), and an older ridge found between flat ice areas (74351).



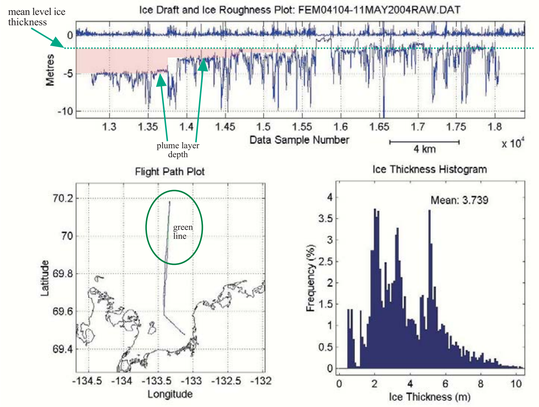


Figure 5 Ice thickness profile data collected along the 26 km section (”green line”) of the helicopter flight path that was flown S to N on May 11, 2004. Undeformed ice plus snow thickness in the area ranged from 1.8 to 2.0 m. Freshwater was dammed to 5 m depth before the *stamukhi* (large grounded ridge) at 1.37 x10^4 data number and to 3.0 and 2.5 m at the ridges found at 1.45 and 1.56x10^4 data numbers. North and offshore from this, thinner refrozen sections were observed indicating a more mobile pack ice reigon.

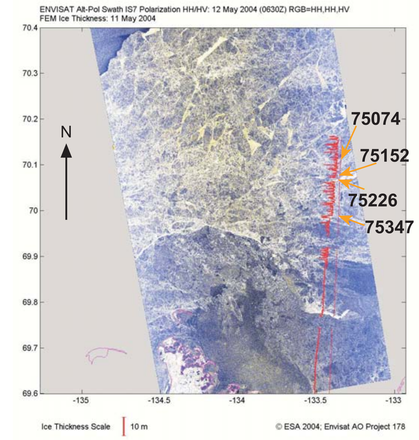
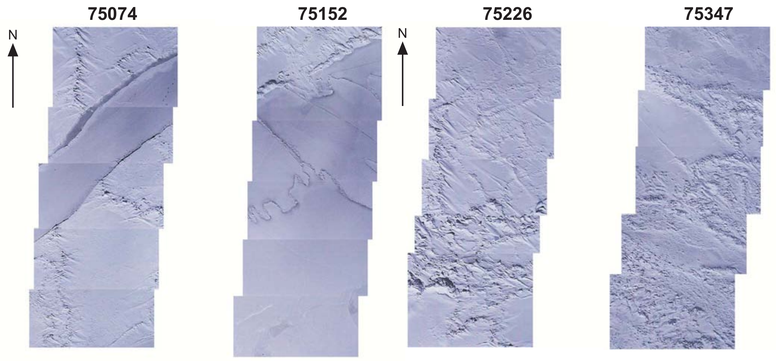


Figure 6 50 km x 80 km ENVISAT image of May 12 overlain with ice thickness observations obtained on May 11. Ice thicknesses are plotted relative to the thin red line that represents the location of the flight path. The dark blue regions are relatively flat pack ice regions while the brighter yellow regions are extensively ridged ice areas or young ice areas with frost flowers on them (video mosaic 75152).

Figure 7 Four mosaics constructed from ~100 m wide overlapping video images that were collected along the inbound flight path while flying at ~100m altitude (red line on Figure 7). Mosaics show an old shear ridge (75347), the present shear ridge area inshore of the large lead (75226), the start of the 2 km lead with the offshore old ice edge (75152), and a smaller 50 m wide offshore lead (75074).



For More Information: http://www.mar.dfo-mpo.gc.ca/science/ocean/seaice/public.html

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