The Canadian Government funded the Circumpolar Flaw Lead (CFL) System Study as a major contribution to the International Polar Year (IPY). The Canadian Research Icebreaker (NGCC Amundsen) has been operating in the Canadian Arctic since July of 2007 in support of CFL. She over-wintered in the Amundsen Gulf (AG) and the Southern Beaufort Sea (SBS) conducting a large scale multidisciplinary investigation of the Banks Island Flaw Lead polynya complex. There have been over 300 investigators from 15 countries participating through 10 integrated science teams rotating on 6 week legs between Sept'07 and August'08 (www.ipy-cfl.ca).

The sea ice conditions during the fall of 2007 and winter of 2008 were significantly different than the past 30 year climatology. The fall began with a very slow freeze-up due to the fact that the multiyear pack ice retreated to a position much further north than usual (Figure 1). This caused a northward migration of the high pressure system to coincide with the northward migration of the multiyear (MY) pack ice edge. As the fall progressed the Beaufort Sea Ice gyre was very active resulting in high velocity circulation of MY ice in an anticyclonic direction away from the Banks Island Coast (compare across dates in Figure 1). This opened up very large flaw leads along the West coast of Banks Island which we were able to use to navigate the Amundsen northwards along the western coast of Banks Island in Late November, 2007. We entered into the pack ice near the northern limit of Banks Island (Figure 2) at the entrance to McClure Strait. We found the MY pack to be highly decayed: thaw holes were common; lots of snow on the surface of the ice and the average thickness of he MY ice was only about 2.8 m. The MY ice spun off banks island opening large cracks and leads in the pack ice and forming large flaw leads again the west coast of Banks Island. This consolidated with first-year ice forming in the interstices of the MY ice (Figure 2). The late fall and early winter saw lots of open water in Amundsen gulf. This was due to cyclones tracking along the open water area from the Chuckchi Shelf through the Southern Beaufort Sea to Amundsen Gulf. The cyclones kept the ocean surface very rough (figure 2) and contributed to a large ocean to atmosphere heat flux. Our in situ measurements showed that the surface mixed layer contained a lot of heat due to the long period of open water in the summer and fall of 2007. This period of open water and very thin ice continued through until about mid to late December when things began to consolidate. Once the ocean was capped the ice grew relatively rapidly. Throughout the winter period the flaw lead polynya of Cape Bathurst and Banks Island consisted of a lot of open water due to first year divergence. These leads were sufficiently large that we were able to keep the Amundsen mobile in this region throughout the winter. Our science plan was predicated on a fast ice bridge forming between Cape Perry and Cape Lambton (the south tip of Banks Island). This never happened due to the late formation and lack of thickness in the first-year ice in Amundsen Gulf. At the time of writing this brief our icebreaker is operating largely in open water (late May'08) and the melt onset has begun. We are about 1 month ahead of climatology for this region for both melt onset and the clearing of ice from Amundsen Gulf. Several Key features regarding projections of sea ice can be gleaned from our experiences overwintering in the Southern Beaufort Sea:

1) At the hemispheric scale we expect the multiyear sea ice pack to retreat to a level approximately the same or less than the record reduction of 2007. This is due to a number of factors:
    a. The remnant MY sea ice had a lot of new snow on it in the late fall of 2008 (so much that we could not land our helicopter on it). This new snow will have restricted growth of the MY ice through the winter of 2008.
    b. The MY pack was dispersed in the late fall due to an anticyclonic rotation in the Beaufort Sea Ice gyre (see figure 1). This caused thin first-year sea ice to grow

between MY floes thereby decreasing the overall albedo of this surface in the spring of 2008 (see Figure 2).

c. The MY pack ice was much more mobile that in other years due to the lack of sufficiently thick ice to slow down dynamic processes. We released 24 ice beacons as part of our CFL projects. These beacons are currently sending telemetry data and have recorded ranges in velocity f from 0.02 km/hr to over 2.0 km/hr depending on beacon, date and location. The largest values are associated with the anticyclonic rotation of the MY ice pack in the Beaufort Gyre.

