Real Time Sea-Ice Monitoring in the Greenland Sea

INGIBJÖRG JÓNSDÓTTIR *IJ@HI.IS*

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WORKSHOP ON MELTING SNOW AND ICE DATA FOR REAL-TIME MAPS AND HYDROLOGICAL MODELS

UNIVERSITY OF REYKJAVÍK 28.02.2017

Users of Sea-Ice Information

- Historically: people living near ice infested waters since the sea ice affected people´s lives in various ways. (No fishing, no travel, no harvest…)
- Seafarers and fishermen for navigational safety
- Meteorologists and climatologists as the sea ice affects weather and plays a big role in climatology
- Tourist companies and others carrying out operations in icy waters
- The media, the public, officials and researchers.

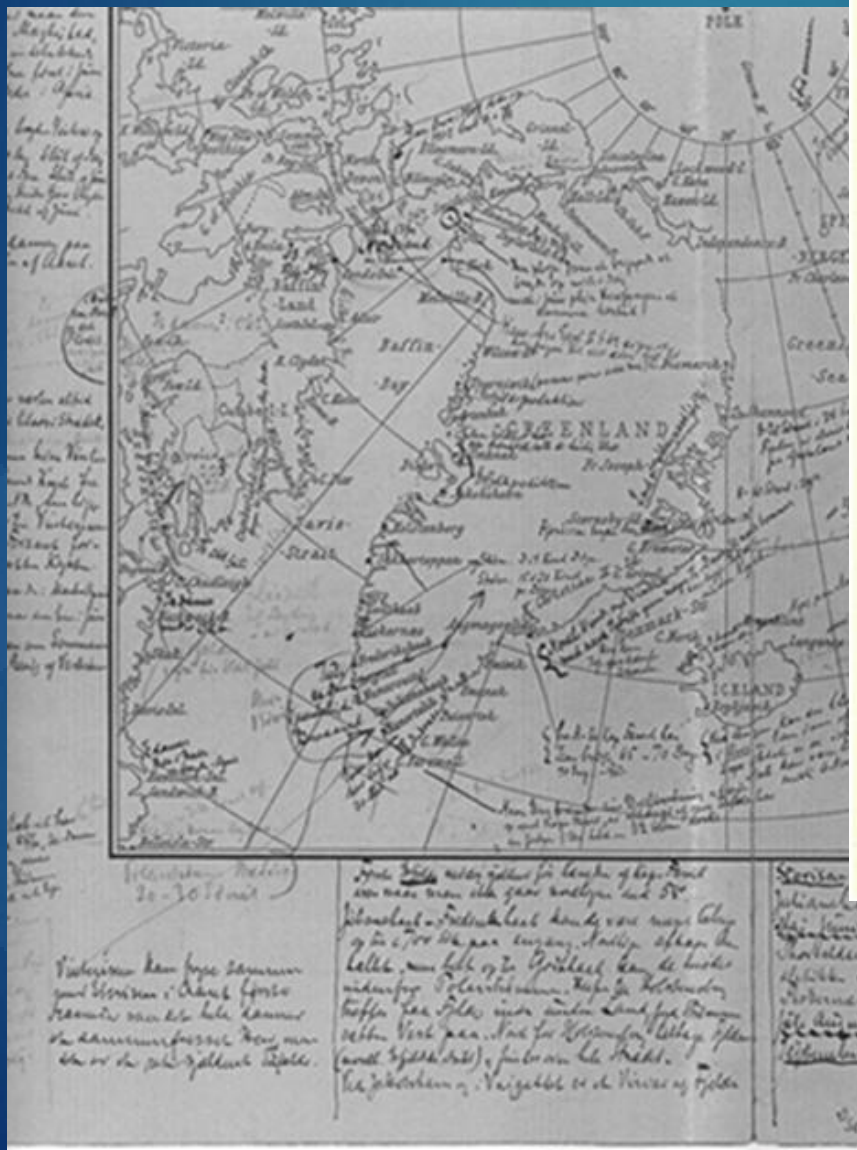
The requirements for ice information vary greatly – concerning the parameters observed, area coverage, geometric resolution, time resolution and timeliness.

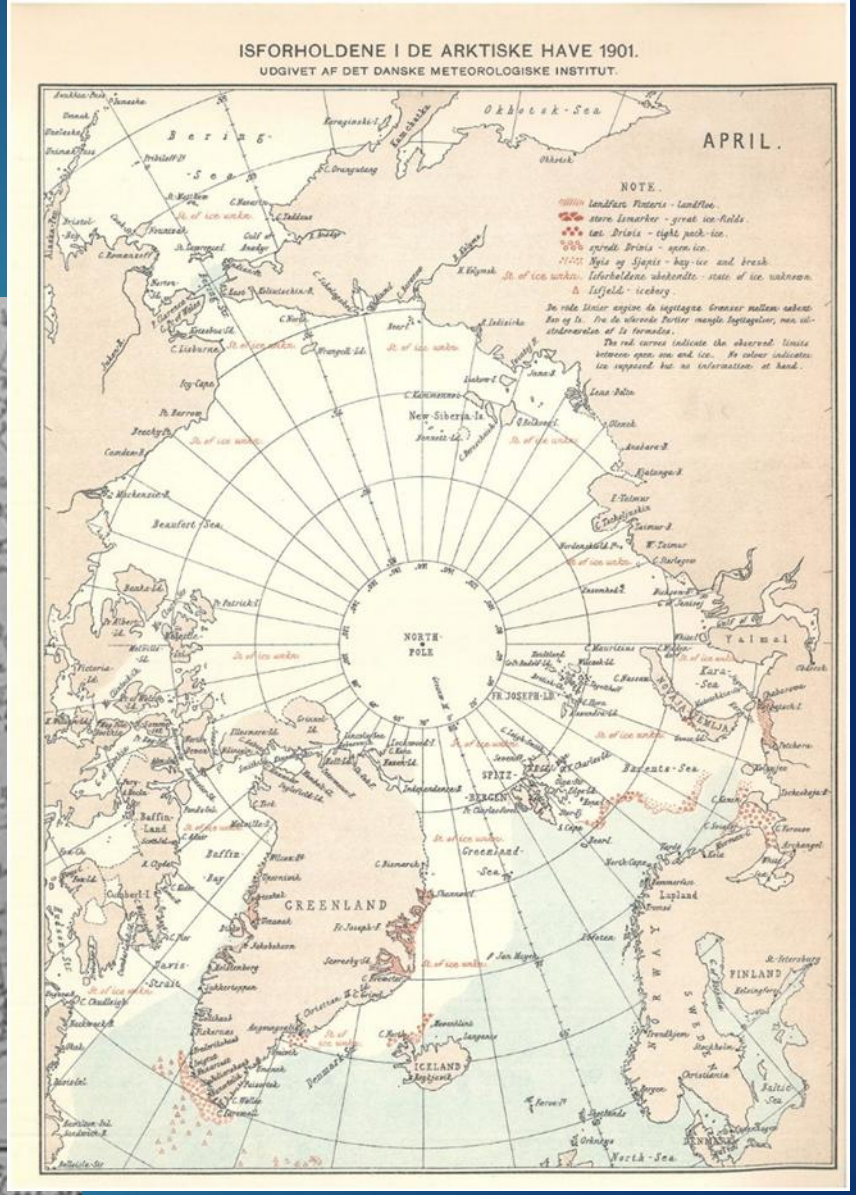
Sea-Ice Data

- Marine Sediment Cores - indication of sea ice and iceberg extent *(diatoms, foraminiferas, IP25, IRD)*
- Historical Sea-Ice Information – maximum ice extent, type, consequence *(charts, logbooks, diaries)*
- Direct observations from ships, aircraft, coastal stations and submarines (thickness data)
- Satellite imagery – optical, thermal, passive and active microwave, lidar.

