Scientific research in Antarctica and the role of SCAR

Jerónimo López-Martínez
President of SCAR

Turkish Antarctic Science Programme Road Map Workshop

Istanbul, Turkey, 18-19 November 2013
SCAR flag flying over the Ridge A international observatory

(Photo C. Kulesa, Feb. 2013)
Temperature

Oceanic circulation

Sea ice and ice shelves

Atmospheric dynamics and ozone hole
Antarctic sea ice

September 2013: 19.47 M km$^2$ measured historical maximum

acquired September 22, 2013 (NASA)
The next hundred years...

In the future the whole of the Antarctic Region is predicted to warm: 3.4°C by 2100

Source: John Turner (BAS)
Ice shelves desintegration

Glaciers calving and retreat

Images: NASA
Antarctic imbalance

Change in mass (Gt)

-2000
-1500
-1000
-500
0
500
1000

Sea level contribution (mm)

-2
0
2
4

1995 2000 2005 2010

East Antarctica
Antarctic Peninsula
West Antarctica

Slide: Andy Shepherd
Consequences in ecosystems
Introduction of foreign species

- Terrestrial: barriers for ‘aliens’ are reduced

- Introduced plants survive due to warming and wetting, and reproduce due to climate-induced invasion of pollinators

- Ecosystem functioning completely changed where predators invade
In summary...

- The ozone hole has shielded much of Antarctica from ‘global warming’
- Parts of the Antarctic are losing ice at a rapid rate
- On average sea ice extent has increased slightly
- The Southern Ocean absorbs significant CO₂; it is both warming and moving towards a more acidic state
- Antarctica will contribute to sea level rise over the next century, though by how much is still uncertain.
- Both marine and terrestrial ecosystems will change
- In order to improve predictions we need a better representation of polar processes and non-linear transitions in models

If you want to understand the Earth’s climate you need to know what is happening in Antarctica
Main ice cores

EPICA Kohnen Station
Jan. 2006
2774 m
300 000 years?

Dome F
Jan. 2006
3029 m
1 000 000 years?

Vostok
1996
3623 m
400 000 years

EPICA Dome C
Dec. 2004
3270 m
800 000 years

Byrd
1968
2164 m
80 000 years

• Existing ice cores
• In preparation
• Future projects
• Lack of information
Dome Fuji ice core stored at the NIPR, Japan

Fig. Van Liefferinge and Pattyn, 2013
12 september 2013

- Maximum 27 Mkm$^2$

- Was bigger than in previous year (2012), which was the second smallest in 20 years

- Largest recorded ozone Hole was in the year 2000 (29.9 Mkm$^2$)
A continent covered by ice

East Antarctica

West Antarctica

Antarctic Peninsula

Image: NASA's Goddard Space Flight Center (using BEDMAP 2)
Subglacial lakes

Water is abundant beneath the Antarctic ice sheet

Tulaczyk and Hossainzadeh, 2011

Wright and Siegert, 2012
Lake Vostok, (approx. 15,000 km²)

Lake Van (3755 km²)
Interest in studying subglacial lakes

- Global Climate Connections
- Paleoclimate Records
- Limnology and Biogeochemistry
- Geodynamics of Lake Evolution
- Subglacial Hydrology
- Ice Sheet Dynamics
- Microbiological Life, Evolution, and Adaptation
Minisubmarine with video-camera in the 800 m depth hole of subglacial Lake Whillans (February 2013)

Subglacial exploration: a scientific and technological challenge

- Clean technologies
- Drilling / access
- Sampling (sediments, waters)
- In situ observations and measurements
• An Interdisciplinary Scientific Body of the International Council for Science (ICSU)

• An observer to the Antarctic Treaty and the United Nations Framework Convention on Climate Change
SCAR’s Mission for 50+ Years...

