

# Mineral Dust Dynamics and Climate Change at High Latitude Mountainous Regions

Dust storm in A'äy Chù, May 2019



Environment and  
Climate Change Canada  
Environnement et  
Changement climatique Canada



Parks  
Canada    Parcs  
Canada



CANADIAN MOUNTAIN NETWORK | RÉSEAU CANADIEN DES MONTAGNES

# DUSTY TEAM MEMBERS

## Collaborators

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Ecologist Team  
Leader  
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Manager  
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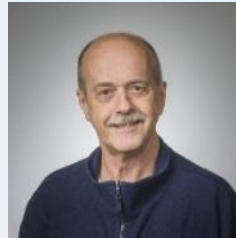
James King  
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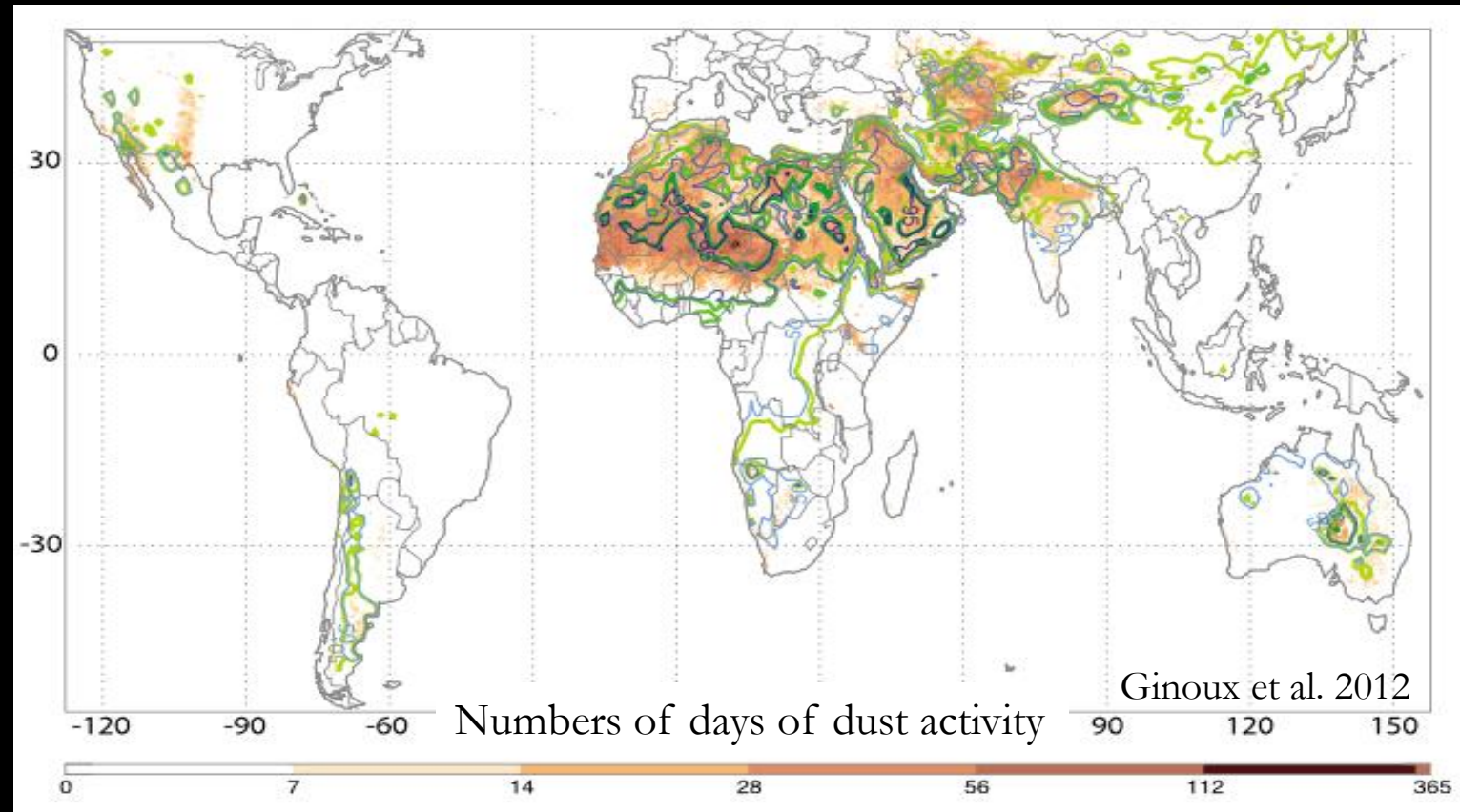


Arnold  
Downey  
MSc Student  
UdeM

Starting  
April,  
2020

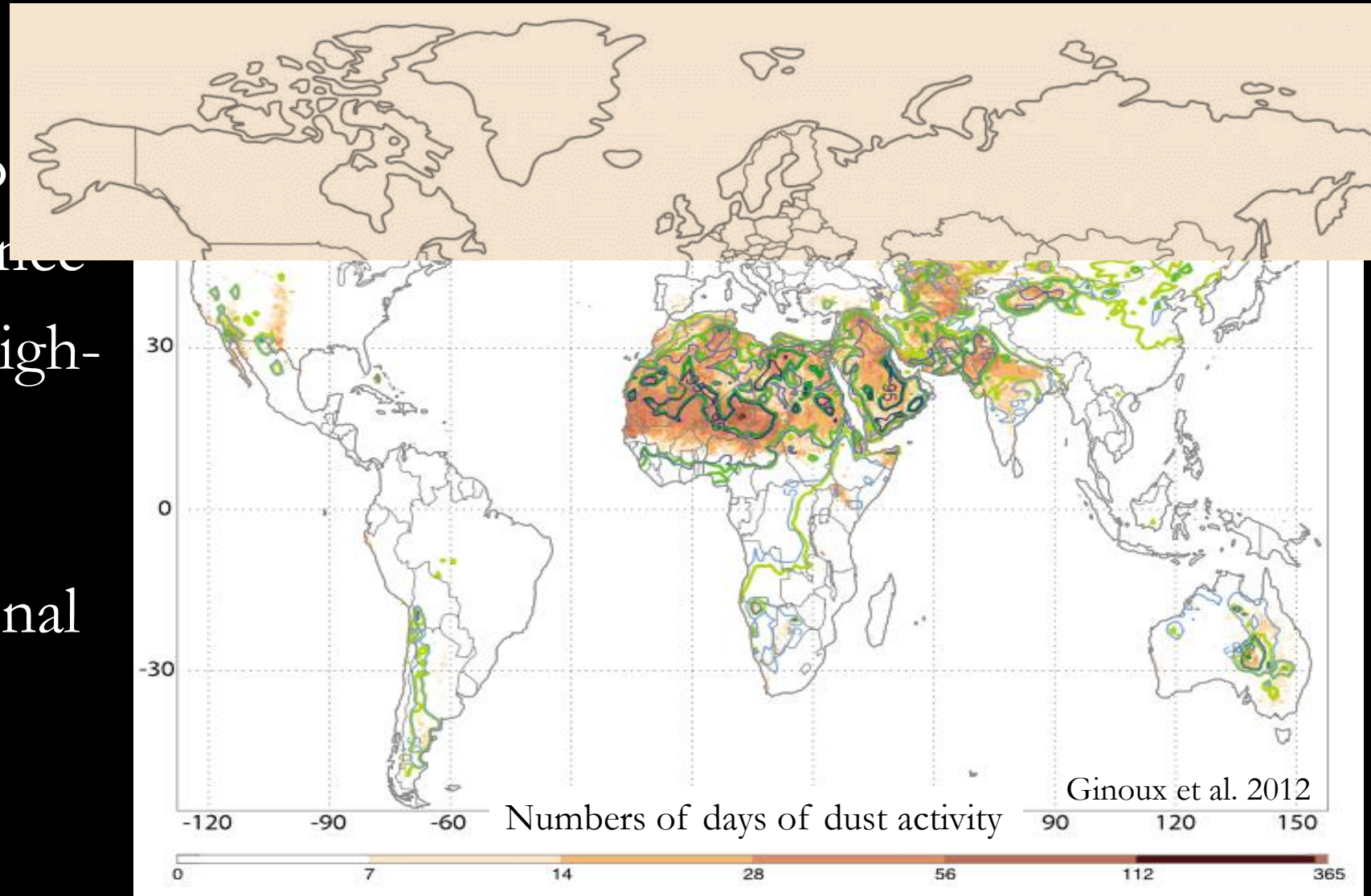
# Global Distribution of Dust Storms

- Are based on global remote sensing approach using surface reflectance
- Ground-truthed by high-resolution field campaigns
- Used directly in regional and global climate models



