Sea Ice Applications

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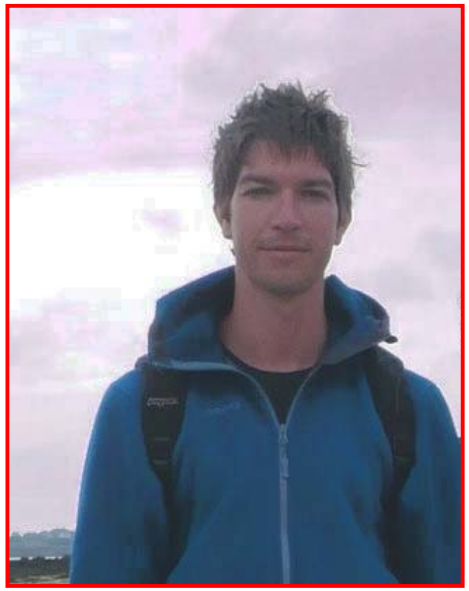
Norwegian Meteorological Institute
Danish Meteorological Institute

EUMETRAIN – Satellite course – Oct. 6th 2011

Short about me



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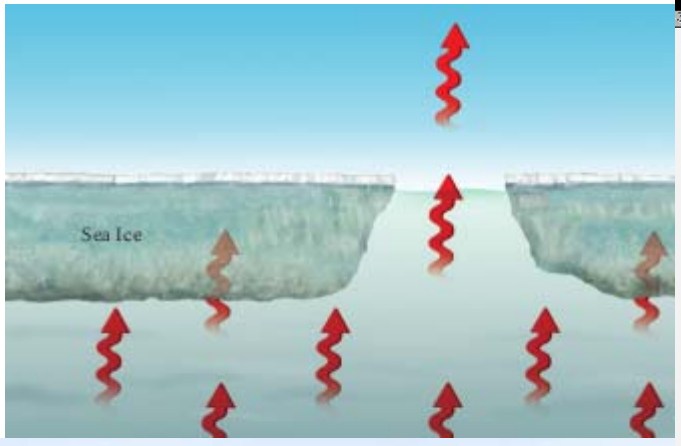
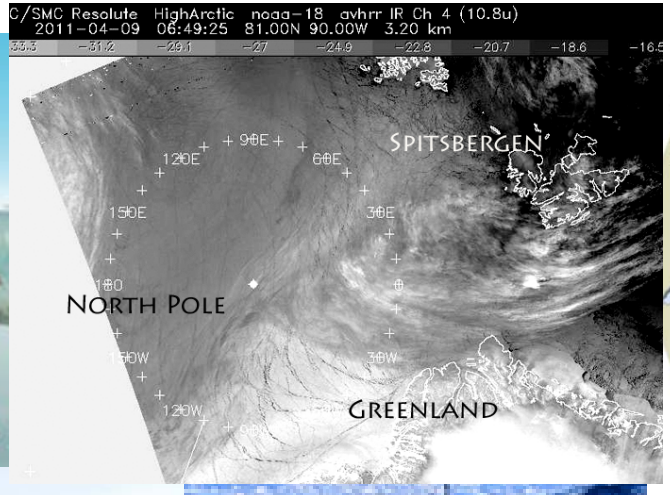
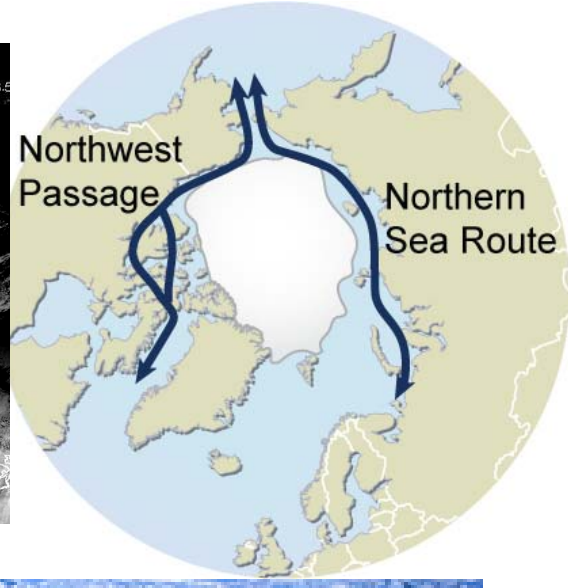
Outline – Sea Ice Applications

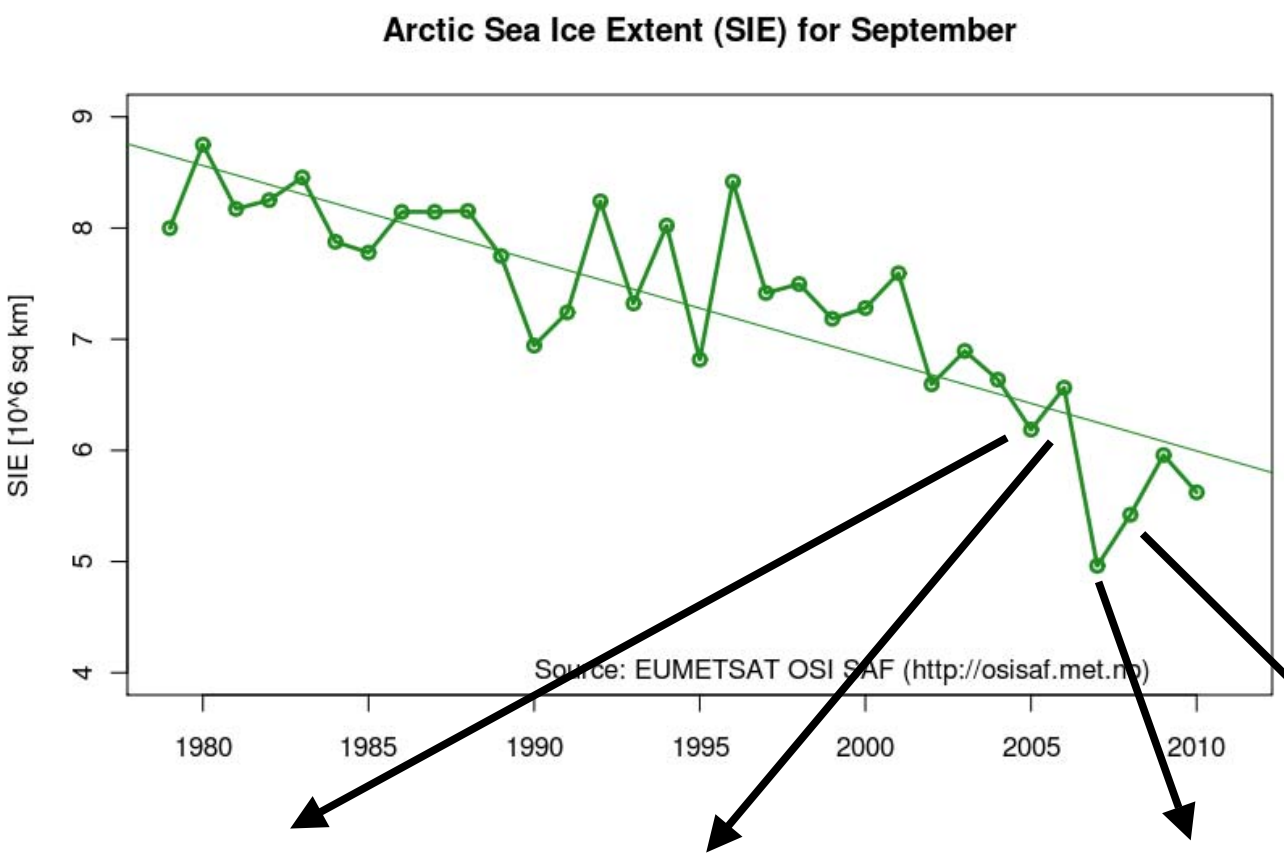
- General knowledge about sea-ice;
- Measuring sea-ice concentration;
- Measuring sea-ice motion;
- Challenges close to and on sea-ice;

