

International Evaluation of SNSB's Earth Observation Research Programme 2005-2010



Cover photo: Kristine Dannenberg

Contents

Introduction 5

Presentation of the Members of the Evaluation Panel 6

General Observations and Recommendations to SNSB 10

Evaluation Comments on the Individual Groups 12

Appendices: Guidelines to the Evaluators 21

 Guidelines to the Research Groups 23

Introduction

The Swedish National Space Board (SNSB) is a governmental agency under the Ministry of Education and Research. One of its major tasks is the promotion and funding of fundamental and applied space research in Sweden. Research by means of Earth Observation (EO) data from space is one of the research areas supported by SNSB. The EO research programme was established already in 1970s and its current budget is 14-15 MSEK/year, supporting around 15 research projects at Swedish universities and research institutes.

SNSB's EO research programme involves many research areas which benefit from the utilisation of Earth Observation satellite data. Forestry, climatology, oceanography, glaciology and studies of urbanisation are examples of the research fields represented in the programme.

The present evaluation process was initiated by SNSB in the spring of 2010 and an Evaluation Panel, consisting of four well-known international experts, was established. The members of the Panel were Prof. Dr. Barbara Koch, Prof. Tuomas Häme, Prof. Jouni Pulliainen and Prof. Ian Robinson, presented in more detail in the subsequent chapter.

The main focus of this evaluation was to assess the impact and results achieved through the support of SNSB during 2005-2010, and to provide recommendations to SNSB regarding further development of the Swedish EO programme. The evaluation report also provides comments on the individual research groups, with recommendations for future work when relevant and appropriate. The individual group, as referred to in the report, considers a group of scientists working within a project supported by SNSB. Thus, the "individual group" does not necessarily correspond to a research group within the local organisation of a university or institute. It should also be noted that the scope of the evaluation is solely the national EO science activities funded by SNSB. Activities of the research groups related to topics other than satellite based EO or funded by other funding bodies were not subject to this evaluation. Consequently, for some groups most of the ongoing projects have been funded by SNSB, whereas for other groups SNSB grants and related projects are only a minor part of the activities. For this reason, the reports on the individual groups and the quantitative outcome in terms of e.g. scientific papers may not be comparable.

During the evaluation process, the research groups holding grants within SNSB's EO programme were requested to submit reports on their science activities and main results within the time frame of 2005-2010. The reports were thoroughly studied by the members of the Evaluation Panel during the summer 2010. The Panel then gathered in Stockholm, on September 28-30, for a joint meeting, including interviews with representatives of the research groups. All the groups were also invited to give a short oral presentation on their achievements within the project(s) during the last six years.

The final result of the Evaluation of SNSB's EO research programme is given in this report. SNSB would like to express its gratitude to the Evaluation Panel for the comprehensive work and also to all the research groups for their participation in the evaluation process.

For environmental reasons, SNSB has chosen not to produce any paper copies of the report.

Kristine Dannenberg, on behalf of SNSB

The Evaluators

Prof. Dr. Barbara Koch is Head of the Department of Remote Sensing and Landscape Information Systems (FeLis) at the University of Freiburg, Germany. She is also leading the Steinbis Research Center in Freiburg, which develops practical applications of Earth Observation.

Barbara Koch graduated from the Ludwig-Maximilians University of Munich, with Master degree in Forest Sciences in 1982 and received her Ph.D. in Remote Sensing in 1988. In 1994 she became a full Professor of Remote Sensing and GIS at the Albert-Ludwigs University of Freiburg, where she established the Remote Sensing and GIS unit. Barbara Koch has been honoured with many awards for her scientific papers. In recent years she has focused her research efforts on development of laser applications and coordination of national and international research projects within remote sensing. She is lecturing in photogrammetry, remote sensing, digital image processing, GIS and environmental impact assessment.



Prof. Dr. Barbara Koch

Prof. Tuomas Häme received his Ph.D. from the University of Helsinki in Forest Mensuration and Management. He has been working in the research and development of remote sensing applications for more than 30 years, often in a close cooperation with the operational users. He has managed or is presently managing several international remote sensing projects. Tuomas Häme's main expertise area is forestry but he has also worked in the fields of civil security and land cover mapping. He is familiar both with optical and radar data analysis techniques.

