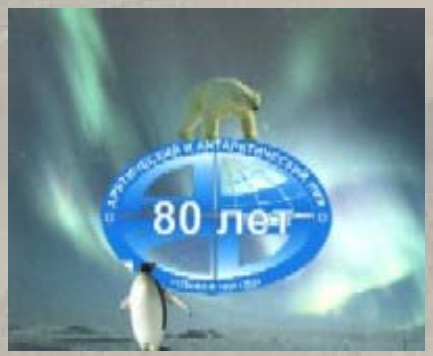
Workshop on Advances in the Use of Historical Marine Climate Data, NOAA/CDC, 29.01-01.02.2002

Sea ice Data Sets Available within the WMO GDSIDB Project and Future Candidates

Vasily Smolyanitsky,

Arctic and Antarctic Research Institute &

JCOMM Expert Team on Sea Ice



• Started in 1989 according to recommendations and resolutions of CMM to provide data for WCP, WCRP etc.

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Near North pole (82ºN,172ºW),
08 September 2000

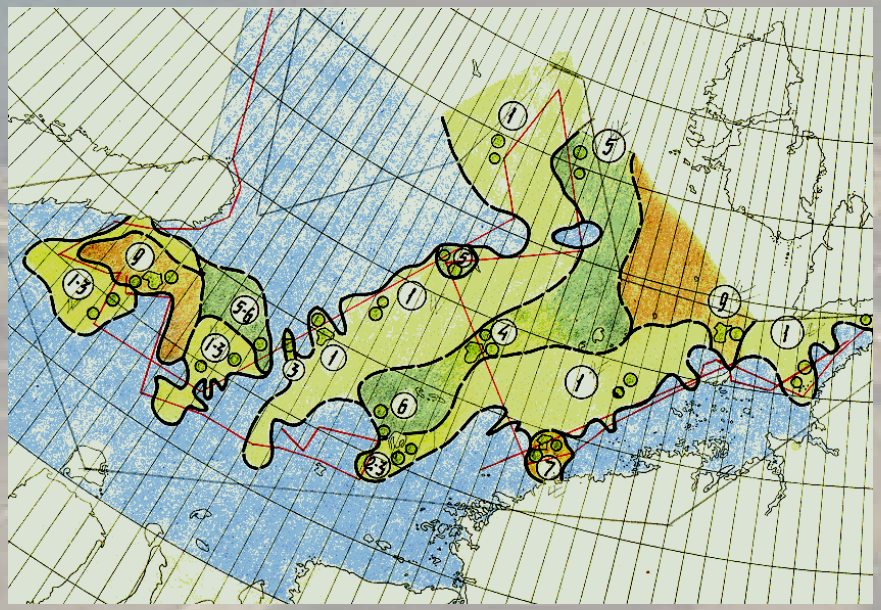
WMO Global Digital Sea Ice Data Bank project, other facts from the history

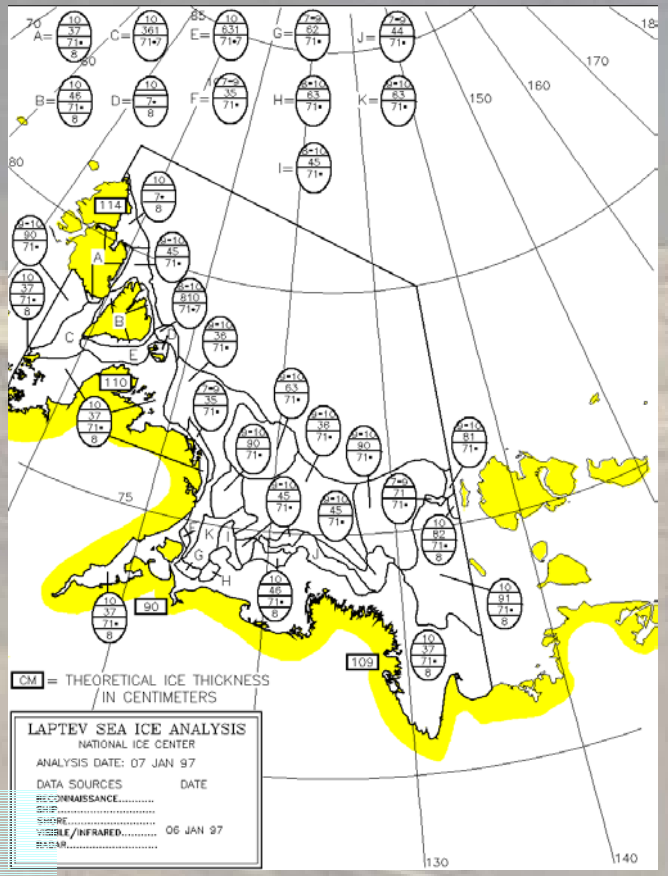
- Started in 1989 according to recommendations and resolutions of CMM to provide data for WCP, WCRP etc.
- At its second session in August 1992 NSIDC, NIC and AARI were only contributors
- In May, 2000 the last 8th session was held there representatives from the main ice services are data centers were present, including AARI, Argentina, BSIM, China, CIS, DMI, Iceland, JMA, NIC, NSIDC
- During 1980s-90s supervised by the former CMM sub-group on sea ice and its own Steering Group with two co-chairmen – Dr R.G.Barry (NSIDC) and Dr I.Ye.Frolov (AARI), has two archiving centers at NSIDC and AARI
- Supported by JCOMM-I resolutions, now supervised by JCOMM PA Services Expert Team on Sea Ice
- In October 2002 next 9th session is planned in Buenos Aires

Prime data source - digitization of historical and operational sea ice charts

Main data unit - sea ice chart , describing linear elements of ice cover and uniform ice zones

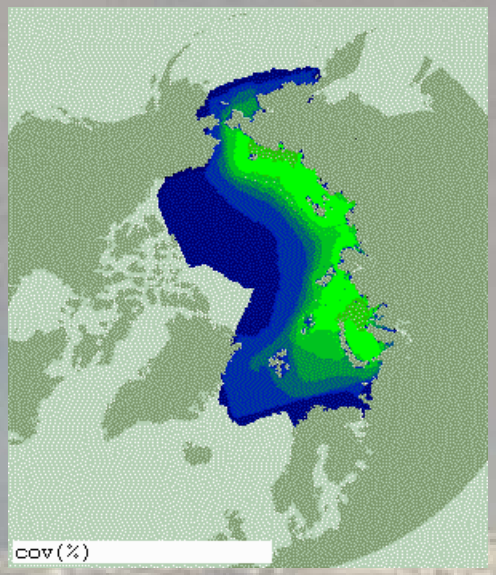
Historical AARI ice chart

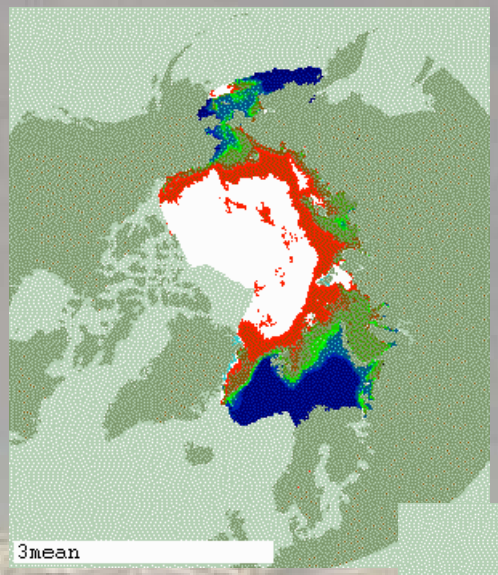




NIC ice chart in standard WMO Nomenclature

1. AARI data set, Arctic, summary for 1950-1992





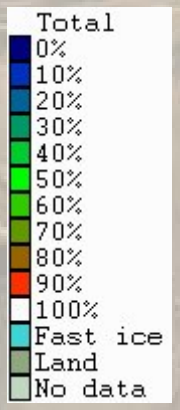
Sea Ice parameters included:

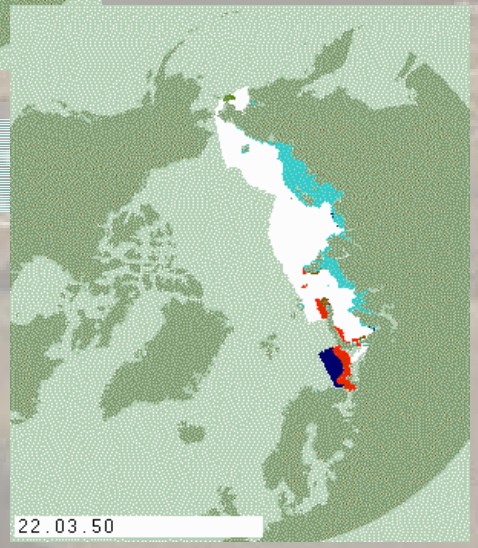
- total concentration
- stages of ice development (up to 11 acc. to WMO Nomenclature, including NY, FY, MY etc.)
- indicator for drifting/fast ice
- estimate of mean-weighted thickness of level ice

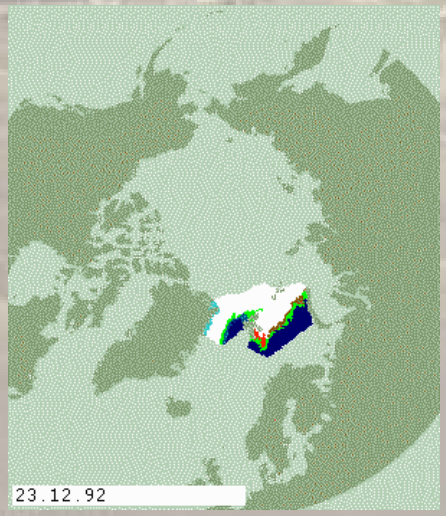
Coverage (n/N), %

Robust mean

- 10-days periodicity with gaps in time and space
- in SIGRID-1, EASE-GRID ArcInfo compatible formats



