Assessment of impact of coastal hazards on scientific and community infrastructure in Svalbard, High Arctic

M.C. Strzelecki [1], M. Jaskólski [1], L. Pawłowski [1], P. Zagórski [2], M. Lim [3], A.J. Long [4]

1- Institute of Geography and Regional Development University of Wroclaw, Poland

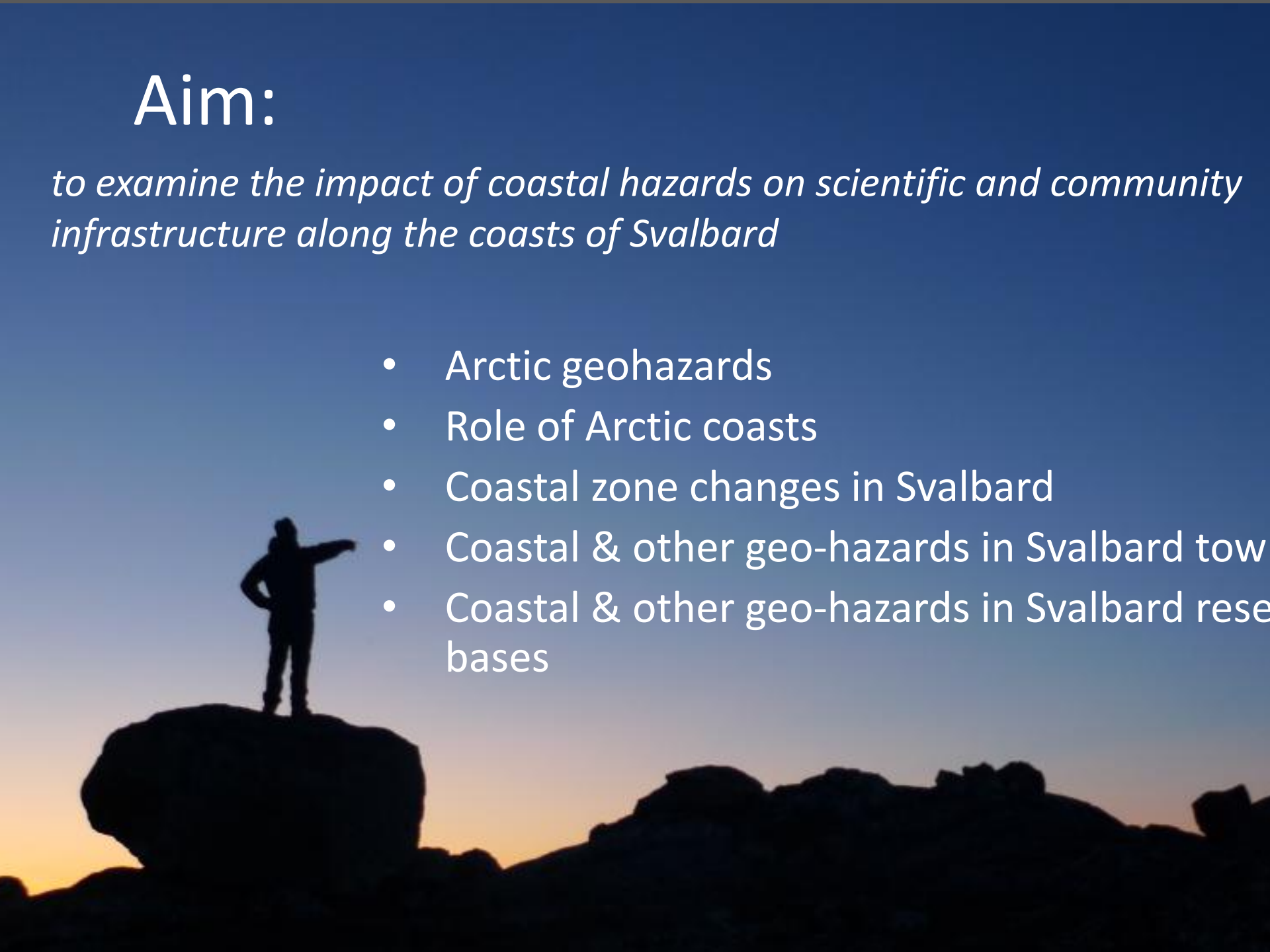
2 - Department of Geomorphology, UMCS LublinPoland

3 - Faculty of Engineering and Environment, Northumbria University, UK

4 - Department of Geography, Durham University, UK

Aim:

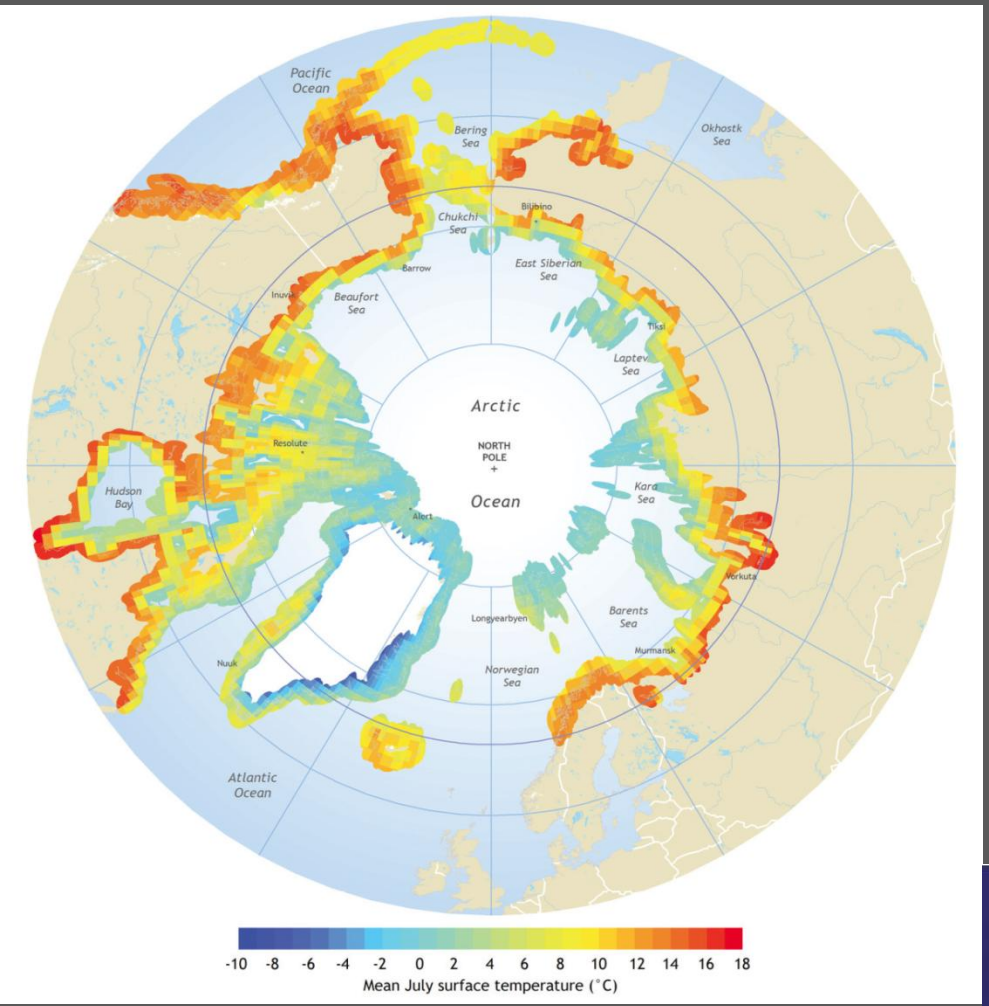
to examine the impact of coastal hazards on scientific and community infrastructure along the coasts of Svalbard

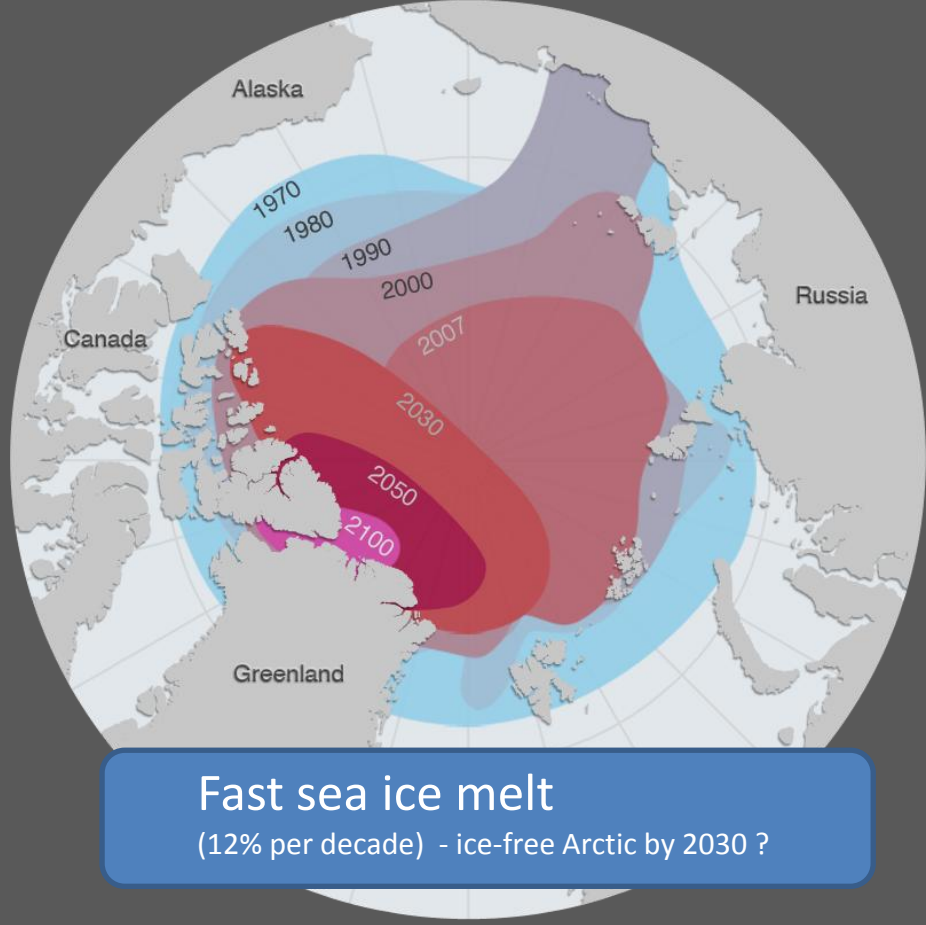


- Arctic geohazards
- Role of Arctic coasts
- Coastal zone changes in Svalbard
- Coastal & other geo-hazards in Svalbard tow
- Coastal & other geo-hazards in Svalbard rese bases

Climate warming in the Arctic

In the Arctic, temperature has increased at twice the rate as the rest of the globe, and could increase by another 8°C by the end of this century.