Tuomas Häme holds a Research Professorship in Earth Observation at VTT Technical Research Centre of Finland being responsible for the remote sensing research at VTT. He works part time also in the VTT ICT operation as a Research Coordinator. Tuomas Häme is a

member of the Mission Advisory Group of the Sentinel 2 satellite and a Finnish delegate to Data Operations Scientific and Technical Advisory Group (Dostag) of the European Space Agency. Tuomas Häme is author of more than 120 scientific papers. He has spent two longer periods abroad, at North Carolina State University and Joint Research Centre.



Prof. Tuomas Häme

Prof. Jouni Pulliainen received his academic degrees, M.Sc., the Licentiate in Technology and Ph.D. in Science and Technology from the Helsinki University of Technology (TKK), Faculty of Electrical Engineering, in 1988, 1991 and 1994, respectively. From 2001 to 2006 he was Professor of Space Technology at the TKK, specializing in remote sensing. Currently he is Research Professor at the Finnish Meteorological Institute (FMI) and Head of the Arctic Research of FMI. His research interests include direct and inverse modelling in remote sensing, and additionally, remote sensing data assimilation and application development for climate change studies. Recently, his work has focused on the active and passive remote sensing of boreal forests and snow cover applying both microwave and optical data, including atmospheric correction.

Jouni Pulliainen has been a principal investigator or project manager of many nationally funded and international research projects, including several ESA and EC contracts. From 1993 to 1994 he was Acting Director of the Laboratory of Space Technology at TKK. He is author of about 250 scientific papers and technical reports in the field of remote sensing.

Jouni Pulliainen has been holding membership in several international scientific committees such as ESA Advisory Committee on Education (2001-2007); ESA CoreH2O MAG (2007 onwards) and ESF European Space Sciences Committee (ESSC, 2008 onwards).



Prof. Jouni Pulliainen

Prof. Ian Robinson is based at the National Oceanography Centre, Southampton, United Kingdom, where he is Professor of Satellite Oceanography in the University of Southampton's School of Ocean and Earth Sciences. He has 40 years experience of research and teaching in physical oceanography. For 32 years he has specialised in applying satellite measurements from a variety of sensors and platforms to gain new global and spatially detailed perspectives of ocean processes, with a recent focus on measurements of sea surface temperature. He has a special interest in developing methods which put remote sensing to work for the wider public good, for example in operational oceanography and monitoring the climate of the ocean.

Ian Robinson has published two major volumes on satellite oceanography, *Measuring the Oceans from Space* in 2004 and *Discovering the Ocean from Space* in 2010, in addition to authoring around 100 refereed publications. He has enjoyed contributing to the work of several international agencies including ESA, NASA and UNESCO, but his greatest satisfaction comes from the 40+ research students whom he has seen go on to successful careers around the world, several in satellite oceanography.

In his spare time he and his wife take delight in visiting their holiday home in beautiful Dalarna, which is why he is always glad to collaborate with oceanographic colleagues in Sweden.



Prof. Ian Robinson

General Observations and Recommendations to SNSB

We (the Evaluation Panel) agree that the Earth Observation (EO) Research Program of the SNSB has been very successful in relation to its aims. The scientific results that have been achieved with the SNSB funding are generally at a good level, in several cases even outstanding. A number of researchers have achieved a strong international science reputation. Many research groups might not exist at all without the EO Programme. It can be concluded that the value for money has been excellent.

On the other hand we note that the influence of the EO approach and the benefits of EO data have not yet penetrated the Swedish scientific community in the Earth and Environmental Sciences to the same breadth and depth as in other European nations of comparable scientific standing. Swedish EO research work remains relatively small and somewhat peripheral to the mainstream of scientific activity. Moreover, with a few notable exceptions, it does not engage very actively with the international EO community, a situation which risks the weakening of Swedish influence in ESA or beyond and makes it harder for Swedish science to benefit from EO-related funding from ESA and EU. Networking of EO researchers with the private sector and operational actors also tends to be modest and has not fully exploited the potential for pull-through of scientific achievements into commercial opportunities or societal benefits expressed, for example, in GMES.

We identified a number of issues that deserve to be considered in order to enhance the impact of EO for improving the level of scientific achievement, to increase the international recognition of Swedish EO research and to promote transfer of the science results to operational and commercial applications. Such aims would maximise the benefits from investment by Sweden in ESA and other space programs.

First we note that the budget of the EO research program, €1.4 to 1.5 million annually, is small in comparison to the total Swedish space budget of €90 million. This implies that Earth Observation is not considered as a key priority area of the SNSB. While this volume of funding seems quite well balanced with demand from the existing research activities, there is a case for SNSB to be more proactive in promoting a much wider uptake of EO methods across the science community.

