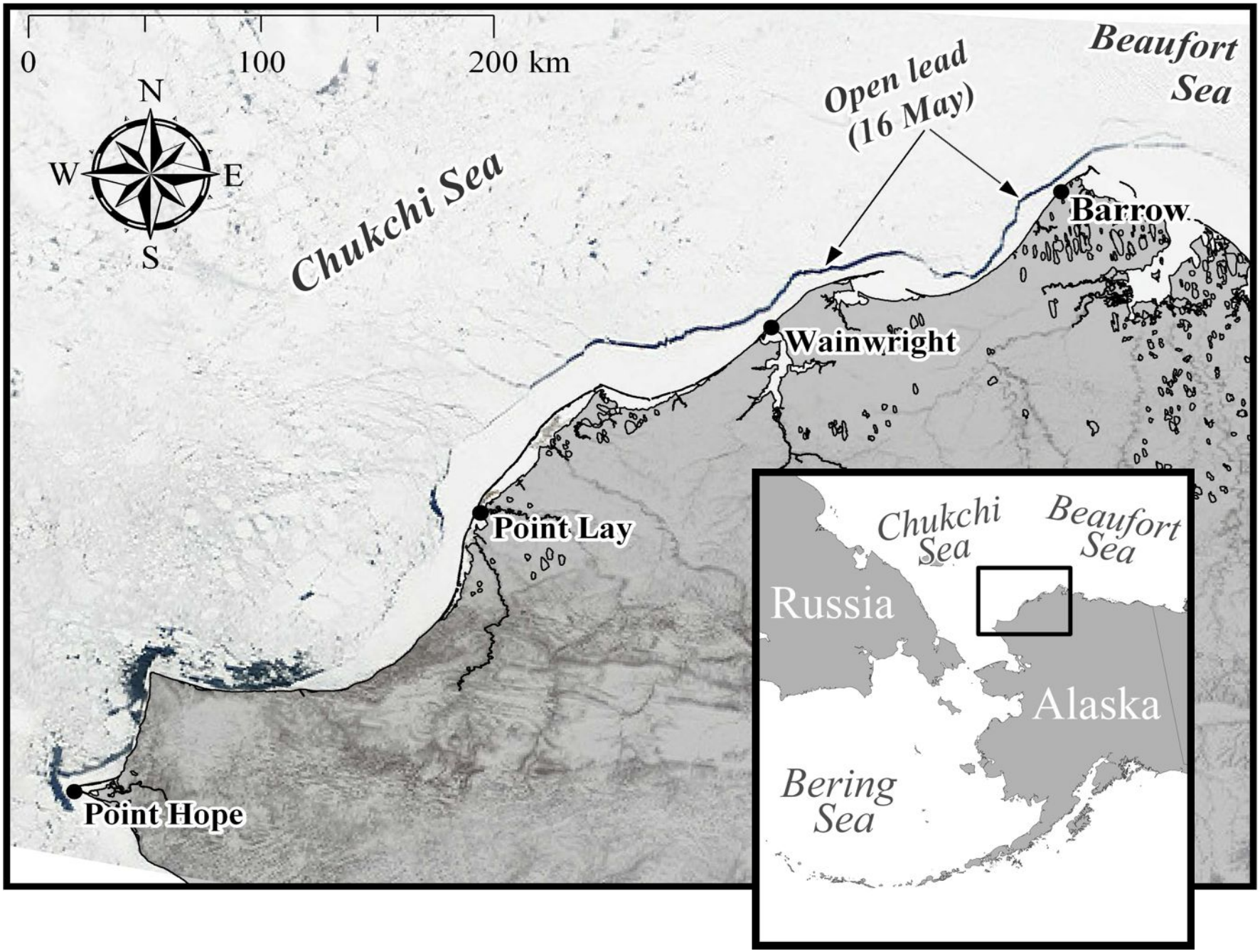
Integrating Geophysical and Iñupiat Knowledge on Alaska Shorefast Ice Stability using Fault Tree Analysis

