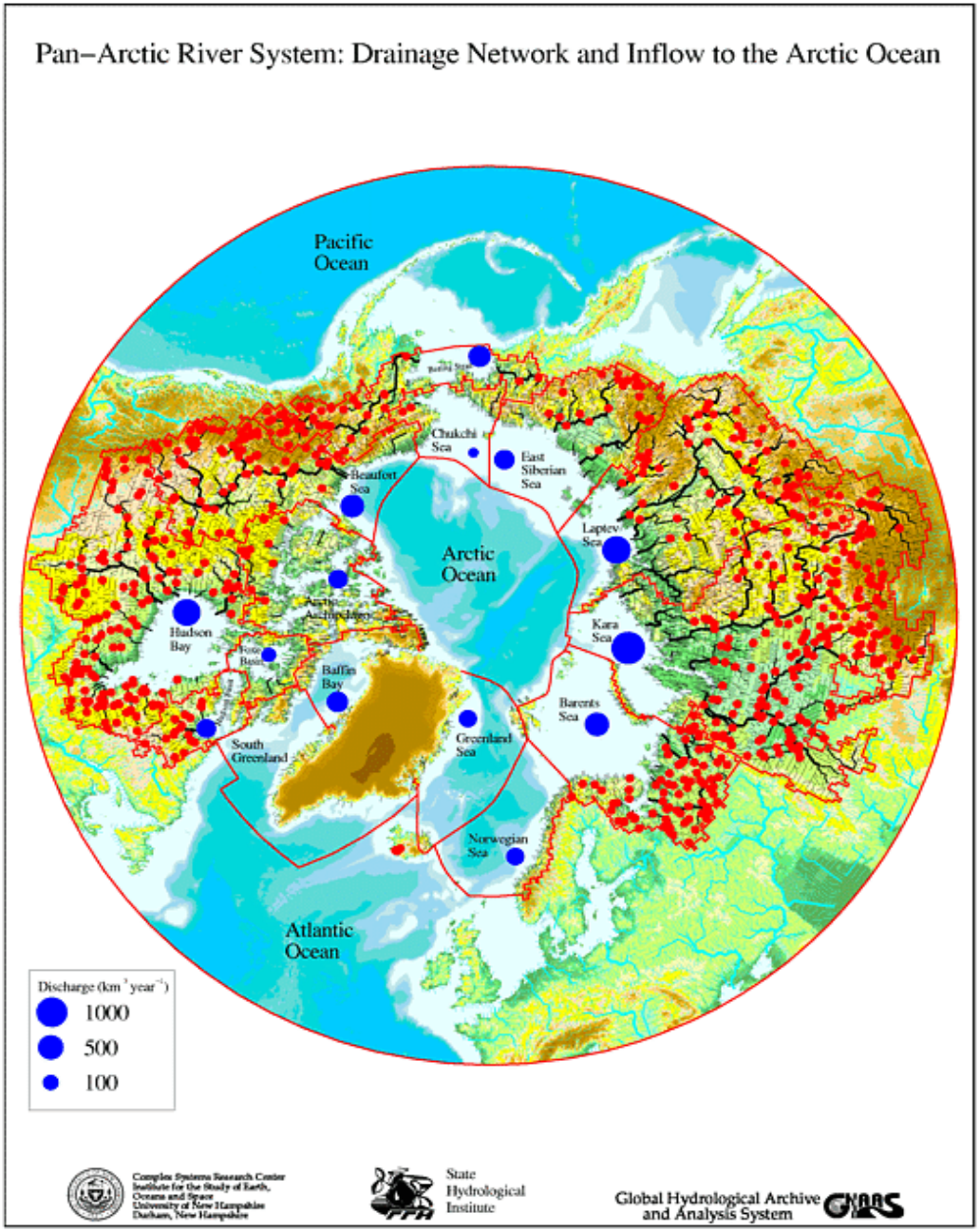
Hydrological networks

A.I. Shiklomanov (AARI, UNH), V.S. Vuglinsky (SHI),

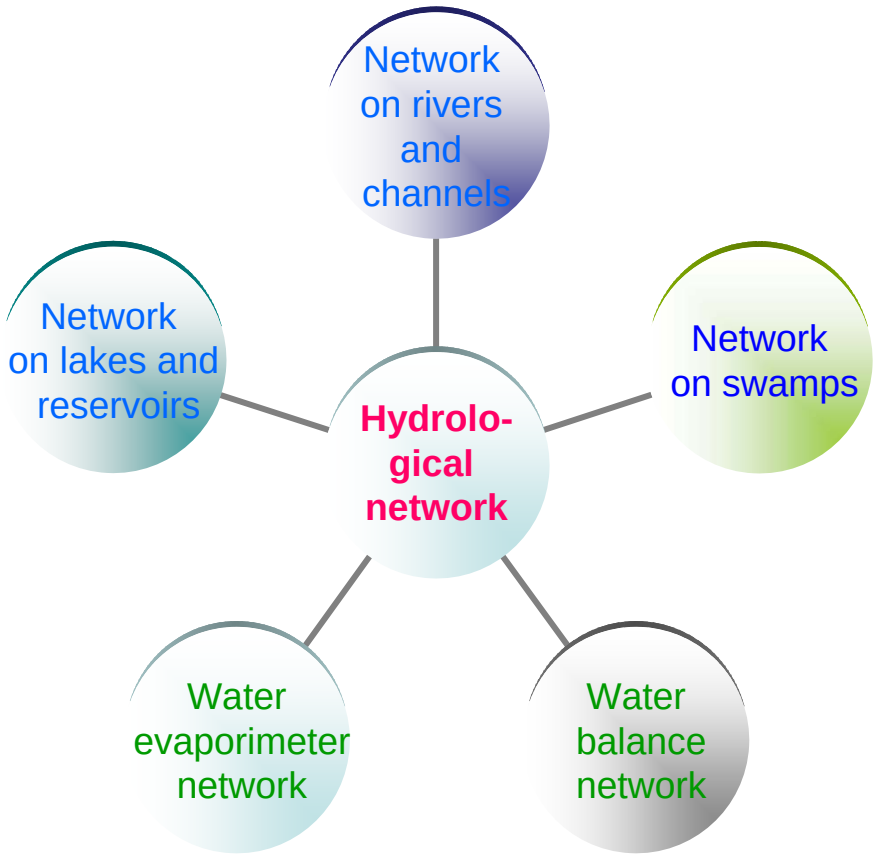
SAON workshop, 7 July, 2008, St.Petersburg



Sub-Basin Name	Long-Term Mean Discharge Km^3
Bering Strait	305
Chukchi Sea	60.2
Beaufort Sea	396
Arctic Archipelago	188
Hudson Bay	684
Foxe Basin	86.1
Hudson Strait	194
Baffin Sea and Southern Greenland	380
Greenland Sea	148
Norwegian Sea	150
Barents Sea	430
Kara Sea	1330
Laptev Sea	760
East Siberian Sea	229
Total Pan-Arctic Drainage	5340

Hydrological network is the main part of surface water inventory. Hydrological observation data are required for many branches of the national economy, scientific purposes, environmental requests and others. Therefore, the requirements for this information are diverse with time.

Main components of hydrological network



THE SYSTEM OF HYDROLOGICAL OBSERVATIONS IN RUSSIA

Main types of observations on rivers:

- Water discharge
- Water level
- Sediment discharge
- Sediment composition
- Water temperature
- Water quality
- Ice regime characteristics
- Ice thickness

Main types of observations on lakes:

