

Antarctic Science: The Next 20 Years

**Society-relevant knowledge,
curiosity-driven exploration**

**Regional science with planetary reach,
Antarctica and the Earth System**



Outline

- International Science and Technology
- Earth System Visioning
- Antarctic Research Priorities and Sustainability
- SCAR Strategic Plan 2011-2016
- The US Antarctic Program in the 21st Century





THE ROYAL SOCIETY

International Science and Technology

- ICSU Foresight Report 2011(draft)
- UNESCO Science Report 2010
- 2011 the UK Royal Society published Knowledge, Networks and Nations, Global Scientific collaboration in the 21st Century

International Council of Science (ICSU)

- Non-governmental organization – founded 1931
- Global membership - 141 countries
- National adhering body is usually a National Academy
- Member bodies include 30 International Scientific Union members and 7 Interdisciplinary Bodies – e.g., SCAR
- Mission - to strengthen international science for the benefit of society.



Landscape for International Science

- **Science is increasingly global**
- **A multipolar science world is developing**
- **The scientific world is becoming increasingly connected**
- Skilled labor migration
- **The primary driver of most collaboration is still the individual scientists**
- **Many global assessment and research programs are separately managed**
- The role of business in science is growing and transnational
- **Science is an important part of international diplomacy**



Megatrends in International Science

- Demography
- Natural resource availability
- **Global environmental change**
- **Human health and wellbeing**
- **Technological change**
- **Enabling information and communication technologies**



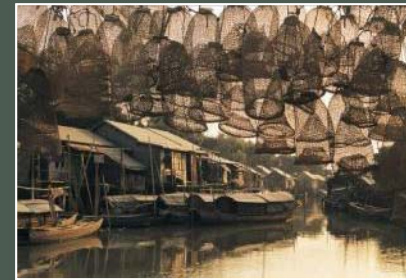
University of Bristol

Key Drivers of International Science

- States and markets
- **Global agendas and arenas**
- State sovereignty, regionalism and globalism
- **Science and society**
- Private sector/military science
- **Scientific integrity and self-regulation**
- **Spatial organization and conduct of science**
- **Collaborative research infrastructures**
- **Epistemic organization/conduct of science**
- **Nature of the scientific record**
- Values, beliefs, ethics
- **Science education and skills**
- **Scientific careers**

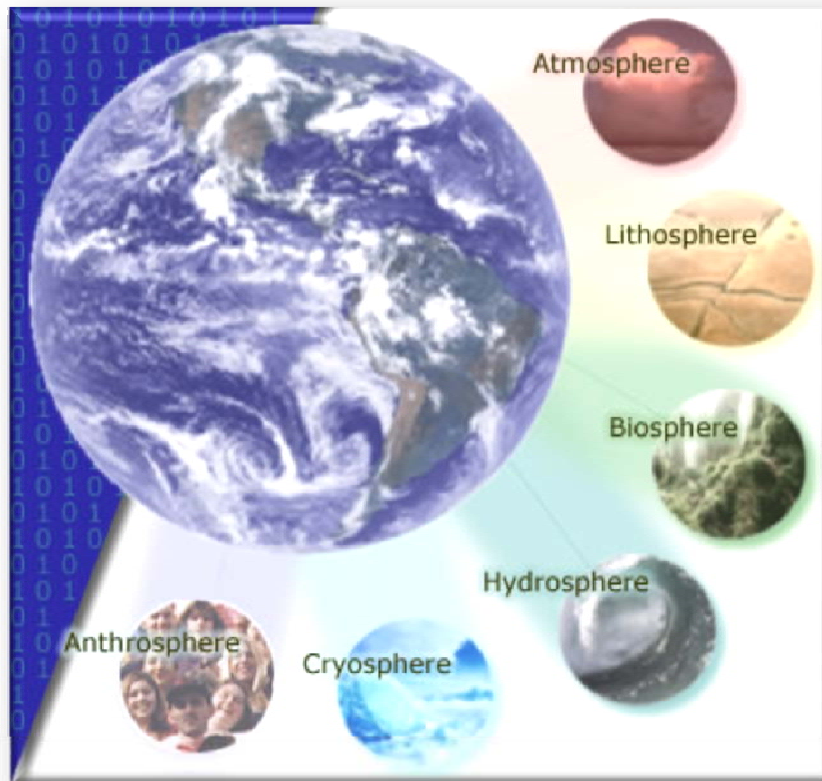


Earth System Visioning



-
- ICSU (2010). Earth System Science for Global Sustainability: The Grand Challenges. International Council for Science, Paris.

