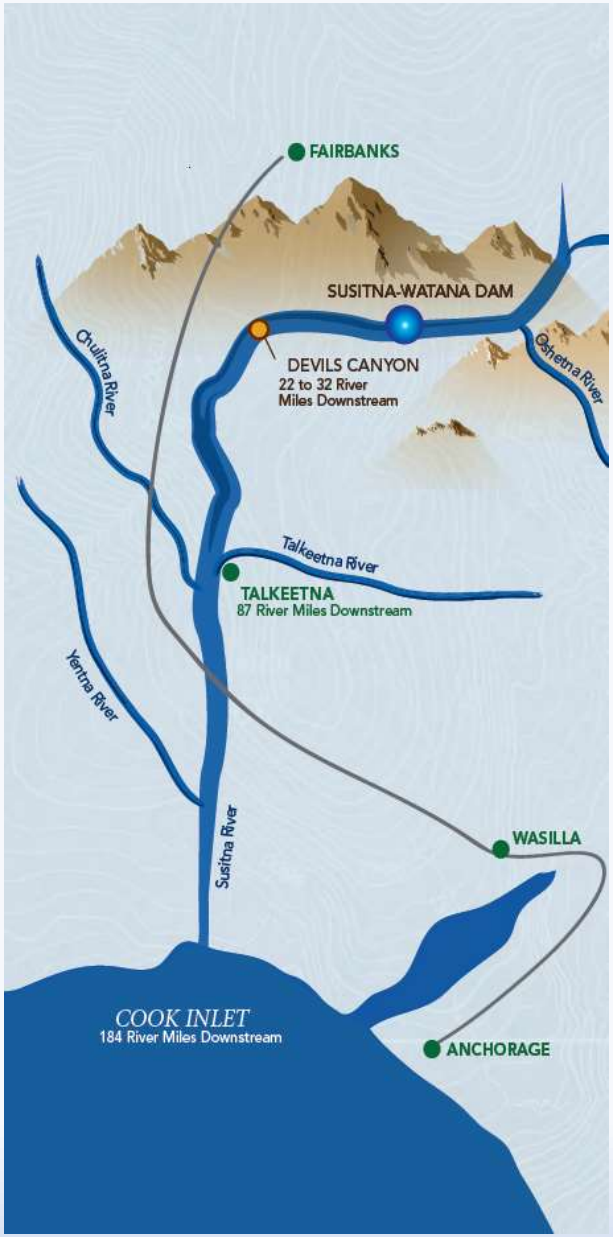


Initial Study Report Meeting

Study 7.7 Glacier and Runoff Changes

October 16, 2014

Prepared by

Dr. Gabriel Wolken,

Alaska Div. of Geological & Geophysical Surveys

Study 7.7 Objectives

- Review existing literature relevant to glacier retreat in south-central Alaska and the Upper Susitna watershed. This review will summarize the current understanding of potential future changes in runoff associated with glacier wastage and retreat.

Study 7.7 Components

- Glacier Changes in Alaska (ISR Part A, Section 4.1; pg 3)
- Runoff from Glaciers (ISR Part A, Section 4.2; pg 4)

- Trends in Permafrost (ISR Part A, Section 5.1; pg 11)
- Controls on Permafrost (ISR Part A, Section 5.2; pg 12)
- Periglacial Landforms (ISR Part A, Section 5.3; pg 13)
- Permafrost Modeling (ISR Part A, Section 5.4; pg 13)

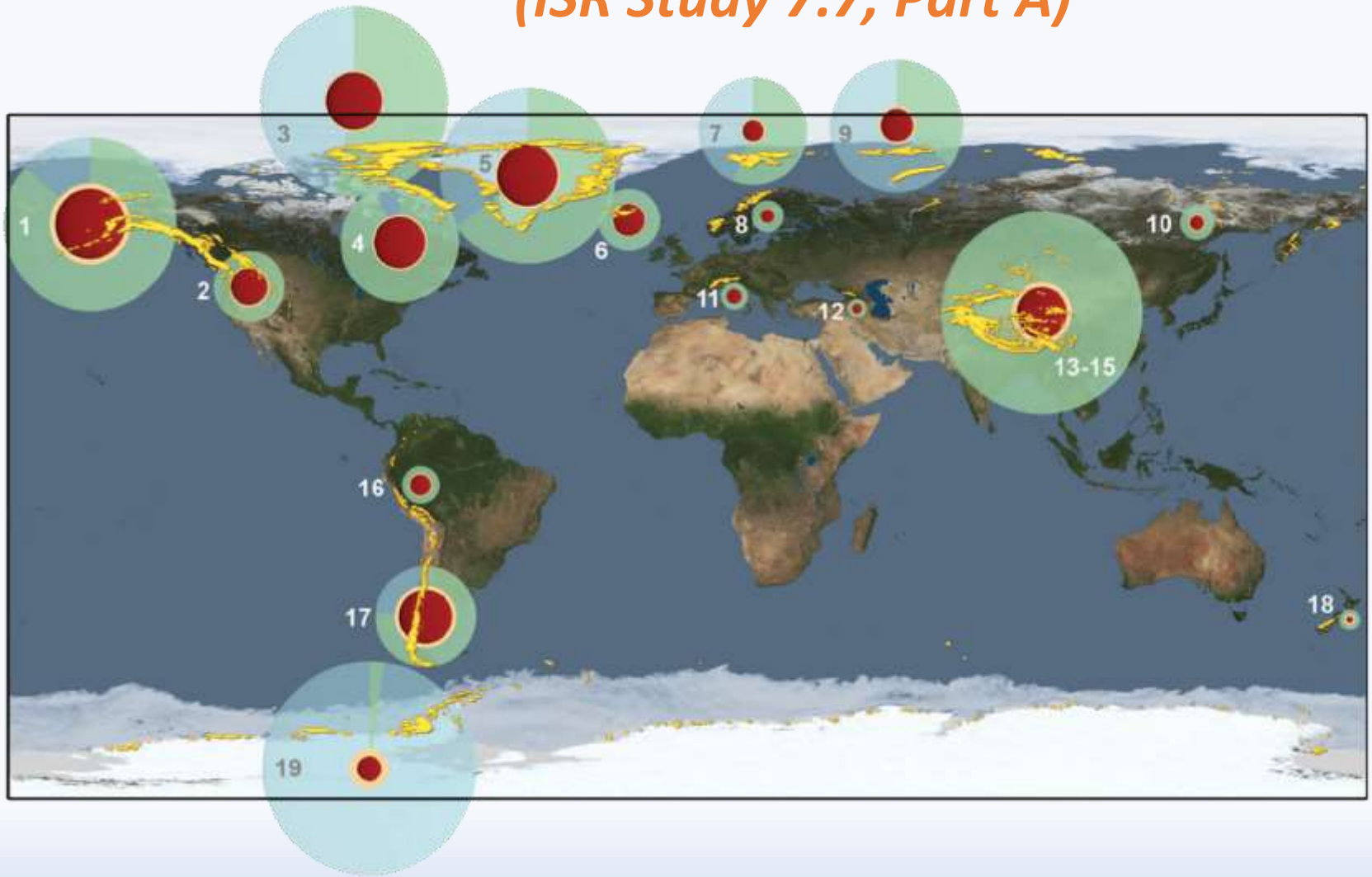
- Runoff (ISR Part A, Section 6.1; pg 14)
- Surface Water and Wetlands (ISR Part A, Section 6.2; pg 15)
- Groundwater and Infiltration (ISR Part A, Section 6.3; pg 15)
- Evapotranspiration (ISR Part A, Section 6.4; pg 16)