We recommend that the SNSB organizes an activity to define a road map for Swedish EO research for the next five and ten years. The road map will be built on the foundation of the new SNSB space strategy that was published in 2010. The road map should be prepared in close cooperation with the Fjärranalyskommitté, FAK. It should also address the future funding levels for the EO research and user programs. The road map should lead to a clearer identification of priority areas which will influence future funding decisions. The road map probably requires the proportion of SNSB's budget spent on EO research to be increased, and this would be justified by growing the number of EO experts embedded within appropriate fields of environmental science, leading to enhanced scientific, operational and commercial benefits and a greater international impact.

We note that Swedish EO research is quite fragmented, mainly carried out by small groups, with a focus on a few specific subjects and application areas. Many of the groups work in a somewhat isolated manner without an adequate national and international network. The Swedish academic system, having relatively few internally funded permanent positions at the

universities, presents a challenge to the sustained success of Swedish EO research. Small groups, dependent on one or very few senior scientists, struggle to develop a sustained research programme on soft funding alone. Interviewing the leaders revealed that some groups are not strongly embedded in host departments which offer little financial support or strategic management oversight.

We recommend the SNSB to extend coordination with other funding agencies, for example by establishing joint funding schemes with them. We also recommend that under the management of the SNSB a mechanism is developed in which grants are awarded on a longer time scale to those research groups with most potential. Long-term commitments from the SNSB would improve the position of the groups within their home institution, and could be made conditional on matching funding commitments from the home institution.

Monitoring of land ecosystems and forests in particular is presently the strongest focus area for Swedish EO research. High scientific quality with recognized individual experts has been achieved particularly in ecosystem productivity research in which Sweden has a long research tradition. On the other hand, several of the SNSB projects in this area are applied research adding little to the development of fundamental theoretical EO analysis.

EO research in the field of marine science is presently limited to a few isolated projects that represent only a small fraction of the diverse methods of ocean remote sensing. If marine science is reckoned to be of importance for Sweden, consideration should be given to encouraging growth of the volume of fundamental and applied EO research in this domain.

Although some scientific success has been achieved in projects which simply make use of given EO data products in a particular application area, we consider that the most significant scientific results have come from the combination of remotely sensed data with other information, supported by in depth knowledge of the EO methodology within a sound understanding of the application area. This approach should be further encouraged to extend the utilization of EO into new fields. In order to achieve a better international position within the EO area, we recommend strengthening the theoretical underpinning of EO research, especially within the larger research groups.

We also recommend strengthening the link between the national research programme and the user programme. In order to encourage this cooperation, we suggest that networking with researchers should be mandatory for applicants within the user programme. The objective should be to highlight the need for fundamental EO science and operational tool development.

The limited cooperation between research groups and ESA is unfortunate, especially taking into account the considerable Swedish contribution to the EO programmes of ESA. We recommend that the SNSB extends its information activities in this field, e.g. by organizing workshops to encourage participation in ESA projects and on preparing tenders to ESA.

We recommend that SNSB reconsider the composition and mandate of FAK. The current arrangement in which representatives from organizations that receive the grants may have an influence in the decisions which may contribute to a conservative distribution of funding. Participation of the beneficiaries in the FAK is only desirable if the role of the FAK is to formulate the EO funding strategy, and is separated from the actual funding decisions. The advisory committee FAK should include both Swedish and European expertise and the members should have a good knowledge of ESA and other international activities.

Evaluation Comments on the Individual Groups

Chalmers University of Technology Department of Radio and Space Science

Lars Ulander, Leif Eriksson *et al*

The main focus of the research group lies within SAR applications in different environments, which is a promising and prospering topic. The group takes an active part in the definition of activities related to ESA Earth Explorer (EE) candidate mission BIOMASS (one of the group members is also member of BIOMASS Mission Advisory Group, MAG). If the mission will be selected as the seventh ESA EE, the group would play a major role in the BIOMASS project.

The group is internationally known for high quality research in the field of radar applications. They are one of the top teams for development of theories and application algorithms and have a number of outstanding publications and a relatively high ranking according to the science index. The unique competence of the group is their innovative work by means of very long wavelength radar systems, such as Carabas. The projects carried out by the group have high scientific value, and contribute to a theoretical background for different environmental applications of SAR, as well as SAR processing algorithms. The output of the group is high in relation to the SNSB funding of the different projects.

The group shows evidence of good international networking and has been successful in obtaining funding from EC and ESA. The group is also important for many other application-oriented groups within Sweden.