New strategies are needed to....



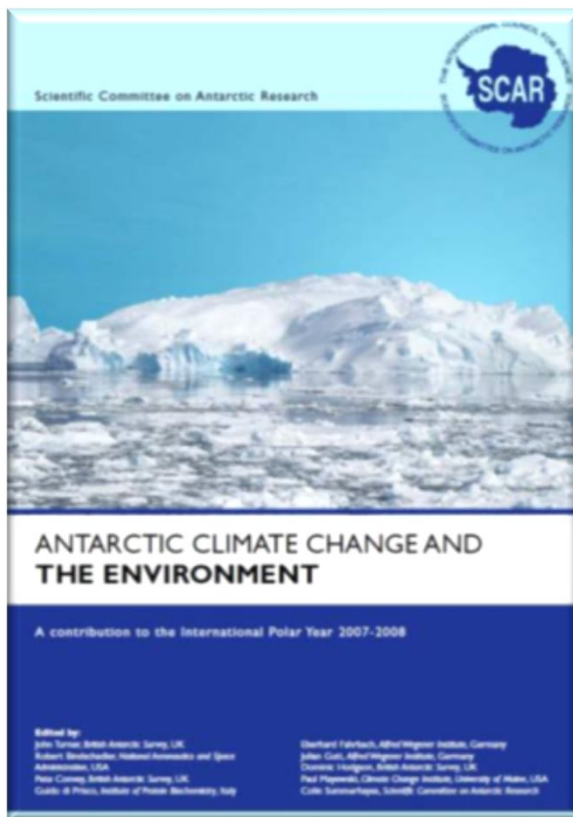
Institute for Computational Earth System Science

...cope with global change by deepening our knowledge of the functioning of the Earth system and its critical thresholds.



The polar science community.....

Antarctic Climate Change
and the Environment



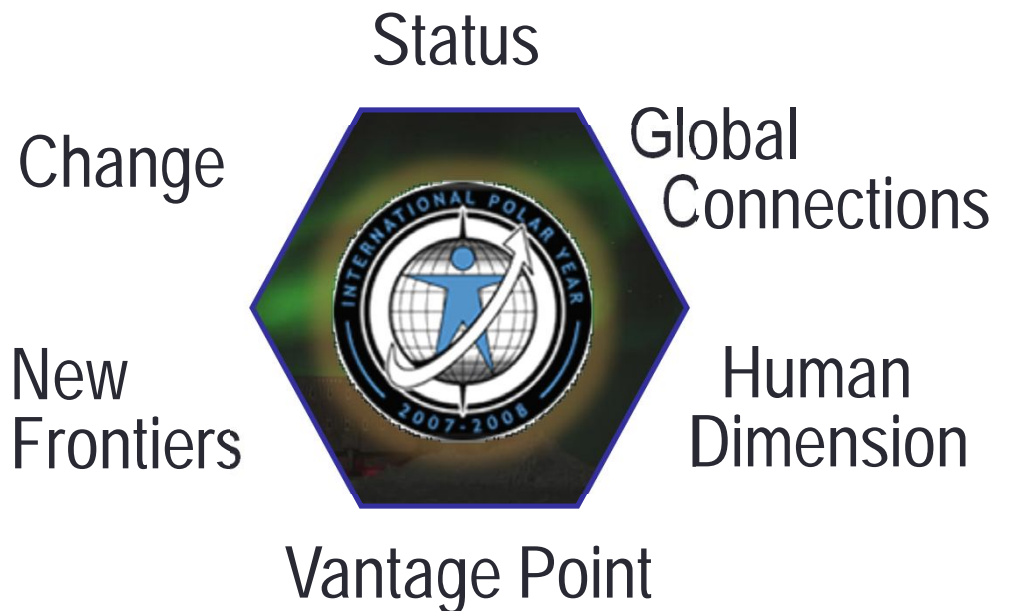
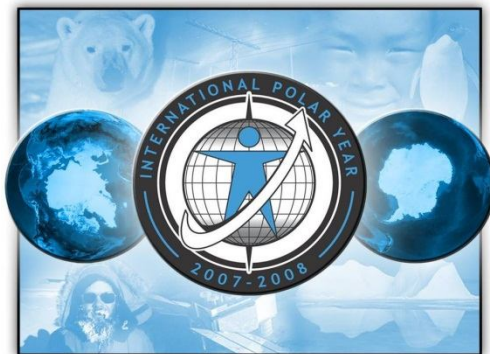
..... has played
an important role in
understanding the
functioning of the Earth
system and the human
impacts on that system
and will continue
to do so.