Matthew Druckenmiller & Hajo Eicken

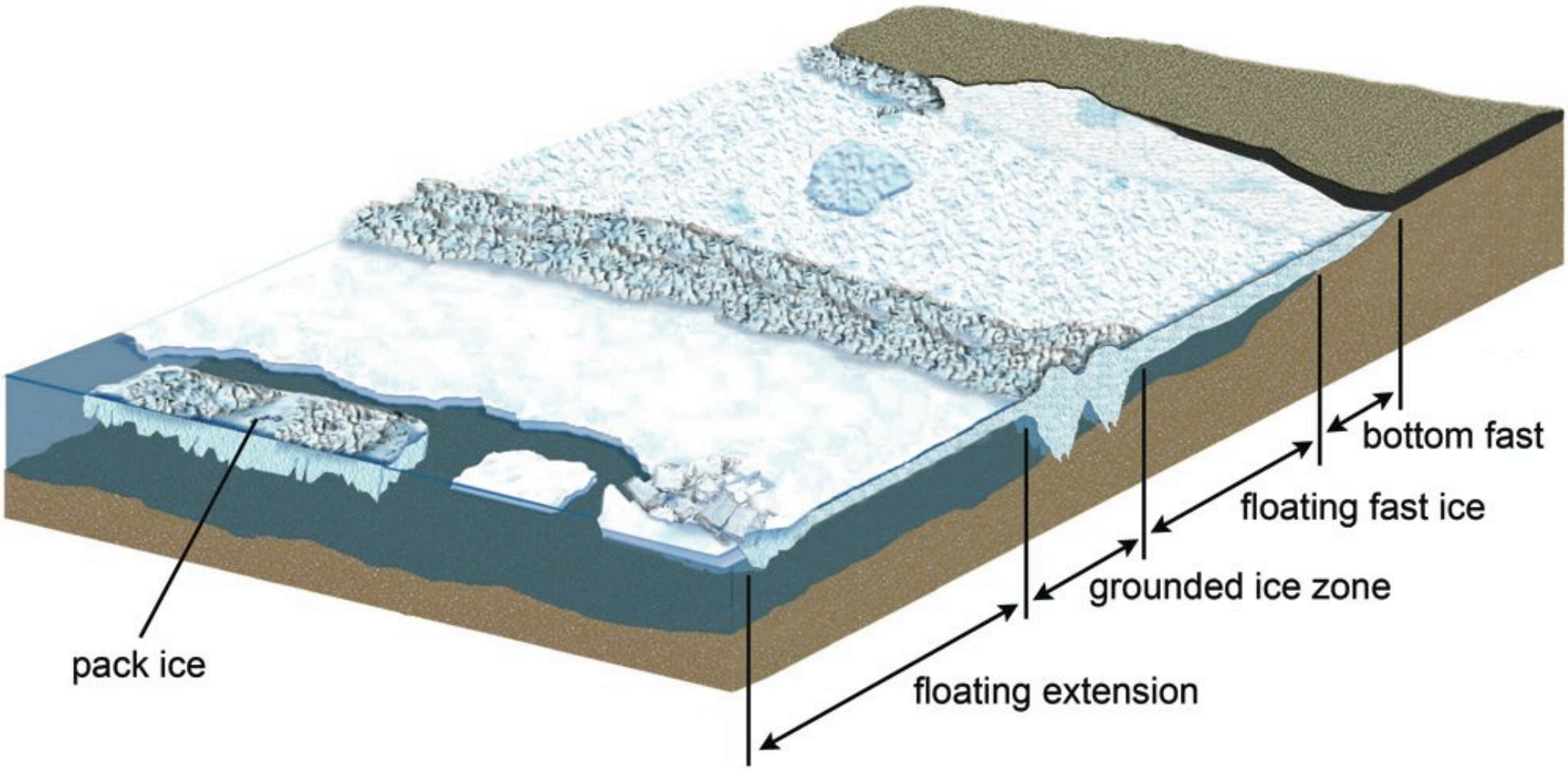
Photo by Chris Petrich


0
100
200 km
N
W
E
S
Chukchi Sea
Open lead
(16 May)
Beaufort
Sea
Barrow
Wainwright
Point Lay
Point Hope
Chukchi
Sea
Beaufort
Sea
Russia
Alaska
Bering
Sea


