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

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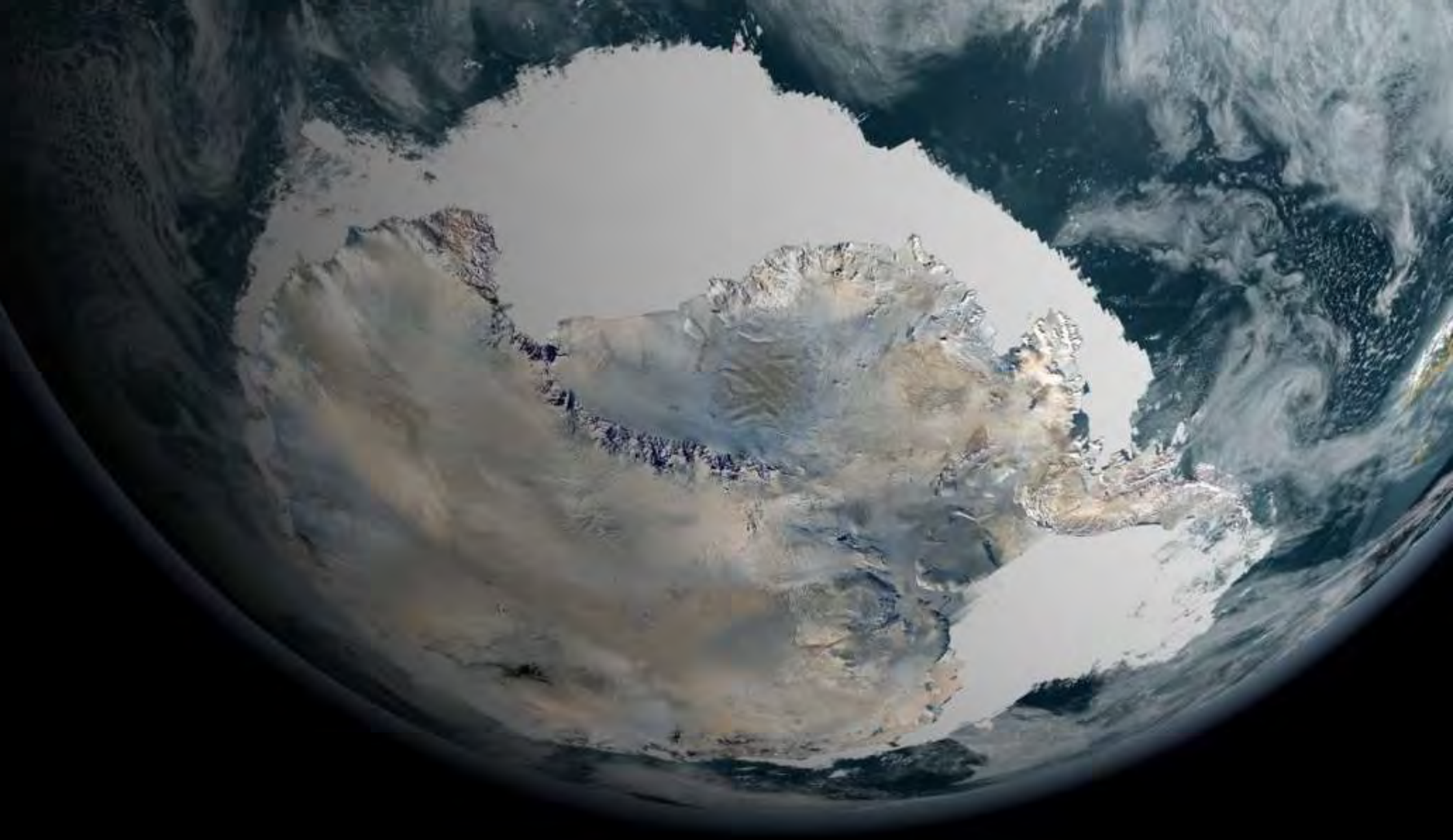
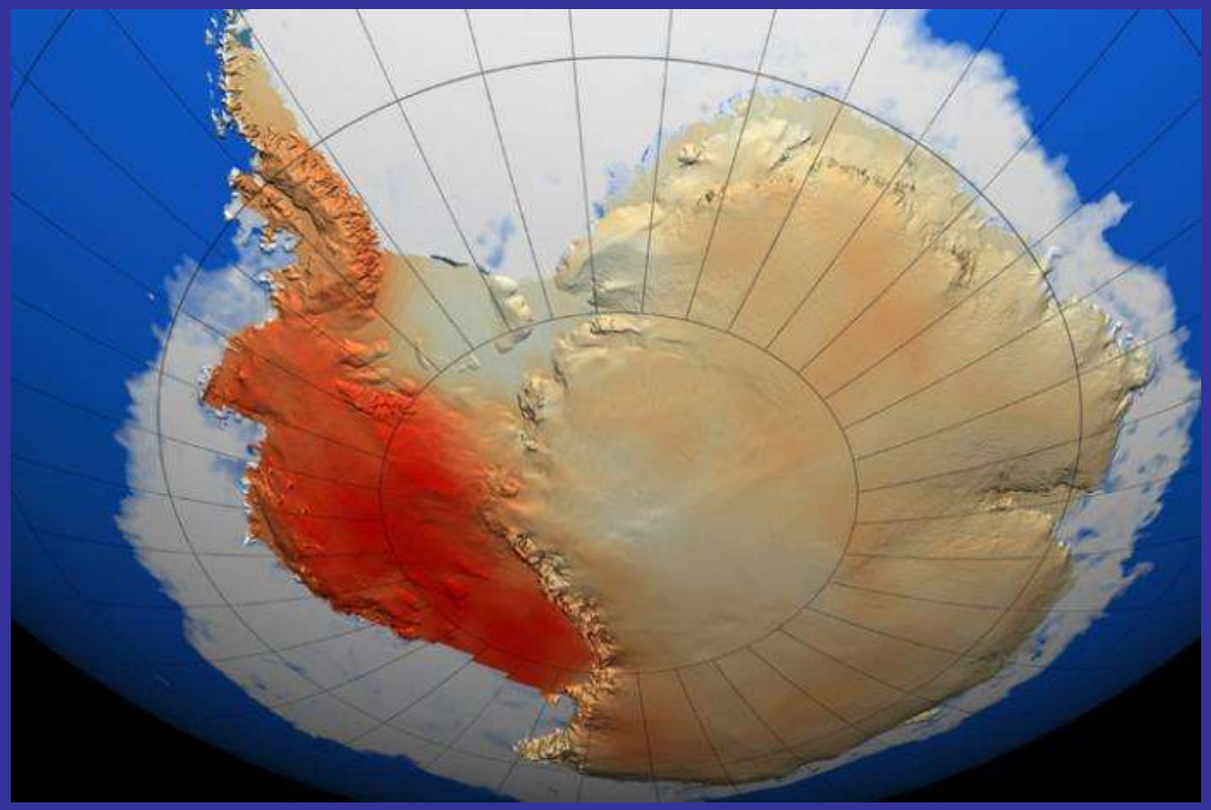
International Council for Science



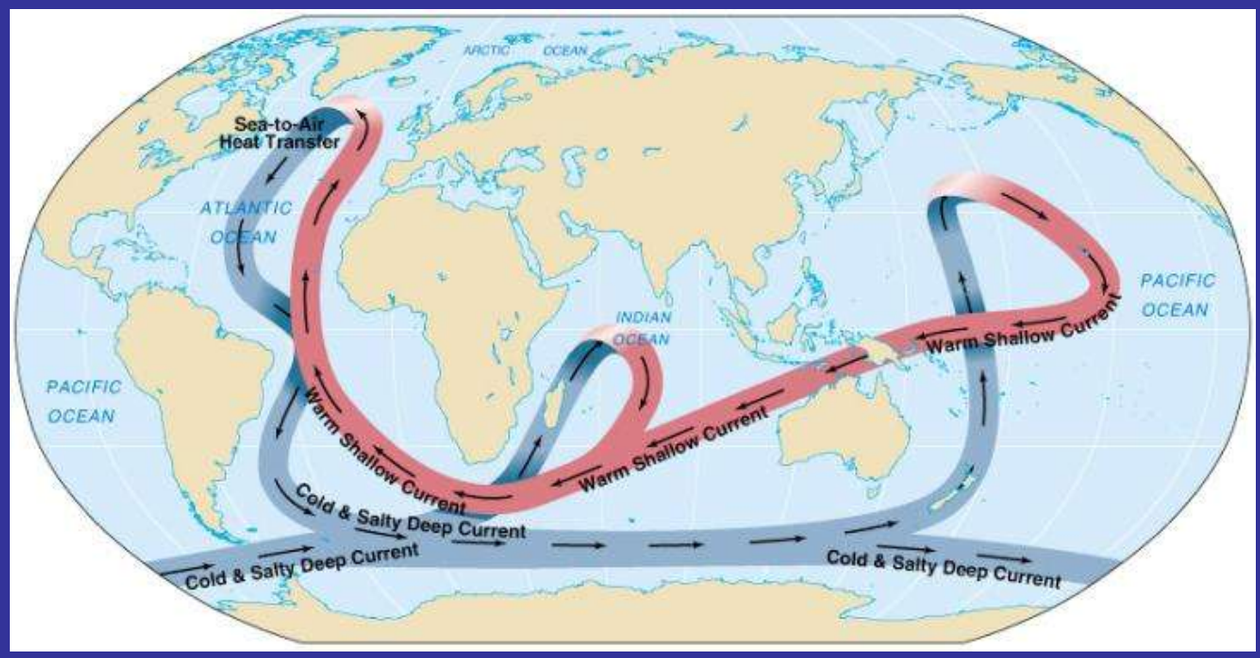
Science in Antarctica

SCAR flag flying over the Ridge A international observatory

(Photo C. Kulesa, Feb. 2013)

