

## Chilean Scientific Activity in Antarctica

Patricia V. Vicuña\*

*Instituto Antártico Chileno, Luis Thayer Ojeda 814, Providencia, Santiago, Chile*

### Introduction

The polar regions, and especially Antarctica, have attracted the attention of the world from many points of view, including: strategic, economic, social environmental, scientific.

In these regards, Antarctica is a paradise for scientists because here they can find a natural laboratory, isolated from the polluted areas, where it is possible to study phenomena that only occur in this place.

Despite today's intense interest, Antarctica remained for a long time unexplored and unknown to the scientific world. It was not until 1957 or 1958, period known as the International Geophysical Year, that the study of Antarctica began in earnest, based upon a spirit of international cooperation. In that year, 12 nations established 67 research stations investigating a wide range of aspects including the topography of the ice and geographical atmospheric characteristics amongst others. The success of the International Geophysical Year demonstrated that it was necessary to have a long term framework in order to maintain a peaceful coexistence in Antarctica. For this reason 12 countries, including Chile, signed the Antarctic Treaty in 1959 which provided a legal framework for operations in the region located South of the 60° S parallel.

Under these rules, many countries have joined the Antarctic Treaty and have established scientific stations in Antarctica, and everybody is working side-by-side under a spirit of international cooperation.

Since the signing of the Antarctic Treaty, continu-

ous research programs have been adding to the knowledge base and understanding of Antarctica, not only for the sake of pure scientific curiosity, but also due to the significant part of Antarctica has played in effecting the dynamic properties of the planet, both in the past and at present. The perspectives that have been attained after more than a half century of investigations in Antarctica have clearly demonstrated the integral roll of Antarctica in the natural systems of the planet Earth.

### Historical Background

Due essentially to its close proximity, Antarctica has always been of keen interest to Chile. As early as the last century, Chile had a presence in Antarctica by way of whalers and sealers. In 1906 Chile prepared its first scientific expedition to Antarctica in order to explore both land and oceans in preparation for future scientific research efforts. Unfortunately, due to events beyond the control of the organizing party, the expedition was abandoned and it wasn't until the summer of 1946-1947 that the first official scientific expedition was carried out. In those days, the expeditions concentrated on studies in the Biology and Geology disciplines.

In 1957 Chile built its first scientific base, Luis Risopatrón, on the Antarctic Peninsula. Since the International Geophysical Year in 1959, Chile, just like the other countries claiming territories in Antarctica, has maintained a permanent presence on the continent, and a program of constant scientific activity. The Chilean Government, in recognition of the importance of this scientific activity in

---

\*corresponding author (pvicuna@inach.cl)

Antarctica, created the Instituto Antartico Chileno (INACH, Chilean Antarctic Institute) in 1964. INACH is a technical organism within the Ministry of Foreign Affairs, responsible for the coordination, planning, orientation and control of all Chilean scientific activity in Antarctica. Since its inception to date, INACH has been developing scientific activity in the area mainly via annual expeditions, generally conducted during the summer months between December and February.

### Logistic and Operational Issues

Every year INACH sends a research vessel to the area, which is used as a platform for the execution of projects. INACH also relies on the support of the vessels from the Chilean Navy, including the new ice breaker, Oscar Viel, which has proven to be greatly beneficial to the research efforts, providing access to traditionally isolated places within the ice flows of the Southern Ocean. The Chilean Air Force also provides invaluable assistance to the scientific

effort by transporting people and cargo from the South American mainland to Antarctica, and also within Antarctica itself.