**Science Leadership** - initiate, develop and coordinate high quality international scientific research in the Antarctic and Southern Ocean region

**Scientific Advice** - provide objective and independent scientific advice to the Antarctic Treaty System and other bodies, such as the IPCC
Elements of the Antarctic Treaty System

Strength Through Partnerships

Scientific Bodies of ICSU

- SCAR
- SCOSTEP
- CODATA
- IASCI
- SCOR
- IGBP/PAGES
- IGBP/SO-GLOBEC
- WCRP
- IGOS-P
- ICED
- iAnZone
- IPICS
- IPACS
- ACAP
- CCAMLR
- COMNAP
- APECS
- CEP
- GBIF
- IPA
- IWC
- WCRP
SCAR Membership

- **31 Full Members:** Argentina, Australia, Belgium, Brazil, Bulgaria, Canada, Chile, China, Ecuador, Finland, France, Germany, Italia, India, Japan, Korea, Malaysia, Netherlands, New Zealand, Norway, Peru, Poland, South Africa, Russia, Spain, Sweden, Switzerland, Ukrania, UK, USA, Uruguay

- **6 Associate Members:** Denmark, Monaco, Pakistan, Portugal, Romania, Venezuela

- **9 ICSU Scientific Unions:** IAU, IGU, INQUA, IUBS, IUGG, IUGS, IUPAC, IUPS, URSI
To accomplish its Mission SCAR has:

- **Standing Scientific Groups**
  - Expert Groups
  - Action Groups
  - Advisory Groups

- **Standing Committees**

- **Scientific Research Programmes**
  - Interdisciplinary Cross Linkage Workshops

- **Partnerships**

- **Open Science Conference**

- **Thematic Symposia/Workshops**
SCAR Scientific Research Programmes

- Major cutting-edge research questions
- International in participation and interdisciplinary in scope
- Expected duration: 6 to 8 years
- Strategic and implementation plans required
- 2-year internal and 4-year external review
- Data management policy and outreach plan
Scientific Research Programs

The new generation of SCAR SRPs

- State of the Antarctic Ecosystem (AntEco)
- Antarctic Ecosystems: Adaptations, Thresholds and Resilience (Ant-ERA)
- Past Antarctic Ice Sheet Dynamics (PAIS)
- Solid Earth Responses and Influences on Cryospheric Evolution (SERCE)
- Antarctic Climate 2100 (AntClim²¹)
State of the Antarctic Ecosystem (AntEco)

‘Biological diversity is the sum of all those organisms that determine how ecosystems function, and underpins the life-support system of our planet’

- Focuses on past and present patterns of biodiversity
- Will provide the scientific knowledge on biodiversity, including genetic diversity, species diversity and ecosystem diversity which,
- Coupled with increased knowledge of species biology, can be used for the conservation and management of Antarctic ecosystems.

Aleks Terauds <Aleks.Terauds@aad.gov.au>
Antarctic Thresholds – Ecosystem Resilience and Adaptation (AnT-ERA)

Examines biological PROCESSES, defines their TOLERANCE limits and determines RESISTANCE and RESILIENCE to change

Themes:
1. Physiology & biomolecular performance
2. Population processes & species traits
3. Ecosystem functioning & services

Julian Gutt <Julian.Gutt@awi.de>
Antarctic Climate Change in the 21st Century (AntClim21)

“Predictions of the future role and response of Antarctica to global change”

Themes:
1. Quantification of Antarctic climate variability
2. Climate model verification for the Antarctic region
3. Antarctic climate prediction to 2100
4. The impact of physical changes on the Antarctic environment and the biosphere

Nancy Bertler <Nancy.Bertler@vuw.ac.nz>
PAIS aims to improve our understanding of ice sheet dynamics during past warm world conditions by:

- Targeting the study of vulnerable areas around the continent;
- Linking ice-proximal records with coastal and offshore record;
- Integrating data into the latest generation of coupled GIA-Ice Sheet-Climate models.

Carlota Escutia <cescutia@ugr.es>
Solid Earth Response and influences on Cryosphere Evolution (SERCE)

SERCE aims to advance understanding of the interactions between the solid earth and the cryosphere, to better constrain ice mass balance and sea level change in a warming world.