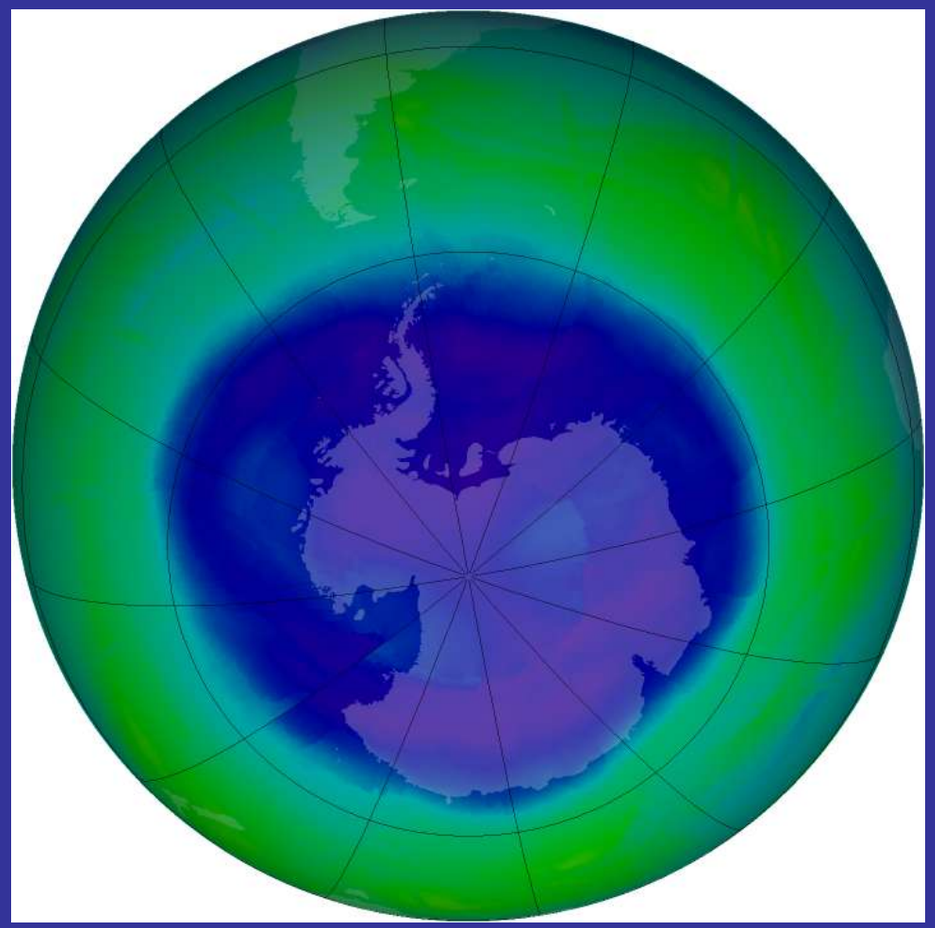


Temperature



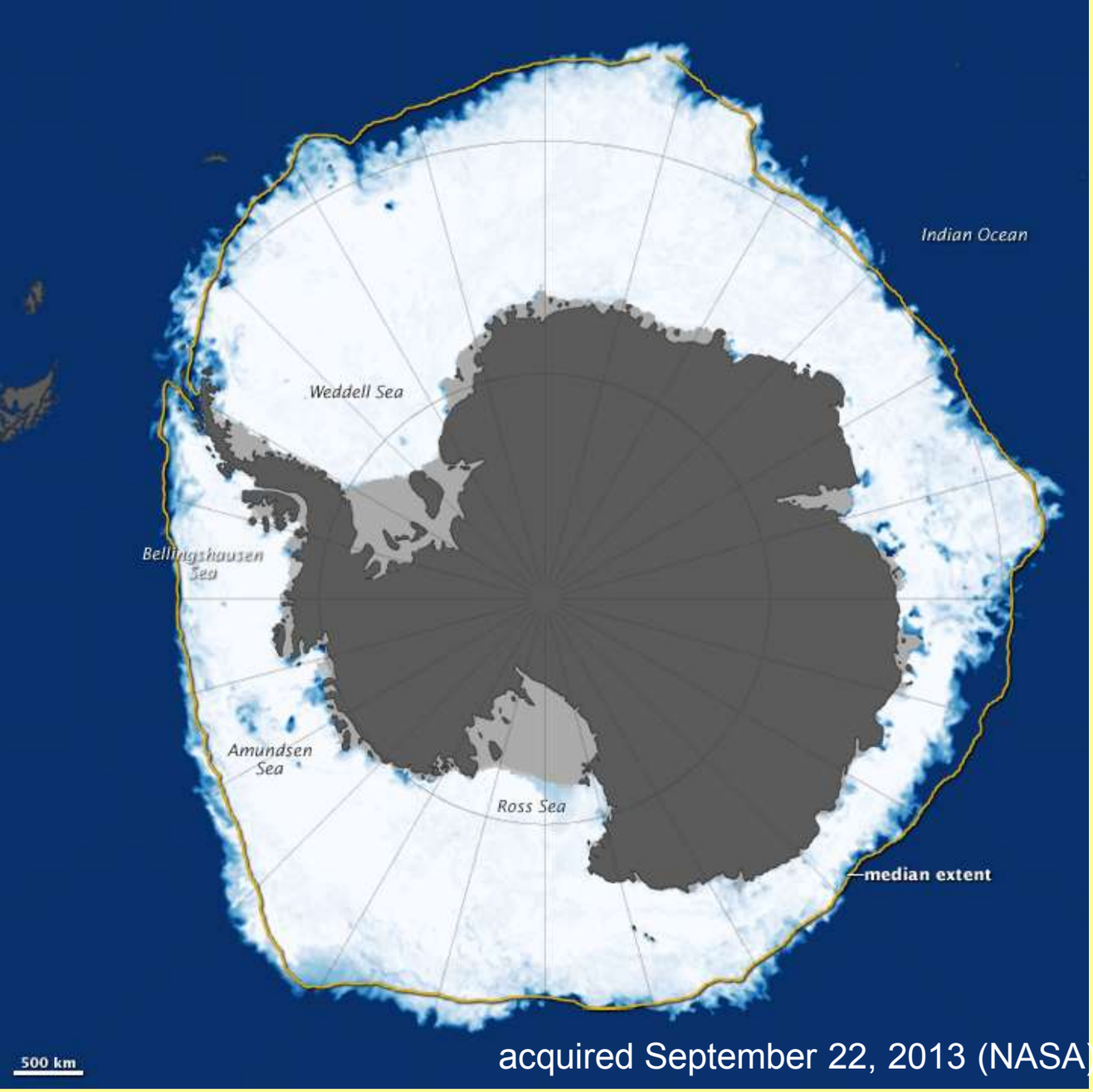
Oceanic circulation

Sea ice and ice shelves



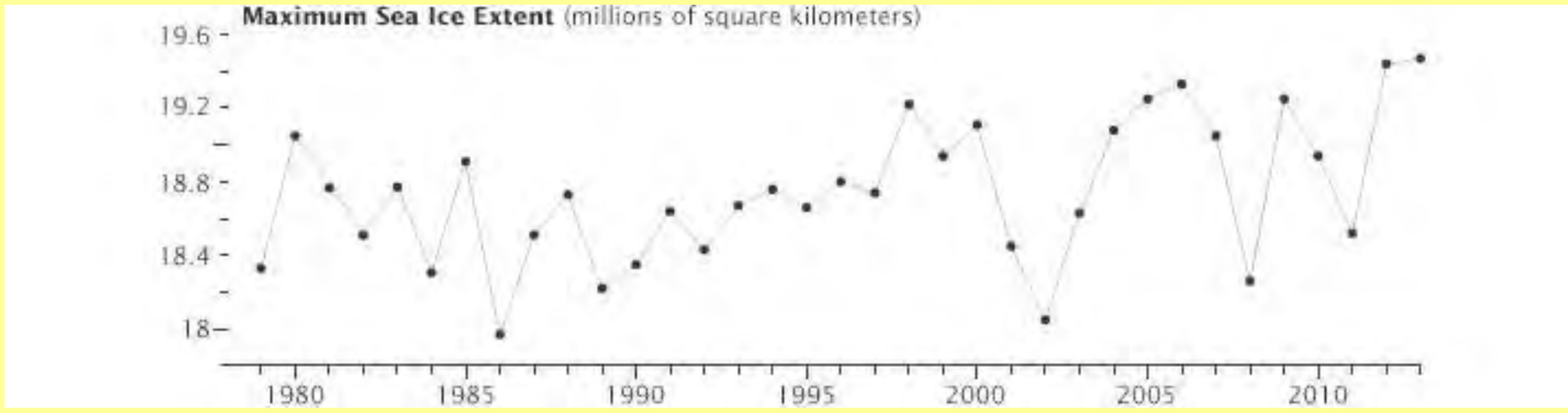
Atmospheric dynamics and ozone hole

Antarctic sea ice

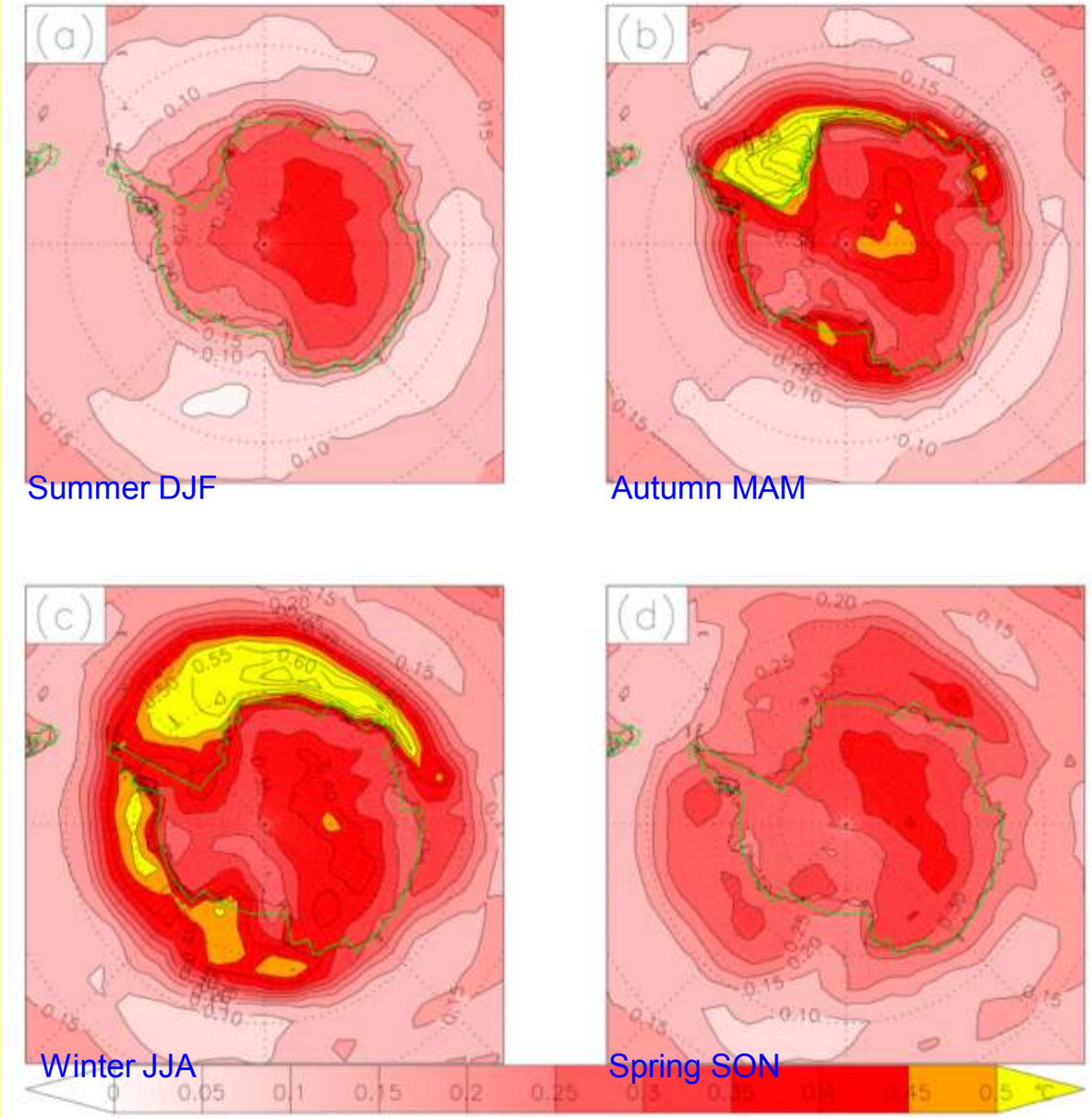


acquired September 22, 2013 (NASA)

September 2013: 19.47 M km^2
measured historical maximum



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)

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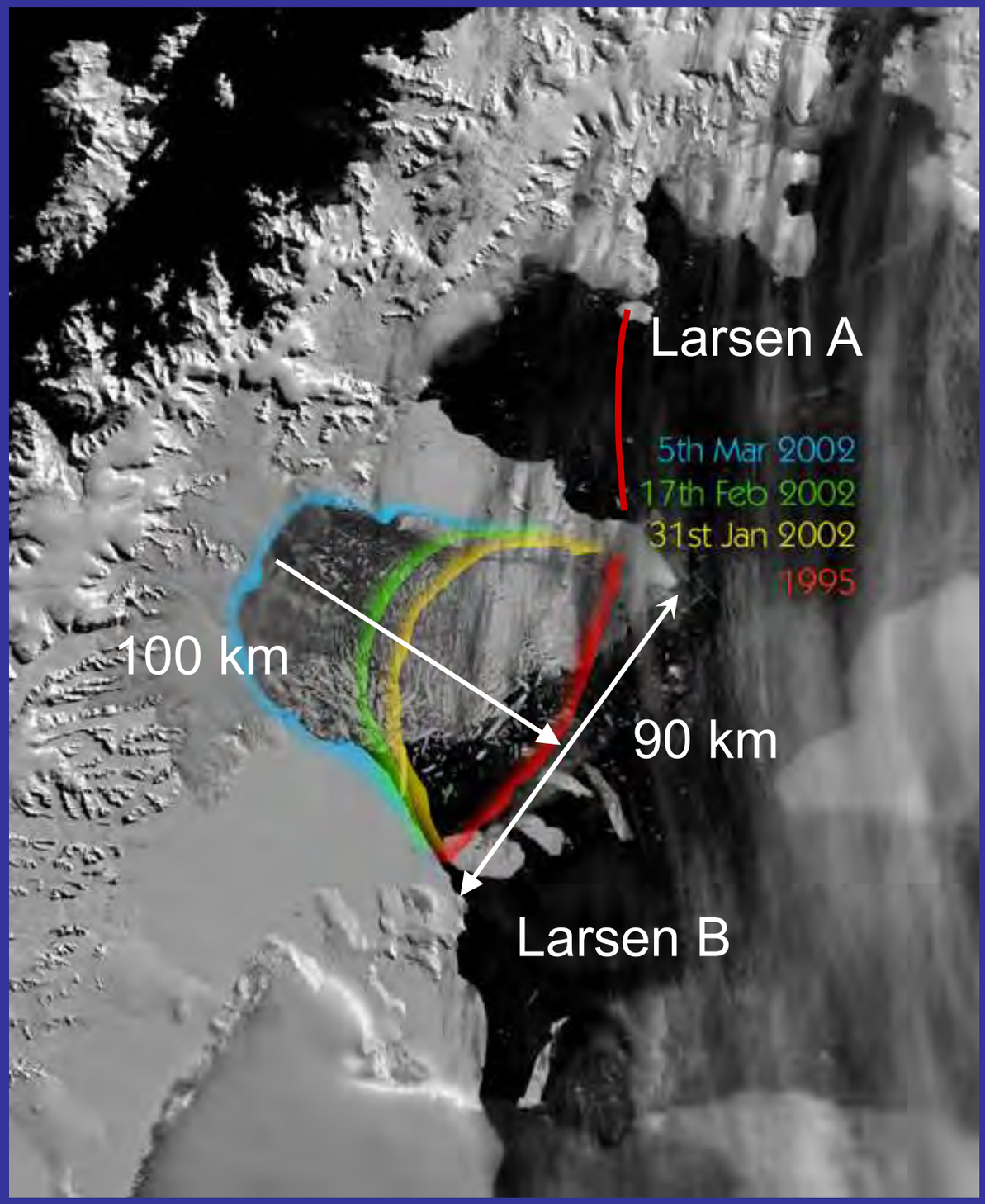
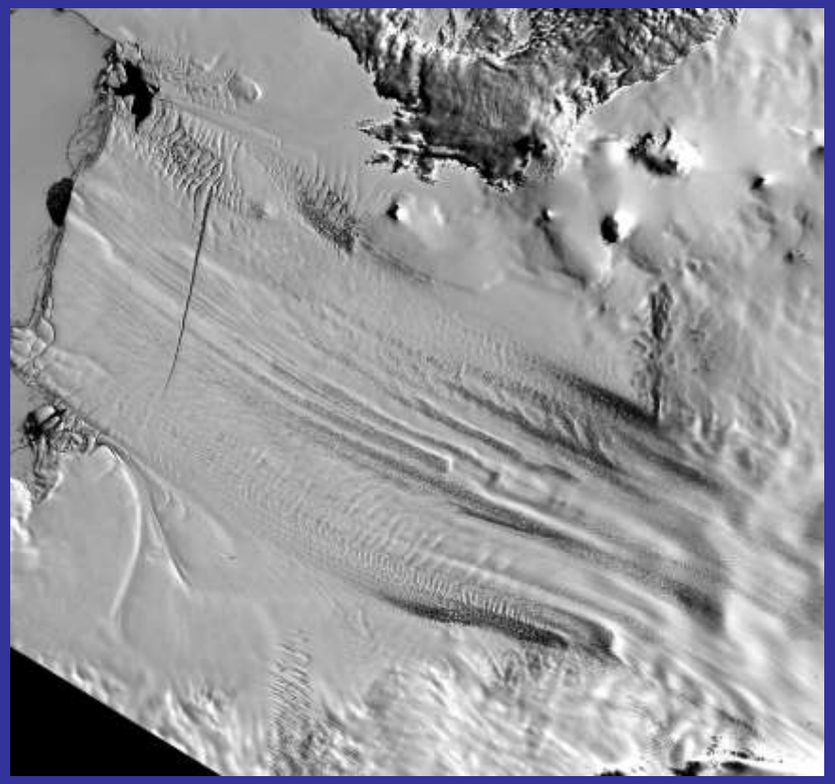
Ice shelves desintegration

