


Arctic coastal observations

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Introduction: Paul Overduin

Field work in the Arctic since 1990, in Canadian Arctic Archipelago, Alaska, Siberia (from Taymyr to Chukotka) and in Scandinavia

Interdisciplinary background – the product of an American experiment in graduate studies

Since 2006 at
Alfred Wegener Institute (AWI)
working on
coastal and offshore permafrost

Goals for my talk

1. Provide some background on my research topics.
2. How has observational science changed over the past 25 years ?
3. Pose the question: what observational science do we need ?

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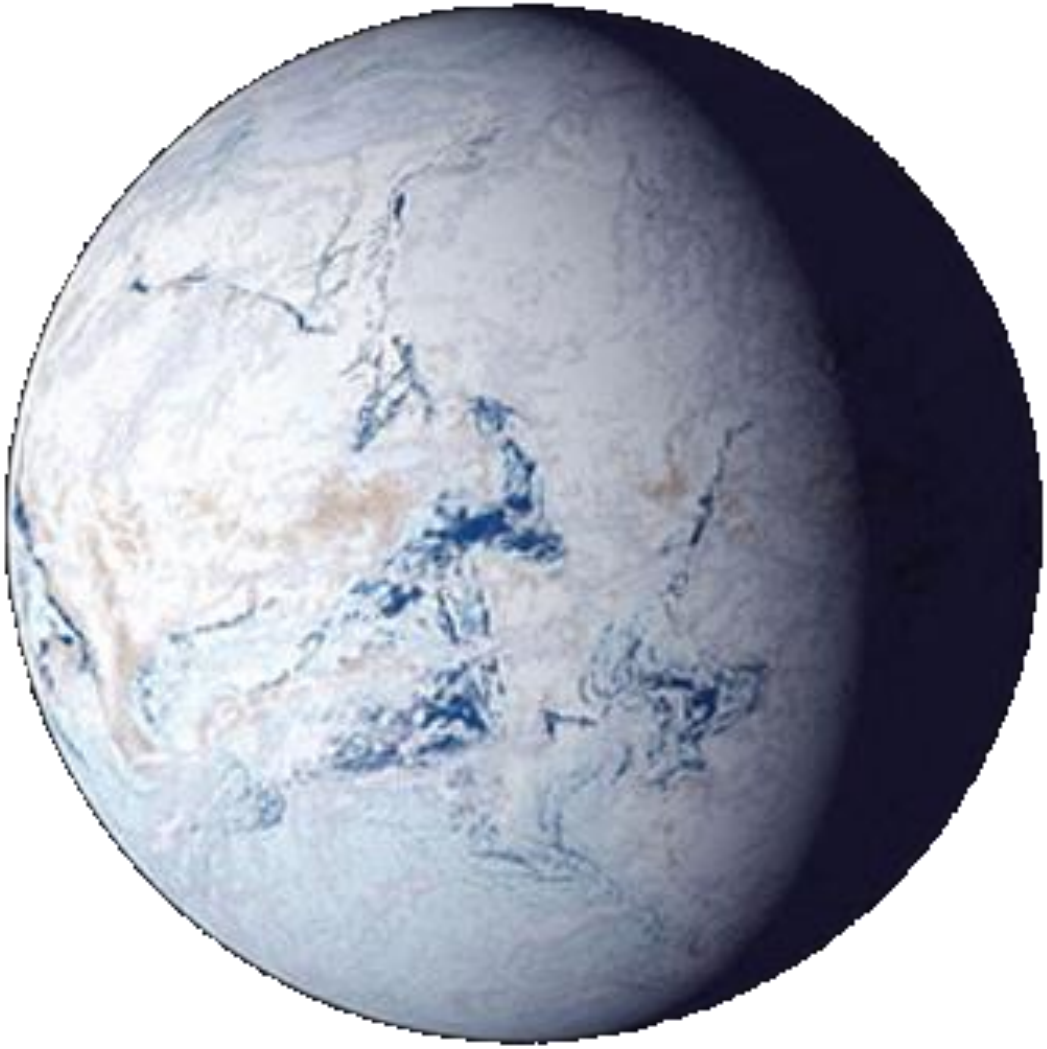
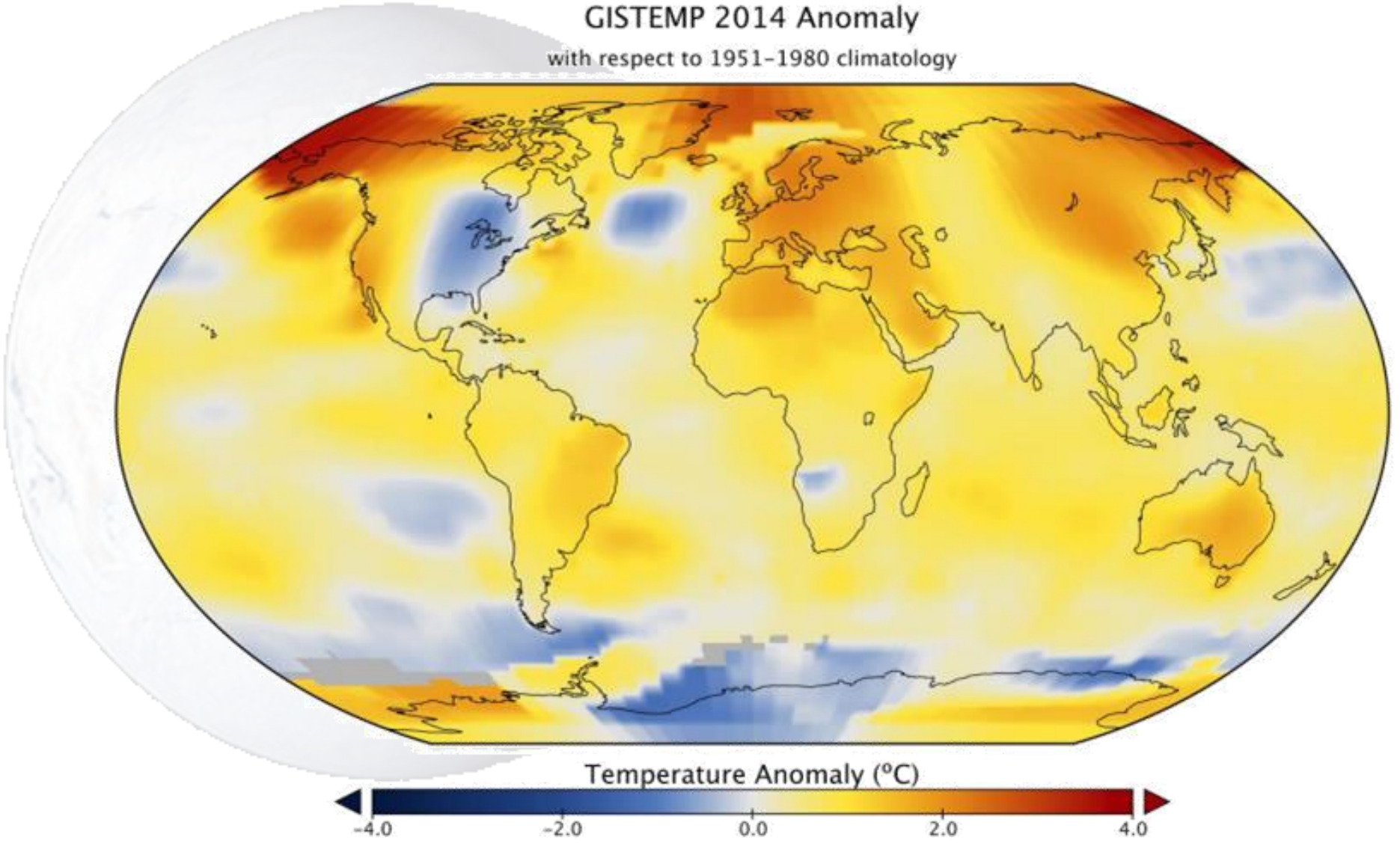
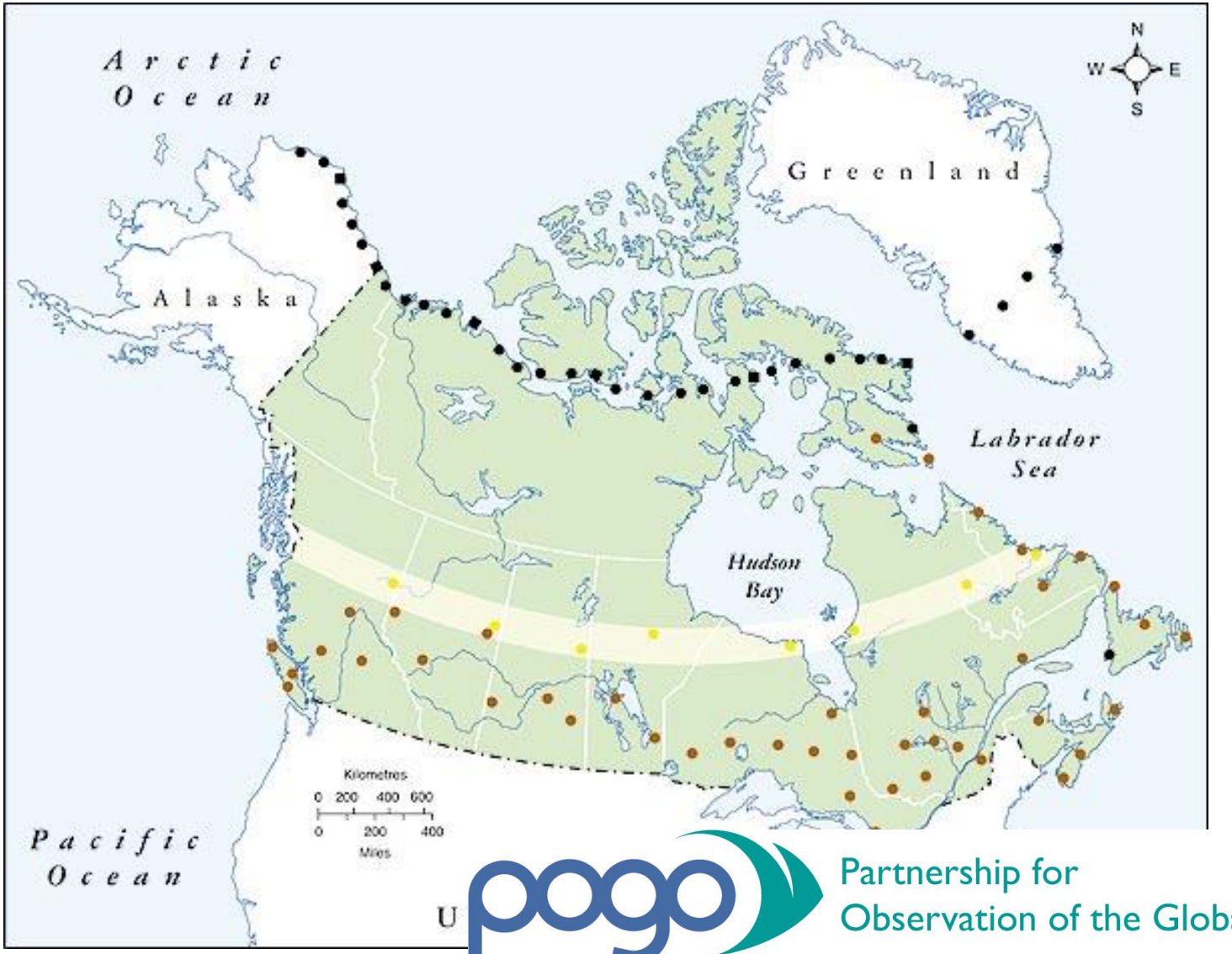
Nuclear Winter