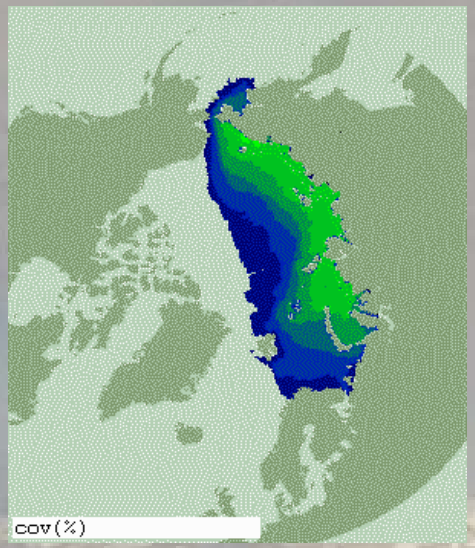




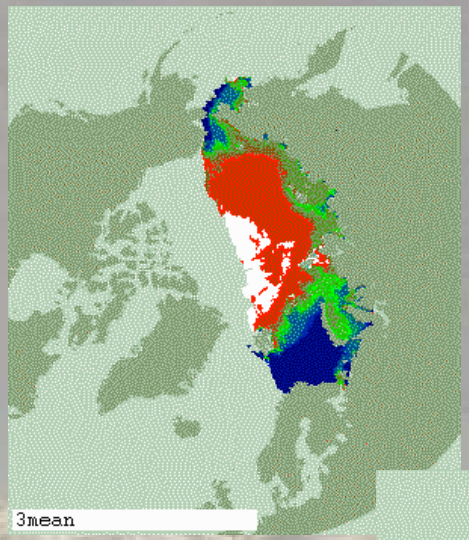
First chart (22.03.1950)

Last chart (23.01.1992)

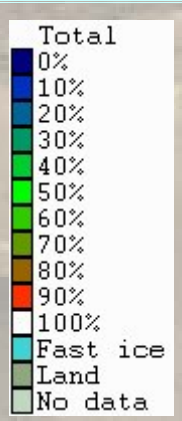
1. (continued) AARI data set, Arctic, summary for 1950-1959

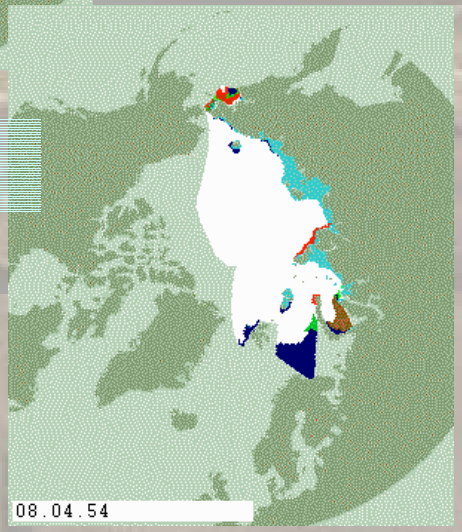


Coverage (n/N), %

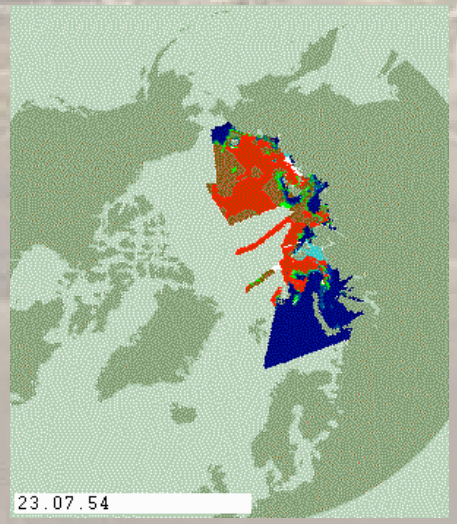


Robust mean



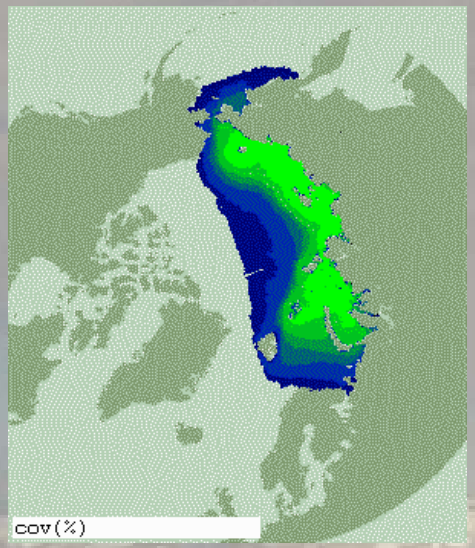


Sample winter chart (April, 1954)

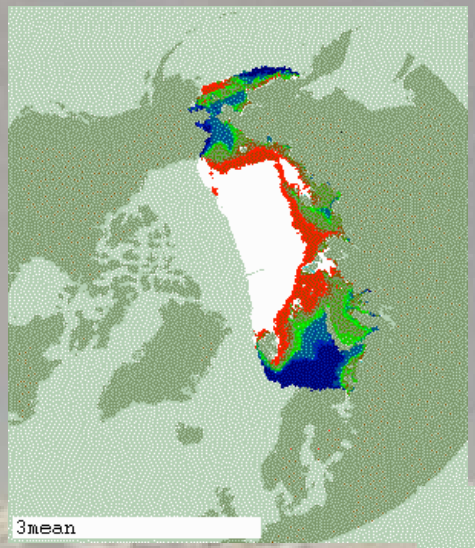


Sample summer chart (July, 1954)

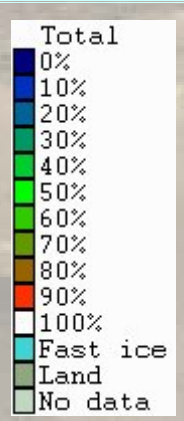
1. (continued) AARI data set, Arctic, summary for 1960-1969

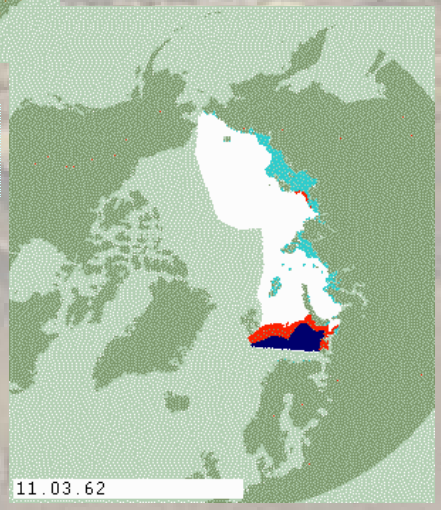


Coverage (n/N), %

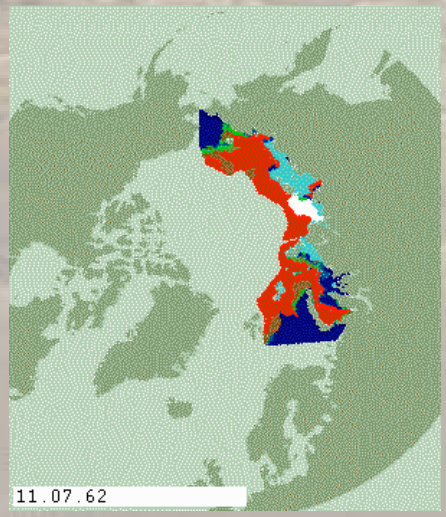


Robust mean



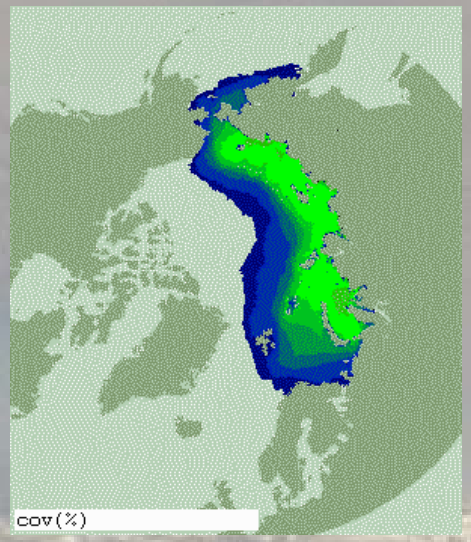


Sample winter chart (March, 1962)

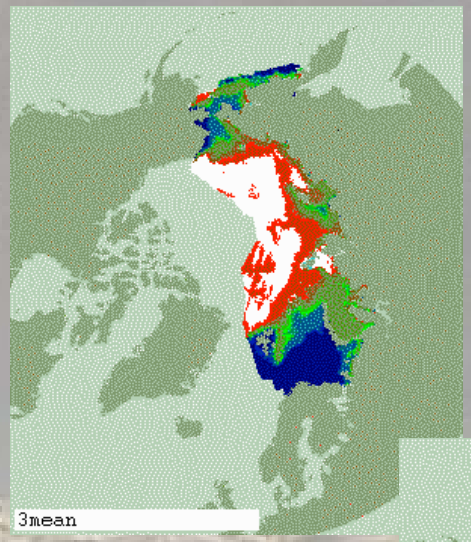


Sample summer chart (July, 1962)

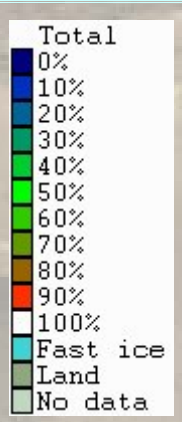
1. (continued) AARI data set, Arctic, summary for 1970-1979