Again, different timescale, precision and properties needed.

DMI Annual reports from the Arctic





Remote Sensing of Sea Ice

- Remote Sensing in regions that are frequently covered by clouds, are inaccessible, dark for considerable part of the year
- Studying features that change fast, are affected by wind, currents and internal forces

Parameters of interest:

Concentration

Ice thickness

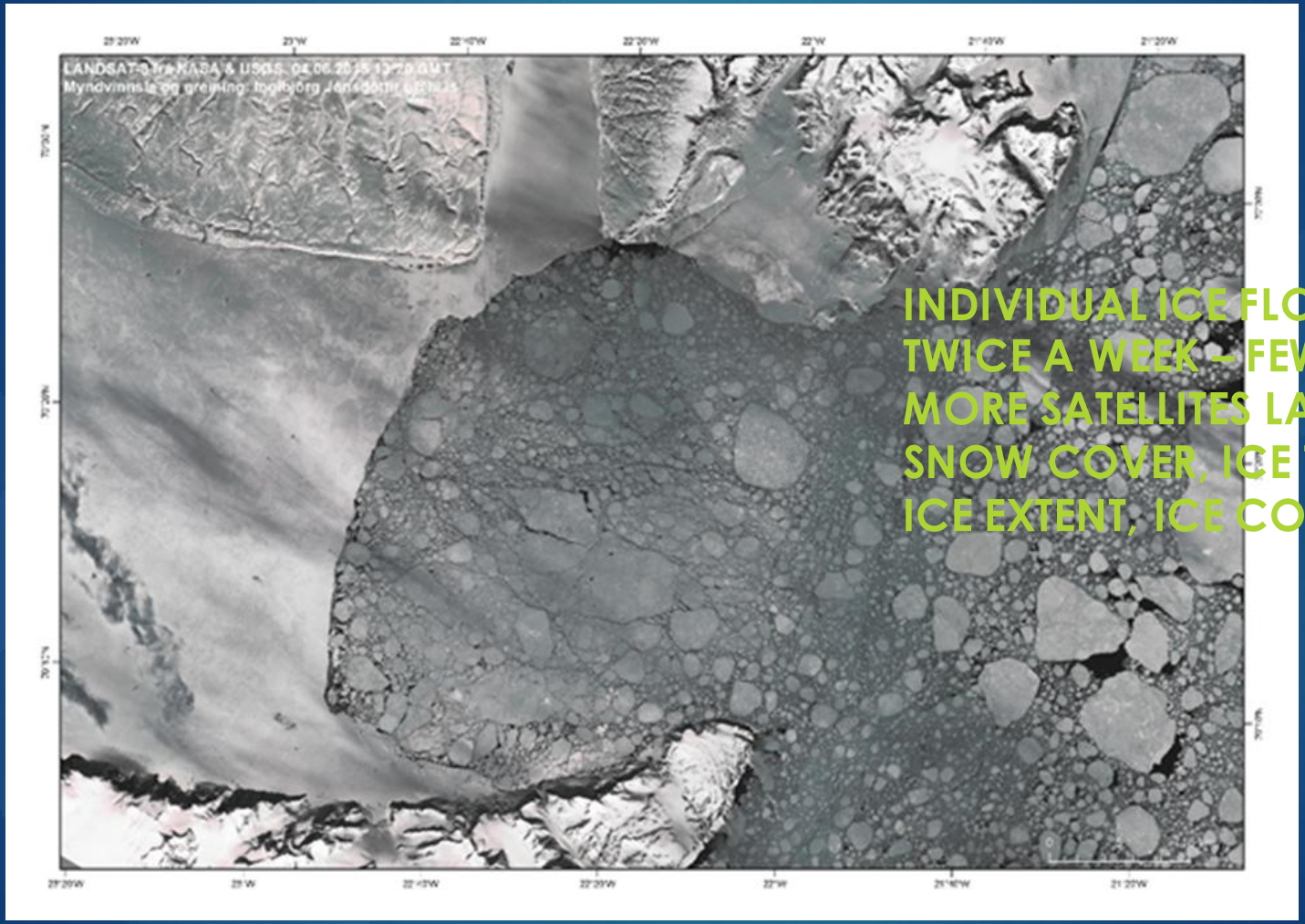
Ice type

Salinity

Ice drift

Surface melt

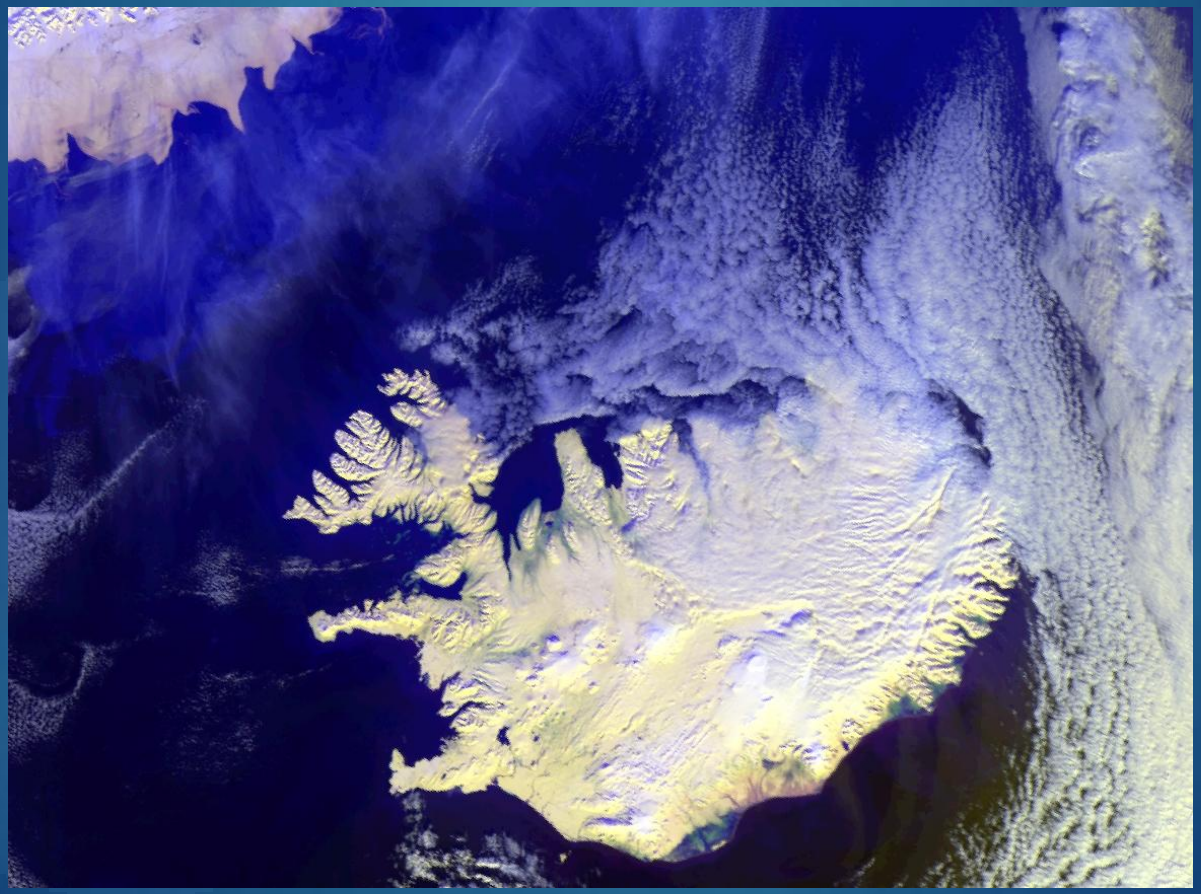
Optical images



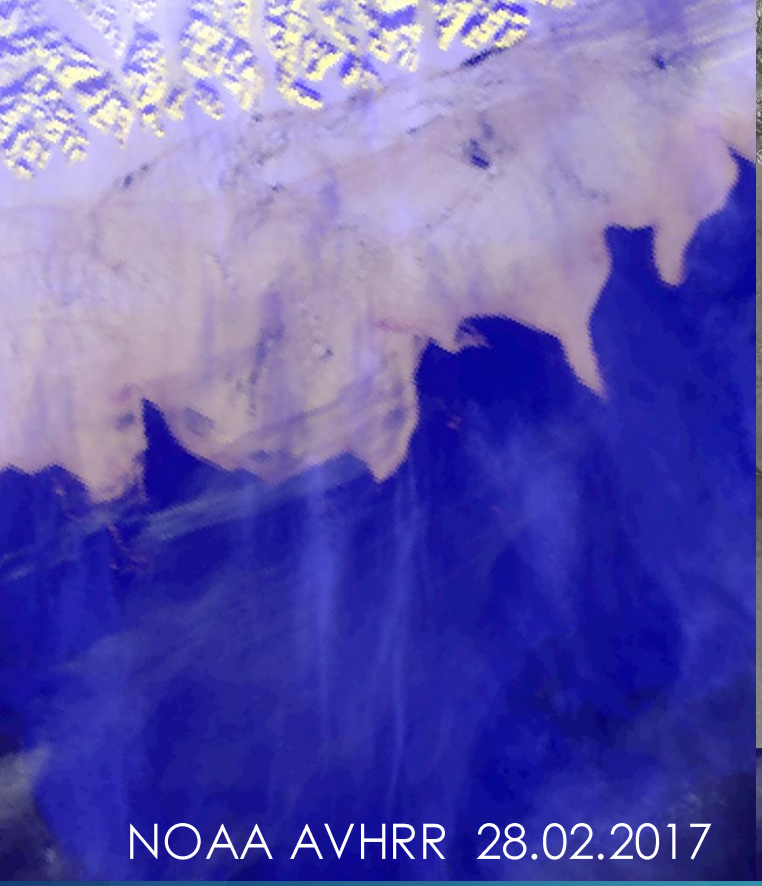
INDIVIDUAL ICE FLOES VISIBLE
TWICE A WEEK – FEW HOURS
MORE SATELLITES LAUNCHED
SNOW COVER, ICE TYPE
ICE EXTENT, ICE CONCENTRATION

