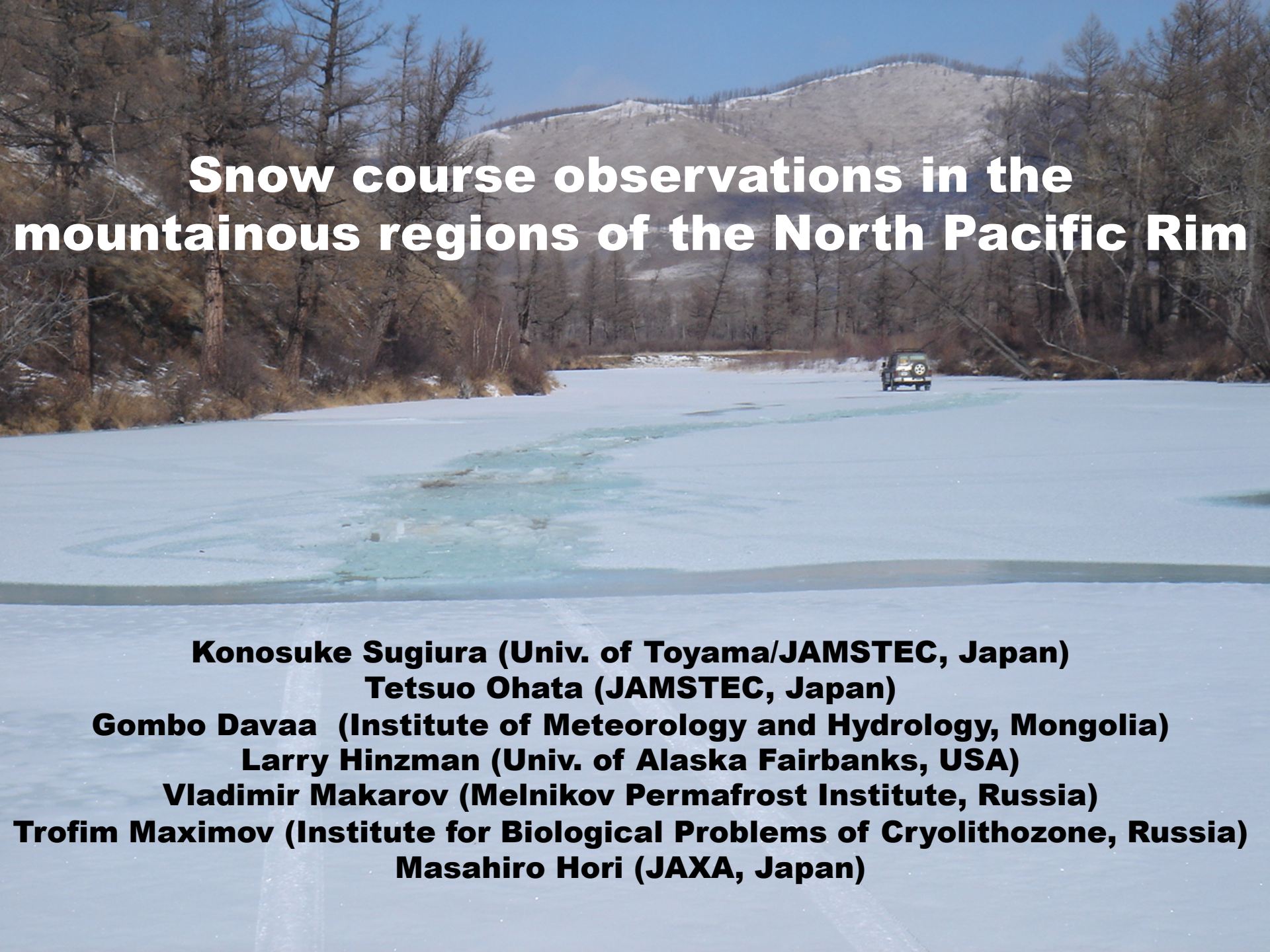
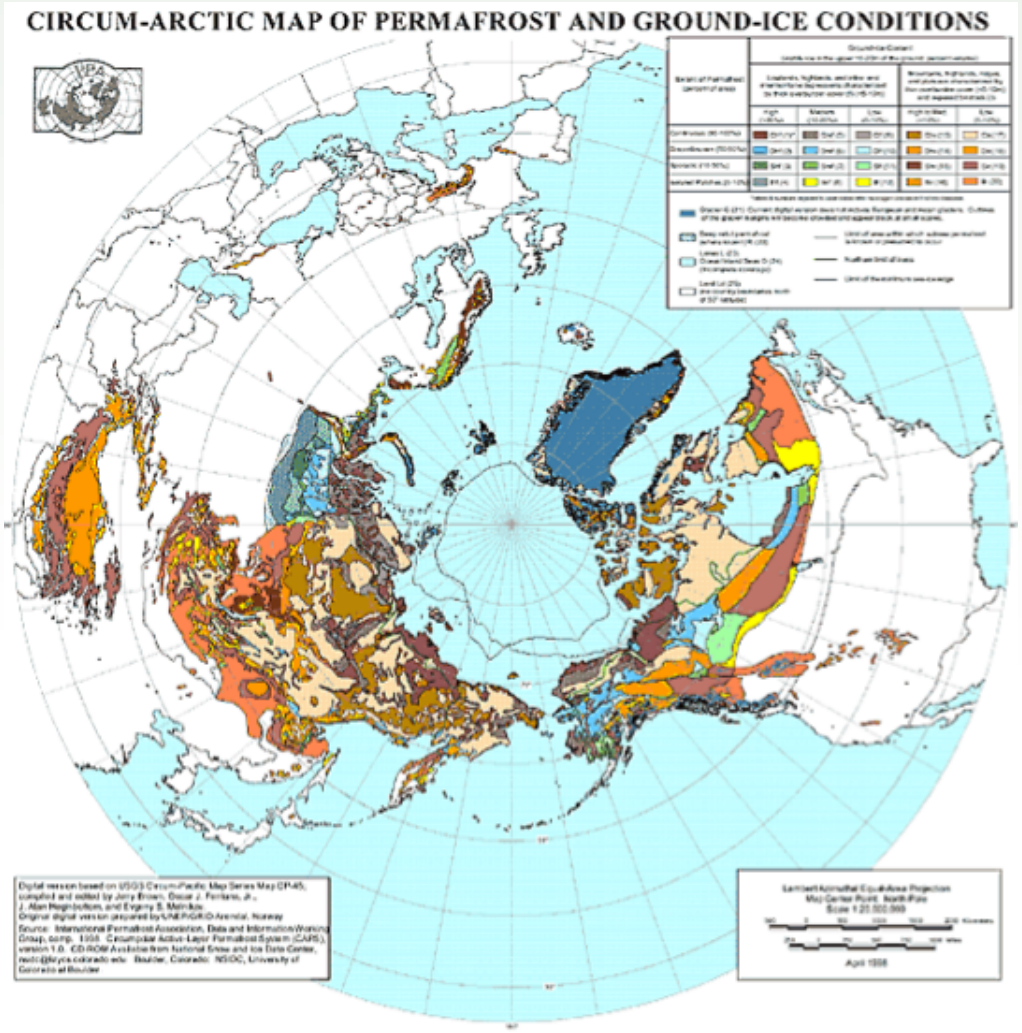


Snow course observations in the mountainous regions of the North Pacific Rim

Konosuke Sugiura (Univ. of Toyama/JAMSTEC, Japan)
Tetsuo Ohata (JAMSTEC, Japan)
Gombo Davaa (Institute of Meteorology and Hydrology, Mongolia)
Larry Hinzman (Univ. of Alaska Fairbanks, USA)
Vladimir Makarov (Melnikov Permafrost Institute, Russia)
Trofim Maximov (Institute for Biological Problems of Cryolithozone, Russia)
Masahiro Hori (JAXA, Japan)

Introduction



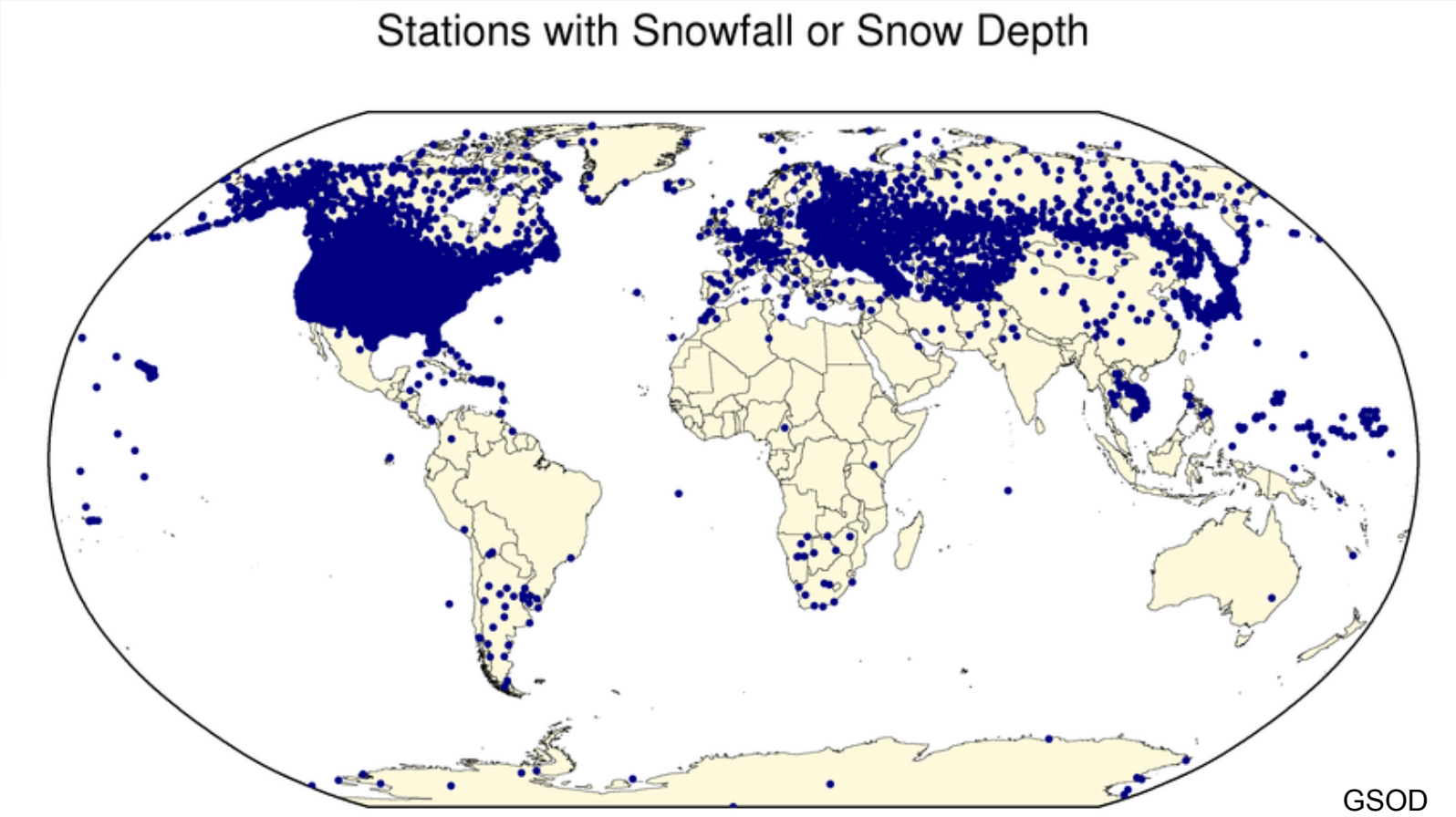
North Pacific Rim

☞Underlain by continuous and discontinuous permafrost

Snowpack conditions in this region

☞Sensitive to a change in a climate

Introduction



The mountainous regions

☞Observatories are located sparsely

Snow surveys in the mountainous regions of the North Pacific Rim have been carried out selectively,