The research is oriented towards basic science: commercial applications have not been very relevant so far. One of the potential commercial products in future might be carbon-trade field radar products. The research is important for the space industry, as the results of this group will help to further develop radar technology for different applications. The key focus of the group is presently on the applications of radar for forests, but since the scope for further development in this field is limited, consideration should be given to working in other environmental application areas, such as ice or sea.

The project leader has very high potential and the group is well organised. However, it is still quite small and needs further support in order to grow.

University of Gothenburg Department of Chemistry

Melissa Chierici, Are Olsen *et al*

This project is concerned with measuring the concentration of dissolved carbon dioxide (pCO₂) in surface sea water and using it for estimating air-sea exchange of CO₂ and its global integration. The specific role of EO in this field of oceanographic research is to use satellite data for extrapolating in situ measurements of pCO₂ in space and time between the occasional

sparsely spaced ship transect lines. The GU group is following the lead of East Anglia University in using this approach and is unique in experimenting with new correlations, including mixed layer depth, to find a better proxy for pCO₂.

The GU group is thus making a useful input to the international team engaged in the IPCC (Intergovernmental Panel on Climate Change) reporting network for estimating the ocean's role as a source and sink of CO₂. Their particular contribution is to extend the geographic coverage into the northern North Atlantic and the Antarctic Atlantic Ocean.

The partnership between GU and Bjerknes Centre in Bergen, Norway, seems to work quite well. There has been some training, with a Master student on the project and a PhD student expected to work 30-40% in future.

The publication of their collaborative work has a high international profile within the context of the IPCC. The facilities for the project seem to be adequate. The emphasis on using EO data, resulting from the SNSB funding, helps to promote remote sensing within this international community.

Evidently the project is delivering good value for the SNSB funding, allowing Swedish involvement in an important climate-related activity. However the group, split between two institutions with only a single key member at each, has long-term vulnerability.

There is an opportunity for SNSB to encourage broadening the scope of the project, through collaboration between the radar group at Chalmers University and the ocean chemists at GU already in the project, to push towards a more complete use of EO for integrating global CO₂ fluxes. This would also offer scope for better engagement with ESA initiatives, which is lacking at present.

Royal Institute of Technology (KTH) **Department of Urban Planning and Environment**

Yifang Ban *et al*

This remote sensing group was established in its present form in 2004. The topic area is remote sensing for urban applications. Some applications in the natural ecosystem monitoring are also considered. The main remote sensing data are from optical satellite remote sensing and space borne SAR (Synthetic Aperture Radar) instruments. Data fusion techniques between the SAR and optical data are also studied. The focus was selected by the group leader because it should offer a good niche in the Swedish remote sensing research community. It should be noted that several projects carried out by the group were not related to satellite based earth observation supported by grants from SNSB. The outcome of these projects was not subject to this evaluation.

EO-related publications of this relatively young group are both peer-reviewed papers and conference papers. In the future, the number and proportion of peer-reviewed papers should be increased. The networking with the city planning authorities and relevant private enterprises seemed superficial at present and should be improved if the research continues to have an applied focus. The group's international networking, particularly with the many

European actors in the research field, also needs to be extended. This would further help the group to find an adequate niche in which they can make a world-class contribution. The present outline of the group's plans for the next five years is somewhat cursory and should be developed further.

Royal Institute of Technology (KTH)

Division of Geodesy

Lars Sjöberg, Mehdi Eshagh *et al*

The work of this geodetic remote sensing group at KTH is concerned with mathematically oriented high quality basic research. GOCE data on the Earth gravity field are extensively utilized and the results obtained have been published in several high quality papers. Two projects funded by SNSB are coordinated by two staff and overall, the research group consists of 8 persons. However, the number of senior staff working with the gravity field and utilizing EO data is only two. Thus, only few researchers are connected to SNSB-funded projects. The work also appears to be rather isolated from international space activities, although relations with CNES have recently been established through a study visit.

The positioning of the group within the university appears to be somewhat fragile, apparently because its emphasis on theoretical research contrasts with the main emphasis on applied geodesy within the Division. Current research of the group is much dependent on the group leader. As he is quite close to retirement age, there is a potential risk to the continuity of activities in the long run. This is emphasized by the fact that research seems to be inadequately linked to potential applications and to other research group within Sweden, and to ESA.

SNSB is currently the only funding source for space geodesy activities – even though the activities may have a high relevance to ESA.

