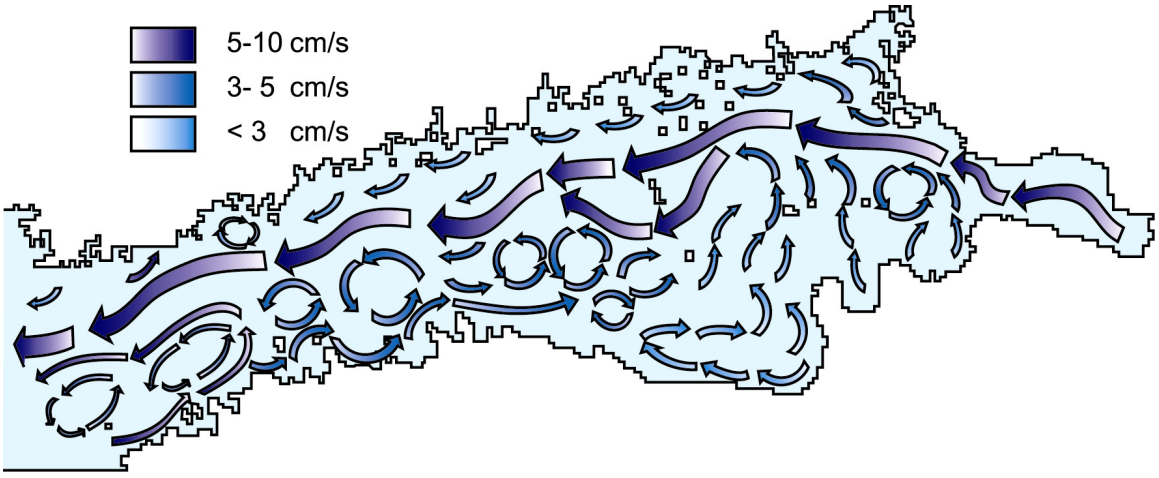
BONUS+ Project

BalticWay
The Potential of Currents
for Environmental Management
of the Baltic Sea Maritime Industry



Annual Report 2
January– December 2010

Synopsis

- The work gathered full speed in the 2nd project year; most of the delays of the 1st year levelled off.
- The basic steps of the technology for environmental management of offshore sea areas established and documented.
- Success in dissemination of the results to scientific community in the form of conference presentations, publications and public lectures.

Highlights

- Mapping of long-term behaviour and dispersion properties of subsurface currents in the Baltic Sea with the use of autonomous drifters based on the longest ever recorded time series of drifters' positions.
- Formulation of the four key steps of the technology of the fairway design, development of algorithms for the identification of an optimum fairway based on local features of environmental risks.
- Quantification of spatial and temporal variability of average and extreme properties of the Baltic Sea wave fields based on numerical simulations for 1970–2007 and historical wave data.

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Scientific Results

Work Package 1 – Forcing and boundary data

WP Leader: ICR

- Task 1.1 *Gathering and unification of data for running the circulation models*, PM 1-12, Leader: IoC
- Task 1.2 *Gathering and unification of data for running the risk model*, PM 1-18, Leader IoC
- Task 1.3 *Common weather forcing and wave-induced radiation stress*, PM 7-24, Leader: DMI

Key progress: adjustment of the existing forcing and boundary data for high-resolution models of the Gulf of Finland

- Recalculation of boundary information at the entrance of the Gulf of Finland for high-resolution (0.5 nautical mile (nm) and 0.25 nm) circulation; adjustment of SMHI data set for running the circulation mode for the high-resolution (0.5–0.25 nm) models of the Gulf of Finland (SYKE).
- (1.2) Gathering and preliminary analysis of the location of ship routes in the Gulf of Finland for risk modelling; contribution to additional deliverable ID No 335 „Towards identification of areas of reduced risk in the Gulf of Finland, the Baltic Sea" (IoC, SYKE).
- Development of measures for the analysis of risk for optimal ship trajectories (IoC, SYKE).
- Determination of the positions of the main ship routes through the Baltic Proper (IFM-GEOMAR) (see also Task 3.3).
- (1.3) Maps of wave stress calculated in 3 nm resolution for the entire Baltic Sea for 1987–1991; first version of offline database of wave properties (incl. wave stress) for the Baltic Sea realized (IoC).
- Boundary values for oil drift modelling extracted from the 40-year database that was generated in the Danish "Sunfish" project with 6 nm resolution in the North Sea & Baltic Sea, and 1 nm in the Wadden Sea and the Danish Straits (DMI).

The WP has fulfilled its key goal – to ensure that the modelling and analysis teams have all necessary data reflecting forcing and boundary information for circulation models and data about ship traffic for risk models at their disposal.

These data sets are, however, not yet unified into a coherent system and the relevant deliverable D1.1 "Unified pool of initial, boundary and forcing data for the circulation, oil spill, and risk models" has not been completed. The delay is partially caused by the need for additional data for the high-resolution simulations of the Gulf of Finland but apparently is also related to very late recruitment of BalticWay personnel in the ICR. As the WP leader has not provided any timetable to successfully end this WP, the coordinating team (IoC) will take over the responsibility for the WP and the deliverable starting from 01 February 2011. IoC will recruit a person capable of creating a coherent database from the existing data sets. A preliminary version of the deliverable will be released by 30 March 2011 and the final version – within 2 months after the end of modelling activities (by 31 August 2011).

Work Package 2 – Circulation modelling in the target areas

WP Leader: SMHI

- Task 2.1 *Simulations of circulation in the entire Baltic Sea with a moderate resolution*, PM 4-18, Leader: SMHI
- Task 2.2 *High-resolution simulations of circulation in the Gulf of Finland and the western Baltic Sea*, PM 7-30, Leaders: Gulf of Finland-SYKE; Western Baltic: IFM-GEOMAR
- Task 2.3 *Validation modelling of the circulation of the entire Baltic Sea*, PM 7-24, Leader: Different circulation model-ICR; Operational ocean model-DMI

Key progress: Task 2.1 fully completed, high-resolution version of the OAAS model implemented for the Gulf of Finland; additional deliverable (ID 397, published paper) released; Task 2.3 completed

- Task 2.1 fully completed: simulations with the moderate-resolution (2 nm) RCO model performed for 1961–2007; the results structured in a database and made available for the partners.
- (2.2) Implementation of the OAAS model with new bathymetry for the Gulf of Finland (resolution of 0.25 nautical miles for the coastal areas of Estonia and Finland, and 0.5 nautical miles for the central part of the gulf and for the Russian waters) (IoC, SYKE).
- Development of a novel method accounting for the strong rotational component of meso-scale currents in the Gulf of Finland for parameterization of subgrid-scale turbulence in numerical simulations (SYKE).
- Joint publication reflecting new aspects of the high-resolution simulations and the new method for parameterization of subgrid-scale turbulence (IoC, SYKE)
- A 5-year run for 1987–1991 completed for the Gulf of Finland with on-line trajectory calculations with the 1 nm OAAS model using RCO model results at the open boundary.
- Two manuscripts finalized jointly with Alexander Sokolov (BNI, Stockholm), which have been sent and submitted to *Oceanologia* and *Marine Pollution Bulletin*. Both manuscripts also address the problem of risk assessment in the Gulf of Finland (SYKE, IoC).
- Processing of 25-year SMHI wind data with the goal to separate windy and calm seasons in the Gulf of Finland (SYKE) (see also Task 4.2).
- A 1 nm grid version of the RCO model covering the earlier used 2 nautical mile domain for the entire Baltic Sea (incl. Gulf of Finland and Bothnian Bay with open boundary in Kattegatt) has been developed (SMHI).
- Intricate test simulations (concerning stability, mass conservation in the model, 2-delta x waves, etc.) as preparations to perform 1 nm simulations with RCO for the ERA40 period (or at least a part of it) (SMHI).
- A long-term simulation with 1 nm resolution is in progress. Most of the working time has been used for tuning and validation. We have focused also on the

performance of a new multi-category sea-ice model to improve the surface currents during winter.