# ~~Global~~ Distribution of <sup>High Latitude</sup> Dust Storms

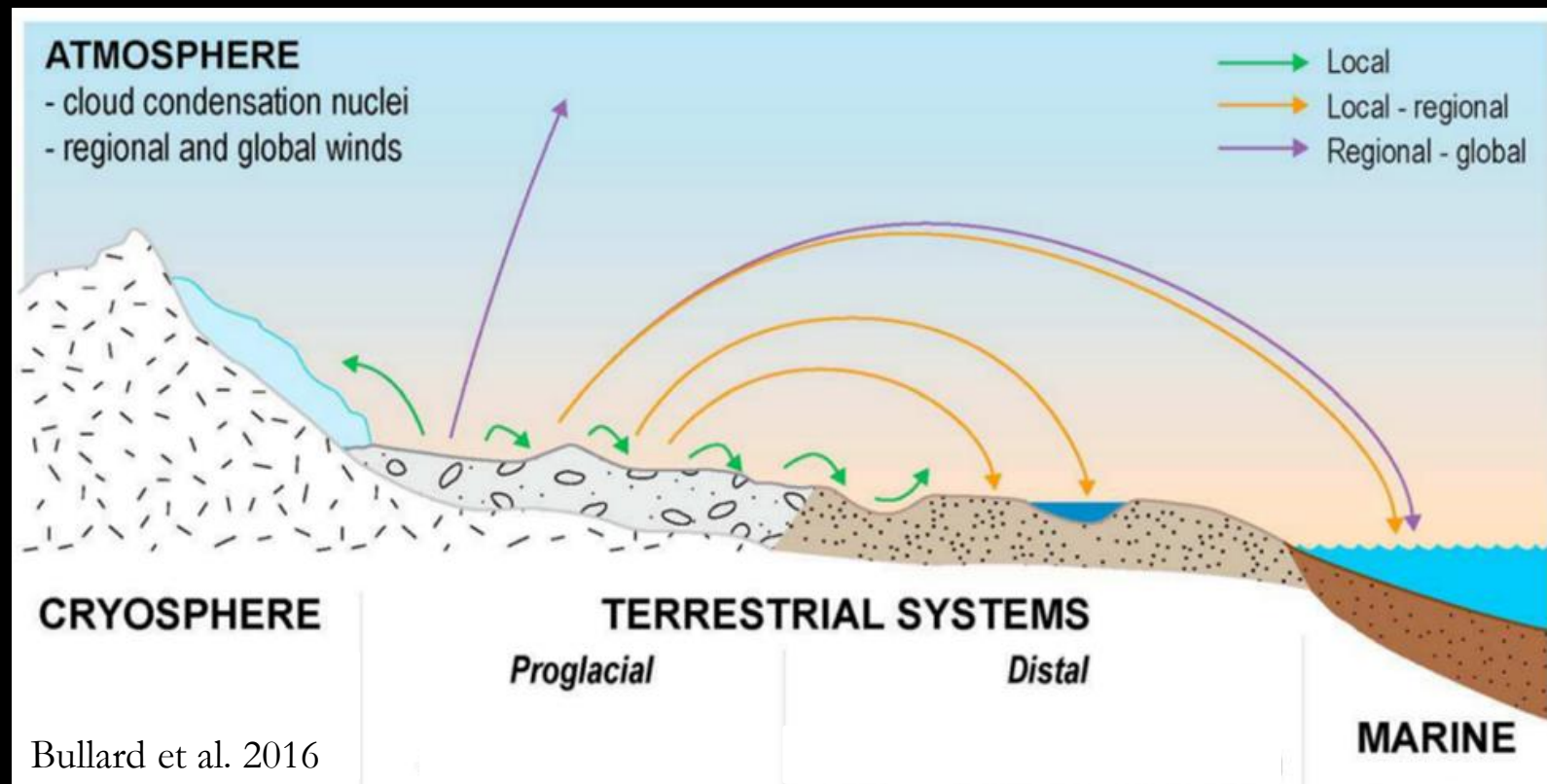
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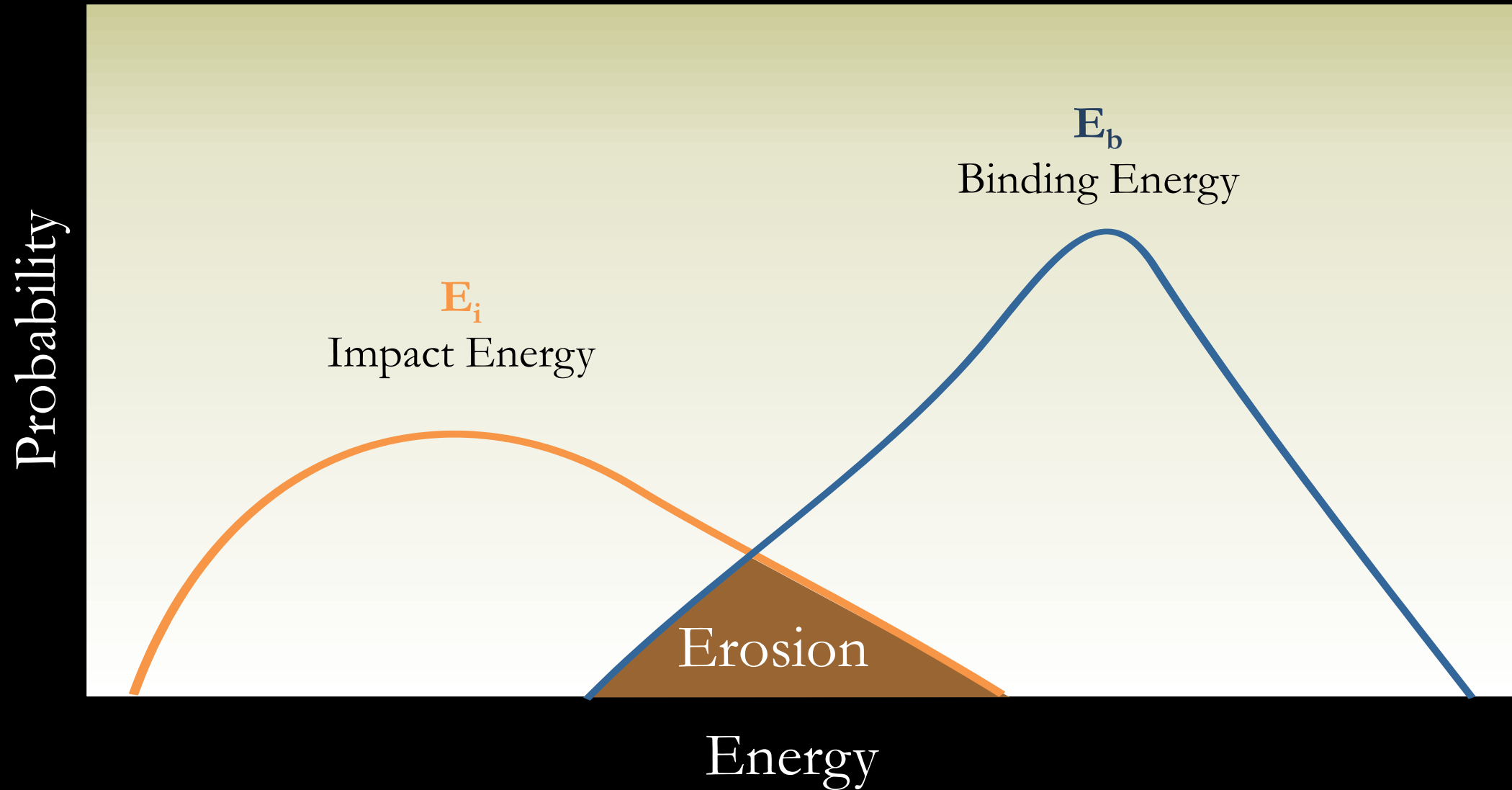
# ~~Global~~ Distribution of <sup>High Latitude</sup> Dust Storms

