

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

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- Data & further information: [sizonet.org](http://sizonet.org); [seaice.alaska.edu/gi/data](http://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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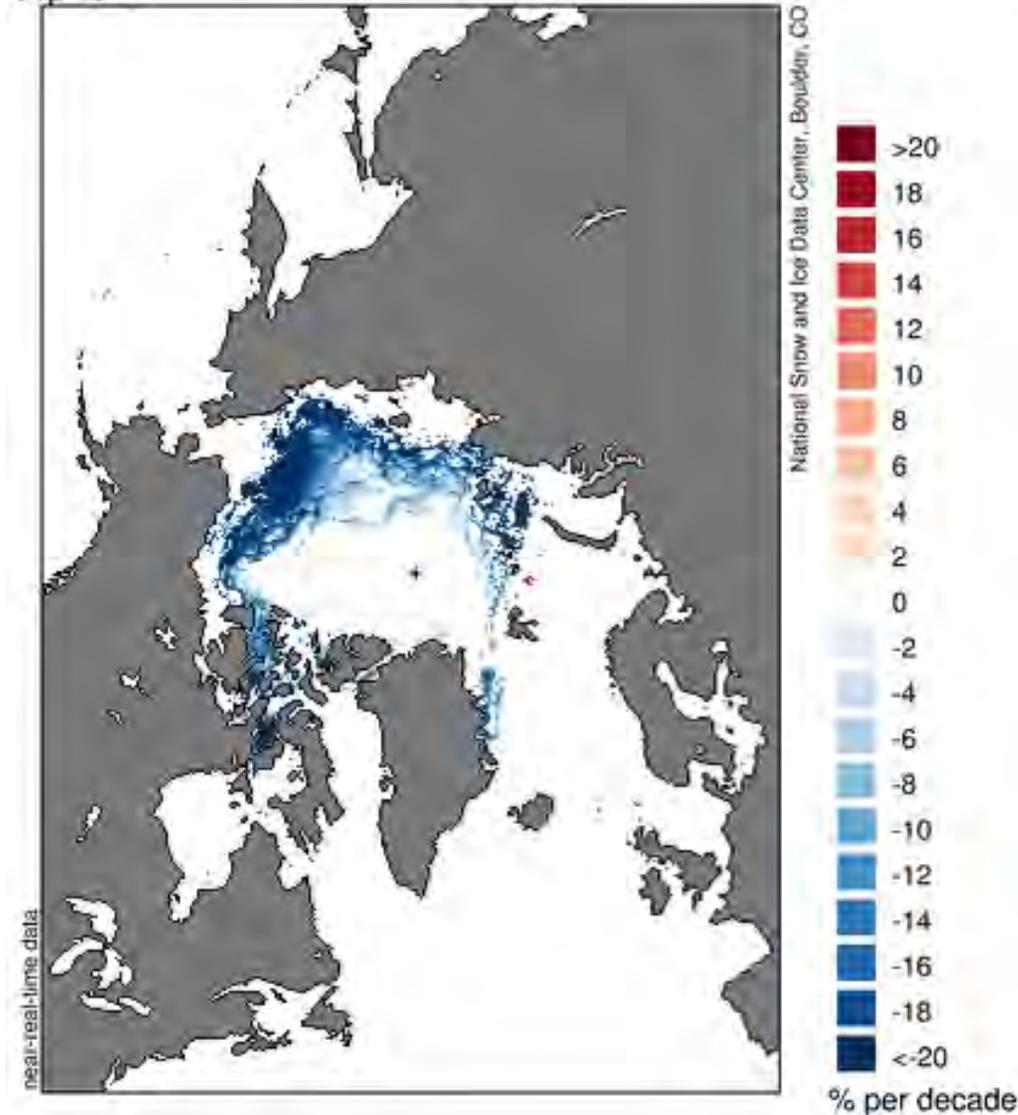


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# Summer ice extent & its reduction