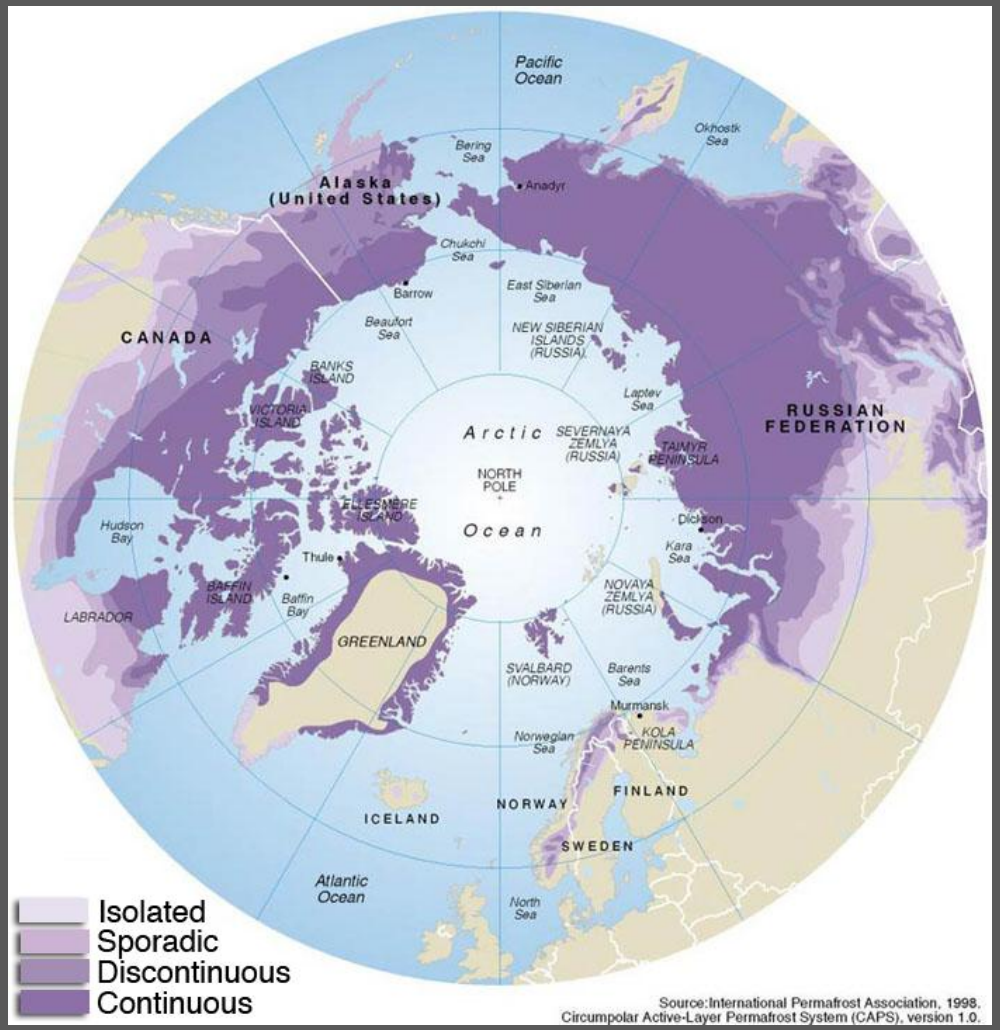
Fast sea ice melt

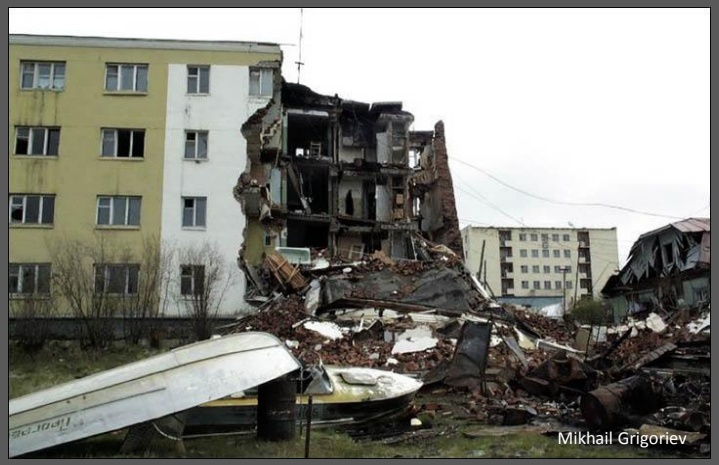
(12% per decade) - ice-free Arctic by 2030 ?

Rapid glacier retreat

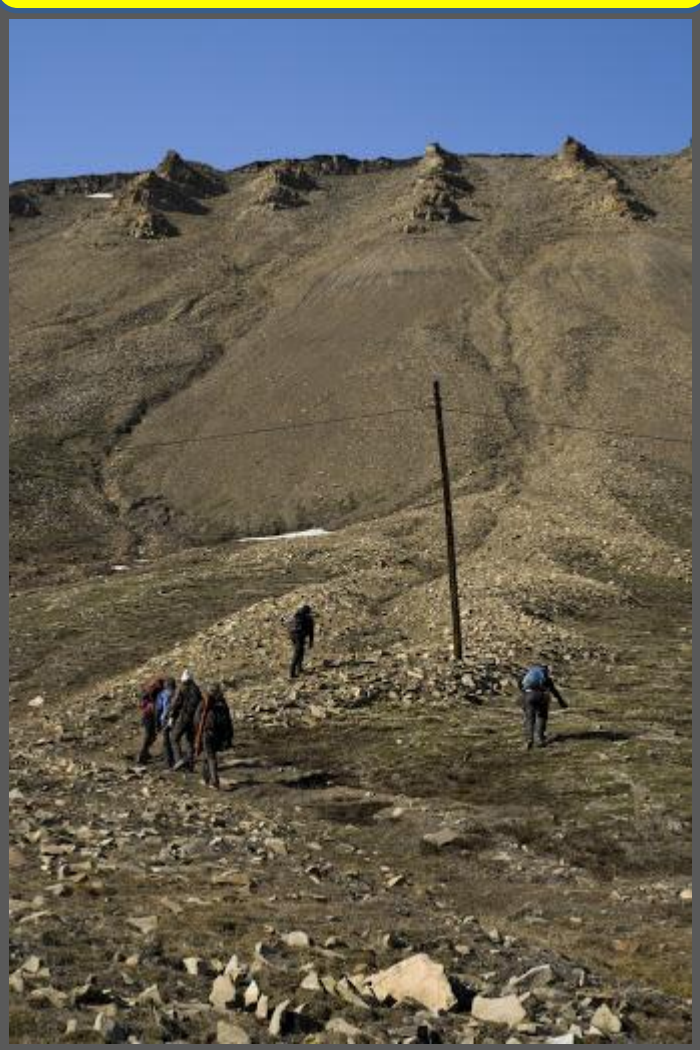
Permafrost thawing:

now frozen ground if about 1 to 3°C warmer than long-term averages

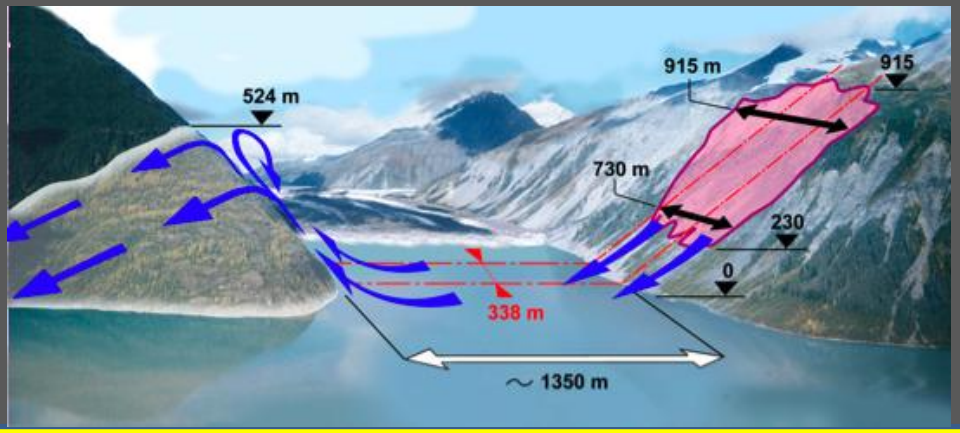




Intensified slope processess

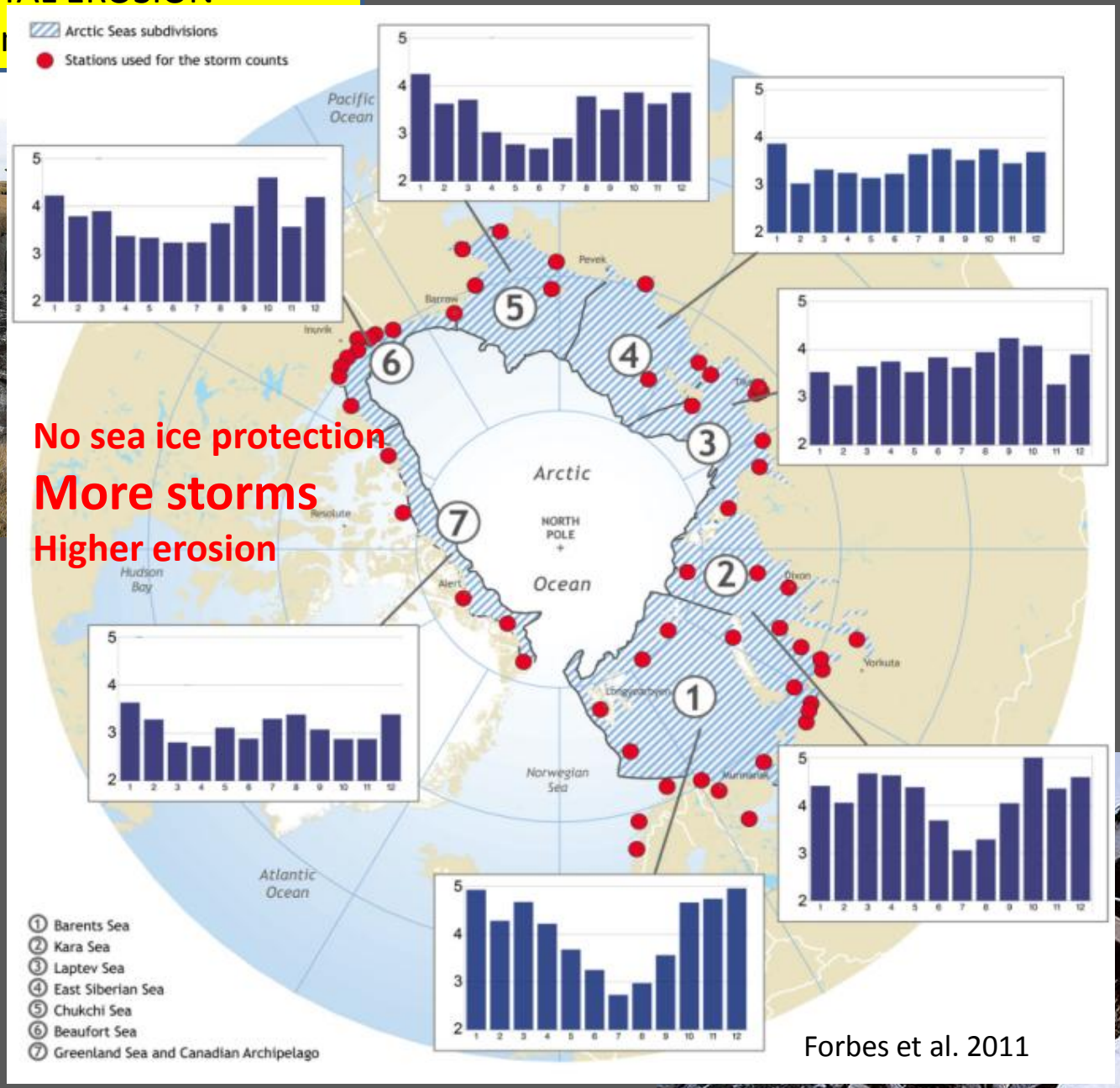


Jökulhlaup – catastrophic floods



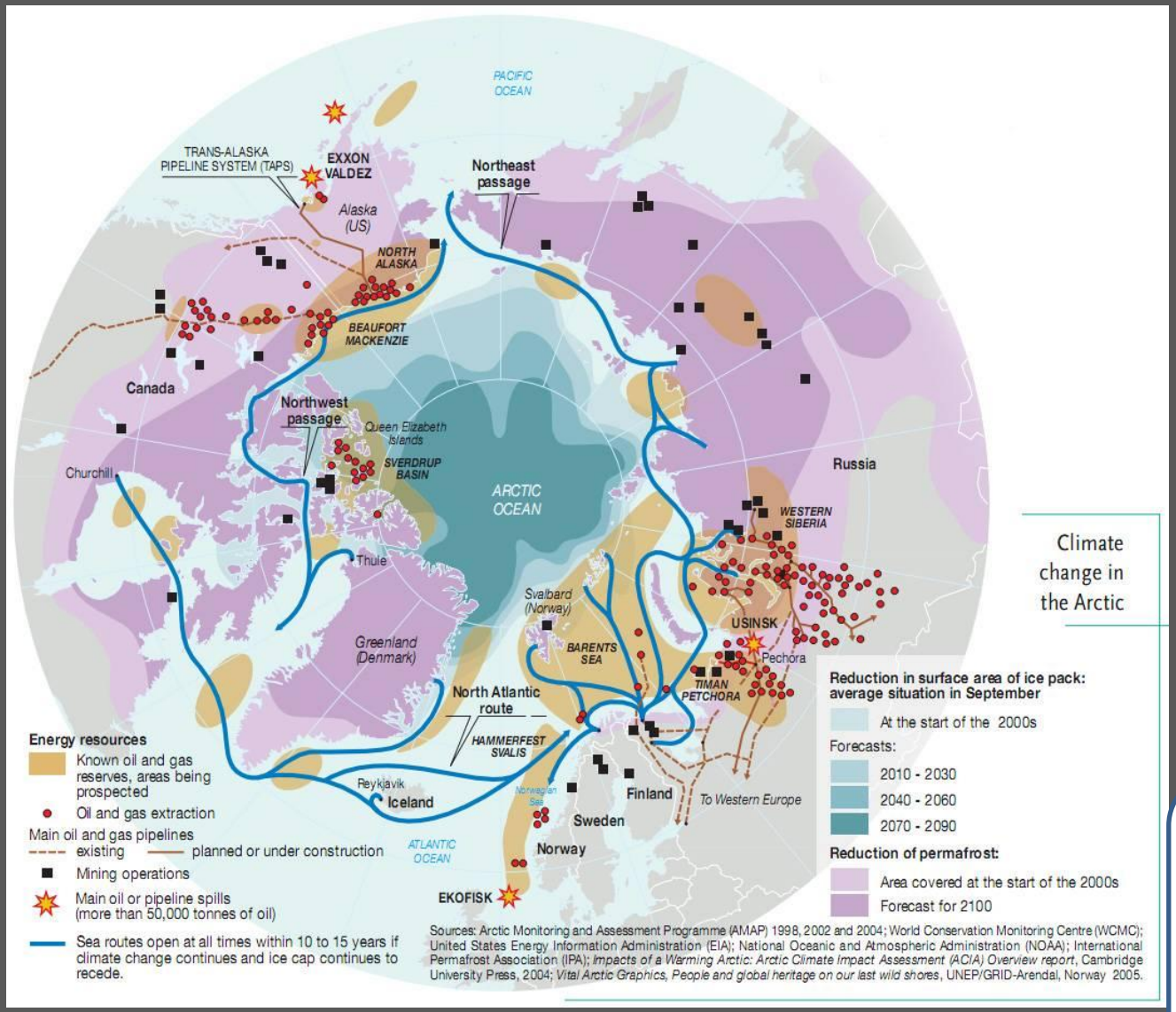
Tsunamis - Lituya Bay, - 9th July 1958 Alaska - wave rose to a maximum height of 516 m a.s.l. (Miller 1960)

COASTAL EROSION (therr



Forbes et al. 2011

WHY ARCTIC COAST ARE SO IMPORTANT?



- new sea-routes ☺
- access to new resources ☺
- new frontlines ☹

MINISTRY OF ECONOMY

GO Arctic!

Study Site

European Gateway to Arctic:

- Startegic location
- Coal mining
- Tourist destination
- Centre for polar science

For Poland:

- Polish Polar Station Hornsund
- 4 regional research stations

Global importance

Svalbard
Global Seed Vault

Imigration crisis:
Refugee camps ?

