Erosion and Flooding on Herschel Island, Yukon Territory, Canada

An Assessment of Coastal Hazards

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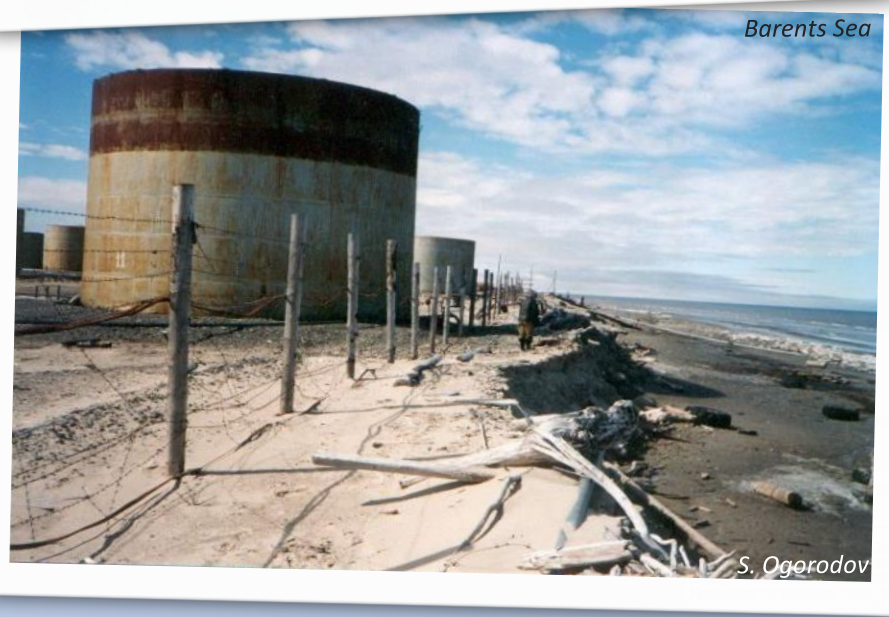
Introduction

- Permafrost coasts make up 34 % of the world's coasts

Lantuit et al., 2011

arcticcoast.info

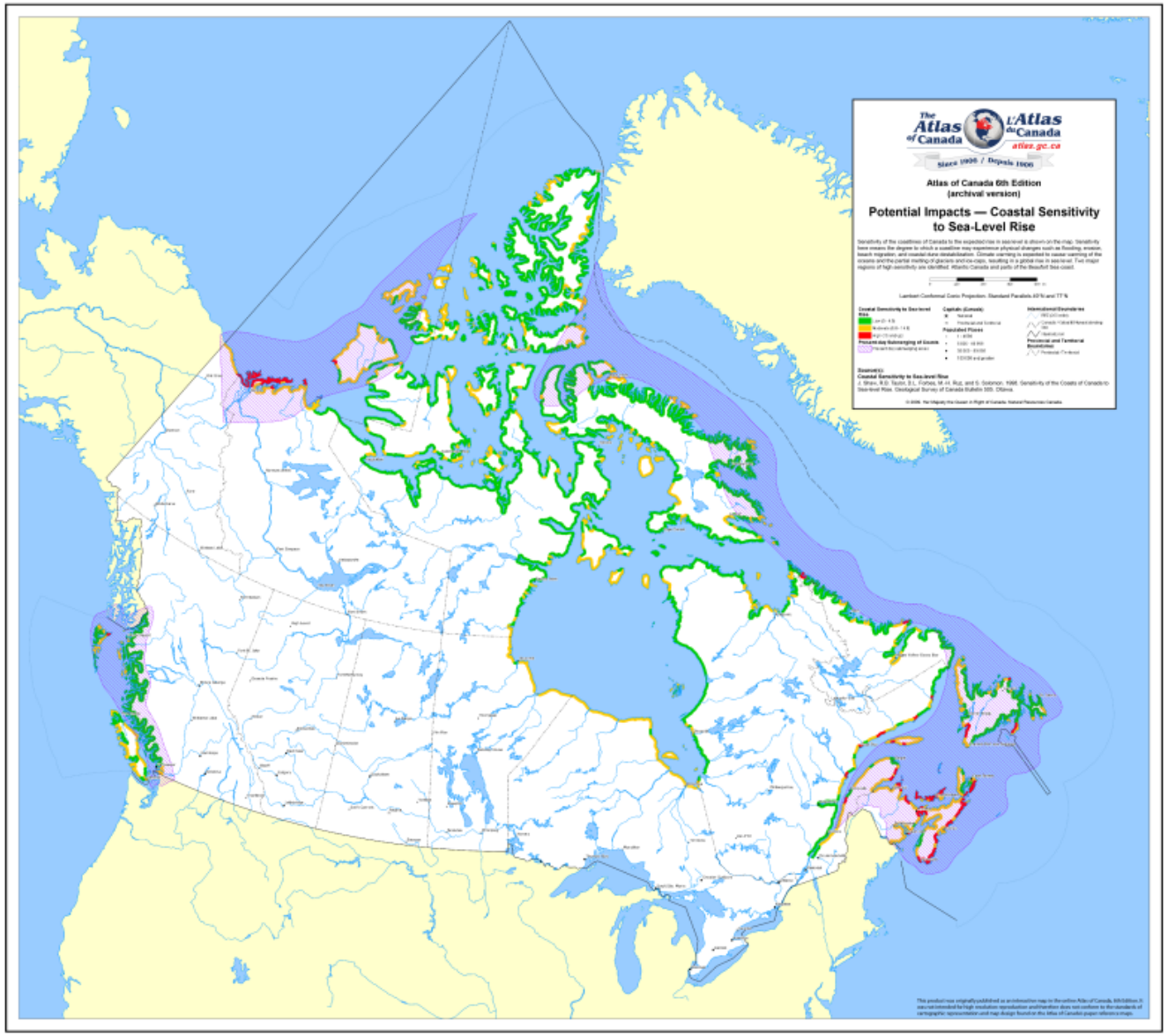
Introduction



Erosion facts

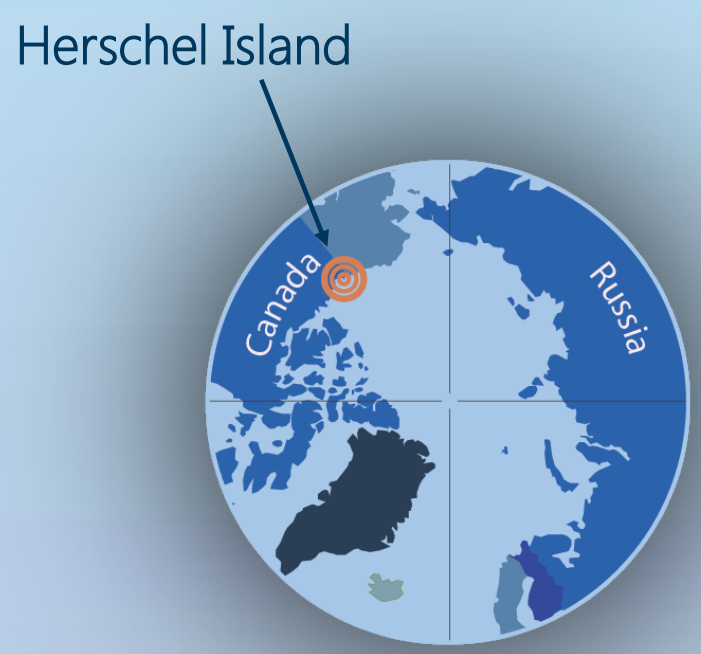
- Rates as high as 20 m/yr
- Impacts on oil and gas facilities, local community infrastructure, cultural sites