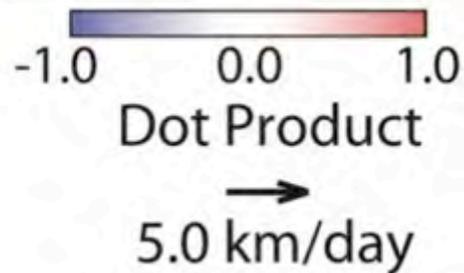
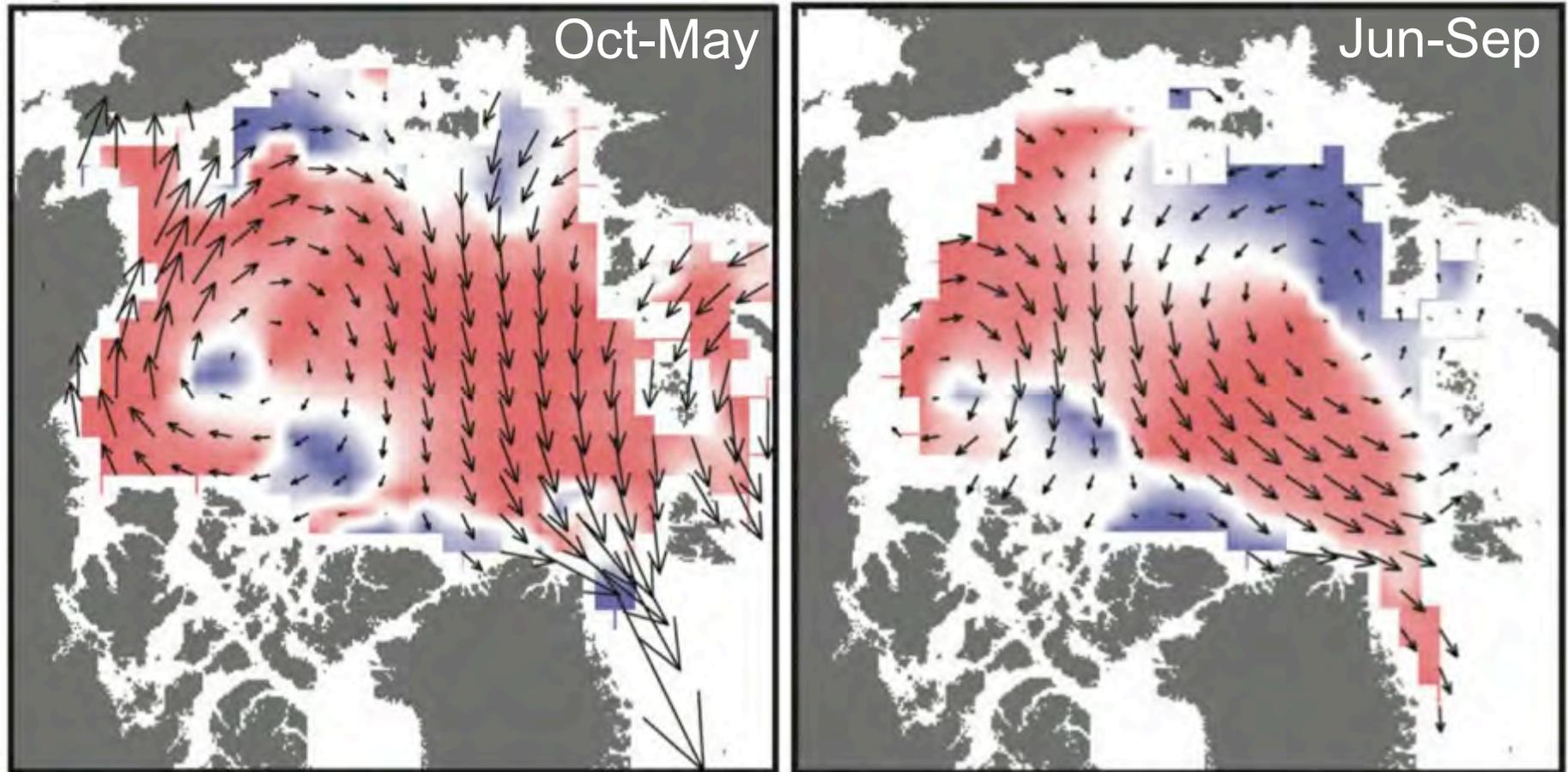
Sea Ice Concentration Trends  
Sep 2014



