JERICO

Application for Transnational Access

to Coastal Observatories

University of Gothenburg

2 April 2012

Description of the project (to be provided in pdf format)
Please contact the manager of the infrastructure/installation you wish to use before writing the proposal

PART 1: User group details

Indicate if the proposal is submitted by

O an individual
X a user group

Information about the applicants (PI and project partners)

Principal Investigator (user group leader)

Title Assoc. Prof Name and Surname Anna Wåhlin_____

Gender O Male X Female

Institution Department of Earth Sciences, University of Gothenburg_____

Department / Research Group Oceanography_____

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_____

Country __Sweden_____

email ___anna.wahlin@gu.se_____

Telephone ___+46708394462_____

Fax ____+46317861986_____

Project partners
(repeat for each partner of the group)

Partner # 1

Title Prof._ Name and Surname Karin Borenäs_____

Gender O Male X Female

Institution _SMHI_____

Department / Research Group ___Oceanographic Research_____

Address SMHI Gothenburg, Sven Källfelts gata 15, SE-426 71 Västra Frölunda_____

Country __Sweden_____

email __karin.borenas@smhi.se_____

Partner # 2

Title Dr._ Name and Surname Bengt Karlson_____

Gender X Male O Female

Institution _SMHI_____

Department / Research Group ___Oceanographic Research_____

Address SMHI Gothenburg, Sven Källfelts gata 15, SE-426 71 Västra Frölunda_____

Country __Sweden_____

email __bengt.karlson@smhi.se_____

Partner # 3

Title Prof._ Name and Surname Göran Björk_____

Gender X Male O Female

Institution _Department of Earth Sciences, University of Gothenburg_____

Department / Research Group _Oceanography_____

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Partner # 4

Title Prof._ Name and Surname Lars Arneborg_____

Gender X Male O Female

Institution _Department of Earth Sciences, University of Gothenburg_____

Department / Research Group _Oceanography_____

Address __Box 460, 405 30 Gothenburg_____

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Partner # 5

Title Dr._ Name and Surname Lene Friis Möller_____

Gender O Male X Female

Institution _Department of Biological and Environmental Sciences, University of Gothenburg_____

Department / Research Group _Plankton ecology_____

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Country __Sweden_____

email __lene.friis.moller@bioenv.gu.se_____

PART 2: Additional information about the applicant(s) expertise

Expertise of the group in the domain of the application

The group has many years of experience in experimental oceanography, physical oceanography, biological oceanography (i.e. phyto- and zooplankton ecology). The group has together published over 100 papers in international peer-reviewed journals in closely related subjects. The whole group has not been engaged in a joint project previously, but all members of the group have worked extensively with the other members. Collaborations have taken place during joint projects both nationally and internationally (e.g. CANIGO). The group has together performed over 25 oceanographic expeditions in Scandinavian and polar waters.

Short CV of the PI

Curriculum Vitae

Dr. A. K. Wåhlin

Senior Researcher in Polar Oceanographjy, Göteborg University

1. Ph. D.

Ph. D. in Physical Oceanography, University of Gothenburg, 2001.

2. Post-doc visits

2008 USA, guest researcher at Woods Hole Oceanographic Institution (4 months)
2003 USA, Florida State University (4 months), visiting Prof. D. Nof.
2002 - 2006 Norway, Oslo University (4 years), Department of Geophysics.

3. Associate Professor (Docent)
Associate Professor in Physical Oceanography, University of Gothenburg, 2007

4. Current position
From Jan 2011, Senior research position (Rådsforskartjänst) in Polar Oceanography (Vetenskapsrådet). Department of Earth Sciences, University of Gothenburg.

5. Previous assignments:
2003 - 1 april 2006. Post-doc Oslo Universitet.
1 april 2006 - 1 april 2007 Research scientist (Vetenskapsrådet), Meteorologiska institutionen, Stockholms Universitet
1 april 2007 - 2010. Research scientist (Vetenskapsrådet), Institutionen för Geovetenskaper, Göteborgs Universitet.

