Safe Arctic Activities Beyond Marine Transportation: Chukchi/Beaufort Sea coastal & offshore ice hazards

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- Data & further information: sizonet.org; seaice.alaska.edu/gi/data
- Chapter on Sea Ice Hazards in Ellis et al. (2015) ***Coastal and Marine Hazards, Risks, and Disasters***, Elsevier, pp. 381-401

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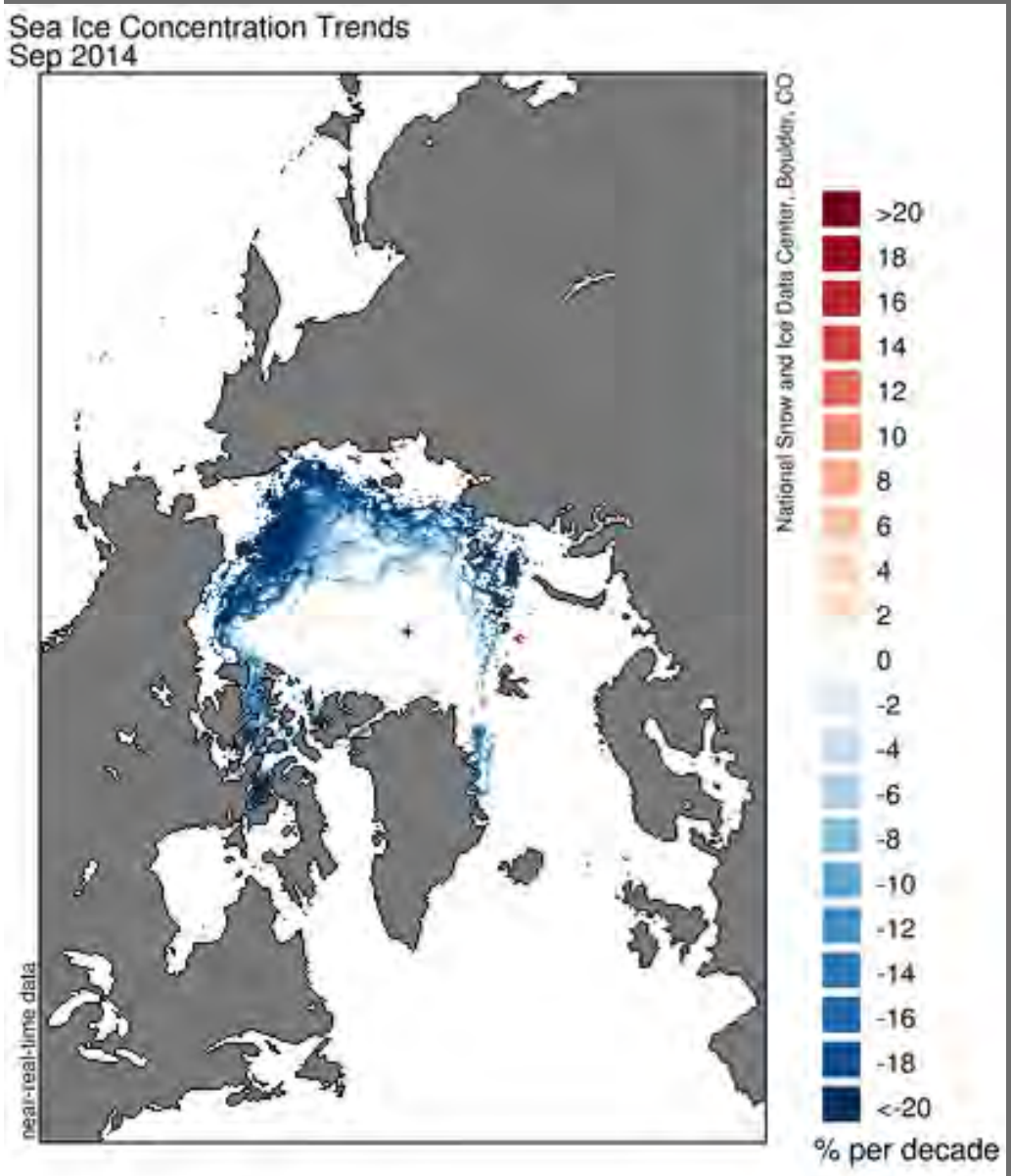
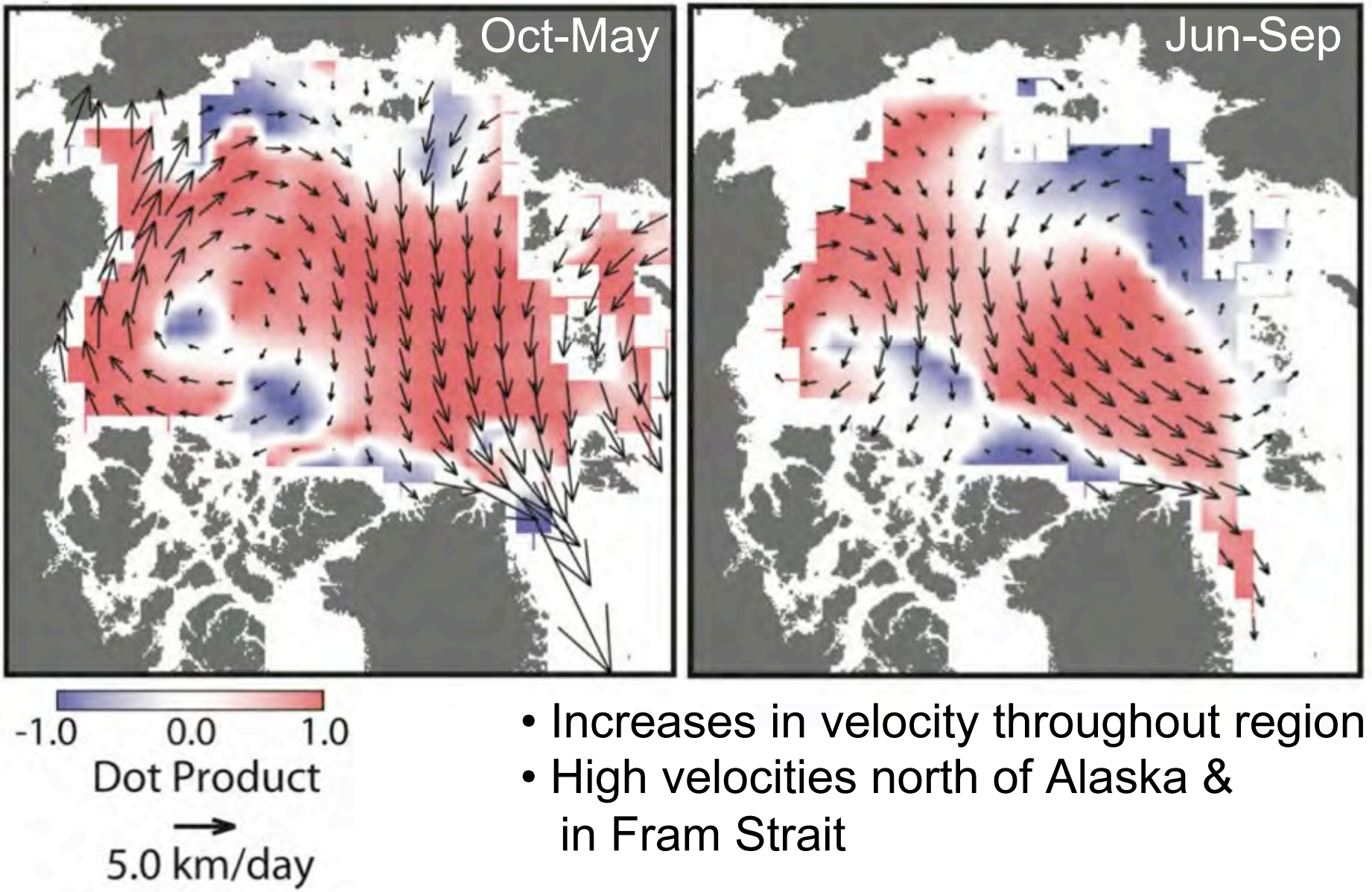
Summer ice extent & its reduction