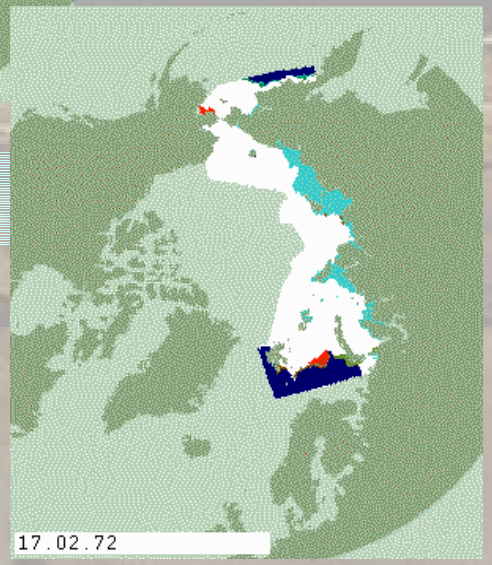


Coverage (n/N), %

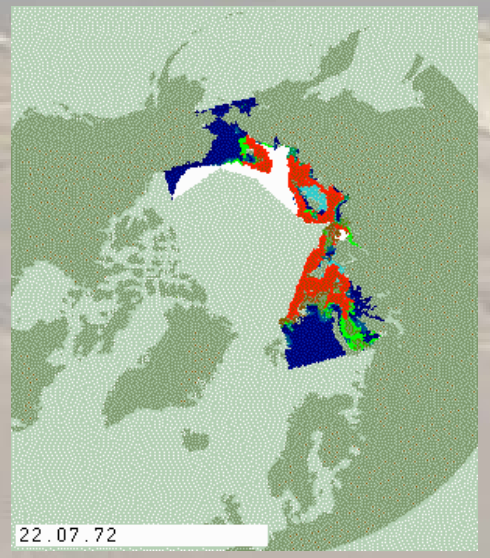


Robust mean



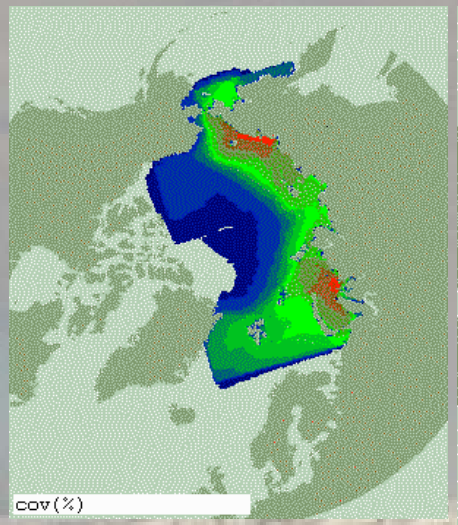


Sample winter chart (Feb., 1972)

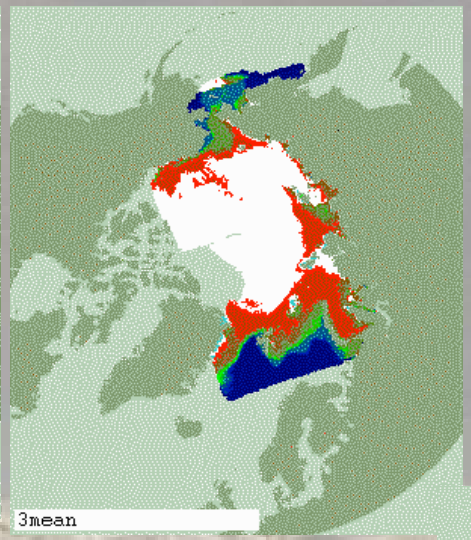


Sample summer chart (July, 1972)

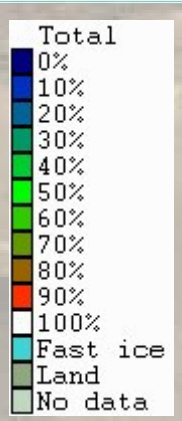
1. (continued) AARI data set, Arctic, summary for 1980-1989

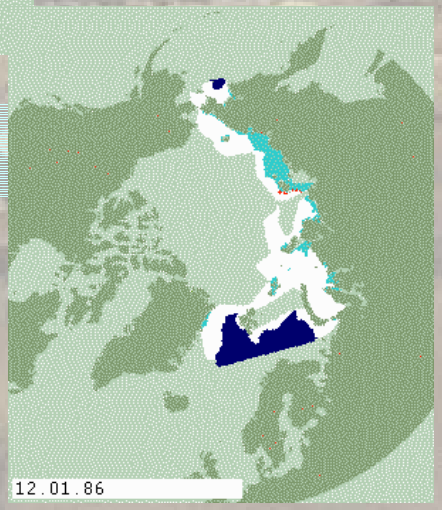


Coverage (n/N), %

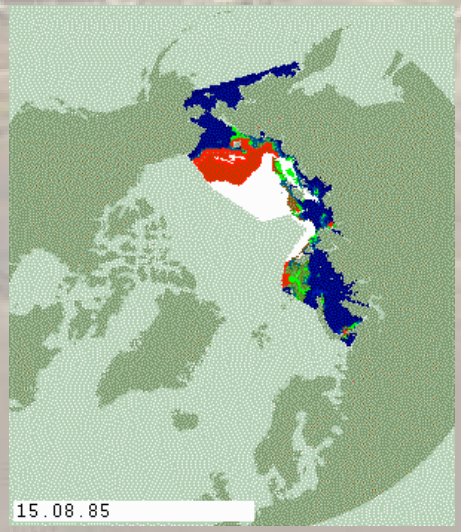


Robust mean



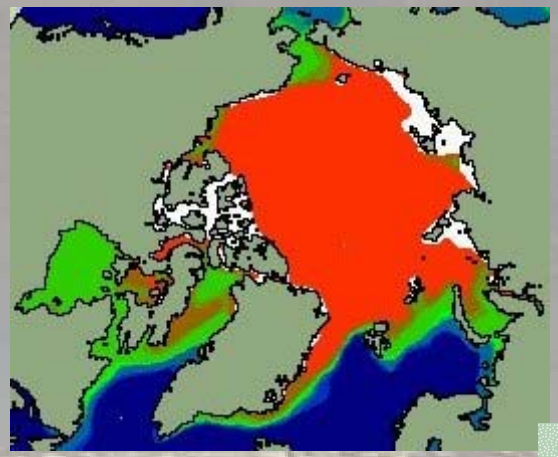


Sample winter chart (Jan., 1986)



Sample summer chart (Aug., 1985)

2. NIC data set, Arctic region, summary for 1972-1994

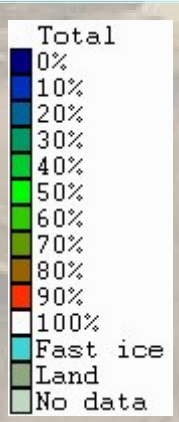


Sea Ice parameters included:
- total concentration
- stages of ice development (up to 11 acc. to WMO Nomenclature, including NY, FY, MY etc.)
- indicator for drifting/fast ice
- estimate of mean-weighted thickness of level ice

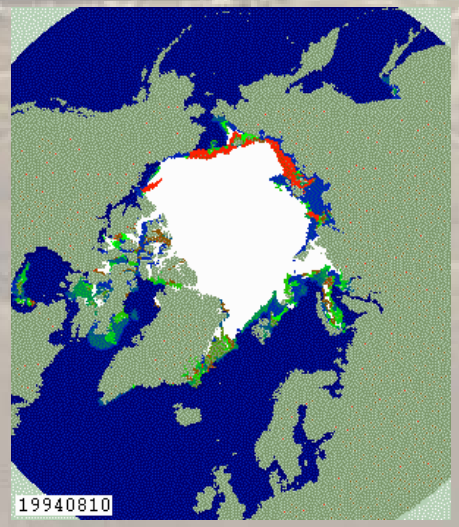
Coverage (n/N) = 100 %

Robust mean

- 7-days periodicity without gaps in time and space
- in SIGRID-1, EASE-GRID ArcInfo .e00 and other compatible formats



First chart (03.01.1972)



One of the last charts (10.08.1994)

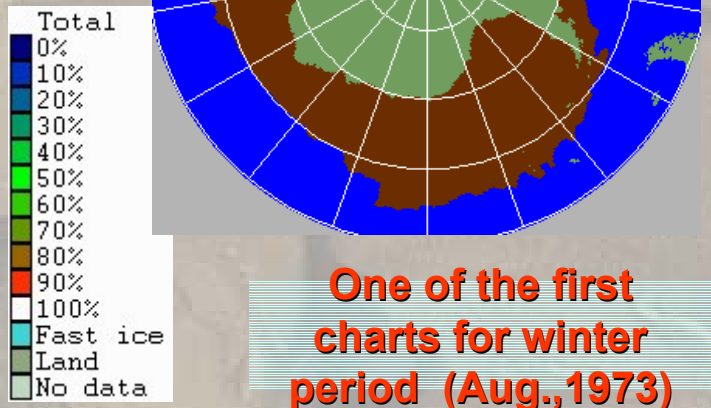
3. NIC data set, Antarctic region, summary for 1973-1994

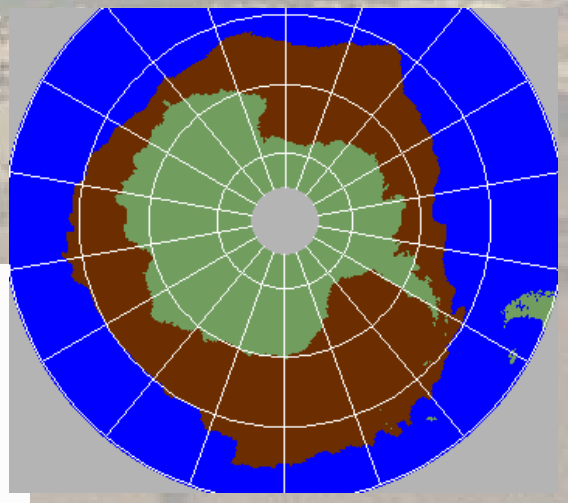
Sea Ice parameters included:

- total concentration
- very few cases for stages of ice development for 70s, but situation much better for 80s and 90s - NY, FY, MY etc. present on last charts)

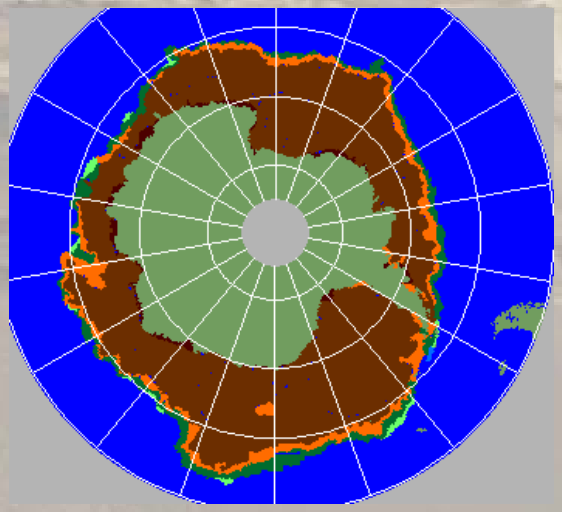
Coverage (n/N) = 100 %

- 7-days periodicity without gaps in time and space
- in SIGRID-1, EASE-GRID ArcInfo .e00 and other compatible formats





