International Polar Year • Nederland

# Status report
# IPY in The Netherlands

*1 September 2006*
*for*
*IPY International Project Office*

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**Contact**

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## 1.1 Budget and finances

**National Programme budget**

The total budget of the Netherlands IPY Programme is 7 million euro.

**National Programme sponsors**

- Dutch Ministry of Education, Culture and Science (OCW)
- Dutch Ministry of Agriculture, Nature and Food Quality (LNV) [*]*
- Dutch Ministry of Transport, Public Works and Water Management (VenW)*
- Dutch Ministry of Housing, Spatial Planning and the Environment (VROM)*
- Dutch Ministry of Foreign Affairs (BuZa)*
- Netherlands Organisation for Scientific Research - Division for Earth and Life Sciences (NWO-ALW)*

**Allocation of National Programme budget**

- **National IPY research projects** ~ 5 million euro (70% of total of the total IPY programme budget) for funding of national IPY research projects
- **Education, Outreach and Communication** ~ 0,7 million euro (10% of total budget), is for activities in the field of Education, Outreach and Communication to bring the polar regions and polar research under the attention of the general public, schoolchildren and policy makers in The Netherlands. This will be done in cooperation with museums and various other external partners.
- **Logistics** ~ 0,5 million euro (7% of total budget) for cooperation with other countries and support of logistics and infrastructural activities in IPY
- **Data Management** ~ 0,12 million euro (2.4 % of the budget for the national research projects) is for Data Management for these research projects.
- Other posts include costs for the coordination by the NWO office (6%), costs related to international activities (i.e. travel to attend, IPY Trust Fund, EPB) (2,5%) and the use of external assignments (4%).

**Timeframe Netherlands IPY Programme**

2006-2010

[*] Also sponsors of the regular Netherlands Polar Programme

## 1.2 Organisation

National IPY committees coordinate the participation and support on a national level. The organisation in the Netherlands consists of a:

- Netherlands IPY Committee
- Committee of Recommendation
- Advisory group on Education, Outreach and Communication

The initiatives for the installation of a Netherlands IPY committee are supported by the Netherlands Organisation for Scientific Research (NWO) and the Royal Netherlands Academy of Science (KNAW). The KNAW is a member of ICSU for the Netherlands and manages the national Scientific Committee on Antarctic Research (SCAR).

**Netherlands IPY committee (August 2006)**

Co-Chair

- Dr. Han Lindeboom
  chair Polar Research Committee - Netherlands Polar Programme
  IMARES-Texel, Wageningen UR and Royal Netherlands Institute for Sea Research (NIOZ)
- Dr. Ad Huiskes
  chair Netherlands SCAR committee
  Netherlands Institute of Ecology (NIOO-KNAW)

Core Members

- Prof. dr. Louwrens Hacquebord
  member of IASC ExCom and member ICSU Planning Group for IPY
  University of Groningen - Arctic Centre
- Dr. Peter van Velthoven
  Royal Netherlands Meteorological Institute (KNMI)
- Drs. Monique de Vries
  chair Steering Committee - Netherlands Polar Programme
  Hoogheemraadschap, Noorderkwartier
- Prof. dr. Jan Stel
  Manager Netherlands Polar Programme (NPP), NWO - Earth- and Life Sciences
  Manager of EPB ExCom and COMNAP
  Maastricht University - International Centre for Integrative Studies (ICIS)

Secretariat

- Dr. Marianne Walgreen
  NWO - Earth- and Life Sciences

## 1.3 Research projects

Researchers from The Netherlands have successfully submitted many research plans with the international ICSU-WMO IPY Joint Committee. Number of plans submitted that include a contribution from Dutch scientist (and reported to Netherlands IPY Committee):

| | Expressions of Intent | Full proposals | Full proposals | Full proposals | Full proposals |
|---|---|---|---|---|---|
| *Deadline* | *14 Jan 2005* | *all* | *30 June 2005* | *30 Sept 2005* | *31 Jan 2006* |
| Total number of proposals NL | 36 | 32 | 17 | 13 | 2 |
| Arctic | 17 | 15 | 10 | 4 | 1 |
| Bipolar | 8 | 9 | 6 | 3 | 0 |
| Antarctic | 10 | 6 | 1 | 5 | 0 |
| Education | 1 | 2 | 0 | 1 | 1 |
| Lead contact from NL | 16 | 9* | 5 | 2 | 2 |
| Potential lead project | 9 | NA | NA | NA | NA |
| IPY endorsement | NA | 29 | 17 | 12 | 0 |

* 7 full proposals with lead country have received full endorsement and 2 finally joint a full proposal leaded by another country.

**Selection and funding of national research projects**

To select the research projects for national funding, the Dutch research Council (NWO) launched outside its regular calls for Polar tesearch, a special call dedicated to research in the IPY framework in January 2006. The funding decisions were announced mid June 2006.

46 projects were submitted (requesting a total budget of about 15 million euros), of which 17 were selected for funding (37%). All funded projects contribute to an international IPY Full proposal endorsed by the international ICSU-WMO Joint Committee. Before March 2007 - the start of IPY - 9 PhD students (4 years) and 6 Postdocs (3 years) will start their research within these IPY projects. Also 6 projects for the coordination of linked projects were selected. Also, all applicants were asked to include a plan for EOC activities in relation to the project proposal.

**National research themes**

The research plans for IPY in The Netherlands focus on four main themes:

1. Changes in the cryoshere due to climate change
2. Changes in the Southern and Arctic ocean
3. Polar terrestrial and coastal ecosystems and global change
4. Influence of human activities on polar regions, and influence of climate change on humans

**Awarded IPY•NL research projects**

Number of awarded projects (excluding coordinating projects):

| | Arctic | Bipolar | Antarctic | *Total* |
|---|---|---|---|---|
| IPY•NL Theme 1 | 3 | 0 | 1 | *4* |
| IPY•NL Theme 2 | 2 | 3 | 0 | *5* |
| IPY•NL Theme 3 | 5 | 1 | 0 | *6* |
| IPY•NL Theme 4 | 1 | 1 | 0 | *2* |
| *Total* | *11* | *5* | *1* | *17* |

| **Awarded projects in International Polar Year • Nederland (IPY•NL) Programme - 2006** | | | | | | |
|---|---|---|---|---|---|---|
| **Project title** | **Name main applicant** | **M /F** | **Organisation *** | **Type of project** | **geographical focus** | **IPY Full proposal** |
| | | | | | | |
| **IPY.NL theme 1: Changes in the cryoshere due to climate change** | | | | | | |
| Meltwater input, flow and calving of Arctic glaciers [1] | Dr. C.H. Tijm-Reijmer | F | UU-IMAU | PhD + assistant | Arctic | 37, 117, 118 |
| Regional modelling of Greenland surface mass balance for key episodes in the past and future [1] | Dr. M.R. van den Broeke | M | UU-IMAU | Postdoc | Arctic | 37, 117, 118 |
| Automatic weather stations in interior East Antarctica | Dr. M.R. van den Broeke | M | UU-IMAU | no personnel | Antarctic | 152 |
| Sediment Supply to the Arctic coastal zone | Dr. ir. I. Overeem | F | TUD | PhD | Arctic | 90 (via 148) |
| [1] part of coordinating project "Arctic glaciers, climate and sea level change" | Prof. dr. J. Oerlemans | M | UU-IMAU | coordinating | Arctic | 37, 117, 118 |
| **IPY.NL theme 2: Changes in the Southern and Arctic ocean** | | | | | | |
| The significance of viruses for polar marine ecosystem functioning (VIRPOL) | Dr. C.P.D. Brussaard | F | NIOZ | PhD | Bipolar | 71 |
| Pelagic Archaea in the changing coastal Arctic (PACCA) [2] | Prof. dr. G.J. Herndl | M | NIOZ | Postdoc | Arctic | 71 |
| Consequences of climate change for Arctic marine pelagic microbial communities (CAMP) [2] | Dr. A.G.J. Buma | F | RUG-CEES | Postdoc | Arctic | 71 |
| Dissolved Aluminium and Manganese as Source Tracers for Iron in Polar Oceans [3] | Prof. dr. ir. H.J.W. de Baar | M | NIOZ | PhD | bipolar | 35 |
| Physical and Chemical Speciation of Dissolved Fe in the Polar Oceans [3] | Dr. L.J.A. Gerringa | F | NIOZ | PhD | bipolar | 35 |
| [2] part of coordinating project "Consequences of climate change for Arctic marine pelagic microbial communities" | Dr. A.G.J. Buma | F | RUG-CEES | coordinating | Arctic | 71 |
| [3] part of coordinating project "IPY-NL-GEOTRACES: Netherlands Contribution to an International Study of the Biogeochemical Cycles of Trace Elements and Isotopes in the Arctic and Southern Oceans" | Prof. dr. ir. H.J.W. de Baar | M | NIOZ | coordinating | bipolar | 35 |