- Increased fetch & solar heating of surface ocean
- Greater wave heights & coastal heat transfer
- Impacts on coastal dynamics & retreat
- Reductions in multiyear ice

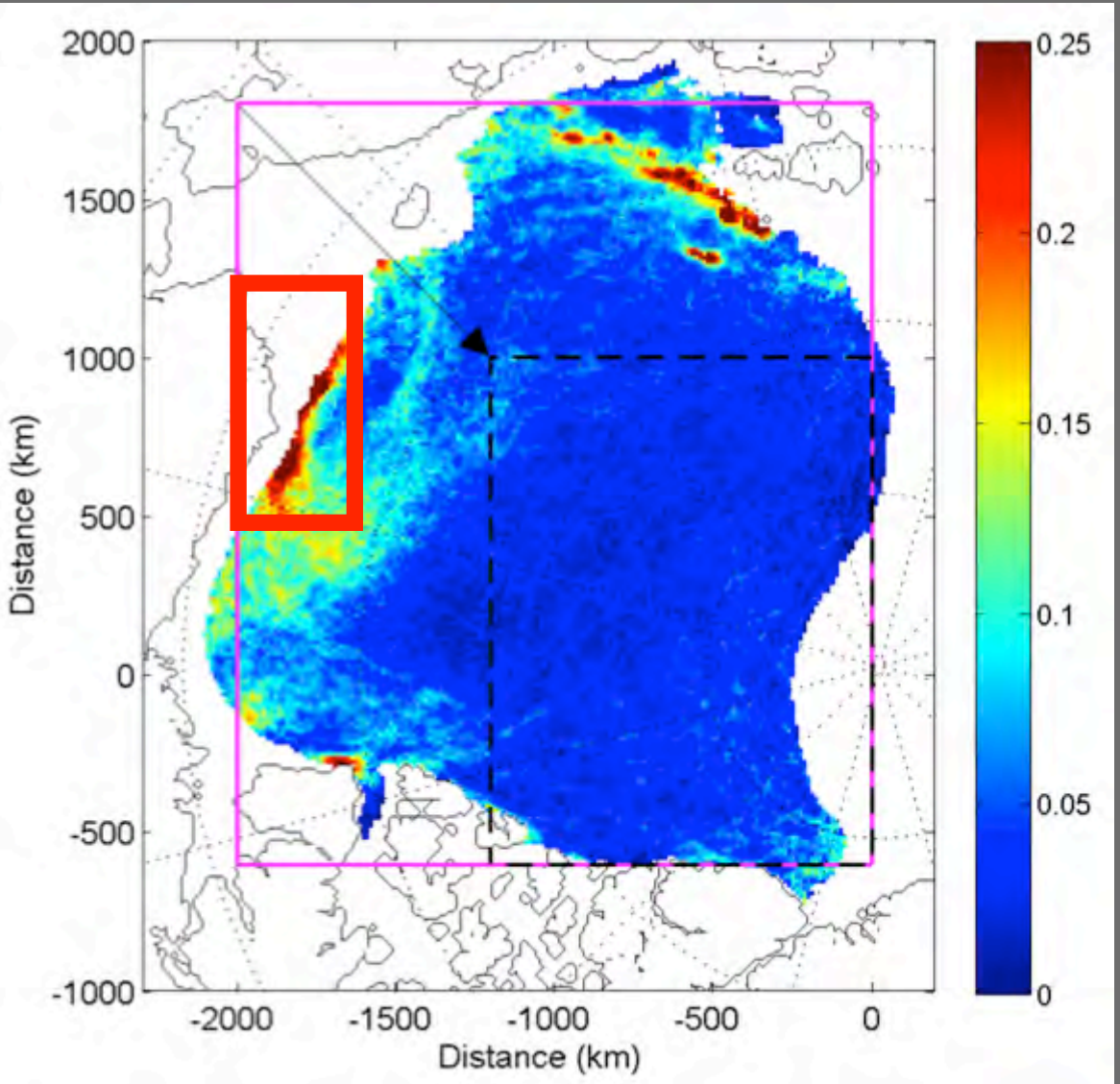
Ice circulation from satellites & drifters

Kwok et al., JGR, 2013



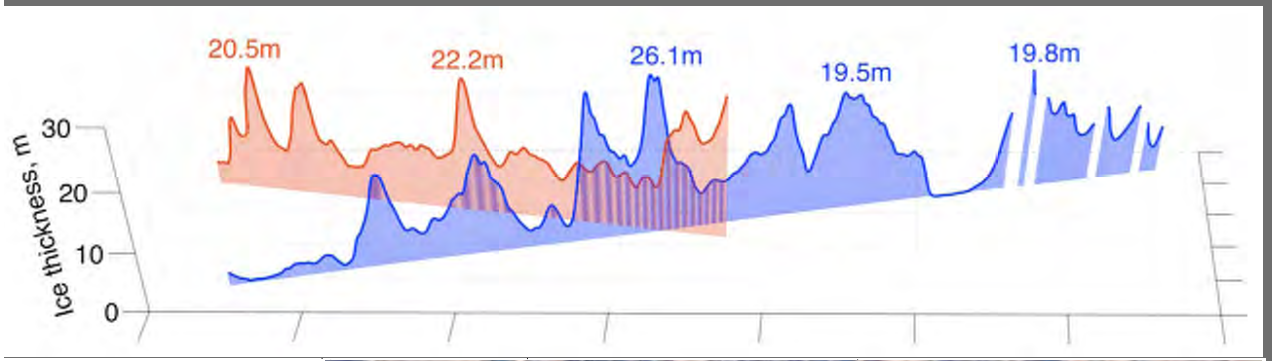
- Increases in velocity throughout region
- High velocities north of Alaska & in Fram Strait

