We can provide modelled data at request!

Below is information on some of the available model runs and parameters from which FoUo can provide data. For more information, please contact xxxxx

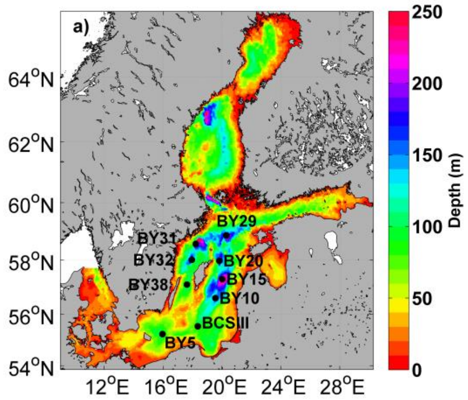
List of output variables from RCO-SCOBI

Basics of the model system

Circulation model:	Rossby Center Ocean model, RCO
Biogeochemical model:	Swedish Coastal and Ocean Biogeochemical, SCOBI
Modell domain:	Baltic Sea
Vertical resolution:	83 depth layers á 3 m
Time step:	150 s
Horizontal resolution:	2 nm
Model origo:	longitude= 9.016700 latitude= 53.84163

Δx= 6.666667x10^{-02} °E, ΔY= 3.333333 x10^{-02} °N.

Examples of studies performed with the RCO-SCOBI model system can be found in the list of references in the end of this document.



Map of the RCO model domain and bathymetry. Monitoring stations are shown by black dots. Eilola et al., 2014.

About available data

Model data from the runs are saved once every second day, in each grid point.

Data can be extracted from specific grid points at all levels during the whole or selected time periods as depth profiles.

Data can also be extracted at specific depth levels, e.g. surface, bottom or others, from the whole model domain at selected times (snapshots) or as averages during selected time periods, e.g. monthly, yearly, seasonal or 30 year mean.

Some of the outputs, for example budget parameters and N or P contents are integrated for different sub-basins of the Baltic Sea (see figure below). These variables are not available for all runs.

Climate-change & nutrient load scenarios

RCO-SCOBI has been used to produce transient climate-change scenarios for the period 1961-2099 for the Baltic Sea, based on the IPCC scenarios A1B and A2 (Nakićenović, 2000).

The scenarios have been regionally downscaled with the Rossby Centre Atmosphere Ocean model (RCAO, Döscher et al., 2002), with a horizontal resolution of 25 km.

RCAO was forced with data at the lateral boundaries of the model domain from the GCMs ECHAM5/MPI_OM (Jungclaus et al., 2006, Roeckner et al., 2006) and HadCM3 (Gordon et al., 2000).

Two realizations using different sets of initial conditions were used for the ECHAM5 scenarios; these are denoted with -r1 and -r3.

Four nutrient load scenarios for the future have been applied: a reference scenario (REF) where nutrient concentrations in rivers and atmospheric deposition continue to be at current levels (see Eilola et al., 2009), a BSAP scenario with riverine nutrient concentration reduction and 50% cut of atmospheric deposition, following targets of the HELCOM Baltic Sea Action Plan, (HELCOM 2007, HELCOM, 2013, Gustafsson et al., 2011), and a business as usual scenario (BAU) with increased river nutrient concentrations (HELCOM, 2007) and current levels of atmospheric deposition. In the scenarios, the river nutrient concentrations and atmospheric depositions were linearly changed over the period 2007-2020, thereafter constant values were assumed. River runoff was calculated as monthly means from the regional climate projections, using a statistical model based on the difference between precipitation and evaporation over land (Meier et al., 2012a).

In total 12 scenario simulations have been produce, so that four different climate scenarios (an ensemble) were used to in combination with each of the three different nutrient load scenarios.