Nuclear Winter **to Global Warming**



Cold war and observations



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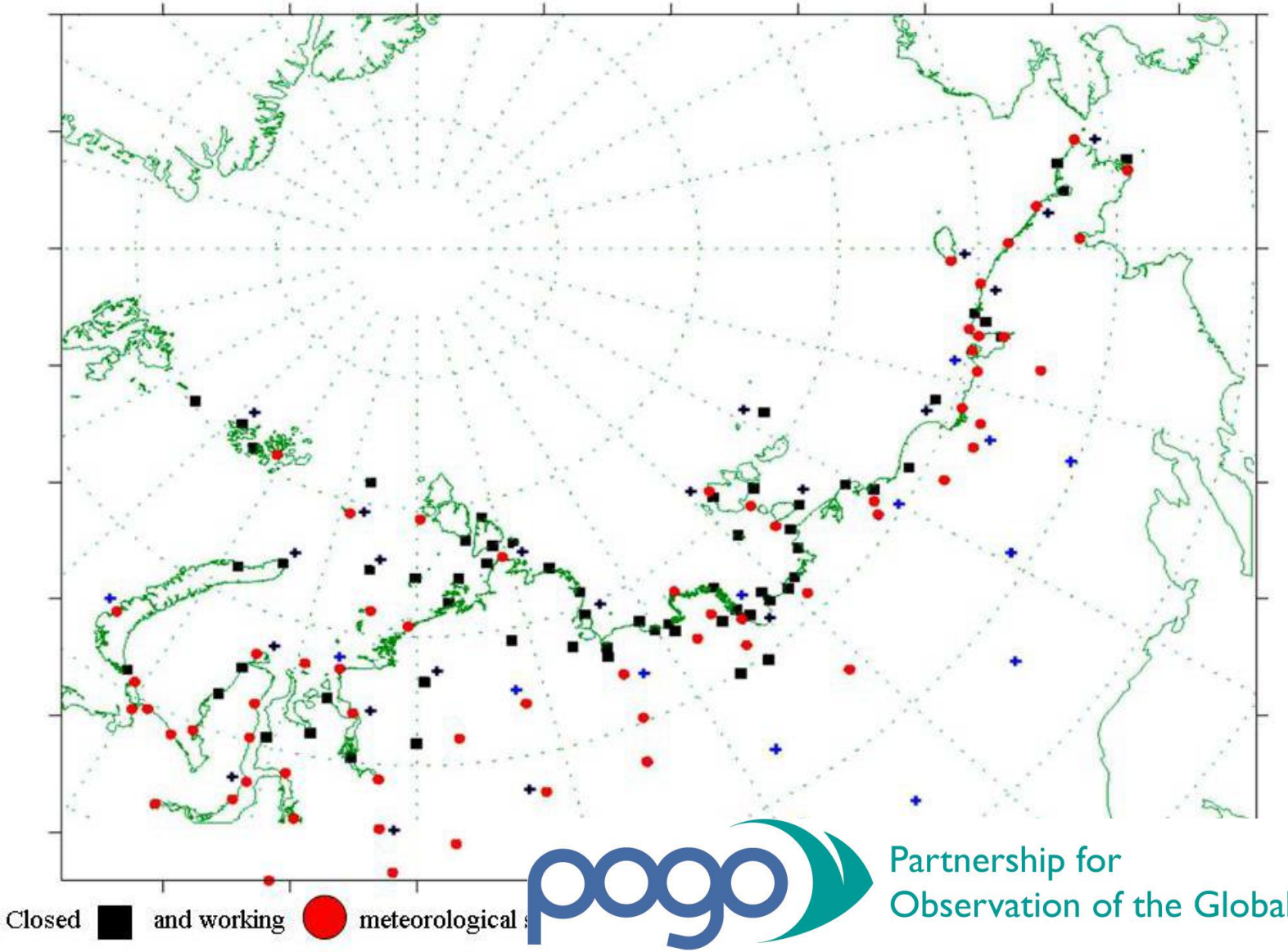
Roshydromet stations



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Topic 1: Permafrost

- International Permafrost Association (IPA) formed in 1960s – uniquely circumpolar
- Two outcomes of IPA relevant for my work:

Permafrost mapping activities, including offshore

Arctic Coastal Dynamics (ACD), since 1999

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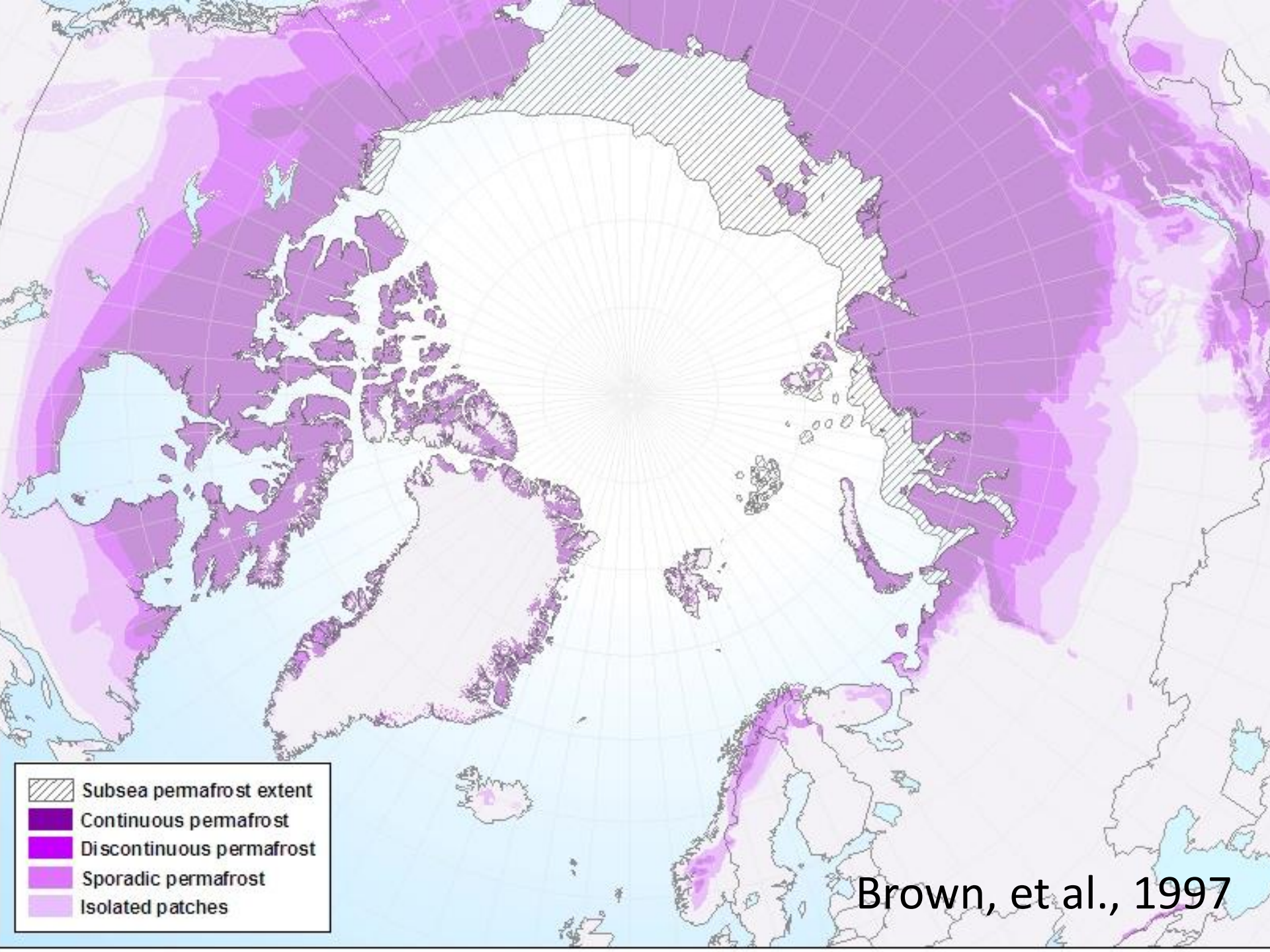
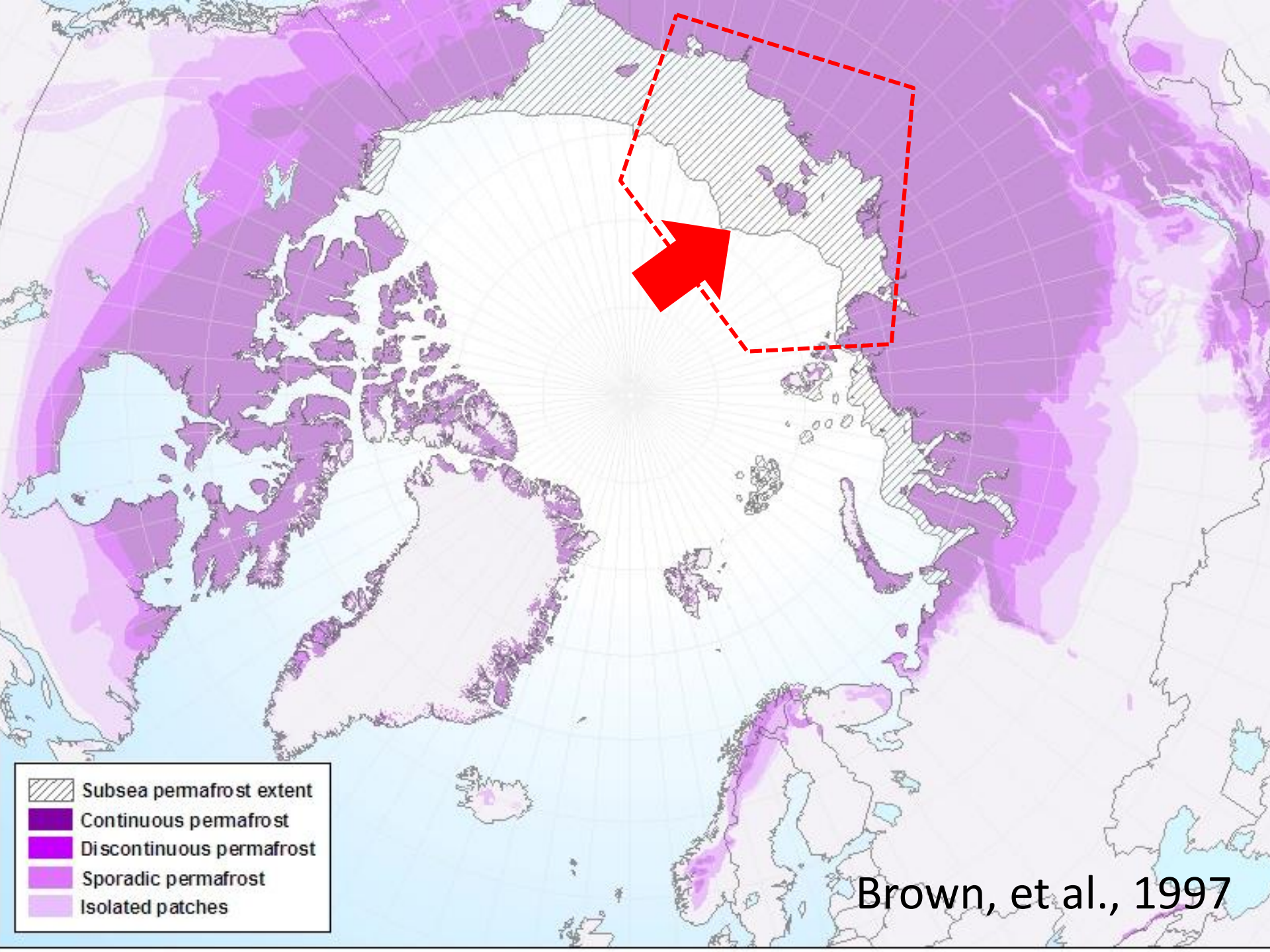

