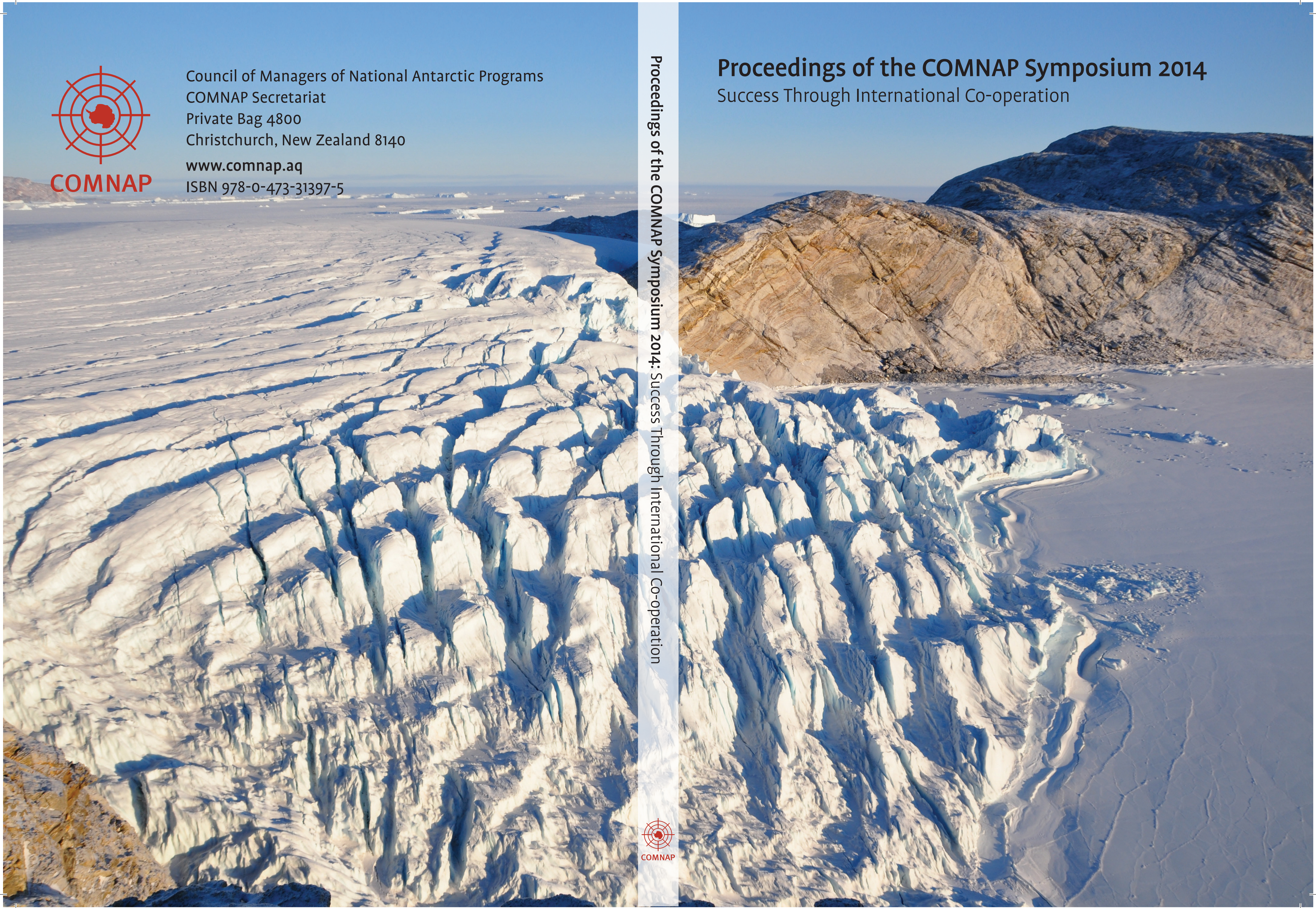

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Proceedings of the COMNAP Symposium 2014: Success Through International Co-operation

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Success Through International Co-operation

PROCEEDINGS OF THE COMNAP SYMPOSIUM 2014

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SUCCESS THROUGH INTERNATIONAL CO-OPERATION
AUCKLAND, NEW ZEALAND
25 AUGUST 2014

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THE COUNCIL OF MANAGERS OF
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Cover photo: Hamuna Icefall, Antarctica, by Iuko Tsuwa, JARE51

Foreword

The 2014 COMNAP Symposium was held in the Sky City Conference Centre, Auckland, New Zealand, on 25 August 2014. The theme of the event was "Success Through International Co-operation". As national Antarctic programmes, we understand that we cannot work in the extreme Antarctic environment on our own. Our years of operation there have taught us that we are most effective at delivery of our science programmes when we work together. With increasingly complex and multi-disciplinary science activities required to answer questions in relation to changing Antarctic and global environments, and, in some cases, reducing budgets to carry those activities to fruition, this need for co-operation is greater today than it ever was in the past.

National Antarctic programmes have collectively developed unique bilateral, multilateral and regional arrangements to successfully deliver science. These arrangements are far-reaching, and operate in both the Antarctic region and beyond Antarctica. COMNAP acts as a forum to assist the managers of the national Antarctic programmes with the establishment of those arrangements.

The recent COMNAP survey of the 29 COMNAP member national Antarctic programmes confirmed a significant and broad set of co-operative efforts amongst national Antarctic programmes. The survey results were presented in the Symposium keynote address by Professor Heinrich Miller, the then Chair of COMNAP. These results showed that to one extent or another every COMNAP member national Antarctic programme participates in or provides support for international scientific co-operation in Antarctica and in its home institutions. There are many interrelationships amongst national Antarctic programmes, with one programme working regularly with up to twenty-two other COMNAP member national Antarctic programmes and with as many as five non-COMNAP national Antarctic programmes. The scale of international co-operation varies from sharing planning procedures to operating joint stations, joint facilities and joint logistics arrangements. All but one (97%) of the programmes said they shared Antarctic stations or facilities, with sharing being interpreted in the broadest sense of that word and not limited to jointly run stations, facilities or operations. Non-Antarctic facilities and operations are also shared, including cargo and equipment storage, ice-core storage, laboratories, and port-related facilities, including clearing agents and cargo operations.

It is remarkable how in the Antarctic the managers of programmes or operations work together to address practical and technical challenges presented to them. This is possible because these managers have established relationships based on trust, on long-term friendships and on sharing a pragmatic approach to the task at hand. Such "on-the-ground" practical relationships should not be undervalued and are often the key to successful support to Antarctic research.

In addition to the keynote speaker, the Symposium Review Committee selected eight proposals for oral presentations and sixteen for posters. Submission was open, and a number of individuals and organisations responded. We are grateful to all those that participated. The result was an informative and productive day that saw over 300 people in attendance.

The open COMNAP Symposium and its published proceedings will continue to be an excellent opportunity to share our Antarctic knowledge and experience. COMNAP continues to stand ready to assist national Antarctic programmes to develop co-operative arrangements in a safe and practical manner.

Kazuyuki Shiraishi
COMNAP Chair

Acknowledgements

The COMNAP Symposium was made possible by support from Antarctica New Zealand. Special thanks go to that organisation and to the local Symposium Organising Committee led by Joanne Avis and subsequently by Kylie Wood.

As Convenor, I would like to thank the other Symposium Review Committee members, who were Heinz Miller (Alfred Wegener Institute), Sandra Potter (Australian Antarctic Division), Kazuyuki Shiraishi (Japan's National Institute of Polar Research) and Dick van der Kroef (The Netherlands Organisation for Scientific Research). Thanks also to copy editor, Janet Bray, for her efforts on these proceedings.

The goals of the Symposium were: to share information and ideas related to international initiatives involved in managing support to Antarctic science; to showcase national Antarctic programme examples of successful delivery of international initiatives in Antarctica; to profile international partnerships in polar environments; and to identify challenges or barriers to international co-operation in the Antarctic and discuss and share possible solutions. Clearly, these goals were met.

The success is, no doubt, due to the work of the authors of the oral presentations and the posters, whose work fell broadly within the session themes of: current achievements, barriers to international co-operation, lessons learned and ways to improve international co-operation. So thanks go to each and every one who dedicated time and effort into the Symposium presentations and posters and who also provided the abstracts and papers that appear in this Symposium proceedings publication.

This was the sixteenth symposium that has taken place; the first was held in Boulder, Colorado, USA in 1962. The symposiums were first organised by the Working Group on Logistics of the Scientific Committee on Antarctic Research, then by the Standing Committee on Antarctic Logistics and Operations (SCALOP), and they are now organised every two years by COMNAP. Each symposium builds on previous meetings while also delivering new ideas and topics for discussion in an open forum.

It was a great pleasure to convene the COMNAP Symposium 2014, “Success Through International Co-operation”, and to see the publication of these proceedings as a record of the Symposium that will last into the future.

John Hall
COMNAP Symposium Convenor
COMNAP Vice-Chair

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COMNAP'S ROLE IN FOSTERING INTERNATIONAL CO-OPERATION

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Co-operation as mandated by the Antarctic Treaty 1959 is a principle objective of the Parties, of their national Antarctic programmes and of the Council of Managers of National Antarctic Programs (COMNAP). As an organisation, COMNAP works to foster international co-operation in support of science by serving as a forum for the 29 member national Antarctic programmes to develop practices that improve effectiveness of activities in an environmentally responsible manner, by facilitating and promoting international partnerships, and by providing opportunities and systems for information exchange. International co-operation is often evidenced by the number of jointly operated Antarctic stations. While this is indeed the ultimate demonstration of international co-operation in Antarctica in support of science, there exists a wide range of other ways national Antarctic programmes co-operate. A recent survey of national Antarctic programmes revealed that to one extent or another every COMNAP member national Antarctic programme participates in or provides support for international scientific co-operation in Antarctica and in their home institutions. There are always opportunities to improve efficiency in Antarctic operations, including increasing international co-operative efforts. This goal is not without its challenges,

and these challenges are presented here, along with some suggestions for improving our efforts in the future.

The Development of International Co-operation in the Antarctic Region

Governmental activities have taken place in the Antarctic region since the days of the Heroic Era of exploration. Such activities originated largely from single countries working independently to explore and claim new territory, to exploit the fisheries or whaling resources, or to carry out other purposes. While scientific discovery was indeed mentioned as one of the other purposes in some Heroic Era campaigns, it was not common; nor was international co-operation.

The pinnacle of governmental activities in the Antarctic begin with the International Geophysical Year (IGY) in 1957–58, when 12 nations participated in a scientific campaign in the area below 60 degrees south and throughout the Sub-Antarctic Islands. The IGY increased the level of governmental activities and it changed the ways nations had been traditionally operating in the Antarctic. These 12 nations, through what became known as national Antarctic programmes, established 52 Antarctic stations in the period from 1 July 1957 through 31 December 1958.[1] Many of these original IGY stations remain in use today. It was noted that during the IGY, the 18-month period would "see nearly 80,000 scientists and volunteers from more than 67 countries"[2] co-

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[1] Karl Heinz Tiedemann, "Das Internationale Geophysikalische Jahr in den Polargebieten", *Polarforschung*, 27, 1/2, (1958) pp. 41–43. (The number does not include stations established north of 60 degrees south.)

[2] T. Malone, "Building on the legacies of the International Geophysical Year", *Eos, Transactions, American Geophysical Union*, 78, 18, p. 185 (1997), doi:10.1029/97EO00121.

operating in a world-wide study of planet Earth. Of those, 5,000 participated in an Antarctic summer campaign and 900 stayed in the Antarctic over winter.[3]

Establishing COMNAP

The post-IGY period up to the early 1980s saw little expansion of involvement of governments in Antarctic activities. However, by 1988, 30 countries had joined the Antarctic Treaty System. It was in September 1988 that COMNAP was established and it was the national Antarctic programmes of the then 23 Consultative State countries that became the founding members of COMNAP. COMNAP was formed to serve the needs of the managers of the national Antarctic programmes, in order to assist them with growing demands for scientific endeavours, with growing logistics and with more-complex operations.

With such growth in science, COMNAP too has grown and is now an organisation with 30 member national Antarctic programmes (29 full members and 1 observer member), including the programmes from all of the current 29 Consultative States of the Antarctic Treaty. In 2007–2008 the International Polar Year (IPY) provided another opportunity to strengthen our international co-operative efforts. The IPY saw approximately 8,600 persons[4] from within national Antarctic programmes travel to Antarctica, each basing themselves from one of

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[3] J. Berguño, & A. Elzinga, "The Achievements of the IGY", In S. Barr & C. Luedecke (Eds), *The History of the International Polar Years (IPYs)* (Springer, 2010), p. 261.

[4] The total number is an approximation, which was obtained by using a collection of sources, including the Antarctic Treaty Electronic Information Exchange System (EIES), the national Antarctic programmes' annual reports, an informal email survey to COMNAP member national Antarctic programmes, and general information from the Web.

the 80 stations, some seasonal, some year-round, that operate there, or remaining on board one of the 25 Antarctic vessels that support those stations and that themselves are platforms for science.

Review of Trends

Since COMNAP was established in 1988 the number of countries that have signed the Antarctic Treaty has grown. Today, in 2014, there are 29 Consultative States and a total of 50 signatories to the Antarctic Treaty (Figure1.1).

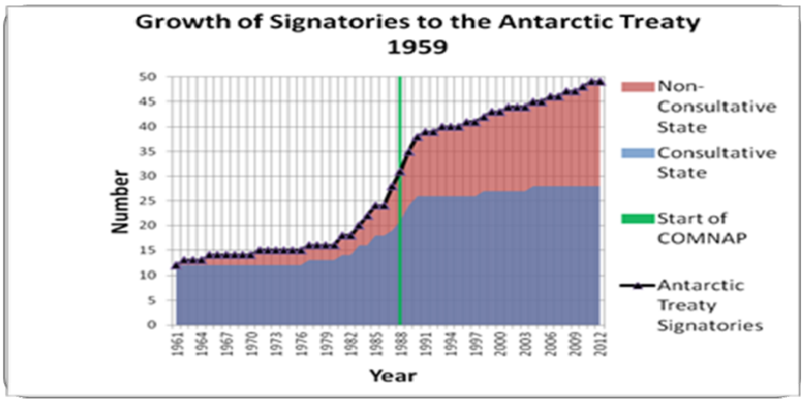


Figure 1.1: Chart showing number of countries that have signed the Antarctic Treaty and, therefore, the number of Consultative State parties and Non-Consultative State parties within the Antarctica Treaty System.

One of the fundamental pillars of the Antarctic Treaty system was agreed in 1958 and is contained in the Antarctic Treaty, Article III, which states “Freedom of scientific investigation in Antarctica and co-operation toward that end, as applied during the International Geophysical Year, shall continue . . .”. This proposal for continued co-operation has been re-emphasised many times during Antarctic Treaty Consultative Meetings. Most recently it was restated in ATCM XXXV Resolution

2 (2012) *Improving International Co-operation in Antarctica*, which recalls in its Preamble, “ . . . the centrality of scientific co-operation in the Antarctic Treaty and its Protocol on Environmental Protection”. Those words have also been put into practice by the national Antarctic programmes many times in the course of their Antarctic operations and in their goal to support science. A few of the many examples of this, coupled with examples of the ways COMNAP has assisted, are presented below.

Logistics and Operations

The joint Antarctic research station, Concordia Station, operated collaboratively by France and Italy, is the ultimate demonstration of international co-operation in Antarctica. While there are other examples of station operations (or station use) in a collaborative manner, including Dallmann Laboratory at Carlini Base (Argentina and Germany), the Dirck Gerritsz Laboratory at Rothera Research Station (Netherlands and UK), and the Law-Racoviţă-Negoiţă Base (Australia and Romania), operating joint stations is only one demonstration of international co-operation in Antarctica.

Other ways to co-operate include sharing air logistics and ship operations. COMNAP’s focus on improving safety and co-ordination of air operations began early in the history of COMNAP (and of SCALOP)[5] with input into the Antarctic Treaty Meeting of Experts on Air Safety in Antarctica 1989, which also saw the development of a standard format for advance exchange, amongst

[5] The Standing Committee on Antarctic Logistics and Operations, which was formed as a sub-group of COMNAP by the founding COMNAP members in 1988. SCALOP was disbanded in 2008.

national Antarctic programmes, of annual air operations plans.

Today, there are several good examples of supporting inter-continental passenger and cargo transfers: in the Dronning Maud Land region (where 11 national Antarctic programmes are involved in the Dronning Maud Land Air Network – DROMLAN – consortium), in the Ross Sea Region, in the East Antarctic region and in the Peninsula region. Arrangements such as DROMLAN include considerable joint investment to upgrade facilities that service the joint operations and allow for increased scientific activity that never would have been feasible by one national Antarctic programme alone. One of the best examples of this is the European Project for Ice Coring in Antarctica (EPICA) programme, which involved scientists and technicians from 10 European nations over a period of 11 years. The main scientific goals of the programme were achieved, and over 200 publications in high-profile journals resulted.

