

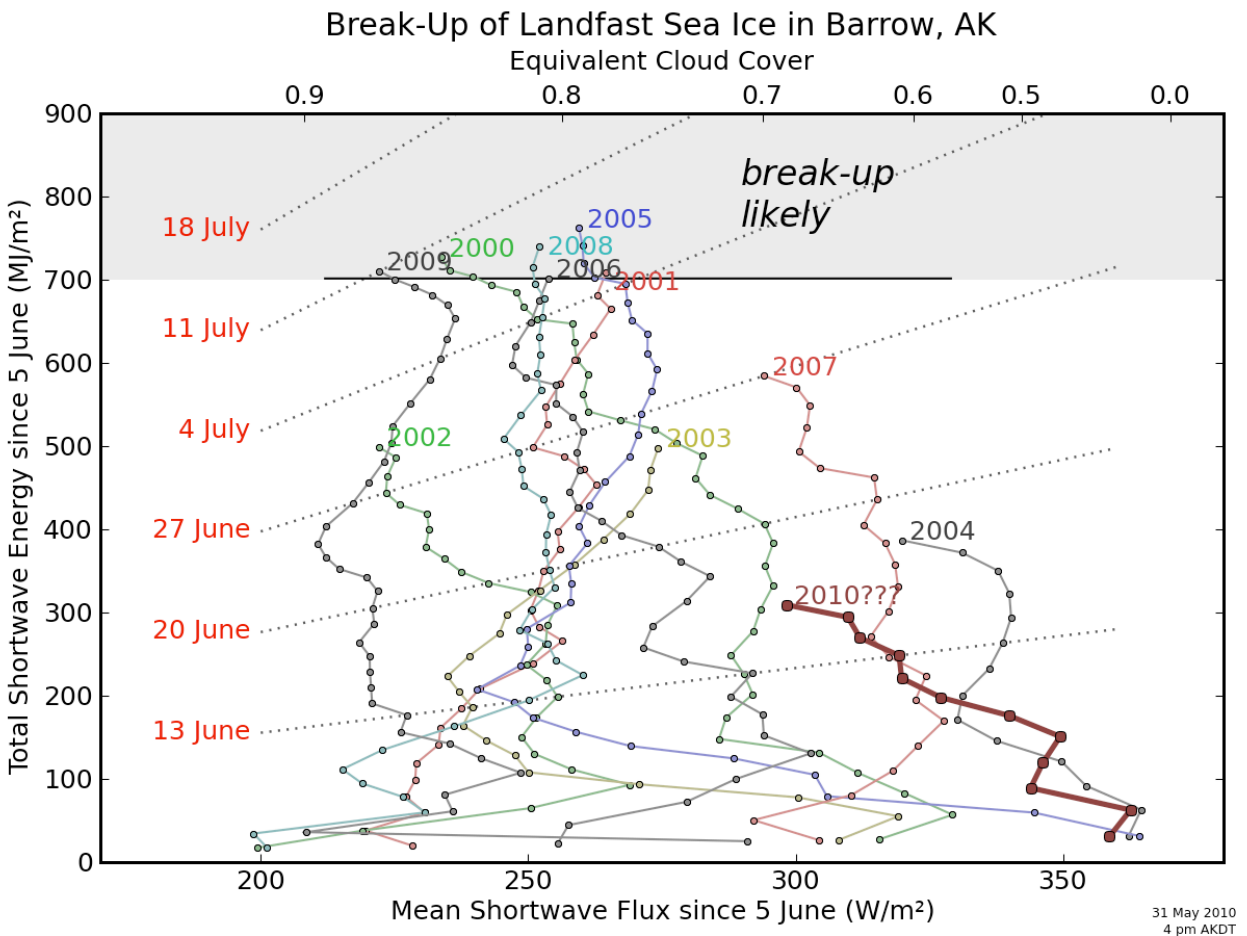
Region: Chukchi Sea / Beaufort Sea

Local outlook for break-up of landfast ice at the Chukchi Sea coast at Barrow, Alaska

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We operate a break-up forecast model for landfast ice at the Chukchi Sea coast at Barrow, Alaska. Up-to-date predictions are available on http://seaice.alaska.edu/gi/observatories/barrow_breakup

In typical years, the timing of break-up appears to be associated with the amount of incoming solar radiation. We use a combination of data from the Department of Energy Atmospheric Radiation Measurement program, NOAA weather observations, and a 16-day GFS-based WRF weather forecast (Zhang and Krieger).



The current 16-day weather forecast does not reach far enough into the future to allow us to project a specific break-up date. In the plot above, the trajectories of incident cumulative solar energy are plotted until break-up for previous years. 2002, 2003, 2004, and 2007 were marked by an absence of grounded, stabilizing pressure ridges. The line marked “2010???” is entirely based on weather prediction at the time of writing. We expect specific break-up forecasts for the second half of June.

Breakup

We define breakup as the first detectable movement of landfast ice shoreward of grounded ridges within the 20 m-isobath off NARL, approximately 5 miles north of Barrow. Typically, ice movement is parallel to the coast, confined by grounded pressure ridges at the 20 m-isobath. However, we exclude ice affected by dust from town and a coastal road, i.e., ice within approx. 100 m offshore. We detect movement from coastal RADAR and from satellite imagery. In previous years, webcam images near NARL were available.