6. Maternity leave
In total 18 months maternity leave for two children during the years 2000 - 2003

7. Supervision of Ph. D. students
Dr. E. Darelius, Ph. D. 2007 (Geofysiskt institutt, University of Bergen). Thesis title: On the influence of Small-Scale Topography on Dense Plumes, with a Special Focus on the Filchner Overflow Plume.
Ongoing: O. Kalen

8. Cruise experience
2010/2011: Oden Southern Ocean. Polar expedition with **Icebreaker Oden** to the Amundsen and Ross Seas, Antarctica. PI on board.
2008/2009: Oden Southern Ocean. Polar expedition with **Icebreaker Oden** to the Amundsen and Ross Seas, Antarctica. PI on board.
2008-2009: Responsible for field course in Marine Environmental Monitoring, University of Gothenburg (2 years), **RV Skagerrak**
2007: Polar expedition with **Icebreaker KV Svalbard** to Storfjorden, Svalbard. PI.

9. Invited oral presentations at international conferences (since 2007):
2011 **Invited speaker** at the Faculty of Science Research Days, University of Gothenburg
2010 **Invited keynote speaker** at the **Scientific Committee for Antarctic Research** Open Science conference, Buenos Aires.
2010 **Invited speaker** to the Crafoord Symposium held jointly with the Crafoord Prize Ceremony **(Royal Swedish Academy of Science)**
2008 **Invited speaker** to the Sandström Symposium, **Stockholm University**.
2008 **Invited speaker** to the Spring colloquium series, **Yale University, USA**.
2007 **Invited speaker** to the **HYDRALAB III General Assembly**, 'Experimental observations of increased entrainment in the presence of submarine canyons and ridges'. **Budapest, Hungary.**
2007 **EGU General Assembly**, 'Topographic steering of dense overflow plumes by canyons and ridges'. Vienna, Austria **(solicited presentation).**

10. Awards and stipends

2010 Crafoord Research Stipend, Swedish Royal Academy of Science
2008 Fulbright Research Fellowship, Fulbright Foundation
2003 Kristine Bonnevie stipend, Faculty of Mathematics and Natural Sciences, Oslo University

11. External examiner for Ph. D. students (in Swedish: 'Opponent')

2011 C. Wang, Ph. D. University of Helsinki. Thesis title: Antarctic Ice Shelf Melting and its impact on the Global Sea Ice-Ocean System.
2011 S. Teigen, Ph. D. University Center of Svalbard/University of Bergen. Thesis title: Water mass exchange in the sea West of Svalbard.
2011 B. Lynge, Ph. D. University of Oslo. Thesis title: High Resolution Tidal Models for the Norwegian Coast
2006 J. Albretsen, Ph. D. Oslo University. Thesis title: The Skagerrak circulation sensitivity to external forcing.

12. Other types of professional recognition

2011 Summer school lecturer: Invited lecturer for the course 'Ocean Biogeochemical Dynamics' arranged by the Tellus platform, University of Gothenburg
2010 Summer school lecturer: Invited lecturer for the Alpine Summer School on Fundamental Processes in Geophysical Fluid Dynamics and the Climate System (topic for 2010 'Buoyancy Driven Flows'), *http://www.to.isac.cnr.it/aosta/*
2009 Convener of *'Mixing in the ocean: Causes and consequences'*, session of IAPSO general meeting, Montreal, Canada.
2008 Co-convener of *'The Nordic Seas and the North Atlantic's Subpolar Gyre:...'*, of Ocean Sciences Meeting in Orlando, Florida, March 2-7, 2008
2007 Convener of *"Turbulence in Buoyant and Dense Plumes"* of the 39th International Liège Colloquium on Ocean Dynamics.

13. Funding record after the post-doc period:

PI or CI of in total 9 grants, amounting to a total sum of 13.400 kSEK from the Swedish Research council, Vinnova, EU, Fulbright and the Royal Swedish Academy of Science

14. Publications.

17 publications in international peer-reviewed journals. H-index: 10
The five most highly cited publications are listed below (in chronological order). Citation data are from Scopus.