1) for clarifying the differences of snowpack characteristics in this region,

2) for reducing the uncertainty of reliably estimating the amount of snow in the cryosphere

This presentation describes the progress and preliminary results of the snow surveys

Observation methods

Snow Depth: Snow stick (10 times with 10-m interval)

Snow Weight: Digital weight scale (cylindrical snow sampler with 50-cm^2 area)

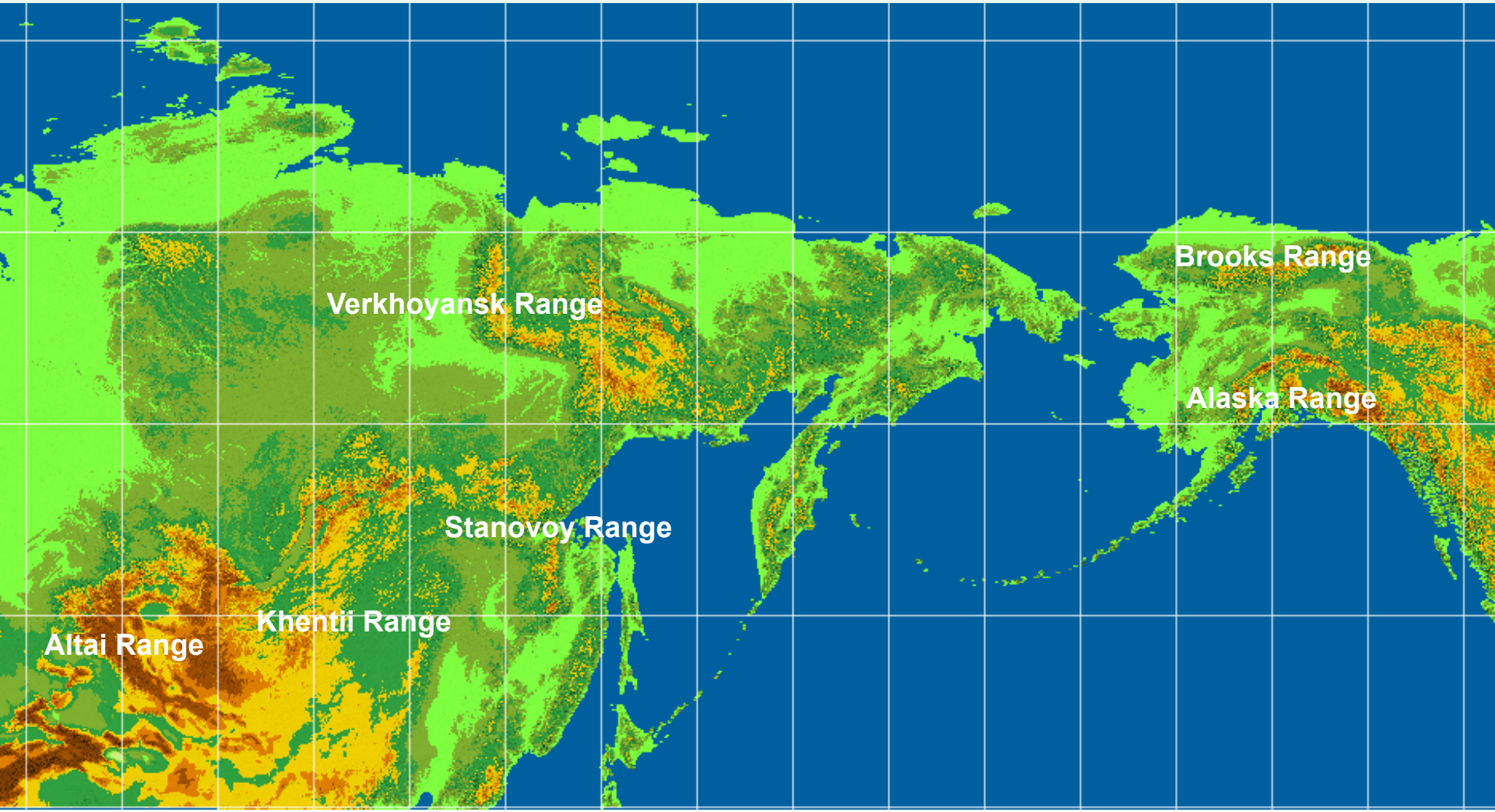
Snow Density & Snow Water Equivalent: Calculated from the Snow Depth and Weight

Snow Hardness: Push gauge

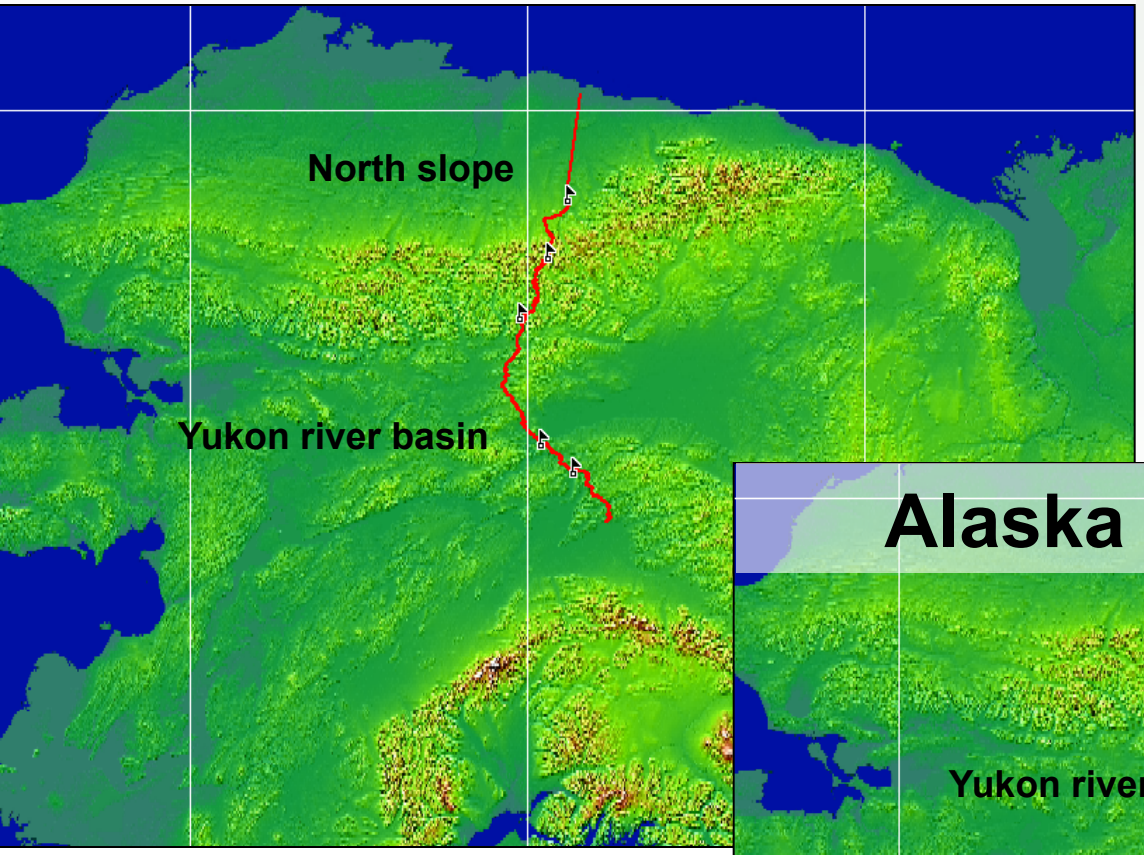
Snow Type: Visual observation method (Snow grain size gauge)

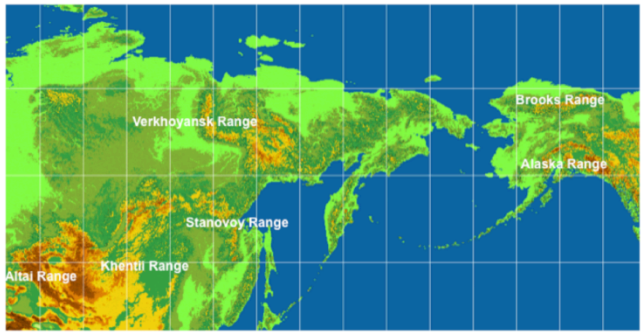
Snow & Air Temperature: Platinum resistance thermometer

