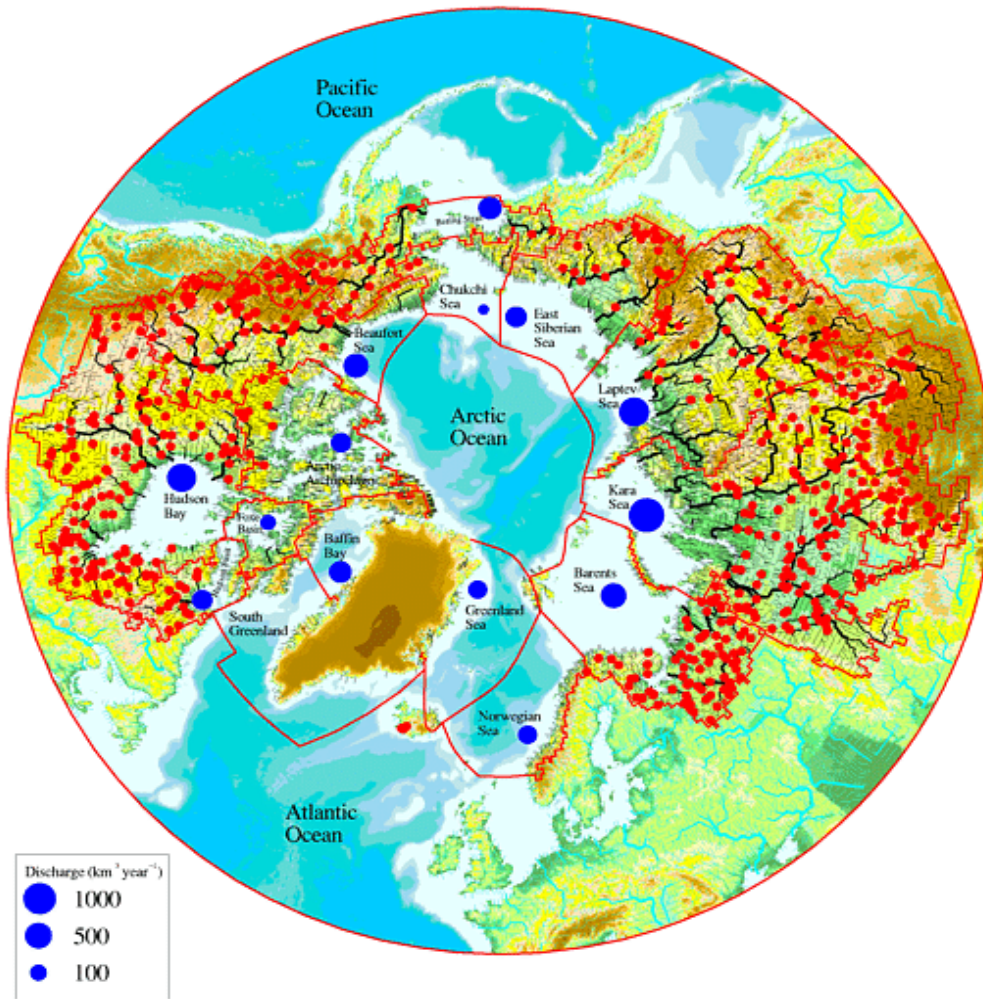


Hydrological networks

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

SAON workshop, 7 July, 2008, St.Petersburg

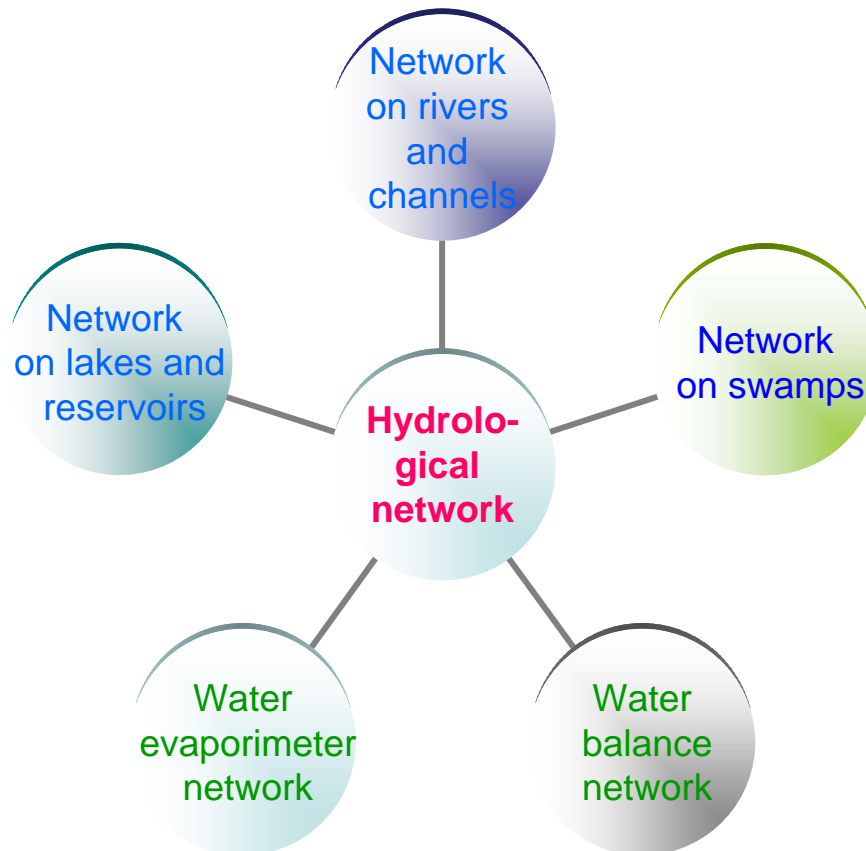
Pan-Arctic River System: Drainage Network and Inflow to the Arctic Ocean



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:

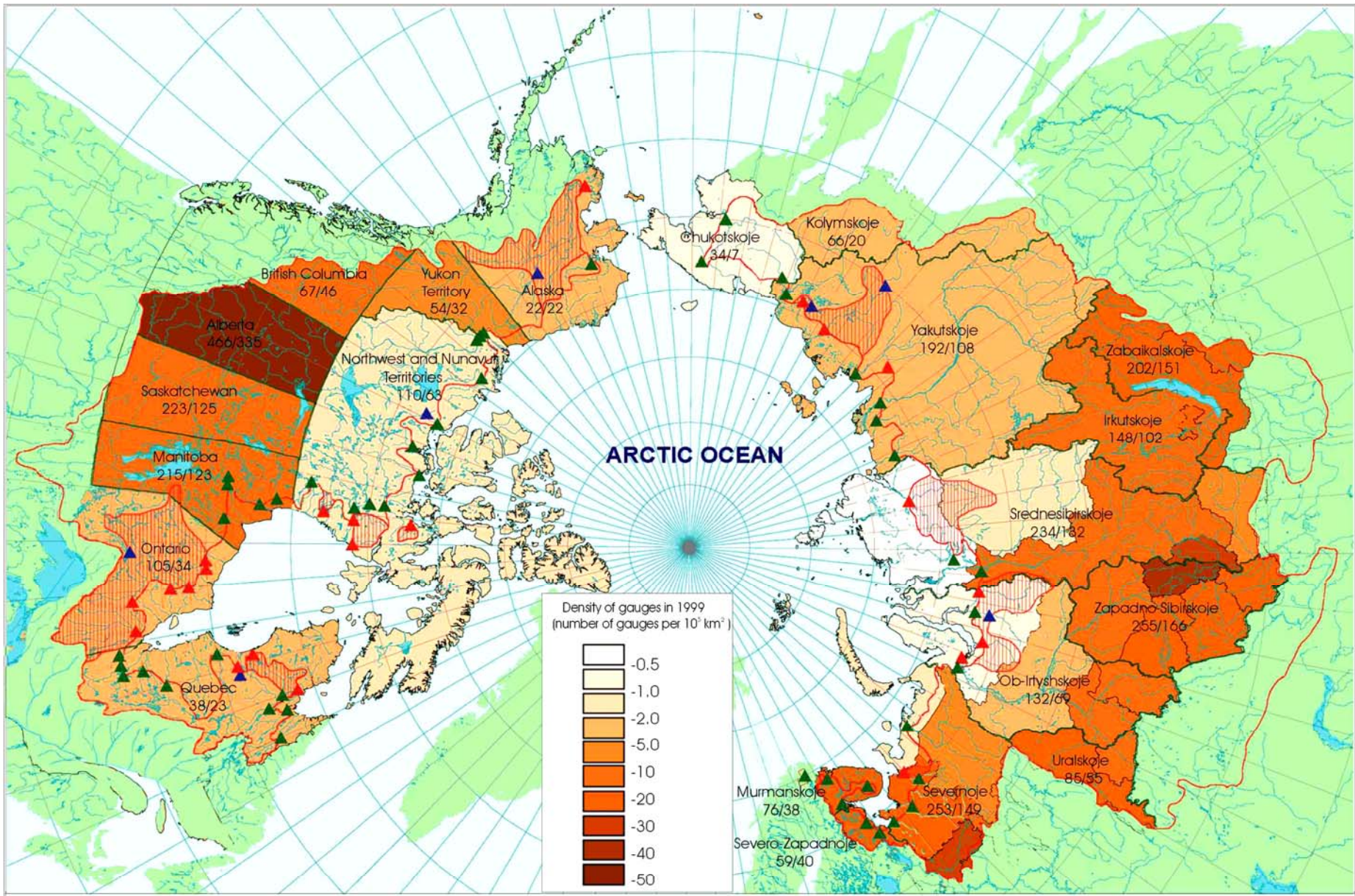
- Meteorological observations
- Water level
- Water temperature
- Water quality
- Waves
- Currents
- Ice regime characteristics
- Ice thickness