- Observed Changes in Climate (ISR Part A, Section 7.1; pg 16)
- Existing Meteorological and Climatological Data (ISR Part A, Section 7.2; pg 17)
- Projections of Future Climate (ISR Part A, Section 7.3; pg 18)

Study 7.7 Variances

- There were no variances to this study as described in RSP Section 7.7.4

Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)



2003-2009

Mass Budget [Gt yr^{-1}]

-1

-10

-100

Area [km^2]

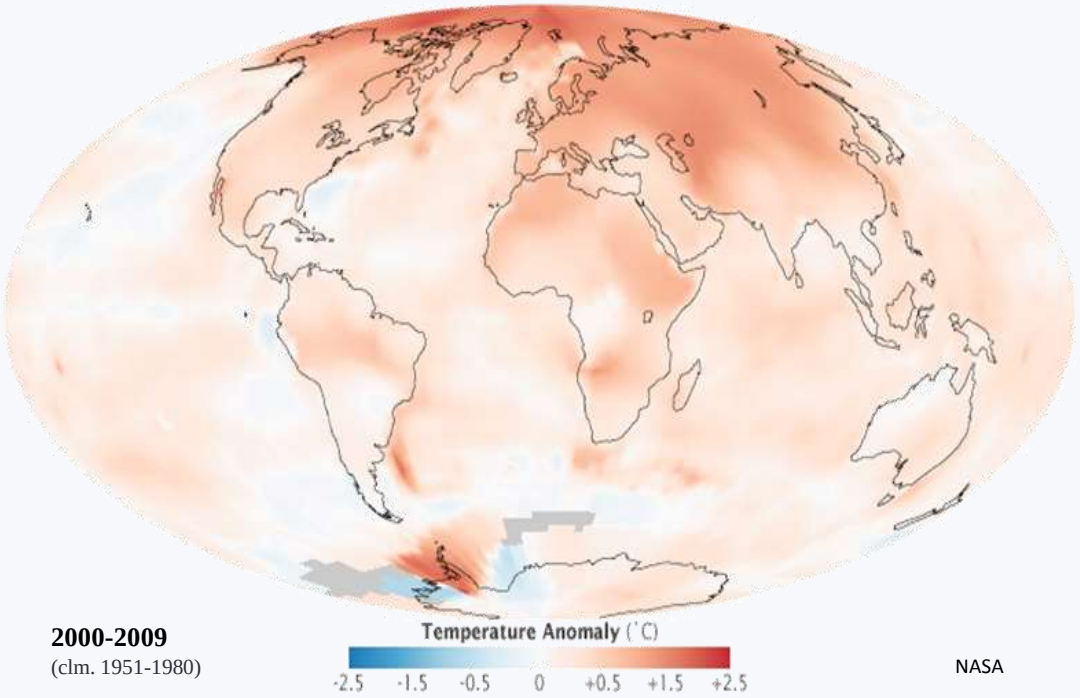
TW

50,000

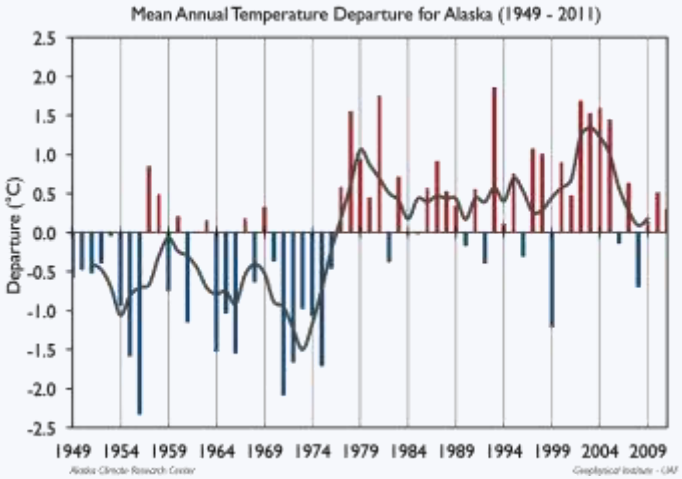
95 % confidence interval

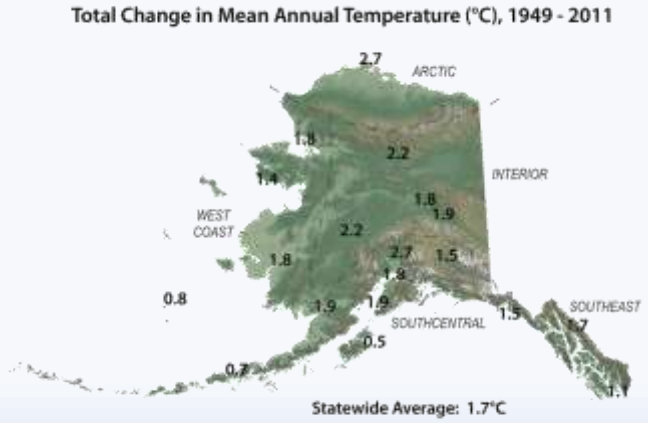
Gardner et al., 2013

Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)



Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)

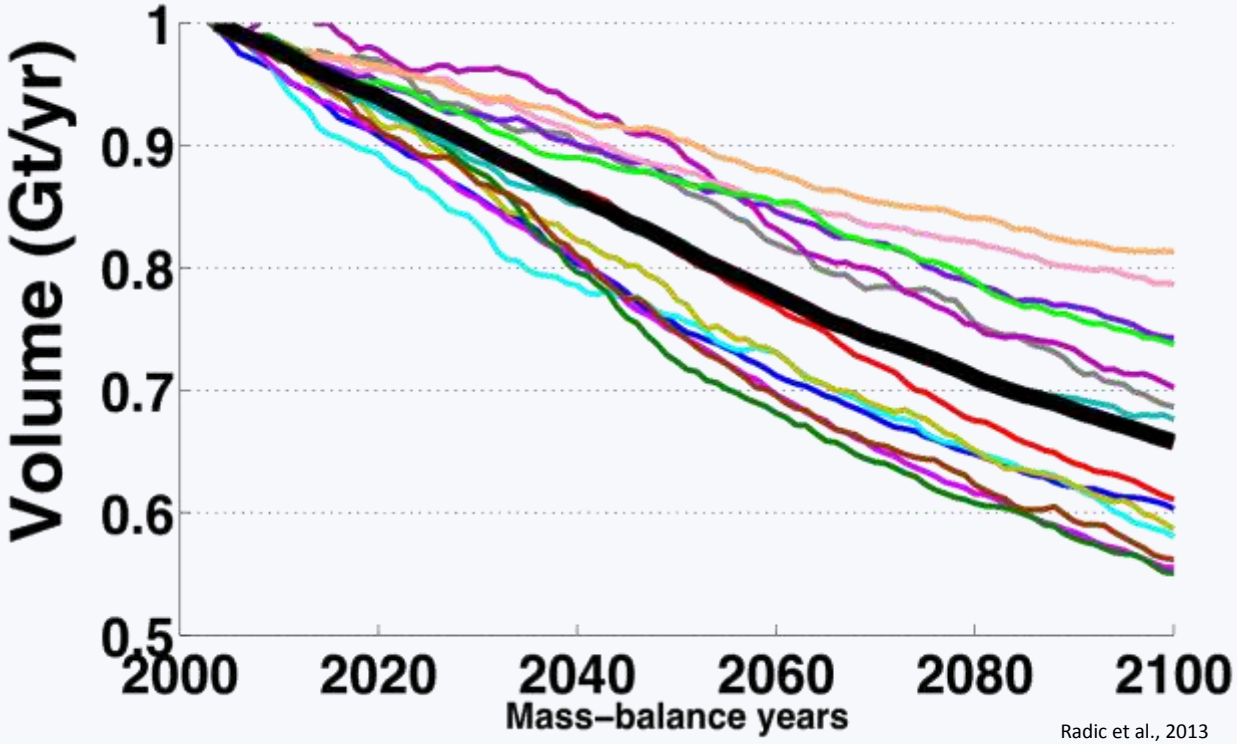




Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)