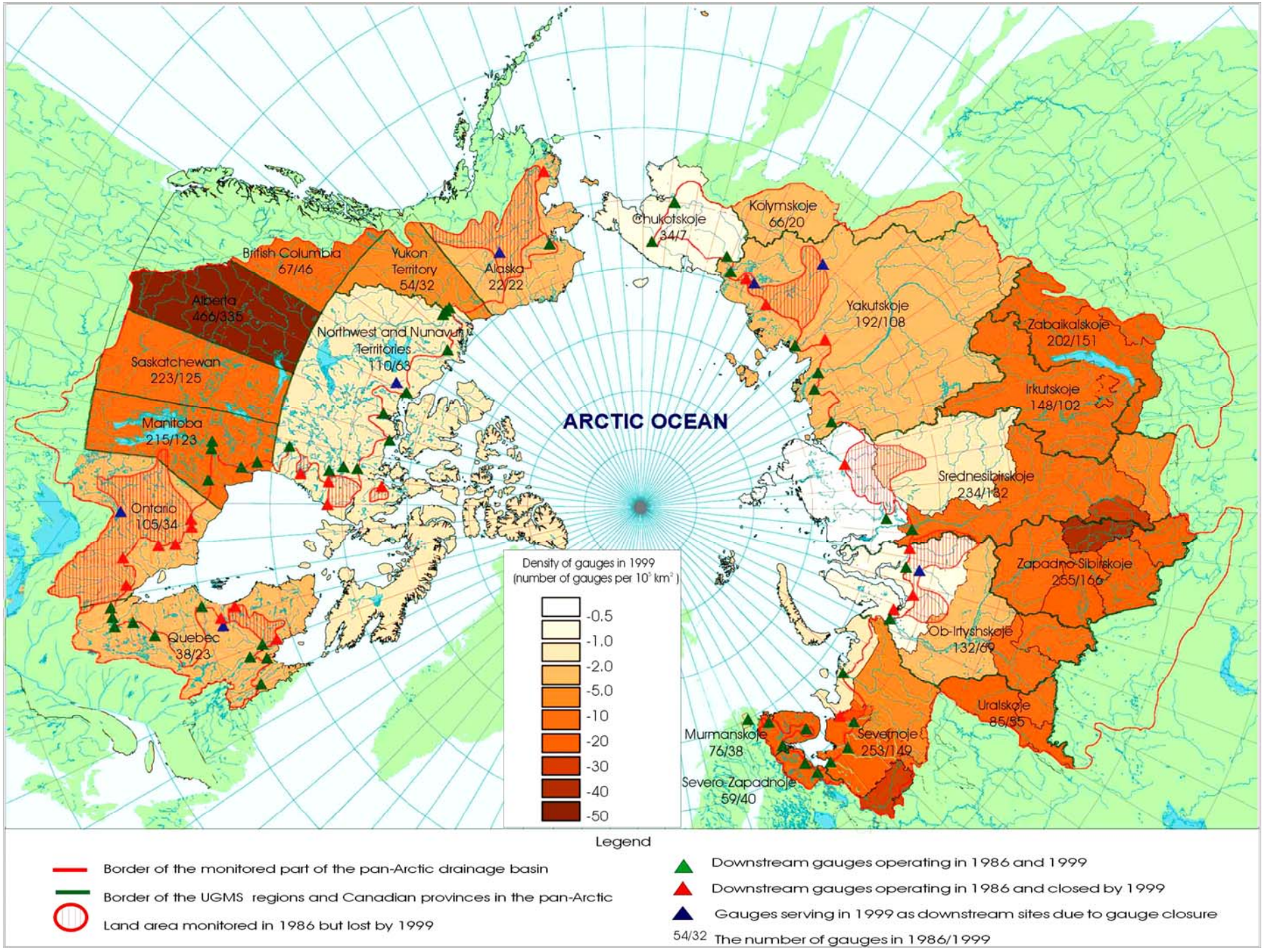
- Meteorological observations
- Water level
- Water temperature
- Water quality
- Waves
- Currents
- Ice regime characteristics
- Ice thickness

Main types of observations on swamps:

- Heat balance
- Meteorological observations
- Water discharge
- Water level
- Water quality
- Ice regime
- Peat and soil properties

Dynamic of hydrological network

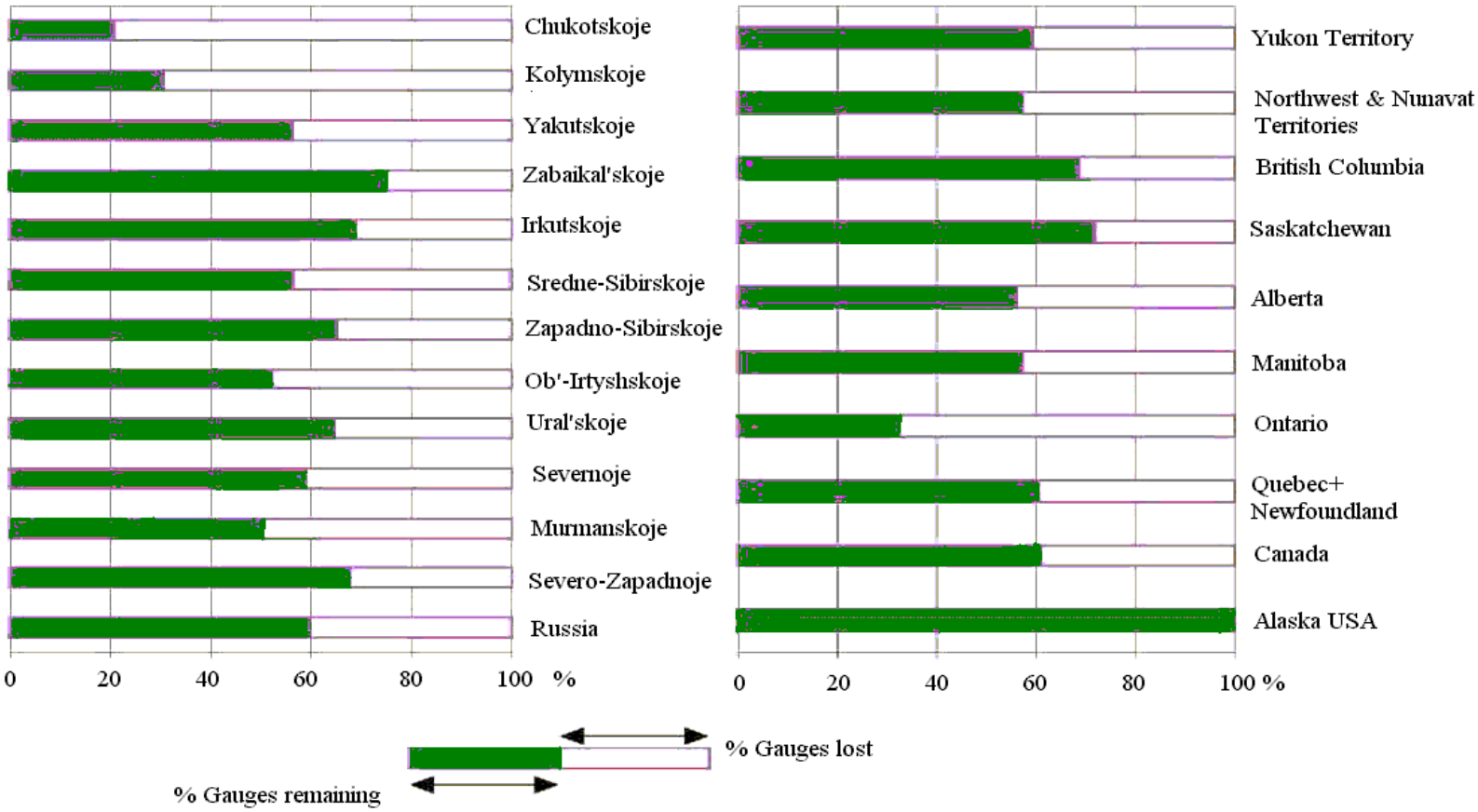
Number of stations						
Rivers		Lakes	Swamps		Evaporation	Water balance
Total	Discharge		Total	Posts		
1986						
4161	**2664**	**514**	**6**	**15**	**302**	**10**
2006						
2844	**2188**	**350**	**3**	**8**	**203**	**6**


ARCTIC OCEAN
British Columbia
67/46
Yukon
Territory
54/32
Alaska
22/22
Alberta
466/335
Saskatchewan
223/125
Manitoba
215/123
Northwest and Nunavut
Territories
110/68
Ontario
105/34
Quebec
38/23
Chukotskoje
34/7
Kolymskoje
66/20
Yakutskoje
192/108
Zabaikalskoje
202/151
Irkutskoje
148/102
Srednesibirskoje
234/182
Zapadno-Sibirskoje
255/166
Ob-Irtyshskoje
132/69
Uralskoje
85/55
Severnoje
253/149
Murmanskoje
76/38
Severo-Zapadnoje
59/40
Density of gauges in 1999
(number of gauges per 10⁵ km²)
-0.5
-1.0
-2.0
-5.0
-10
-20
-30
-40
-50
Legend
Border of the monitored part of the pan-Arctic drainage basin
Border of the UGMS regions and Canadian provinces in the pan-Arctic
Land area monitored in 1986 but lost by 1999
Downstream gauges operating in 1986 and 1999
Downstream gauges operating in 1986 and closed by 1999
Gauges serving in 1999 as downstream sites due to gauge closure
54/32 The number of gauges in 1986/1999

