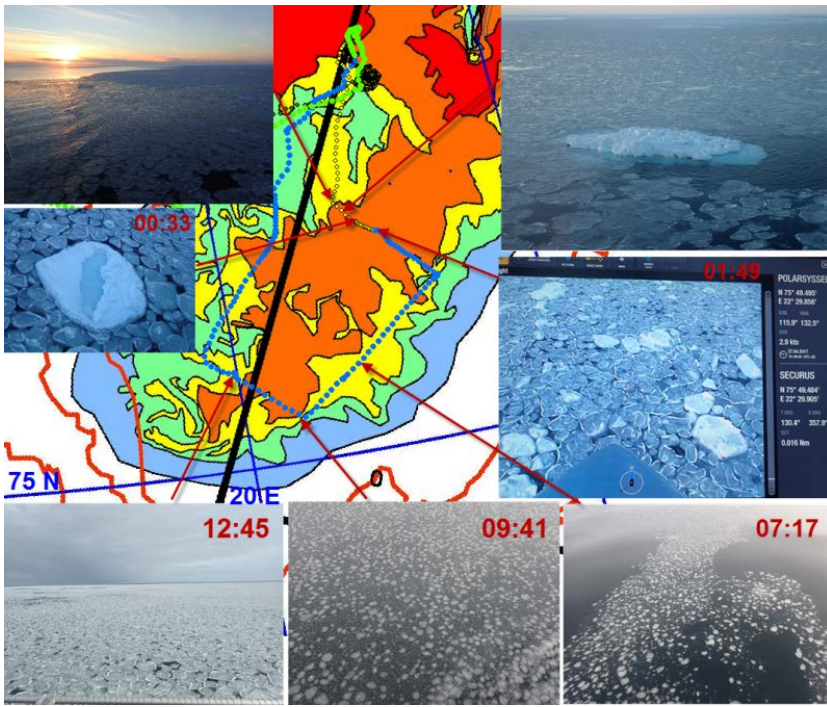


Three years (2017-19) of field observation of the marginal ice in the Western Barents Sea

Nataliya Marchenko, The University Centre in Svalbard



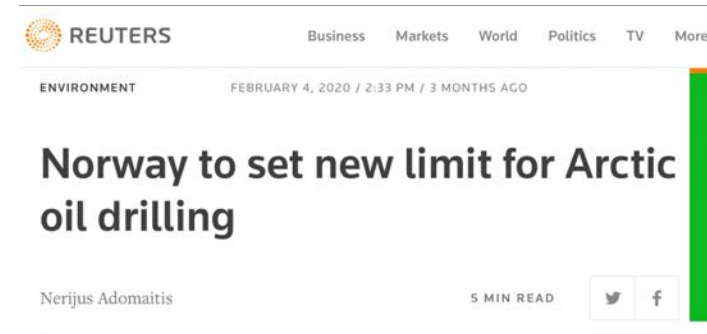
**Comparison with
Sea Ice Maps
Measurement
3D modelling**



Motivation

- Knowledge of sea ice state (distribution, characteristics and movement) is interesting both from a practical point of view and for fundamental science. The western part of the Barents Sea is a region of increasing activity – oil and gas exploration may growth in addition to traditional fishing and transport. So the information is requested by industry and safety authorities.
- Sea Ice Maps give us ice concentration.

But how ice looks like in reality?
What are the properties of local ice and possible threats?



OSLO (Reuters) - Norway may restrict oil firms' access to offshore resources in the Arctic by moving the so-called ice edge, a line that sets a legal limit on the extent to which companies can go north in search of oil. The ice edge is a legally drawn boundary that is meant to approximate the constantly changing southern fringe of the permanent ice sheet. Anything north of that legal line is off-limits to oil drilling under Norwegian law.

