30.08.2013

NOOS Activity
Exchange of computed water, salt, and heat transports across selected transects

Project Aims	Transports across certain transects constitute a measure of the current hydrodynamic situation. The knowledge of computed transports is also of great value to assess the dispersion of pollutants or the development of ecological parameters. The exchange of transport data between operational forecaster and users will serve several purposes: 1. Data from different models could be used for a better characterization of the current hydrodynamic situation. 2. Data from different models can be used for a model intercomparison. 3. Data from other models than the own could be used for forcing one's own model at its open boundaries. 4. Predicted model data can be compared with transports derived from measurements (if available).
Lead agency Lead scientist	Bundesamt für Seeschifffahrt und Hydrographie (BSH) Federal Maritime and Hydrographic Agency Stephan Dick, stephan.dick@bsh.de

How to compute the transports?

1 Define transects (given in Figures 1 & 2 and Table 1 & 2) for your grid taking into account the grid type (e.g. Arakawa C). All transects should start or end at the coast. As the discretisation of topography is different in every model, please check if the transects start/end at the coast. In case of connected transects, please be sure that you do not have any overlapping grid points or gaps in the transects.

2 For every grid cell (grid box) on the transect, calculate the normal component of water, salt, and heat transports. The direction of positive transports is given by the arrows in figures 1 & 2.

Note: For most members, the transects will be either parallel or orthogonal to their grid axis. In that case the normal velocity will be in the x- or y-direction. In case of the 'oblique' transects, normal velocities could be computed explicitly for each grid cell (e.g. done by IMR) or alternating u- and v-velocities should be used on the transect.

Calculate normal components of:

water transport [m³/s]:
$tr_n = u_n * dx * h$
with u_n normal component of velocity
dx grid spacing
h layer thickness at position of normal velocity

heat transport [J/s = W]:
$q_n = tr_n * c_p * \rho * T$
with c_p heat capacity of ocean = 4.000*10³ J/kg/K
ρ density of water (1026 kg/m³)
T temperature in °K

Please use constant values for c_p = 4.000*10³ J/kg/K and ρ = 1026 kg/m³.
They are valid for seawater with a salinity of approx. 34 PSU and T = 10°C.

salt transport [kg/s]:
$st_n = tr_n * S * 10^{-3} * \rho$
with S salinity (= g salt per 1 kg sea water)

3 Calculate tidal mean values of normal transports for each grid cell. The integration period is 24.8 hours in order to take into account the diurnal inequality. The integration interval should be centred around midday.

e.g. $\overline{tr_n} = \int_P tr_n \, dt / P$

....

with dt time increment
P 2 tidal periods (~24.8 h)

4 Calculate inflow and outflow by summing up all negative and positive transports of grid cells on the transect. In a first step use your own model layers.

$$tr_{n\,pos} = \sum_T tr_{n\,pos} \qquad tr_{n\,neg} = \sum_T tr_{n\,neg}$$

$$q_{n\,pos} = \sum_T q_{n\,pos} \qquad q_{n\,neg} = \sum_T q_{n\,neg}$$

$$st_{n\,pos} = \sum_T st_{n\,pos} \qquad st_{n\,neg} = \sum_T st_{n\,neg}$$

5 Calculate net transports:

$tr_{n\,net} = tr_{n\,pos} + tr_{n\,neg}$
$q_{n\,net} = q_{n\,pos} + q_{n\,neg}$
$st_{n\,net} = st_{n\,pos} + st_{n\,neg}$

6 Calculate vertically integrated transports by integrating positive, negative and net transports using your own model layer data.

7 Calculate transports for 'NOOS layers'. The NOOS layers are fixed levels in the z-coordinate system with mean (undisturbed) water level as reference level 0. The first layer includes the variable surface fluctuation ζ.

Definition of 'NOOS layers':			
	layer 1	ζ -10m	(or ζ – bottom)
	layer 2	10-20m	(or 10m – bottom)
	layer 3	20-30m	(or 20m – bottom)
	layer 4	30-40m	(or 30m – bottom)
	layer 5	40-50m	(....)
	layer 6	50-75m	(....)
	layer 7	75-100m	(....)
	layer 8	100-150m	(....)
	layer 9	150-200m	(....)
	layer 10	200-800m	(....)

Note: In the bottom layer the lower level is the maximum depth of the transect which is normally less than the lower level of the layer. Different models may have different numbers of NOOS levels.