Europe

Norwegian politicians propose putting refugees on Svalbard – remote Arctic islands with more polar bears than people

Country's Green Party hopes that putting people on the archipelago will boost employment for the 2,600 people who live there – who are outnumbered by the 3,000 polar bears

Andrew Griffin | @_andrew_griffin | Sunday 13 September 2015 15:20 BST | 50 comments

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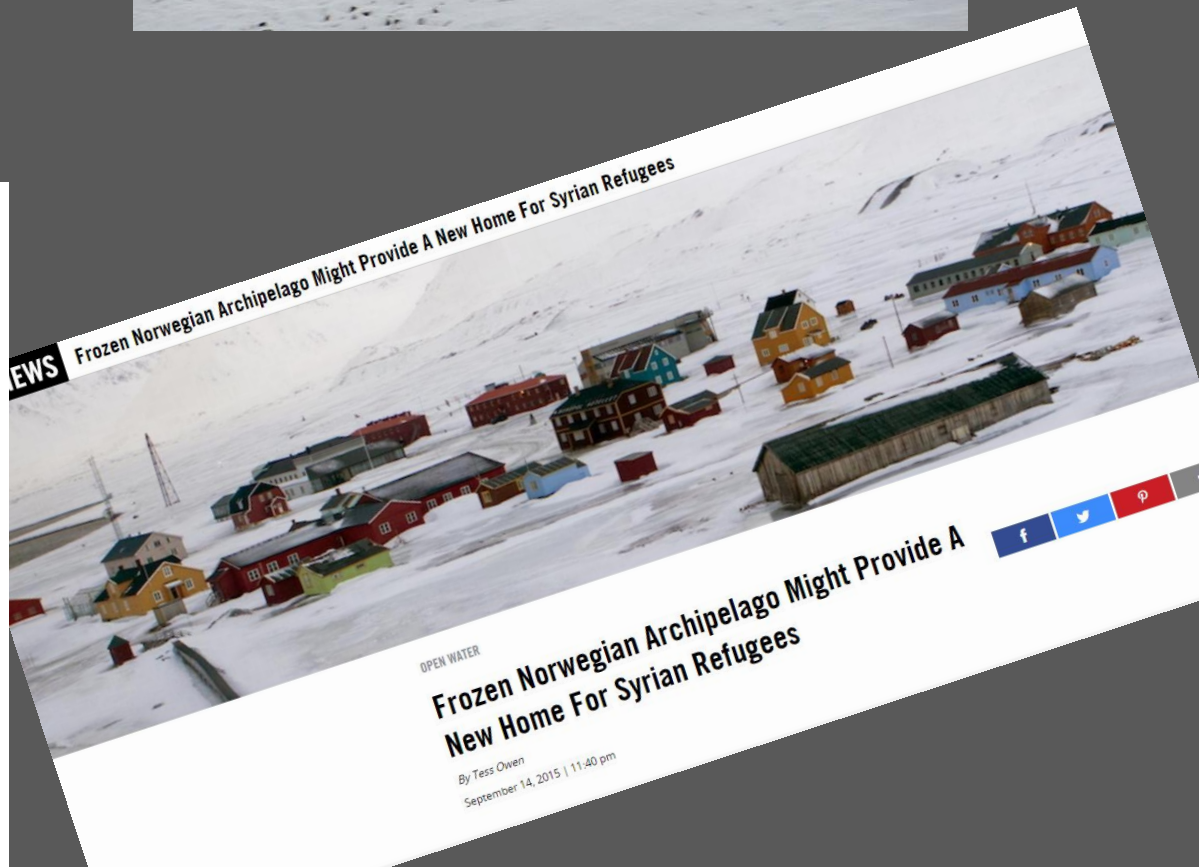
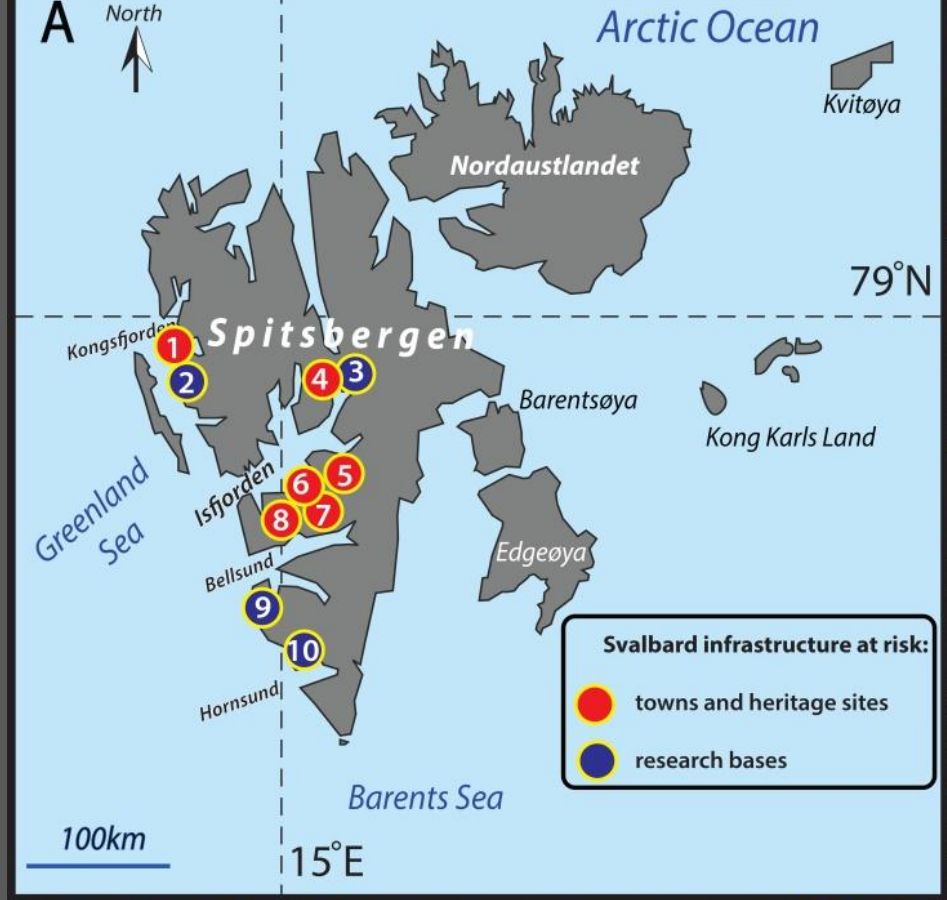


Methods:

Combination of:

- GIS + aerial photography
- Geomorphological mapping in Longyearbyen, Pyramiden, AMUPS, CALYPSO, HORNSUND
- Environmental Assessments CVI, Leopold Matrix
- Interviews with locals + research base officers


A
North
Arctic Ocean
Kvitøya
Nordaustlandet
79°N
Spitsbergen
Kongsfjorden
1
2
3
4
Barentsøya
Kong Karls Land
Greenland Sea
Isfjorden
5
6
7
8
Bellsund
Edgeøya
9
10
Hornsund
Barents Sea
100km
15°E
Svalbard infrastructure at risk:
towns and heritage sites
research bases