- (2.3) The DMI model CMOD has been run for the Baltic sea over 20 years using the DKRZ computer with a resolution of 3 nm in the coarse domain (North Sea and Baltic Sea) and 0.5 nm for the nested domain (the western part of the Baltic Sea) (ICR).
- The results of this model run are validated against observations and climatic data compared against observations. It is demonstrated that the results in the high-resolution domain in the western part of the Baltic Sea are of good quality and can serve as input to the TRACMASS (Lagrangian) model. They present a reliable dynamic ocean state, which enables us to use them for the planned Baltic Way research. Additionally climatic analyses have been carried out on inflow regimes during the last 20 years (ICR).
- A circulation model with a 1.3 nm resolution has been run for 1990–2009 in order to analyse the circulation and drift patterns in the whole Baltic Sea; analysis of the results in progress (IFM-GEOMAR) (see also Task 3.3).
- Drift modelling and comparison of drift behaviour in the western Baltic Sea and the Gulf of Finland has been performed (IFM-GEOMAR in cooperation with SYKE) (see also Task 3.3).

The WP is running as planned. The work is even partially ahead of schedule. Task 2.1 was completed a few months before the scheduled time and Task 2.3 as scheduled but with even higher resolution than planned.

Work Package 3 – Particle trajectory and oil spill modelling

WP Leader: MISU

- Task 3.1 *Implementation of the MISU method for exact and invertible calculations of trajectories at IoC and ICR*, PM 1-12, Leader: MISU
- Task 3.2 *Calculation of Eulerian and Lagrangian trajectories of water particles*, PM 4-30, Leader: MISU
- Task 3.3 *Modelling of oil drift patterns in the Baltic Sea*, PM 10-33, Leader: DMI

Key progress: Task 3.1 fully completed; large sets of trajectories calculated for the Gulf of Finland using two methods and for the northern Baltic Proper using TRACMASS, modelling of oil drift patterns in progress for both target areas (Gulf of Finland and south-western Baltic); additional deliverable (ID 336, published paper) released

- Task 3.1 fully completed, TRACMASS code in intense use at IoC and implemented at ICR; further improvements of the TRACMASS code performed and made available to the partners (MISU, IoC, ICR).
- (3.2) Calculations of a set of trajectories for the Gulf of Finland with two methods:
  - Offline with the use of TRACMASS and 2nm RCO model data, duration up to 60 days; time lag between starting points 10 days; up to 5 particles in each grid point (IoC).
  - Online using 1nm OAAS model, duration 10 days; time lag 10 days; 10 particles in each grid point (SYKE).
- Calculations of a set of trajectories for the northern Baltic Sea with the use of TRACMASS and 2 nm RCO model data, duration up to 120 days; time lag between starting points 10 days; up to 5 particles in each grid point (IoC).
- Analysis of temporal variability of the number of trajectories reaching the nearshore and leaving the Gulf of Finland; establishing optimum parameters of the length of trajectory calculations, time lag between the starting points, establishing the proper definition of the nearshore for the RCO model data (IoC).
- Additional deliverable (ID 336, published paper) released, reflecting the necessary temporal scales for such calculations in the Gulf of Finland (IoC).
- Off-line version of the database of trajectories (Deliverable D3.1) based on 2 nm RCO model data substantially updated for the Gulf of Finland and the northern Baltic Proper (IoC).
- Running the TRACMASS code and analyzing the results using MATLAB. Now trying to change the readfile in order to read in the DMI CMOD results and analyse the trajectories in the western part of the Baltic Sea (ICR).
- The TRACMASS model has been successfully set up for the western Baltic Sea using the DMI current output data. Running the model for the whole year of 1985 to compute the net transport in the western Baltic Sea (ICR).
- (3.3) Analysis of net and bulk transport patterns in surface layer of the Gulf of Finland performed for 1987–1991; joint publication accepted for *Boreal Environment Research* (IoC, MISU and SYKE).

- The model system and set-up that is providing the forcing and input fields for the offline 3D oil drift model is substantially updated based on high-resolution bathymetry information developed by IoC and SYKE. The chain of nested models with a resolution from 0.5 to 3 nm has been tested.
- Coupling of wave-induced currents with the circulation model is currently in progress. Preliminary stages of the coupled model exist and test runs have been performed for two years. Problems with HIRHAM meteorological forcing identified and removed (DMI).
- Extension of the drift modelling to the areas of Kattegat, Belt Sea and Bornholm Basin; adaptation of the drift model to the new (higher) resolution of 1.3 nm; drift modelling on the basis of high-resolution model results currently in progress (IFM-GEOMAR; see also Task 2.3).
- Determination of the positions of the main ship routes through the Baltic Proper for the needs of drift and risk modelling (IFM-GEOMAR) (see also Task 1.2).
- Drift modelling and comparison of drift behaviour in the western Baltic Sea and the Gulf of Finland in cooperation with SYKE (IFM-GEOMAR).

The WP is running as planned. The preliminary versions of the deliverables have been created. The research in Task 3.2 has been extended towards detailed analysis of the optimum design of the parameters of trajectory simulations.

Work Package 4 – Synthesis: Identification of areas of reduced risk

WP Leader: IFM-GEOMAR

- Task 4.1 *Identification of areas of reduced risk from the analysis of Lagrangian and Eulerian trajectories*, PM 7-30, Leader: MISU
- Task 4.2 *Uncertainties and seasonal and interannual variability of the areas of reduced risk*, PM 13-36, Leader: IoC
- Task 4.3 *The effect of local wind and waves*, PM 13-33, Leader: DMI
- Task 4.4 *Areas of reduced risk associated with favourable subsurface current patterns*, PM 16-36, Leader: SYKE

Key progress: Development of methods for the calculations of the equiprobability line, identification of seasonal variations of transport patterns, analysis of the role of the impact of ocean model resolution on the optimum fairways, discovery of the difference in gradients of risk measures in different sea areas

- (4.1) Quantification of the patterns of net transport and the ratio of net and bulk transport in the Gulf of Finland based on 2 nm model results for 1987–1991 (IoC).
- Development of two different numerical methods for the calculation of the equiprobability line in the conditions of the Gulf of Finland (IoC).
- Developing algorithms for the construction of the optimal fairway between any given two points, testing this algorithm, and estimating the quality of concrete fairways (SYKE, IoC, see also Tasks 6.1 and 7.1).
- Discovery of the difference in gradients of risk measures in different sea areas, with potential substantial implications in terms of maritime spatial planning (IoC).
- (4.1 and 4.2) Identification of the level of seasonal variations in the patterns of net and bulk transport; joint publication addressing these aspects accepted in *Boreal Environment Reseach* (IoC, SYKE, MISU) (see also Task 3.3).
- (4.2) First attempts towards quantification of the uncertainty of the identification of areas of reduced risk by means of the use of two different methods for the calculation of the equiprobability line (IoC).
- Additonal deliverable (ID 335) released in the form of published paper addressing the concept of equiprobability line (IoC, SYKE; see also Task 7.1).
- (4.2 and 4.3) Processing of 25-year SMHI wind data with the goal to separate windy and calm seasons in the Gulf of Finland (SYKE) (see also Task 2.2).
- (4.3) Analysis of spatio-temporal patterns of changes to wave properties in the entire Baltic Sea performed using SMHI geostrophic wind data (IoC).
- Variability of the Baltic Sea wave properties in weekly, seasonal, interannual and climatological time scales established based on numerical simulations and an analysis of historical wave observations (IoC)
- Patterns in spatial variability of wave properties in the Baltic Sea and in their long-term changes established from numerical simulations (IoC)
- Results of Task 4.3 disseminated as a series of four publications in international journals (IoC) (see also Task 8.3).

- Task 4.4: started; development of the relevant numerical code currently in progress (SYKE, IoC).

The WP is running as planned. The obtained results seem to be richer in content than originally predicted. The concept of areas of reduced risk has been considerably expanded. The results of the project may have major implications in maritime spatial planning.