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

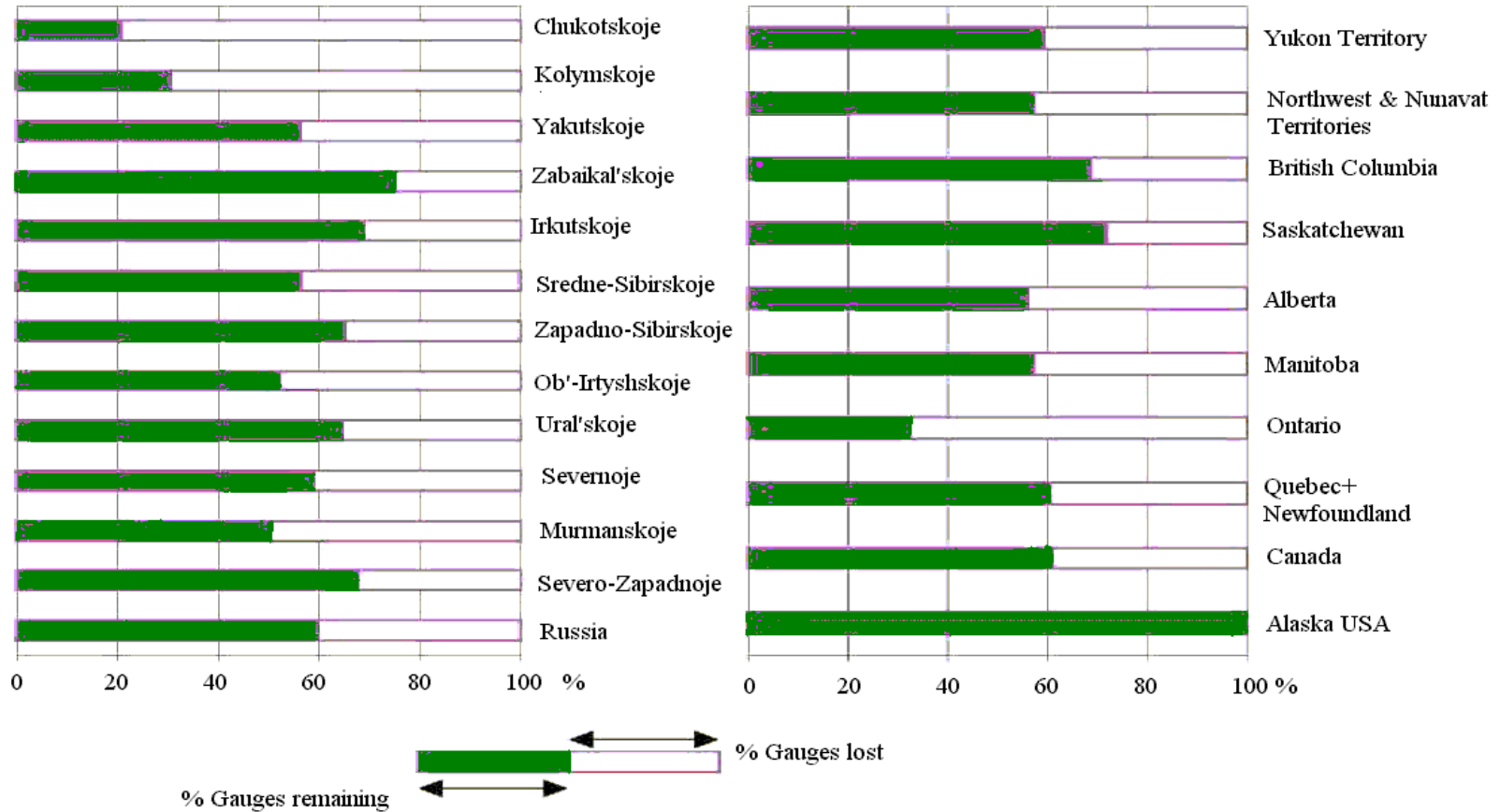


54/32 The number of gauges in 1986/1999

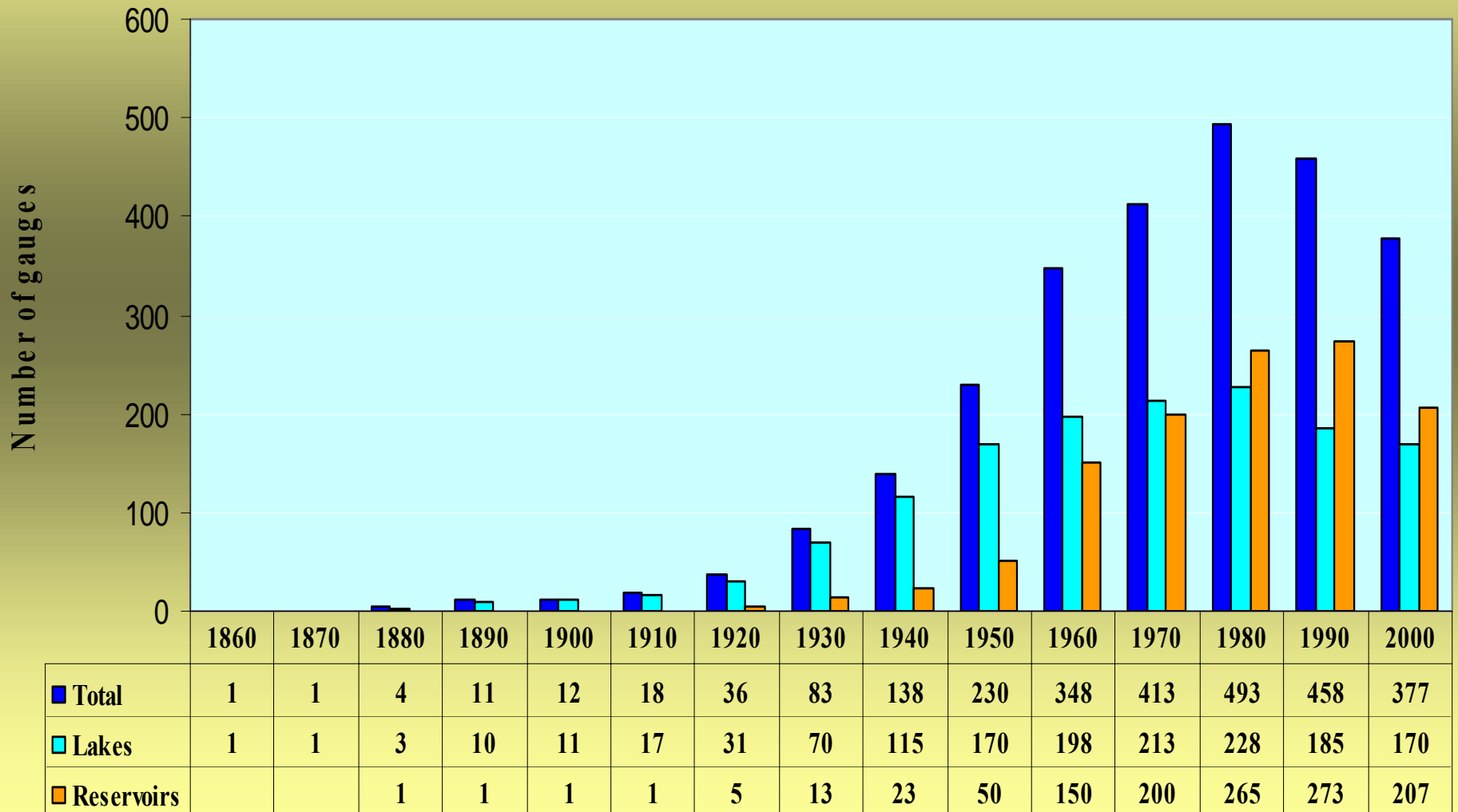
Network density of hydrological stations within the territories of Regional Offices of Hydrometeorological Service (ROHS) of Russia on rivers discharging to the Arctic Ocean

ROHS	Area, thou.km ²	Hydrological stations number		Density of hydrological stations, km 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'-Irtysškoje	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



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
<i>Total</i>	100.0	2307		1907		744		514	

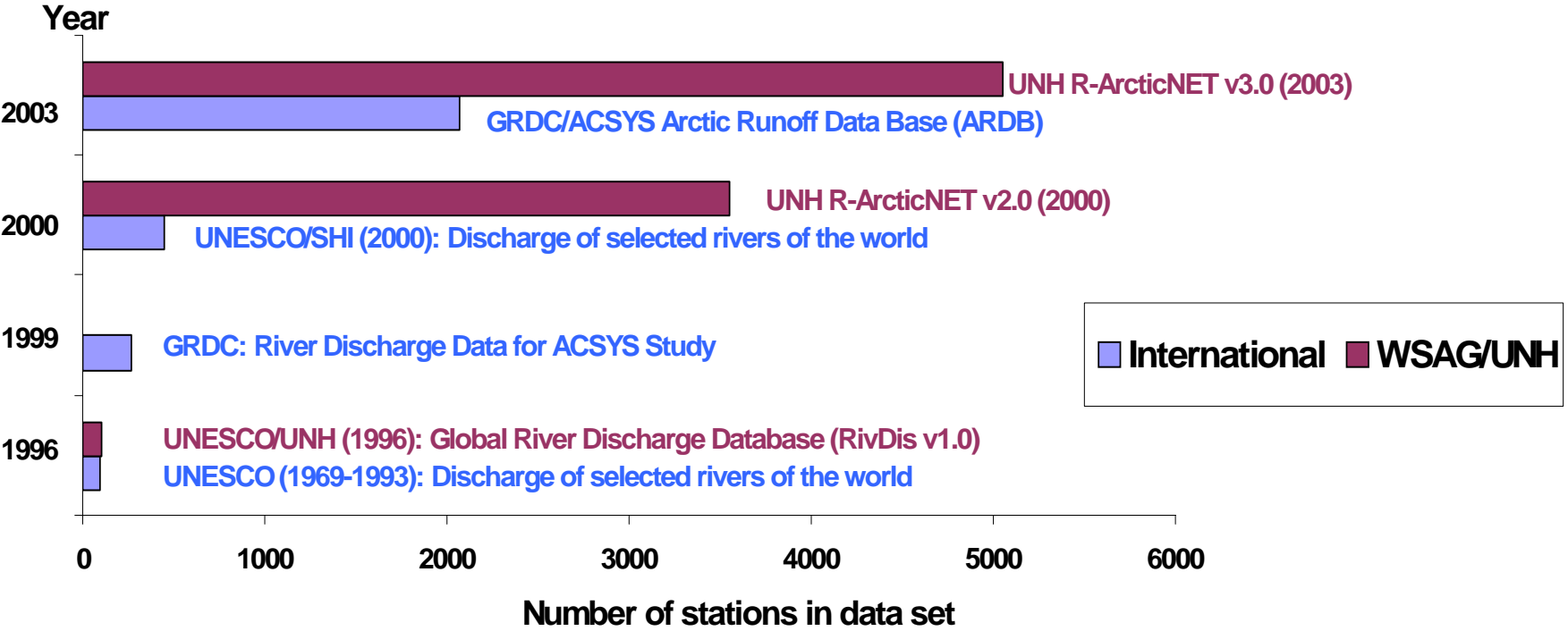
Gauges and gauge density by permafrost type for the Russian pan-Arctic drainage system