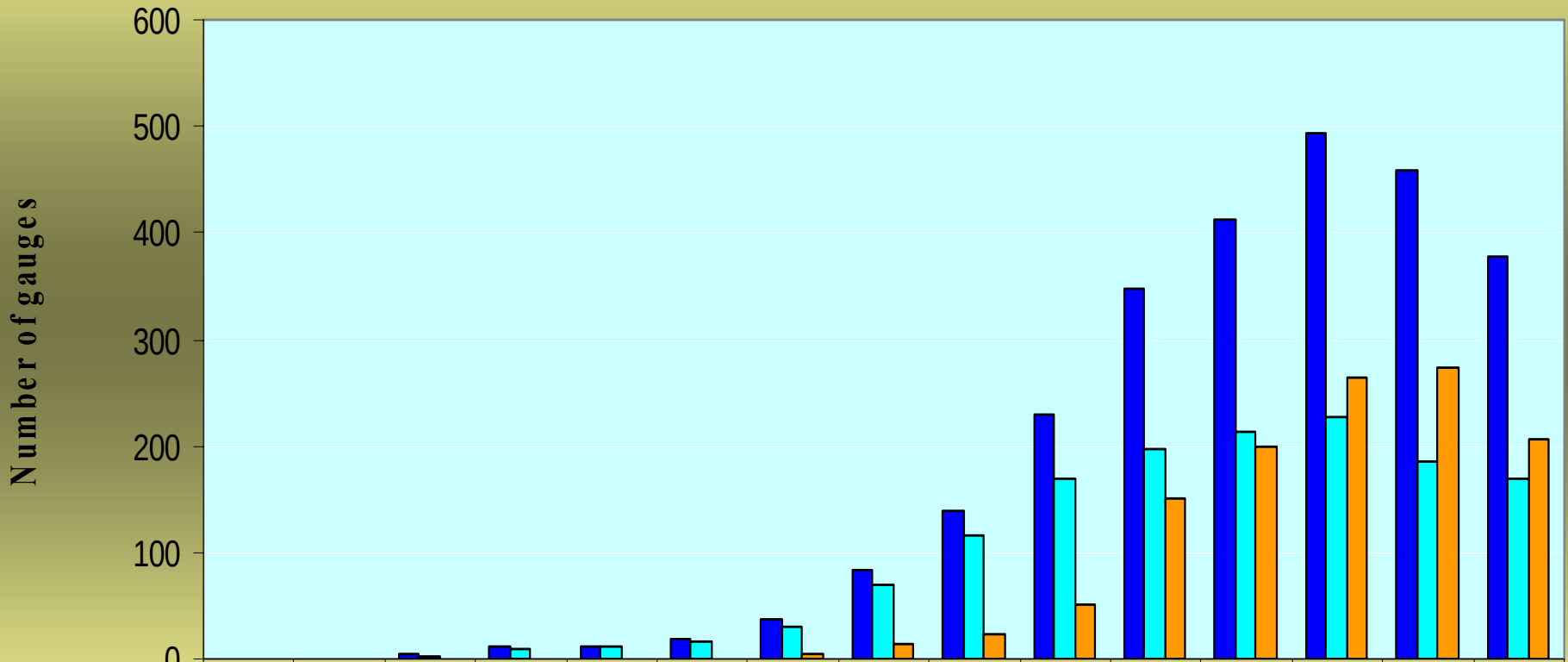
Network density of hydrological stations within the territories of Regional Offices of Hydrometeorological Service (ROHS) of Russia on rivers discharging to the Arctic Ocean

ROHS	Area, thou.км^2	Hydrological stations number		Density of hydrological stations, км^2/station	
		1986	2002	1986	2002
Murmanskoje	145	105	54	1381	2685
Severnoje	1165	323	232	3607	5022
Ural'skoje	514	209	141	2459	3645
Ob'-Irtyshskoje	1370	217	151	6313	9073
Srednesibirskoje	2534	305	218	8308	11624
Irkutskoje	810	273	180	2967	4500
Zabaikal'skoje	701	240	183	2921	3831
Kolymskoje	461	80	40	5763	11525
Yakutskoje	3103	284	184	10926	16864
Chukotskoje	738	45	13	16400	56769
Total	11541	2081	1396		
Average density				5546	8267

Reduction of the hydrological network in different regions of Russia and Canada within the Arctic Ocean drainage area



Dynamics of the hydrological network on lakes and reservoirs of Russia



	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Total	1	1	4	11	12	18	36	83	138	230	348	413	493	458	377
Lakes	1	1	3	10	11	17	31	70	115	170	198	213	228	185	170
Reservoirs			1	1	1	1	5	13	23	50	150	200	265	273	207

Gauges and gauge density by land cover type for the Russian pan-Arctic drainage system

Land Cover	%	All River Gauges		Long Term River Gauges		Large River Gauges		Precipitation	
Class	Area	Count	Density	Count	Density	Count	Density	Count	Density
Polar desert	8.0	75	74	49	48	17	17	10	10
Tundra	9.7	66	54	52	42	24	20	20	16
Forest/tundra	29.4	571	153	464	124	178	48	80	21
Taiga forest	41.1	1166	223	994	190	389	74	236	45
Steppe/shrub	11.9	429	284	348	231	136	90	168	111
Total	100.0	2307		1907		744		514	

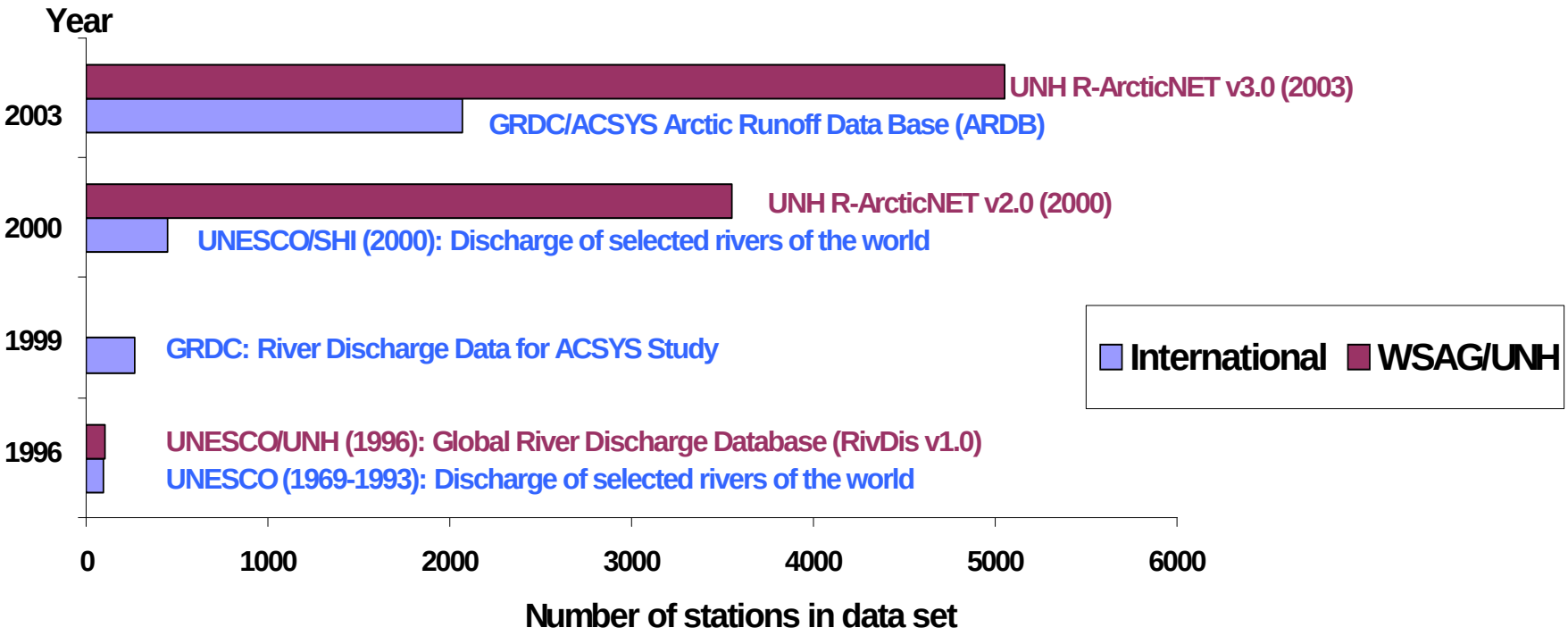
Gauges and gauge density by permafrost type for the Russian pan-Arctic drainage system