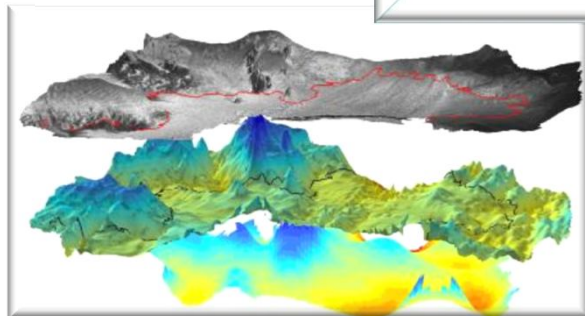
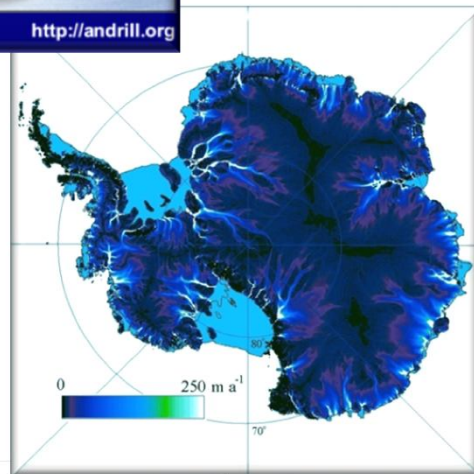
The International Polar Year 2007-2008...

....uniquely positions the Antarctic science community to address the ICSU Grand Challenges in Sustainability....

- > 220 projects
- > 50,000 participants
- > 60 nations



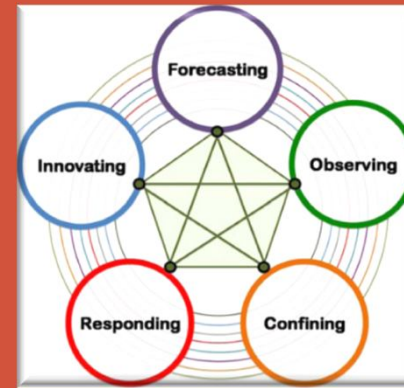
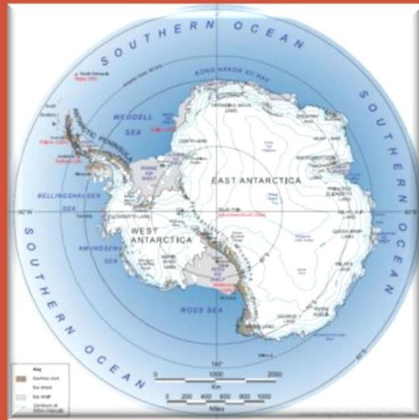
The way forward is to....



....build upon and integrate expertise within the sciences and humanities and apply it to pressing research questions about human interactions with the Earth system.

The polar research community has a major role to play.