One of the first charts for winter period (Aug.,1973)



One of the last charts for winter period (Aug., 1994)

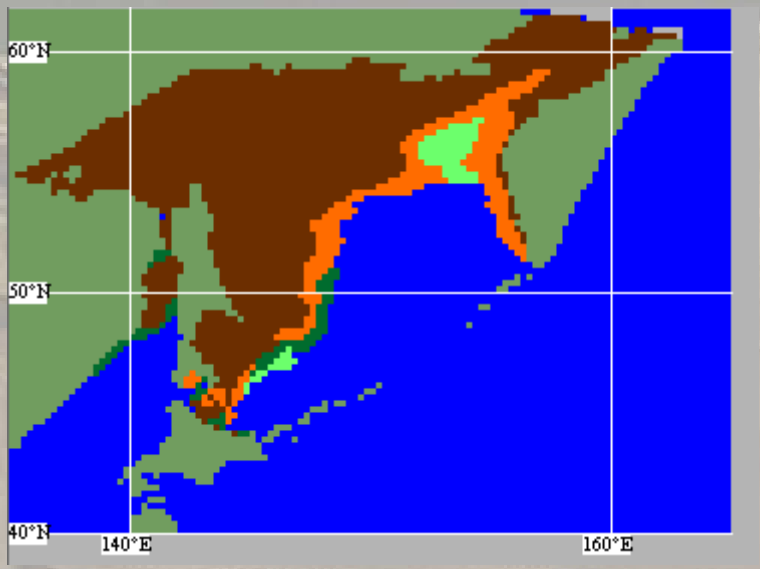
4. JMA data set, Sea of Okhotsk, summary for 1971-2001

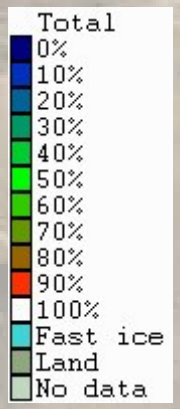
Sea Ice parameters included:

- total concentration

Coverage (n/N)
= 100 % for ice season
(~December - ~ May)

- 5-days periodicity without gaps in time and space
- in SIGRID-2, EASE-GRID





Sea Ice chart for 03.02.1994

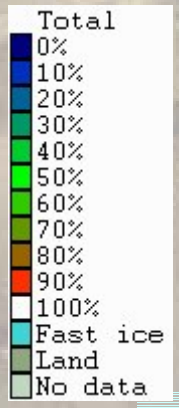
5. BSIM data set (FIMR and SMHI), Baltic Sea, summary for 1960-1979

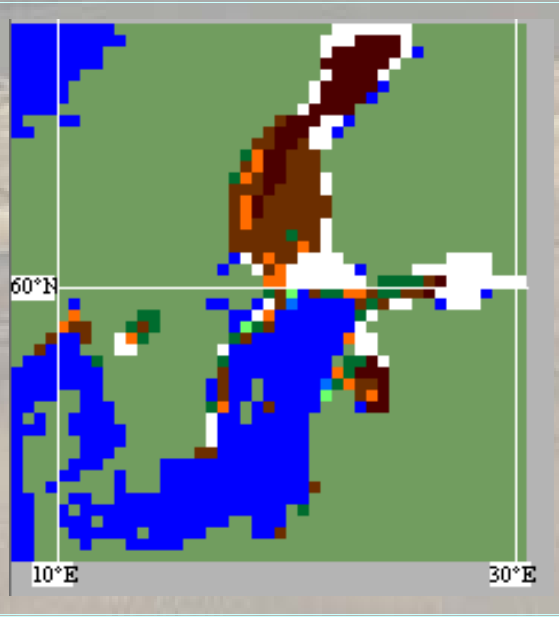
Sea Ice parameters included:

- total concentration
- sea ice thickness / 9 stages of ice development acc.
- fast ice indicator

Coverage (n/N)
= 100 % for ice season
(~November - ~ June)

- 3-4-days periodicity without gaps in time and space
- in SIGRID-1, Baltic code, EASE-GRID





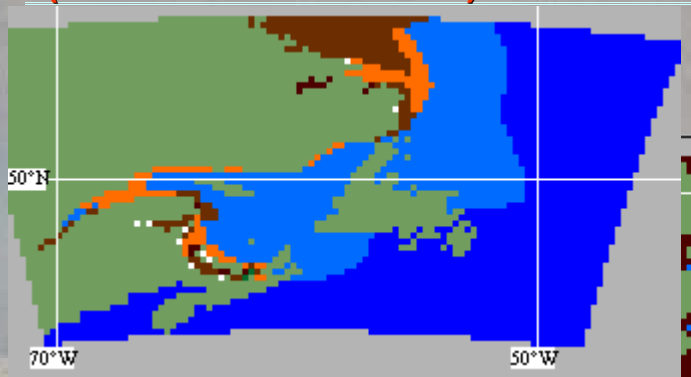
Sea Ice chart for 14.02.1967

6. CIS data set, Canadian Arctic, summary for 1968-1998

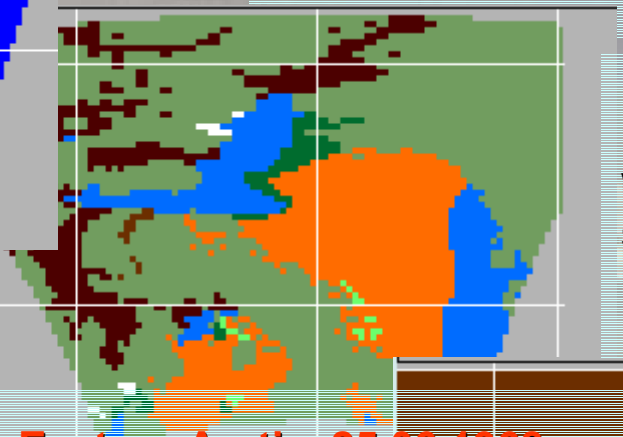
Coverage (n/N)
= 100 % for ice season
(~November - ~ June)

Sea Ice parameters included:
- total concentration
- stages of ice development (up to 11 acc. to WMO Nomenclature, including NY, FY, MY etc.), mean-weighted thickness…..
- indicator for drifting/fast ice

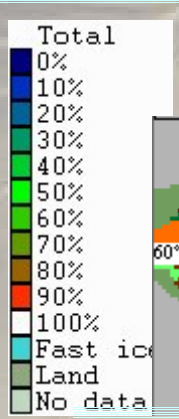
- 7-days periodicity without gaps in time and space
- in SIGRID-1, ArcInfo .e00

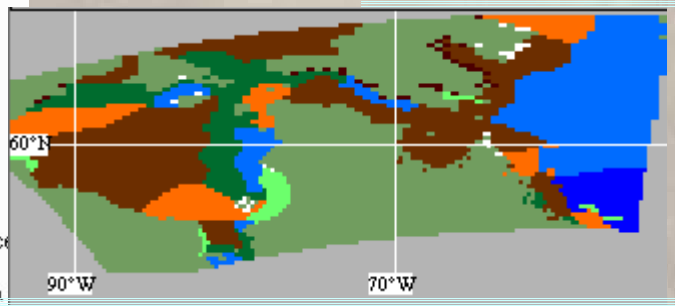


Eastern Coast, 14.02.1969

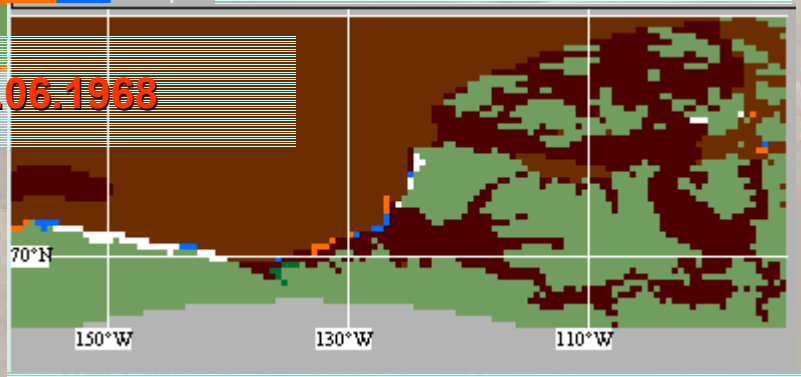


Eastern Arctic, 25.06.1968





Hudson Bay, 21.06.1971



Western Arctic, 21.06.1974

Total summary:

1. Sea Ice total concentration, ice extent and estimates of mean-weighted thickness of level ice are available on the basis of AARI data for Eurasian shelf seas
- with least amount for summer period (June-early September) for 1950…1992 and for second half of winter (Feb-March-May) for the NSR area
- for other months (October-December, April) efficient material starts in 1960s

2. Starting from late 1960s blended datasets based on AARI, CIS and NIC charts and containing sea Ice total concentration, ice extent and estimates of mean-weighted thickness in principal can be constructed for the Arctic Ocean with 7-10 days periodicity on ~25x25 km grid.