Energy Management

Recognising that reducing the use of fossil fuels in Antarctic operations was important, COMNAP began work in 1991 on the use of alternative energy. Reducing the use of fossil fuels requires an understanding of where exactly fuel is being used, and COMNAP has worked with national Antarctic programmes on compiling this information. In 2007 COMNAP submitted the Energy Management Guidelines to the ATCM, and it continues to encourage national Antarctic programmes to implement these simple, but effective, guidelines in all of their Antarctic operations. Retrofitting older stations to improve energy efficiency is expensive, and so sharing ways and costs to reduce energy use has many advantages, including, but not limited to, good environmental consequences.

The joint wind farm project on Ross Island is an excellent example of co-operation by two national Antarctic programmes (New Zealand and USA) to reduce costs relating to upgrading station infrastructure, to share costs on the wind farm itself and to contribute to joint logistics and operations in support of science. The wind farm on Ross Island was commissioned in January 2010, after three years of joint preparation and planning. The US Antarctic Program provided heavy civil works, power line and interconnection; and Antarctica New Zealand provided wind turbines, the power store construction and engineering. To date, the system has performed better than anticipated, saving 475,000 litres (125,000 gallons) of fuel annually. New Zealand's Scott Base, which was built during the IGY in 1957, can now meet 100% of its power requirements by utilising the wind power system.

Supporting "BIG" Science

In the early days of Antarctic scientific research, science was often compartmentalised, along science discipline lines. That is, a geologist did a geology project and a biologist focussed on a particular species of fish or other animal or plant. Today, science is more complicated, with broad research questions that require a multi-disciplinary approach in order to solve a problem or question, particularly in the context of climate change-related research. The recent Scientific Committee for Antarctic Research (SCAR) Horizon Scan process identified no fewer than 80 future science questions considered to be of major importance to our understandings of our global environment in the next 50 to 60 years. Of those 80 questions, the majority require an interdisciplinary approach, which in turn requires international co-operation and an exchange of scientists amongst programmes and into various areas of Antarctica and the Southern Ocean.

Today, we see many examples of sharing and exchange of science support capacity across programmes. This is nicely evidenced by the statistics around vessel space use in at least two recent examples. In the 2012–13 season, the German vessel *Polarstern* carried scientists from 15 different countries, with 26% of the ship time being utilised by scientists from non-German institutions. More recently, in 2013–14, the Chilean vessel *Aquiles* carried 33% of its passengers from Chilean institutions, while the remaining 67% came from 26 different countries (Figure 1.2).

Survey on International Co-operation

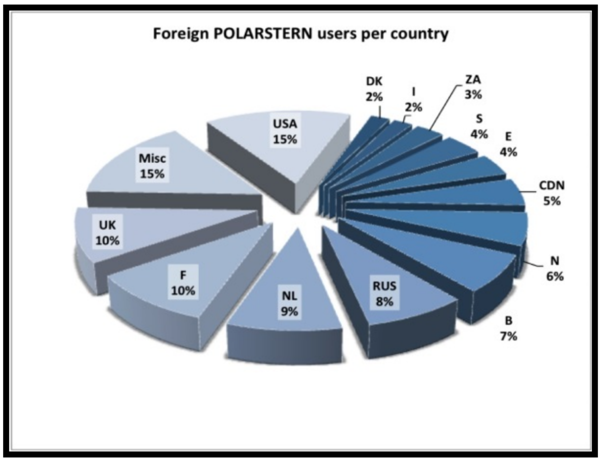
On more than one occasion, there has been criticism as to the level of international co-operation amongst national Antarctic programmes. Such criticism is not based on fact. COMNAP, throughout the years, has surveyed members on the level of international co-operation taking place, on the barriers to such co-operation and on ways that can be implemented, in order to continually improve.

The results of a December 2013 survey were presented to ATCM XXXVII in COMNAP IP047 *International Scientific and Logistic Collaboration in Antarctica*. Survey results indicated that to one extent or another every COMNAP member national Antarctic programme participates in or provides support for international scientific co-operation in Antarctica and in its home institution. There are many interrelationships amongst national Antarctic programmes, with one programme working regularly with up to twenty-two other COMNAP member national Antarctic programmes and with as many as five non-COMNAP national Antarctic programmes. Since the first COMNAP survey in 1997, there has been an average 30% increase in international co-operation across all the COMNAP member national Antarctic programmes. The scale of international co-operation varies from sharing planning procedures to operating joint stations, joint facilities and joint logistics arrangements. Some national Antarctic programmes have a long and significant record of statistics, which clearly show the number of places offered to international scientists at stations, on vessels and aircraft, and in laboratories in home institutions.

Furthering International Co-operation

While national Antarctic programmes and, through them, COMNAP, are already very actively promoting and living co-operation, there is still room for improvement. Such improvement, however, requires support on the national level and in a number of ways, including:

- Allowing for greater flexibility for national Antarctic programmes to allocate national logistic resources to international collaborative projects, whether they are of technical or scientific nature;
- Allocating special funding resources for such joint ventures;
- Streamlining funding cycles and ensuring long-term funding security (five years minimum);
- Utilising COMNAP Expert Groups as a forum to continue to show that COMNAP is effective in co-ordinating national Antarctic programmes' support for science across national boundaries.



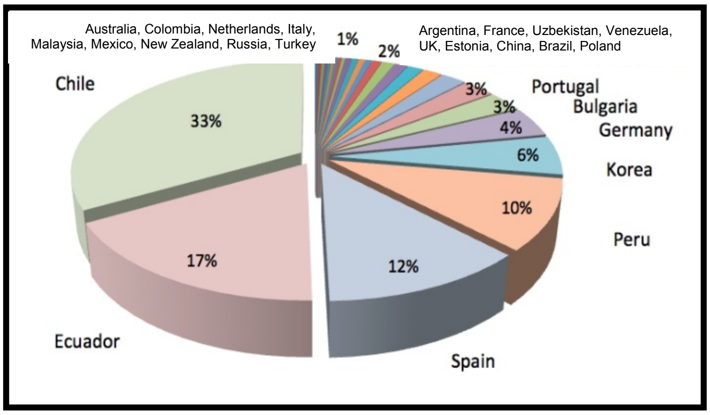


Figure 1.2: The chart at the top shows the nationality of non-German scientists using the German vessel Polarstern *between 1983 and 2012. In total 26% of* Polarstern *ship time was used by foreign scientists. The chart at the bottom shows the nationality of scientists using the Chilean vessel* Aquiles *in the 2013–2014 Antarctic season.*

Conclusion

COMNAP member national Antarctic programmes manage support to their Antarctic science unilaterally, bilaterally and within multilateral operations that often support big science projects. Within COMNAP, national Antarctic programmes work together to understand and promote best practice and to develop practical tools on subject areas that include search and rescue (SAR), emergency response and contingency planning, waste management and Accident Incident and Near-Miss Reporting systems. Huge challenges, recently identified by the SCAR Horizon Scan process, lie ahead. COMNAP is prepared to help national Antarctic programmes deliver their countries' science programmes.

Dirck Gerritsz Laboratory at Rothera Research Station: A Highly Successful UK–Netherlands Polar Collaboration

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Introduction

What can national Antarctic programmes do to enhance international collaboration? This paper contains ideas and policies taken from the latest Netherlands Polar Programme (NPP) and focussed around the very successful collaboration with the British Antarctic Survey (BAS) in the operation of the Dirck Gerritsz Laboratory at the UK Rothera Research Station, Adelaide Island, Antarctica. These ideas and policies could help to make your programme more successful in the near future. The paper elaborates on three major ways of collaboration. Find out which way you would like to follow to become more successful. But first pick up our "measuring stick" for success.

What About Success?

We think our audience must first agree on a "measuring stick". What is a success when it comes to international collaboration in Antarctica? Let's make sure we have the same understanding of success before we claim any success for our collaborative UK–Netherlands Dirck Gerritsz Laboratory.

To get there, we start with some helpful definitions. According to Wikipedia, **co-operation** is “the process of groups . . . working or acting together for their common/mutual benefit, as opposed to working in competition for selfish benefit”.[1]

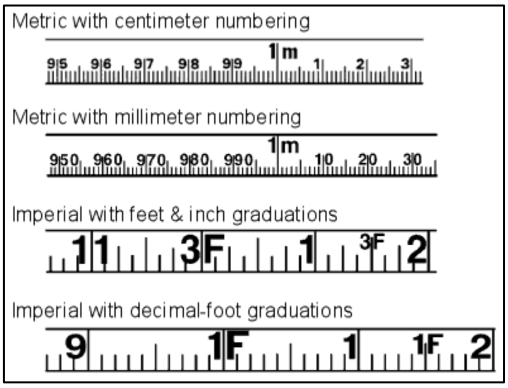


Figure 2.1: Thinking of a “measuring stick” to determine success.

If success has to be demonstrated within the objectives of this COMNAP symposium –“Success through international **co-operation**”– it is key that we are able to show a benefit for both partners. The title of this paper makes it a bit more difficult to claim success, as true collaboration raises the ambition level beyond simple co-operation. Again according to Wikipedia, **collaboration** is “working with others to do a task **and** to achieve shared goals. It is a recursive process where two or more organizations work together to realize shared goals . . .” (Our emphasis.)[2]

[1] Retrieved from http://en.wikipedia.org/wiki/Cooperation.

[2] Retrieved from http://en.wikipedia.org/wiki/Collaboration.

So, to qualify as a successful UK–Netherlands collaboration we, as partners, need to work together for our own benefit to do a task and achieve shared goals.

Each national programme is obviously free to choose its own goals and decide on benefits. Nowadays, we know collaboration is about shared goals. What are the best shared goals for national Antarctic programmes to examine?

1. **SCAR** – the Scientific Committee on Antarctic Research – helps to define shared goals. At the moment, SCAR is using a method of "Horizon Scanning" to develop a shared community view of the most important scientific questions in Antarctic and Southern Ocean science. "The Scan outcomes [will] assist in aligning international programmes, projects and resources to effectively facilitate Antarctic and Southern Ocean science in the coming years."[3]

2. **COMNAP** – the Council of Managers of National Antarctic Programs – "develop[s] and promote[s] best practice in managing the support of scientific research in Antarctica".[4] It is also involved in "facilitating and promoting international partnerships".[5]

[3] SCAR, *Horizon Scan Framework: Objectives*, Retrieved from http://www.scar.org/horizonscan/framework/objectives.

[4] COMNAP, *About COMNAP*, Retrieved from https://www.comnap.aq/SitePages/Home.aspx.

[5] Ibid.

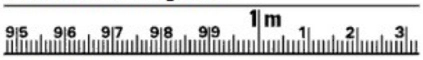
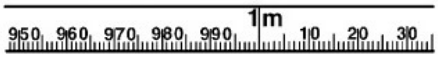
“Stick to success”	Science	Logistic	Infrastructure	Policy
SCAR measuring stick 	√			
COMNAP measuring stick 		√	√	
ATCM measuring stick 				√
National measuring stick 	√	√	√	√

Figure 2.2: Applying the “measuring stick” to Antarctic activities.

By attending this symposium, participants acknowledge the important role of SCAR and COMNAP. The information and contacts acquired in these meetings must be beneficial, and this is one of the major reasons why people from the Antarctic community have travelled to New Zealand from all over the world.

Next to SCAR and COMNAP policies, success can also be measured against national and international policy.

3. **ATCM**: For the international political dimension we look at the Antarctic Treaty Consultative Meeting. Activities able to fulfill policies adopted by the ATCM should be evaluated as being successful.

One of the key policies supported by the ATCM is the reduction of proliferation of stations in the Antarctic Treaty Area, and the sharing of logistics and infrastructure to minimise cumulative environmental impacts.

This policy approach could also be extended by looking at the work of the Committee for Environmental Protection (**CEP**), which provides advice to the Antarctic Treaty. Environmental protection is one of the key shared goals in our collaboration. We have demonstrated our commitment to this work by producing an Initial Environmental Evaluation (IEE) for the Dirck Gerritsz Laboratory and through investment in renewable energy.

4. **National (science) policies:** An effective national Antarctic policy should acknowledge the importance of an international polar science agenda and incorporate it in the national agenda to provide the polar science community with good opportunities for international collaboration. Such a recognition is essential for securing funding of international polar activities.

International collaboration is the <u>only</u> way for the NPP to carry out polar research. Dutch governmental policy is to minimise the human footprint in Antarctica as much as possible. To be effective in this measure, the government decided not to add its own national station. The Antarctic part of the NPP, as a consequence, is funded under the condition that access to Antarctica for Dutch scientists is realised through international collaboration. This policy stimulates the NPP to make use of and/or add to existing infrastructure and logistics.

It creates opportunities to contribute and add strength to existing science programmes and facilities.

International collaborations and partnerships are also seen as vitally important for BAS, and for the UK generally, to deliver modern Antarctic science. The recently published report *UK Science in Antarctica: 2014 to 2020*[6] has a section devoted to national and international collaboration. BAS sees collaboration as vital for maintaining the UK as a world-leader in polar research, and its excellent international networks frequently make it the partner of choice for science and logistics collaborations in the polar regions. BAS values highly its long-standing relationships with many Antarctic Treaty nations, especially its high-level bilateral agreements, such as the one between BAS and the NPP, as it knows they deliver new and high-quality scientific research and impact.

The Dirck Gerritsz Laboratory

Before taking our measurements, we give you the actual background of our new shared facility.

In the Antarctic summer season 2012–2013 the Dutch Dirck Gerritsz Laboratory became operational at the UK Rothera Research Station. It consists of a general purpose "container docking" station that was built swiftly in two summer seasons by BAS. Four containerised mobile laboratories, designed and constructed in the Netherlands, have been inserted into this station. The laboratories provide a range of biological science

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[6] Department of Business, Innovation and Skills, 2014. Retrieved from https://www.gov.uk/government/publications/uk-science-in-antarctica-2014-to-2020.

facilities, including a clean room installation and temperature-controlled experimental chambers. The result is a highly innovative, flexible and world-class modular mobile lab facility for the use of Dutch researchers. The successful construction and operation of the facility is only possible because of the very close co-operation between the NPP and BAS.

Figure 2.3: Rothera Station with Dirck Gerritsz Lab (left) and Bonner Lab (right). (Photo: NWO.)

Much attention has been given to minimising the energy consumption of the laboratory. Recent analysis has shown that the photovoltaic solar panels fitted to the roof and the installed heat pumps were able to provide 16% of the energy needed by the building, including the four embedded mobile laboratories with their variety of lab equipment. The laboratory can be monitored remotely in the Netherlands and the UK over the Internet through satellite links. All installations at the laboratory comply with UK safety regulations.

All Dutch scientists submit themselves to all the BAS rules and regulations at the station. Even flight tickets for Dutch scientists from Europe to Antarctica are booked by BAS in Cambridge, UK in order to maximise efficiency, avoid mismatches in field planning and minimise costs. Permitting Dutch scientists working on site at the station is also totally integrated in the BAS annual Antarctic Act permit. Only when samples are taken off-station back to the Netherlands, according to approved science plans, are additional permits (from Dutch authorities) necessary and applied for. All these examples of joint working and collaboration contribute to a very efficient and reliable operation for both partners and avoid working with two national standards at one location. The collaboration is based on excellent mutual trust, long experience of working together, and our shared goals aimed at investigating climate change in Antarctica.

The UK–Netherlands collaboration is formalised in a Memorandum of Understanding (MoU). This acts as a high-level agreement to work together, but also includes arrangements for cost sharing and support services. Committing ourselves to this collaboration has very significant benefits for both the NPP and BAS.

It realises bilateral collaboration in three ways:

(1) In logistics:
Every season Dutch scientists are transported to Rothera by BAS, either by aircraft or by ship, depending on field season planning. Benefits for the NPP are obvious. The NNP itself has no logistic capability and is dependent on partners such as BAS for getting Dutch scientists into and out of the field. Through cost sharing, BAS benefits from this arrangement as well. This arrangement qualifies as a mutual success in itself. Cost

sharing and using any potential spare capacity are beneficial to both partners. However, the collaboration is much more than just “buying and selling support tickets”.

(2) In science:
Collaboration between the Netherlands and UK at Rothera has a long history over more than 40 years. At first, the logistic support resulted in just a few individual Dutch scientists working on/from Rothera station, perhaps working solo within their own domain of research, but always contributing to the science output coming from the station. Now, most Dutch science is produced within an international collaborative setting and through co-authored publications.