8 For every day, write a file 'tr_*yyyymmdd_inst*' (e.g. tr_20040213_bsh) containing all transports for all transects.

with *yyyy* year
mm month
dd day
inst institution

Format description:

Write for all transects in:

first line:

```
        write(iweg,'(a10,a12,i3,a17,i3)')date(1:10),
     + '   Transect:',itr,'   No. of layers:',ktra(itr)
```

with `date = yyyy.mm.dd`
itr = no. of transect
ktra(itr) = number of layers for each transect

Output in second line: vertically integrated transports (= total mean transport)

```
     write(itweg,'(9e12.4E2)')(water(i3),i3=1,3),
     +  (heat(i3),i3=1,3),(salt(i3),i3=1,3)
```

with i3=1: net water, heat and salt transport
i3=2: positive water, heat and salt transport
i3=3: negative water, heat and salt transport

Output in next 1 to ktra(itr) lines: transports for each NOOS layer

```
        do k=1,ktra(itr)
        write(itweg,'(9e12.4E2)')(water_k(i3,k),i3=1,3),
     +  (heat_k(i3,k),i3=1,3),(salt_k(i3,k),i3=1,3)
        enddo
```

with i3=1: net water, heat and salt transport for layer k
i3=2: positive water, heat and salt transport for layer k
i3=3: negative water, heat and salt transport for layer k

Example of BSH model output for transects 3 to 5:
(from file 'tr_20040213_bsh'):

```
2004.02.13   Transect:  3   No. of layers:  0
  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
2004.02.13   Transect:  4   No. of layers:  8
  0.2867E+06  0.4486E+06 -0.1619E+06  0.3398E+15  0.5379E+15 -0.1980E+15  0.4498E+07  0.1374E+08 -0.9245E+07
  0.2916E+05  0.5846E+05 -0.2930E+05  0.3450E+14  0.7010E+14 -0.3560E+14  0.4767E+06  0.1872E+07 -0.1395E+07
  0.4890E+05  0.6632E+05 -0.1742E+05  0.5830E+14  0.7952E+14 -0.2123E+14  0.1208E+07  0.2112E+07 -0.9041E+06
  0.4769E+05  0.6177E+05 -0.1407E+05  0.5689E+14  0.7401E+14 -0.1712E+14  0.1200E+07  0.1885E+07 -0.6853E+06
  0.4166E+05  0.5461E+05 -0.1295E+05  0.4968E+14  0.6543E+14 -0.1575E+14  0.1023E+07  0.1657E+07 -0.6349E+06
  0.4166E+05  0.5461E+05 -0.1295E+05  0.4968E+14  0.6543E+14 -0.1575E+14  0.1023E+07  0.1657E+07 -0.6349E+06
  0.4662E+05  0.6940E+05 -0.2277E+05  0.5519E+14  0.8325E+14 -0.2806E+14  0.5477E+06  0.2093E+07 -0.1545E+07
  0.4662E+05  0.6940E+05 -0.2277E+05  0.5519E+14  0.8325E+14 -0.2806E+14  0.5477E+06  0.2093E+07 -0.1545E+07
 -0.1562E+05  0.1409E+05 -0.2971E+05 -0.1961E+14  0.1687E+14 -0.3647E+14 -0.1527E+07  0.3734E+06 -0.1901E+07
2004.02.13   Transect:  5   No. of layers: 10
 -0.3488E+06  0.1117E+06 -0.4605E+06 -0.4223E+15  0.1339E+15 -0.5562E+15 -0.1483E+08  0.3272E+07 -0.1810E+08
 -0.4635E+04  0.4191E+04 -0.8826E+04 -0.5684E+13  0.4988E+13 -0.1067E+14 -0.3058E+06  0.9567E+05 -0.4015E+06
  0.5756E+03  0.6099E+04 -0.5523E+04  0.5684E+12  0.7264E+13 -0.6695E+13 -0.1244E+06  0.1482E+06 -0.2727E+06
  0.2156E+03  0.7438E+04 -0.7223E+04  0.1435E+12  0.8868E+13 -0.8725E+13 -0.1319E+06  0.1882E+06 -0.3200E+06
 -0.6515E+02  0.7838E+04 -0.7903E+04 -0.1842E+12  0.9346E+13 -0.9530E+13 -0.1330E+06  0.1966E+06 -0.3296E+06
 -0.6515E+02  0.7838E+04 -0.7903E+04 -0.1842E+12  0.9346E+13 -0.9530E+13 -0.1330E+06  0.1966E+06 -0.3296E+06
 -0.9927E+04  0.2391E+05 -0.3383E+05 -0.1216E+14  0.2870E+14 -0.4086E+14 -0.6338E+06  0.7263E+06 -0.1360E+07
 -0.9927E+04  0.2391E+05 -0.3383E+05 -0.1216E+14  0.2870E+14 -0.4086E+14 -0.6338E+06  0.7263E+06 -0.1360E+07
 -0.7026E+05  0.3045E+05 -0.1007E+06 -0.8510E+14  0.3665E+14 -0.1217E+15 -0.2962E+07  0.9943E+06 -0.3956E+07
 -0.1200E+06  0.0000E+00 -0.1200E+06 -0.1449E+15  0.0000E+00 -0.1449E+15 -0.4679E+07  0.0000E+00 -0.4679E+07
 -0.1348E+06  0.0000E+00 -0.1348E+06 -0.1626E+15  0.0000E+00 -0.1626E+15 -0.5094E+07  0.0000E+00 -0.5094E+07
```

