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# Antarctic Research in Finland 1998–2005



International  
Evaluation



ACADEMY OF FINLAND  
RESEARCH FUNDING AND EXPERTISE

# ANTARCTIC RESEARCH IN FINLAND 1998–2005

International Evaluation

## Members of the evaluation Panel

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*Editor:*  
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# KUVAILULEHTI

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Julkaisun nimi	ANTARCTIC RESEARCH IN FINLAND 1998-2005 International Evaluation		
Tiivistelmä	<p>Raportissa arvioidaan suomalaisten tutkimusyksikköjen tekemä etelämannertutkimus ajanjaksolta 1998-2005. Tutkimuksen laatua, innovatiivisuutta sekä tuottavuutta verrataan etelämannertutkimuksen kansainväliseen tasoon. Lisäksi arvioidaan Suomen etelämannertutkimuksen politiikkaa sekä tutkimuksen nykyistä organisaatiota ja rahoitusjärjestelmää. Arvioinnin toteutti Opetusministeriön toimeksiannosta Suomen Akatemia, joka kutsui tehtävää varten kolmihenkisen kansainvälisen asiantuntijaryhmän. Ryhmä perusti arvionsa yksikköjen itsearviointiin, muuhun etukäteisaineistoon sekä toukokuussa 2006 yksikköihin tehtyihin vierailuihin.</p> <p>Asiantuntijaryhmä totesi, että osa tutkimuksesta on ollut menestyksekkästä mutta että tutkimuksen tuloksellisuus jää yleisesti ottaen sekä keskimääräisen kansainvälisen tason että keskimääräisen Suomen Akatemian rahoittaman tutkimuksen tason alapuolelle. Yhtenä lähtökohtaisena syynä nähtiin se, että tutkimusrahoituksen taustamotivaationa on ollut Suomen liittyminen etelämannersopimukseen ja tämän vaatima tutkimuspanostus. Asiantuntijaryhmä ehdotti että etelämannertutkimusta suunniteltaisiin ja koordinoitaisiin enemmän tutkimuksellista tavoitteista lähtien. Ryhmä pani myös merkille, että Suomen etelämannertutkimus integroituu heikosti kansainvälisen tutkimuksen kenttään, että useimmat tutkimusryhmät ovat pieniä ja että tutkimusryhmien välinen yhteistyö on vähäistä. Näiden seikkojen vuoksi ns. kriittistä massaa ei useinkaan saavuteta. Asiantuntijaryhmä kehotti selvittämään, voitaisiinko asiaan vaikuttaa tutkimus- ja rahoituspoliittisilla ratkaisuilla ja ehdotti, että etelämannertutkimuksen koordinoinnissa pyrittäisiin aktiivisemmin edistämään kansainvälistä ja kansallista yhteistyötä erilaisin toimenpitein. Varsinaisen tutkimusrahoituksen nykyinen määrä nähtiin sinänsä riittäväksi. Sen sijaan todettiin että etelämannertutkimuksen logistiikasta ja Suomen etelämanneraseman Aboan toiminnasta vastaavan FINNARP:n rahoitus on nykyisellään riittämätön. Tähän nähden logistiikan todettiin toimivan tehokkaasti ja järjestelmällisesti.</p> <p>Tutkimuksen linjauksissa asiantuntijaryhmä suositteli panostamista sellaisiin vahvoihin aloihin, joissa Suomella on mahdollisuus merkittävällä tavalla edistää kansainvälistä tutkimusta. Kerätyt pitkän aikavälin havaintosarjat todettiin merkittäviksi ja niitä suositeltiin jatkettavaksi. Näitä aineistoja tulisi kuitenkin myös aktiivisemmin käyttää hyväksi esimerkiksi numeerisessa mallinnuksessa. Yleisesti kaivattiin tutkimusryhmiltä selkeämpää näkemystä siitä, mihin tieteellisiin ongelmiin tutkimuksella viime kädessä pyritään vastaamaan.</p>		
Asiasanat	Etelämannertutkimus, etelämannersopimus, tutkimuspolitiikka, tutkimuksen rahoitus, arviointi, geotieteet, geologia, geofysiikka, geodesia, glasiologia, ilmakehätieteet, merentutkimus		
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Title	ANTARCTIC RESEARCH IN FINLAND 1998-2005 International Evaluation		
Abstract	<p>The report contains the findings and recommendations of the evaluation of Antarctic research carried out in Finland during 1998–2005. The quality, innovativeness and effectiveness of the research is compared with international standards. In addition, the Finnish Antarctic research policy and its coordination as well as the funding instruments are assessed. The evaluation was carried out by the Academy of Finland under the commissioning of the Ministry of Education. The Academy convened a threemember international panel for the purpose. The panel based its evaluation on selfassessments of the units, other background information, and on site visits made to the units in May 2006.</p> <p>The panel concluded that, even though a number of success stories can be found, the average output of Finnish Antarctic research is below international standards and even below the average level of the research funded by the Academy of Finland. The panel identified as one underlying fact that the motivation for research funding has been Finland’s membership in the Antarctic Treaty, which requires significant research input in the Antarctica. The panel recommended that the research be planned and coordinated with more clearly scientific aims. The panel also noted that Finnish Antarctic research weakly integrates with the international community; that most research units are small; and that there is little cooperation among the units. For these reasons the critical mass required for successful research is seldom reached. The panel recommended to consider whether it is possible to counter this with new research and funding policies. The panel also recommended that the coordination of Antarctic research should more actively foster international and national collaboration. The present amount of research funding was considered in itself sufficient. On the other hand, it was concluded that the funding of FINNARP for logistic services and for the maintenance of the research station Aboa is not sufficient to sustain the present level of activity. Otherwise the logistics was found effective and wellorganised.</p> <p>As to the research content, the panel recommended that the existing strengths be exploited, which would enable Finland to contribute to international Antarctic research in a significant way. The data sets from longterm monitoring programmes were considered important, and it was recommended that they be continued. However, the data should be exploited more actively, especially in more theoretical work and numerical modelling. In general, the panel expected a more problemoriented approach and recommended that the individual research groups review their aims and longterm goals.</p>		
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# PREFACE

In June 2005, the Ministry of Education commissioned the Academy of Finland to conduct an evaluation of Finnish Antarctic research for the period 1998–2005. Antarctic research as an explicit instrument of policy commenced in 1989, when Finland became a consultative party of the Antarctic Treaty. Until 1998, the research was coordinated by the Ministry of Trade and Industry, which also conducted the first evaluation of Finnish Antarctic research in 1995. The Finnish Antarctic research programme was reorganised in 1997, so that from 1998 onwards, the Ministry of Education has had the general coordinating responsibility. The Ministry also allocates funding to the research, while the organisation of the calls for applications and the evaluation of the applications are undertaken by the Academy of Finland. Three such calls have been organised during the evaluation period: in 1998, 2002 and 2004. In 1998, the logistics was reorganised to create a permanent logistical secretariat, FINNARP, based within the Finnish Institute of Marine Research. In addition, the Coordination Committee of Antarctic Research, with members from all relevant institutions, was established to coordinate the research.

After the commissioning the Academy appointed a steering board to supervise the evaluation. Board members were Professors Timo Jääskeläinen (chairman) and Kirsti Loukola-Ruskeeniemi from the Research Council for Natural Sciences and Engineering, and Professors Juha Kämäri and Liselotte Sundström from the Research Council for Biosciences and Environment. On behalf of the Academy, the evaluation process was managed by Science Adviser Pekka Katila, who was backed by Senior Science Advisers Ritva Taurio and Pentti Pulkkinen. Henriikka Katila acted as project officer while Tanja Eronen produced a summary report on the unit selfevaluations. At its meeting on 20 January 2006, the steering group confirmed that the evaluation panel is chaired by Dr John R Dudeney (ex Deputy Director of the British Antarctic Survey), the other two members being Professor Francisco J. Navarro (Universidad Politécnica de Madrid) and Professor W. Richard Peltier (University of Toronto). The personal profiles of the panel members are in Appendix B. In March 2006, Dr Mikko Lensu was appointed as coordinator of the evaluation.

The objective, as defined to the evaluation panel, was to evaluate the scientific quality of the Antarctic research and the functioning of the associated administration, including coordination, financing, and logistics. The panel was asked to evaluate the quality of research of each research unit included in the review. The central issue was the quality, innovativeness and efficiency of the research as measured by international standards. The panel was also asked to characterise the evaluated field as a whole and provide recommendations on its future development. These guidelines are given in more detail in the Terms of Reference for the Panel (Appendix A).

The units in the evaluation were research groups, identifiable through their responsible leaders, rather than departments or institutes. All the research groups that had received funding through the Antarctic calls of the Academy, or participated in the FINNARP expeditions conducted between 1999–2004, were included. This criterion covered all sustained Antarctic research in Finland. In addition, the Coordinating Committee for Antarctic Research, as well as FINNARP logistics, were evaluated. The evaluation assessed all Antarctic-related research activities of these units during the evaluation period. The evaluation process had two phases: the self-

evaluation of the units, and the site visits. The questionnaires (Appendix D) designed to assess the Antarctic research activities, research funding and resources, as well as the scientific output were sent to the units in October 2005 and received by the end of the year. These provided background material to the evaluation panel. The site visits were made during the period of 8–11 May 2006 in Helsinki and Oulu (Appendix C). The meetings with the units had a typical duration of one hour and consisted of a short presentation of the research followed by discussions between the panel and the group. After visiting two or three units the panel had an internal meeting to discuss initial conclusions.

## CHAIRMAN'S INTRODUCTION

Science in the Antarctica has moved from exploration of Antarctica, through exploration in Antarctica to exploration from Antarctica. Now, and for the future, Antarctica is of vital importance for humankind as a platform for understanding the complexities of natural and anthropogenic change in the Earth system, and as a weather-cock of such change. Antarctica has been both the herald of major human impact – the obvious example being the appearance of the stratospheric ozone hole – and the repository of crucial palaeo-climatic information – the atmospheric temperature and carbon dioxide record for the past 800,000 years. These are but two of many examples and we can be confident there will be new ones in the future.

It is undeniable that international politics has been a major driver for the exploration of Antarctica and remains so today. It could be argued that much of the investment in science made by various national governments only happened because of the over-riding national political imperatives, and this is probably true. But the end result is a unique and highly effective symbiosis of politics and science, which has stood the test of time and is now firmly enshrined in the Antarctic Treaty. It is becoming clear that science in and from the continent has fundamental importance for humankind and is worth the investment independent of the politics, whether it be for Earth system science, or for fundamental physics, space science and astronomy.

Conducting science in Antarctica is intrinsically expensive. Thus it is very important for credibility, quality and long-term health of programmes that only those questions be addressed for which the Antarctic dimension, or a bipolar perspective, is essential for success. Science which could quite easily be done elsewhere or which does not address fundamental issues should not be undertaken.

Some countries have taken a strategic view of the science to be done, setting specific high-level research goals, using these to steer the allocation of resources, and judging outcomes against them – the directed, so called “top-down”, approach. Others have taken a more reactive methodology, the responsive or “bottom up” approach, in which little or no strategic framework is imposed. Both have strengths and weaknesses and it is largely a matter of culture and precedent in individual countries that decides this. However, for Antarctic research where significant logistic investment and long-term operational planning go hand-in-hand with the science there is a good argument for strategic science planning.

As with any science undertaking, it is vital for continuity and credibility that quality is tested and established. For the input side of the activity this should, and generally is judged through independent peer review of proposals, ideally done using international panels. Outcomes are best judged through regular independent review of the overall productivity of projects, both against their own aims, and in comparison with National and International norms.

It is from this general starting point that my two colleagues and I carried out the review of the Finnish National Antarctic Programme. This document contains our considered views. I would like to take the opportunity to thank everybody who participated in the review for their willingness to engage, their openness and the welcome we received wherever we went. I would particularly like to thank the staff at the Academy and Mikko Lensu for their unfailing courtesy, efficiency and hospitality. I would also like to applaud the Academy for its intention to openly publish the outcome of this review, something that is certainly not universally done elsewhere in the Antarctic community.

# EXECUTIVE SUMMARY

## OF RECOMMENDATIONS

**The Panel recommends that** Finland carry out a review of why it is carrying out a research programme in Antarctica and whether the current programme meets its national aims.

**The Panel concludes** that overall the research output from the Antarctic Programme is below the average achieved from other programmes funded by the Academy in Finland.

**The Panel concludes** that international collaboration is relatively weak and that overall the Finnish Antarctic programme performs relatively poorly in comparison to most other National Antarctic Programmes. **The Panel therefore recommends** that the Academy consider whether there are further funding mechanisms it can bring to bear to foster international collaboration.

**The Panel concludes** that there is little pent-up demand that is not being met by the current level of funding.

**The Panel recommends** that the Academy consider whether there is an argument for targeting the funding into fewer but larger research grants and thereby countering the problem of critical mass.

**The Panel recommends** that the Ministry of Education consider the establishment of a Graduate School in Polar Science.

**The Panel recommends** that the Ministry of Education review the purpose, composition and terms of reference of the Coordinating Committee for Antarctic Research (CCAR) to ensure that the Committee is meeting its needs.

**The Panel recommends** that the CCAR take a more active role in championing Antarctic research in Finland and in fostering a group identity for the research community.

**The Panel recommends** that the CCAR establish a formal arrangement for taking account of the activities and research priorities of the Scientific Committee for Antarctic Research (SCAR), both in its tactical decision-making and in any strategic review of the direction of the Antarctic programme.

**The Panel recommends** that for those meetings of CCAR where scientific judgements are made to provide recommendations on funding to the Academy, the membership should be increased to include a small multi-disciplinary group of foreign experts.

**The Panel recommends** that the operating budget of FINNARP be urgently reviewed by the Ministry of Transport and Communications, taking advice from FINNARP on what is needed to maintain the current volume of activity. As a rough estimate, a 40 per cent increase in FINNARP budget would be sensible.