General knowledge about sea-ice





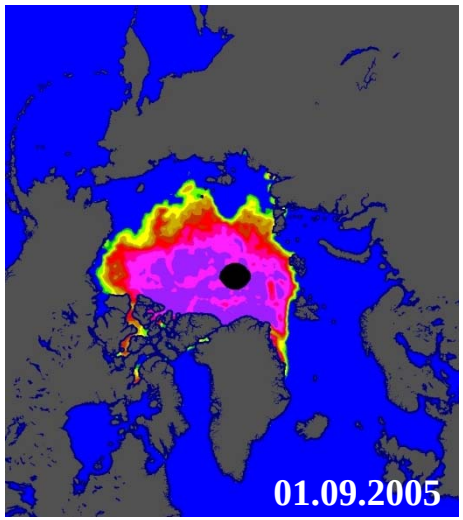


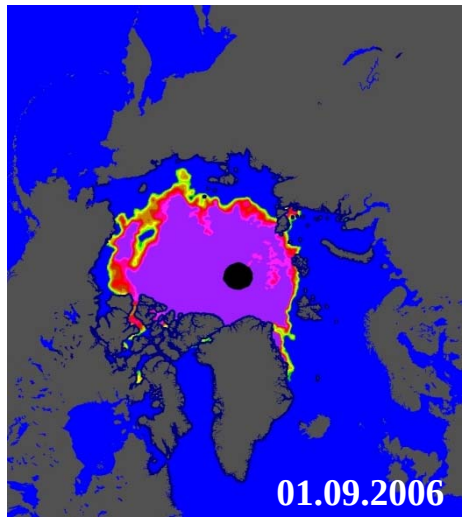


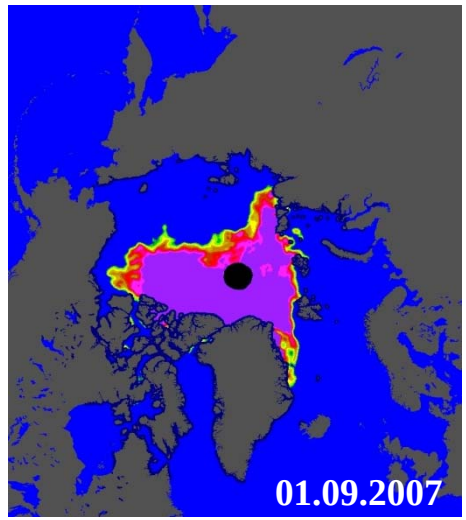
<u>September 2011:</u>

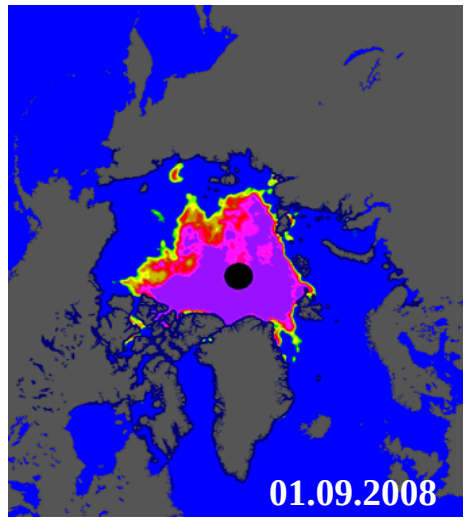
A) Less than 2007?

B) More than 2007?

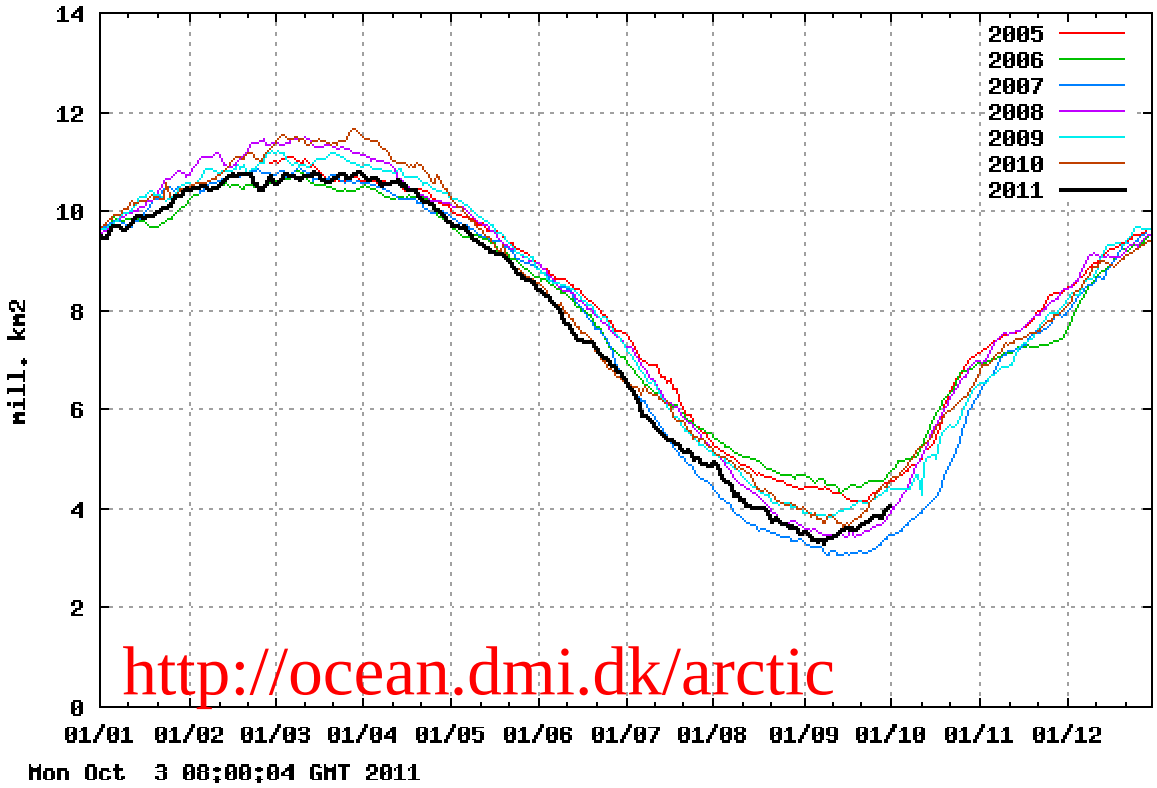


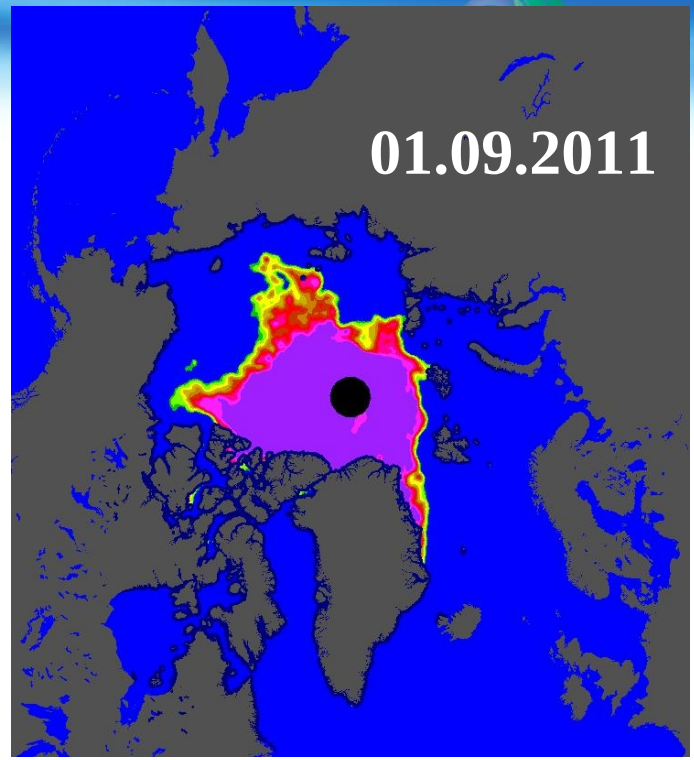


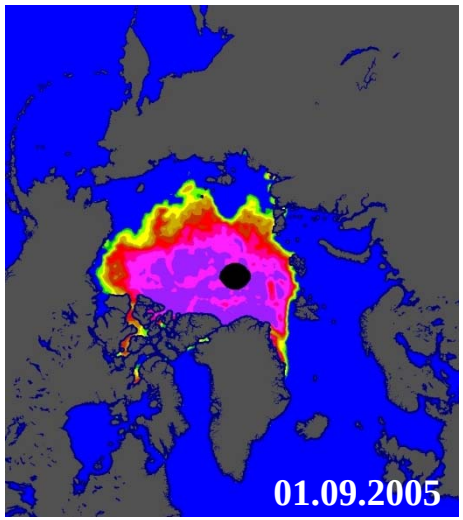




OSI SAF


2005
2006
2007
2008
2009
2010
2011
mill. km2
14
12
10
8
6
4
2
0
01/01 01/02 01/03 01/04 01/05 01/06 01/07 01/08 01/09 01/10 01/11 01/12
Mon Oct 3 08:00:04 GMT 2011
http://ocean.dmi.dk/arctic


