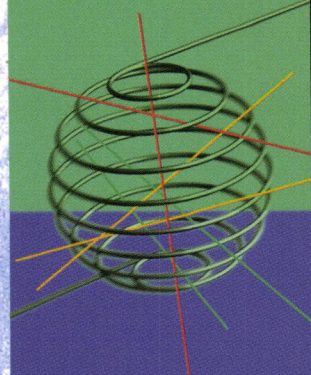


**BELGIAN
SCIENTIFIC
RESEARCH
PROGRAMME
ON THE ANTARCTIC**

PHASE 4 1997/2000



SCIENTIFIC SUPPORT PLAN FOR A SUSTAINABLE DEVELOPMENT POLICY



Introduction

The Antarctic Treaty concluded in Washington in 1959 is the crystallization of a unique international consensus on the peaceful use of this vast area on our planet⁽¹⁾. Its principles are demilitarization, the ban on nuclear tests and on the disposal of radioactive waste material – the respect of which is guaranteed by a system of mutual inspection – and the promotion of international scientific cooperation. The approval in 1991 of the “Protocol on Environmental Protection to the Antarctic Treaty” (Madrid Protocol), turned the area into a natural reserve dedicated to peace and science. The Protocol prohibits any non-scientific activity relating to mineral resources and otherwise, makes provision for the realization of environmental evaluations to be based upon scientific evidences. Belgium has played an active role in the negotiations on this Protocol, thus acting in full line with its role of founder member of the Treaty.

The conduct of scientific activities remains the corner stone of the well functioning of the Antarctic Treaty System⁽²⁾. It is the condition for access to the decision-making process within such System and also to the full execution thereof.

Scientific research provides the terms of reference to the Antarctic Treaty System so as to pursue a policy of protection and rational management of the environment. On the other hand, the Antarctic provides unique opportunities to address some scientific issues most important to the understanding of the global dynamics of the Earth system – such as the dynamics of the global climate, the fluctuations in ocean level, the formation of oceanic deep waters or the evolution of continental margins.

In 1985, the Government took the initiative to organize a structured action of scientific research on the Antarctic with the will to insert it in a visible way in the concerns which are those of any founder member of the aforesaid treaty. It was the first time that Belgium established a national multi-annual programme specifically devoted to the Antarctic. Two subsequent phases of the Programme were implemented over the 1988-1996 period.

Belgium's involvement in Antarctic research is currently covered by the Fourth Phase of the Programme (1997-2000) which was launched under the federal “Scientific Support Plan for a Sustainable Development Policy”.

Although sustainable development as such is not mentioned explicitly in the objectives nor in the strategy of the Antarctic Treaty System, the underlying concept appears to be fully in line with the System's preoccupations. This is clear from the battery of measures and actions from such System, to the effect of preserving the fauna and flora, creating protected areas, preventing marine pollution, eliminating waste material or protecting indigenous species. Being declared a natural reserve where human activity is severely controlled by the Madrid Protocol, the Antarctic presents itself as the model site where the sustainable development concept can be realized on a large scale.

⁽¹⁾ The Antarctic Treaty applies to the entire area south of the 60° south parallel. Such area includes the southern sectors of the Atlantic, Pacific and Indian oceans, constituting a hydrographical entity called the Southern Ocean.

⁽²⁾ The Antarctic Treaty System is the whole complex of arrangements, including the Treaty itself, made for regulating relations amongst Parties, e.g. the *Madrid Protocol*, the *Convention for the Conservation of Antarctic Marine Living Resources* and the *Convention for the Conservation of Antarctic Seals*.



Overall objectives

- Allow Belgium to maintain its position within the group of countries willing to develop a research effort in accordance with the spirit of the Antarctic Treaty System.
- To contribute to the advancement of scientific knowledge in the light of the needs related to the protection of the Antarctic and its associated ecosystems and to the assessment of the role of the Antarctic in the evolution of the global climate.
- To ensure an operational interface with the Antarctic Treaty System for matters of scientific or technical nature, or needing such kind of developments.

Implementation

A call for research proposals, open to all Belgian institutions likely to be in a position to present proposals, was issued in July 1996. Proposals were selected on the grounds of a scientific assessment carried out by foreign experts in accordance with the peer review method.

Research-work is implemented by means of four-years projects undertaken by teams of university- or federal scientific institute-based scientists. Emphasis is given on a multi-disciplinary approach of the dynamics of the global functioning of Antarctic main natural systems and of their evolution and interactions. Research topic and priorities are in full line with major international projects and programmes such as ANTOSTRAT, EASIZ, EPICA, GLOBEC, IGBP, ODP and SO-JGOFS.

Field activities are embedded in scientific expeditions organized by other Antarctic Treaty parties.

All research costs (personnel, equipment, travel, working and overheads) are financed by the Federal Office for Scientific, Technical and Cultural Affairs (OSTC).