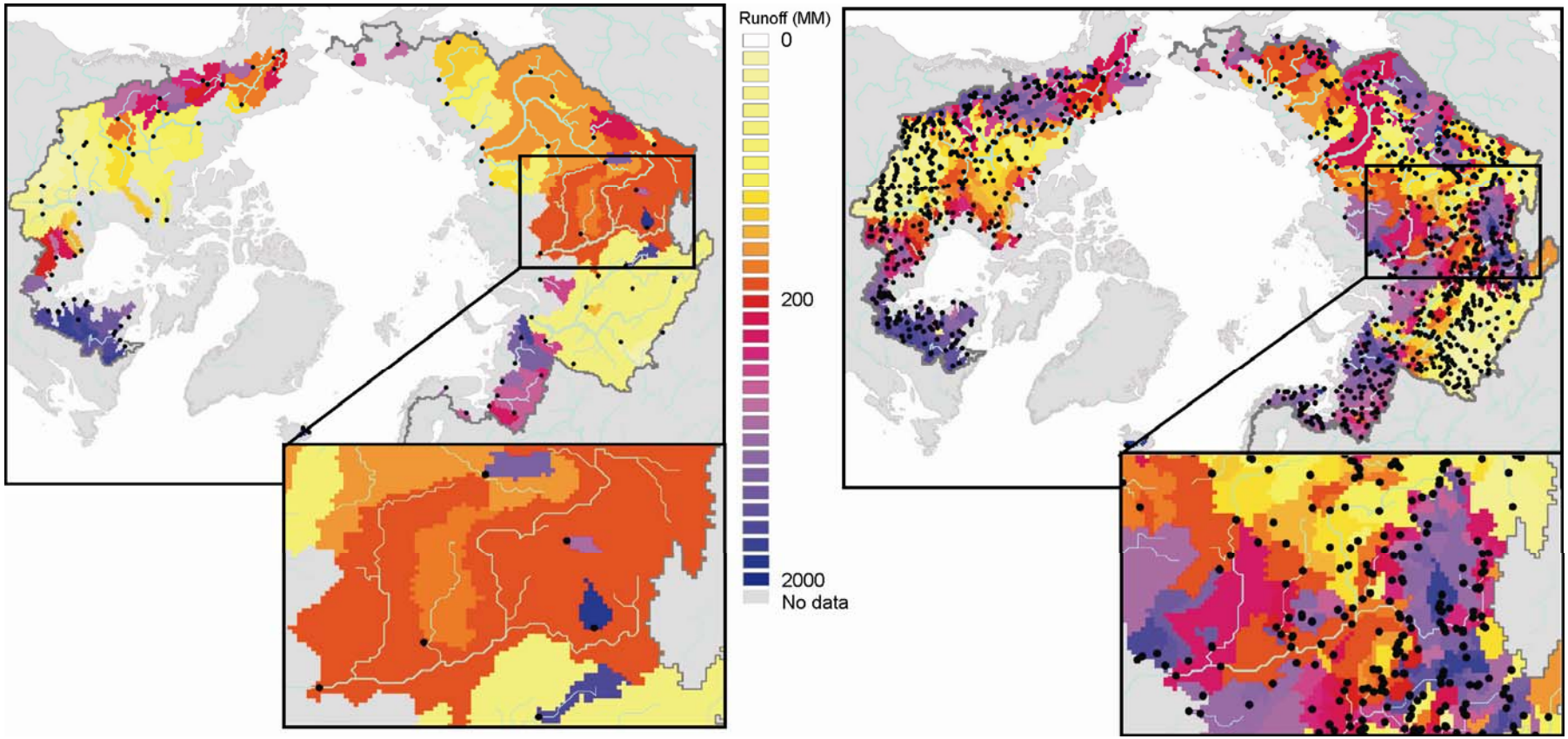
Permafrost Class	Percent Area	All River Gauges Count	All River Gauges Density	Long Term River Gauges Count	Long Term River Gauges Density	Large River Gauges Count	Large River Gauges Density	Precipitation Count	Precipitation Density
Continuous	48.5	507	81	391	62	169	27	102	16
Discontinuous	7.2	103	111	81	87	41	44	18	19
Intermittent	8.9	203	176	176	152	80	69	46	40
Sparodic	8.1	194	184	164	155	78	74	42	40
No permafrost	27.2	1300	368	1095	310	376	106	306	87
Total	100.0	2307		1907		744		514	

Density: Gauges per 1 000 000 km^2 of class

Total domain area: 12 970 000 km^2

DATA DISSIMINATION AND COLLECTION


Year
2003
2000
1999
1996
UNH R-ArcticNET v3.0 (2003)
GRDC/ACSYS Arctic Runoff Data Base (ARDB)
UNH R-ArcticNET v2.0 (2000)
UNESCO/SHI (2000): Discharge of selected rivers of the world
GRDC: River Discharge Data for ACSYS Study
UNESCO/UNH (1996): Global River Discharge Database (RivDis v1.0)
UNESCO (1969-1993): Discharge of selected rivers of the world
International
WSAG/UNH
0
1000
2000
3000
4000
5000
6000
Number of stations in data set



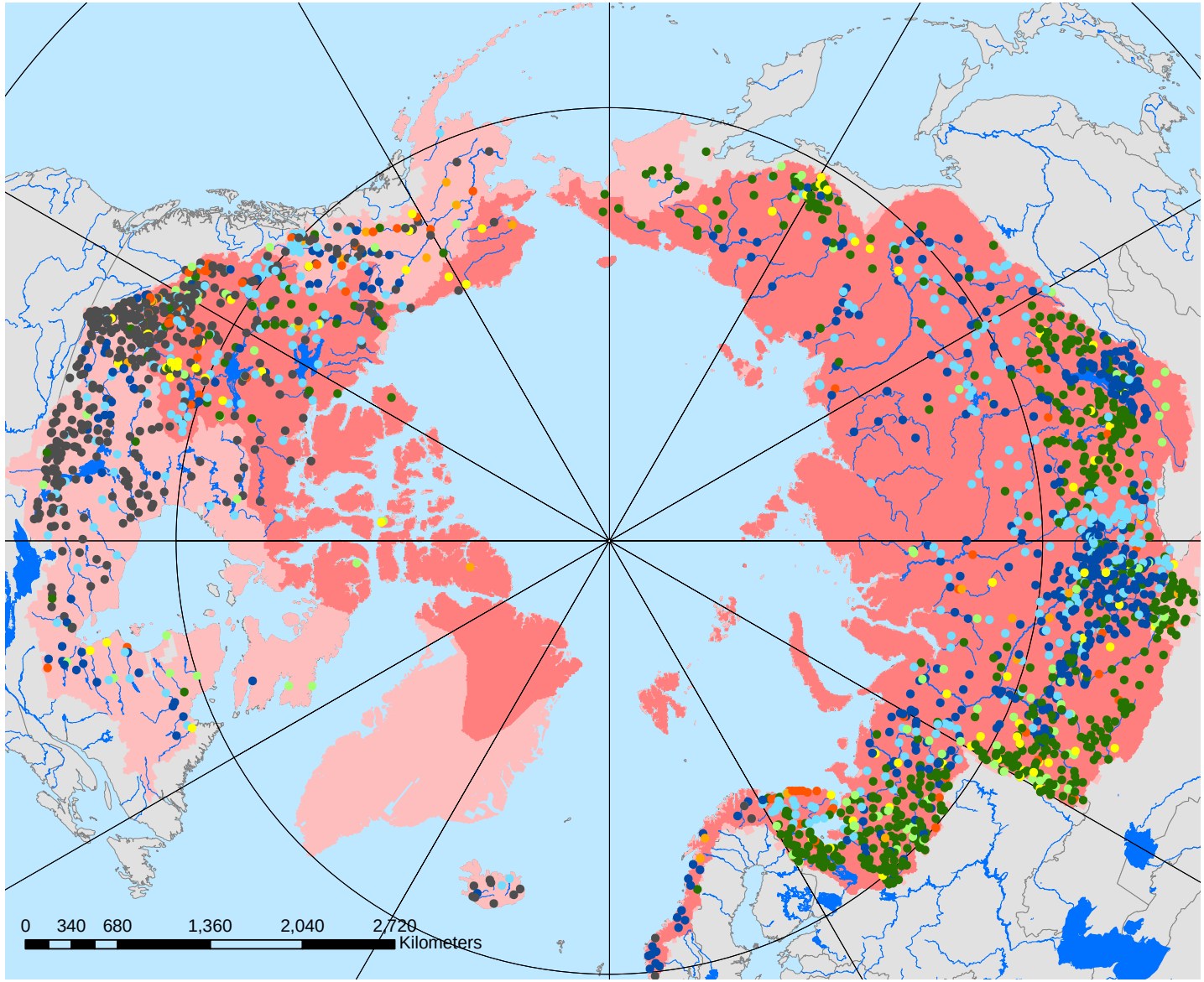
Long-term mean annual runoff in the pan-Arctic based on observational data from data available in 1998 (UNESCO/UNH (1996): Global River Discharge Database RivDis v1.0) and from data available in 2006 (UNH R-ArcticNET v4.0 (2005). A Regional, Hydrometeorological Data Network For the pan-Arctic Region. Shown only gauges and watersheds larger 5000 km2).