9 Compress your daily output file (e.g. using gzip) and put the *.gz-file on your ftp server.

Transports computed by the BSH model can be found on the anonymous ftp server: ftp.bsh.de

in directory: outgoing/opmodel/v4/transports

10 Please send an email to stephan.dick@bsh.de

with URL (and password?) of your data

Additional output for water transports

(according to agreement at WG meeting on 08.04.2013 we will start with water transports, heat and salt transports may be treated similar in the future)

1 see No. 1 on page 2

2 see No. 2 on page 2, but only for normal components of water transports.
(Heat and salt transports may be treated later in a similar way.)

3 Calculate hourly mean values of normal transports for each grid cell.

e.g. $$\overline{tr_n} = \int_H tr_n \, dt/H$$

with dt time increment
H 1 hour

Note: Mean values must be computed using data of each time step and must be in accordance with the time stepping procedure used to solve the vertically integrated continuity equation.

8 Calculate total (net) transports by horizontally summing up all mean hourly transports of all grid cells on the transect. In a first step use your own model layers.

$$tr_{n\,net} = \sum_T tr_n$$

9 Calculate vertically integrated transports by summing up all net transports of your model layers.

10 Calculate transports for 'NOOS layers'. The NOOS layers are fixed levels in the z-coordinate system with mean (undisturbed) water level as reference level. The first layer includes the variable surface fluctuation ζ.

For definition of 'NOOS layers' see page 3.

11 For every day, write a file 'tw_*yyyymmdd_inst*' (tw: transport of water) (e.g. tw_20040213_bsh) containing the hourly water transports for all transects.

with *yyyy* year
mm month
dd day
inst institution

12 Compress your daily output file (e.g. using gzip) and put the *.gz-file on your ftp server. You may use the same directory on the ftp server as for the tr_... data sets.
(see also chapter 9 to 10 on page 5)

Format description for new output file ('tw*_yyyymmdd_inst*'):

Write for all transects in:

first line:

```
        write(iweg,'(a10,a12,i3,a17,i3)')date(1:10),
     + '   Transect:',itr,'   No. of layers:',ktra(itr)
```

with date = *yyyy.mm.dd*
itr = no. of transect
ktra(itr) = number of layers for each transect

Next 24 lines:

hourly mean transports
column 1: vertically integrated transport (`tr_hour`)
column 2-11 transports for each NOOS layer (`tr_hour_k(k),k=1,10`)