| IPY.NL theme 3: Polar terrestrial and coastal ecosystems and global change | | | | | | |
|---|---|---|---|---|---|---|
| How trait spectra of bryophytes, vascular plants and soil invertebrates interact to control carbon turnover in arctic tundra: mechanisms underlying climate change impacts | Dr. J.H.C. Cornelissen | M | VU-ALW | PhD | Arctic | 213 |
| Long-lived evergreen shrubs from polar ecosystems as monitors of present and past climate change:reconstruction of annual polar temperature and Arctic Oscillation phase changes with a new climate multiproxy (wintermark T, 18O and 2H in plant segments) [4] | Prof. dr. J. Rozema | M | VU-ALW | Postdoc + assistant | bipolar | 59 |
| Geographical and temporal variation in health issues in Arctic breeding birds [5] | Dr. M.J.J.E. Loonen | M | RUG-AC | Postdoc + assistant | Arctic | 172 |
| Contrasting breeding investments in a small arctic shorebird: trade-off between breeding effort and fighting disease? [5] | Prof. dr. Th. Piersma | M | NIOZ | Postdoc | Arctic | 172 |
| Arctic breeding waterfowl as vectors for avian influenza viruses [5] | Dr. M.R.J. Klaassen | M | NIOO | PhD | Arctic | 172 |
| Combining behaviour-based and epidemiological models to identify the role of Arctic breeding migratory birds in the ecology of diseases, notably Avian Influenza [5] | Prof. dr. J.A.P. Heesterbeek | M | UU | Postdoc | Arctic | 172 |
| [4] part of coordinating project "Effects of global warming on ecosystem functioning in Polar habitats. The Dutch involvement in the TARANTELLA project" | Dr. A.H.L. Huiskes | M | NIOO | coordinating | Bipolar | 59 |
| [5] part of coordinating project "BIRDHEALTH Health of Arctic and Antarctic bird populations" | Dr. M.J.J.E. Loonen | M | RUG-AC | coordinating | Bipolar | 172 |
| | | | | | | |
| **IPY.NL theme 4: Influence of human activities on polar regions, and influence of climate change on humans** | | | | | | |
| Green Harbour, Spitsbergen, and the international history of exploitation of the polar areas [6] | Prof. dr. L. Hacquebord | M | RUG-AC | Postdoc + assistant | Bipolar | 10 |
| The coal exploitation of the Dutch Spitsbergen Coal Company (NESPICO) in Green Harbour, Spitsbergen, in its national and international context [6] | Prof. dr. L. Hacquebord | M | RUG-AC | PhD | Arctic | 10 |
| [6] part of coordinating project "LASHIPA-NL: The exploitation of the natural resources in Polar Regions, 1600-2000" | Prof. dr. L. Hacquebord | M | RUG-AC | coordinating | Arctic | 10 |

The abstracts of the awarded IPY.NL projects are included in Annex 1.

The **funded projects** contribute to 11 different international IPY Activities / Full Proposals; The Netherlands is the lead country in 5 of these activities. These are:

| IPY Planning Chart | | ID No | Short Title | Full Title | lead country |
|---|---|---|---|---|---|
| Arctic | land | 90 | ACCO-Net | Arctic Circum-Polar Coastal Observatory Network | Germany |
| Arctic | land | 213 | ENVISNAR | Environmental baselines, processes, changes and Impacts on people in sub-arctic Sweden and the Nordic Arctic Regions | Sweden |
| Arctic | ice | 37 | GLACIODYN | The dynamic response of Arctic glaciers to global warming | Netherlands |
| Arctic | ice | 118 | Greenland Ice Sheet | The Greenland Ice Sheet – Stability, History and Evolution | Denmark |
| bipolar | land | 59 | TARANTELLA | Terrestrial ecosystems in ARctic and ANTarctic: Effects of UV Light, Liquefying ice, and Ascending temperatures | Netherlands |
| bipolar | land | 172 | BIRDHEALTH | Health of Arctic and Antarctic bird populations | Netherlands |
| bipolar | people | 10 | LASHIPA | Large Scale Historical Industrial Exploitation of Polar Areas | Netherlands |
| bipolar | ocean | 35 | IPY-GEOTRACES | International Polar Year GEOTRACES: An international study of the biogeochemical cycles of Trace Elements and Isotopes in the Arctic and Southern Oceans | Netherlands |
| bipolar | ocean | 71 | PAME | Polar Aquatic Microbial Ecology | Norway |
| bipolar | ice | 117 | IPICS-IPY | International Partnerships in Ice Core Science (IPICS)-International Polar Year Initiative | USA |
| Antarctic | ice | 152 | TASTE-IDEA | Trans-Antarctic Scientific Traverses Expeditions – Ice Divide of East Antarctica | Germany |

**No funding** was available in the dedicated IPY•NL subsidy round for the research projects contributing to the following IPY Full proposals where The Netherlands is the lead country:

| IPY Planning Chart | | ID No | Short Title | Full Title | lead country |
|---|---|---|---|---|---|
| Arctic | Ice | 120 | NORCLIM | Northern High Latitude Climate variability during the past 2000 years: implications for human settlement | The Netherlands* |
| Bipolar | Atmosphere | 175 | COPOL | Fate, uptake and effects of contaminants in the Arctic and Antarctic ecosystem (COntaminants in POLar regions) | The Netherlands** |

* Although no funding could be granted in the IPY•NL subsidy round for the research project under NORCLIM, a small financial contribution was recently granted for the coordination costs of NORCLIM. This will allow Dr. S.R. Troelstra (Vrije Universiteit Amsterdam -FALW) to continue his role as coordinator of the international NORCLIM consortium. Ongoing research projects by other financial sources will secure the research input in NORCLIM by The Netherlands.

** Due to a lack of funding for research projects under COPOL at the moment, The Netherlands (by lead contact Dr. ir. N.W. van den Brink, WUR-ALTERRA) will probably not be able to continue as a lead country. They will try to find a solution for the coordination of the international IPY project within the international consortium members.

Funding for the endorsed IPY project GIIPSY (lead country: The Netherlands) will come from other sources than the IPY•NL programme.

| IPY Planning Chart | | ID No | Short Title | Full Title | lead country |
|---|---|---|---|---|---|
| Bipolar | Space | 91 | GIIPSY | Global Inter-agency IPY Polar Snapshot Year | The Netherlands (ESA) |

**Other NWO subsidy rounds in 2006 specially dedicated to polar research in The Netherlands**

- **NWO programme Cooperation Russia** - submitting applications for collaboration in joint research projects and fellowship grants. In 2006 one of the priority areas is "Polar Research". Deadline: 4 October 2006
- **NWO Netherlands Polar Programme** - once every 2 years open for applications for Antarctic and Arctic research. The next call for proposals is expected to open after mid September 2006 (deadline Nov/Dec 2006)

| Netherlands organisations with scientific interest in IPY | | |
|---|---|---|
| **Name organisation** | **Acronym** | **Website** |
| ALTERRA | WUR-ALTERRA | www.alterra.nl |
| Arctic Centre - University of Groningen | RUG-AC | www.let.rug.nl/arctic |
| Centre for Ecological and Evolutionary Studies - University of Groningen | RUG-CEES | www.rug.nl/cees |
| Centre for Isotope Research - University of Groningen | RUG-CIO | www.cio.phys.rug.nl |
| Delft University of Technology - Civil Engineering & Geosciences | TUD | www.citg.tudelft.nl |
| Institute for Marine and Atmospheric research Utrecht – Utrecht University | UU-IMAU | www.phys.uu.nl/~wwwimau |
| International Centre for Integrative Studies - Maastricht University | UM-ICIS | www.icis.unimaas.nl |
| Netherlands Institute of Ecology | NIOO-KNAW | www.nioo.nl |
| Royal Netherlands Institute for Sea Research | NIOZ | www.nioz.nl |
| Royal Netherlands Meteorological Institute | KNMI | www.knmi.nl |
| Vrije Universiteit Amsterdam - Faculty of Earth and Life Sciences | VU-ALW | www.falw.vu.nl |

## 1.4 Education, Outreach and Communication

A total budget of 0,7 million euro is available for activities in the field of Education, Outreach and Communication (EOC). The aim is to bring the polar regions and polar research under the attention of the general public, schoolchildren and policy makers in The Netherlands. This will be done in cooperation with museums and various other external partners, as Netherlands IPY Committee will not be able to organise or fund all the desired activities by itself.

In the period of 2007-2010 the Netherlands IPY Committee will organise several key activities at different moments in time and at various locations in The Netherlands. The IPY EOC activities in the Netherlands will also be imbedded in an international, mainly European, context as far as relevant and possible. The Netherlands is active in the European Polar Board, working on EOC in IPY on a European level, and in COMNAP INFONET (deals with practical and technical aspects of communicating to the public the activities the National Antarctic Programs). The Netherlands also has a representative in the IPY Youth Steering Committee (IPY YSC).

Examples of activities currently under development in the **Netherlands IPY EOC Programme** are:

- *Cultural kick-off IPY (Thursday 8 March 2007)*
  In The Netherlands the IPY will be formally opened on March 8th and 9th, 2007, with a cultural event and a scientific symposium. The cultural event will be the performance of the Antarctic Symphony of Sir Peter Maxwell Davies by the ´Noord Nederlands Orkest´ in the Fries Natuurmuseum (where a photo exhibition will be opened) in the city of Leeuwarden. Organisation is in cooperation with the province of Friesland and the museum.