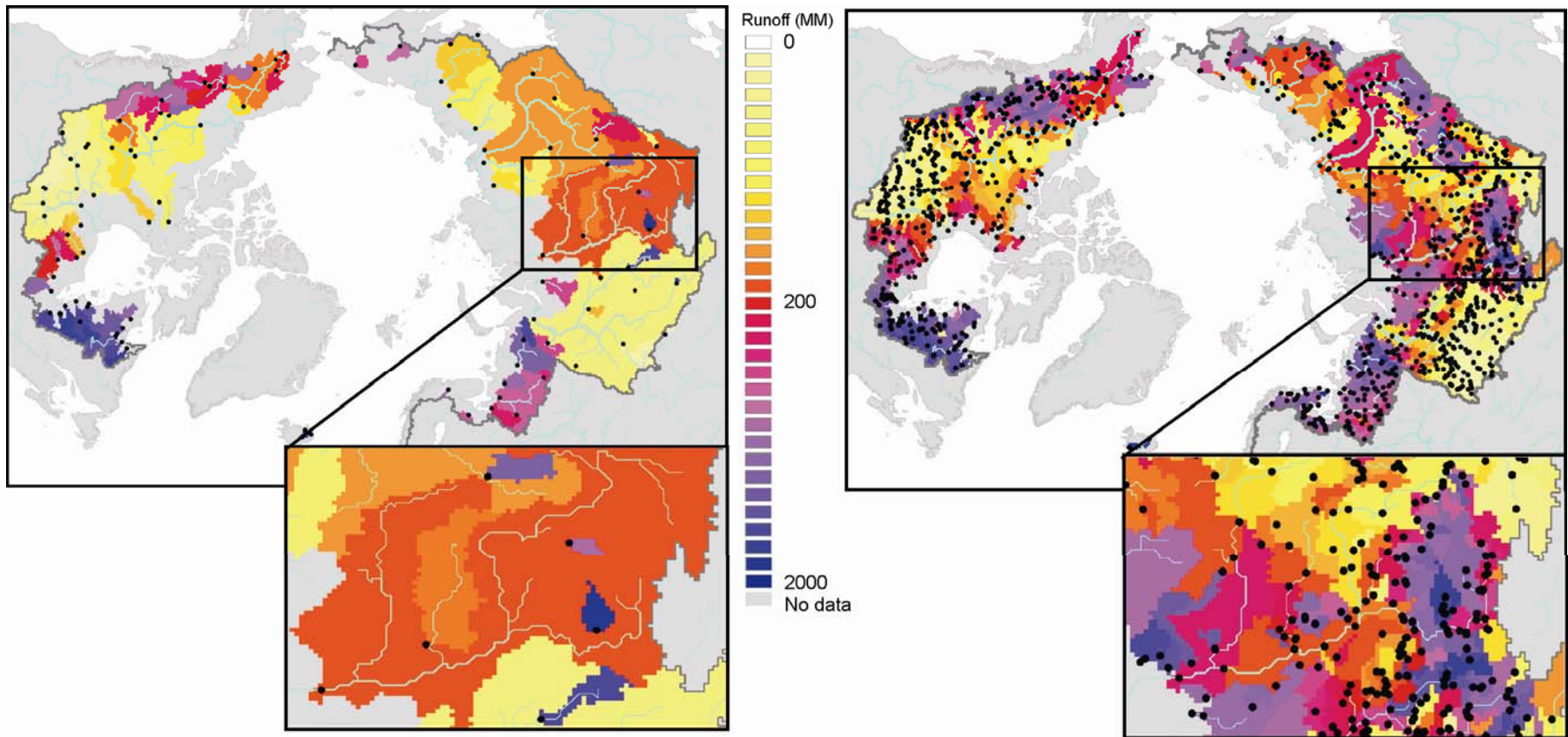
Permafrost Class	Percent Area	All River Gauges		Long Term River Gauges		Large River Gauges		Precipitation	
		Count	Density	Count	Density	Count	Density	Count	Density
Continuous	48.5	507	81	391	62	169	27	102	16
Discontinuous	7.2	103	111	81	87	41	44	18	19
Intermittent	8.9	203	176	176	152	80	69	46	40
Sporadic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

Density: Gauges per 1 000 000 km² of class

Total domain area: 12 970 000 km²

DATA DISSIMINATION AND COLLECTION





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

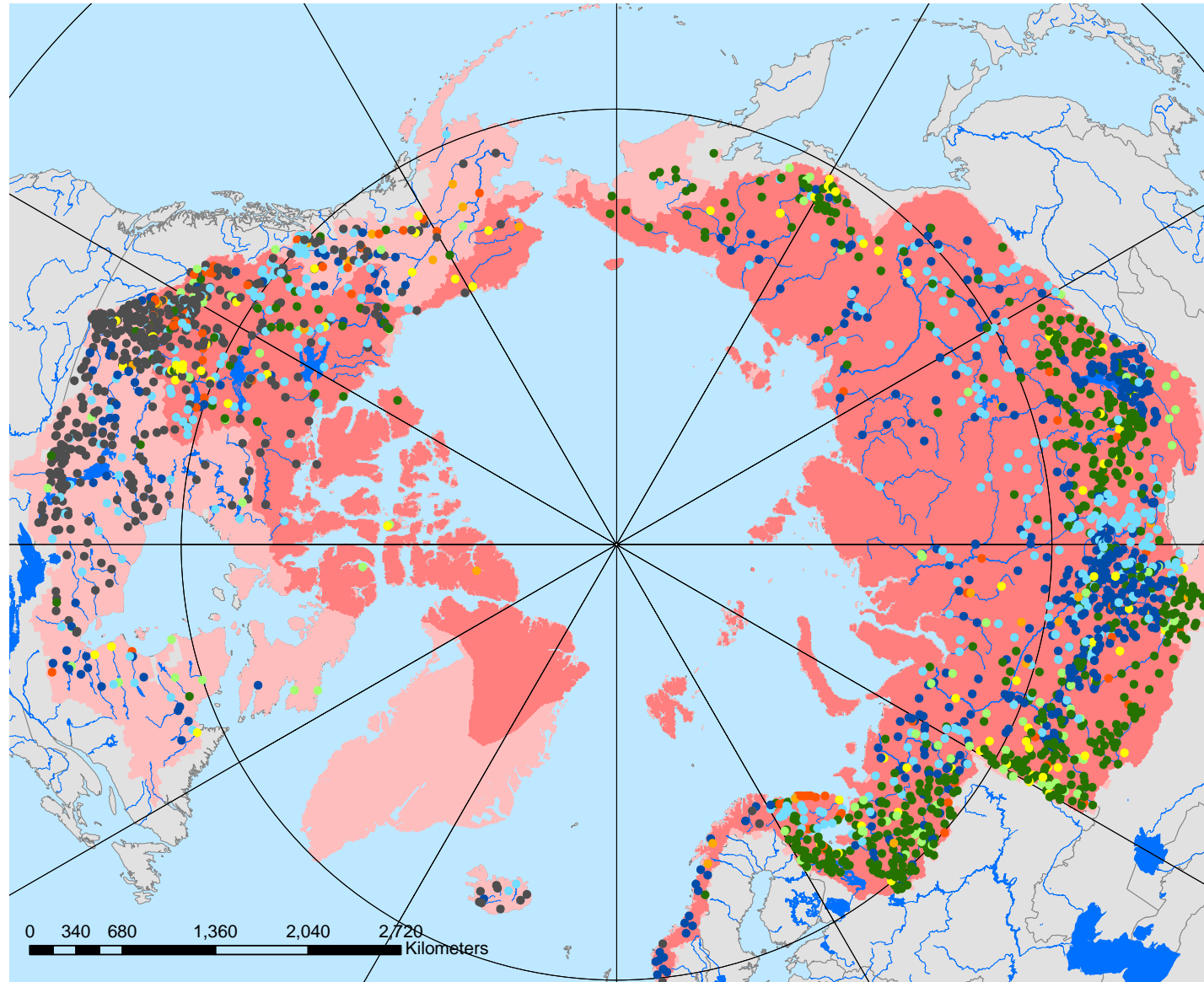
1024 stations with
daily data

2193 stations with
monthly data

ARDB stations
Status: April 2005

Time Series End

- 1919 - 1970
- 1971 - 1975
- 1976 - 1980
- 1981 - 1985
- 1986 - 1990
- 1991 - 1995
- 1996 - 2000
- 2001 - 2003