**The Panel recommends** that more emphasis is put upon exploiting research possibilities which play to existing strengths, examples would be: Antarctic geodesy/ glaciology, bi-polar conjugate studies of the coupled solar wind, magnetosphere, ionosphere system, the application of Antarctic aerosol data to the refinement of aerosol modules in Global Circulation Models and studies of the dynamics of the ozone hole combining the Antarctic data sets with numerical modelling.

**The Panel recommends** that the Finnish funding system continue to give priority to maintaining the collection of key environmental data sets, especially the Antarctic ozone observations and the aerosol measurements carried out at Aboa.

**The Panel recommends** that more emphasis be put upon clarifying and focusing research aims. Especially the long-term goals of some groups carrying out monitoring or sampling programmes were not obvious to us.

**The Panel recommends** that more priority be given to ensuring that various environmental data sets collected by the Antarctic projects are fully exploited for scientific purposes.

**The Panel notes** that there is little evidence of significant collaboration within the Finnish Antarctic community and **recommends** that efforts be made to address this.

# 1 BACKGROUND

## 1.1 Antarctic research as part of Finnish cold regions research

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Cold regions research is a strong, diverse and well-established field in Finland for obvious reasons: the country lies between latitudes 60°N and 70°N, is covered by snow every winter and its coastline can become completely ice-bound in winter. Finland has actively fostered cooperation with other circumpolar countries through the European Union, Arctic Council, and other organisations. It has sought to advertise its expertise in relevant research areas as well as its experience in maintaining and sustaining economic development in the far north. Economic and political motivations are a strong driving force behind the Finnish cold regions research as well and many research fields have grown as responses to practical problems in winter navigation, exploitation of resources, environmental protection, and so on.

Almost all cold regions research in Finland is quite rightly focussed on the Arctic. Antarctic research has its roots in the political decision to become a Consultative Party to the Antarctic Treaty, which was driven initially by the possibility of commercial mineral exploitation, and subsequently by environmental considerations. The Antarctic research programme was based on pre-existing Arctic research expertise and there have been few purely Antarctic topics. Rather, the research has supplemented or brought a bi-polar dimension to similar work done in the Northern hemisphere. However, the Finnish policy towards Antarctic research funding is rooted in a “responsive” approach, which is demand-led rather than based on top-down direction. The corpus of Antarctic research therefore constitutes a rather incoherent whole and is lacking overall national strategies formulated from a scientific point of view. The volume of the Antarctic research has not varied much and has been maintained at a level of 1.7 M€/year during the evaluation period. This represents approximately two per cent of the volume of all cold regions research in Finland, which is estimated to be 70 M€/year<sup>1</sup>.

## 1.2 Finnish Antarctic research before 1998

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### *1.2.1 Coordination and funding*

Finland acceded to the Antarctic treaty in 1984, at which point the Ministry of Trade and Industry took responsibility for Finnish Antarctic Activities. Finland became a consultative party of the Treaty in 1989 and a full member of the Scientific Committee on Antarctic Research (SCAR) in 1990. The Ministry also established the Polar Commission to coordinate Arctic and Antarctic research. Antarctic research started in 1988. Before this Finnish Antarctic research had been virtually nonexistent. Before 1998, the Ministry funded the logistics of the research programmes, while the groups relied on their usual funding agencies to fund their research topics. For each expedition the logistics was arranged on a project basis by a hired logistician. All activities were gathered under the general heading of the Finnish Antarctic Research Programme (FINNARP).

<sup>1</sup> Matti Saarnisto, The current status of Finnish Arctic Research and an outline of research strategies, Ministry of Trade and Industry 1998 (In Finnish)

### 1.2.2 The field activity

The Finnish research station Aboa (73°03'S, 13°25'W) was established in 1988 and the first research expedition was undertaken during the Austral summer of 89/90, after which the expeditions were organised in cooperation with Sweden and Norway. Altogether six expeditions were arranged during the period 1988–1997. There was a strong emphasis during this time on marine research, which was conducted during all expeditions, either on board Finnish R/V Aranda (89/90 and 95/96), on board a hired logistic vessel, or by participating in international cruises. During four of these expeditions research was conducted at Aboa station in the areas of geology, geophysics and meteorology. There were no expeditions conducted during the Austral summers of 90/91, 94/95 and 96/97. Marine meteorological buoys did remain operative during this period, however. The field activity is summarised in the following Table. In addition there were campaigns carried out in cooperation with other countries at their stations or on board, most notably the ozone programme carried out at the Argentine station, Marambio (64°15'S, 56°40'W), which commenced during the Austral summer 89/90.

Table 1: The expeditions 1988–1997

Expedition	Austral summer	Research at Aboa	Marine research
	88/89	Station built	Biological
1 <sup>st</sup>	89/90	Meteorological, geological, geophysical, medical, geodetic	Biological, chemical, marine geological, physical, meteorological
2 <sup>nd</sup>	91/92	Geological, geophysical, geodetic	Physical, meteorological
3 <sup>rd</sup>	92/93		Physical, meteorological
4 <sup>th</sup>	93/94	Geological, meteorological, geodetic	Biological
5 <sup>th</sup>	95/96		Chemical, geological, physical, meteorological
6 <sup>th</sup>	97/98	Geophysical, geological	Chemical, geological, physical, meteorological

### 1.2.3 The 1995 evaluation

The previous and first evaluation of Finnish Antarctic Science was carried out by the Ministry of Trade and Industry in 1994–1995<sup>2</sup>. The Ministry invited Dr J.P. Hansen (Denmark), Dr Christian Hjort (Sweden) and Professor Egil Sakshaug (Norway) to evaluate the natural and medical sciences and Ms Sirkka Numminen (Technical Research Centre of Finland) to evaluate technological and commercial results. The evaluation report also contains a thorough political study by Mr Juha Rumpunen from the Finnish Institute of International Affairs. The commercial aspects from the point of view of Finnish industry were also considered: shipbuilding (research and logistic vessels), land transport (all terrain vehicles), construction technology (research stations), and measurement technology (geodetic instruments, meteorological sounding).

The evaluation covered the years 1988–1994 and thus the research pertaining to the expeditions 95/96 and 97/98 has not been covered by any evaluation, including

2 The evaluation of the Finnish Antarctic Activities, Ministry of Trade and Industry Publications 4/1995

the present one. The general comments and recommendations of the 1995 evaluation can be summarised as follows.

*General.* The driving impetus stems from political rather than scientific motives and this state of matters is likely to continue. The localisation of activities is determined by logistics rather than research. There is a clear link to Arctic studies and part of the research could have been carried out in Finland.

*Quality and quantity.* The overall quality of research was judged to be satisfactory with some high-level studies. Geology, geophysics and marine sciences would suffice to constitute a body of significant research required by the Antarctic Treaty.

*Coordination.* Planning of research and cruises should be improved. The research should have more international rooting. The establishing of a single coordinating body with logistic facilities and funding resources is recommended.

*Approval and funding.* The opportunities should be advertised and open for all. The processes should be transparent and based on peer reviews. The funding structure should be reconsidered.

### **1.3 The framework of Antarctic research during the evaluation period**

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#### ***1.3.1 The reorganisation of research***

As a result of the review in 1995, a significant reorganisation was carried out which took account of the recommendations made. The responsibility for research was transferred from the Ministry of Trade and Industry to the Ministry of Education, which subsequently arranged the funding through the Academy of Finland. A permanent logistic secretariat was created as well as a standing committee to act as a co-ordination and strategy body linking the various Government agencies and research institutions with an interest in the programme. The new arrangements came into operation in 1998, with the 98/99 expedition being the first to have been undertaken in the context of the new regime.

#### ***1.3.2 Logistics and research station Aboa***

Following the 1998 reorganisation, responsibility for logistics was vested permanently with the Finnish Institute of Marine Research, which is under the jurisdiction of the Ministry of Transport and Communications. The acronym FINNARP (Finnish Antarctic Research Programme), which was previously a general heading of the research, was thereafter reserved for the logistic secretariat only. FINNARP is funded by the Ministry of Transport and Communications for administration, logistic costs and the servicing of the Aboa station. The logistic services are provided to approved research projects without additional cost. They cover transport, personal equipment and personal maintenance. Logistical synergy is sought mainly by arranging joint Nordic expeditions. FINNARP also prepares for each research project an Environmental Impact Assessment based on which the Ministry of the Environment decides on the final acceptance of the project.

Aboa (73°03'S, 13°25'W) was built in Queen Maud Land, Antarctica, in 1988 and is presently managed by FINNARP. The Swedish station Wasa is at the same location, and the two stations form the Nordenskiöld Base Camp. The stations cooperate both in research and logistics. Aboa is used only during Austral summer. It can house ten persons and it consists of a main building, three laboratory containers, storehouse containers, a vaulted hall, a generator building, and a vehicle hall. The station was refurbished in 2003–2004 and the power system was enhanced in 2003–2004 to allow year-round measurements.

### ***1.3.3 The Coordination Committee for Antarctic Research***

The Coordination Committee for Antarctic Research (CCAR) is the main body of cooperation between authorities in Finnish Antarctic research. It was established in 1997 when the responsibility for Antarctic matters was transferred from the Ministry of Trade and Industry to the Ministry of Education. The Committee is chaired by a representative of the Ministry of Education and members are nominated for three-year periods. During the period 2003–2006 the membership represented the following institutions.

- Ministry for Foreign Affairs
- Ministry of the Environment
- Ministry of Trade and Industry
- Academy of Finland
- Finnish Institute of Marine Research
- Finnish Meteorological Institute
- Geological Survey of Finland
- University of Helsinki

In addition, the head of FINNARP logistics acts as an expert member of the CCAR. The main tasks of the committee are coordination and strategic planning. It coordinates and fits together the various components of the research (research projects, logistics, and environmental obligations). It also suggests the general strategies for research and funding and monitors the results. The Finnish Antarctic research strategy for 2003–2006 was prepared by the committee in 2002. As concerns individual research projects, the role of the committee is advisory and the funding decisions are principally made by the Academy of Finland.

### ***1.3.4 International treaties and organisations***

The Antarctic Treaty entered into force in 1961. Finland joined the Treaty in 1984 and became a Consultative Party in 1989. The general responsibilities related to the membership belong to the Ministry of Foreign Affairs. The Treaty has spawned a number of measures and conventions collectively known as the Antarctic Treaty System (ATS) consisting of the following:

- Convention for the Conservation of the Antarctic Fauna and Flora
- Convention for the Conservation of Antarctic Seals,
- Convention for the Conservation of Antarctic Marine Living Resources,
- Convention on the Regulation of Antarctic Mineral Resource Activities (never ratified),
- Protocol on Environmental Protection (Madrid Protocol).

The specific responsibilities following from the Madrid Protocol belong to the Ministry of Environment, and each research project with activities in Antarctica needs a license from that Ministry before it can proceed. The decision-making and executive body of ATS is the annual Antarctic Treaty Consultative Meeting (ATCM), in which representatives of the ministries participate. Representatives of Finnish research institutions may participate in the Treaty activities or meetings as experts attached to the Finnish Delegation.

International research coordination is the responsibility of the Scientific Committee for Antarctic Research (SCAR), a non-governmental organisation that is a member of the International Council of Science (ICSU). SCAR business is conducted principally by its three Standing Scientific Groups (for geosciences, life sciences and physical sciences). It also has a large number of working groups and other scientific teams promoting cooperation within all relevant research fields. SCAR also coordinates research projects of its own. Administrative decisions are made by the SCAR Delegates Meeting and an Executive Committee. Finland is represented in SCAR by the Finnish National Committee for Polar Research, which works under the delegation of the Finnish Academies of Sciences and Letters. The committee is presently chaired by the Finnish Geodetic Institute and has members from all major research institutions and universities involved in polar research. The committee members represent Finland in the SCAR Delegates Meeting and in the Standing Scientific Groups. The SCAR working groups have representatives from several Finnish institutions as well.

The international organisation with responsibility for coordination of management, logistics and operations is the Council of Managers of National Antarctic Programs (COMNAP), which was established in 1988. It is also a non-governmental organisation, although all its members represent National Antarctic Institutes of one sort or another. In 2005 its members operated 37 year-round and 12 significant seasonal stations with a winter population of 1,030 and a summer population of 3,760 people, and conducted operations using 39 different vessels. COMNAP has annual council meetings, an executive committee, and a secretariat for administration. SCALOP, the Standing Committee of Antarctic Logistic Operators, is a part of COMNAP. Both COMNAP and SCALOP have representatives from FINNARP.

JCADM, the Joint Committee on Antarctic Data Management, is a joint advisory committee of SCAR and COMNAP. It also coordinates the development of the Antarctic Data Directory System (ADDS), the main part of which is the Antarctic Master Directory (AMD). The Arctic Centre of the University of Lapland acts as the AMD interface for Finnish researchers.

Both SCAR and COMNAP have the status of Observers to Antarctic Treaty Consultative Meetings.

### ***1.3.5 The Academy of Finland as an Antarctic research funding agency***

The main source of Antarctic research funding is the Ministry of Education. This funding is distributed by the Academy of Finland, which comes under the jurisdiction of the Ministry. The Academy is a major funding organisation allocating about 240 million euros yearly to high-quality research endeavours. Funding decisions are normally made by the four Research Councils: for Biosciences and Environment;

Culture and Society; Health; and Natural Sciences and Engineering. These decisions are based on ratings made by international expert panels that are appointed by the Councils.

However, in the case of Antarctic funding the total amount of the allocated funding is agreed between the Ministry of Education and the Academy. The ministry then commissions the Academy of Finland to organise a call for applications. In this regard the programme is a regional thematic programme. The Academy then appoints a responsible science advisor and a temporary board with representatives from Research Councils that cover the field of the applications. Each submitted application is reviewed and rated by an appropriate expert panel or, when such cannot be found, by two peer reviewers. The rated applications are then presented to the Coordinating Committee of Antarctic Research for their opinion. The Academy Board finally makes the funding decisions based on the ratings and opinions of the Coordinating Committee. There have been three calls: 1998, 2001 and 2004 that have respectively allocated funding of 1.3, 1.4 and 2.0 million euros. Outside of this process there has been no funding of Antarctic research from the Academy except through the grant of one research fellowship.