Arctic Runoff Data Base in GRDC

2405 stations

1024 stations with daily data

2193 stations with monthly data



Arctic Runoff Data Base in GRDC

Summary statistics of river discharge data kept in the ARDB by country

8 countries

earliest record from 1877 (RU)

latest record from 2003 (US)

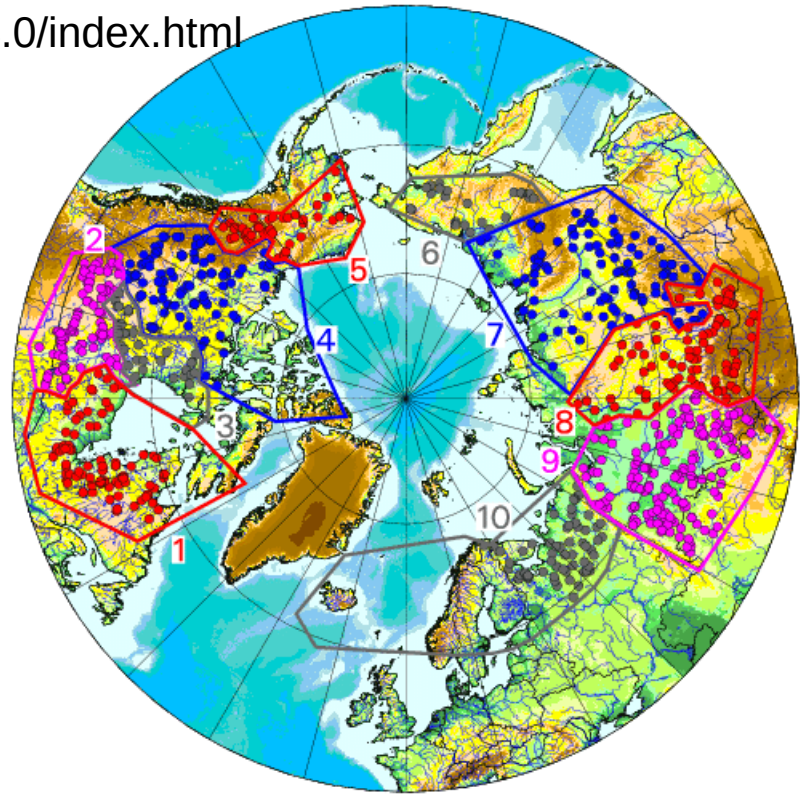
average time series length of 35 years

(Status: April 2005)

Country	data from 8 countries (out of totally 239	number of stations [-]	station-years [-]	individual values [-]	average time series length [years]	shortest record [years]	longest record [years]	earliest data [year]	latest data [year]	latest import [year]
World	**monthly data (total)**	**2,405**	**85,359**	**1,024,308**	**35.5**	**1**	**123**	**1877**	**2003**	**2004**
	original monthly data	2,193	71,503	858,036	32.6	1	123	1877	2001	
	original daily data	1,024	34,391	12,552,715	33.6	1	116	1883	2003	
CANADA	**monthly data (total)**	**821**	**27,852**	**334,224**	**33.9**	**2**	**110**	**1892**	**2001**	**2004**
	original monthly data	627	15,794	189,528	25.2	1	95	1902	1996	
	original daily data	818	27,680	10,103,200	33.8	2	110	1892	2001	
FINLAND	**monthly data (total)**	**3**	**96**	**1,152**	**32.0**	**9**	**53**	**1949**	**2001**	**2002**
	original monthly data	3	96	1,152	32.0	9	53	1949	2001	
	original daily data	3	96	35,040	32.0	9	53	1949	2001	
ICELAND	**monthly data (total)**	**11**	**546**	**6,552**	**49.6**	**32**	**71**	**1932**	**2002**	**2003**
	original monthly data	10	411	4,932	41.1	21	61	1932	1993	
	original daily data	10	494	180,310	49.4	32	71	1932	2002	
KAZAKHSTAN	**monthly data (total)**	**97**	**2,876**	**34,512**	**29.6**	**3**	**52**	**1936**	**1994**	**2004**
	original monthly data	97	2,876	34,512	29.6	3	52	1936	1994	
	original daily data	6	126	45,990	21.0	10	50	1938	1987	
MONGOLIA	**monthly data (total)**	**5**	**152**	**1,824**	**30.4**	**9**	**40**	**1945**	**1984**	**2004**
	original monthly data	5	152	1,824	30.4	9	40	1945	1984	
	original daily data	1	5	1,825	5.0	5	5	1978	1982	
NORWAY	**monthly data (total)**	**24**	**1,985**	**23,820**	**82.7**	**58**	**109**	**1892**	**2001**	**2001**
	original monthly data	10	556	6,672	55.6	6	97	1892	1988	
	original daily data	22	1,866	681,090	84.8	61	109	1892	2001	
RUSSIA	**monthly data (total)**	**1,407**	**51,068**	**612,816**	**36.3**	**1**	**123**	**1877**	**2000**	**2004**
	original monthly data	1,405	50,877	610,524	36.2	1	123	1877	2000	
	original daily data	128	3,363	1,227,495	26.3	1	116	1883	1999	
UNITED STATE	**monthly data (total)**	**37**	**784**	**9,408**	**21.2**	**1**	**57**	**1947**	**2003**	**2004**
	original monthly data	36	741	8,892	20.6	1	55	1947	2001	
	original daily data	36	761	277,765	21.1	1	57	1947	2003	

R-ArcticNet - A Database of Pan-Arctic River Discharge

http://www.r-arcticnet.sr.unh.edu/v4.0/index.html

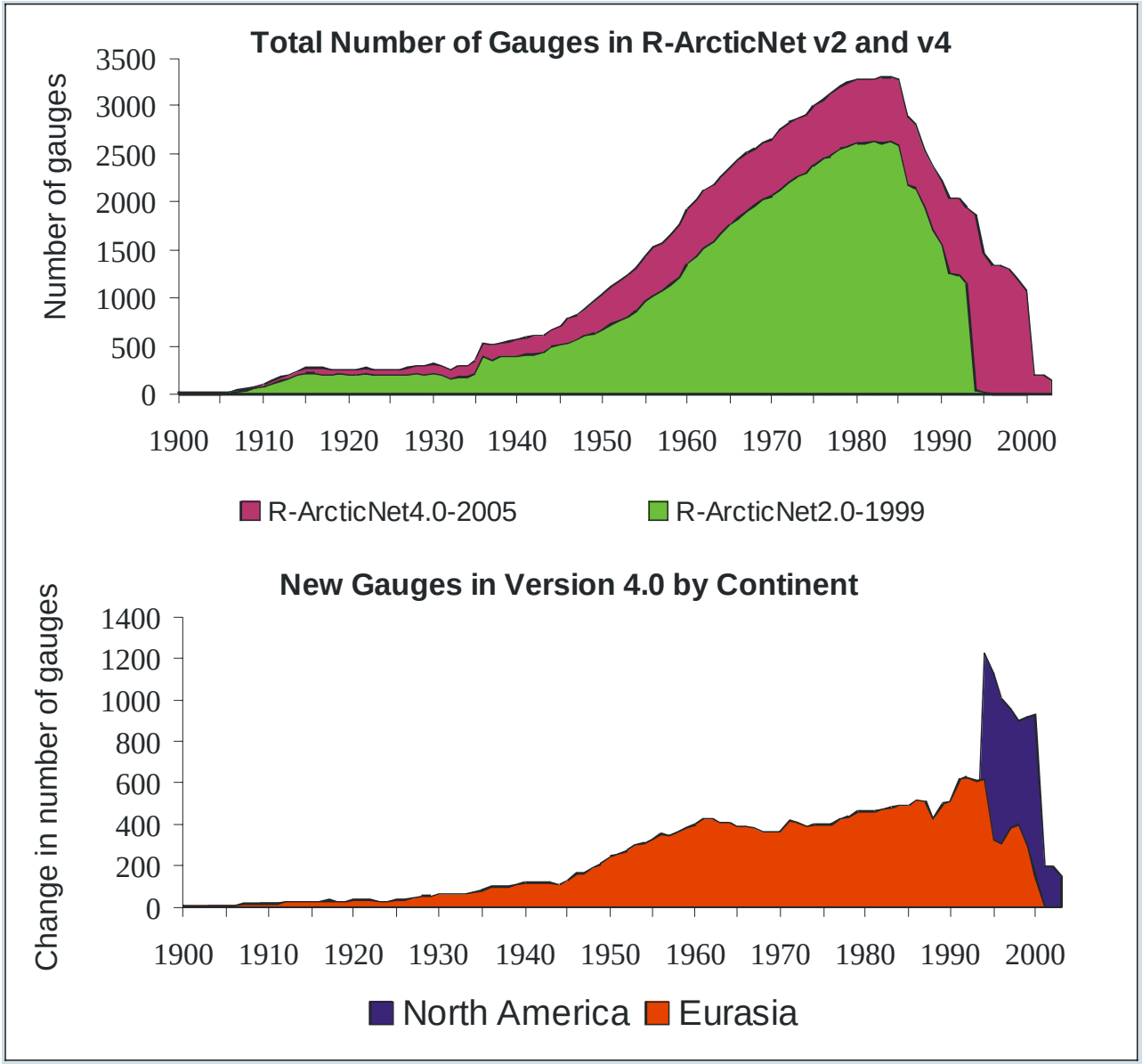


1. South and East Hudson Bay
2. Nelson
3. Northwest Hudson Bay
4. Mackenzie
5. Yukon
6. Anadyr Kolyma
7. Lena
8. Yenisei
9. Ob
10. Barents, Norwegian Sea

Tabular indices of all gauges sorted by:
Station Name, Station Code, Drainage Area.