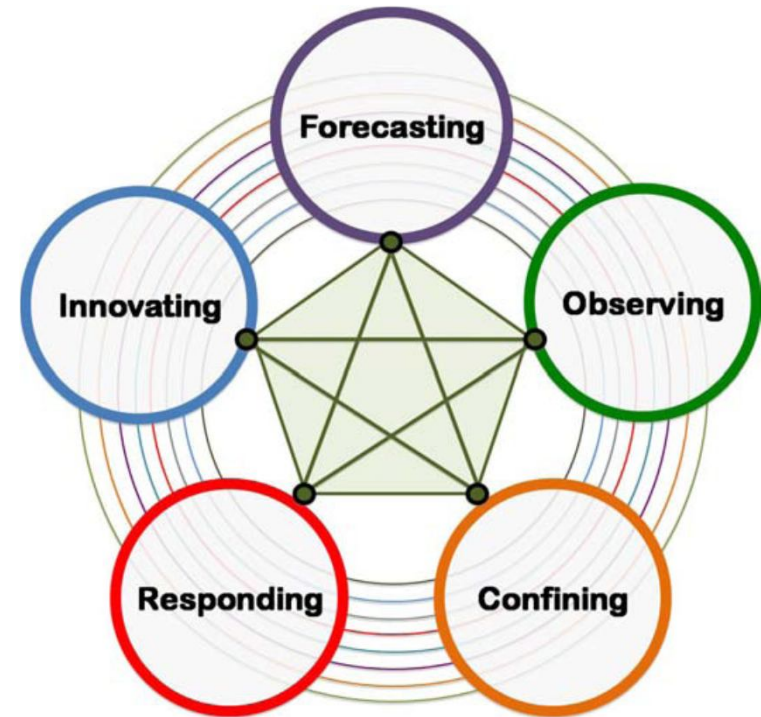
Antarctic Research Priorities and Sustainability

- ICSU (2010). Earth System Science for Global Sustainability: The Grand Challenges. International Council for Science, Paris

The ICSU Grand Challenges

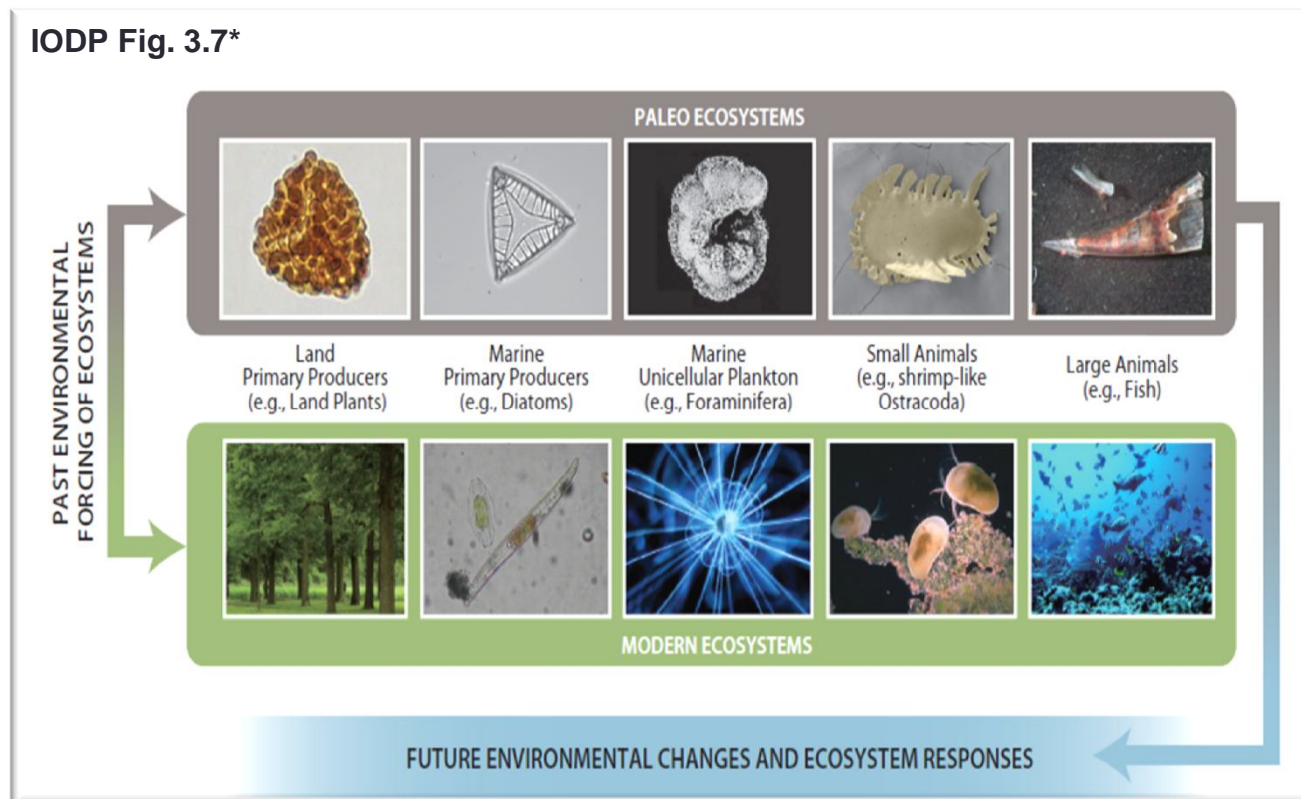
Research in Antarctica and the Southern Ocean is uniquely positioned to be a leader in these efforts.