- *Scientific kick-off IPY (Friday 9 March 2007)*
  A scientific Polar Symposium focussing on IPY will be held at the city of Groningen. Organisation in cooperation with the Dutch SCAR Committee.

- *Education (2007 - 2009)*
  The aim is to have one or more educational contest(s) for schoolchildren in primary and secondary education, in connection with a prize for participation in fieldwork together with scientific IPY•NL researchers.
  The Netherlands intents to participate in the "International Polar Contests for the IPY (a proposal by the International Polar Year Youth Steering Committee)" and will develop a plan to implement this idea in The Netherlands.

- *Science and Technology Week (October 2007)*
  The Science and Technology Week in the Netherlands is a yearly event of 1 week, in which a great variety of institutions take part to bring science and technology closer to the public. Universities, research institutes, observatories, companies, museums and libraries open their doors. Each year has a specific theme and in 2007 the topic will be: polar regions and climate change. Target audience: children and young people in the age between 8-16 years old and their (grant)parents. The Science and Technology Week is an existing organisation that will take care of the logistical aspecst and general communication, the Netherlands IPY organisation will provide input regarding the content.

- *Scientific polar symposium (April 2008)*

- *TV Documentary (2008)*
  The IPY•NL programme asked Musch &Tinbergen Ffimproductions to develop a scenario for a documentary on (the development of) a selected number of IPY•NL research projects. The topic will include ecology, ice and culture in relation to climate in the Arctic. Anticipated broadcasting: national (and possibly international) television.

- *Scientific Polar Symposium – closing of IPY (March 2009)*
  Location: Middelburg, Organisation in cooperation with the NIOO-KNAW.

- *Website development (2005 –2010)*
  www.ipy.nl : national programme website, currently mainly focussing on research, further development is anticipated.

www.natuurinformatie.nl/poolgebieden (available in Dutch only): Educational website for general public with information on polar regions (with existing contributions by the Netherlands Polar Programma). It includes a summary of the Dutch translation of the ACIA rapport and will be updated with information on IPY and research in IPY.

- *Museum exhibitions (2007-2009)*
  Starting in 2005 as much as possible museums (including some zoo's) in The Netherlands have been informed of the coming IPY. Several clusters of museums have shown interest to realise exhibitions and (educational) activities within the framework of IPY. The main role of the Netherlands IPY Committee is to inform museums on the coming IPY, to make enthusiastic, to provide ideas and information for content and links to other IPY activities, and support (e.g. by letters of recommendation) museums to secure external funding or attract sponsors.

- *Publication of books (2007, 2008, 2009)*
  The aim is to realise the publishing of different types of books (e.g. a comic, a paperback and a children's book) in cooperation with interested publishers. A connection of with other key activities in our IPY programme, such as the Science and Technology Week and museum exhibitions is being pursued.

Furthermore, The Netherlands is involved in the following EOC related IPY Full Proposals:

| IPY Planning Chart | | ID No | Short Title | Full Title | lead country |
|---|---|---|---|---|---|
| Arctic | People | 201 | NORMA | Northern Material Culture through International Polar Year Collections, Then and Now: In the Footsteps of Murdoch and Turner (*NL involved through ID # 348:* Social Dynamics of Material Culture in the Arctic; (1) The Challenges of Social Change in East Greenland (2) Cultural Revival and Material Culture in Southeast Siberia) | USA |
| Bipolar | E&O | 168 | IPY YSC | International Polar Year Youth Steering Committee | Canada |
| Bipolar | E&O | 328 | ICEE | Integrated Communication, Education and Evaluation (*NL involvement through ID# 427*: Polar Presentation & Education Toolkit) | USA |

A contribution to the EOC project a "Polar Education Toolkit" is still under discussion. The IPY project "Social Dynamics of Material Culture in the Arctic" is related to activities supported by the National Museum of Ethnology, Leiden in The Netherlands.

## 1.5 Data Management

The total programme budget for the Data Management of the research projects funded in the IPY•NL programme is 0,12 million euro (2.4 % of the budget for the national research projects). Budgets for data management were not yet included in the national project proposals themselves. In the Netherlands the data management for IPY projects will be coordinated by the Data Management Group at the Royal NIOZ (also responsible for the National Antarctic Data Centre).

The co-chair of the ICSU-WMO IPY Data Management Sub-Committee (Taco de Bruin, Royal NIOZ) is also the scientific data manager for the Data Management Group in the Netherlands. The Netherlands is involved in the IPY "Data Information Service" Full proposal.

| IPY Planning Chart | | ID No | Short Title | Full Title | lead country |
|---|---|---|---|---|---|
| Bipolar | Data | 49 | IPY DIS | International Polar Year (IPY) Data and Information Service (DIS) for Distributed Data Management | USA |

# Annex 1: Abstracts IPY•NL research projects

## IPY.NL theme 1:
## Changes in the cryoshere due to climate change

*Arctic*

**Arctic glaciers, climate and sea level change**

Prof. dr. J. Oerlemans
Universiteit Utrecht - Instituut voor Marien & Atmosferisch Onderzoek Utrecht (IMAU)
*(coordinating project)*

This coordinated research proposal defines the Netherlands contribution to IPY research into the dynamics and mass balance of Arctic glaciers. If they were to melt completely, Arctic glaciers, including the Greenland ice sheet, have the combined potential to increase global sea level by 8 m. Arctic glaciers have lost a considerable amount of mass in the last century (see the Arctic Climate Impact Assessment report, ACIA), thereby contributing significantly to the observed sea level rise of 2 mm per year. Recent research shows that Arctic glaciers may be capable of reacting much faster to changes in climate and surface mass balance than previously assumed. Observations show that an increased flux of surface melt water that has drained to the glacier bed during recent warmer summers leads to increased glacier velocities. The thinned glacier surface is situated in a warmer environment, thereby experiencing increased melting and so forth. Understanding and being able to model this phenomenon is very important because this positive feedback could lead to a collapse of, for instance, the Greenland ice sheet that is much faster than has been assumed so far. To achieve this, intensive observations of ice velocity and meltwater production will be carried on five Arctic glaciers, including an outlet glacier on the Greenland ice sheet (subproject 1). Another important question we want to answer is how the Greenland ice sheet evolved through the last interglacial (Eem, subproject 2); the Eem was several degrees warmer than today's climate, and could serve as an analogue of a future enhanced greenhouse climate. To calculate the surface mass balance of the Greenland ice sheet, a prerequisite for accurate ice volume calculations, we will use a regional atmospheric climate model (subproject 4). The Netherlands will also participate in the new deep drilling in north Greenland to reconstruct climate of the north Atlantic region over the last 140,000 years. By analysing the concentration and isotopic composition of methane in air trapped in the ice, we hope to be able to determine and locate the main methane sources on Earth (subproject 3).

This project contributes to the following international IPY activities:
**GLACIODYN** The dynamic response of Arctic glaciers to global warming
Lead Country: Netherlands (IPY Activity ID No 37)
**IPICS-IPY** International Partnerships in Ice Core Science (IPICS)-International Polar Year Initiative. Lead Country: USA (IPY Activity ID No 117)
**The Greenland Ice Sheet** – Stability, History and Evolution
Lead Country: Denmark (IPY Activity ID No 118)

*Arctic*

**Meltwater input, flow and calving of Arctic glaciers**

Dr. C.H. Tijm-Reijmer
Universiteit Utrecht - Instituut voor Marien & Atmosferisch Onderzoek Utrecht (IMAU)
(subproject 1 of "Arctic glaciers, climate and sea level change")

Water stored in glaciers, ice sheets and ice caps in the Arctic is estimated to correspond to a sea level rise of 8 m. Arctic glaciers have lost a significant amount of mass over the past several decades as a consequence of global warming (see the ACIA report), and are estimated to contribute 0.15 to 0.30 mm per year to global sea level rise. In addition, the effect of climate change on glaciers and ice sheets will also affect e.g. ecosystems in lakes and fjords due to increased fresh water supply. A glacier or ice sheet loses mass through surface melt and several also through calving of ice bergs at the glacier front. The surface melt water is transported to the base of the glacier via moulins and crevasses, and runs off through sub-glacial channels. The

increase of the supply of melt water to the drainage system of a glacier may lead to higher ice velocities, at least temporarily, and larger iceberg production. Through this mechanism large glaciers and ice sheets may react unexpectedly fast to climate changes. In this research project we will measure ice velocities and melt water production on five glaciers for a period of five years. The theoretical interpretation of these observations will give us more insight in the relation between ice velocities, melt water supply and iceberg calving, including the seasonal and inter-annual variability of these processes. The results will be used to improve glacier models in order to improve our estimates of the response of Arctic glaciers to climate change.