Go Straight To The Datafiles

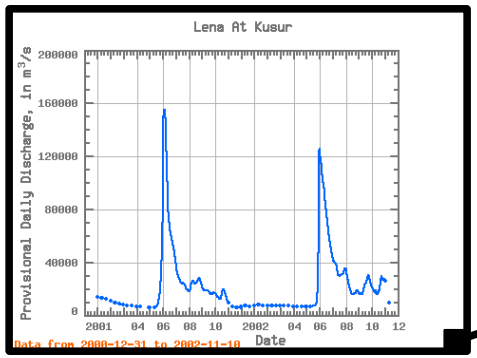
Return to R-Arctic Net Home Page

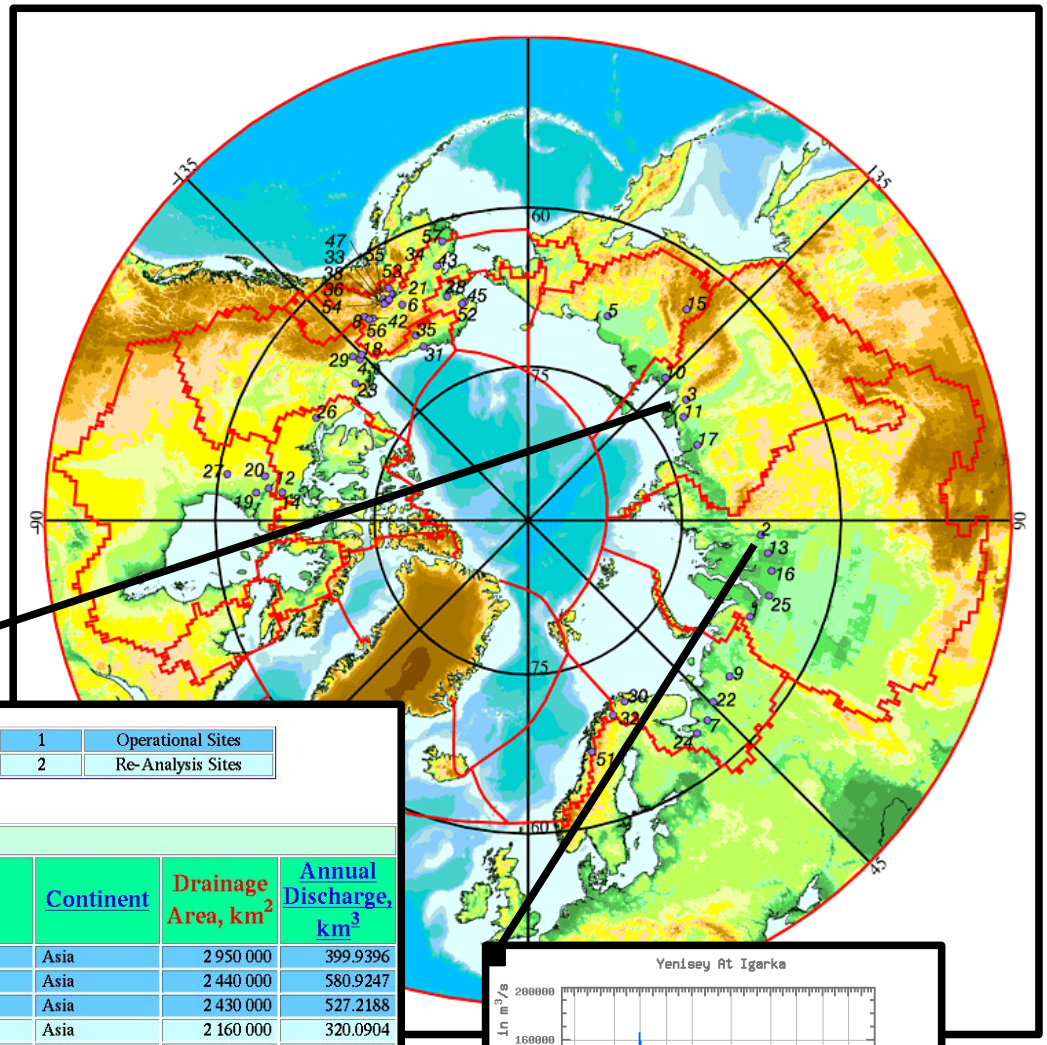

Total Number of Gauges in R-ArcticNet v2 and v4
Number of gauges
3500
3000
2500
2000
1500
1000
500
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
R-ArcticNet4.0-2005
R-ArcticNet2.0-1999
New Gauges in Version 4.0 by Continent
Change in number of gauges
1400
1200
1000
800
600
400
200
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
North America
Eurasia

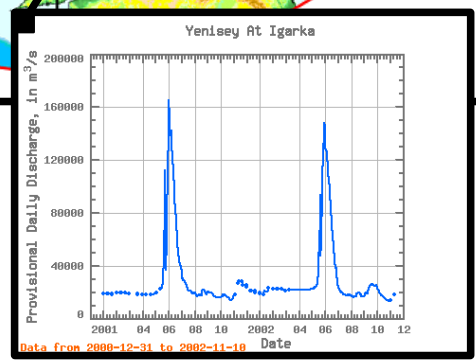
ArcticRIMS

A Regional, Integrated Hydrological Monitoring System for the Pan -Arctic Land Mass