- Challenge 1 – Forecasting
- Challenge 2 - Observing
- Challenge 3 - Confining
- Challenge 4 - Responding
- Challenge 5 – Innovating

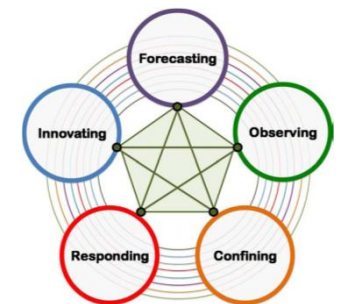


Challenge #1...

Forecasting - Improve the usefulness of forecasts of future environmental conditions and their consequences for people.



Environmental Change and Ecosystem Response

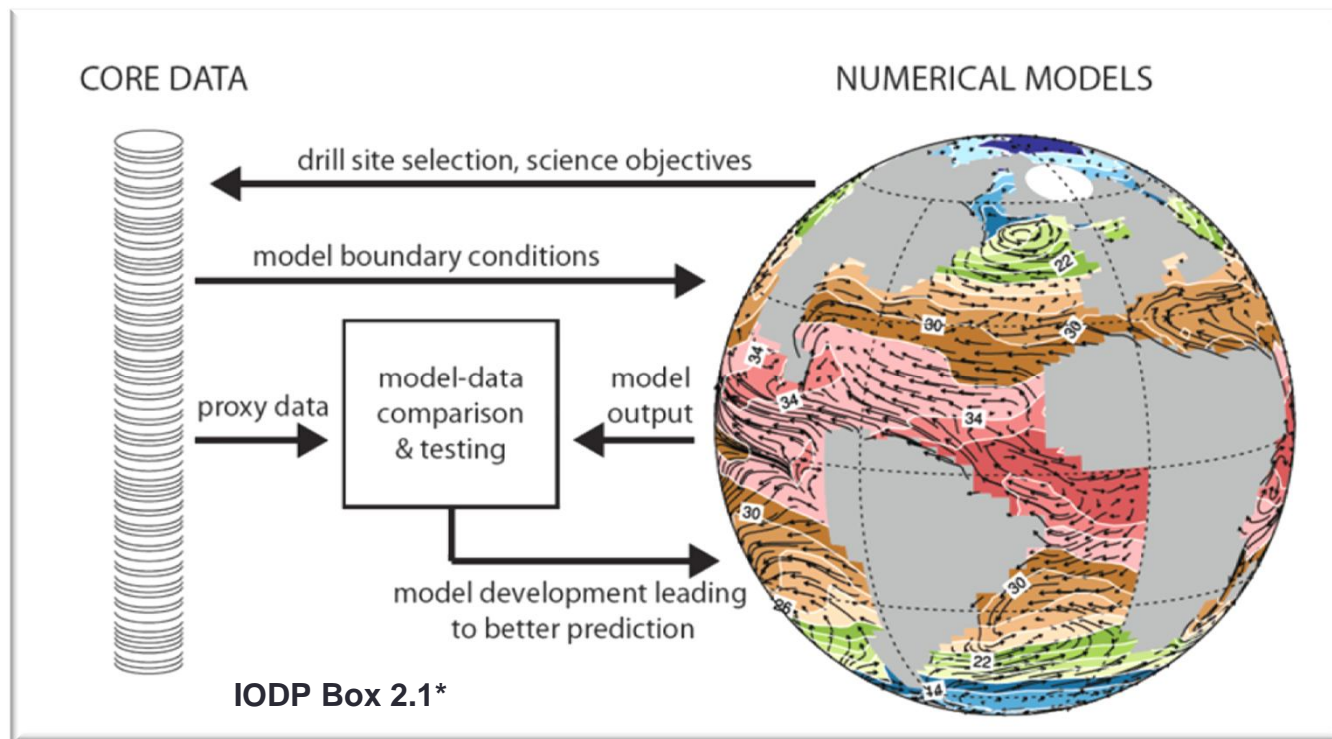


* Illuminating Earth's Past, Present, and Future
International Ocean Discovery Program, Exploring Under the Sea
Science Plan 2013-2023