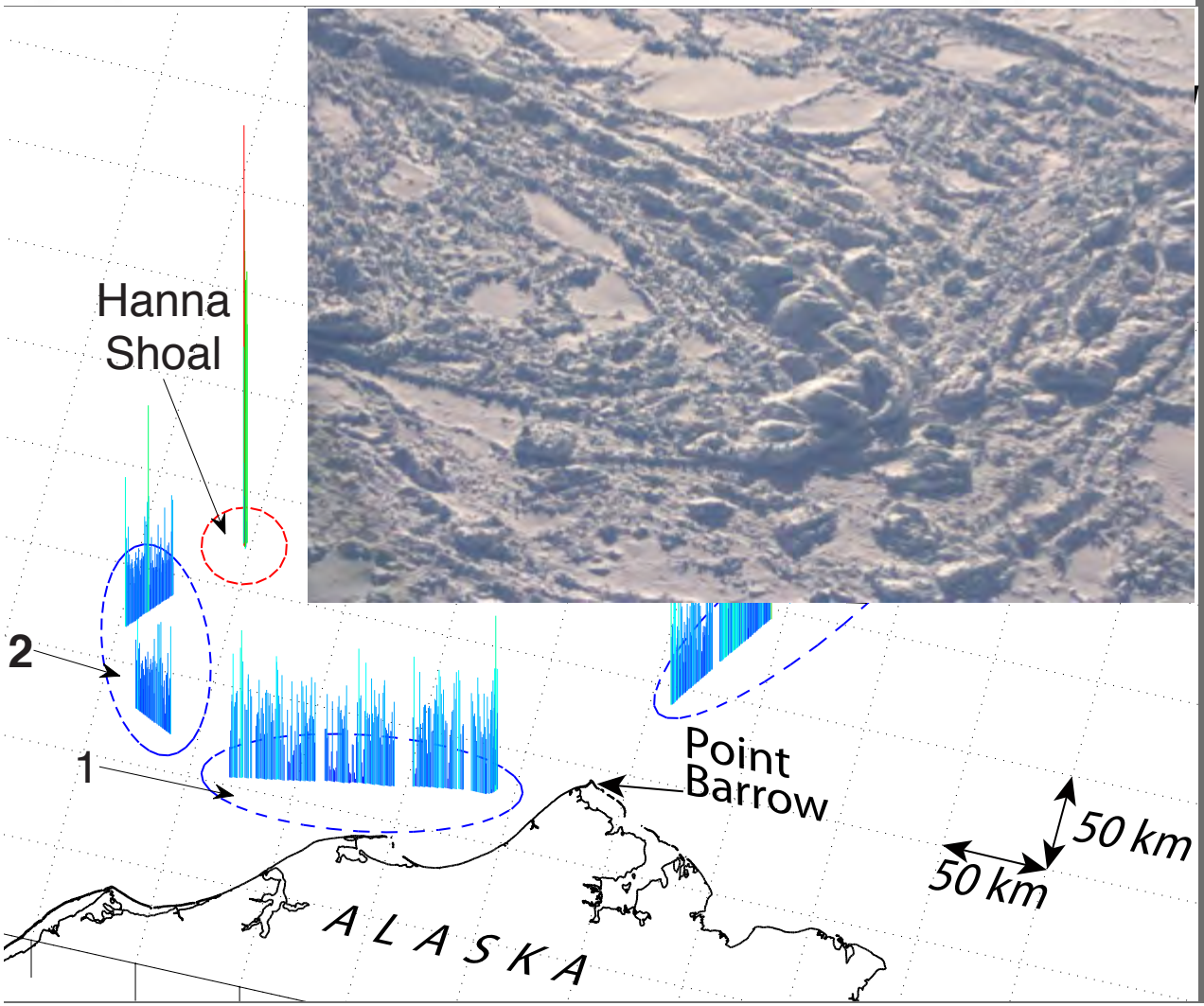
Beaufort/Chukchi ice deformation zone



- Obtained from SAR-derived strain fields (RGPS data; Herman & Glowacki, TC, 2012)
- Highly deformed sea ice as a key ice hazard – oil & gas exploration leases downstream
- Ice-coast interaction; tidal and current forcing