Subsea permafrost extent
Continuous permafrost
Discontinuous permafrost
Sporadic permafrost
Isolated patches
Brown, et al., 1997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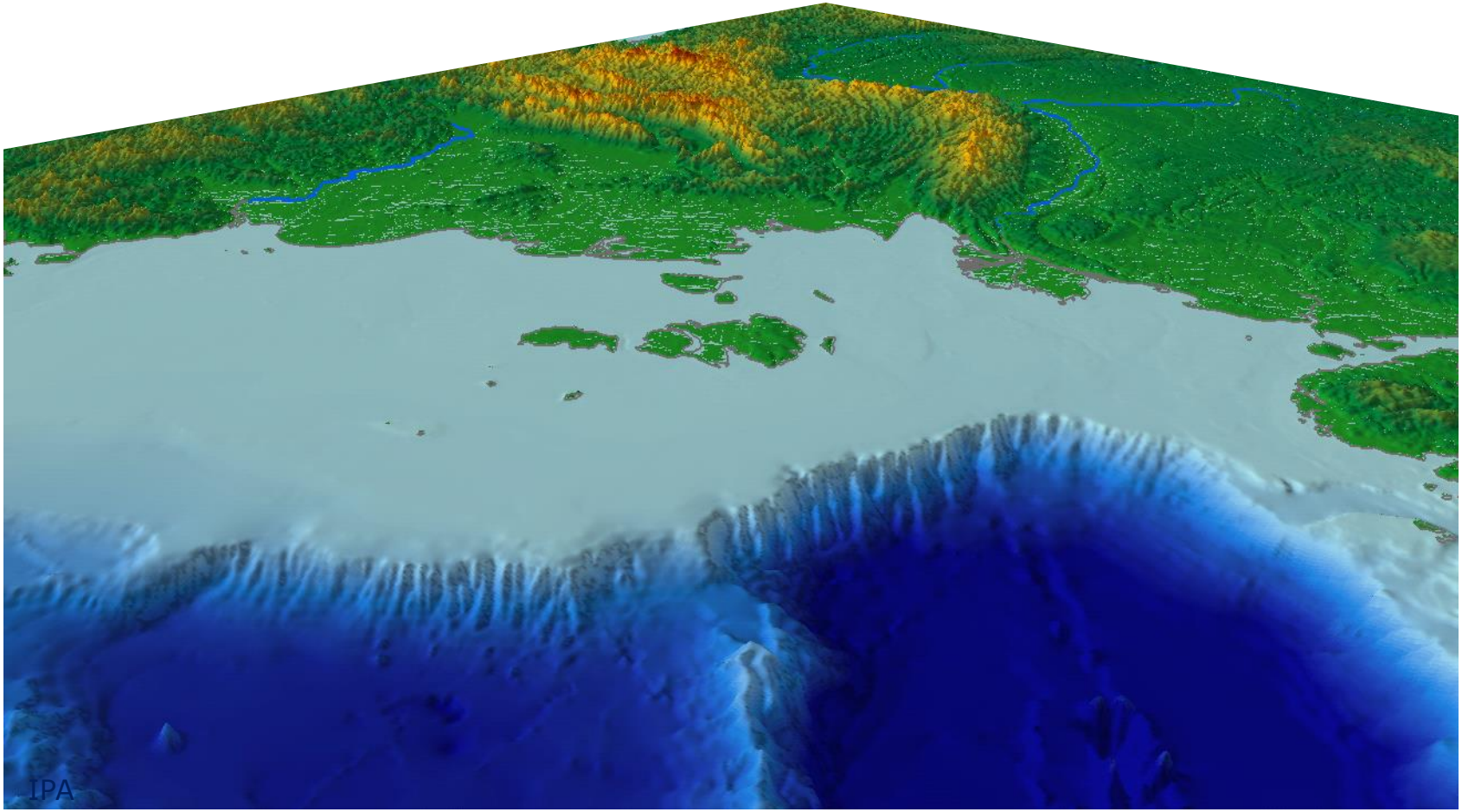
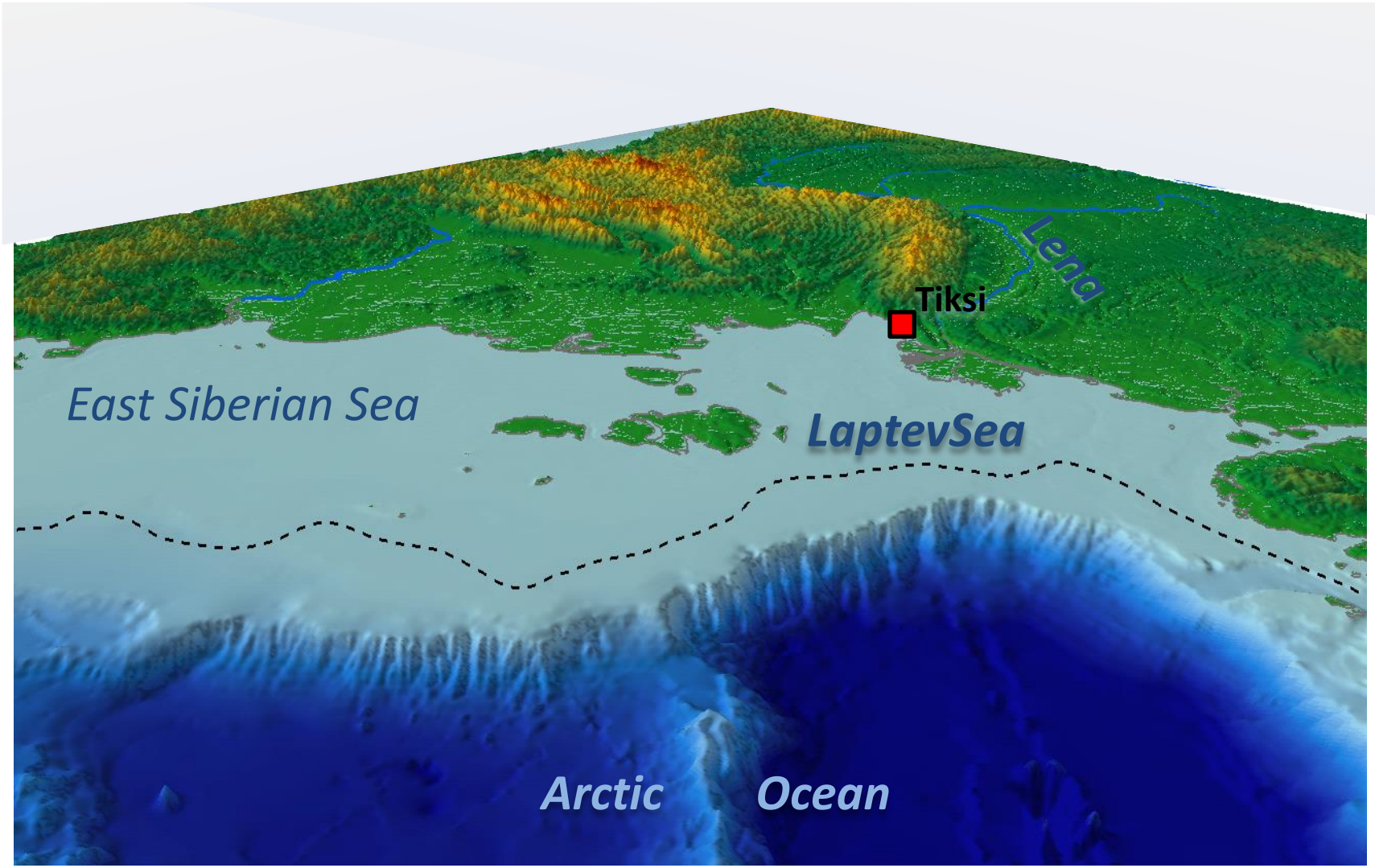
East Siberian Shelf



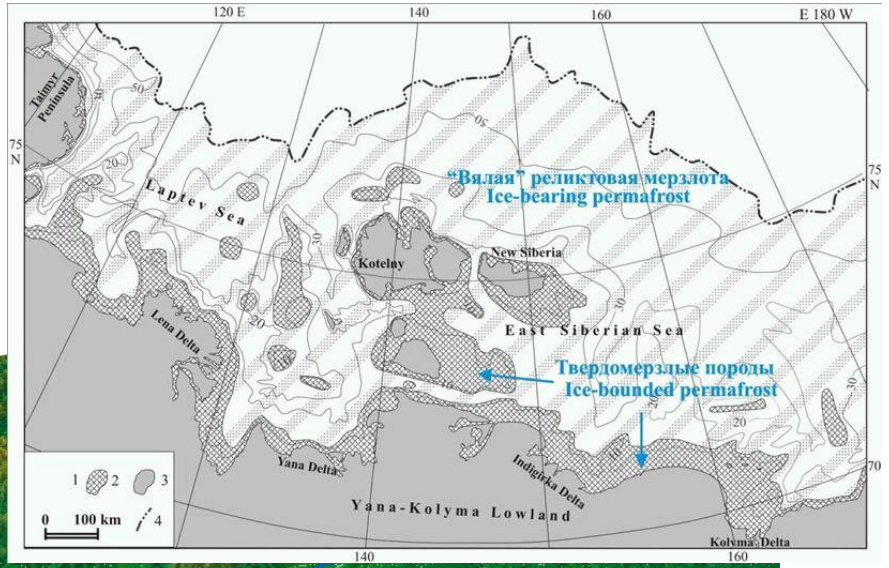
East Siberian Shelf IPA Permafrost Extent



East Siberian Shelf
Modelled Extent

ice-bonded

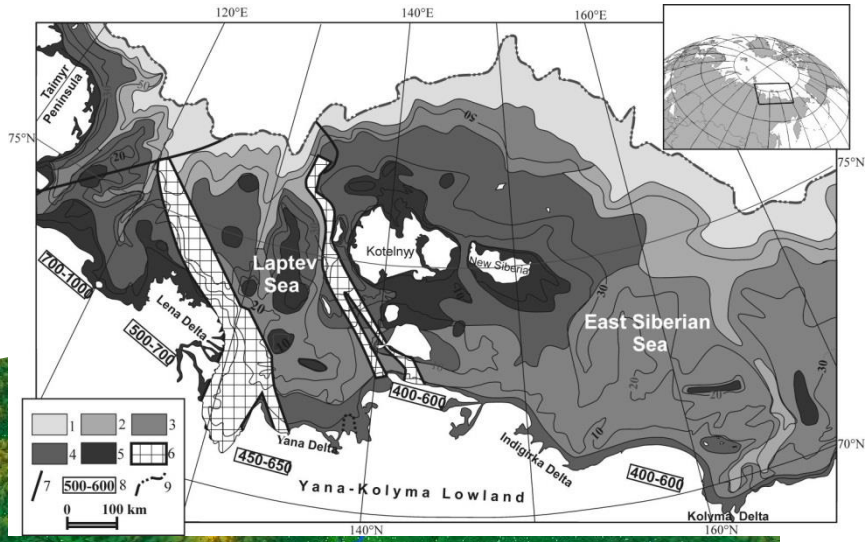
ice-bearing



Hubberten & Romanovskii (2003)