- Glacial isostatic adjustment (GIA) and ice mass change
- The influence of solid earth parameters (e.g. heat flow, substrate) on ice sheet dynamics (and, hence, ice sheet mass balance…)
- Builds on the IPY Polar Earth Observing Network (POLENET) geophysical sensor deployment with modeling studies

Terry Wilson <twilson@mps.ohio-state.edu>
Other initiatives

- Southern Ocean Observing System (SOOS)
- Ice sheet Mass Balance (ISMASS)
- Antarctic Conservation Strategy
- Antarctic and Southern Ocean Science Horizon Scan
**MISSION:** To establish a multidisciplinary system to deliver the sustained observations of the Southern Ocean that are needed to address key challenges of scientific and societal relevance, including climate change, sea-level rise and the impacts of global change on marine ecosystems.

[www.soos.aq](http://www.soos.aq)
Antarctic Climate Change and the Environment (ACCE)

- Coordinates research across SCAR on past and potential future climate change over the Antarctic continent and in the Southern Ocean
- Annual Updates produced

John Turner <jtu@bas.ac.uk>
Data, Information and Products

• Standing Committee on Antarctic Data Management
  – Managers of National Antarctic Data Centers, Antarctic Master Directory

• Standing Committee on Antarctic Geographic Information
  – Manages Geographical Information, Gazetteer of Place Names, Antarctic Digital Database, Features Catalogues, Map catalogue
To achieve the Antarctic Treaty vision about share information, SCAR established the

**Standing Committee on Antarctic Data Management (SCADM)**

SCADM developed the

**Antarctic Data Management System (ADMS)**

ADMS:

A repository with data descriptions (metadata), linked to a network of data providers (**National Antarctic Data Centres (NADCs)**)
The SCAR Standing Committee on Antarctic Data Management (SCADM) was established to

- promote long-term preservation and accessibility of scientific data relating to Antarctica and the Southern Ocean in sustainable repositories

- assist in establishing Antarctic scientific data management policies, priorities and best practices

Members of SCADM are the managers of National Antarctic Data Centres or a relevant national contact if a NADC has not yet been established.

25 countries are active within SCADM

Further information can be found at:
http://www.scadm.scar.org
The Antarctic Data Management System consists of a network of National Antarctic Data Centres and the Antarctic Master Directory (AMD), coordinated by SCADM.

The Antarctic Master Directory (AMD) is the world’s largest repository of Antarctic data set descriptions. It is hosted by NASA’s GCMD.
The AMD content:

Total DIFs = 8448
New Records = 506
6% increase since July 2012
(Prior year’s growth: 4.2%)

51% of AMD records provide access to data through the “Get Data” Link.

Total #records: 4308
The AMD content:

Data from all disciplines in Antarctic research
Products

- Antarctic Digital Database,
- Antarctic Digital Magnetic Anomaly Project,
- Antarctic Biodiversity Information Facility and the SCAR Marine Biodiversity Information Network,
- Antarctic Biodiversity Database,
- Antarctic Map Catalogue,
- Antarctic Master Directory,
- Antarctic Bedrock Mapping,
- Composite Gazetteer of Antarctica,
- Continuous Plankton Recorder Database,
- International Bathymetric Chart of the Southern Ocean,
- Reference Antarctic Data for Environmental Research (Met, Ice and Ocean),
- Seismic Data Library System
- ........
The proven method of "Horizon Scanning" will be applied to develop a community view of the 100 most important scientific questions in Antarctic and Southern Ocean science over the next two decades.

- Community input has already provided about 1000 questions.
- SCAR will assemble 75 of the world's leading Antarctic scientists, policy makers, leaders, and visionaries in NZ next April.

http://www.scar.org/horizonscanning/
1st SCAR Antarctic and Southern Ocean Science Horizon Scan

**Purpose**

To identify the 100 most compelling questions in Antarctic and Southern Ocean science during the next two decades.

The Scan outcomes will assist in aligning international programs, projects and resources to effectively facilitate Antarctic science in the coming years.

Provide a community-based vision of the direction of Antarctic science in the next two decades.

Opportunity to enhance existing partnerships, forge new relationships and communicate the importance of Antarctic science.