Sensitivity to Sea Level Rise



Shaw et al., 1998

Study Area



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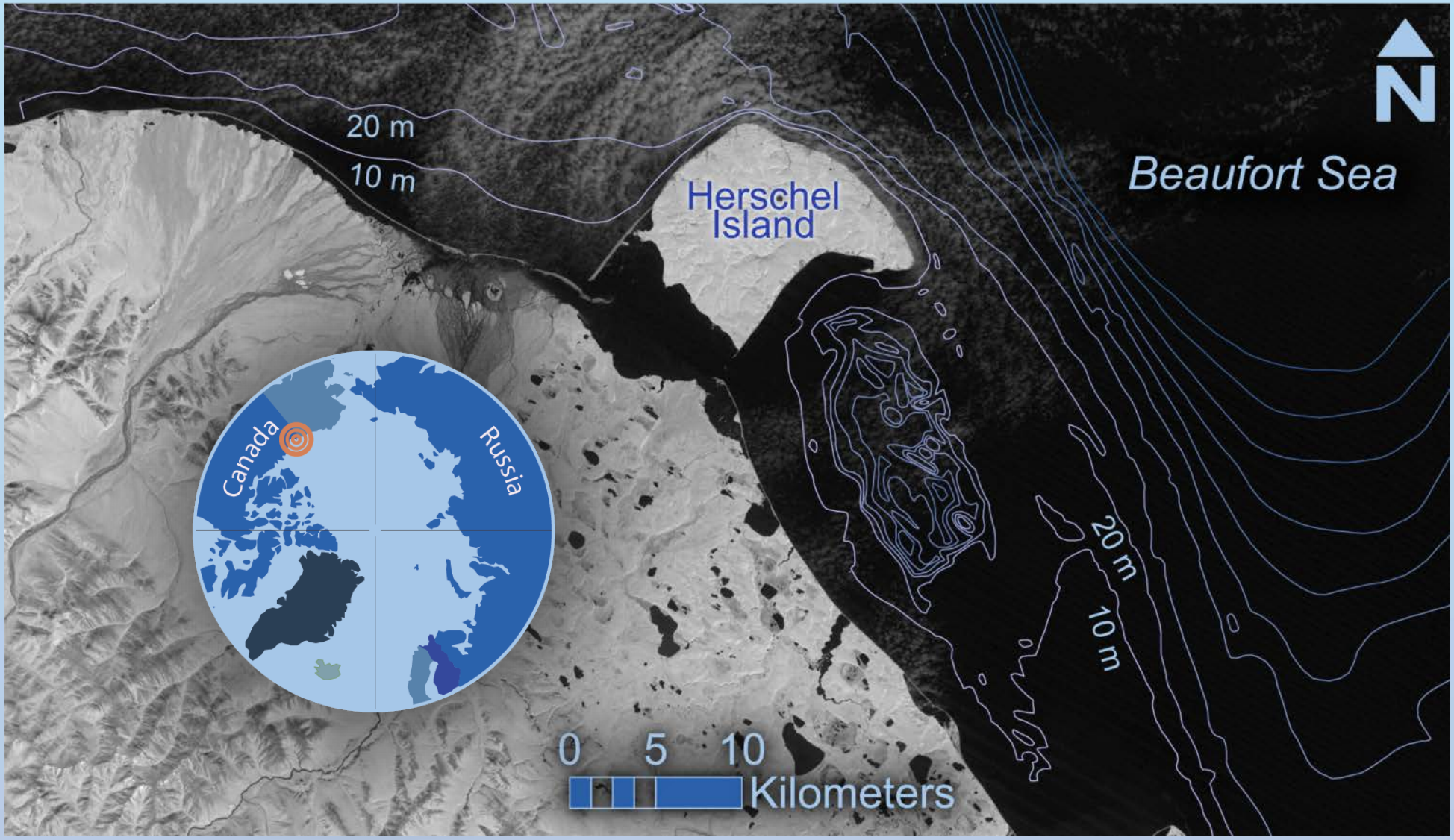
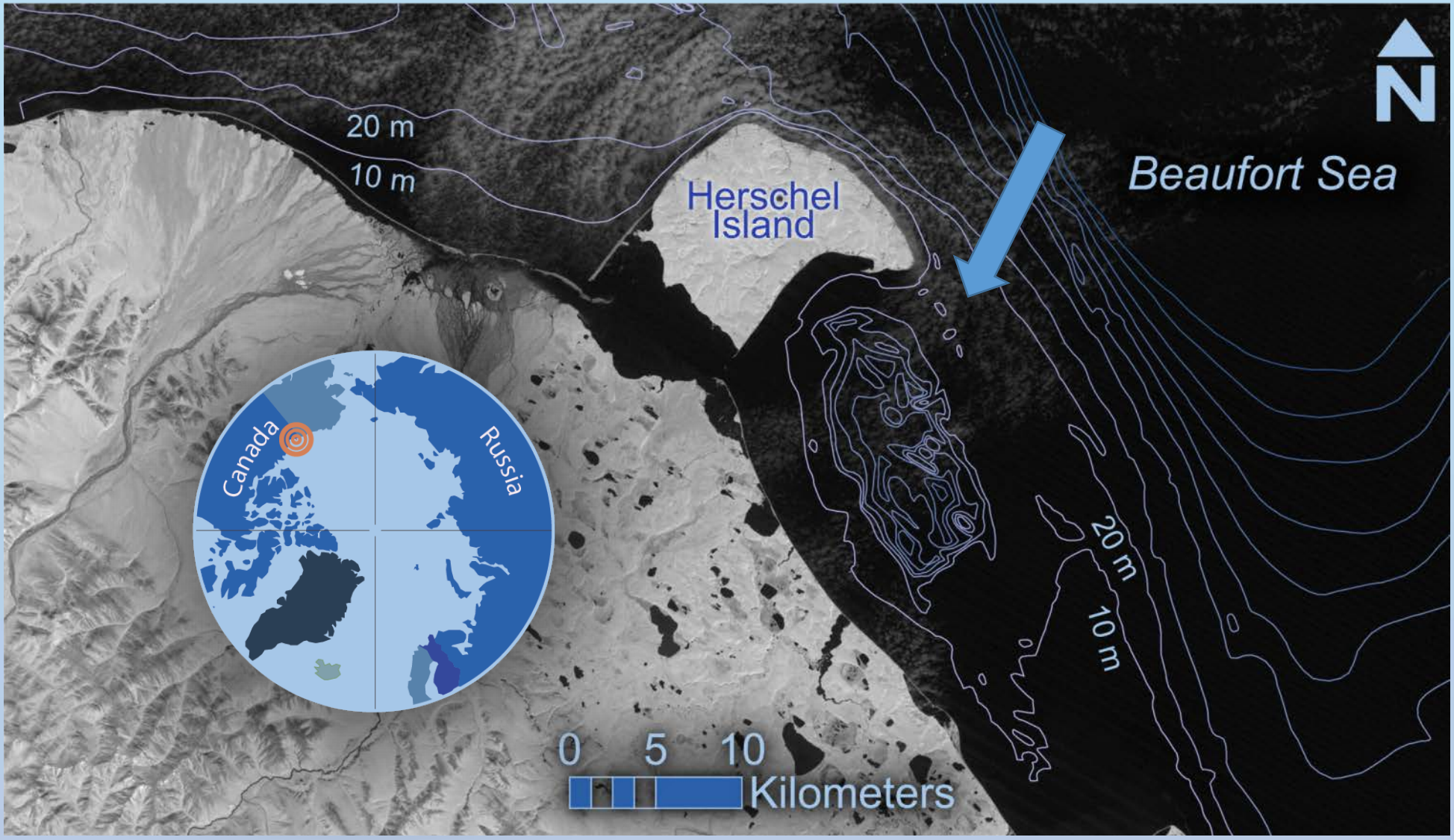

20 m
10 m
Herschel Island
Beaufort Sea
N
Canada
Russia
20 m
10 m
0 5 10
Kilometers