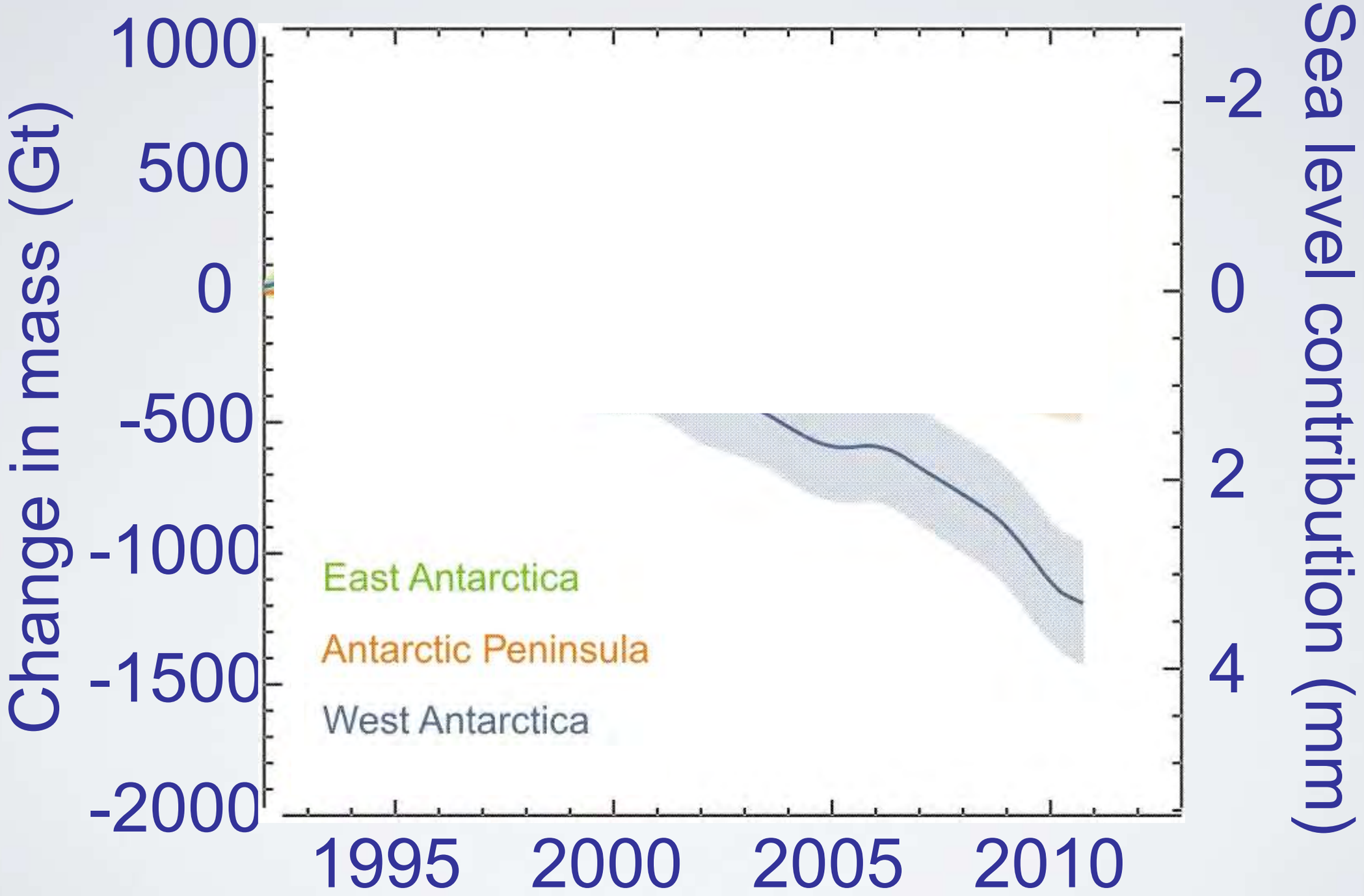


Glaciers calving and retreat



Images: NASA

Antarctic imbalance



Slide: Andy Shepherd

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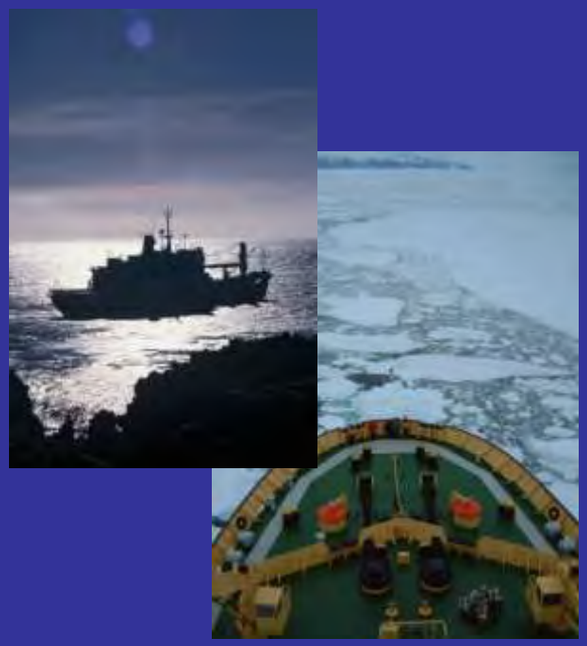
Consequences in ecosystems

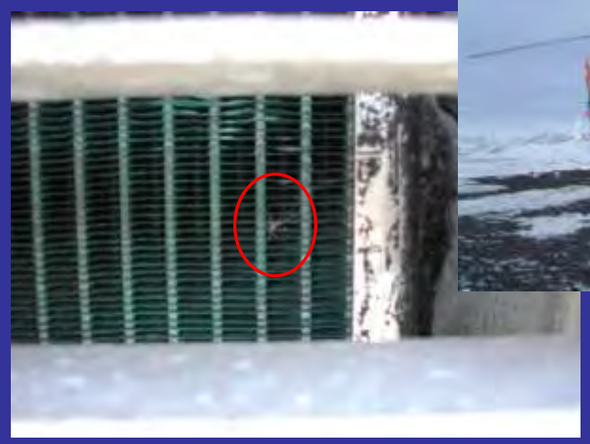
Introduction of foreign species



Ships

Containers

Food



Vehicles

Shoes

Clothes

-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 CO_2; 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

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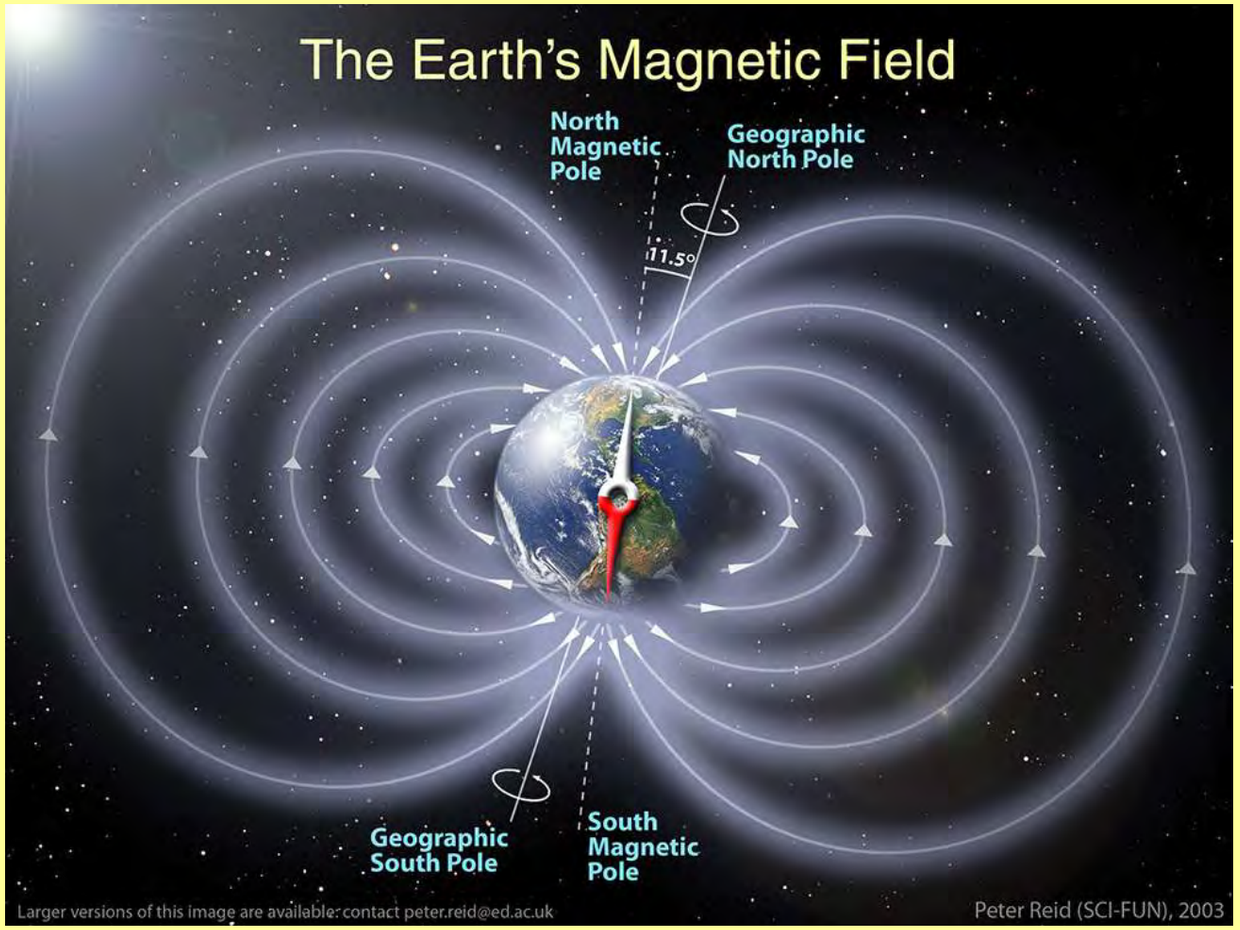
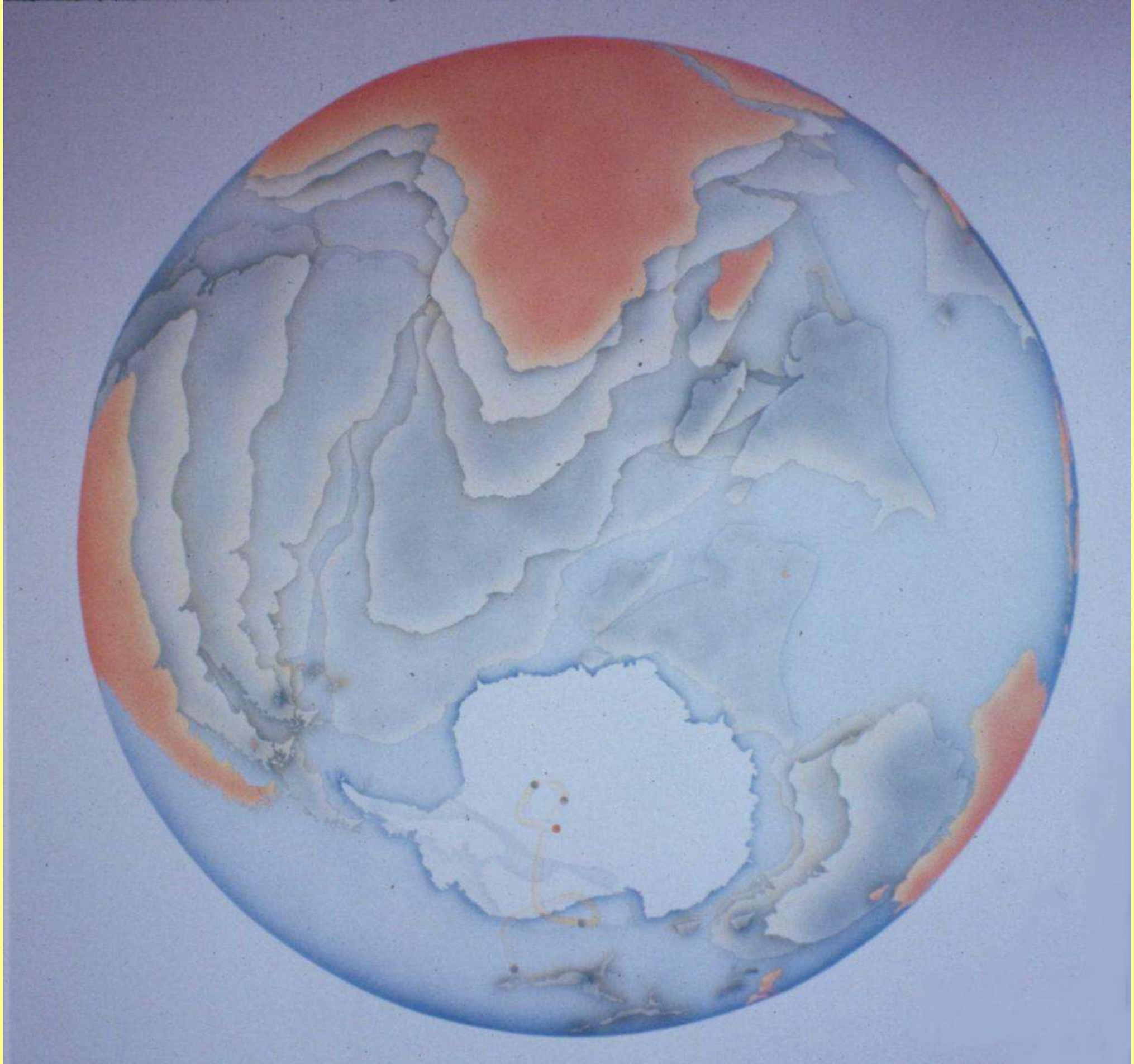
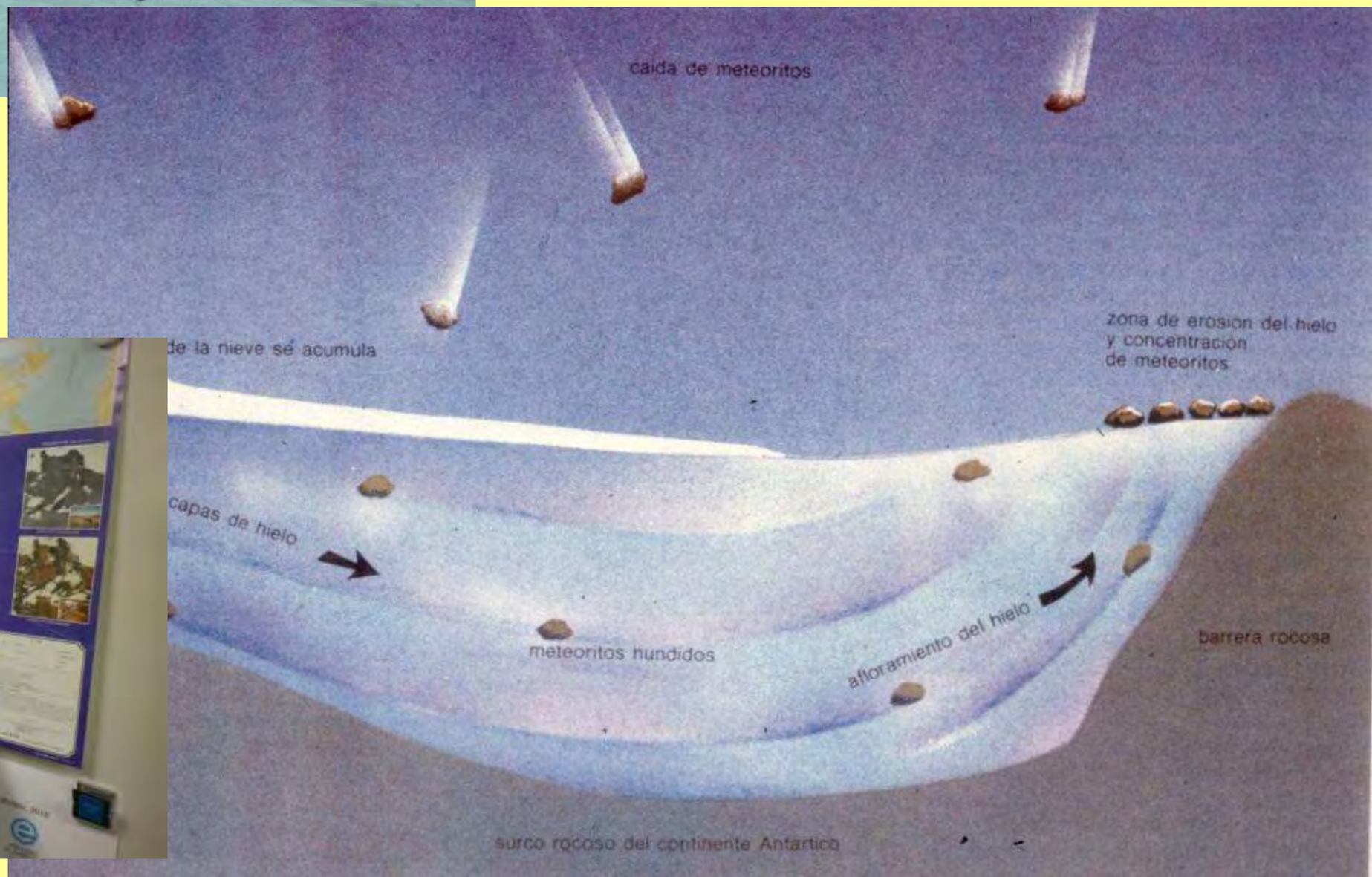