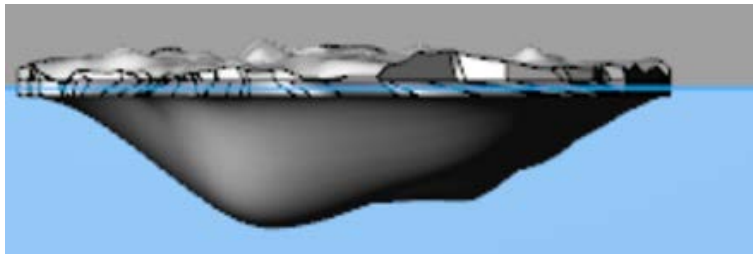
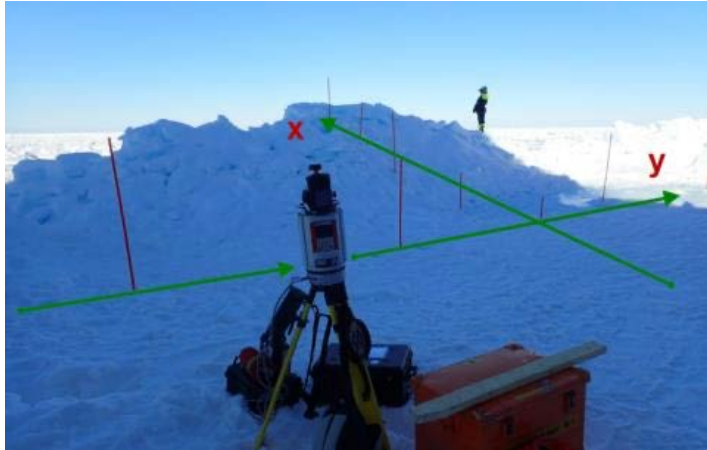


"It's one of the difficult issues (for the government to decide on)," Prime Minister Erna Solberg told Reuters in an interview.

<https://www.reuters.com/article/us-norway-arctic-oil/norway-to-set-new-limit-for-arctic-oil-drilling-idUSKBN1ZY1R1>

EGU20 -OS1.11 – Nataliya Marchenko: Three years (2017-19) of field observation of the marginal ice in the Western Barents Sea

Methods



- Three last years (2017-19) the Arctic Technology Department of the University Centre in Svalbard (UNIS) performed expeditions on MS Polarsysse in April in the sea ice-marginal zone of the Western Barents Sea, as a part of teaching and research program.
- We used
 - ❖ Ice drilling, mechanical tests, laser scanning, time-lapse, underwater video.
 - ❖ Comparison with current sea ice maps
 - ❖ 3D modelling.



Results 1. Description of ice categories on the map



Sea ice maps show ice categories in various colors, defined by ice concentration. The appearance of ice in the color areas depends on place, time and ice state.
In the marginal zone of the Barents Sea in April, the colors correspond the follows



Red – Dense ice field consisting of small (4-5 m) angular ice floes, repeated larger floes (20-30 m) with hummocky formations (up to 2 m sail and 4 m draft) and smaller (less than 1 m) round pieces with their debris in between;



Orange in the northern part of the ice tongue – round floes (2-4 m) with frequent inclusions of ice floes (10-15 m, up to 25 m) containing hummocks (up to 2 m sail);



Yellow in the northern part of the ice tongue – similar to the orange zone by content, but with less ice coverage and less floes with hummocks;

Orange in the southern part of the ice tongue – dense and thick pancake ice, fairly uniform oval shape (25-27 cm wide and 37-41 cm long);

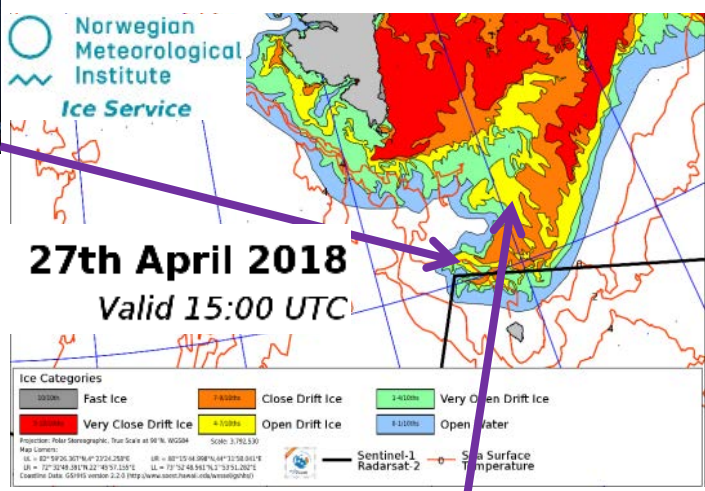
Yellow in the southern part of the ice tongue – thin pancake ice (20 cm in diameter) amidst dense slush;