Latitude, Longitude and Altitude: Handy-type GPS

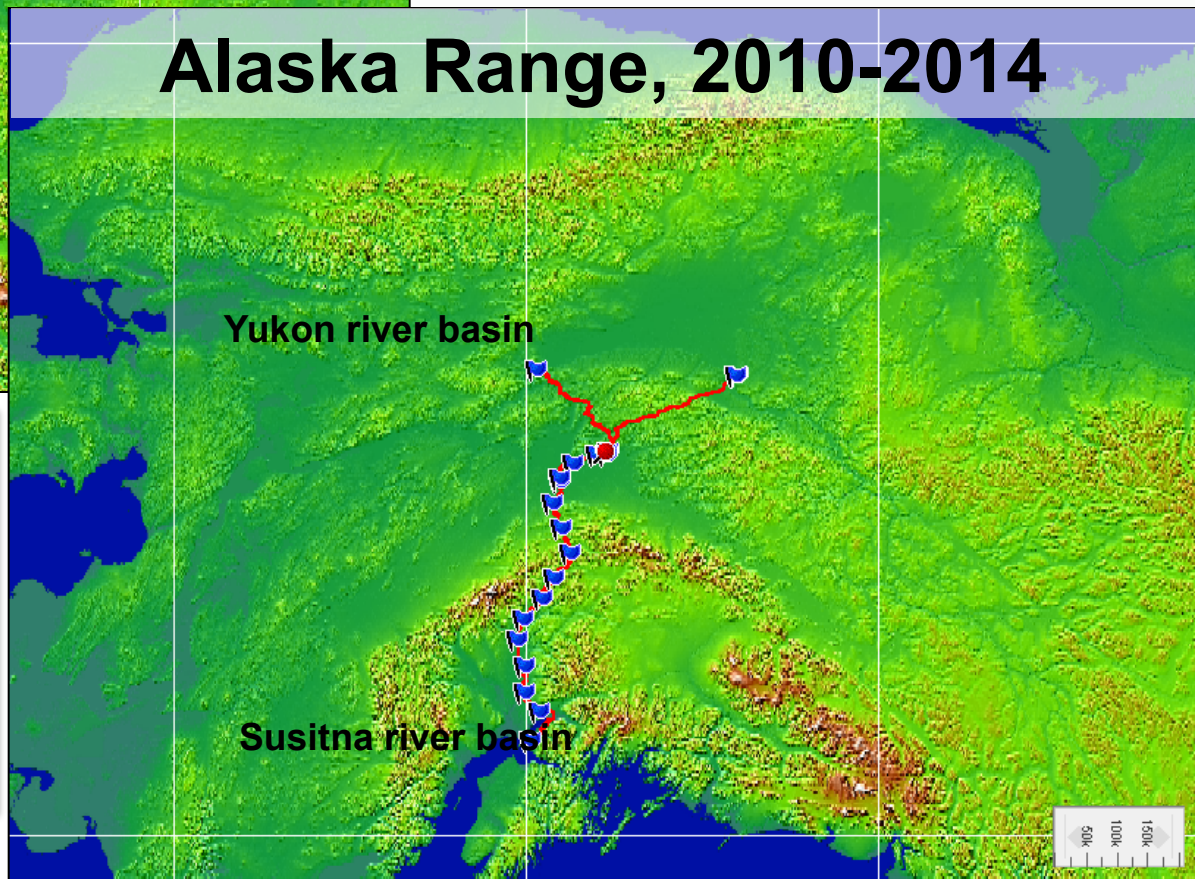

Brooks Range
Verkhoyansk Range
Alaska Range
Stanovoy Range
Khentii Range
Altai Range

Brooks Range, 2009

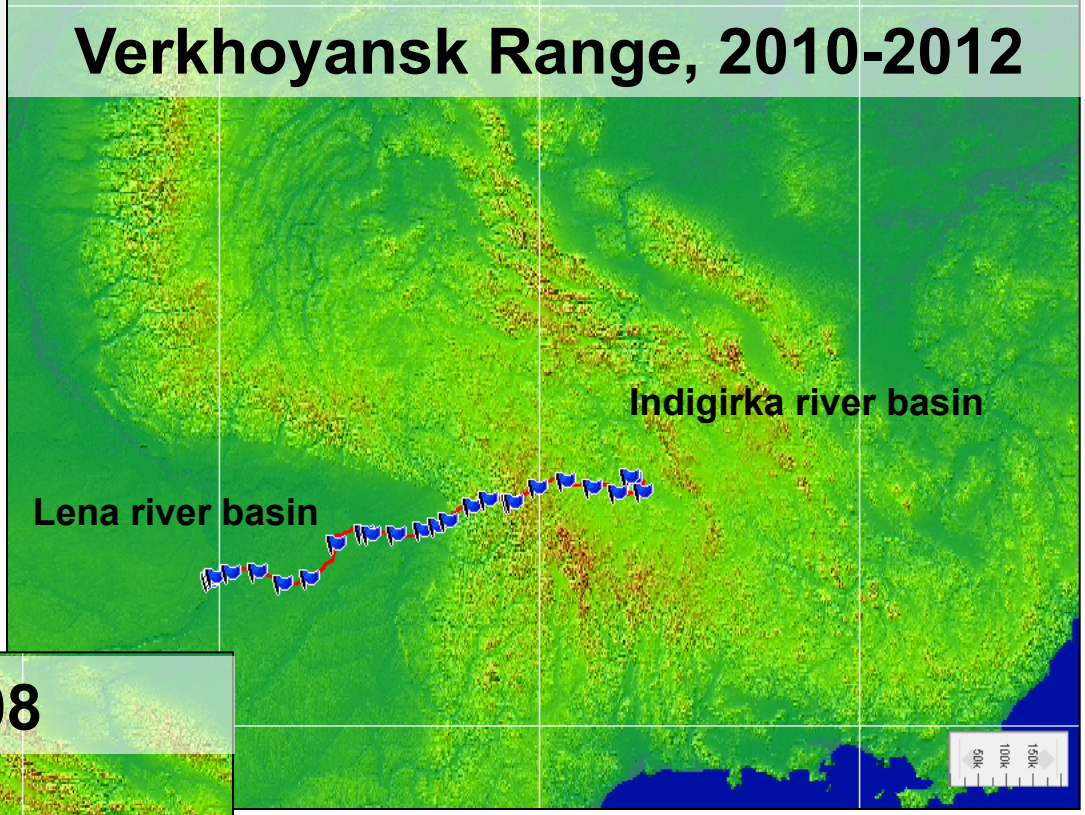


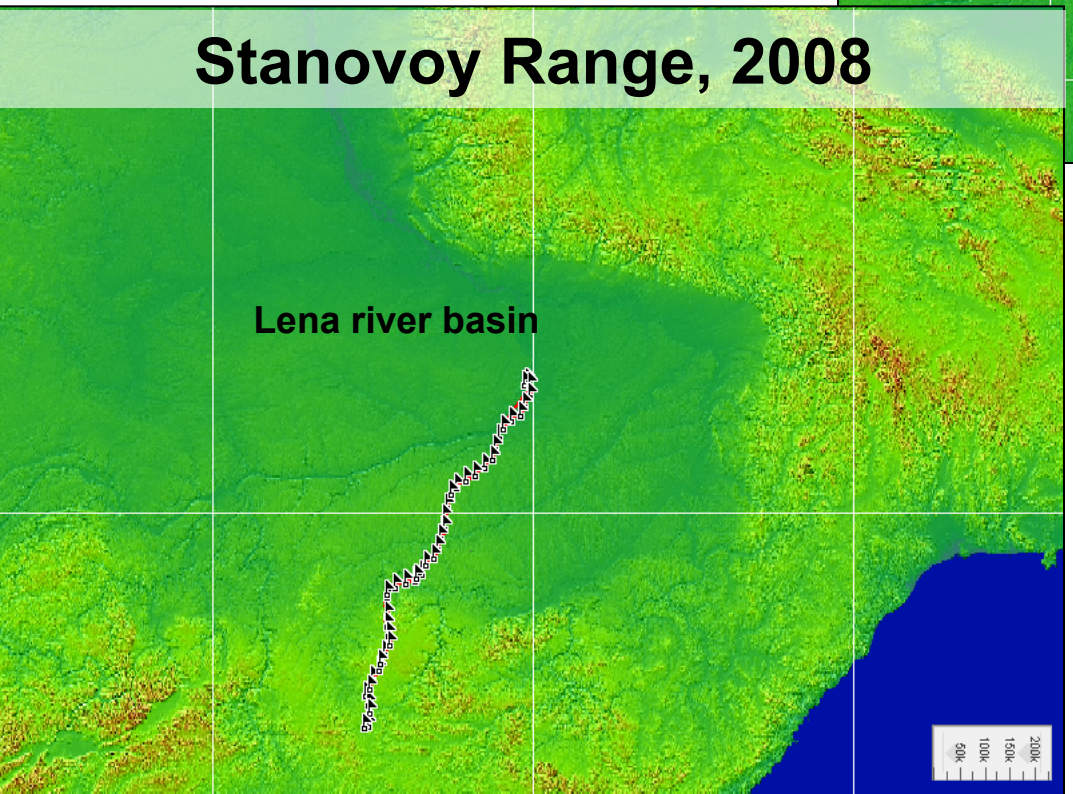


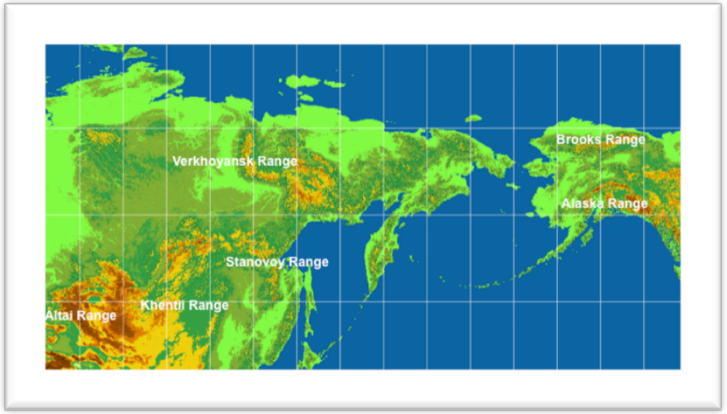
Alaska Range, 2010-2014



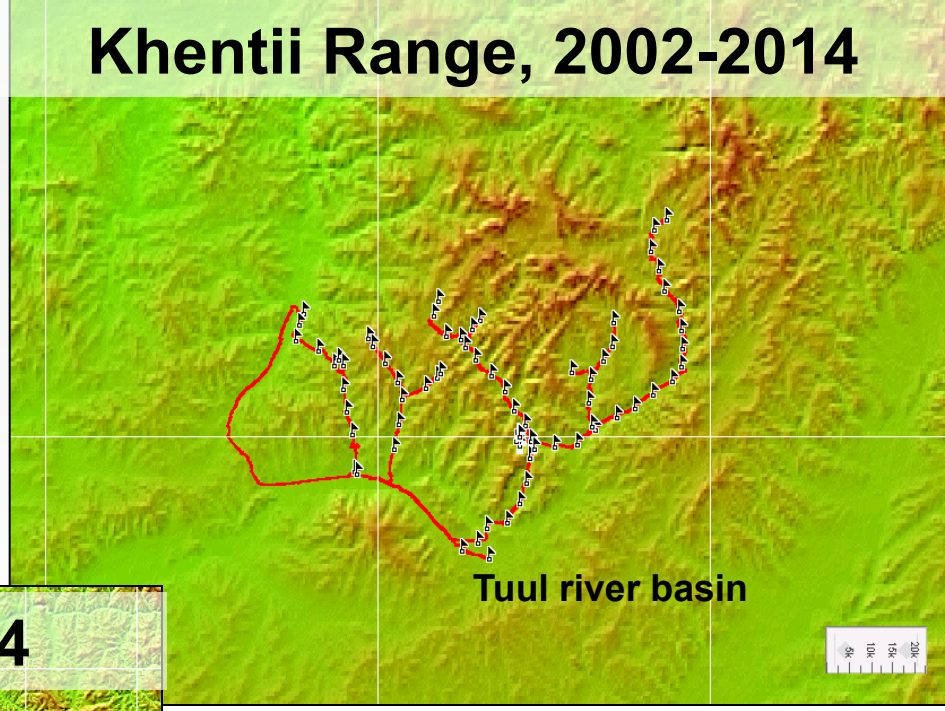

KAMAZ


Verkhoyansk Range, 2010-2012
Indigirka river basin
Lena river basin
50k
100k
150k