### ***1.3.6 Other funding sources***

The other major source of research funding has been through the budgets of the institutions themselves. The resources allocated through this mechanism have consisted mainly of person-months of salary support, and funds for the purchase of instrumentation. The FINNARP logistics budget has partly funded the costs associated with certain instrumentation installed at Aboa and Marambio. Normally FINNARP does not fund the logistic costs of research projects directly but rather in terms of the provision of cost-free services. The volume of funding from other Finnish sources, e.g. foundations and ministries, has been small. In only one case has the research been partly funded from the Framework Programmes of the European Union. The other international funding consists of person-months of support for visiting scientists, free logistic services and some travel support.

## **1.4. Overview of Antarctic research during the evaluation period**

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### ***1.4.1 The research***

During the evaluation period 1998–2005, eight FINNARP expeditions were undertaken. However, only the six that took place between 99/00 and 04/05 are included in this evaluation, as the 97/98 expedition was done under the old organisation and the 05/06 expedition returned in February 2006 (Table 2) However, due to Aboa refurbishing there was little research done during the expeditions 01/02 and 02/03. No research personnel participated in the 01/02 expedition but research data sets were collected by FINNARP technical personnel.

*Table 2: The FINNARP expeditions completed during the evaluation period.*

Expedition	Austral Summer	Research on Aboa	Aboa Maintenance by FINNARP
7 <sup>th</sup>	99/00	Palaeoclimatological, geophysical, meteorological, geological	Servicing
8 <sup>th</sup>	00/01	Palaeoclimatological, geophysical, meteorological, geological, geodetic	Servicing
9 <sup>th</sup>	01/02	Geodetic	Preparation for refurbishing
10 <sup>th</sup>	02/03	Geological, geodetic	Station refurbishing
11 <sup>th</sup>	03/04	Palaeoclimatological, geophysical, atmospheric, geodetic	Automatic weather station and wind generators
12 <sup>th</sup>	04/05	Geophysical and atmospheric	Three wind generators

Altogether eleven research teams from six different universities and research institutes carried out sustained Antarctic research during the evaluation period (Tables 3 and 4). These teams are the subject of this evaluation. Three of the teams have not participated in measurement activities in Antarctica but have used data sets collected during this period or in the course of prior expeditions. As compared to the period 1988–1997, the most significant change is the small volume of marine research, which previously constituted a major portion of all research. The vessels used in FINNARP logistical activities were not used for research, except such measurements that could be obtained without interrupting the ship’s course (FMI/ARG, UH/Geophysics). The other marine research (FIMR/DPO, UO/Thule) was through participation in international cruises. Another change that has occurred, mainly due to the lack of research cruises, has been the absence of biological research.

*Table 3: The research units*

Institution	Unit	Acronym	Main Field of Antarctic Research
Finnish Geodetic Institute	Dep. of Geodesy and Geodynamics	FGI	Gravity and GPS measurements
Finnish Institute of Marine Research,	Dep. of Physical Oceanography	FIMR/DPO	Ocean-atmosphere interaction
Finnish Meteorological Institute	Aerosol Research Group	FMI/ARG	Aerosol studies
Finnish Meteorological Institute	Arctic Research Centre + Earth Observation unit	FMI/ARC +EO	Ozone and UV monitoring
Finnish Meteorological Institute	Space Research Programme	FMI/Space	Solar-Terrestrial phenomena in upper atmosphere
Geological Survey of Finland	Division of Land use and environment, Division of Geophysics	GTK	Glacial history, glaciology, marine geology
University of Helsinki, Dep. of Geology		UH/Geology	Continental magmatism, Gondwana break-up
University of Helsinki, Dep. of Physical Sciences	Division of Atmospheric Sciences, group of atmospheric modelling	UH/Atmosphere	Parameterisation of atmospheric models
University of Helsinki, Dep. of Physical Sciences	Division of Geophysics, snow and ice research group	UH/Geophysics	Seasonal snow cover
University of Lapland	Arctic Centre, glaciological research team	UL/AC	Glaciology, climatological ice core analysis
University of Oulu	Thule Institute, global change programme	UO/Thule	Palaeoceanographic sedimentology

Table 4: The participation of the units in Antarctic campaigns

Unit	Funded in Academy calls			Research at Aboa during FINNARP expeditions						Antarctic research on other stations (S) or vessels (V), expedition or year
	98	01	04	99/00	00/01	01/02	02/03	03/04	04/05	
FGI					x	x	x	x		00/01, 03/04 (S)
FIMR/DPO		x								04/05 (V)
FMI/ARG	x	x	x	x	x				x	99/00, 04/05 (V)
FMI/ARC+EO	x	x	x							1998-2005 (S)
FMI/Space	x									
GTK										
UH/Geology	x	x	x	x	x		x	x		
UH/Atmosphere		x	x							
UH/Geophysics	x	x		x	x			x	x	all expeditions (S), 99/00 (V)
UL/AC	x	x	x	x	x			x		99/00, 00/01, 03/04 (S)
UO/Thule		x								2000 (V)

### 1.4.2 The resources

The total funding of Antarctic research during the evaluation period was 13.1 M€ (1.7 M€/year), of which 6.5 M€ is the funding of FINNARP from the Ministry of Transport and Communications. The actual research funding was thus 6.6 M€ of which 3.7 M€ came from the Academy of Finland (Figure 1). Of the eleven units, nine received funding from the Academy, and of these four were funded in all three Antarctic calls. In all of these cases Academy has been the largest source of funding (Figure 2). Two units (FGI, GTK) funded all research from their own budgets. Also for the remaining units the next largest source of funding has been their own budgets. The FINNARP funds redirected to research are usually related to the instrumentation mounted permanently at Aboa or to other measurement equipment used in the Antarctica. The remaining share, from foundations, the European Union etc. has been small.

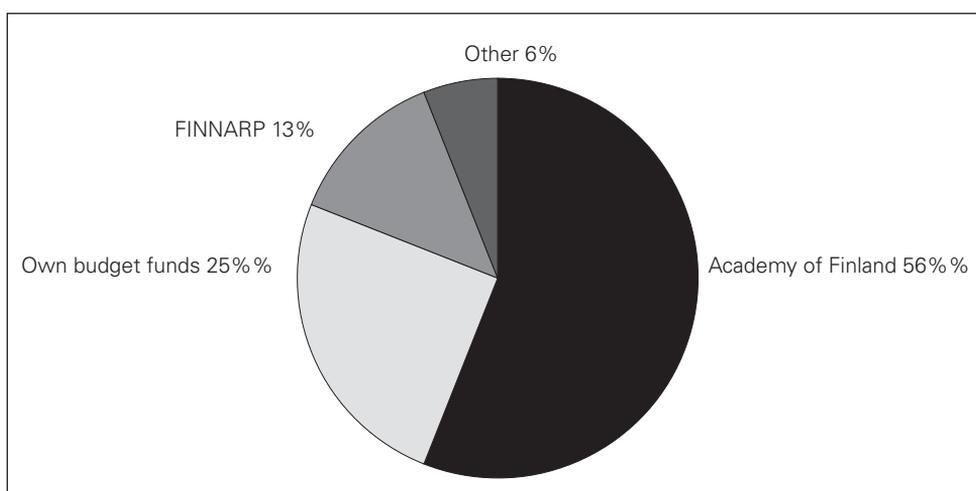


Figure 1: The funding of Antarctic research during the evaluation period. FINNARP logistics is not included.

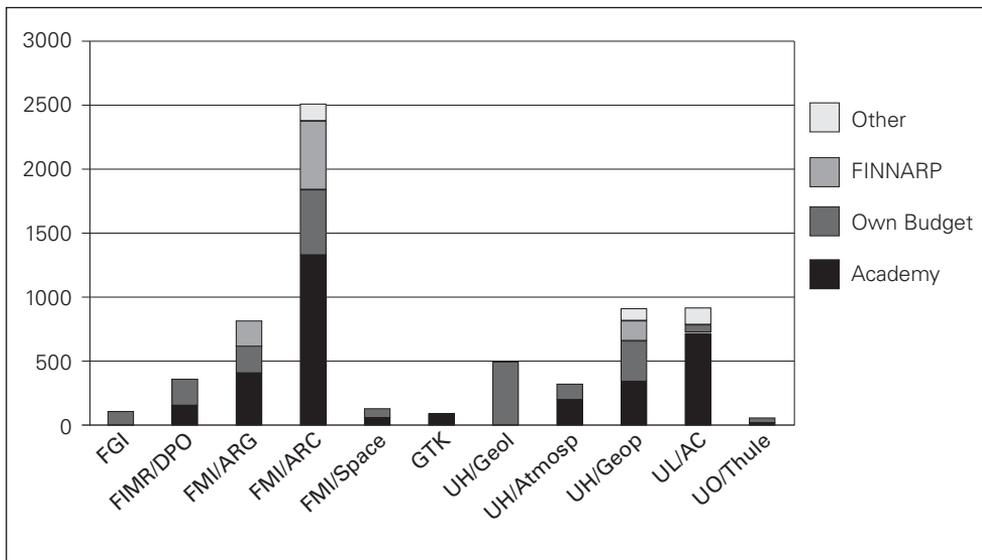


Figure 2: The funding of the evaluated units (k€)

The total manpower input over the evaluation period was 1,953 person-months, which corresponds to the average of 20 FTE (full-time equivalent) workers for the period 1998–2005. Subtracting the 319 months devoted to FINNARP logistics and 274 months for work by technical and other assisting personnel, leaves a total of 1,337 months that were devoted to research or 14 FTE researchers on average. Postgraduate students constitute 64 per cent of the research personnel.

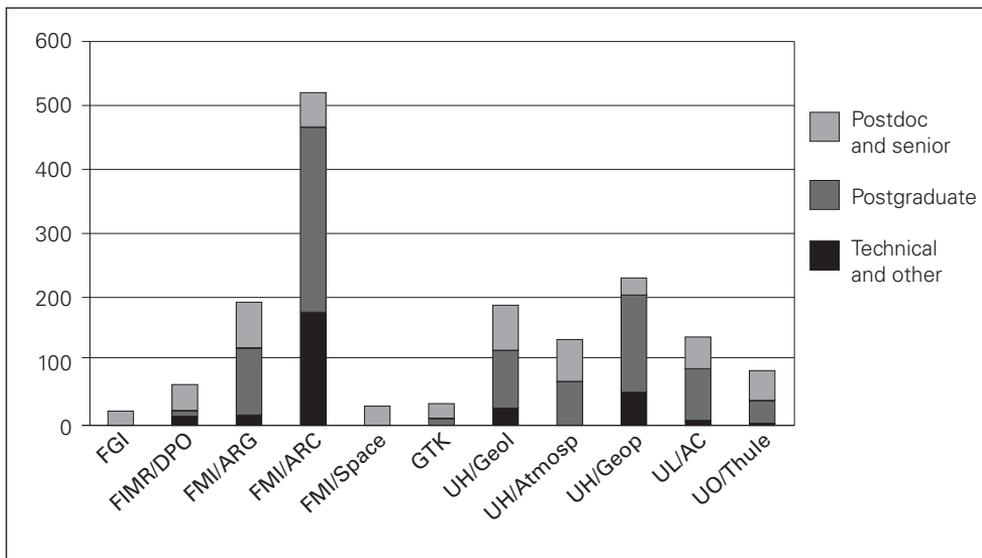


Figure 3: The personnel-month input to research during 1998–2005. One person working full time throughout the period corresponds to 96 months.

## 2 GENERAL COMMENTS AND RECOMMENDATIONS

The involvement of Finland in Antarctic research is rooted explicitly in a political decision by the Finnish Government to be a Consultative Party to the Antarctic Treaty. The objective is to participate fully in the international discussion and decision-making on the status and future of the Antarctic Treaty, and to support and promote the comprehensive protection of the Antarctic environment and associated ecosystems. To become a Consultative Party a nation must demonstrate that it has a significant and continuing research programme in Antarctica. Almost invariably this has resulted in the establishment of a research station located in the continent or surrounding islands, though the Netherlands successfully argued that having a programme that utilised existing infrastructure maintained by other nations was an effective and environmentally sound approach. Finland opted in 1988 to establish a summer only research station – Aboa – located in Dronning Maud Land, and to collaborate with Argentina to make ozone observations from the Argentine research station Marambio.

The overall strategic aims of the programme are contained in a document, *Finnish Antarctic Research Strategy 2003–2006*, which was prepared by the Coordinating Committee for Antarctic Research (see Section 1.3.2). Research funding is provided via the Academy of Finland through a regionally based “thematic” programme, which has earmarked funding of 0.5 M€ per annum, currently dispersed to the community through a call for proposals once every three years. The stated policy is to carry out research that is scientifically significant and in areas where Finland already has a high level of expertise. The strategy document does not attempt to identify in detail particular research topics for prioritising the expenditure, though it does indicate three general topic areas: atmospheric research, geosciences and snow & ice research where Finland is deemed to be strong. In essence therefore, the programme is bottom-up and demand driven. A modest logistics capability is delivered by FINNARP (see Section 1.3.3) hosted by the Finnish Institute for Marine Research and funded by the Ministry of Transport and Communications with an annual budget of 0.85 M€.

### 2.1 Panel overview

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The political imperative for Finnish involvement in Antarctica sets the context for the science programme. There has been no attempt to argue a case for the intrinsic value and excitement of using Antarctica as a platform, both alone and through bi-polar studies, for outstanding “Earth System” or fundamental research, and hence no vision of where the research should be heading. The members of the panel were struck by the fact that even the Academy’s call for research proposals in 2004 had the statement “The Treaty requires that scientific research be conducted in Antarctica” as the primary reason for the work. It is also of note that the Coordination Committee for Antarctic Research (CCAR) accepts that “Antarctic research is not a high priority in Finland”. This background does nothing to foster a vibrant research programme and perhaps it is not too surprising that the overall conclusion of the panel is that the

programme is scientifically incoherent, lacks excitement, tends to be under-supported by the community, and under-performs both against national and international norms. It is, of course, true that all nations involved in Antarctica have a political dimension to their presence there. However, the countries that are really successful in research are those that have recognised the great value of Antarctica as a laboratory for studying issues of global importance to humankind and have consequently made the scientific case much more prominent in justifying their activities.