Study Area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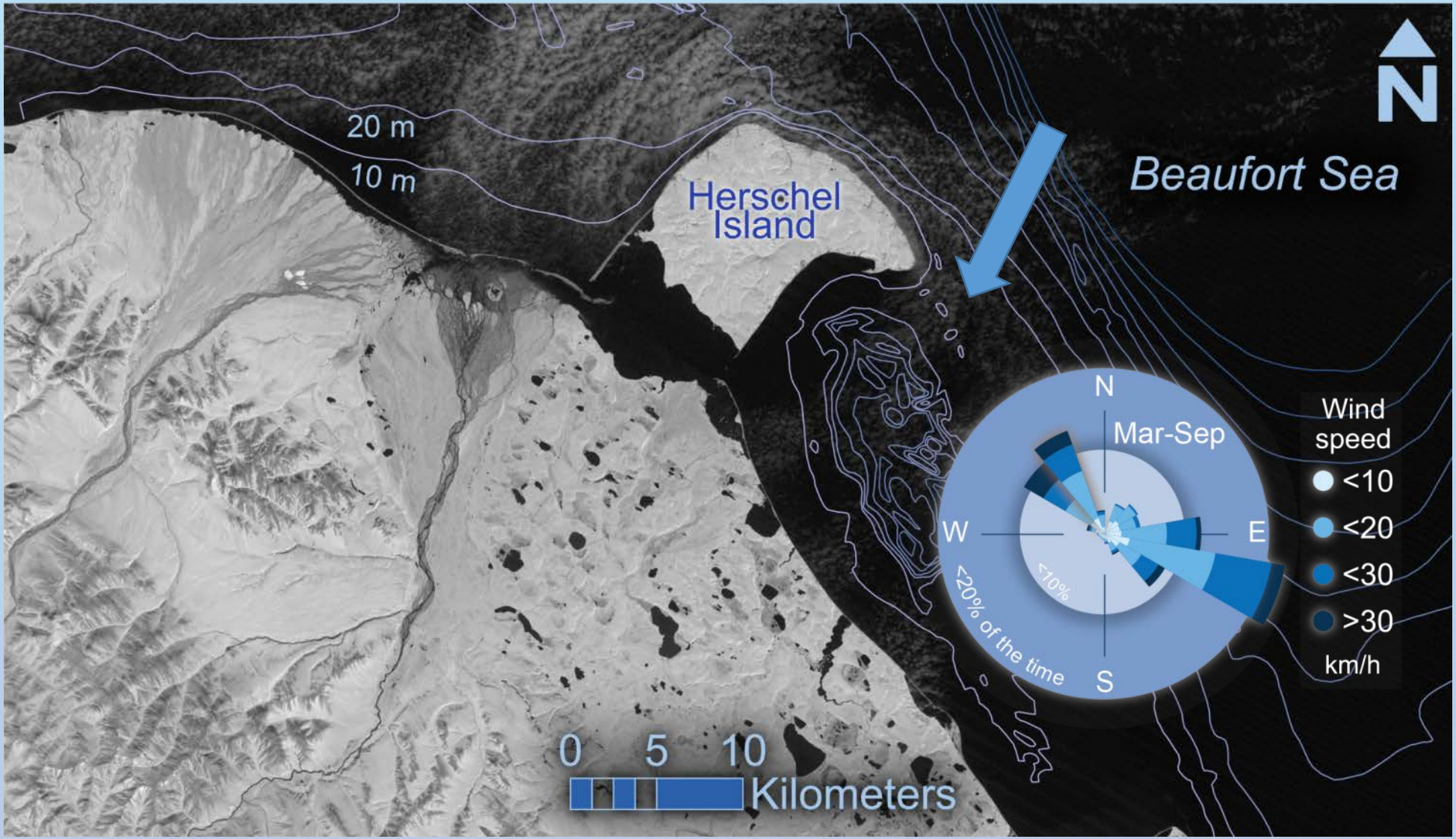
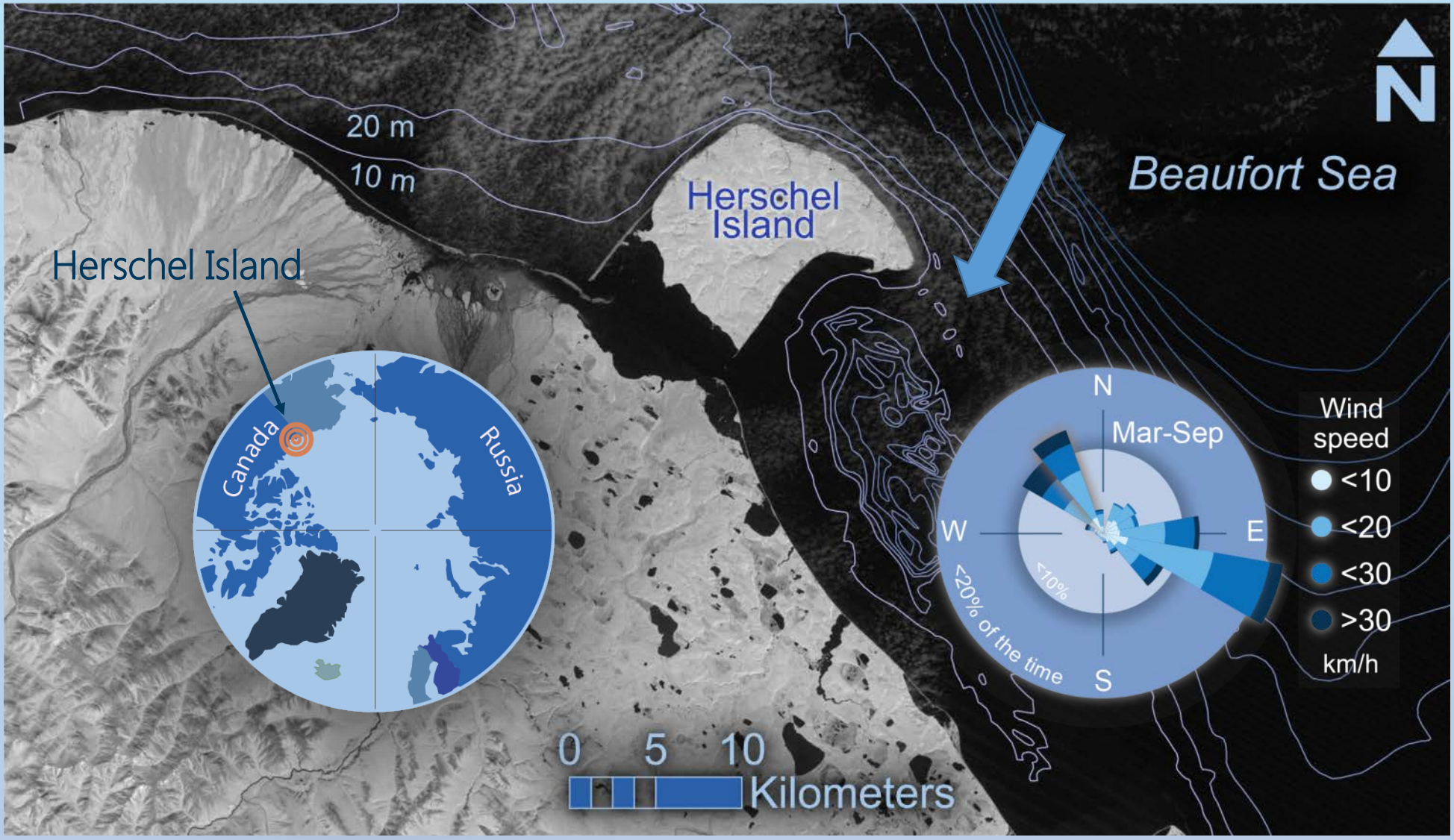

20 m
10 m
Herschel Island
Beaufort Sea
N
N
Mar-Sep
W
E
S
<10%
<20% of the time
Wind speed
<10
<20
<30
>30
km/h
0 5 10
Kilometers