The Earth's Magnetic Field
North Magnetic Pole
Geographic North Pole
11.5°
Geographic South Pole
South Magnetic Pole
Larger versions of this image are available: contact peter.reid@ed.ac.uk
Peter Reid (SCI-FUN), 2003



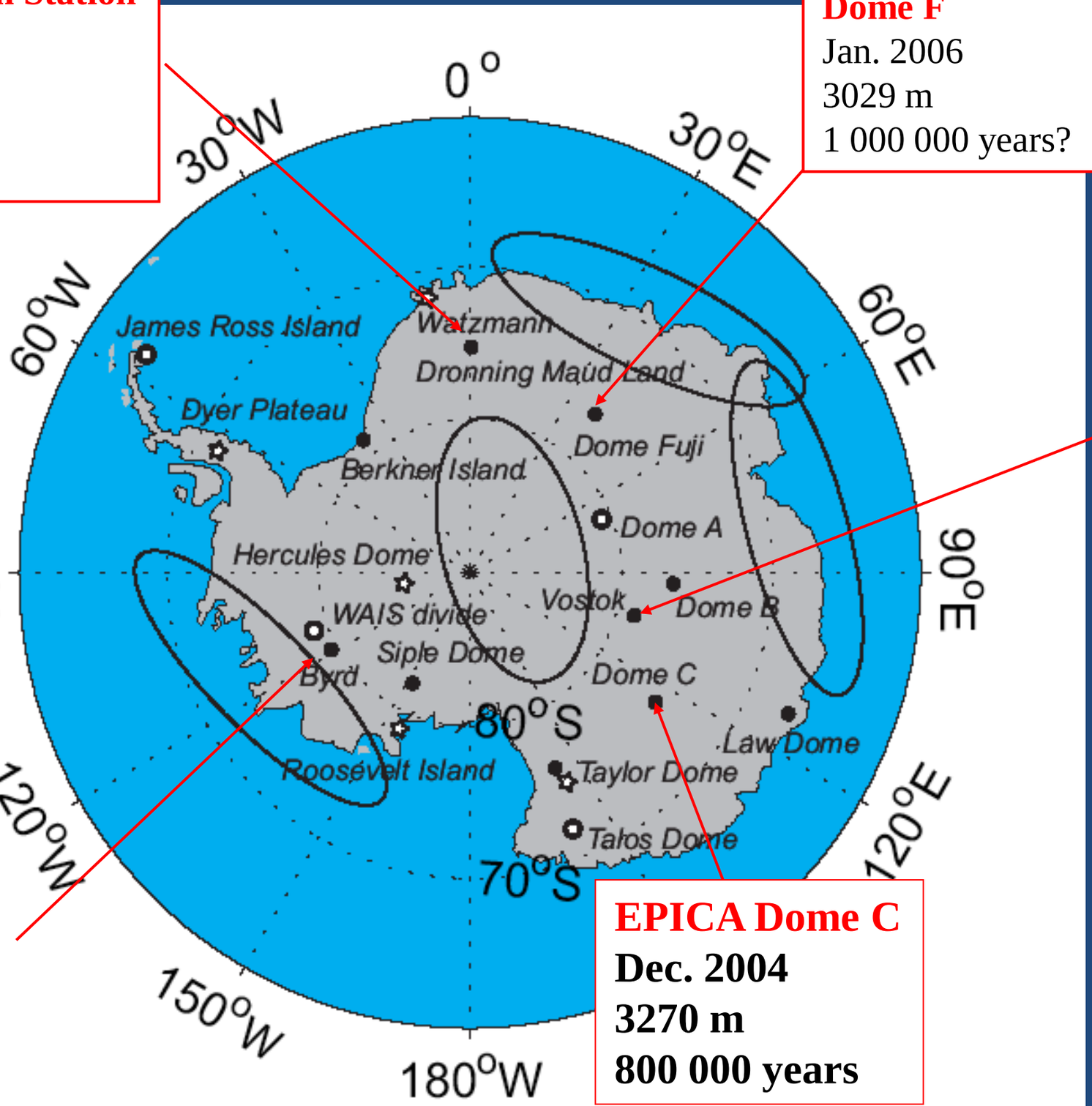

caída de meteoritos
de la nieve se acumula
zona de erosion del hielo
y concentración
de meteoritos
capas de hielo
meteoritos hundidos
afloramiento del hielo
barrera rocosa
surco rocoso del continente Antartico


Studies on the Nansen Ice Field
E-54 and BEARE 2012-2013

Main ice cores

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

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



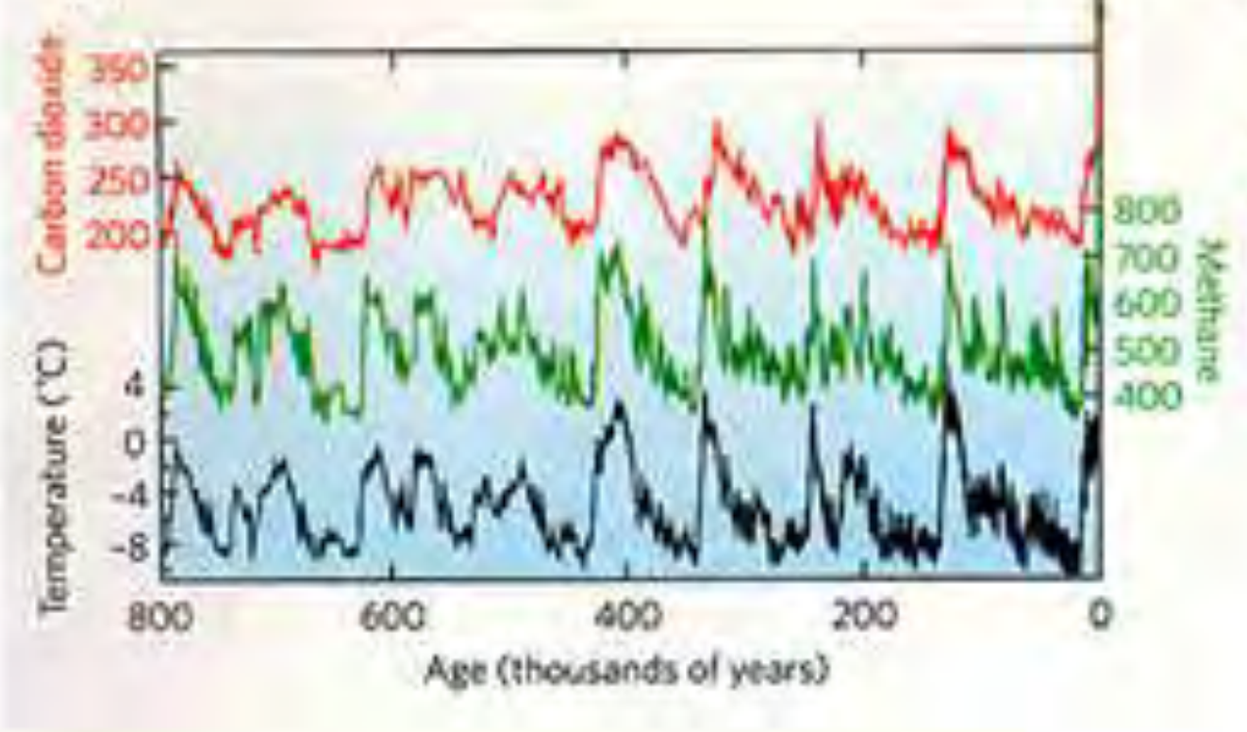
Vostok
1996
3623 m
400 000 years

Byrd
1968
2164 m
80 000 years

EPICA Dome C
Dec. 2004
3270 m
800 000 years

- ● Existing ice cores
- ○ In preparation
- ✪ Future projects
- ▭ Lack of information

Dome Fuji ice core stored at the NIPR, Japan



EPICA Project

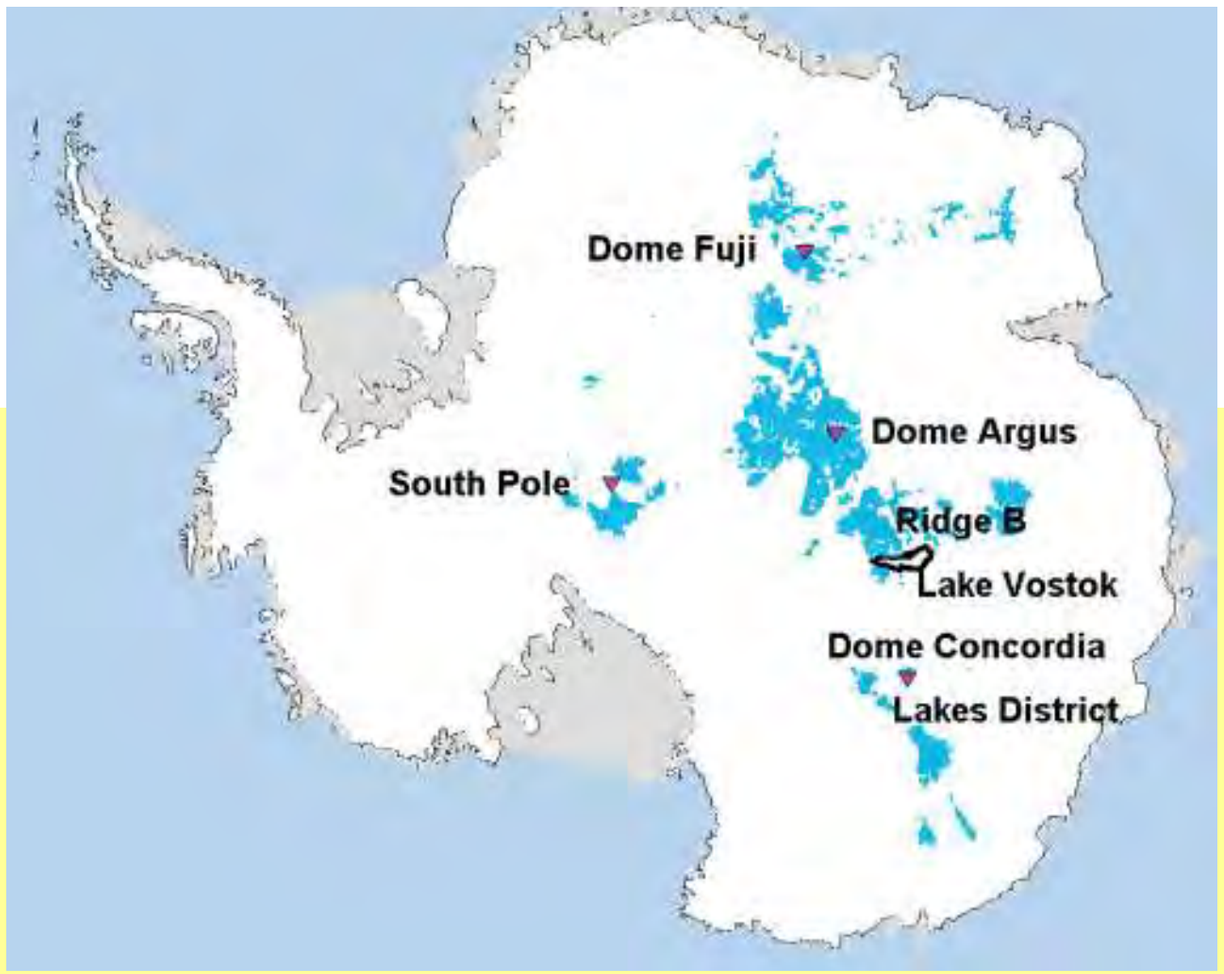
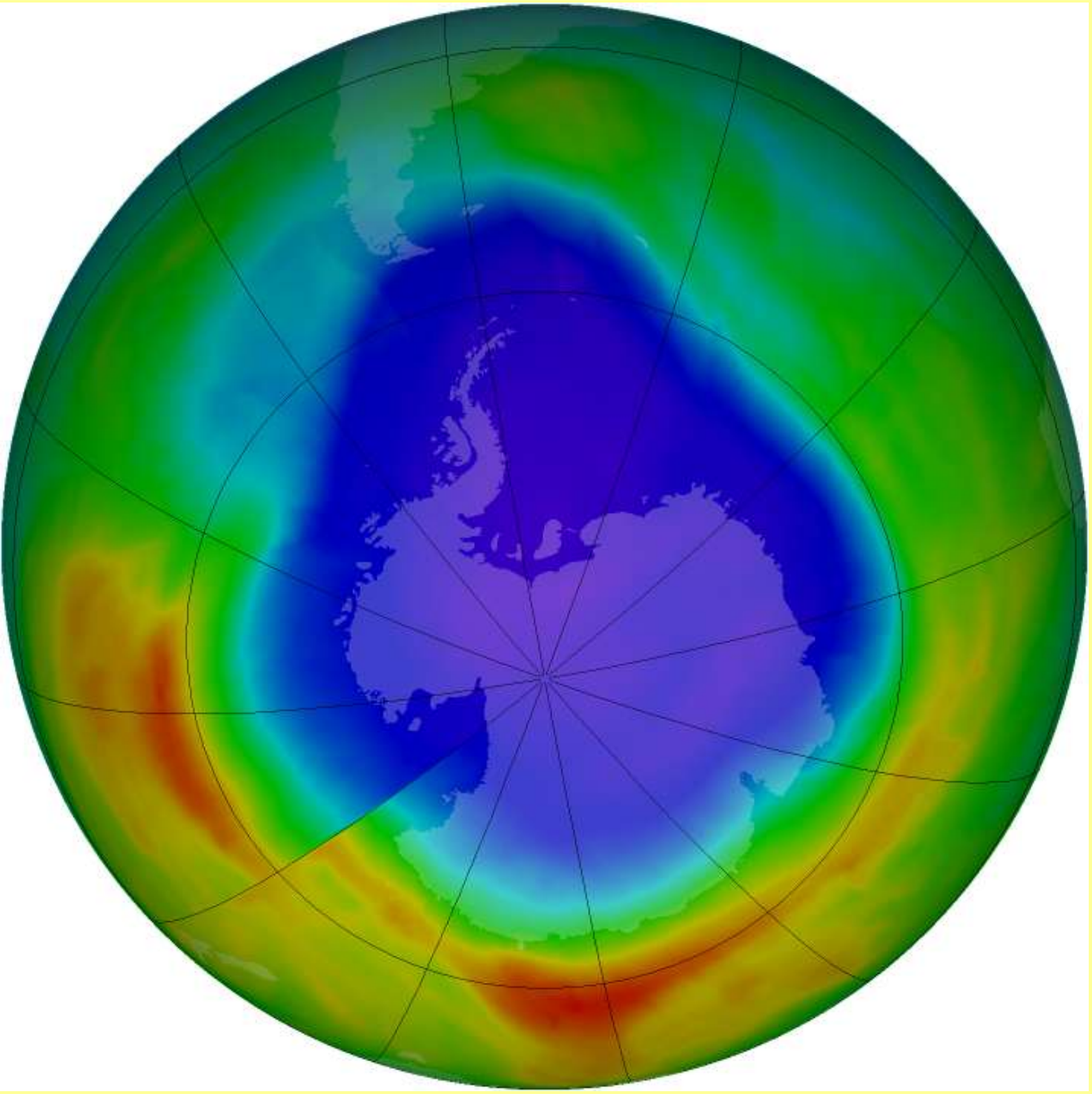