The Antarctic Treaty System criteria for establishing whether the research programme of a candidate Consultative Party is sufficiently “substantial” are not codified, but are based rather on open debate at Treaty meetings that establishes precedent. However, at ATCM XXIX in Edinburgh Consultative Parties reaffirmed their view that the construction of a station or base in Antarctica was not a pre-condition for attaining Consultative Party status. The ATS does not contain a mechanism for judging whether a national research programme of an existing Consultative Party remains adequate. In these circumstances, if the primary driver for a nation’s membership is political, there is little incentive to give priority to the research programme and its cost can be seen merely as an overhead for membership of the Treaty club. We do not wish to assert that Finland falls into such a category, but it could be perceived with some justification to be tending in that direction. However, we conclude that there has been no change in the primary motivation for the programme since the 1995 Review concluded that: *the driving impetus stems from political rather than scientific motives and this state of matters is likely to continue.*

The mediocre performance of the research programme will only be improved by recognising the intrinsic value and importance of research in Antarctica, and by giving it more prominence and priority.

**The Panel recommends** that Finland carries out a review of why it is carrying out a research programme in Antarctica and whether the current programme as assessed in this report meets its national aims.

## 2.2 Overall performance and productivity

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The research funding was set at 0.5M€ per annum in 1998 and has not been indexed to account for inflation since then. This funding has been dispersed through three grant rounds organised by the Academy in 1998, 2001 and 2004. The success rate for applications for these grant rounds has been much higher than for grant rounds in general with an average for the three rounds of 57 per cent of applications being successful compared with only 27 per cent for the 2005 general call. In terms of funding, 48 per cent of the total requested was provided compared with only 11 per cent for the general call (See Table 5 for more detail). We were also informed by the Academy that occasionally it had been necessary to go further down the ranking of proposals in making research grants than would be normal for the general calls. Taken together, this suggests there is no pent-up demand and hence on this evidence alone there is no strong argument for increasing the level of funding. However, there may be other, strategic, reasons for doing this.

Table 5: The success rates of Antarctic calls compared with the general call of 2005.

Call	Applications			Funding (million €)		
	Received	Funded	Success %	Applied	Allocated	Success %
Ant/98	9	6	67	2,1	1,3	60
Ant/02	12	8	67	3,3	1,4	42
Ant/04	12	5	42	4,7	2,0	43
Gen/05	430	117	27	126,8	14,2	11

There were a total of eleven separate research groups that were included within the evaluation. With the exception of the FMI-Arctic Research Centre, the groups were all small with normally the part-time involvement of one or two professorial or senior researchers and two or three postgraduates. The overall total staff resource consists of a little over one FTE professor, about two senior researchers and a little over two postgraduates per year for the eight years under evaluation. All of the teams represent relatively small parts of the wider work of the group. There is a problem of critical mass, with small teams that are isolated from each other and with very small national pools of peers with whom to consult and interact. There may be an argument for targeting the funding onto fewer but larger research grants, thereby building capacity within specific teams.

Overall output of internationally peer-reviewed publications is low in comparison with both national and international norms. Counting all publications that are at least partially based on Antarctic research, the total output for the eight years under evaluation is 53. For an input of 134 person-years of research effort, this is equivalent to 0.41 papers per FTE per year. The Academy reported that overall the research it funds produces one peer-reviewed paper per FTE, whilst in physics it is two per FTE<sup>3</sup>. The international norm for first-rank institutions would be closer to two per FTE per year. Out of these 53 papers 43 were counted by the citation index of ISI Web of Science<sup>4</sup> in May 2006 and attracted a total of 181 citations or 4.2 citations per paper, excluding self-citation. However, the distribution was highly skewed, with 40 of the publications attracted less than two citations each, including self-citation, whilst six had more than ten citations (excluding self-citation) and one had in excess of 40 citations. Removing from the set four most cited publications (10%) leaves 39 publications and 78 citations or 2.0 citations per paper.

The panel formed the view that the outputs of the various research programmes was competent and workmanlike, but there was no single piece of work that was of front rank in quality or excitement from an international perspective.

**The Panel concludes** that overall the research output from the Antarctic Programme is below the average achieved from other programmes funded by the Academy in Finland.

**The Panel concludes** that there is little pent-up demand that is not being met by the current level of funding.

<sup>3</sup> Susan Linko and Anton Danielsen: Research in natural sciences and engineering funded by the Academy of Finland: Assessment of impact of projects, Publication of the Academy of Finland 6/06 [in Finnish]

<sup>4</sup> <http://www.isiwebofknowledge.com/>

**The Panel recommends** that the Academy consider whether there is an argument for targeting the funding onto fewer but larger research grants, thereby building capacity within specific teams to counter the problem of critical mass.

### 2.3 Postgraduate training

The programme has been only moderately effective in delivering postgraduate training although this is to some degree connected to the modest level of resources provided. Over the eight-year period commencing in 1998 thirteen Master’s theses, three Licentiate’s and six PhDs have been produced (Table 6). A significant problem insofar as graduate training is concerned derives from the isolation and small scale of the groups within which the work is being conducted. This results in the absence of a sense of being members of a larger community among the students who are involved in Finnish Antarctic research. If Finland sees genuine benefit to derive from its investments in both Arctic and Antarctic research it is the opinion of the panel that steps must be taken to impose coherence upon the milieu within which post-graduate training is carried out. In our collective view this might best be accomplished through the graduate school mechanism that has been effectively employed to enhance the coherence and efficiency of research instruction in other areas of science. In order to maximize the number of organizations involved, most benefit would derive from a school that was “bipolar” by design. One aspect of the functioning of the proposed school should be the organization of regular meetings of all participants, both students and professors, perhaps on a twice-yearly basis.

*Table 6: Master’s, Licentiate’s and Doctoral theses*

	1998	1999	2000	2001	2002	2003	2004	2005
FGI								
FIMR/DPO			D					
FMI/ARG			M			D	D	
FMI/ARC+EO		M		L L				M D
FMI/Space								
GTK								
UH/Geology			D			M	D	
UH/Atmosphere							L	
UH/Geophysics		M		M			M	
UL/AC	M				M		M	
UO/Thule						M	M	M

**The Panel Recommends** that the Ministry of Education consider the establishment of a Graduate School in Polar Science

### 2.4 International comparison

A stated aim of the 2003 strategy is to foster international collaboration. There were typically 1–3 contributing foreign visitors per unit to the programme. Taken together their input amounted to about 40 months, which corresponds to 0.4 FTE for the

period 1998–2005. The corresponding numbers for Finnish scientists making overseas visits to collaborate were about 140 months or 1.5 FTE. Given this modest level of collaborative activity, a similarly modest level of internationally co-authored publications is only to be expected.

Turning next to the relative weight of the Finnish Antarctic Research programme compared with those of other countries, the panel were able to call upon a recent publication of Dastidar and Persson (2005)<sup>5</sup> in which is presented the results of a study of total numbers of papers and citation rates for all countries carrying out Antarctic research. This study used a dataset created via a search on “Antarc\*” of the SCI (Science Citation Index) database for the period 1980 to 2003. This does not capture all the output relating to Antarctic science since there will be papers based on Antarctic material, particularly in space sciences, which do not include Antarctica in the title. In the case of Finland Dastidar and Persson found 52 papers for the period 1980–2003. In comparison, from the 53 papers for the period 1998–2005 (Section 2.2) the search on “Antarc\*” singles out 33. However, the effect of this should be similar for all countries and hence the relative rankings should be largely unaffected. As well as determining a total count of output, the study calculated for each country the total number of citations in its output that appeared in foreign publications, and the total number of citations made in foreign publications to that country’s publications. Figure 5 is adapted from the Table provided in Dastidar and Persson (2005). It gives a measure of the relative success of a country’s research programme, as measured by the ratio of citations given to those received, as a function of number of publications produced (on a log scale). It is clear from this that the Finnish programme does relatively poorly compared with most other programmes, and in particular does not compare well with its Scandinavian neighbours.

Dastidar and Persson (2005) also provided a network map using multi-dimensional scaling to represent the collaboration structure between countries. We reproduce this map in Figure 4. This shows a distinct core/periphery structure with a group of countries that are both highly productive and highly collaborative occupying the centre of the diagram, surrounded by a ring of other nations that occupy the periphery of Antarctic research activity. Finland is one of the peripheral countries, giving further evidence that the programme is not maximizing the possibilities for international collaboration.

The average citation rate per paper (excluding self-citation) for each country is also provided by Dastidar and Persson (2005). This indicates that for Finland the rate is 1.1, whilst the median value for all the countries is 2.4, with upper and lower quartiles of 1.2 and 3.2 respectively.

Figure 5 The success of a Country in receiving citations in foreign publications compared with the level of citations it gives to foreign publications (calculated as citations received minus citations given divided by citations given) as a function of its output of publications (self citation is excluded).

In interpreting the data compiled by Dastidar and Persson (2005) it must be borne in mind that no account is taken of the very wide disparity in spending by different nations from the USA and UK at one extreme to Finland at the other. To a large extent Figure 5 shows that more money produces more output. However, the citation

5 Dastidar & Persson, 2005, *Current Science* 89, No 9

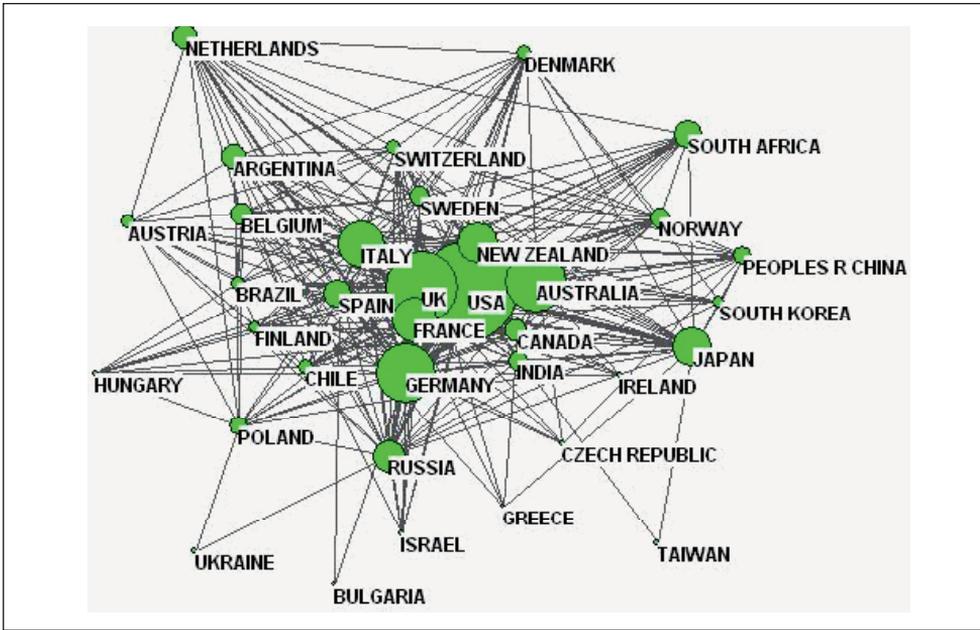


Figure 4: The collaborative structure of Antarctic science.

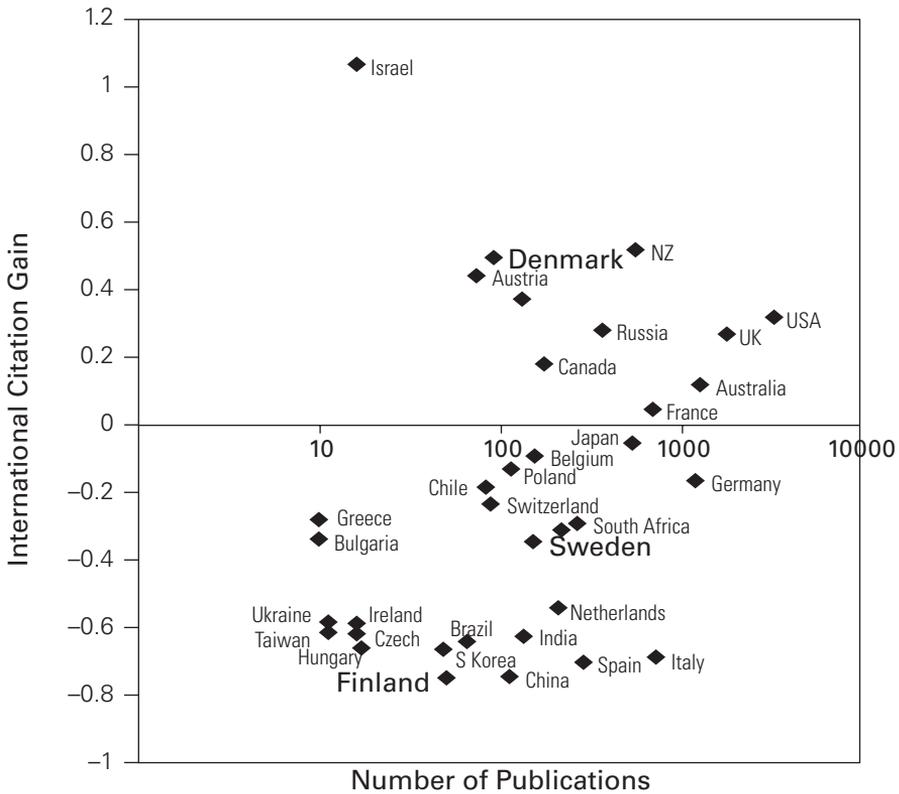


Figure 5: The success of a Country in receiving citations in foreign publications compared with the level of citations it gives to foreign publications (calculated as citations received minus citations given divided by

analysis should be relatively insensitive to budget and does contain a clear message for the Finnish programme.

For a relatively small programme such as that of Finland strong international collaboration is crucial. The Academy may wish to consider whether there would be merit in establishing specific competitive funding mechanisms to encourage such collaboration. This might be in the form of funded fellowships to attract leading foreign scientists to have extended visits or to allow Finnish post-doctoral level scientists to spend extended time overseas, but with a period of employment to exploit their new expertise when they return home.