Most of the scientists stay in Antarctica for a period of approximately 20 to 30 days, however, if their investigations require extra time they can stay for the full annual expedition period of approximately 2 months, or in special cases, the whole year as is the case happen with two current projects related to oceanographic studies and the monitoring of upper atmosphere. During their time in Antarctica, scientists can stay at any of the following INACH bases, support bases (Fig. 1), or in temporary camps, or in some cases, at neighboring foreign bases:

Julio Escudero Base, Fildes King George Island (INACH)  
 Julio Ripamonti, Ardley Island (INACH)  
 Yelcho Base, Doumer Island (INACH)  
 Cape Shirreff, Livingston Island (INACH)  
 Luis Risopatrón Base in Robert Island (INACH)  
 Patriot Hills Base 80° latitude (INACH)  
 Prat Base, Greenwich Island (Navy)  
 O'Higgins Base, Antarctic Peninsula (Army)  
 Carvajal Base, Antarctic Peninsula (Air Force)  
 Camps or foreign bases

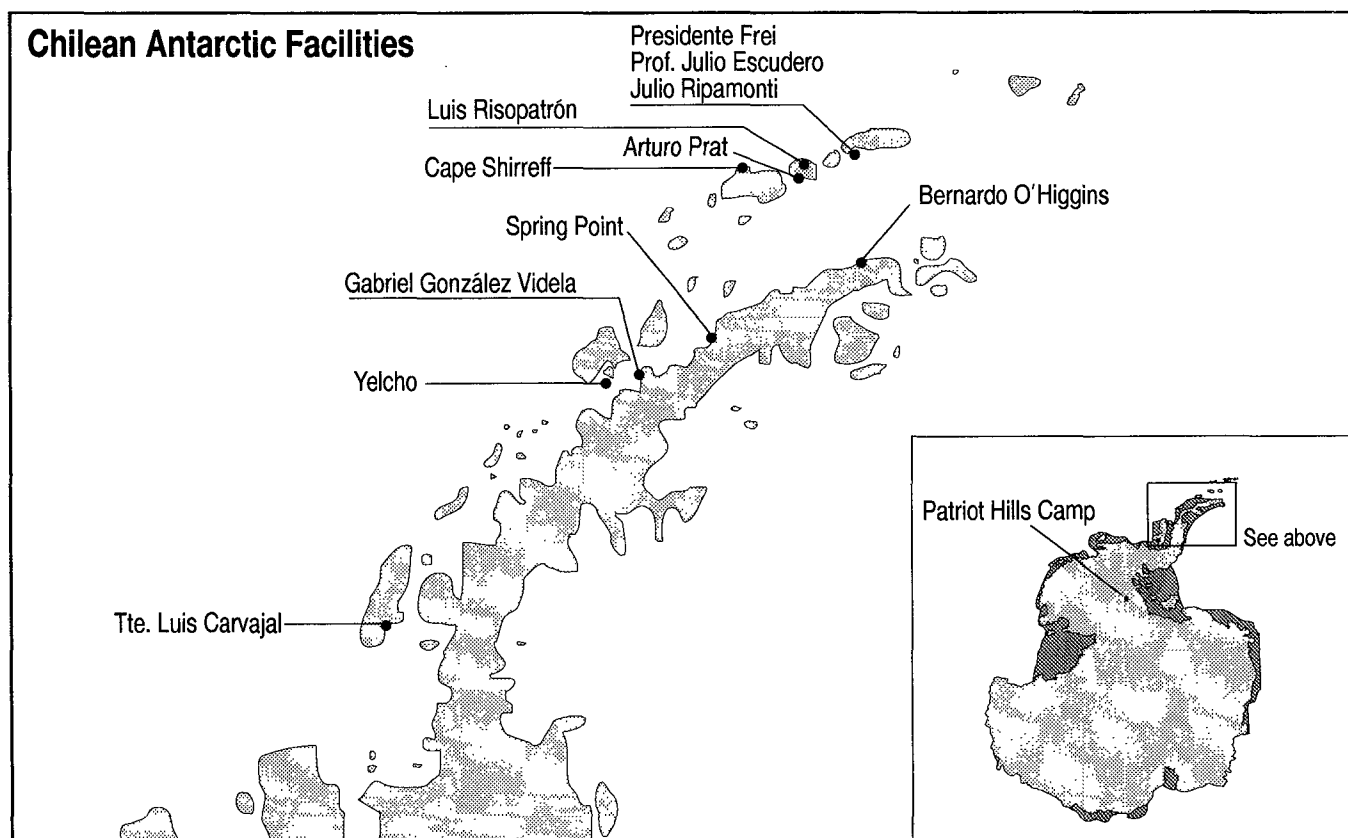


Fig. 1. Chilean Antarctic facilities.