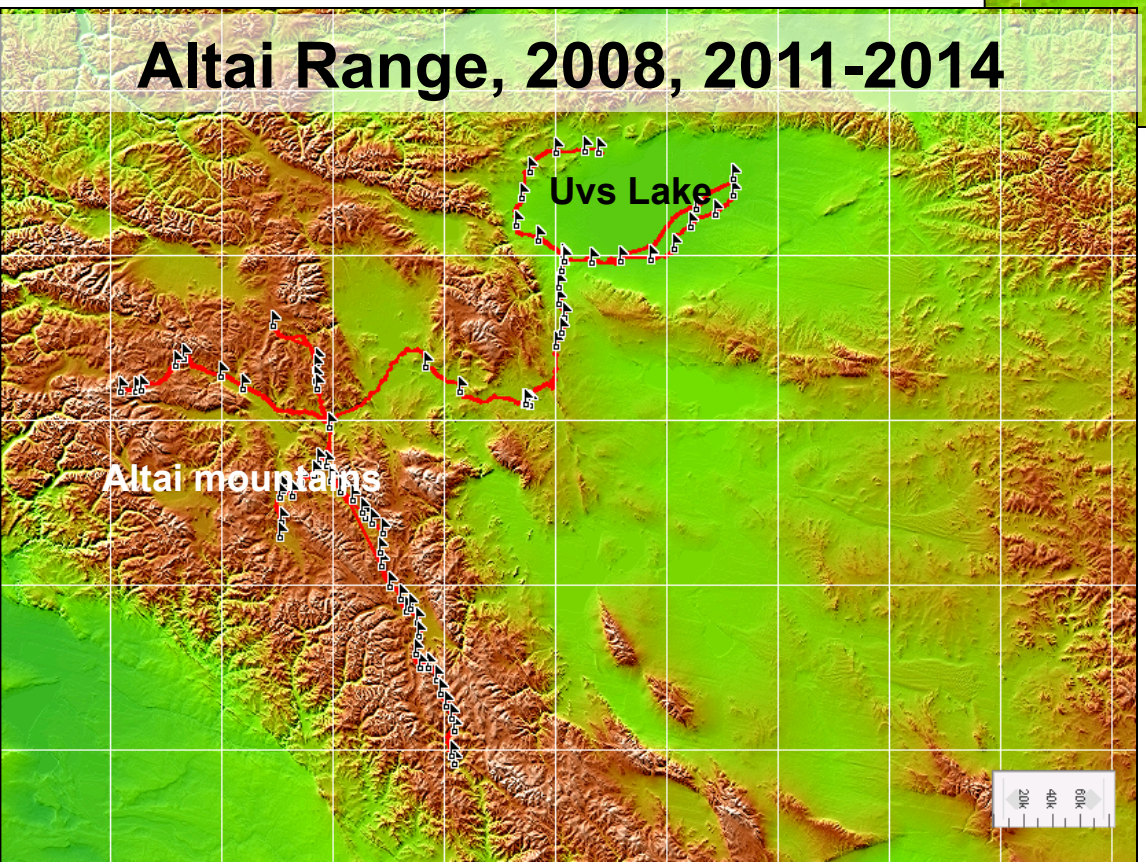

Stanovoy Range, 2008
Lena river basin
50k
100k
150k
200k

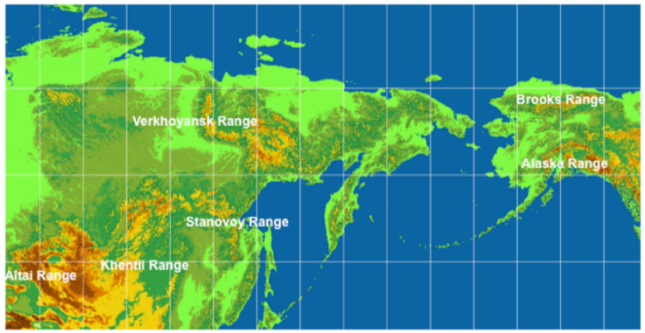

Verkhoyansk Range
Brooks Range
Alaska Range
Stanovoy Range
Khentii Range
Altai Range