The success of the International Polar Year (IPY) in 2008–2009 made it possible to increase the funding for the NPP. This has enabled periodic calls for research proposals, dedicated to working at Rothera Research Station and using available lab facilities, which are now announced on a regular basis by the NPP for Dutch polar scientists. Collaboration between Dutch and UK scientists in each proposal is mandatory. Before each proposal goes out for international expert peer review, BAS scientists are involved at the early stage of the review process to assess the quality of the research, and BAS operations managers participate in the pre-assessment of the logistic feasibility of project applications. Each year pre- and post-season science and logistic meetings are organised to plan and monitor progress. Appropriate polar training for Dutch researchers through BAS is also part of the collaboration.

This overall integrated collaborative approach has been very positively evaluated by the Netherlands polar sciences community and is now a highlight in the Netherlands' national polar science policy to create focus and mass.

The NPP funded, and BAS scientists are now working towards, a special volume with co-authored papers for an international high-impact scientific journal – *Deep Sea Research* – based on research undertaken at Rothera. This is strongly supported by BAS and the NPP.

(3) In infrastructure:
The IPY raised much public attention across the world about the importance of polar regions. A highlight in creating public attention in the Netherlands at the end of the IPY was a successful Dutch Royal visit to Rothera in 2009. This visit triggered a high-level policy by the Netherlands to increase its commitment to shared polar infrastructure. At the end of 2009, plans were developed in close collaboration with BAS for what became the Dirck Gerritsz Laboratory, which was officially opened in January 2013.

The Dirck Gerritsz Laboratory (see photograph) is a flexible stand-alone addition to the Bonner biological laboratory operated by BAS at Rothera. It significantly increases the laboratory capacity and capabilities of the station with facilities that were not available before. This flexible set-up is beneficial to both partners.

Why is international co-operation something we give high priority in our polar programme and in our quest for success? In 2010 the science and technology indicators were reported to the Dutch Ministry of Education, Culture and Science. It reported the following:

> International cooperation is abundant within the Dutch science system. It proves to be an effective model to absorb essential knowledge and skills from elsewhere, and to create a critical mass of funds and resources to perform at international research frontiers, judging by the high citation impact score of these international co-publications. This score exceeds world average by 55%, and **is the main contributing factor to the top five position of the Netherlands within the global citation impact ranking**.[7] [Our emphasis.]

The Dirck Gerritsz Laboratory in its conception and in its operation is very much part of this effective model.

So, to claim our success:

1. **Relating to goals set by SCAR** –The Dirck Gerritsz Laboratory UK–Netherlands collaboration aligns both research projects and resources in an effective way to facilitate Antarctic science in the coming years. The Netherlands polar science programme adopts many SCAR goals and, at present, contributes with a focus on trace metals, ocean acidification, marine viruses, algae and ice cap modelling. All research efforts are directed as contributions for delivering answers on the effects and impact of climate change. We believe these activities are successful when evaluated against SCAR goals.

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[7] R. Tijssen, H. Hollanders & M. Kanerva, *Science and Technology Indicators 2010: Summary Report on the Netherlands* (Ministry of Education, Culture and Science, Netherlands Observatory of Science and Technology (NOWT), 2010) p. 36. Retrieved from http://nowt.merit.unu.edu/docs/NOWT-WTI_2010_english_summary.pdf.

2. **Relating to goals set by COMNAP** – The Dirck Gerritsz Laboratory UK–Netherlands collaboration is an example of best practice in managing the logistics support of scientific research in Antarctica, and it also facilitates and promotes international partnerships. We believe our activities are successful when evaluated against COMNAP goals.

3. **Relating to goals set by ATCM** – The ATCM wishes to reduce the further proliferation of research stations in the Antarctic Treaty Area and aims for more-shared stations and facilities to keep the human footprint in Antarctica as small as possible. The Dirck Gerritsz Lab fits perfectly with this policy and has to be considered as a success.

4. **Relating to goals set by national policy** – The Dirck Gerritsz Laboratory UK–Netherlands collaboration fits very well with the national polar science strategies and goals of both countries. In the Netherlands, the MoU with BAS, and the Dirck Gerritsz Laboratory itself, provide focus and mass in its polar programme, secure research funding for the mid-term, and realise international policies embedded in the Netherlands' national policy. It is evaluated in the Netherlands, and in the UK, as a very successful international collaboration.

Conclusions

What can you do to enhance international collaboration in Antarctic science and logistics? Ideas and policies to make this happen:

- Seek your shared goals using SCAR, COMNAP and ATCM international policies.
- Integrate and create synergy between national and international policies.
- Seek your “best fit” for collaboration with other national Antarctic programmes.
- Promote and support co-authorship of research publications.
- Use your “stick to success”.

Chilean Strategies to Increase International Co-operation

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Introduction

At the end of the 2003, a decision by the Chilean government moved the headquarters of the Chilean Antarctic Institute / Instituto Antártico Chileno (INACH), south, from Santiago to Punta Arenas. With Punta Arenas being one of the major world gateways for national Antarctic programmes to Antarctica, the new location presented many opportunities to increase the international collaborations INACH had at the time. Developing new strategies to increase international co-operation is difficult and requires financial backing of governments to support international partnerships in science. For the INACH this has meant there has been a rapid growth in its science programme supported by new funding coming mainly from its government funding agency, the Comisión Nacional de Investigación Científica y Tecnologica de Chile (CONICYT). This paper explores the implementation of new strategies and results achieved to date. It also presents examples of sharing of facilities and logistics, together with education and other initiatives and the Chilean Antarctic science programme, that have resulted from the strategy.

The Chilean Antarctic Science "Ladder"

In the past ten years, the Chilean National Antarctic Science Program (PROCIEN) has experienced rapid growth. Such growth would not have possible without new funding partnerships with national institutions. In that respect, several CONICYT programmes and also the INNOVA Agency play a key role. Chilean Antarctic research groups, which had their proposals approved in the peer reviewed INACH and CONICYT procedures last year, received a total amount of US$2,800,000 funding, with US$1,800,000 of that figure coming from CONICYT. This funding is used, along with INACH internal funding, to allow scientists to work in and travel to Antarctica (with logistics support also provided by INACH) and to continue to work on their Antarctic research back in Chile (with the CONICYT and INACH funding).

Year-round funding such as this means that scientists can feel confident choosing to focus on an Antarctic topic. Therefore, interest in doing Antarctic science has grown, although only 40% of proposals get funded. This proportion continues to increase as more funding is made available and more scientists manage to increase the quality of their proposals. Therefore, several calls for proposals every year, run in English, plus selection committees and a peer-review system that are international, have resulted in a significant increase in the number of publications in ISI-indexed journals.

In addition to the INACH funding in support of Antarctic science projects, which is generally along the lines of US$30,000 per annum per project, INACH supports education initiatives. Under these, master's and PhD candidates are able to supplement their scholarships by applying for support for their thesis work to a value of up to US$4,000 per annum.

What all the research funding opportunities have in common is that each allows for inclusion of international scientists on the project it supports. In the CONICYT "FONDECYT" programme, international scientists have access to up to US$6,000 of funding that can be used for travel and subsistence while working in Chile. A smaller CONICYT programme, to foster international networks and visitors, and two other bigger funding schemes, the PIA or "Antarctic Rings" scheme (up to US$300,000 per annum per project), and the FONDAP (Fondo de Financiamiento de Centros de Investigación en Areas Prioritarias; up to US$1,500,000 per annum per project) provide funding in support of the Chilean government's stated priority areas, and are all specifically targeted for internationally collaborative projects. However, no Antarctic proposal has so far managed to get funds from a FONDAP call.

"Top-Down" Approach

The model has worked well to date. A "bottom-up" approach requiring Chilean scientists to include international collaborators into their science projects has worked well. Therefore, INACH is now expanding on this by implementing a "top-down" approach through INACH working relationships with other national Antarctic programmes, seeking to build partnerships based on the CONICYT funding model.

What this means is that if another country is funding an Antarctic science project that includes within it a Chilean scientist, INACH will provide the funding and logistics for that project's work in Antarctica in the area of operation of INACH. What this does is to require Chilean scientists to be more fully aware of the science programmes of other nations, to encourage strong international partnerships, and to develop country-to-country relations amongst the national Antarctic programmes that may not have been possible in the past.

To support this, INACH has purposely expanded its English-language material, both in peer-reviewed journals and in publications for its outreach activities. It has recently organised a workshop in Punta Arenas, held in English, with experts from the USA, the European Union and South America, to share information and identify opportunities for collaboration and funding.

"Bottom-Up" Approach

Chilean scientists understand that their Antarctic research proposals have a greater chance of being funded if they can include an international collaborator. Since 2006, this factor alone has meant there has been a significant increase in the quality of science proposals and the number for projects that include international collaborators. For last season, of the 53 Antarctic field projects funded, 29 of them included at least one international collaborator and these collaborators came from 21 different countries.

Since 2001, the number of proposals submitted has significantly increased: from nearly no proposals in 2001, to over 70 in the last funding round in 2013.

The Chilean National Antarctic Science Program Today

The results of applying both these strategies have been astounding, and a robust scientific programme is underway. INACH supported 72 scientific projects in the 2013–2014 season, 53 of which went into the field. The projects were within six lines:

Line I: The State of the Antarctic Ecosystem
Line II: Antarctic Thresholds – Ecosystem Resilience and Adaptation
Line III: Antarctic Climate Change
Line IV: Earth Science and Astronomy
Line V: Antarctic Microbiology and Molecular Biology
Line VI: Antarctic Environment

Each of these six lines is associated with one of the Scientific Committee for Antarctic Research (SCAR) programmes. Each receives significant and long-term funding from the range of sources discussed above.

Opening New Horizons for Science

INACH recognised that expanding the science programme would mean providing new platforms for the conducting of such science in Antarctica. However, consideration had to be given to how such science could take place without expanding the programme's Antarctic "footprint". First, renovated building spaces were completed at the existing stations of Escudero, Guillermo Mann (Cape Shirreff), O'Higgins, Yelcho and Prat. In combination with increased national co-operation with the Chilean Navy, this allows for better access by scientists to these improved stations. Second, the Teniente Luis Carvajal station at the southern end of Adelaide Island, which had closed in 2003, was reactivated, allowing for scientific investigation in an area further south than the other stations permit. Finally, in the upcoming season, Chile will launch the RS *Karpuj*, a 24.5 metre, 105 ton vessel, which will be equipped with dry and wet laboratories, echo-sounding equipment, and a winch and carousel water sampling system. The vessel will be based at Fildes Bay, King George Island, and after being launched for testing there this season it will be fully deployed for scientific operations in the 2015–2016 season.

Fundamental to our overall strategy has been the strengthening of our Communications and Education Department. Our key product is the “FAE”, a National Antarctic School Fair, which allows several outreach and science-promoting activities all along the country every year. Students aged from 14 to 16 participated in the 2013 fair, and we received 150 scientific works, representing the efforts of 327 students and 118 teachers. The fair has had an annual growth of 15%.

Conclusion

No one approach is right for increasing international collaboration in Antarctic science. However, we do know that Antarctic science outcomes are possible only through international collaboration. Through COMNAP, national Antarctic programmes can understand the science their countries wish to deliver and also what work we can do together to succeed in delivering that. The results of the SCAR Horizon Scan mean that there is even more-complex science on our Antarctic horizon. Only through developing and applying new strategies to support that work will our results be available to the global community.

Success Through International Co-operation in Ice Core Science at Aurora Basin

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In 2008 the Australian Antarctic Division (AAD) planned, and attempted to establish, an ice core drilling camp 550 kilometres from Casey Station in the Aurora Basin. The camp was planned to be inserted and extracted using ski planes after an initial reconnaissance to find a suitable landing site close to the desired drilling location. On conducting multiple reconnaissance flights it was determined that landing was not possible due to safety concerns posed by large and numerous sastrugi on the surface. The project was cancelled and resources directed elsewhere for the summer. AAD planners then determined that to attempt the project again with some better degree of certainty it was best to travel to the desired drill site by traverse, establish a skiway and then input the camp and personnel by fixed-wing ski plane.

The Australian programme does not have a traverse capability and it was decided that to raise one for this project would be too costly and take too long. Hence discussions with France commenced about the possibility of a co-operative effort using French–Italian traverse equipment and expertise to establish a skiway at the drill site. Much of this relaxed and informal discussion over co-operation on the project was undertaken in the margins of a COMNAP meeting, further highlighting the value of such engagement for Antarctic co-operation.

France and Italy maintain a significant traverse capability for both science and logistics. This traverse is used annually from the coastal station at Dumont d'Urville (DDU) to resupply the French–Italian Concordia station at Dome C and to undertake scientific research. Through interactions at COMNAP and in Hobart the French and Australian programmes agreed to work together to deliver what would be a significant international science project.

Thirty tonnes of camp stores were packed and sent to DDU from Hobart on the French ship *L'Astrolabe* in March 2012. These stores were then held at Cape Prud'homme, the nearby traverse staging area, for transport to Aurora Basin on the traverse. In November 2013 the traverse team arrived at DDU on *L'Astrolabe* and were joined by three Australians who had flown in via McMurdo and Casey using US and Australian aircraft.

The traverse departed on 25 November and travelled on the standard route towards Dome C until reaching D85, where it turned west and headed towards Aurora Basin. In doing so the traverse travelled over previously unexplored terrain following waypoints derived by the Institut Polaire Français Paul Emile Victor (IPEV), using satellite imagery.

IPEV had run a traverse to Vostok in 2011–12 to resupply Dome C, using the previous generation of traverse equipment, and a new set of two living and power vans, built specifically for that operation, was available. For the later traverse, all the logistic details (fuel, food, specific spares, science equipment, Aurora Basin camp stores) were organised and then delivered to DDU during the 2012–2013 season (three 20-foot containers and two 10-foot containers). Planning for the traverse route, the time table, the composition of the traverse party and the glaciology operations was then undertaken in 2013.

The traverse was made up of:

- One Kässbohrer PB330 to open and grade the track
- Four Challenger C65 tractors (one fitted with a 20 ton winch, one fitted with bad-weather lights and 40 kw emergency electric generator, one with a 11 tm Fassi crane)
- Three SAB fuel tanks of 12 m^3
- Two 15 m caravans
- One unit as store
- Five 6 m sleds for cargo
- Two vehicles (one tractor and the Kässbohrer) were equipped with the navigation equipment (comprising satellite compass, accurate GPS, computer and recording software).
- Two tractors were fitted with two 11 tm hydraulic cranes.

Figure 4.1: French/Italian traverse equipment. (Photo: AAD/IPEV.)

Instead of taking a direct track between the DDU traverse camp base (Cape Prud'homme) to the Aurora Basin camp point, it was decided to follow the Concordia traverse track for 500 kilometres then turn west. The track waypoints were selected from radar satellite pictures in order to avoid possible crevasse zones, to keep a nearly constant altitude and to avoid high sastrugi areas.

The traverse crew comprised three mechanics (one was traverse manager) and doctor from IPEV, two glaciologists from Laboratoire de Glaciologie et Géophysique de l'Environnement Grenoble, two mechanics from AAD (one was the Aurora Basin camp manager) and one glaciologist from AAD.

The traverse departed from Cape Prud'homme on 25 November 2013 and reached Aurora Basin on 9 December 2013. On arrival at the drilling site the team set about establishing a skiway and camp. The skiway was built using traverse vehicles and was 2,200 metres in length and 50 metres wide. The 30 tonne container of stores was also unpacked, and after nine days the traverse commenced its return to DDU, leaving the three Australians in place to receive the rest of the expedition cargo and personnel by ski plane. A tracked quad and small snow groomer remained at the site to maintain the skiway over the season.

After departure for the return traverse journey on 19 December 2013 the traverse arrived at the coast on 31 December 2013. Overall the traverse consumed 44,000 litres of SAB fuel for a total of 2,700 kilometres travelled. The Concordia logistic traverse had left fuel at D85, in order to top the tanks up on the outward leg and to give fuel for the return.

All waste was repatriated; the workshop caravan was also equipped with a toilet incinerator and one tank to collect urine.

On 20 December the first flight of an Australian-chartered Basler arrived at the Aurora Basin camp and over subsequent days the Basler and a Twin Otter delivered the remaining necessary cargo and personnel for the expedition. The camp was established with sleeping and living tents, drill tents, generator tent and science processing tent.

Figure 4.2: Aurora Basin camp. (Photo: AAD/IPEV.)

The science project was also an international co-operation, with fourteen partner organisations contributing from six nations, these being Australia, China, Denmark, France, Germany and the USA.

The project involved a wide range of science activities during the short time in the field, and continues with an extensive collaboration designed to derive the full range of science results from the ice core. Three ice cores were recovered from the site. The main core, drilled with the assistance of Danish team and drill, reached 303 metres and will extend back around 2,000 years. Two shorter cores, just over 100 metres, were drilled for additional analyses covering the last several centuries. The 100 metre hole from one core was also used to pump air from the porous firn for analysis in France and Australia. This work provides large gas volumes for analysis of atmospheric changes in recent decades. At this point, just over six months since collection, some of the cores are undergoing sampling in Hobart, while upper sections prepared in the field are analysed at Desert Research Institute in Nevada, and one of the 100 metre cores is at the Alfred Wegner Institute in Germany, undergoing X-ray and other physical analyses.