Formats used to archive data from sea ice charts

1. **WMO SIGRID (Sea Ice GRID) or SIGRID-1. The most used up to now format. Proposed by SMHI expert T.Thompson. Approved by WMO in 1989. Uses *raster* coding of charts. At each node of geographical grid with basic resolution of 15' all coded acc. to WMO Sea Ice Nomenclature sea ice parameters are written as ASCII string like: *CT92CA609708CB309508CC108508* Linear objects and dynamic processes can be also coded. All ice identifiers (~50), identifications are summarized in *Code Tables***

2. **WMO SIGRID-2. Proposed by AARI expert A.V.Bushuev. Approved by CMM in 1994. Similar to SIGRID but is more friendly for the user to understand codes and produce shortened ASCII strings. Presently used by JMA to code charts for the Sea of Okhotsk. Part of AARI material is also duplicated in SIGRID-2.**

Formats used to archive data from sea ice charts *(continued)*

3. **In order to facilitate user access, in 1996-1997 NSIDC and AARI converted sea ice charts from basic SIGRID into EASE-GRID projection coinciding with 25 or 12.5 km SSM/I. One grid correspond to sea ice parameter, e.g. CT (total concentration) or MY (partial concentration of multi-year ice)**

4. **In 1997-2000 while preparing Joint Russian-USA Artic Ocean sea ice Atlas AARI and and NIC archives in SIGRID-1 were converted or reproduced in GIS ArcInfo .e00 and other import format. However, SIGRID coding for ice parameters remained.**

5. **In 2000-2002 in cooperation with IICWG (International Ice Charting Working Group) a new draft SIGRID-3 is under preparation for both** *operational* **and** *historic* **data. Uses** *vector* **coding. Utilizes: a) WMO adopted SIGRID-1** *Code Tables,* **b) ESRI .*shp* open format to code uniform zones of sea ice parameters, c) descriptive information (like agency, projection, region etc.) is put into supplementary .xml file.**

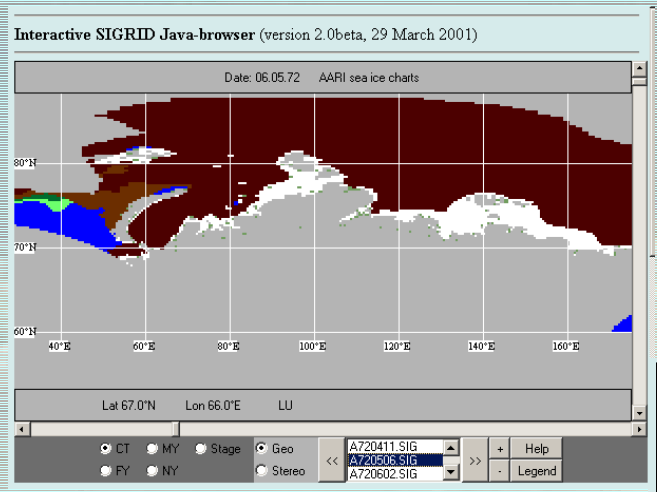
   SIGRID-3 is expected to be considered and possibly recommended for adoption by WMO Secretariat at ETSI-I in October 2002

Access to the GDSIDB data

1. At NSIDC (http://www.nsidc.org) use http- or ftp-links to copy data in SIGRID or EASE-GRID formats or contact User services

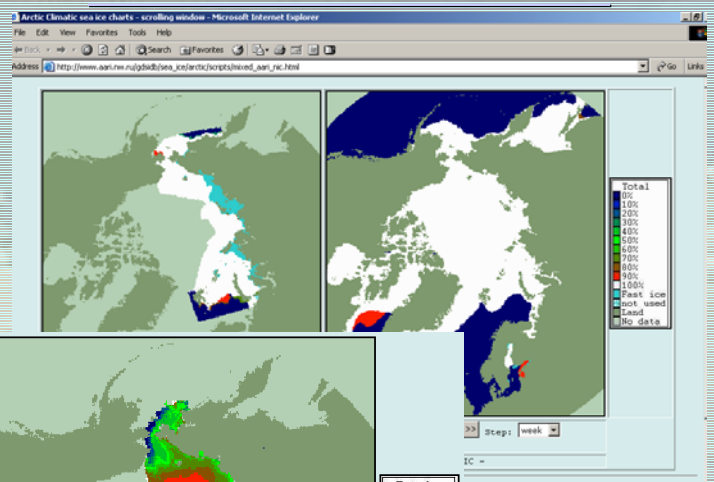
Access to the GDSIDB data *(continued)*

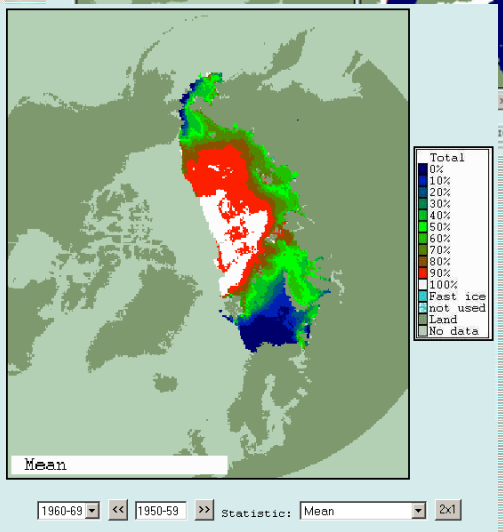
2. At AARI web-site (http://www.aari.nw.ru) go to GDSIDB page (http://www.aari.nw.ru/gdsidb/) to get graphical replica of SIGRID data, various climate statistics or e-mail to wdc@aari.nw.ru to get data in SIGRID format



Java-browser for SIGRID data

Mixed AARI and NIC charts





Decadal statistics for AARI data

Access to the GDSIDB data (continued)

3. Order at NSIDC User services and use Joint Russian-USA Artic Ocean sea ice Atlas for NIC data for 1972-1994 and AARI data for 1950-1992 in SIGRID and GIS ArcInfo compatible formats.

Anticipated data sets within GDSIDB archive

#	Institute	Region	Time interval	Exchange date/notes
1.	AARI	Antarctic Arctic ???	1971-1990 (10-days period 1933-1949	SIGRID-1,3
2.	Argentinean Navy Hydrographic Service	Weddell and Bellingshausen Seas	App. 1982 to 1990, point observations Current observations	2001-2002 Point observations in NIC-code in .db format, submitted with weekly interval to NSIDC and AARI ftp-servers

Anticipated data sets within GDSIDB archive *(continued)*

3.	Australia (within the ASPeCT project)	Antarctic, en-route and pointal observations	1980-1997	In WMO code
4.	BSIM (jointly SMHI and FIMR)	Baltic Sea	1980 – 1998, 3-4 days interval 1999 - 2000	SIGRID-3
5.	CIS	Canadian Arctic	1999-ongoing data forward in time	SIGRID-3

Anticipated data sets within GDSIDB archive *(continued)*

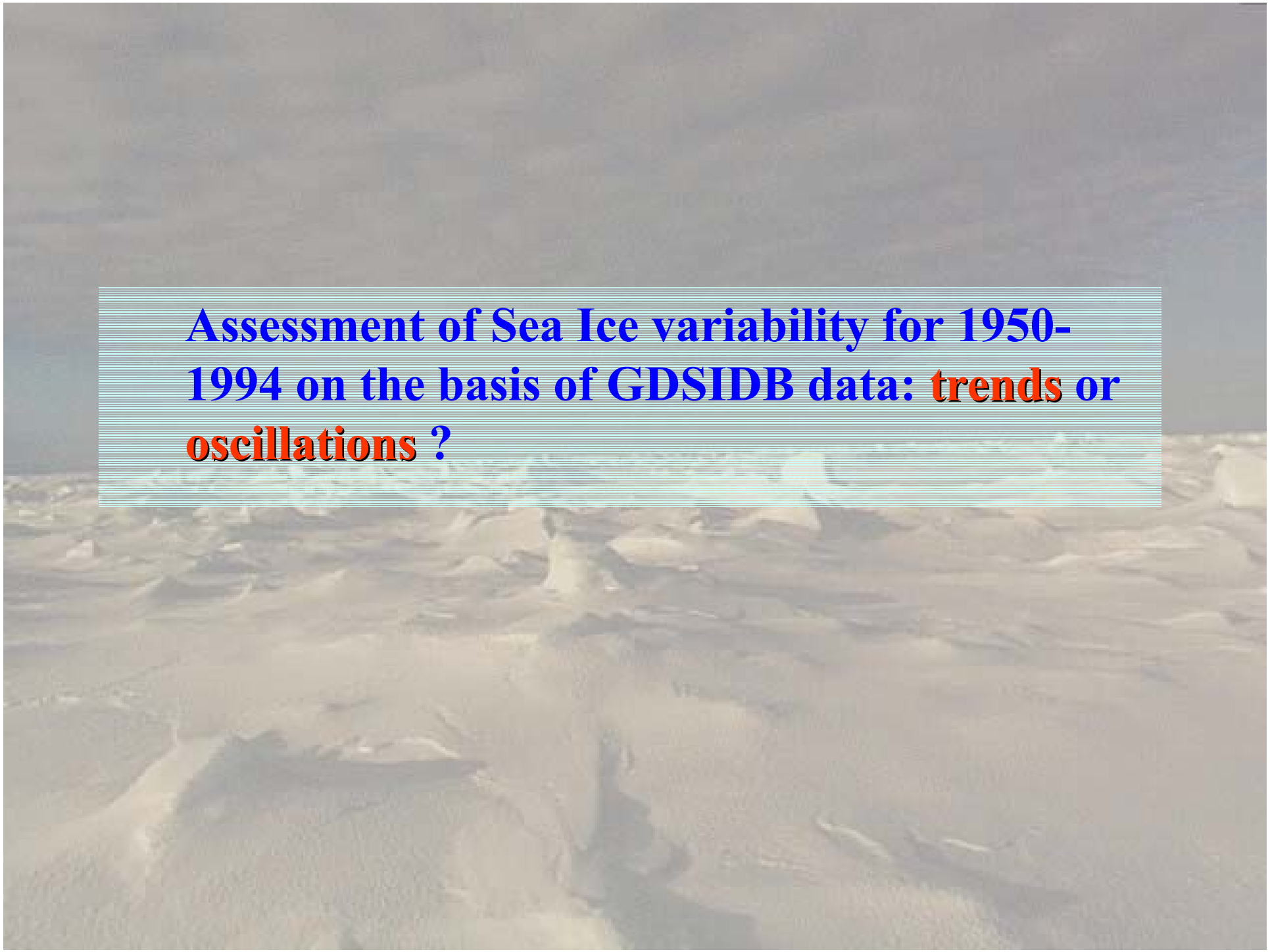
6.	China, State Oceanic Administration	Bohai Sea	1968 – up to present 1952/53 – up to present	0,1° by 0.1° grid, total and partial concentrations and stages of development maximum annual extent to be submitted before the next meeting
7.	DMI	Greenl and waters	March 1999 – up to present	SIGRID-3