High resolution images – LANDSAT 8 NASA & SENTINEL-2 ESA

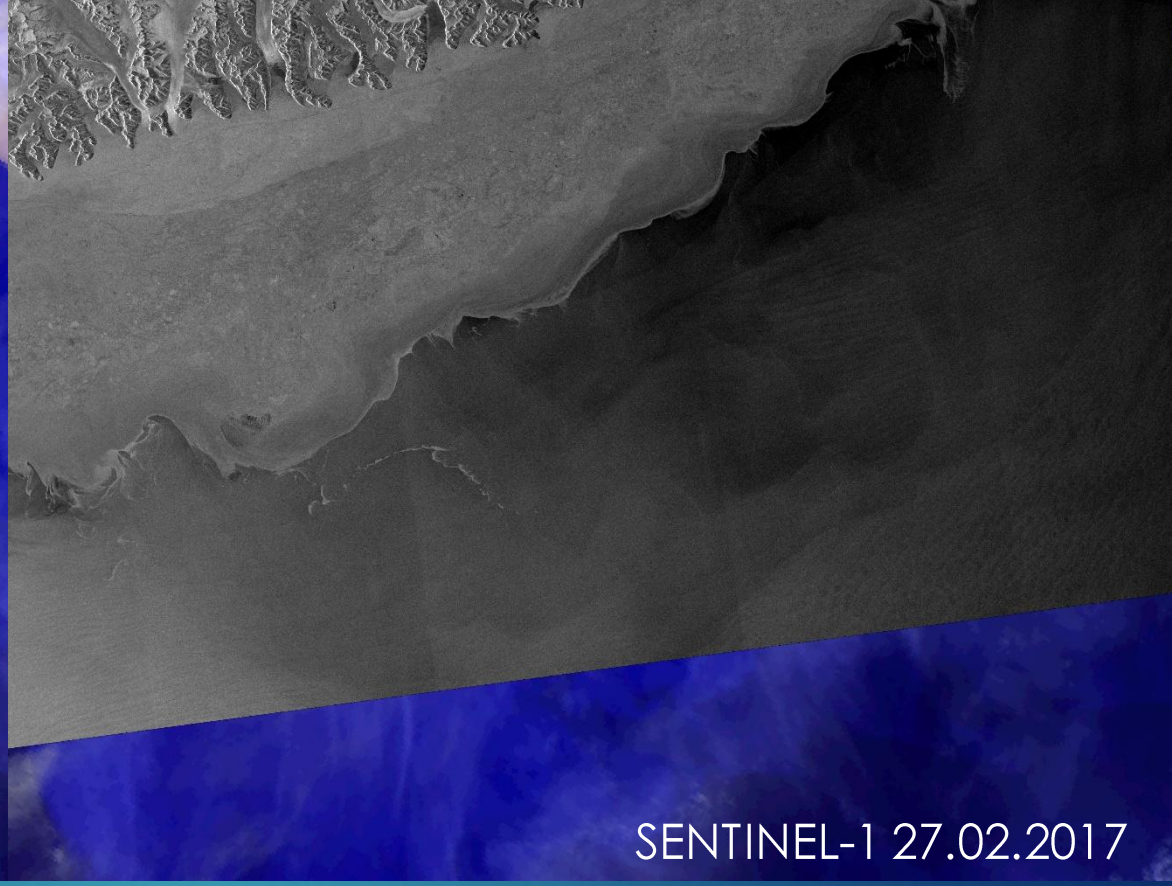
Denmark Strait 28.02.2017 12:30 GMT



NOAA AVHRR



NOAA AVHRR 28.02.2017

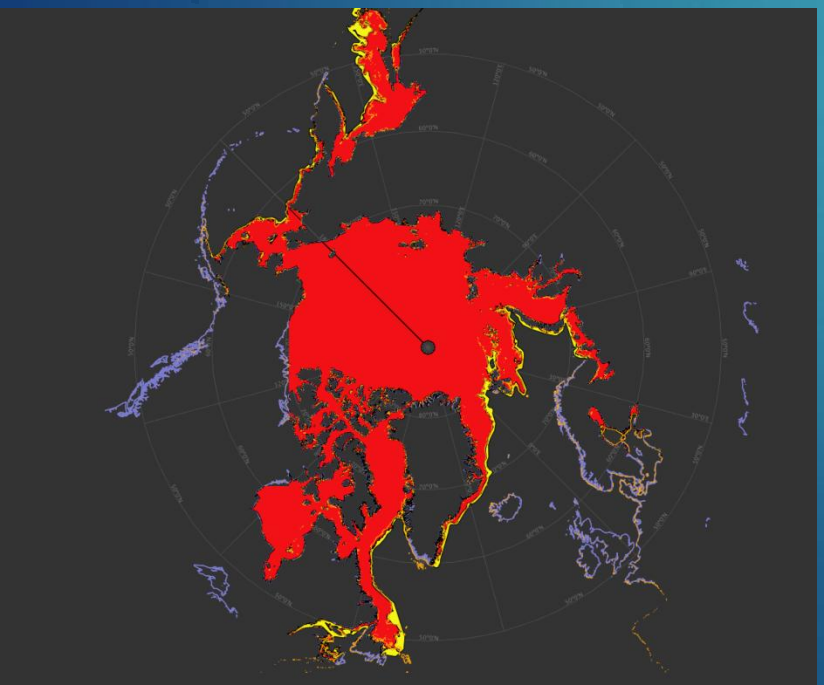


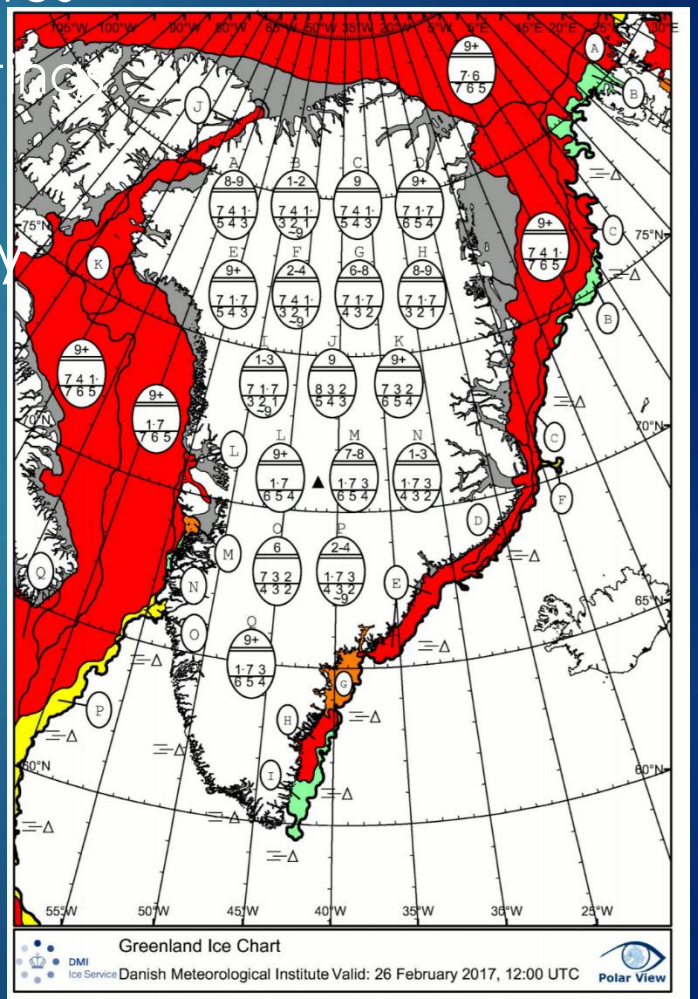
SENTINEL-1 27.02.2017

Good to have different image types for comparison
In general radar images are starting to fulfill requirements