## Differences/Importance

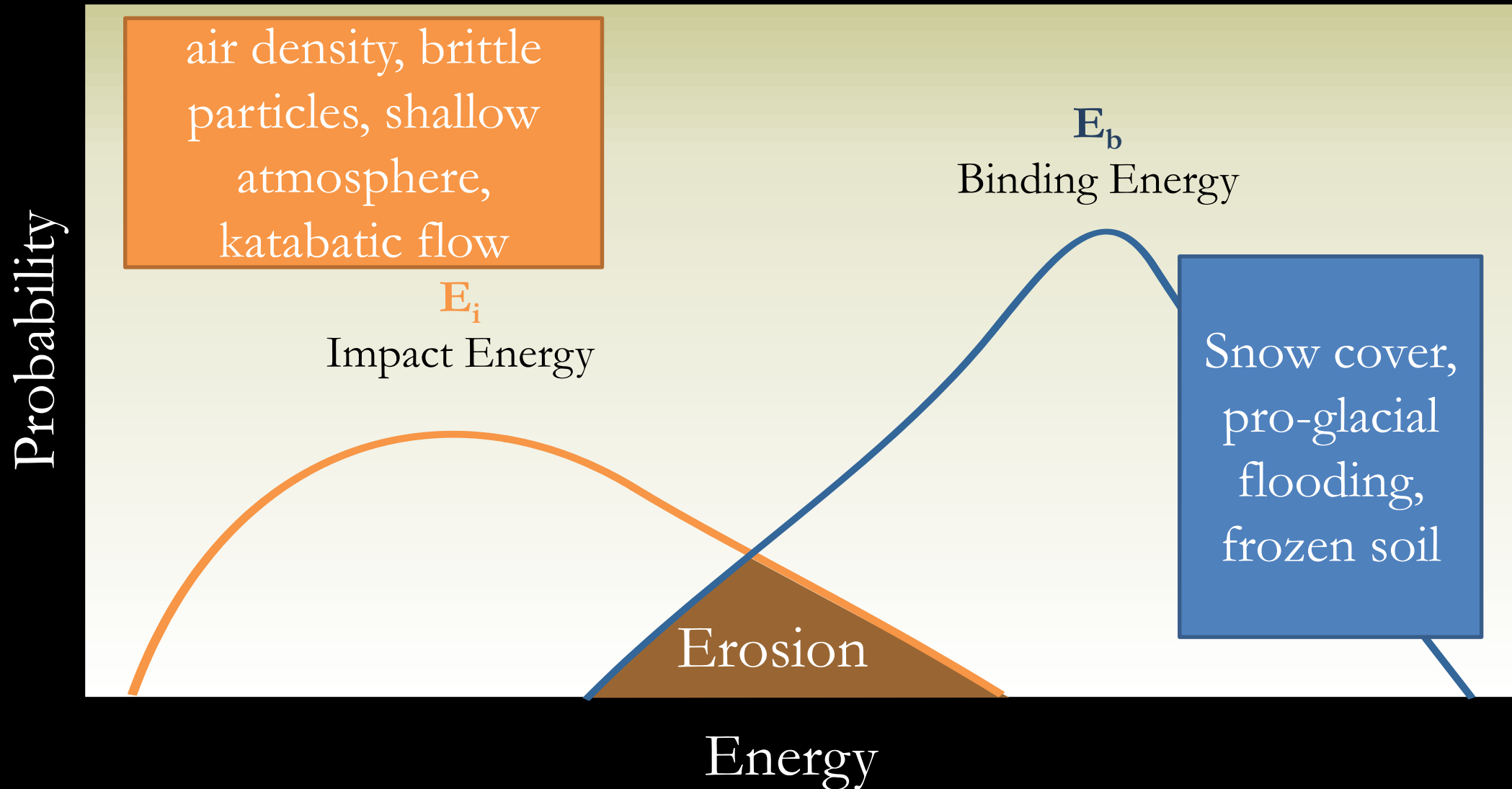
- Seasonal production of wind erodible material
- Shallow boundary layer concentrates emissions
- Local and synoptic meteorological mechanisms important
- Hydrologically isolated landscapes limit nutrient distribution



