Assessment of Climate Change for the Baltic Sea Basin - The BACC Project - 22-23 May 2006, Göteborg, Sweden

Detection of Past and Current Climate Change

3) Hydrology: Runoff, Ice and Snow

River runoff in winter has increased

- Positive trends in annual values of river runoff for 1920-2002 were detected for several rivers in Denmark, Southern Sweden and Lapland.
- In Russia, in some basins located south and southwest of the Gulf of Finland, annual runoff for 1978-2002 increased by about one third, compared to long-term values.
- Significant positive trends were rather common in the entire north of the Baltic Sea basin in winter river runoff (Dec-Feb) during the period 1941-2002.
- Winter runoff from Finland into the Baltic Sea has increased at 785 m^3 per second during the period 1912-2003.
- In the Russian part of the Baltic Sea basin, winter runoff has increased remarkably: 40-140% in the basins south and southwest of the Gulf of Finland, and 6-44% in the Karelian Isthmus.
- The increase of wintertime runoff has also been observed in Estonia, Latvia and in Belarus (Fig. 2).
- A warming trend has been observed in the Finnish, Estonian and also in the Byelorussian lakes (Fig. 3).

Runoff

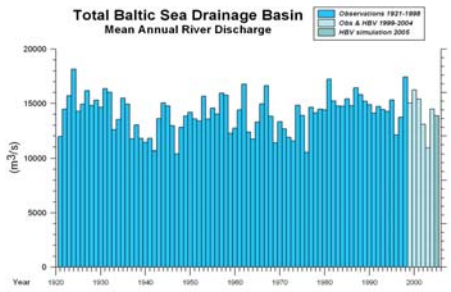

Fig. 1 Annual river runoff to the Baltic Sea for the period 1921-2005. (Prepared by Phil Graham).

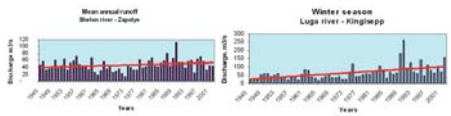

Fig. 2 An example of data series for mean annual runoff and mean winter runoff (Dec-March) in the Russian territory of the Baltic Drainage. The observation site of Zapolye is located at 58° 03` N and 30° 06` E; Kingisepp at 59° 23` N and 28° 36` E.

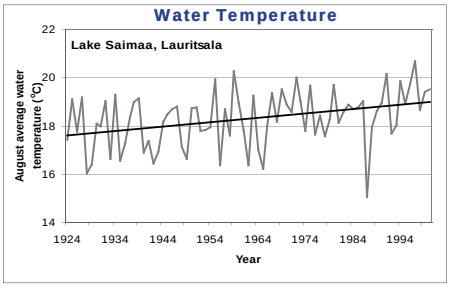

Fig. 3 The average water temperature in August in Lake Saimaa during 1924-2000.

Ice cover duration, extent and thickness in lakes and rivers have decreased

- Ice melt timing in rivers in Russia occurs 15-20 days earlier than in the 1950s.
- Ice cover duration shows a strong negative trend in lakes in the northern part of the Polish Lowland (1961-2000), in lakes in Russia (Fig. 4), and for some lakes in central and southern Finland since the middle of the 19th century (Fig. 5).
- Maximum ice cover thickness decreased in Polish and Russian lakes (Fig. 6).
- Maximum ice cover thickness decreased by 15-20% in Russian rivers by the end of the 20th century (Fig. 7).
- Maximum ice cover thickness mostly increased in eastern and northern Finland and decreased in southern Finland.

Ice Cover

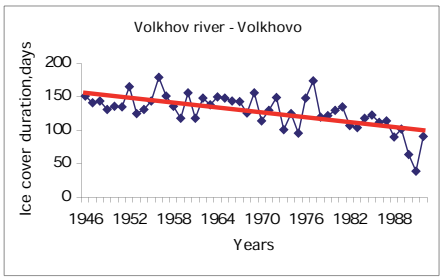

Fig. 4 Long-term changes in the ice cover duration in river Volkhov (prepared by V.Vuglinsky).