01.09.2011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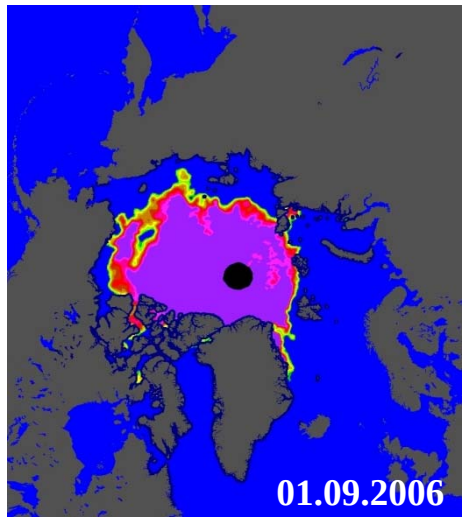
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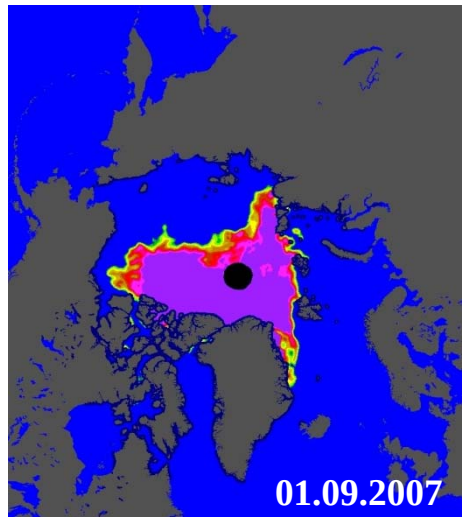
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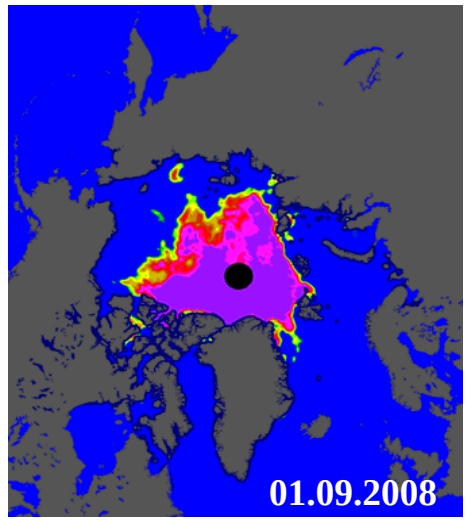
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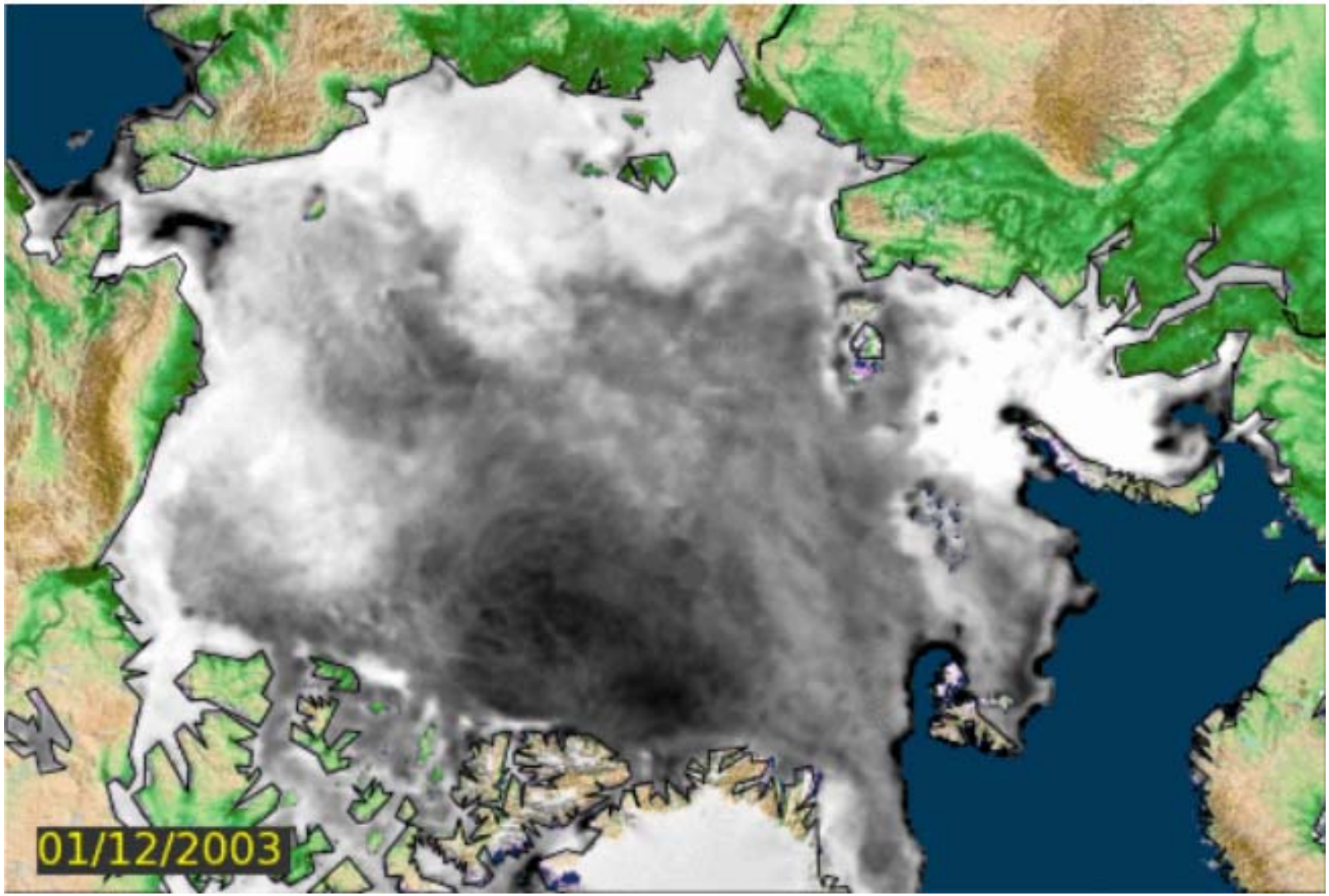
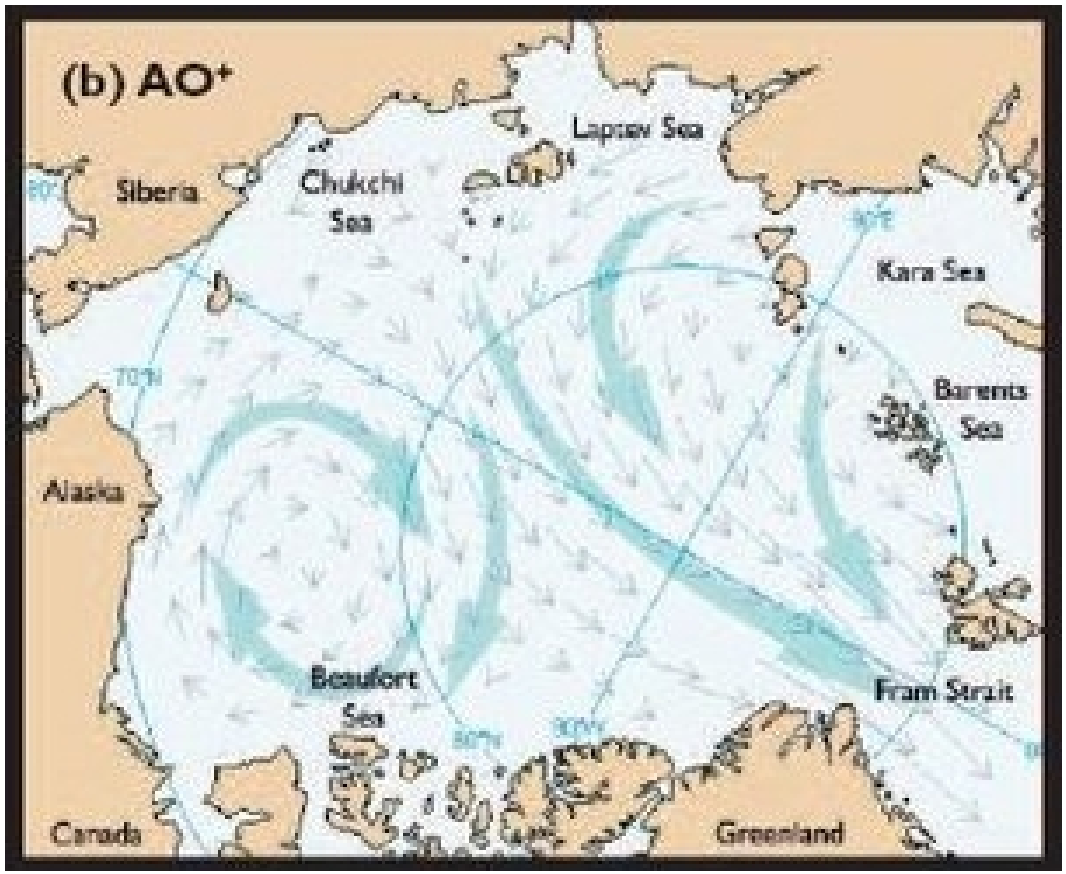
OSI SAF
Ocean and Sea Ice



Pushed by winds and oceanic currents, sea-ice moves everyday, up to several 10s km every day.