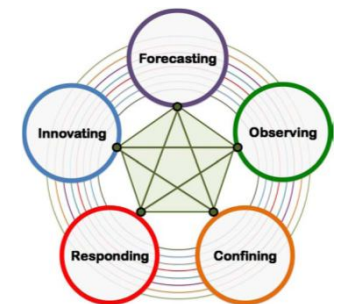
Challenge #2...



Observing - Develop, enhance, and integrate the observations systems needed to manage global and regional environmental change.



Integration of Models and Observations



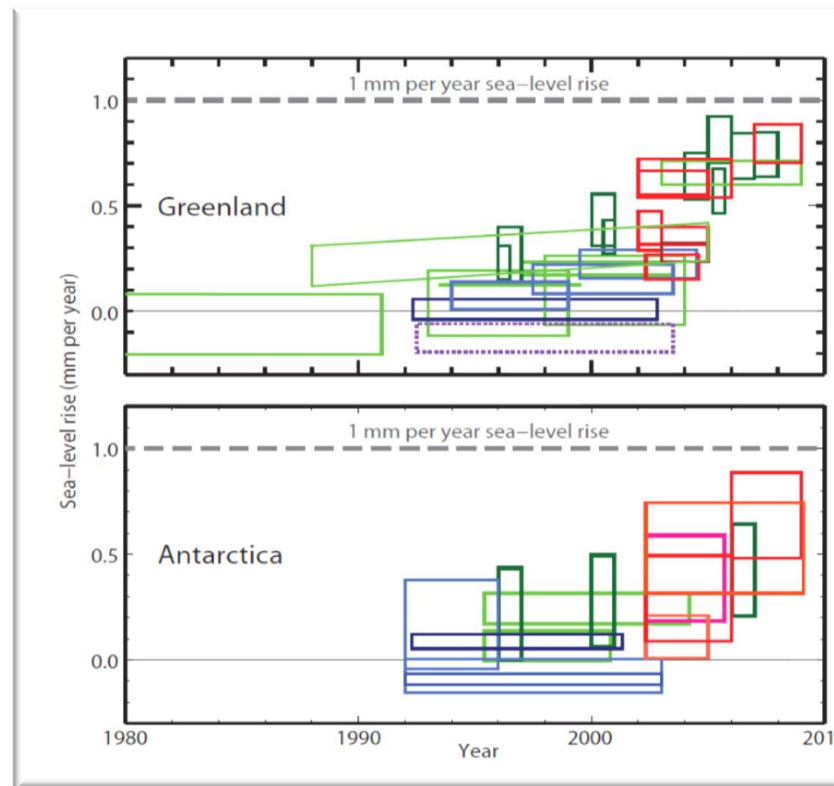
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Challenge #3...

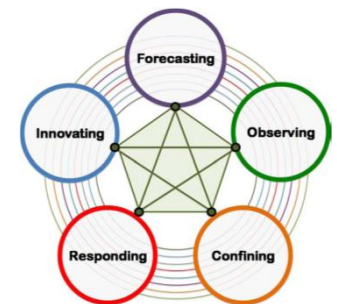


Confining - Determine how to anticipate, recognize, avoid and manage disruptive global environmental change.

Future Sea Level



Coupled atmospheric, oceanic, cryospheric, and geologic models



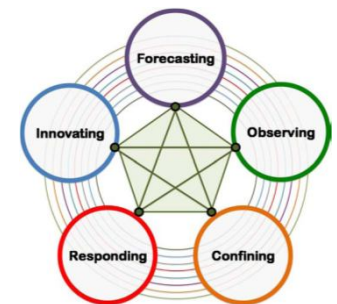
Challenge #4...



Responding - Determine what institutional, economic and behavioral changes can enable effective steps toward global sustainability.



Antarctica as a continent for science and peace - scientific advice in support of decision- and policy-makers for conservation and protection.



