

Definition of Landfast Sea Ice

Numerous definitions of landfast ice exist in the literature, which consider to different extents all the processes that occur in the nearshore zone in the presence of sea ice. According to Weaver (1951) “fast ice or landfast ice is the young coastal ice which, in stationary sheets, builds seaward from the shore of landmasses ... by being more or less attached to the shore, or by being otherwise confined”. The World Meteorological Organization (1970) defines fast ice as “Sea ice which remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, or over shoals, or between grounded icebergs”. Stringer *et al.* (1978) define the fast ice zone as “the area generally shoreward of the 20m isobath with quite stable ice much of the year” and only include ice contiguous with the shore. Barry *et al.* (1979) list three criteria that can distinguish landfast ice from other forms of sea ice: “(i) the ice remains relatively immobile near the shore for a specified time interval; (ii) the ice extends from the coast as a continuous sheet; (iii) the ice is grounded or forms a continuous sheet which is bounded at the seaward edge by an intermittent or nearly continuous zone of grounded ridges”. Furthermore, according to the WMO, sea ice can be classified as either landfast ice or pack ice, while Weaver describes drift ice as a third category, which is “transitory between the fast ice and the polar pack ice”. Similarly, Stringer *et al.* define a category for ice in the shear zone between the landfast ice and pack.

Clearly these definitions all have their ambiguities and may not always agree on whether sea ice in a given situation is landfast or not. They all agree that landfast ice is adjacent to the coast and characterized by a lack of motion, although none specify a time interval over which this must occur. From remotely sensed data, it is generally not possible to identify sea ice that is grounded, but it is possible to identify sea ice that is both stationary and contiguous with the coast provided we define the time period over which the ice is to remain immobile.

For this project we define landfast ice according to the following criteria:

- 1) the ice is contiguous to the coast
- 2) the backscatter signature remains constant over period of 20 days

Criterion 1 actually consists of two parts, as it contains the requisite that before a region can be identified as landfast ice must first be identified as ice. This task is not as trivial as it might sound since level, smooth sea ice can exhibit very low backscatter similar to calm open water, which can be roughened by waves such that it has a very high backscatter coefficient similar to deformed ice. Generally this will only cause problems in the very early and very late parts of the season because at other times a region of open water will not remain open water for long and will therefore not satisfy the second criterion. In this scheme, as discussed in section 2, the definition of what is and what is not landfast sea ice comes down to the period of time over which the backscatter must remain constant.

A period of 20 days was chosen to represent multiple synoptic periods and therefore exclude regions of pack ice that merely come to rest temporarily adjacent to the landfast ice as a result of short term circulation patterns. This also determines the time interval between sets of radarsat imagery that are acquired, which is described in the methods section.

Mapping and Characterization of Recurring Spring Leads and Landfast ice in the Beaufort and Chukchi Seas (AK-03-06, MMS-71707)

References

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