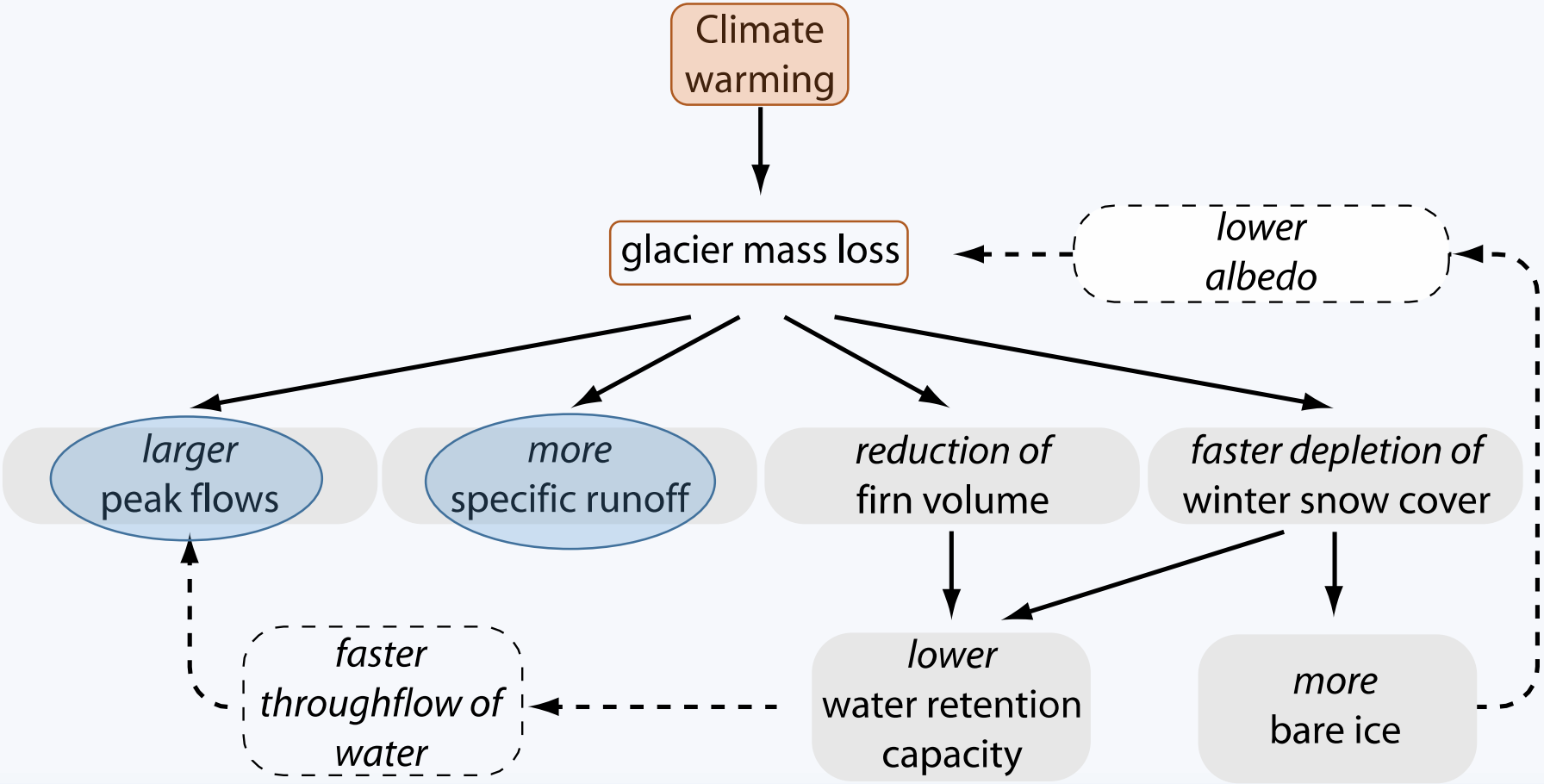
Reference	Original unit	Mass change (Gt yr^{-1})	Specific mass change (m w.e. yr^{-1})	Domain (area, km^2)	Period	Method
Alaska and NW Canada						
Arendt et al. 2002	–52±15 km^3 yr^{-1} w.e.	–52±15	-0.57	Alaska (90,000)	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	–96±35 km^3 yr^{-1} w.e.	–96±35	-1.07	Alaska (90,000)	5/1995-5/2000	Laser altimetry
Tamisiea et al. 2005	-110±30 km^3 yr^{-1} w.e.	-110±30	-1.26	Alaska (87,000)	4/2002-6/2004	GRACE
Chen et al. 2006	-101±22 km^3 yr^{-1} w.e.	-101±22	-1.11	Alaska (90,957)	4/2002-11/2005	GRACE
Luthcke et al. 2008	-84±5 Gt yr^{-1}	-84±5	-1.02	Gulf of Alaska (82,505)*	4/2003-9/2007	GRACE
Berthier et al. 2010	-41.9±8.6 km^3 yr^{-1} w.e.	-41.9±8.6	-0.48	Alaska (87,860)	1962-2006	geodetic
Wu et al. 2010	-101±23 Gt yr^{-1}	-101±23		Alaska **	4/2002-12/2008	GRACE
Luthcke et al. 2013	-68.8±11 Gt yr^{-1}	-68.8±11	-0.91	Alaska (76,000)	12/2003-12/2010	GRACE
Gardner et al. 2013	-50±17 Gt yr^{-1}	-50±17	-0.57	Alaska (87,100)	2003-2009	GRACE
Arendt et al. 2013	-65±11 Gt yr^{-1}	-65±11	-0.79	Gulf of Alaska (82,505)	12/2003-12/2010	GRACE
Arendt et al. 2013	-61±11 Gt yr^{-1}	-61±11	-0.74	Gulf of Alaska (82,505)	10/2003-10/2009	GRACE
Arendt et al. 2013	-65±12 Gt yr^{-1}	-65±12	-0.79	Gulf of Alaska (82,505)	10/2003-10/2009	ICESat
Subregions in Alaska						
Adalgeirsdottir 1998	-34 km^3 ice	-0.71	-0.39	Harding Icefield (1,800)	1950/52-1994/96	Laser altimetry/map