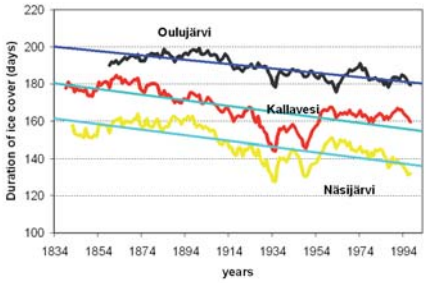

Fig. 5 Duration of the ice cover in Lake Näsijärvi, Lake Kallavesi and Lake Oulujärvi (11-year moving average), Finland (Korhonen, 2004).

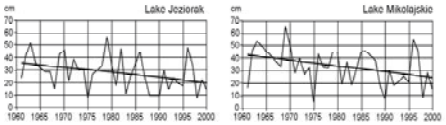

Fig. 6 Maximal ice cover thickness at two lakes in the Polish Lowland.

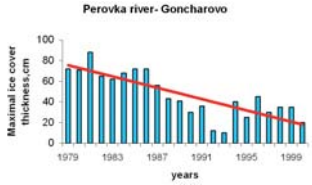

Fig. 7 Long-term changes in maximal ice cover thickness at river Perovka, European Russia.

Snow cover duration and thickness have decreased

- Snow cover duration and water equivalent in the southern parts of all Fennoscandian countries decreased, but the opposite trend was observed in the north.
- Snow cover increased in the Scandinavian mountains. Wintertime snowmelt in western and southern parts of Finland intensified towards the end of the 20th century, while maximum snow storage increased in eastern and northern Finland (Table 1).
- More snow was measured in the north of Sweden and in the Norwegian mountains, while snow depth decreased in the southern parts of Sweden.
- Snow cover duration in Latvia decreased on average by 12 days during 1945-1996, but at a statistically significant level only at three stations.
- Permanent snow cover in Lithuania in the last decades of the 20th century tends to occur earlier and to disappear earlier than in the middle of the century.
- Duration of snow cover in Estonia decreased during the recent 4 decades by more than 1 day per year in some regions, the observed decrease was pronounced in the western and central parts.
- In Poland, snow cover duration (by -4 days/10 years) and depth (by -13 cm/10 years) shows a slight negative tendency during 50 investigated winter seasons.
- An increasing tendency in the variability of snow cover depth and duration was observed in the lowland area of Poland since the 1950s or 1960s (Fig. 8).
- Three areas with different tendencies in snow cover duration were identified in the central and northern parts of the Baltic Sea basin (Fig. 9).

Snow Cover

Table 1. Mean maximum water equivalents of snow (Lmax) in six drainage basins in Finland

Drainage basin	L_{max} (mm) 1961-1990	L_{max}(mm) 1991-2005	Difference (%)
Vantaanjoki	109	77	-29
Kyrönjoki	92	70	-24
Vuoksi	146	154	+5
Oulujoki	162	186	+15
Kemijoki	175	195	+11
Paatsjoki	149	178	+19

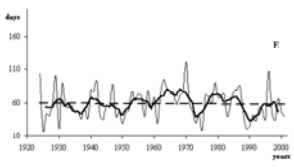

Fig. 8 Areal mean duration of snow cover in Poland during 1925–2001 (5- year moving mean series and linear trend line) (Falarz ,2004).

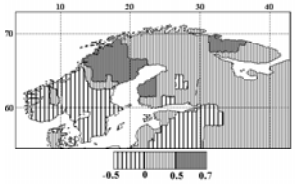

Fig. 9 Spatial variability of trends of the duration of snow cover (days per year) 1936-2000 (Kitaev et al, 2005)

Organised by: Göteborg University, GKSS, BALTEX

Support by: SMHI, Kungl. Vetenskapsakademien, FIMR