Arctic Runoff Data Base in GRDC

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

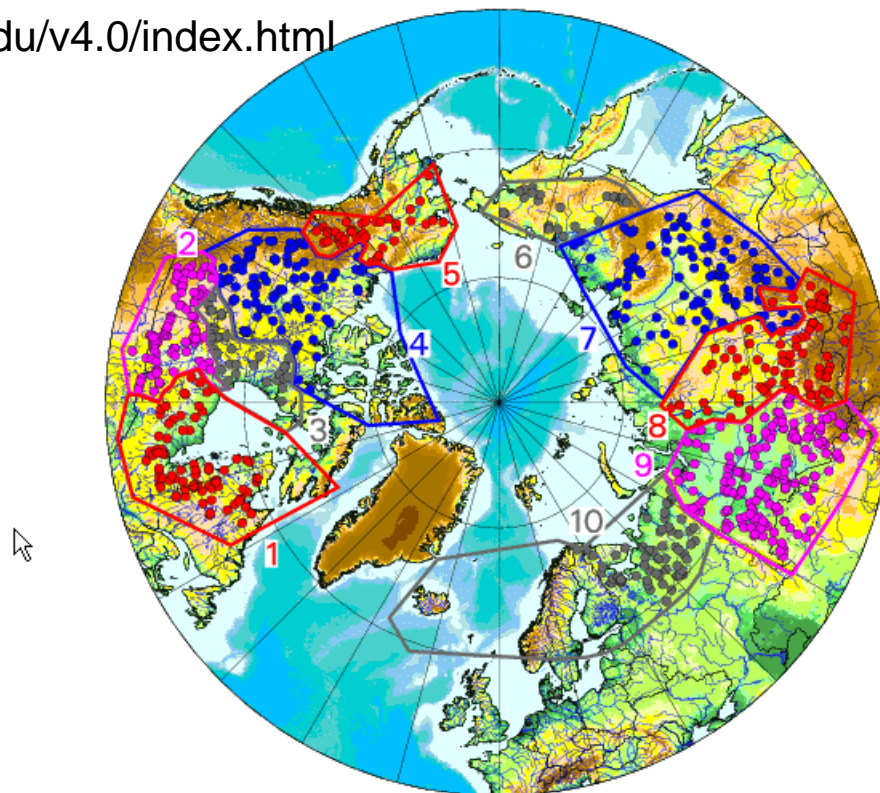
8 countries
 earliest record from 1877 (RU)
 latest record from 2003 (US)
 average time series length of 35 years

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 STATES	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	

(Status: April 2005)

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

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



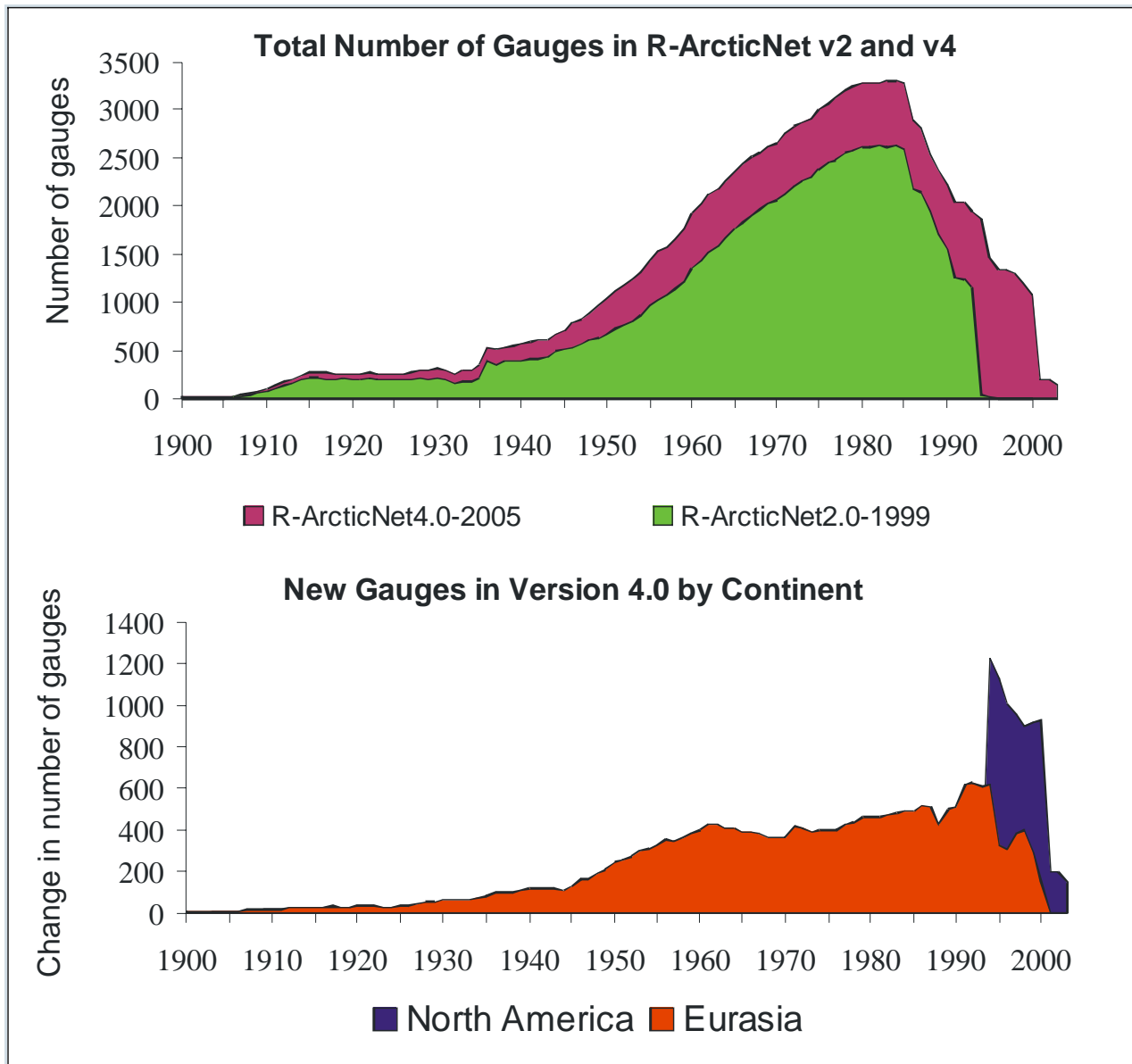
1. South and East Hudson Bay
2. Nelson
3. Northwest Hudson Bay
4. Mackenzie
5. Yukon