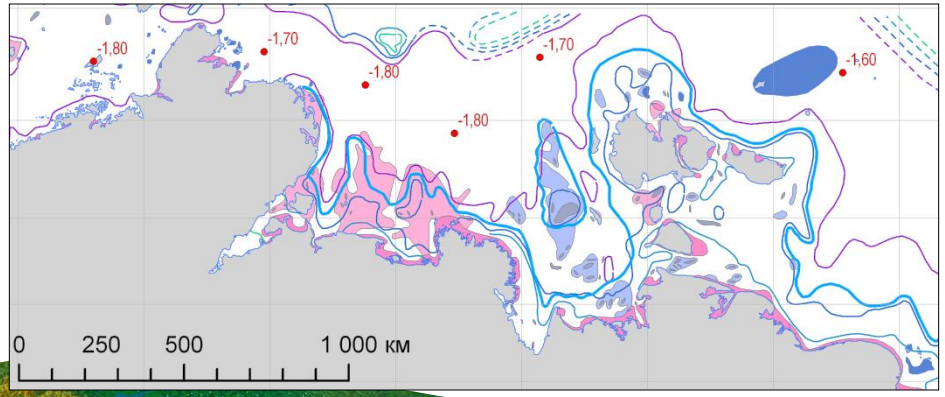
East Siberian Shelf Modelled Thickness

- < 100 m
- 100-200 m
- 200-300 m
- 300-400 m
- 400-600 m



Romanovskii *et al.* (2005)

East Siberian Shelf
Modelled Extent



relict ice-bonded permafrost
ice-free cryotic sediment

Zhigariev (1997)

Vaildation data is required

- How can we test our understanding of submarine permafrost distribution and degradation?
  - Industry data
  - Research on process studies

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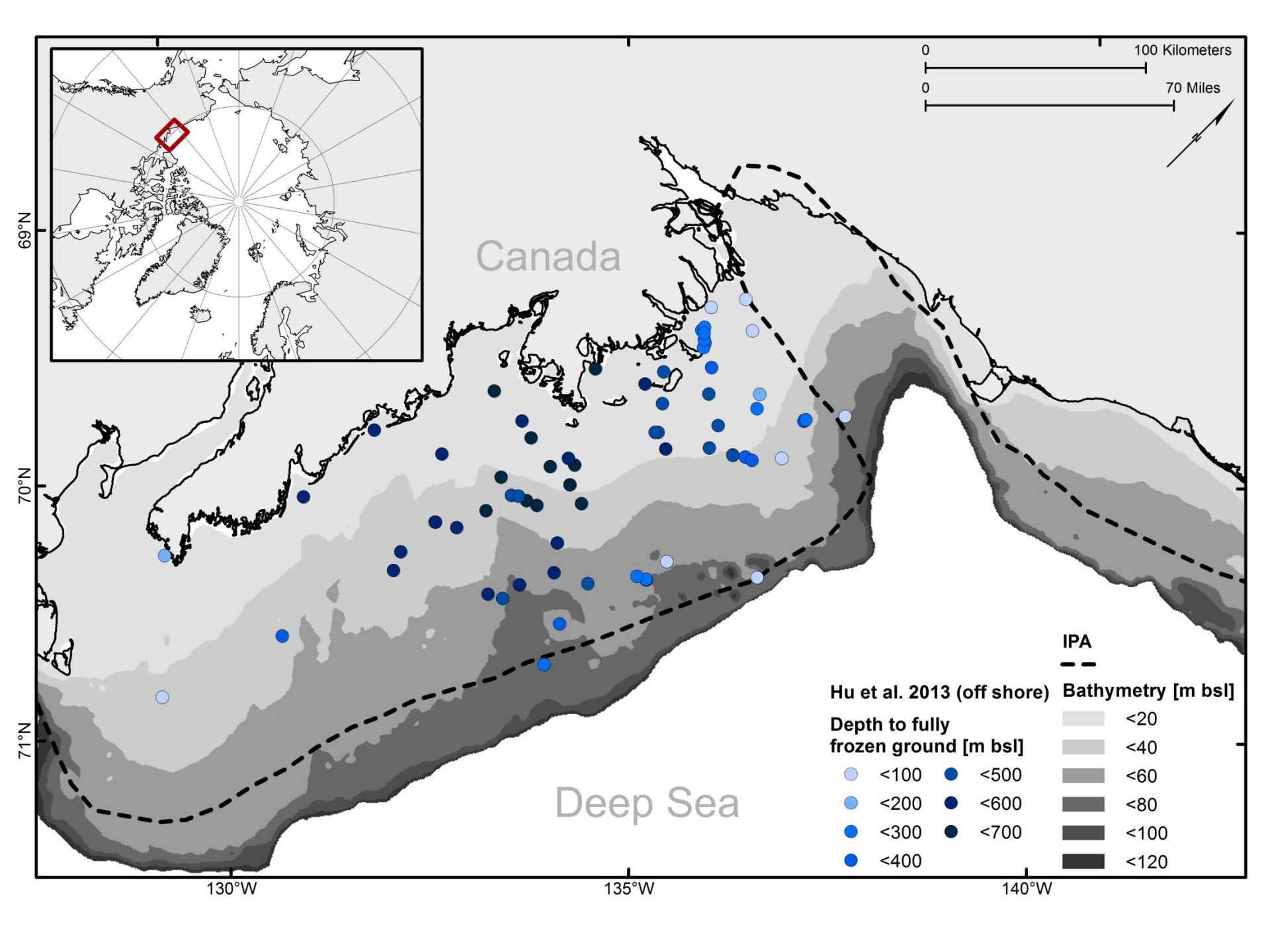
0
100 Kilometers
0
70 Miles
Canada
Deep Sea
69°N
70°N
71°N
130°W
135°W
140°W
IPA
Bathymetry [m bsl]
<20
<40
<60
<80
<100
<120
Hu et al. 2013 (off shore)
Depth to fully frozen ground [m bsl]
<100
<200
<300
<400
<500
<600
<700

Vaildation data is required

- How can we test our understanding of submarine permafrost distribution and degradation?
  - Industry data
  - Research on process studies
- What‘s the Challenge?
  - Logistics, logistics, logistics
  - Circumpolar or at least bi-national funding
  - Politics