Top 5%-ile of deformed ice (3 d interval), Nov- Apr, 1996-2008

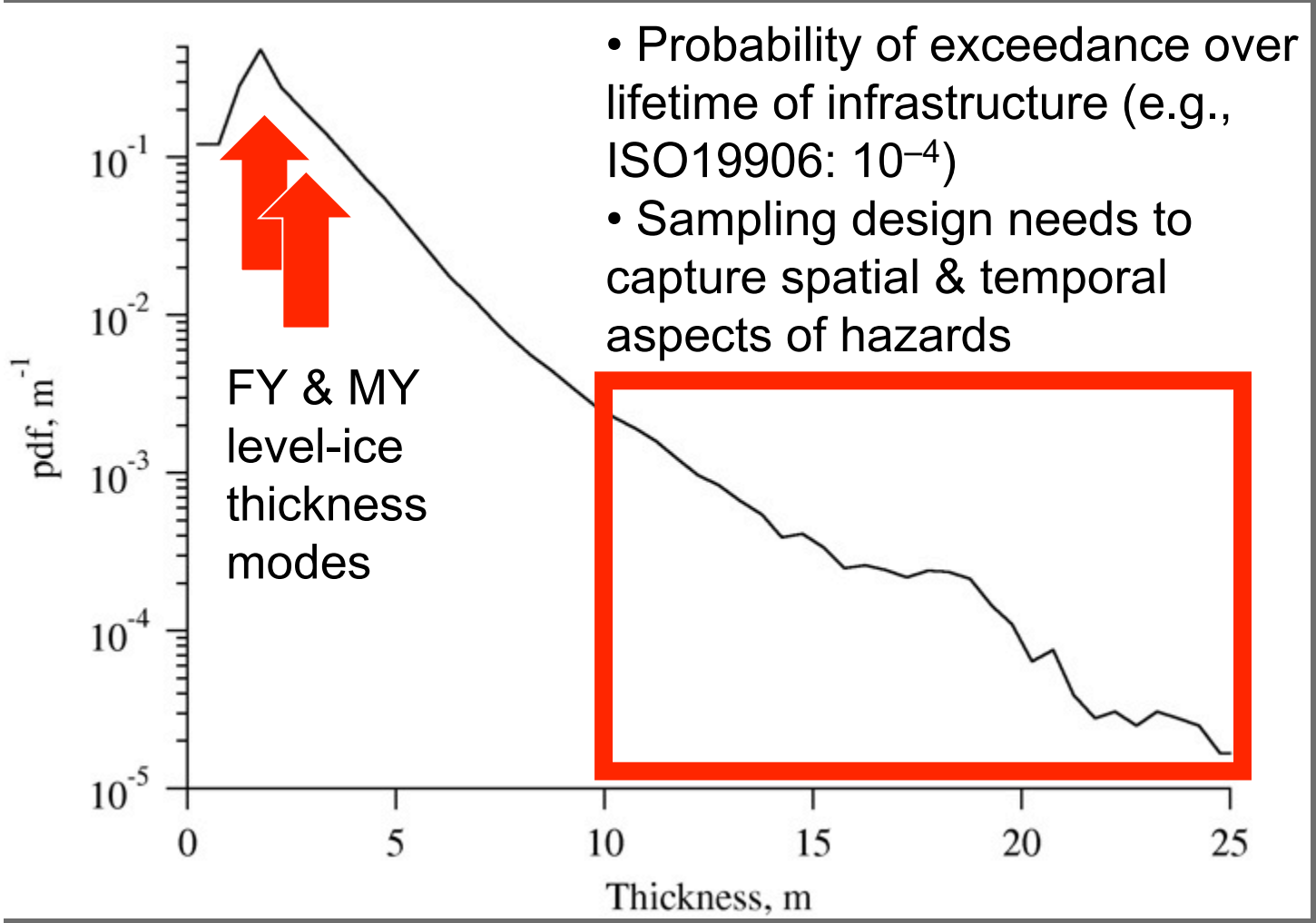




Hanna Shoal

- Grounding of pressure ridges on shoal (<25 m water depth)
- Formation of grounded floebergs (few kms in size)
- Significant local hazard; continues to form every year – though later in season

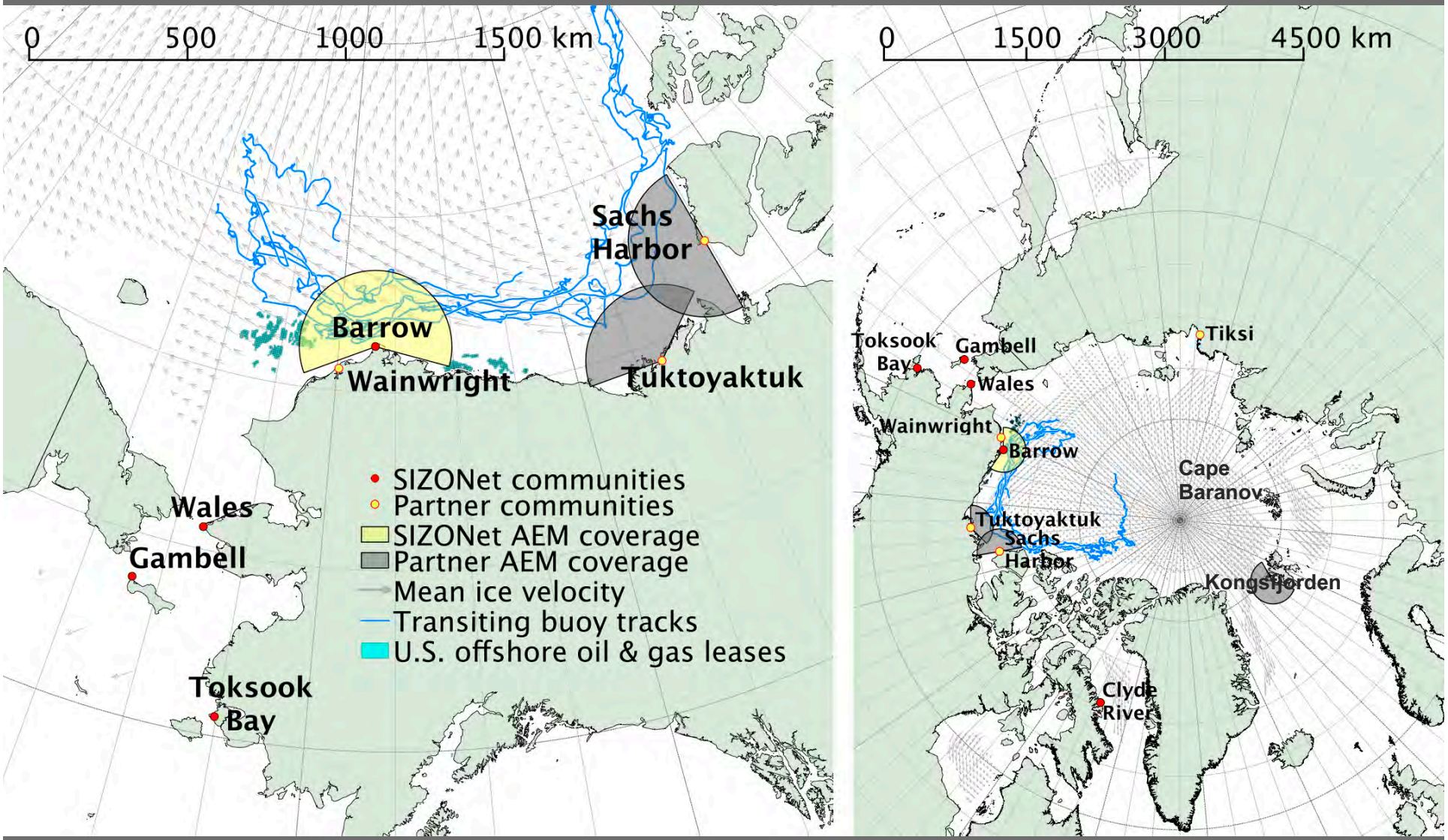
Capturing statistics relevant for hazard assessments