Lund University

Earth and Ecosystem Sciences

Jonas Ardö, Lars Eklundh, *et al*

The remote sensing research activity is part of the Department of Earth and Ecosystem Sciences in which the staff number is around 80. The history of remote sensing research in Lund goes back to the 1970's. It has tended to focus on ecosystem studies in the Sahel area in Africa, but has recently expanded also to the northern ecosystems. More specifically, primary productivity is investigated by combining optical space borne data and field (flux) measurements. Remote sensing data are key information sources and relatively simple analysis methods are often applied. However, the combination of data has led to outstanding world-class results, published in the leading journals. The research belongs to the basic research category.

While the scientific quality of the research is excellent, it does have a somewhat narrow scope. For instance, satellite radar images have not been used and are not even considered as a potential source of data. The networking has been kept to a minimum. In Sweden, the main partner is the SMHI, with which cooperation is active and fruitful. The remote sensing researchers have not been particularly active in the EU or ESA domain, although they argued that the principal reason for not opening up more to the science and operational communities is lack of human resources, i.e. time. The remote sensing research is funded from several sources, but the SNSB funding has been crucial.

The research in the Sahel in Africa has more than a 30-year history and the group wants to continue it into an undefined future. They claim that the significance of the research is even increasing because of the changing climate. Very interesting recent research has been done by combining the socio-economic and primary productivity data. Future research topics for the Sahel work are outlined only in a general manner.

The research in the northern ecosystems started in the 1990's. It has focused on carbon assimilation and phenology and has produced plenty of articles in leading journals. A special deliverable from the research has been the Timesat software for time series analysis of satellite images. The software are available free of charge and several hundred copies have been downloaded. The agenda for the next five years research was very well defined.

We conclude that the remote sensing research in Lund University has led to excellent results. The university could have even more to offer to the science world and operational applications within the context of climate treaties and food security, for instance. This would require a true desire by the researchers and the university to increase the volume. The funding opportunities from ESA and EU may be underutilized in the remote sensing research in Lund.

Lund University

Centre for Sustainability Studies

Lennart Olsson *et al*

The group works in the field of Earth Observations and health studies, specifically sustainability studies using EO and GIS. The background rationale for this project is the potential the project team leader sees in this area. The field is interesting and there are few other groups working in it worldwide. This research project is still at the beginning and needs to be developed to achieve at least preliminary results before it can be properly evaluated.

The presentation of the project was quite shallow and did not provide much insight into the research aspects. The output after one year is still very limited. The definition of the intended output is still missing. The scientific potential can currently not be judged because of a lack of a sound research concept describing a hypothesis and a clear methodological approach. The future prospect of this research is unclear and could not be convincingly clarified during the interview.

It appears that the group is intending to develop new applications based on established methods and algorithms. Consequently the research is very application oriented. However, no practical application has been identified so far. It remains unclear whether the research in this

project is to be user-driven. Without user input it will be difficult to develop or realise any commercial potential.

The team leader is a senior scientist, which gives stability to the group. However, the international standing of the group in relation to the EO activity is uncertain. The group is rather small, even though there are a number of collaborating scientists to the group. The EO research seems to be very much dependent on SNSB funding.

Even though the importance of international research in this field is very high, we do not expect it will be easy for the group to make a significant contribution in the international context. The international networking needs to be improved if the project is to be relevant.

The group is recommended to:

- Better describe the scientific value and potential of the research project.
- Develop activities within or related to a relevant ESA programme.
- Try to get additional international funding from EC and UN organizations in order to secure the group's future and develop a better perspective for this kind of research.
- Try to trigger education by attracting Ph.D. students

Swedish University of Agricultural Sciences Department of Forest Resource Management

Johan Fransson, Mats Nilsson, Håkan Olsson *et al*

The topic of this group is the application of remote sensing for forestry. This is a prospering field which has a clear focus on the development of practical applications.

The group has high scientific competence in remote sensing for forestry and works quite broadly with all types of remote sensing data. It is involved in a number of important projects within Europe and is successful in getting funds from SNSB. In recent years there has been good co-operation with the radar applications group at Chalmers.

The group has a very active international network and is visible in the international community, where it is perceived to have a leading role in application of optical satellite data to forestry. The group is involved in BIOMASS as well as in the LEAF proposal to ESA's 8th Earth Explorer mission. The SNSB funding of the group is important but not crucial.