Work Package 5 – Validation experiments

WP Leader: SYKE

- Task 5.1 *Measurement of the current-induced surface drift and its dispersion properties in the Baltic Sea Proper*, PM 4-18, Leader: MISU
- Task 5.2 *Measurement of current-induced surface drift and its dispersion properties in the surface layer and subsurface layer of the Gulf of Finland*, PM 7-30, Leader: SYKE
- Task 5.3 *Measurement of current-induced surface drift and its dispersion properties with the use of airborne and remote sensing methods*, PM 1-36, Leader: LDI

Key progress: Task 5.1 completed, surface drift properties established for the Gulf of Finland using an economical technical solution and subsurface drift properties for the Baltic Proper using professional drifting buoys; devices for remote measurements of surface drift upgraded

- Decision of the project meeting (March 2010): (i) to purchase several commercial drifting buoys for validation experiment in the Baltic Proper; (ii) to construct and build low-cost drifters to be used in severe conditions of the Gulf of Finland; (iii) to use as the situation permits ships of opportunity and small vessels for the experiments in order to avoid large rental costs.
- (5.1) Two professional drifting buoys purchased in late spring 2010 (MISU).
- Several long-term experiments with drifting buoys performed in the Baltic Proper, with a maximum duration of >4 months (MISU, IoC provided help towards removing a drifter from the sea).
- Deployment of four surface drifters in the Baltic Proper in late autumn 2011 (MISU).
- Analysis of the data provided by the surface drifters in the Baltic Proper in progress (MISU).
- (5.2) Ten low-price autonomous drifters following the surface layer (depths 0–1 m) built and tested (IoC).
- Pairs and triples of drifters deployed in different locations of the Gulf of Finland for about 1–2 weeks each time; the data analysis currently in progress (IoC).
- Equipment for remote sensing of pollution updated for new airborne carries, the spectral resolution increased and test flights performed (LDI).
- A co-operation has been established with the Finnish Meteorological Institute to carry our drifter experiments onboard R/V Aranda (SYKE).
- Test measurements of spatial distribution of the concentration of dissolved organic matter in Tallinn Bay and Muuga Bay (LDI)

The initial delays in project year 1 (2009) have been completely resolved during the second year. The WP is technically running as planned. An in-depth discussion during the annual meeting (March 2010) has resulted in several innovative and relatively low-cost solutions for the validation experiments. The basic idea is to use different devices in

different sea areas and to use ships of opportunity whenever possible. This has resulted in a much larger amount of high-quality data.
Although Task 5.1 is successfully completed, the team plans several additional validation experiments in the Baltic Proper. This is financially possible because of extensive use of ships of opportunity, contribution from the Estonian Border Guard to board a drifter that was stuck near Hiiumaa, and the use of small vessels for experiments in the Gulf of Finland.

Work Package 6 – Risk analysis and mathematics of inverse problems

WP Leader: IoC

- Task 6.1 *Modelling of environmental risk*, PM 1-33, Leader: IoC
- Task 6.2 *Analysis of the properties of the water age*, PM 7-33, Leader: SMHI
- Task 6.3 *Development of a probabilistic approach for ensemble forecasts*, PM 13-33, Leader: SMHI
- Task 6.4 *Mathematical background of the concept of areas of reduced risk*, PM 1-36, Leader: IoC

Key progress: Introduction and analysis of integral measures of environmental risk, introduction of an improved definition of water age, calculation of 2D fields of the probabilities of coastal hit and water (particle) age; quantification of the impact of ocean model resolution in ensemble forecasts for one target area (Gulf of Finland)

- (6.1, 6.4) Quantification of the patterns of net transport and the ratio of net and bulk transport in the Gulf of Finland based on 2 nm model results for 1987–1991 (IoC, SYKE, MISU, see also Task 4.1).
- Development of two different numerical methods for the calculation of the equiprobability line in the conditions of the Gulf of Finland (IoC, see also Task 4.1).
- Identification of the level of seasonal variations in the patterns of net and bulk transport; joint publication addressing these aspects accepted in *Boreal Environment Research* (IoC, SYKE, MISU, see also Tasks 4.1 and 4.2).
- Development of algorithms for the construction of the optimal fairway between any given two points, testing this algorithm, and estimating the quality of concrete fairways (SYKE, IoC, see also Tasks 4.1 and 7.1).
- (6.2) Introduction of an improved definition of water age (defined as the time necessary for a particle to travel to the coast) (SYKE) and development of numerical methods for its calculation both on-line and off-line (with the use of TRACMASS) (IoC, SYKE).
- Analysis of water (particle) age for the Gulf of Finland based on 2 nm RCO data (IoC) and based on results of the OAAS model with different resolutions (SYKE).
- (6.3) First attempts towards quantification of the uncertainty of the identification of areas of reduced risk by using two different methods for the calculation of the equiprobability line and two different measures of risk (see also Tasks 4.1 and 4.2).
- Quantification of the impact of ocean model resolution in ensemble forecasts for one target area (Gulf of Finland) (SYKE, IoC).
- Establishing the typical time scale for the integral values of the probability of coastal hit and particle age to reach their asymptotic values in the Gulf of Finland (SYKE, IoC).
- (6.4) Quantification of spatial and temporal variability of average and extreme properties of the Baltic Sea wave fields based on numerical simulations for 1970–2007 and historical wave data.

- First version of a method allowing to estimate whether or not substantial gain can be obtained from this technology for a particular sea area (see also Task 7.2) (IoC, SYKE)
- Additional deliverables addressing the mathematical background of the concept and the methods of calculation of areas of reduced risk released (see below).

The WP is running as planned. As in WP4, the developments and results within this WP are much richer in content than originally predicted. We are looking forward to a number of highly interesting results during the third project year.

Work Package 7 – Applications

WP Leader: DMI

- Task 7.1 *Development of a prototype of the fairway design*, PM 10-33, Leader: DMI
- Task 7.2 *Implementation plan and estimates of the gain of the proposed technology*, PM 16-33, Leader: IoC
- Task 7.3 *Implementation plans for potential applications of the results*, PM 16-36, Leader: IoC

Key progress: Formulation of the four key steps of the technology of the fairway design, development of algorithms for the identification of an optimum fairway based on local features of environmental risks, introduction of new measures to unambiguously estimate the potential gain of the proposed technology

- (7.1) Formulation of the four key steps of the technology of fairway design (ocean model, trajectory model, maps of environmental risks, algorithms of optimisation); development of a generic application in which these four steps are used as independent blocks (IoC).
- Development of algorithms for the identification of an optimum fairway based on local features of spatial maps of environmental risks (SYKE).
- First attempts of the development of algorithms accounting for the potential gain (SYKE, IoC).
- (7.2) Development and demonstration of a model prototype of the fairway design for the Gulf of Finland, incl. estimates of the increase in the fairway length and the gain in terms of an increase in response time to the pollution (SYKE, IoC).
- (7.2) First version of a method allowing to estimate whether or not substantial gain can be obtained from this technology for a particular sea area (see also Task 6.4) (IoC, SYKE).
- (7.3) First version of an implementation plan of the entire technology for the protection of specific vulnerable areas (IoC).

The WP is running as planned.

Work Package 8 – Management and dissemination

WP Leader: IoC

- Task 8.1 *Integration and harmonisation of the activities*, PM 1-36, Leader: IoC
- Task 8.2 *Management and overall quality control*, PM 1-36, Leader: IoC
- Task 8.3 *Dissemination and public awareness, exploitation and IPR management*, PM 1-36, Leader: IoC

Key progress: Consortium Agreement finalised and signed by all partners; dissemination of the results to scientific community speeding up; project largely kept running as scheduled.