Fig. Van Liefferinge and Pattyn, 2013



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

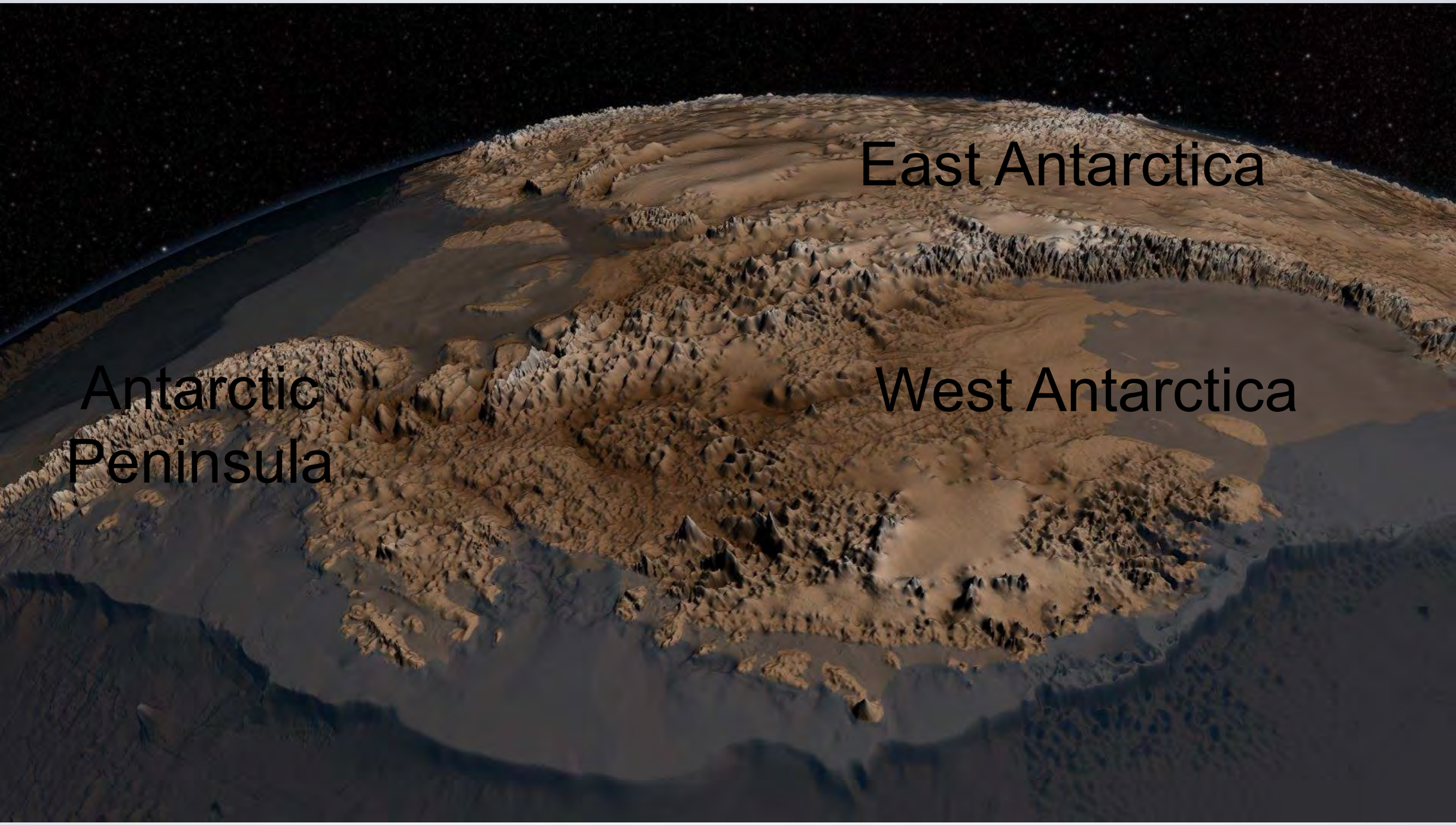


Image: NASA's Goddard Space Flight Center (using BEDMAP 2)

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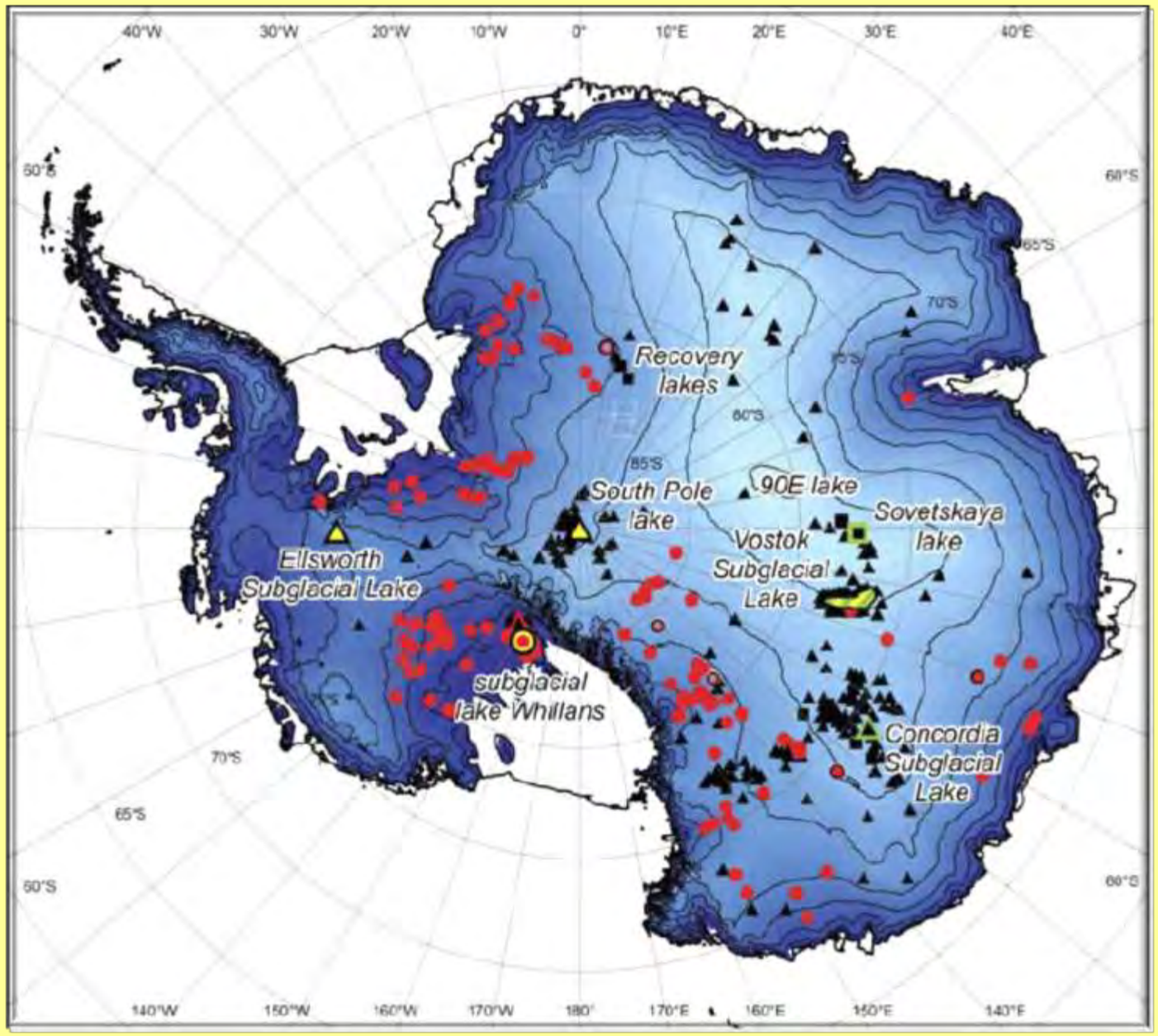
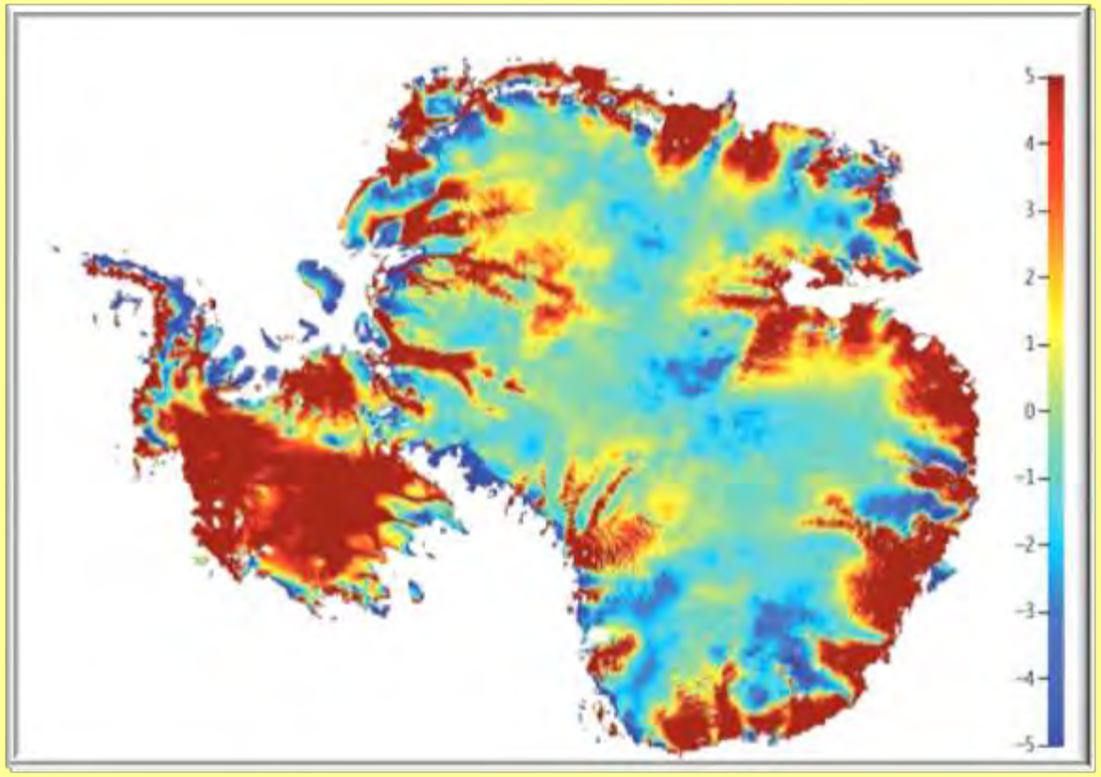
Water is abundant beneath the Antarctic ice sheet