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](#)

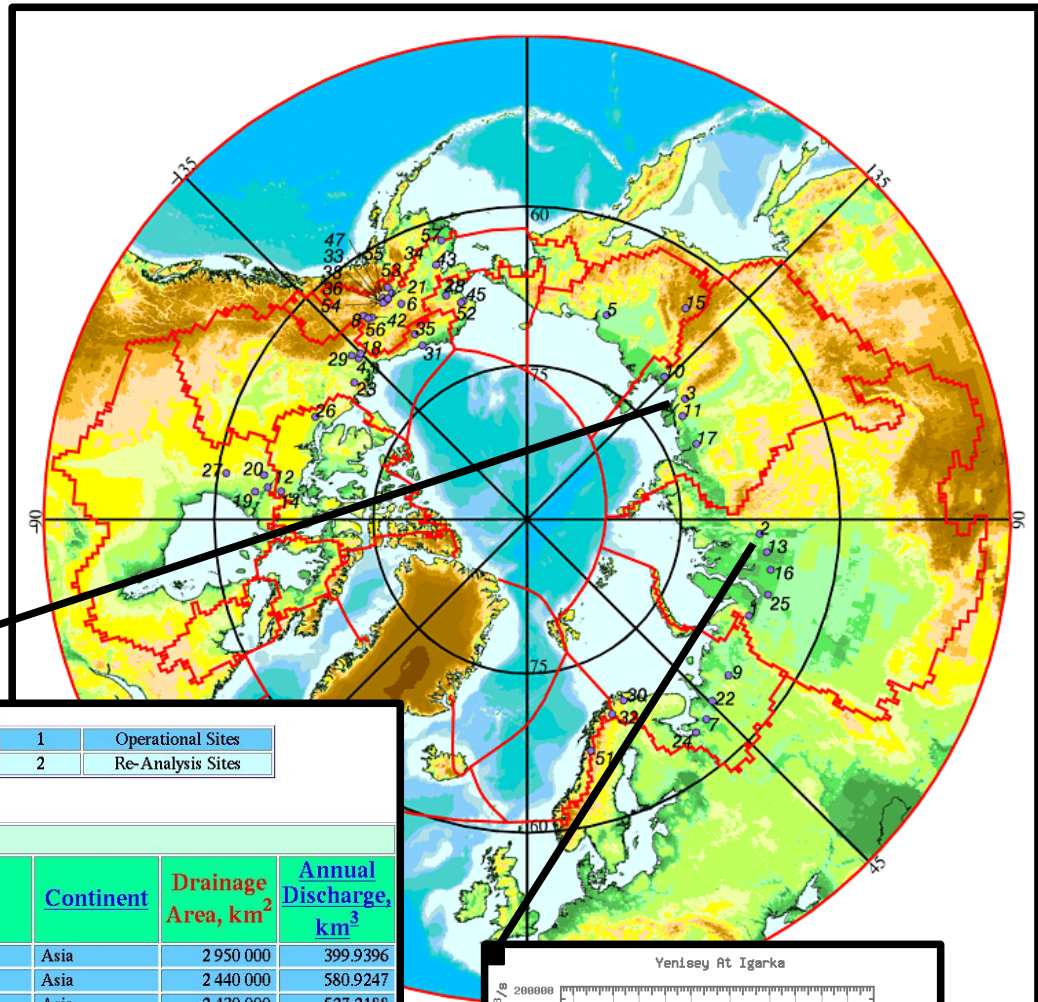
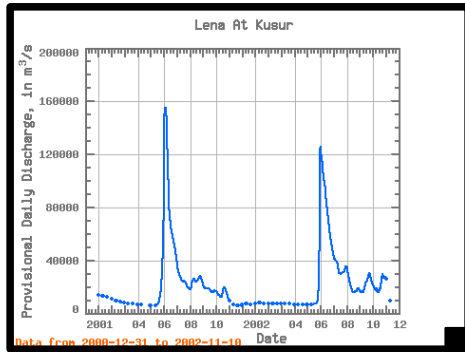
[Return to R-Arctic Net Home Page](#)