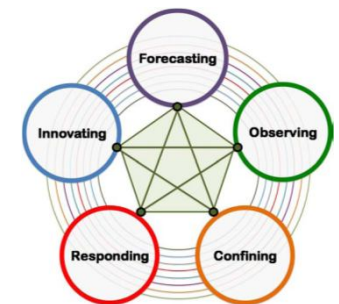
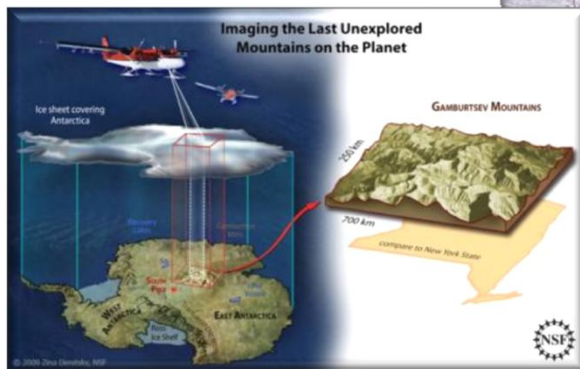
Challenge #5...



Innovating - Encourage innovation in developing technological, policy, and social responses to achieve global sustainability.



The latest technologies and innovative solutions facilitate research in Antarctic Science.





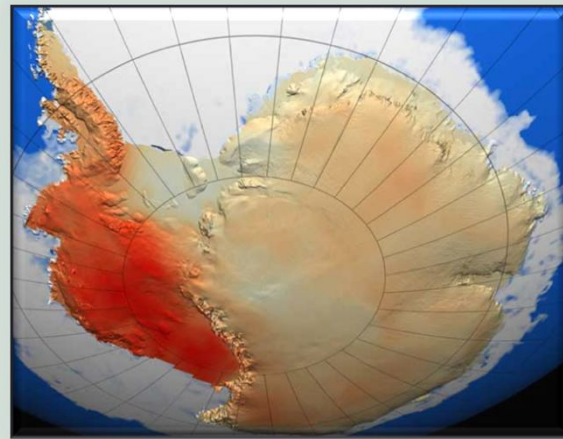
Scientific Committee on Antarctic Research (SCAR)

An Interdisciplinary Scientific Body of the International
Council Of Science

- Antarctic Science and Advice in a Changing World: SCAR Strategic Plan 2011-2016

The Scientific Committee on Antarctic Research (SCAR)

- The U.S. was a founding member in 1958
- 36 Country Members
 - Venezuela slated to join in 2012
 - Discussions with Czech Republic, Belarus and Austria
- 9 ICSU Unions



Antarctic Science and Policy Advice in a Changing World

SCAR Strategic Plan 2011-2016



Strategic Vision and Mission

- **VISION:** A world where the science of Antarctica benefits all, excellence in science is valued and scientific knowledge informs policy making.
- **MISSION:** To be the leading non-governmental, **international facilitator and advocate of research** in and from Antarctica, to provide **objective and authoritative scientific advice**, and to **bring emerging issues to the attention of policy makers.**

“In strategy it is important to see distant things as if they were close and to take a distanced view of close things.”
unknown



Interdisciplinary Earth System Science

- **Understanding the Earth system, its components, connections and feedbacks** is a major endeavor of contemporary Antarctic science and a focus of SCAR research.
- Scientific frontiers often lie at the interfaces between disciplines requiring **interdisciplinary approaches** to advance knowledge.
- Promote an interdisciplinary philosophy that **eliminates barriers to cross-fertilization of ideas.**

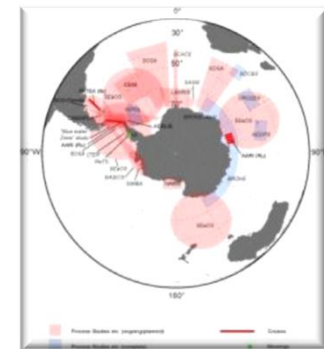
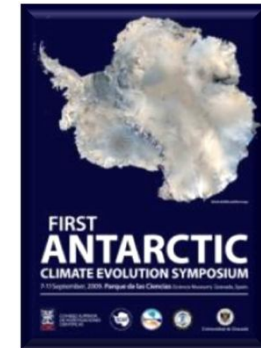
“Excellence encourages one about life generally; it shows the spiritual wealth of the world.”