Operationally the camp continued to be supported by flights from Casey, with scientists rotating in and out, while camp stores were back-loaded in preparation for closing the camp at the end of the expedition. In all, 30 flights of Basler and Twin Otter aircraft were made between Casey and Aurora Basin. Finally, the last flight departed the camp on 25 January 2014, and all camp stores and personnel were safely returned to Casey. Importantly, just over 500 metres of ice core had been removed, with most flown to Casey for onwards ship travel to Hobart, while a second core was flown to Dome C for analysis by a French team at Concordia.

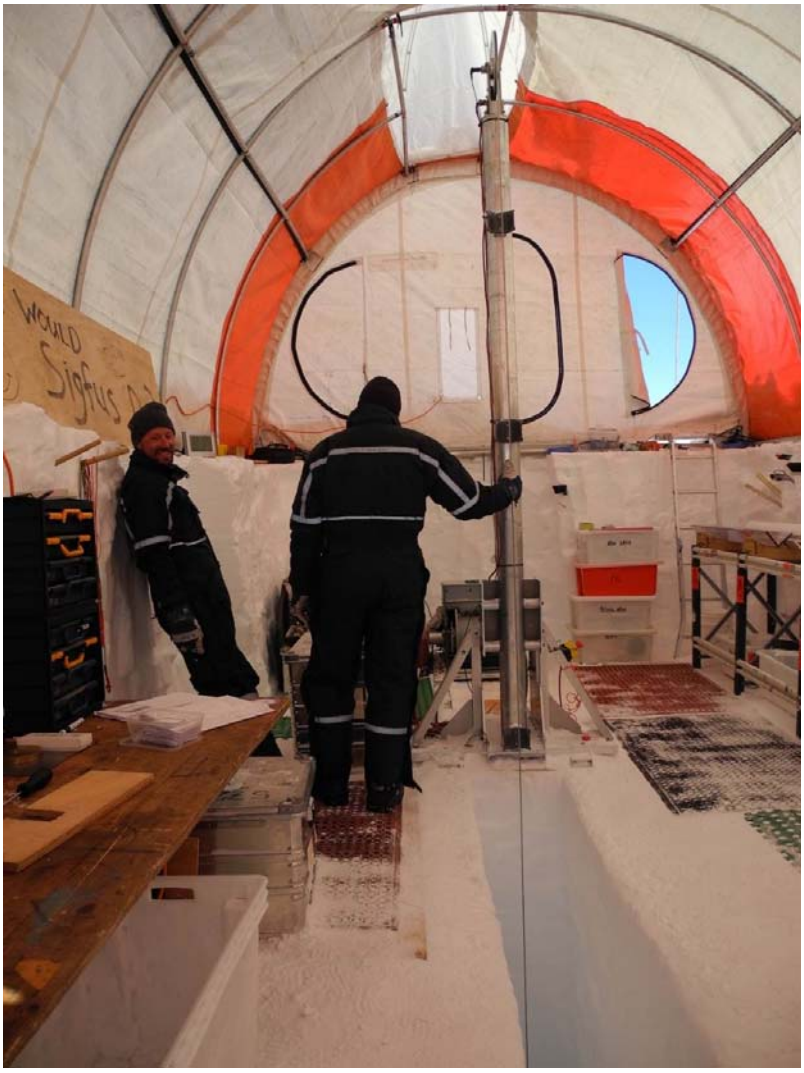

Figure 4.3: Inside the drill tent. (Photo: AAD/IPEV.)

The Aurora Basin Project was a significant example of international co-operation using French–Italian traverse capability coupled with Australian aviation capability to operationally deliver a significant multinational deep-field science expedition. The science was also reliant on co-operative efforts to ensure the right skill sets and equipment, such as the drill, were available. With no single nation in the area possessing all of the logistic or scientific tools to complete the expedition it was only through international co-operation that eventual success was achieved. In a time of tight budgets for national Antarctic programmes the Aurora Basin Project demonstrates that individual nations need not invest in all the necessary capabilities individually for a project when co-operation between nations with complementary capabilities is able to deliver a successful result.

MEDEVAC IN ANTARCTICA DURING DEEP WINTER: AN OUTSTANDING EXAMPLE OF INTERNATIONAL COLLABORATION

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Introduction

During the entire Antarctic winter of 2013 the German research vessel *Polarstern* was operating in the southern hemisphere and in the ice-covered Weddell Sea. The *Polarstern* is operated by the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, and is managed by the shipping company Reederei F. Laeisz. The vessel left Cape Town on 8 July with 50 international scientists on board. Reading through the documents of the ship's surgeon shows that the voyage was unproblematic from the medical aspect during the first weeks.

Case History

Approximately four weeks after sailing, a young American scientist consulted the ship's doctor with flu-like symptoms concerning the respiratory tract.

Figure 5.1: RV Polarstern *during the polar night. (Photo: M. Hoppmann, AWI.)*

The disorder manifested as dry cough, coldness, sore throat and slight reddening. There was no fever. The pulmonary system was without pathological findings, and the circulatory situation was stable. Thus, a symptomatic treatment was started. A considerable dry tickly cough and consequent sleep disorders brought the doctor to admit the patient to the ship's hospital some days later.

One week after the first consultation the patient for the first time complained of a worsening of symptoms and increasing difficulties with walking. Beyond that she felt a tingling sensation in both hands. She had not mentioned to the doctor before this time that she was on an anti-asthmatic medication, a fact that could have been of importance. From that point – 14 July – the disease developed continuously, with the patient experiencing tingling sensations and becoming unable to move hands and legs. From day to day an aggravation of motor activity and increasing paraesthesia could be observed. Assistance was needed to a great extent with food intake, sitting up in the bed and personal hygiene.

After consultation with a neurological clinic in Germany the symptoms were diagnosed as those of Guillain–Barré syndrome. Guillain–Barré syndrome is a neurological disease developing over days or weeks, often triggered by infectious diseases and spreading along the nerve tract. Symptoms are weakness, and paralysis beginning in the legs and extending to arms and trunk, with risk of respiratory paralysis. The only treatments are plasmapheresis or doses of immunoglobulins, neither of which is possible on board, even in a well-equipped ship's hospital.

Figure 5.2: Ship's hospital on RV Polarstern. *(Photo: H. Grobe, AWI.)*

Over the following days the patient suffered increasingly from difficulties with swallowing and respiratory effects. Four days after first occurrence of the neurological symptoms the captain and ship's surgeon decided to contact the Alfred Wegener Institute (AWI) in order to discuss the possibilities of a medevac.

Chronology of the Medevac

At the time that the discussions of a medevac began, 18 July, the RV *Polarstern* was operating in the Weddell Sea, at position 66° 53' S / 027° 02.1' W; ice coverage was 10/10.

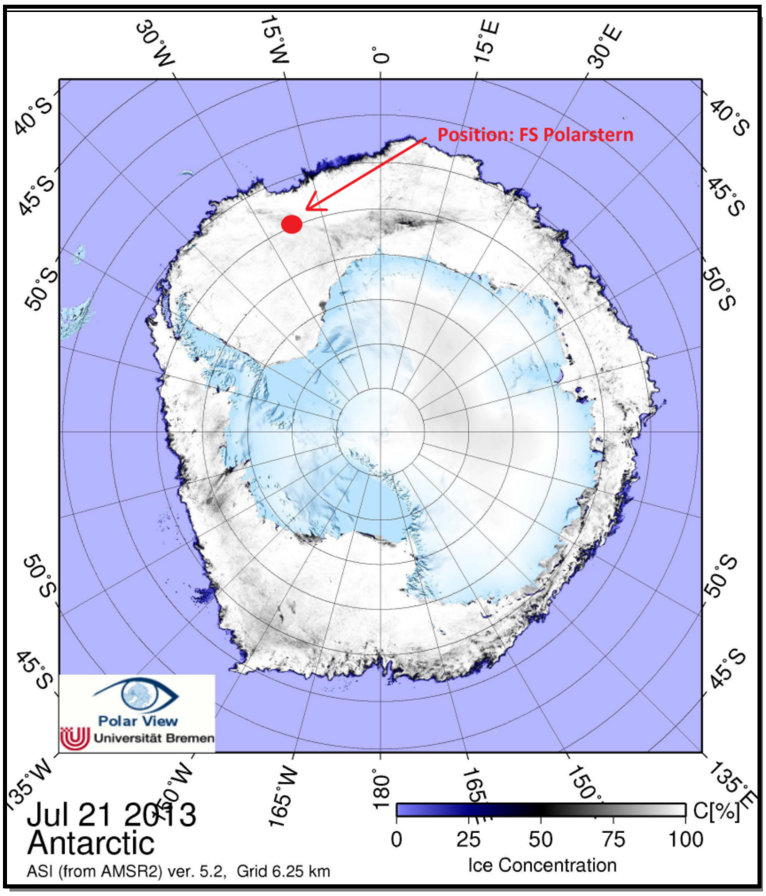

Figure 5.3: Position of RV Polarstern*, 18 July 2013. (Image: G. Heygster, University of Bremen.)*

Considering the position of the vessel it seemed reasonable to head for King George Island and to continue the medevac by air. A port call at Ushuaia had been on the agenda after the vessel left the pack ice of the Weddell Sea, but waiting until then would have meant a delay of about 1.5 days, and so the King George Island option was favoured. The ETA was calculated for 22 July.

Immediately after the decision was made, AWI got in contact with the Chilean National Antarctic Program (INACH) requesting a possible air lift via its Base Eduardo Frei.

Additionally, other national Antarctic programmes operating on the Peninsula (Argentina, UK) were contacted in case an alternative plan had to be sought. Likewise, the US Antarctic Program (National Science Foundation: NSF) was involved and informed about the operations. The NSF was to take care of the patient's transport from Punta Arenas for further medical treatment and rehabilitation.

In parallel, the German Foreign Office and the Chilean Air Force worked on schedules for sending in an aircraft corresponding to the progress of the vessel as it approached King George Island. Because of heavier ice conditions than expected the ETA was updated to 23 July. The Chilean Antarctic Program as well as the military attaché of the German embassy received the confirmation that a Hercules C-130 aircraft was on its way from Santiago de Chile to Punta Arenas on 22 July.

The Argentine Antarctic programme (Dirección Nacional del Antártico – Instituto Antártico Argentino: DNA) was on standby all the time in case RV *Polarstern* should not be able to reach Base Eduardo Frei due to ice and weather conditions and had to deviate to Ushuaia. The colleagues at the British Antarctic Survey were informed of the situation by AWI and they provided advice.

Figure 5.4: Hercules C-130 aircraft of the Chilean Air Force at Base Eduardo Frei. (Photo: V. Vallejos, INACH.)

Early in the morning of 23 July the plane landed at the Chilean airfield of Base Eduardo Frei. On board was an Air Force medical team, with complete equipment necessary for an intensive care transport. The following hours became critical. RV *Polarstern* approached the island within helicopter range at the expected time, but due to deterioration of the weather the helicopter flight had to be delayed for hours. The weather situation at Eduardo Frei was also deteriorating, and only at the last possible minute was the helicopter flight from the *Polarstern* to the base made. At 15.45 hours the patient arrived at the Hercules, which was waiting with engines running, ready for take-off. Only three hours later the patient was admitted to the hospital “Clinica Magellanes” in Punta Arenas. The following day she was repatriated with the assistance of the NSF. An ambulance jet provided by health insurance then took her to Portland, Oregon for further treatment and rehabilitation.

Thanks to close and fast collaboration and assistance of the national Antarctic programmes INACH, DNA, NSF and BAS, the medevac succeeded for the benefit of the patient, despite the difficult environmental conditions. The authors would like to express their gratitude to the Chilean Air Force, which carried out the transport under these conditions and provided all required personnel and equipment.

THE CHINESE FIXED-WING AIRCRAFT PROJECT: AN OPPORTUNITY FOR NEW COLLABORATION IN EAST ANTARCTICA AVIATION OPERATION – FOR BOTH LOGISTICS AND SCIENCE

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This young country of New Zealand has a long and deep relationship with Antarctic exploration. We cannot forget that this is the last civilised country that Robert F. Scott visited before the expedition in which he perished, and it was also the first place to which the news of the fate of the expedition reached. This is the country that witnessed the endeavour of Sir Ernest Shackleton, who was trying to rescue his Ross Sea party. This is the country where the biggest scale of international co-operation in Antarctic undertakings is taking place. Each austral summer, hundreds of intercontinental flights between Christchurch's International Antarctic Centre and McMurdo Sound ferry thousands of scientists and logistic staff in or out of that white continent. Acting as an important gateway for Antarctic exploration in history and Antarctic research today, New Zealand is where we could find good examples for Antarctic co-operation.

China has a short history of Antarctic expeditions; this year will mark our 30th anniversary. Although short, the history of the Chinese programme, CHINARE, since the early 1980s has shown the true spirit of collaboration among the Antarctic Treaty countries. Prior to establishing a station in Antarctica, we dispatched many scientists to the white continent to join other countries' programmes and to learn both sciences and logistics in Antarctica. For the past 30 years, by participating in Antarctic programmes, China has made contributions to the understanding and protection of Antarctica. Now CHINARE maintains four stations, of which two are year-round, providing unique platforms for scientists from all over the world.

Actually, Chinese Antarctic programmes operate at a relatively small scale. In recent years, there have been about 230 expeditioners participating in the Chinese Antarctic programme each season, of whom about 80% are based in East Antarctica at Zhongshan Station or Kunlun Station. The limitation on the number of expeditioners is due to the one-ship operation model of the programme. The only polar region operational vessel, RV *Xuelong*, has to carry out both the logistics and science missions. Zhongshan Station has to be resupplied each season due to the scale of operation and the lack of collaboration resources. Great Wall Station could be resupplied by utilising international collaborations; however, our vessel must visit that station every other year for fuel resupply and provision of bulk materials.

In addition to its logistics responsibilities, the *Xuelong* vessel needs to fulfil a scientific function, mostly related to marine science. Prydz Bay, the Drake Passage and the Weddell Sea have been the main areas where marine science is carried out from the icebreaker. Both logistics and science missions have a rigid time limitation on vessel operation, which leads to difficulties with scheduling the vessel.

Without aviation support, people going into or out of East Antarctica rely totally on the icebreaker, which means loss of valuable working time in the field. For those eminent scientists, long periods away from their domestic communities discourage them from making the trip south. Furthermore, the logistics of supporting both Kunlun Station and field activities is through the use of snow tractors. The speed of the full-loaded traverse fleet is very slow, and a quick response to any emergency situation is not possible.

One fixed-wing aircraft would solve the problems of the one-icebreaker operation model. Firstly, such an the aircraft is capable of ferrying personnel from an intercontinental flight point (such as Novolazarevskaya or Casey Station) to Zhongshan Station, from where further flights to Kunlun Station can be made; thus some key scientists and operations staff could be quickly delivered.

Also one fixed-wing aircraft could be a vital resource when dealing with an emergency. History has shown the important role that aircraft could play during the evacuation of injured people from the remote field. In 2005, one inland expeditioner with altitude sickness had to be evacuated by the US Antarctic Program Twin Otter in a location 100 miles from Dome A. In 2010, one seriously injured worker at Zhongshan Station was successfully evacuated out of Antarctica by utilising three different aircraft operating from the Australian side. Then, in 2011, again one expeditioner with altitude sickness was successfully evacuated by air to Davis Station.

Those three cases highlight the disadvantage of CHINARE from a lack of an aviation operation, and the associated risks with inland activities.

A fixed-wing aircraft would also offer potential benefits for the scientific community. The aircraft could be used as a unique platform for some scientific programmes, making a good flying laboratory.

This project started in the year 2007. One of the key issues was the selection of aircraft model. Several had been examined carefully, with the pros and cons of each aircraft taken into consideration. After consulting with domestic and international experts we selected the Basler BT-67 as our first choice. The use of this kind of aircraft and its original model can be traced to 1940s, and the original was the first aircraft to land and take off at the South Pole. Even old models of the BT-67, after modifications from Basler, are durable, and experience has shown their suitability for the harsh environment of Antarctica. The aircraft can meet different needs, ranging from basic logistics to rescue missions, and can also act as a unique scientific platform. Also, by selecting a model that is widely used in Antarctica, if necessary we are in a good position to work with operation partners who use the same type of aircraft.