Study Area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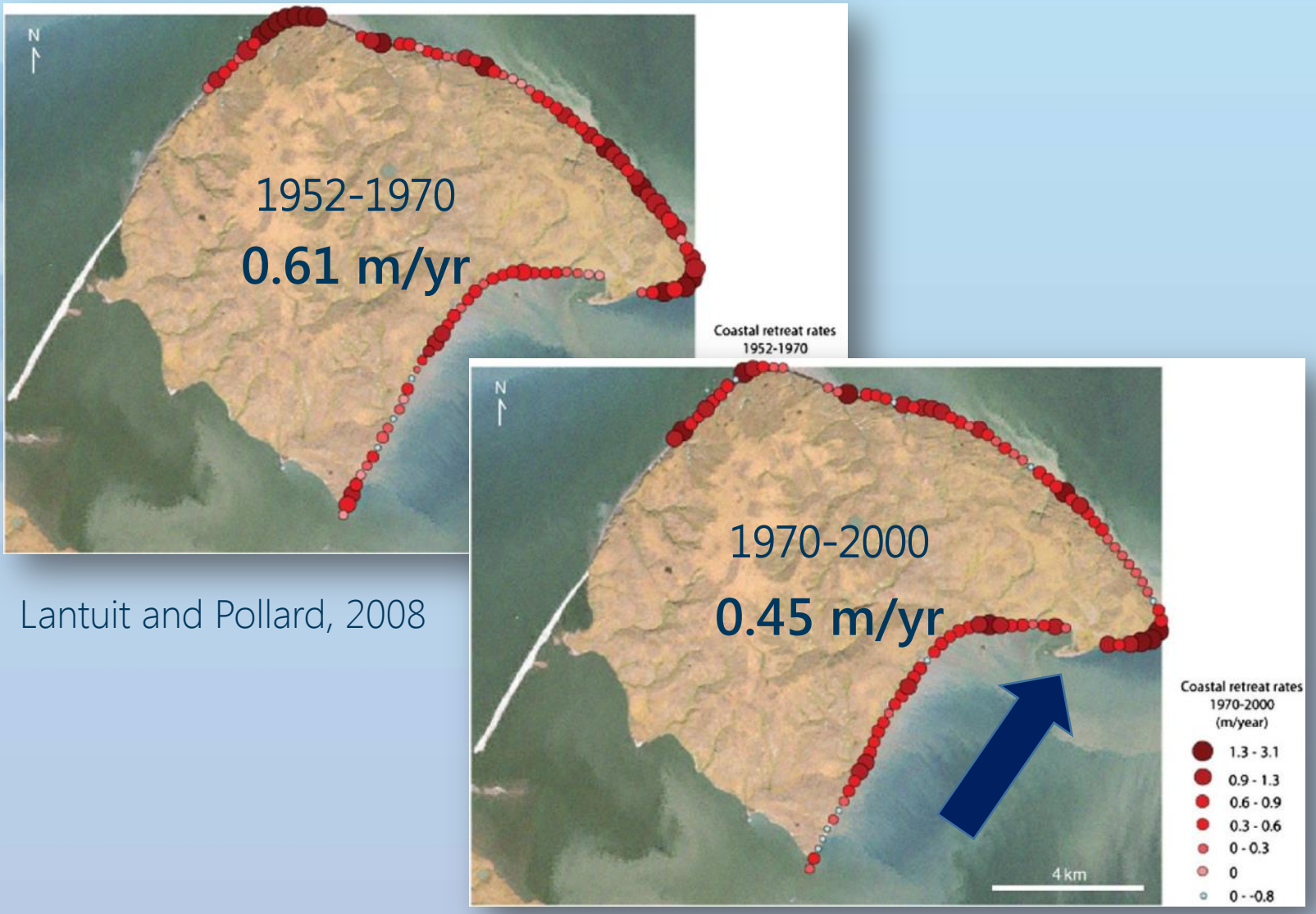
Background



Lantuit and Pollard, 2008

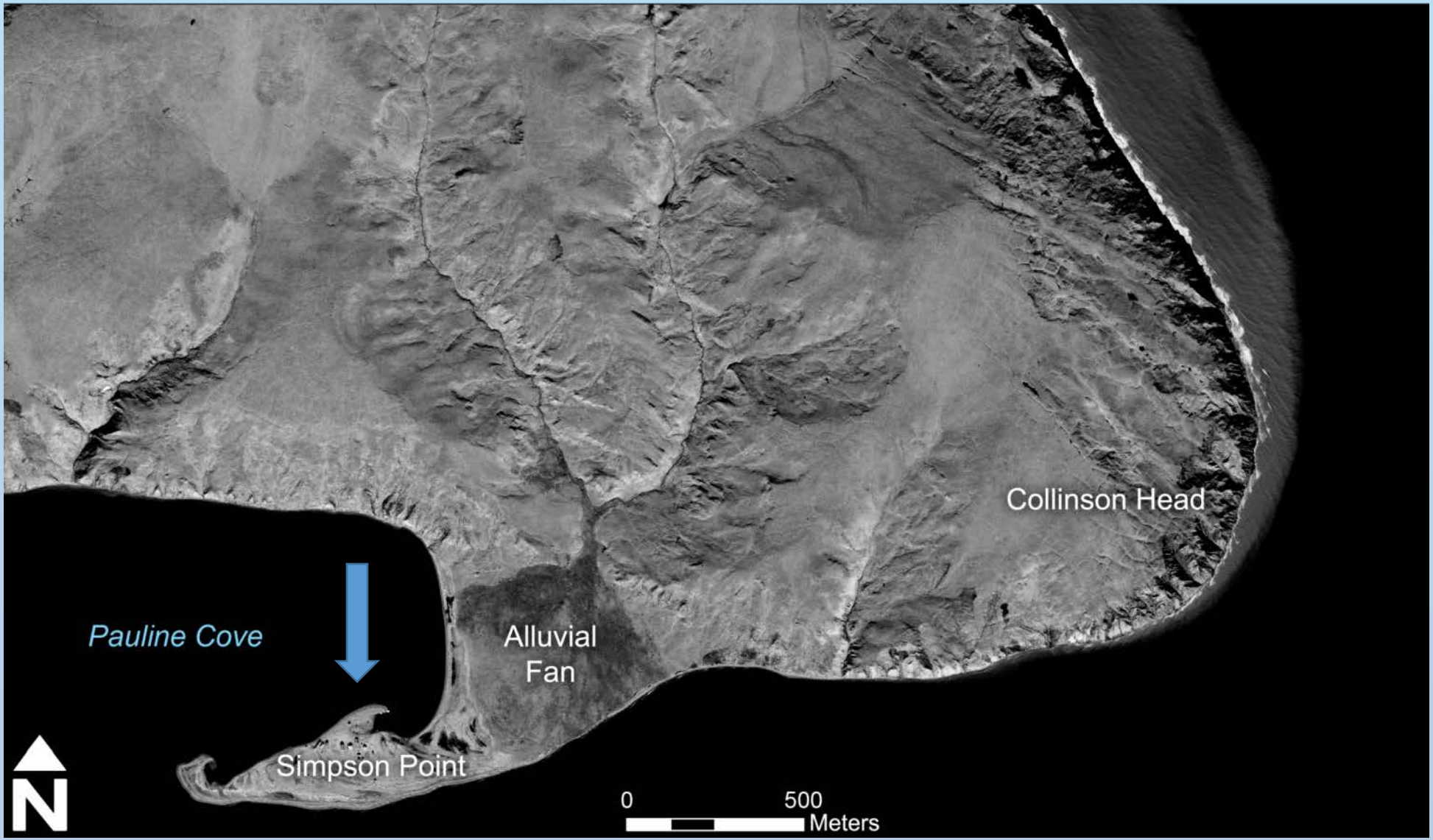
Period	Erosion (m/yr)
1955-1979	6.5
1979-2002	8.7
2002-2007	13.6