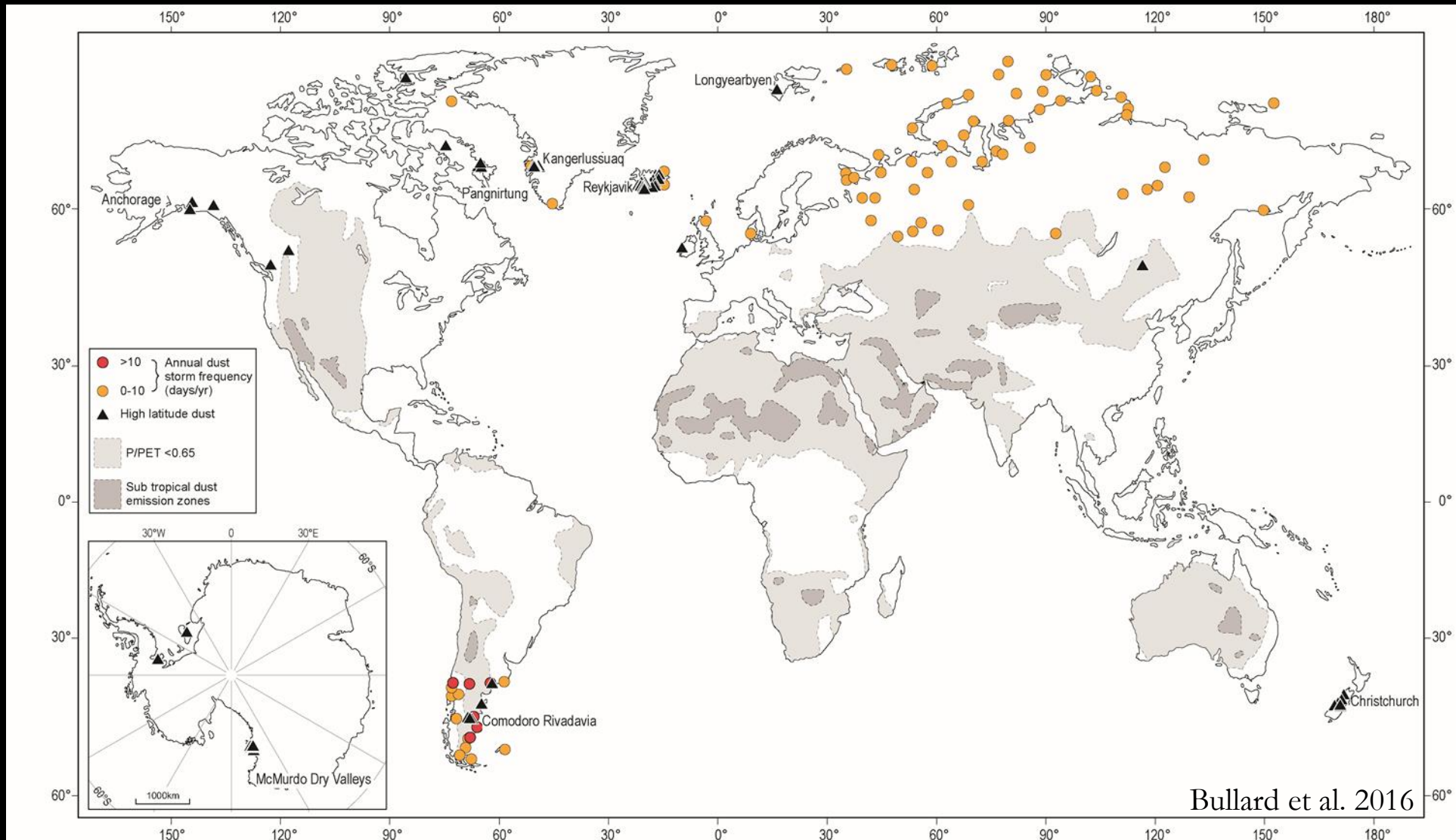
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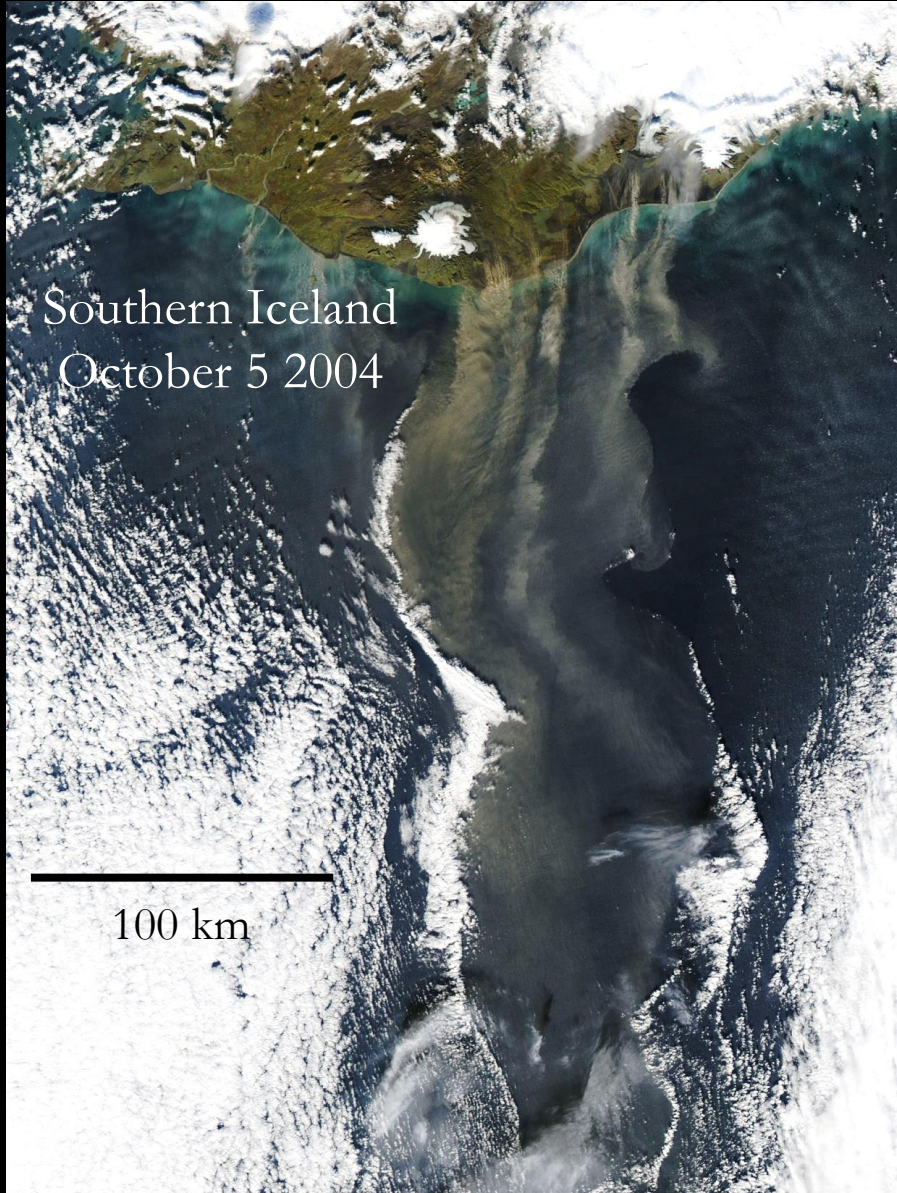