The Chinese BT-67 will operate mainly in East Antarctica, using our Zhongshan Station as an operation hub. As stated before, that main part of CHINARE activities takes place in East Antarctica. Zhongshan Station is situated in Larsemann Hills, which sit at the west edge of the Amery Ice shelf. Larsemann Hills is a gateway to inland East Antarctica, serving as a supporting base for activities at Dome A, the Prince Charles Mountains and Vostok Station. Both China and Russia use their bases here to support their inland activities. The presence of one BT-67 will provide this area with constant and valuable aviation support, either for logistics or for science. In particular it will support

China’s inland scientific Kunlun Station, where the deep ice-core drilling is taking place and an ambitious astronomy observation station is planned.

The strengthening of the existing aviation network capability in the area through the introduction of an extra BT-67 will allow collaboration opportunities to emerge. Firstly, long-term scientific programmes based on the scientific configuration of the Chinese aircraft could be designed and implemented with parties interested in this region. In terms of logistics, the new BT-67 could provide feeder flights in the Larsemann Hills area, where four countries’ stations are situated, and in the inland area where two permanent stations operate. This will make good use of the existing intercontinental flight facilities. Thirdly, since there are several BT-67 already operating, one more BT-67 will add more back-up capability if others fail to accomplish tasks.

Fourthly, a Chinese inland traverse could provide much ground assistance to aviation operations in this region: laying of fuel depots, search and rescue, and so on. Also, Zhongshan Station can provide accommodation and other services to the crew and passengers. China also wishes to learn from and to share experience and technology with other relevant parties in this region. Due to the projected increase in aviation activities in the Larsemann Hills area, there arises a requirement for co-ordinating such activities, including those around helicopters, unmanned aerial vehicles and fixed-wing aircraft. This further requires a full exchange of programme information, weather data and communications. China welcomes and is committed to discussions of those issues, either within the COMNAP framework or bilaterally.

The deterioration of ice cap stability at the nearby Progress skiway has required both Russia and China to look for an alternative site for future skiway operations. China is willing to co-operate with other parities in this region to build and maintain such a facility.

Larsemann Hills is an area that has demands for both intercontinental and intracontinental flight services, and has the potential to become an intercontinental flight hub. China is looking at different approaches to fulfil the intercontinental flight demands from the science and logistics communities.

The Dome A area is at a high altitude and the low pressure there means some challenges for aviation operation. No BT-67 has ever landed there. To provide aviation support to Dome A we need to find a solution. For example, a relay station near Kunlun Station at an appropriate altitude could extend the BT-67 service range as far as possible, and then a light and fast-wheeled vehicle fleet could transport personnel and cargo to Kunlun Station.

Even with aviation support in service, there is still need for a ground traverse fleet to transport bulk cargoes, such as fuel and large and heavy items, to/from Kunlun Station. Also, the laying of fuel depots for the proposed aviation activities will rely on the ground traverse. In addition, the ground traverse fleet could also act as an important asset for land-based search and rescue missions.

To make good use of the new aircraft and the existing aviation network, China is committed to investing more on facilities and equipment. Facilities at Zhongshan Station were upgraded just recently, and special equipment will be procured for aviation operation. Also, China is planning to find an alternative skiway site near Zhongshan Station. The increased aviation activities will require close co-ordination among national operators. The history of Antarctic expeditions has proved that collaboration is the only way to carry out both scientific research and logistic operation, due to the harsh environment. A new medium-sized aircraft fully owned by the Polar Research Institute of China will provide lots of collaboration opportunities for many partners. China is open to other national operators for further discussion on both science and logistics.

Dronning Maud Land Air Network: A decade of internationally co-ordinated air operations

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Introduction

The Dronning Maud Land Air Network (DROMLAN) is a partnership between the national Antarctic programmes active in the Dronning Maud Land (DML) region: Belgium, Finland, Germany, India, Japan, the Netherlands, Norway, Russia, South Africa, Sweden and the United Kingdom. DROMLAN has set up a substantial logistic process, supplementing the only ship-borne access of one or two ship-calls per season, with a number of regular flight connections to all research stations within DML and beyond towards East Antarctica. The collaboration under the umbrella of DROMLAN is looking back at a successful record over a period of more than 10 years.

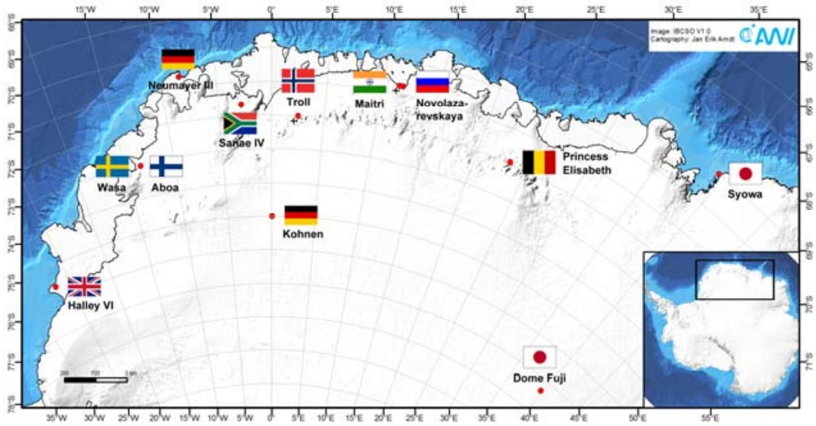

Figure 7.1: Locations of the permanent and summer-only stations of the DROMLAN community. Summer stations are Aboa–Wasa (Finland, Sweden), Kohnen (Germany), Princess Elisabeth (Belgium). (Image: J. E. Arndt and R. Krocker, AWI.)

Air operations into and within Antarctica have been an important tool for science and logistics since the beginning of international co-operation under the Antarctic Treaty. National Antarctic programmes established the first regular intercontinental flight connections to McMurdo and South Pole stations, as well as to the Peninsula. The further development of air operations in Antarctica is a standing item at the Antarctic Treaty Consultative Meetings (ATCMs) and COMNAP AGMs. In this context, in 1999 the European Polar Board (EPB) also addressed “the need for long-range air support to European Polar research, both in the Arctic and in the Antarctic”. The Norwegian Polar Institute took the initiative to check the Antarctic option, i.e. access from Cape Town into DML. In January 2001 a first test flight was organised, departing from Cape Town with an Ilyushin-76TD (IL-76TD) aircraft to a temporary prepared blue-ice landing strip on the inland ice in DML

(71° 31’ S, 08° 48’ E). The neighbouring national programmes were invited to participate in the flight, with a goal to jointly develop a concept afterwards. These activities resulted in a multilateral agreement, which later formed the foundation for the Dronning Maud Land Air Network as an umbrella for internationally co-ordinated air operations in the long term.

The DROMLAN Steering Committee (DROMLAN SC), consisting of one representative from each member national programme, meets annually. The DROMLAN post-season meetings, hosted by one of the DROMLAN member countries, deal with the operational matters and lessons learnt after each season. On behalf of the DROMLAN SC, the DROMLAN operator, Antarctic Logistics Centre International (ALCI), based in Cape Town, organises the intercontinental and intra-Antarctic air operations.

Infrastructures

The DROMLAN members co-ordinated their efforts to get the needed infrastructure in place to operate DROMLAN in the long term. They contributed initially in-cash or in-kind to the national programmes of Russia (the Russian Antarctic Expedition: RAE) and Norway (the Norwegian Polar Institute: NPI), in order to promote the upgrade of the existing runway near the station Novolazarevskaya (Novo Runway) and the construction of a new runway next to Troll Station (Troll Runway). Both runways are operational throughout the season. Great amounts of aviation fuel have to be carried to Novolazarevskaya by RAE and to Troll by NPI.

The Novo Runway (70° 50’ 39’’ S, 11° 35’ 44’’ E; 550 metres above sea level) is located at the inland ice plateau about 17 kilometres southwest of the station

Novolazarevskaya (70° 46’ 37’’ S, 11° 49’ 26’’ E; 110 metres above sea level) in the Schirmacher Oasis. The runway was established in 1979 and closed down in the early 1990s. It was reopened in season 2001–2002 and upgraded to receive intercontinental flights, and, secondly, to serve as the logistic base for all intra-Antarctic flight operations. A summer-only technical base – the so-called ALCI Airbase – is operated next to the runway in order to provide the ground service, to ensure regular maintenance of the runway, and to run a passenger and cargo terminal for DROMLAN intercontinental and intra-Antarctic flights. The base consists of mobile modules on sledges, which provide accommodation for permanent staff, crews and up to 50 passengers in transit.

The Troll Runway (71° 57’ S, 02° 28’ E; 1,298 metres above sea level) is located at Grjotlia, near Jutulsessen, on a blue-ice field about 7 kilometres north of Troll station (72° 01’ S, 02° 32’ E; 1,275 metres above sea level). The runway was completed in 2005. Since then DROMLAN and national flights for the Norwegian Antarctic programme have been received. Because of the short distance between the airfield and the station all permanent staff for ground service and equipment needed for runway maintenance as well as for servicing aircraft are based at Troll Station. DROMLAN passengers in transit are accommodated next to the runway in tents.

The DROMLAN flight weather service was established at Neumayer Station III in co-operation between the Alfred Wegener Institute (AWI) and the German Weather Service (Deutscher Wetterdienst: DWD). Every year, two experts share the service time over one summer season.

Daily outputs, such as general forecasts for stations and field parties, aviation forecasts, including DROMLAN Aerodrome Forecast (DAF), and the DROMLAN weather charts, are distributed from Neumayer Station III.

At the respective DROMLAN stations, preparations such as skiways, ground service, fuel storage and refuelling facilities, regular weather observations, communications, and accommodation for transit passengers for the intra-Antarctic flight traffic are made. Also, the ship-borne delivery of aviation fuel is organised by the national programmes.

As the Antarctic gateway for DROMLAN, ALCI runs an office in Cape Town. The office staff provide all services for passengers, such as environmental and pre-flight briefings, flight check-in, cargo storage, customs clearance, and handling and loading for the intercontinental departures and arrivals. During the season the ALCI staff are responsible for the operational management of the intercontinental and intra-Antarctic flights.

A 10-years Summary of Collaboration with the Operator ALCI

Intercontinental flights Cape Town – Antarctica – Cape Town

Since the beginning of the DROMLAN collaboration the long-range aircraft Ilyushin-76TD (IL-76TD) became the working horse for the DROMLAN intercontinental flights. During the 10 years from season 2003–2004 until season 2013–2014 the IL-76TD has successfully accomplished 108 round-trip flights between Cape Town and the destinations Novo Runway and Troll Runway.

Figure 7.2: Landing of IL-76TD at Novo Runway. A total of 8,197 passengers and 1,584 tons of cargo (counted by one way) were transported into Antarctica and back during 10 years of the ALCI–DROMLAN collaboration. (Photo: A. Nagaev, Russia.)

The passengers (Table 7.1) are scientists and technicians deployed by the national programmes forming the DROMLAN community, and the so-called support staff deployed by ALCI to run the airfield and terminal at Novo. In addition, other national and/or non-governmental activities, e.g. adventure expeditions, are allowed to join the flights, if free capacities are available. The participation of these annex passengers is organised with The Antarctic Company (TAC), a member of IAATO based in Cape Town.

User	Passenger share (%)	Cargo share (%)
DROMLAN participants	68	40
Support staff and crewing	14	48
Other national activities and TAC	17	11

Table 7.1: Ten years' mean share of utilisation of the IL-76TD flights for passengers and cargo.

Figure 7.3 shows the variation of passenger numbers from season 2004–2005 until 2013–2014. The record for DROMLAN members shows an increasing demand until the start of the International Polar Year (IPY) in season 2007–2008. In the following seasons the number of DROMLAN passengers is at almost a constant level, indicating that the air transportation within the national programmes became a fixed share. On the other hand, the ALCI support staff were able to be reduced over the number of seasons by approximately 35%. The maximum of TAC participation in season 2011–2012 was because of the occasion of the 100th anniversary of the expeditions of Amundsen and Scott, when various public activities took place.

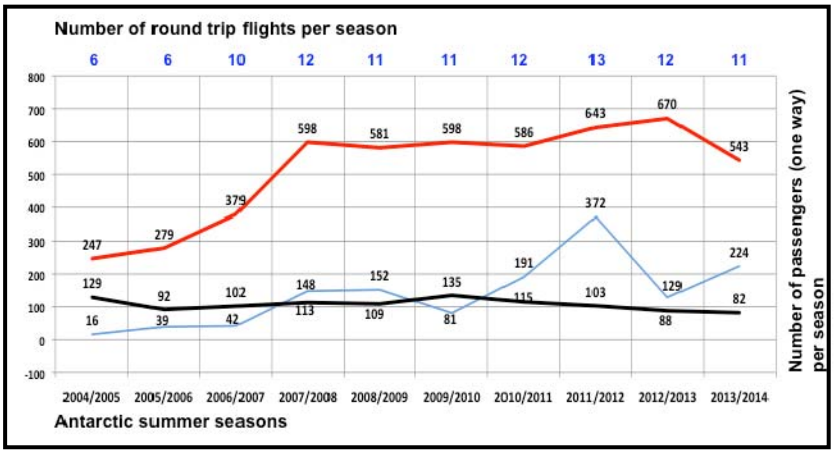

Figure 7.3: Number of passengers on board the IL-76TD (counted by one way) over the period of 10 summer seasons: DROMLAN members (top/red), ALCI support staff (middle/black), and TAC participants (bottom/blue). The number of intercontinental flights per season is shown at the top.

Air Operations in Antarctica

The key component in getting to the frontiers of polar research is the efficient intra-Antarctic air traffic under the DROMLAN umbrella. Novo Runway and ALCI Airbase comprise the logistic base for all small-sized ski-equipped aircraft deployed for this service. Since the 2006–2007 season the full infrastructure for intra-Antarctic air operations has been in place every season. The flight scheme ensures regular access to the stations and field parties, with transportation of scientific equipment and/or collected samples etc., as requested by the DROMLAN members. Two ski-equipped aircraft, basically BT-67, are regularly deployed. In case of additional requests or technical reasons a Twin Otter is embedded in the intra-Antarctic flight traffic.[1] Thus, a back-up aircraft is permanently available during the season. From season 2007–2008 until now, the AWI, as one of the DROMLAN members, has operated the research aircraft Polar 5 (seasons 2007–2011) and Polar 6 (seasons 2011–2014) within this system.

In addition the IL-76TD aircraft performed paradrop missions in the frame of intra-Antarctic air operations from Novo Runway between scheduled intercontinental flights. From 2006 until 2013, a total of 2,278 drums (438 tons) were dropped at the stations Vostok (five missions), Aboa–Wasa (two missions) and the fuel depot FD83 (five missions).

A comprehensive service for search and rescue and medical evacuation is in place during the summer

[1] H. Gernandt & and U. Hedman, *DROMLAN Annual Report 2013* (internal report to DROMLAN Steering Committee Meeting, Seoul, 7 July 2013); H. Gernandt & and U. Hedman, *DROMLAN Annual Report 2014* (COMNAP AGM 2014-MP 7.2, Christchurch, 27–29 August 2014).

season. All stations, as well as field parties, can be reached by one of the available ski-equipped aircraft. From the runways at Novo and Troll the transport back to Cape Town is possible at short notice. The IL-76TD and crew are on standby at Cape Town. Smaller aircraft can be quickly mobilised, if requested because of medical reasons or other circumstances. Altogether, 12 medevac missions were successfully completed in the period.

DROMLAN support to polar research in science and logistics

The early-season air-borne access into DML – independent of ship supply – opened new possibilities for full season time, especially for the summer-only stations.

An early example within the DROMLAN record was the air transportation support to the European Project for Ice Coring in Antarctica (EPICA) at Kohnen Station. All scientists and engineers were transported via DROMLAN and they completed the ice core drilling within only three summer seasons (2003–2004 to 2005–2006).