Barrow, March 2009
Photo by Craig George


Barrow, March 2009

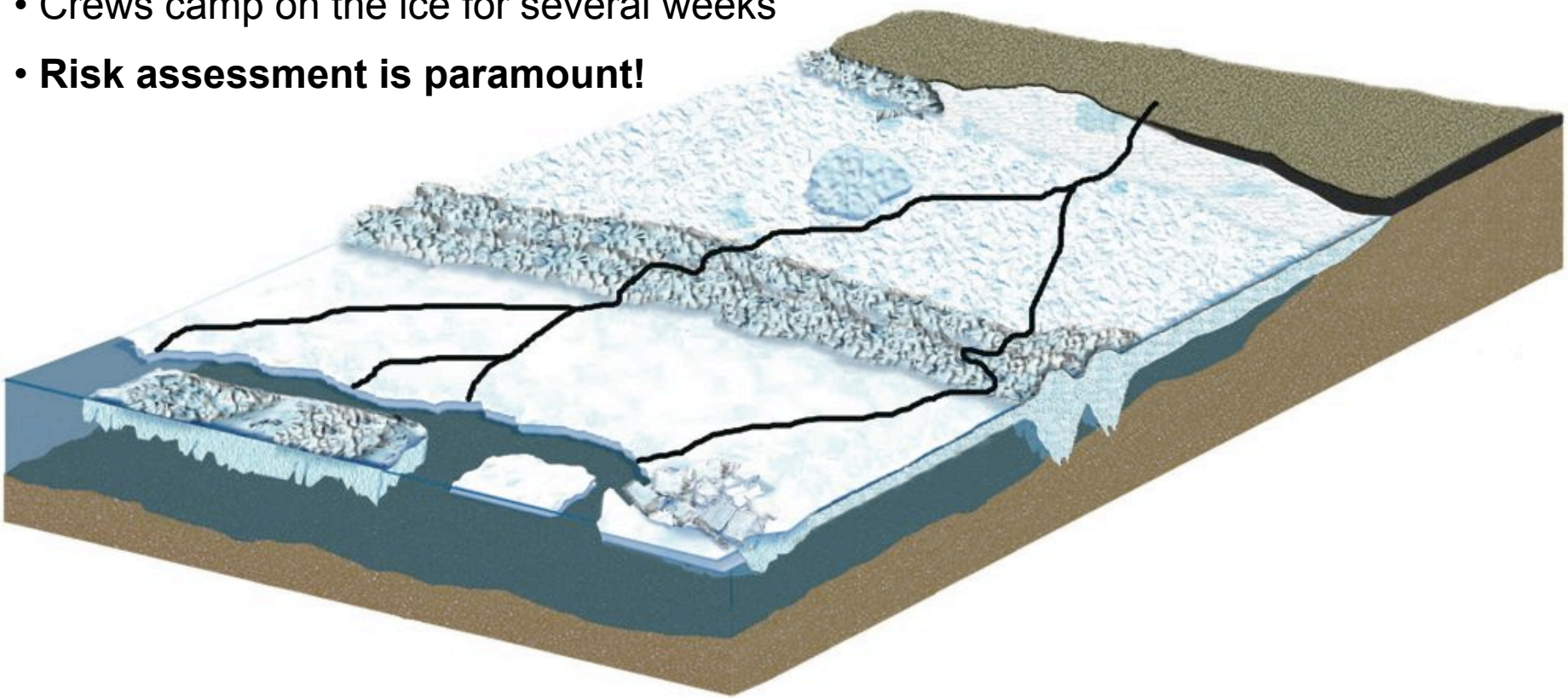
Shorefast Ice in the Chukchi Sea



Adapted from an illustration by Deb Coccia

Iñupiat Use of Shorefast Ice

- The Iñupiat build ice trails across a range of ice types and conditions.
- A couple hundred people may be on the ice at once.
- Crews camp on the ice for several weeks
- **Risk assessment is paramount!**