Independent on cloud cover and light
With more satellites coverage is improving

IICWG

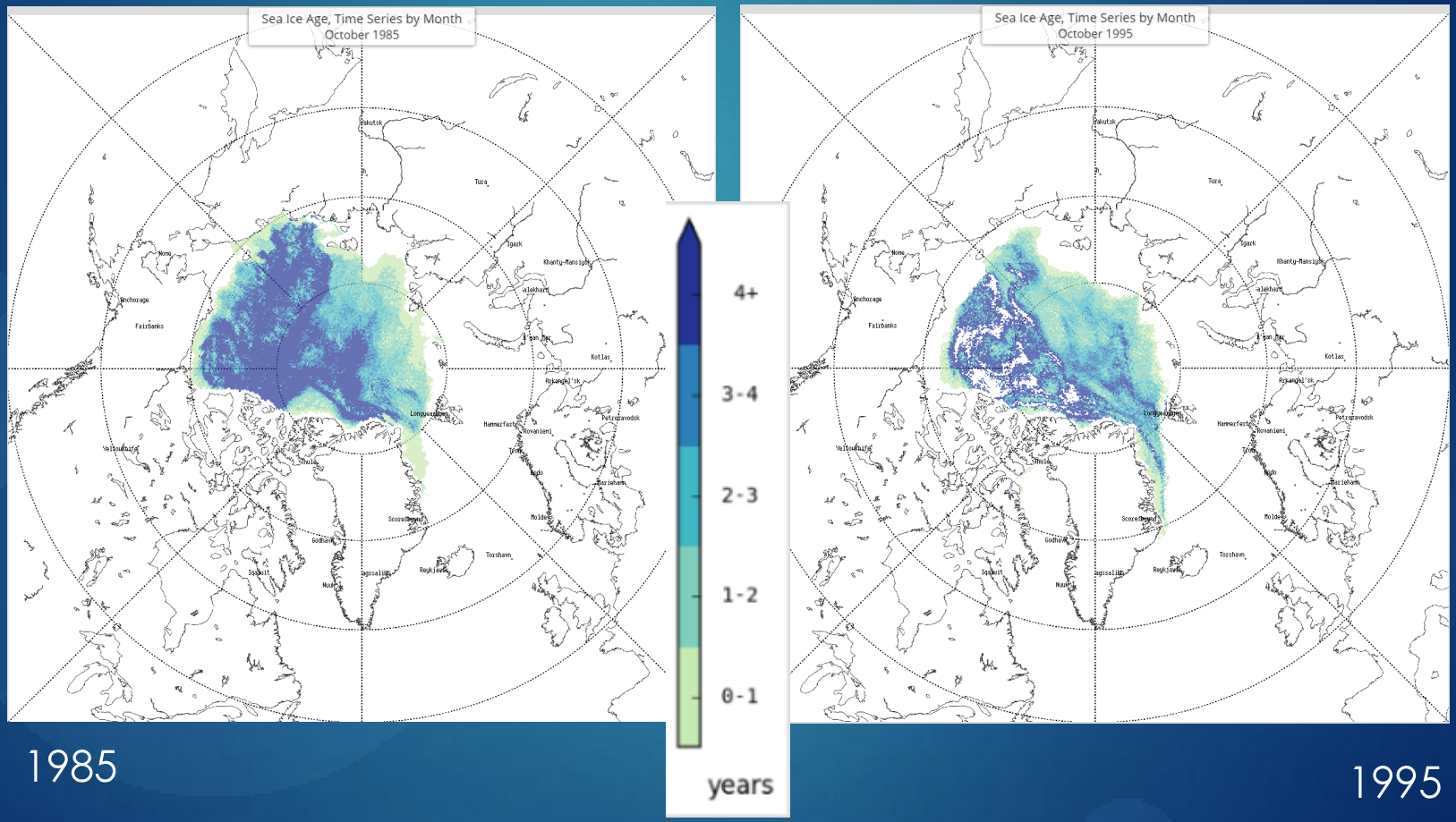
- International Ice Charting Working Group link to WMO
- Monitoring and research of both hemispheres
- Annual meetings and more thematic meet
- Strong collaboration between nations
- Standards – to enhance navigational safety





ARCTIC vs ANTARCTIC – what is happening?