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

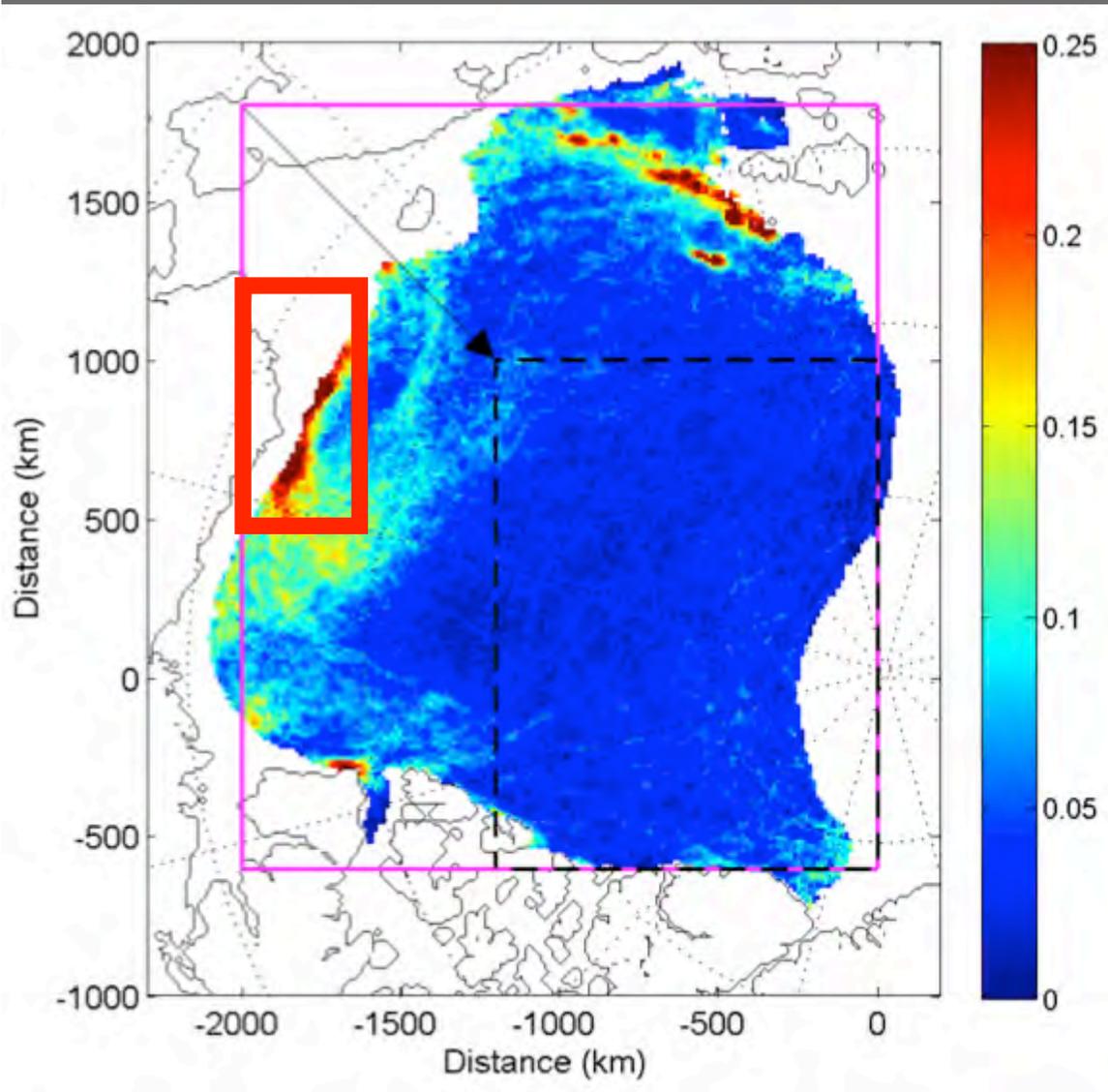
# Ice circulation from satellites & drifters