Adapted from an illustration by Deb Coccia


Later freeze-up in fall


Less multi-year ice incorporated


More frequent breakout events in winter and spring


Earlier break-up in late spring and early summer

Later freeze-up in fall

Less multi-year ice incorporated

More freque

winter and s

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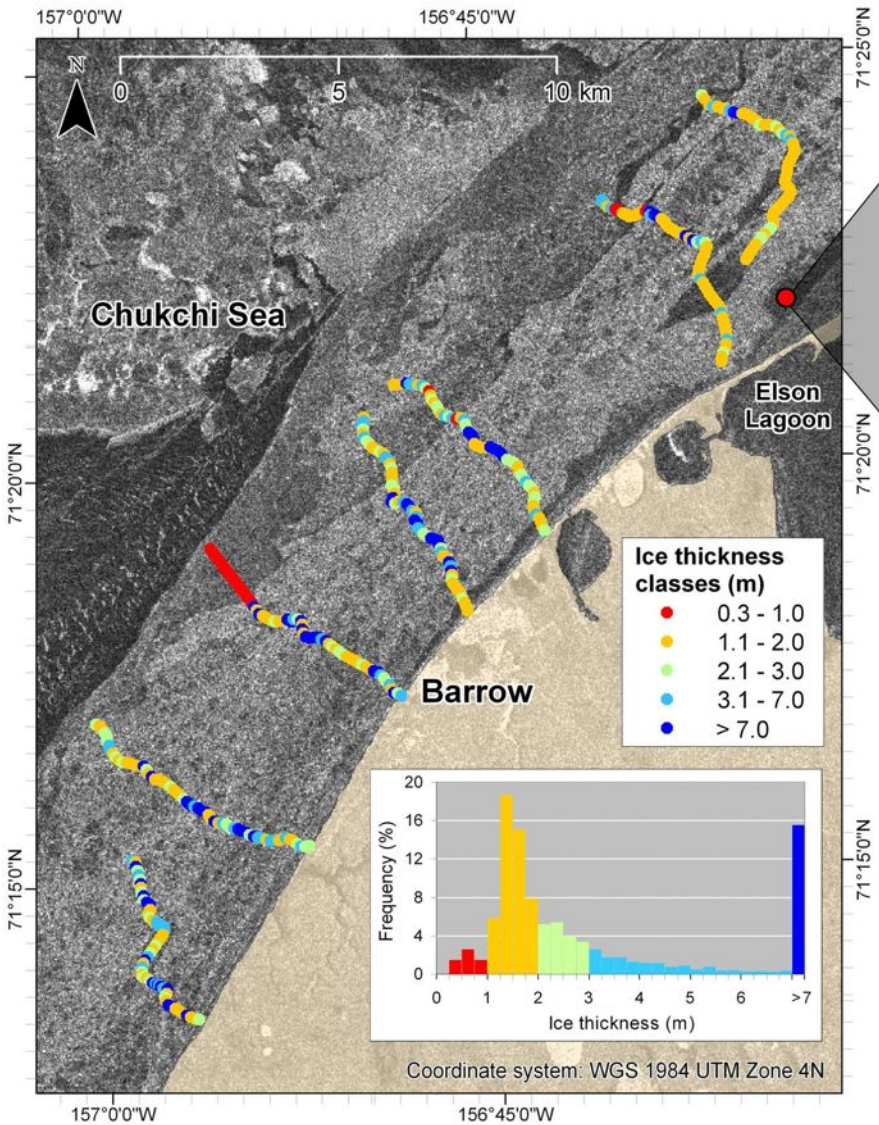
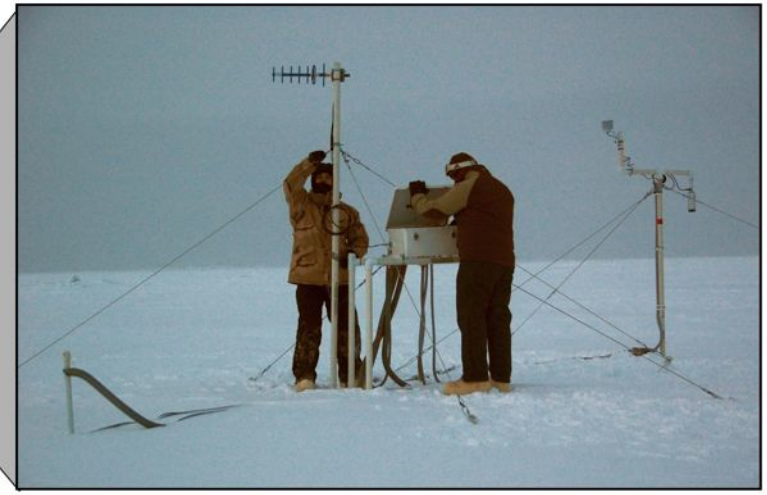
Photo by Craig George