Khentii Range, 2002-2014



Altai Range, 2008, 2011-2014

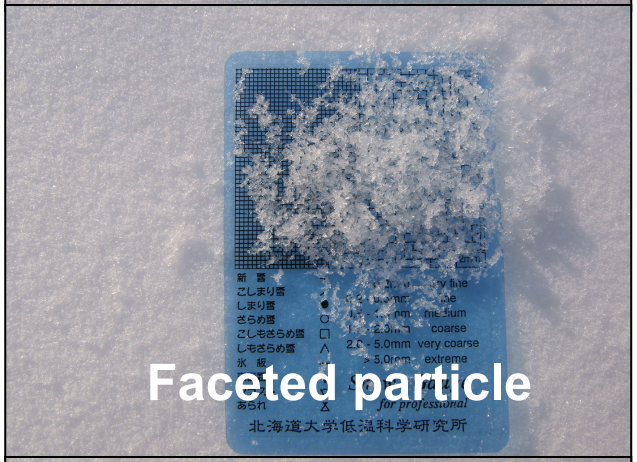




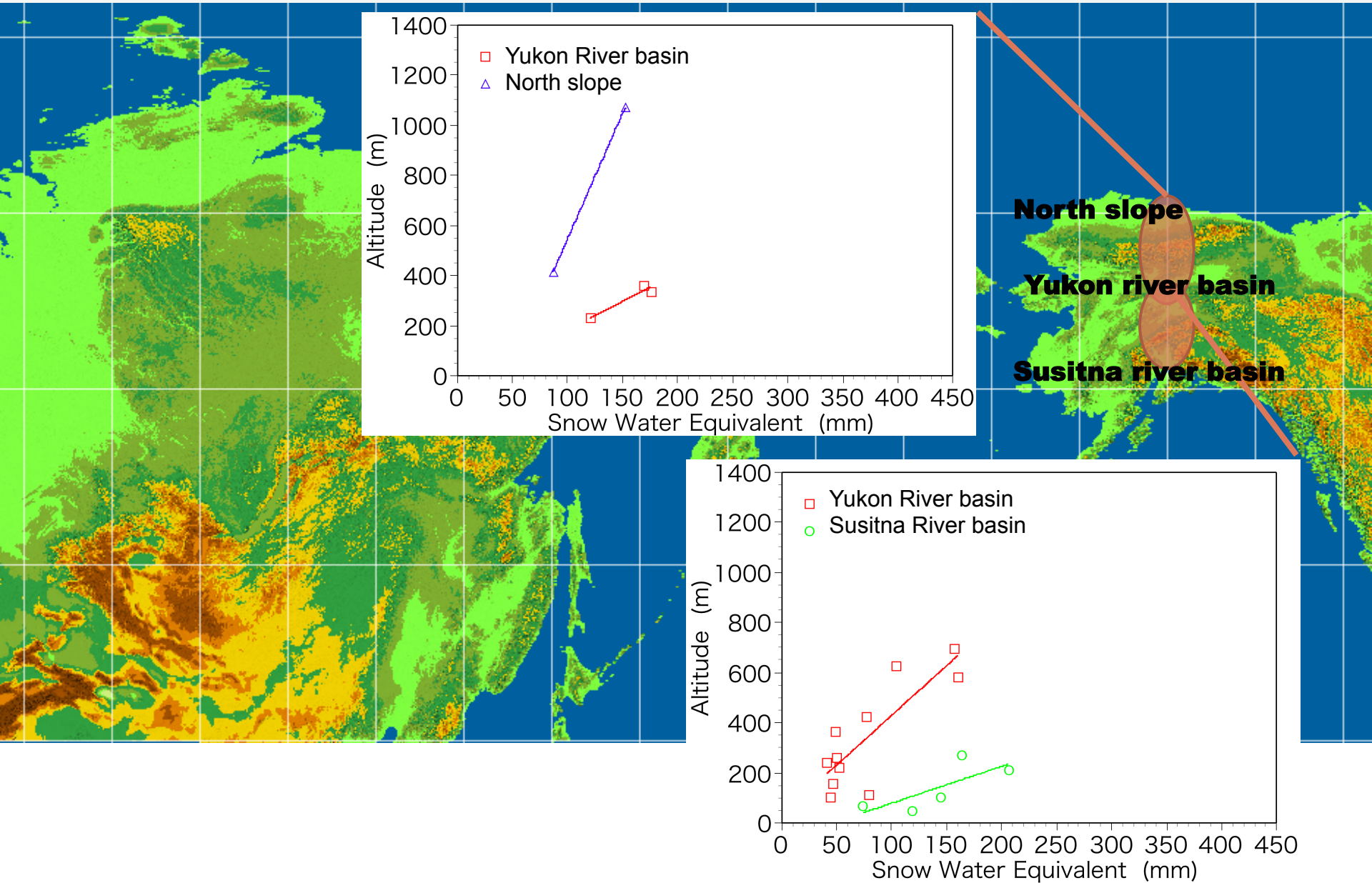
Results

Type of snow

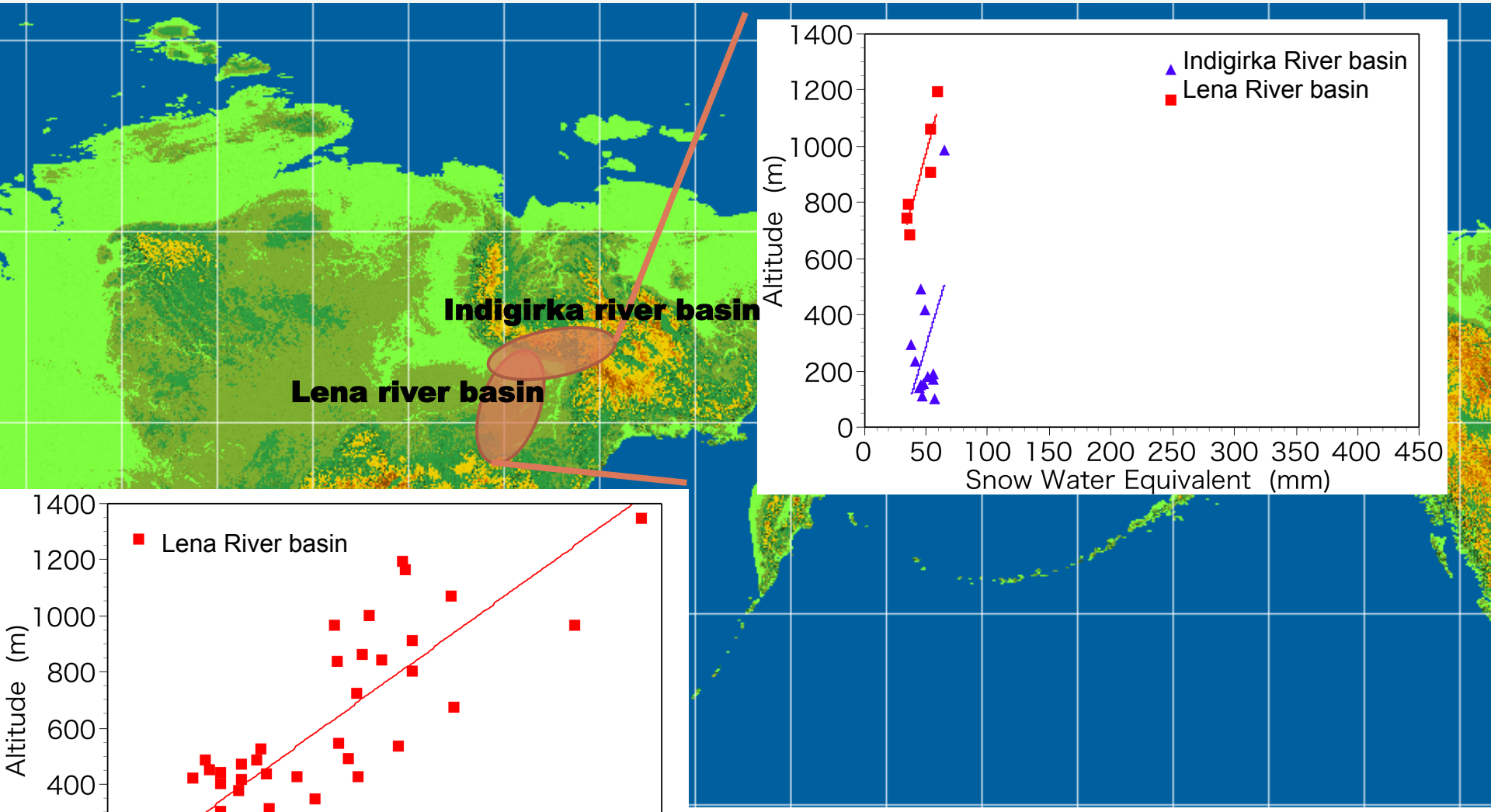
➢Similar to the most part of observed area



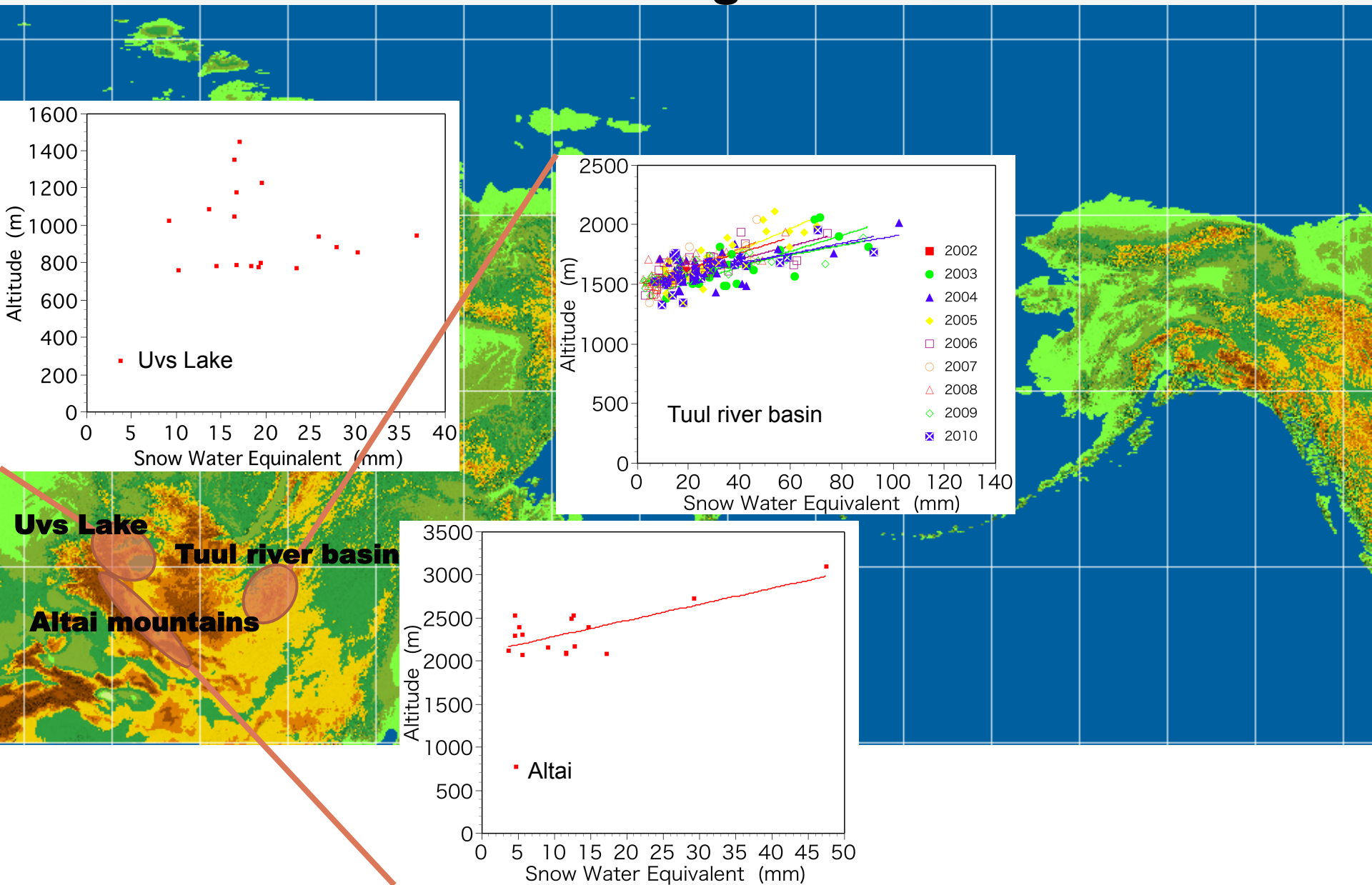
Altitude dependence of snow water equivalent in Alaska



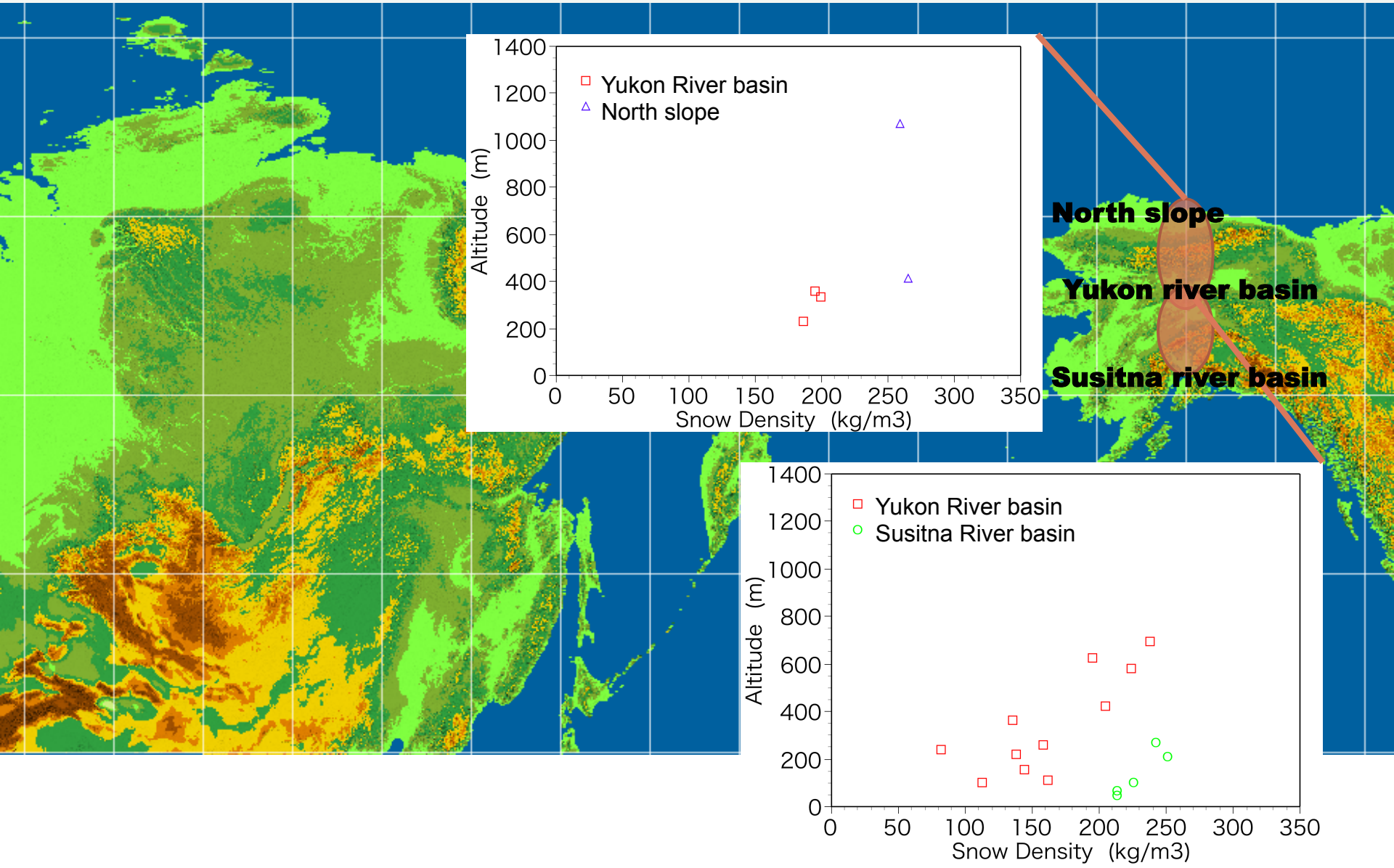
Altitude dependence of snow water equivalent in Siberia