*Arctic*

**Regional modelling of Greenland surface mass balance for key episodes in the past and future**

Dr. M.R. van den Broeke
Universiteit Utrecht - Instituut voor Marien & Atmosferisch Onderzoek Utrecht (IMAU)
(subproject 4 of "Arctic glaciers, climate and sea level change"))

The Greenland ice sheet (GrIS) contains enough water to raise global sea level by about 7 m. Recent research shows that meltwater that has formed at the ice sheet surface drains to the bed of the glacier, accelerating the ice flow. As a result, the glacier thins, the surface lowers, melting increases and the cycle starts anew. This positive feedback between surface climate and ice dynamics is part of the mounting evidence that large ice volumes such as the GrIS could react much faster to a change in climate than has been assumed thus far. In spite of the potential threat this poses for low-lying countries such as the Netherlands, it is still unknown whether the GrIS is growing or shrinking under the present climate conditions and how it has contributed to sea level change in the past and will contribute to sea level change in the future.

A crucial boundary condition for the accurate modelling of past, present and future volume changes of the GrIS is the surface mass balance, comprising the sum of all mass fluxes towards (solid precipitation) and away (melt, sublimation, erosion) from the ice sheet surface. Because reliable GrIS surface mass balance fields are not available, we do not know the volume of the GrIS and its contribution to sea level changes during the previous interglacial (the Eemian, 125,000 years ago) or during the last glacial maximum (LGM, some 21,000 years ago), nor can we predict with any certainty how the GrIS will behave in a (future) enhanced greenhouse climate.

In this project, the surface mass balance of the GrIS will be modelled for these key periods in the past and future. By using a regional atmospheric climate model (RACMO2), driven at the boundaries by state-of-the-art atmospheric general circulation models, this can be done at unprecedented high resolution (18 km) to match the typical resolution of ice dynamical models. Another big advantage of using a meteorological model is the availability of spatially and temporally realistic melt fluxes to study the interaction with ice dynamics. With results from this research we will be able to hindcast and predict the changes in the volume of the GrIS with much improved accuracy and with that its contribution to past and future changes in global sea level.

*Antarctic*

**Automatic weather stations in interior East Antarctica**

Dr. M.R. van den Broeke
Universiteit Utrecht - Instituut voor Marien & Atmosferisch Onderzoek Utrecht (IMAU)

Because of their wide range of applications, Automatic Weather Stations (AWS) play a crucial role in modern Antarctic climate research. Since 1995, the Institute for Marine and Atmospheric Research Utrecht (IMAU) has successfully operated AWS at nine Antarctic sites in Dronning Maud Land and on Berkner Island. Apart from the 'standard' meteorological variables pressure, temperature and wind, these AWS also measure humidity, shortwave and longwave radiation, snow temperatures at five depths and snow accumulation. This has yielded unique datasets of climate and mass balance of the various Antarctic climate zones (coastal, katabatic and interior).

During the International Polar Year (IPY, 2007-2009), several ground traverses will penetrate the remote interior plateau of East Antarctica to search (among other things) for the oldest ice chronology on Earth. One of those traverses will connect the Norwegian Troll station to Amundsen-Scott South Pole station, via the former Plateau station and the pole of inaccessibility. This offers a unique opportunity to extend the present operational area of IMAU AWS to the deep interior ice sheet. In this proposal we ask funding to design and build two AWS with low temperature specifications for installation along this IPY traverse, and one prototype for testing at Kohnen

station. We plan for these AWS to be installed at the site of former Plateau station and on the interior slope of west Dronning Maud Land, an area that is meteorologically unexplored. The AWS will be left unattended for a period of 3-5 years, relaying their data to Utrecht through the ARGOS system.

This project contributes to the following international IPY activities:
**TASTE-IDEA** Trans-Antarctic Scientific Traverses Expeditions – Ice Divide of East Antarctica
Lead Country: Germany (IPY Activity ID No 152)

*Arctic*

**Sediment Supply to the Arctic coastal zone**

Dr. ir. I. Overeem
Technische Universiteit Delft, Faculteit Civiele Techniek – Geowetenschappen

Changes in the polar system due to changing global climate are both rapid and dramatic. Polar change has been selected as one of the main themes of the International Polar Year 2007-2008. Changing Northern Hemisphere temperatures, thinning of the sea-ice, and melting of the glaciers have all been recently reported. The main research question of this proposal is how the sediment supply to the Arctic coastal system is influenced by the changing climate. Accurate understanding of the effects of climate change on river sediment fluxes is needed to predict changes in the biological productivity of the Arctic coastal ecosystem, which is extremely vulnerable to changes in sediment and associated nutrient supply.
The responses are complex; will increased glacier melting and increasing precipitation result in increased water and sediment discharge? Or will the decrease of glacier area result in decreased sediment production? Does the sediment transport capacity of the river systems decrease with decreasing glacial meltwater? And how much sediment is stored in the glacio-fluvial floodplains and long does it lag in the basin before it reaches the coast? We need to unravel these complexities in the direction and timing of the system responses to perturbations, only then can we make predictions of the sediment and nutrient supply to the ocean. The objective of this research is to describe the interacting forcing factors and responses in a numerical model.
Our existing numerical sediment transport model will be advanced to deal with two critical issues. Firstly, innovative algorithms will have to be developed to link glaciological physical parameters to sediment production. Glacial sediment production can be linked to to glacier dimensions and basal sliding speeds. Subsequently, these process descriptions can be incorporated as a module into our climate-driven sediment flux model, Hydrotrend, which models the river sediment flux as a function of total drainage basin area, basin relief, precipitation, temperature, vegetation and groundwater balance. Secondly, the presently 1D model will be enhanced into a spatially-distributed model, i.e. a grid-based model. This will allow sediment storage in the glacial and fluvial domain. Lag-time of sediment supply will inherently follow when the sediment transport capacity is reduced.
To validate our model field observation in Arctic river systems are of vital importance. We selected two end-member systems bordering Baffin Bay. Kangerlussuaq river system drains the active Greenland Ice Cap. This system is the base-case for model validation of short-term climate changes and effects on glacier and sedimentary system. Data on the forcing factors and water and sediment fluxes will be collected in the first IPY field season in 2007. To get an understanding of the longer-term response we will study McBeth river system on Baffin Island. McBeth river is decoupled from the last remnant of the Laurentide Ice Sheet, the Barnes Ice cap and allows a source-to-sink sediment supply reconstruction since the last deglaciation.
The overarching goal of the modeling framework is to ingest state-of-the-art topographical, climatological and glaciological data or modeling results as input and to predict the water and sediment fluxes in an arbitrary Arctic river basin. The potential effects of the future melting of the Greenland Ice Cap on the sediment flux to the Arctic coastal ecosystem can then be assessed.

This project contributes to the following international IPY activities:
**ACCO-Net** Arctic Circum-Polar Coastal Observatory Network
Lead Country: Germany (IPY Activity ID No 90)
via the IPY Activity: Sediment supply to the Arctic coastal zone (IPY Activity ID No 148 which joined under IPY Activity ID No 90)

# IPY.NL theme 2:
# Changes in the Southern and Arctic ocean

*Bipolar*

**The significance of viruses for polar marine ecosystem functioning (VIRPOL)**

Dr. C.P.D. Brussaard
Koninklijk Nederlands Instituut voor Onderzoek der Zee (NIOZ)

Microbial communities (phytoplankton, bacteria, archae, heterotrophic protozoa and viruses) comprise the majority of the biomass in the oceans and drive nutrient and energy cycling, thereby supporting also the polar ecosystems. The emergent awareness that the response of ecosystems to climate change depends largely on the responses of the underlying microbial community, that phytoplankton productivity is of vital importance to the global climate system, and that viruses are major players influencing biodiversity and biogeochemical processes, underlines the need to elucidate the ecological role of viruses in polar ecosystems. Despite the likely importance of viruses in polar aquatic ecosystems, the ecological role of viral mediated mortality of polar microbes (and phytoplankton in particular), and the quantitative significance of polar viruses with respect to climate and global environmental change are barely studied. The present project will be the first comprehensive study to focus on viruses and viral mediated processes in polar environments. As part of the Polar Aquatic Microbial Ecology (PAME) IPY activity program, this project?s objectives are 1) To examine the abundance and composition of viruses and their host (prokaryotes and phytoplankton) in bipolar marine environments, 2) To compare the significance of viruses and their impact on microbial mortality and geochemical cycling in the aquatic polar ecosystems (Arctic vs. Antarctic), and 3) To unravel the impact of climate and global environmental change on the ecological role of viruses and their activities. Particular efforts in the presently proposed activities will focus on viral mediated mortality of phytoplankton, the group of organisms that form the base of each pelagic food webs. In order to clarify the ecological importance of viruses for the polar ecosystems an integrated study assessing the presence, meaning and functionality of virus and host in the field is planned in combination with laboratory research exploring the effect of climate change related environmental factors on virus-host interactions (specifically of the relevant polar phytoplankter Micromonas pusilla). Both the Arctic and the Antarctic seas are key regions in the ocean?s circulation and are considered sensitive to global warming. The global change-induced environmental changes will directly impact the polar microbial community and most likely enhance the significance of viruses. The results of this timely proposed project will largely advance our comprehension of the importance of viruses for the functioning and biodiversity of the polar marine microbial ecosystems. The results are expected to provide new insights in our understanding of the structure of polar marine pelagic food webs and geochemical cycling, as well as to what extent both polar regions are different. The obtained data will, furthermore, be essential for a more accurate evaluation of global carbon cycle models.