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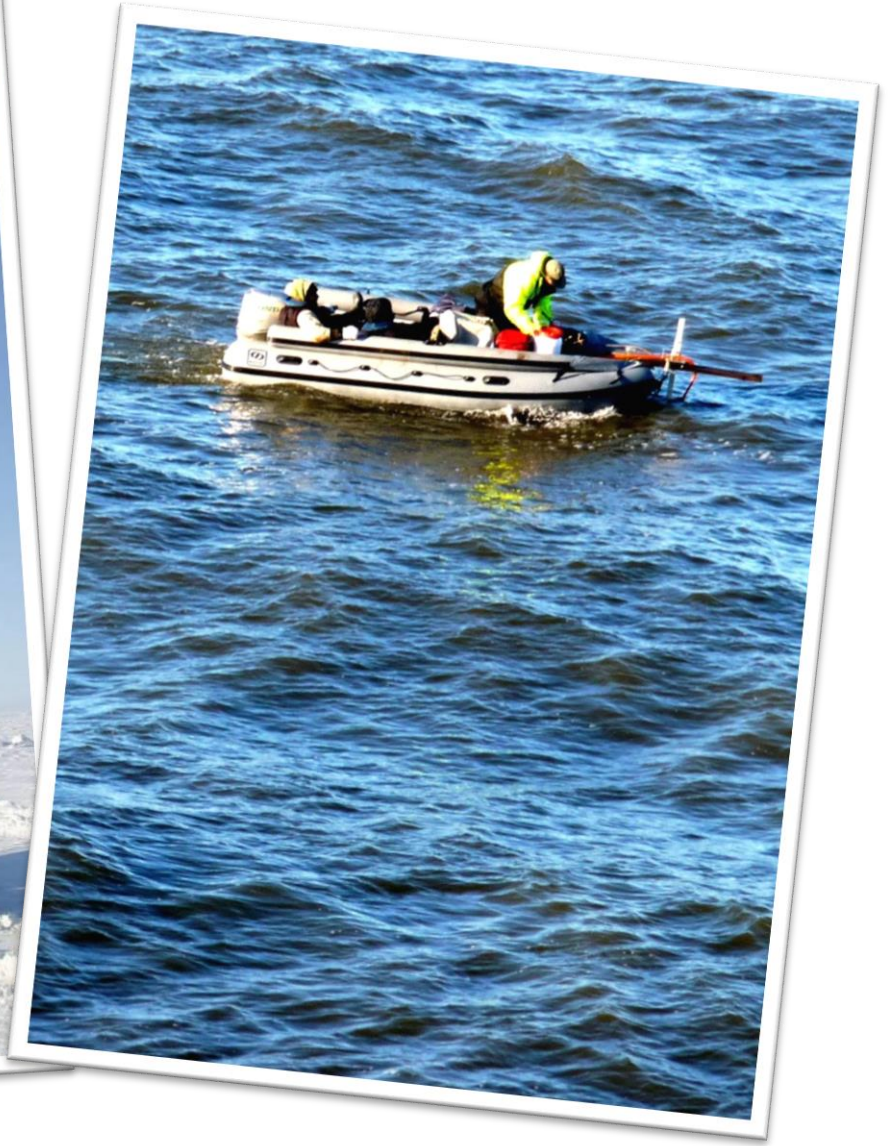
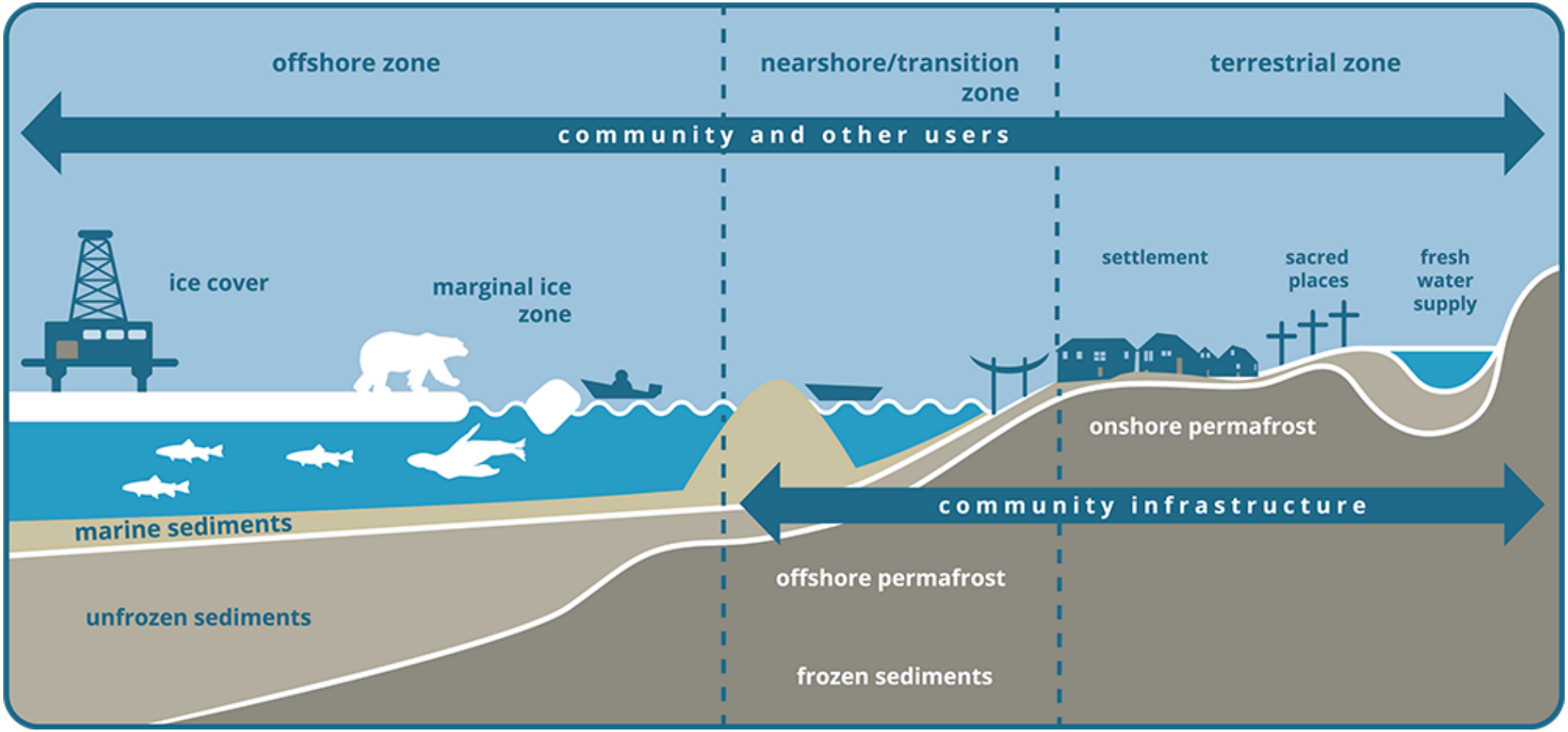
Science research on process studies



. . . vs. our species´ research

Topic 2: Coastal Dynamics

- Arctic Coastal Dynamics project (ACD) studies how the arctic coast changes



Lena Delta, Siberia

Tiksi

0 100 200 km

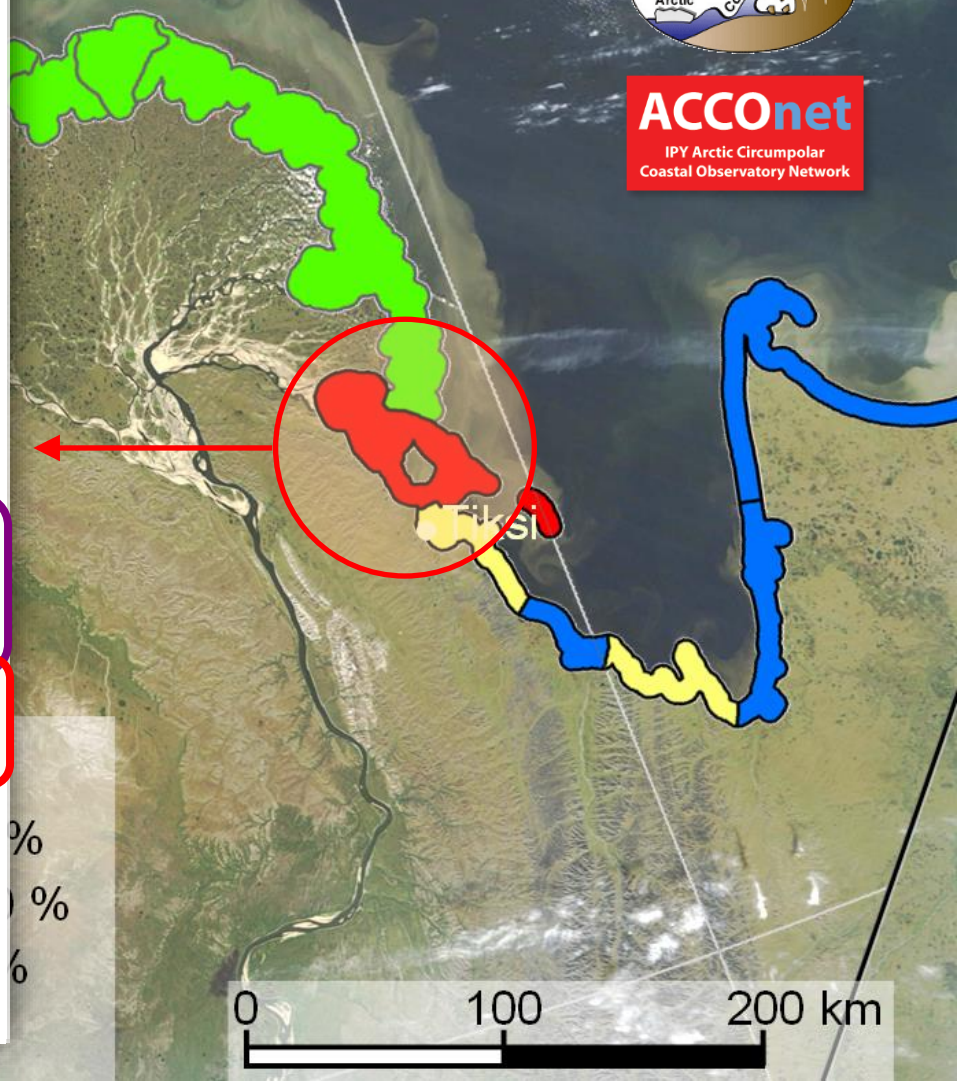
Ground ice contents along the Laptev Sea shoreline