The Scan will not attempt to directly address policy makers’ issues but policy makers will be included as Scan participants, and Scan outputs will benefit the other activities.
Management of the Horizon Scan

- SCAR Action Group on Horizon Scan Planning
  - 1st meeting December 2012 – Cambridge, UK
  - Organization of the process and First round of questions

- International Steering Committee (ISC)
  - Named July, 2013
  - Second round of questions
  - Selection of the Retreat participants

- The Horizon Scan Retreat
  - April 2014, in New Zealand

- Funding/Sponsorship
  - Tinker Foundation
  - Antarctica New Zealand/NZ Antarctic Research Institute
  - COMNAP
  - Several National Antarctic Programs and Institutes

Official Report to the Community:
SCAR Open Science Conference, August 2014
An Integrated Strategy for Antarctic and Southern Ocean Science and Policy Advice

**SCAR Science Horizon Scan (SHS)**
- Science Community (SCAR)
- Science funders (NAPs, funding agencies)
  - ACS

**Antarctic Conservation Strategy (ACS)**
- **Audiences**
  - Policy Makers
  - CEP/ATCM
  - ESP

**Antarctic Environments Portal (AEP)**
- **Audiences**
  - Policy Makers
  - CEP/ATCM
  - Antarctic Treaty Parties

**Affiliated Activities**
- Martha T. Muse Prize
- Muse Fellows Colloquium

**Societal Benefit**
- Encourage international partnerships and cooperation
- Expand the global knowledge database
- Inform policy discussions
- Improve decision-making
- Attain conservation and stewardship goals
- Educate and engage the public
• SCAR, with partners such as COMNAP and IUCN, is developing a strategy entitled ‘Antarctic Conservation for the 21st Century’ (ACS)
• The ACS links closely with the Environments Portal being developed by New Zealand, SCAR, Australia and others.

Jana Newman <j.newman@antarcticanz.govt.nz>
Scientific Advice to Policy Makers

- SCAR provides scientific advice to policy makers e.g. the Antarctic Treaty and the UNFCCC
- Advice to the Treaty is through its Standing Committee on the Antarctic Treaty System
- Provides papers (WPs and IPs) on subjects such as climate change, non-native species, persistent organic pollutants, marine noise,…
- Also provides a SCAR Science Lecture
Capacity Building, Education and Training

- Develop scientific capacity in its Members, emerging National Antarctic Programs, and students and early career scientists

- Promote and facilitate the incorporation of Antarctic science in education at all levels and communicate scientific information about the Antarctic region to the public

SCAR/COMNAP Fellowships

SCAR Visiting Professor Scheme

Martha T Muse Prize
SCAR & COMNAP Fellowships

Allows researchers from one SCAR/COMNAP Member country to undertake short term visits to major international laboratories, field facilities, and/or home institutions of other SCAR/COMNAP Member countries

- Encourages involvement of early career scientists
- Strengthens international capacity and cooperation
- Awards up to US $15,000

www.scar.org/awards
SCAR Visiting Professor Scheme

For mid- to late career stage scientists and academics. It provides them the opportunity to undertake short-term visits to a facility in or operated by SCAR Member countries, to provide training and mentoring.

- Strengthens international capacity and cooperation
- Awards up to US $2,500

www.scar.org/awards
SCAR Meetings

- SCAR Biology Symposium, 15-19 July 2013 (Barcelona, Spain)
- SCAR EXCOM Meeting and cross linkages meeting, 20-23 July (Barcelona, Spain)
- Biennial SCAR Meetings, 22 Aug/3 Sept 2014 (Auckland, New Zealand)
- SCAR International Symposium on Antarctic Earth Sciences, July 2015 (Goa, India)
- Biennial SCAR Meetings, 2016 (Malaysia)
Applications for SCAR Membership

• Have to be considered by the full meeting of the SCAR Delegates.

• This can of meetings are every two years and the next one will be in September 2014.

• Applications must be made at least six months in advance (i.e. by March, 1, 2014)
SCAR has a long and rich history as well as an special place amongst international scientific organizations, in that its focus, Antarctica, inspires everyone from school children to leading scientists and policy makers.

SCAR is foremost an organisation of members and they are very welcome those countries interested in contributing to Antarctic research.
For further details on SCAR activities see www.scar.org