The overall budget of this new phase amounts to 235 MBEF (about 6 MEURO). In addition the OSTC contributes a sum of 20 MBEF (about 0.5 MEURO) to the operational costs of the European Project for Ice Coring in Antarctica (EPICA).

Funding, management, coordination and diffusion of the Programme are in the hands of the OSTC. Scientific liaison with the Antarctic Treaty System is also the responsibility of the OSTC.

An Antarctic Support Committee, with advisory status, is empowered to formulate opinions on the progress made in the course of the Programme and to put forward any suggestions on the measures that it considers should be taken to attain more efficiently its objectives. It is composed by representatives of the following entities:

- Federal Authority:
 - Agriculture
 - Foreign Affairs (also national contact point)
 - OSTC (also national contact point)
 - Public Health and the Environment
- Flemish Community
- Walloon Region

RESEARCH TOPICS

The Programme is organized within seven research lines under three areas. They are:

Marine biota and global change

- Structure, functioning and resilience of key ecosystems
- Ecofunctional biodiversity
- Biogeochemical cycle of carbon and global changes

Dynamics of the southern ocean

- General circulation in relation to the formation of deep waters
- Dynamics of the marginal sea ice zone

Palaeoenvironmental records

- Ice cap (EPICA)
- Marine sediments



Structure, functioning and resilience of key ecosystems

Ecofunctional biodiversity

Biogeochemical cycle of carbon and global change

Structure, functioning and resilience of key ecosystems

- Integrated studies of the biogeochemical, ecological and physical mechanisms responsible for biological production and its fate, and their development as a consequence of global change.
- Development and application of ecodynamical / physical coupled mathematical models (biogeochemical cycles C, N, Si, P, S + ecology/ocean-ice-atmosphere interactions) in order to:
- determine the resilience of the ecosystems in function of the environmental conditions;
- simulate the evolution of ecosystem dynamics under the influence of modifications of the global conditions, and basically those related to the climate.

Ecofunctional biodiversity

- Identification and description of the mechanisms linking production and biodiversity in key ecosystems of the Southern Ocean.
- Evaluation of the role of biodiversity in the resilience of marine ecosystems of the Antarctic with respect to global changes.
- Analysis of the importance of trophodynamics in biodiversity, more in particular in the benthos, with respect to the interactions between the transience of nutrient availability and the physical forcing.
- Development of innovative taxonomical, genetic and molecular tools and methods for the characterization of the biodiversity of the polar marine biota, and more in particular, of the cryptic biodiversity and the biodiversity of the cosmopolitan species (bacteria, picoplankton, etc).

Biogeochemical cycle of carbon and global changes

- Mathematical modelling of the paths, the mechanisms and the fluxes of carbon circulation and exportation all along the key compartments of the trophic web and their response to the physical and chemical forcing (ecodynamical/physical coupled models) so as to determine, on the appropriate time and space scales, the role of the major subsystems of the Southern Ocean in the sequestration of CO₂, taking into account phenomena such as:
- the respective role of nutrients (micro-nutrients, such as Fe and Mn, and nitrogenous nutrients), the ocean-ice-atmosphere interactions and the composition of plankton assemblages on the rate, the variability and the fate of primary production;
- the respective importance of recycling and transfer of organic matter typical of each of the different sub-systems of the Southern Ocean in the global balance of carbon fluxes;
- the respective role of the dissolved (microbial loop) and particulate phase in the balance of carbon fluxes.
- Quantitative evaluation of the balance of dissolved and particulate carbon fluxes, at benthos level and with respect to the sequestration of CO₂.