Arendt et al. 2002	-5.3 km^3 yr^{-1} w.e.	-5.3		Alaska Range **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	-1.0 km^3 yr^{-1} w.e.	-1.0		Brooks Range **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	-5.4 km^3 yr^{-1} w.e.	-5.4		Coast Range **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	-2.7 km^3 yr^{-1} w.e.	-2.7		Kenai Mountains **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	-25.7 km^3 yr^{-1} w.e.	-25.7		St. Elias Mountains **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	-6.8 km^3 yr^{-1} w.e.	-6.8		Western Chugach Mountains **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	-1.3 km^3 yr^{-1} w.e.	-1.3		Wrangell Mountains **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2002	-4.2 km^3 yr^{-1} w.e.	-4.2		Tidewater glaciers **	1955-5/1995	Laser altimetry/maps
Arendt et al. 2006	-7.4 ± 1.1 km^3 yr^{-1} weq	-7.4 ± 1.1	-0.80	Western Chugach Mts (9,300)	1955-5/1995	Laser altimetry/maps
Larsen et al. 2007	-16.7 ± 4.4 km^3 ice yr^{-1}	-15.0±4.0	-1.03	Southeast Alaska (14,580)	8/1948-2/2000	geodetic
Arendt et al. 2008	-0.43±0.12 m w.e. yr^{-1}	-21.2±3.8	-0.64	St Elias Mtns (32,900)	9/2003-8/2007	Laser altimetry
Arendt et al. 2008	-0.63±0.09 m w.e. yr^{-1}	-20.6±3.0	-0.63	St Elias Mtns (32,900)	9/2003-8/2007	GRACE
Johnson et al. 2013	3.93±0.89 Gt yr^{-1}	3.93±0.89	-0.61	Glacier Bay (6,428)	1995-2011	Laser altimetry
Das et al. in press	-0.07±0.19 m w.e. yr^{-1}	-0.34±0.93	-0.07	Wrangell Mountains (4,900)	1957-2000	Laser altimetry/DEM
Das et al. in press	-0.24±0.16 m w.e. yr^{-1}	-1.18±0.78	-0.24	Wrangell Mountains (4,900)	2000-2007	Laser altimetry/DEM

Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)



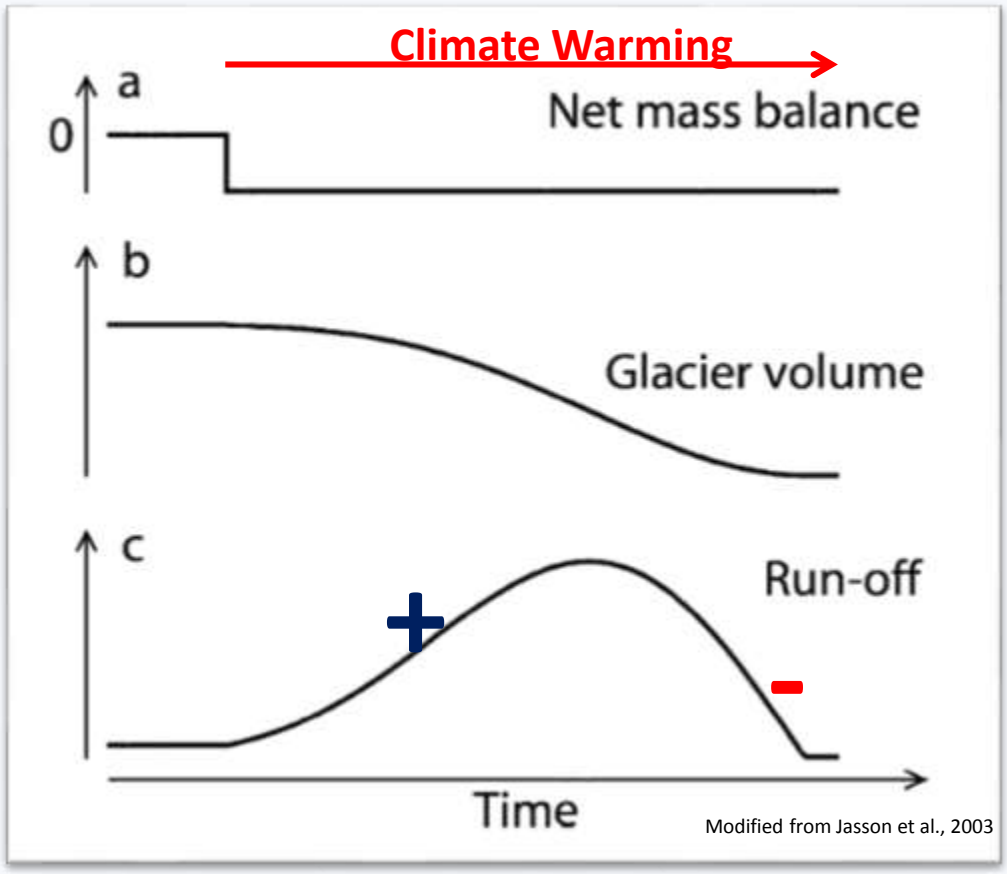
Radic et al., 2013

Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)