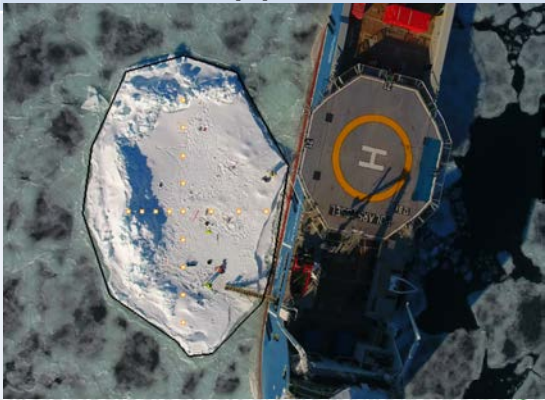
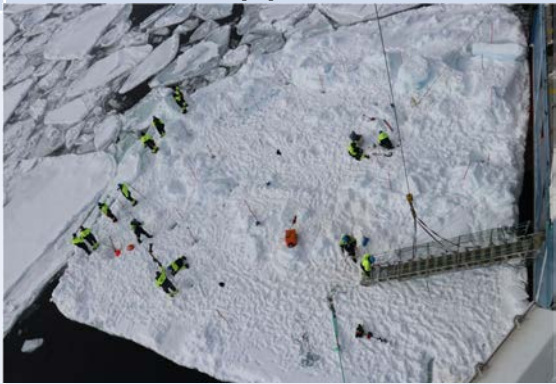

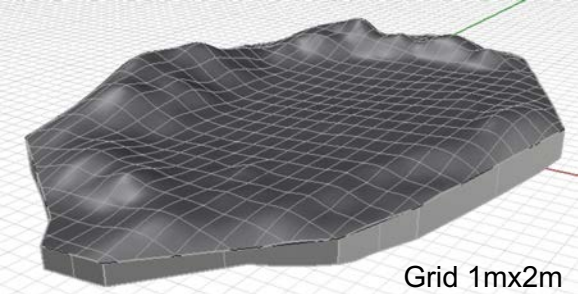
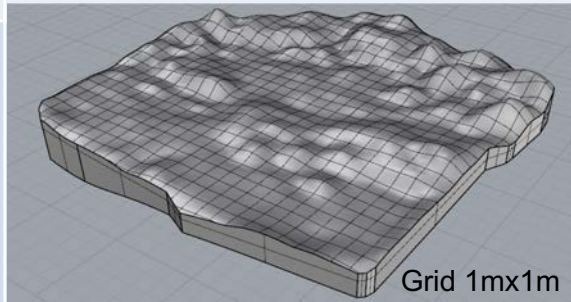
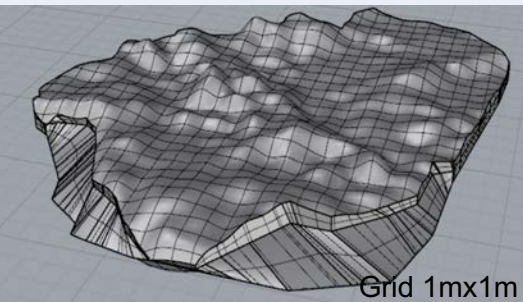


Green peripheries of the ice tongue consist of ice strips tens to hundreds of meters wide with the same composition as the yellow zone, located within ice free water.