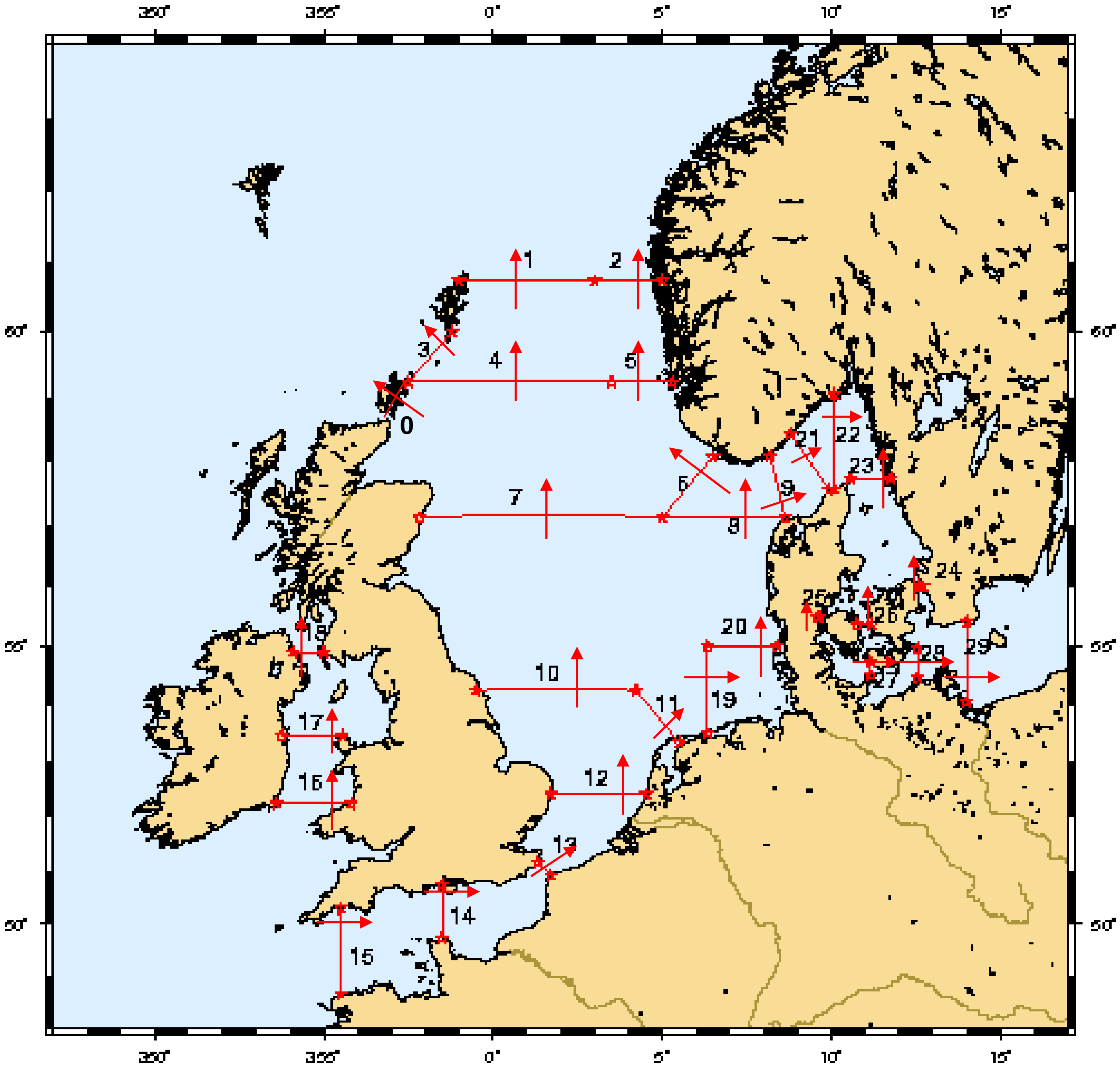
```
        write(itweg,'(11F12.1)')tr_hour,
     +        (tr_hour_k(k),k=1,10)
```