For the seasons 2007–2008 to 2009–2010 the transport requests have been very high for the replacement of existing research stations as Halley VI (UK) and Neumayer Station III (Germany) and foundation of the station Princess Elisabeth (Belgium). In season 2012–2013 the transportation of snow samples and ice cores

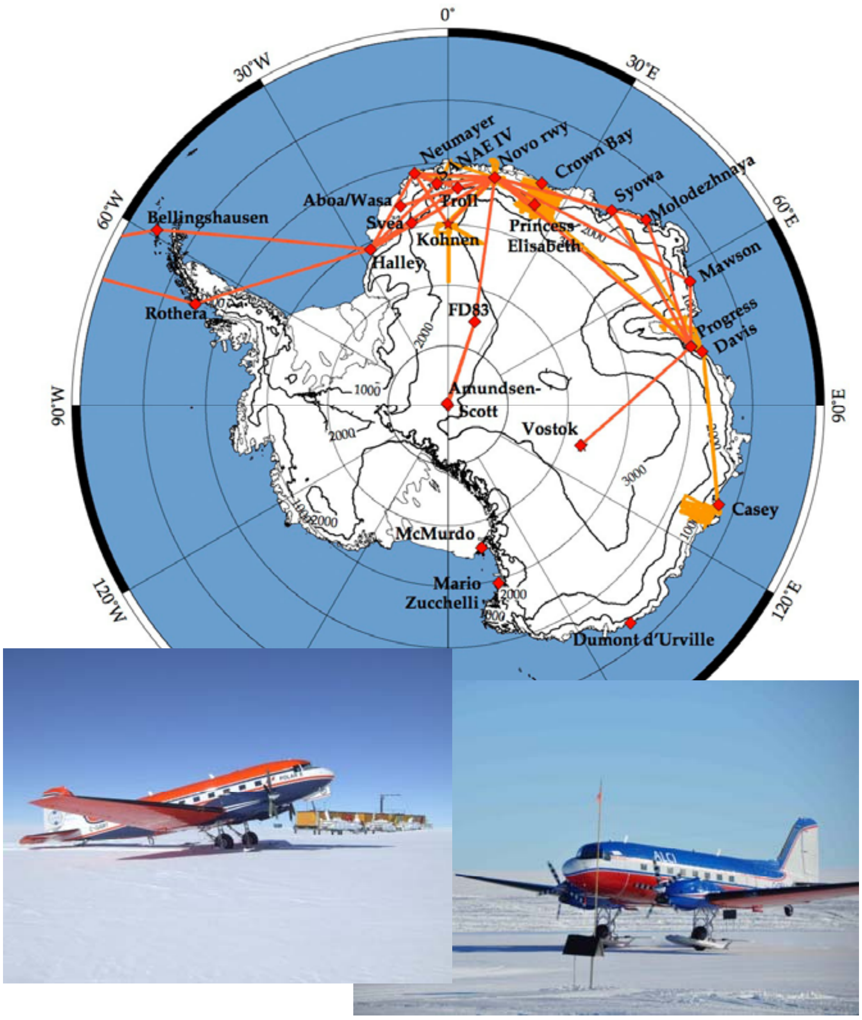

Figure 7.4: As an example, the map shows the range of the intra-Antarctic flight traffic for season 2011–2012: science flights and logistic flights within DML and beyond in East Antarctica. The photographs show research aircraft Polar 6 at Kohnen (left) and aircraft C-GEAJ Mia for logistics at Troll (right). (Map: D. Steinhage, AWI; Photo of Polar 6: AWI archive; Photo of Mia: A. Stemmet, South Africa.)

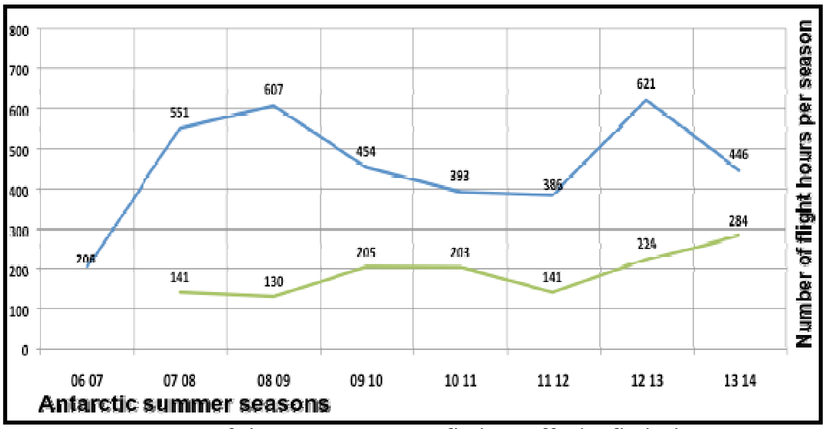

Figure 7.5: Activity of the intra-Antarctic flight traffic by flight hours: logistics with aircraft BT-67 Lidia and Mia and Twin Otter (top/blue); science with research aircraft BT-67 Polar 5 (seasons 2007 to 2011) and BT-67 Polar 6 (seasons 2011 to 2014) (bottom/green).

in large quantities from Kohnen Station to Neumayer Station resulted in a maximum of flight hours.

Since season 2007–2008 the AWI research aircraft have regularly used the DROMLAN services and infrastructure. Altogether, 21 research projects were accomplished with extended survey flights in DML and East Antarctica.

And last but not least, high-profile activities such as Antarctic Treaty inspection teams have been using the transportation services of DROMLAN to visit stations within DML; that is, the inspection by Norway in 2008–2009, the inspection by Japan in 2009–2010 and the joint inspection teams Russia–USA and Germany–South Africa during summer season 2012–2013. To make all requested support feasible, the running costs for management and for deployment of aircraft and crews, as well as a share to the running expenses of both Novo and Troll runways, are allocated to all users (passengers/cargo) via the ticket prices for the intercontinental segment and via flight hours for the intra-Antarctic operations.

Conclusion

DROMLAN, as the first internationally organised air gateway, has offered easier and more-frequent access into DML. Each summer season the regular 10 to 12 round-trip flights from Cape Town into DML and the established intra-Antarctic flights allow researchers to have greater freedom and better cost-effectiveness in choosing their period and location of stay on the continent.

The search-and-rescue and medevac system constitutes a new safety standard for the DML region, which has never been available before. It has significantly improved the working conditions and safety for all personnel in DML.

The efficient and trustful collaboration between national Antarctic programmes and a dedicated DROMLAN operator is a straightforward way to co-ordinate and provide all the needed services by one hand. None of the national programmes has sufficient capacity to alone take care of the full performance and co-ordination of the intercontinental and intra-Antarctic DROMLAN operations.

DROMLAN is open to extending the collaboration with other national Antarctic programmes, to allow joining, or support of, new and challenging scientific projects.

Implementation of a Facility Management System (FMS) using Building Information Modelling (BIM) and 3D GIS for the King Sejong Korean Antarctic Station

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Introduction

The Building Information Modelling on GIS (BoG)-based FMS (Facility Management System), which has been implemented for the King Sejong Korean Antarctic Station, is presented in this paper. The BoG-based FMS is a system that could handle, display and manage facilities in a Web environment using Building Information Modelling (BIM) and 3D GIS technologies. The main purposes of implementing this system are as follows: (a) collecting, building and updating facilities information; (b) building a system that can handle and manage facility information efficiently and systematically; and (c) exploring the possibilities of whether such new cutting-edge technologies can be applied to real remote sites such as the King Sejong Station. After going through several steps, the system has been successfully implemented throughout the scope of the project and is now expected to give several benefits to the Korea Polar Research Institute (KOPRI).

Background

The King Sejong Station was inaugurated on 17 February 1988 and is located on King George Island as a permanent research station. It has actively carried out various kinds of research in the Antarctic area for over 26 years. Over the past few years the station has undergone several minor refurbishments and a major upgrading. Also, there have been the installation and construction of some new facilities. The number of buildings at the station has now reached 42.

However, during the station's development it was found that the facility information had not been managed properly. Some blueprints of the old buildings were missing and much of the facility information was out of date, due to a lack of manual management of the information and frequent job transfers within KOPRI. Also, many layouts and blueprints were in traditional 2D, and interpretation of these required some expertise. These difficulties had affected the ability of the person concerned to efficiently manage the facility. KOPRI therefore recognised that, as a first step, it needed to build an up-to-date collection of facility information.

Traditionally, facility information for the station was managed separately in two places: at the station, and at the headquarters of KOPRI in Korea. There was no specific facility management system to integrate information at both places, a situation that caused a continual discrepancy between the two sets of information, and it was hard to synchronise them. Facility information was stored in a PC folder personally categorised by the person in charge and there was no standard for overall facility management. For this reason, KOPRI decided to employ a standard-based FMS using

Web technology to increase integration and performance.

BIM and BoG

BIM can be considered as a 3D blueprint. Building Information Models (BIMs) are files (often, but not always, in proprietary formats and containing proprietary data) that can be used to support decision-making about a place or building. BIM is the latest technology for facility management.

Unlike BIM, which generally focusses on one or several buildings around a specific location, BoG integrates BIM and 3D GIS on one platform to achieve seamless management of numerous spatial objects that are inside and outside of buildings. KOPRI decided to adopt this BoG platform for the management of many facilities in and around the King Sejong Station, including buildings, machinery and other items.

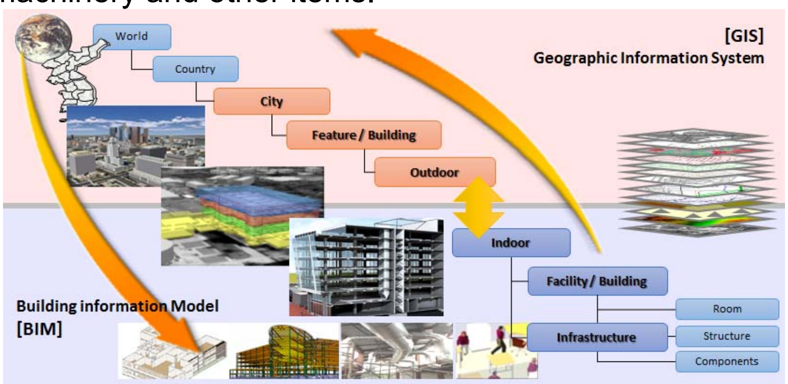


Figure 8.1: Concept diagram of BoG.

Data Collecting and BIM

BIM was carried out in three phases. First, a BIM modeller conducted interviews about the facility information concerns, and collected existing data, layouts, blueprints and literature in Korea. Second, the BIM modeller conducted an initial draft of the station's BIM by using the collected existing data, excluding some buildings that were missing layout or blueprints. Lastly, to create precise and up-to-date BIM models for the station, some BIM professionals visited the King Sejong Station with the over-wintering research team in December 2013. BIM professionals measured all buildings and facilities, including large machinery and pipelines, to compare original data and real data.

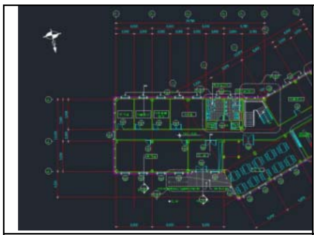
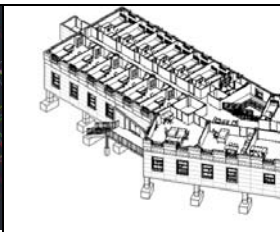
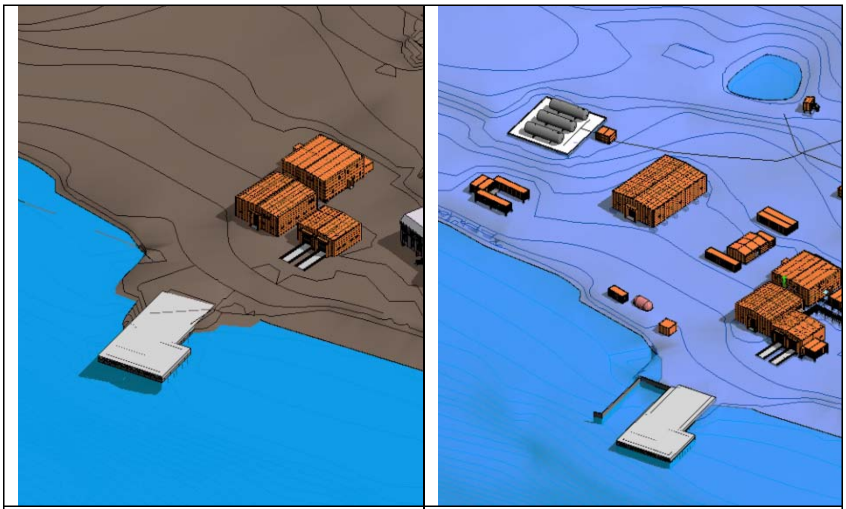
		
Original Layout	Initial BIM	On-site Surveying

Figure 8.2: Data collecting and BIM.



Before On-site Surveying | After On-site Surveying

Figure 8.3: Before and after on-site surveying.

Facility Classification for FMS

All facilities were classified based on a standard, to increase the efficiency and effectiveness of the FMS. From among several standards, KICT Facility Classification Standard was selected for the classification. By linking attributes to the classified code of a facility object, BIM professionals could easily build an integrated facility information database.

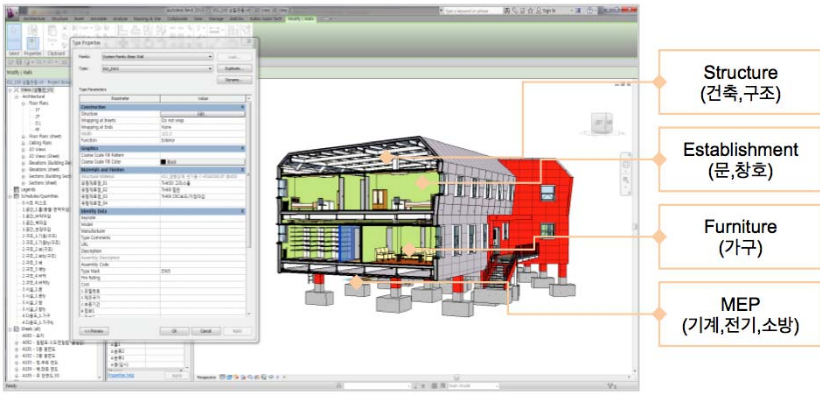
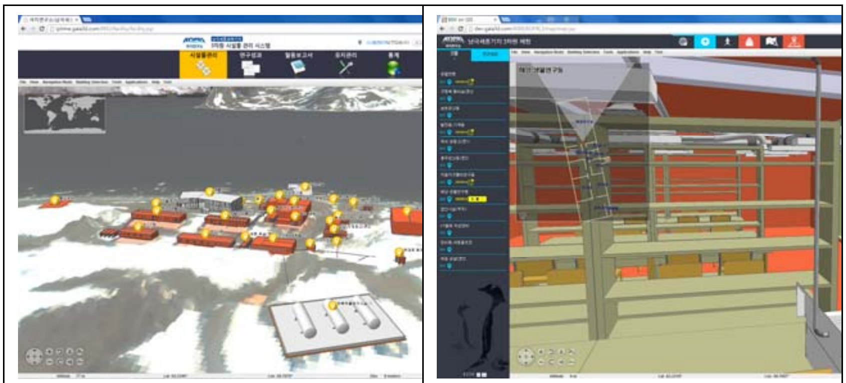


Figure 8.4: Facility classification.

Final System

As a result of this vigorous effort, KOPRI will launch the new 3D facility management system for the King Sejong Station this coming summer. This system adopted BoG technology for the first time in the world, to help people efficiently and effectively manage facilities and buildings. The system basically displays BIM data based on 3D GIS, providing a realistic experience to all users. It is also possible to interactively move in and out of the buildings, and to see the outside of the building from the inside of the building and vice versa. Moreover, the system allows users to look up the objects of the buildings, and properties of objects, one by one, floor by floor, by similar properties, or by all. Administrators can also edit the properties of objects and do spatial queries for analysis of the data.

The system shows whole buildings in 3D and provides functions to search, look up, and edit properties of buildings and facilities in the station. It aims at providing two Web services: public Web for general users and private Web for internal users of KOPRI. Public Web will allow users to virtually travel the station without physically getting to the station and to experience the whole station in 3D. The private Web helps professionals in KOPRI to manage the facility and to train people who plan to go to the station for research, facility management, and so on. It is expected that this system will provide a virtual experience, an interesting introduction to the station for general users, and improved performance of efficiency in facilities management.



Private Web Service for Internal Users	Public Web Service for General Users

Figure 8.5: Two Web services.

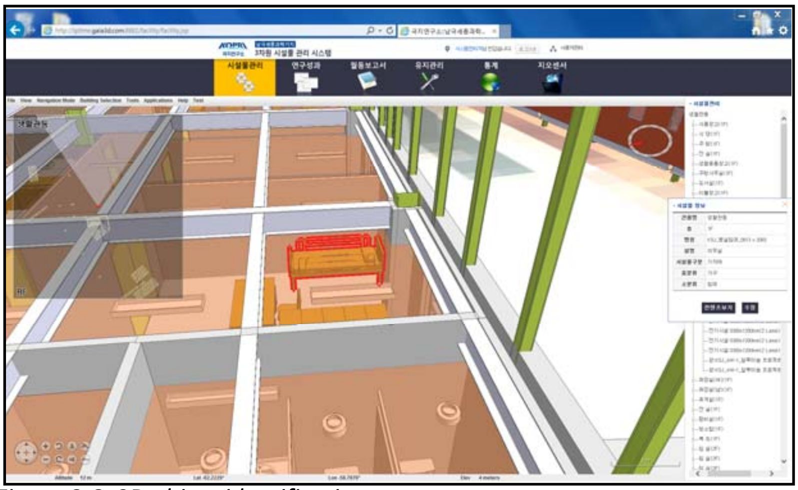


Figure 8.6: 3D object identification.