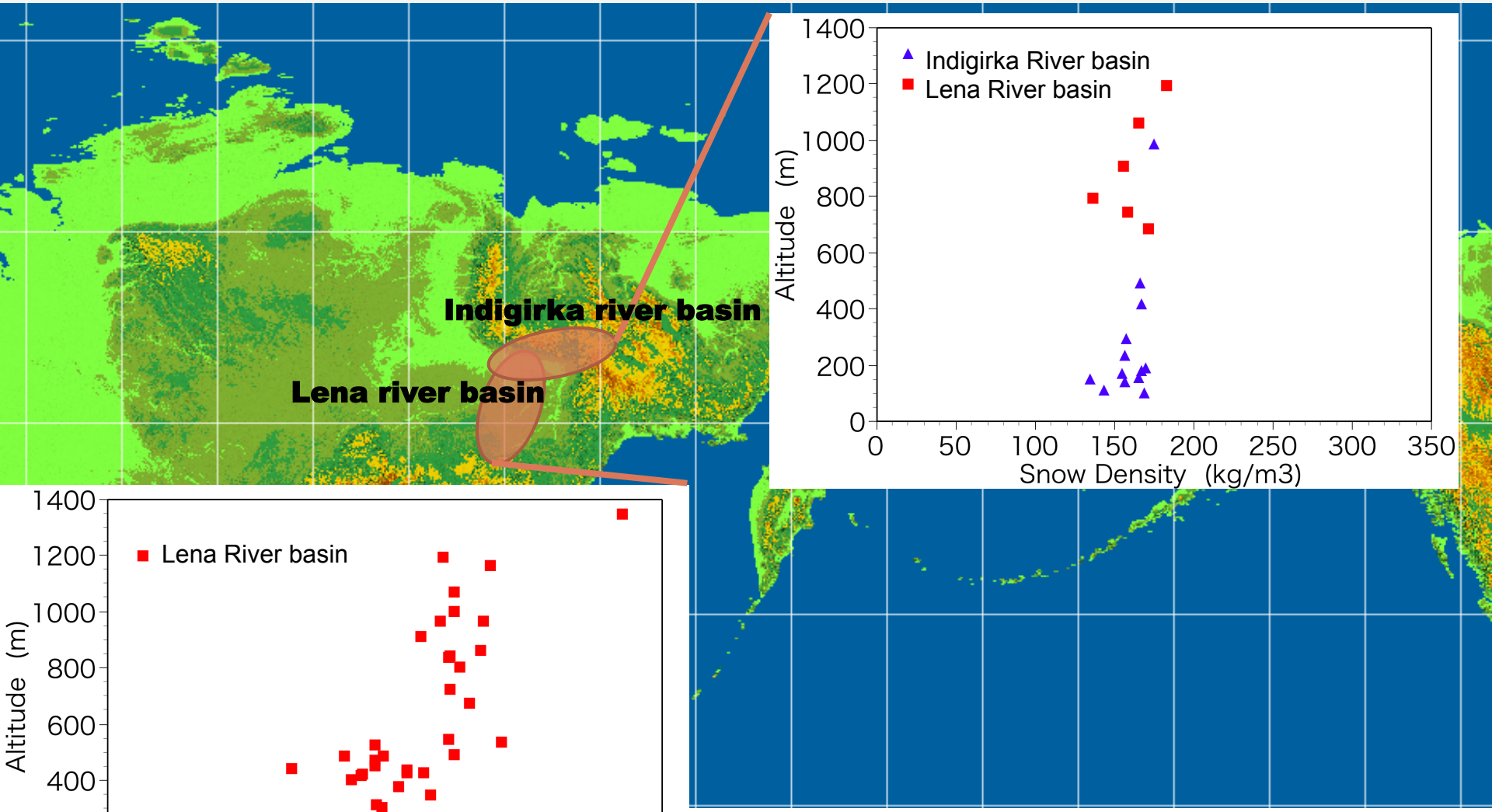
Altitude dependence of snow water equivalent in Mongolia



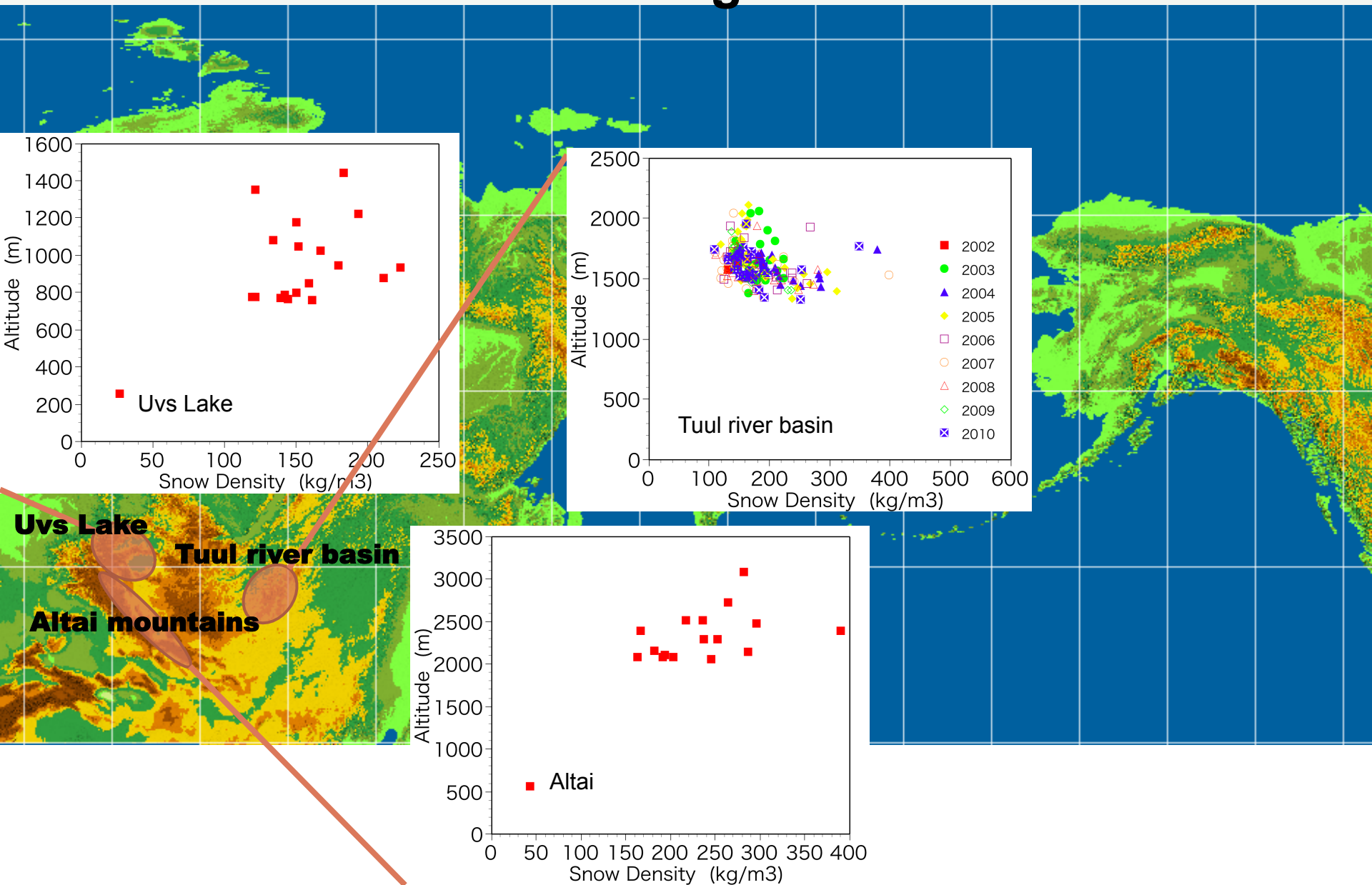
Altitude dependence of snow density in Alaska



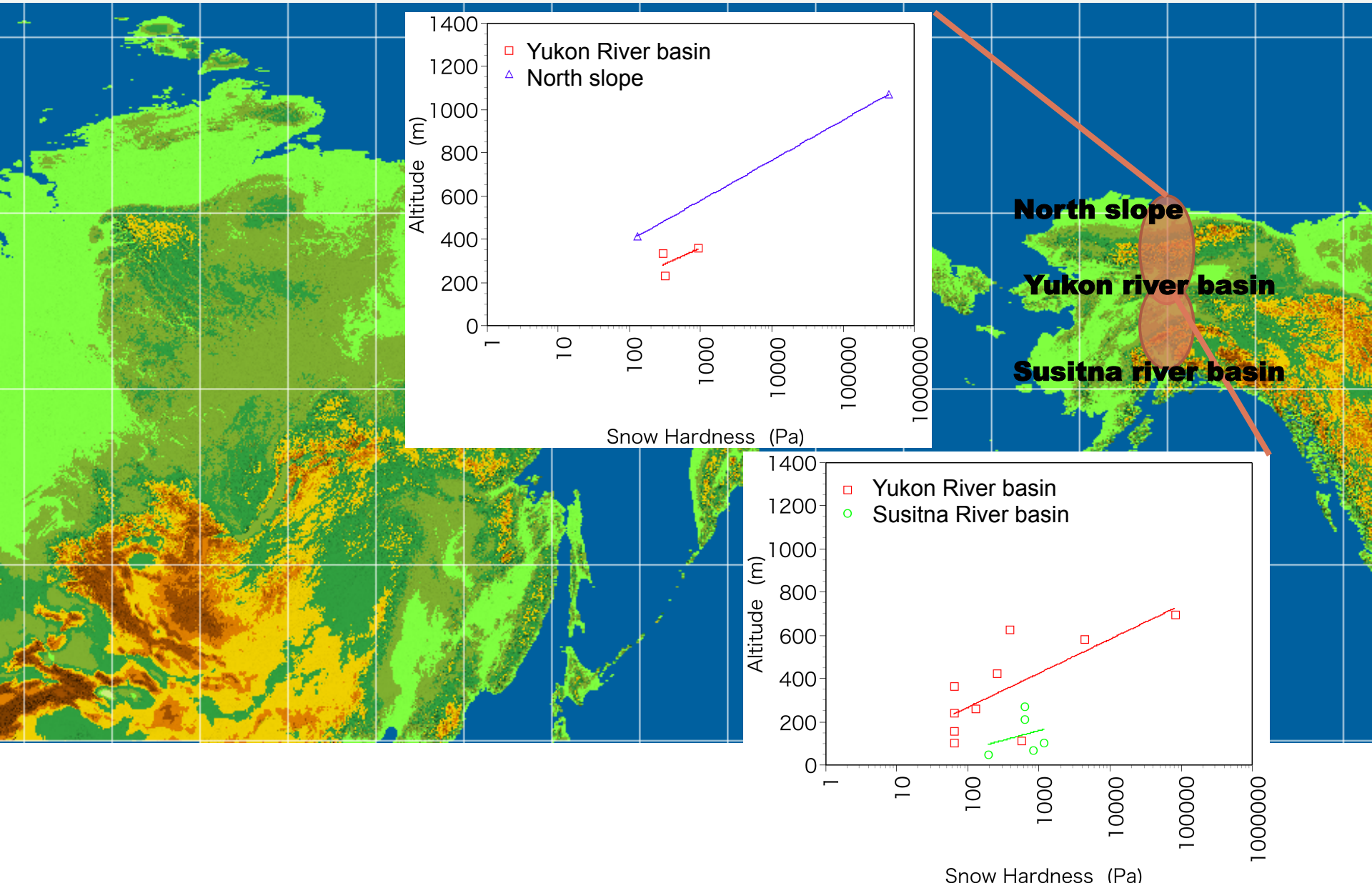
Altitude dependence of snow density in Siberia