- (8.1) Very successful cooperation reached between most of the teams; effective data flow and competence transfer launched; coordination of efforts of partners in simulations, analysis and validation experiments.
- (8.1 & 8.2) Scientific part of the Annual Meeting organised jointly with FP7 FET coordination action GSD, several important management decisions taken by the Project Council at the administrative Annual Meeting resulting in successful validation experiments.
- (8.2) Consortium Agreement finalised and signed by all partners.
- (8.3) Intense dissemination of the results to stakeholders and society (IoC)
  - Two appearances at political and public stakeholder events directly or indirectly using the results of the project (see below)
  - Six popular papers (incl. two explicitly addressing the results of the project) published
  - 15 interviews to different media channels (IoC) for Estonian TV, radio, and newspapers (incl. one interview to the Finnish leading daily newspaper Helsingin Sanomat).
- (8.3) Dissemination of the results to the scientific community speeding up
  - 14 Public lectures and presentations addressing different aspects of the project, mostly to the scientific and engineering community
  - Seven research papers in peer-reviewed scientific journals published
  - One PhD – largely based on the project results – awarded in Civil and Environmental Engineering, Tallinn University of Tehnology (IoC)
  - Presentation of project results at 10 international conferences
- Demonstration of the principles of the entire technology and estimates of gain to the scientific and marine community in Australia (IoC, LDI).

The WP is mostly running as planned, with small modifications caused by external issues. See also the appendix on the background for the statistical information.

- Project web site set up in July 2009 in a basic version, http://wavelab.ioc.ee/bonus-balticway has been expanded substantially in year 2; in order to avoid duplication some information about the particular activities of the project (Activities, Publications etc.) stored on the sister website of the Wave Engineering Laboratory.
- Deliverable D1.1 postponed; see detailed information in the description of WP1 and also below about measures planned to ensure its launch.

Peer-reviewed publications addressing the results obtained in the BalticWay project

1. A. Räämet and T. Soomere 2010. The wave climate and its seasonal variability in the northeastern Baltic Sea, *Estonian Journal of Earth Sciences* **59**, 1, 100–113.

2. T. Soomere, B. Viikmäe, N. Delpeche, K. Myrberg 2010. Towards identification of areas of reduced risk in the Gulf of Finland, the Baltic Sea, *Proceedings of the Estonian Academy of Sciences* **59**, 2, 156–165.

3. A. Räämet, T. Soomere, I. Zaitseva-Pärnaste 2010. Variations in extreme wave heights and wave directions in the north-eastern Baltic Sea, *Proceedings of the Estonian Academy of Sciences* **59**, 2, 182–192.

4. O. Andrejev, A. Sokolov, T. Soomere, R. Värv, B. Viikmäe 2010. The use of high-resolution bathymetry for circulation modelling in the Gulf of Finland, *Estonian Journal of Engineering* **16** (3), 187–210.

5. B. Viikmäe, T. Soomere, M. Viidebaum, M. Berezovski 2010. Temporal scales for transport patterns in the Gulf of Finland, *Estonian Journal of Engineering* **16** (3), 211–227.

6. T. Soomere, A. Räämet, 2010. Long-term spatial variations in the Baltic Sea wave fields, *Ocean Science Discussions* 7, 1889–1912.

7. T. Soomere, I. Zaitseva-Pärnaste, A. Räämet, D. Kurennoy 2010. О пространственно-временной изменчивости полей волнения Финского залива (Spatio-temporal variations of wave fields in the Gulf of Finland), *Фундаментальная и прикладная гидрофизика* (Fundamental and Applied Hydrophysics) 4(10), 91–102 (in Russian).

Dissemination at conferences

1. The Joint Baltic Sea Research Programme BONUS Annual Conference, January 19–21, 2010, Vilnius, Lithuania: T.Soomere, B.Viikmäe.
   B.Viikmäe, R.Isotamm, N.Delpeche. An empirical method to determine patterns of risk of coastal pollution in the Gulf of Finland.
   T.Soomere, N.Delpeche, B.Viikmäe. Semi-persistent patterns of transport in surface layers of the Gulf of Finland.
2. International workshop „Water Seminar Day“, March 18, 2010, Frederick University, Nikosia, Cyprus: T.Soomere, K. Döös, B.Viikmäe, N.Delpeche
   T. Soomere. Implications of intense fast ferry traffic on nearshore water quality and beach erosion
   K. Döös. Relative dispersion of surface drifters and model simulated trajectories
3. EGU General Assembly, May 02–07, 2010, Vienna, Austria: I.Didenkulova.
   T. Soomere, N. Delpeche, B. Viikmäe and M.Viidebaum (poster). The use of current-induced transport for coastal protection in the Gulf of Finland, the Baltic Sea.
4. 15th Biennial Workshop of Joint Numerical Sea Modelling Group (JONSMOD), May 10–12, 2010, Delft, The Netherlands: B. Viikmäe.
   B. Viikmäe. The Use of Lagrangian Trajectories for Minimization of the Risk of Coastal Pollution.

5. 6th Study Conference on BALTEX, June 14–18, 2010, Międzyzdroje, Poland: A.Räämet, B.Viikmäe.
   A. Räämet, T.Soomere. A reliability study of wave climate modelling in the Baltic Sea.
   B.Viikmäe, T. Soomere, N. Delpeche, H.E.M. Meier and K. Döös. Utilizing Lagrangian trajectories for reducing environmental risks.
   O.Andrejev, B.Viikmäe, A.Sokolov, T.Soomere, K.Myrberg. Using multi-year circulation simulations to identify areas of reduced risk for marine transport. Application to the Gulf of Finland.
   N.Delpeche, T. Soomere, B.Viikmäe (poster). Towards a quantification of areas of high and low risk of pollution in the Gulf of Finland, with the application to ecologically sensitive areas.
6. 2nd conference (school) on Dynamics of Coastal Zone of Non-tidal Seas, June 26–30, 2010, Baltiysk, Russia: I.Zaitseva-Pärnaste, A.Giudici.
   I. Zaitseva-Pärnaste, A. Räämet, T. Soomere. Comparison between modelled and measured wind wave parameters in Estonian coastal waters.
7. The ANNiMS Student Conference, July 21–22, 2010, Townsville campus, James Cook University.
   T.Soomere (keynote lecture). Towards a future technology of environmental management.
8. Humboldt Kolleg Ukraine "Mathematics and Life Sciences", August 5–8, 2010, Kiev, Ukraine
   E. Quak. The BalticWay Project: The Potential of Currents for Environmental Management of the Baltic Sea.
9. 10th International Marine Geological Conference „The Baltic Sea Geology – 10", August 24–28, 2010, St. Petersburg, Russia: K.Kartau, T.Soomere, A.Terentjeva, O.Tribštok, B.Viikmäe.
   I.Zaitseva-Pärnaste,T.Soomere. Long-term variations of wave heights and its comparison with ice conditions in Estonian coastal waters.
   B.Viikmäe, T. Soomere, N. Delpeche. Potential of using Lagrangian trajectories for environmental management in the Gulf of Finland.
10. 5th International Student Conference on „Biodiversity and Functioning of Aquatic Ecosystems in the Baltic Sea Region", October 6–8, 2010, Palanga, Lithuania: B. Viikmäe, M. Viidebaum; MSc student K. Kartau
    B.Viikmäe, T.Soomere, N.Delpeche. Using Lagrangian Trajectories to Find Areas of Reduced Risk of Coastal Pollution in the Gulf of Finland.
    M.Viidebaum, B.Viikmäe, N.Delpeche. Sensitivity study of the Lagrangian trajectory model TRACMASS.
    I. Zaitseva-Pärnaste, T. Soomere (poster). Wave climate in the eastern part of the Baltic Sea