Kwok et al., JGR, 2013



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

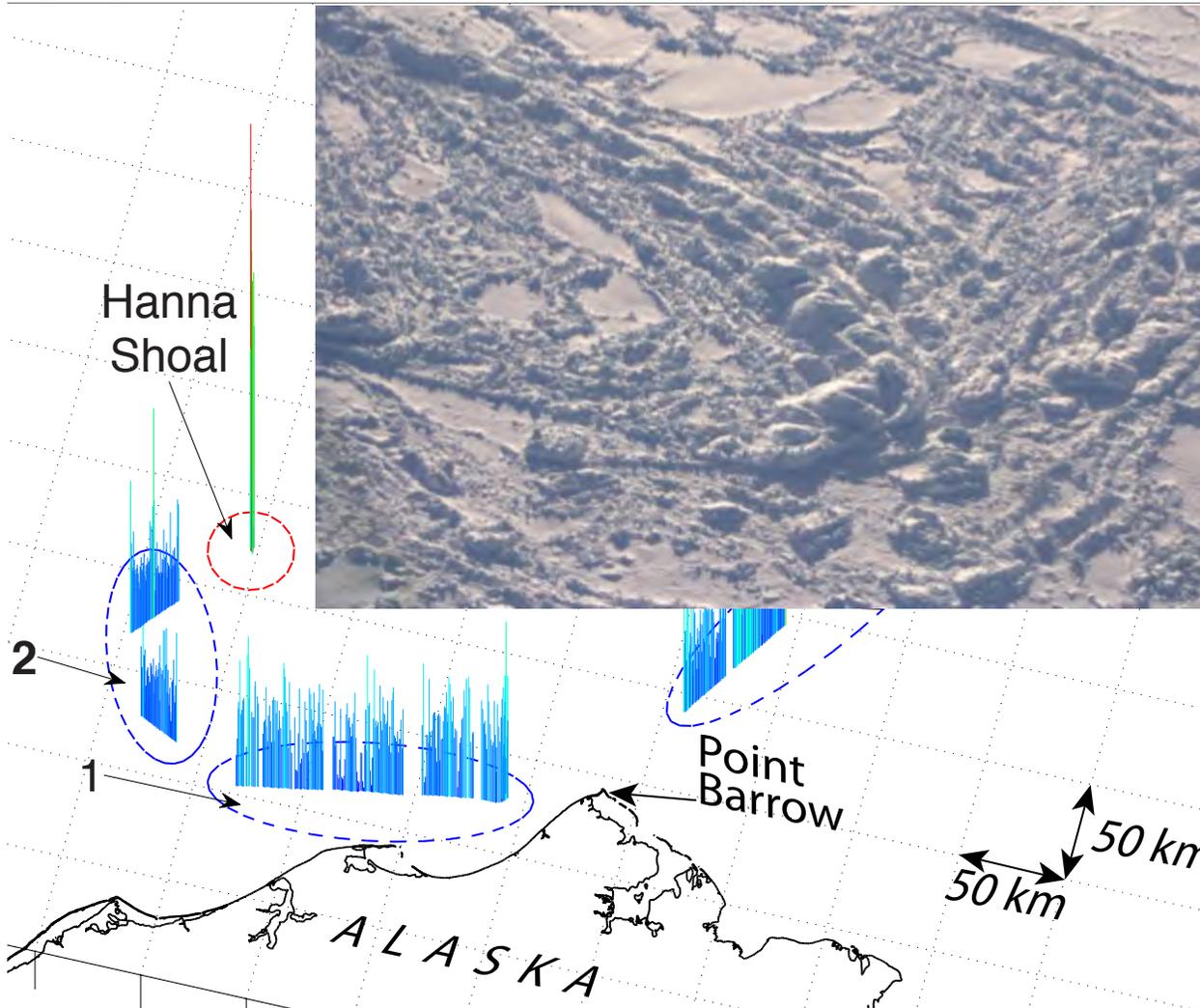
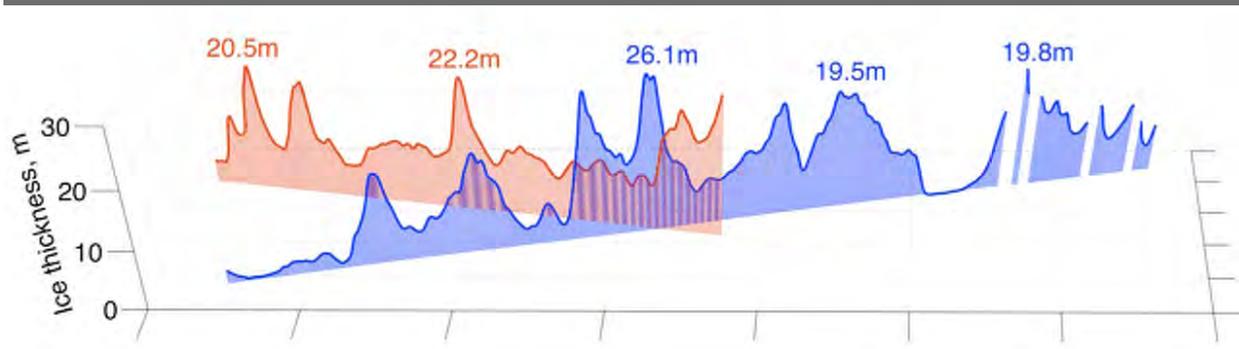
# Beaufort/Chukchi ice deformation zone