T.S. Eliot (1888 – 1965)



Emerging Frontiers

- Antarctica and Global Climate
- Deciphering Paleoclimate
- Organisms, Ecosystems and Biodiversity
- Ice Sheet Dynamics and Sub-ice Environments
- The Poles as a Vantage Point
- Observing Systems



Southern Ocean
Observing System

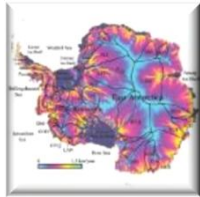
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T.S. Eliot (1888 – 1965)



SCAR Scientific Research Programs

2004-2010



SALE
ATHENA

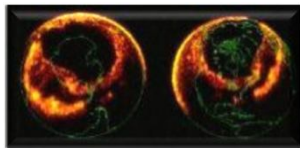
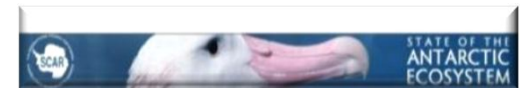
2005-2013



EBA

2013- 2021(?)

AntEco



ICESTAR

2010 -2014



AAA

Ant-ERA



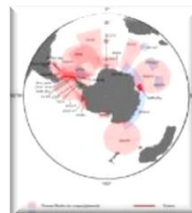
Figs & photos: J. Gutt & W. Dimmler, Marum/AWI, J. Turner et al

2004-2012



ACE

PROGRAMS



SOOS



AntClim21



SERCE



AGCS



ISMAS





The US Antarctic Program in the 21st Century

- Access
- Observations
- Technology
- Policy

Access



- **Transcontinental access**

- Distributed network of land-based stations
- International network of scientific stations
- Continental interior - land traverses
- Network of coastal observing sites with ocean access

- Intra-continental air system of multi-capability aircraft – fixed wing, long range geophysical aircraft, helicopters, gliders
- Circum-Southern Ocean (International) flotilla of ships/ROVs, AUVs, etc.
- **Year-round access – expanding the field season**

Access (cont.)



- **Service and maintain observatories and remote field stations**
- **Records of climate change**
 - Offshore, onshore and beneath the ice and sediment coring/drilling capabilities
 - Rapid deployment coring capabilities and associated laboratories
- **Intellectual Access**
 - Minimize barriers to international cooperation and partnerships
 - Create incentives for international participation
 - Synergy and leverage

Observations



- **Southern Ocean**

- Moorings, ROV/AUV, shipborne observations
- Instrumented biomes - instrumented organisms and bio/physico/geochemical sensor arrays and moorings

- **The Continent**

- Instrumented ice sheets – on, within and beneath
- Distributed network of sub-ice aquatic environment observatories
- Expanded remote survey capabilities

- **Enhanced space borne sensors and coverage**

- Ice sheet observations
- Southern ocean observations
- Living systems observations
- Geo-synchronous satellites over Antarctica and the Southern Ocean

- **Sustained time series observations**

- Expansion of LTER Network

Technology



- **Application of new and innovative technologies**

- Next generation development or adaption of technologies to Antarctica
- Genomics, proteomics, and other -omics
- Automated instrument packages and experiments
- Improved sensors
- Miniaturization
- *In situ* experiments

- **Information and communications technologies**

- Remotely operated observatories
- High band width
- Real-time data collection and transmission

- **Next generation of coupled Earth System Science models**

Policy



- **Climate**

- United Nations Framework Convention on Climate Change (UNFCCC)
- Intergovernmental Panel on Climate Change (IPCC)

- **Environmental Conservation and Protection**

- Antarctic Treaty System
 - Committee on Environmental Protection
- Convention for the Conservation of Marine Living Resources
- ATS Meetings of Experts

Essentials for US Leadership in International Antarctic Science



- Encourage and support cutting-edge, high risk/high reward, innovative science
- Invest in science support, logistics, and infrastructure
- Promote and facilitate participation in international partnerships and programs
- Foster and value linkages with global programs and international science organizations
- Serve as an example in Antarctic policy-making arenas



Thank you for
the opportunity
to speak to you
today !

THE END