Total and regional runoff to the Baltic Sea

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Key message

During the last 7 years the total inflow has decreased from a top flow rate of more than 16000 in 1998 to less than 11000 m^3/s in 2003. This is an extremely low runoff exceeded only in 1942, 1947 and 1976. The runoff during 2003 to the Bothnian Sea was the lowest since 1921. The total runoff to the Baltic Sea in 2004 was close to the long term mean value.

The annual fresh water inflows to the Baltic Sea are 14200 m^3/s. During the period 1950 - 2004 total runoff to the Baltic Sea area show no long-term trends. On the other hand this time period is characterised by dry and wet periods lasting for a couple of years to a decade by and large following the NAO index. From a regional point of view the runoff enters the Gulf of Bothnia (6000 m^3/s), the Gulf of Finland and the Baltic Proper (3500 m^3/s) and to a lesser extent in Gulf of Riga and in Kattegat (1000 m^3/s) on average.

Results and Assessment

Runoff is a quantitative background indicator on the freshwater discharge, carrying the nutrients from the drainage areas to the coast.

Runoff is an important parameter on the change of pressure on nutrient supply due to varying climate and climate change. Also change in land-use can influence runoff. To evaluate the change of pressure on nutrient supply to the Baltic region it is necessary to know the variability of runoff and normalise for this natural variability.

The indicator shows the annual runoff from drainage areas but integrated over the Baltic sub-regions. Runoff is governed by the precipitation - evaporation on land areas and is also influenced by air temperature. It is the sum of direct river and diffusive runoff. In all sub-regions a strong seasonal, annual and decadal variability can be distinguished. Especially wet and dry periods are characterising the runoff. The 1970s were a fairly dry period compared with the 1980s and the later part of the 1990s. Geographically, the runoff is of about the same size in the Gulf of Bothnia, Gulf of Finland and the Baltic Proper, whereas the Gulf of Riga and the Kattegat contributes to a lesser extent to the total runoff.

