

## **Calculated Baltic Sea temperature, ice, salinity and oxygen concentrations for the 1500-1995 period with forcing files.**

### **1. Basic References**

Gustafsson, E.O., and A., Omstedt (2009). Sensitivity of Baltic Sea deep water salinity and oxygen concentrations to variations in physical forcing. *Boreal Environmental Research* 14: 18-30.

Hansson and Gustafsson (2009). Salinity and hypoxia in the Baltic Sea since AD 1500, submitted.

Hansson, D., Eriksson, C., Omstedt, A., and D., Chen (2009). Reconstruction of river runoff to the Baltic Sea, submitted.

Hansson, D., and A., Omstedt (2008). Modelling the Baltic Sea ocean climate on centennial time scales; Temperature and Sea Ice. *Climate Dynamics* 30(7-8), 763 - 778. DOI: 10.1007/s00382-007-0321-2.

Omstedt, A. and L., Axell (2003). Modeling the variations of salinity and temperature in the large Gulfs of the Baltic Sea. *Continental Shelf Research*, 23, 265-294

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### **2. Material and Methods**

The PROBE-Baltic model have been used to examine oxygen dynamics including hypoxia dynamics during paste 500 year. The study is described in Hansson and Gustafsson (2009). The description of reconstructed forcing fields are given in Hansson and Omstedt (2007) and Hansson et al., (2009). Validation studies of the oxygen modelling is also given in Gustafsson and Omstedt (2009). Other model results/reconstructions from the 1958-2008, 1893-1999 and 1500-2001 periods *are freely available on request*, see (<http://www.oceanclimate.se/products.htm>).

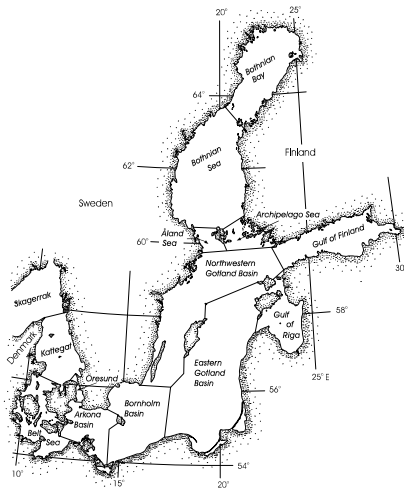


Figure 1. Division of the Baltic Sea into natural sub-basins and used in the PROBE-Baltic model (Omstedt and Axell, 2003).

### 3. Results and available files

#### 3.1 Calculated daily temperature, ice, salinity, oxygen and water age

Time series (from different sub-basins in the Baltic Sea) of surface and bottom temperatures ( $T_s$ ,  $T_b$  in  $^{\circ}\text{C}$ ), ice thickness ( $h_i$  in m), ice concentration ( $A_i$  in %), surface and bottom salinity ( $S_s$ ,  $S_b$  in psu), surface and bottom oxygen concentration ( $O_s$ ,  $O_b$  in ml/l) and water age at bottom (Age in year) have been calculated and are available as a number of files, see Table 1. The time resolution is one day. The surface properties refer to values at 1 m below the surface. The deep properties refer to values 1 m above model depth. These files are put into a compressed file under the name **PB ocean time series I Oxygen 1500-1995.zip** and have the size of 40 Mbite.

Table 1. Calculated data available in file **PB ocean time series I Oxygen 1500-1995.zip**

Sub-basin	Acronym	Model depth	Variables	File name
Kattegat	ka	100	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	ka_graph.dat
Öresund	or	30	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	or_graph.dat
Belt Sea	be	40	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	be_graph.dat
Arkona Basin	ar	50	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	ar_graph.dat
Bornholm Basin	bh	90	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	bh_graph.dat
E Gotland Basin	go	250	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	go_graph.dat
NW Gotland B.	nw	250	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	nw_graph.dat
Gulf of Riga	gr	50	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	gr_graph.dat
Gulf of Finland	gf	120	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	gf_graph.dat
Archipelago Sea	as	90	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	as_graph.dat
Åland Sea	al	220	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	al_graph.dat
Bothnian Sea	bs	155	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	bs_graph.dat
Bothnian Bay	bb	130	$T_s$ , $T_b$ , $h_i$ , $A_i$ , $S_s$ , $S_b$ , $O_s$ , $O_b$ , Age	bb_graph.dat

