

Laptev Sea and East Siberian Sea landfast ice: Mechanism of formation and variability of extent

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Outline

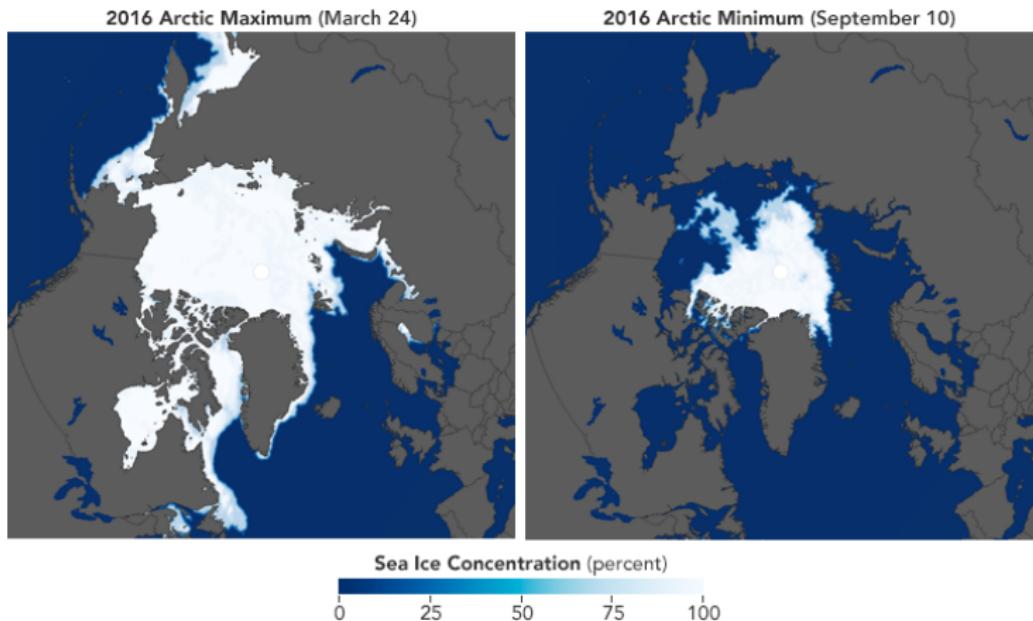
I. Introduction

II. Variability of landfast ice extent

III. Mechanism of landfast ice development

IV. Summary and outlook

I. Arctic sea ice



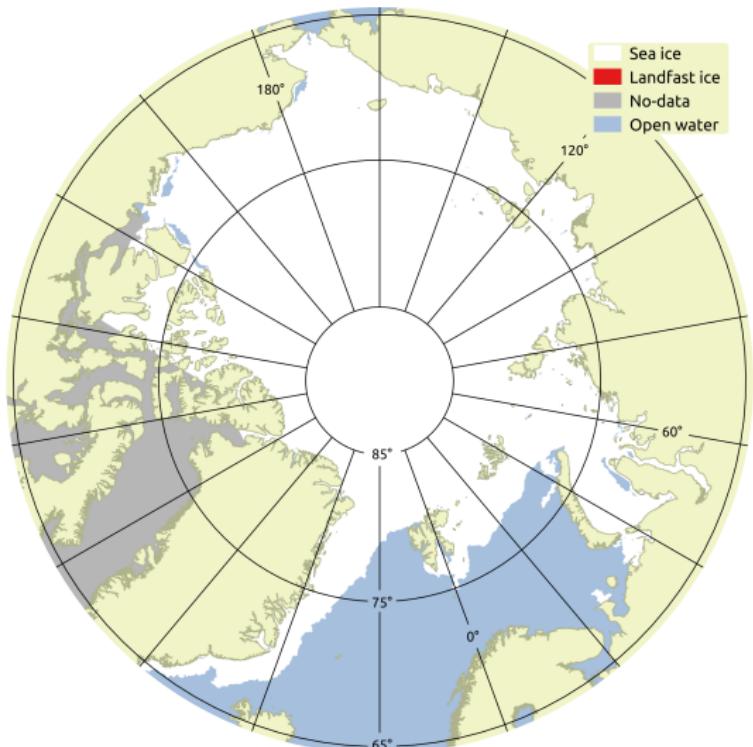
I. The importance of Arctic sea ice

- ▶ Sea ice regulates the climate (reflects about 80% of solar radiation)
- ▶ Important component of ecological system (provided habitat and hunting platform)
- ▶ Impacts human activity (navigation, exploration, indigenous people activity)