Sea ice extent & age –from NSIDC



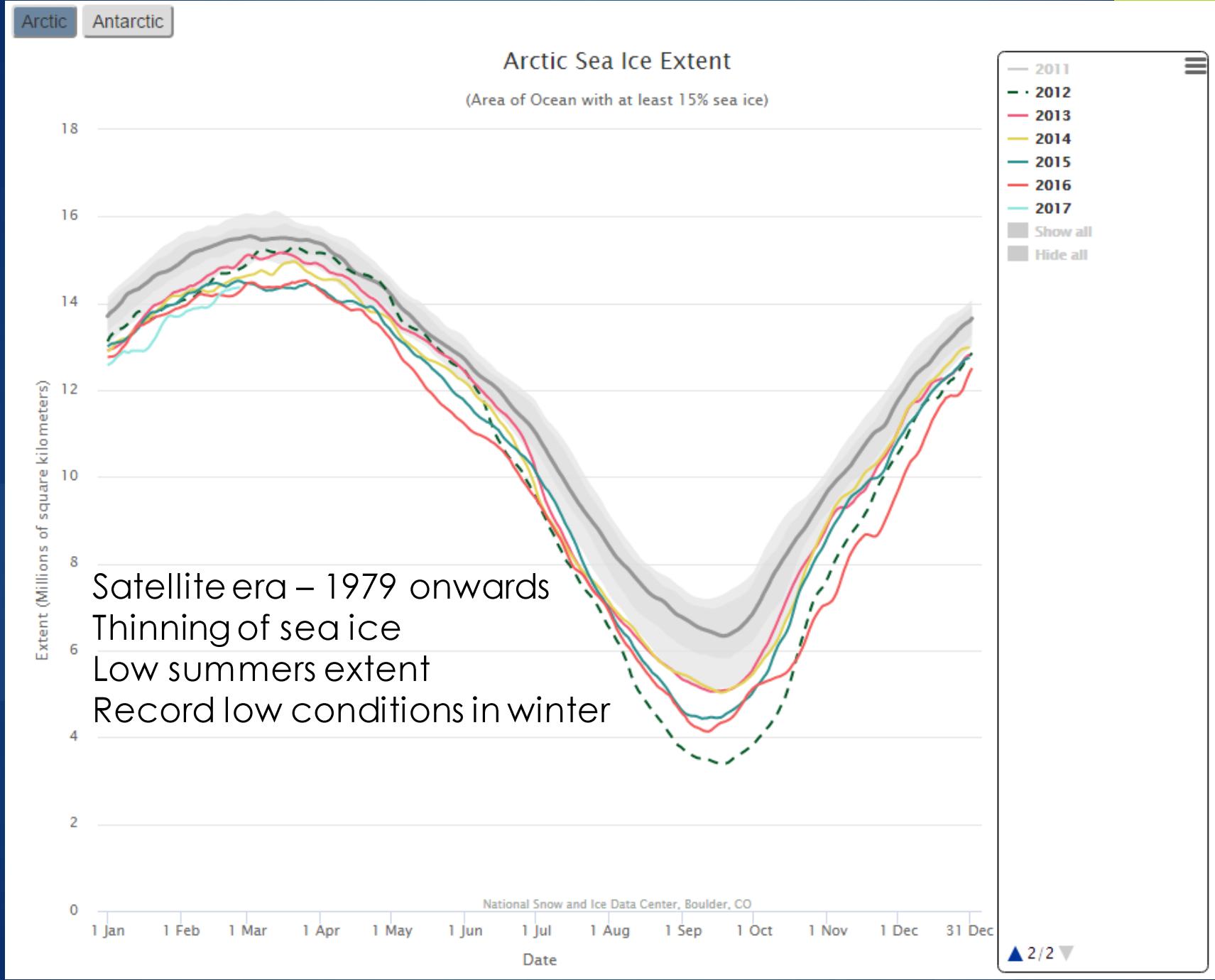
1985

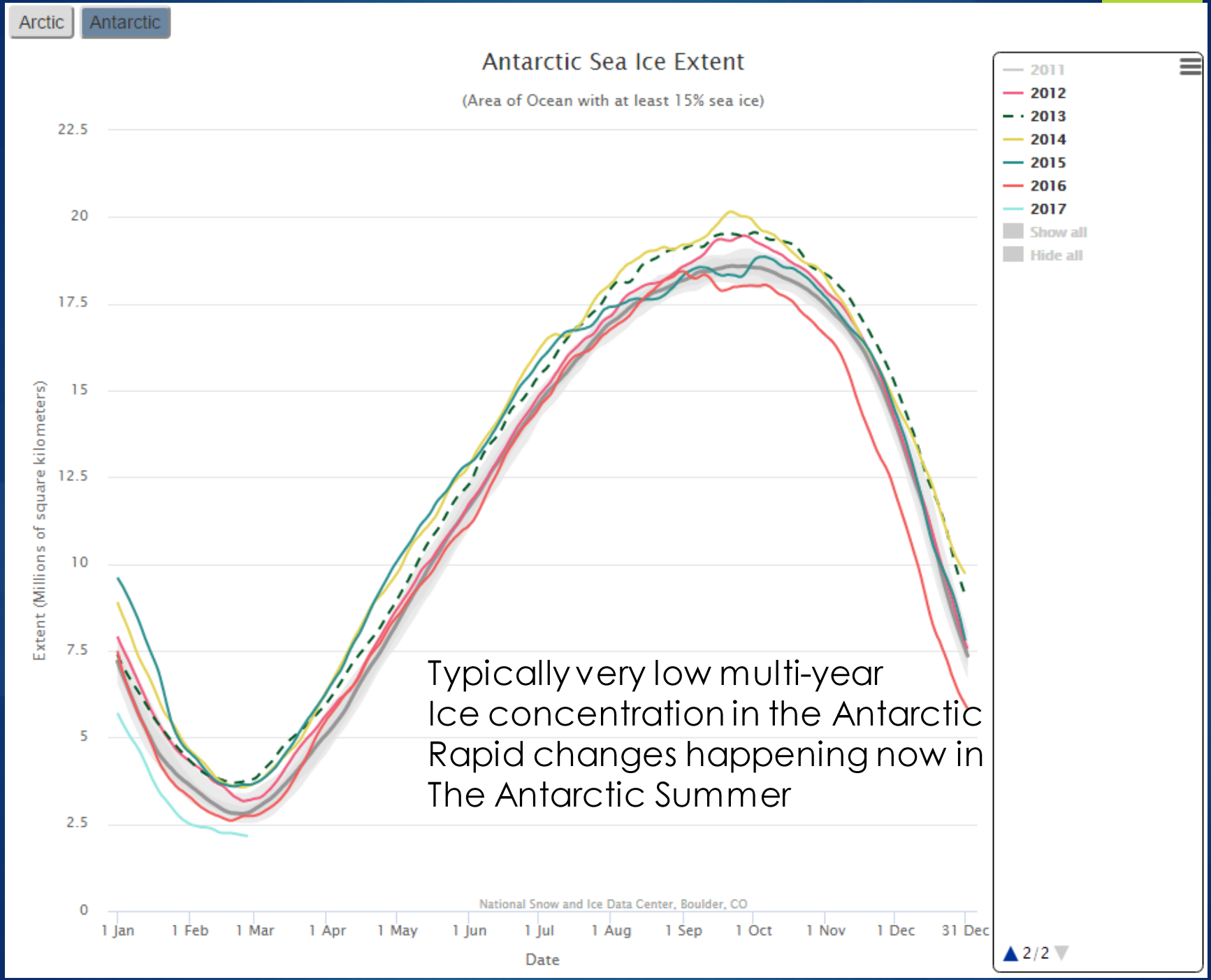
1995

National Snow and Ice Data Center

2005

2014


Arctic
Antarctic
Arctic Sea Ice Extent
(Area of Ocean with at least 15% sea ice)
Extent (Millions of square kilometers)
18
16
14
12
10
8
6
4
2
0
1 Jan
1 Feb
1 Mar
1 Apr
1 May
1 Jun
1 Jul
1 Aug
1 Sep
1 Oct
1 Nov
1 Dec
31 Dec
Date
National Snow and Ice Data Center, Boulder, CO
2011
2012
2013
2014
2015
2016
2017
Show all
Hide all
2/2
Satellite era – 1979 onwards
Thinning of sea ice
Low summers extent
Record low conditions in winter


Arctic
Antarctic
Antarctic Sea Ice Extent
(Area of Ocean with at least 15% sea ice)
Extent (Millions of square kilometers)
22.5
20
17.5
15
12.5
10
7.5
5
2.5
0
1 Jan
1 Feb
1 Mar
1 Apr
1 May
1 Jun
1 Jul
1 Aug
1 Sep
1 Oct
1 Nov
1 Dec
31 Dec
Date
National Snow and Ice Data Center, Boulder, CO
2011
2012
2013
2014
2015
2016
2017
Show all
Hide all
2/2
Typically very low multi-year
Ice concentration in the Antarctic
Rapid changes happening now in
The Antarctic Summer

Remote Sensing of Snow & Ice various projects….