Breakup process

Breakup proceeds in two stages: Initially ice shoreward of grounded pressure ridges begins to move collectively, followed by a period of sporadic break-out events of individual grounded ridges. After the disappearance of the snow cover in the first half of June, landfast ice closest to the shore weakens structurally due to solar heating of dirty ice and ice under meltponds. Eventually, winds of usual speed are able to push the ice along shore. With reduced snow cover, more solar energy is absorbed and the oceanic heat flux to the ice increases, eroding grounded pressure ridges from below. Some years in the past have seen insufficient stabilization by grounded pressure ridges, leading to the sudden disappearance of the entire coastal ice within 24 hours during the second half of June. These cases cannot be predicted with the approach presented here. However, if significant grounded ridges are present, break-up should take place in the first half of July, with some grounded ridges possibly persisting into early August.

Current ice situation

As usual, landfast ice off Barrow comprises of patches of deformed ice (rubble) and ice grown in place close to shore, sheltered by pressure ridges at the 20 m-isobath (approx. 0.5 to 5 km off shore), and attached ice further toward the coastal polynia.

In mid May, smooth landfast ice had a deeper snow cover than last year (30 cm in 2010 vs. 20 cm in 2009). There was evidence of desalination in the upper 15 cm as early as mid May (approx. 1 to 2 weeks earlier than expected), possibly the result of warm ice due to deep snow and above-average temperature in April. However, the ice reached its usual thickness of 1.3 to 1.6 m, presumably because freeze up happened a few weeks earlier than in previous years. Grounded pressure ridges seem to be in place between Barrow and Point Barrow. However, South of Barrow, landfast ice is essentially smooth and only few if any grounded ridges are present. [See section below on winter-spring landfast ice development] (Update after initial deadline for the submission of this outlook: Both the reduction of surface albedo on the tundra and meltpond formation South of Point Barrow began around 10 June, which is almost one week later than in the previous three years but similar to 2000 and 2001.)

Uncertainties

The break-up forecast applies to snow-covered landfast ice with a relatively clean snow surface. For this year, we expect near-shore landfast ice to be held in place by grounded pressure ridges, allowing it to weaken in place starting with the appearance of meltponds, before drifting out past grounded pressure ridges either to the North or to the South. However, the coastal road became snow-free already in mid May, resulting in dust deposited on the snow on sea ice clearly visible on the 100 to 200 m closest to the shore. Hence, we expect the ice adjacent to coastal infrastructure to develop meltponds and subsequently disintegrate earlier than the ice this forecast applies to. In particular, large portions of ice overlooked by the Barrow SIZONet webcam are affected by dust.

The start date of integration is the assumed beginning of meltpond formation. As last year, we use June 5 as start date for heat flux integration. The break-up forecast relies on a weather forecast that needs to produce accurate solar energy averaged over one to two weeks. Based on GFS ensemble runs, the uncertainty of cumulative solar shortwave radiation is equivalent to approx. ± 2 days in break-up prediction, based on a 16-day forecast.

This forecast is sponsored by the NOAA Alaska Center for Climate Assessment and Policy (ACCAP) at the University of Alaska Fairbanks (UAF). Data are acquired through grants from NSF (SIZONet) and DHS, and courtesy NOAA and NASA. Data of a 16-day weather forecast are courtesy Jing Zhang and Jeremy Krieger at the Arctic Regions Supercomputing Center (ARSC) and UAF. Break-up information is available on http://seaice.alaska.edu/gi/observatories/barrow_breakup

Winter-Spring Landfast Ice Development

The landfast sea ice off Barrow, Alaska was of narrow and variable extent through much of the winter and early spring. While small concentrations of multi-year (MY) floes were likely present in the landfast ice earlier in the year northwest of Point Barrow, it wasn't until March 26 that MY ice became incorporated in the landfast ice off Barrow. These floes ranged from 10 to 400 m in diameter and with an average thickness of 2.4 m (derived from ground-based EM measurements). Given the general regional drift pattern of MY ice as revealed by Envisat satellite imagery, this ice most likely arrived from the northeastern Beaufort Sea. While these "low profile" floes did not directly contribute significantly to the anchoring strength of the landfast ice, their dynamic entrainment likely led to ice convergence at grounded first year (FY) ridges within the 20m isobath in some areas along the coast.

In mid-April, landfast ice extent off Barrow increased to what has been more typical in recent years (approx. 6 to 8 km). The ice that was added was largely FY ice of average level undeformed thicknesses only slightly below the thickness measured at our mass balance site, which is in level FY ice that has frozen in place since mid November. This ice was weakly anchored yet stayed attached throughout May (to the advantage of the local native whaling community, which harvest 14 bowheads from this newly added ice) due largely to steady East winds that kept the pack ice well offshore. Also, heavy shear ridges NW of Point Barrow likely provided protection by deflecting pack ice moving SW from the Beaufort Sea away from the landfast ice off Barrow.

For the previously discussed break-up forecast these observations are relevant in the sense that the seasonal persistence of grounded ridges provides confinement for the shoreward level ice for which the model's forcings are applied.