# Where are these high latitude dust sources?



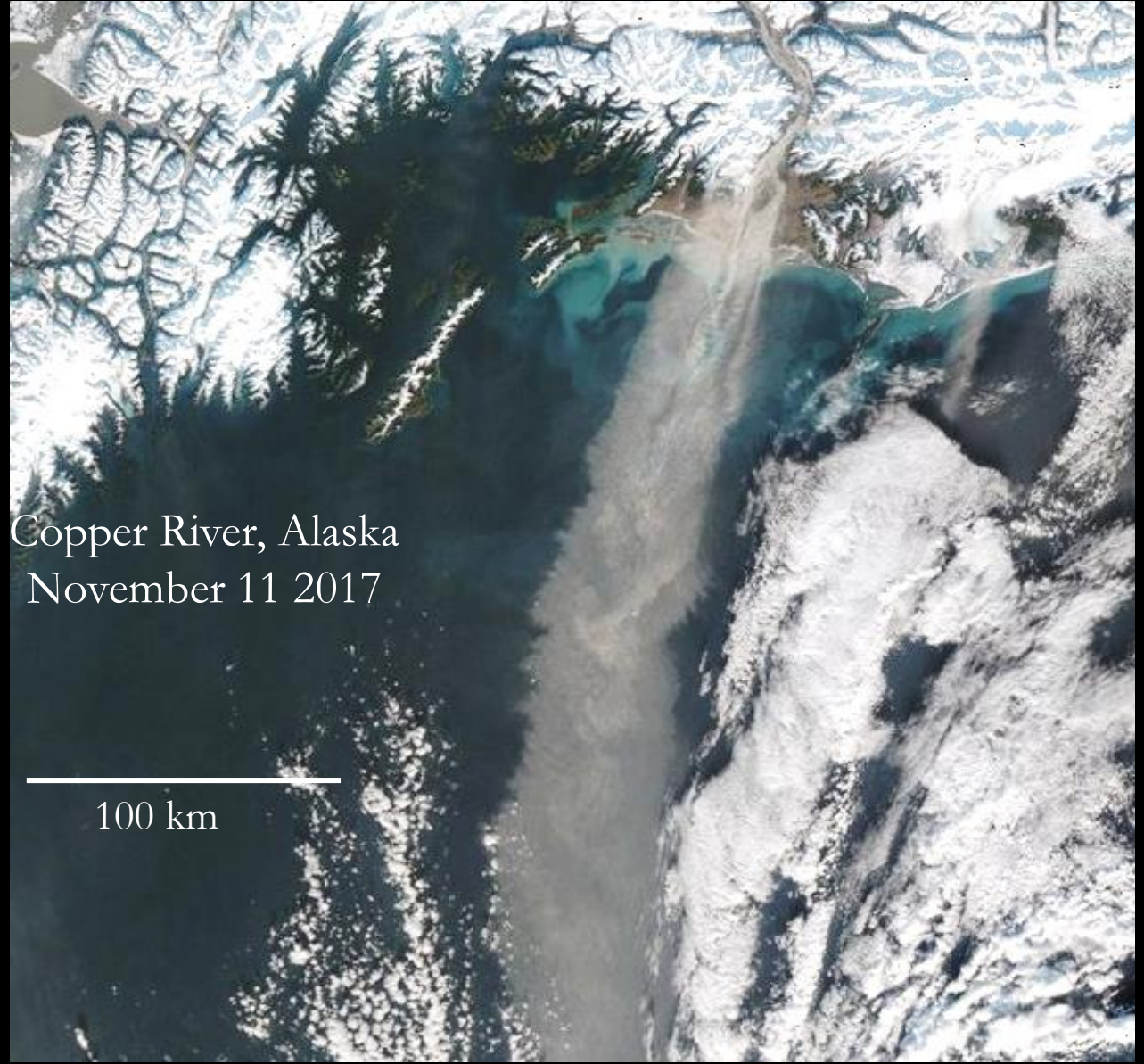


# Where are these high latitude dust sources?



Southern Iceland  
October 5 2004

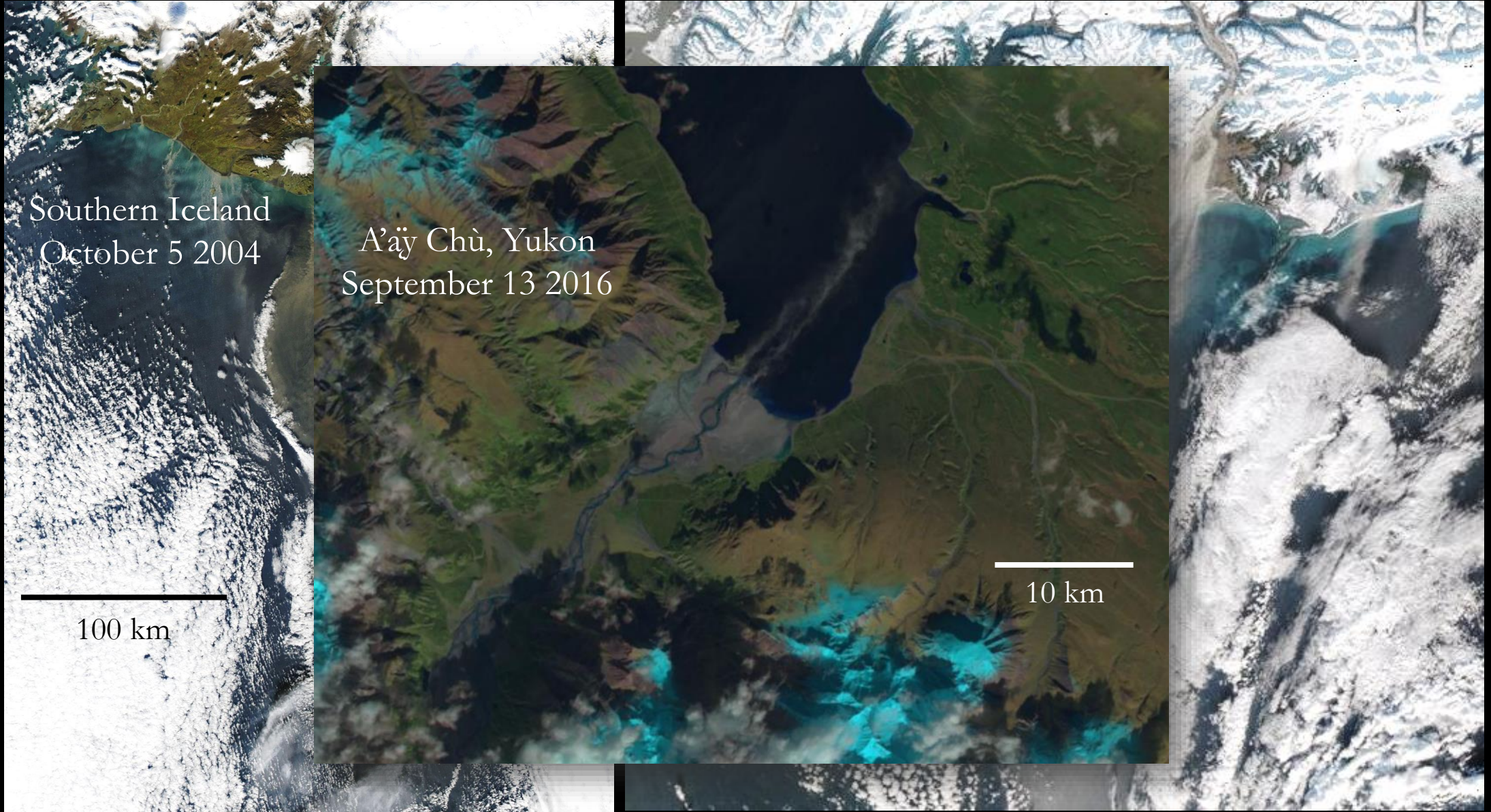
100 km



Copper River, Alaska  
November 11 2017

100 km

# Where are these high latitude dust sources?



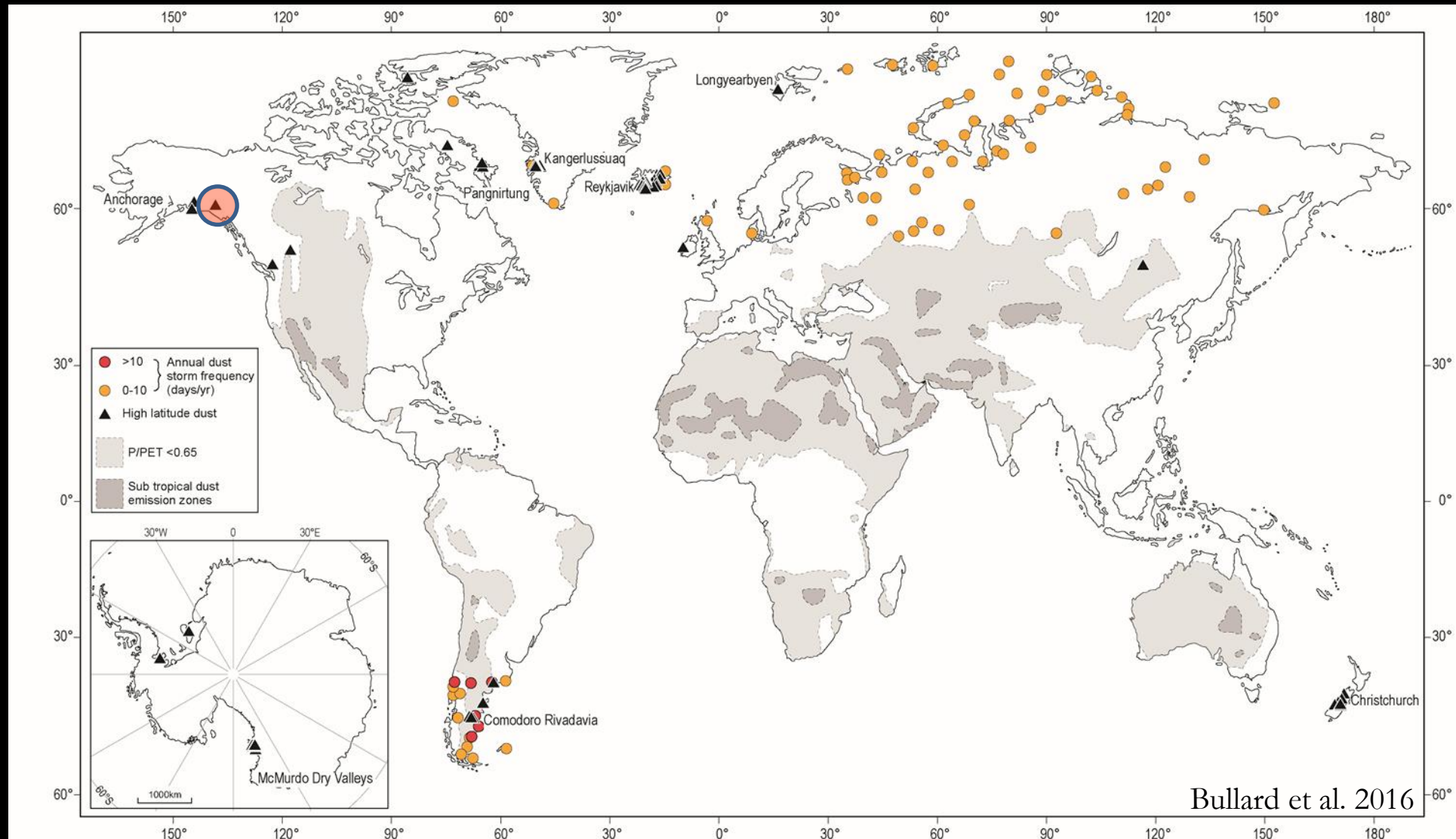