Public lectures and presentations

1. T.Soomere. Nord Stream as a challenge for the society. Annual meeting of the Estonian Water Society, February 5, 2010.
2. T.Soomere. Nord Stream as a challenge for the Baltic Sea marine science. Tallinn House of Teachers, February 7, 2010.
3. Dr. Urmas Raudsepp (Marine Systems Institute at Tallinn University of Technology) presented an overview of recent developments of the Baltic Way team to the East Estonian crisis regulation committee (Kohtla-Järve), March 26, 2010.
4. T.Soomere. Offshore secrets: sea waves and currents. Open University of the Tallinn University of Technology, May 14, 2010.
5. T. Soomere. The Baltic Sea in development: surrises for maritime spatial planning (On new ways of treatment of marine-induce hazards), Seminaron spatial planning of coastal areas, Vihula, Lääne-Virumaa, May 20, 2010.
6. T.Soomere. Towards a future technology of environmental management: the use of properties of currents for minimizing coastal pollution. Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Hobart, August 17, 2010.
7. T.Soomere. Are regional wave climates changing? Technical Meeting Series of the Tasmanian Divisions of RINA (Royal Institute of Naval Architects) and IMarEST (Institute of Marine Engineering, Science and Technology), Australian Maritime College, University of Tasmania, Launceston, August 18, 2010.
8. T.Soomere. New aspects of the meaning of extreme waves in maritime engineering design. Australian Maritime College, University of Tasmania, Launceston, August 18, 2010.
9. T.Soomere. The changing wave climate of the Baltic Sea. Invited lecture to the 6th autumn school of young geologists “Schola Geologica – 6”, Roosta, October 8–10, 2010.
10. T.Soomere, Patterns of changes to the regional wave climate. School of Earth and Environmental Sciences, James Cook University, Townsville, Australia, 02 November 2010.
11. T.Soomere, Towards the use of properties of currents for environmental management, with applications to ship-caused pollution, public lecture to the Institute of Marine Engineering, Science and Technology (IMarEST), Queensland Branch, Townsville Marine Museum, Australia, 11 November 2010.
12. T.Soomere, Contribution of fundamental research towards solving challenges of changing times, Oceans Institute, University of Western Australia, Perth, 24 November 2010.
13. T.Soomere, Patterns of changes to the regional wave climate, School of Environmental Systems Engineering, University of Western Australia, Perth, 25 November 2010.
14. E.Quak. The Baltic Way project: The potential of currents for environmental management of the Baltic Sea, Universität Ulm, Germany, 17 December 2010.

Popular papers addressing the results of the BalticWay project

1. T. Soomere, Nord Stream eirab tundliku Läänemere eripära (Nord Stream ignores the specific features of the vulnerable Baltic Sea), Tallinna Tehnikaülikooli aastaraamat 2009 (Yearbook of the Tallinn University of Technology 2009), TTÜ Kirjastus 2010, pp. 243–249 (in Estonian).
2. T. Soomere, Läänemere lainekliima muutuste keerises (Changing wave climate in the Baltic Sea). Preeden, U. Ja Laumets, L. (eds.), *Globaalsed muutused* (*Global Changes*). Schola Geologica VI. Eesti Looduseuurijate Selts, Tartu Ülikooli Ökoloogia ja Maateaduste Instituut, Tallinna Tehnikaülikooli Geoloogia Instituut, Tallinna Tehnikaülikooli Mäeinstituut. Sulemees, Tartu 2010, pp. 59–73 (in Estonian).

PhD thesis partially based on the BalticWay developments

A.Räämet, Spatio-temporal variability of the Baltic Sea wave fields in changing climate conditions, 22 June 2010 (Tallinn University of Technology, supervisor T.Soomere)

Meetings and Events

• January 19–21, Vilnius	BONUS Annual Conference, attended by all partners
• February 9, Helsinki	International workshop Bonus Day 2010, attended by IoC
• March 18, Nikosia	International workshop „Water Seminar Day", attended by IoC and MISU
• March 18–20, Cyprus	Project annual meeting and international workshop, attended by all partners
• April 14, Helsinki	Project discussion meeting, attended by SYKE and IFM-GEOMAR
• April 14–15, Brussels	International conference BIG-STEP (Business, Industry and Government – Science and new Technologies for Enhancing Policy), attended by IoC
• May 06–08, Tallinn	Workshop targeted at the formulation of the basic steps of the technology for environmental management, attended by IoC and SYKE
• May 10–12, Delft	15th Biennial Workshop of Joint Numerical Sea Modelling Group (JONSMOD), attended by IoC
• May 11, Copenhagen	HIROMB-BOOS scientific workshop, attended by DMI and ICR
• May 24–25, Helsinki	Project discussion meeting, attended by SYKE and SMHI
• June 8, Helsinki	The BONUS Coordinators' Forum, attended by IoC
• June 9, Helsinki	The BONUS Advisory Board meeting, attended by IoC

• June 14–18, Międzyzdroje	6th BALTEX Study Conference, attended by IoC, SYKE, SMHI, IFM-GEOMAR
• June 20–24, Tallinn	Discussion of the abilities and limitations of the WAM model for wave calculation in the Baltic Sea, attended by ICR and IoC
• June 21–25, Tallinn	Training in the TRACMASS code, attended by IoC and ICR
• June 26–29, Tsinghua U	2nd international conference „Nonlinear Waves: Theory and Applications“, attended by IoC
• June 26–30, Baltiysk	2nd school on Dynamics of Coastal Zone of Non-tidal Seas, attended by IoC
• June, Geesthacht	Project discussion meeting, attended by DMI and ICR
• July 21–22, Townsville	The ANNiMS Student Conference, attended by IoC
• August 5–8, 2010, Kiev	Humboldt Kolleg Ukraine “Mathematics and Life Sciences”, attended by IoC
• August 24–28, St. Petersburg	10th International Marine Geological Conference „The Baltic Sea Geology – 10”, attended by IoC
• September 2–4, Tallinn	Finnish-Estonian Humboldt Kolleg “The Baltic Sea as a Bridge”, including discussions of the project status and future steps, attended by IoC, SYKE, IFM-GEOMAR and the BONUS Executive Director
• September 20–24, Nantes	ICES Annual Science Conference, attended by IFM-GEOMAR
• October 6–8, Palanga	5th International Student Conference on „Biodiversity and Functioning of Aquatic Ecosystems in the Baltic Sea Region“, attended by IoC
• October 18–22, Kiel	Project discussion meeting, attended by SYKE and IFM-GEOMAR
• November 24–25, Gothenburg	BALTEX Scientific Steering Group meeting, related to BONUS Phase II, attended by IFM-GEOMAR

Comparison with original plans

- The unclear contract and payment situation delayed the start of the project to a certain extent in the first project year, especially for the Estonian partners IoC and LDI, and DMI from Denmark. This affected the allocation of existing and the hiring of new personnel as well as the purchase of equipment. Consequently, a part of the work undertaken in the project has not fully progressed as expected.
- The measures taken to ensure fulfilling the goals of the project were agreed with the BONUS Secretariat, described in the Annual Report for the first project year (2009) and discussed in detail at the BalticWay Annual Meeting (March 2010).
  - The contractual and financial issues were resolved in the middle of the first project year (2009).
  - Additional staff has been hired to ensure a smooth running of the work in 2009 and 2010.
- The joint efforts of all teams during the second half-year of 2009 and the entire year of 2010 made it possible to complete the majority of activities and plans foreseen for the first two years

Comparison with original research plan

- Due to the delay in the start of the work, the work was concentrated in the first three work packages during the first project year. For this reason a part of the validation experiments, originally foreseen for the second project year, will be performed during the third project year. This change is purely technical and does not impact the run of the project.

Comparison with original financial plan

- As personnel at IoC, LDI, ICR and DMI only reached full strength in the middle of the first project year and as these teams consequently redistributed their efforts homogeneously for the remaining 2.5 years, personnel costs for the first two years for some partners are slightly below the foreseen amounts.
- As no experiments were run in WP 5 in the first year, a part of the experiments (incl. the corresponding budget for equipment and associated costs for field works) will be used during the third project year.

Influence of third party results

- The discussions about the construction of the NordStream pipeline created considerable interest for Baltic Sea matters among politicians and state administrators but also from the general public. This was also reflected by heightened media attention, which provided increased opportunities to inform about the BalticWay project, as well as to get in touch with important stakeholders needed later on for the application of the technology to be developed in real-life situations. This activity was extremely intense in 2009 but continued to some extent also in 2010.

- Meetings with political and public administration stakeholders involving presentation of preliminary results of the project:
  - T. Soomere (IoC) participated in the discussion of the concept and principles of the new legislation on the use and protection of the marine environment by the Estonian Ministry of Environment and made several suggestions to the concept directly resulting from the BalticWay project and related to the necessity of accounting for the different internal dynamics and patterns of transport in different sea areas (30 March 2010).
  - *Baltic Conference on Intellectual Cooperation*, November 4–5, Vilnius, Lithuania: T. Soomere was a co-author of the oral presentation "Science, society and environment: the case of NordStream" presented by Ivar Puura (5.11.2010), containing several suggestions based on the results of the BalticWay project

Changes in the work plan

- While the timing of the activities has been changed due to the delayed start, the delay has been mostly resolved during the second project year. Only several technical activities of validation experiments that were not possible to carry out to full extent in 2010 have been postponed to the third project year.