Jones et al., 2009

Period	Erosion (km^2/yr)
1955-1985	0.48
1985-2005	1.08

Mars et al., 2007

Study Area


Collinson Head
Pauline Cove
Alluvial
Fan
Simpson Point
N
0
500
Meters

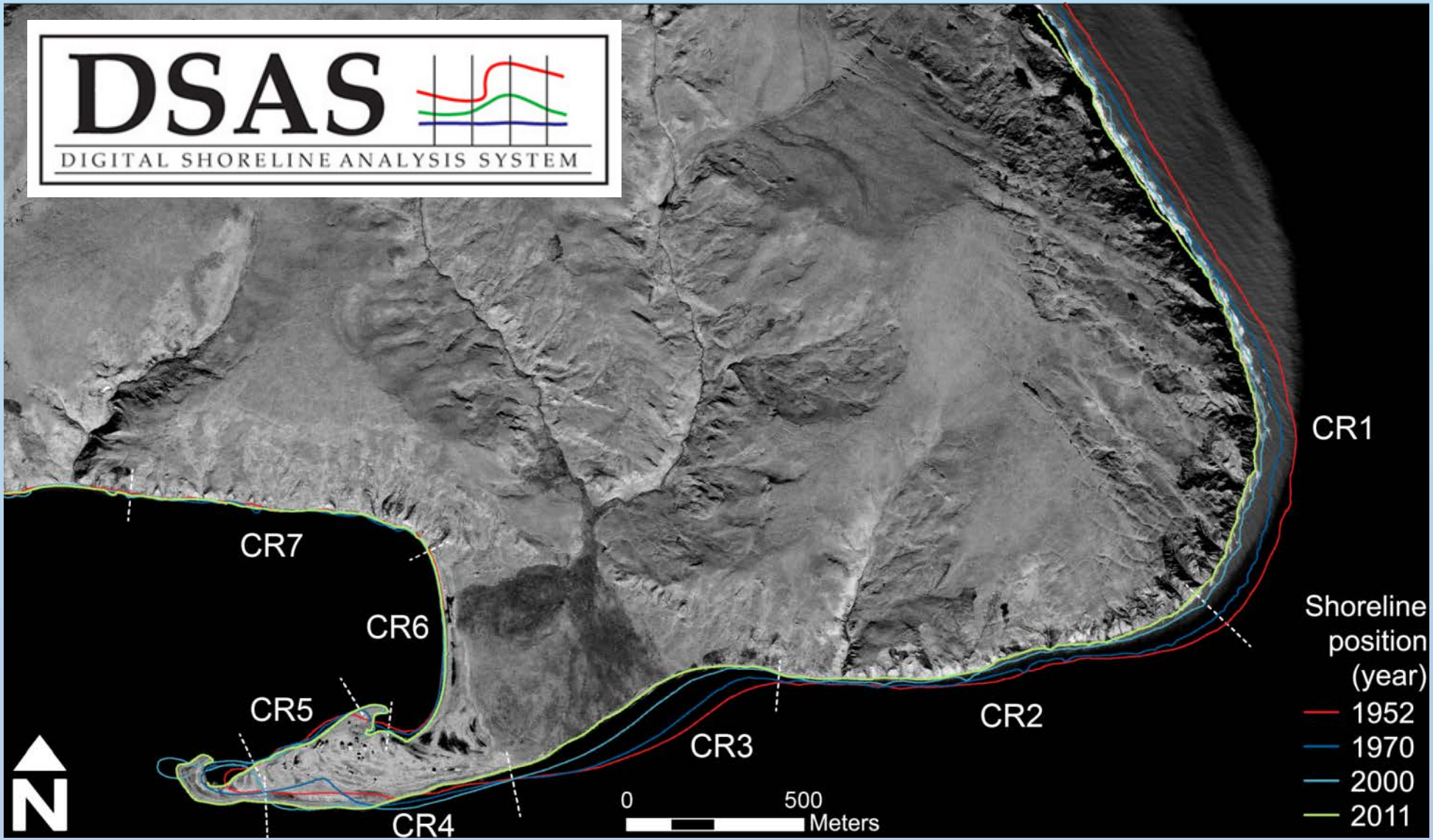
Objectives

- Establish coastal retreat rates for
  - 1952-1970
  - 1970-2000
  - 2000-2011

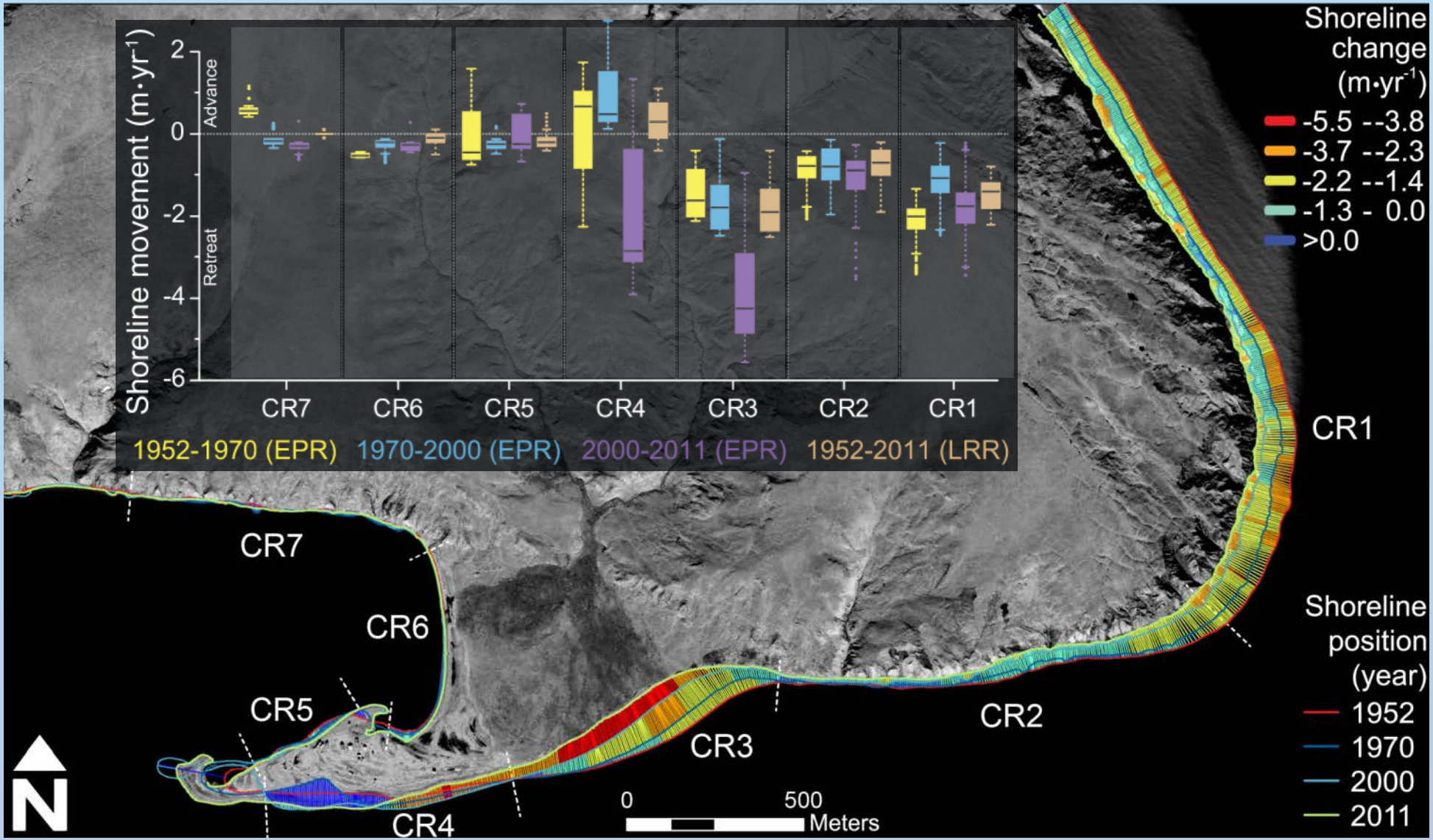
- Assess flooding potential
  - IPCC RCPs 2.6, 8.5