Example of BSH model output (from file 'tw_20130702_bsh') for transects 0 to 1:

```
2013.07.02   Transect:  0   No. of layers:  7
    -10504.8     15147.1       655.7      -621.4     -2149.4     -3979.8    -15741.1     -3815.9          .0          .0          .0
    197608.8     74746.8     33380.6     31719.0     26998.4     11163.5     15289.4      4311.1          .0          .0          .0
    464211.4    134222.4     81099.3     75671.5     66926.5     34280.9     56398.2     15612.6          .0          .0          .0
    630723.8    161646.7    113193.8    104761.8     94528.5     50814.0     82256.7     23522.4          .0          .0          .0
    584669.9    139039.1    105452.6     97813.4     89050.4     47989.9     81298.5     24026.2          .0          .0          .0
    385281.4     82748.4     69279.0     64828.9     58996.1     31731.2     59903.3     17794.5          .0          .0          .0
     94694.8      1617.4     18147.9     18037.1     15585.9      8389.9     25587.9      7328.7          .0          .0          .0
   -145119.2    -62768.8    -23273.1    -21380.9    -19947.0     -9179.4     -6420.5     -2149.5          .0          .0          .0
   -254802.7    -89402.6    -41714.6    -39637.0    -34088.2    -16198.6    -26439.9     -7321.8          .0          .0          .0
   -334384.1   -101691.7    -56218.7    -53048.1    -45375.8    -23675.2    -43470.5    -10904.0          .0          .0          .0
   -401037.3   -109359.2    -69262.2    -65466.5    -56095.3    -31335.0    -56258.0    -13261.0          .0          .0          .0
   -451463.3   -111236.5    -81014.6    -76632.8    -65431.3    -38259.5    -64250.2    -14638.4          .0          .0          .0
   -428173.9    -94201.2    -80074.2    -75334.5    -63909.2    -38930.1    -61644.1    -14080.6          .0          .0          .0
   -303828.9    -50371.2    -61288.1    -56852.3    -47981.1    -31534.6    -45173.2    -10628.4          .0          .0          .0
    -67271.7     14130.3    -21238.4    -18349.3    -13887.9    -13284.4    -12057.8     -2584.3          .0          .0          .0
    215749.0     73958.2     31106.2     30576.4     29994.8     11922.4     29187.7      9003.2          .0          .0          .0
    390000.1    103797.0     66849.2     61581.6     57494.4     29011.5     54799.6     16466.7          .0          .0          .0
    391231.6     92345.4     69449.3     63966.9     59596.4     31770.3     56848.5     17254.8          .0          .0          .0
    299259.3     55630.1     53703.8     51594.8     48343.2     27604.8     47890.6     14492.1          .0          .0          .0
    212866.3     17641.2     39742.3     41105.5     38942.7     25100.9     38868.5     11465.3          .0          .0          .0
    204201.0      5623.1     41805.0     43656.4     40319.0     28127.2     34880.0      9790.4          .0          .0          .0
    242399.7     16829.5     53039.0     51762.2     45632.7     31483.0     34427.9      9225.5          .0          .0          .0
    248650.9     26459.8     55814.9     52061.3     44625.1     30157.5     31447.5      8084.8          .0          .0          .0
    208199.3     26999.9     46959.0     43446.2     36611.3     23870.7     24324.0      5988.3          .0          .0          .0
2013.07.02   Transect:  1   No. of layers:  9
   3186457.4    281070.1    274244.7    279689.6    278045.1    277316.3    627244.9    621207.4    538458.0      9181.4          .0
    723761.0     74011.1     59331.9     66015.1     68103.5     68558.4    137714.8    135498.1    111855.3      2672.8          .0
  -2058851.9   -161880.0   -183009.7   -177565.8   -172343.7   -170944.7   -415161.8   -413666.9   -359037.9     -5241.4          .0
  -4093419.2   -337738.1   -361497.6   -357995.6   -350889.3   -349479.9   -818899.3   -816287.6   -689480.7    -11151.0          .0
  -5173763.3   -432641.8   -458296.7   -456469.8   -448632.1   -447770.3  -1037138.2  -1035279.4   -843884.0    -13651.0          .0
  -5037238.6   -421583.6   -450070.8   -450739.0   -443107.0   -443112.6  -1018063.9  -1018742.9   -779976.4    -11842.4          .0
  -3826086.0   -311789.4   -346601.2   -350293.8   -344200.6   -345126.4   -789699.6   -793828.5   -537875.7     -6670.8          .0
  -1983345.5   -138646.1   -182581.2   -190673.8   -188042.4   -189555.1   -438593.7   -445157.9   -209693.3      -401.9          .0
    270304.5     73392.3     22802.7      8549.9      5355.3      3721.9     -4633.0    -12252.6    167506.7      5861.3          .0
   2468513.2    283279.8    226646.8    206131.3    195809.3    194090.6    423900.5    415951.9    512245.7     10457.3          .0
   4184151.1    455652.2    388185.3    362178.5    345302.7    343437.2    761829.2    754043.7    760332.4     13189.8          .0
   4942050.6    547728.4    466179.6    433021.7    411489.7    410159.4    912243.7    906403.3    841023.2     13801.6          .0
   4472151.0    530665.8    437164.1    396504.7    370815.0    370789.3    817579.9    815247.9    721252.8     12131.6          .0
   2818383.5    401794.2    301724.4    256818.7    228170.6    229716.6    487530.6    489254.3    415524.8      7849.3          .0
    303065.0    189220.7     85595.3     40710.1     13917.4     15600.5     -8257.3     -3679.1    -30898.5       855.9          .0
  -2090363.5    -17645.2   -123811.1   -168101.9   -190107.8   -188773.1   -475890.0   -469420.5   -449972.2     -6641.7          .0
  -3695052.6   -159005.8   -266408.2   -310088.1   -327974.3   -327485.2   -790631.4   -784681.3   -717097.3    -11681.1          .0
  -4401419.8   -217052.9   -328938.8   -375615.2   -391773.9   -392134.9   -936699.4   -932340.0   -813608.4    -13256.1          .0
  -3975954.0   -172518.5   -289071.4   -342605.1   -361029.2   -362627.9   -866022.4   -865298.4   -705908.8    -10872.4          .0
  -2763676.6    -55983.4   -176856.1   -238201.6   -262081.6   -264627.1   -639609.1   -642470.9   -477415.2     -6431.6          .0
   -848413.4    118205.2     -2838.5    -69879.5   -100670.3   -103802.8   -269741.2   -275824.1   -143447.6      -414.7          .0
   1491988.5    327060.5    205388.1    135902.2     99807.2     96614.7    191055.1    182542.6    247819.1      5799.1          .0
   3733604.6    539579.5    409900.9    333860.7    293172.9    289643.5    634008.6    623676.6    599430.6     10331.4          .0
   5274980.6    705569.2    564262.7    476461.3    426836.2    422997.8    932275.9    921574.2    812413.5     12589.8          .0
2013.07.02   Transect:  2   No. of layers: 10
   4704237.4    225607.9    214890.0    207341.8    200306.8    199496.4    450855.3    450751.9    775642.5    745183.6   1234161.3
```