This project contributes to the following international IPY activities:
**PAME** Polar Aquatic Microbial Ecology
Lead Country: Norway (IPY Activity ID No 71)

*Arctic*

**Consequences of climate change for Arctic marine pelagic microbial communities.**

Dr. A.G.J. Buma
Rijksuniversiteit Groningen, Faculteit der Wiskunde en Natuurwetenschappen- Mariene Biologie
*(coordinating project)*

Recent climatologic research in the Arctic shows a significant increase in mean seasonal temperatures leading to an ongoing reduction in Arctic sea ice cover. The increase in sea surface temperature is expected to enhance thermal stratification of the water column. In addition, increased precipitation and run-off will cause enhanced input of meltwater and sediments in marine waters, thereby also strongly affecting water column stability and turbidity. Stratospheric ozone depletion in the Arctic is anticipated to intensify for the decennia to come, resulting in enhanced ultraviolet radiation. These shifts in temperature and the light climate are likely to affect marine microbial communities, which are the main drivers of the biogeochemical cycles. Phytoplankton are very sensitive to changes in both temperature and the light climate, whereas bacterial and viral

activity and community composition will be directly or indirectly (via the dissolved organic matter pool) affected. At the same time the enhanced sediment-input could directly affect the prokaryote community because shifts are expected in favour of species that specifically attach to suspended particles, such as the Crenarchaea. In a very recent pilot experiment we have demonstrated shifts in bacterial consortia as a result of prolonged manipulated irradiance exposure at an Arctic marine site (Kongsfjorden Spitsbergen). So far, extremely little is known about spatial and temporal diversity of Arctic marine microbial communities. Yet, serious consequences for the carbon flux can be anticipated.

During two field campaigns in the Kongsfjorden (79N), Spitsbergen, in 2007 and 2008, two sister projects will be executed that both combine in situ measurements with microcosm studies in which the light climate and the concentration of suspended matter will be manipulated. In the first project (Subproject 1: CAMP) extensive reseach will be done on the composition, diversity and production of microbial communities in relation with environmental factors such as temperature, salinity and turbidity, by combining classical and molecular techniques. Furthermore, temperature, turbidity and light quality and quantity will be manipulated in microcosm experiments in which natural eukaryote and prokaryote microbial communities will be incubated. The consequences of these simulated aspects of climate change will be investigated on the molecular, ecological and physiological level. In the second project (Subproject 2: PACCA) specific attention will be given to the role of a group within the Archaea (the Crenarchaea) and the possible shifts of the prokaryotes as a result of changes in suspended matter Recent research suggests that a substantial part of these Crenarchaea are ammonia oxidisers. At the same time, Crenarcheal density in Arctic coastal waters seems positively correlated with the concentration of suspended particles. As a results, these particles appear to be ?hot-spots? of ammonia oxidation. Climate change in Arctic systems could therefore favour Archaea at the expense of Bacteria. The proposed research complies with IPY Theme I (Baseline information) and with Theme II (Climate change) and will give new insight in overall production as well shifs in species composition related with the predicted change in the Arctic climate.

This project contributes to the following international IPY activities:
**PAME** Polar Aquatic Microbial Ecology
Lead Country: Norway (IPY Activity ID No 71)

*Arctic*

**Consequences of climate change for Arctic marine pelagic microbial communities (CAMP)**

Dr. A.G.J. Buma
Rijksuniversiteit Groningen, Faculteit der Wiskunde en Natuurwetenschappen- Mariene Biologie
(subproject 1 of "Consequences of climate change for Arctic marine pelagic microbial communities")

The Arctic climate is changing at an unsurpassed rate. Recent data show dramatic increases in mean seasonal temperatures leading to an ongoing reduction in Arctic sea ice cover. The increase in sea surface temperature is expected to enhance thermal stratification of the water column. In addition, increased precipitation and run-off will cause enhanced input of meltwater and sediments in marine waters, thereby also strongly affecting water column stability and turbidity. Stratospheric ozone depletion in the Arctic is anticipated to intensify for the decennia to come, resulting in enhanced ultraviolet radiation. These shifts in temperature and the light climate are likely to affect marine microbial communities, which are the main drivers of the biogeochemical cycles. Phytoplankton are very sensitive to changes in both temperature and the light climate. At the same time, bacterial and viral activity and community composition will be directly or indirectly (via the dissolved organic matter pool) affected. In a very recent pilot experiment we have demonstrated shifts in bacterial consortia as a result of prolonged manipulated irradiance exposure at an Arctic marine site (Kongsfjorden Spitsbergen). So far, extremely little is known about spatial and temporal diversity of Arctic marine microbial communities. Yet, serious consequences for the carbon flux can be anticipated.

The aim of the proposed research is to investigate the effects of temperature and irradiance on phytoplankton, bacterial and viral activity and species composition. We will conduct a series of field surveys in the Arctic (Koldewey lab. Kongsfjorden, Spitsbergen), covering spring, summer and autumn periods. Microcosm experiments (in 12 L UV transmissive PMMA bottles) will be set-up in UV transparent incubators, and exposed to natural solar radiation in a matrix of temperatures (2: environmental, elevated), irradiance quantities (3: 90 %, 60%, and 30% of incident) and irradiance qualities (3: PAR only, PAR + UVAR, PAR + UVBR + UVAR). Here, climate change induced changes in meltwater input and water turbidity will also be addressed. In addition to standard physical (T, irradiance) and chemical parameters (a.o. nutrients, DOC, POC),

phytoplankton growth, species composition and some photoacclimation parameters (e.g. xanthophyll cycling) will be followed in each microcosm for the duration of the experiments. Bacterial metabolic activity will be studied using production and respiration measurements on the community and on a single cell level by microautoradiography combined with catalyzed reporter deposition fluorescence in situ hybridization (MICRO-CARD-FISH). Fingerprinting techniques (DGGE) will be applied to assess the composition of the eukaryote and prokaryote communities. Sequence information will be used to develop oligonucleotide probes for more detailed MICRO-CARD-FISH analyses. Thus, we will perform a complex structure-function analysis of the microbial community.

*Arctic*

**Pelagic Archaea in the changing coastal Arctic (PACCA)**

Prof. dr. G.J. Herndl
NIOZ
(subproject 2 of "Consequences of climate change for Arctic marine pelagic microbial communities")

Pelagic Archaea are ubiquitously present in the oceanic water column although they are generally less diverse than Bacteria. Archaea form together with Bacteria the prokaryotic plankton of the ocean, representing the main drivers of biogeochemical cycles and playing a central role in the microbial loop of aquatic food webs. Although no representative of the pelagic, non-thermophilic Archaea has been brought into culture until very recently, advances in culture-independent methods allowed us to show that planktonic Archaea are taking up bicarbonate, thus, at least a substantial fraction of the Archaea are chemoautotrophic. This conclusion was confirmed by the first representative of a Crenarchaeum brought into culture. Apparently, some of these Crenarchaea are ammonia oxidizers as indicated by the presence of the amoA gene, a gene encoding for one of the key enzymes of ammonia oxidizers. At specific ecological conditions, these ammonia-oxidizing Crenarchaea are the dominant ammonia oxidizers in coastal systems. However, we also have evidence that not all the archaeal phylotypes are ammonia oxidizers, as indicated by the lack of the amoA gene in samples where ammonia concentrations are low.
We hypothesize that the climate change affecting the Arctic coastal waters favors Archaea relatively more than Bacteria, leading possibly to shifts in the prokaryotic community from Bacteria to Archaea dominating the prokaryotic community. This hypothesis, although untested thus far, is based on recent findings as increased melt water input increases the amount of allochthonous suspended matter in coastal Arctic systems. Crenarchaeal abundance has been found to be positively related to particle concentration. The crenarchaeal fraction of the prokaryotic community is relatively more abundant on particles than in the free-living community in coastal Arctic systems. These particles might form hot spots of ammonia oxidation as some creanarchaeal phylotypes are ammonia oxidizers while other crenarchaeal phylotypes are preferentially utilizing D-amino acids which are common in tundra soil. All these recent advances in our understanding of the ecology of marine non-thermophilic planktonic Archaea are pointing towards the fact that the recent climate changes in Arctic systems might favor Archaea over Bacteria. As planktonic Archaea are generally less diverse than Bacteria and prokaryotes are at the base of marine food webs, this hypothesized shift in the prokaryotic community might have severe consequences for coastal Arctic food webs.