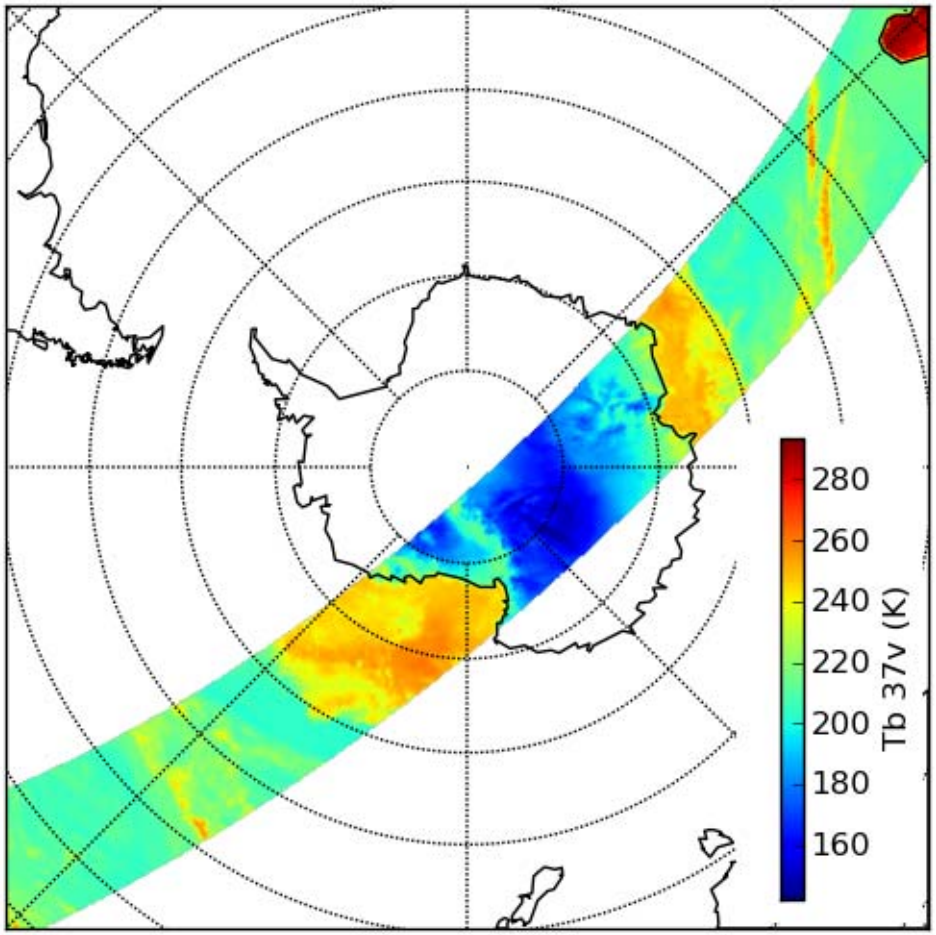
Left: main circulation pattern in the Arctic

Sea-ice drift can be observed with buoys drifting with the ice, or with satellites (more in a few slides!)

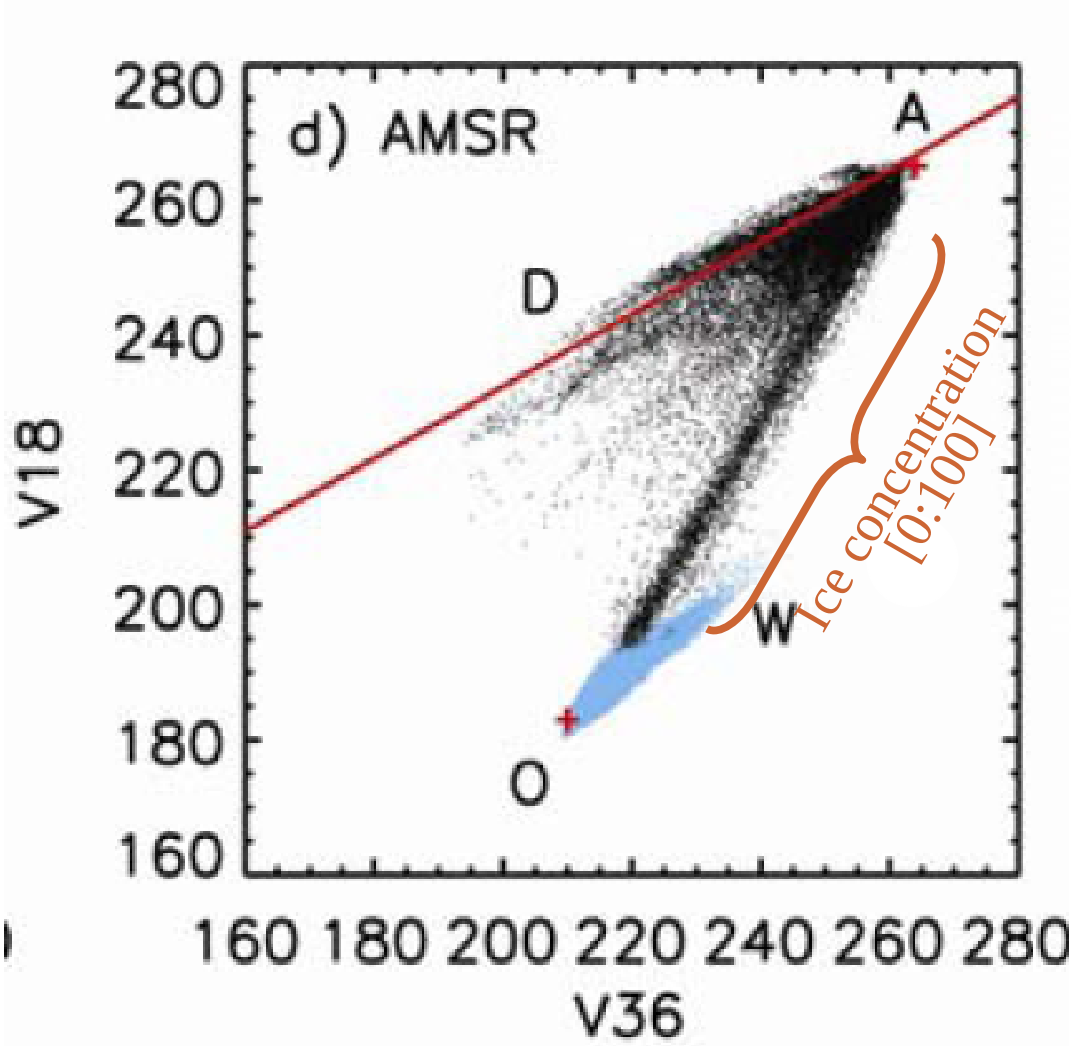
Outline – Sea Ice Applications

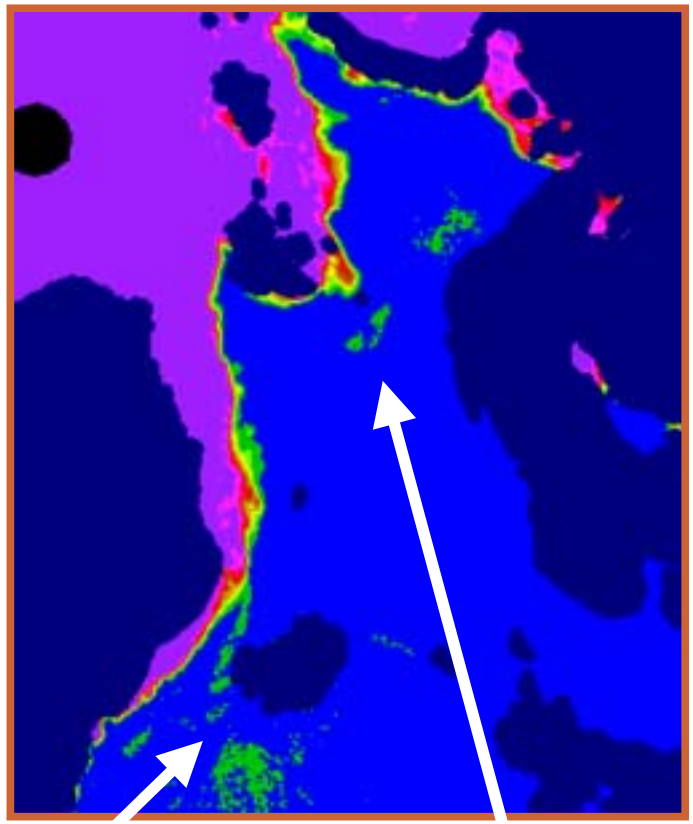
- General knowledge about sea-ice;
- Measuring sea-ice concentration;
- Measuring sea-ice motion;
- Challenges close to and on sea-ice;