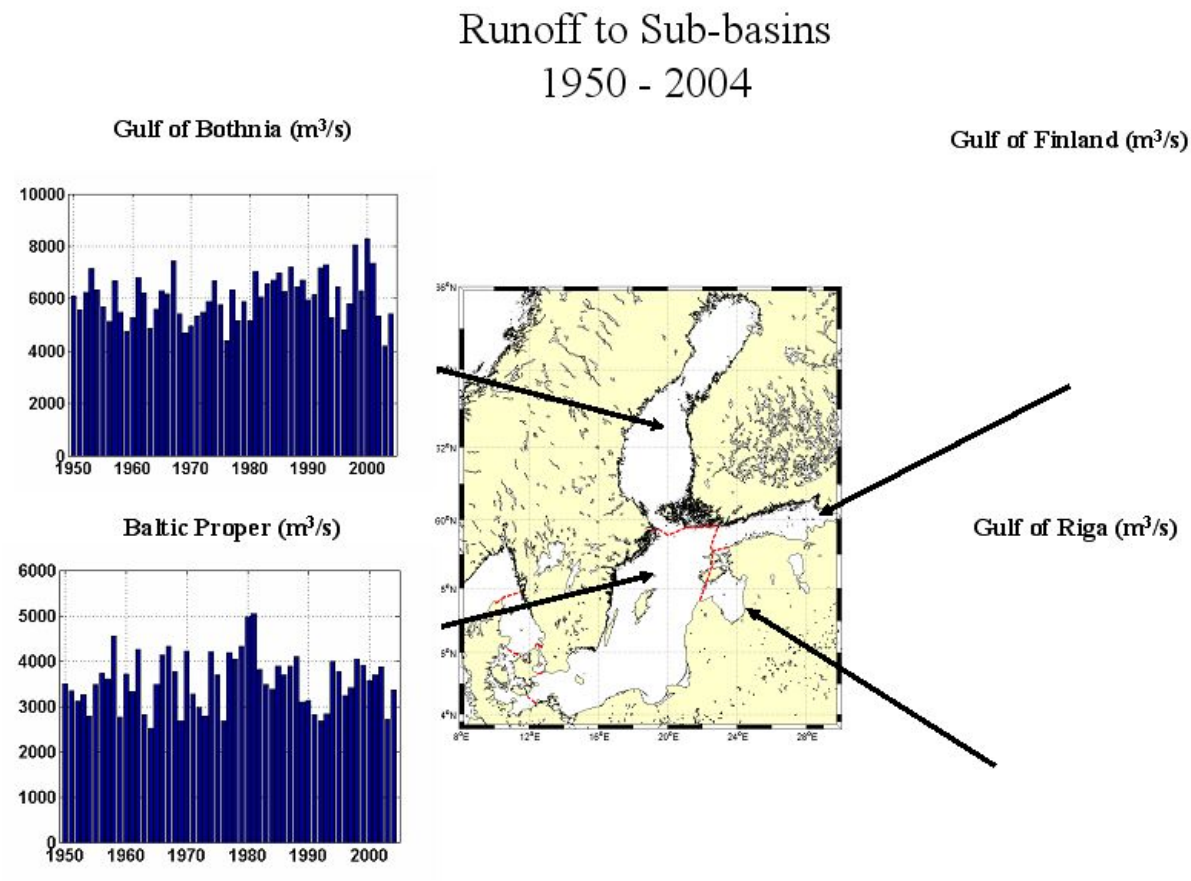

Figure 1: Runoff from years 1950 - 2004 to the Baltic sub basins based on annual mean values. **Click image to enlarge.**

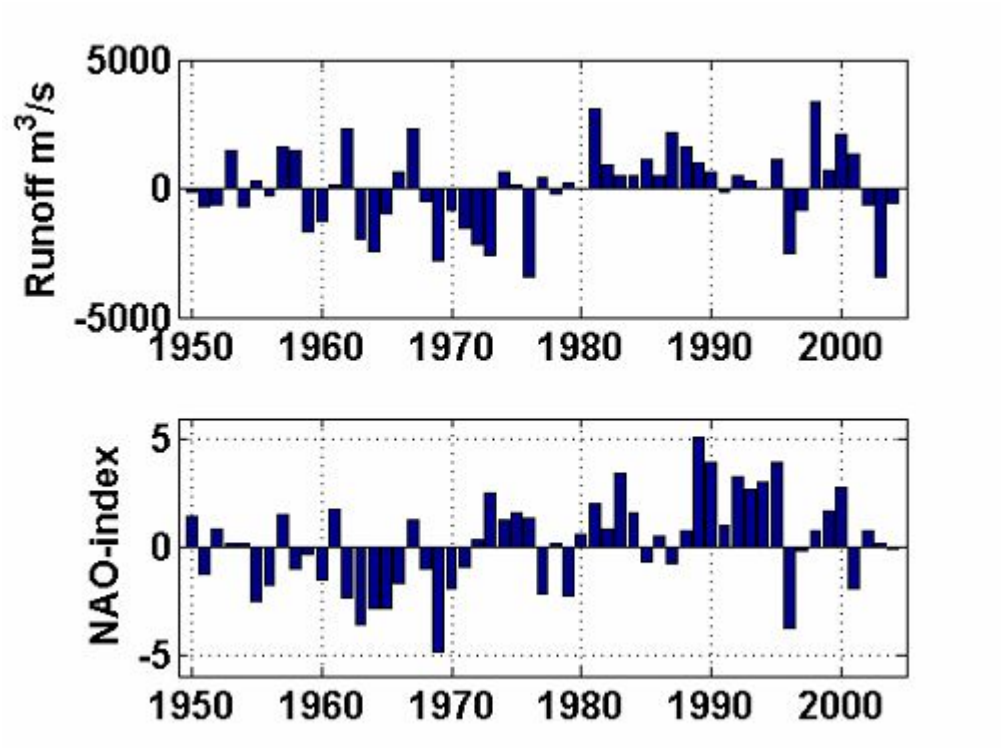

Figure 2: Total runoff deviation and NAO-index during years 1950 - 2004 to the Baltic Sea based on winter mean values of the NAO index. Positive index indicates stronger westerly winds bringing warmer and wetter winters to Scandinavia.

Assessment

There is no obvious trend in the annual runoff during the last 50 years, neither in the total nor from sub-regions. The dry period found during the 1970s could have masked the marine eutrophication since the runoff was lower than average and hence also the total load of nutrients. During the wet periods the total nutrient load (pressure) increased making marine eutrophication (effects) even worse.

During the last 5 years runoff has fallen from a high to a very low annual value, which should lead to a slight increase in surface layer salinity and a lower nitrogen concentration in the Baltic Sea sub basins. The most dramatic decrease took place in the runoff to the Gulf of Bothnia and to the Gulf of Finland. A decrease in runoff only took place during 2003 in the Gulf of Riga and the Baltic Proper. 2004 was a year with runoff close to normal values i.e 14200 m^3/s.

References

Bergström, S. And B. Carlsson 1994. River runoff to the Baltic Sea 1950 - 1990. AMBIO Vol. 23, No. 4-5, 280 - 287.