Darelius, E. and **A. Wåhlin**, 2007. Downward flow of dense water leaning against a topographic ridge. *Deep-Sea Research part I*, 54 (7), 1173-1188. **Number of citations: 18**
Wåhlin, A., 2004: Downward channeling of dense water in topographic corrugations, *Deep-Sea Research part I,* 51 (4), 577 - 599. **Number of citations: 21**
Borenäs, K. M., **A. Wåhlin**, I. Ambar and N. Serra, 2002: The Mediterranean outflow splitting - a comparison between theoretical models and CANIGO data. *Deep Sea Research II*, 49, 4195-4205. **Number of citations: 24**
Wåhlin, A., 2002: Topographic steering of dense bottom currents with application to submarine

canyons, *Deep-Sea Research part I*, 49 (2), 305 - 320. **Number of citations: 37**
Wåhlin, A. and G. Walin, 2001: Downward migration of dense bottom currents. *Environmental Fluid Mechanics* 1 (2), 257 - 279. **Number of citations: 20**

Examples of relevant publications of the participants in the field of the project

1. Björk, G. and K. Nordberg, Upwelling along the Swedish west coast during the 20th century, Continental Shelf Research, 23, 1143-1159, 2003.
2. Møller, LF., Riisgård, H.U. (2007). Population dynamics, growth and predation impact of the common jellyfish Aurelia aurita and two hydromedusae, Sarsia tubulosa, and Aequorea vitrina in Limfjorden (Denmark). Mar. Ecol. Prog. Ser., Vol. 346: 153–165, 2007
3. Arneborg, L. (2004). Turnover times for the water above sill level in Gullmar Fjord Cont. Shelf Res., Vol. 24, 443–460.
4. Holliday, N.P., Hughes, S.L., Borenäs, K., Feistel, R., Gaillard, F., Lavìn,, A., Loeng, H., Mork, K., Quante, M., and R. Somavilla. Long-term physical variability in the North Atlantic Ocean. In Reid, P.C., and Valdés, L., 2011. ICES status report on climate change in the North Atlantic. ICES Cooperative Research Report No. 310, 21-46.
5. Karlson, B., Sahlsten, E., Edler, L., Kuylenstierna, M. & Granéli, W. (1996). Subsurface chlorophyll maxima in the Skagerrak - processes and community structure. J. Sea Res., Vol. 35: 139-158.
6. Wåhlin, A., Muench, R, Arneborg, L., Björk, G., Ha, H. K., Lee, S. H. and Alsén, H., 2012. Some implications of Ekman layer dynamics for cross-shelf exchange in the Amundsen Sea. Journal of Physical Oceanography, in press
7. Jaspers C, Møller LF, Kiørboe T (2011) Salinity Gradient of the Baltic Sea Limits the Reproduction and Population Expansion of the Newly Invaded Comb Jelly *Mnemiopsis leidyi*. PloS One 6(8): e24065. doi:10.1371/journal.pone.0024065

PART 3: Detailed scientific description of the project

List the main objectives of the proposed research

(one page maximum)

- To detect the position of the Kattegat-Skagerrak front using in situ observations from autonomous gliders and research vessel, as well as satellite images
- To correlate the position and variability of the front with possible driving mechanisms and apply a conceptual model for the transport along the front
- Determine the three-dimensional properties of the front and correlate the hydrography to the biology
- To investigate the distribution of phytoplankton using chlorophyll fluorescence as a proxy for phytoplankton biomass. Coccolithophorids has a special focus and turbidity will be used as a proxy.
- To investigate the distribution of zooplankton including jellyfish

Give a brief description of the scientific background and rationale of your project

(one page maximum)

The conditions in Kattegat are crucial for the water exchange with the Baltic Sea. In the northern part the relatively fresh Kattegat water masses are separated from the more saline Skagerrak water by a front. The dynamics of this front is of special interest since it may have an impact on the Baltic Sea inflow. The front also plays an important role for many biological processes, for example, the

spreading of larvae by the frontal current. More recent observation techniques have increased the amount of data considerably, so that it is now possible to evaluate existing process models for the position and motion of the front. In the present project the vertical extent of the front and water masses will be examined and the data compared to time series of remote- and underway measurements. The effect the front has on algae bloom, larvae transport and zooplankton (including jellyfish) distribution will be examined. Preliminary results point to enhanced mixing in the vicinity of the front, and the effects of this will be further examined during the project.