Sea Ice Concentration



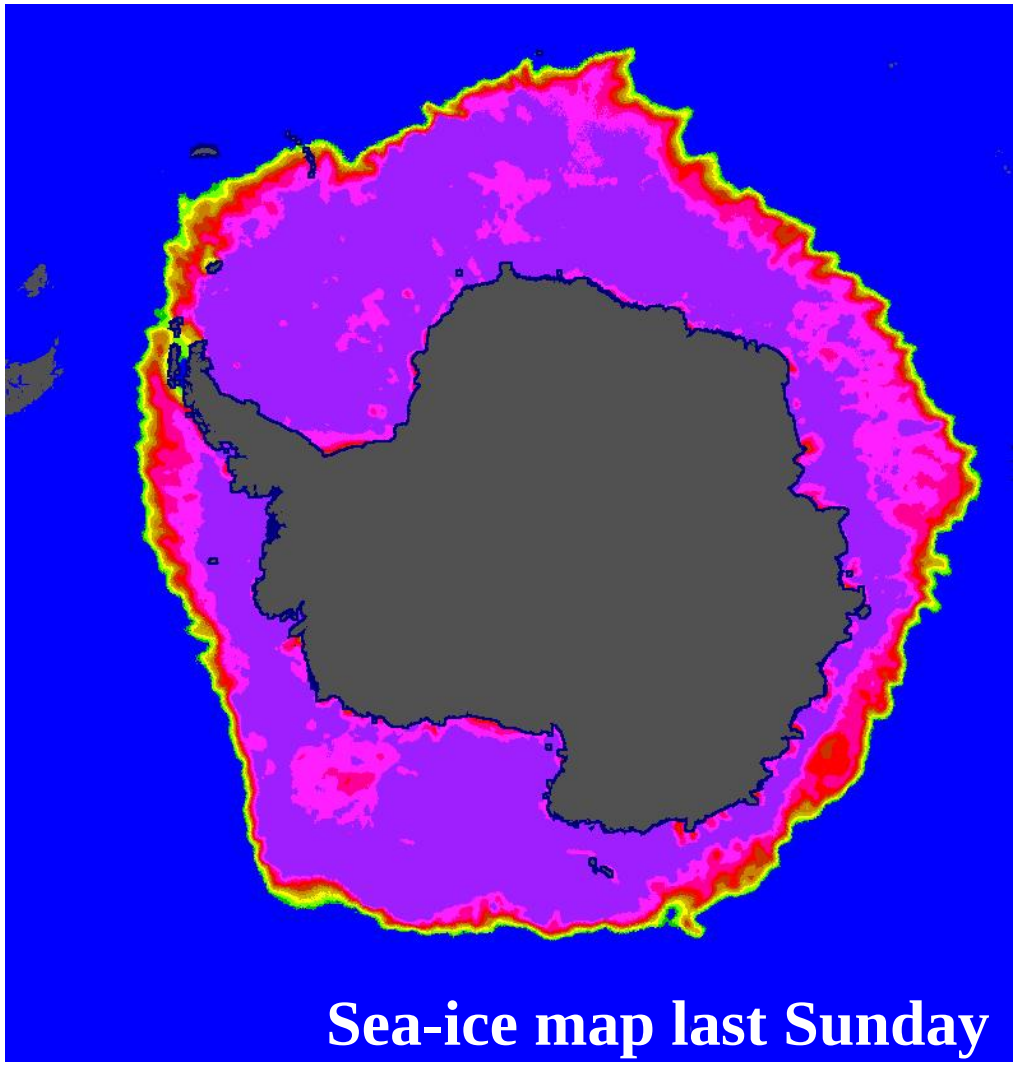
- Use SSM/I or AMSR-E instruments (US/JPN): Passive Microwave Imagers (left);
- Measure emitted radiances at e.g. 19, 37, 85 GHz (H. and V. pol);
- Does not need solar light;
- Mostly see through clouds.
- 30 to 50 km resolution.

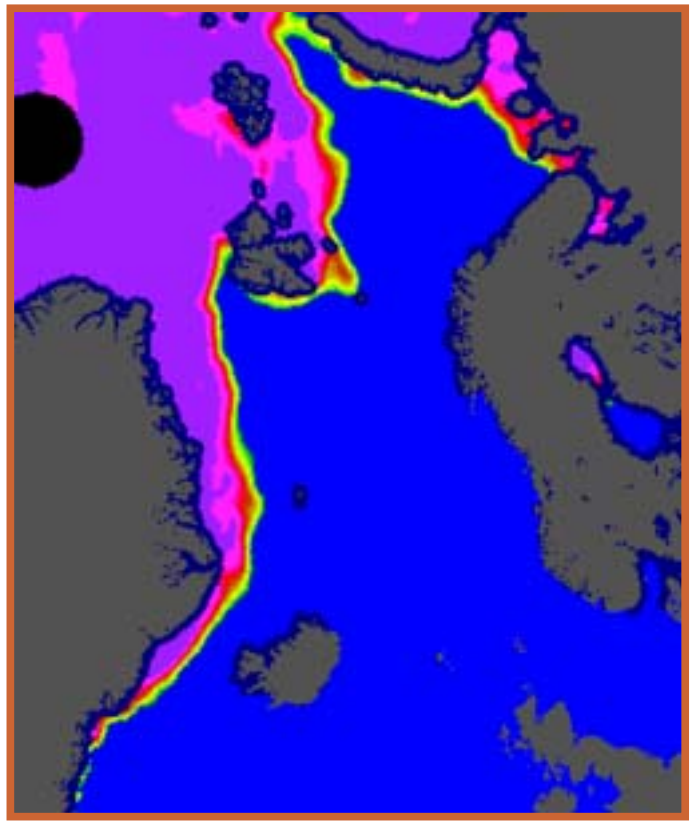




Thick clouds (CLW) or
Surface Wind

Comiso *et al.* (2007) Enhanced Sea Ice Concentrations from Passive Microwave Data, *NASA*





Final product of the OSI SAF

Comiso *et al.* (2007) Enhanced Sea Ice Concentrations from Passive Microwave Data, *NASA*