Graham, Phil 1999. Modelling runoff to the Baltic Sea. AMBIO Vol. 28, No. 4, 328-334.

http://www.cgd.ucar.edu/cas/jhurrell/indices.data.html#naostatdjfm

For reference purposes, please cite this Baltic Sea environment fact sheet as follows:

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Data

Observations are collected at the BALTEX Hydrological Data Centre (http://www.smhi.se/sgn0102/bhdc/bhdc.htm), whereas modelled data is done at SMHI using the HBV-model (Graham-99). Gulf of Riga runoff is based observations up through 2001,while simulations are used for 2002. Gulf of Finland runoff is based on observations up through 1997, while simulations are used for 1998-2002. Baltic Proper runoff is based on observations up through 1996, while simulations are used for 1997-2003. For 2004 all data is based on model simulations carried out by Dr. Phil Graham, SMHI.

Year	Runoff (m3/s)
1950	14086,30
1951	13495,10

1952	13564,30
1953	15656,50
1954	13467,30
1955	14481,40
1956	13900,70
1957	15794,90
1958	15670,10
1959	12488,20
1960	12949,60
1961	14329,40
1962	16483,70
1963	12248,80
1964	11740,60
1965	13250,10
1966	14842,60
1967	16519,50
1968	13715,10
1969	11412,50
1970	13357,40
1971	12627,60

1972	12029,90
1973	11585,00
1974	14816,40
1975	14358,10
1976	10795,70
1977	14621,20
1978	13993,00
1979	14435,40
1980	14219,80
1981	17281,80
1982	15136,20
1983	14686,10
1984	14716,70
1985	15324,70
1986	14676,40
1987	16389,30
1988	15777,50
1989	15167,30
1990	14864,00
1991	14054,30

1992	14717,70
1993	14456,00
1994	14165,40
1995	15291,50
1996	11650,40
1997	13340,10
1998	17544,50
1999	14909,30
2000	16324,90
2001	15548,90
2002	13560,00
2003	10752,00
2004	13665,00

Year	NAO Index
1864	-1,02
1865	-1,24
1866	0,54
1867	-1,38
1868	2,81
1869	1,70

1870	-3,01
1871	-1,01
1872	-0,76
1873	-0,50
1874	2,32
1875	-1,35
1876	0,21
1877	0,05
1878	1,46
1879	-2,22
1880	0,89
1881	-3,80
1882	3,87
1883	-0,23
1884	1,44
1885	-0,89
1886	-1,12
1887	0,45
1888	-2,75
1889	-0,01

1890	1,78
1891	-0,82
1892	-2,02
1893	-1,07
1894	2,68
1895	-3,97
1896	1,12
1897	1,09
1898	1,02
1899	0,03
1900	-2,13
1901	-0,33
1902	-1,41
1903	3,89
1904	0,23
1905	1,98
1906	2,06
1907	2,06
1908	1,44
1909	0,00

1910	2,10
1911	0,29
1912	0,24
1913	2,69
1914	1,48
1915	-0,20
1916	-0,69
1917	-3,80
1918	-0,80
1919	-0,80
1920	3,18
1921	1,63
1922	1,85
1923	1,73
1924	-1,13
1925	2,39
1926	0,11
1927	1,72
1928	0,63
1929	-1,03

1930	0,91
1931	-0,16
1932	-0,50
1933	0,25
1934	0,86
1935	0,97
1936	-3,89
1937	0,72
1938	1,79
1939	0,37
1940	-2,86
1941	-2,31
1942	-0,55
1943	1,48
1944	0,61
1945	1,64
1946	0,27
1947	-2,71
1948	1,34
1949	1,87

1950	1,40
1951	-1,26
1952	0,83
1953	0,18
1954	0,13
1955	-2,52
1956	-1,73
1957	1,52
1958	-1,02
1959	-0,37
1960	-1,54
1961	1,80
1962	-2,38
1963	-3,60
1964	-2,86
1965	-2,88
1966	-1,69
1967	1,28
1968	-1,04
1969	-4,89

1970	-1,89
1971	-0,96
1972	0,34
1973	2,52
1974	1,23
1975	1,63
1976	1,37
1977	-2,14
1978	0,17
1979	-2,25
1980	0,56
1981	2,05
1982	0,80
1983	3,42
1984	1,60
1985	-0,63
1986	0,50
1987	-0,75
1988	0,72
1989	5,08

1990	3,96
1991	1,03
1992	3,28
1993	2,67
1994	3,03
1995	3,96
1996	-3,78
1997	-0,20
1998	0,72
1999	1,70
2000	2,80
2001	-1,89
2002	0,76
2003	0,20
2004	-0,07