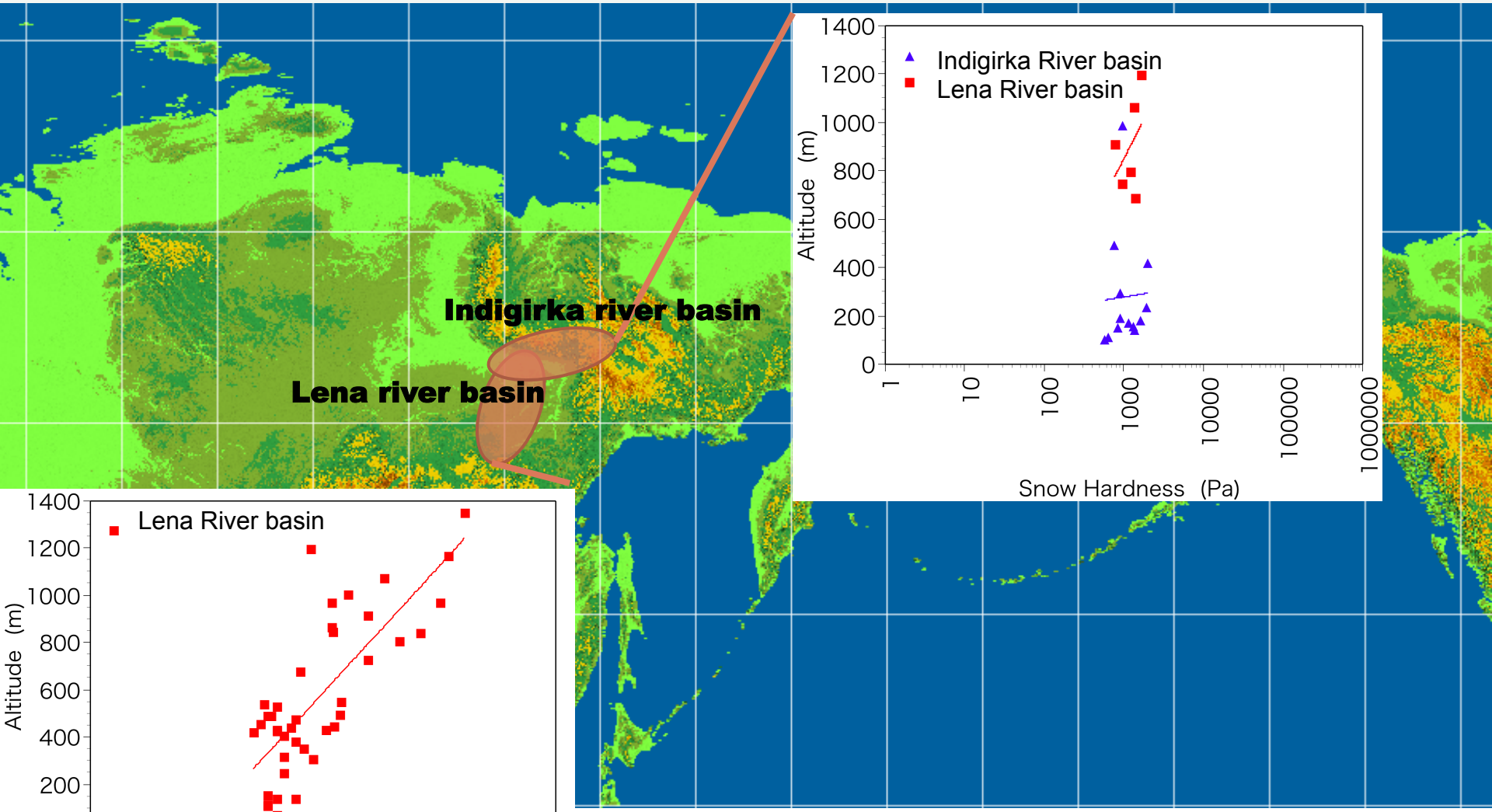
Altitude dependence of snow density in Mongolia



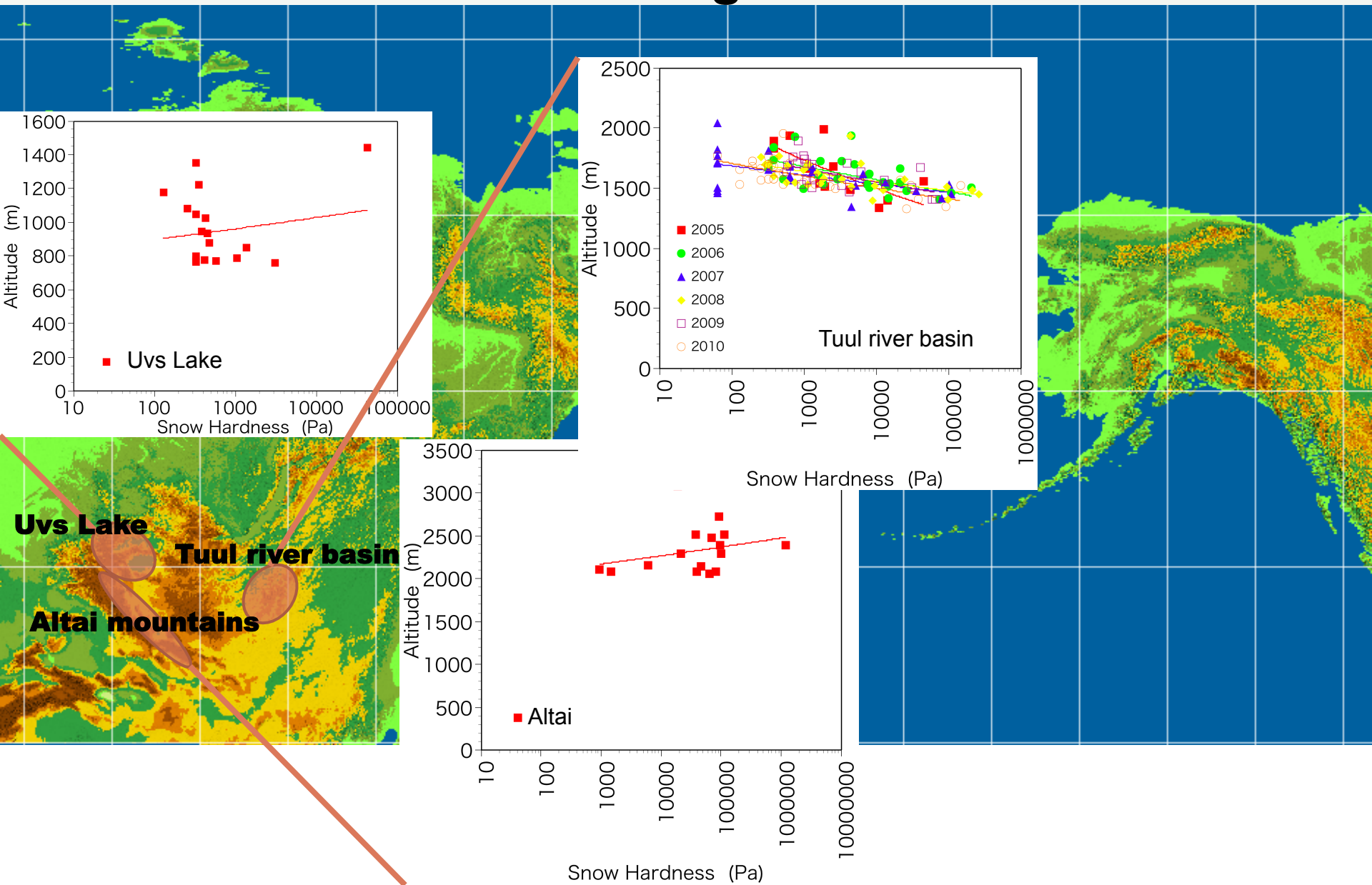
Altitude dependence of snow hardness in Alaska



Altitude dependence of snow hardness in Siberia



Altitude dependence of snow hardness in Mongolia



Example of datasets of snow pit observations (SnowSurveyMongolia2010.xls)

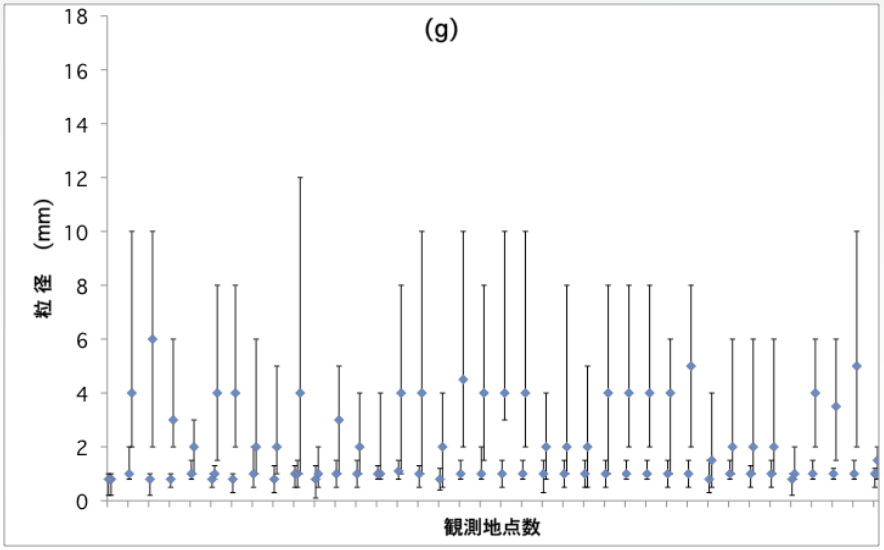
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Snow survey in Feb. 2010													
2														
3														
4	Point No.	SnowDepth	SnowDensity	SnowWaterEquival	SnowHardness	Lat.			Lon.			Alt.	Remark	
5		cm	gcm-3	mm	Pa	dd.mmss.s			ddd.mmss.s			m	Photos(*.JPG)	
66	2/24 along the way to Bayan River													
67	BA1	7.7				48	0	20.9	107	38	15.0	1475	2010_KMBA01-0	
68	BA2	6.4	0.1680	10.8	148679.9	48	3	12.6	107	37	54.0	1525	2010_KMBA02-0	
69	BA3	9.6				48	5	24.3	107	38	12.7	1545	2010_KMBA03-0	
70	BA4	10.9	0.1473	16.1	389.8	48	7	54.3	107	39	0.9	1580	2010_KMBA04-0	
71	BA5	9.5				48	10	17.2	107	41	37.5	1637	2010_KMBA05-0	
72	BA6	8.4				48	12	41.5	107	42	42.8	1693	2010_KMBA06-0	
73	BA7	13.1	0.1092	14.3	389.8	48	14	4.8	107	42	55.7	1744	2010_KMBA07-0	
74	BA8	7.6				48	7	36.5	107	38	7.1	1591	2010_KMBA08-0	
75	BA9	10.4	0.1500	15.6	649.6	48	7	48.7	107	34	49.8	1716	2010_KMBA09-0	
76														