The group's plans for further research are well in line with current trends in this area towards a more multi-sensor approach. Therefore, there is good potential for sustaining the group's research activity. There is some commercial potential for the group's work in the field of forest mapping. However, the group has hardly implemented their methodological developments in practical applications apart from the national forest inventory. The commercial potential may lie mainly in the LiDAR field.

Two PhD dissertations are reported which is a rather small number given the amount of funding received by the group. As regards number of publications, one would expect more peer-reviewed publications for a group of around 20 persons.

It is recommended that the research quality would benefit from concentration in depth on a few selected topics in order to produce more fundamental research results and more significant application developments. These are needed to reach the leading edge of research (which is already the case for the LIDAR research of the group).

Swedish Meteorological and Hydrological Institute (SMHI) Research Department

**Karl-Göran Karlsson, Magnus Lindskog, Ronald Scheirer, Abhay Devasthale,
Anke Thoss *et al***

There are two main research topics: (a) improved cloud analysis schemes over the Arctic and their application to Arctic climate simulations; (b) the assimilation of high resolution cloud-resolving radiance data using 4-d pattern matching algorithms. In both topics a high quality of scientific research is evident, with a strong publication profile in the international literature. EO methods are already well established within meteorology; these two projects are aimed at obtaining more information from improved satellite data products. The projects are on course to deliver the promised scientific benefits, and so no modifications are recommended.

Research results from both topics are already being applied. New assimilation techniques are being implemented in the NWP (Numerical Weather Prediction) operational forecasting suite and in arctic climate forecast models, where they can be expected to deliver significant public benefit.

The research teams are well led by relatively young researchers with strong career potential. A mix of postdocs and junior research level staff contribute. Junior research staff at SMHI is encouraged to register for PhD: close co-operation with MISU helps to ensure that research training is available, but presently only one PhD student works on SNSB projects.

The research depends on powerful computers for numerical analysis and a good infrastructure for data access and processing. SMHI provides these facilities very effectively.

SMHI is engaged with the Eumetsat Satellite Application Facilities (SAFS) for NWP and for Climate, ensuring that the satellite meteorology research is carried out collaboratively with colleagues across Europe. Thus the research teams interact well with the European and wider international community. There is less engagement with ESA, which should be encouraged, for future atmospheric satellite programmes such as Sentinels 4 and 5.

The work of SMHI is mainly operational and its capacity for fundamental research is relatively limited. It is therefore appropriate for some of the SNSB EO funding to be spent on satellite meteorology research within SMHI, especially when the scientific quality is high as in this case. The research team could not have been so productive without the SNSB funding. Given the ongoing need for new researchers to be trained in the field of satellite meteorology, SNSB should in future encourage research proposals from SMHI that make provision for research students, and which explicitly allocate time for the project leaders to play a role in the supervision of those students (in collaboration with a partner university).

Overall these are well run projects producing very good science and leading to improved capacity in operational meteorology. They deliver good value for the SNSB funding.

Stockholm University
Department of Physical Geography and Quaternary Geology

Ian Brown, Johan Kleman *et al*

The glaciology group of the Stockholm University is focusing on two fields of research. Johan Kleman and his team work mainly with paleo-glaciology, whereas the main interest of Ian Brown is in the mapping of glaciers applying SAR data (e.g. such dynamic features as the firn line). Earth Observation data also play a crucial role in the paleo-glaciology research, even though the method of using optical EO data is quite straight forward visual interpretation. The scientific quality is very good in both application areas. Especially, contributions in paleo-glaciology are commended as internationally relevant research.

The position of the paleo-glaciology research team appears to be quite well established within the university. This is evidently not the case for activities concerned with the development of actual EO data interpretation methodologies – even though there is considerable potential for important future achievements. However, the ongoing EO research is quite well connected to activities of ESA and other domestic research groups. This may compensate, at least to a degree, the isolated position and the small size of the group. Activities related to EO methodology development are currently performed by a single person.

The work has been co-funded by sources other than SNSB, for example through the ESA PolarView project. Nevertheless, SNSB funding has apparently a major impact for the continuity of the research.

Stockholm University
Department of Systems Ecology

Susanne Kratzer *et al*

Over the last five years, a small research team has been created that is now recognised as a serious player in the challenging international research field of ocean colour remote sensing. This is a direct result of the SNSB funding used to support the leader and her research students, who have established an optical oceanography fieldwork facility for high quality in-situ light measurements and coincident determination of sea water constituents. The facility is used for regular measurements in Swedish coastal waters, underpinning much-needed research to improve the retrieval of water constituents from satellite ocean colour data.