### 3.2 Reconstructed forcing time series of weather, river runoff and sea levels

The forcing files for the PROBE-Baltic model includes reconstructed weather data with a time resolution of 3 hours, sea level data representing the Kattegat sea levels on daily time scale and river runoff to the different sub-basins with a time resolution of one month. Also the reconstructed monthly net precipitation (precipitation-evaporation) over the different sub-basins is given as a separate file. These files are put into a compressed file under the name **PB forcing time series II Oxygen 1500-1995.zip** and have the size of 195 Mbite.

Table 2. Reconstructed weather data available in file **PB ocean time series I Oxygen 1500-1995.zip**.

Sub-basin	Acronym	Variables	File name
Kattegat	ka	Date, TA, UG, VG, CL, RH	ka1500_1995.dat
Öresund	or	Date, TA, UG, VG, CL, RH	or1500_1995.dat
Belt Sea	be	Date, TA, UG, VG, CL, RH	be1500_1995.dat
Arkona Basin	ar	Date, TA, UG, VG, CL, RH	ar1500_1995.dat
Bornholm Basin	bh	Date, TA, UG, VG, CL, RH	bh1500_1995.dat
E Gotland Basin	go	Date, TA, UG, VG, CL, RH	go1500_1995.dat
NW Gotland B.	nw	Date, TA, UG, VG, CL, RH	nw1500_1995.dat
Gulf of Riga	gr	Date, TA, UG, VG, CL, RH	gr1500_1995.dat
Gulf of Finland	gf	Date, TA, UG, VG, CL, RH	gf1500_1995.dat
Archipelago Sea	as	Date, TA, UG, VG, CL, RH	as1500_1995.dat
Åland Sea	al	Date, TA, UG, VG, CL, RH	al1500_1995.dat
Bothnian Sea	bs	Date, TA, UG, VG, CL, RH	bs1500_1995.dat
Bothnian Bay	bb	Date, TA, UG, VG, CL, RH	bb1500_1995.dat

Where TA is the air temperature ( $^{\circ}\text{C}$ ), UG and VG the geostrophic wind components in east and north direction (m/s), CL total cloudiness (%) and RH relative humidity (%). In the PROBE-Baltic calculations the geostrophic winds are reduce to 10 meters and the air temperature is corrected for land influence according to formulas given by Omstedt and Axell(2003).

Table 3. Reconstructed river runoff data available in file **PB ocean time series I Oxygen 1500-1995.zip**.

Variables	File name
Record number, year, month, $Q_f$ (1 – 11)	qf1500_1995.dat

Where  $Q_f$  is given in ( $\text{m}^3\text{s}^{-1}$ ). The sequence of freshwater forcing follows the structure given in Table 4.

Table 4. The freshwater flux to the basins Öresund (or), Åland Sea (al) and the Archipelago Sea (as) is put equal to zero.

$Q_f$	Basin
1	Northern and Western Central Basin
2	Gulf of Riga
3	Eastern Central Basin
4	Bornholm Basin
5	Arkona Basin
6	Belt Sea
7	Kattegat
8	Bothnian Bay
9	Bothnian Sea
10	Gulf of Finland
11	Total freshwater flux

Table 5. Reconstructed net precipitation data available in file **PB ocean time series I Oxygen 1500-1995.zip**.

Variables	File name
month, P-E(1 – 13), year	pme1500_1995.dat

Where (P-E) is given in ( $\text{m}^3\text{s}^{-1}$ ). The sequence of freshwater forcing follows the structure given in Table 2.

Table 6. Reconstructed Kattegat sea level data available in file **PB ocean time series I Oxygen 1500-1995.zip**.

Variables	File name
Date, zka	zw1500_1995.dat

Where zka is given in (m).