Southern Iceland  
October 5 2004

A'äy Chù, Yukon  
September 13 2016

100 km

10 km

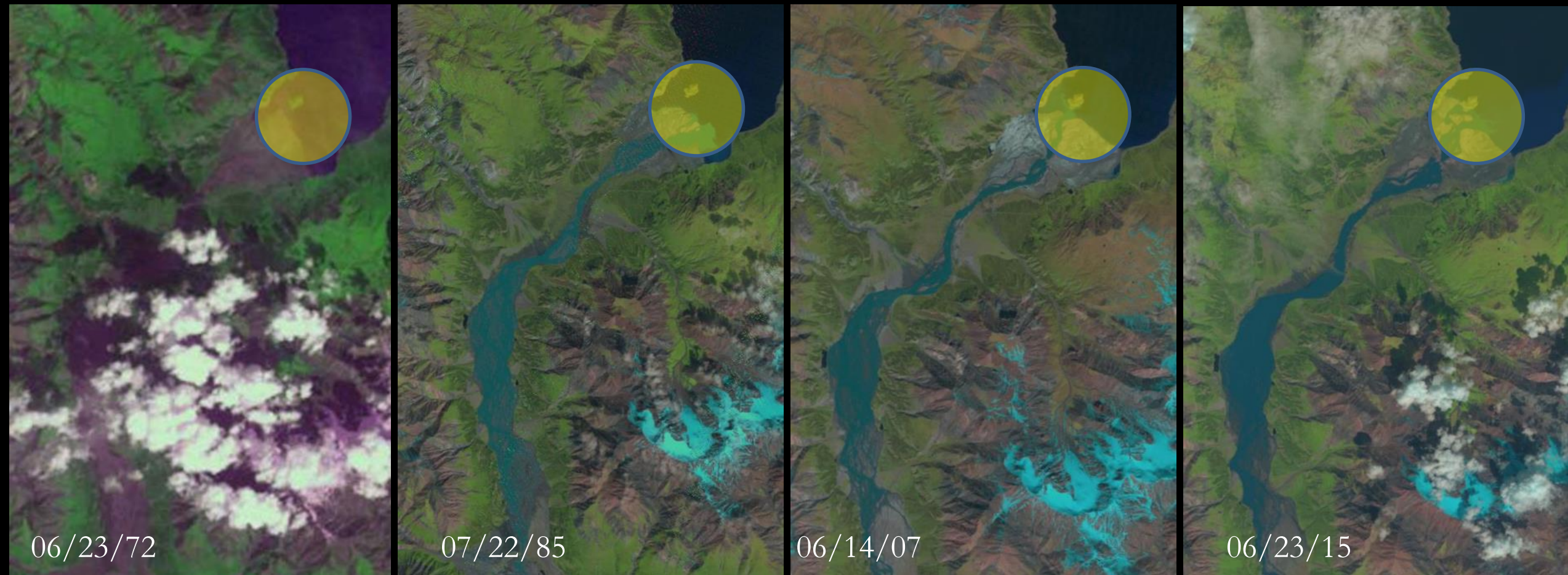
# A'äy Chù, Kluane First Nation, Yukon



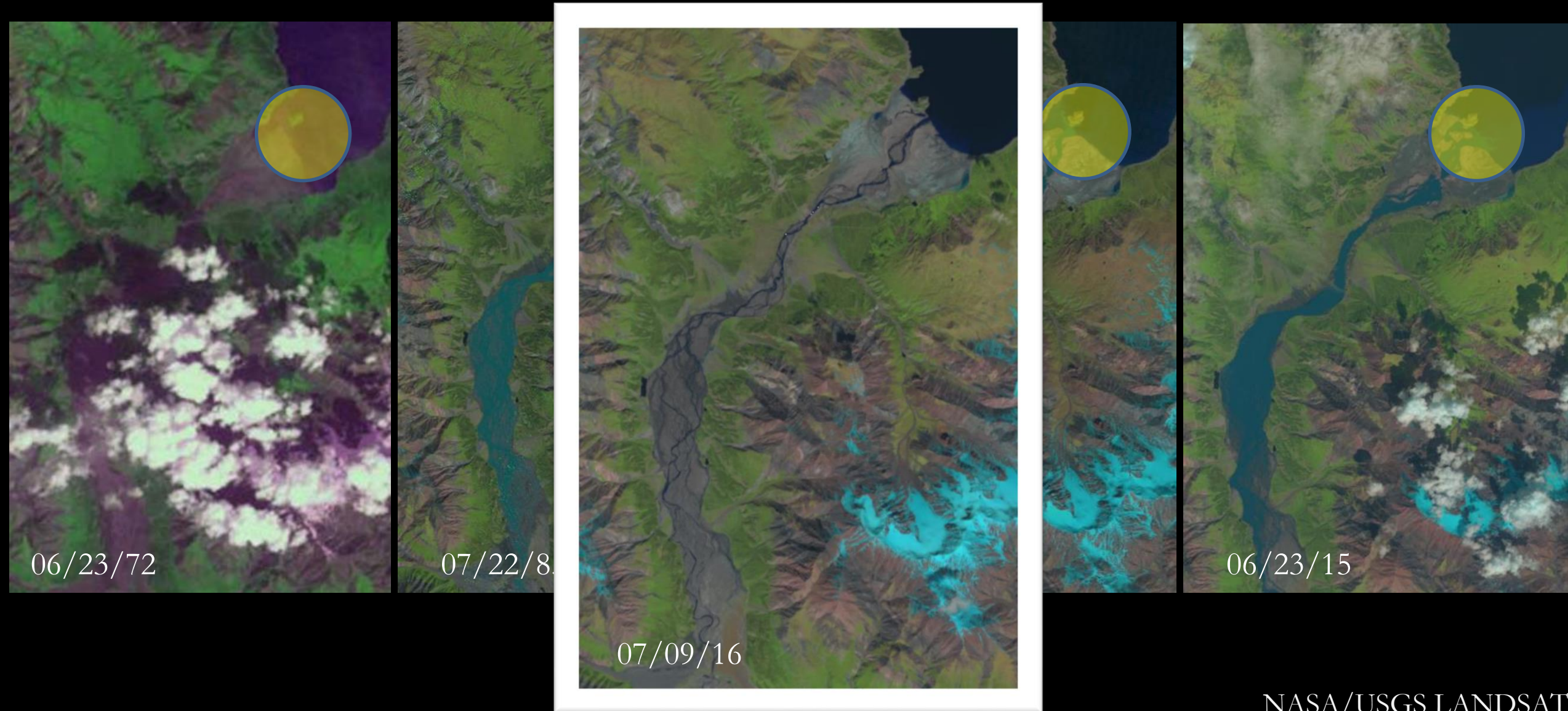
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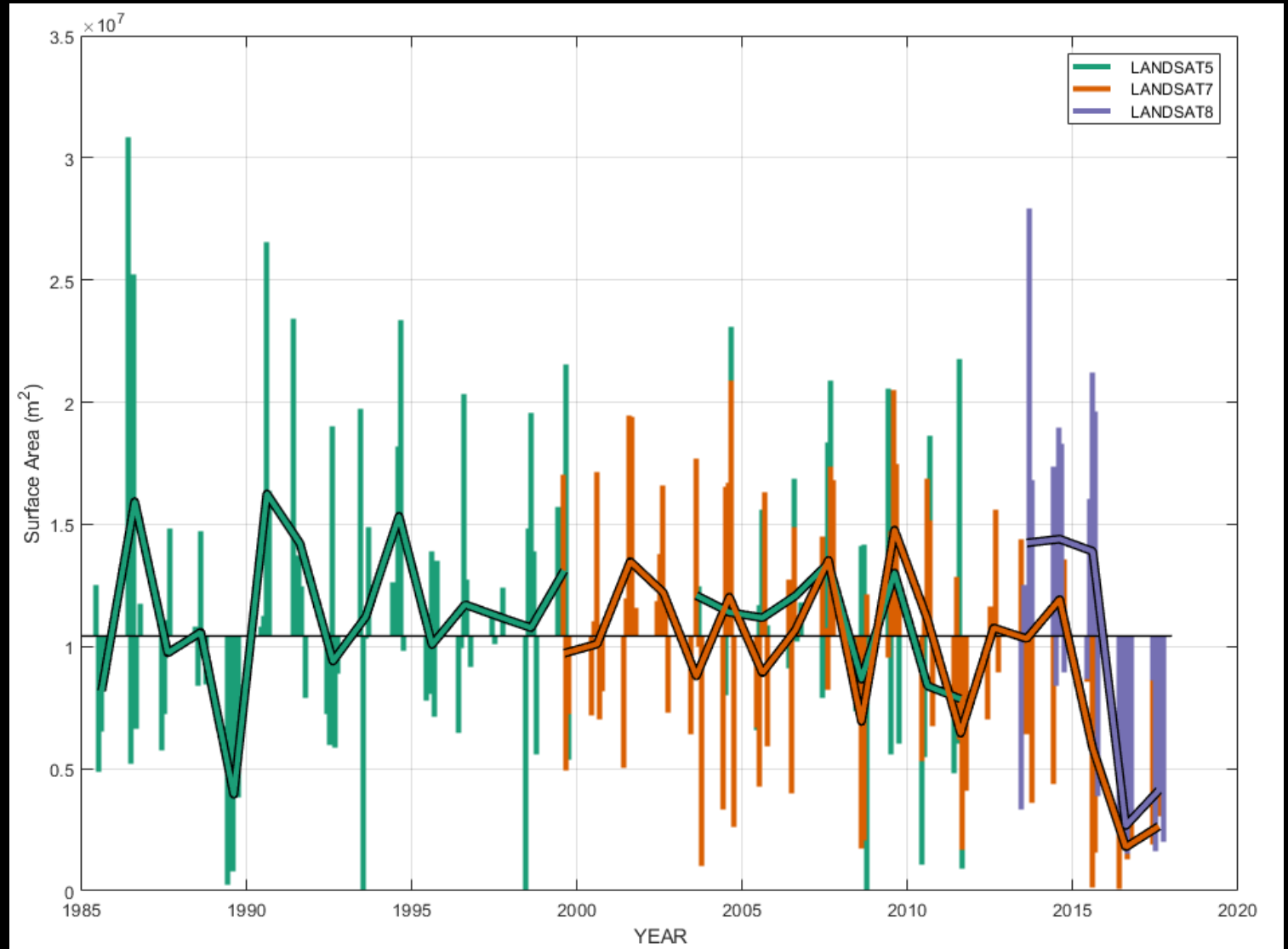