Anticipated data sets within GDSIDB archive *(continued)*

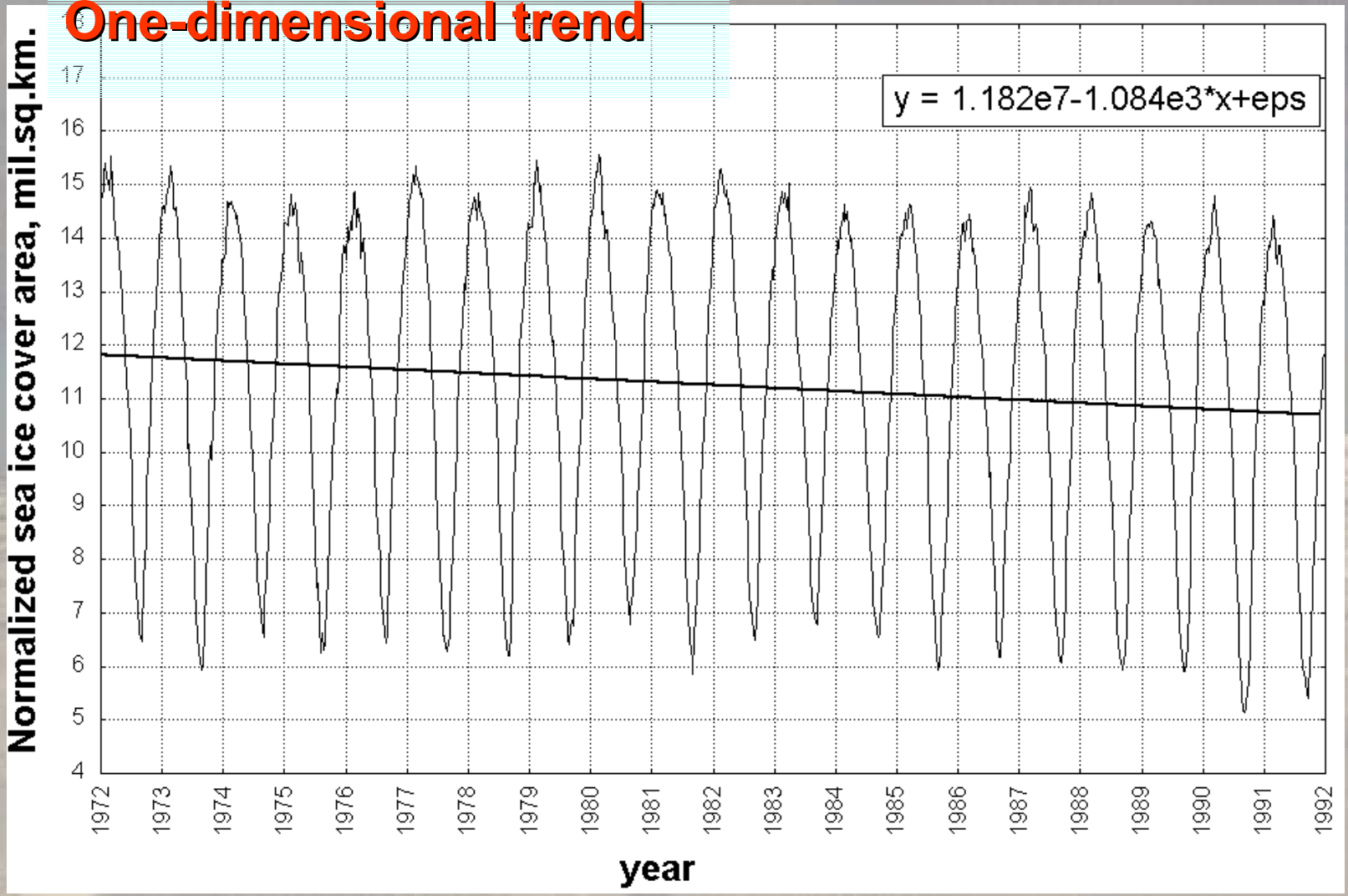
8.	Germany, Federal Maritime and Hydrographic service (BSH)	Baltic Sea(south of 56°N and to the west of 14 20')	1960-1982 and updates	to be determined
9.	Icelandic Meteorological Office	Icelandic waters	to be determined	to be determined
10.	JMA	Sea of Okhotsk	ongoing data forward in time	Once a year in SIGRID-2 format

Anticipated data sets within GDSIDB archive *(continued)*

11	NIC	Arctic Antarctic Arctic Antarctic	1995 – 1996 1995 – 1997 1996 - till present 1998 – till present	need to be converted to standard format and undergo QC before submission ArcInfo e00-format, available on-line via NIC web-site, SIGRID-3

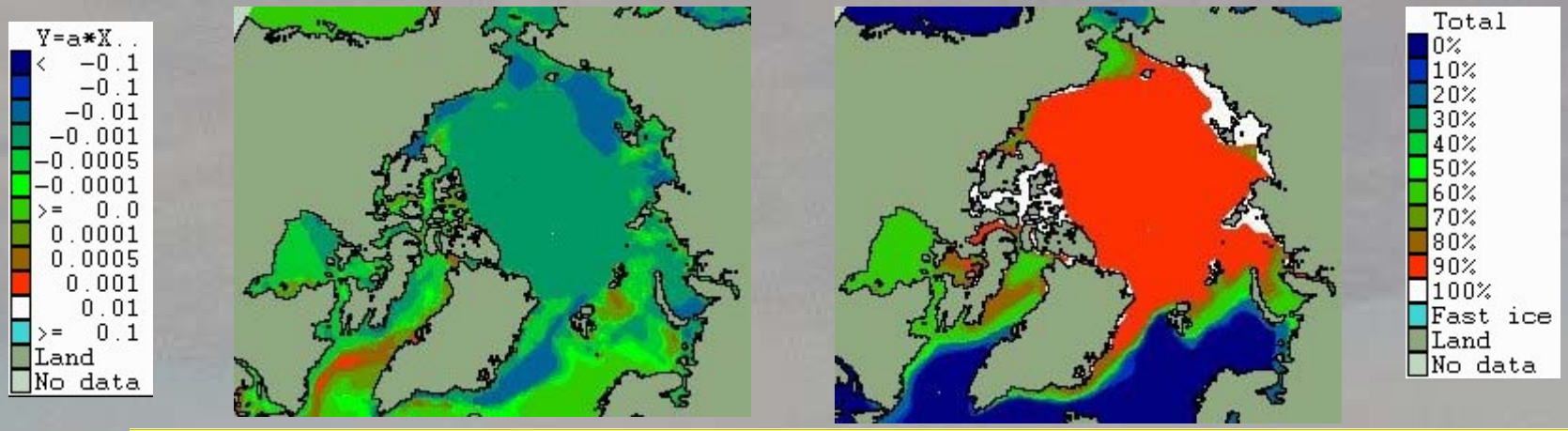

Assessment of Sea Ice variability for 1950-1994 on the basis of GDSIDB data: trends or oscillations ?

One-dimensional trend



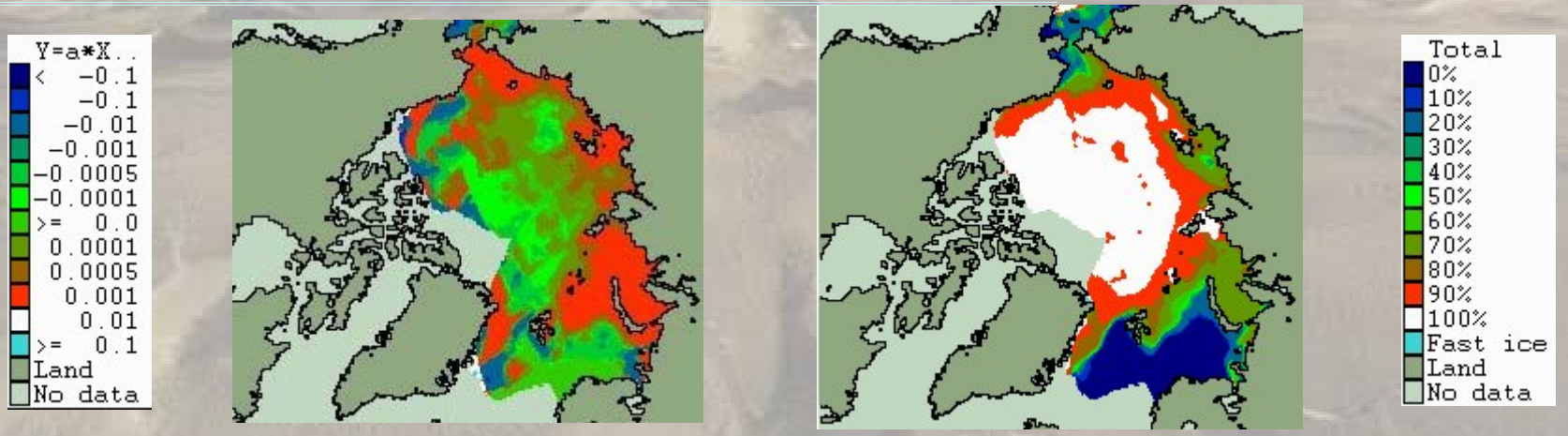
Weekly values and linear multi-annual trend of the normalized (by total concentration) sea ice cover area for Northern Polar Region for 1972-1991 period, 7-days NIC sea ice charts

