



Centrum
Studiów
Polarnych

"Importance of calving for mass budget of Arctic glaciers"

Sopot Scientific Seminar on Ice Calving in the Arctic (3SICA)

15-17 October, Sopot, Poland



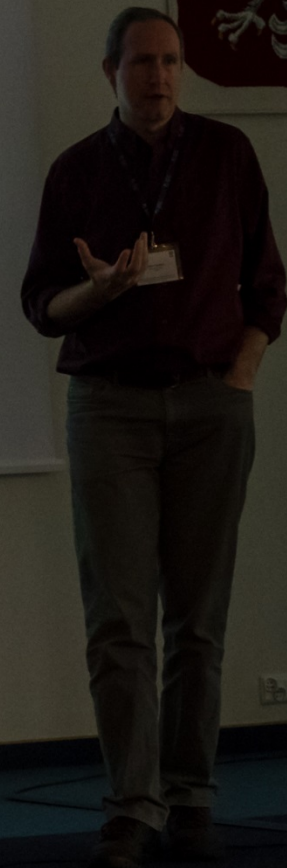
Motivation: What is the Ice Discharge to the Ocean of Northern Hemisphere Glaciers and Ice Caps?

Table 1. Pan-Arctic Comparison of Ice Discharge Estimates^a

Region		Period	Ice Discharge (Gt a ⁻¹)	% of Pan-Arctic Discharge (excluding Greenland)	Data Source
CAA	Queen Elizabeth Islands	2012	2.59	7.5	This Study
	Baffin and Bylot Islands	1999–2003	0.25	0.7	<i>Gardner et al.</i> [2011]
Alaska	All Glaciers	2006–2010	17.1	49.7	<i>Burgess et al.</i> [2013]
Russia	Academy of Sciences Ice Cap	2003–2009	1.4	4.1	<i>Moholdt et al.</i> [2012]
	Franz-Josef Land	1952–2001	4.3	12.5	<i>Glazovsky and Macheret</i> [2006]
	Novaya Zemlya	1952–2001	1.4	4.1	<i>Glazovsky and Macheret</i> [2006]
	Severnaya Zemlya	1952–2001	0.75	2.2	<i>Glazovsky and Macheret</i> [2006]
Svalbard	All Glaciers	2000–2006	6.75	19.6	<i>Blaszczyk et al.</i> [2009]
Pan-Arctic glaciers and ice caps (excluding Greenland)			34.54	100	<i>Dowdeswell et al.</i> [2008]

^aCAA, Canadian Arctic Archipelago.

Source: Van Wychen, W., Burgess, D.O., Gray, L., Copland, L., Sharp, M., Dowdeswell, J. and Benham, T. (2014): Glacier velocities and dynamic ice discharge from the Queen Elizabeth Islands, Nunavut, Canada. *Geophysical Research Letters*, 41(2), 484–490.



**Ice Discharge to Ocean (M_c) =
ice flux at terminus gate + retreat/
advance of terminus**

$$M_c = (u h w) + (r h w)$$

Need to know:

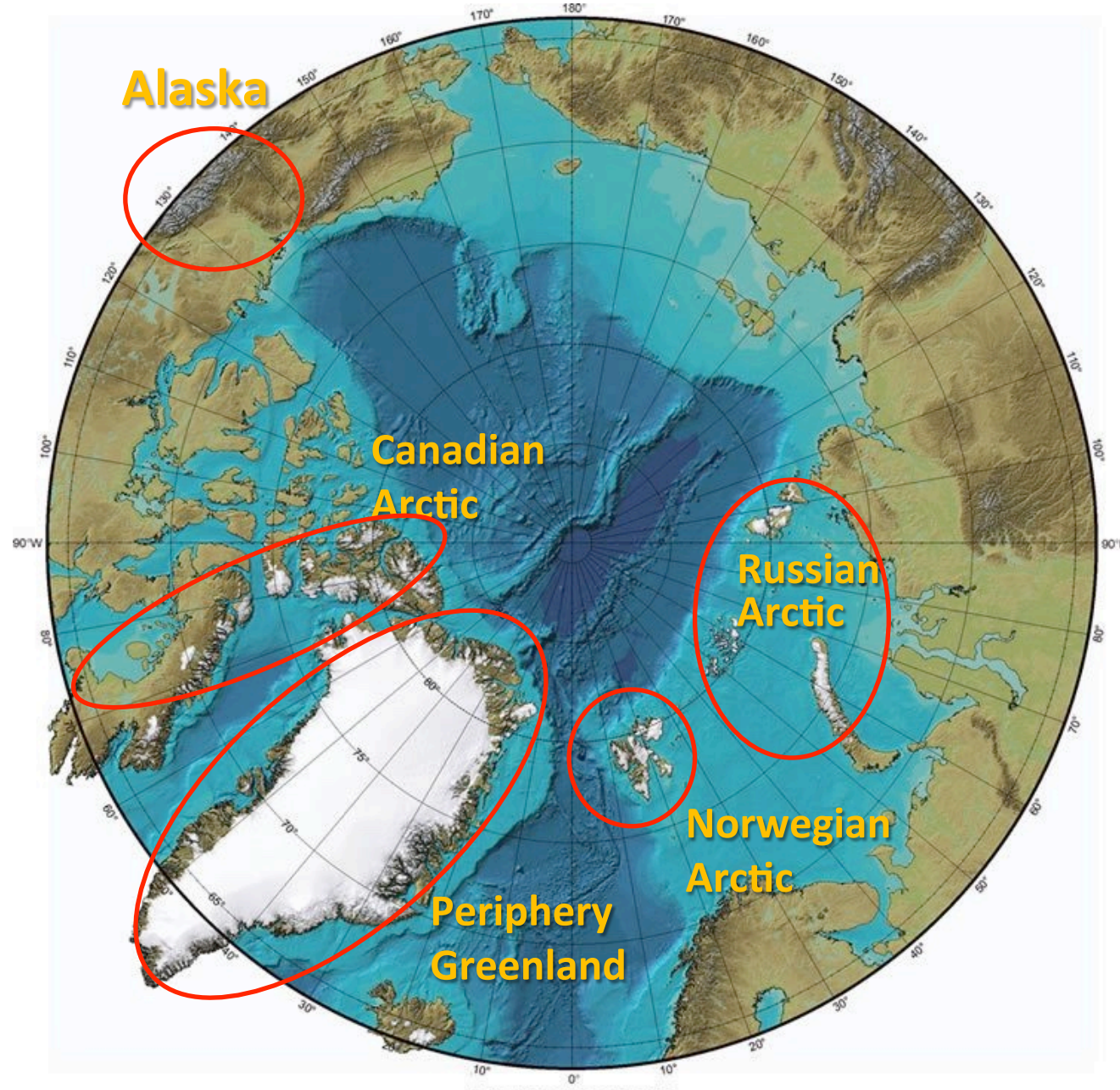
u = ice velocity

$h + w$ = ice thickness & width

r = retreat/advance rate

Compute annual average value over period
2000-2015

Study Area



Methods

Suggested methods for glaciers without well-constrained measurements:

- Compute average annual terminus retreat/advance over period ~2000-2015
- Compute mean terminus retreat/advance rate over whole terminus width, not just length change at centreline
- Surface velocity = ~90% of depth averaged velocity
- Winter velocity = ~90% of annual average velocity
- Ice density = 900 kg m^{-3}
- Where possible calculate ice fluxes from summation of discharge through separate blocks across terminus, rather than a single centreline mean value
- Use width/depth scaling, and comparison with nearby glaciers of similar size, to estimate thickness of glaciers with no measurements
- **If 'non-standard' methods are used due to the availability of existing data, then provide a clear description of the methodology and assumptions used, and realistic error estimates**