B
5

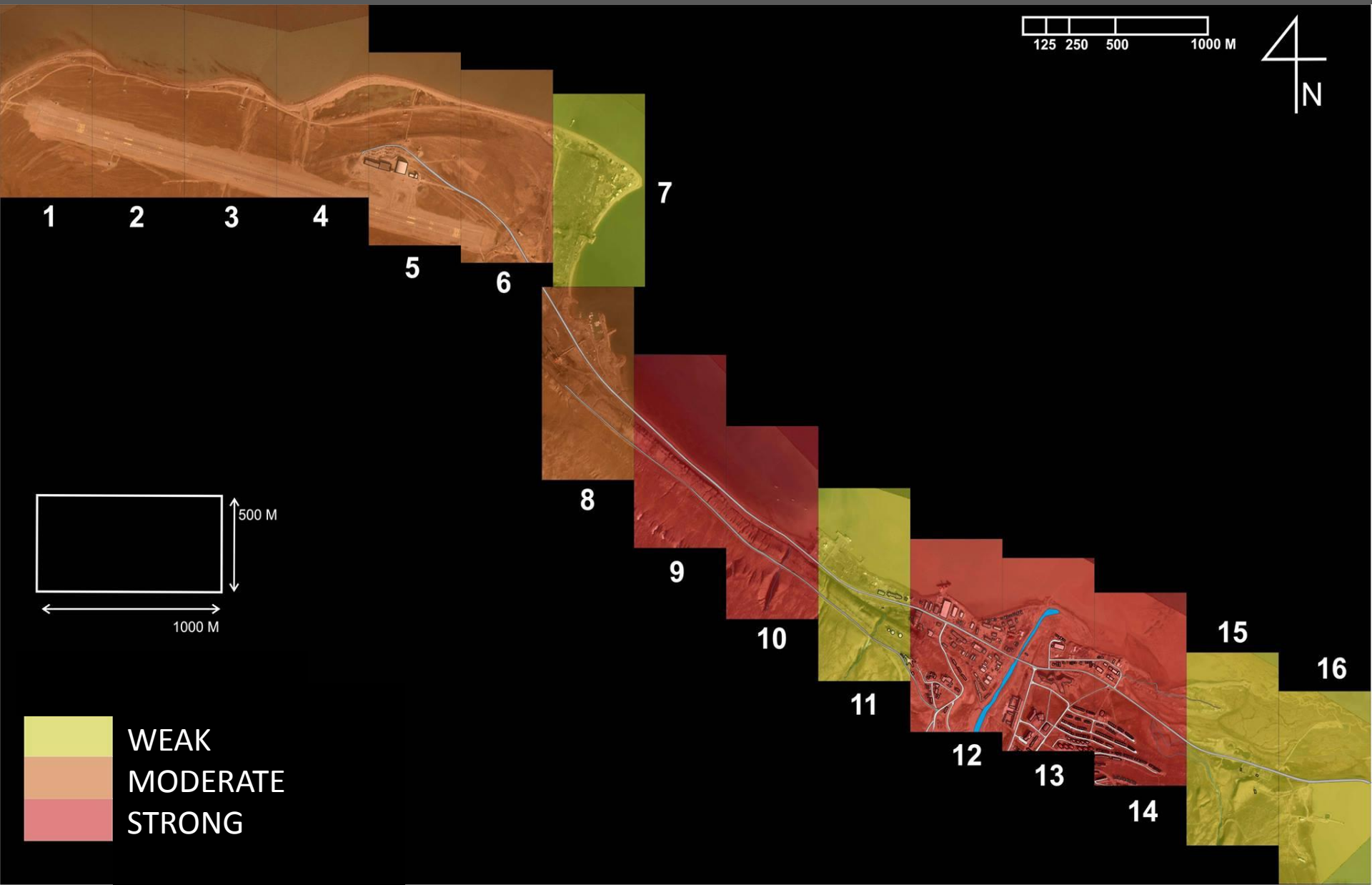

10


6

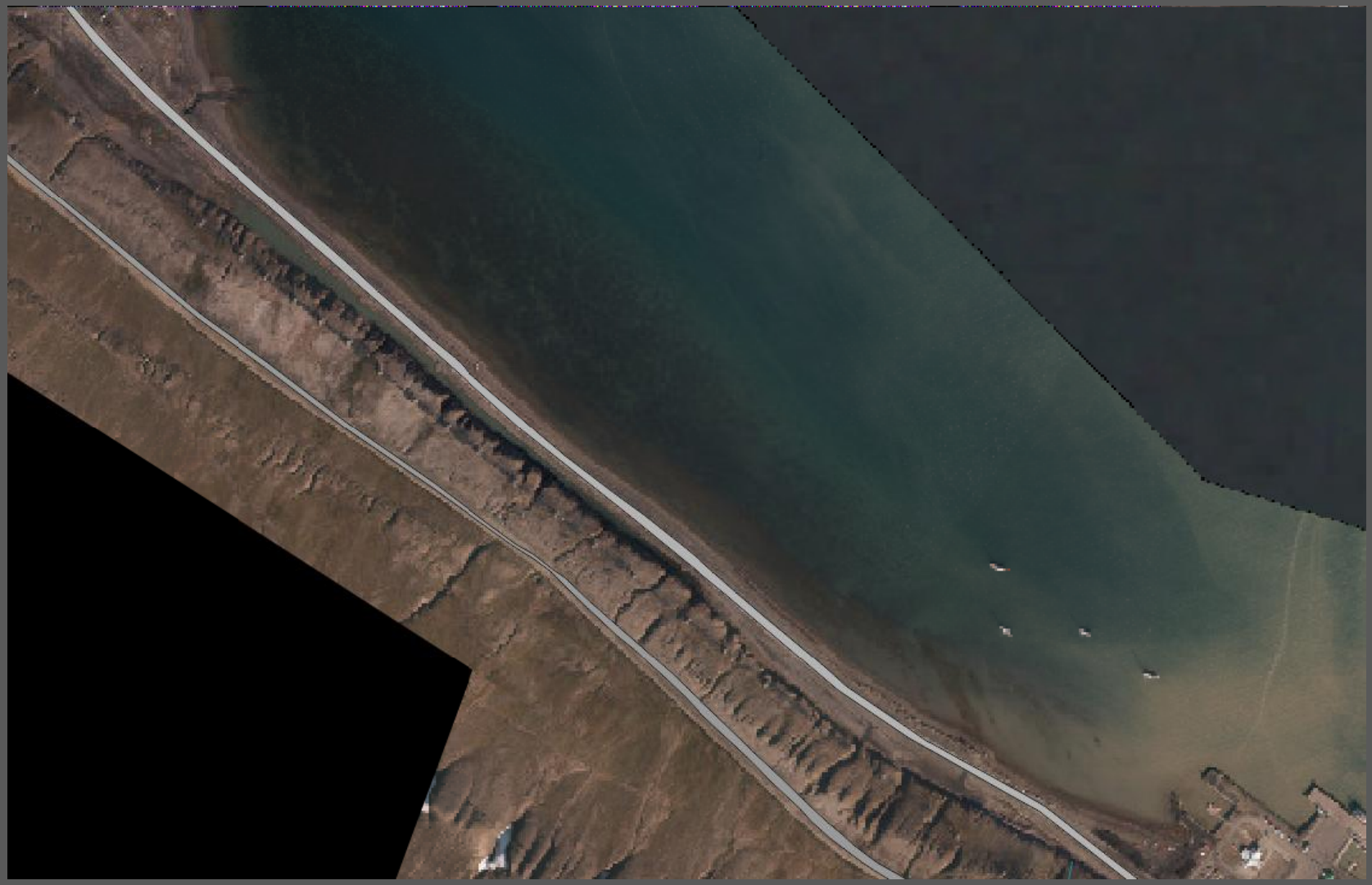

4

Longyearbyen

Mapping hazards



Section 9-10: main road



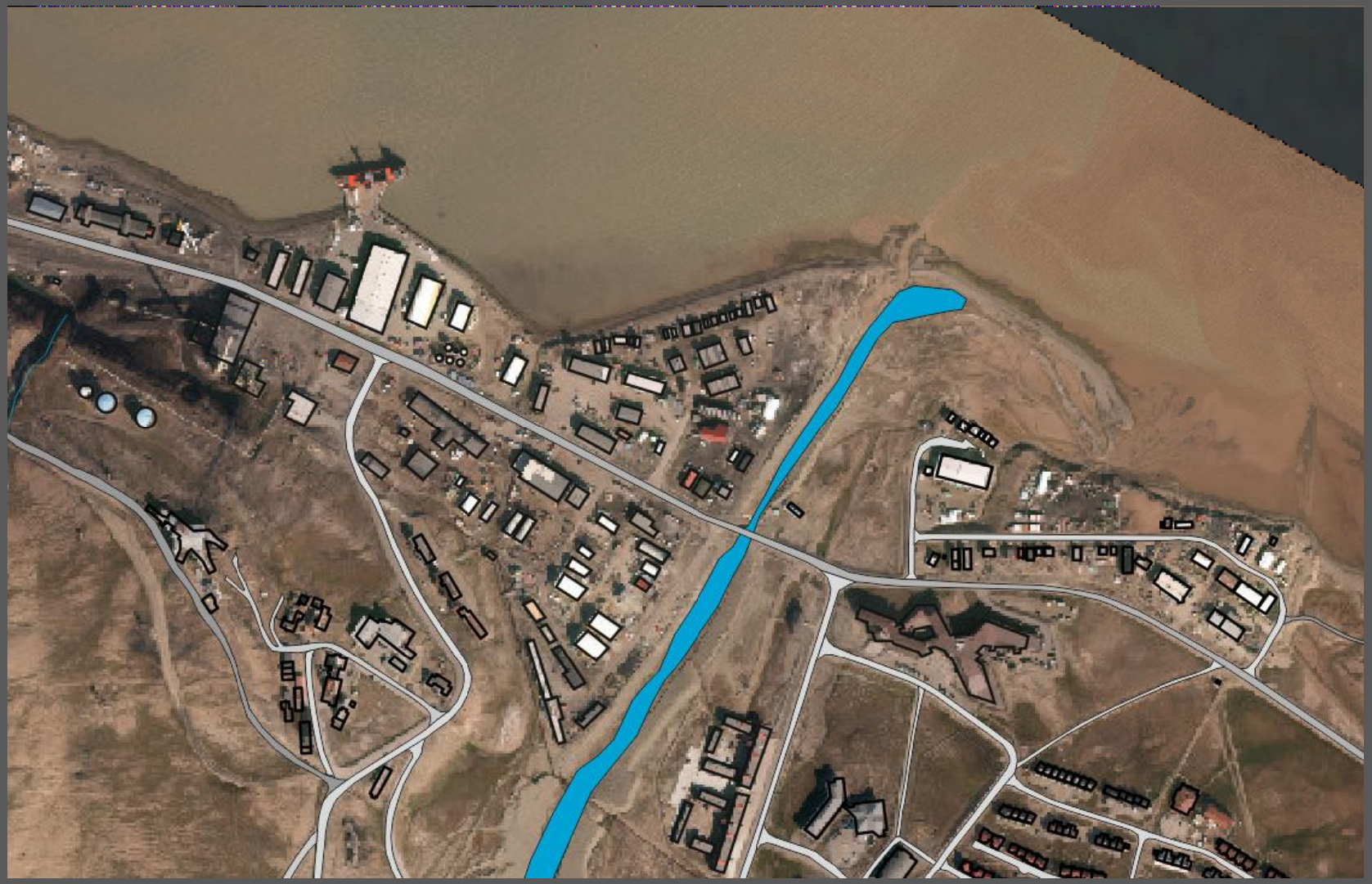

Coastal erosion


Debris flows and rock falls

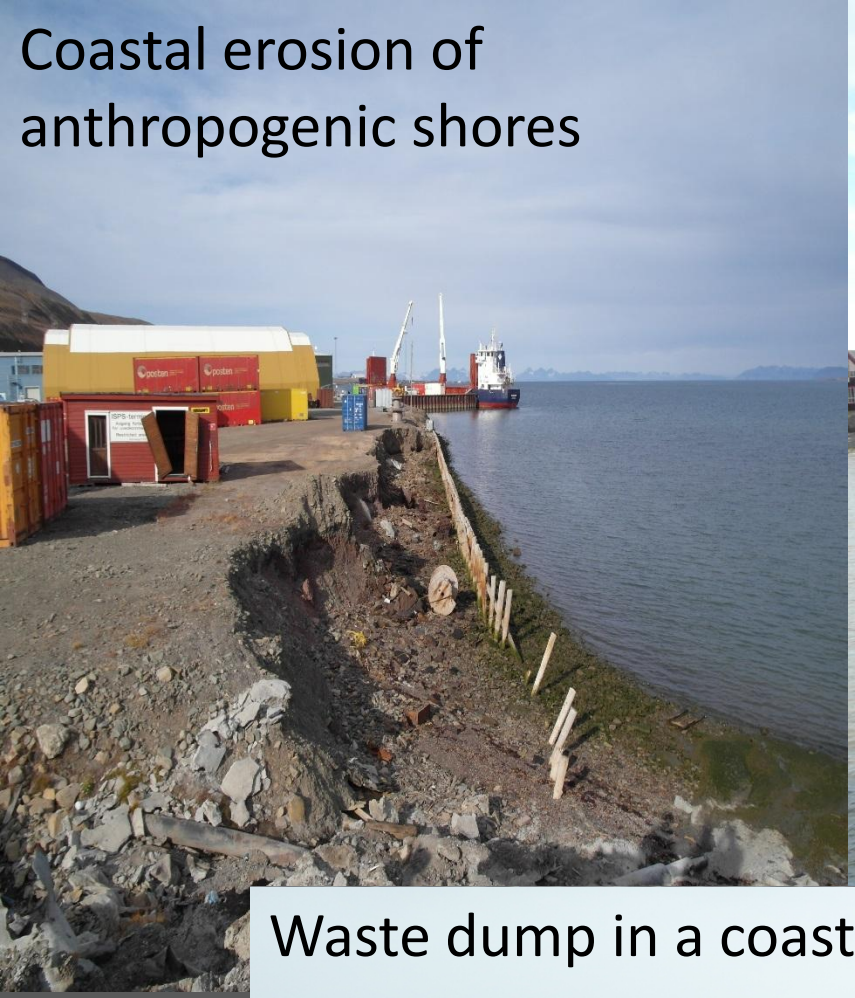

Permafrost thawing


Industrial stream erosion

Section 12-14: Delta area



Coastal erosion of anthropogenic shores



Waste dump in a coastal zone

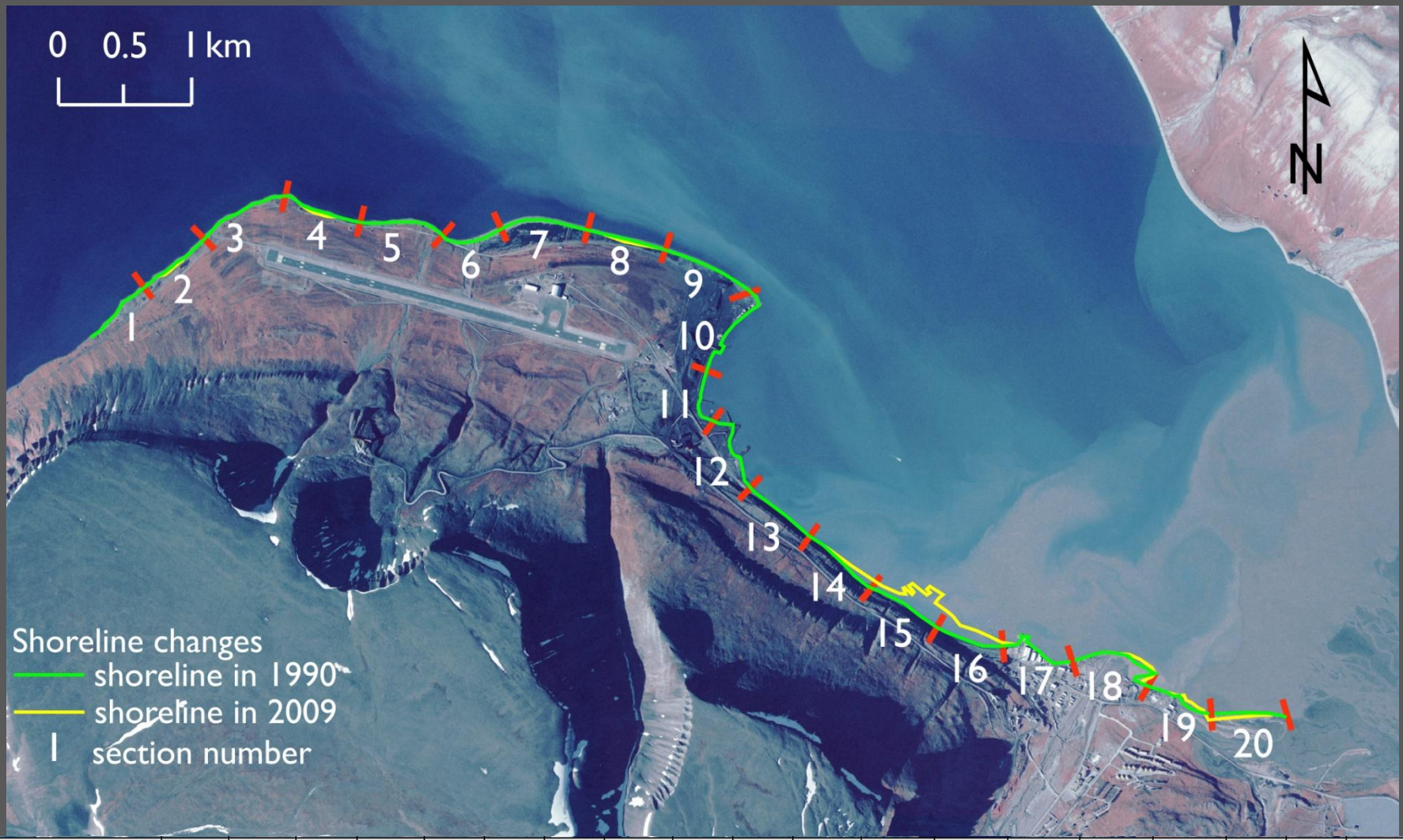
Degradation of permafrost (solifluction) + coastal erosion

Channelisation of braided river system

Impact of town development on delta system