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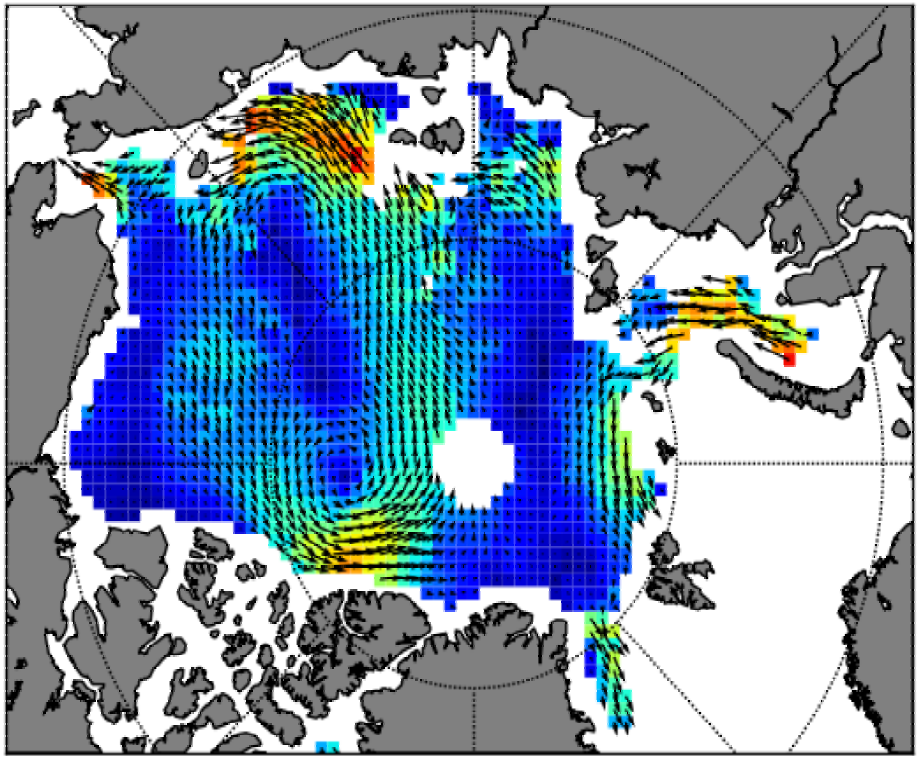
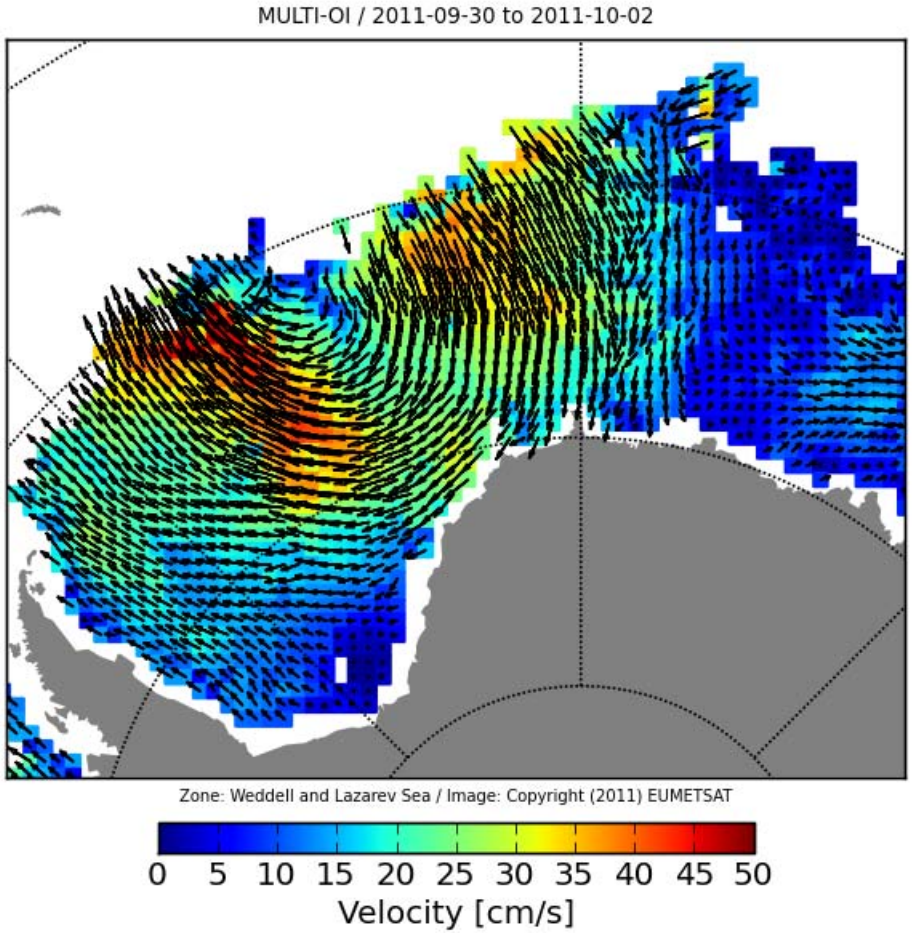
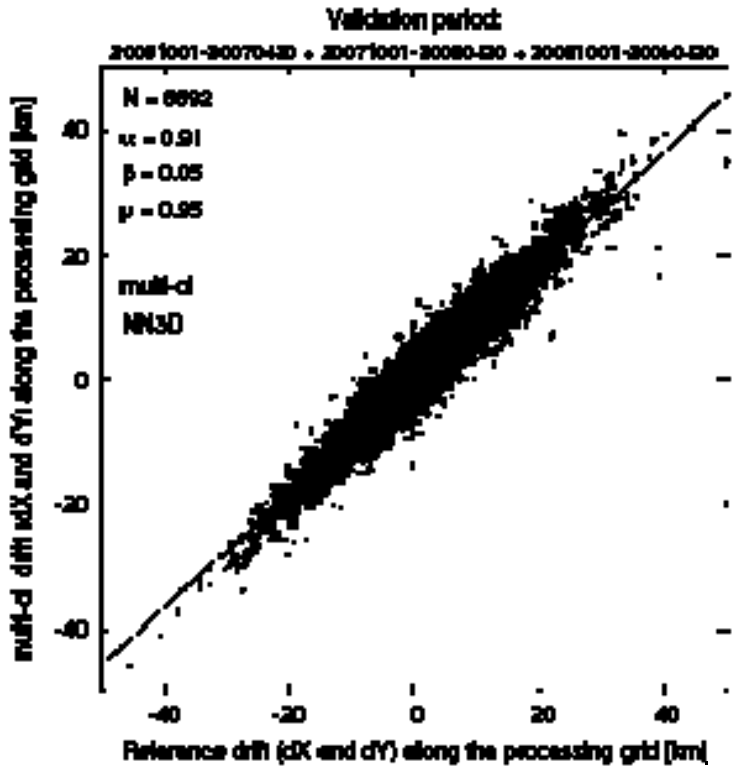
Sea Ice Motion



- Use SSM/I, AMSR-E and ASCAT instruments.
- Measure cross-correlation between two images (AMV).
- Works in Arctic and Antarctic.
- Validated against GPS buoys drifting over the ice.

Sea Ice Motion





<u>Acknowledgements</u>: ITPs: Woods Hole Ocean. Inst., NP-35: Arctic & Antarctic Res. Inst., Tara: Damocles.