The ensembles enable analysis of mean values and standard deviation of the different simulated parameters, and thereby give the ability to quantify the spread within each ensemble. This can be used to estimate uncertainties in the model simulations, due to systematic biases in the models and uncertainties in future greenhouse-gas emission levels. The approach of the production of the climate and nutrient scenarios and evaluation of model performances are further described in Meier et al., 2011a, Meier et al., 2011b, Meier et al, 2011 c, Meier et al., 2012a and Meier et al. 2012b.

Hence, available scenarios are:

RCAO-ECHAM5-A1B_r1-RCO-SCOBI-(BSAP/REF/BAU)

RCAO-ECHAM5_A1B_r3-RCO-SCOBI-(BSAP/REF/BAU)

RCAO-ECHAM5_A2-RCO-SCOBI-(BSAP/REF/BAU)

RCAO_HadCM3_A1b-RCO-SCOBI-(BSAP/REF/BAU)

Data deliver

Data is normally delivered in ascii-files as one long vector. The number 1.0000000E+10 means that there are no data, e.g. in grid points where there are land, islands or bottom.

- Data for depth profiles at specific locations are given after each other. The first 86 rows are:
    - Nr of depth — First row tells how many depth levels there are
    - Depths levels — Second row->row 84 are the different depth levels in cm.
    - Nr of stations — Row 85 show the number of stations data are extracted from.
    - Dataframes — Row 86 show the number of data frames, snapshots that are extracted

  From row 87 and forward the data at each station are given after each other, when all stations are written, then the first station is given again for the next date etc.

- 2D data, thus data at selected depth levels, starts with information about the file. The first 10 rows are:
    - Nrframes — one frame is given for each snapshot
    - Xsize — Nr of grid points west to east direction
    - Ysize — Nr of grid points in south to north direction
    - Minvalue — Lowest value of the output
    - Maxvalue — Highest value of the output
    - Average — Mean value of the output
    - Xmin — Lowest longitude (°E) of the lower left corner of the grid point
      Xmax — Highest longitude (°E) of the lower left corner of the grid point
    - Ymin — Lowest latitude (°N) of the lower left corner of the grid point
    - Ymax — Highet latitude (°N) of the lower left corner of the grid point

  After the first 10 rows is the data given as a long vector where the first Ysize numbers of rows are the first column if you reshape the data to a matrix. The next Ysize numbers of rows are the second column etc. The final matrix would then be of the size: Ysize of rows:Xsize of columns. If more than one date are extracted the data from the next snapshot are followed and give a 3rd dimension to the matrix, thus Ysize of rows:Xsize of columns:Z Nr of frames.

Examples of different outputs are shown below.

Output variables

Var.nr.	Variables	Unit	Comment
1	free surface height	cm	
2	barotropic u-velocity	cm/s	Current, moment or sum?
3	barotropic v-velocity	cm/s	Current, moment or sum?
4	potential temperature	C	
5	salinity	psu	
6	turbulent kinetic energy	cm2/s2	
7	dissipation	cm2/s3	
8	u-velocity	cm/s	Current in W-E-direction
9	v-velocity	cm/s	Current in S-N-direction
10	zooplankton	mgC/m3	
11	phytoplankton 1	mgCHL/m3	Diatoms
12	phytoplankton 2	mgCHL/m3	Flagellates and other
13	phytoplankton 3	mgCHL/m3	Cyanobacteria
14	Detritus/nitrogen detritus	mgC/m3	Detritus is separated into N and P in newer SCOBI versions
15	ammonium	mmolN/m3	
16	nitrate	mmolN/m3	
17	phosphate	mmolP/m3	
18	oxygen	ml/l	
19	benthic nitrogen	mmolN/m2	
20	benthic phosphorus	mmolP/m2	
21	pelagic resusp tracer	mg C/m3	
22	benthic resusp tracer	mmolN/m2	
23	pelagic IronPO4	mmolP/m3	Available in newer SCOBI version.
24	benthic IronPO4	mmolP/m2	Available in newer SCOBI version.
25	phosphorus detritus	mgC/m3	Available in newer SCOBI version.
104	u10	m/s	Wind, momentan or sum? 10 m height
105	v10	m/s	Wind, momentan or sum? 10 m height
108	cloudiness		
166	scobi secchi	m	
168	Primary production	kton C	Budget, only for runs with timstep 75 sec
169	Nitrogen fixation	kton N	Budget, only for runs with timstep 75 sec
170	Pel DIN uptake to pp	kton N	Budget, only for runs with timstep 75 sec
171	Pel DIP uptake to pp	kton P	Budget, only for runs with timstep 75 sec
172	Pel N remineralization	kton N	Budget, only for runs with timstep 75 sec
173	Pel P remineralization	kton P	Budget, only for runs with timstep 75 sec
174	Net sedimentation of N	kton N	Budget, only for runs with timstep 75 sec
175	Net sedimentation of P	kton P	Budget, only for runs with timstep 75 sec
176	Pelagic denitrification	kton N	Budget, only for runs with timstep 75 sec
177	Benthic denitrification	kton N	Budget, only for runs with timstep 75 sec
178	Benthic N release	kton N	Budget, only for runs with timstep 75 sec
179	Benthic P release	kton P	Budget, only for runs with timstep 75 sec
180	Burial of N	kton N	Budget, only for runs with timstep 75 sec
181	Burial of P	kton P	Budget, only for runs with timstep 75 sec
182-192	External supply of N and P	kton	From river, point sources and atmosphere
313-316	Transport org P	ngP	Not available for all runs.