	primary_contact_person	regional_sea_code	segment_name
	Name of primary contributor	Unique sea code	Segment name
segment_no	segment_code	old_nr_sys	segment_comment
ACD segment no.	ACD segment code (regional code and no.)	Original segment no. (if relevant)	Space for additional comments
onshore_form	onshore_comment	backshore_form	backshore_elevation
delta=d, lowland(<10m)=l, upland(10-500m)=u, highland(>500m)=h, wetland=w	Space for additional comments	cliff=c, slope=s, flat=f, ridged/terraced=r, anthropogenic=a, complicated=x	In meters
backshore_material_1	backshore_material_2	backshore_comment	shore_form
lithified=l, unlithified=u	mud-dominated=m, sand-dominated=s, gravel-dominated=g, diamict=d, organic=o, mixtures= e.g mg, sg	Space for additional comments	beach=b, shore terrace=t, cliff=c, complicated=x
beach_form	shore_material_1	shore_material_2	shore_comment
fringing=f, barrier=b, spit=s (to be filled if shore_form=b)	lithified=l, unlithified=u	mud-dominated=m, sand-dominated=s,	Space for additional comments
depth_closure	distance_2m_isobath		10m_isobath
In meters (if available)	In meters (if available)		if available)
distance_100m_isobath	offshore_material	ground_ice_1	ground_ice_2
in meters (if available)	mud-dominated=m, sand-dominated=s, gravel- mict=d, es= e.g	Poor(0-2)=p low(2-20)=l, medium(20-50)=m, high(>50)=h	In % total volume of shoreline
ground_ice_comment	change_rate	change_rate_interval	dynamic_process
Space for additional comments	In meter/year (erosion=minus, accumulation=plus)	in years (years of observation, e.g. 1956-1999)	erosive=e, stable=s, accumulative=a
dry_bulk_density	organic_c	soil_organic_c	data_sources
in t/m3 (if no data available use of: clay=1.3 silt=1.5, sand=2, or mixtures, e.g. silty sand=1.8)	in weight %	in kg/m2 (if available)	Provides the sources or references(citation) of used information (i.e. published, unpublished observations or reports)
mappers	comments		
Names of all mappers	Space for additional comments		