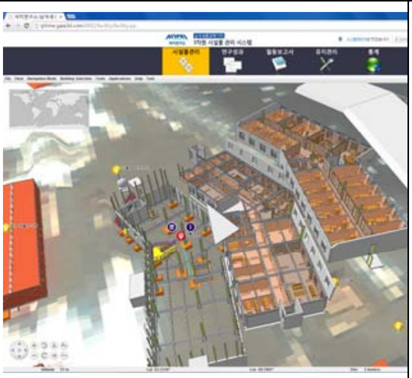
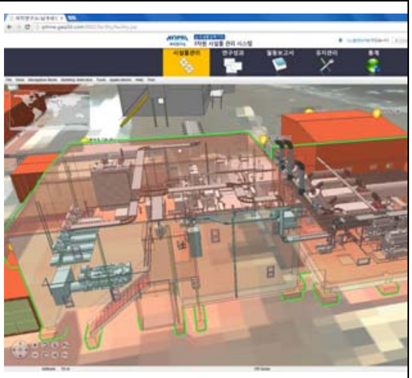
	
Object Control by Floor	Indoor Objects Visualisation Using Transparency

Figure 8.7: 3D visualisation for FMS.

Expectations

There are three major benefits to this system that KOPRI has launched. First, KOPRI can effectively and efficiently manage the facilities and machinery in the King Sejong Station using this system. BIM has been proven as a more effective form of facility management because the large quantity of property information it provides helps the understanding of the status of all objects in buildings. It is expected that all buildings in the station could be managed remotely and successfully throughout this system.

Secondly, the system can be used for training people or squads who plan to visit the station. There are numerous groups of people who visit the station every year, and KOPRI is required to teach and train them about the buildings or facilities for the purpose of better research, environment, safety, and so on. This system provides functions to navigate inside the buildings, to look around the station, to search research materials, and to show the outlook from the station, so it can potentially help people or squads to get familiar with the station.

Lastly, the station, which is currently operating under the management of KOPRI, is funded by Republic of Korean Government. Many Korean citizens, like King Sejong in ancient Korea, have a substantial interest in science and research, and they pay close attention to the King Sejong Station. Since the system will provide public Web pages to look around the station in 3D, people who are interested in the station can simply visit the website and virtually experience the station. The system also effectively advertises the station to the public. In addition, many children visit KOPRI to learn about the Antarctic stations owned by the Korean government and the various scientific studies conducted by KOPRI. KOPRI can utilise the system to provide them with the impression of having visited the King Sejong Station and to motivate them to have a passion for science.

An Operations GIS for Antarctica

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Introduction

The British Antarctic Survey (BAS) is developing a Web-based GIS system that will provide easy access to detailed, relevant, reliable, up-to-date information about BAS operations. The aim is to improve situational awareness and to support decision-making, thereby increasing effectiveness and reducing risk.

Challenges for BAS Antarctic Operations

Like other organisations that have been active in Antarctica for an extended period, BAS has built effective systems for Antarctic operations. However, these have developed organically over time and comprise several disparate systems for ship, aircraft and overland field travel operations, which may interlink in an overcomplicated manner.

Operations data may be held in several different formats, including tables/lists, spreadsheets, proprietary formats for software that is related to GPS systems, or even paper documents such as annotated maps. The data may also be duplicated in other systems so that the same feature may have several names, co-ordinates, and sets of attributes. Clearly, this creates potential for version- control problems between different systems, increasing risk for field operations, for example in the case of someone relying on an out-of-date depot map. There is a high reliance on the knowledge and experience of a small number of experts and the lore of BAS Operations.

The existing ways of working have been proved to be effective and safe over many years of successful Antarctic operations. Now, and looking to the future, BAS operations in Antarctica are becoming ever more complex. Increasingly ambitious logistics have an ever wider reach and use more-complex assets. For example, an internationally collaborative, deep-field airborne survey campaign from a remote camp needs more logistical investment than a science project with self-supporting two-person overland travel.

Safety as well as efficiency is paramount for Antarctic operations. Effective access to reliable, up-to-date information and easy data sharing help to reduce risk, especially in an era of increasing international collaboration and joint planning.

How an Operations GIS can Help: the Vision for a System at BAS

To address these problems BAS is developing a Web-based Operations GIS (OpsGIS) system that has the following properties:

- It integrates disparate data from existing, separate sources into one centrally managed system.
- It is a Web-based system designed with low bandwidth situations in mind by ensuring that all frequent data transfer will use lightweight web services optimised to minimise data download.

For example, the OpsGIS links to an external aircraft position service, but only takes the aircraft information, not the map backdrop, which is provided locally within the GIS.

- It can be used in a stand-alone mode in remote locations where there is no Web access.
- It has an easy-to-use interface that is similar to existing systems, such as the SCAR Antarctic Digital Database and the UK Antarctic place-names gazetteer Web-map, that are already familiar to many users (Figure 9.1).

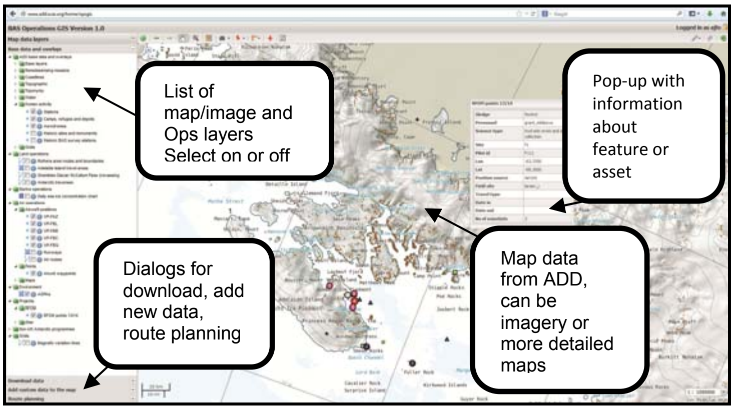

Figure 9.1: The user interface to the BAS OpsGIS has a similar layout and style to the SCAR Antarctic Digital Database and the UK place-names gazetteer.

- It enables the user to examine operational data, such as: depot locations and contents; field party locations, tracks, personnel, equipment and activity; real-time ship and aircraft locations (Figure 9.2); and established routes and waypoints overlaid on a range of map and image backdrops. These backdrops include topographic data from the SCAR Antarctic Digital Database, other large-scale map data compiled by BAS for specific areas, Landsat Image Mosaic of Antarctica (LIMA) imagery, other satellite imagery, aerial photography acquired by or held by BAS, and place names from the UK gazetteer.

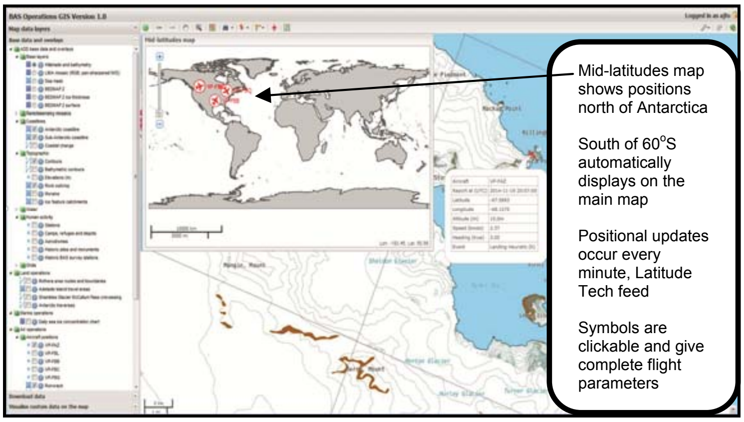

Figure 9.2: Display of near-real-time aircraft positions and flight parameters.

- It allows previously separate data sources to be analysed together.
- It provides a toolbox for route-planning, travel time and fuel-burn calculations, upload of GPS tracks, simple map production and more (Figure 9.3).

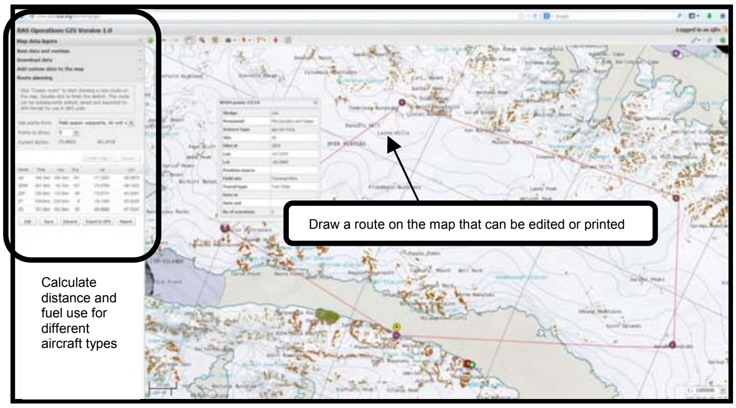

Figure 9.3: Route planning tools in the BAS OpsGIS.

- It promotes everyone working with the same, up-to-date and time-stamped information.
- It is scalable: it can expand to the Arctic and other areas of operational interest as/when required.
- It creates an operations data repository, building up an archive of activity and, hence, for example, potential environmental impact.

Deployment of the BAS Operations GIS

The concept is for the system to run on local networks on BAS stations and ships, and at BAS Cambridge, and for eventual periodic synchronisation to accommodate changes to the operational data. The system can also be operated independently on laptops by field parties or at remote camps such as Fossil Bluff and Sky Blu.

Heavyweight, unchanging core data such as satellite imagery and underlying topographic map layers are stored locally, so that only active operational information uses Internet bandwidth.

From the beginning, the Operations GIS has been built on Open Source systems so that it is not dependent on specific software suppliers and proprietary data formats. It is fully OGC GIS Standards compliant to enable easy exchange of data with other systems through Web-services.

Status of the BAS Operations GIS (November 2014)

BAS already has substantial experience from developing other Web-map and Web-GIS systems. These include Polar View (www.polarview.aq), the SCAR Antarctic Digital Database (www.add.scar.org), the CCAMLR GIS (https://gis.ccamlr.org/home), the South Georgia GIS (www.sggis.gov.gs), the UK place-names gazetteer (www.antarctica.ac.uk/apc), and the NERC Arctic Office Web-map (www.arctic.ac.uk). The BAS OpsGIS builds on and leverages this experience and expertise.

A prototype system was installed in the 2013–14 austral summer at the BAS Rothera Research Station and on the RRS *James Clark Ross* (JCR). This was regarded as a field trial to refine requirements and identify IT issues in the Antarctic setting.

Following much further work at BAS on refining the user interface and expanding the portfolio of data layers, a Version 2 is available for BAS research stations and ships for austral summer 2014–15. Key new developments are: (a) much improved upload of a wide variety of common formats (GPS tracks, KML, shapefiles) to enable custom operational data to be viewed on the map; (b) a comprehensive route planning package, including fuel burn reports; and (c) a large increase in the amount of operations-related data in the system.

Possible Future Developments: Towards a COMNAP GIS?

The issues with proliferation of systems and the increasing complexity of operations facing BAS are likely common to other large organisations with increasingly complex and collaborative polar operations and a long history. Multinational working, with different operational systems working in parallel, demands effective joint planning. Easy sharing and access to accurate, reliable, up-to-date information is key to this.

A COMNAP Operations GIS could improve many of these issues by providing access to a standard set of COMNAP-approved operational information, including, for example: up-to-date information about Antarctic facilities; airborne operations information; real-time aircraft and ship positions; location of field camps; and much more. A universal data set of satellite image and topographic information, including sea ice services, and other geographic information such as place names, from SCAR products and other sources, would underpin the operational layers. A toolbox could provide systems for sharing and exchange of operational information between organisations as well as tools for tasks such as route planning.

The Web-based GIS technology is now mature enough to guarantee a reliable operational system. However, a trap with GIS systems is to gain resources to build and populate the system, but not to continue to support and develop it. In this case the GIS inevitably becomes unreliable; without proper software maintenance, the information becomes out-of-date and the GIS loses relevance and the confidence of the users. At BAS we call this effect “GIS entropy” and recognise that we need to continue to provide adequate ongoing resources for the OpsGIS to maintain a robust, reliable and relevant system.

Conclusions

The British Antarctic Survey has developed an Operations GIS to support BAS activities in Antarctica. A prototype used in Antarctica in 2013–14 demonstrated the value of this and, following further development, an operational system is deployed for 2014–15. An initiative by COMNAP to develop a similar system could make the advantages demonstrated by the BAS OpsGIS available to the wider Antarctic operations community and be a valuable resource for improved international collaboration.

Poster Presentations

THE ARGENTINIAN, BRAZILIAN, BULGARIAN, CHILEAN, PORTUGUESE AND SPANISH ANTARCTIC PROGRAMMES: AN EXAMPLE OF EXCELLENT CO-OPERATION IN SCIENCE

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The Chilean Antarctic Institute / Instituto Antártico Chileno (INACH) project "Geochemical signatures of tephras from Quaternary Antarctic Peninsula volcanoes" was realised with the logistic support by of the Chilean Navy and the Brazilian, Bulgarian and Spanish Antarctic programmes. The Antarctic stations of Bulgaria, Chile and Spain helped with facilities for laboratory and field work. The project contributed substantially to a better understanding and interpretation of individual climatic events, as well as tendencies in the climatic evolution of the northern Antarctic Peninsula.

The project "Permafrost and climate change in the maritime Antarctic (PERMANTAR)" is an excellent example of international collaboration that contributes to the global scientific effort to bridge the gap in the knowledge of Antarctic permafrost characteristics, sensitivity and implications for climate change. PERMANTAR involves researchers from Portugal, Spain, Bulgaria, the USA and Argentina and there is multifunctional collaboration between all of the research centres in all scientific tasks involved. The logistics are provided by the Spanish Antarctic programme and the Bulgarian Antarctic Institute, and an experienced Swiss company is responsible for permafrost drilling.

Argentinian and Bulgarian scientific co-operation has a long-standing history. Twenty years ago, in 1994, Bulgarian geologists worked in the Argentinian field camp at Byers Peninsula, Livingston Island. The data obtained have produced a series of palaeogeographic maps, showing the relative positions of the Antarctic Peninsula and Patagonia, from the Late Jurassic to the present, and these provide new insights. Last austral season two Bulgarian biologists took part in the project "Algae from terrestrial and temporary aquatic habitats on the South Shetland Islands: species diversity, ecology and biogeography", realised in the vicinity of the Argentinian base on Deception Island. During the survey several unknown diatom species were found; four were described as new to science.

INTERNATIONAL CO-OPERATION AT THE J. G. MENDEL CZECH ANTARCTIC STATION

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The presented poster describes the achievements gained so far from the international scientific, as well as logistic, co-operation at the J. G. Mendel Czech Antarctic Station, James Ross Island, Antarctic Peninsula region, as one of many examples for the COMNAP symposium's main topic. Above all, the main purpose is to declare the heartfelt intention of the Antarctic research programme of the Czech Republic, the youngest member of COMNAP, of open access to its facility, to be shared according to the Antarctic community's ideals and to provide background facilities for research, in the best manner of international co-operation.

TWO METHODS FOR PREDICTION OF SNOWDRIFTS AROUND BUILDINGS IN THE ANTARCTIC

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The Japanese Syowa Station has suffered from heavy snowdrifts around the buildings in the centre area since the construction of some buildings adjacently. Snow accumulation is a serious burden in terms of stress to buildings, access problems and the need to remove the snow build-up. Obviously it is important to plan an appropriate design and layout of the buildings in order to minimise snowdrifts. Therefore, the Japanese Antarctic Research Expedition has developed two methods to predict snowdrifts around buildings. One is wind tunnel experiments using scaled terrain and building models with artificial snowflakes. Recently, a wind tunnel test was implemented for a new large building (24 metres long and 12 metres wide), the results of the test provided guidance on the best shape for the new building. Subsequently, a two-storey building was constructed in the central region of the station. As a result, the snowdrifts around the building are smaller than those that had earlier been experienced in the area. The wind tunnel experiment is useful, but it takes time and adds costs.

Another prediction method is a three-dimensional numerical simulation over complex terrain and buildings. We completed a simulation using the RIAM-COMPACT, which was developed by T. Uchida, an Associate Professor of the Research Institute for Applied Mechanics (RIAM), Kyushu University. The method can predict unsteady three-dimensional airflow around buildings. The numerical result demonstrated a good agreement with actual snowdrifts. We intend to apply the same simulation to other areas and buildings, and to make heavy use of the method for building planning in Antarctic stations in the future.

