**Titile slide**

Thank you for the introduction.

Good morning everyone. As Ruediger said, I will talk about landfast ice OR simply fast ice in the Siberian Arctic.

**Outline**

First I will give some general information about arctic sea ice and particulary fast ice. Which will lead you to the main objectives of my PhD thesis.

The second and the third part of the the talk are devoted to the main obtained results. In the second part of of the talk, I will describe the annual (or seasonal) fast ice cycle and changes in fast ice regime occuring in the recent 15 years.

The in the third part I will present some mechanisms responsible for development of extensive fast ice cover in the Laptev and East Siberian Seas.

After this, I will summ up th main findings and put it into the general context.

**Arctic Sea ice**

The Arctic ocean is permanently covered by sea ice. In winter, when the temperatures are negative, sea ice covers nearly entire ocean. The left map shows sea ice extent for the 17 March 2015 (it was the seasonal maximal sea ice extent). Positive temerature is summer lead to sea ice melt, and sea ice cover remains mainly on the cneral part of the ocean and north of Canada and Greenland. The left map shows seasonal minima in 2015 sea ice extent.

**The importance of Arctic sea ice**

Presence of sea ice is imortant for numerous reasons. For example,

Sea ice is an important componemt of the global climate system. Sea ice reflects about 80% of incoming solar radiation, threfore it help to keep the arctic region cold.   
  
Sea ice is also important as a part of ecosystem. Marine mammals use it as aplatform for hunting and breeding, miroorganisms live inside the sea. Sea ice also affect live in the water colomn as it limits light penetration.

Sea ice has an influence on human activity. It restricts naviatiion and exploration in the Arctic.

**Arctic fast ice**

Most of the ice (pack ice) moves in response to the wind and currents action. There are 2 major ocean current which drive sea ice drift: Beaufort Gyre - antycyclonic (clockwise circulation) in the central and Canadian Arctic and Transpolar drift — cross Arctic drift from Sinerian seas to the Fram Strait.

There is also ice, which does not move. It is fast ice or landfast ice. This map represents a typical winter. Fast ice here comprises about 13 % of the total sea ice area.

When fast ice is mapped for operational purposes (like it is done at AARI, where they update sea ice charts every week) the expert decides if the ice is classified as fast ice or not. Usually the use a time interval of 2-7 days and if the ice stays immobile, they call it fast ice.

There also other ways to map fast ice. They rely on semi-automatic or automotic processing of sattelite imagery. In this case a computer defines what is fast ice and there is a stict algorithm which defines fast ice. Such methods usually use a longer time interval, on av about 20 days.

**Importance of Arctic fast ice**

Why do we want to separate between pack ice (drifting ice) and fast ice? The answer is because it is important that there is motionless sea ice close to the coast.

First, it is important for the state of the Arctic Ocean. When ofshore wind drags pack ice away from the coast, areas of open water for at the fast ice edge. There areas are cold polynyas, and it is place of active sea ice formation. During sea ice formation, dense saline water is release (brine). The realease of brine away from the coast is important for oceanic processes.

Fast ice aslo protects coast from the action of wind and waves and therefore, protestc it from errosion. At the place where fast ice is attached to the shore or sea ice bootmn, it maintains negative temeratures, which protects permafrost from melting.

Finally, fast ice is used by people. It is used for winter commutes betwee vilages and as a platfrm to transport cardo in winter to remote places. Indeginous people hunt from fast ice.

**Changes in Arctic sea ice and fast ice**

I think everyone has heard that Arctic sea ice undergies significant changes during the last 3 decades. The left plot shows how sea ice extent changes from 1980s to present days. On average, the sea ice extent declines thougout all month with lower rate in March and higher rates in September. The studies also show that there is an acceleration in sea ice loss over the past deade.

There are also changes is fast ice cover. According to Yu et al, it winter fast ice extent derceres from 1976-2007. The areas with decreasin fast ice extent are shown in red. The stars marks regions with significant changes and Laptev Sea is among them. The speed of decline there is more than 8% per decade.   
  
Also there is an Arctic-wide treand towards a shorter fast ice season. In the LS and ESS the season becomes shorter by 2.5 weeks every decade.

However, we dont kno what are the reasons from these changes in fast ice and if these rates of changes we the same for the past decade (when the accelaration of sea ice decline was observed).