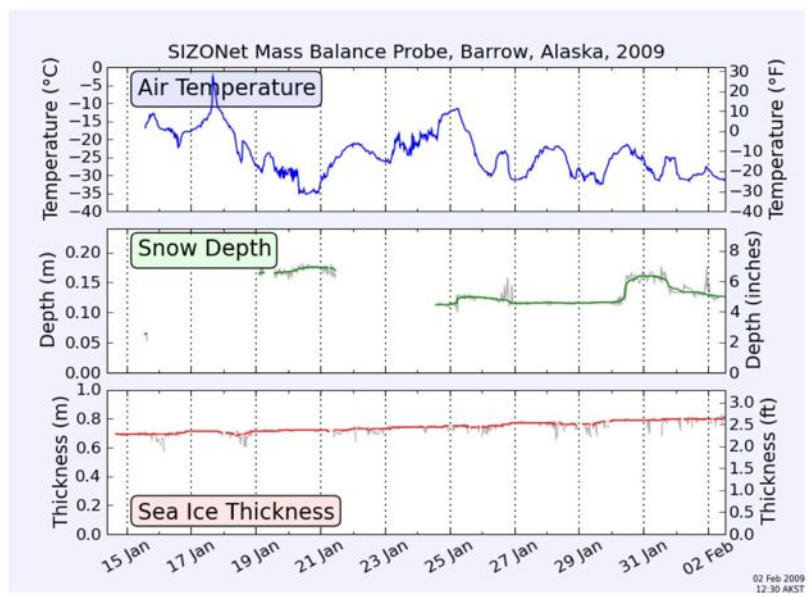
Barrow Sea-Ice Observatory

Ice trail mapping and profiling



Mass balance site

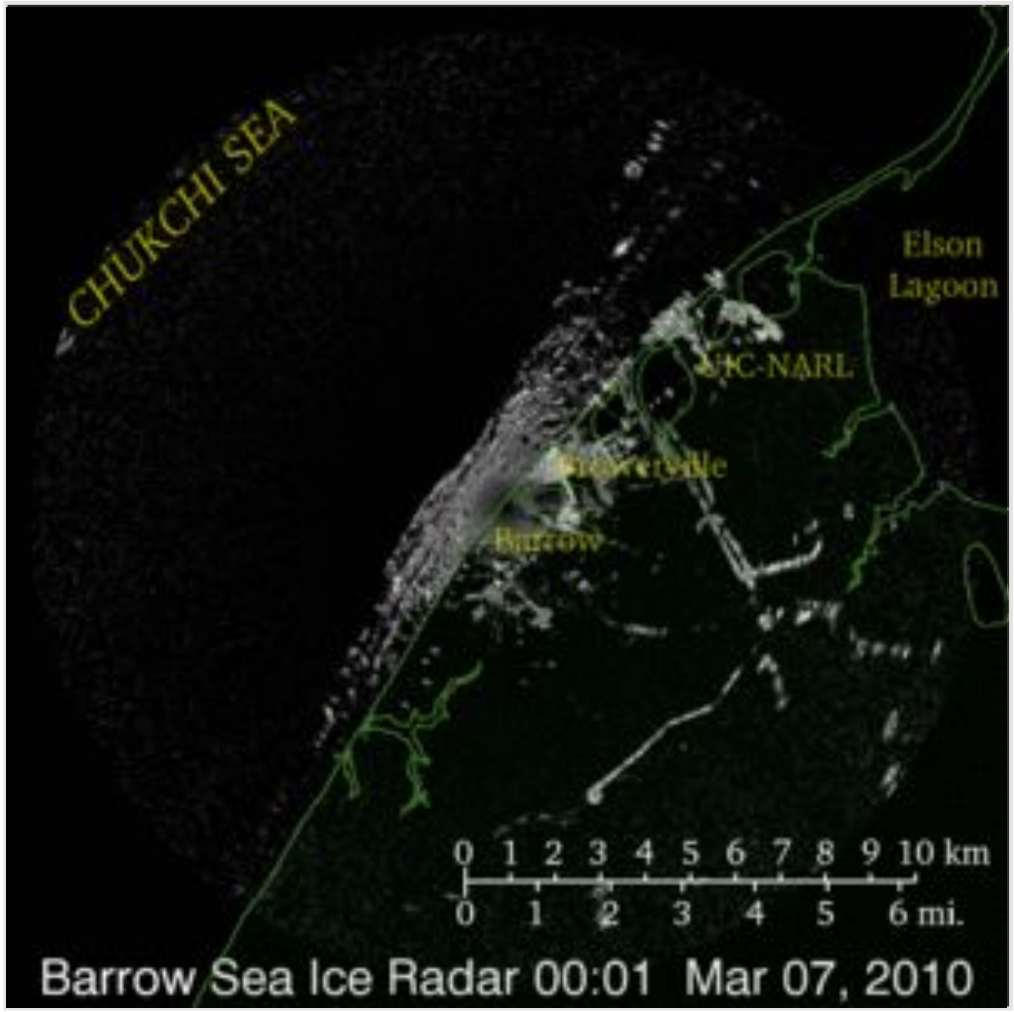




Barrow Sea-Ice Observatory

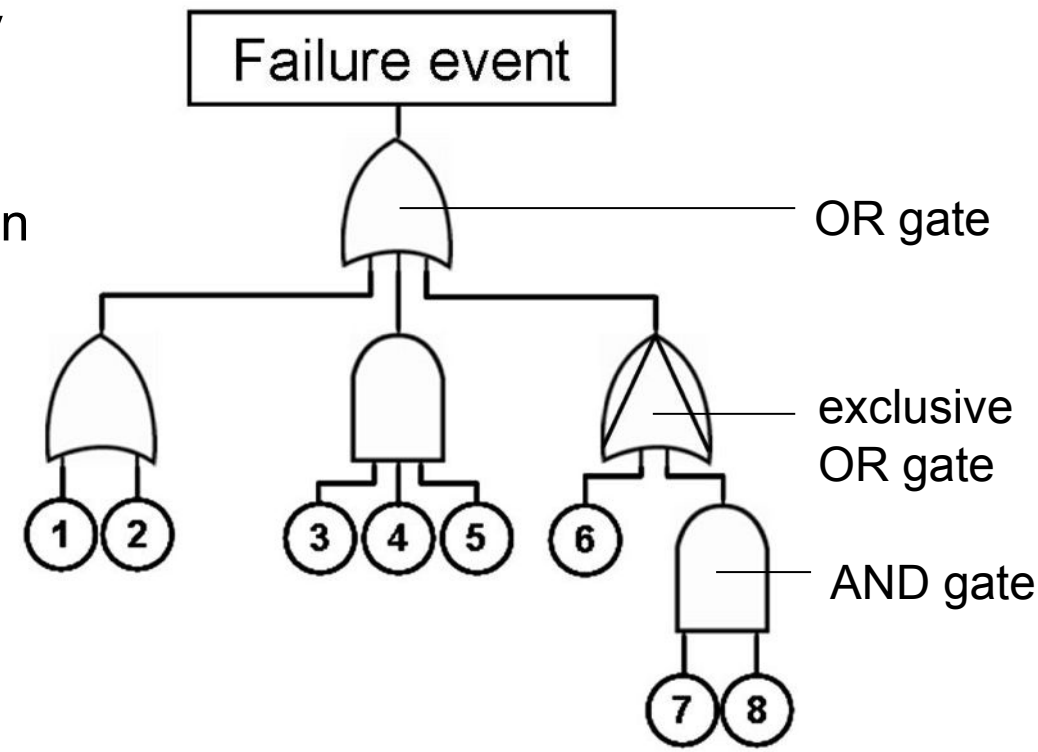
Coastal X-band Radar

24 hr radar animation

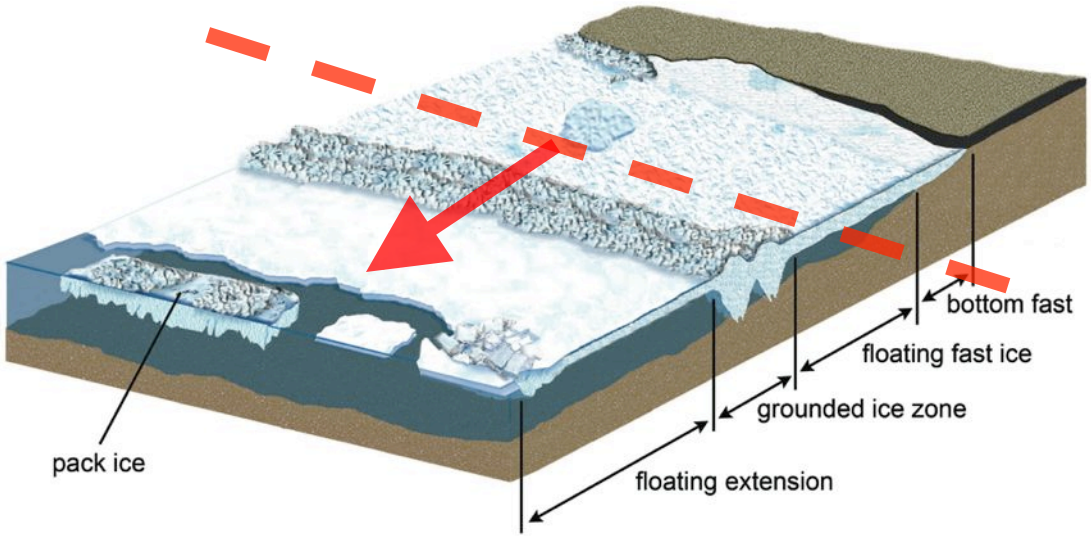


Fault Tree Analysis (FTA)

- Relies on defining an undesired event (or failure)
- Combines a series of lower level events using logical operations to describe the behavior of a system (potential paths to failure)
- Can be used for probability analysis
- Historically developed as an engineering tool to assess failure of complex systems