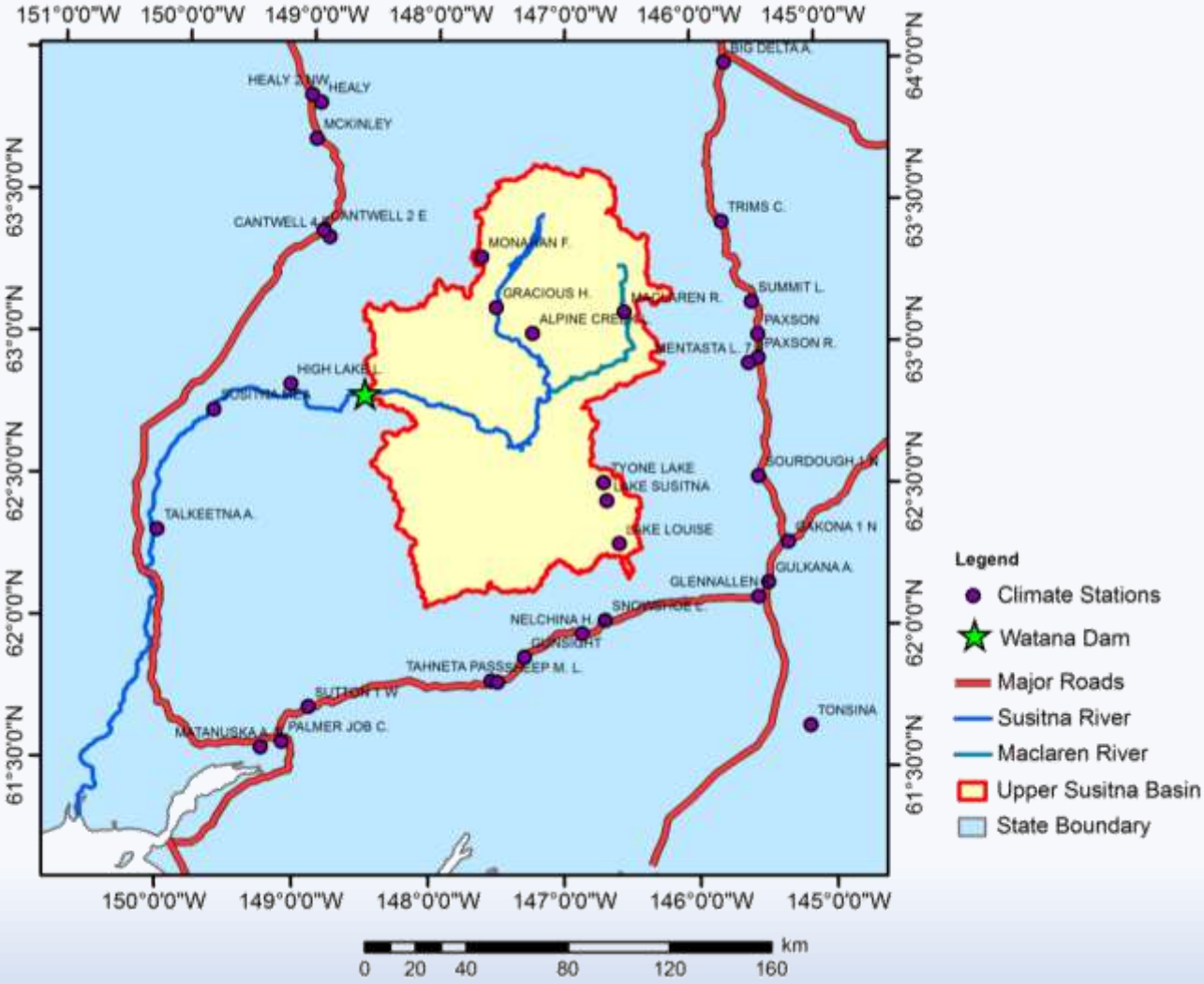
Hock et al., 2005

Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)