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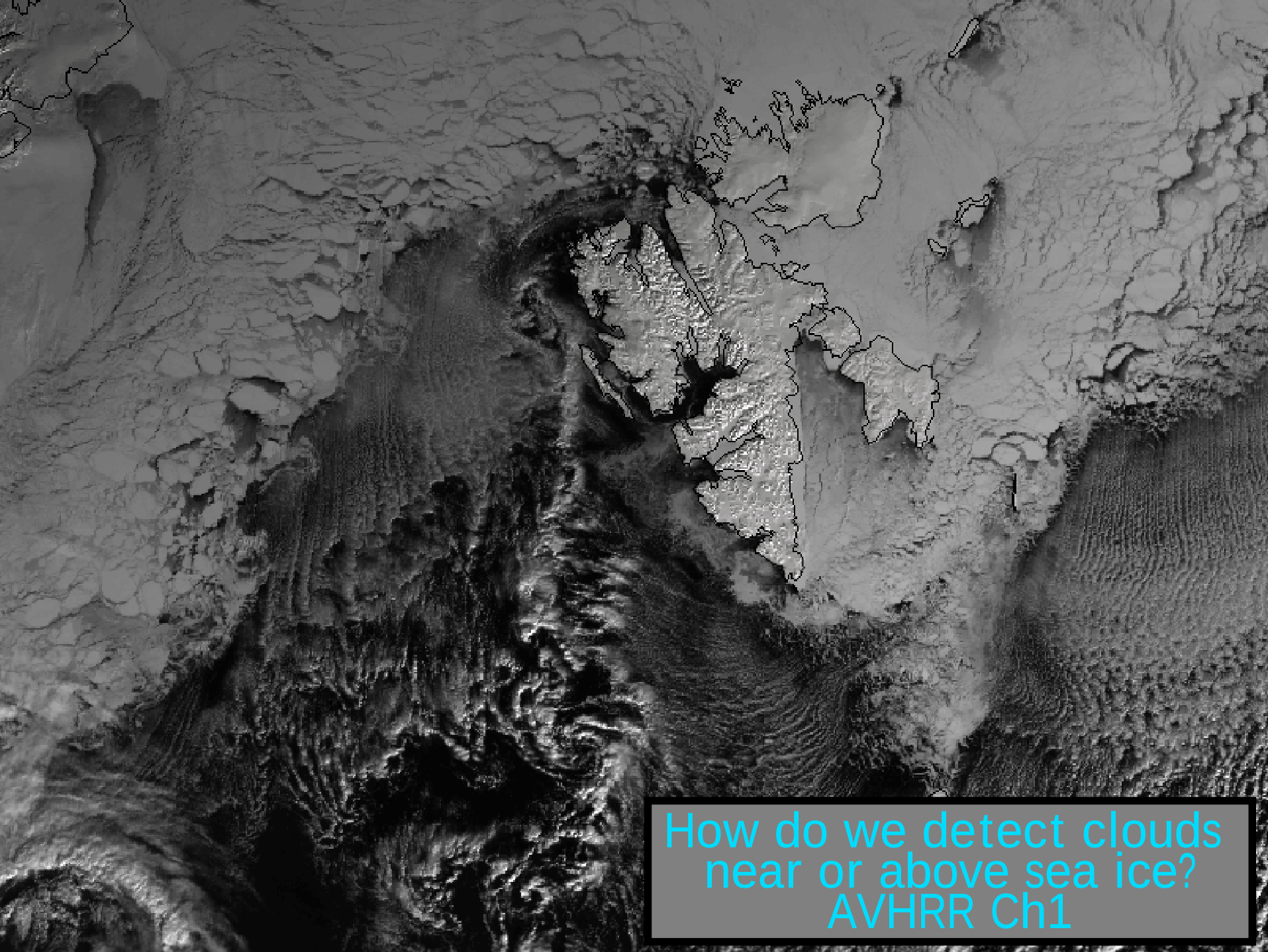
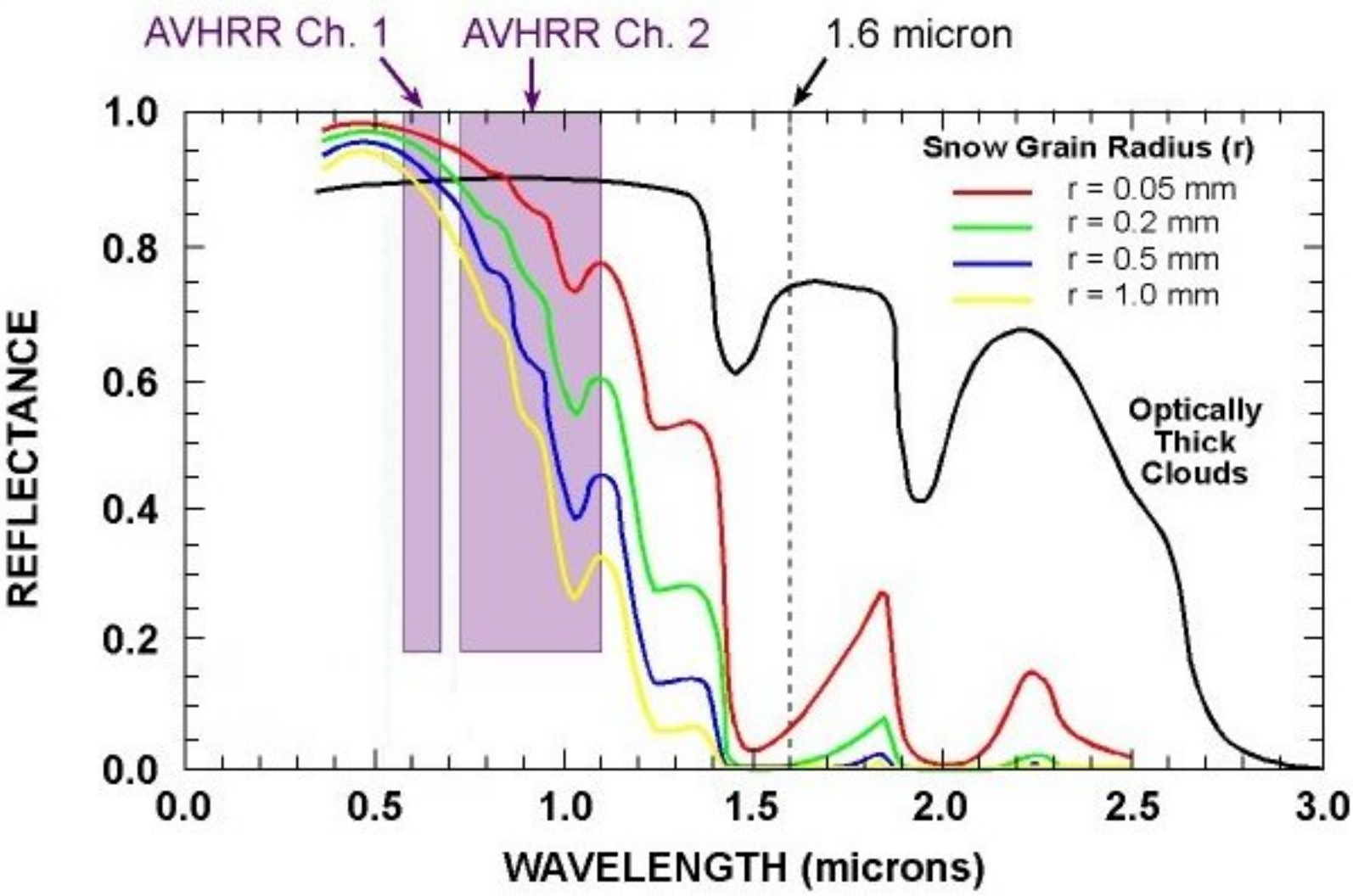
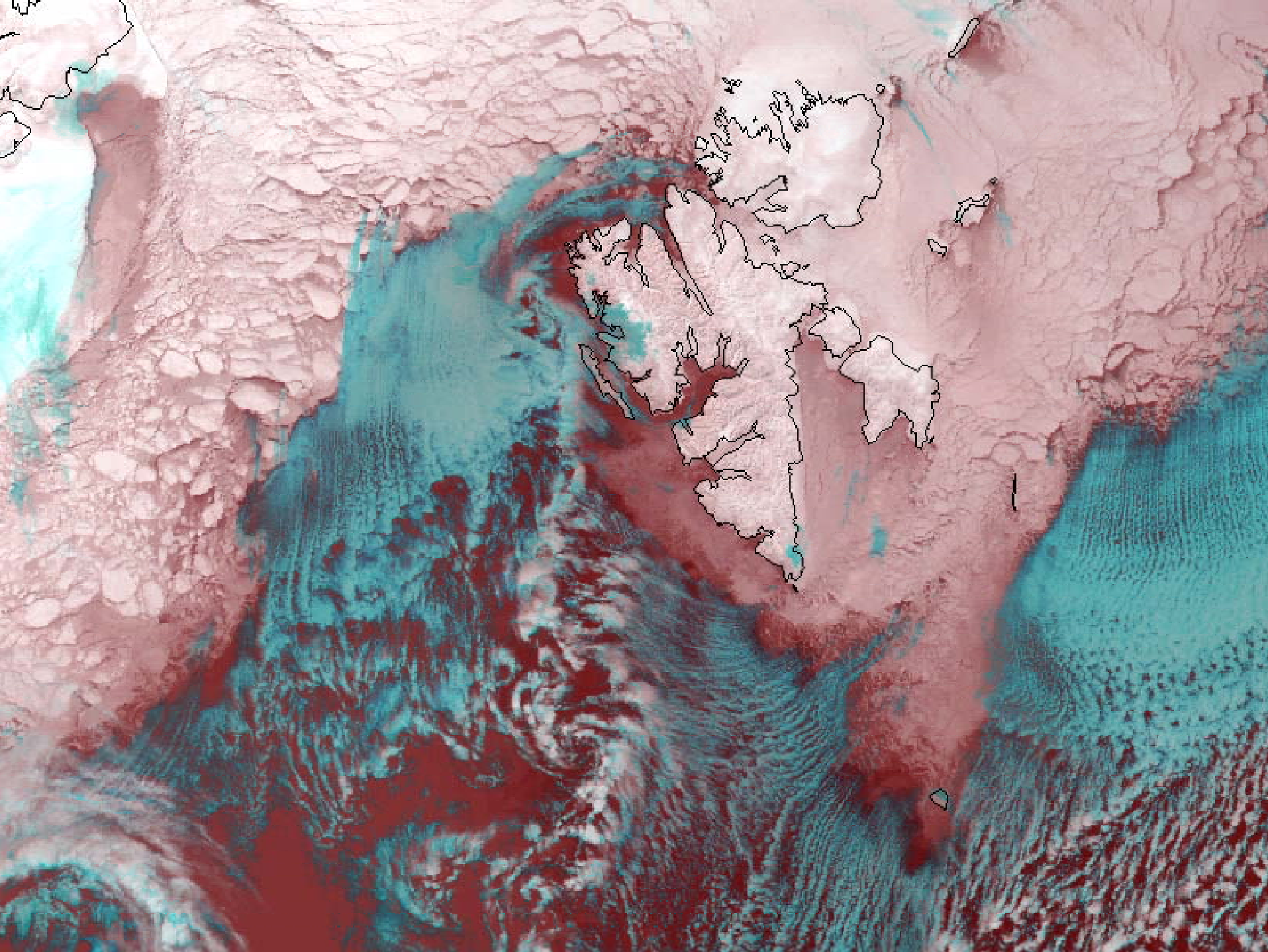
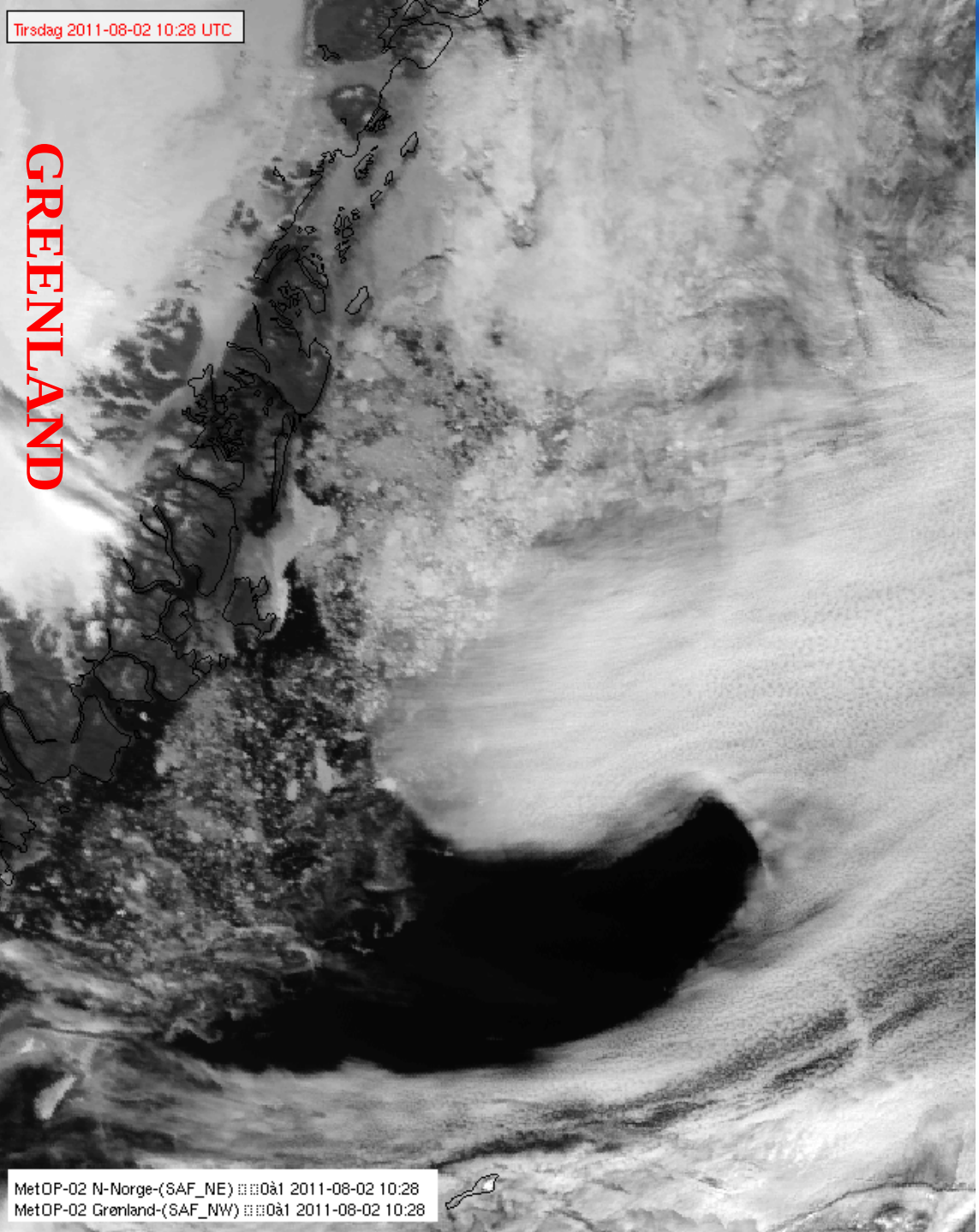
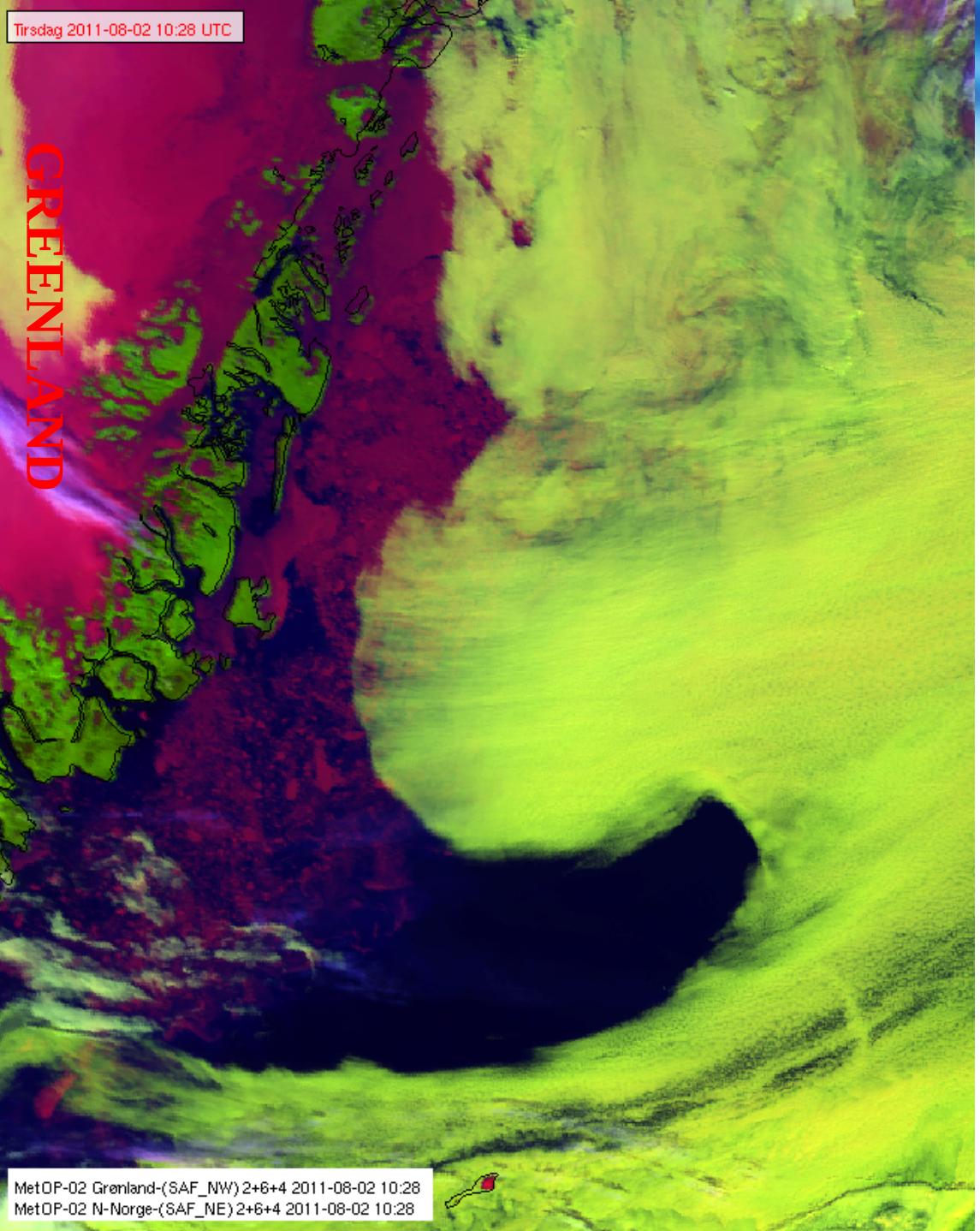

How do we detect clouds
near or above sea ice?
AVHRR Ch1


AVHRR Ch. 1
AVHRR Ch. 2
1.6 micron
Snow Grain Radius (r)
r = 0.05 mm
r = 0.2 mm
r = 0.5 mm
r = 1.0 mm
Optically Thick Clouds
REFLECTANCE
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
WAVELENGTH (microns)





- Clouds over open ocean is (relatively) easy.
- Sea-ice has same reflectance (albedo) than clouds in AVHRR Ch1.



- Clouds over open ocean is (relatively) easy.
- Sea-ice has same reflectance (albedo) than clouds in AVHRR Ch1.
- But some channel combinations (e.g. with Ch3b) allow to distinguish the two under day light.
- Basis for an operational product to be released end of this year.

Summary – Sea Ice Applications

- Sea-ice must be observed for safety, weather prediction, climate monitoring, ecosystem studies;
- Cruises/campaigns/buoys are expensive (harsh conditions);
- Satellites offer a grand opportunity to measure:
  - Sea-ice concentration (melt/freeze);
  - Sea-ice motion;
  - With challenges for cloud/ice screening.

http://osisaf.met.no

Thank You!