*Bipolar*

**IPY-NL-GEOTRACES: Netherlands Contribution to an International Study of the Biogeochemical. Cycles of Trace Elements and Isotopes in the Arctic and Southern Oceans**

Prof. dr. ir. H.J.W. de Baar
NIOZ
*(coordinating project)*

In GEOTRACES we defined 6 key trace metals which, with additional metals Co, Ni, Ag, the Si isotopes and changes of CO2 will be investigated in our national IPY-GEOTRACES subprojects 1-7. The distribution and biological availability of Fe (sub 1) is strongly controlled by its physical-chemical speciation (sub 2) within seawater, where colloids and Fe-organic complexes are dominant actors. Cu (sub 4) at the cell wall of phytoplankton acts in reductive dissociation of Fe-organic complexes, hence facilitates Fe uptake and growth. This may partly explain the nutrient-type distribution of Cu in the oceans. The external sources of Fe into the oceans are either from above (dust) and below (sediments) and will be constrained by Al and Mn (sub 3) for aeolian dust

input and sedimentary redox cycling sources, respectively. The Fe strongly enhances large diatoms, thus Fe (as well as Ag; sub 4), have via the siliceous frustules of these diatoms, a link with the Si cycle and isotope fractionation (sub 5). Diatoms in turn strongly control by their CO2 fixation the biological pump for uptake of CO2 from the atmosphere into polar oceans (sub 6). The increasing CO2 in polar ocean waters causes major shifts of seawater chemistry, including general acidification, and these shifts likely affect phytoplankton ecophysiology (sub 7), with key functions of metal Fe (sub 1-2) in the overall photosynthetic apparatus and Zn (sub 4) in carbonic anhydrase, where Cd and Co (sub 4) may substitute for Zn in the latter carbonic anhydrase.

This project contributes to the following international IPY activities:
**IPY-GEOTRACES** International Polar Year GEOTRACES: An international study of the biogeochemical cycles of Trace Elements and Isotopes in the Arctic and Southern Oceans
Lead Country: The Netherlands (IPY Activity ID No 35)

*Bipolar*

**Physical and Chemical Speciation of Dissolved Fe in the Polar Oceans**

Dr. L.J.A. Gerringa
NIOZ
(subproject 2 of "IPY-NL-GEOTRACES" )

Dissolved (<0.2 micron) Fe in seawater in fact consists of several sizes, from fine colloidal Fe next to an operationally defined soluble (<smallest size cutoff ultra filtration) pool. Moreover organic Fe (III)-complexes exist within both the colloid pool(s) and the soluble pool. Implications are twofold. Firstly within surface waters, the colloid fractions cannot be assimilated unless first dissolved or photo reduced into a bio-available Fe form. Similarly not all Fe (III)-organic complexes are available, where dissociation or photo-reduction serve to make Fe more suitable for plankton uptake. Secondly dissolved Fe in the deep ocean appears controlled by competition between two pools. Global ocean Fe models postulate the soluble Fe (III)-organic maintaining Fe in solution, while the colloids are removed towards the seafloor. The more or less equilibrium distribution of dissolved Fe between colloids and organic complexes will be measured along two sections in the Southern Ocean, and at stations in the Arctic Ocean. Moreover it is realized this quasi-equilibrium description alone is inadequate to fully understand and quantify the reactivity of dissolved Fe for either uptake by plankton in surface waters, or adsorptive scavenging removal in deep waters. Towards more realistic and complete understanding it is essential to combine the above with a kinetic approach for quantification of the rates of transformation between various Fe pools in seawater. Latter transformation rates likely are the key rate-limiting factor(s) for Fe uptake by biota or Fe scavenging rates in the deep ocean. These kinetic experiments will be done in pristine natural seawater, and combined with plankton growth studies as the ultimate proof of biological availability of dissolved Fe in polar ocean waters.

*Bipolar*

**Dissolved Aluminium and Manganese as Source Tracers for Iron in Polar Oceans**

Prof. dr. ir. H.J.W. de Baar
NIOZ
(subproject 3 of "IPY-NL-GEOTRACES")

The two opposing Fe source hypotheses of Fe coming either from above by aeolian dust input from adjacent continents, or from below sediments will be assessed by obtaining a reliable dataset of dissolved Fe, Mn, Al in the polar oceans. The high accuracy dataset of dissolved (<0.2 micron filtrate) Fe in seawater (subpr. 1), will be taken at a series of stations, at a resolution of 48 sampling depths per station, along two transects at zero meridian and across Drake Passage, and at stations in the Arctic Ocean. For the same sampling grid, the dissolved Al will be measured as source tracer for aeolian dust input, and dissolved Mn as the source tracer for reductive dissolution input from underlying sediments (this subproject 3). In collaboration with Dr. Baker (UEA), aerosol dust samples will be collected with an air pump filtration system while the Polarstern is underway between stations, as to obtain estimates of abundance of Fe, Mn, Al in aerosols, from which by dissolution experiments and transport modeling, models for settling and partial dissolution of aerosol dust will be pursued. Maxima of reduced Fe(II) in surface waters (subpr. 1) may serve as indicator of wet deposition/dissolution events. In collaboration with dr. Rutgers vd Loeff (AWI), additional natural radio-isotope tracers 228Ra and 227Ac will be measured to furthermore serve as source tracers for dissolved Fe from sediments at continental margin and deep abyssal seafloor, respectively. The above tracers (Fe, Al, Mn, 228Ra, 227Ac) in combination with the relative

distribution in seawater of dissolved Fe between colloids and dissolved organic states (subpr. 2), will serve to validate a budget model including the two external source terms (above and below), biological uptake and decomposition, and adsorptive scavenging removal.

## IPY.NL theme 3:
## Polar terrestrial and coastal ecosystems and global change

*Arctic*

**How trait spectra of bryophytes, vascular plants and soil invertebrates interact to control carbon turnover in arctic tundra: mechanisms underlying climate change impacts**

Dr. J.H.C. Cornelissen
Vrije Universiteit Amsterdam, Faculteit der Aard- en Levenswetenschappen - Systeemoecologie

Cold northern biomes, particularly peatlands dominated by bryophytes, have been accumulating of carbon in plant litter and older soil organic matter. Changes in the turnover (decomposition) of this organic material and in the release of carbon through soil respiration as a consequence of global warming, will have profound repercussions for regional carbon budgets and will feed back to climate. Climate change will affect carbon turnover both through the species composition of the vegetation, via its effects on organic matter production and quality, and through the changing composition and activity of the decomposer (including invertebrate detritivore) communities. Understanding high-latitude climate change effects on carbon cycling therefore requires knowledge on changes in the species composition of the constituent plants and decomposer organisms. The most exciting innovation of the proposed project is its focus, not on the species and their diversity per se, but rather on the functional traits that they have evolved in relation to the actual processes of carbon turnover. We will for the first time link functional trait spectra of plants, with particular emphasis on bryophytes (e.g. litter water retention capacity or pH), with functional trait spectra of animals, particularly soil invertebrates (e.g. morphology of mouth parts), to help us understand and predict their interactive effects on carbon turnover. The main objectives of our project are (1) to study how functional trait compositions of bryophyte, vascular plant and soil invertebrate communities interact to control belowground carbon turnover in wet and drier arctic tundra, and (2) how the functionally based associations among these groups of organisms are affected by climate warming.
We will address this objective through a combination of four approaches addressing specific research questions, all to be carried out near the arctic Abisko Research Station (ANS), North Sweden, which is also the coordination site of the IPY umbrella project ENVISNAR:

1. Trait-based databases will be constructed that will contain the predominant species of bryophytes, vascular plants and soil invertebrates and their measured trait values, to be screened for using tailor-made standardized assays. The focus will be on traits underlying carbon dynamics. This work will be the key to interpreting the interactive effects of biota on carbon turnover in the studies under point 2, 3 and 4 below.

2. We shall sample vegetation, litter and soil fauna biomass and functional trait composition in a range of wet and dry ecosystems in the Abisko-Torneträsk region, in order to detect and quantify general patterns of association among functional trait spectra of bryophytes, vascular plants and soil invertebrates.

3. To assess the impact of simulated climate change scenarios on associated trait compositions of bryophytes, vascular plants and invertebrates, we shall sample these biota in two in situ global change manipulation experiments, in which both realistic summer and winter warming scenarios are mimicked.

4. To investigate the mechanisms by which plant composition (relative abundance of bryophytes versus vascular plants) and invertebrate functional trait spectra (specifically community functional dissimilarity) affect soil carbon turnover and soil respiration, we shall create a microcosm experiment with artificial ecosystems representing wet and drier peatlands. 13C labelled litter will be introduced and the label tracked through different ecosystem compartments, biota and soil respiration CO2. Comparison with delta-13C signatures of

different soil invertebrate species in different plant and fauna composition treatments will reveal the contributions of soil fauna to carbon turnover.