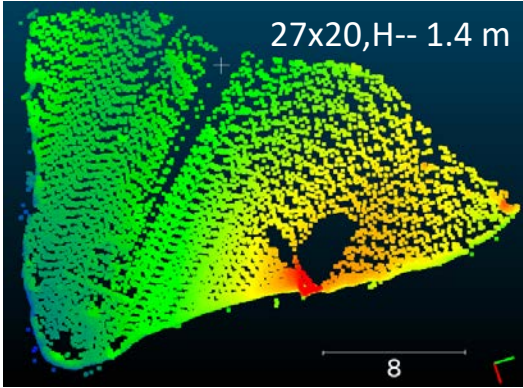
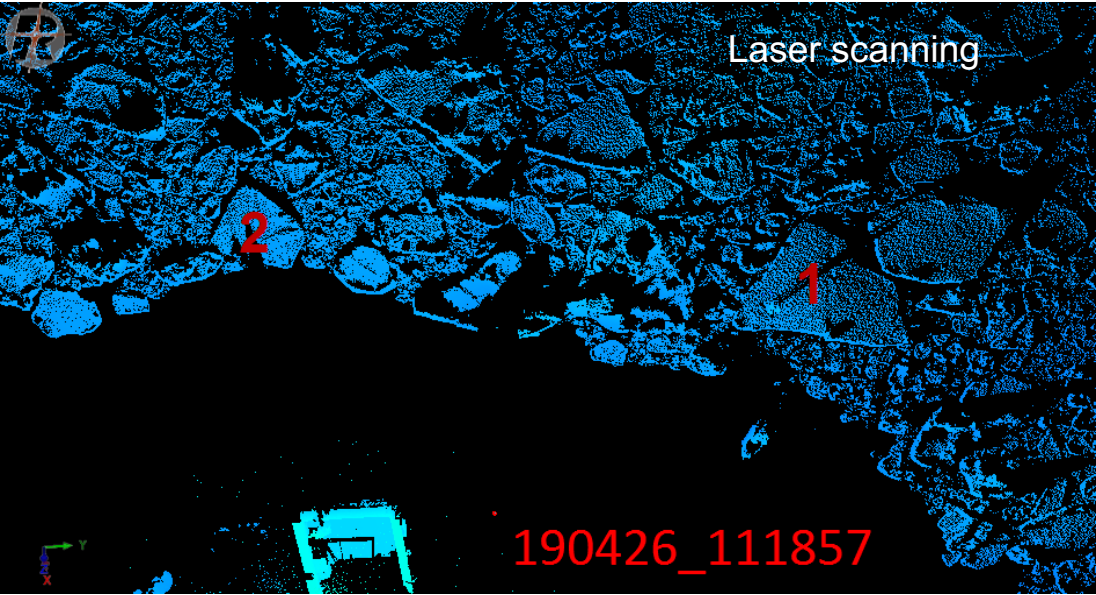
Icebergs (up to 10 m high) can be met in ice free water as far as 75°N. In April 2018 we observed Iceberg (4 m high and 20 m in diameter) at the points 75,12°N and 19,13°E



1	Floe 1_24 April 2017	Floe 2 – 26 April 2018	Floe 3 - 28 April 2018
2	76.394°N and 22.865°E	75.587°N and 21.578°E	75.182°N and 19.205°E
3	90 m	45 m	22 m
4	- 7° C/ 7.7 ppt	- 8° C/ 4.5 ppt	- 5° C/ 4.5 ppt
5			
6	 Grid 1mx2m	 Grid 1mx1m	 Grid 1mx1m
7	43x30	27x27	23x23
8	2.16/3.82	2.2/2.94	1.6/4.56
9	2655/3270	942/1469	752/1000

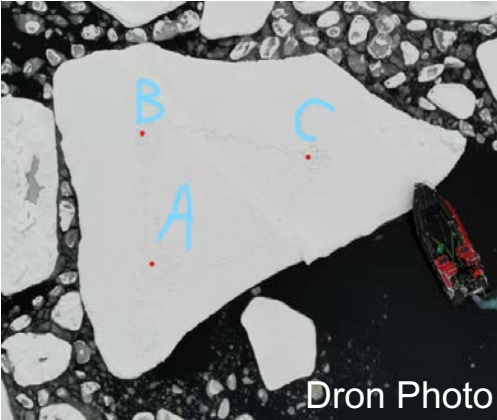
Explanation of the lines in the table:
1 – Floe number and date of observation,
2 – Coordinates,
3 – Sea depth in the place,
4 –Average Air Temperature / Average Ice Salinity,
5 – Photo,
6 – Perspective view of above water surface and side wall (3D model),
7 – Horizontal size, m.,
8 – Max Sail/ Draft, m.,
9 – Submerged volume/Total ice volume , m³