IN COLLABORATION WITH ANDRI GUNNARSSON & LANDSVIRKJUN

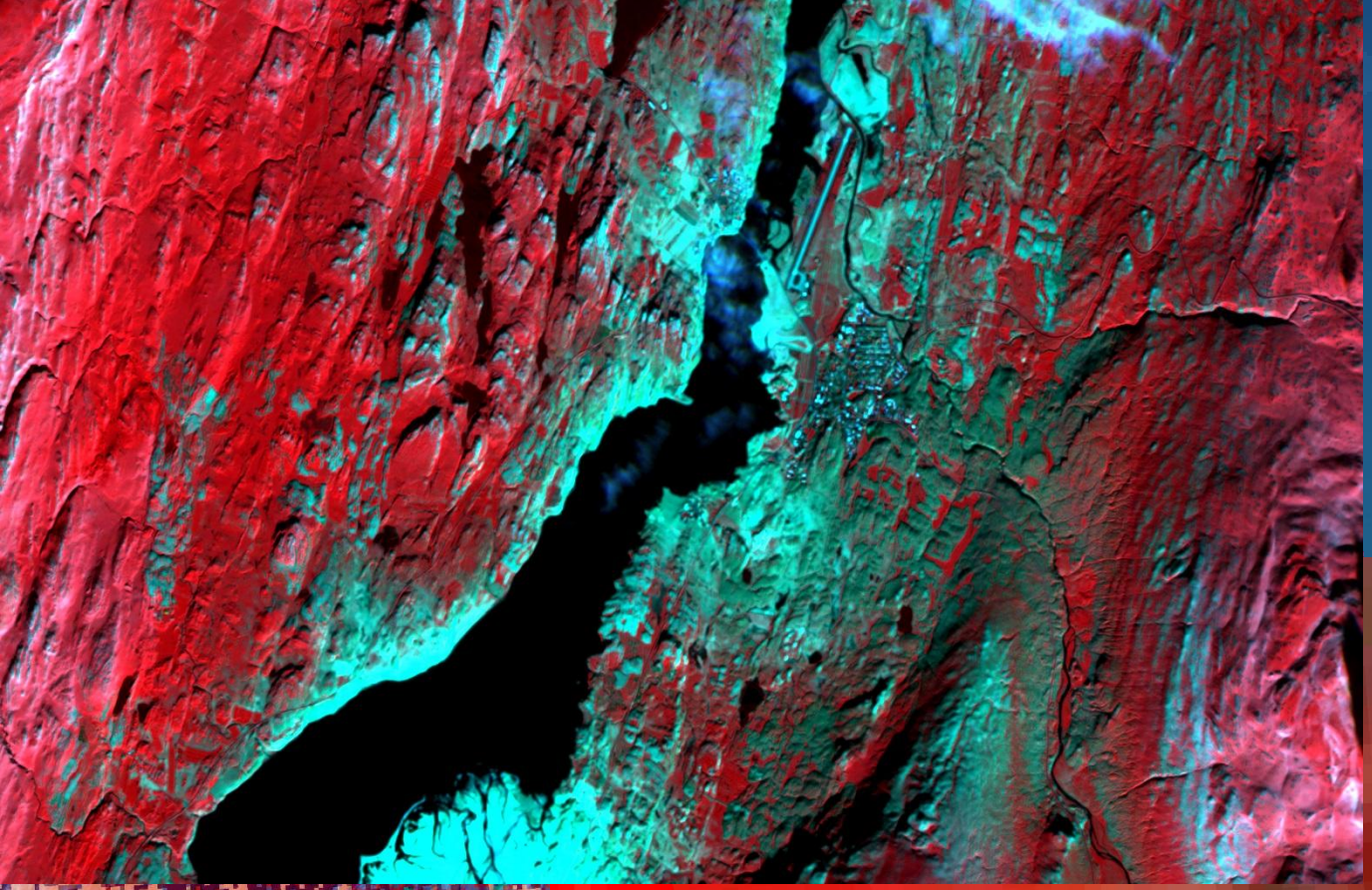
- Guðjón Fjeldsted Ólafsson Iceland
- Helena Björk Valtýsdóttir Sweden
- Emma Garcia Spain
- Gunnar Snær Hermannsson Denmark
- Melissa Peterson USA

Main snow projects

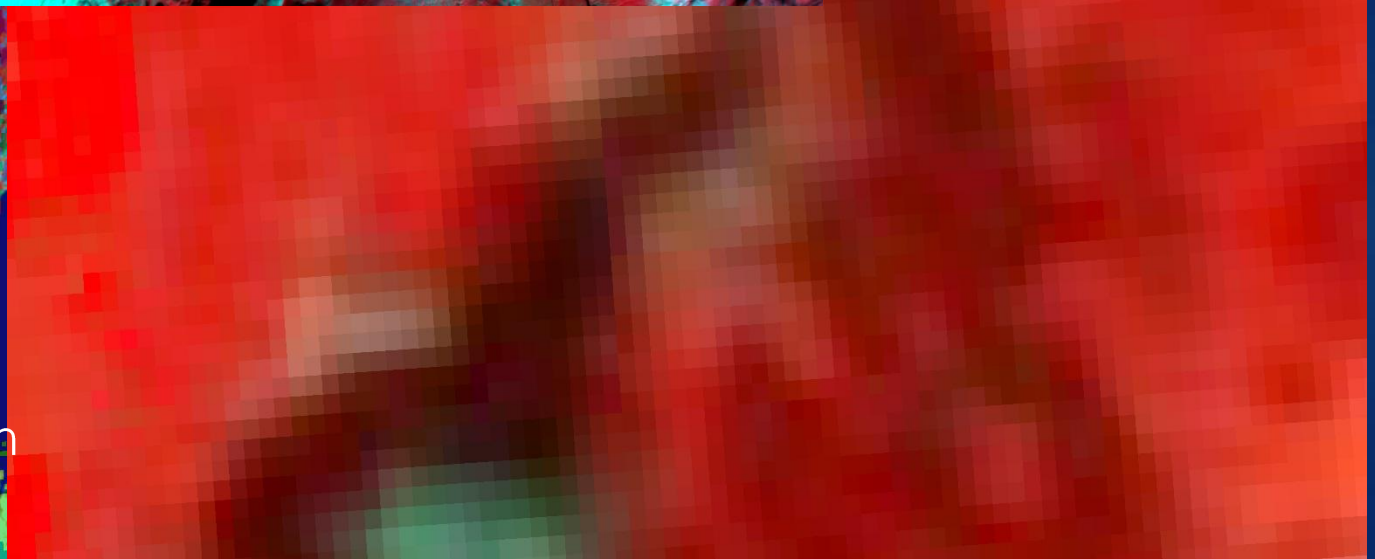
- Provide real-time estimate of snow extent using MODIS, VIIRS, NOAA AVHRR data
  - Cloud cover a challenge,
- Test image classification methods (supervised, unsupervised, hybrid)
  - Study radiative properties of the snow cover and link to water content and other variables
- Comparison of data types of different geometric resolution (LANDSAT/SENTINEL vs MODIS/VIIRS/NOAA)
- Using radar images to larger extent for regular monitoring of snow