Subglacial lakes

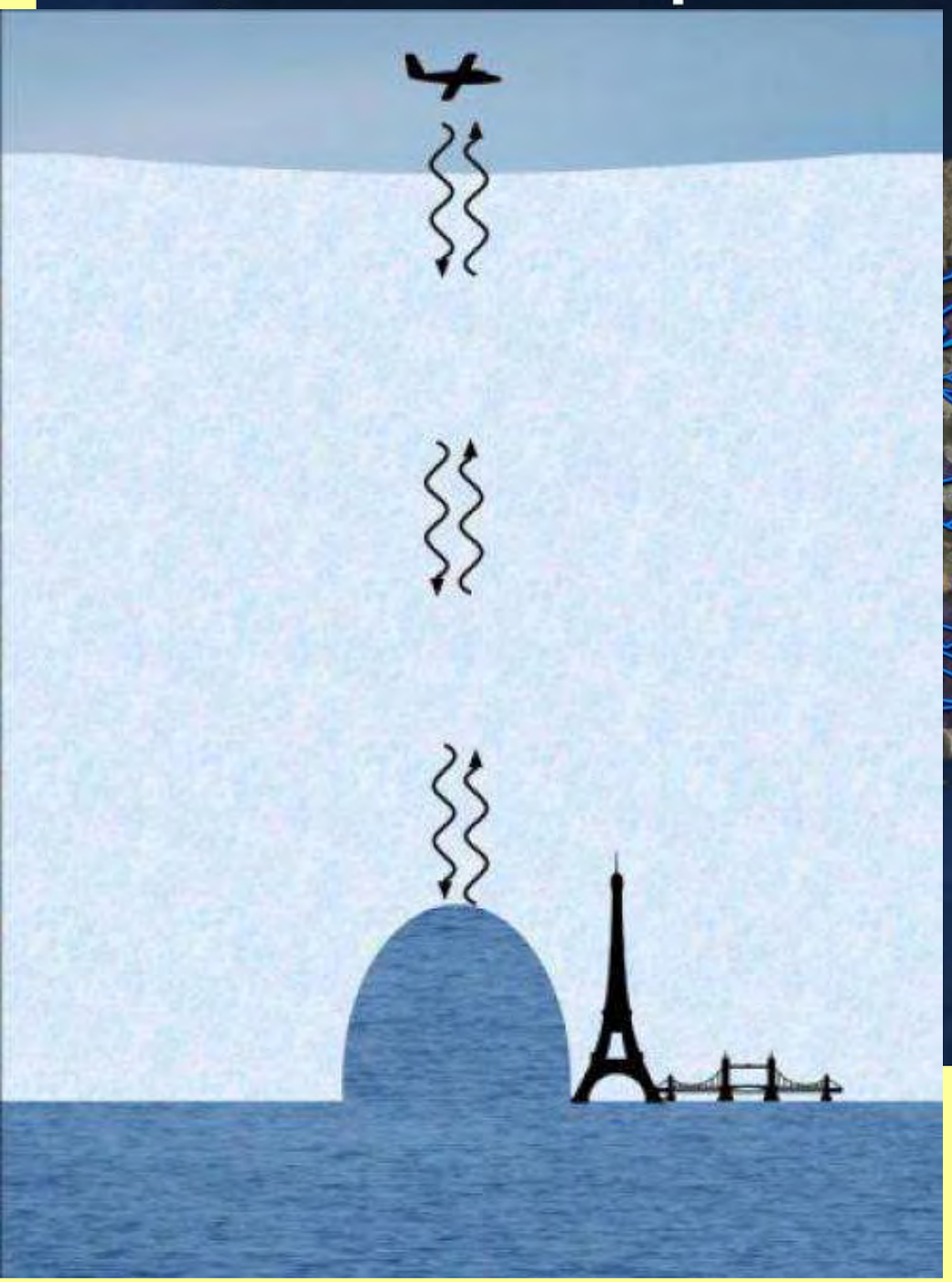


Wright and Siegert, 2012



Tulaczyk and Hossainzadeh, 2011

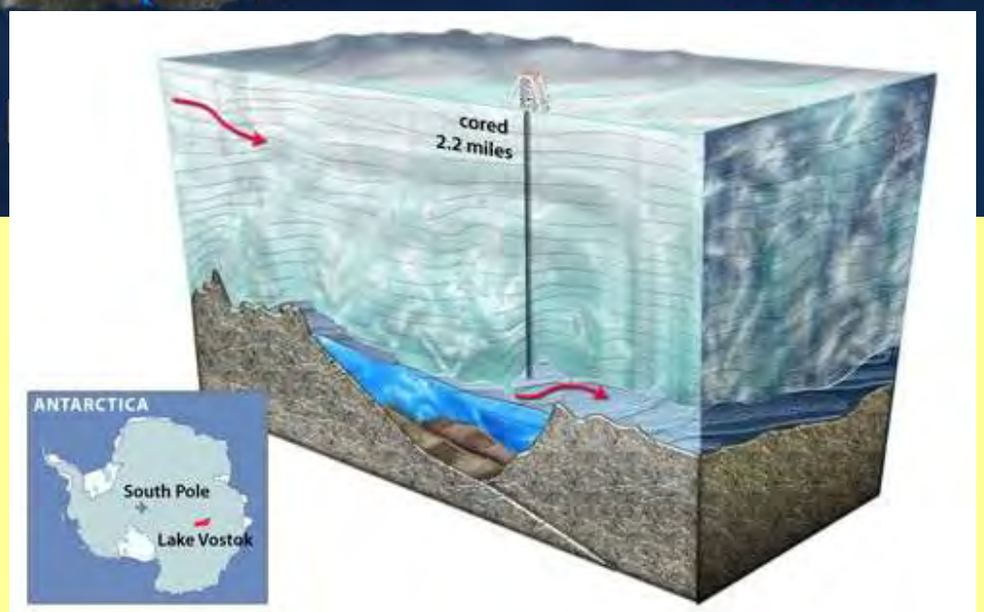
Lake Vostok,
(approx. 15,000 km^2)



Ice 2,000 m thick
(1.2 miles)

Lake
Vostok

Rivers

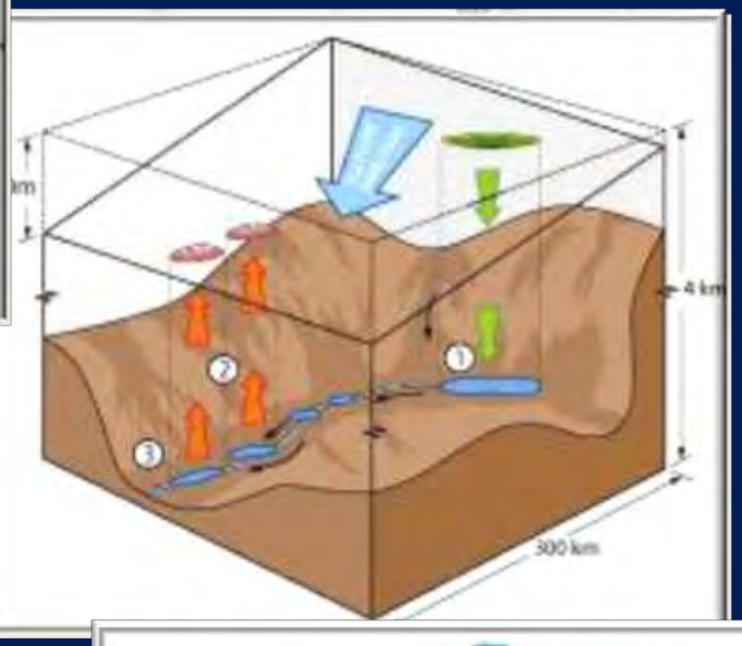


Le Brocq, A.M. et al. Nature Geoscience, Oct. 2013

Interest of studing subglacial lakes

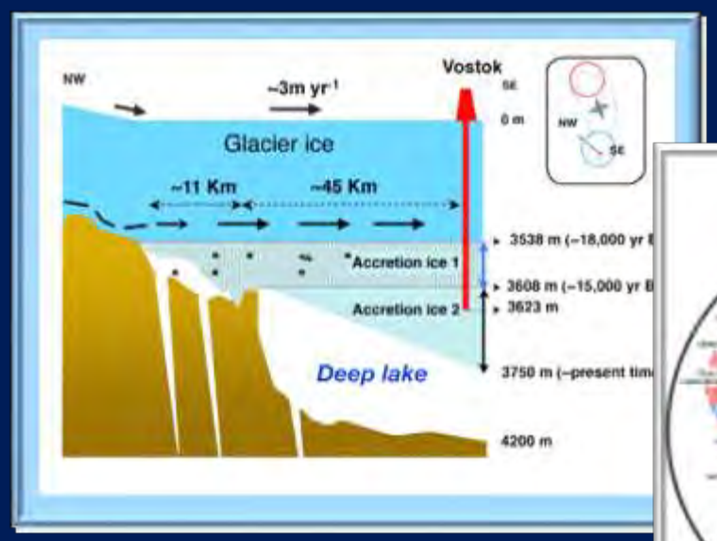
GLOBAL CLIMATE CONNECTIONS

GEODYNAMICS OF LAKE EVOLUTION

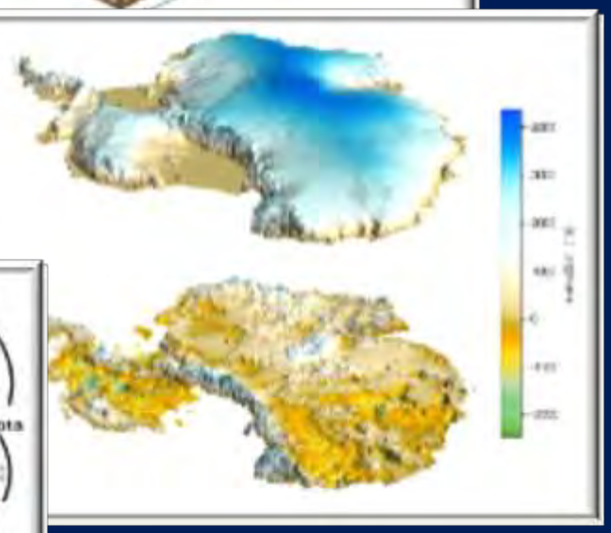


SUBGLACIAL HYDROLOGY

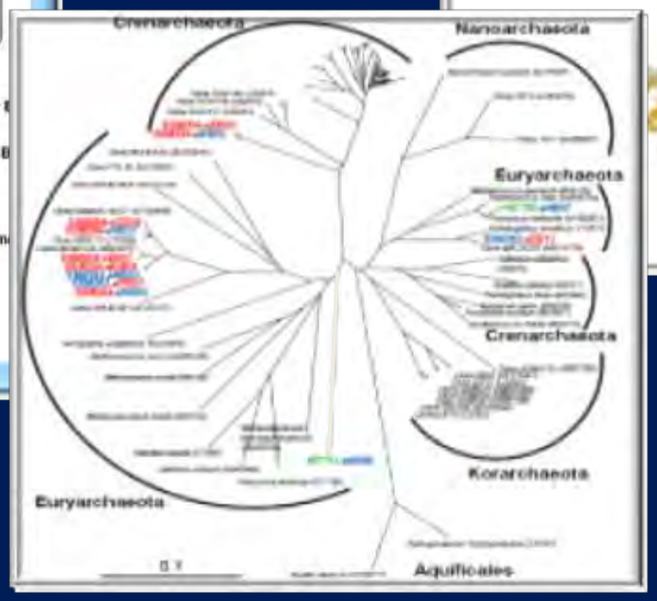
PALEOCLIMATE RECORDS



ICE SHEET DYNAMICS



MICROBIOLOGICAL LIFE, EVOLUTION, AND ADAPTATION



LIMNOLOGY AND BIOGEOCHEMISTRY

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)

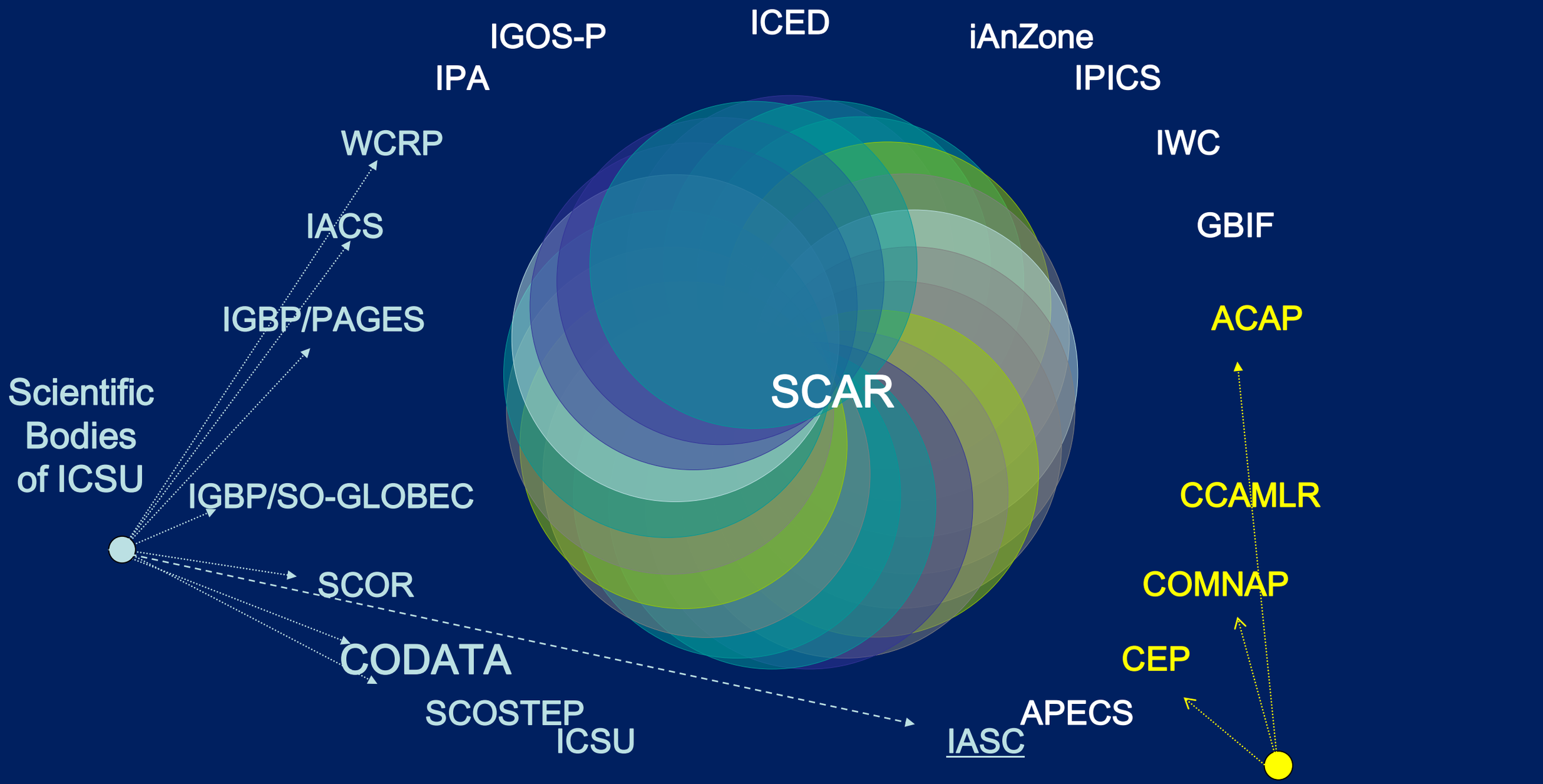
- An observer to the Antarctic Treaty and the United Nations Framework Convention on Climate Change

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

Strength Through Partnerships



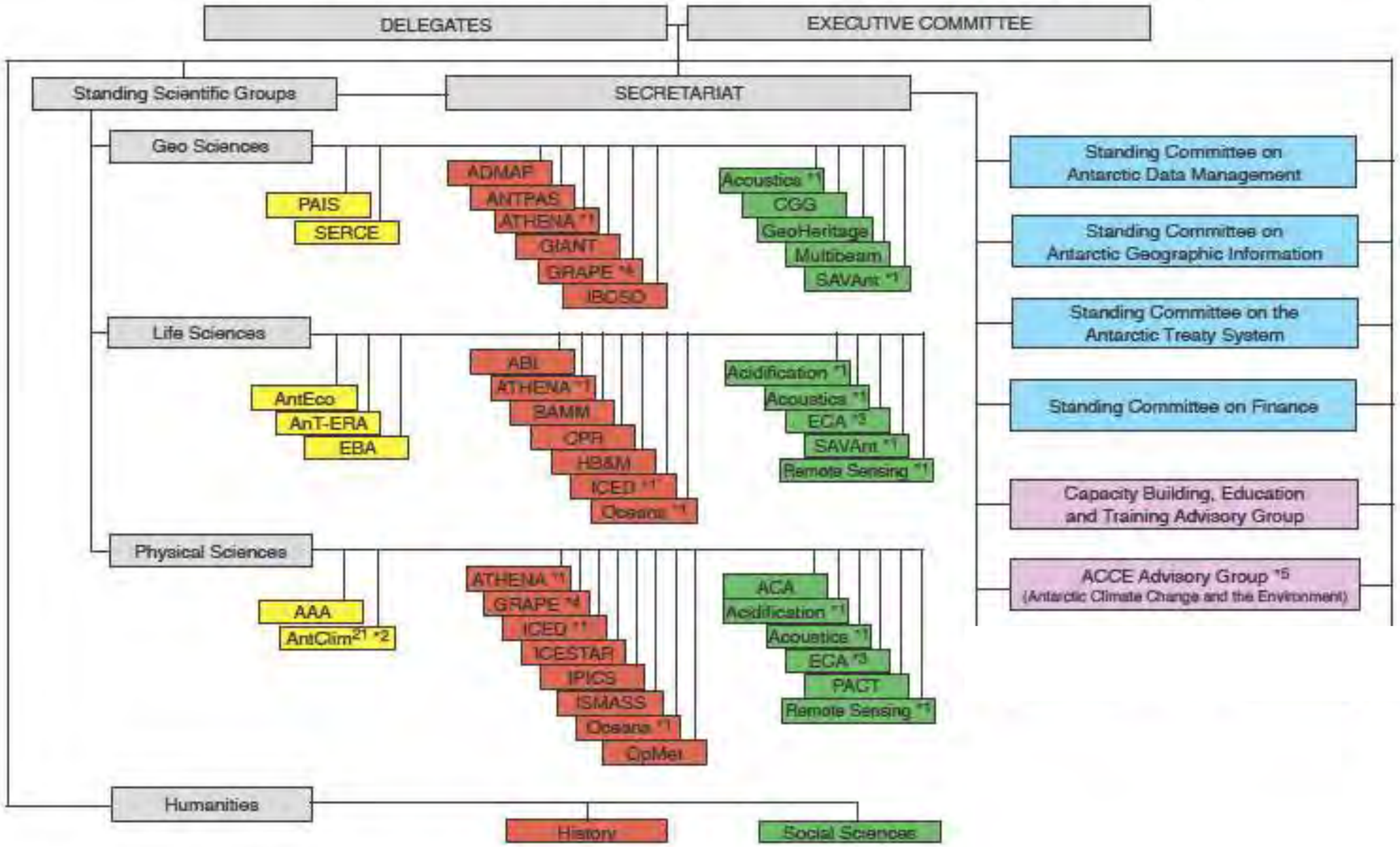
SCAR Membership

- 31Full 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**

The Organisation of the Scientific Committee on Antarctic Research (SCAR) (October 2012)



*1 jointly sponsored
*2 incorporates ASPeCt and ITASE
*3 incorporates AGAFS
*4 incorporates GWSWF
*5 incorporates PCPBEA

For Acronyms, see below

Scientific Research Programme Group

Expert Group

Action Group

Standing Committee

Advisory Group

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

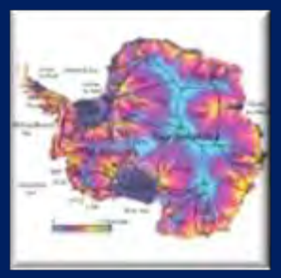
Scientific Research Programs

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 (AntClim^{21})**

SCAR Scientific Research Programmes

2004-2010



SALE
ATHENA

ICESTAR
EG-ICESTAR

2004-2012

AGCS

ACE

2005-2013

EBA

2010 -2014+

AAA

2013- 2021(?)