ArcticRIMS

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

Real-Time River Discharge Monitoring

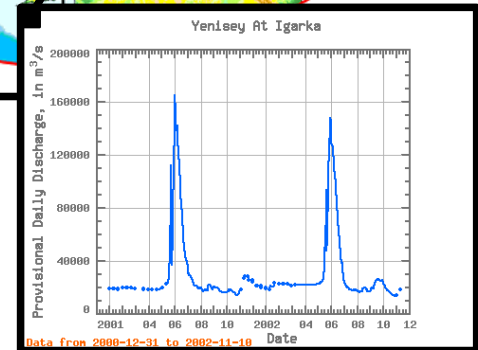


List of Arctic RIMS Discharge Stations

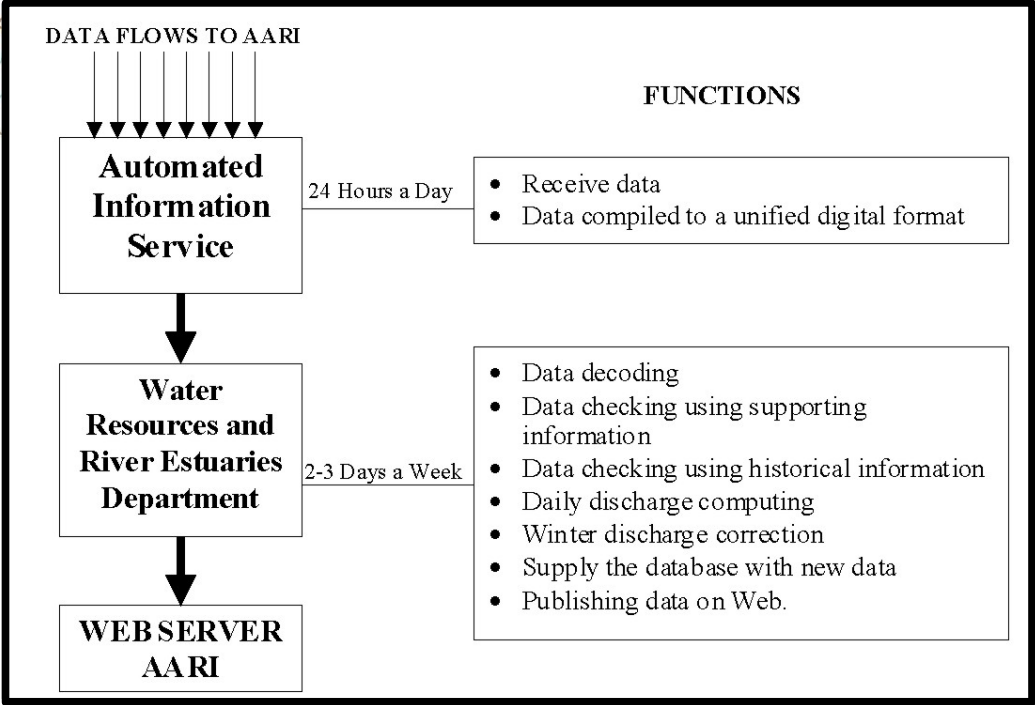
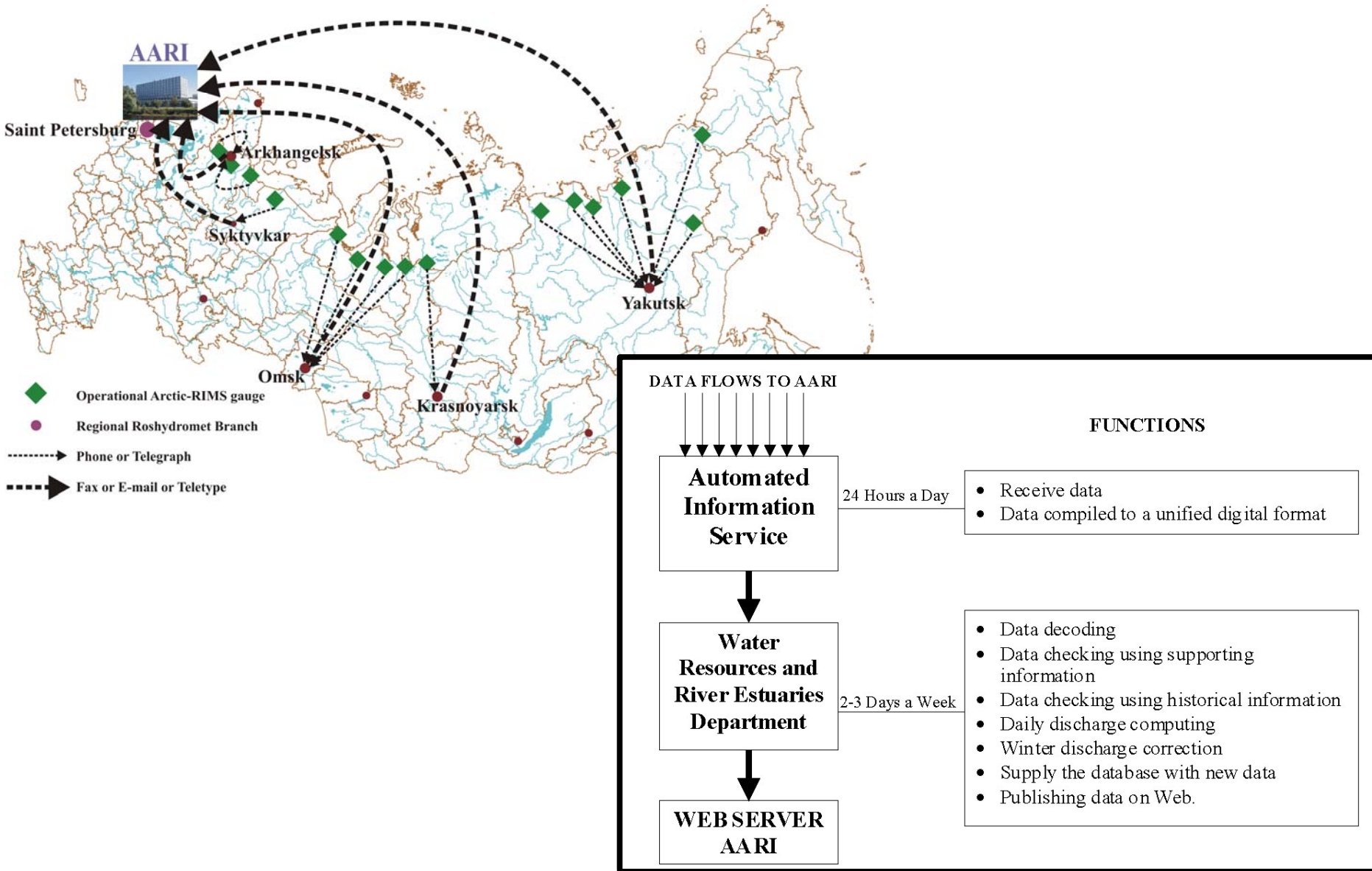
1	Operational Sites
2	Re-Analysis Sites

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

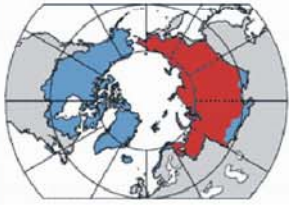


Russian Data Flow to the Arctic and Antarctic Research Institute (AARI)



Data Explorer

ArcticRIMS



Political Units	Time Series			Climatology		
	DAILY	MONTHLY	YEARLY	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

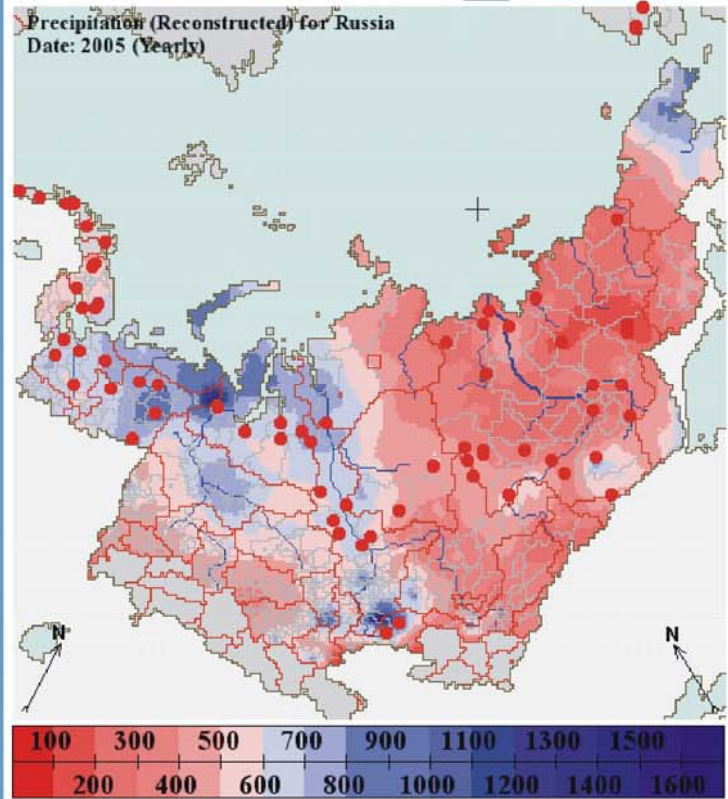
Continent Sea Basin Watershed
 RIMS WALE

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](#)



[Get Single Image](#)

[Previous](#) 2005 [Next](#)

Start Animation

From To

Time Series Graph for above Dates for basin for grid cell

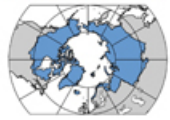
Basin Name

Mouse over	
Longitude	189.7
Latitude	80.4
Sub Nation	Ocean or Lakes
Administrative Division	Ocean or Lakes
Precipitation, mm/year	<input checked="" type="checkbox"/> Out of the basin
Precipitation Anomaly, mm/year	<input checked="" type="checkbox"/> 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:

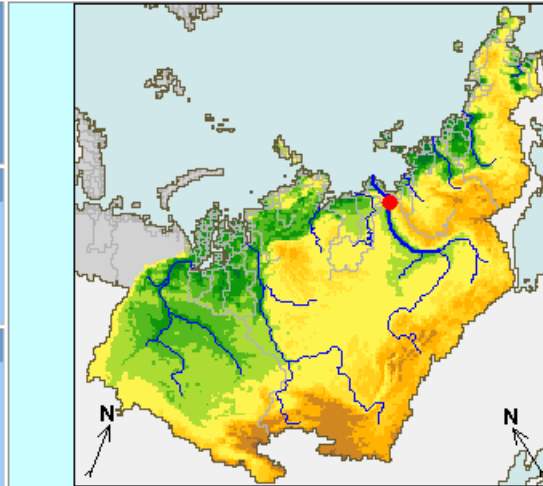
3821

R-ArcticNet ID:

6342

ArcticRIMS ID:

3



Source:

ROSHYDROMET, Russia

Latitude:

70.68

Longitude:

127.39

Continent:

Asia

Drainage area:

2430000 km²

Contributing area:

2430000 km²

Interstation area:

6342 km²

Next Upstream Station:

[6147](#) [6236](#) [6266](#)

Next Downstream Station(s):

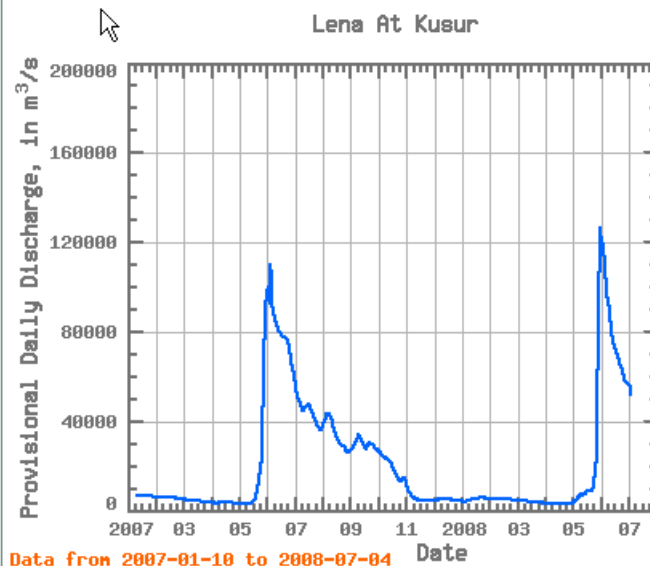
[6344](#)

Operational Site

Monthly Climatology and other Graphs

Graph Type:	
Beginning Date:	Ending Date:
<input type="radio"/> Discharge Climatology	1936 2000
<input type="radio"/> Archival Monthly Discharge	1936 January 2000 December
<input type="radio"/> Archival Daily Discharge	1978 January 1 1999 December 31
<input type="radio"/> Provisional Monthly Discharge	2000 January 2008 June
<input checked="" type="radio"/> Provisional Daily Discharge	2007 January 10 2008 July 4
<input type="radio"/> Provisional Monthly Stage	2000 January 2008 June
<input type="radio"/> Provisional Daily Stage	2000 January 10 2008 July 4

Discharge Graph Units - m³/s km³ mm



Available Data Downloads

Data Type

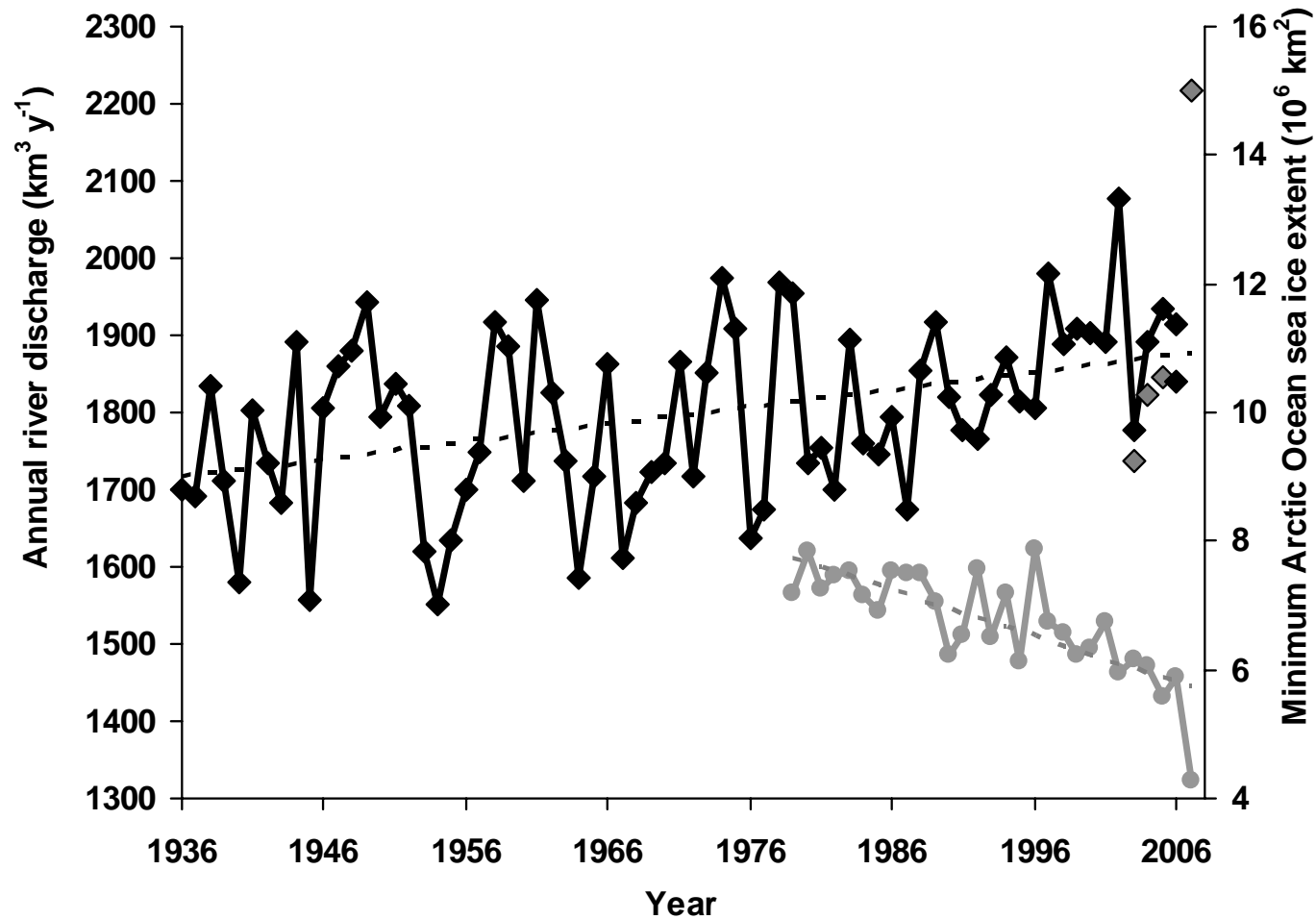
Daily

Monthly

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

$R = -0.7$

Russian Pan-Arctic River Discharge 1936-2007



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