Section	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CVI	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	5.5	5.5	4.2

Shoreline retreat linked with change in sediment supply



Section no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Total shoreline change in m	0.48	-5.83	2.82	-3.94	0.31	7.28	0.57	-1.14	6.85	0.66	-0.01	18.61	22.74	20.08	80.15	87.21	4.25	7.59	4.98	-10.34
Mean annual shoreline change [m/year]	0.03	-0.31	0.15	-0.21	0.02	0.38	0.03	-0.06	0.36	0.03	0	0.98	1.2	1.06	4.22	4.59	0.22	0.4	0.26	-0.54

Pyramiden:
abandoned Soviet town

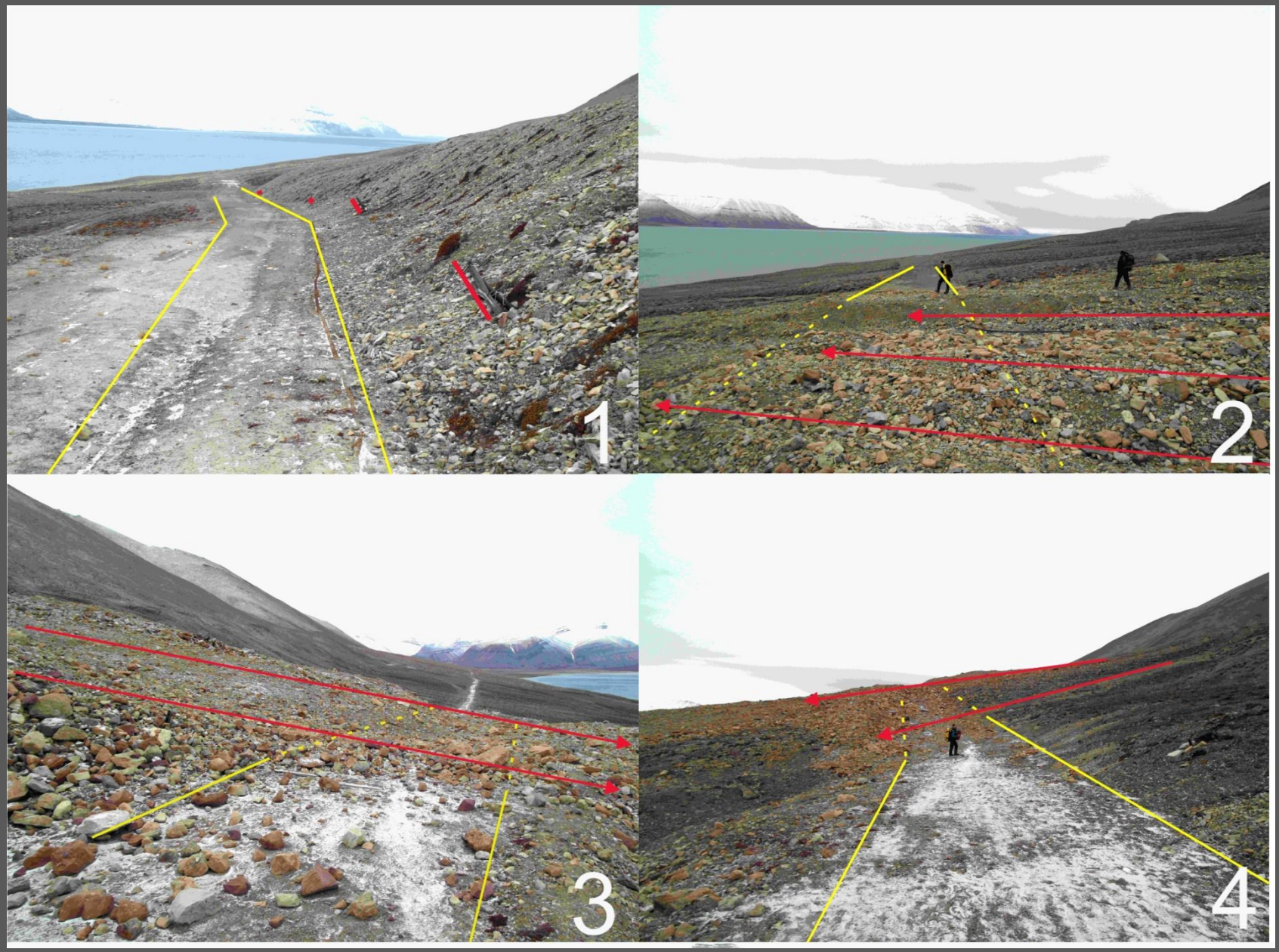
housing
services
industry, stores
technical infrastructure
airport
sport s and gym
mine waste dump