2) In the Southern Beaufort Sea (SBS) sub-region we expect the spring to progress ahead of climatology and for the ice to be approximately the same or less than the record reduction in 2007. This is due to a number of factors:
   a. The ice was thinner than in previous years due to the late formation of sea ice in the SBS and Amundsen Gulf (AG). This late season freeze-up was due to the large heat storage in the surface mixed layer and the feedback drawing cylones over the open waters of the AG in the fall of 2007. These cyclones kept the ocean surface roughness higher than usual and resulted in delayed onset of freeze-up.
   b. The fast ice bridge never formed this year between Cape Perry to Cape Lambton (south tip of Banks Island). Strong winds in April and May flushed the ice out of AG and the flaw lead system is now largely open water. This condition is about 1 month ahead of climatology.
   c. The open water is beginning to retain a lot of heat from surface insolation and a stable and warming surface mixed layer is beginning to form (late May). This is also about 1 month early. This heat will continue to build over the summer and will likely result in delayed freeze-up in the fall of 2008.
3) In the western limit of the NW passage we expect the spring to progress ahead of climatology and for the ice to be approximately the same or less than the record reduction in 2007. This projection is due to a number of factors:
   a. There is only a remnant amount of multiyear sea ice north of Banks Island in McClure Strait. This ice entered the passage last fall and circulated down through Prince of Whales Strait back into Amundsen Gulf.
   b. No MY ice plug formed in the fall of 2007 in McClure Srait due to the fact that the Beaufort Sea Ice Gyre rotated ice away from the entrance to McClure in the fall when this plug typically formed. Because the surface flow was from the east to the west the MY ice never entered McClure stait when it was open in the fall. This means that the majority of ice in the NW limit of the NW passage is FY ice. We also note that if the MY edge retreats to north of the western entrance to McClure then we would expect no ingress of MY ice into this passage in August or September of 2008 either.
   c. The first-year ice in McClure is relatively thick (170cm) but is predominantly first-year sea ice thus we expect it to weaken as the spring progresses and it will become mobile earlier than if the usual plug of MY ice was present.
   d. Given these conditions we expect the western limits of the NW passage to be similar to those which occurred in 2007. We note that the NW passage was open to ship traffic from August to December of 2007.