FIELD, LABORATORY AND NUMERICAL STUDIES OF SNOWDRIFT AROUND THE GERMAN ANTARCTIC STATION, NEUMAYER III

Koui Kim, Hartwig Gernandt, Toshio Hannuki, Yuichiro Ishinabe, Yoichi Yamagishi, Takanori Uchida, Ryo Araya, Kenji Kosugi, Shigeto Mochizuki and Kenji Ishizawa
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To date, our ability to predict snowdrift around buildings has been limited in Antarctica, because of lack of field data and understanding of the snowdrift development processes. To provide design tools for Antarctic buildings that can be used in practice to minimise the snowdrift problems, an international joint project was conducted between the Polar Engineering Group of the Japanese National Institute of Polar Research (NIPR) and the Department of Operations and Research Platforms of the Alfred Wegener Institute (AWI).

We carried out a series of laboratory experiments using the low-temperature wind tunnel at Shinjo Cryospheric Environmental Laboratory, Japan, which could reproduce natural blowing snow using artificial snowflakes. Numerical simulation was also performed with the use of “Airflow Analyst”, integrating Computation Fluid Dynamics (CFD) simulation with ArcGIS software. Furthermore, V & V (verification and validation) were conducted using the field snowdrift accumulation data provided from AWI.

International Exchanges and Co-operation in the New Chinese Polar Research Vessel Programme

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"Globally joint design and made in China" has been upheld as the fundamental principle since the very beginning of the new Chinese polar research vessel programme. This thought could be spotted in each phase of the programme, spanning from the preliminary research, to inviting two classification societies to check the drawings; from the international bidding to the basic design – all of which promised the smooth operation and the future success.

Extensive International Research

Through exchanging ideas with counterparts from Europe and the Korea Polar Research Institute (KOPRI) and attending related seminars as part of COMNAP, we have learnt from our colleagues effective and practical ways of organisation according to the advantages of different enterprises. This has allowed us to meet demands while drawing on our colleagues' important experience of the design and construction of vessels and their use of the resultant major facilities on board. All of these inspired us to integrate domestic and overseas workforces for design and research, to manufacture a world-class icebreaker.

Co-operation of Two Classification Societies

The “joint design” means far more than co-operative drawings of the basic design in a narrow sense; it includes the idea of collaborations in all perspectives. The introduction of prestigious foreign classification societies is a typical example. It not only bridged the gap in classification of icebreakers, but also simplified participation in drawing checks, supervision, survey and classification, which ensured that the newly built ship would live up to our expectations to the largest extent. Furthermore, the involvement of international classification societies helped create explicit classing standards and facilitated the design. In addition, the dual classing systems enabled two classification societies to bring features into play and avoid shortcomings, which made the process feasible and efficient.

International Bidding for Basic Design

As the most critical stage of the programme, the basic design demonstrated the principle of “globally joint design” required by the State Council of China. International bidding made it possible for us to reach qualified and world-renowned design companies with rich experience and good performance in manufacturing of polar research vessels and the capability to offer reasonable, reliable and cutting-edge solutions.

We invited the China Classification Society (CCS) and the Lloyd’s Register of Shipping to review the technical and business content in the bid invitation documents of the basic design. We also included Korean and Canadian experts in the evaluation panels. All the bidding companies took pride in their experience of manufacturing world-leading icebreakers. Finally, after four rounds of negotiations that lasted for four months, an agreement on design was signed with Finnish company Aker Arctic Technology Inc.

It is the perseverance in international co-operation that turns our hope for a world-class icebreaker into a reality and helps meet our expectations for the new vessel.

XXXII Antarctic Operation – OPERANTAR XXXII – and International Co-operation

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The representatives of the Secretariat of the Inter-Ministerial Commission for the Resources of the Sea (SECIRM) and members of the Delegation of the Brazilian Antarctic Programme intend to present a summary of the XXXII Antarctic Operation, which was recently completed, emphasising the co-operation with the Antarctic programmes of Chile, Bulgaria, Portugal, Germany, South Korea, Ecuador, Peru, Poland and Spain regarding the logistical aspects of the operation, especially for the transport of personnel and cargo using logistical flights, which were carried out by the Brazilian Air Force and the ships of the Brazilian Navy. The support given, in some cases was essential to initiate the activities of Antarctic bases. Notable also was the use of the facilities of the Argentinian Base Cámara for research purposes during the summer.

The relevance of the subject lies in sharing this experience with other delegations, as well as the satisfaction of having contributed to the achievements of other countries in Antarctica. The Brazilian Antarctic Programme, especially the Brazilian Navy, will be available in case there is any need of support in the future.

A DECADE OF ART IN ANTARCTICA: 2004–2014

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The Cultural Project Department of Dirección Nacional del Antártico (DNA) of Argentina enhances and promotes the exploration of aesthetic proposals for developing artistic projects focussed in the Antarctic.

The Art in Residency Programme and the International Co-operation Programme are included in the Antarctic summer campaign, which takes place between November and March of each year. Art works are then shown in national and international, temporary and itinerant exhibitions entitled "Polar south – Art in Antarctica", as well as in other media, including seminars, lectures, printed material and exchanges.

Some goals of the project are to enhance links between arts and sciences by promoting the interaction of the different disciplines, to improve links with institutions, associations, and universities to build international co-operation, and to generate an international Antarctic artists' link.

Introduction to the Art and Culture Programme

The Art and Culture Project was outlined in May 2004 by the DNA. The project was initiated with Argentinian artists and was included in the International Co-operation Programme in 2006, with artists from Spain and Canada, by finding out aesthetic possibilities of contemporary art associated with current matters concerning the environment, and by diffusing works at national and international levels.

The Art Programme in Antarctica received other artists who worked with the aesthetic research on different disciplines, by combining art and science to produce a reflexive conscience for spreading works related to Antarctica. Artists from Chile, Brazil, Uruguay, Ecuador, Mexico, USA, Canada, Spain, France, Italy, UK, Bulgaria, Germany, Austria, India, Australia, New Zealand and Russia have participated in our programme. The programme is open to all disciplines, such as painting, sculpture, printing, drawing, music, performance, video, photography, and literature, among others.

A NEW SERIES OF AIR OPERATIONS PLANNING MAPS FOR ANTARCTICA

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Good maps are essential for planning safe and efficient air operations in Antarctica. Existing Air Navigation charts are out of date, predate high-quality continent-wide topographic datasets such as the SCAR Antarctic Digital Database (ADD) and Landsat Image Mosaic of Antarctica (LIMA), and are available only at small scales. They are designed for high-altitude, over-flight aviation, not the science and operations support role of aircraft in Antarctica, and they lack detail and up-to-date COMNAP-compliant information about Antarctic infrastructure.

In response, several national operators have produced Air Operations maps at 1:1M scale to support their own airborne activities, but these have been produced independently and have a variety of styles, content, sheet boundary systems, projections and units and cover only about a third of the continent. Feedback from map users is that the existing bespoke maps are very useful, but would have even greater utility as a consistent, continent-wide series.

In response, the British Antarctic Survey, Belgian Institut Géographique National, Norwegian Polar Institute and US Polar Geospatial Center are collaborating to produce a new series of Air Operations Planning Maps at 1:1M scale. The maps will have a consistent scale, projection, content and style to provide coherent, standardised coverage of the Antarctic continent. The maps are focussed on planning for science and operations support by Twin Otter-type aircraft, and are not Air Navigation charts.

The initial objective is to provide coverage of priority areas for the Antarctic summer season of 2014–15. The maps will be freely available for download from the SCAR Map Catalogue, either for printing or for further overlay of users' specific operational information.

This collaborative project shows how international co-operation can produce key operational resources for the Antarctic community that would be beyond the scope of each individual organisation and much less useful if produced independently without international co-ordination for consistency and standardisation.

A NEW PHASE FOR THE ANTARCTIC SEA ICE INFORMATION

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The Polar View programme (http://www.polarview.aq) helps enhance the safety and efficiency of vessels operating in the Antarctic by providing up-to-date sea ice information. This operational service has been providing timely information since 2005. Polar View users in the Antarctic include national programme scientists, tourist vessels, fisheries vessels and private expeditions. Polar View has also provided direct support to a number of search and rescue activities in recent years. These operations have benefited from easier access to sea ice information required by the rescue co-ordinators. Most recently Polar View provided imagery to a number of vessels involved in the rescue of the MV *Akademik Shokalskiy*.

A variety of satellite images and derived information products are created and delivered by a team of international collaborators. The next European radar satellite, called Sentinel-1 and launched successfully on 3 April 2014, will provide a significant improvement in access to satellite radar imagery that is routinely used for sea ice navigation in the polar regions.

In recent years, the International Ice Charting Working Group (IICWG, https://nsidc.org/noaa/iicwg/), which co-ordinates the world's ice centres on all matters concerning sea ice and icebergs, has increased attention on Southern Ocean requirements for sea ice information. This includes efforts to improve co-ordination and co-operation between the national ice services that currently produce Antarctic ice charts (USA, Russia and Norway). The next IICWG meeting, which will focus on Southern Ocean ice charting, will be held from 20 to 25 October in Punta Arenas, Chile.

This communication will highlight the existing and growing international co-operation that delivers the Antarctic Polar View and sea ice-charting services. This is an important opportunity to communicate directly with the national Antarctic programmes in order to inform them of new developments, demonstrate improvements resulting from the new European Polar Ice project, and receive feedback on requirements.

SPANISH 2013–2014 ANTARCTIC CAMPAIGN AS AN EXAMPLE OF INTERNATIONAL CO-OPERATION

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Since 1988, Spain has successfully operated two Antarctic stations. They are "Juan Carlos I" on Livingston Island, and "Gabriel de Castilla" on Deception Island. During these 25 years, co-operation with the neighbour countries of the Antarctic Peninsula has been an important feature, and includes scientific exchanges, logistics and operational issues.

Through these 25 years, the Spanish Antarctic programme has regularly used its polar vessels: *Hespérides* and *Las Palmas* to conduct marine research and logistical support at both stations. It is noteworthy that during the 2013–2014 season, for various reasons, neither vessel was available for research and/or logistical support to our stations. Based on a continuous and long-standing relationship with the Antarctic programmes of Brazil, Chile and Argentina, and through excellent sustained international co-operation, we were grateful to be able to complete most of the organisational requirements in relation to the Spanish Antarctic stations. This successful co-operation involved many major infrastructures from the three mentioned countries, including ships and aircraft, which were used to transport scientists and technical staff, as well as all the scientific equipment needed to properly run the two stations. A total of five ships were used – *Ary Rongel* (Brazil), *Aquiles* and *Oscar Viel* (Chile), and *Castillo* (Argentina) –

along with planes of the Brazilian Air Force, the Chilean Air Force and Aeriovías DAP.

Undoubtedly, the implementation of the Spanish campaign could not have been possible without the excellent relationship with these three Antarctic programmes, through the co-operation and assistance over the years, which is promoted and maintained within the COMNAP community. This is a good example of how, through international co-operation among Antarctic programmes, many obstacles can be resolved in tough times. In the specific case of Spain, this co-operation was very useful in carrying out a full Antarctic campaign, with all its complex implications in terms of resources, manpower and infrastructure.

Sharing logistics to support an evolving scientific programme on the Ronne–Filchner Ice Shelf

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British Antarctic Survey (BAS) has just recommenced tractor traverse in support of science projects after not having done much of this sort of activity for over 40 years. This poster discusses a collaboration with the Alfred Wegner Institute (AWI) in support of a joint science project that commenced out of discussions by BAS to seek logistics support from AWI.

BAS is undertaking a number of large science projects in the area of the Ronne–Filchner Ice Shelf over the next three or four years. Out of recent experience using tractor traverse it has been realised that there are considerable logistics benefits to using this method in support of bigger logistics tasks. BAS was also looking to expand upon the current commitments, with another large project undergoing grant review.

Out of this building challenge and without having the capital to invest in new traverse vehicles, BAS requested from AWI that they provide two traverse vehicles to meet this logistics challenge. Discussions between BAS and AWI generated the scope to science co-operation, with the planned traverse to support both AWI and BAS needs. Both BAS and AWI are committing ship time in different seasons to support the logistics inputs to this remote deployment site, along with a shared traverse infrastructure that will work across time to support the joint science activities.

The net result is a considerably lighter logistics burden on both organisations, and the development of a pronouncedly expanded joint science programme between the two organisations. The author sees this as an indicator of how large field campaigns can be more cheaply facilitated in the future, both in terms of methods and in terms of co-operation. It is noted that a similar example of co-operation with traverse between the Australian Antarctic Division (AAD) and the Institut Polaire Français Paul Emile Victor (IPEV) has coincidentally been undertaken in the last year in East Antarctica, which tends to support this proposition.

Antarctic Peninsula Interactive Station Information Map: a tool to promote international collaboration and co-operation

Nature A. McGinn, Brad Herried, and Paul J. Morin
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Many successful collaborations and co-operative agreements begin with sharing information and increasing awareness of opportunities and common interests. In order to share information about opportunities, there must be opportunities to share information. International scientific collaborations often spring from scientists discovering common interests while presenting at conferences or identifying shared pursuits through publications in journals. Collaborations could benefit from earlier realisation of such commonalities and awareness of opportunities and facilities through which to pursue them.

To that end, we are developing an interactive, informational map of the stations in the Antarctic Peninsula. We have chosen to focus on the Peninsula region because of the relative density and proximity of stations. We are creating this map with the following aims in mind: ease-of-use, informative visuals, comprehensiveness, and accessibility. In order to promote collaboration and co-operation through awareness, the information about the stations that we intend to incorporate into the map includes: statistics, descriptions and pictures of the stations; information and pictures of scientific facilities; details about ongoing on-site and local environmental monitoring and data collection; and the areas of research focus. We believe that this informative, centralised, user-friendly tool will serve both the scientific and the programme-management communities. In the interest of promoting future collaborations, co-operation from national programmes will be required in order to build this comprehensive interactive map and to maintain up-to-date information over time.

EIGHT YEARS' ACTIVITIES OF A WORKSHOP ON ANTARCTIC MEDICAL RESEARCH AND MEDICINE: PROMOTING ASIAN CO-OPERATION

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The Japanese Workshop on Antarctic Medical Research and Medicine has been held every year since 2004 to organise medical research and operational medicine in Japanese Antarctic activities and to discuss medical research of the next expedition team. Participants from other Asian nations have been invited to attend since 2006. This international participation is ideal, because the Antarctic medical research group of individual nations is small; therefore we must join with others in an action internationally.

In total, the number of participants is beyond 400, including about 30 Asian members from Korea, China and India. This network also provides a place for the exchange of information about practical operational medicine, such as construction of new stations, inner highland operations, and so on.

The workshop is beginning to perform the function of an Asian local network on Antarctic medical research. It is expected that the workshop will stimulate the research of each nation and encourage international Antarctic medical research.

APPENDICES

Appendix A:
COMNAP Symposium 2014: Success Through International Co-operation

Programme

Time	Title/Speaker/Organisation
1130–1150	**Welcome** John Hall, Symposium Convener **Keynote Address: COMNAP's role in fostering international co-operation** Heinrich Miller, COMNAP Chair Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research
1150–1210	**Dirck Gerritsz laboratory at Rothera Research Station: a successful UK–NL collaboration** Dick van der Kroef Netherlands Organisation for Scientific Research, Earth and Life Sciences
1210–1230	**Chilean strategies to increase international co-operation** José Retamales Instituto Antártico Chileno
1230–1250	**Success Through international co-operation in ice core science at Aurora Basin** Robb Clifton Australian Antarctic Division
1250–1310	**Medevac in Antarctica during deep winter: an outstanding example of international collaboration** Eberhard Kohlberg Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research
1310–1330	Discussion
1400–1600	Poster Session
	The Chinese fixed-wing aircraft project: an

1600–1620	**opportunity for new collaboration in East Antarctica aviation operation – for both logistics and science** Tijun Zhang Polar Research Institute of China
1620–1640	**Dronning Maud Land Air Network: a decade of internationally co-ordinated air operations** Hartwig Gernandt Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research
1640–1700	**Implementation of a Facility Management System (FMS) using Building Information Modeling (BIM) and 3D GIS for the King Sejong Korean Antarctic Station** Hyoung Chul Shin Korea Polar Research Institute
1700–1720	**An operations GIS for Antarctica** Andrew Fleming British Antarctic Survey
1720–1800	Questions, discussion and concluding remarks

Appendix B:
List of files contained on accompanying Symposium DVD

Oral Presentations
Presentation 1 Miller
Presentation 2 Van der Kroef
Presentation 3 Retamales
Presentation 4 Clifton
Presentation 5 Kohlberg
Presentation 6 Zhang
Presentation 7 Gernandt
Presentation 8 Shin
Presentation 9 Fox

Poster Presentations
Poster 1 Pimpirev
Poster 2 Kapler
Poster 3 Ishizawa
Poster 4 Kim
Poster 5 Han
Poster 6 PROANTAR
Poster 7Juan
Poster 8 Fox
Poster 9 Fleming
Poster 10 Ojeda
Poster 11 Dinn
Poster 12 McGinn
Poster 13 Ohno

Presentations and poster files can also be found on the COMNAP website: www.comnap.aq.