This project contributes to the following international IPY activities:
**ENVISNAR** Environmental baselines, processes, changes and Impacts on people in sub-arctic Sweden and the Nordic Arctic Region
Lead Country: Sweden (IPY Activity ID No 213)

*Bipolar*

**Effects of global warming on ecosystem functioning in Polar habitats. The Dutch involvement in the TARANTELLA project. Umbrella proposal.**

Dr. A.H.L. Huiskes
Nederlands Instituut voor Ecologie (NIOO-KNAW), Centrum voor Estuariene en Mariene Ecologie
*(coordinating project)*

Especially in the higher latitudes temperature has risen markedly, because of global change and it is assumed that this trend will continue in the coming decades. This change in temperature is causing a change in moisture availability in the polar regions as well. Temperature and moisture availability play an important role in the functioning of terrestrial ecosystems in the polar regions. However, a proper understanding of the effects of the changes in temperature and moisture availability on the functioning of the terrestrial ecosystems in both polar regions is lacking at present. Because the changes in ecosystems structure and functioning are slow in the natural situation, an experimental approach has been developed, using Open-Top Chambers, which increase the temperature and moisture availability. These experiments are performed by various research groups in both the Arctic and the Antarctic. It is the aim of the endorsed IPY project TARANTELLA to compare the effects of experimentally induced climate change and enhanced UV-B radiation on the structure and processes of the various components of Antarctic and Arctic terrestrial ecosystems to determine similarities and differences in response between the Arctic and the Antarctic biome.
NIOO and VUA have been using Open-Top Chambers in both Arctic and Antarctic terrestrial ecosystems. The aim of the present proposal is to focus on a number of novel studies in both polar regions, using the already existing infrastructure. The Dutch involvement in the TARANTELLA project comprises three projects:
In project I we will focus on temperature-induced changes in water availability and water sequestration, using experimental studies with deuterium-labeled water in combination with studies of the natural abundances of deuterium in several water sources (rain, snow, soil water) to track possible changes in the type of water sequestration. This will be the first field study in which this integrated approach will be used to study the effects of climate change on water use of vascular plant species.
In project II we correlatively and experimentally study the transfer of 18O and 2H from rainwater and spring melt water to segments of the tundra plants. The Annual Growth Increment of and values of delta18O and delta2H therein represents a new climate proxy by which past temperature and variation of the Arctic oscillation is reconstructed.
In project III we will study the effects temperature change and changes in water availability on carbon and nitrogen fluxes, focusing on the rates of decomposition and on the role of the invertebrate community in the decomposition process. This proposal is the first in Antarctica to study the consequences of warming on the role of invertebrates in the decomposition process while no overall comparison has previously been attempted between Arctic and Antarctic situations.

This project contributes to the following international IPY activities:
**TARANTELLA** Terrestrial ecosystems in ARctic and ANTarctic: Effects of UV Light, Liquefying ice, and Ascending temperatures
Lead Country: The Netherlands (IPY Activity ID No 59)

*Bipolar*

**Long-lived evergreen shrubs from polar ecosystems as monitors of present and past climate change:reconstruction of annual polar temperature and Arctic Oscillation phase changes with a new climate multiproxy (wintermark T, 18O and 2H in plant segments)**

Prof. dr. J. Rozema
Vrije Universiteit Amsterdam, Faculteit der Aard- en Levenswetenschappen - Systeemoecologie
(subproject 2 of "The Dutch involvement in the TARANTELLA project.")

Annual growth of longlived (40-100+ yrs) evergreen polar shrubs can be used for high resolution climate reconstructions similar to tree-ring based climate reconstructions at lower latitudes. Transfer relationships between tundra plant growth characteristics and climate factors are obtained from experimental warming and correlative analyses in polar climate zones. Air temperature in the arctic tundra ecosystems is enhanced 1-1.5 oC with ITEX Open Top Chambers. The new climate multi-proxy consists of Annual Growth Increments (AGIs) and Winter Mark Distances (WMDs) and delta18O and delta2H values of annually grown plant segments. We study three evergreen polar shrubs: Cassiope tetragona and Empetrum nigrum in the Arctic and Empetrum rubrum in the (sub) antarctic, with a focus on Cassiope. By low polar temperatures and permafrost conditions stems of the evergreen shrubs studied are well preserved in soil cores for decades and ages (upto 600 yrs B.P C-14 dated). In our preparatory research temperature reconstructions based on Annual Growth Increments (AGIs) and Winter Mark Distances (WMDs) of the past decades and centuries have been obtained. The resolution of AGI and WMD of living (extant) Cassiope-based temperature reconstruction is 1 year, when WMDs from a soil core are used the resolution varies (5-15 years). Annual growth of Cassiope measured as WMDs of the past 20 years appeared to anticorrelate with the index of Summer Arctic Oscillation (AO). This is in accordance with phase shifts of the AO (and North Atlantic Oscillation NAO) during the last 30 years. A positive phase of AO is associated with increased summer (rain) precipitation and reduced winter precipitation with expected increased values of 18O and 2H in plant segments of polar shrubs as a result. Increased summer rain is associated with increased cloudiness, low summer temperatures and reduced plant growth. The opposite holds for the negative phase of AO: reduced summer (rain), a decrease of delta18O and delta2H values and increased annual growth (Fig. 3). Field and climate room experiments are planned to relate annual growth of polar shrubs to variation of temperature, precipitation or global solar (PAR) radiation. WMDs (and delta18O and delta2H values) can also be measured of Cassiope stems preserved in the arctic soil profile, enabling further temperature and AO variation reconstruction on a decadal and centennial scale. Our AGI and WMD based temperature reconstructions will be compared with temperature reconstructions based on oxygen isotopes from ice-cores drilled on Svalbard (0-600) and existing arctic climate data since ca 1910. Based on these comparisons of temperature reconstruction climate scenarios (IPCC 2001; ACIA 2004) may be evaluated.

*Bipolar*

**BIRDHEALTH Health of Arctic and Antarctic bird populations**

Dr. M.J.J.E. Loonen
Rijksuniversiteit Groningen, Faculteit der Letteren – Arctisch Centrum
*(coordinating project)*

Little is known about spatio-temporal patterns in infections of migratory birds. What is the epidemiology of infections? How much do various infections affect the fitness of the host and how variable is the host defence to battle these infections. In a set of four projects we want to study these questions in arctic breeding birds. Each project tackles a specific aspect, but all projects are linked in an effort to understand co-evolution of pathogens and hosts and the chances of transmission of pathogens to conspecifics or other species.

This project contributes to the following international IPY activities:
**BIRDHEALTH** Health of Arctic and Antarctic bird populations
Lead Country: The Netherlands (IPY Activity ID No 172)

*Arctic*

**Geographical and temporal variation in health issues in Arctic breeding birds**

Dr. M.J.J.E. Loonen
Rijksuniversiteit Groningen, Faculteit der Letteren – Arctisch Centrum
(subproject 1 of "BIRDHEALTH")

Recently, there has been a lot of attention on the risk of migratory birds being a vector of diseases to domestic animals and humans. However little is known about the effect of these diseases on the birds themselves. How do birds cope with an infection? How do they reduce the risk of being infected? Will the pathogens survive over a long period? These questions are highly relevant for arctic breeding migratory birds. They link remote areas but also go through periods with varying density, before, during and after migration. For some species, the Arctic can be a pathogen low resort during a period of high susceptibility when the animals spread out over the tundra to breed.

For other species, the chance of becoming infected during the breeding season might be extremely high due to colonial nesting in high densities. Birds and pathogens have co-evolved and both try to survive. There are many potential strategies for both parties. Pathogens can differ in their effect on behaviour and survival of the infected host. The host might vary the activity of its immune system. In this project we aim for a basic understanding of parasite-host interaction explaining geographical and temporal variation in both the prevalence of infection and immune system functioning of the host. We will screen individually ringed birds and compare infected animals with uninfected or medicine-treated animals over a wide variety of species and study spatio-temporal variation. This variation will be linked to environmental changes like pollution, global warming and habitat loss.

*Arctic*

**Contrasting breeding investments in a small arctic shorebird: trade-off between breeding effort and fighting disease?**

Prof. dr. Th. Piersma
NIOZ
(subproject 2 of "BIRDHEALTH")

Small shorebirds breeding in the High Arctic have very high thermoregulatory and incubation costs. Sanderlings Calidris alba are known to have a breeding system in which females sometimes lay two clutches of four eggs. The male incubates the first clutch, the female incubates the second clutch herself. The advantage for double-clutching individuals is obvious: a higher reproductive success. However, this breeding strategy also entails substantial costs for both parents. First, the female has to lay an additional set of eggs soon after having laid a first complete clutch. Secondly, two birds have to separately take care of the incubation of a clutch and chick guarding. In the proposed research we wish to investigate the possible relation between immune response and breeding effort at a study site in Northeast Greenland with a known Sanderling population that shows both the single- and the double-clutch strategy. We hypothesise that Sanderlings might be able to make such large investments in reproduction by economising on their immune system in the relatively parasite- and disease-poor High Arctic environment. Only high-quality birds that are free of parasites are expected to be able to down-regulate their immune system. In their wintering habitat in Western Europe and especially tropical Africa, Sanderlings scavenge between decaying organic material and need to maintain high levels of immunity. The contrast in breeding strategies within a single Arctic bird species enables us to gain knowledge on fundamental questions about disease risk and immune function of Arctic shorebirds that spend part of their life in Western European marine habitats and may yield important information on the spread of diseases by migratory birds.