I. Forms of sea ice

- ▶ Based on stage of development - frazil ice, pancake ice, first-year, multi-year ice
- ▶ Based on deformation - level ice, deformed ice
- ▶ Based on ability to move - pack ice and landfast ice

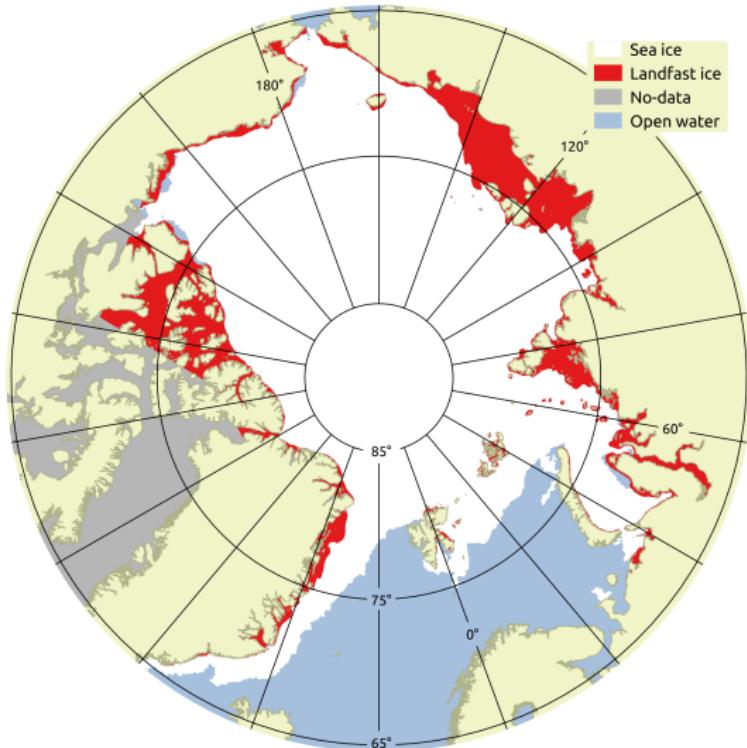
I. Arctic sea ice



May, 5, 2015

based on Operational Sea Ice Charts,
Arctic and Antarctic Research Institute, Russia (AARI Charts)

I. Arctic landfast ice



~ 13% of total sea ice extent

- ▶ affects state of the Arctic Ocean [Maqueda et al. 2004, Itkin et al. 2015]
- ▶ protects coasts from erosion [Rachold et al. 2000, Eicken et al. 2005]
- ▶ helps to maintain submarine permafrost [Rachold et al. 2000]
- ▶ affects human activity [Johannessen et al. 2005, Hughes et al. 2011, Weintrit 2013]

May, 5, 2015

based on AARI Charts

I. Landfast ice definition

'Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs.'

World Meteorological Organization (WMO)

Operational sea ice mapping

expert's opinion (2-7 days)