317-320	Transport DIN	nmolN	Not available for all runs.
321-324	Transport DIP	nmolP	Not available for all runs.
325-328	Transport Pelagic resusp	ngC	Not available for all runs.
332-335	Transport IronP	nmolP	Not available for all runs.
336-339	Transport PDT	nmolP	Not available for all runs.
	Hypoxic area	km2	Calculated using model rawdata
	Cod reproduction volume	km3	Calculated using model rawdata
	Pools of nutrients	kton	Calculated using model rawdata

Examples of outputs:

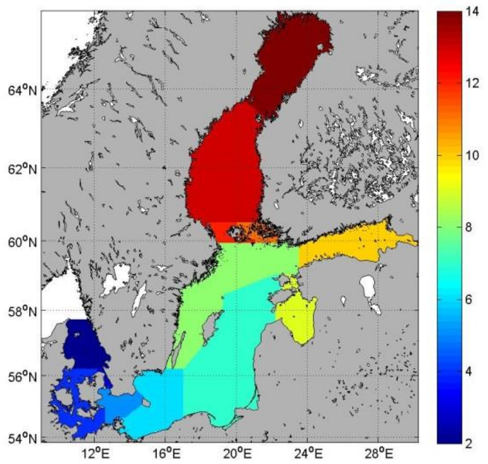
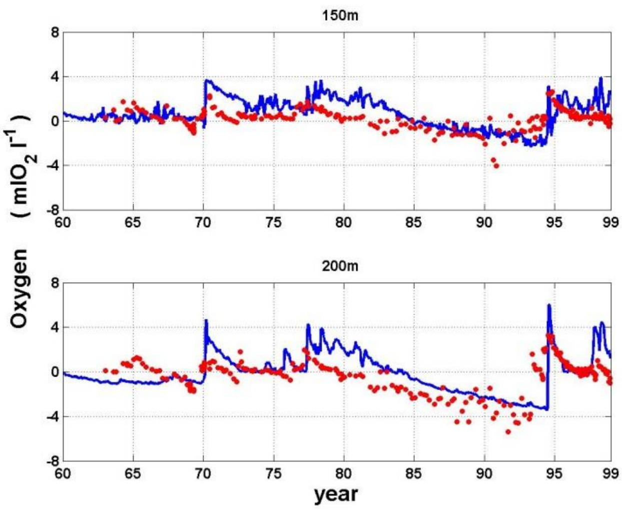


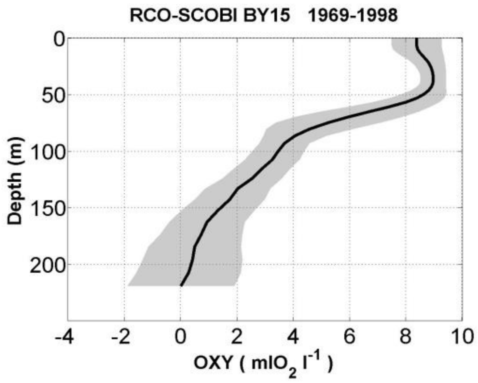
Figure showing the division of the Baltic Sea into sub-basins.