- 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

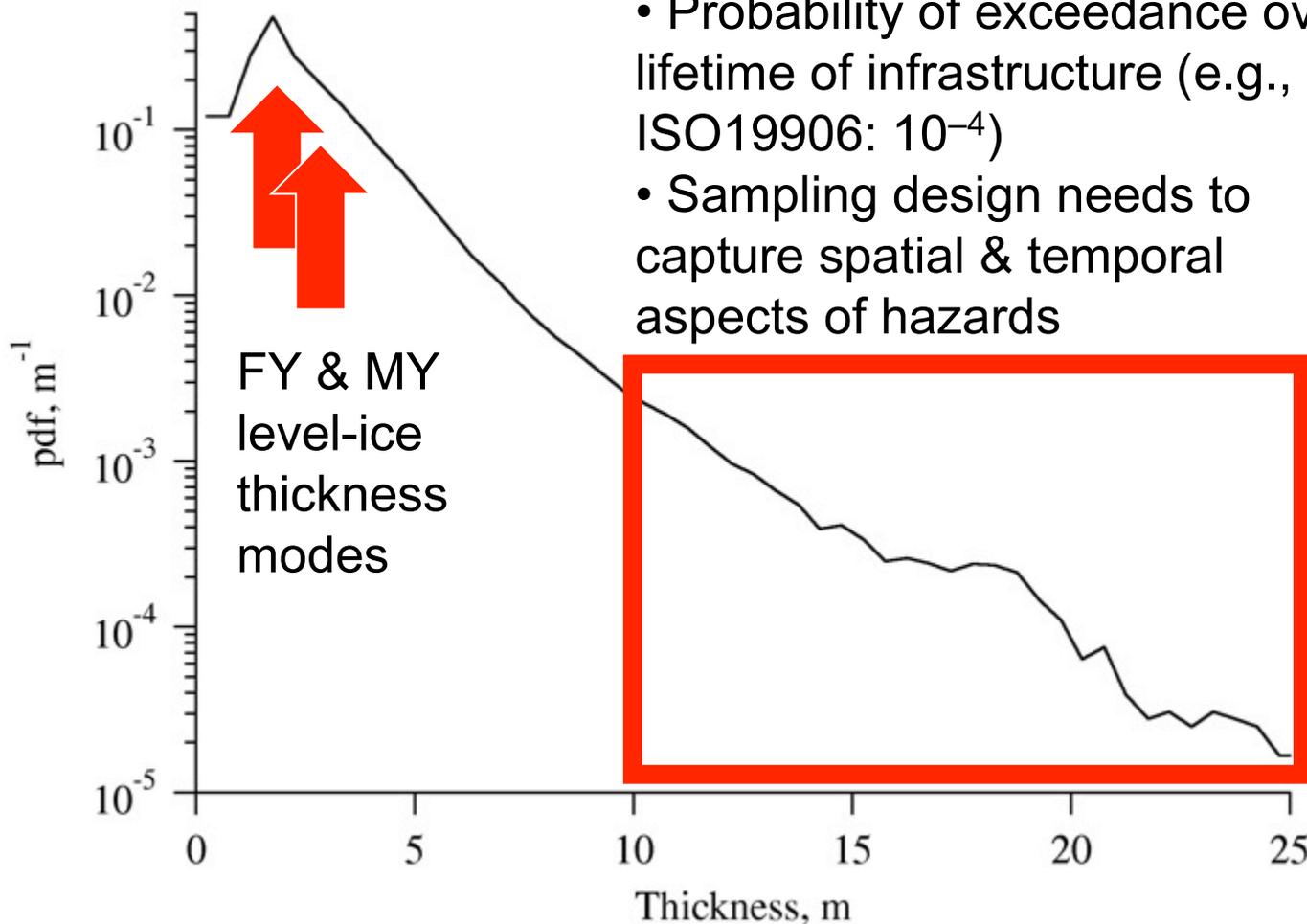
Top 5%-ile of deformed ice (3 d interval), Nov- Apr, 1996-2008