Real-Time River Discharge Monitoring







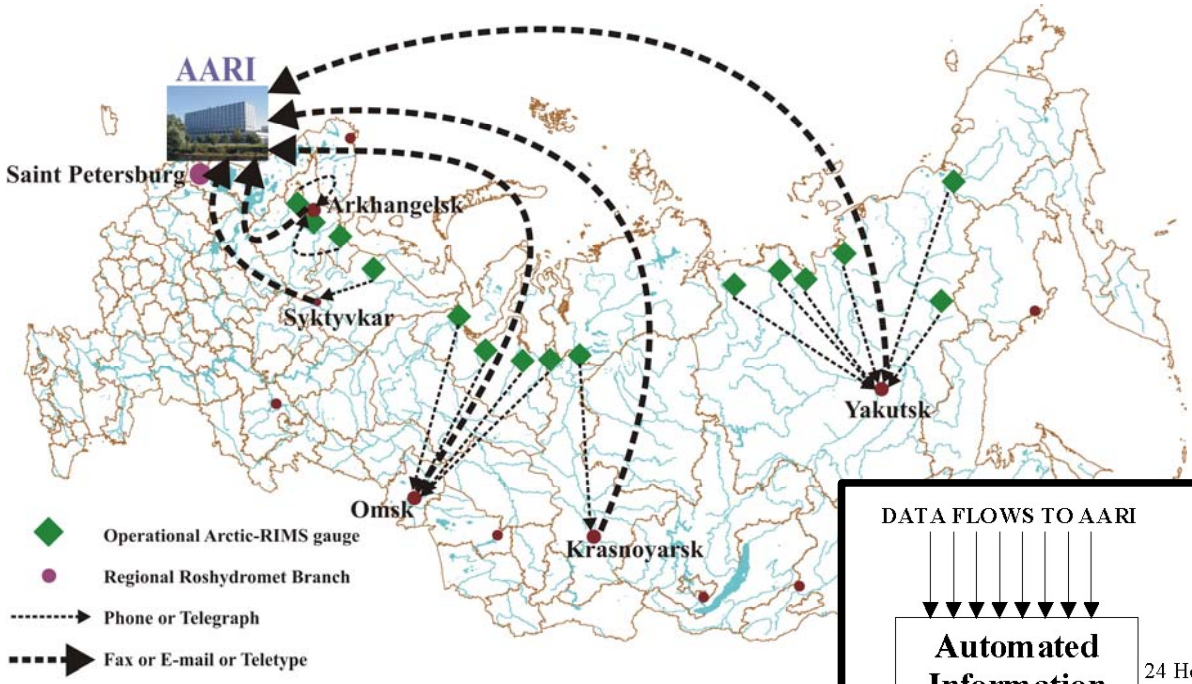
List of Arctic RIMS Discharge Stations

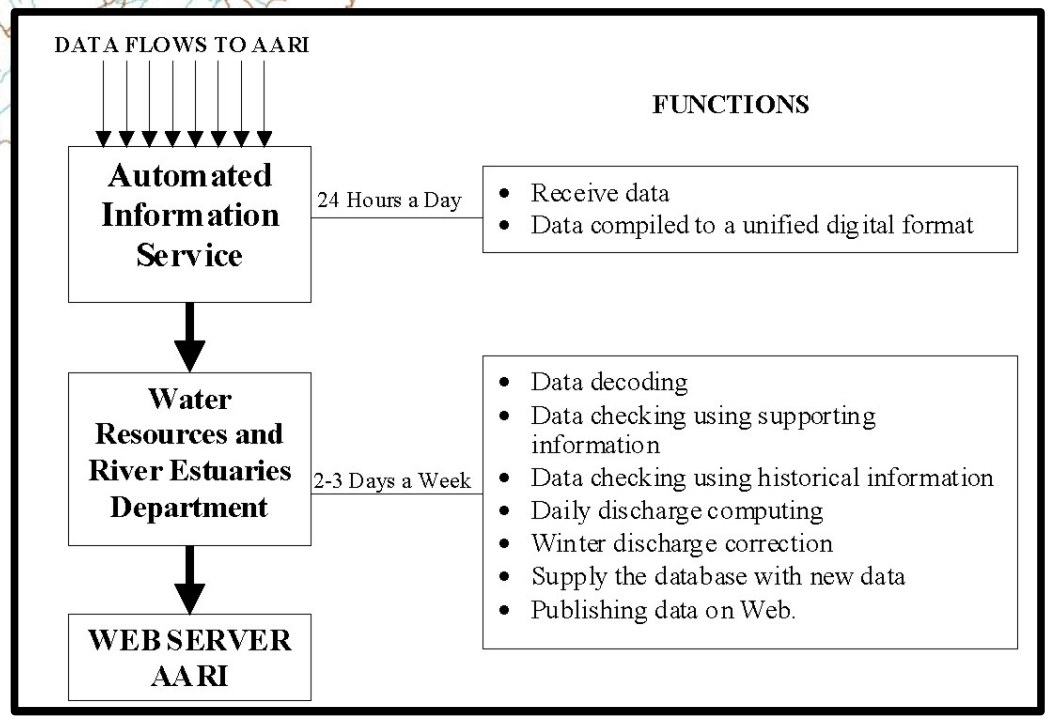
1	Operational Sites
2	Re-Analysis Sites

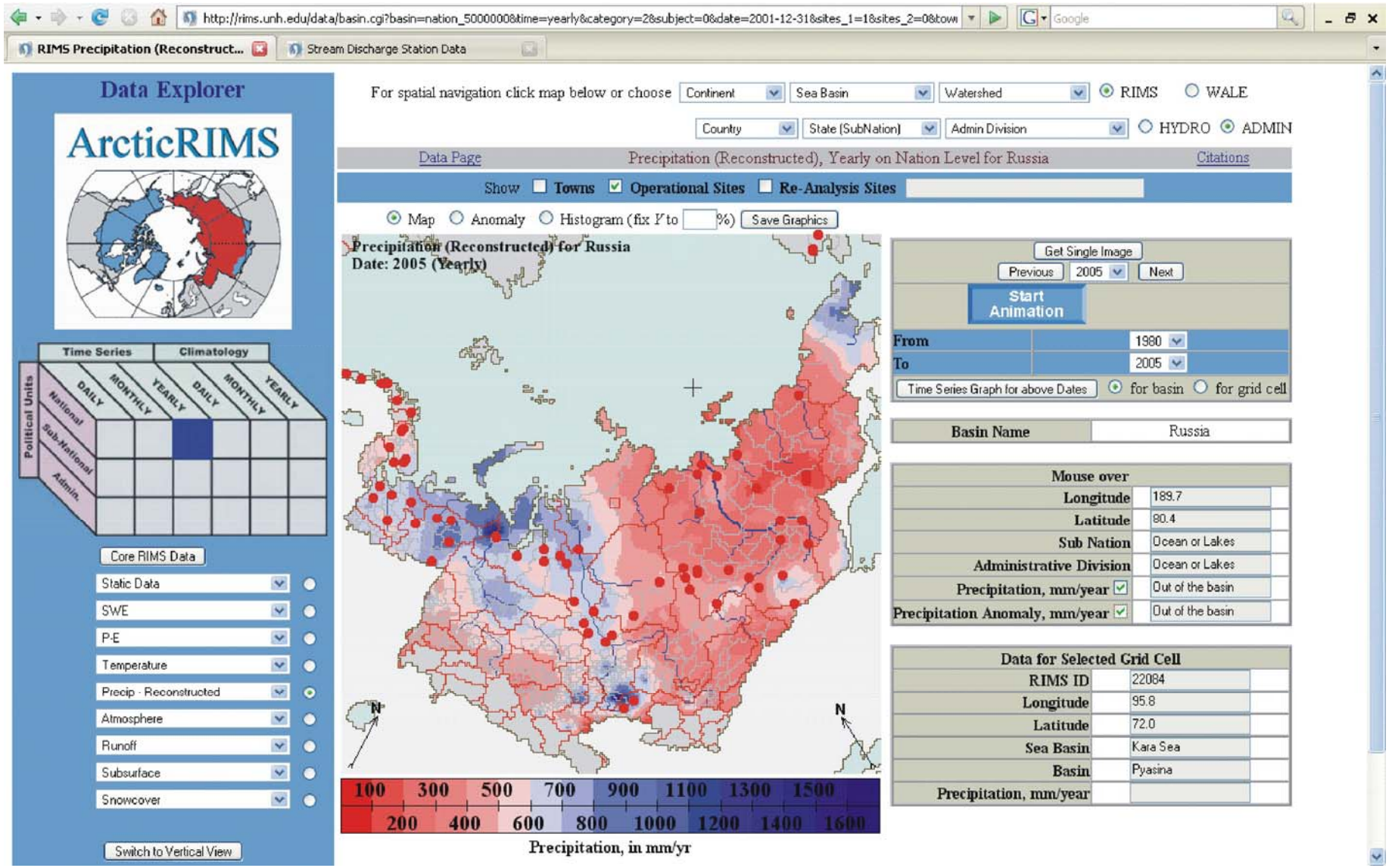
Sort by

#	R-Arctic Net ID	Arctic RIMS ID	Station Code	Station Name	Continent	Drainage Area, km^2	Annual Discharge, km^3
1	7142	1	11801	OB AT SALEHARD	Asia	2 950 000	399.9396
2	6656	2	9803	YENISEY AT IGARKA	Asia	2 440 000	580.9247
3	6342	3	3821	LENA AT KUSUR	Asia	2 430 000	527.2188
4	6666		10031	Ob at Belogorje	Asia	2 160 000	320.0904
5	6544		9092	Yenisey at Pod. Tunguska	Asia	1 760 000	339.6112
6	3660	4	10LC014	MACKENZIE RIVER AT ARCTIC RED RIVER	North_America	1 680 000	285.5269
7	3642		10KA001	MACKENZIE RIVER AT NORMAN WELLS	North_America	1 570 000	266.6053
8	6952		11056	Irtish at Tobolsk	Asia	1 500 000	67.6447
9	6076		9079	Yenisey at Yeniseysk	Asia	1 400 000	243.6156
10	3622		10GC001	MACKENZIE RIVER AT FORT SIMPSON	North_America	1 270 000	212.6472
11	3112		05UE005	NELSON RIVER AT KELSEY GENERATING STATION	North_America	1 010 000	68.1493
12	6147		3042	Lena at Tabaga	Asia	897 000	220.9728
13	6458		8084	Angara at Boguchanyu	Asia	866 000	111.8897
14	7709	5	15565447	YUKON R AT PILOT STATION AK	North_America	831 390.83	202.4296
15	7134		11619	Irtish At Ekaterininskoje	Asia	828 000	27.9724
16	6950		11048	Irtish at Omsk	Asia	769 000	27.6886
17	6236		3229	Aldan at Verkhoyanski' Perevoz	Asia	696 000	165.9740

Russian Data Flow to the Arctic and Antarctic Research Institute (AARI)