FTA applied to a Shorefast Ice Break-Out



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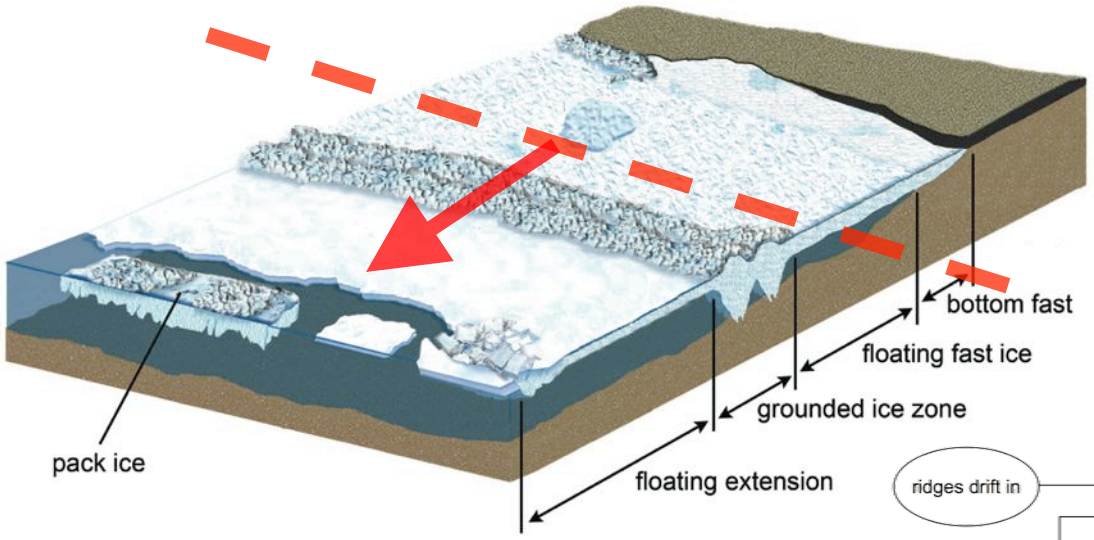
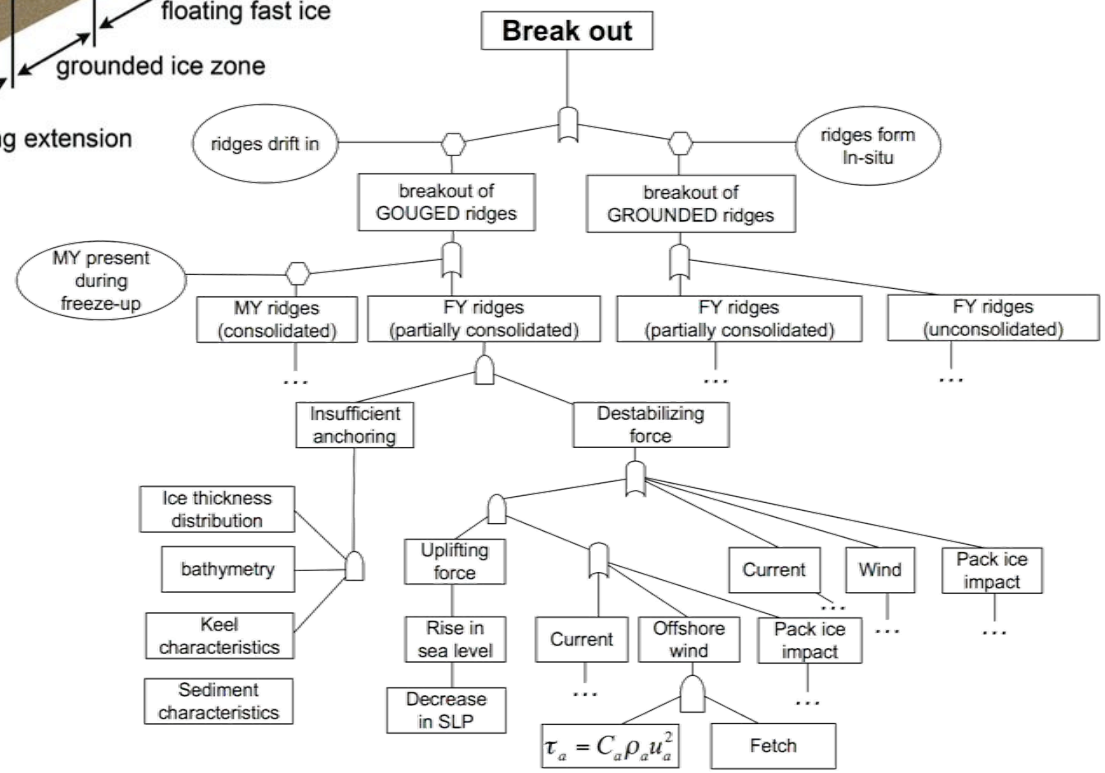
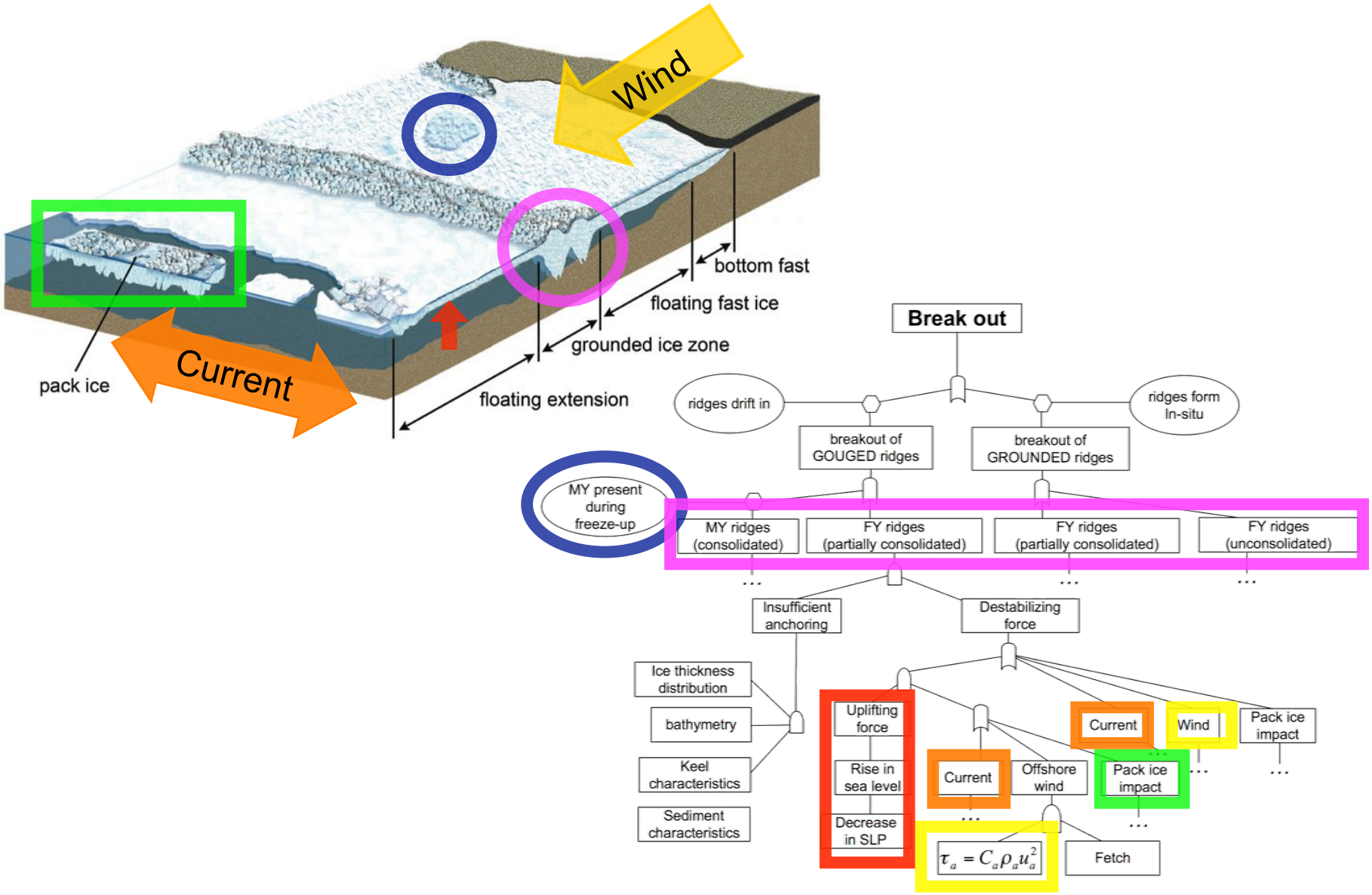




FTA applied to a Shorefast Ice Break-Out



Initial Assessment regarding Fault Tree Analysis applied to Shorefast Ice Stability

1. Enhances communication between scientists and local experts

2. Approximates hunters' decision making during risk assessment

3. Method to assess the likelihood (or frequency) of failure events

   - Challenges exist in assigning probabilities to basic level events.

4. A framework to organize knowledge and observations surrounding past and future failure events

   - Druckenmiller et al. (2009) Toward an integrated coastal sea-ice observatory: System components and a case study at Barrow, Alaska. Cold Reg. Sc. Tech. 56(2-3): 61-72.
   - Mahoney et al. (2007) How fast is landfast ice? A study of the attachment and detachment of nearshore ice at Barrow, Alaska. Cold Reg. Sc. Tech. 47: 233-255.
   - George et al. (2004) Observations on Shorefast Ice Dynamics in Arctic Alaska and the Responses of the Inupiat Hunting Community. Arctic 57(4): 363-374.

Acknowledgements

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Matthew Druckenmiller (mldruckenmiller@alaska.edu) &
Hajo Eicken (hajo.eicken@gi.alaska.edu)