The baroclinic Rossby radius (the length scale at which the effects of the Earth's rotation become important) based on the two water masses is around 10 kilometers, i.e. small compared to the width of Kattegat. Hence the dynamics are expected to be rotationally dominated for baroclinic flows (Nielsen, 1998). The halocline is only present in the deeper eastern parts of Kattegat, and the water column in the shallow plateau in the western parts is more or less homogeneous (Pedersen, 1993). The northern surface front is found in the neighborhood of the border between Kattegat and Skagerrak. The front moves considerably in the north-south direction and it is debated where its mean position is located and the range of the variability (Jakobsen, 1997). In Fig.1 a recent example of the front is given.

Nielsen (2005) suggests that the surface front in the northern part plays an important role for the circulation in the entire Kattegat (Nielsen, 2005). The density gradient across the front may cause a large-scale anticyclonic circulation in the upper layer, and a corresponding cyclonic circulation in the lower layer. This hypothesis was supported by a new data set and also by a previous investigation by Andersson and Rydberg (1993). According to Nielsen (2005) the lower layer circulation supplies oceanic water to the Baltic and it is put forward that the strength and location of the Kattegat-Skagerrak front may have an impact on the Baltic Sea inflow. The question of what controls the position of the front remains more or less open though (Nielsen, 2005).

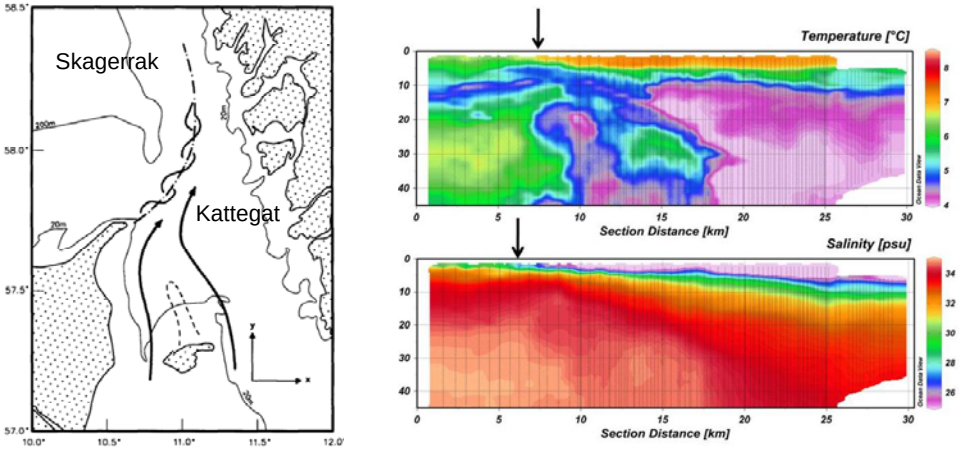

Figure 1. Map showing the approximate position of the Kattegat-Skagerrak front. (From Jacobsen, 1997). Right panel: Transects across the surface front showing temperature and salinity on April 12, 2010 (Sweden to the right). These data were obtained with dense MSS microstructure profiling. The temperature- and salinity fronts are indicated by black arrows.

Nielsen (2005) discussed the possibility of fish eggs and larvae to be transported by the baroclinic flow if the front zone is in the vicinity of the spawning area. This mechanism can hence be of major importance for the size of the recruitment. Carstensen et al. (2004) suggests that phytoplankton blooms could get started in hydrodynamically active regions, such as the front zone, and then be transported to other parts of the Kattegat. The invasive ctheonophore *Mnemiopsis leidyi* is reintroduced every year to the Skagerrak/Kattegat area where it potentially has a major impact on the pelagic food web (Møller&Tiselius, unpublished). The pathway of re-introduction is still unknown and this study will give new information on what controls if and when the ctenophores arrive.

All studies of the Kattegat-Skagerrak front suffer from a shortage of data, and in particular data with good spatial coverage. It is anticipated that the combination of the new type of data, obtained from remote sensing, underway measurements, and autonomous glider data in combination with transects will provide better statistics for the surface front and contribute to a better understanding of the mechanisms that determine the position of the Kattegat front and the general dynamics in this area.