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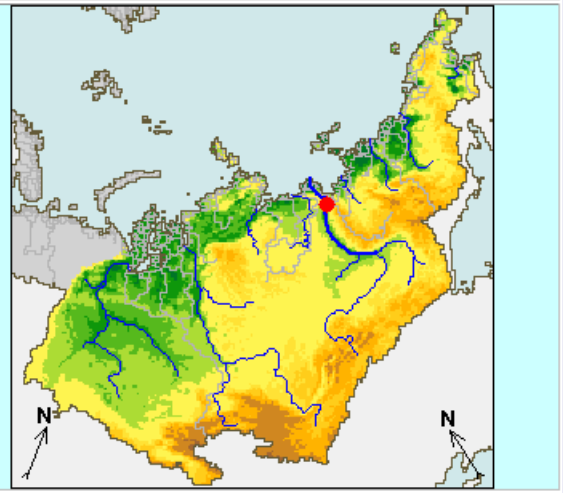
RIMS Precipitation (Reconstruct...
Stream Discharge Station Data
Data Explorer
ArcticRIMS
Time Series
Climatology
Political Units
DAILY
MONTHLY
YEARLY
National
Sub-National
Admin.
Core RIMS Data
Static Data
SWE
P-E
Temperature
Precip - Reconstructed
Atmosphere
Runoff
Subsurface
Snowcover
Switch to Vertical View
For spatial navigation click map below or choose
Continent
Sea Basin
Watershed
RIMS
WALE
Country
State (SubNation)
Admin Division
HYDRO
ADMIN
Data Page
Precipitation (Reconstructed), Yearly on Nation Level for Russia
Citations
Show
Towns
Operational Sites
Re-Analysis Sites
Map
Anomaly
Histogram (fix Y to
%)
Save Graphics
Precipitation (Reconstructed) for Russia
Date: 2005 (Yearly)
N
N
100 300 500 700 900 1100 1300 1500
200 400 600 800 1000 1200 1400 1600
Precipitation, in mm/yr
Get Single Image
Previous
2005
Next
Start Animation
From
1980
To
2005
Time Series Graph for above Dates
for basin
for grid cell
Basin Name
Russia
Mouse over
Longitude
189.7
Latitude
80.4
Sub Nation
Ocean or Lakes
Administrative Division
Ocean or Lakes
Precipitation, mm/year
Out of the basin
Precipitation Anomaly, mm/year
Out of the basin
Data for Selected Grid Cell
RIMS ID
22084
Longitude
95.8
Latitude
72.0
Sea Basin
Kara Sea
Basin
Pyasina
Precipitation, mm/year

Station Information

ArcticRIMS

Stream Discharge Station Data



Station Name:

LENA AT KUSUR

Station Code:	R-ArcticNet ID:	ArcticRIMS ID:
3821	6342	3

Source:	Latitude:	Longitude:	Continent:
ROSHYDROMET, Russia	70.68	127.39	Asia

Drainage area:	Contributing area:	Interstation area:	Next Upstream Station:
2430000 km^2	2430000 km^2	6342 km^2	6147 6236 6266

Operational Site

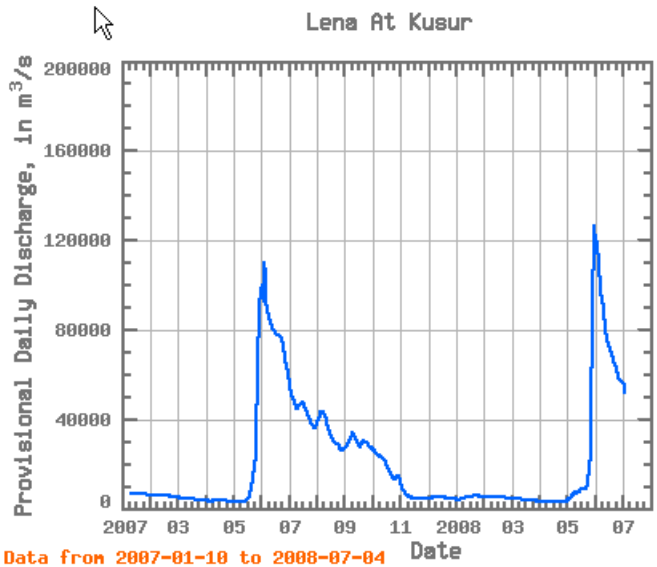
Next Downstream Station(s): 6344

Monthly Climatology and other Graphs

Graph Type:

Beginning Date:	Ending Date:
○ Discharge Climatology	
1936	2000
○ Archival Monthly Discharge	
1936 January	2000 December
○ Archival Daily Discharge	
1978 January 1	1999 December 31
○ Provisional Monthly Discharge	
2000 January	2008 June
◉ Provisional Daily Discharge	
2007 January 10	2008 July 4
○ Provisional Monthly Stage	
2000 January	2008 June
○ Provisional Daily Stage	
2000 January 10	2008 July 4

Discharge Graph Units - ◉ m^3/s ○ km^3 ○ mm

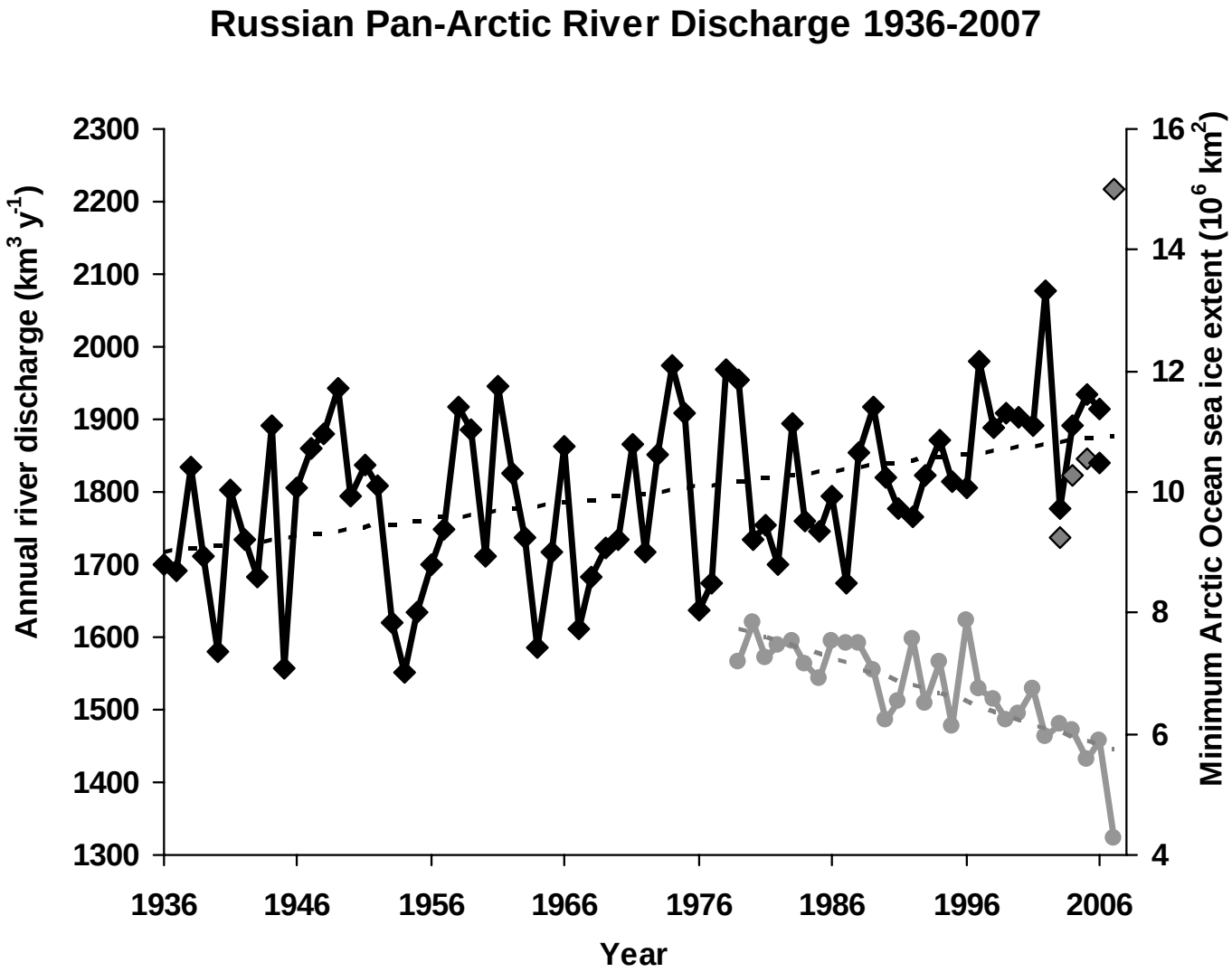


Available Data Downloads

Data Type	Daily	Monthly

Eurasian Arctic River Discharge to the Arctic Ocean and Maximum Sea Ice Extent in the Arctic Ocean

R= - 0.7



Rivers: Ob', Yenisey, Lena, Severnaya Dvina, Pechora, Kolyma

SAON Hydrology

- Hydrological networks to monitor river inflow to the Arctic Ocean
- Reference hydroclimatic network to track hydrological response on climate change