- Probability of exceedance over lifetime of infrastructure (e.g., ISO19906: 10^{-4})
- Sampling design needs to capture spatial & temporal aspects of hazards

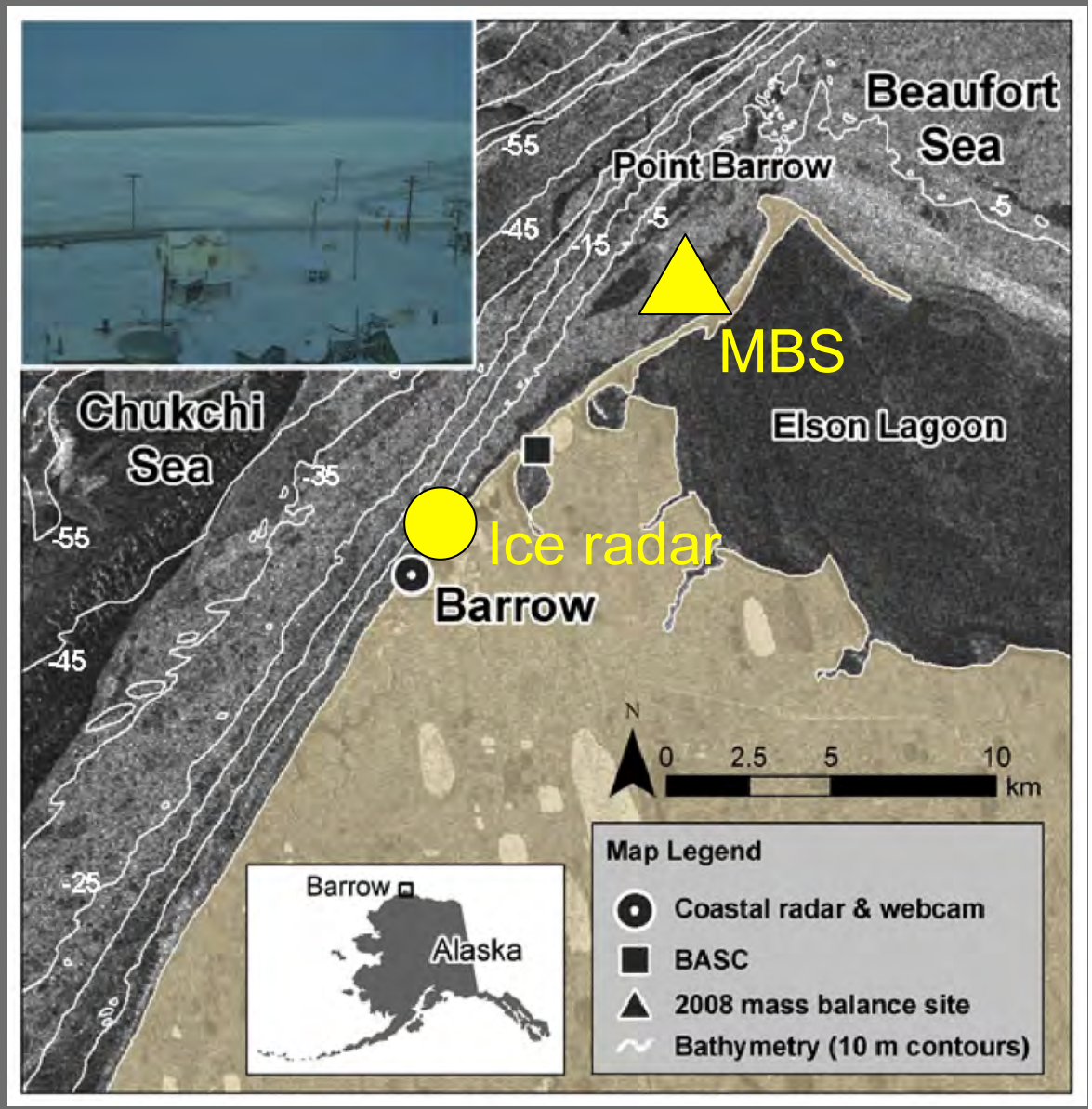
- Long-term observations of ice mass budget need to be adapted to capture data relevant for hazard assessments