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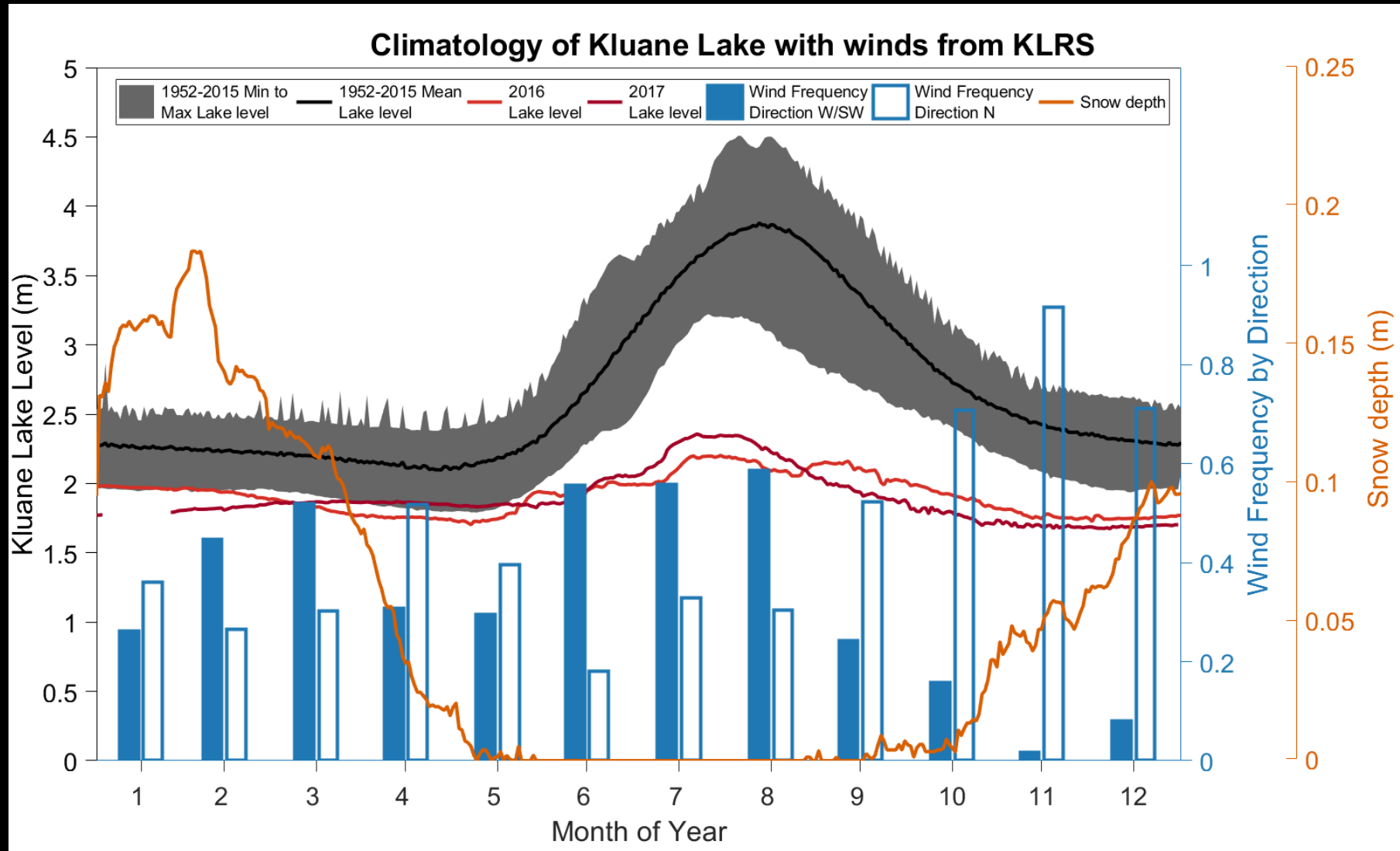


# LANDSAT satellite image classification

- A net decrease in the cover of water in the valley in summer months
- Large variation in other years, but no other years had consecutive years below average cover



# Impact of River Piracy on potential wind erosion



# A'äy Chù, Kluane First Nation, Yukon

- Potential impacts include health of lake, flora, & fauna, permafrost, public health, tourism
- Cumulative impacts are being felt by many sectors requiring a mutli-method approach