Changes in the deliverables

- Deliverable D8.1 – the Project web portal – is under continuous development. It has been set up in a basic version in July 2009 at http://wavelab.ioc.ee/bonus-balticway and expanded substantially in year 2. In order to avoid duplication of material, a part of the portal reflecting the activities of the IoC BalticWay team is presented in the fact stream of the Wave Engineering Laboratory.
- A test version of deliverable D2.1 (database of 3D velocity fields) has been released ahead of the schedule, in autumn 2009, and considerably updated during the second project year
- Four added deliverables (already published scientific papers) have been delivered.

- The delay of deliverable D1.1 "Unified pool of initial, boundary and forcing data for the circulation, oil spill, and risk models" is partially caused by the need for additional data for the very high-resolution simulations of the Gulf of Finland.
- The following measures are foreseen in order to ensure release of the deliverable D1.1 as soon as possible. The coordinating team (IoC) will take over the responsibility for the WP and its deliverable starting from 01 February 2011. IoC will recruit a person capable of creating a coherent database from the existing data sets. A preliminary version of the deliverable will be released by 30 March 2011 and the final version within 2 months after the end of modelling activities (by 31 August 2011).
- At the moment all year 3 deliverables are expected to be on time, with no delays or changes currently expected.

Added Deliverables

ID 334: The wave climate and its seasonal variability in the northeastern Baltic Sea, scientific paper by A. Räämet and T. Soomere, *Estonian Journal of Earth Sciences* **59**, 1, 100–113, 2010.

ID 335: Towards identification of areas of reduced risk in the Gulf of Finland, the Baltic Sea, scientific paper by T. Soomere, B. Viikmäe, N. Delpeche, and K. Myrberg, *Proceedings of the Estonian Academy of Sciences* **59**, 2, 156–165, 2010.

ID 336: Temporal scales for transport patterns in the Gulf of Finland, scientific paper by B. Viikmäe, T. Soomere, M. Viidebaum, and M. Berezovski, *Estonian Journal of Engineering* **16** (3), 211–227, 2010.

ID 397: The use of high-resolution bathymetry for circulation modelling in the Gulf of Finland, scientific paper by O. Andrejev, A. Sokolov, T. Soomere, R. Värv, and B. Viikmäe, *Estonian Journal of Engineering* **16** (3), 187–210, 2010.

ID 439: Variations in extreme wave heights and wave directions in the north-eastern Baltic Sea, scientific paper by A. Räämet, T. Soomere, and I. Zaitseva-Pärnaste, *Proceedings of the Estonian Academy of Sciences* **59**, 2, 182–192, 2010.

ID 440: Spatio-temporal variations of wave fields in the Gulf of Finland (title in Russian: О пространственно-временной изменчивости полей волнения Финского залива), scientific paper by T. Soomere, I. Zaitseva-Pärnaste, A. Räämet, and D. Kurennoy, *Фундаментальная и прикладная гидрофизика* (Fundamental and Applied Hydrophysics) 4(10), 90–101 (in Russian).

Appendices

Current Team Composition

1. IoC, Tallinn:	Tarmo Soomere tarmo.soomere@cs.ioc.ee Ewald Quak ewald.quak@cs.ioc.ee Nicole Delpeche nicole.delpeche@gmail.com (Maternal leave from Sept 2010) Bert Viikmäe bert@ioc.ee Andrus Räämet andrus.raamet@ttu.ee Mikk Viidebaum mikk@cens.ioc.ee (started February 15, 2010) MSc students Andrea Giudici (04 March–13 July 2010) Katri Kartau
2. SYKE, Helsinki:	Kai Myrberg kai.myrberg@ymparisto.fi Oleg Andrejev Oleg.Andrejev@ymparisto.fi
3. MISU, Stockholm:	Kristofer Döös doos@misu.su.se Joakim Kjellson joakim@misu.su.se
4. SMHI, Norrköping	Markus Meier markus.meier@smhi.se Anders Höglund anders.hoglund@smhi.se
5. DMI, Kopenhagen	Jun She js@dmi.dk Jens Murawsky jmu@dmi.dk
6. GKSS, Geesthacht	Emil Stanev emil.stanev@gkss.de Lu Xi xi.lu@gkss.de
7. IFM-GEOMAR, Kiel	Andreas Lehmann alehmann@ifm-geomar.de Klaus Getzlaff kgetzlaff@ifm-geomar.de Hans-Harald Hinrichsen (as consultant) hhinrichsen@ifm-geomar.de
8. LDI, Tallinn	Sergey Babitchenko sergeyb@ldi.ee

Original Deliverables List

Del. no.	Deliverable name	WP no.	Nature	Dissemination level	Delivery date (project months)	Responsible Partner
D1.1	Unified pool of initial, boundary and forcing data for the circulation, oil spill, and risk models	WP1	Database	Public	PM 24 DELAYED	ICR
D2.1	Database of three-dimensional (3D) velocity fields	WP2	Database	Public	PM 30	SMHI
D3.1	Database of trajectories of water particles	WP3	Database	Public	PM 33	MISU
D4.1	Identification of areas of reduced risk from the analysis of trajectories	WP4	Technical Report	Public	PM 30	MISU
D4.2	Uncertainties and seasonal and interannual variability of the areas of reduced risk		Technical Report	Public	PM 33	IoC
D4.3	The effect of local wind and waves on the areas of reduced risk.		Technical Report	Public	PM 33	DMI
D4.4	Areas of reduced risk associated with favourable subsurface current patterns		Technical Report	Public	PM 36	SYKE
D5.1	Measurement of current-induced surface drift and its dispersion properties	WP5	Technical Report	Public	PM 36	SYKE
D6.1	Mathematical background of the concept of areas of reduced risks	WP6	Scientific Paper	Public	PM 36	IoC
D7.1	Development of a simplified prototype for fairway design	WP7	Technical Report	Public	PM 33	DMI
D7.2	Implementation plan and estimates of the potential gain from the proposed technology		Technical Report	Public	PM 33	ICR
D7.3	Implementation plans for potential applications of the results and description of legal and political aspects		Popular publication	Public	PM 36	IoC
D8.1	Project web portal	WP8	Web-based	Public	PM 4 available	IoC
D8.2	Year 1 report		Technical Report	Public	PM 13 submitted	IoC
D8.3	Year 2 report		Technical Report	Public	PM 25 submitted	IoC
D8.4	Final report		Technical Report	Public	PM 37	IoC
D.8.5	Advanced Study School		Training Event	Public	PM 30	IoC

Background for the statistical information

1. Number of times your project has contributed to consultations carried out by European Commission. (Provide more information in annual and final reports.)
2009: 1; 2010: none; total 2009–2010: 1

2. Number of times the scientists working in your Project have served as members or observers in stakeholder and scientific committees.
2009: 16; 2010: 26; total: 42 (calculated on annual basis, overlappings possible)

T. Soomere (IoC):

1. Estonian representative in the Marine Board of the European Science Foundation
2. EASAC Environmental Steering Panel, founding member, Estonian representative
3. Member of the Board of the Estonian Academy of Sciences
4. Chair of the Committee on Marine Sciences of the Estonian Academy of Sciences (since 2007)
5. Member of the expert group of the Ministry of Environment for estimating the content of the environmental impact assessment of the Nord Stream gas pipeline
6. Member of the Estonian national maritime commission
7. Invited expert to the discussion of the concept and principles of the new legislation of the use and protection of marine environment by the Estonian Ministry of Environment
8. Co-organiser of the international workshop „Water Seminar Day“ (18 March 2010, Frederick University, Nikosia, Cyprus), organised jointly by the BalticWay team, FP7 FET Coordination Action “Global Systems Dynamics and Policies” GSD and Frederick University.
9. Organiser of the Estonian-Finnish Humboldt Colloquium “The Baltic Sea as a Bridge” (Tallinn, 02–04 September 2010)
10. Member of the CBO (Conference of Baltic Oceanographers) steering committee
11. Member of the steering committee of the Baltic Sea Science Congress 2011
12. Member of the steering committee of the international conference „The Baltic Geology – 10” (24–28 August 2010, Saint Petersburg, Russia)
13. Member of the Scientific Council of the Laboratory of Multiphase Flows at Tallinn University of Technology