Tracking the state of the seasonal ice zone and the MY/FY transition regions



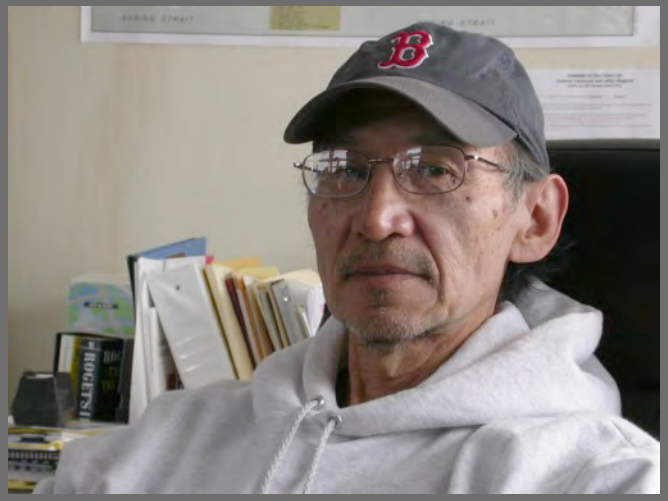
The Barrow sea-ice observatory

- *Remote sensing* (km-scale)
- *Coastal radar* (sub-km scale)
- *Thickness and topography* (sub-km scale)
- *Hydrography* (sub-km scale - moorings)
- *Ice mass-balance* site (10s m-scale)
- *Local ice observations* (J. Leavitt, B. Adams and others)
- www.sizonet.org
- seaice.alaska.edu/gi



M. Druckenmiller et al., CRST, 2009

Key collaborating Iñupiaq & Yupik sea-ice experts

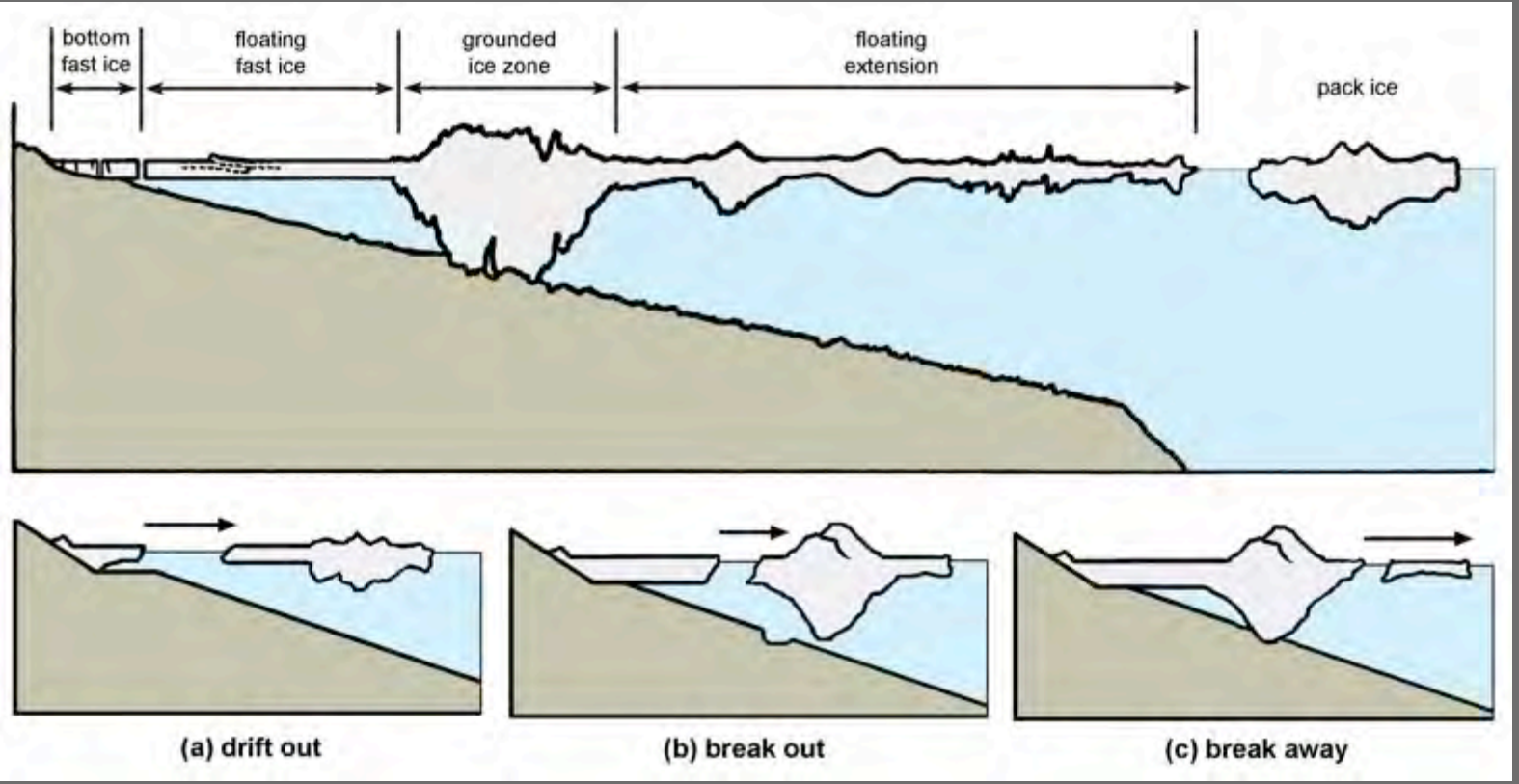


- Winton Weyapuk Jr. (Wales)
- Joe Leavitt, Billy Adams (Barrow)
- Simeon John (Toksook Bay)
- Paul & Leonard Apangalook Sr. (Gambell)