*Arctic*

**ARCTIC BREEDING WATERFOWL AS VECTORS FOR AVIAN INFLUENZA VIRUSES**

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(subproject 3 of "BIRDHEALTH")

Influenza virus (IV) outbreaks pose a major threat to human and animal health and the economy. Various data indicate that Arctic breeding migratory waterbirds, notably Anseriformes and Charadriiformes species, are a reservoir and vector for IV. With its dense human population, extensive pig and chicken farming (with increasing outdoor ranging), its many shallow water bodies that attract migratory waterfowl in unparalleled numbers, The Netherlands form a European hot spot for influenza outbreaks in poultry and potential transmission to man. For risk reduction, early recognition and management of outbreaks, the proposed multidisciplinary research initiative will provide critical knowledge on:
(1) what species of Arctic breeding waterbirds are carriers of avian IV and how this correlates with specific ecological features of the species,
(2) the spatial and temporal variation in IV prevalence among these species,
(3) which individuals are most susceptible for IV infection and how it impacts their fitness and
(4) the role of Arctic moulting ponds as reservoirs for avian IV.
We envisage a multidisciplinary research project covering the fields of bird ecology, virology and epidemiology. Using a flyway approach, IV prevalence and bird fitness and behaviour will be monitored at a high spatial and temporal resolution in various populations of waterfowl, all in order to elucidate the interactions between Arctic breeding birds and IV.

*Arctic*

**Combining behaviour-based and epidemiological models to identify the role of Arctic breeding migratory birds in the ecology of diseases, notably Avian Influenza**

Prof. dr. J.A.P. Heesterbeek
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(subproject 4 of "BIRDHEALTH")

In contrast to expectations of the last century that infections could be brought under control, today we increasingly face threats from new emerging agents, transcending species boundaries, entering new geographic areas but also from well-known agents that turn out to be very persistent, escape immunity, that are difficult to control in outbreaks or that continuously evolve and thus, escape existing treatments.
Avian influenza excellently exemplifies these issues: it has repeatedly crossed species-boundaries (e.g. from wild waterfowl to poultry species), continues to escape immunity by frequent mutations and is thus difficult to control in outbreaks. Although it will be impossible to prevent such outbreaks, a fundamental understanding of the origin and spread of influenza viruses (IV) through animal and human populations may play a key role in designing strategies to recognize the threats early and to minimize the risk of outbreaks.
Therefore, we aim to combine epidemiological and behaviour-based models and in particular, to shed light on the role of migratory waterfowl in the spread of infectious diseases by successively testing the assumptions of 1)Within-individual processes: Testing consequences of IV infections on individuals, e.g. on reproductive success, mortality; 2) Between-individual processes: What are the population-level consequences and patterns given the assumptions under 1) and transmission rates/ modes (local and individual events)?
For both, we will identify the conditions under which IV may persist in a host-population and determine characteristics of the spatio-temporal spread of IV among populations. Thus, combining epidemiology and bird migration in such model will identify key times and places for the spread of infectious diseases as well as sensitive parts in the dynamics of hosts and pathogens and thereby, provide a basis for potential management actions.

## IPY.NL theme 4:
## Influence of human activities on polar regions, and influence of climate change on humans

*Bipolar*

**LASHIPA-NL: The exploitation of the natural resources in Polar Regions, 1600-2000**

Prof. dr. L. Hacquebord
Rijksuniversiteit Groningen, Faculteit der Letteren – Arctisch Centrum
*(coordinating project)*

The exploitation of natural resources in polar areas is an instructive example of the way man is dealing with the natural resources in the world. In both Polar Regions the voyages of discovery enabled the commercial companies to penetrate into the polar areas to begin with the exploitation of the natural resources and to start scientific research. On many places in the regions settlements and stations were established to support the production of raw materials and to facilitate scientific research.
Until now, the exploitation of natural resources in polar areas and the history of science were almost exclusively studied from a regional and national approach based on written sources in the archives in the countries involved. The aim of the IPY LASHIPA-project # 636 is to study the various (hunting, whaling, mining and research) settlements/stations in the field and the written sources in the archives from a bi-polar, international and comparative perspective.
The principal research question of the coordinating project is:
Why, how and under what economic circumstances were the natural resources in the Polar Regions exploited, what was the role of the settlements/stations in this process? What were the economic results and what were the consequences of these activities for the natural environment, the geopolitical situation, and the development of the international law?

Field research will be carried out in the historical sites in both polar areas and archive research will be done in the countries involved in the project to collect the necessary data to answer the principal question of this research. In this way the exploitation activities in polar areas of companies from Norway, Netherlands, Sweden, UK, Russia and the USA will be studied in the field and in the archives. The outcome of the various studies will be compared with each other to achieve a better understanding of the exploitation of natural resources in Polar Regions.
For practical and methodological reasons the research will concentrate on two selected areas: Green Harbour on Spitsbergen and the Antarctic Peninsula including South Georgia. Both areas have had a very similar and comparable exploitation history.
LASHIPA-NL, the Dutch part of the international project will concentrate on the exploitation of the natural resources in Green Harbour in Spitsbergen. One PhD-project of LASHIPA-NL will focus on the pre-industrial exploitation of natural resources in Green Harbour. Its an archaeological project which will concentrate on the excavation of the remains of an early European whaling station and a Pomor hunting station on Kokerineset. The other PhD-project of LASHIPA-NL will study the history of the coal exploitation of the Dutch Spitsbergen Coal Company (NESPICO) in the same fjord in de period after the industrial revolution.
The post-doc of LASHIPA-NL has the task to produce a synthesis based on previous research in polar history, the outcome of the two PhD-projects of LASHIPA-NL, and the other LASHIPA projects in the Antarctica peninsula (South Georgia) to explain the development of polar industries, the economic results and its consequences for the natural environment, the geopolitical and the development of international law.

This project contributes to the following international IPY activities:
**LASHIPA** Large Scale Historical Industrial Exploitation of Polar Areas
Lead Country: The Netherlands (IPY Activity ID No 10)

*Bipolar*

**Green Harbour, Spitsbergen, and the international history of exploitation of the polar areas**

Prof. dr. L. Hacquebord
Rijksuniversiteit Groningen, Faculteit der Letteren – Arctisch Centrum
(subproject 3 of "LASHIPA-NL")

The geographical discoveries in the polar areas have made it possible for individuals and companies to penetrate into the polar areas. The discoveries led not only to further exploration and exploitation of natural resources but also to the development of scientific research. In both cases, settlements and stations were built to facilitate the work and to lodge the people. These settlements and stations play an important role in the coordinating LASHIPA-NL project. Together with the written sources the settlements/stations are the main source of information to address the principal research question of the coordinating LASHIPA-NL project:
Why, how and under what economic circumstances were the natural resources in the Polar Region explored and exploited, what was the role of the settlements/stations in this process? What were the economic results and what were the consequences of these activities for the natural environment, the geopolitical situation, and the development of the international law.
For practical and methodological reasons the LASHIPA research will concentrate on two selected areas: Green Harbour on Spitsbergen and the Antarctica peninsula including South Georgia. Both areas have had a very similar and comparable economical development.
LASHIPA-NL, the Dutch part of the international project will concentrate on the exploitation of the natural resources in Green Harbour in Spitsbergen.
The aim of the post-doc project is to produce a broad synthesis, in general terms explaining the development of polar industries and its consequences from a comparative, bi-polar and international historical perspective. The synthesis not only will draw on the research within the two PhD-projects of LASHIPA-NL in Green Harbour in Spitsbergen, but also on the results of the other LASHIPA projects in the Antarctica Peninsula region and previous research in polar history of science, industry and geopolitics ? research often published in Scandinavian languages and therefore not accessible to the broader international community.
In order to synthesize and address the principal question of the LASHIPA-NL project, the post-doc project will focus on the driving forces behind the exploitation of the natural resources, the technological systems used by the companies, the social organisation of the workers, the control of the area and the natural resources, the geopolitical and international law consequences and the approach of the natural resources. These six different but interrelated themes, cover the four periods studied within the LASHIPA project; the whaling periods in the Arctic (1550-1982) and

Antarctic (1904-1982), the mining period in the Arctic (1870-present), fisheries and tourism (1900-present) and the oil industry period in the Arctic (1900-present).

*Arctic*

**The coal exploitation of the Dutch Spitsbergen Coal Company (NESPICO) in Green Harbour, Spitsbergen, in its national and international context**

Prof. dr. L. Hacquebord
Rijksuniversiteit Groningen, Faculteit der Letteren – Arctisch Centrum
(subproject 2 of "LASHIPA-NL"))

This PhD project involves research into the history of the Dutch Spitsbergen Company (NESPICO). NESPICO was founded in 1920 and mined coal in Green Harbour fjord on Spitsbergen from 1921 to 1926. In I932 the propriertors sold the mine, including its settlement Barentsburg, to the Russian Trust Arktikugol. The PhD student will study NESPICO's motives, policy, results, including its ecological impact in Spitsbergen, in its technological, economical, political and legal context. Were NESPICO's motives purely commercial or did they have political aspects, too, connected with the policy of the Dutch government with regard to Spitsbergens international status, which was defined by the 1920 Spitsbergen Treaty? What explains NESPICO's ability to mine on a very high technological level in such a remote region? Wat was the structure of Barentsburg? What security, legal and political instruments did NESPICO have to protect its interests on Spitsbergen? What explains NESPICO?s ultimate failure?
This project will contribute to the conservation of a unique item of Dutch cultural heritage outside The Netherlands. It will provide vital information for the development of sustainable cultural heritage tourism and sustainable exploitation of the natural resources in polar areas. This is of great societal significance as, as it is, both industries threaten the natural environment.