…….

APENDIX A


350°
355°
0°
5°
10°
15°
60°
55°
50°
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29

NOOS transects						
No.	**Transect**	**From**		**To**		**Measurements available?**
		Latitude	**Longitude**	**Latitude**	**Longitude**	
0	Pentland Firth	58° 32' N	3° 10' W	59° 17' N	2° 30' W	
1	Shetland N	60° 41' N	0° 55' W	60° 41' N	3° 00' E	Transect 'Feie-Shetland' (N)
2	Sognesjoen	60° 41' N	3° 00' E	60° 41' N	6° 00' E	Transect 'Feie-Shetland' (N)
3	Shetland S	59° 55' N	1° 15' W	59° 17' N	2° 30' W	
4	Orkney	59° 17' N	2° 30' W	59° 17' N	3° 20' E	Transect 'Utsira' (N)
5	Utsira	59° 17' N	3° 20' E	59° 17' N	6° 30' E	Transect 'Utsira' (N)
6	Lista	58° 10' N	6° 32' E	57° 08' N	5° 00' E	Station 'Lista' (N)
7	Aberdeen	57° 08' N	2° 15' W	57° 08' N	5° 00' E	Transect 'Hanstholm-Aberdeen' (N)
8	Hanstholm W	57° 08' N	5° 00' E	57° 08' N	8° 40' E	Transect 'Hanstholm-Aberdeen' (N)
9	Okso	57° 08' N	8° 38' E	58° 07' N	8° 10' E	Transect 'Oksoe-Hanstholm' (N)
10	Flamborough Hd.	54° 15' N	0° 35' W	54° 15' N	4° 14' E	
11	Terschelling	54° 15' N	4° 14' E	53° 15' N	5° 30 E	Transect 'Terschelling' (NL)
12	Noordwijk	52° 25' N	1° 40' E	52° 25' N	4° 35' E	Transect 'Noordwijk' (NL)
13	Dover Strait	51° 10' N	1° 20' E	50° 55' N	1° 42' E	
14	Cherbourgh	50° 40' N	1° 25' W	49° 45' N	1° 25' W	
15	Plymouth	50° 25' N	4° 25' W	48° 35' N	4° 25' W	
16	Rosslare	52° 17' N	6° 20' W	52° 17' N	4° 10' W	
17	Dublin-Holyhead	53° 27' N	6° 20' W	53° 27' N	4° 35' W	
18	Larne	54° 53' N	6° 00' W	54° 53' N	5° 00' W	
19	Rottumerplaat	53° 15' N	06° 20' E	55° 00' N	06° 20' E	Trans. 'Rottumerplaat' (NL), 'NSB II' + 'Ems' (D)
20	Sylt	55° 00' N	06° 20' E	55° 00' N	08° 40' E	Station 'NSB II' (D)
21	Torungen-Hirtshals	57° 33' N	9° 58' E	58° 30' N	8° 45' E	Transect 'Torungen-Hirtshals' (NL)
22	Skagerrak	57° 33' N	10° 05' E	59° 10' N	10° 05' E	FerryBox transect R2 (NL)
23	Kategatt	57° 45 ' N	10° 30 ' E	57°45 ' N	11° 50' E	Station 'Läsö Rende' (DK)
24	Oresund	56° 01 ' N	12° 34 ' E	56°01 ' N	12° 44 ' E	Station 'Drogden' (DK)
25	Little Belt	55° 32' N	9° 42 ' E	55°32 ' N	9° 48' E	
26	Great Belt	55° 22 ' N	10° 45 ' E	55°22 ' N	11° 14 ' E	Station 'W26' (DK)
27	Fehmarn Belt	54° 30' N	11° 09' E	54° 45' N	11° 09' E	Station 'Fehmarn Belt' (D)
28	Darss Sill	54° 26' N	12° 33' E	54° 58' N	12° 33' E	Station 'Darsser Schwelle' (D)
29	Arkona Basin	54° 00' N	14° 00' E	55° 30' N	14° 00' E	Station 'Arkona Becken' + Station 'Oder Bank' (D)