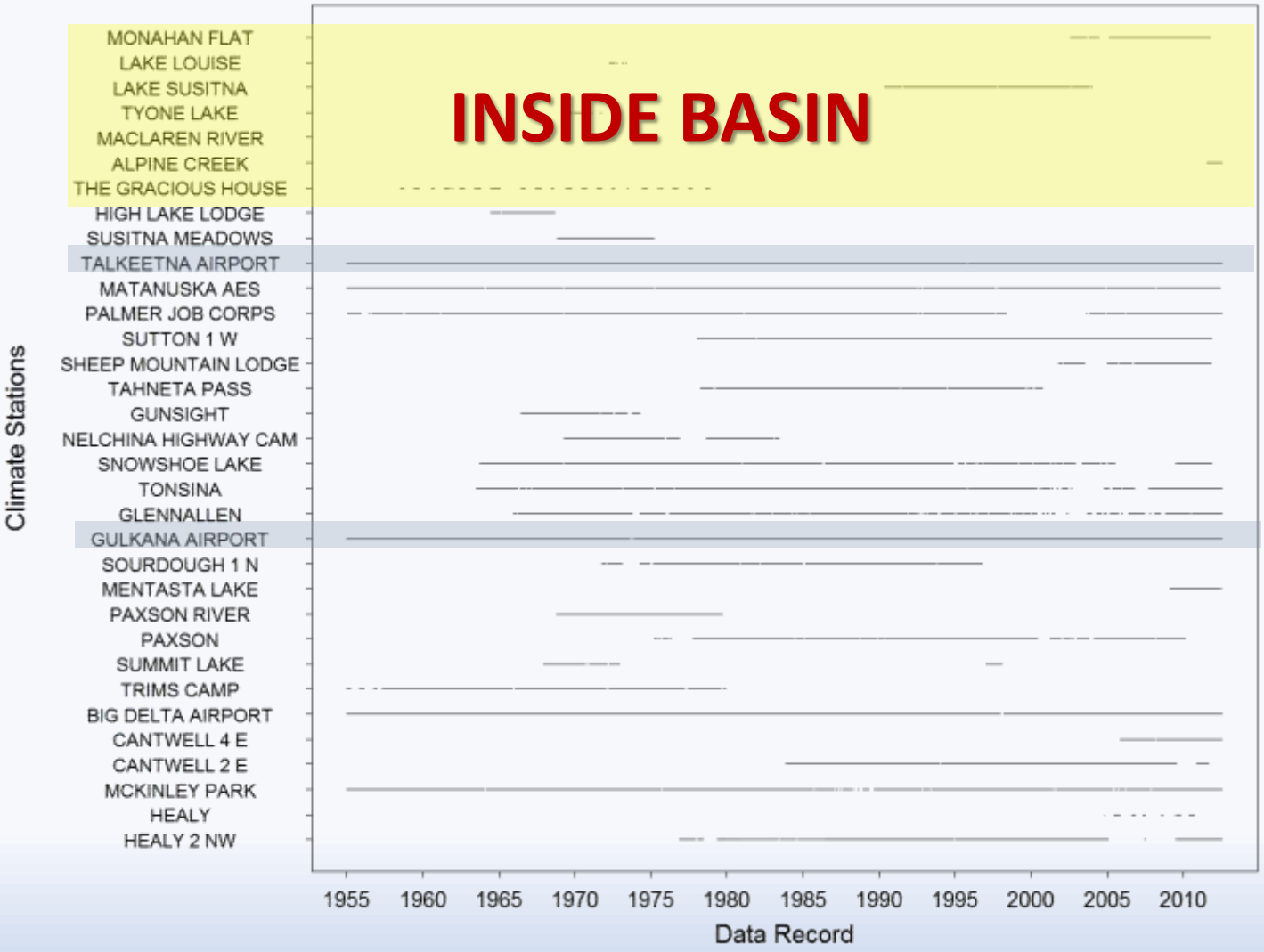


Modified from Jasson et al., 2003

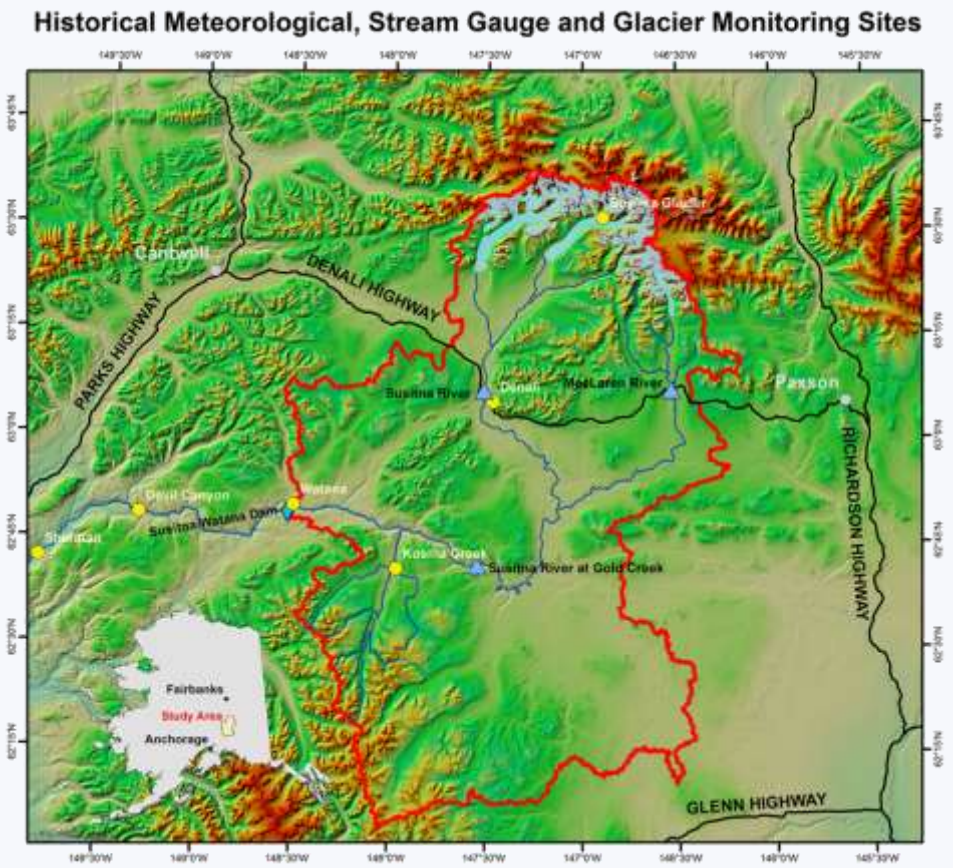
Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)

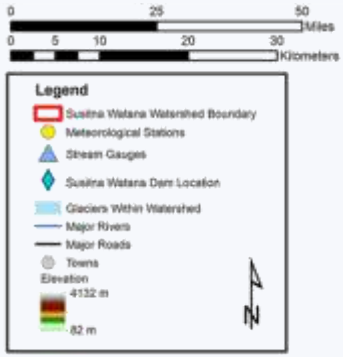


Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)