Two-dimensional trend: 1972-1994



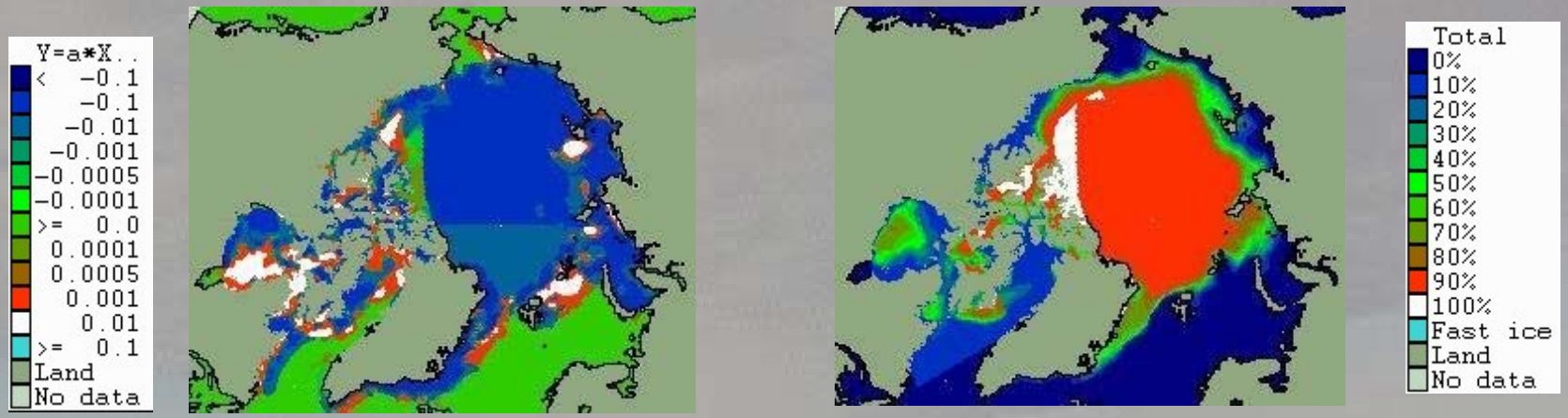
Linear trend and robust mean (total concentration) for 1972-1994 (NIC data)

Two-dimensional trend: 1950-1992



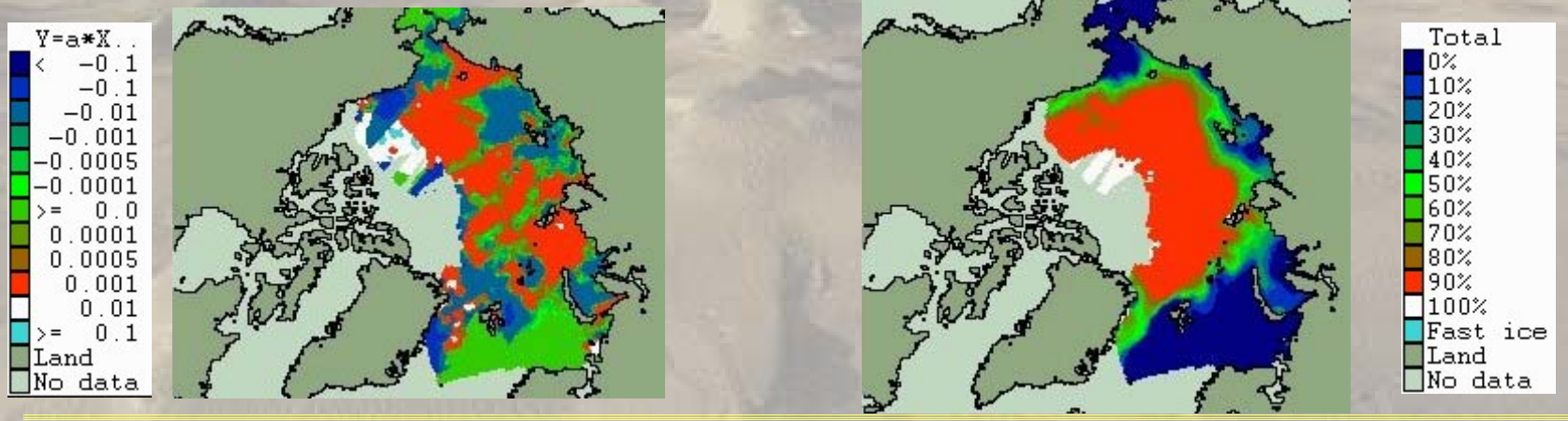
Linear trend and robust mean (total concentration) for 1950-1992 (AARI data)

August, 1972-1994



Linear trend and robust mean (total concentration) for August, 1972-1994 (CIS&NIC data)

August, 1950-1992

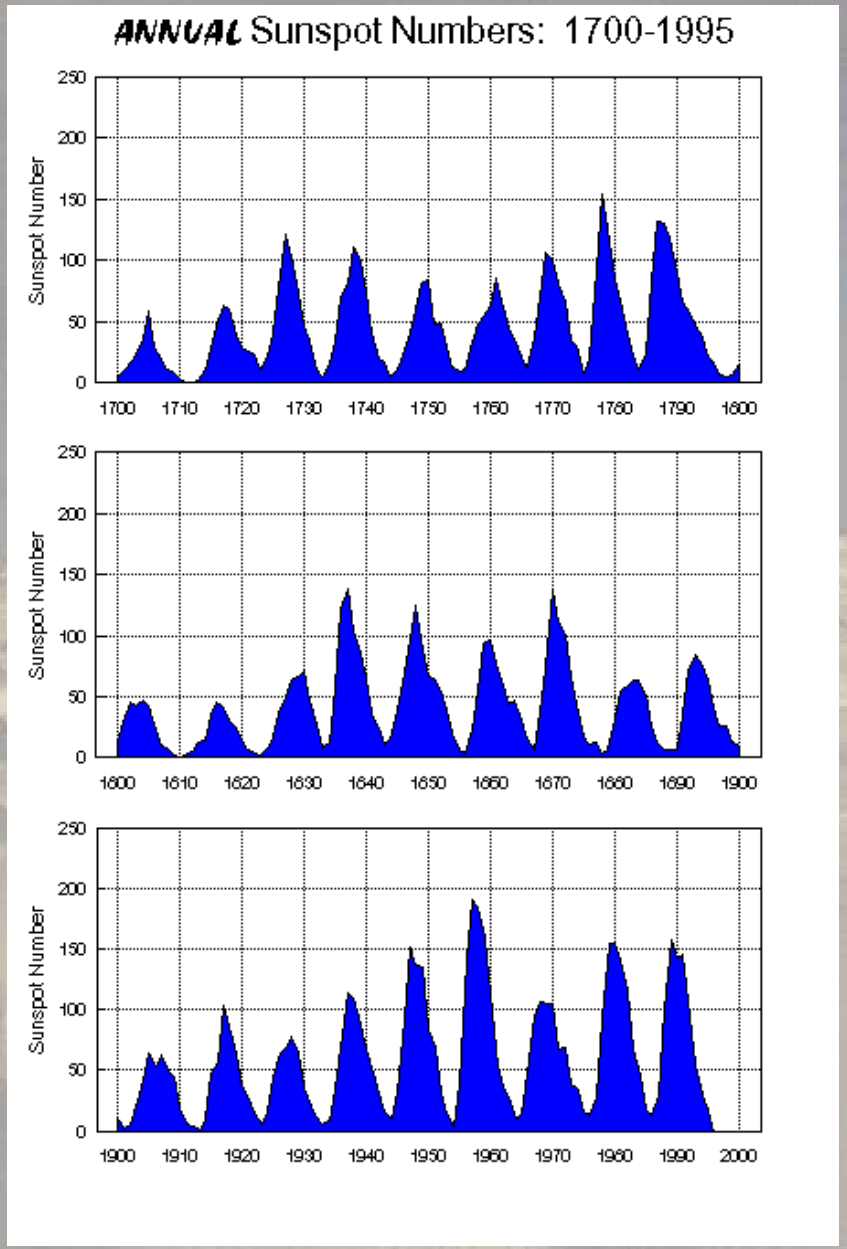


Linear trend and robust mean (total concentration) for August, 1950-1992 (AARI data)

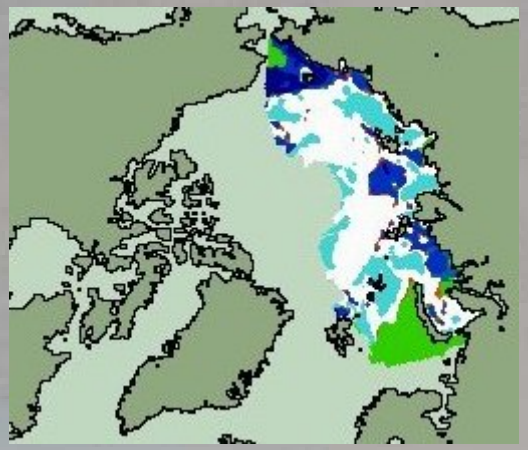
Sub-periods ?

1954-1963 (19 Solar cycle)
1964-1975 (20 Solar cycle)
1976-1985 (21 Solar cycle)
1986-1995 (22 Solar cycle)

To simplify analysis, solar cycles are chosen, however, cosmic influence is definitely indirect, while decadal variability of patterns of atmospheric circulation over Arctic is obvious



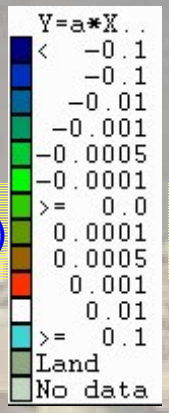
August, 1954-1963



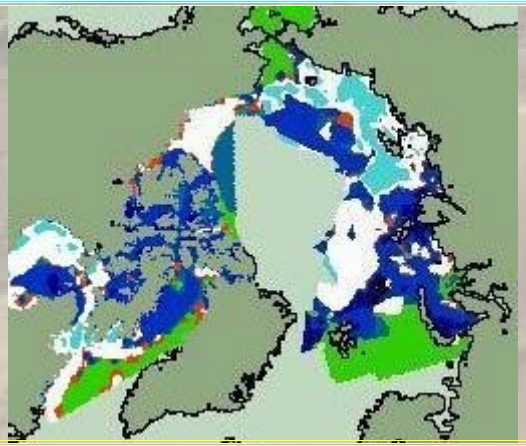
Linear trend, Aug 1954-63 (AARI data)

August, 1964-1975

Linear trend, Aug 1964-75 (AARI&CIS data)