Shoreline Dynamics

Shoreline Dynamics

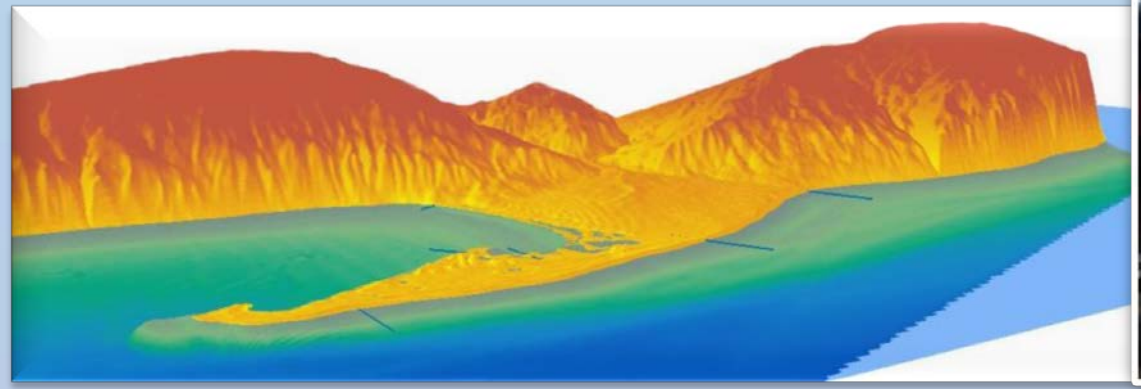


Shoreline Dynamics



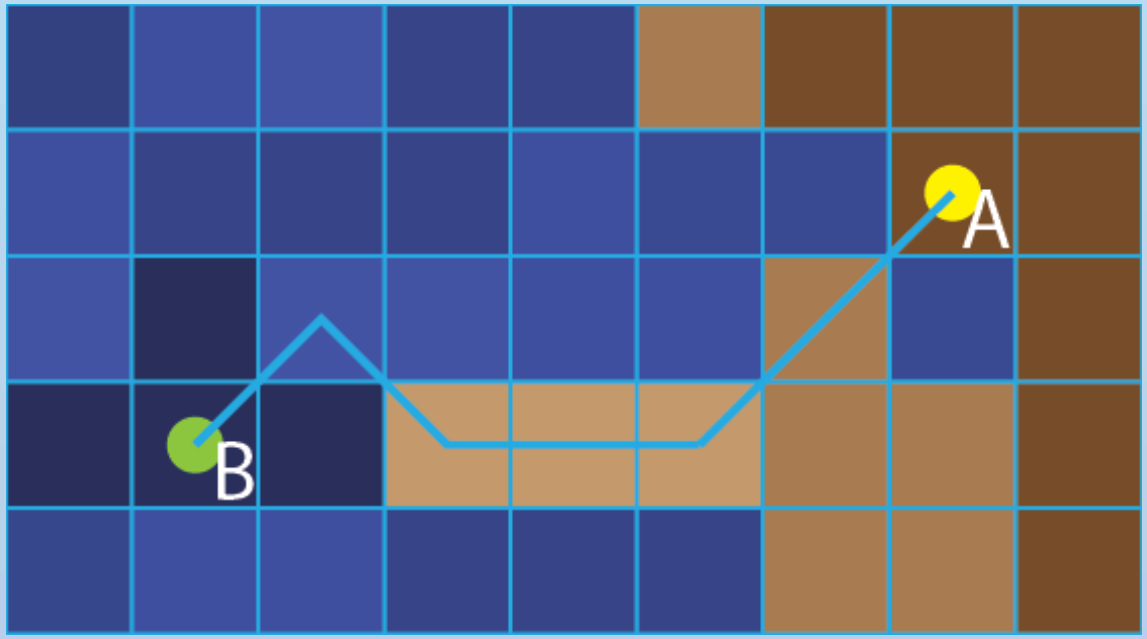
Coastal Flooding Assessment

- 2013 LiDAR
  - < 1 m point spacing
  - Low-pass filtering
  - Derivatives:
    - Elevation
    - Slope



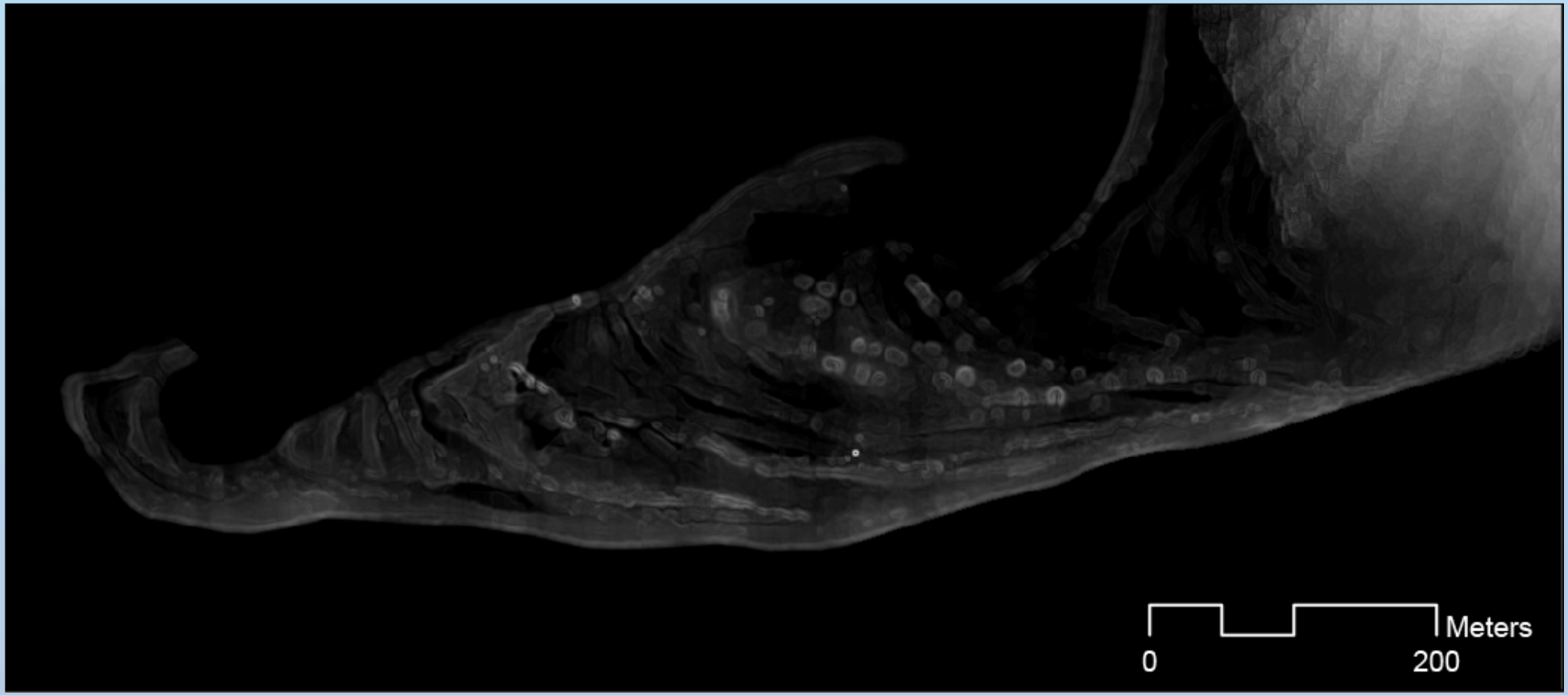
Coastal Flooding Assessment

Least cost analysis



Coastal Flooding Assessment

Least cost analysis



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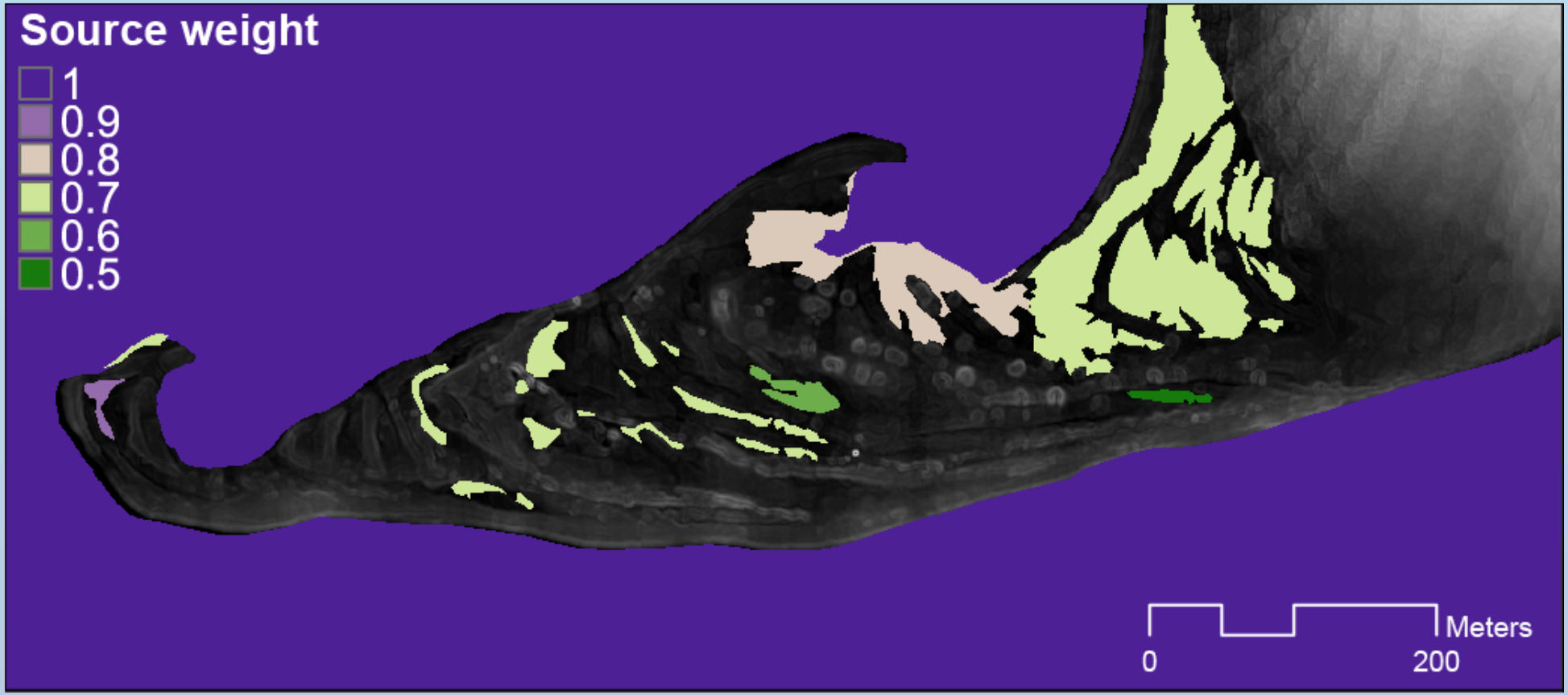