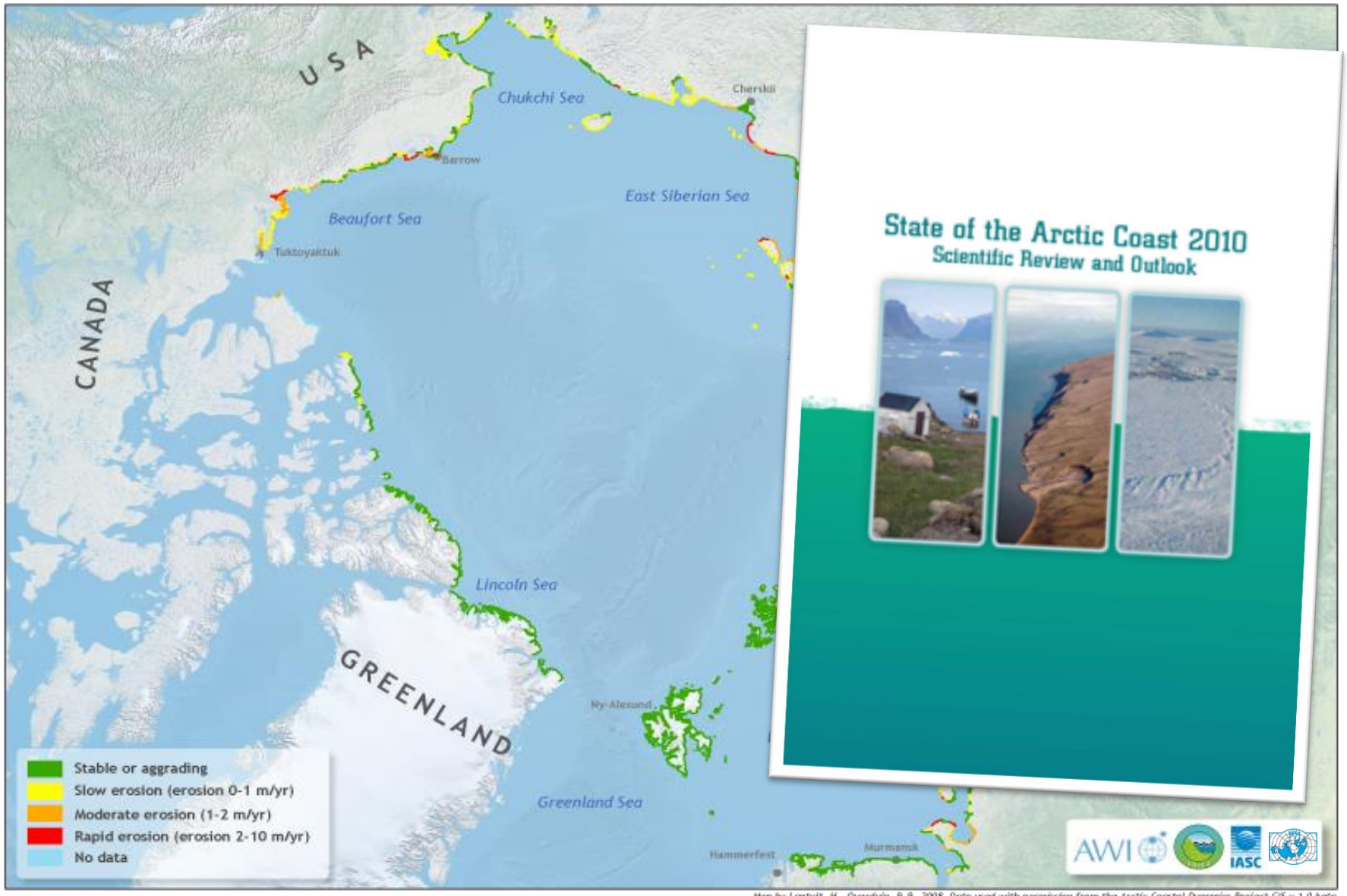
Permafrost properties

Erosion

Geochemistry



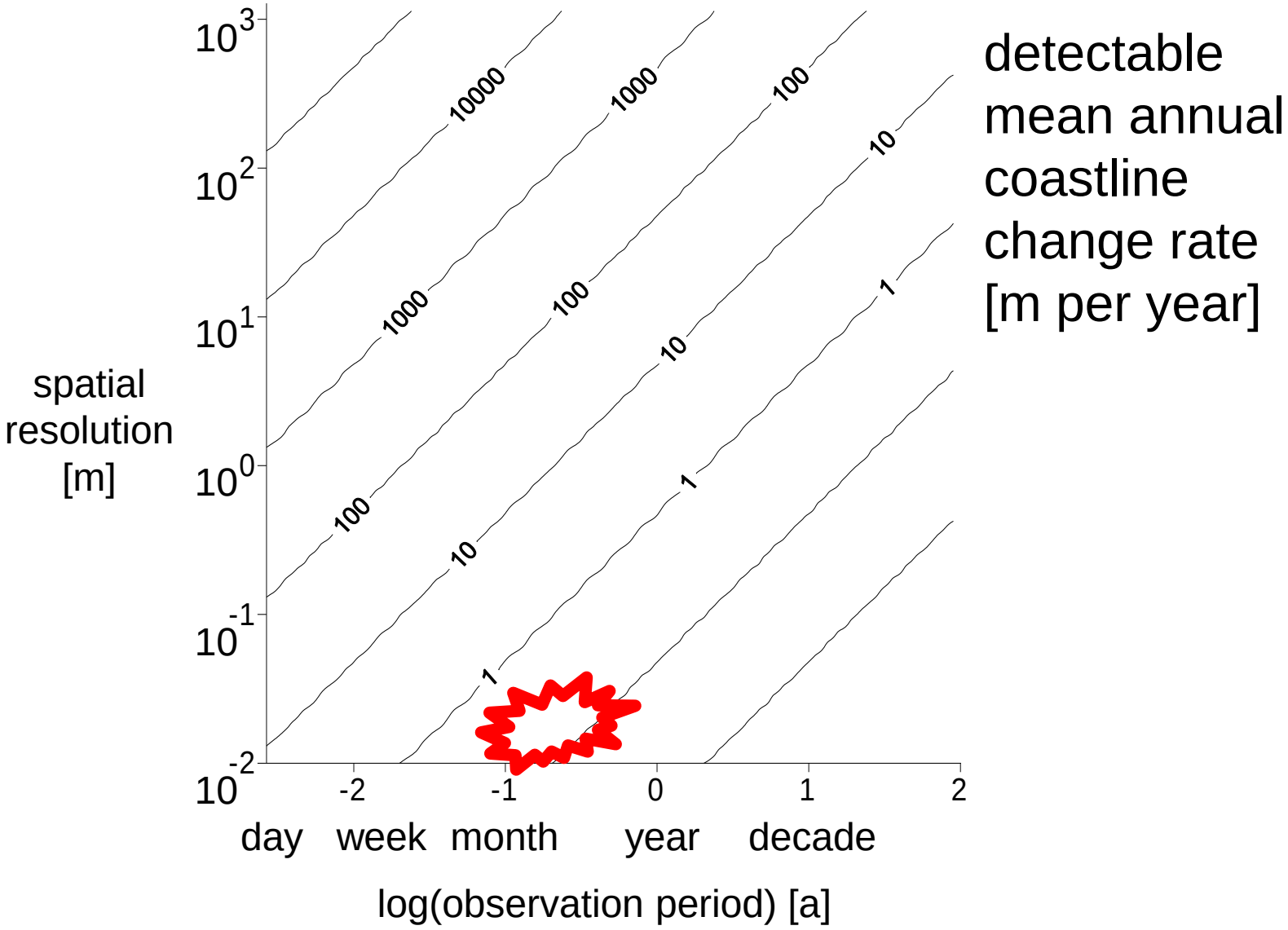
ACD: Geodatabase and Review



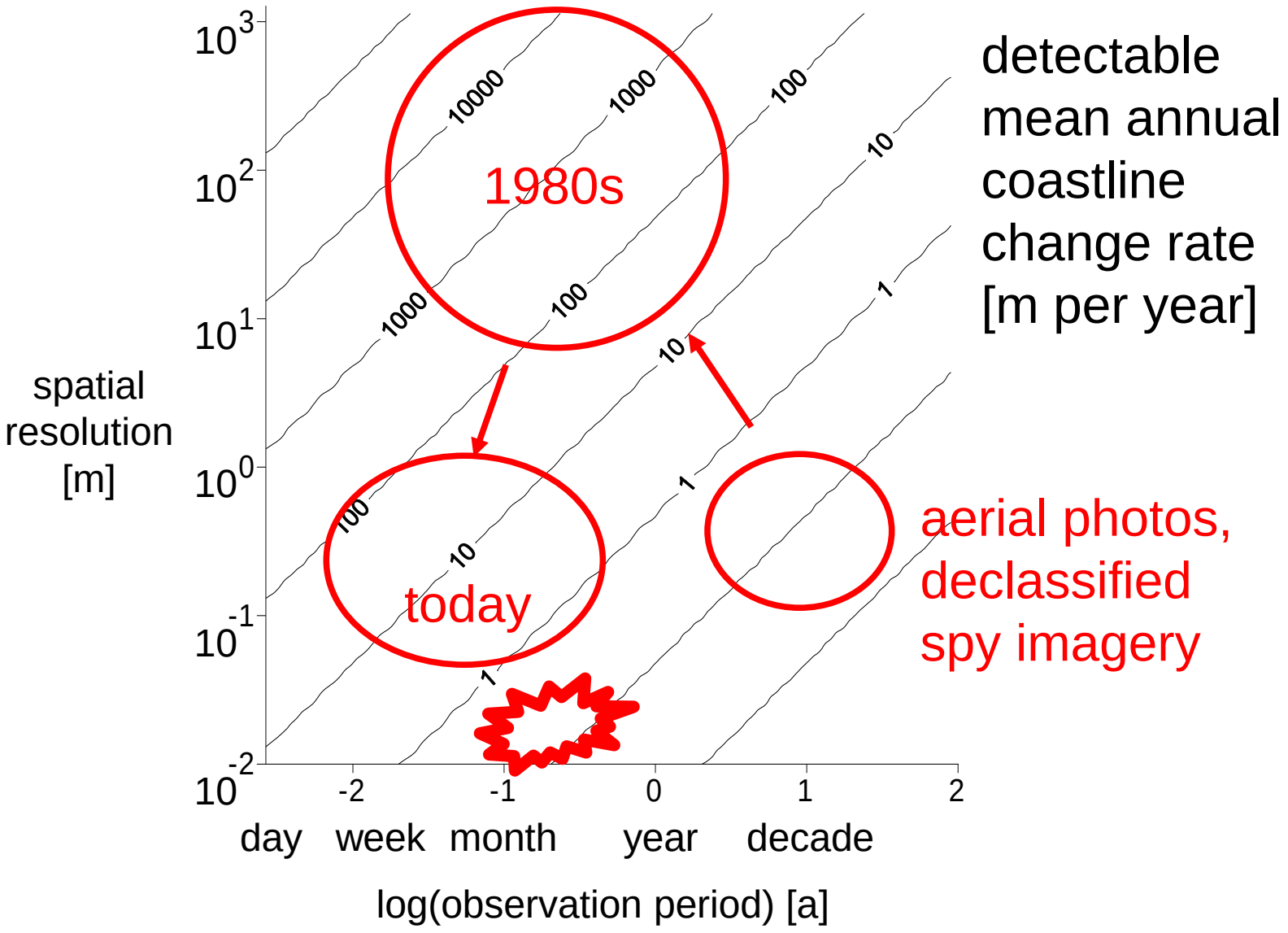
Lantuit et al., 2012
Forbes, D. , Kremer, H. , Rachold, V. and Lantuit, H. 2010

Arctic coastal erosion is extreme

Remote sensing for larger scale change



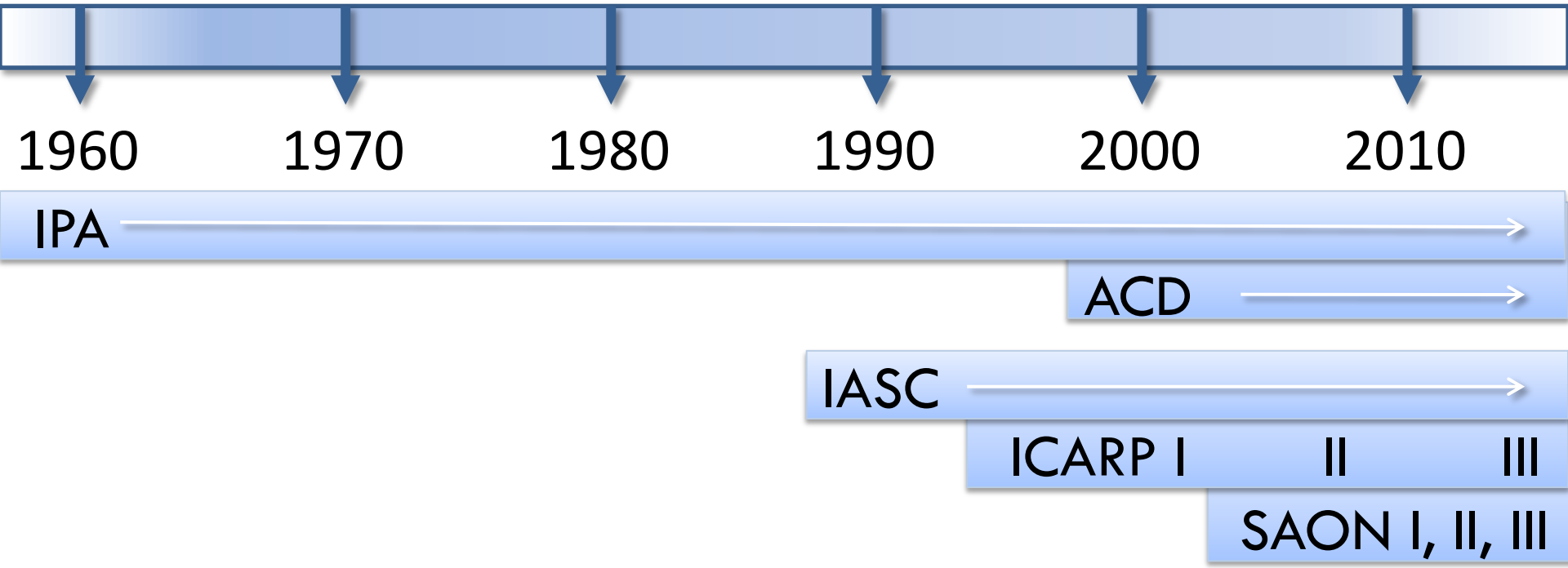
Remote sensing for larger scale change



Coastal research: where are we?

- Are erosion rates increasing?
- Challenges!
  - Linking land to ocean:
    - river discharge – estuary – shelf – ocean
    - coast – shelf – slope – basin
  - No international funding agencies: what exists is bi-lateral; Belmont Forum starts to address this gap
  - Trans-disciplinary requirements vs. Cultural differences
  - Politically sensitive region
  - Linking economic and science activity not a priority → science needs to inform political leadership

Arctic Science Timeline



Nat'l sci. funding agencies
Gov. agencies

→

Div., piece-wise funding

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Starting point

1. The edge of the arctic ocean needs looking at:

Submarine permafrost distribution/degradation rate and coastal dynamics need observation and validation.

1. Monitoring has shifted from a national agency activity towards a research science activity.
2. What observational science do we need ?

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