SERCE

AnT-ERA

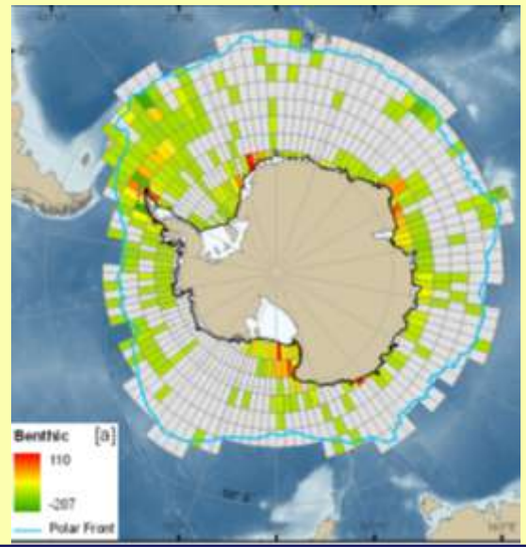
AntClim^{21}

PAIS

AntEco

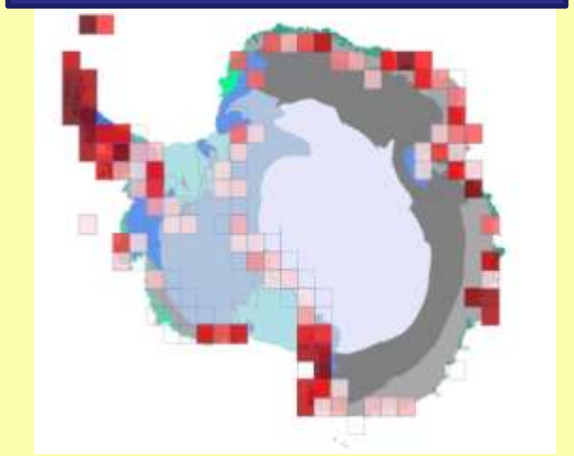
State of the Antarctic Ecosystem (AntEco)

'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.

Major gaps in our understanding of biodiversity



Aleks Terauds <Aleks.Terauds@aad.gov.au>

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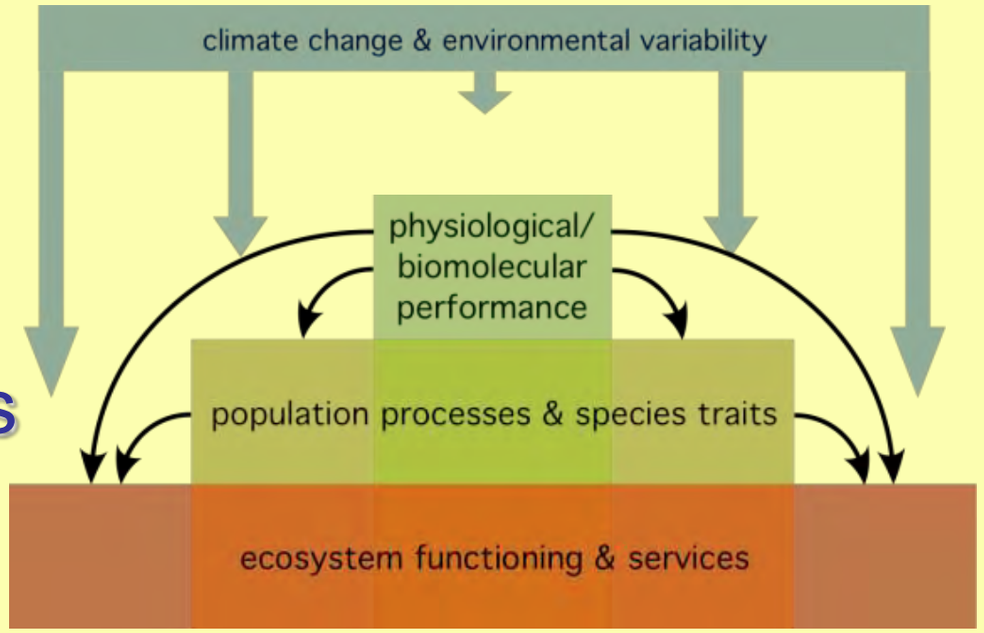
Antarctic Thresholds – Ecosystem Resilience and Adaptation (AnT-ERA)

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



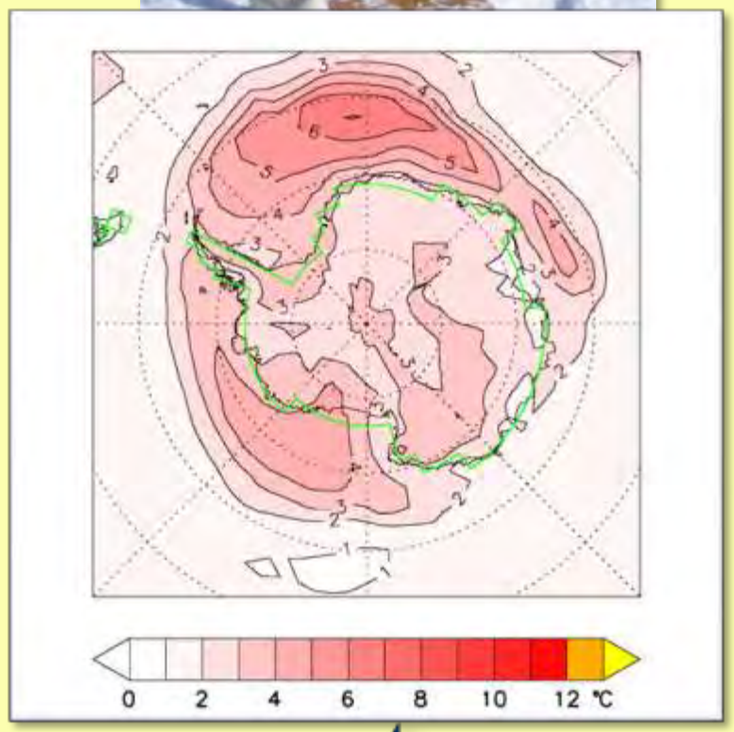
Julian Gutt <Julian.Gutt@awi.de>

Antarctic Climate Change in the 21st Century (AntClim21)

"Predictions of the future role and response of Antarctica to global change"

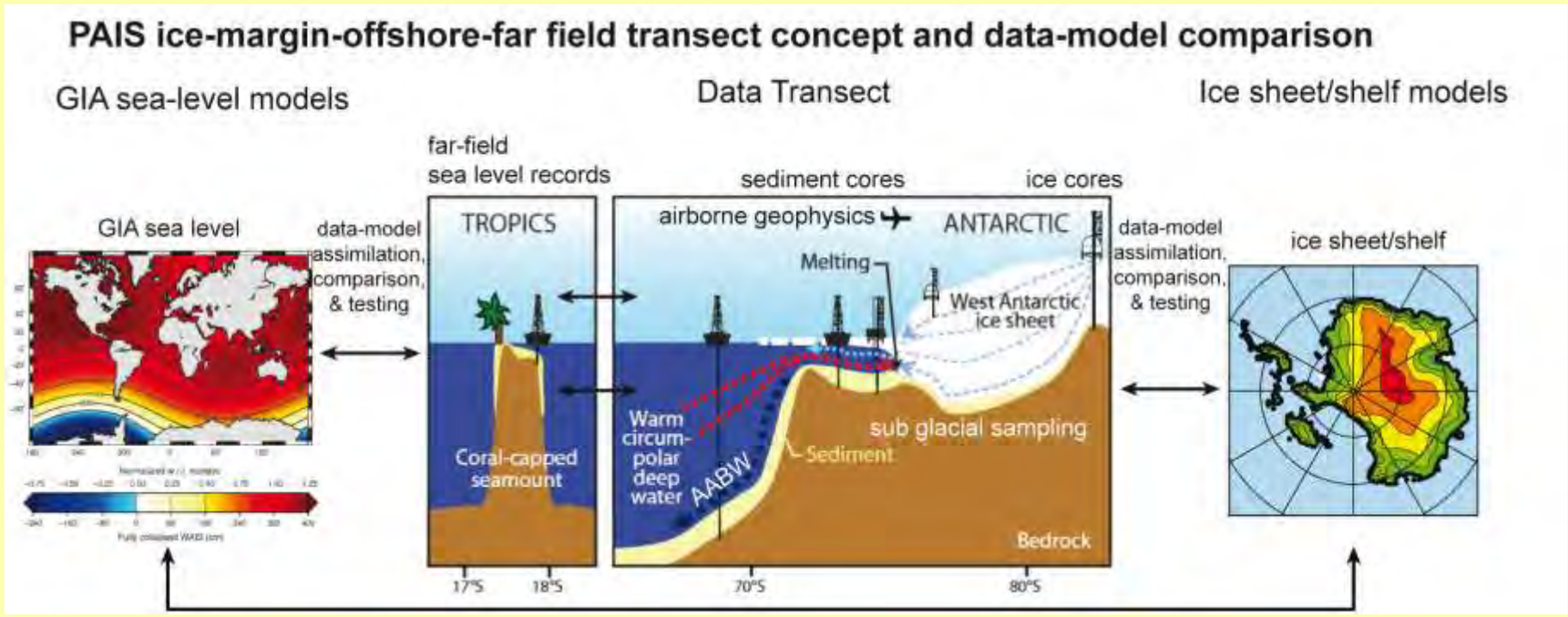
Themes:

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>

Past Antarctic Ice Sheet Dynamics (PAIS)



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>

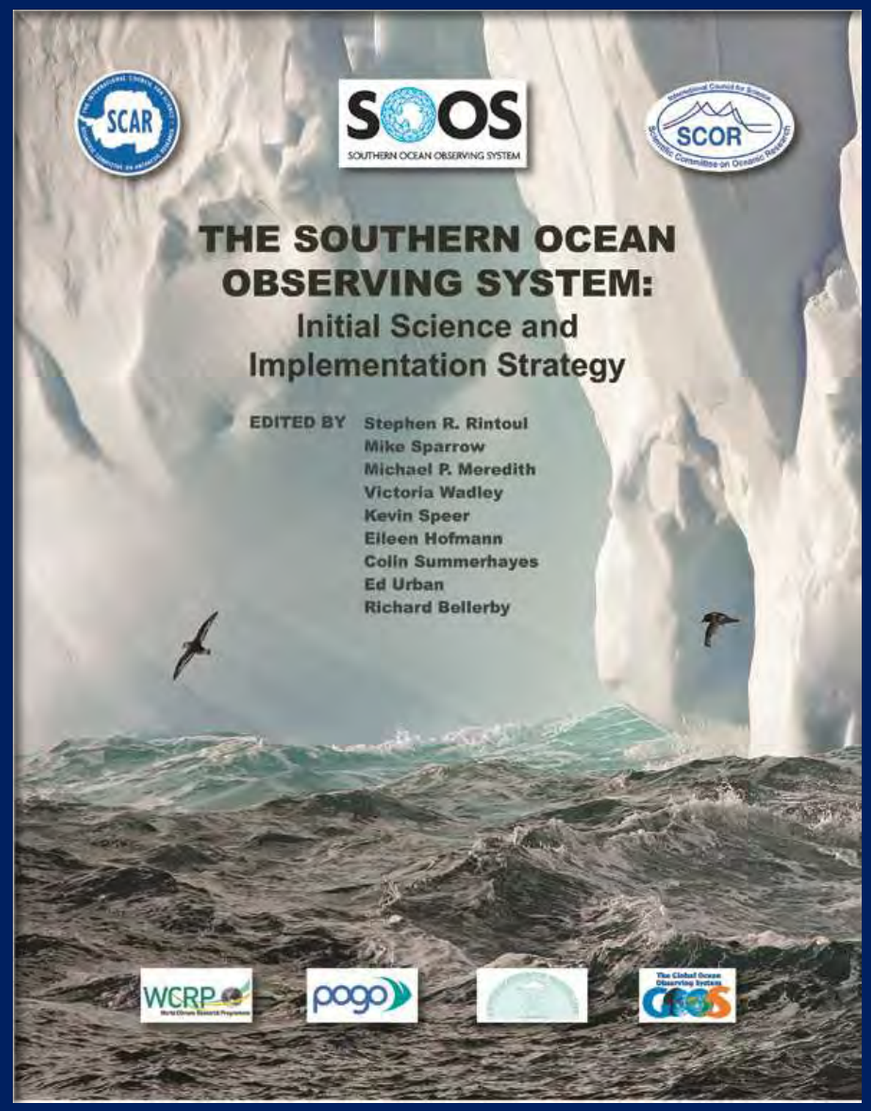
Other initiatives

- Southern Ocean Observing System (SOOS)
- Ice sheet Mass Balance (ISMASS)
- Antarctic Conservation Strategy
- Antarctic and Southern Ocean Science Horizon Scan

The Southern Ocean Observing System

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



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

Antarctic Data Management

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))