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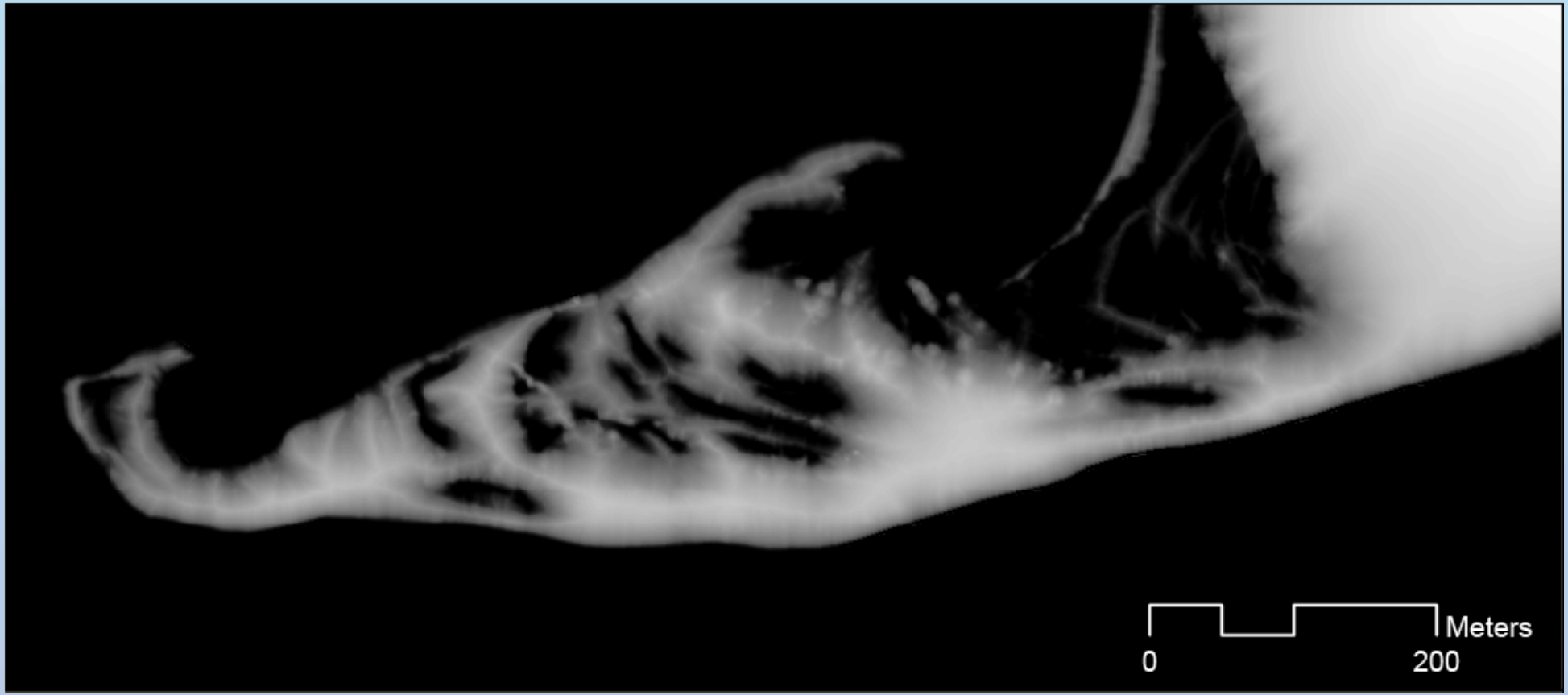

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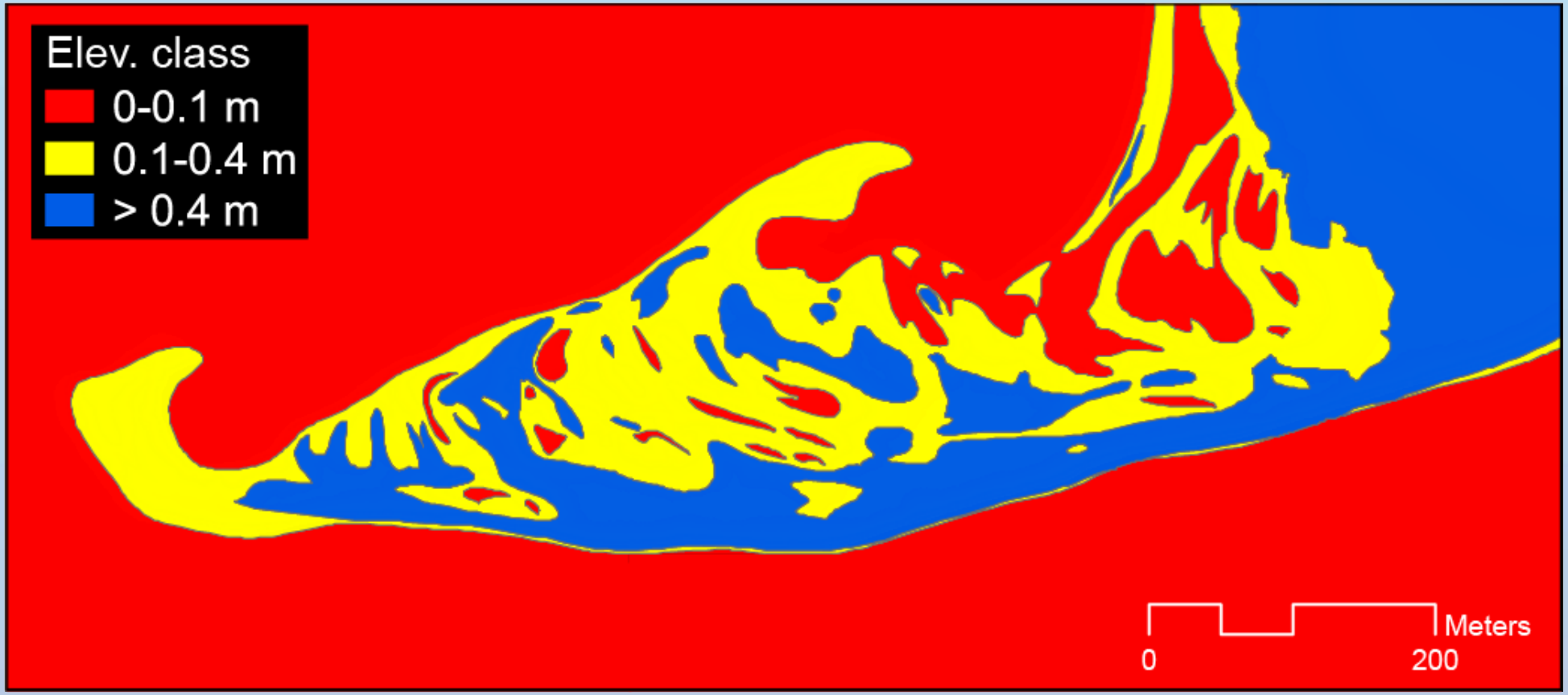