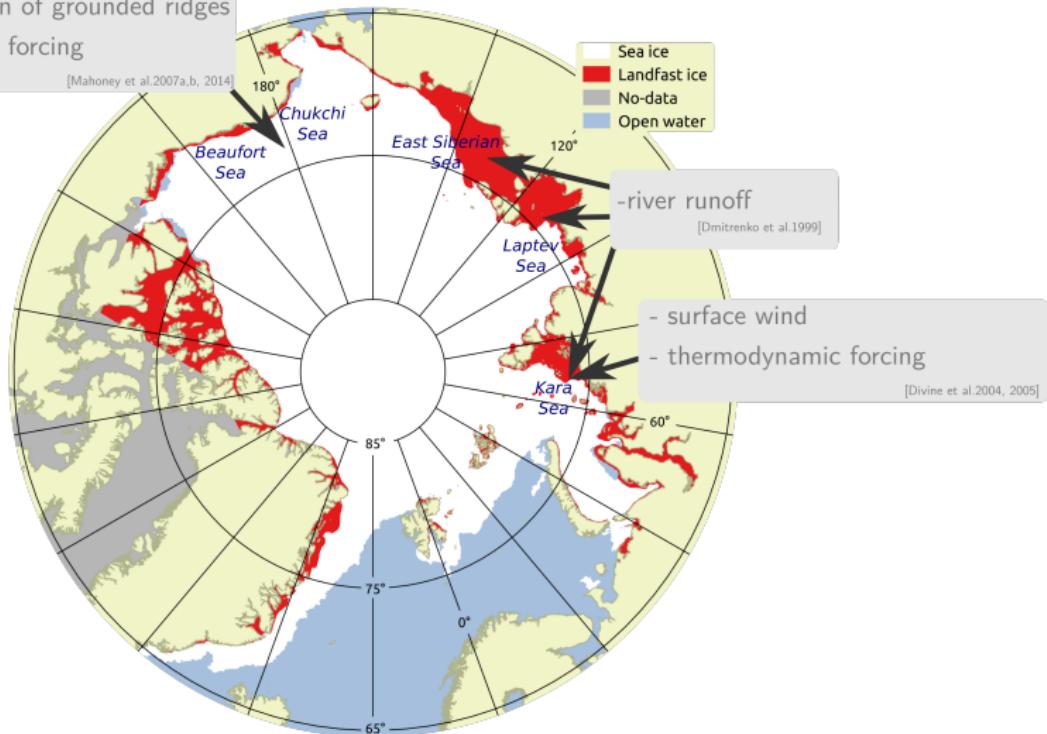
Semi-/automatic mapping

strict definition
(eg. 25 days[Mahoney et al.])

I. Factors controlling landfast ice extent

- alongshore chain of grounded ridges
- thermodynamic forcing

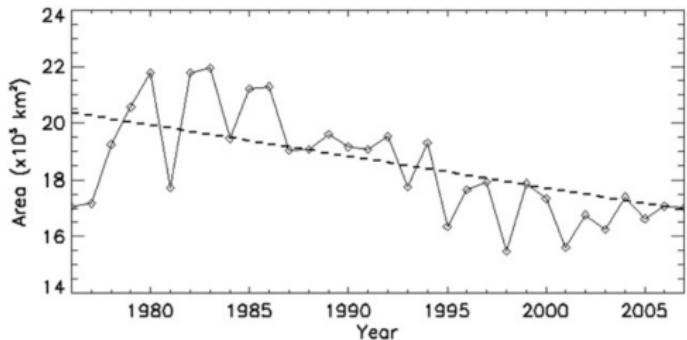
[Mahoney et al.2007a,b, 2014]



May, 5, 2015

based on AARI Charts

I. Changes in Arctic landfast ice



Arctic winter landfast ice extent

[Yu et al.2014]

- decrease in extent
- shorter landfast ice season

I.Objectives

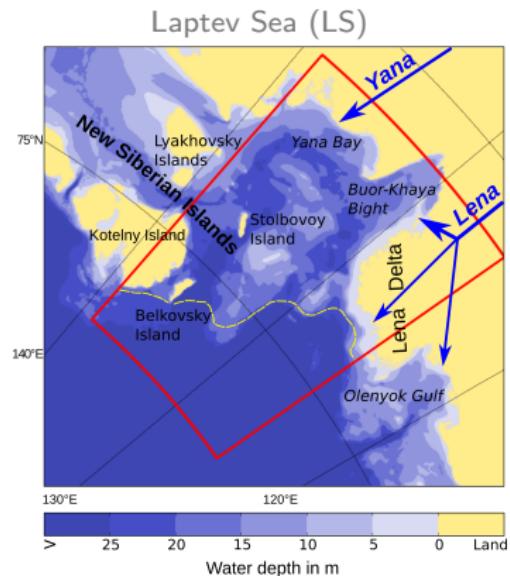
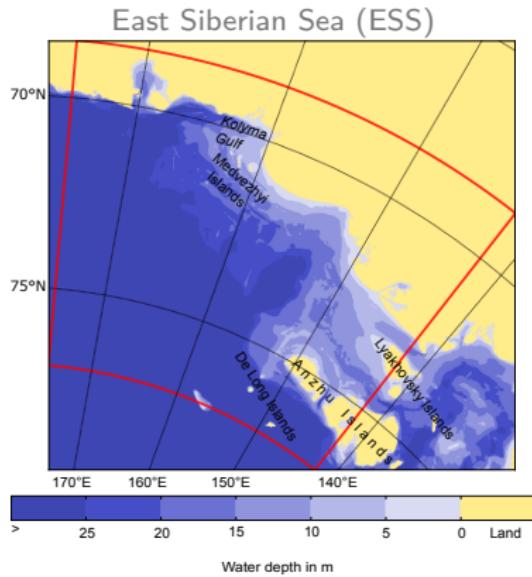
Objective 1 - Annual variability

- ▶ To describe the **annual fast ice cycle** and reveal the **mechanisms driving the seasonal development** of fast ice.