Present the proposed experimental method and working plan

The Skagerrak-Kattegat front will be examined using a combination of autonomous glider data, ship-based transects and remotely sensed data together with underway measurements from the Color Fantasy Ferry box system on the route Oslo-Kiel operated by JERICO partner NIVA.

The experiment will take place in late spring 2013. The gliders will be used to cover a half-circle of short transects where we expect the front to be located (the track will be adjusted during the course of the experiment in order to capture the front region). The transects are located so that the main current will move the glider along the front, while the glider moves across the main front and current making several short transects (Figure 2)

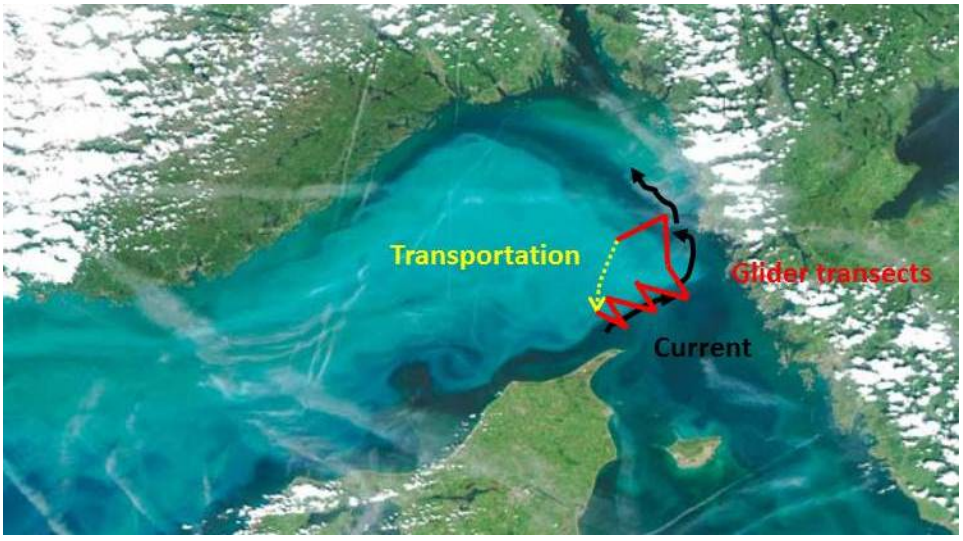

Figure 2. Satellite image showing ocean color (TERRA MODIS, processed by Martin Hansson, SMHI) together with the proposed glider sections (red), the main current (black) and the return track for the glider (out of the main current).

The gliders will measure salinity, temperature, oxygen content, chlorophyll fluorescence, turbidity, dissipation rates of turbulent kinetic energy, and all other available hydrographic sensors that can be used to characterize the front and the mixing within the front. During deployment and recovery we will also make use of the research vessel Skagerak for 5 days on each occasion. The same transects will then be occupied with the research vessel, from which most of the biological sampling will take place with water sampling for phytoplankton and net tows for zooplankton and jellyfish (Hydrobios MultiNet). From the research vessel we will also measure hydrography with a Seabird CTD (fitted with sensors for chlorophyll fluorescence, turbidity etc.), currents with a ship-born ADCP, and mixing using an MSS turbulence profiler. These measurements will be used for intercalibration of the gliders as well as to complete the dataset.
Data produced will be available to JERICO partners and will be submitted to the Swedish Oceanographic Data Centre at SMHI.

Indicate the type of access applied for

O	remote	*(the measuring system is implemented by the operator of the installation and the presence of the user group is not required)*
O	partially remote	*(the presence of the user group is required at some stage e.g. installing and un-installing)*
X	in person/hands on	*(the presence of the user group is required/recommended during the whole access period)*

Indicate the proposed time schedule including expected duration of access time
(half a page maximum)

May 20 to June 14, 2013 (28 days)
The research vessel departs on a Monday from Kristineberg, on the Swedish West coast, for the deployment and recovery cruises. It is preferable if the equipment can arrive on the Friday before the deployment, and if the technician can arrive on the Sunday so that we can get all people and the equipment to Kristineberg on Sunday evening (it is a 2 hour drive from Gothenburg).