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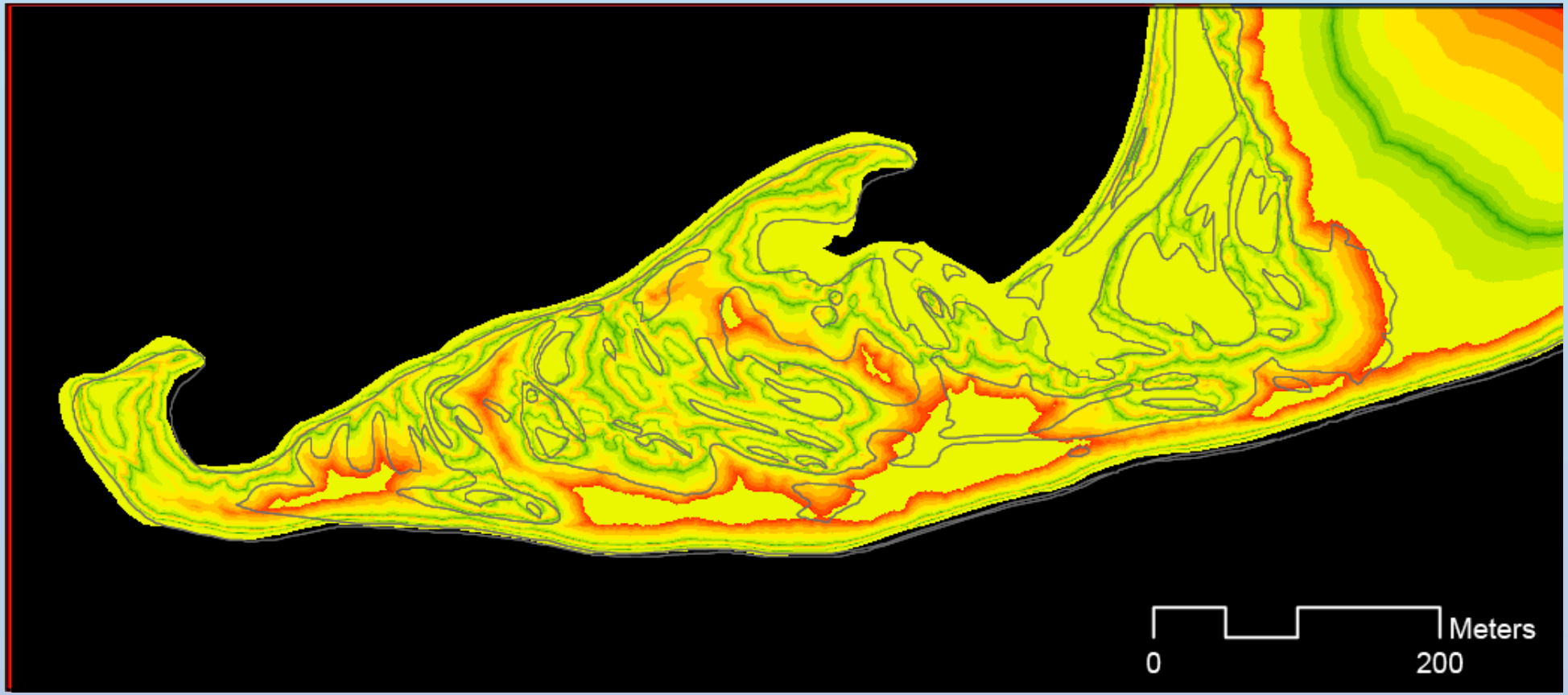
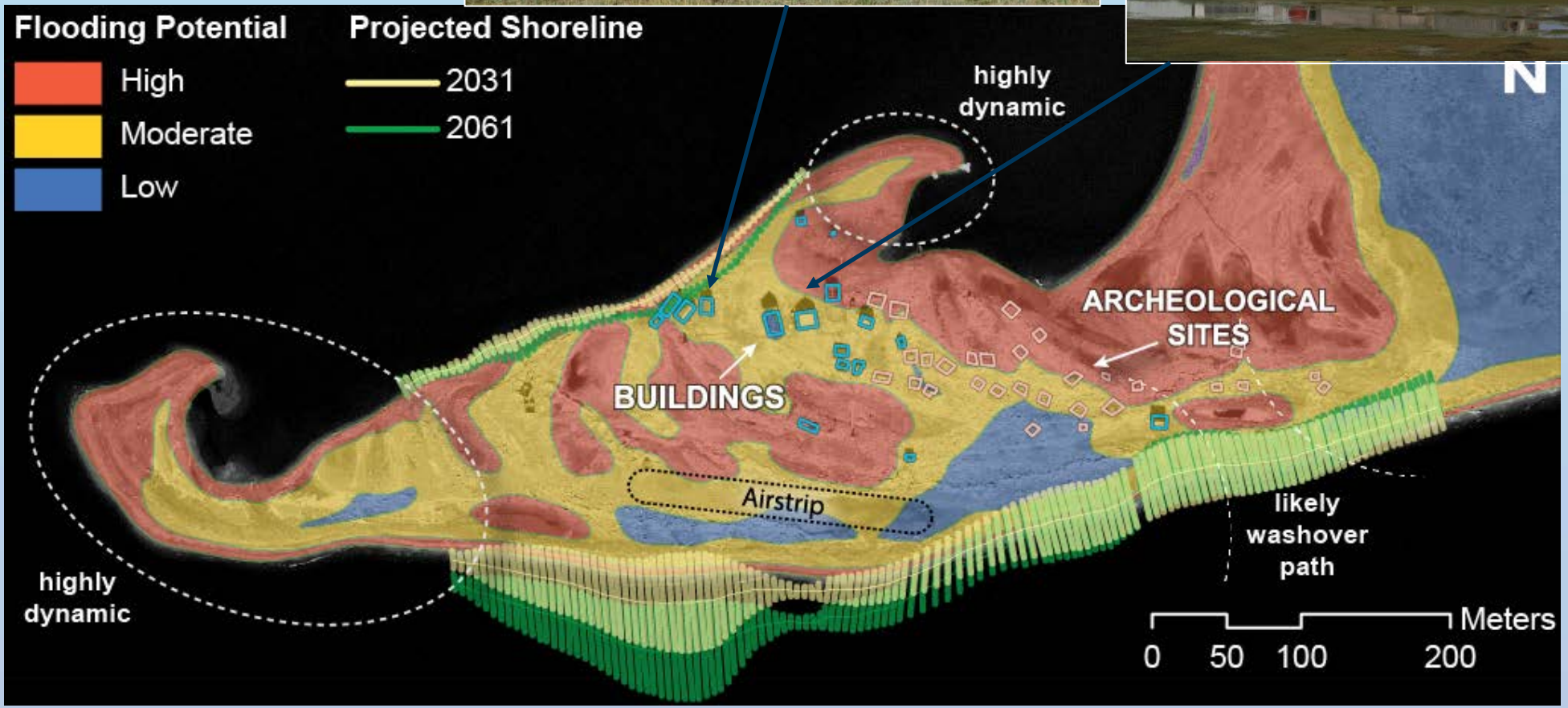


Coastal geohazards



Discussion

- Shoreline change
  - Complements Lantuit et al., 2008
  - Higher spatial resolution, more insight
  - Predictions of shoreline position could be improved
- Flooding potential
  - Establishment of tidal datum crucial
  - Not dynamic
  - Indicates distribution of flood prone areas

Conclusions

- Shoreline dynamics
  - widespread shoreline retreat, acceleration
  - highest rates of erosion → highest wave exposure and ice content
  - Very high retreat rates (up to -4.0 m· a^{-1}) in CR3
  - Spit is most dynamic
- Historic settlement vulnerable
- Geohazard maps are useful decision making tools

Thank you

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