Objective 2 - Interannual variability

- ▶ To evaluate **changes** in fast ice cover **on interannual scales** and link them to climate processes.

II. Laptev and East Siberian Seas

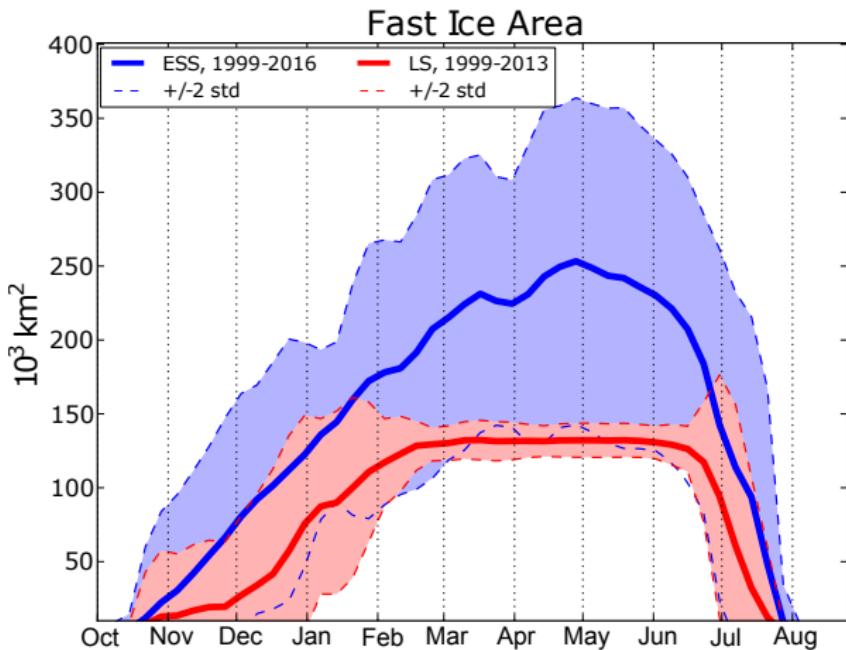


Selyuzhenok et al.(2015)

II. Annual landfast ice cycle, 2001

animations

II. Mean annual landfast ice cycle



Interannual variability

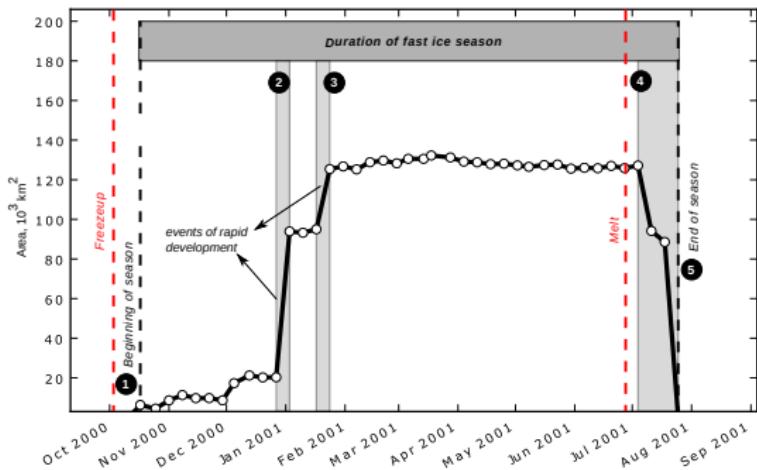
Laptev Sea:

- ▶ high in November–February
- ▶ low throughout the rest of season
- ▶ the lowest in winter

East Siberian Sea:

- ▶ the highest in winter

II. Key events of annual cycle



A typical annual landfast ice cycle for the Laptev Sea
[Selyuzhenok et al. 2015]

Laptev Sea, 1999-2013

Time series of Key events 1-5

East Siberian Sea, 1999-2015

Time series of Key events 1,5

and Key events 2,3 for some seasons

II. Beginning of landfast ice season