Host infrastructure

Indicate the type(s) of JERICO host facility(s) you are interested in
(Tick more than one if it is useful for your project)

O ferrybox	O fixed platform	X glider	O calibration laboratory

Indicate the specific JERICO host facility(ies) you wish to choose
COBS 4 POL GLIDER

Explain briefly why you think your project will be best carried out at the specified host facility(ies)

The facility is positive towards transporting the equipment and performing experiments in Swedish waters.

If possible, list other JERICO facility(ies) where you think your experiment could alternatively be carried out

Provided they are positive towards performing experiments in Swedish waters, the following facilities could be used:
COSYNA_3 (GLIDER); CSIC-Glider and CETSM

Additional information

Is there a facility similar to the one you wish to utilize in your country?

O Yes X No

If yes, please indicate your reasons for requesting access to the JERICO facility you have chosen

Have you already submitted an Access Proposal to any of the participating facilities under this or previous EU Programs?

O Yes X No

If yes, please indicate the name of the institution, submission date and reference number for each such proposal

Is this a resubmission of a previously rejected proposal? *(Select "yes" if this application is a revised version of a proposal submitted to JERICO before that was rejected by the Selection Panel)*

O Yes X No

If yes, please give the exact reference number and submission date. Kindly describe briefly the changes made in comparison to the rejected version.

Is this a continuation of an earlier project funded under a previous call for Transnational Access in JERICO at the same facility?

O Yes X No

If yes, please give the exact reference number and submission date. Kindly indicate also what has been achieved in the previous experiment and the reasons why the objectives have not been fully met.

PART 4: Technical information

Wherever possible, please specify your requests regarding the use of your chosen facility's equipment/instruments/sensors, including any additional services, data or other requirements.

If possible we would like to use two gliders. Glider G2, equipped with pumped Seabird CTD, Aanderaa oxygen optode, Wetlabs triplet sensor for CDOM, Chl-a fluorescence and turbidity, and glider G1, equipped with non-pumped Seabird CTD and a Rockland Scientific MicroRider turbulence probe (microconductivity, shear and temperature at up to 512Hz).
We need the technician to travel to Sweden and operate the glider during the deployment and recovery cruises.
Satellite communication
Processing of data
Lithium batteries for the main experiment

List all material/equipment you plan to bring to the JERICO facility (if any):

Please provide a detailed and realistic budget for the expenses you expect to incur for travel/boarding and the shipment of equipment, if applicable in your case *(note that a maximum of two travel grants will be assigned to each user group, depending on the length of the requested period of stay)*.

Costs for freight plus travel for one person, two trips to Sweden**:

Transport of gliders, air freight, 1000 EUR each way each glider
4000 EUR

Flight ticket, Liverpool-Gothenburg, 1 person, 1000 EUR each trip
2000 EUR

Rental of minivan in Sweden for transportation of equipment and personnel, 2x7 days
600 EUR

Hotel in Gothenburg, one person, four nights, 100 EUR per night
400 EUR

Food and berth on R/V Skagerak, one person, ten nights, 50 EUR per person and day
500 EUR

Daily allowance, 1 person, 14 days, 50 EUR per day
700 EUR

Sum for 2013
8200 EUR

Indirect costs (45 %): 3690 EUR

Total sum: 11890 EUR

***** The equipment is insured by the University of Gothenburg. Should the equipment be damaged or lost there will be a deductible fee of approximately 5000 EUR. This fee will not be covered by the University of Gothenburg***

Please tick the appropriate boxes and give detailed information for the kind of risks associated with your proposed activity

☐ Chemical :
☐ Biological :
☐ Radiological :

Date of compilation 120403

Signature of the PI

Signature of an appropriate authorised person
(e.g. Head of Department, Research Office) Gian Selldeni

This section reserved to the JERICO TNA Office

Date of proposal receipt by email

Assigned reference number

Signature of receiving officer

National Research Council of Italy OGS CNRS IBW PAN hcmr NIVA

Ifremer Helmholtz-Zentrum Geesthacht CSIC National Oceanography Centre