1-Baltic Sea as a whole
2-Kattegat
3-Öresund
4-Belt Sea
5-Arkona basin
6-Bornholm basin
7-East Gotland basin
8-NW Baltic proper
9-Gulf of Riga
10-Gulf of Finland
11-Archipelago sea
12-Åland sea
13-Bothnian sea
14-Bothnian bay
15-Baltic proper (basin 5-10)



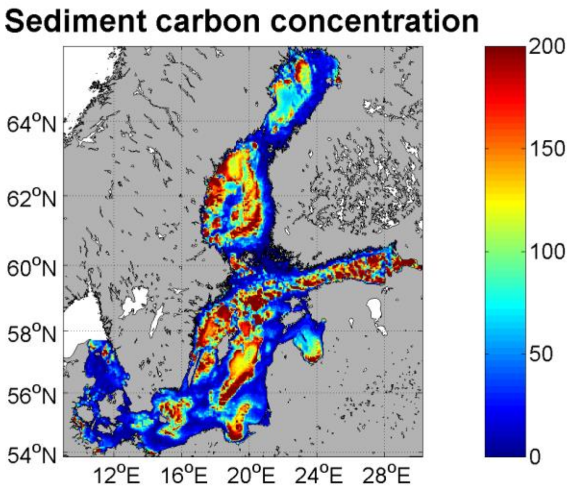
Oxygen (ml O_2 l^{-1}) concentrations below the halocline (80 m), at 150 m and 200 m depth in the eastern Gotland Basin (station BY15). Blue lines show model results 1960–1998 and red circles show available observation data.

Fig 5, Eilola et al., 2009.



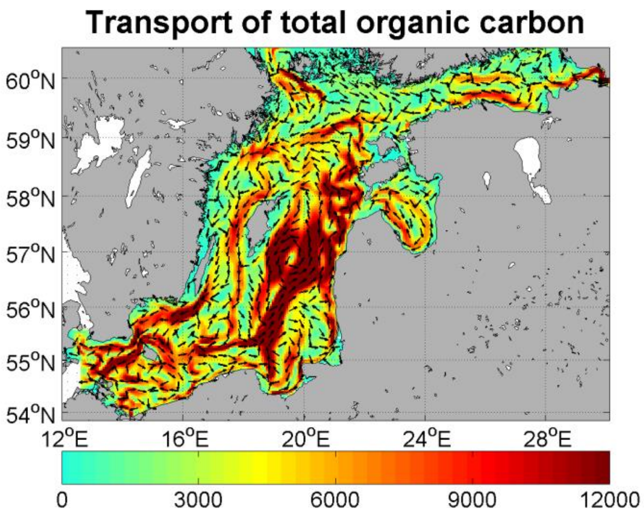
30-year (1969–1998) mean profiles of oxygen (ml O_2 l^{-1}) concentrations from the eastern Gotland Basin (BY15) (black line). The ±1 standard deviation is shown by the shaded area.

Fig 6, Eilola et al., 2009.



The modelled average (1970–2007) benthic organic carbon concentrations (g C m^{-2}) in the Baltic Sea. Calculated from modelled benthic nitrogen using redfield ratio.

Fig 9a, Almroth-Rosell et al, 2011.



Vertically integrated average (1970-2007) horixontal transport of organc carbon (ton C km^{-1} $year^{-1}$). Calculated from transport of N using redfield ratio.

Fig 7a, Almroth-Rosell et al, 2011.

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