# 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

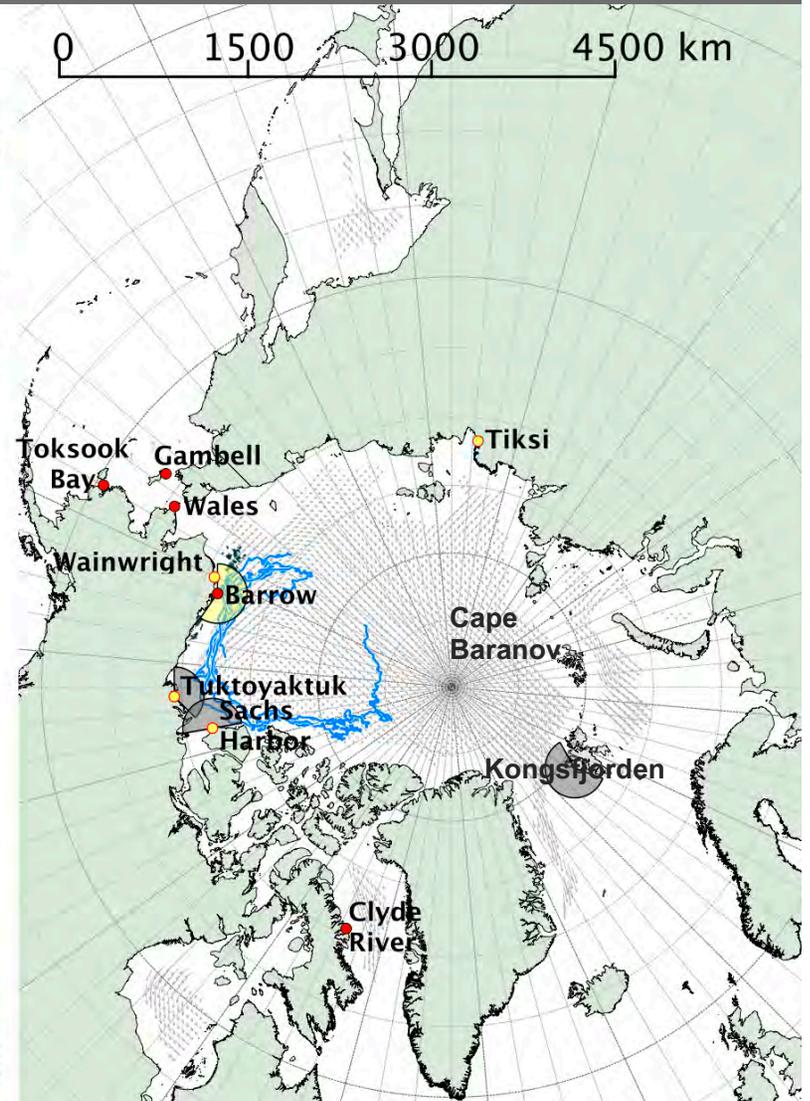
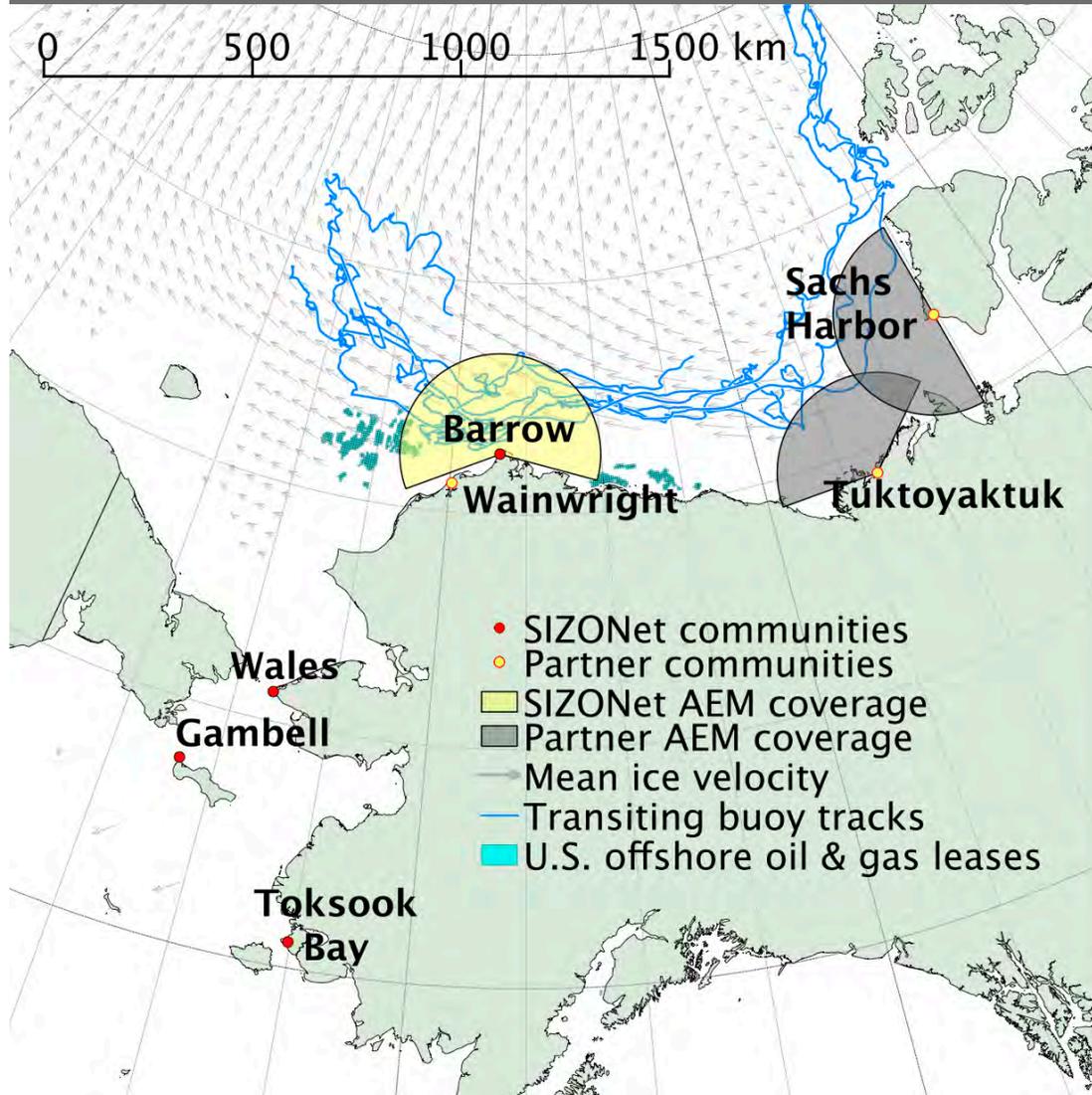
# Capturing statistics relevant for hazard assessments