The team has built an impressive database of inherent optical properties and in situ constituent data for validation of satellite ocean colour data products in the optically complex Case 2 waters characteristic of the Baltic Sea. This work is important for Swedish ocean science, is making a unique contribution to ESA's MERIS calibration/validation activity and has attracted the interest of Vattenfall Power Consulting, a Swedish commercial enterprise.

The panel recognises the scientific value of the project and its achievement of confirming the error-quantified performance of Case 2 MERIS algorithms. Because the group is relatively new the publication record is not yet large, when compared with that of some of the other programmes reviewed, but the citation record from the most recent papers is good and expanding, confirming that the results from their experimental facility command international respect. There is potential for further significant results if the team can be maintained.

The group appears to be well managed, has accumulated sufficient facilities for laboratory and field work, has access to technical and expert support from internationally recognised collaborators from the ocean colour community, and is contributing to research training of two PhD students. This emergence in a few years of a well-rounded, if small, group demonstrates a good return on the SNSB funding and the success of a committed project leader. The group has become a fruitful point of interaction between ESA and Swedish EO. Through a network agreement it has become a focus for research and training collaboration across Nordic and Baltic countries and attracts others working in this field; for example an EU Marie Curie fellow will soon join, adding additional scientific experience to the group.

However, being entirely dependent on soft funding, the activity remains vulnerable in the medium-long term. In order to provide long-term stability to the group, an adequate baseline support from the hosting Department would be beneficial, justified by the positive reputation that the group now brings to Stockholm University.

Stockholm University
Department of Meteorology

Peter Lundberg *et al*

This project applies gridded data of sea surface topography to the study of the wind-driven ocean circulation in the North East Atlantic Ocean, with particular attention to the recirculation in the Norwegian Sea and the cross-ridge flow over the Iceland-Faeroe ridge. The sea surface height anomaly data produced by the French from several satellite altimeter datasets have been used to retrieve barotropic velocities for comparison with in situ current observations and also with flows predicted by an atmospherically driven ocean GCM.

This research is novel when applied in this region. It has demonstrated the benefits of using satellite altimetry in mainstream physical oceanography studies. In this case the use of the satellite data has led to new interpretations of the patterns of recirculation compared with Norwegian studies based on in situ measurements alone.

The group performing the work is established within Swedish physical oceanography. They are well networked at the Scandinavian level and they have published the work funded by SNSB in good oceanographic journals. The project serves also as a training ground for some PhD students in physical oceanography. Several former PhD students have gone on to work as oceanographers in SMHI.

The SNSB funds have been used in this project to demonstrate how satellite altimetry can make an important contribution to the science of ocean dynamics, with potential application

to improved understanding of how ocean circulation may impact on climate, although there is little immediate prospect of commercial or operational applications.

The level of engagement of the group with the satellite oceanography community outside Sweden seems very limited. Although high quality oceanographic research is being performed, the use of satellite data is entirely passive, relying on standard data products derived by other agencies without any attempt to evaluate their quality and reliability in the context of the particular oceanographic context. There is scope for a more critical assessment of the quality of the ocean topography, with feedback to the ocean altimetry scientists who produce the standard products.

If the group seeks further funding, it is recommended that SNSB encourage more engagement with relevant international groups, such as the international Ocean Topography Science Team. They should also try to connect with ESA new initiatives in coastal altimetry.

Uppsala University

Department of Earth Sciences

Cecilia Johansson et al

The snow mapping research project of Cecilia Johansson (Uppsala University) is essentially an activity that combines expertise from several research groups to develop near-real-time methods to provide EO data-aided information on snow cover to reindeer herders. The results and scientific impact of the project cannot be assessed yet, as the project is still at an early stage concerning results. However, the successful outcome of the project would introduce an interesting new application of applying EO data for a practical end-use. If the project is successful, the results can be beneficial for other applications as well, e.g. ecology. However, the risks associated with the project are high.

The research appears to fit well into the scope and activities of the university. A benefit of the project is also that it combines various fields of research (from several institutes), and that it establishes a network including EO specialists, geography/Earth sciences, meteorology/hydrology and local Sami people.

The project is totally dependent on the SNSB funding.

Appendices

Guidelines to the Evaluators

The Evaluation Panel is invited to evaluate specific research groups **(A)** and also to provide a more general view on the Swedish Earth Observation research **(B)**.