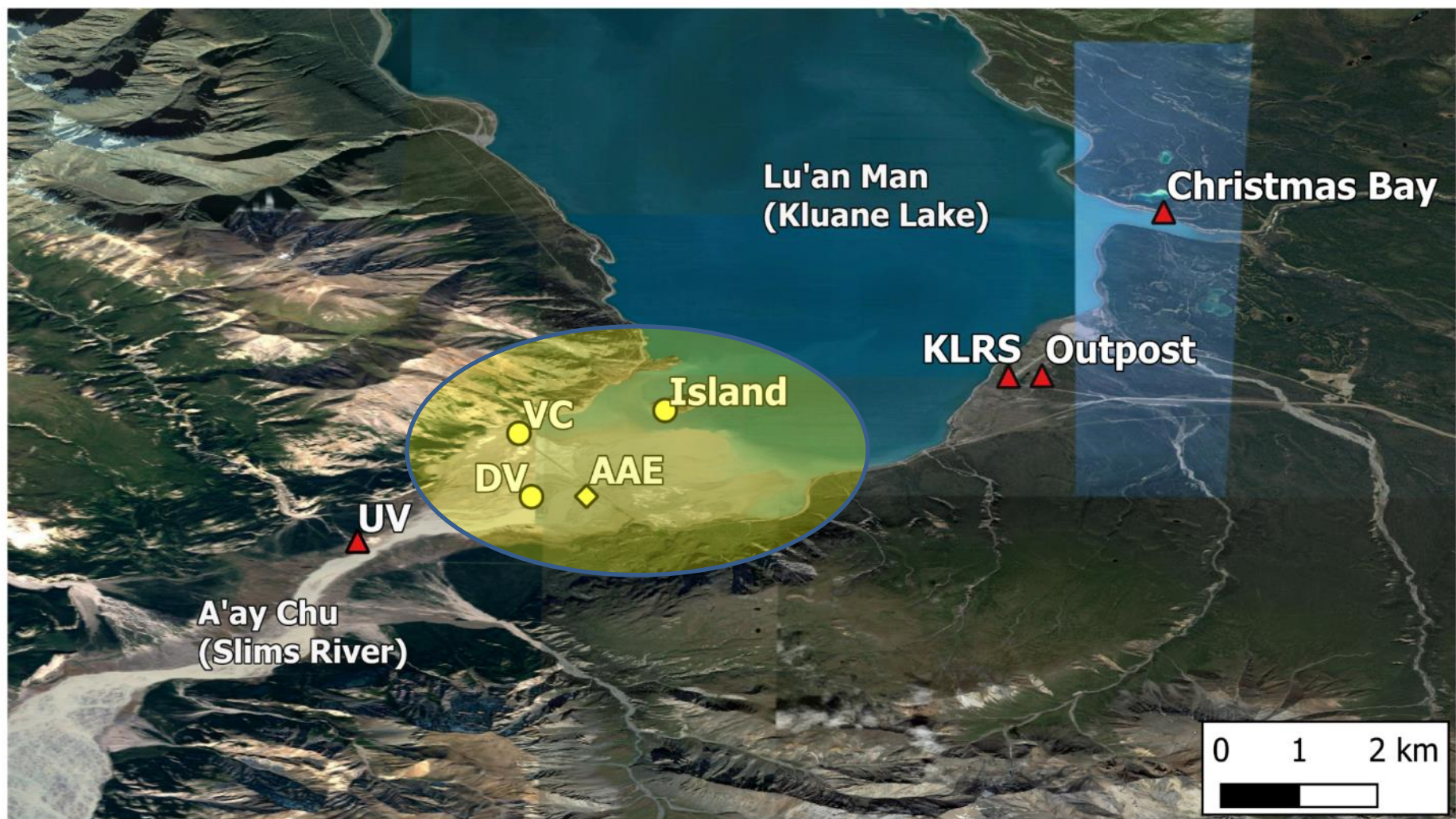
# PROJECT OBJECTIVES

1. Identify the mechanisms that produce pro-glacial valley wind erosion mineral dust (MD) (YEAR 1-2)
2. Characterize physical, optical and chemical properties of airborne and deposited mineral dust at high latitudes (YEAR 1-2)
3. Evaluate the importance of nutritional inputs provided from mineral dust deposition onto surrounding landscapes (YEAR 2-3)
4. Compare and evaluate mineral dust production from ground and satellite measurements against The Fourth Generation Atmospheric Global Climate Model (CanAM4) (YEAR 3)

# A'äy Chù Field Instrumentation



# A'äy Chù Sampling Locations



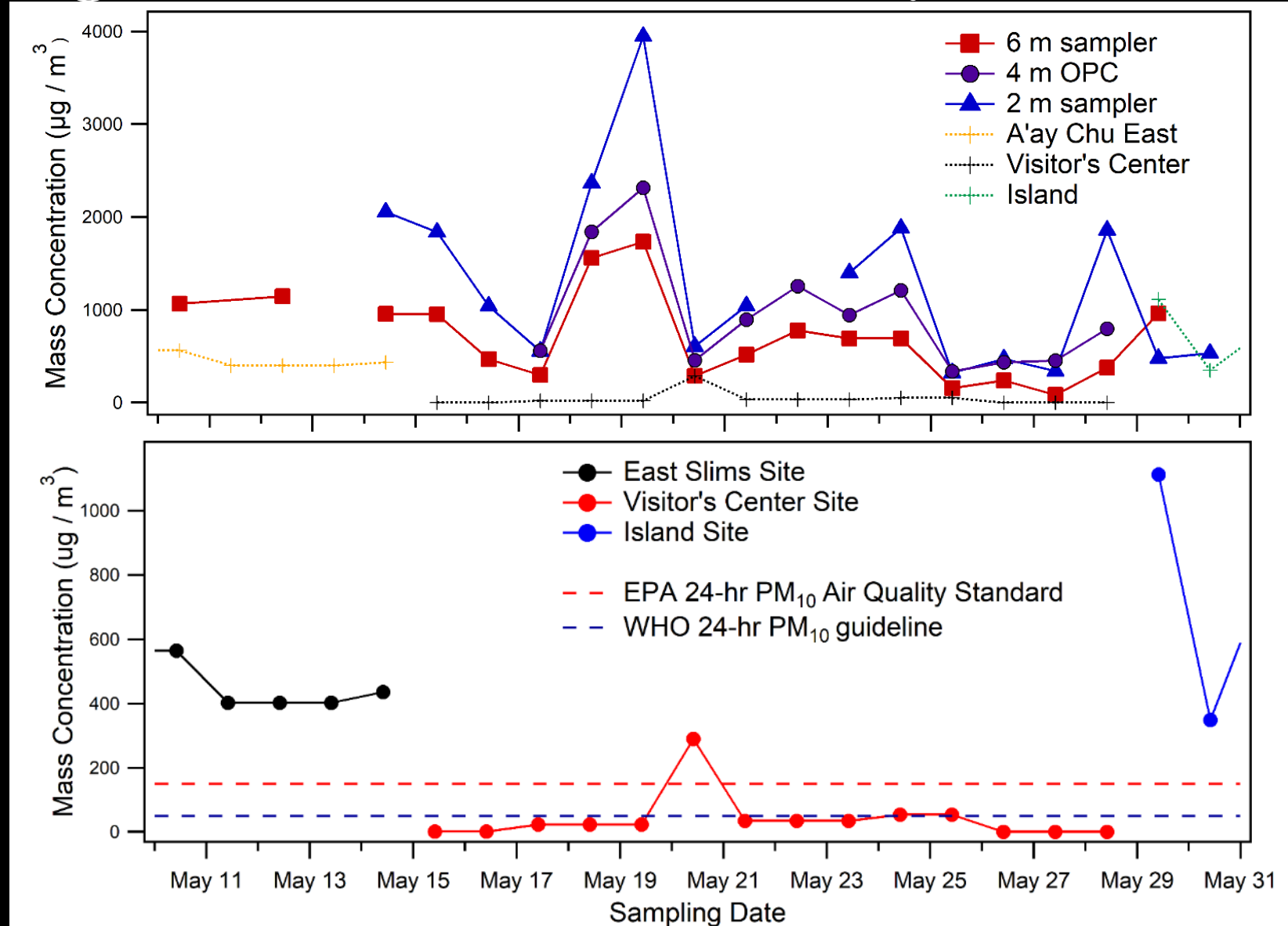
● Air Sampling + Deposition Traps

◆ Air Sampling Only

▲ Deposition Traps Only

# Particle Sizing and Gravimetric Analysis

- 24-hour average PM<sub>10</sub> concentrations from filter samples
- Mobile station PM<sub>10</sub> exceeded air quality thresholds



# Ambient Concentrations of As, Pb

Site	As (ng / m <sup>3</sup> / day)	Pb (ng / m <sup>3</sup> / day)
DV site (h = 2 m)	23.2	18.4
A'ay Chu East, May 11	7.41	6.39
A'ay Chu East, May 14	8.80	6.44
Most Populated Site  Visitor's Center, May 20	4.20	6.00
Island, May 29	18.9	13.45
Island, May 30	5.22	4.49
Environmental Monitoring Threshold <sup>1</sup>	3 ng / m <sup>3</sup> / yr	100 ng / m <sup>3</sup> / day

1. MDDELCC, 2016. Normes et critères québécois de qualité de l'atmosphère, version 5, Québec, ISBN 978-2-550-77015-2 (PDF), 29 p. [En ligne]. <http://www.mddelcc.gouv.qc.ca/air/criteres/index.htm>

# Canadian Mountain Network

- Knowledge co-Production potential within the CMN
  - Western science approach leaves open many possibilities to engage and benefit from a more diverse approach to knowledge coproduction
- What does being part of CMN mean to you?
  - CMN provides the key setting to expand the knowledge of this dynamic system not unique to the region and can benefit other communities by providing knowledge on effects, adaptation measures, and coping strategies

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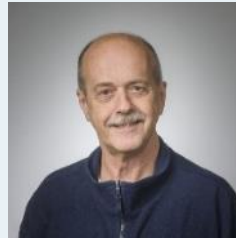
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