## Project Selection

Any Chilean scientists wishing to participate in the annual scientific expeditions to Antarctica, submit their research projects for consideration to the National Contest of Scientific and Technological Investigation in Antarctica, organized by INACH. As a bare minimum, all these projects must be compatible with the national interests in the region, conform to national legislation, and obey the norms of the Antarctic Treaty System. The submissions are grouped into the categories of Earth, Oceanic, Atmospheric, Biological and Social Sciences, and Engineering and Technology. All the projects are evaluated scientifically by 3 specialists from the relevant discipline. Due to the limitations of accessibility, all projects are also critically examined with respect to their logistics and operative feasibility.

All projects are further categorized into 3 groups:

*Projects covered by institutional agreements.* Either local between different Chilean institutions, or bilateral agreements with foreign institutions

*Monitoring projects.* Typically related to gathering information on a long term basis as part of the commitments made with international scientific organizations

*Competing projects.* Those projects which are supported by INACH as a result of the annual selection process can have a maximum duration of 3 years, after that time they must resubmit for further consideration.

## 1997-1998 Chilean Research Program

For the season 1997-1998, 16 projects are being supported, some of which involve field work, and others only with laboratory activities.

### *Projects Covered by Institutional Agreements*

- Cartography and Geographical Information System (GIS) of the South Shetland Islands
- Implementation and operation of the scientific marine Antarctic station Arturo Prat

- Glaciological studies at Patriot Hills
- Geodynamic evolution of volcanic processes in the Bransfield and Gustavo Prince rifts, and their relationship with the Southern region
- Telemedicine in Antarctica

### *Monitoring Projects*

- Ecological studies of the Antarctic fur seal, *Arctocephalus gazella*
- Monitoring and the ecology of three species of penguins in the South Shetland Islands
- Neutrons Monitor MN-64 for the Chilean Antarctic Territory

### *Under Development (Three Years of Duration)*

- Reproductive ecology of bryozoa in Antarctica
- Bases for a global evaluation model of the chemical changes in the Fildes Peninsula atmosphere, King George Island
- Paleoflora of the Meso-Cenozoic on the South Shetland Island, Antarctica
- Low degree Metamorphism of and volcanism of the Meso-Cenozoic volcanic rocks of the Robert and Livingston Islands, South Shetland Islands
- The recent Antarctic foraminifera and their link with South American microfauna
- Quantitative Evaluation of the P-T-t trajectories of metamorphosis in the Metamorphic Complex of Scotia, and South Shetland, Antarctica
- Tectonics of the Southern end of South America and the Antarctic Peninsula
- Convergence and divergence of the Chilean and North American conduct and actions with respect to Antarctic matters and in the Southern marine spaces between 1939 and 1949

## Five Year Plan for Scientific and Technological Research in Antarctica

The great diversity of interest, together with a limited budget has forced INACH to look for ways to optimize the work to be done in Antarctica. This necessarily required that scientific investigation had to be orientated toward areas that demonstrated a

clear national convenience, or where there were comparative logistical advantages. Toward this end, INACH organized an Antarctic Seminar in which scientists involved in Antarctic activities were invited to participate in the formulation of a 5 Year Plan for Scientific and Technological Investigation in Antarctica. The plan that was developed fixed the following priority areas for study over the next 5 years:

#### *Earth Sciences*

- Geology: This study focuses on the area in and around Patriot Hill on the 80th parallel, important with respect to the construction of the Gondwana base, and also from a geopolitical point of view.
- Glaciology: Despite of the importance of this science in Antarctica, in Chile there is very little development in this area.
- Paleontology: The study of macro and micro plants, which would lead to the reconstruction of paleoclimate and Paleo environments
- Geodesy and Cartography: Cartographic study of the South Shetland Islands

#### *Marine Sciences*

- Dynamics of the marine ecosystem and its resources, e.g. fishery studies, handling of the Antarctic resources, population ecology of krill and predators
- Adaptation of organisms to the Antarctic winter
- Oceanography of the Bellingshausen Sea

#### *Biological Sciences*

- Ecology of different animal species, reproduction, feeding, etc.
- Ecology of animal populations, feeding, reproduction, distribution, abundance of birds and marine mammals
- Ecology of terrestrial inland water ecosystem, e.g. nutrient cycles, organic matter, etc.
- Environmental studies, e.g. ecotoxicology, environmental impact, marine debris

#### *Space and Atmospheric Sciences*

- Physics and chemistry of the upper atmosphere

#### *Social Sciences*

- Sailing in adjacent waters, human settlements, studies of the Antarctic Treaty System

#### *Human Biology and Medicine*

- Antarctica constitutes an important laboratory by virtue of its isolation, photoperiod and low temperatures.

### **Projects Carried Out under International Agreements**

#### *International Cooperation*

Antarctica is very interesting place for scientists, they can study aspects those are unique to this place. Apart from a scientific point of view, many countries are interested in supporting scientific research in Antarctica due to the significance of maintaining an active presence in Antarctica, sometimes resulting in projects approaching what can be considered as a duplication of effort in some region. International Organizations like SCAR or COMNAP have played an important role in order to coordinate the scientific work, share experiences and collaborate directly on projects.

Another important consideration is related to budgets. There is little possibility that individual budgets will be increased, despite the fact that the cost of logistics and scientific instruments are ever increasing. This situation is leading Antarctic member countries toward the sharing of costs. It will lead to a decrease in national facilities and an increase in internationally cooperative activity. Chile, is very interested in fomenting international collaboration on Antarctic research, especially in the form of significant partnerships with other nations, or in terms of formal international research programs. Some examples of projects of this types are:

#### *Paleobotanic Studies on South Shetland Island*

This project has been underway for more than 10 years, the main objective is to characterize the flora and interpret paleoclimatic, paleoecologic and pale-

ogeographic conditions in Antarctica. This project is being developed under an agreement between INACH, the Universidad de Chile and the University Claud Bernard of Lyon, France.

***Geodynamic Evolution of Volcanic Processes in the Bransfield and Gustavo Prince Rifts, and Their Relationship with the Southern Region***

This is a new international project between INACH, Universidad de Chile and the University of Pisa, Italy. The main objective is to create a geodynamic model and evaluate the volcanic process of the Antarctic Peninsula, and its relationship with the southern part of South America.

***Cooperative Investigations on Seabirds and Pinnipeds at Cape Shirreff, Livingston Island, Antarctica***

This project is a cooperative effort between INACH and the U.S. Antarctic Marine Living Resources Program (AMLR). The main objective is to provide scientific information needed to detect, monitor, and predict the effects of harvesting and associated activities on target, dependent, and related species and populations of the Antarctic marine living resources and the ecosystem of which they are part.

***Telemedicine in Antarctica***

This is a project between INACH, Universidad de Chile, and the National Research Center (CNR) of Rome, Italy. The main objective is to improve medical services and medical education in Antarctica via the application of telemetric systems for health care.

***Tectonics of the Southern End of South America and Antarctica Peninsula***

This is a cooperative project between INACH, the Universidad de Chile and the Washington University, St. Louis, U.S.A. The study is questioning whether there is subduction in South Shetland Trench.