Example of datasets of snow pit observations (SnowPitMongolia2010.xls)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Place	Date/Information		depth	Snow type	Snow grain size						Photo	Note
2						d1diameter,mm			d2diameter,mm				
3				cm		min	max	mean	min	max	mean	*.JPG	
260	BA9	Feb24,2010		surface									
261		13:00 - 13:14	~	6.0	/□	0.5	1.5	1	0.1	0.2	0.1	2010_HMBA09-2	
262		Ta(degC): -21.9	~	11.0	^^	1	6	2	0.1	1	0.5	2010_HMBA09-3	
263		Ts(degC): -20.9											
264		Tg(degC): -17.9											
265		Photo: 2010_HMBA09-0,1											
266													
267													
268	UL2	Feb25,2010		surface									

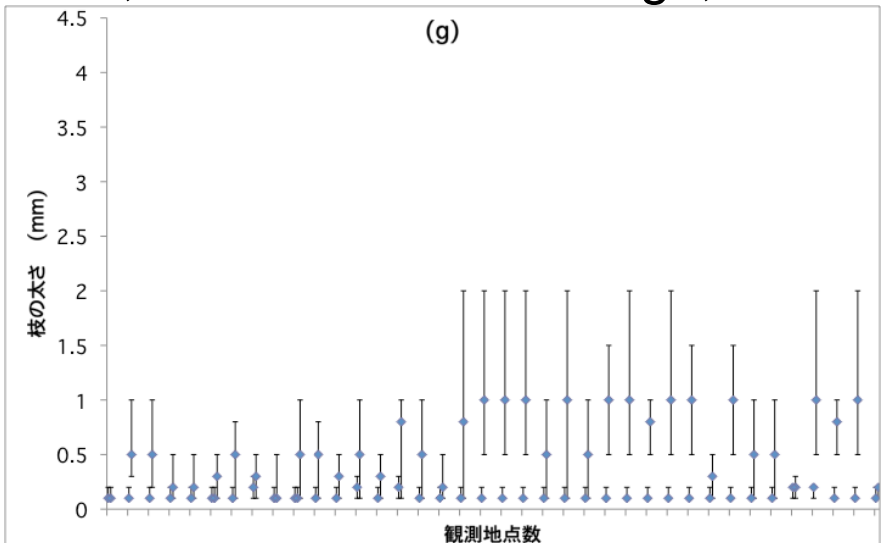
Example of grain size distribution

(38 points, Khentii mountain range, Feb 2010)



Example of grain thickness distribution

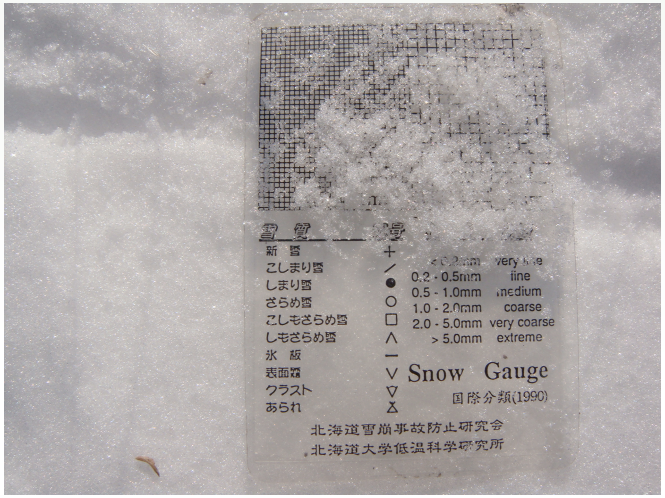
(38 points, Khentii mountain range, Feb 2010)



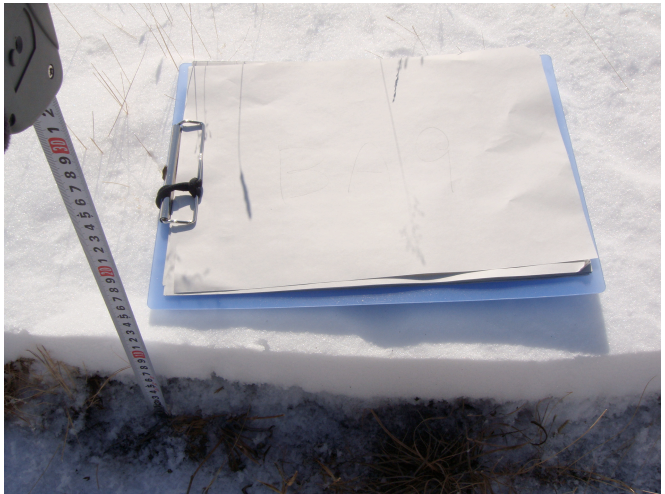
Example of datasets of snow pit observations

Landscape at the point
(2010_HMBA09-0.jpg)

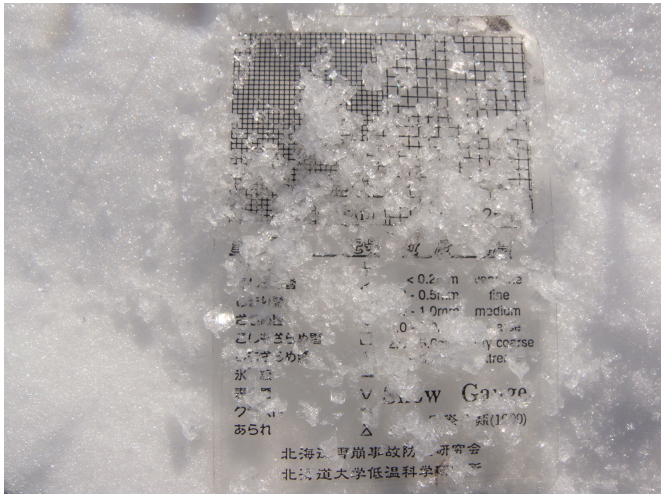
Close-up photography of grains each snow layer
(2010_HMBA09-2.jpg)



Snowpack
(2010_HMBA09-1.jpg)



(2010_HMBA09-3.jpg)



Conclusion

The traverse lines for snow surveys were set to the Brooks, Alaska, Verkhoyansk, Stanovoy, Khenteii and Altai Ranges which were characterized by a tundra, taiga and steppe.

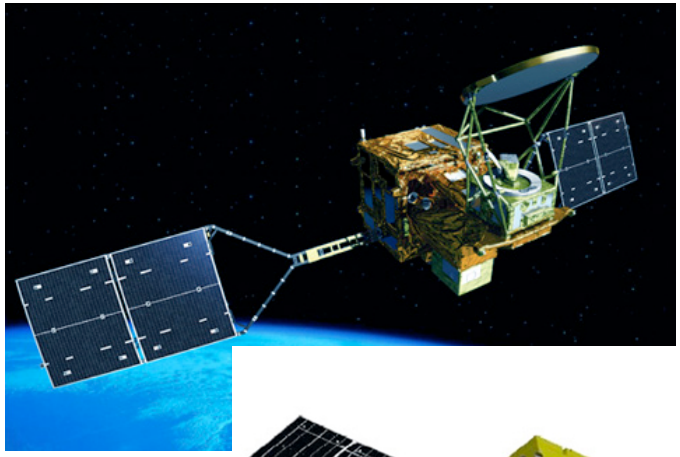
The following conclusions were reached.

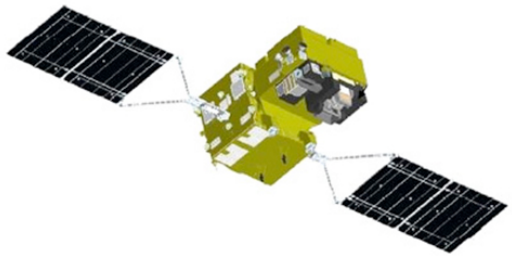
1. The bottom of the snowpack in the mountainous regions is composed of the typical depth hoar layer.
2. The total SWE in the coastal area increases with an increase in altitude.
3. The altitude dependence of the total SWE in the internal area becomes weak.
4. The total snow density ranges from 100 to 300 kg/m^3 at the the coldest period, though it usually reaches 500 kg/m^3 at the snow melting period.

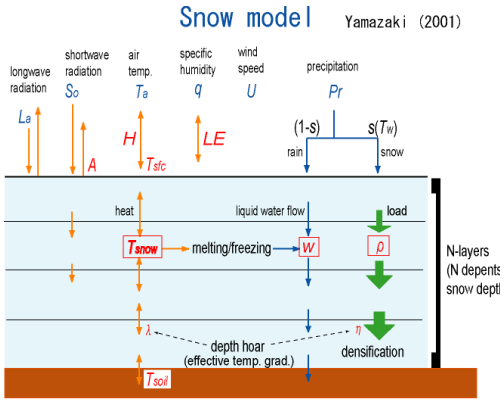
Conclusion

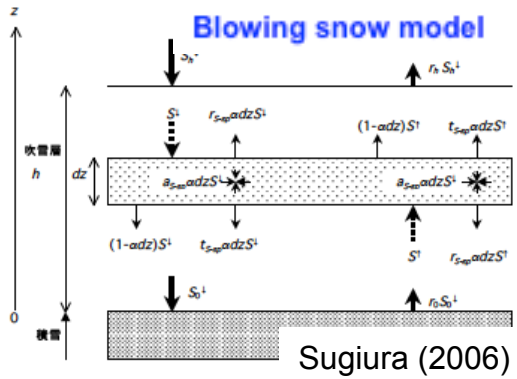
5. The snow surface hardness increases with an increase in altitude due to vegetation pattern.

These snow survey data will enable us to carry out 1) further analysis and 2) development of datasets ***for satellite calibration/validation*** and ***for model validation/improvement***.









Sugiura (2006)