**The Panel concludes** that overall the Finnish Antarctic Programme performs relatively poorly in comparison with many other nations active in Antarctic research.

**The panel recommends** that the Academy consider whether there are further funding mechanisms it can bring to bear to encourage and foster productive international collaboration.

## 2.5 Success stories

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Having painted a somewhat gloomy picture, it is important to highlight some success stories:

The Ozone & Ultra-Violet Radiation Programme run by the Arctic Research Centre of the Finnish Meteorological Institute has provided, and continues to provide essential datasets for posterity on the historical behaviour of the Antarctic ozone hole and on its behaviour as (hopefully) it recovers in the future. These datasets will be crucial to the monitoring of the effectiveness of the Montreal Protocol, and will provide warning of any unpleasant surprises that might appear during that process. It is also an excellent example of very cost-effective long-term international collaboration.

The experimental work on air quality carried out by the Finnish Meteorological Institute in collaboration with the University of Helsinki is delivering a comprehensive, and now year-round database of atmospheric aerosols from Dronning Maud Land. The Antarctic work is part of a much larger programme of aerosol research studying Arctic pollution for which it provides a baseline from an unpolluted air mass.

The University of Helsinki's Atmospheric Physics Programme studies the dynamics of the Antarctic boundary layer. It has clearly focussed goals and well designed experimental work closely coupled to modelling. It aims to apply its findings directly to improving the performance of the Finnish numerical weather prediction model as well as other general circulation models employed for research purposes.

The work on Gondwana break-up located in the Geology Department of the University of Helsinki led by an Academy Research Fellow takes full advantage of the geophysical setting of Aboa and is focussed on an important problem concerning the processes that are responsible for super-continent break-up.

# 3 REPORTS ON THE EVALUATED INSTITUTIONS

## 3.1 Coordination Committee for Antarctic Research

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The Coordination Committee for Antarctic Research (CCAR) is managed through the Science Policy Division of the Ministry of Education and its membership comprises representatives from the interested Ministries, research and academic sector, FINNARP and the Academy of Finland (see Section 1.3.2). The remit of the CCAR covers logistical, environmental, political and scientific coordination and policy advice, including giving opinions on the funding of research projects to the Academy. It has prepared, revised (2002) and maintained oversight of the *Finnish Antarctic Research Strategy* (1997). The CCAR normally meets two or three times per year. It is estimated that the resource allocation to the committee is nine FTE person-weeks per year.

The panel met with the full committee, heard a presentation by its chairperson and participated in a question and answer session. The panel also drew on the comments in the self-assessment forms and meetings with the research groups in order to gain an understanding of how the CCAR is perceived by the community it serves.

### *The Panel Evaluation*

The panel concluded that while the CCAR carries out its essential responsibility for coordination competently, its existence, role and output are often invisible to, or misunderstood by, the research community. This lack of connectivity to the community undercuts its effectiveness. The panel got the impression that the CCAR was a rather “passive” group who did not see it as their role to be an active champion for Antarctic research within the wider official or academic communities. The CCAR has organised half-day seminars every two to three years, but does not actively attempt to bring the research teams together to foster a sense of community or encourage multi-disciplinary thinking. Rather, the CCAR is content to accept that Antarctic research is not a high priority in Finland and to carry out its activities against that background, largely unseen. The individual Antarctic research teams, already suffering from having very small peer groups within Finland, remain isolated from each other and there is an incoherence in the programme overall. There do not appear to be any formal arrangements within CCAR for liaison with the Scientific Committee for Antarctic Research (SCAR), which contributes to this lack of coherence.

The CCAR oversees the call for proposals for research funding every four years, and makes recommendations to the Academy on which proposals should be funded. It makes these recommendations based on both the logistical practicalities and (to a lesser extent) on science quality. The panel formed the impression that the CCAR as currently constituted was not well suited to forming scientific opinions. The pool of scientific expertise is small and given that the overall research community is itself small, this difficulty can potentially be made worse by conflicts of interest.

**The Panel recommends** that the Ministry of Education review the purpose, composition and terms of reference of the CCAR to ensure that the Committee is meeting its needs. In doing this, the Ministry is invited to take into account the following three recommendations:

**The Panel recommends** that the CCAR take a more active role in championing Antarctic research in Finland and in fostering a group identity for the research community.

**The Panel recommends** that the CCAR establish a formal arrangement for taking account of the activities and research priorities of the Scientific Committee for Antarctic Research (SCAR), both in its tactical decision-making and in any strategic review of the direction of the Antarctic programme.

**The Panel recommends** that for those meetings of CCAR where scientific judgements are made to provide recommendations on funding to the Academy, the membership should be increased to include a small multi-disciplinary group of foreign experts.

### **3.2 Finnish National Antarctic Research Programme (FINNARP)**

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FINNARP is a unit responsible for the logistical arrangements and other implementation support of Antarctic research (see Section 1.3.3). It is organisationally part of the Technical Department of the Finnish Institute of Marine Research (FIMR) and is located in Helsinki. Its main responsibilities are the organising of expeditions and managing of the research station Aboa. The Head of the FIMR technical department presently acts as the Manager of National Antarctic Program (MNAP) and represents Finland in COMNAP while the Head of FINNARP Logistics is the SCALOP member of Finland. FINNARP also advises the CCAR and the Finnish Representatives at the ATCM (see Section 1.3.4 for these organisations). FINNARP employs permanently three persons and additional personnel are employed for expeditions. The period 1998–2005 included six completed expeditions. In addition, Aboa was expanded to increase the capacity of the summer only accommodation and equipped to provide an automated year round measurement capability. The annual budget is 850 k€ was set in 1998 and has not been increased subsequently to take account of inflation. The total funding 1998–2005 was 6,512 k€.

The Panel held a meeting with Hannu Grönvall and Henrik Sandler and had the written comments from the self-assessments to help it form an opinion. The Panel was also able to draw upon the experience of its Chair (UK MNAP 1998–2005) in assessing FINNARP's role on the international stage.

#### ***The Panel Evaluation***

The panel rates FINNARP as a highly effective and efficient organisation that delivers a surprising amount given its funding level. FINNARP delivers a very good service to its customers and this is very well recognised both in the comments provided in the self-assessment and verbal praise provided during our visits to the groups.

Over the past eight years FINNARP has played a full and active part in the work of COMNAP and SCALOP where it is recognised as an active and influential partner.

The Nordic agreement on logistics sharing between Finland, Sweden and Norway has been a very successful way of leveraging the FINNARP capability. It has been a great help in maintaining the volume of Finnish activity during a period of fixed funding. However, FINNARP cannot be expected to continue to maintain the current volume of activity with its present budget. Not only has there been a steady loss of spending power due to inflation through the past eight years, but the crude oil price has risen from the 12–14 \$/barrel of 1998 to the present 60+ \$/barrel. This is particularly difficult for Antarctic Logistics operations for which oil is a relatively large call on budgets. A decision will have to be taken soon to either reduce the volume of activity to fit the budget, or increase the budget.

**The Panel recommends** that the operating budget of FINNARP be urgently reviewed by the Ministry of Transport and Communications, taking advice from FINNARP on what is needed to maintain the current volume of activity. As a rough estimate, a 40 per cent increase in FINNARP budget would be sensible.

### 3.3 Finnish Geodetic Institute, Department of Geodesy and Geodynamics

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FGI is a medium-sized research institute for mapping sciences and for global geodesy and its application to the understanding of geodynamic processes. The main premises are located in Kirkkonummi, about 30 km from Helsinki. FGI resides under the Ministry of Agriculture and Forestry and the operating expenses in 2004 were 3.7 M€, from which 3.1 M€ is covered by budget funds. The institute has several responsibilities for geo-spatial data production and research. FGI/DGG is one of the four departments of FGI and one of its research themes is the mapping of the Earth's crust through GPS and gravity anomaly measurements, specifically the crustal deformations induced by changes of glacial ice masses. In Finland this research is related to the postglacial land uplift (2–7 mm/year) but the methods can be used to assist in the understanding of Antarctic glacial history as well, including the contribution that mass loss from the Antarctic ice-sheet may be contributing to the current rate of global sea level rise due to ongoing global warming of the lower atmosphere. The issue of the current and future stability of the great polar ice sheets is one of the most important issues in modern environmental science and the discipline of geodesy has a vital role to play in understanding the problem.

The Antarctic research of FGI is currently focused upon the measurement of crustal deformation using both gravity field and global positioning system based observations. These measurements were initiated during the 89/90 and 91/92 expeditions with the GPS and relative gravity measurements. The first absolute gravity determinations were made during the 93/94 expedition using an instrument designed by James Faller of the JILA Laboratory in Boulder, Colorado. This was among the first of its kind and has served as a reference for subsequent gravity surveys made by FGI and by institutes from other countries. The absolute gravity determinations were repeated during the 00/01, 03/04 and 05/06 expeditions and were extended to two other stations at Dronning Maud Land. The variation due to snow

cover changes has also been taken into account. In the year 2003, a permanent GPS station was also installed at Aboa.

The Panel met with the Director Dr Markku Poutanen and leading scientists of the Institute and had the benefit of the written comments from the self-assessments to help it form an opinion.

### *The Panel Evaluation*

The expenses of the research, which are funded through the FGI internal budget, are less than two per cent of the total Antarctic research expenses 1998–2005. However, the programme has produced no published papers. Given the very high quality of Finnish geodetic research in general, the work of the Geodetic Institute in Antarctica could very profitably be enhanced through a focussed incremental investment. This would enable the Finnish community to contribute far more visibly to an extremely important area of modern geophysical research.

**The Panel recommends** that serious consideration be given to developing a focussed Finnish programme in the area of Antarctic geodesy/glaciology to be led by the FGI. This would be a natural focus for the community as it would play to existing strength. The FGI is an excellent organization with a first-rate staff that would be capable, given adequate resources for the Antarctic component of its effort, to deliver important scientific returns to the country.

### **3.4. Finnish Institute of Marine Research, Department of Physical Oceanography**

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FIMR is a medium-sized research institute under the jurisdiction of the Ministry of Transport and Communications and is located in Helsinki. The operating expenses (excluding FINNARP) in 2005 were 10.5 M€ from which 8.9 M€ was covered by budget funds. The main responsibility of FIMR is research and monitoring of the Baltic Sea and its ice cover. The institute also maintains several information and forecasting services. FIMR/DPO is one of the three research departments of FIMR, the other two being devoted to chemical and biological oceanography. The research of FIMR/DPO principally seeks to develop better forecast models. In mid-winter, 10–100 per cent of the Baltic is ice covered, and the research projects typically combine oceanographic modelling, ice cover physics, and marine meteorology. This work has a strong interconnection to research done on other ice-covered seas and vice versa.

The Antarctic research of FIMR/DPO has been focussed upon ocean-atmosphere interactions in the Atlantic sector of the Southern Ocean, especially the Weddell Sea. These activities were initiated during the 89/90 season with meteorological measurements and the deployment of three meteorological drifting buoys on ice floes. The deployment continued in 91/92 and 95/96 with two and four meteorological buoys respectively. In 95/96, three position drifters were also deployed, bringing the total to twelve. The studies undertaken using the data obtained from these deployments were connected to International buoy programmes. The work was continued during the R/V Polarstern drifting station expedition in November 2004–January 2005 with measurements of radiation fluxes and heat balance and on air-ice fluxes. The research expenses incurred in this work constituted approximately five per

cent of those for all Antarctic research. This work has been funded from the FIMR internal budget and by the Academy of Finland through the 2002 call.

The Panel was unable to meet with a representative of this research programme because of illness but had the written comments from the self-assessments and comments from former collaborators to help it form an opinion.

### ***The Panel Evaluation***

The FIMR team led by Prof. Launiainen has actively participated in the International Program on Antarctic Buoys (IPAB/WMO), deploying drifting buoys in the Weddell Sea that provide valuable data for estimating the air-water/sea ice fluxes (radiation, turbulent fluxes) and constraining sea ice dynamics. These are important elements for analysing the production rate and/or properties of the Antarctic bottom water, which could exert a long-term influence on global climate.

The scientific productivity of this team has not been especially outstanding. There have been four published papers, equivalent to 0.8 per FTE at a cost of 87 k€ per paper and only a single PhD thesis has been generated.

The deployment of further satellite-monitored drifting buoys could provide international “visibility” to the Finnish activities on marine Antarctic research at a relatively low cost. Though no marine campaigns are being done at present within the Finnish Antarctic Research Programme, such deployment could be done from other countries’ research vessels. The deployment of further drifting buoys has been recommended by SCAR XXVIII (Bremerhaven, 2004). However, the fact that two experienced members of the team have left the unit (implying, in fact, that some research lines have been interrupted or abandoned) makes the future of this research unit unclear.

**The Panel recommends** that FIMR consider whether it wishes to continue its research in Antarctica in a sustained manner.

### **3.5 Finnish Meteorological Institute, Aerosol Research Group**

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FMI is a large research institute under the jurisdiction of the Ministry of Transport and Communications. The operating expenses in 2004 were 41.5 M€, of which 27.2 M€ came from budget funding. FMI provides weather prediction services and conducts research in meteorological sciences and geophysics. There are five research programmes and two separate research units, in Kuopio and in Sodankylä. FMI/ARG belongs to the Air Quality research programme. The group is located in Helsinki and investigates the physical and chemical properties and behaviour of aerosol particles in the lower troposphere. In addition to conducting a measurement programme in Finnish Lapland, FMI/ARG initiated Arctic aerosol studies in Greenland in 1989 and has continued to operate several measurement campaigns in different Arctic areas. The Antarctic research is a minor but natural extension of this work.

FMI/ARG has extensive cooperation with UH/AG, the Aerosol Group of the Division of Atmospheric Sciences, University of Helsinki, and the two groups also share some facilities. UH/AG is a major research group of about 30 researchers and its main topics are the formation of fresh atmospheric aerosols, and micrometeorological fluxes.