***O'Higgins Satellite Station***

One of the main international projects that Chile is supporting in Antarctica is related to the establish-

ment of a German-Chilean Antarctic Satellite Station. After careful evaluation it was decided that the best place to locate the ERS/VLBI Station was close to the O'Higgins Base on the Antarctic Peninsula. The station receives information from a series of ERS satellites, especially useful in Antarctica where this active satellite uses an advanced microwave technique which permits imaging to take place and measurements to be made, irrespective of cloud or sunlight conditions.

This station was built on the Antarctic Peninsula by Germany with the logistic support of Chile, accordance with bilateral agreement. The construction of the station was financed by Germany, who is responsible for the installation and operation of the antenna. The Chilean counterparts coordinate logistical support, including transportation, water supply, etc. Chile is also responsible for promoting an active participation of universities and research institutions. The Germans will operate the Station for 10 years period during which the Chilean partners will have free access to the data. Once the first stage of the project will be finished (after 10 years), the satellite station, its equipment and installations will be handed over to Chile, with the commitment that thereafter German scientists will have free access to the data.

This station is a part of an important network of installations that currently cover nearly the whole Antarctica, gathering interesting information about this continent in the areas of geology, cartography, climatology, oceanography, glaciology, and others.

We believe that the use of remote sensing technique such as this is of vital importance to Antarctica, both from the scientific and operative point of view. Apart from providing information over a vast area, this technique is especially useful for studying areas where due to their location or inclement weather conditions, it is very difficult or dangerous to conduct field work.

Chilean scientists can make use of the information generated by INACH, and receive support for their research work, providing their scientific projects are deemed worthy by the selection panel, and under the condition that their investigations have no eco-

conomic benefits. INACH and the Chilean Antarctic research community in general, are always eager to work closely with our international counterparts in the pursuit of common goals in this important area of scientific research in Antarctica.

***Globesar 2 Project: Classification and Monitoring of the Sea Ice (pack-ice) Dynamics using SAR Images of the RADARSAT Satellite in the Southern Ocean, Antarctica***

This is a joint project between Chile, represented by the Chilean Antarctic Institute (INACH) and the Chilean Hydrographic and Oceanographic Service, and from Canada, the Globesar 2 organizer, CCRS (Canadian Centre for Remote Sensing), CIDA (Canadian International Development Agency) and IDRC (International Development Research Centre). The main objective is to study the physical characteristics, dynamics and distribution of the sea ice (pack-ice) using Radar images. The study also considers field work during a 3 year period, where sea-ice samples will be taken and correlated with images from the RADARSAR satellite.

***Monitoring of the Dynamic Processes in Antarctic Geosystems (MODPAG)***

This research project is a international effort directed to get information on Antarctic geosystems using data that comes from the satellites ERS-1 and ERS-2.

**Antarctic Scientific Data Information System (SIDCA)**

In 1993, Chile initiated a project to form the

National Center of Antarctic Data with the objective of creating a integrated database of scientific, legal, logistical and environmental information related to the activities that Chile developed in Antarctica. In this regard, Chile has created the Antarctic Scientific Data Information System (SIDCA), and is one of the participating countries in the SCAR-COMNAP Joint Committee on Antarctic Data Management.

SIDCA has been structured to store and integrate the information from the projects that INACH sponsors and develops. Other important objectives are:

- Fulfill the agreements reached in the Antarctic Treaty System regarding the exchange of information between the Antarctic member countries.
- Provide the national scientific community a platform by which the they can access scientific data.
- Improve the scientific administration of the Antarctic projects that INACH carries out.
- Diminish the technological breach that exists between Chile and other countries with Antarctic interests that have invested in the development of specialized data centers.
- Allows the remote access to the stored information through Internet

By attaining these objectives, Chile will be a leader in Latin America in the area of scientific data collection and significantly shorten the technological gap that exists with the more developed countries, such as the United States, the United Kingdom and New Zealand.

*Received 20 September 1997*

*Accepted 20 November 1997*