A

The documentation submitted by the research groups according to the guidelines (see the file “Guidelines to the research groups”), along with the presentations given by the groups during the meeting in 28-30 September 2010, should be the basis for the evaluation. The evaluators are kindly asked to address several points listed below when evaluating the groups. These points should also be addressed in the subsequent evaluation report to be written jointly by the Evaluation Panel at the end of the meeting in 28-30 September 2010.

1. The scientific quality of the results obtained.
If possible, please distinguish between results of value for:
 - a) earth sciences and climate studies,
 - b) new applications of EO (Earth Observation) data,
 - c) new methods for usage/interpretation of EO data,
 - d) any other aspects if relevant.
2. The scientific potential and value of the projects proposed, indicating possible recommendations for modifications of goals and methods.
3. Importance and international standing of the research work performed and planned.
4. The importance of the research for commercial and other applications:
 - a) Has research resulted in any commercial applications?
 - b) Is there a potential for such applications in future?
5. Qualifications and capability of the project leader and the staff, including a discussion of such aspects as adequacy of size, age and gender structure of the groups as well as future prospects of the groups and possible need for changes.
6. Standing of the research group within its University/Institute:
 - a) Are the research and educational activities an integrated and essential part of the activities of the University/Institute?
 - b) Has the group been successful with respect to supervision of the PhD students?
 - c) Does the number of PhD students graduated correspond to the needs and size of the research group?
7. The sufficiency of existing facilities and equipment. Recommendations on equipment for future work.
8. Adequacy of interaction and collaboration with ESA and the national actors (other research groups, SNSB).

9. Analysis of the impact of the current and past support from the SNSB, including suitability of the grant structure, duration of the grant and funding level. Recommendations for any changes, if relevant.
10. Other considerations by the Panel.

B

In addition, the Panel is asked to address more general aspects of Swedish EO research activities, supported by SNSB, including organisation, strategy, management and international standing of Swedish EO research as well as adequacy of the structure of SNSB support to the scientists.

The following questions and aspects should be addressed by the Panel:

1. What is the strength (and weakness) of Swedish EO research?
2. What is the international standing of Swedish EO research? Is Sweden an important international partner to ESA and research groups in other countries?
3. Are there any over-represented research areas taking into account the quality and relevance of the activities?
4. Is there an adequate balance between basic and applied EO research in Sweden?
5. Is there a good outcome of and potential for new EO applications and services based on the achievements of Swedish research groups?
6. Does SNBS provide adequate support to the research groups (size of the support, balance between small and large groups, duration of the support, i.e. annual grants vs multi-year grants etc)?
7. Is there any need for specific strategic actions (e.g. strategic calls for grants etc)?
8. Is there a need for any changes with respect to the strategy of SNBS regarding its support of Swedish EO research activities?
9. Any further considerations and recommendations.

Guidelines to the Research Groups

The research groups are requested to submit a written report to Swedish National Space Board no later than July 2, 2010.

The report should contain the following information:

Administrative and financial review for the time period 2005-2010

1. Name of the principal grant holder
2. Address
3. Scientific co-workers
4. List of all space-relevant research grants including source of grant (e.g. SNSB, FORMAS, VR, faculty etc.), project title, amount of the grant and fiscal year.
5. List of personnel in May 2010 including name, gender, degree, position, year of birth, research activity (%) and source of funding for the principal grant holder, research staff and graduate students.
6. Research output: dissertations during 2005-2010, cooperation with other research groups and a brief account of outreach activities.

Scientific overview and list of publications during the time period 2005-2010

1. Description of the SNSB project(s):
 - (a) abstract of the project(s) (max 300 words),
 - (b) objectives and methods,
 - (c) main results – separate descriptions of scientific results, new development of equipment, techniques, methods and applications,
 - (d) participation in ESA projects and other international projects,
 - (e) EO applications and services that have been developed by the research group itself or by the partners on the basis of the scientific results,
 - (f) industrial cooperation,
 - (f) activities to address gender equity aspects within the research group,
 - (g) plans for the next three to five years (including personnel situation, faculty and external funding),
 - (h) publications during the past six years.

The descriptions under b-g should not exceed 6 pages in total for each project.

2. Short CVs for the senior researchers within the project(s).
3. Reprints of up to five most significant scientific papers (in digital format) published during the reporting period.

The report should be submitted to Kristine Dannenberg, kristine.dannenberg@snsb.se, no later than July 2, 2010.



Box 4006, SE-171 04 Solna
Telefon: +46 8 627 64 80
Fax: +46 8 627 50 14
E-mail: rymdstyrelsen@snsb.se
www.rymdstyrelsen.se