N

500 m

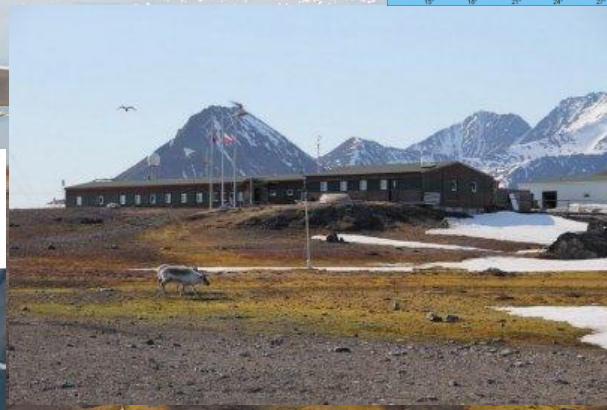

20
4
1
2
3
14
15
16
11
12
13
18
17
19
8
7
5
9
6
10
fans
river channels
debris flows
20
mapped hazards
N
500 m

Solifluction and debris flows – destrution of roads



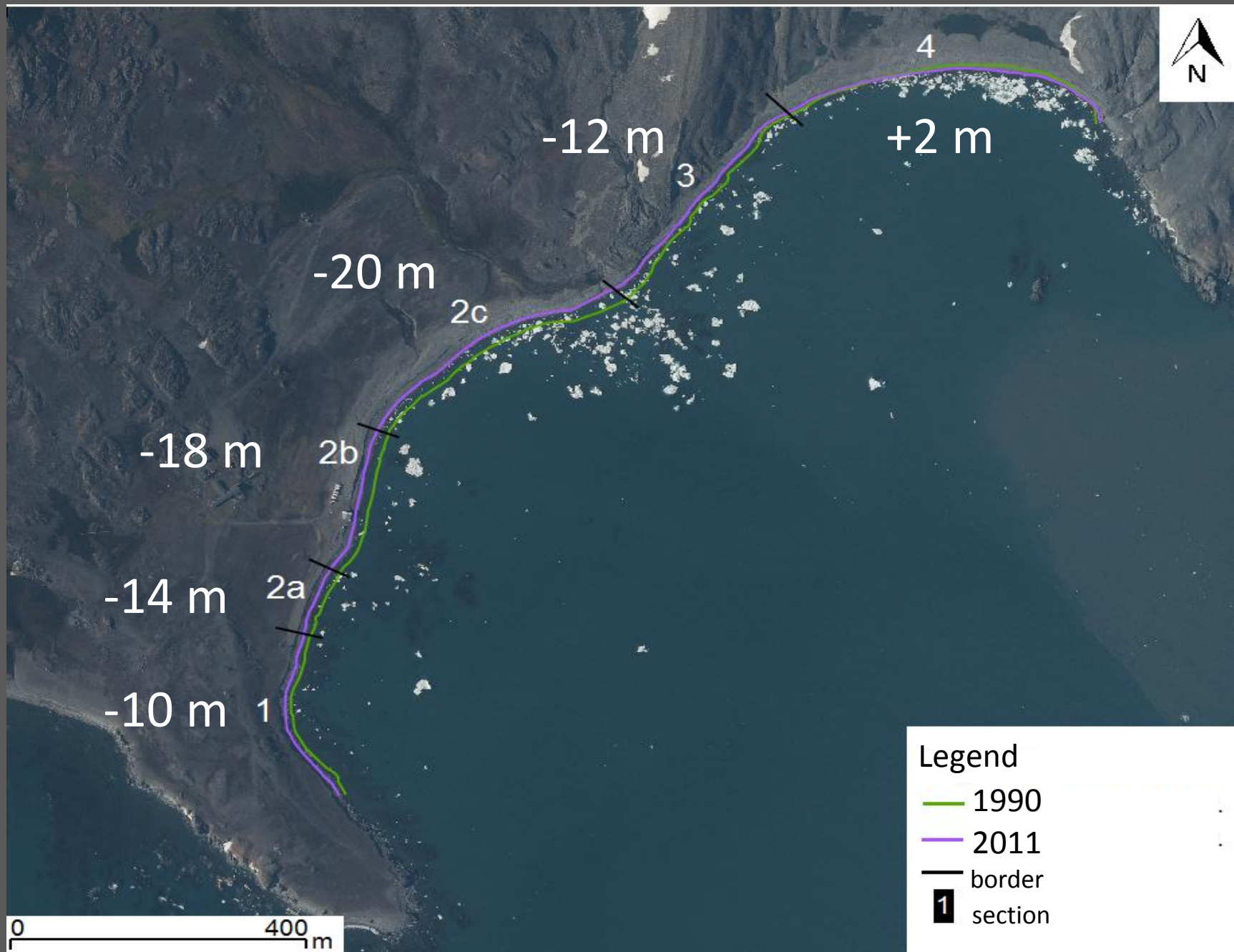
Fluvial action
(erosive & accumulative)

Polish Polar Station
Hornsund



Hornsund *– scientific infrastructure at risk of coastal erosion*

Digital Shoreline Analysis System – increased erosion



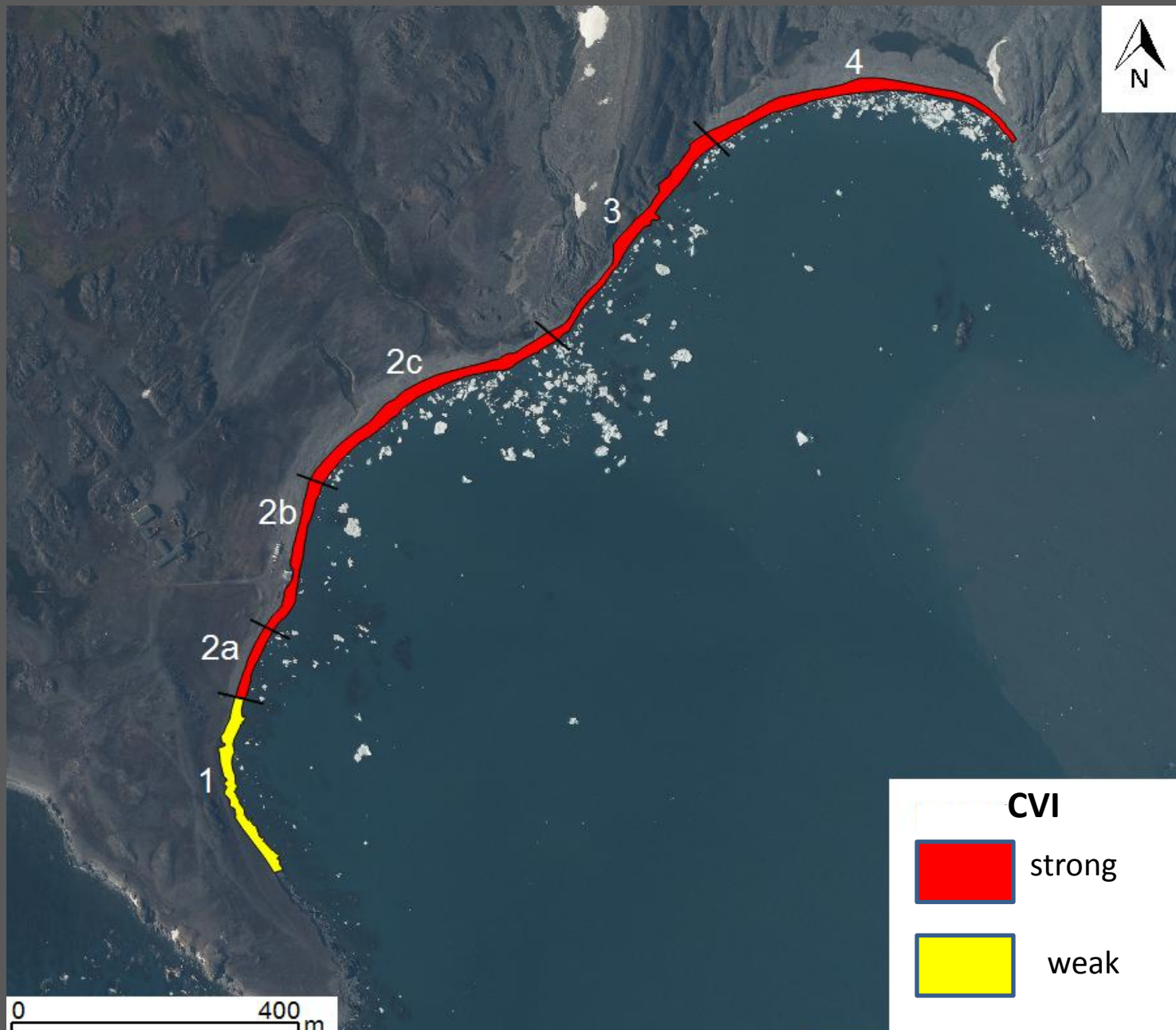
Coastal zone vulnerable to:

- Erosion

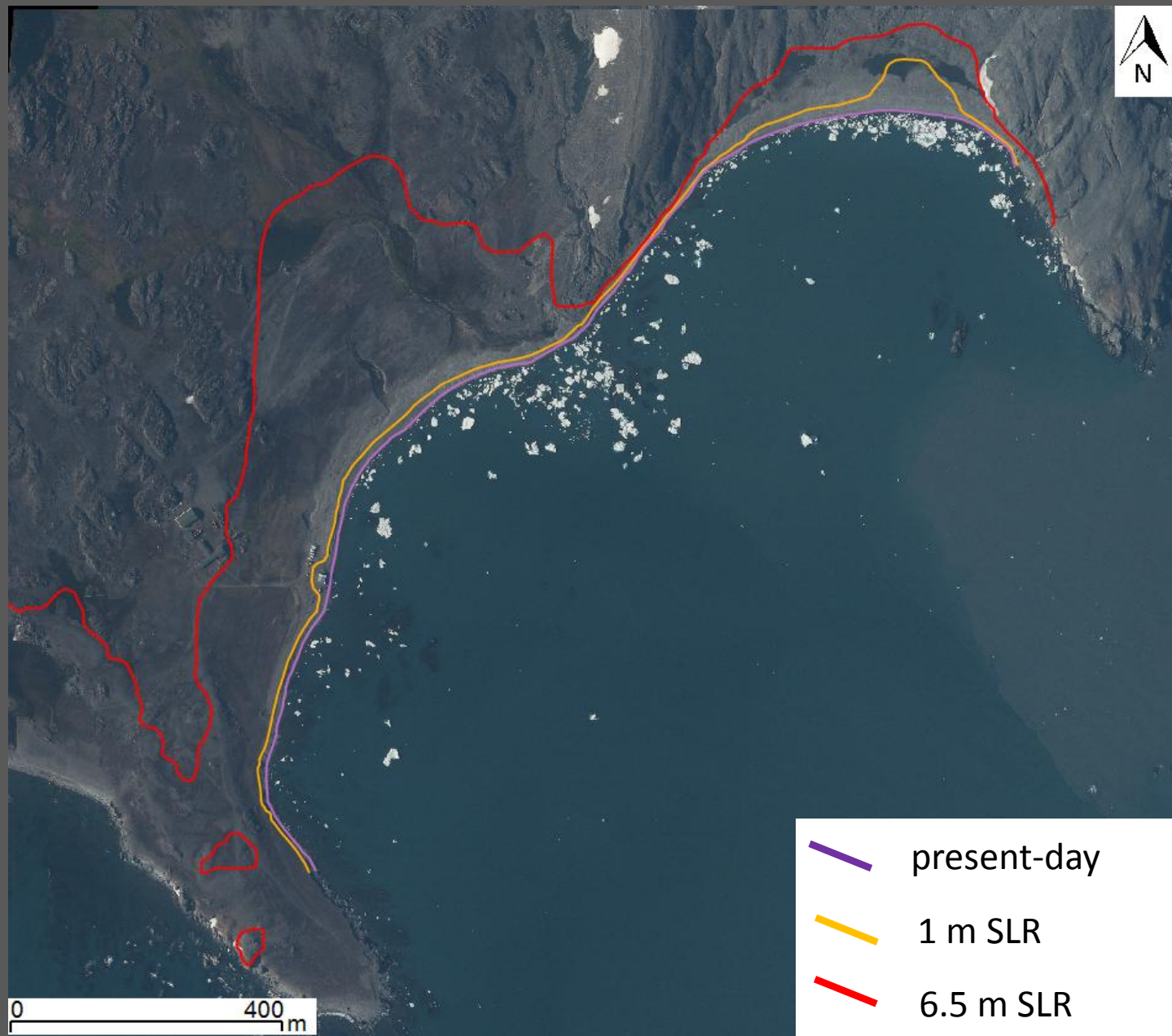
- Permafrost degradation

-dead-ice melting + slope processes

- human activity (heavy machines)



Modelling sea-level rise scenarios



Conclusions

- Svalbard towns and research bases are not prepared for rapid coastal changes associated with climate warming
- In Longyearbyen increased coastal erosion may lead to destruction of main road and several buildings
- Erosion of illegal waste dumps may cause severe environmental changes in fjord ecosystem (Lonyearbyen, Piramiden)
- Degradation of coastal permafrost and coastal erosion threat for infrastructure of Polish Polar Station
- Establishment of coastal monitoring programme is of crucial importnace for sustainable coastal zone management in Svalbard
- Ongoing research seeks to develop these concepts into a new model of High Arctic coastal dynamics under human impact

Acknowledgements:

FNP
Foundation for Polish Science

Project HOMING PLUS:
„Assessment of impact of coastal hazards on scientific and urban infrastructure in polar regions using remote sensing, geoinformation and new geomorphological mapping methods”

NATIONAL SCIENCE CENTRE

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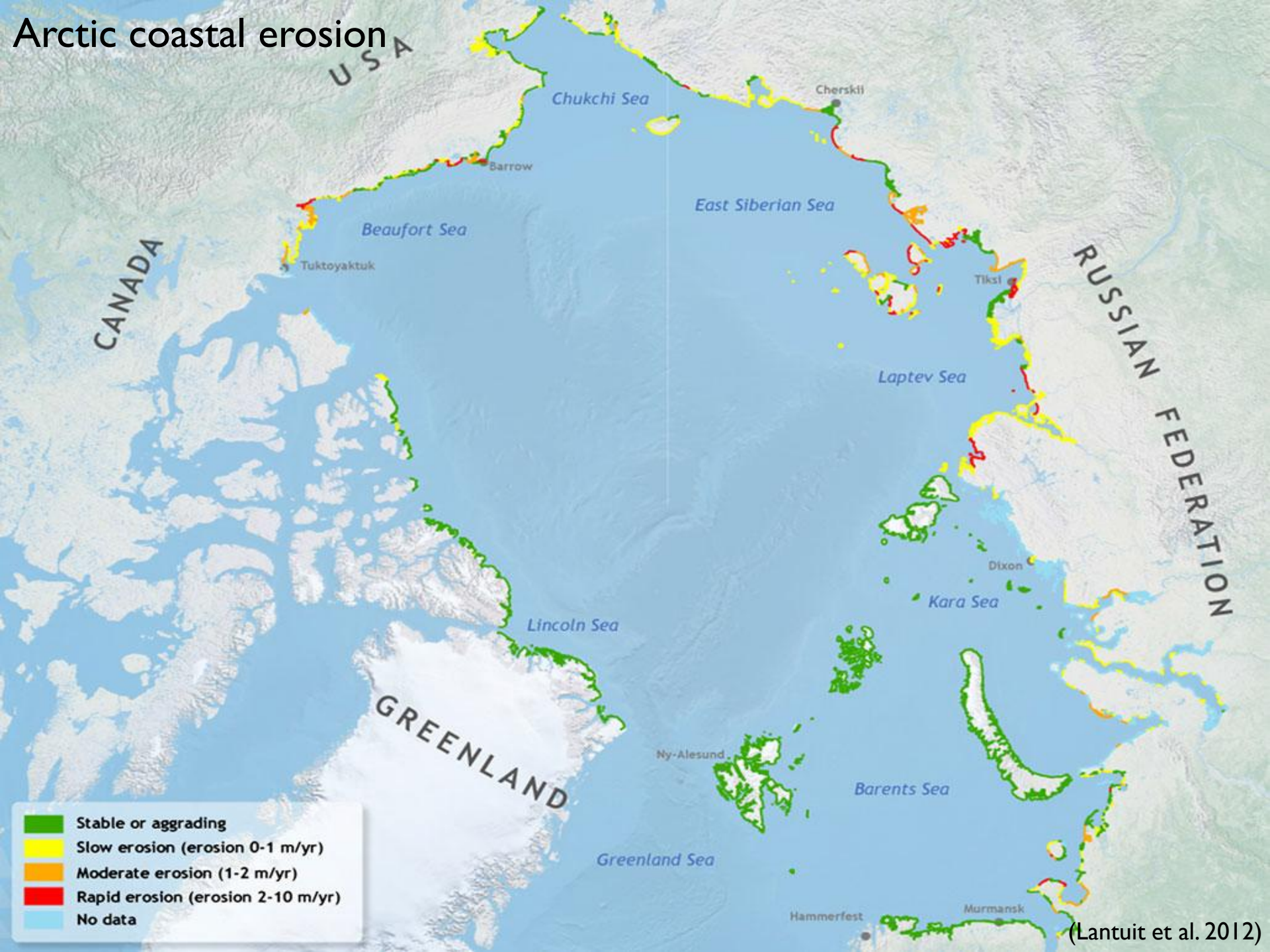
APECS
Association of Polar Early Career Scientists
Shaping the Future of Polar Research

Thank you

Check poster 4

Arctic coastal erosion



(Lantuit et al. 2012)