Results 3. Flat Ice floe measurement



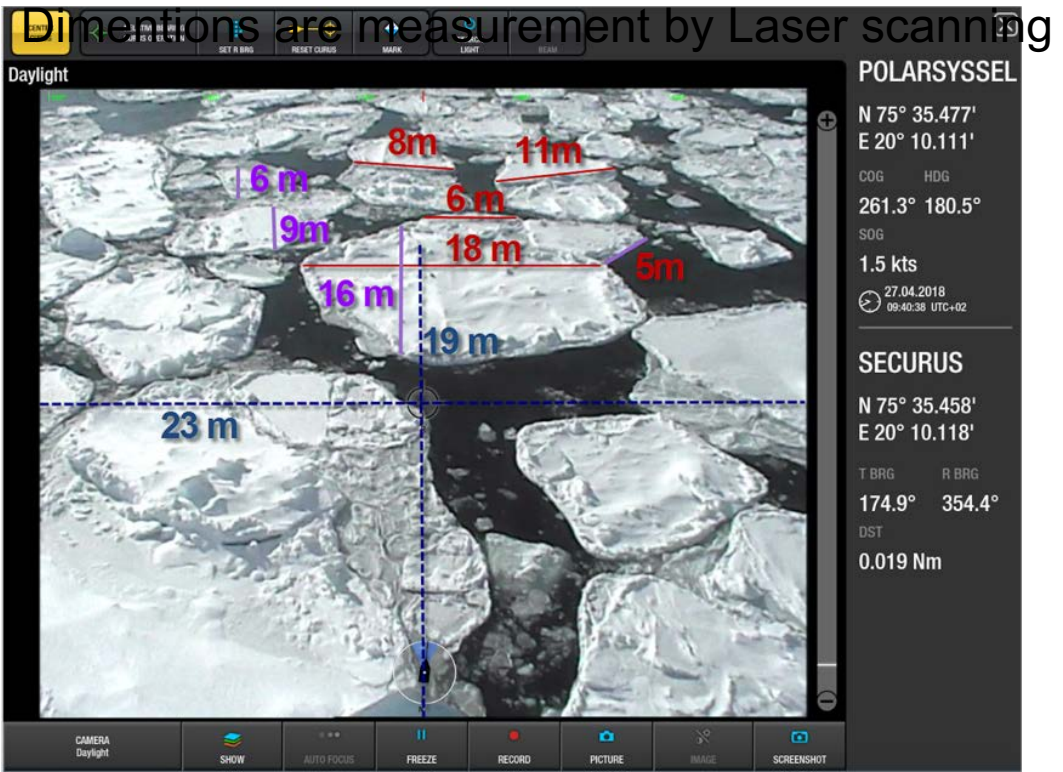
Letter	Thick ness [m]	Freeboard [m]	Snow [cm]
A	2,0	0,2	4-8
B	2,4	0,25	5-10
C	1,5	0,2	4-9

Floe	Ice thick ness	Free board	Snow	Length	Width	H-range
1-ABC	2,0	0,22	0,06	27	20	1,4
2-D	1,6	0,11	0,05	11	11	0,7
3-E	0,8	0,05	0,05	16	9	1,5
4-FGHI	1,5	0,15	0,05	14	10	1,5
5-KJ	1,8	0,20	0,07	23	12	2
6-LMN	1,8	0,15	0,06	17	11	1,3
7-OPST	1,3	0,07	0,04	20	16	1,7
Avera ge	1,5	0,14	0,05	18,3	12,7	1,4



Practical consideration, looking on ice floe composition

Ice composition on the MS Polarsyssel monitor
During observation. 27.04.2018



Rescue operation after collision of Cruise
vessel Maksim Gorkiy with ice floe
20 June 1989. Greenland Sea. 77 ° 37 N, 4 ° 10 E



Conclusions

- The distinguishing feature of ice in the marginal zone of the Barents Sea is the existence of relatively small ice floes (15-30 m wide) up to 5 m in thickness, containing consolidated ice ridges.
- Several such floes were investigated by drilling, laser scanning and ice mechanical tests, on testing stations in the ice tongue, stretching to Bear Island and in the place with very shallow water (20 m) where ice concentrated.
- The flat ice floes have an average thickness of 1.5 m, freeboard 0.14 m and size 18x12 m.
- These investigations provided a realistic characterization of sea ice in the region and are a valuable addition to the long-term studies of sea ice in the region performed by various institutions.