FMI/ARG initiated Antarctic measurements in 1995 at Terra Nova Bay station (Italy). Following this, the work has been conducted in collaboration with UH/AG. The first Aboa measurements were made during the 99/00 and 00/01 expeditions with the new laboratory equipment designed for the purpose. In 2003, a system for year round aerosol concentration measurements was installed at Aboa and this was updated in 2005. Measurements were also made during ship transit from Europe to Antarctica during the 99/00 and 04/05 expeditions. The expenses incurred in this work constitute about 12 per cent of the total Antarctic research expenses in the 1998–2005 period, of which approximately half was covered by the Academy of Finland and the other half by internal budget funds, FINNARP and additional but minor sources.

The Panel received a presentation from Dr Virkkula, held a discussion with members of the group at FMI and had the written comments from the self-assessments to help it form an opinion.

### *The Panel Evaluation*

The combined expertise of the FMI and University of Helsinki aerosol research groups make for a very powerful internationally recognised “centre of excellence” in this area of study, with several consistently productive scientists of international standing. This is indicated by their high bibliometric productivity indicators, for example the h-index<sup>6</sup>. The joint Antarctic programme is a rather small part of the overall programme. Its primary objective is to understand and quantify aerosol processes in the Antarctic Boundary layer. The wider purpose is to use the clean Antarctic tropospheric measurements as a baseline against which to assess the contribution of natural background aerosols and processes in the Arctic air in general and the air over Finland specifically.

An internationally important and comprehensive observational database of aerosol composition and behaviour in the vicinity of Aboa station is being built up. The addition of a year-round monitoring capability at Aboa has been very important, greatly increasing the value of the data collected. The transects from Europe to the Antarctic through the Atlantic and Southern Ocean have also provided an important dataset.

The Antarctic work is primarily observational and the outputs reflect this. It was not obvious to the panel that there was a clear vision as to where the Antarctic Programme was headed. There did not appear to be any structured use of the datasets to test hypotheses, and very little evidence in the published output of actually using the Antarctic datasets to provide the “clean” background against which to interpret the Arctic data (one conference abstract is cited on this general topic). The role and behaviour of tropospheric aerosols in the overall chemistry and dynamics of the atmosphere is of significant interest, and as yet, global circulation models do not incorporate aerosol behaviour with adequate accuracy. Although it became clear in discussion with the group that they recognised the potential for using the observational data to refine and improve the treatment of aerosols in the FMI global circulation modelling work, there did not appear to be much yet happening to exploit this very important opportunity.

6 <http://arxiv.org/abs/physics/0508025>

The peer reviewed (published and in press) output since 1998 totals twelve papers, or a publication rate of 0.75 papers per FTE, at a direct cost (excluding logistics) of 66 k€ per paper. This is a modest level of output, although quite cost-effective. The work has produced two doctorates and one licentiate.

**The Panel recommends** that the group articulate a clear research strategy for the aerosol programme.

**The Panel recommends** that application of the Antarctic dataset to the refinement of the treatment of tropospheric aerosols in GCMs be pursued vigorously.

### 3.6 Finnish Meteorological Institute, Arctic Research Centre and Earth Observation

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FMI/ARC is a separate research unit within the FMI and is located in Sodankylä, about 100 km north of the Arctic Circle. ARC has research programmes in Earth Observation, Climate and Global Change, and Air Quality. The polar ozone research of ARC was initiated following the discovery of Antarctic ozone hole, and in 1988 monitoring programs were launched in both hemispheres. When the Sodankylä-Pallas GAW (Global Atmospheric Watch) station was established in 1996, corresponding measurement activities, especially UV, were added to the Antarctic agenda. FMI/ARC has participated in Marambio ozone research from the start of the sounding program in 1988, and coordinates currently FMI Antarctic Ozone/UV research.

FMI Earth Observation (FMI/EO) is a research unit at the Kumpula campus specializing in the global change remote sensing applications. The unit originates from the former FMI UV/Ozone research group and remote sensing parts of the former FMI Geophysics department. The EO ozone and UV research group has carried the main responsibility of the Marambio operations since the early 1990s and leads the FMI remote sensing and UV activities in the current project.

The Antarctic ozone measurements began in 1988 at Marambio station (Argentina) in collaboration with Servicio Meteorologico Nacional and have continued ever since. For UV radiation a chain of three measurement stations was established in 1999 located at the Argentine Antarctic bases Belgrano II (77°52'S, 34°38'W), Marambio, and in the Argentine city of Ushuaia. This was done in collaboration with Instituto Nacional de Meteorología, Spain, Dirección Nacional del Antártico – Instituto Antártico Argentina, and Centro Austral de Investigaciones Científicas, Argentina. Generally Argentina has taken care of the measurements and Finland, as well as Spain for the UV measurements, has provided some of the instrumentation, consumables (balloons, ozone sondes) and input to data quality control issues and methods. The expenses during the 1998–2005 period constituted approximately 39 per cent of all Antarctic research expenditure. About half of these costs have been covered by the Academy of Finland through grants received through the three calls for proposals, one fifth by FINNARP and the rest by internal budget funds and other sources.

The Panel members met with the scientist involved in this programme and had the written comments from the self-assessments to help it form an opinion.

### *The Panel Evaluation*

This is the single largest Finnish Antarctic programme, both in terms of cost and in manpower. The group has been consistently successful in bids for funding from the Academy, has attracted funding from the EU, and also receives significant funds from FINNARP, primarily for consumables for the ozone observations, and partial salary support from the FMI budget.

This is primarily a monitoring programme and as a consequence should not be expected to have a prolific output of research publications. The real strength of the programme is the essential “legacy” datasets that it has acquired and continues to acquire that document the behaviour of the Antarctic ozone hole. These data are critical for the assessment of the effectiveness of the Montreal Protocol, providing “ground truth” for space based ozone observations and for providing early warning of unexpected behaviour during the anticipated recovery of the stratospheric ozone layer over the coming century. The ozone record from Marambio is now one of the most comprehensive available and becomes more valuable with each year that is added to it. There is further added strength as a result of the bipolar dimension to the work.

It is often difficult to win money from funding agencies to support the maintenance of long-term datasets, so it is very pleasing to see that the Academy of Finland, along with FINNARP and FMI have demonstrated a long term commitment to providing such support.

The programme is also a very good example of effective international collaboration that, through efficient sharing of expertise and resources, has delivered an output of global value which could not have been delivered by the partners acting on their own. However, the panel notes that research collaboration with Argentine scientists is as yet embryonic, but that there are now positive developments that the panel encourage the group to follow up.

The research output of the group is relatively low with a total of ten papers at 0.23 papers per FTE and quite expensive at 250 k€. These papers have mainly been either observational or technical (e.g. equipment design or data validation based). There has been a total of five post-graduate degrees conferred in the past eight years spread between three separate university partners. Only one of these was a PhD. The group is effective in making its data available internationally, which is a key factor in measuring the worth of a monitoring programme. The datasets that the group now has available should form a sound basis for further doctoral projects, so the group is strongly encouraged to bring more PhD students into the programme.

The datasets are also a very valuable resource for stratospheric modellers, particularly in understanding the dynamics of the ozone hole. The group is encouraged to put more emphasis in this area, utilising the strong modelling capability within FMI, possibly in conjunction with a new PhD project.

**The Panel recommends** that the Finnish funding system (the Academy, FMI, FINNARP) continue to put a high priority on maintaining the programme of ozone and related observations for the foreseeable future.

**The Panel recommends** that the ARC group continue its efforts to build a research collaboration with scientists from Argentina to fully exploit the research potential of the datasets collected.

**The Panel recommends** that the ARC group put more emphasis on studying the dynamics of the ozone hole through the combination of the observational data and numerical modelling of the stratosphere.

### 3.7 Finnish Meteorological Institute, Space Research Programme

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FMI/Space is one of the five research programmes of FMI. Its main field of study is solar-terrestrial phenomena in the upper atmosphere, the best-known example of which are the Auroral processes. Surface based optical, magnetic and radar ground observation networks have a key role to play and FMI/Space operates the Fennoscandian MIRACLE network. Such networks are concentrated in the northern hemisphere, but since the late 1990's new instruments have been installed in the Antarctic. FMI/Space will participate to these international projects, the first step having involved participation in the establishment of the Kerguelen SuperDARN station in 1998–1999. Bipolar low altitude satellite data will be analysed as well.

During the development of the Kerguelen radar (1998–1999), FMI employed a radar scientist from the University of Uppsala as a ¼ -time project manager. Several (3–4) FMI/Space scientists have since used the radar data in their research. Optical data from Zhongshan station (China) and magnetic data from British and US stations are available as well. The data analysis tools, applicable also to Antarctic observations, are being developed by a team of two senior scientists and two post-graduate students. Since 2005, FMI/Space has co-chaired the SCAR programme ICESTAR (Interhemispheric Conjugacy Effects in Solar-Terrestrial and Aeronomy Research). Antarctic research expenses of FMI/Space have been funded by the first call of the Academy of Finland, SCAR and FMI itself and have constituted about two per cent of all Antarctic research expenses in the period 1998–2005.

The panel received a presentation by Dr Kauristie on the programme and also had the group's written self-assessment to help in its assessment.

#### *The Panel Evaluation*

The Antarctic component of the group's work is very small, but the investment in the Kerguelen radar through a grant from the Academy has provided very cost-effective access to a very powerful international bipolar network of HF radars through membership of the SuperDARN consortium.

The group has strong international collaborative links and the senior scientists have sustained international quality productivity.

The group has a clear strategy of bringing together modelling and observations both to improve understanding of the fundamental physics involved and to develop practical tools for predicting “space-weather” events, which can be very disruptive of modern electrical power, as well as communications and navigation systems. They are a productive group, and although they have not yet published papers that specifically relate to Antarctic datasets collected from the Kerguelen radar, there are five publications since 2000 that have drawn upon the overall SuperDARN network.

Given the global nature of the terrestrial response to solar disturbances, analyses that draw upon a single data-set are anyway unlikely to be of much lasting importance.

The overall field of Solar Terrestrial Physics is now a mature one in which there are unlikely to be large leaps in understanding. Even so, there remain many significant phenomena in which the underlying plasma physics remains to be properly understood. It is likely that studying the global response of the coupled ionosphere/magnetosphere and solar wind system using bipolar ground-based arrays with in-situ observations and modelling will be one effective way to unravel these secrets. The Group is well placed to capitalise on these opportunities, though there is not yet much evidence in their published output of significant effort in this direction.

**The Panel recommends** that the group put effort into exploiting the significant opportunities they now have for leading bipolar conjugate studies of the coupled solar wind, magnetosphere, ionosphere system.

### 3.8 Geological Survey of Finland, Division of Land Use and Environment and Division of Geophysics

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GTK is a large research institute under the jurisdiction of the Ministry of Trade and Industry. It is the national geoscience agency with many responsibilities and activities, the operating budget of which in 2005 was 55 M€. The Antarctic research group is located in the Southern Finland Office of GTK, in Espoo. GTK participated in seven expeditions made under the old organisation 1987–1998 and the topics included Antarctic glacial history, subglacial conditions, marine geology and the break-up of the supercontinent of Gondwana. The volume of Antarctic related research has remained small and has been funded entirely through internal GTK funds. The work has relied on data and results from expeditions carried out prior to the evaluation period. The investment of internal funds, represented about one per cent of all Antarctic research expenses in the period 1998–2005.

The panel met with the Head of the Unit, Karita Åker, and with Petri Lintinen and made use of the group's written self-assessment to help in its assessment.

#### *The Panel Evaluation*

The collaboration with the Department of Geology of the University of Helsinki on the Gondwana breakup studies should continue to be fruitful. However, the level of commitment of GTK to Antarctic research is extremely modest for such a large organization, especially given the acknowledged importance of the understanding of polar processes in the general area of global change science. Output is modest with just one published paper, representing 0.36 papers per FTE at 76 k€ per paper.

**The Panel recommends** that GTK consider developing a more focused effort in the area of polar processes, particularly in the area of glaciology and polar ice sheet stability, especially as there exists such a strong connection between this area of science and the effort that is required to develop the safety case for a spent fuel repository for high level nuclear waste in the event of a re-glaciation of the Finnish land mass.

### 3.9 University of Helsinki, Department of Geology

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UH is the largest of the Finnish universities with over 38,000 students and the Department of Geology belongs to its Faculty of Mathematics and Science. It has six professorships in two divisions, for geology and mineralogy, and for geology and paleontology. The department is located at Kumpula campus in Helsinki and has traditions in geochemical and petrological research on anorogenic continental magmatism. The Antarctic work continues and expands this research and is focussed upon the assessment of the geological evolution of the supercontinent of Gondwana.

UH/geology participated in the Antarctic expeditions in the periods 89/90, 91/92, 93/94, and 97/98 and also had logistic responsibilities during the latter three. The work continued during the expeditions in 99/00, 00/01, 02/03 and 03/04 and concentrated upon the investigation of exposed rock outcrops in the surroundings of Aboa. The expenses, which constitute about seven per cent of Antarctic research costs in the period 1998–2005, have been funded through the three calls of the Academy of Finland.

The panel met with the Head of the Department Prof. Juha Karhu and with the most deeply involved faculty member Dr Arto Luttinen and also had the group's written self-assessment to help in its assessment.

#### *The Panel Evaluation*

The research being undertaken by this group on the magmatic events that attended the break-up of the supercontinent of Gondwana is quite interesting from the perspective of global tectonophysics. The interval of time between the Neoproterozoic and the Cambrian is of course one of the most interesting in Earth history. In the earlier interval it has been suggested that the planet experienced the most severe episodes of glaciation since its formation, in the latter interval there occurred the so-called "Cambrian explosion of life". This time was also marked by the break-up of the supercontinent of Rodinia. It would appear to be very advantageous if the group working in the University of Helsinki Department of Geology were to join forces with the geophysicists who are also involved in the palaeomagnetic work required to better understand the dispersal pattern of the individual continental fragments after break-up occurs.

This group has a very good record of attracting research funding and would appear to be in a position to count on at least a further five years of support for the programme upon which it is focused. The work involves high-level geochemistry that is supported by well-equipped laboratory facilities and the work takes excellent advantage of the location of the Aboa station. However, the geophysical work on internal mantle dynamical process is not well known. The published output is again quite modest at six papers in total, representing 0.39 per FTE at 78 k€ per paper.