Snow/ice
vs clouds

Sentinel-2
Vs
MODIS

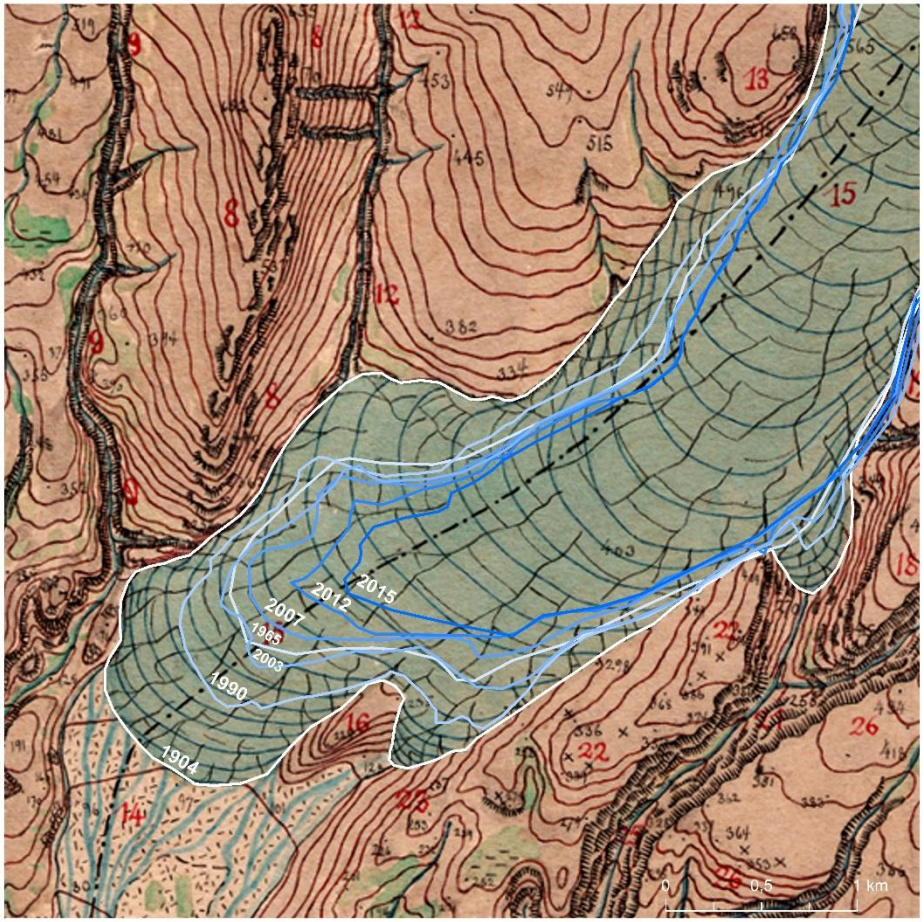


Classification

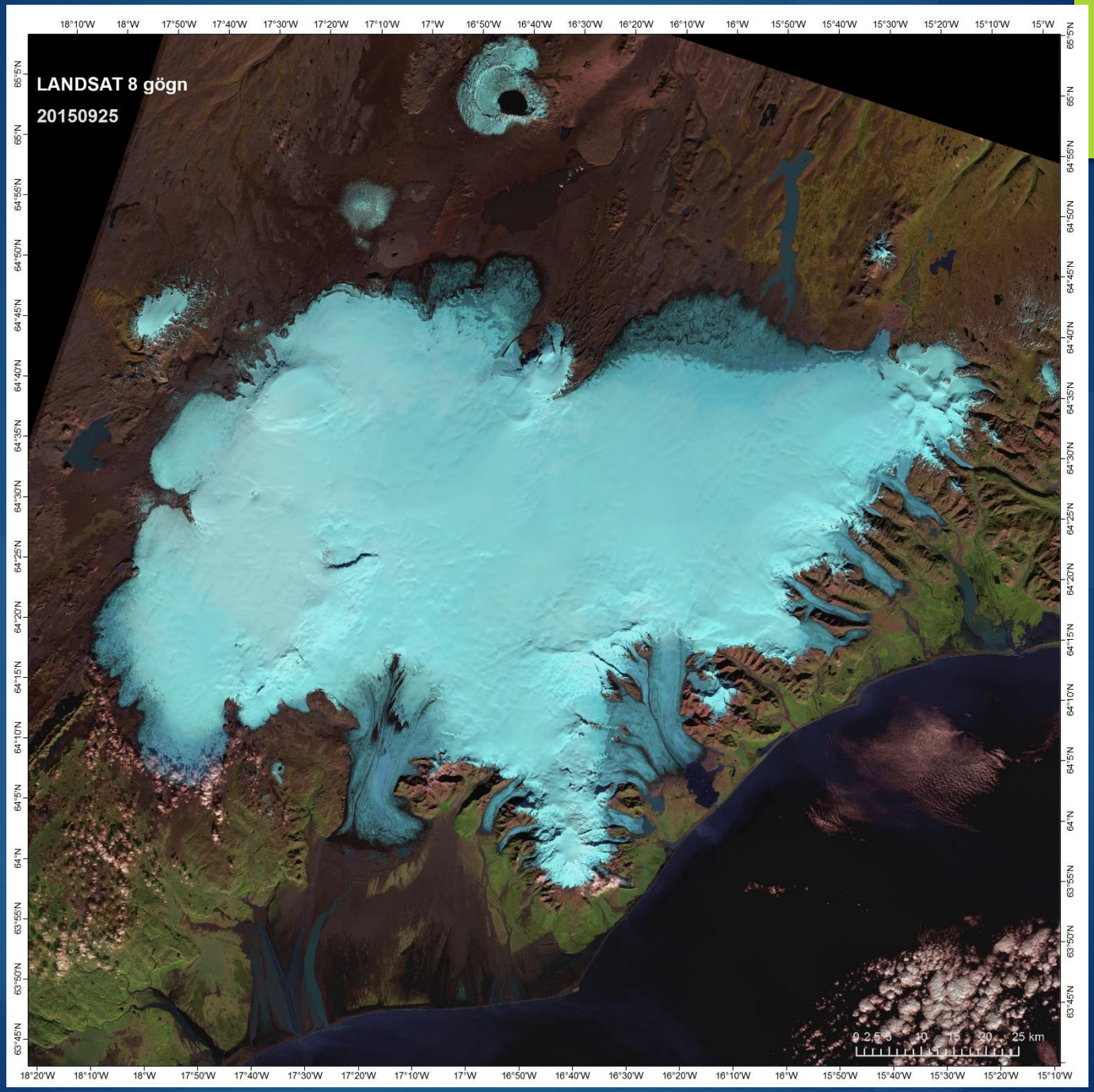


Environmental Change

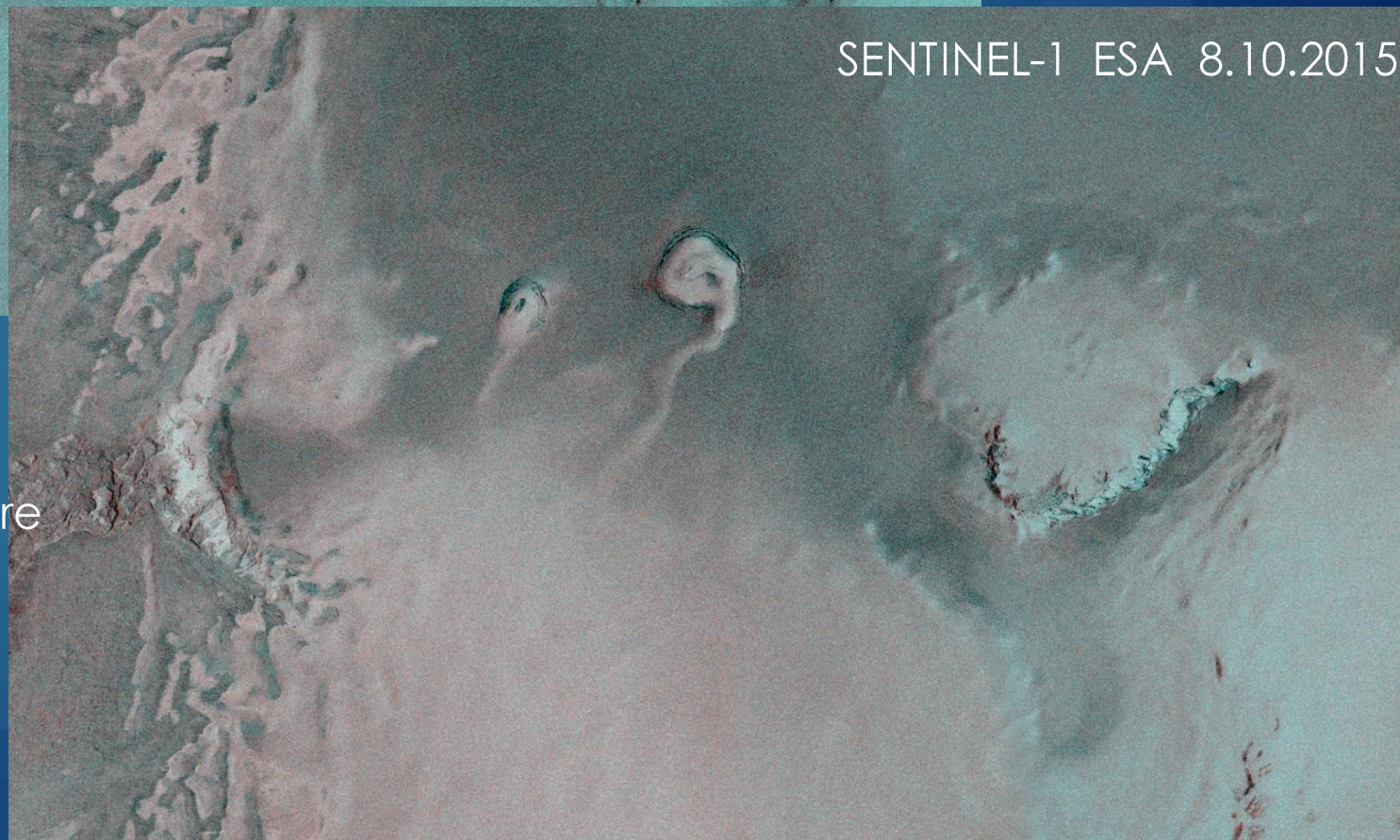
LANDMÆLINGAR ÍSLANDS *SAMSÝN*



Sólheimajökull frá frumteikningum Herforingjaráðsins 1904-2015