Ewald Quak (IoC)

14. Vice-chair of the Engineering panel for the evaluation of Marie Curie Initial Training Network proposals in the EU FP7 People

15. Evaluator of the ComplexityNet call, representing the Estonian Academy of Sciences
16. Member of the Expert Panel for the ex-post evaluation of 44 Belgian interuniversity networks in the framework of the IAP-VI programme
17. Member of the Program Committee, FOCUS K3D Conference on semantic 3D media and content in Sophia-Antipolis, France, February 11-12, 2010
18. Member of the Program Committee, Conference Shape Modeling International 2010 in Aix-en-Provence, France, June 21-23, 2010
19. Member of the Program Committee, SAGA Fall School in Kolympari, Greece, October 4-8, 2010
20. Member of the Program Committee, Euromed2010 Conference on Digital Heritage in Lemesos, Cyprus, November 8-13, 2010
21. Contact point Special Interest Group on Geometric Modeling, CAD, Evolving Interfaces and Surfaces of the European Consortium for Mathematics in Industry (ECMI)

Markus Meier (SMHI)

22. Organizer of the international BONUS+ program workshop "Uncertainties of scenario simulations," Norrköping, Sweden, 14 October 2010.
23. Member of the scientific committee of the 8th Baltic Sea Science Congress (BSSC) 2011, St.Petersburg, Russia, 22-26 August, 2011.
24. Co-convener of the theme session "Impact of changing climate and human-induced pressures on the Baltic Sea Ecosystem" at the Baltic Sea Science Congress (BSSC), St.Petersburg, Russia, 22-26 August 2011.
25. Co-Convener of the theme session "Integration of multidisciplinary knowledge in the Baltic Sea to support science-based management" at the 2011 Annual Science Conference of International Council for the Exploration of the Sea (ICES), Gdansk, Poland, 19-23 September 2011.

Andreas Lehmann (IfM-GEOMAR)

26. Member of the scientific steering comittee of BALTEX

3. Number of times the effort of your Project has resulted in modifications made to relevant policy documents and action plans (in particular, Baltic Sea Action Plan).
2009: 2; none in 2010; total 2009–2010: 2

4. Number of suggestions for designing, implementing and evaluating the efficacy of pertinent public policies and governance originating from the work of your Project.
2009: 6; 2010: 2; total 2009–2010: 8

IoC: 2 contributions in 2010

1. T. Soomere participated in the discussion of the concept and principles of the new legislation on the use and protection of the marine environment by the Estonian Ministry of Environment and made several suggestions to the concept directly resulting from the BalticWay project and related to the necessity of accounting for the different internal dynamics and patters of transport in different sea areas (30 March 2010).
2. *Baltic Conference on Intellectual Cooperation*, November 4–5, Vilnius, Lithuania: T.Soomere was co-author of the oral presention "Science, society and environment: the case of NordStream" presented by Ivar Puura (5.11.2010), containing several suggestions based on the results of the BalticWay project

6. Number of persons and working days spent by foreign scientists using other major facilities involved in your Project.

2009: 1 person, 3 days; 2010: 1 person, 6 days; total: 2 persons, 9 days

ICR & IoC: 1 person, 6 working days: Ms Lu Xi (ICR) visited IoC June 20–26 to implement the TRACMASS code for the ICR facilities.

7. Number of popular science papers produced by your Project.

2009: 6; 2010: 6; total 12

1. Soomere, T. Tugev tuul puhub saarerahvale merel meelehärmi (Strong wind affects the life of island people), *Maaleht* (weekly newspaper targeted to countryside people), 3(1163), 21.01.2010, p. 10–11 (in Estonian)
2. Soomere T. 2010. Pliniuse medal TTÜ vanemteadurile (Plinius Medal for the Senior Scientist in Tallinn University of Technology), *Mente et Manu* 11(1785), 4.06.2010, p. 2 (in Estonian)
3. T. Soomere, Nord Stream eirab tundliku Läänemere eripära (Nord Stream ignores the specific features of the vulnerable Baltic Sea), Tallinna Tehnikaülikooli aastaraamat 2009 (Yearbook of the Tallinn University of Technology 2009), TTÜ Kirjastus 2010, pp. 243–249 (in Estonian).
4. T. Soomere, Läänemere lainekliima muutuste keerises (Changing wave climate in the Baltic Sea). Preeden, U. Ja Laumets, L. (eds.), *Globaalsed muutused* (*Global Changes*). Schola Geologica VI. Eesti Looduseuurijate Selts, Tartu Ülikooli Ökoloogia ja Maateaduste Instituut, Tallinna Tehnikaülikooli Geoloogia Instituut, Tallinna Tehnikaülikooli Mäeinstituut. Sulemees, Tartu 2010, pp. 59–73.
5. Soomere, T. Hiidlained: meremeeste müütidest tänapäeva tipptehnoloogiasse (Freak waves: from myths to rocket science), *Tarkade Klubi* (Estonian popular science journal), Special issue 2010, 44–45 (in Estonian).
6. CENS-CMA: Coastal research on the crest of a wave, Marie Curie Actions: Inspiring Researchers, European Commission, Directorate-General for Research, 2010, 232–235.

8. Number of interviews to media given by members of your Project's consortium.

2009: 19; 2010: 15; total 2009–2010: 34

IoC: 15

1. The TV channel Kanal 2 broadcast a comment by T.Soomere on the case of issuing the permit to the Nord Stream by Finland (12.02.2010).
2. Anonymous, The pipeline construction phase is the most dangerous, Postimees Online 12.02.2010; 23:54 (online version of the daily newspaper The Postman), based on comments of T.Soomere to the TV channel Kanal 2 (12.02.2010).
3. Interview with T.Soomere to the state radio channel „Vikerraadio" in the series „Fellows of the Academy of Sciences" (12.03.2010), broadcast also (17.04.2010).
4. Comment by T.Soomere to Radio Kuku Marine Hour about launching construction of the Nord Stream gas pipeline in the Baltic Sea and about the request of the Nord Stream AG for a permission of environmental monitoring in the Estonian Exclusive Economic Zone (10.04.2010).
5. Interview with T.Soomere in the national TV channel ETV broadcast in the series „2020" dedicated to foresights to the future of the Baltic Sea (18.04.2010).
6. Comment by T.Soomere to Radio Kuku morning broadcast about the state-of-the-art and future of the problems caused by ash clouds stemming from the Islandic volcano eruption (21.04.2010).
7. Heli Saavalainen "Hyökyaalto oli vieda hengen Suomenlahdella" (Fast ferries to Tallinn pose a serious threat to boats and yachts in shallow waters off Helsinki: Surge caused by passing ship nearly kills boater in Gulf of Finland), Helsingin Sanomat 09.05.2010, pp. A12–A13), the leading daily newspaper in Finland published a story about ship-wave-induced boat accident in the Gulf of Finland, with an expert comment about the possible reasons by T.Soomere; English version: http://www.hs.fi/english/article/Fast+ferries+to+Tallinn+pose+a+serious+threat+to+boats+and+yachts+in+shallow+waters+off+Helsinki/1135256773766
8. Tiina Jõgeda, "High-speed ferries excite killer waves" (Kiirlaevad tekitavad tapvaid laineid), full-page article largely based on the research into ship wakes performed in the Wave Engineering Laboratory (Eesti Ekspress, 10(1087), 20.05.2010, p. 4).
9. Comment by T.Soomere to Radio Kuku about studies into killer waves performed in the Wave Dynamics Laboratory (20.05.2010).
10. A 'live on air' interview of T.Soomere to TV channel TV3 focusing on the properties of ship waves in Tallinn Bay and their potential for studies into killer waves (20.05.2010).
11. An interview of T. Soomere to the Reporter's Hour, state radio channel Vikerraadio, about the meaning and potential consequences of the oil pollution in the Gulf of Mexico (by phone from Istanbul, 04.06.2010).
12. Interview with T.Soomere about the Alexander von Humboldt Colloquium „The Baltic Sea as a Bridge" was broadcasted by the state radio channel Vikerraadio (03.09.2010).
13. Interview with T.Soomere about the key ideas of the Alexander von Humboldt Colloquium „The Baltic Sea as a Bridge" was broadcasted twice by Kuku Raadio in Marine Hour (04.09.2010).