**The Panel recommends** that the group join forces with the geophysicists in the University to strengthen the palaeomagnetic input to their programme.

### 3.10 University of Helsinki, Division of Atmospheric Sciences

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UH/Atmosphere belongs to the Department of Physical Sciences, the Faculty of Mathematics and Science, and is located at Kumpula campus in Helsinki. It has five professorships and the main research themes are meteorology, aerosol physics, micrometeorology, and space physics. There are several research groups, one of which is the group of atmospheric modelling. The group is led by a professor and has one other senior researcher working together with several graduate students. Its main research themes include Antarctic meteorology in general and mesoscale and microscale meteorology in particular including the study of boundary layer and turbulent processes over sea ice covered ocean and radiative transfer. The Antarctic work is an extension of similar work done in the Arctic and was initiated in 2002. The team has analysed data taken during the Finnish Antarctic expeditions but has not yet participated in them directly. The research expenditures under this component of the Finnish Antarctic programme constitute about five per cent of all Antarctic research expenses during the period 1998–2005. About 2/3 of this has been covered by the two latest calls of the Academy of Finland and 1/3 from the Division's own budget.

The panel met with the Head of the Unit Prof. Hannu Savijärvi, Dr Timo Vihma and others, and also had the group's written self-assessment to help in its assessment.

#### *The Panel Evaluation*

This is a talented and enthusiastic group of scientists with a well-thought out research agenda involving a mix of research topics directed towards the improvement of the parameterisation schemes that are employed to represent sub-grid-scale processes in global scale models. This is an important area of modern atmospheric and climate dynamics research. In this context, the team members are users of Polar MM5 mesoscale atmospheric model and have registered as members of Polar MM5 working group; however, no deep involvement in the working group has been achieved so far. The group appears to be very well led but its publication record is not exceptional, there being five papers in total representing 0.45 papers per FTE at a cost of 63 k€.

**The Panel recommends** a much more active collaboration of this unit with the larger groups in Finland that are also engaged in Antarctic research.

**The Panel recommends** that this team gets deeply involved in the Polar MM5 Working Group, as one of the planned modifications of Polar MM5 is “improved snow/ice albedo parameterisation”, which is a subject of current research by the unit under evaluation.

### 3.11 University of Helsinki, Division of Geophysics

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UH/Geophysics belongs to the Department of Physical Sciences, the Faculty of Mathematics and Science, and is located in Helsinki. There are three professorships, one for solid earth and two for hydrosphere. Presently one hydrosphere chair focuses on hydrology and the cryosphere and the other on oceanography and modelling. Most cryosphere research concerns sea ice and snow cover, which constitutes the

main research theme of the Division. Most topics studied by the snow and ice research group are as relevant to the Antarctic as they are to the Arctic.

The Antarctic research of the group was initiated in the early 1990's and was focussed upon sea ice research. The morphology, ridges and snow cover of pack ice were surveyed and ice drift was modelled. During the 98/99, SWEDARP expedition solar radiation investigations were made in the Weddell Sea. After this the interest was directed toward the snow research at Aboa station. Two projects (1999–2001, 2002–2005) were carried through. In the latter also other surface types (blue ice, bare ground) were included in the study programme. The group has participated in four FINNARP expeditions (1999, 2000, 2003 and 2004). The field work has been based on shallow and deep snow pits and cores of the upper 10 m layer of the glacier and has been carried through in a 15° sector extending 400 km inland from the shelf edge. Measurements have been made in the field and from samples transported to Helsinki. Remote sensing (space and airborne) and automated ground monitoring have supported the field work. The funding applied in support of this component of the Finnish programme corresponds to about 14 per cent of total Antarctic research funding during the period 1998–2005. Somewhat more than a third of this was obtained through applications to the two first calls of the Academy of Finland, one-third from the budget of the Division and collaborating institutions, and the remainder part from FINNARP and other sources.

The members of the panel met with the Head of the Unit Aike Beckmann and with the lead scientist in this programme Matti Leppäranta and also had the group's written self-assessment to help in its assessment.

### *The Panel Evaluation*

This programme is another in the suite of Finnish Antarctic undertakings that is primarily measurement based and descriptive in nature and lacking in clearly identified scientific goals. The productivity of the group is very modest (8 papers in total, representing 0.41 per FTE at 112 k€ per paper), although the lead scientist Dr Leppäranta has a good personal publication deriving from work in a variety of fields. However, the work on snow is a new area of activity for him and is as yet somewhat immature. Nevertheless, the work on Antarctic mass balance and on the importance of snow albedo parameterisation for climate models is directed towards the resolution of important issues and could lead to high impact outcomes. This would require that the research team put a stronger emphasis on satellite data-derived analysis, using measurements near Aboa station for ground-truth. The fact that funding for this work has been discontinued is unfortunate given the importance of the topics. A gap in the data series collected so far would have a negative impact, so efforts should be made to continue the data collection.

**The Panel recommends** that the cooperation with the teams of the Finish Geodetic Institute and the University of Lapland-Arctic Centre, concerning the influence of snow cover variations on the gravity signal, be strengthened.

**The Panel recommends** that an effort be made to integrate this research in large-scale (both in space and time) climate simulation, with focus on seasonal snow cover and albedo feedback. This team's research on snow cover should also be integrated in the

international ongoing research on mass balance of Antarctica. The latter could be achieved e.g. by joining the ISMASS (Ice Sheet Mass Balance and Sea Level) expert group within the Standing Scientific Group on Physical Sciences of SCAR (in this regard the panel notes that Leppäranta is the Finnish representative in the latter SSG of SCAR).

In the light of the importance of the topics and the potential high impact of the results, **the Panel recommends** that funding be provided in order to continue/restart the field measurements and support the research.

### 3.12 University of Lapland, Arctic Centre

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The University of Lapland was founded in 1979 and is located in Rovaniemi, which is close to the Arctic Circle. UL/AC is a centre of research and informatics affiliated to the university with research themes covering global change, sustainable development and environmental and minority law. The glaciological research team belongs to the global change research group. A major research subject of the team is palaeoclimatic studies of glacier ice sounded by radars and analysed from core and surface samples. The team has participated in the Antarctic expeditions 99/00, 00/01 and 03/04. The work has concentrated on the blue ice areas of Dronning Maud land using Aboa and Sanae (South Africa) stations as bases. Techniques include ground-penetrating radar and coring, especially long horizontal cores. Core samples have been shipped to Finland for analysis, which in addition to chemical and isotope analyses, applies flow models constructed for the blue ice fields. Some blue ice cores drilled by the Dutch have also been analysed. The majority of the expenses, which have constituted about 14 per cent of Antarctic research expenses in the period 1998–2005, were covered from the three calls of the Academy of Finland.

The panel met with Dr Moore at the University of Oulu and also had the group's written self-assessment to help in its assessment.

#### *The Panel Evaluation*

Moore is among the leading experts on blue ice and is heavily involved in the development of technical methodology. His scientific productivity is good, considerably better than the average of the evaluated units, though that strictly linked to Antarctic research is more modest at five papers in total (representing 0.43 papers per FTE at 184 k€ per paper). The fraction of his efforts that are directed specifically towards Antarctic research is higher than that of the other units and is focused upon the single subject of glaciology. The effort unfortunately is not well integrated into the ongoing international effort coordinated by SCAR, particularly the large international programmes in climate evolution, such as ACE, that are being driven strongly by the climate records derived from deep vertical ice coring activities.

At some stage in the near past, because of budgetary constraints, Finland had to decide between joining the European Program for Ice Coring in Antarctica (EPICA) and the Ocean Drilling Programme (ODP). Having chosen the latter, Finland missed the opportunity to join a most relevant European initiative, in which Moore could have substantially contributed considering his expertise in ice core chemistry. The Finnish Antarctic Programme has yet the possibility to join international initiatives

concerning ice coring in Antarctica. Though expensive, this would provide a strong international visibility to the Finnish Antarctic research. This is especially important at the present moment, when remarkable international efforts, such as IPICS (International Partnerships in Ice Core Science), are building a robust partnership in this field of glaciology.

In the opinion of the panel it is unlikely that the combination of horizontal drilling methodology and numerical modelling for dating purposes that is being developed by Moore in the blue ice areas will lead to useful records of palaeoclimate change. The numerical model is too simplistic and the error bars are large, so it is unclear whether this team's work on blue ice areas will be successful in providing reliable palaeoclimate information from coastal areas. However, in case of succeeding it would constitute a most important contribution to Antarctic palaeoclimate research. Because of this, Moore's efforts in this area deserve continued support.

Moore's team is too small, he being the only staff senior scientist focused on glaciology within the University of Lapland Arctic Centre. Moreover, there is no science department (and therefore no faculty) at this university. This prevents this unit from growing within the University of Lapland. Consequently, better integration of this activity with that of other Finnish teams is to be strongly encouraged. The lack of a science department has another implication: this team's students have to register either at Oulu or Helsinki universities, where, being e.g. chemistry students, are forced to take some courses of little interest for their Arctic Centre related career, and not allowed to take some others such as geophysics which are crucial for the aims of the glaciological research at the Arctic Centre.

The **Panel recommends** that the University of Lapland consider the possibility of creating a second permanent position (at the level of senior scientist) associated with the glaciology group of the Arctic Centre, in order to sustain the important research undertaken by this group.

The **Panel recommends** that Finnish universities be flexible in accepting the choice of courses by the students linked to research centres such as the University of Lapland Arctic Centre (or other research institutions), in order to allow them to build a robust academic background in the areas of their current research.

The **Panel recommends** that the Finnish Antarctic authorities consider the possibility of Finland joining the ongoing international initiatives for ice coring in polar regions, making the necessary financial contribution to them.

### 3.13 University of Oulu, Thule Institute

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UO/TI is an independent research institute of the University of Oulu, which is the second largest university in Finland with its 17,000 students and 3,000 employees. UO/TI operates as a national and international expert institute on Northern and environmental issues. Its research work is divided into three programmes: 1) Global change in the North, 2) circumpolar health and wellbeing, and 3) northern land use and land cover. A major research theme in the global change programme is long-term climate history and glacial cycles, and there are glaciological and palaeoceanographic

projects related to this. The Antarctic palaeoceanographic and palaeoclimatological research of the team has background in the sediment and marine geological studies of the 95/96 FINNARP expedition. The present research is mainly based on the results of Ocean Drilling Program (ODP) expedition Leg 188 in January–March 2000. Cores were drilled from Prydz Bay, Antarctica, and one team member participated to the expedition as a research scientist. The expenses are less than one per cent from all Antarctic research expenses 1998–2005. Less than one half has been covered by the second call of the Academy of Finland and the rest by budget funds.

The panel met with the Director of Thule Institute, Kari Laine, and the Head of the Unit, Kari Strand, and also had the group's written self-assessment to help in its evaluation.

### *The Panel Evaluation*

This is a good group of practitioners of the sedimentary arts with well focused and clear aims that. The group is willing to work as part of a larger programme and to adopt the objectives of the programme as its own. It is difficult to discern the existence of a particular aspect of the effort that the team sees as its own. The productivity within the larger project has nevertheless been relatively good as measured by the funding required per paper published and per FTE (total of 5 papers representing 0.72 papers per FTE and only 10 k€ per paper). If no further funding of this work is forthcoming the effort in this area must be considered over. It was not clear to the members of the panel why there did not exist any collaboration with Moore or any other partners within the Finnish community.

Two aspects of this team's research have particular interest. First, the studies focused on the Eocene-Oligocene time window, as this represents the onset of glaciation in East Antarctica, as yet poorly understood. Second, the research tools employed. In particular, the analysis of clay mineral distributions and geochemistry, as this differs from the proxies/methods used by other international teams (such as stable isotope ratios, biogenic silica with timing based on microfossils or sediment composition in ice rafted debris), so providing a tool for cross-validation. If the results of this team's analysis of ODP leg 188 would have improved the present knowledge (and uncertainties) of the dating of the time, in the Eocene-Oligocene transition, when the East Antarctic ice sheet reached the continental margin, this would have been a significant contribution, as it would have allowed its comparison with the time of opening of Drake passage and the onset of the circumpolar current. Unfortunately, the team's results just confirmed – without reducing its level of uncertainty – the 34–37 Ma B.P. already obtained from the analysis of other proxies.

This team is too small, having a single senior scientist (Strand), who additionally has management responsibilities at Thule Institute. This calls for an extended partnership.

The **Panel recommends** that real effort be made to develop collaborative interactions within the Finnish community, especially with other partners who that could provide the analytical tools not available to this unit.

The **Panel recommends** that the already exiting collaborations at the international level within the OPD/IODP programs be strengthened as concerns to the publication of joint research papers.

# APPENDIX A:

## TERMS OF REFERENCE FOR THE PANEL

### A. The objective

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The objective is to evaluate the Finnish Antarctic research during the period 1998–2005. This includes the evaluation of the scientific quality of the research and the evaluation of the functioning of the administration (coordination, financing, logistics, communications). The key issues are

- Strengths, weaknesses and success stories
- Opportunities, challenges and threats
- National and international collaboration
- Available resources
- Utilization of results and data
- Research training
- Future objectives of the research groups
- Recommendations on improvement on unit level and on general level

### B. Evaluation of research units

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The panel is asked to evaluate the quality of research of each unit. The central issue is the quality, innovativeness and efficiency of the research as measured by international standards. The panel is also asked to comment on the following issues:

- The impact of the research (scientific, societal, and on the unit itself)
- National and international collaboration
- Any other issue the panel considers important

For each evaluated unit the panel is asked to select among themselves one member who will provide a written statement on the opinion of the panel.

### C. General recommendations

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The panel is also asked to characterise the evaluated field as a whole and provide recommendations for its future development. In addition to the research itself these may concern the following:

- Resources (facilities, personnel, economic resources)
- Coordination, administration and international relations
- Research network and data management infrastructures
- National funding policies and research strategies
- Education and career policies
- Impact of the field on other research fields and on society in general
- Any other issue the panel considers important

The chairman of the panel is asked to provide a written statement on the general recommendations.