Loftmyndir LMÍ, Loftmynda, Samsýnar, ýmis kort LMÍ, LANDSAT 1-8, SPOT

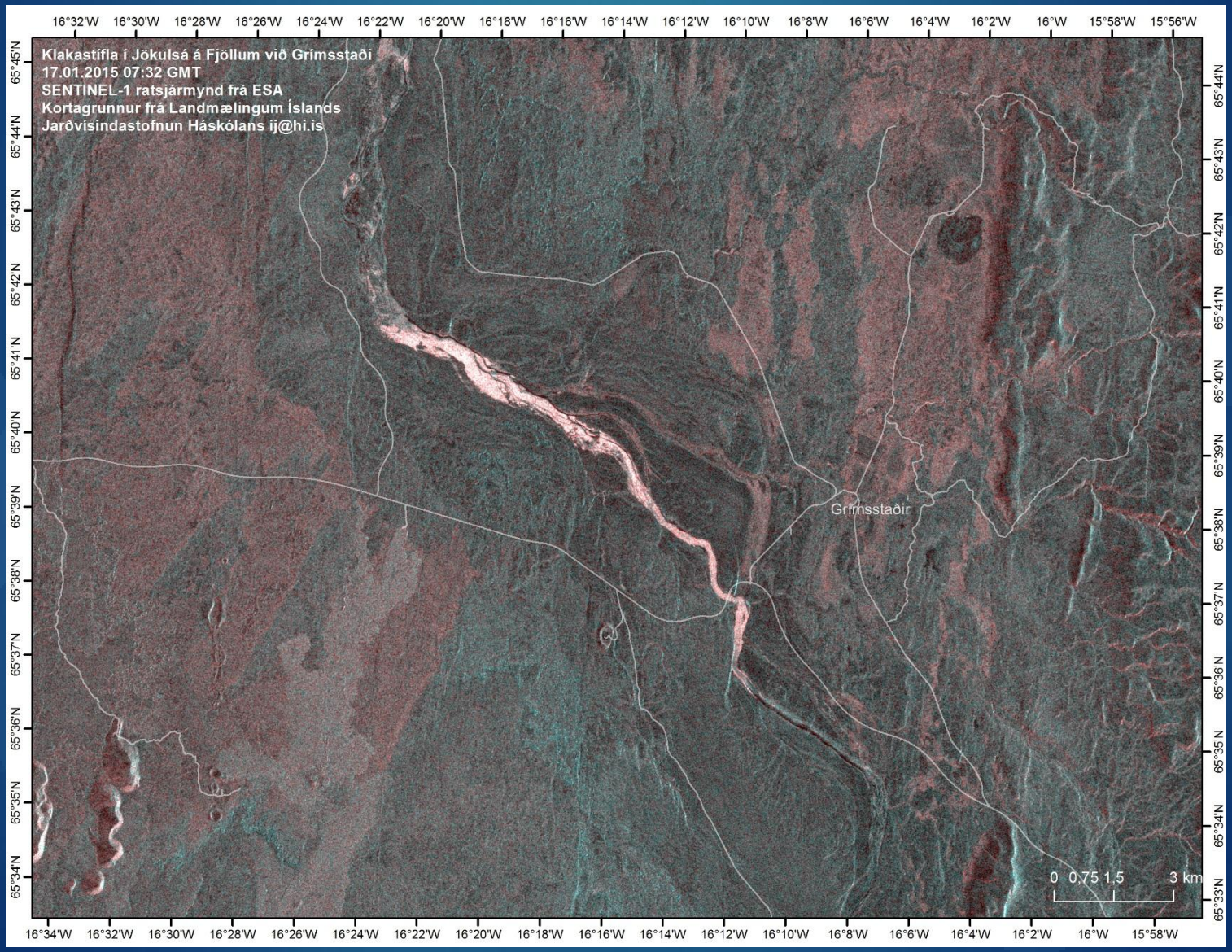

LANDSAT 8 gögn
20150925
0 2.5 5 10 15 20 25 km


LANDSAT 1 gögn
19730922
0 2,5 5 10 15 20 25 km



Skaftárkatlar
Cauldrons before
And after flood

Ice dam in river Jökulsá á Fjöllum



Thank you !