14. Interview with I.Didenkulova to TV channel ETV reflecting common features of ship waves in Tallinn Bay and tsunamis (12.09.2010).
15. Ulvar Käärt, „The central government should clean up the sea, say Tallinn City officers“ (Linn haisvast Pirita tee äärest: riik koristagu merest roisukraam), reflects an interview with T. Soomere (Eesti Päevaleht, No. 223, 28.09.2010, p. 8, in Estonian).

12. Number of times your project has contributed to dissemination products/events addressed to general public concerning coupling between marine environmental quality and human health and well-being.
2009: 10; 2010: 13; total 2009–2010: 23

IoC: 13

1. Anonymous, Scientist from TUT receives the Environmental Deed 2009 (Keskkonnateo tiitel TTÜsse), *Mente et Manu*, No 2(1776), 29.01.2010, p. 1 (in Estonian).
2. Margus Maidla, The scientist riding the ninth wave (Tarmo Soomere, mees üheksanda lainega, interview with T.Soomere), Kultuuri KesKus (monthly journal focusing on various aspects of culture), May 2010, p. 48–49 (07.05.2010) (in Estonian).
3. T.Soomere. Nord Stream as a challenge for the society, public lecture to the annual meeting of the Estonian Water Society, February 5, 2010.
4. T.Soomere. Nord Stream as a challenge for the Baltic Sea marine science, public lecture to geography teachers, Tallinn House of Teachers, February 7, 2010.
5. T.Soomere. Towards a future technology of environmental management: the use of properties of currents for minimizing coastal pollution, public lecture to the Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Hobart, August 17, 2010.
6. T.Soomere. Are regional wave climates changing? Public lecture in the framework of Technical Meeting Series of the Tasmanian Divisions of RINA (Royal Institute of Naval Architects) and IMarEST (Institute of Marine Engineering, Science and Technology), Australian Maritime College, University of Tasmania, Launceston, August 18, 2010.
7. T.Soomere. New aspects of the meaning of extreme waves in maritime engineering design, public lecture to the Australian Maritime College, University of Tasmania, Launceston, August 18, 2010.
8. T.Soomere. The changing wave climate of the Baltic Sea. Invited lecture to the 6th autumn school of young geologists “Schola Geologica – 6”, Roosta, October 8–10, 2010.
9. T.Soomere, Patterns of changes to the regional wave climate. School of Earth and Environmental Sciences, James Cook University, Townsville, Australia, 02 November 2010.

10. T.Soomere, Towards the use of properties of currents for environmental management, with applications to ship-caused pollution, public lecture to the Institute of Marine Engineering, Science and Technology (IMarEST), Queensland Branch, Townsville Marine Museum, Australia, 11 November 2010.
11. T.Soomere, Contribution of fundamental research towards solving challenges of changing times, Oceans Institute, University of Western Australia, Perth, 24 November 2010.
12. T.Soomere, Patterns of changes to the regional wave climate, School of Environmental Systems Engineering, University of Western Australia, Perth, 25 November 2010.
13. E.Quak, The Baltic Way project: The potential of currents for environmental management of the Baltic Sea. Universität Ulm, Germany, 17 December, 2010.

13. Number of datasets your project has delivered to the common metadata base of the Programme.

2009: 3; 2010: none; total 3

14. Number of scientists that attended international workshops, WG meetings, conferences, intercalibration exercises, etc. paid by BONUS+

2009: 18; 2010: 36 times (13 persons); total 2009–2010: 54

2009: Total 36 times, 13 persons

IoC: 25 times, 9 persons

Tarmo Soomere	Lithuania, Vilnius	2010-01-18	2010-01-21
Bert Viikmäe	Lithuania, Vilnius	2010-01-19	2010-01-21
Tarmo Soomere	Soome, Helsinki	2010-02-08	2010-02-09
Nicole Delpeche	Cyprus	2010-03-15	2010-03-22
Bert Viikmäe	Cyprus	2010-03-16	2010-03-22
Tarmo Soomere	Cyprus	2010-03-16	2010-03-22
Ewald Quak	Cyprus	2010-03-18	2010-03-21
Tarmo Soomere	Turkey, Istanbul	2010-04-20	2010-04-24
Bert Viikmäe	The Netherlands, Delft	2010-05-09	2010-05-13
Tarmo Soomere	Belgium, Brussels	2010-05-10	2010-05-11
Tarmo Soomere	Turkey, Istanbul	2010-06-01	2010-06-05
Tarmo Soomere	Finland, Helsinki	2010-06-08	2010-06-09
Andrus Räämet	Poland, Miedzyzdroje	2010-06-13	2010-06-18
Bert Viikmäe	Poland, Miedzyzdroje	2010-06-13	2010-06-19
Tarmo Soomere	Australia, Townsville, Hobart	2010-06-24	2010-08-22

Andrea Giudici	Russia, Baltiysk	2010-06-26	2010-07-01
Ewald Quak	Ukraina, Kyiv,	2010-08-04	2010-08-08
Anna Terentjeva	Russia, Sankt Peterburg	2010-08-22	2010-08-29
Olga Tribštok	Russia, Sankt Peterburg	2010-08-22	2010-08-29
Bert Viikmäe	Russia, Sankt Peterburg	2010-08-23	2010-08-29
Tarmo Soomere	Russia, Sankt Peterburg	2010-08-23	2010-08-29
Bert Viikmäe	Lithuania, Palanga	2010-10-05	2010-10-09
Katri Kartau	Lithuania, Palanga	2010-10-05	2010-10-08
Mikk Viidebaum	Lithuania, Palanga	2010-10-05	2010-10-09
Tarmo Soomere	Belgium, Oostende + Australia	2010-10-12	2010-12-10

SMHI: 1 person, 1 time (Markus Meier to visit SYKE, 24 May 2010)

LDI: 1 person, 1 time (presentations in Australia, part of costs)

SYKE: 2 persons, 9 times
March 2010 Kai Myrberg and Oleg Andrejev, BalticWay Annual meeting, Cyprus, 4 days
June 2010 Kai Myrberg and Oleg Andrejev, BALTEX workshop Poland, 4 days
June 2010, Oleg Andrejev, workshop in IoC, 2 days
October 2010 Kai Myrberg, negotiations with A Lehmann, Kiel, 5 days
November 2010 Oleg Andrejev, St.Petersburg, consultations with Russian collegaues, 2 days
November 2010 Kai Myrberg, Stockholm, consultations with A. Sokolov
December 2010 Kai Myrberg, Stockholm, consultations with A. Sokolov

Use of Infrastructure

SMHI:

Supercomputer facilities and disk space for data storage

Purpose: Production and storage of forcing data sets and RCO model simulations (cpu time, disk and tape storage).

Amount of use: 600 000 CPU hours

In-kind contribution: 50 000 €

IoC: Cluster of 98 Opteron CPU

Purpose: Performing calculation of Lagrangian trajectories with the use of the TRACMASS code, intermediate storage of trajectory data

Amount of use: 5 000 CPU hours

In-kind contribution (approximate): 2500 €

3-D Graphics Workstation

Purpose: Three-dimensional visualisation of simulation results

Amount of use: 200 working hours
In-kind contribution (approximate) 2000 €

LDI: Lidar system

Purpose: Remote measurements of dissolved organic matter and surface pollution in sea water

Amount of use: 20 hours (test regime) + 20 hours (measurements in the Gulf of Finland)

In-kind contribution (approximate) 10 000 €