A database for community-based ice observations

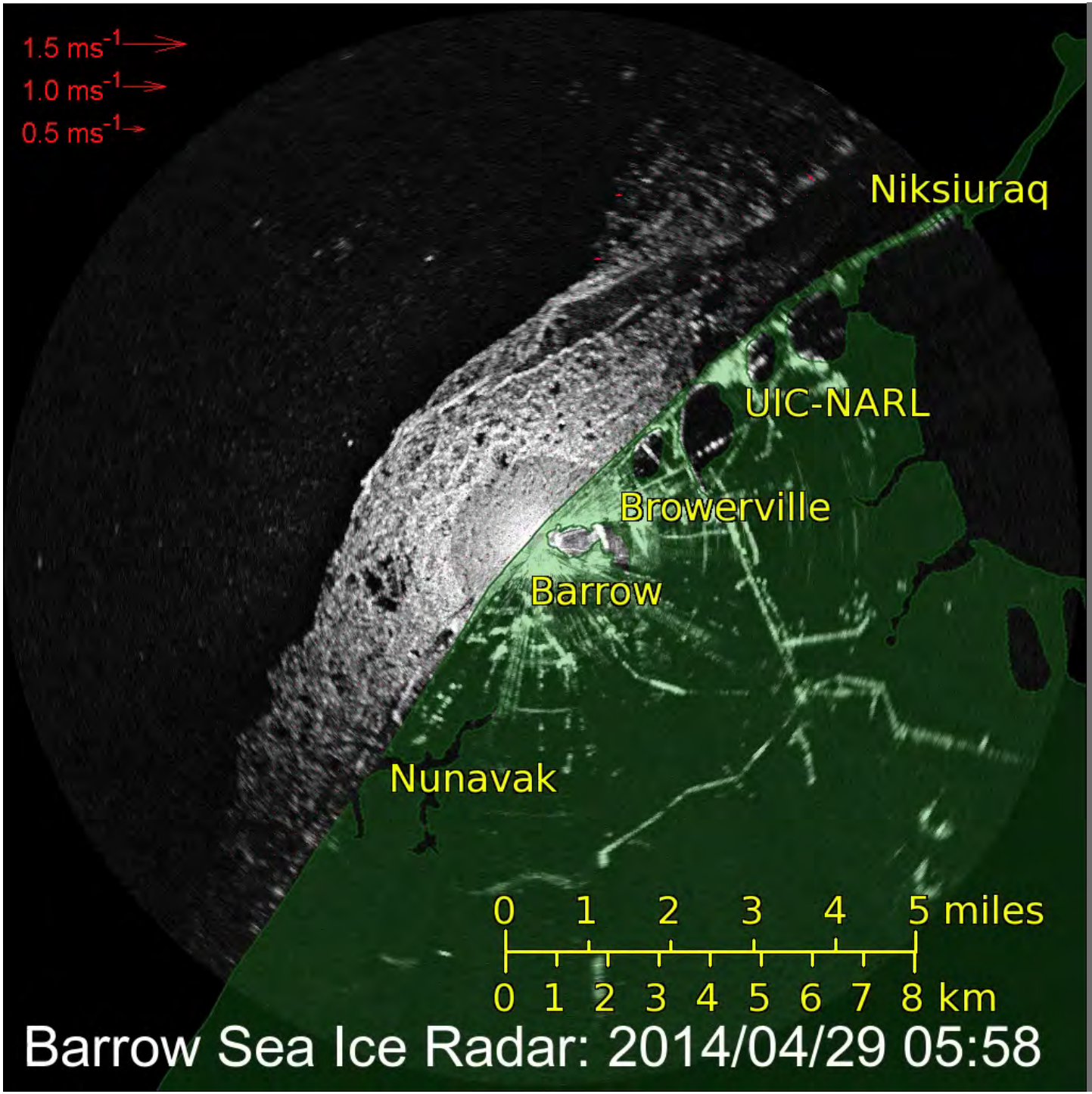
Access database at: https://eloka-arctic.org/sizonet

Frameworks for risk assessment



M. Druckenmiller et al., in prep.

- Hazard of landfast ice break-out/away events
- Environment, people & procedures: How to guide operations through integration of observing systems, models, local & indigenous knowledge, and engineering



Shorefast ice break-out at Barrow, April 2014

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Conclusions

- Tracking ice deformation and deformed ice increasingly relevant: Remote sensing approaches, drifting sensors
- Community-based observations: Validation of forecasts; hazard assessments; response

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