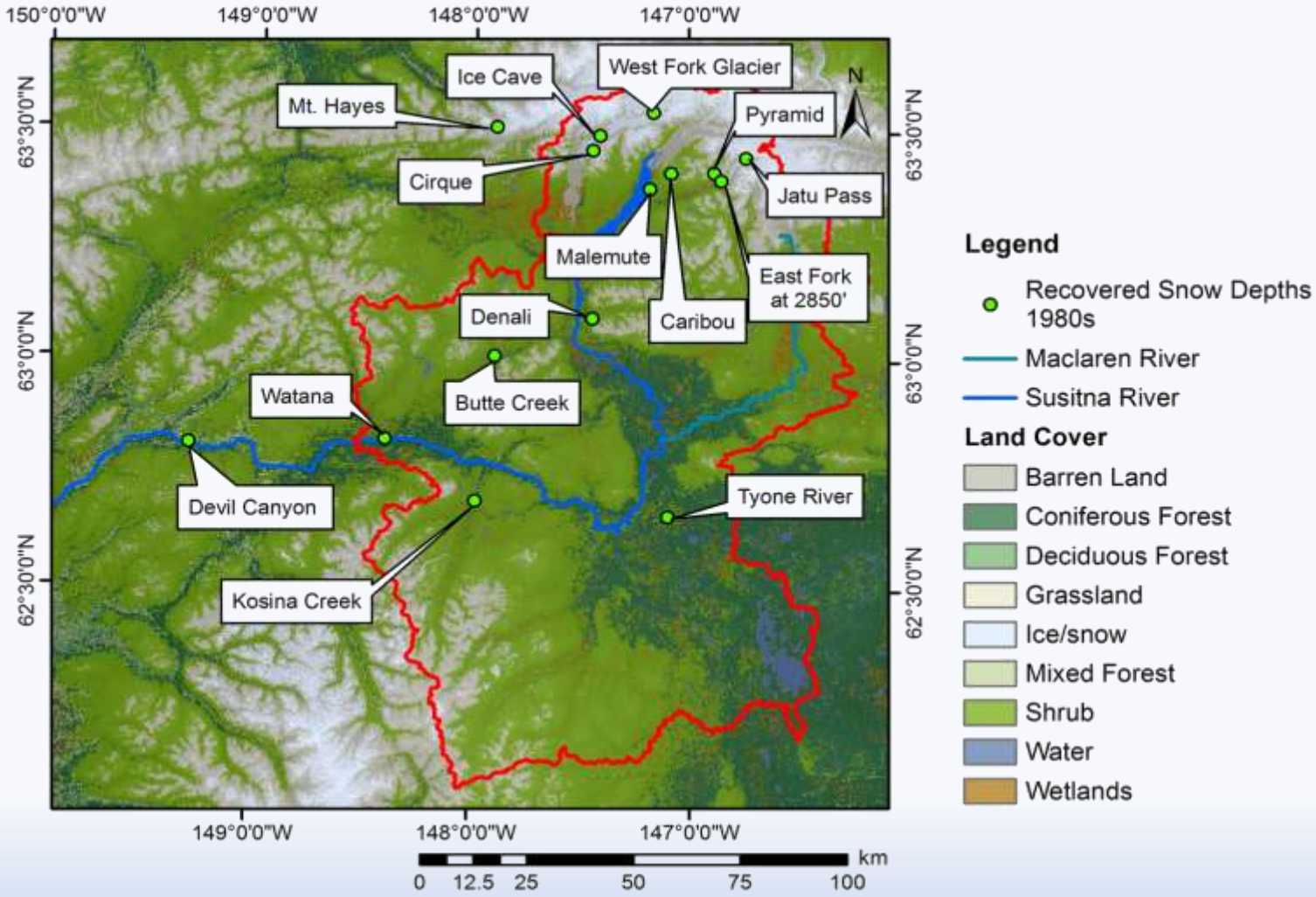


Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)

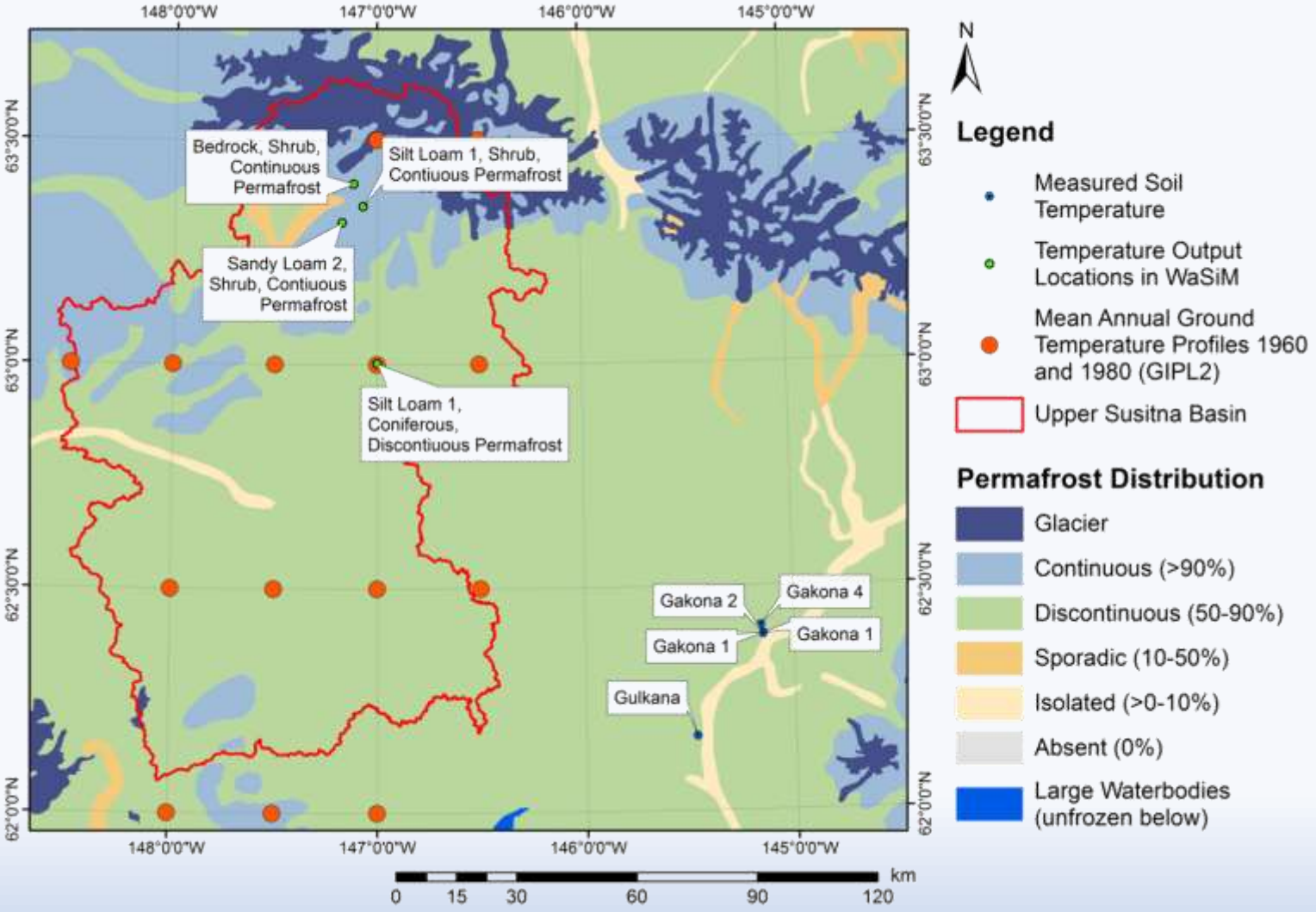




Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)



Study 7.7 Summary of Results in ISR (ISR Study 7.7, Part A)



AEA Proposed Modifications to Study 7.7 in ISR

- This FERC required portion of this study is complete

Steps to Complete Study 7.7 (ISR Study 7.7, Part A – Executive Summary)

- This FERC required portion of this study is complete

Licensing Participants Proposed Modifications to Study 7.7?

- Agencies
- CIRWG members and Ahtna
- Public