Antarctic Data Management

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

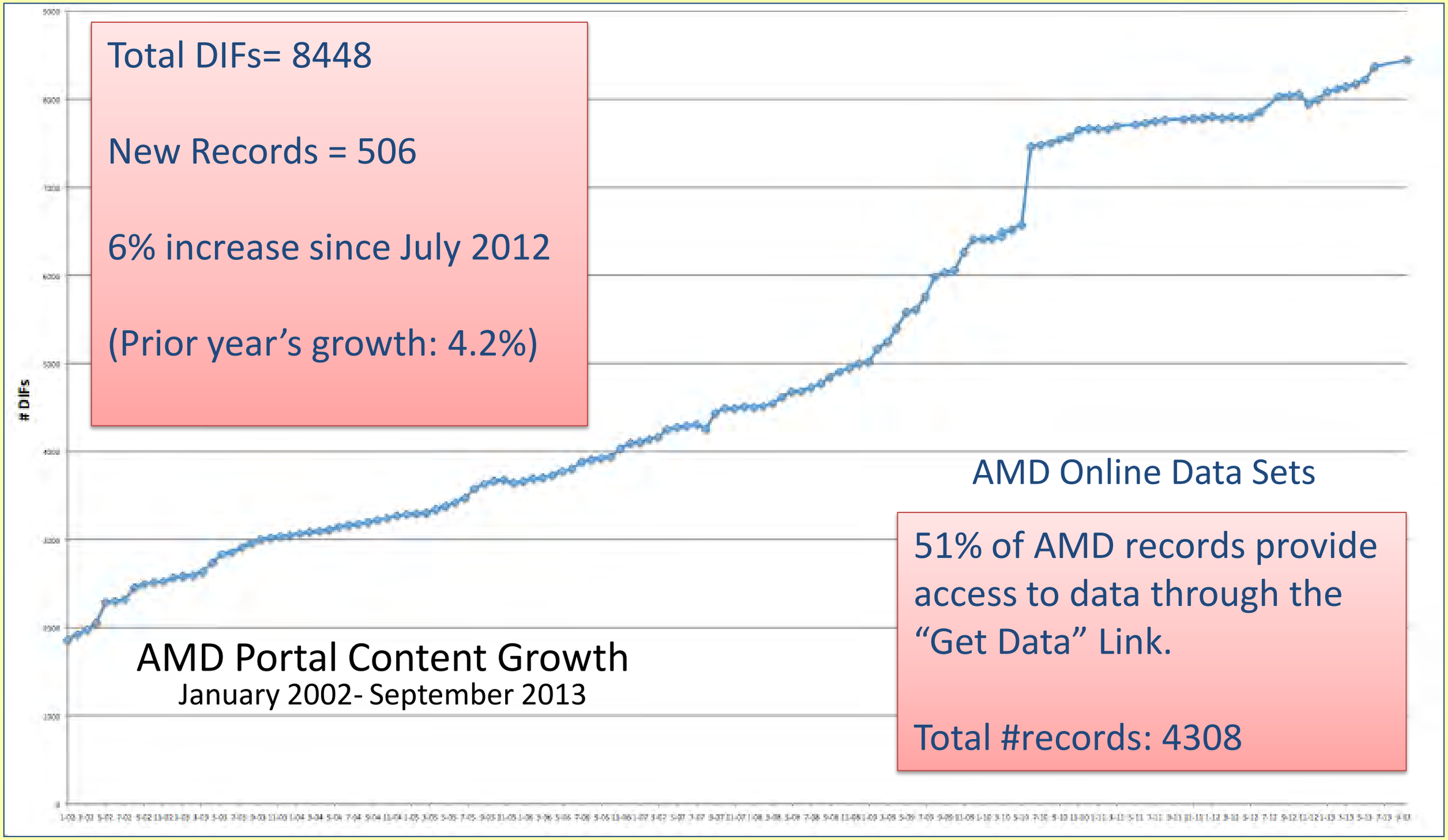
Antarctic Data Management

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.

Antarctic Data management

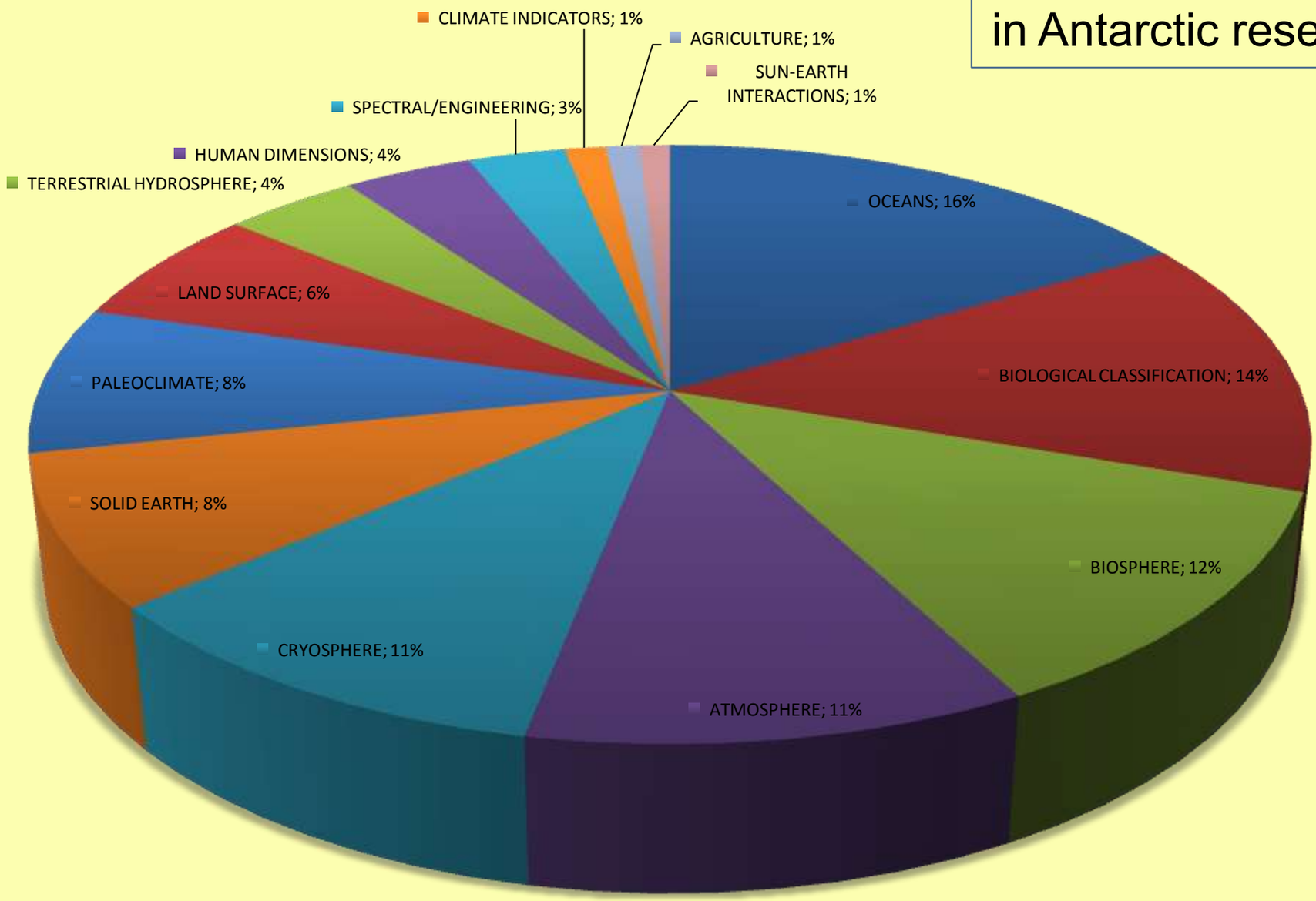
The AMD content:



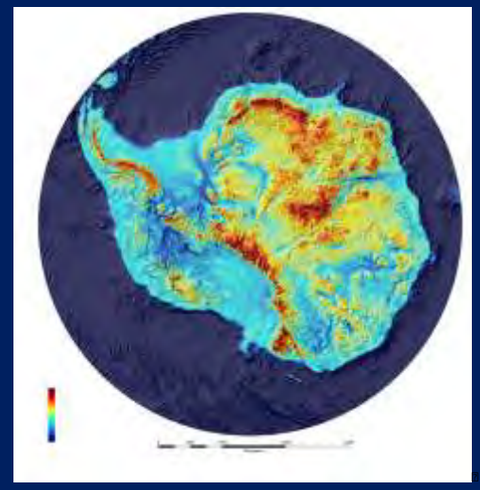
Antarctic Data Management

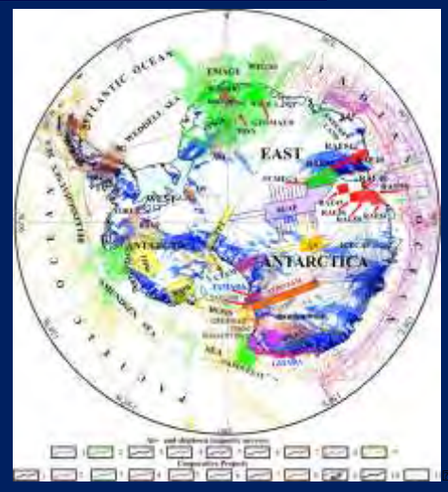
The AMD content:

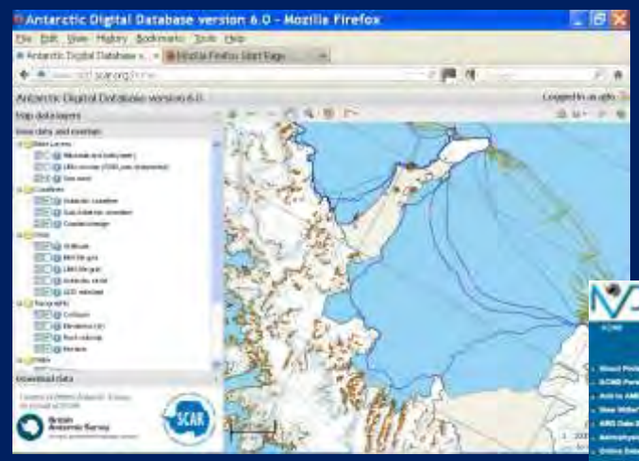
Data from all disciplines in Antarctic research



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 Future of Science in the Antarctic Region

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/

SCAR

ICSU
International Council for Science

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.

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

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)

Audiences
- Science Community (SCAR)
- Science funders (NAPs, funding agencies)
- ACS

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

Antarctic Conservation Strategy (ACS)

Audiences
- Policy Makers
- CEP/ATCM
- ESP

Antarctic Environments Portal (AEP)

Audiences
- Policy Makers
- CEP/ATCM
- Antarctic Treaty Parties

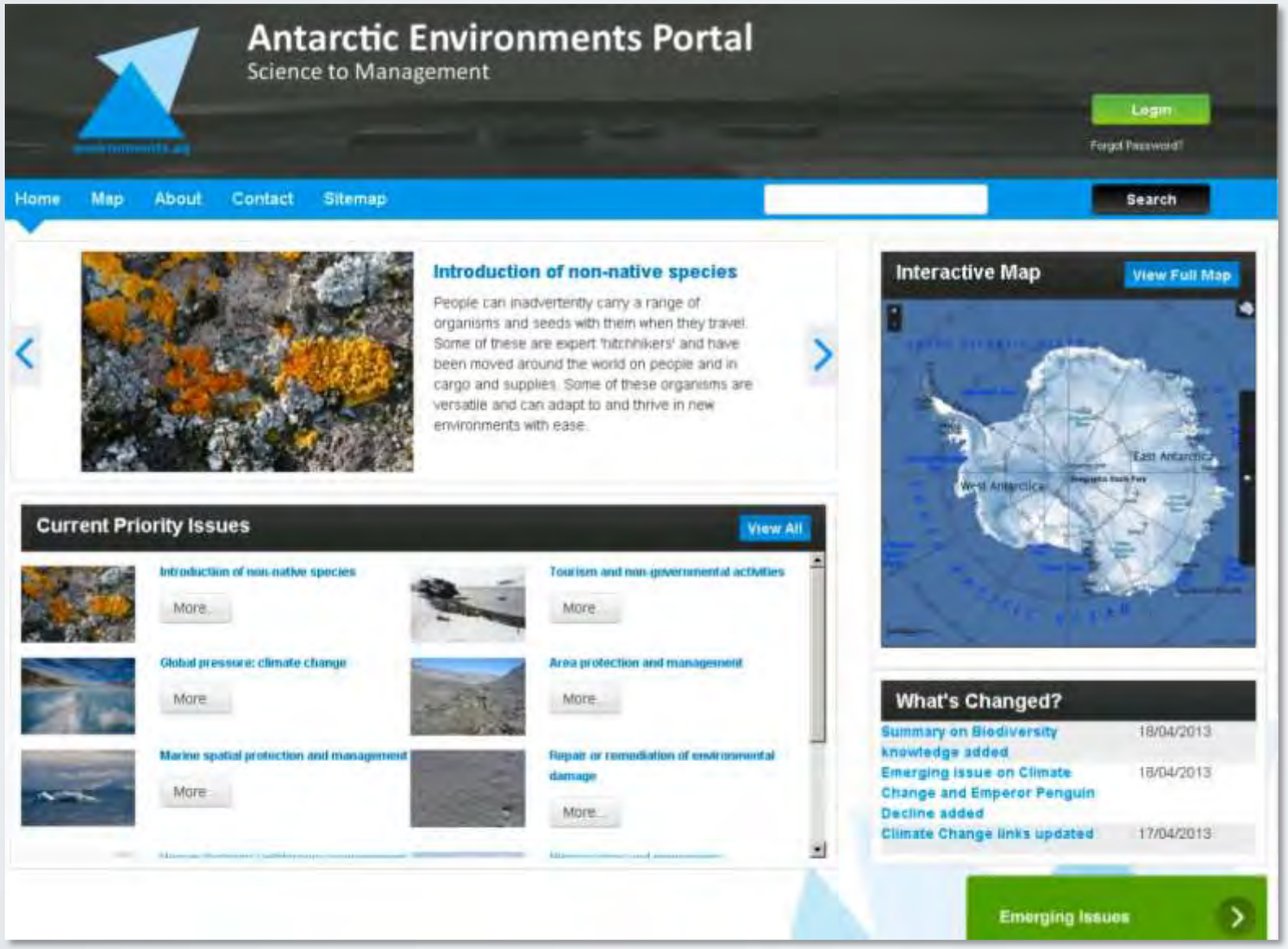
Societal Benefit

- 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

Scientific Advice to Policy Makers

- 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.



environments.aq

Jana Newman <j.newman@antarcticanz.govt.nz>

SCAR

ICSU
International Council for Science

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

Secretariat of the Antarctic Treaty
Secrétariat du Traité sur l´Antarctique
Секретариат Договора об Антарктике
Secretaria del Tratado Antártico

SCAR

ICSU
International Council for Science

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

ICSU
International Council for Science

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

COMNAP

ICSU
International Council for Science

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