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

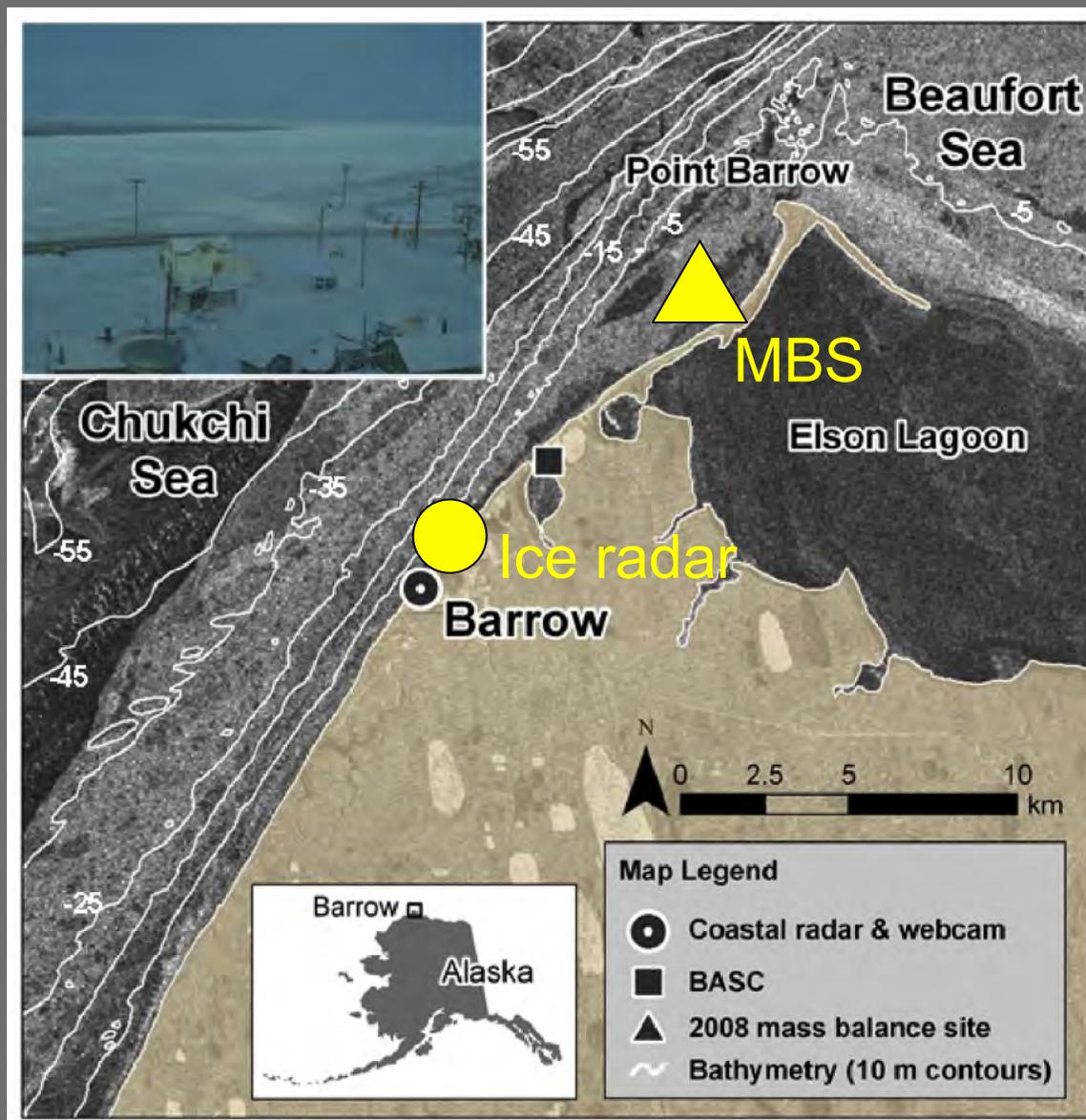
- Long-term observations of ice mass budget need to be adapted to capture data relevant for hazard assessments

# 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](http://www.sizonet.org)
- [seaice.alaska.edu/gi](http://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



Local Observations  
Seasonal Ice Zone Observing  
Network (SIZONet)

Exchange for Local Observations and  
Knowledge of the Arctic



Home About Research Methods Public Information Data Add observation Contacts Logged in as Joe Leavitt Log out

General observation information

Weather detail

Ice detail

Wildlife

Activity detail

Photos/Video

Observation ID: BARLE120301  
Recorder: Joe Leavitt

Observer: Leavitt, Joe

Observation Location: Barrow

If known, enter location in decimal degrees:

Lat: (Between 45 and 90)

Lon: (Between -180 and -125)

Observation date

2012-03-01

(yyyy-mm-dd)

Observation time

: (hh:mm)

Conditions: Storm/blizzard

Precipitation:

Skies: Cloudy

Wind speed: Strong

Visibility: Limited

Change wind dir:

Wind direction: ENE

Ice fog:

Air temperature is approximately °C

Wind speed is approximately m/sec

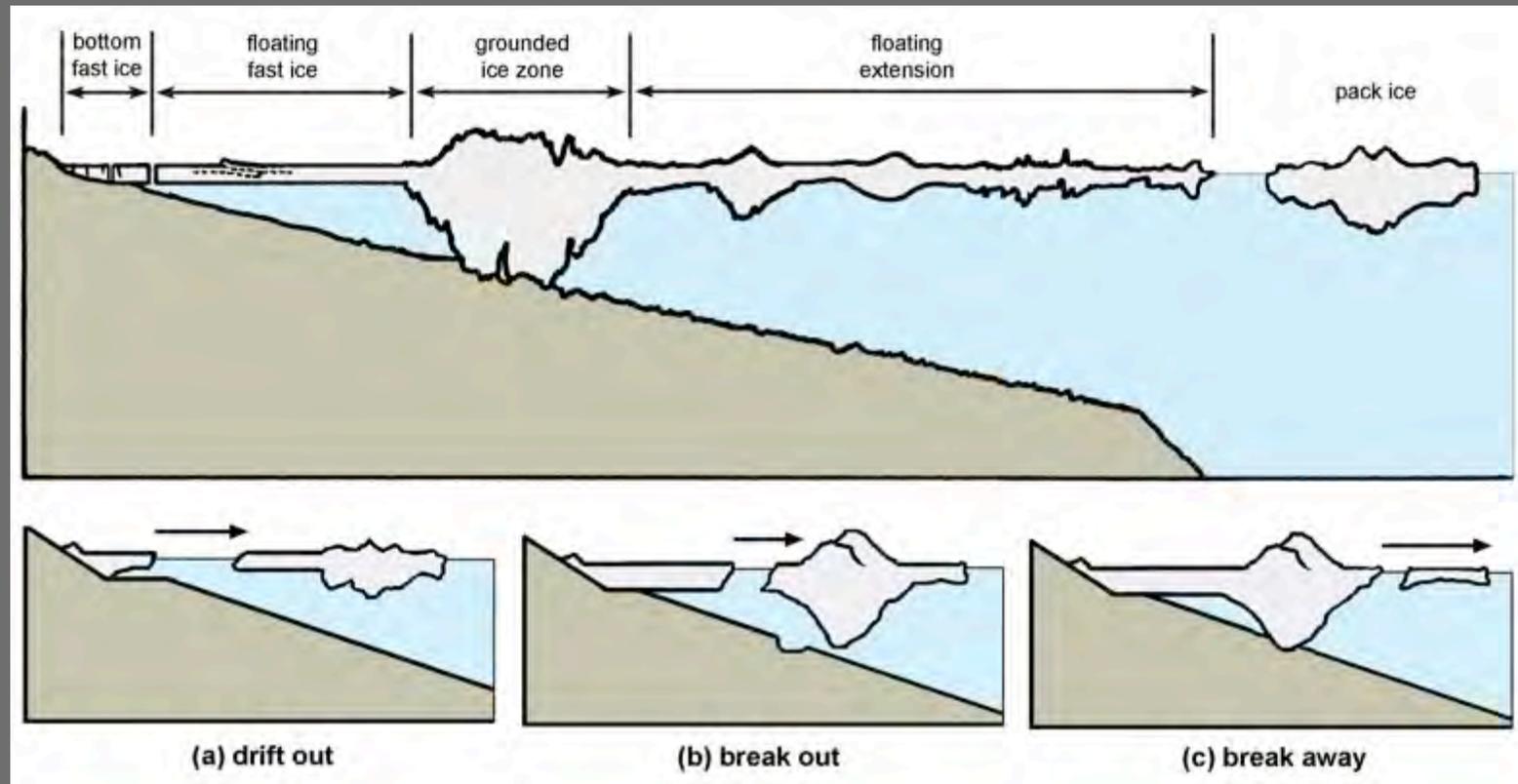
Visibility is approximately km

Update observation

The SIZONet Observation Database is a collaborative between [SIZONet](#) and [ELOKA](#). This Web site is hosted by the [National Snow and Ice Data Center](#).

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

# Frameworks for risk assessment



M. Druckemiller 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

1.5 ms<sup>-1</sup> →  
1.0 ms<sup>-1</sup> →  
0.5 ms<sup>-1</sup> →

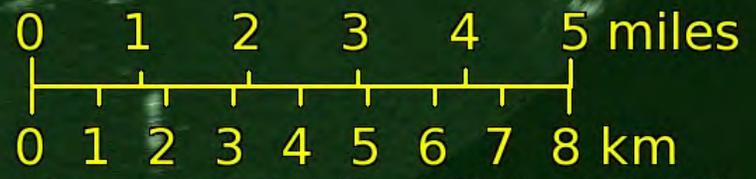
Niksiuraq

UIC-NARL

Browerville

Barrow

Nunavak



Barrow Sea Ice Radar: 2014/04/29 05:58

Shorefast ice  
break-out at  
Barrow, April  
2014

# 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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