Table 1

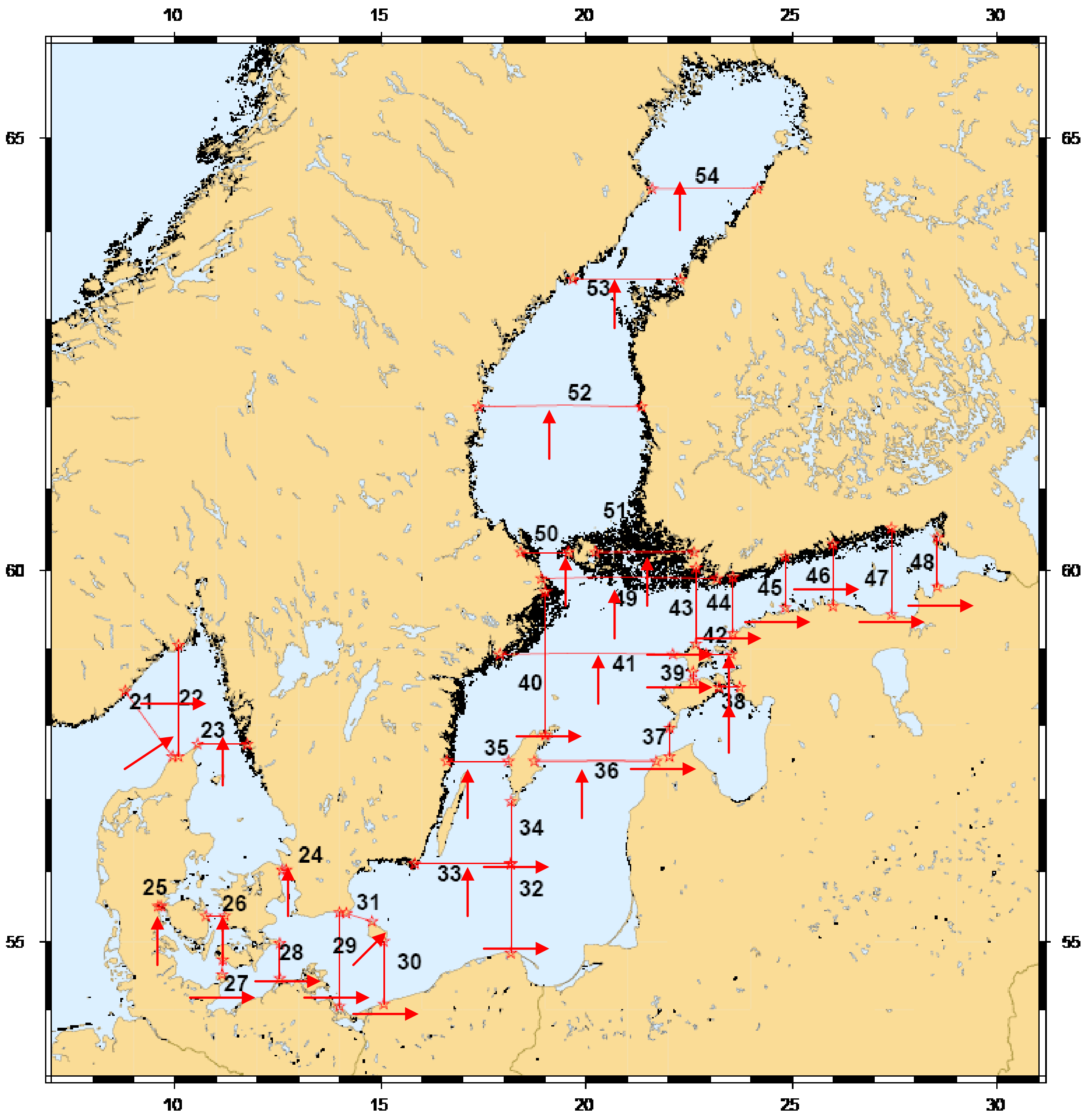


Fig. 2 **Position of BOOS transects**

Direction of positive transports

BOOS transects						
No.	**Transect**	**From**		**To**		**Measurements available?**
		Latitude	**Longitude**	**Latitude**	**Longitude**	
22	Skagerrak	57° 33' N	10° 05' E	59° 10' N	10° 05' E	FerryBox transect R2 (NL)
23	Kategatt	57° 45 ' N	10° 30 ' E	57°45 ' N	11° 50' E	Station 'Läsö Rende' (DK)
24	Oresund	56° 01 ' N	12° 34 ' E	56°01 ' N	12° 44 ' E	Station 'Drogden' (DK)
25	Little Belt	55° 32' N	9° 42 ' E	55°32 ' N	9° 48' E	
26	Great Belt	55° 22 ' N	10° 45 ' E	55°22 ' N	11° 14 ' E	Station 'W26' (DK)
27	Fehmarn Belt	54° 30' N	11° 09' E	54° 45' N	11° 09' E	Station 'Fehmarn Belt' (D)
28	Darss Sill	54° 26' N	12° 33' E	54° 58' N	12° 33' E	Station 'Darsser Schwelle' (D)
29	Arkona Basin	54° 00' N	14° 00' E	55° 30' N	14° 00' E	Station 'Arkona Becken' + Station 'Oder Bank' (D)
30	Bornholm S	55° 00' N	15° 04' E	54° 05' N	15° 04' E	
31	Bornholm N	55° 17' N	14° 47' E	55° 24' N	14° 10' E	
32	Slupsk Sill	54° 50' N	18° 10' E	56° 06' N	18° 10' E	
33	Middlebank	56° 06' N	18° 10' E	56° 06' N	15° 50' E	
34	Gotland S	56° 06' N	18° 10' E	56° 58' N	18° 10' E	