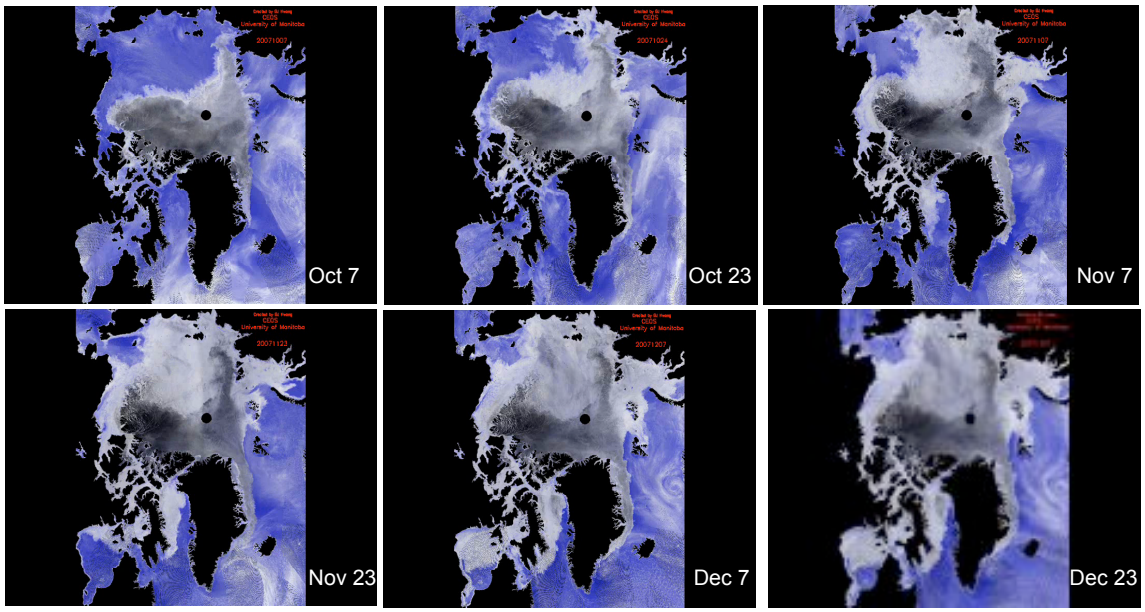

Figure 1. A selection of AMSR-E passive microwave images from October to December of 2007 for the northern hemisphere showing the distribution of multiyear sea ice. The pack ice was very mobile in the fall of 2007 (see text) that had implications for how the northern hemisphere, southern Beaufort Sea and NW passage ice is expected to evolve this summer.

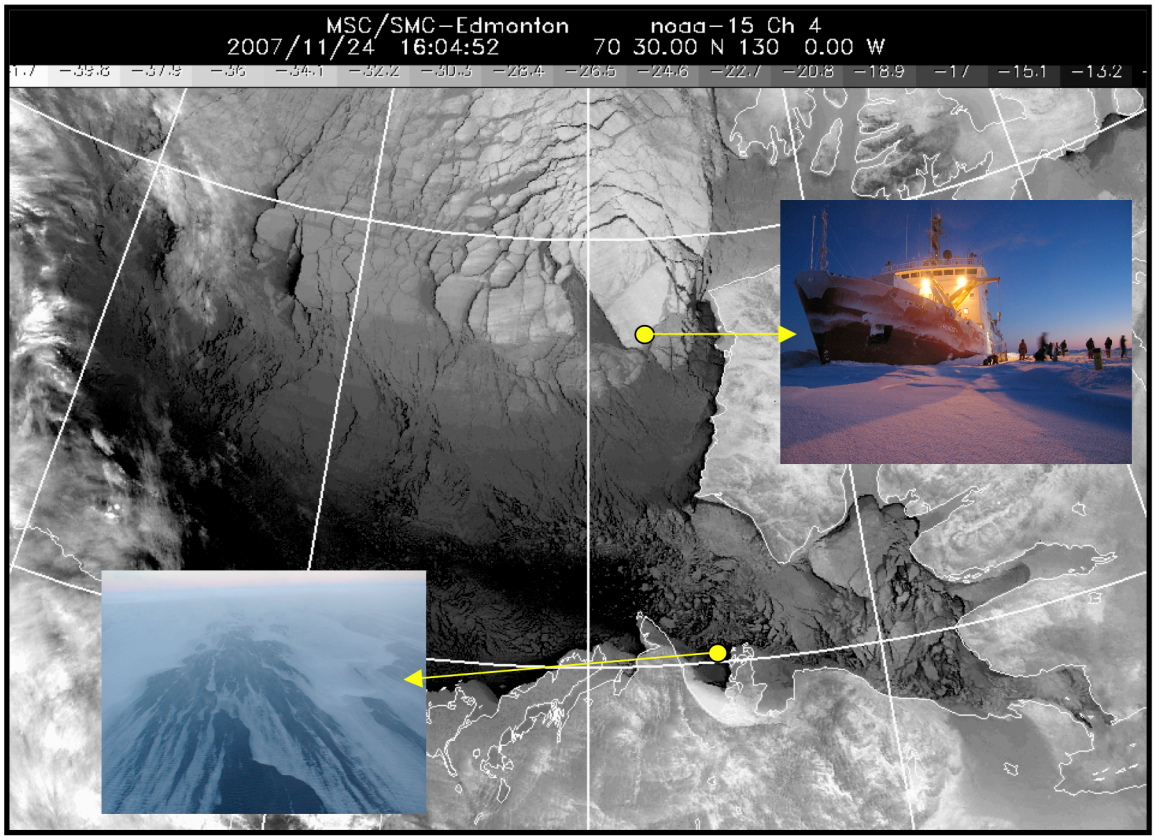

Figure 2. AVHRR near infrared image of the southern Beaufort Sea and Amundsen Gulf showing the NGCC Amundsen sampling mulitiyear sea ice and open water conditions in late November, 2007.