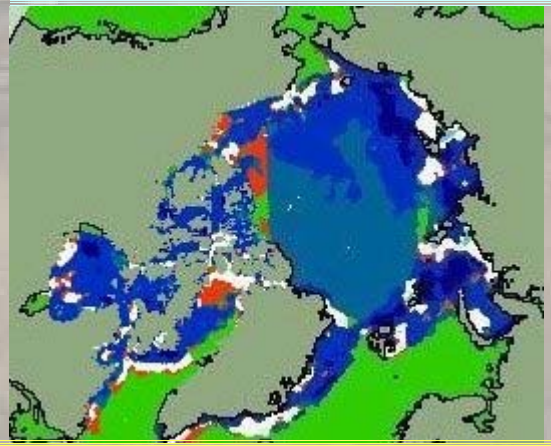


August, 1976-1985



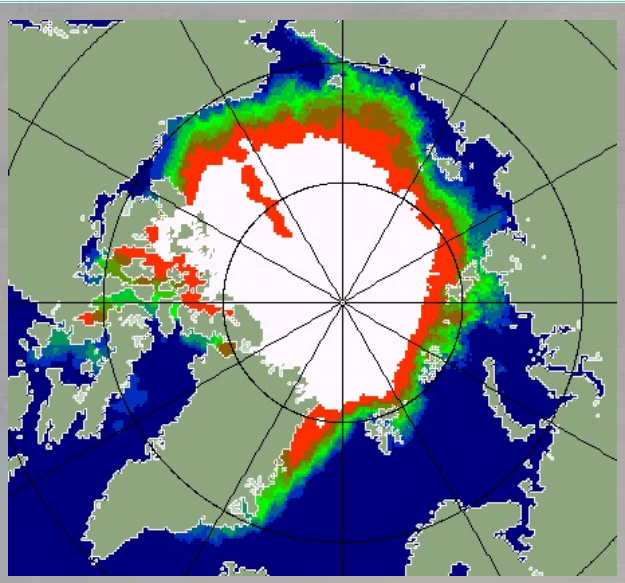
Linear trend, Aug 1976-85 (AARI&CIS data)

August, 1986-1995



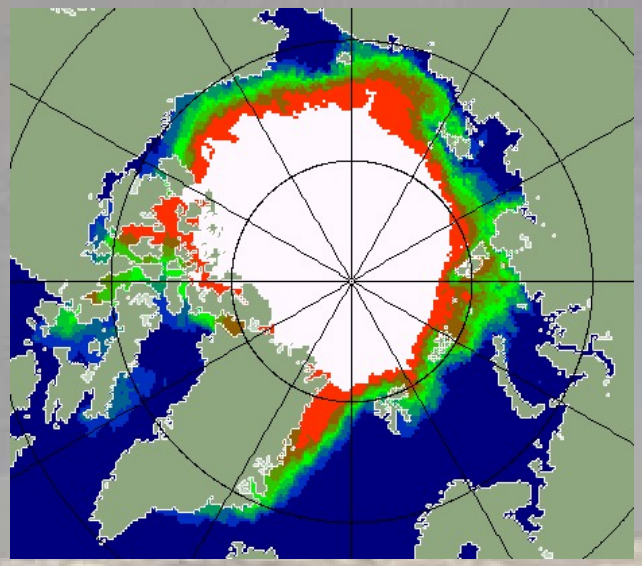
Linear trend, Aug 1986-95 (NIC&CIS data)

August, 1950-1959

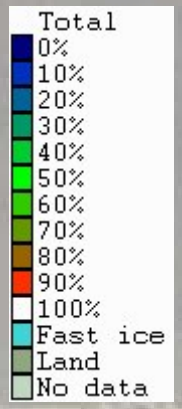


Robust mean, Aug 1950-59 (AARI&J.Walsh data)

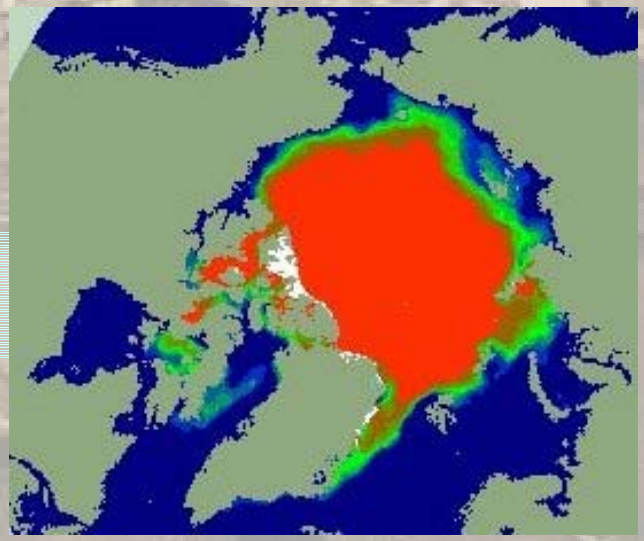
August, 1960-1969



Robust mean, Aug 1960-69 (AARI&J.Walsh data)



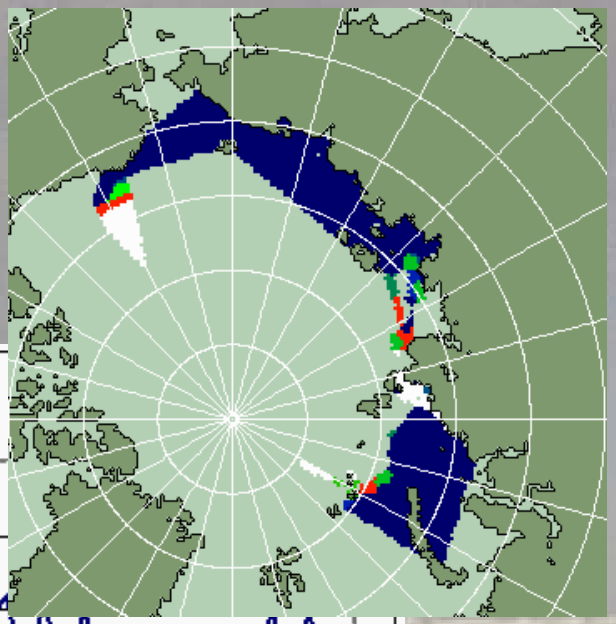
August, 1986-1995

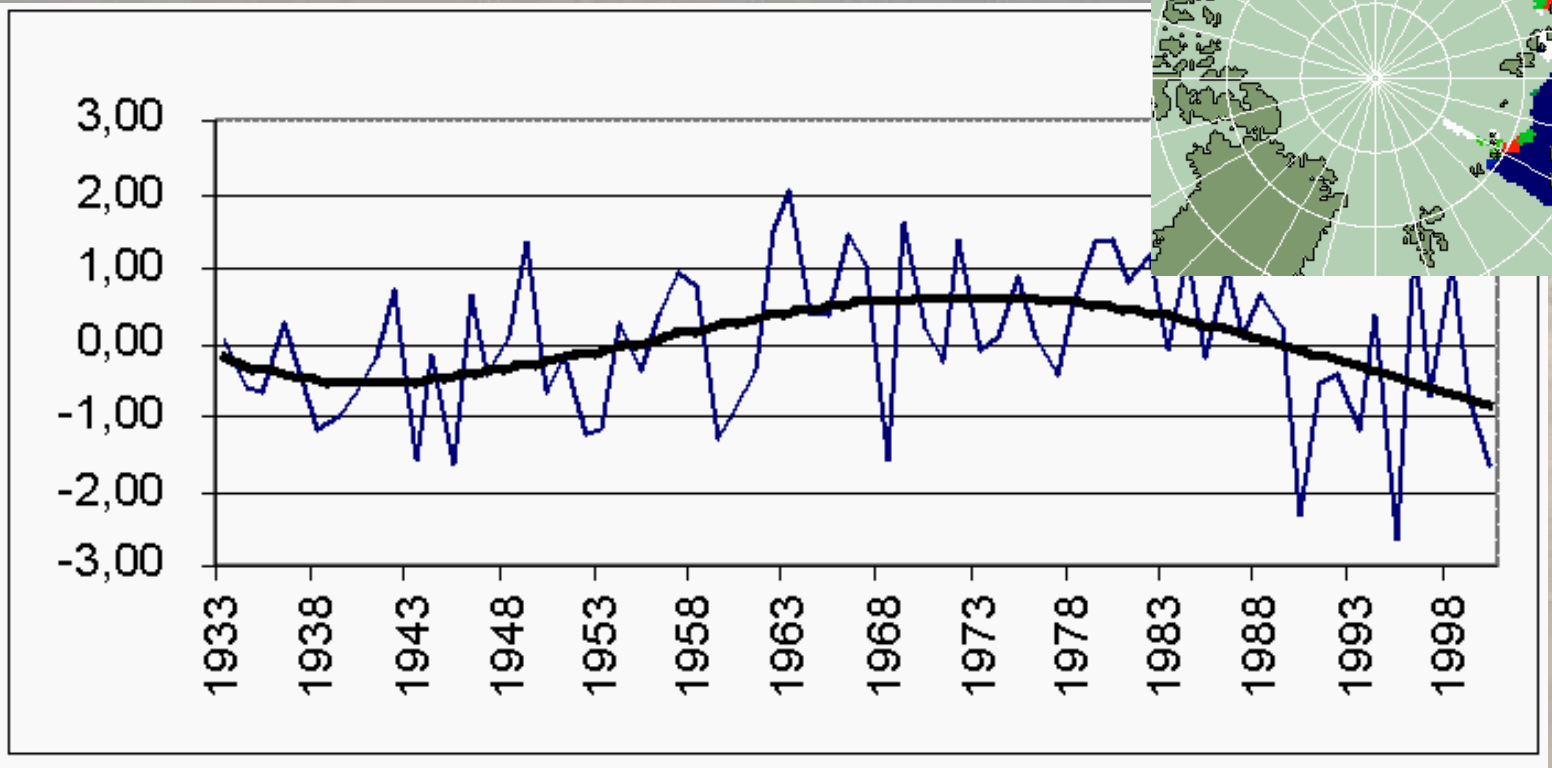


Robust mean, Aug 1986-95 (NIC&CIS data)

Further in past ….

Ice chart for 14.09.1937 (supporting NP-1 station)





Annual variations of ice extent in the last 10-days period of August within the area of Eurasian shelf seas (Kara, Laptevs, East-Siberian and Chukcha) based on AARI data. Black line – 4th order smoothing polynomial. Vertical scale – r.m.s of ice extent. Courtesy: A.G.Egorov, AARI

You are welcome to GDSIDB web-page for complete set of statistics, in graphic and digital form:

http://www.aari.nw.ru/gdsidb/