General circulation in relation to the formation of deep waters

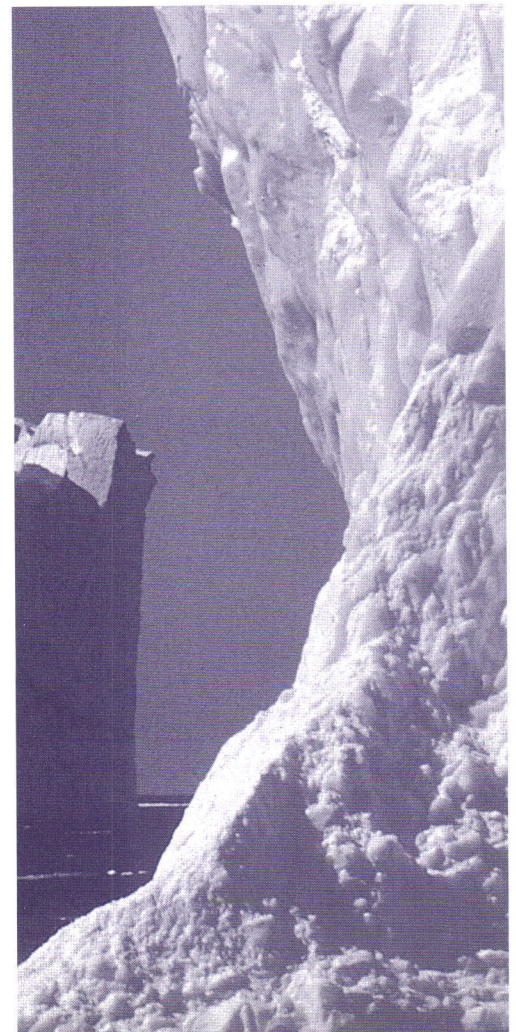
Dynamics of the marginal sea ice zone

General circulation in relation to the formation of deep waters

- Development and application of high resolution 3D primitive equation models of regional circulation for a better understanding of the formation and spreading of deep waters, in the light of the following phenomena:
 - the ocean-ice-atmosphere interactions, and more in particular the effects of salt rejection due to the melting of sea ice, and the rheology of ice;
 - the interactions between the ocean and the continental platform (effect of the relief on vertical transport).
- Validation and calibration of the models for concrete cases, such as those found in the Weddell Sea.
- Elaboration of algorithms for the processing of satellite images, so as to:
 - calibrate and validate such models;
 - better parameterize the physical phenomena that are important for the study of deep waters;
 - obtain more realistic boundary conditions.

Dynamics of the marginal sea ice zone

- Elaboration of vertical circulation models covering the full annual cycle of ice-ocean-atmosphere interactions, particularly taking into account: the alteration of the physical and chemical features of sea ice as a result of biota activity, leads formation and sub-glacial topography.
- Extension of the models to horizontal dimensions; adaptation of the models in view of the coupling with biogeochemical models of carbon, nitrogen, phosphorus and silicon circulation.



Ice Cap (EPICA)

- Study of the dynamics of the basal ice expected from the EPICA drilling, so as to determine the boundary conditions (glacier/bedrock) having an impact on the dynamics of the ice cap basis.

Ice Cap (EPICA)

Marine sediments

- Analysis of the flow mechanisms of the ice cap and the drainage glaciers, combining site measurements, satellite images and mathematical modelling in view of reconstructing the dynamic response of Antarctica to the climate signals.
- Modelling atmosphere/ice cap transfer functions, such as the accumulation and the ablation of snow and ice, so as to determine the forcing for regional ice cap flow models.

Marine sediments

- Very high-resolution geophysical studies of the structure and the genesis of sedimentary deposits nearby the ice cap (more in particular, in the sectors of the continental shelf with a high rate of preservation, on the slopes and in the peri-antarctic basins), in order to decipher what is recorded from the dynamics of the ice cap in response to the climate variations of the Quaternary.
- Development of new technological approaches and innovative methods of analysis in geophysics, applied to the study of sedimentary palaeoclimatic records.



Marine biota and global change

MEIOBENTHIC BIODIVERSITY
AND FLUXES WITHIN THE
ANTARCTIC BIOGEOCHEMICAL
ENVIRONMENT

Prof. M. Vincx (RUG)

ECOFUNCTIONAL BIODIVERSITY
OF BENTHIC CRUSTACEAN
TAXOCOENOSES IN THE
SOUTHERN OCEAN

Dr Cl. De Broyer (RINS)

AN INTEGRATED APPROACH
TO ASSESS CARBON DYNAMICS
IN THE SOUTHERN OCEAN
Coordinator: Dr F. Dehairs

Dr F. Dehairs (VUB)
Dr Ch. Lancelot (ULB)
Prof. L. André (RMCA)
Dr M. Frankignoulle (ULg)
Dr E. Deleersnijder (UCL)

New and export production
Study and modellisation of the planktonic system
Barite geochemistry
Air/sea exchanges
1D modelling of the sea-ice and water column

RESPONSE OF THE SOUTHERN
OCEAN GLOBAL ECOSYSTEM
TO PHYSICAL AND TROPHIC
CONSTRAINTS
Coordinator: Dr J.-H. Hecq

Dr J.-H. Hecq (ULg)
Dr G. Pichot (MUMM)
Prof. V. Demoulin (ULg)

Ecosystem functioning and modelling
Physical modelling
Role of the picophytoplankton

Dynamics of the southern ocean

STUDY OF CONVECTIVE
MOVEMENTS IN THE
SOUTHERN OCEAN

Dr G. Pichot (MUMM)

Palaeoenvironmental records

MASS BALANCE OF THE
ANTARCTIC ICE CAP (A
CONTRIBUTION TO EPICA)

Prof. A. Berger and
Dr H. Gallée (UCL)

EPICA BASAL ICE - EASTERN
ANTARCTICA

Prof. R. Souchez (ULB)

DYNAMICS OF THE ANTARCTIC
ICE CAP AND CLIMATE CHANGES
(A CONTRIBUTION TO EPICA)

Prof. H. Decleir (VUB)

ANTARCTIC SHELF-SLOPE
DYNAMICS: AN INNOVATIVE
GEOPHYSICAL APPROACH

Prof. M. De Batist and
Dr J.-P. Henriët (RUG)

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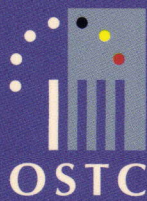
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