35	Gotland W	57° 31' N	16° 36' E	57° 31' N	18° 06' E	
36	Gotland E	57° 31' N	18° 44' E	57° 31' N	21° 42' E	
37	Gulf of Riga W	57° 35' N	22° 01' E	57° 58' N	22° 01' E	
38	Gulf of Riga N	58° 30' N	23° 14' E	58° 30' N	23° 44' E	
39	Saaremaa N	58° 35' N	22° 36' E	58° 42' N	22° 36' E	
40	Gotland N	57° 52' N	19° 00' E	59° 44' N	19° 00' E	
41	Stockholm W	58° 56' N	17° 54' E	58° 56' N	22° 06' E	
42	Hiiumaa E	58° 56' N	22° 55' E	58° 56' N	23° 32' E	
43	Hiiumaa - Hanko	59° 04' N	22° 40' E	60° 02' N	22° 40' E	
44	Gulf of Finland W	59° 12' N	23° 34' E	59° 55' N	23° 34' E	
45	Tallinn - Helsinki	59° 32' N	24° 50' E	60° 11' N	24° 50' E	
46	Vergi - Porvoo	59° 33' N	26° 00' E	60° 20' N	26° 00' E	
47	Ontika - Hamina	59° 27' N	27° 25' E	60° 32' N	27° 25' E	
48	Neva Bight	59° 48' N	28° 32' E	60° 25' N	28° 32' E	
49	Baltic Proper N	59° 54' N	18° 54' E	59° 54' N	23° 10' E	
50	Aland W	60° 14' N	18° 24' E	60° 14' N	19° 34' E	
51	Aland E	60° 14' N	20° 13' E	60° 14' N	22° 37' E	
52	Bothnian Sea	62° 00' N	17° 22' E	62° 00' N	21° 20' E	
53	Kvarken	63° 28' N	19° 40' E	63° 28' N	22° 17' E	
54	Bothnian Bay	64° 28' N	21° 36' E	64° 28' N	24° 10' E	

Table 2