## APPENDIX B: THE PANEL MEMBERS

John Richard Dudeney, PhD, BSc, FRAS., OBE. (1945). British. Recently retired Deputy Director of the British Antarctic Survey. During his employment with BAS he was UK Delegate to the Council of Managers of National Antarctic Programmes (COMNAP), UK Delegate and Member of Executive of Forum of Arctic Research Operators (FARO), Chair of IAGA Joint Working Group on Antarctic Research, Chair of SCAR Solar Terrestrial & Astrophysical Research Working Group (STAR), Member of UK National Committee on Antarctic Research, and an Expert Member of UK delegation to the Antarctic Treaty Consultative Meetings. He was also a Principal Investigator in the NASA Global Geospace Science Mission, a Principal Investigator in the Polar Anglo-American Conjugate Experiment (PACE), a Principal Investigator in the Southern Hemisphere Auroral Radar Experiment (SHARE), and Principal Investigator in the SuperDARN HF Radar Network. Dr Dudeney carried out research in the general area of Solar Terrestrial Physics during his career with over 75 research and popular publications to his name. Dr Dudeney received the Polar medal in 1976 for services to Antarctic Science and a “clasp” to the Polar Medal in 1995. He was honoured with the award of an OBE in 2005 for services to science. He is a Director and member of the Board of *Antarctic Science* Ltd, and was *Senior Rapporteur* at the 2006 Antarctic Treaty Consultative Meeting in Edinburgh.

William Richard Peltier, BSc, MSc, PhD, FRSC. (1943) Canadian. University Professor and Professor of Physics in the University of Toronto, Toronto, Ontario, Canada. One element of his research programme is focused upon the theory of Ice-Earth-Ocean interactions during the Late Quaternary and modern instrumental eras and upon the way, in which the climate system has controlled and been controlled by such interactions. He currently holds the position of Director of the University of Toronto Centre for Global Change Science. Past positions have included the Presidency of the Committee on Mathematical Geophysics of the IUGG. His research has attracted a large number of major awards including the Sloan, Steacie, Killam, Guggenheim and Leiv Erikson Fellowships, the Patterson Medal of the Canadian Ministry of the Environment, the J. Tuzo Wilson Medal of the Canadian Geophysical Union, the Bancroft Award of the Royal Society of Canada and most recently the Vetlesen Prize of the G. Unger Vetlesen Foundation of New York, which is often considered the equivalent of the Nobel Prize in the Earth Sciences. He was also recently elected as a Foreign Member of the Norwegian Academy of Science and Letters. His publications include 250 papers in the open refereed literature, 49 book chapters and 45 additional items including encyclopedia articles etc. In 2001, he was recognized by the Highly Cited project (Science Watch Magazine, volume 12, No. 6, Nov.–Dec. 2001) as the fifth most highly cited Earth scientist in the world over the decade 1991–2001 (all sub-disciplines included: i.e. geophysics, atmospheric physics, oceanography, geology, glaciology, etc.).

Francisco José Navarro, BSc, MSc, PhD. (1960). Spanish. University Professor at the Technical University of Madrid, Spain. His main research interests are numerical

modelling of glaciers and ice-sheets (with a focus on high-order models) and glaciological applications of ground-penetrating radar. Dr Navarro has been the Principal Investigator of nine research projects within the Spanish Polar Research Programme. He has participated in five Antarctic and three Arctic field campaigns, including wintering-over at Amundsen-Scott South Pole Station in 1983–84. His publications include over 50 research publications and popular science articles. His awards include the Antarctic Services Medal of the United States of America. He is presently Spanish representative in the Standing Scientific Group on Physical Sciences of SCAR.

# APPENDIX C: VISITING PROGRAMME 8–11 MAY 2006

## Mon 8, Helsinki, Academy of Finland

- 10:00-11:00 Panel internal meeting and meeting the representatives of the Academy.  
11:00-11:30 Meeting with the chairman of the evaluation steering board

## Mon 8, Helsinki, Kumpula Campus area, Dynamicum Building

- 13:00-14:00 Meeting with the Coordination Group of Antarctic Research  
14:30-15:30 Meeting with the FINNARP logistics  
15:30-16:30 Reserved for a meeting with the research group of Finnish Institute of Marine research, cancelled due to illness.  
16:30-17:30 Panel internal meeting

## Tue 9, Helsinki, Kumpula Campus area, Dynamicum Building

- 09:00-11:00 Meeting with research groups of the Finnish Meteorological Institute  
09:00-09:50 Aerosol research group  
09:50-10:15 Space research group  
10:15-11:00 Arctic Research Centre  
11:00-12:00 Panel internal meeting

## Tue 9, Helsinki, Kumpula Campus area, Physicum Building

- 13:15-14:15 Meeting with the research groups of the University of Helsinki  
13:15-14:15 Division of Geophysics, snow and ice research group  
14:15-15:15 Division of Atmospheric sciences, group of atmospheric modelling  
15:30-16:30 Department of Geology  
16:30-17:30 Panel internal meeting

## Wed 10, Oulu, University of Oulu

- 11:00-12:00 Meeting with the glaciology group, Arctic Research Centre, University of Lapland  
14:00-15:00 Meeting with the global change research unit, Thule Institute, University of Oulu  
15:00-16:00 Panel internal meeting

## Thu 11, Espoo, Geological Survey of Finland

- 09:00-10:00 Meeting with the research group of the Geological Survey

**Thu 11, Kirkkonummi, Finnish Geodetic Institute**

10:30-11:30 Meeting with the research group of the Geodetic Institute

**Thu 11, Helsinki, Academy of Finland**

14:00-15:00 Panel internal meeting

15:00-16:00 Meeting with the evaluation steering board, end of evaluation

# APPENDIX D: THE SELF-EVALUATION QUESTIONNAIRE

## A) GENERAL INFORMATION

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1. Describe and assess briefly the objectives and strategies of your Antarctic research team<sup>7</sup>. Describe how they are related to the Finnish Antarctic research strategy.
2. Give a short history of your Antarctic research team. Also indicate on which research areas your team has focused in relation to Finnish Antarctic research in general. Max. length one page.
3. Estimate roughly the share of the Antarctic research volume (in €) in your unit to the total research funding of your unit.

## B) RESOURCES USED BETWEEN 1998 AND 2005

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4. Indicate in Table 2 the TOTAL funding of your unit's Antarctic research since 1998.

*Table 1. Funding of the Antarctic research since 1998.*

Financier	Purpose of use	Funding period	Amount (kEUR)	Person months
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5. Research personnel during 1998–2005

Indicate in Tables 3a and 3b the number of Antarctic research personnel and person-years of all personnel in 1998 and 2005, respectively, by personnel category. Include personnel who contributed to the Antarctic research during 1998–2005.

*Table 3a. The number of all personnel and foreign citizens who participated in the Antarctic research during 1998–2001.*

Personnel category	Sex (M/F)	Number of personnel		Person-months of all personnel
		All staff	Foreign citizens	
Professors				
Other senior researchers				
Postdoctoral researchers				
Postgraduate students				
Other academic personnel				
Technical personnel				
Total				

Table 3b. The number of all personnel and foreign citizens who participated in the Antarctic research during 2002–2005.

Personnel category	Sex (M/F)	Number of personnel		Person-months of all personnel
		All staff	Foreign citizens	
Professors				
Other senior researchers				
Postdoctoral researchers				
Postgraduate students				
Other academic personnel				
Technical personnel				
Total				

6. Give number of the FINNARP support personnel during 1998–2005 who contributed to your research project. (FINNARP = logistiikkasihteeristö).
7. How many people from your team visited the Antarctic research station Aboa (or other station / research vessel, which one?) during 1998–2005?
8. What was the total **person-weeks** of your team spent on the Antarctic research station Aboa, (or other station / research vessel, on which one?) during 1998–2005 (without support personnel time)?

### C) RESEARCH FACILITIES AND EQUIPMENT

9. Indicate in Table 4 the main research facilities related to Antarctic research administrated by your unit or by other organization.

Table 4. Main Antarctic research facilities.

Facility / Main research equipment	Purpose or task
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10. Indicate in Table 5 the facility development since 1998 at your unit. List the major changes in research facilities, including field research equipment.

Table 5. Facility development since 1998.

Year	Major changes in research facilities
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11. What are the main strengths and weaknesses of your present Antarctic research facilities? How do you find the present situation and what are the major development needs?

## D) RESEARCH

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12. Indicate in Table 6 the Antarctic research projects of your unit during 1998–2005.

*Table 6. Research projects during 1998–2005.*

Name of project	Field of study	Duration of project	Number of personnel employed	Working months	Partners
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13. What was the main motive that triggered your unit's Antarctic research? 1
14. Describe the main scientific achievements of your unit's Antarctic research.
15. Do you consider your Antarctic research successful (*justify your answer*)? What are the main problems and difficulties in your research?
16. Do you plan to continue the research work? Have you applied for funding? Did you receive the funding?
17. Describe interdisciplinary research aspects of your Antarctic projects.

## E) NATIONAL COOPERATION

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18. Identify your research team's national research cooperation partners and define the type of cooperation.
19. Give information about the results and productivity of this research cooperation. Give some concrete examples.
20. How do you cooperate and coordinate Antarctic research between your team and other teams?

## F) INTERNATIONAL COOPERATION

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21. Describe the cooperation between your unit and international partners. Give a list of institutional partners and projects.
22. Indicate in Table 7 all international cooperation during 1998–2005.

*Table 7. International cooperation during 1998–2005.*

Name of project / research topic	Duration of project	Working months	Partners (Organization and Country)
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23. How much working time your team's personnel has spent abroad since 1998?
24. How many contributing foreign researchers visited your unit since 1998 and how long they stayed?
25. Describe and evaluate the impact and results of international cooperation.
26. Has your team contributed to the Antarctic Master Directory (AMD) database or applied it?
27. Describe and evaluate the role of ATCM secretariat for your research. Have anyone from your unit participated in ATCM? When and why?
28. Have anyone from your unit participated in international committees such as SCAR / COMNAP / IASC etc.? When and why?

## G) RESEARCH OUTPUT

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29. Indicate in Table 8 the number of publications and presentations since 1998 related to Antarctic research.

*Table 8. Publications and presentations since 1998.*

	1998–2001	2002–2004	2004–
Published abroad:			
– Articles (with referee practice)			
– Articles, reviews, conference papers			
– Thesis, monographs, books and edited volumes			
–Invited presentations			
In total			
Articles in popular magazines or papers			
Other outputs:			

30. Indicate in Table 9 the five most important scientific publications since 1998 and papers accepted for publication (please enclose a list of all publications related to your unit's Antarctic activities during 1998–2005).

*Table 9. Scientific publications since 1998 and papers accepted for publication*

31. Indicate in Table 10 the Master's and Doctoral theses related to Antarctic research in your unit since 1998.

*Table 10. Master's and Doctoral theses since 1998.*

Name of the student	University (abbr.)	Year of Master's Degree	Year of Doctoral Degree	Supervisor	Placement (employer) of the student after graduation

## H) SOCIETAL IMPACT

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32. Give information about the societal impact of your unit (e.g. political / technological / cultural / social / regional etc.). Describe the cooperation of your unit with bodies of public administration and other organisations.
33. Identify the intellectual property rights (patents, patent applications, copyrights, licenses etc.) and other commercialised products at your unit since 1998.
34. Describe and evaluate the employment situation of the graduated and post-graduated students of your unit and generally in your field of Antarctic research.
35. Estimate what proportion of graduates leaves Finland to work abroad and what are the main reasons for this (researcher training, to obtain professional experience etc.)?

## I) ENVIRONMENTAL IMPACT

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36. How does the Protocol on Environmental Protection to the Antarctic Treaty and its provisions effect your on-site based research work?
37. List and describe possible environmental issues concerning your Antarctic research.
- Impacts:  
Problems:  
Threats:

## J) ANTARCTIC RESEARCH ADMINISTRATION AND COMMUNICATION IN FINLAND

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38. How do you find the coordination and management of Antarctic research in Finland?
39. Describe and evaluate the role of FINNARP and its logistics services to your research.
40. Describe and evaluate the role of FINNARP's pre-expedition training for your project? What issues you would like to note concerning the training?
41. Describe and evaluate the role of the *Coordination Committee of Antarctic research* from your point of view.
42. Has anyone from your unit participated in the administrative work of the *Coordination committee of Antarctic research*?

## K) SWOT ANALYSIS – Strengths, Weaknesses, Opportunities and Threats

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43. Use Table 11 to evaluate your unit's strengths, weaknesses, opportunities and threats related to Antarctic research.

*Table 11. SWOT*

Strengths	Weaknesses
Opportunities	Threats

## L) FUTURE PLANS AND ADDITIONAL INFORMATION

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44. Are there planned activities related to Antarctic in your unit?
45. You can add any relevant information for the help of the evaluators.

# APPENDIX E: LIST OF ACRONYMS

For the acronyms of evaluated research units see Table 4.

ADDS	Antarctic Data Directory System
AMD	Antarctic Master Directory
AT	Antarctic Treaty
ATCM	Antarctic Treaty Consultative Meeting
ATS	Antarctic Treaty System
CCAR	Coordinating Committee for Antarctic Research
COMNAP	Council of Managers of National Antarctic Programmes
FINNARP	Finnish Antarctic Research Programme
FTE	Full Time Equivalent
GCM	Global Circulation Model
ICSU	International Council of Science
JCADM	Joint Committee on Antarctic Data Management
MNAP	Manager of National Antarctic Programme
ODP	Ocean Drilling Program
SCALOP	Standing Committee of Antarctic Logistic Operators
SCAR	Scientific Committee on Antarctic Research
SCI	Science Citation Index

Finnish Antarctic research has been evaluated by an international expert panel. The report contains the results and recommendations of the evaluation. The key issue is the quality, innovativeness and effectiveness of the research as measured by international standards. Finland's Antarctic research policy is also addressed.

This is the second evaluation of Finnish Antarctic research, which was started in 1989 when Finland became a consultative party of the Antarctic Treaty. The evaluation was carried out by the Academy of Finland commissioned by the Ministry of Education.



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