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Cheers to an historic polar research collaboration

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Australian Antarctic scientists joined with polar researchers around the world on 25 February 2009 to officially celebrate two years of intensive, internationally coordinated scientific research for the International Polar Year (IPY).

Credit: Sandra Zicus, ACE CRC

Held in Geneva, Switzerland, the celebration coincided with the release of the collaboration's report, '*The state of polar research'*, which provides an overview of both the collective impact of the international and interdisciplinary research conducted during the IPY and the future of polar research.

The IPY ran over two years (2007–09) to enable one full year of research to be conducted at each pole. It was sponsored and coordinated by the International Council for Science (ICSU) and the World Meteorological Organization (WMO). Over 160 endorsed interdisciplinary science projects were assembled from the ideas of researchers in more than 60 countries. The IPY was the largest coordinated planetary research effort in the past 50 years, and it met the current need to urgently understand the rapid changes occurring at Earth's higher latitudes.

During the program, five Australian-led research projects made significant advances in scientific understanding in Antarctica and the Southern Ocean (see below). Their success in delivering on the four major goals of the IPY – advances in polar knowledge, a legacy of infrastructure and observational systems, inspiring a new generation of scientists, and public outreach – will help ensure the scale, impact and broad understanding of Antarctic research made

possible by the IPY will continue.

Much of the work conducted during the IPY is feeding into ongoing external projects – such as ice core research for determining past climate variability – which is providing vital additional perspective on global environmental changes.

Aliens in Antarctica?

The Aliens in Antarctica project[1] saw an international team of scientists from nine nations, coordinated by the Australian Antarctic Division, investigate the likelihood of the introduction of non-native species across a wide range of national Antarctic programs and tourist operators. Teams examined the type and number of 'propagules' (seeds, spores and eggs) that could be unintentionally imported into Antarctica on personal clothing and equipment, fresh food, cargo, ships and aircraft. The travel history of crews and passengers was also obtained to identify the geographic range from which invasive species could be drawn.

The Australian team examined over 2000 items of fresh fruit and vegetables destined for Australian Antarctic stations and conducted laboratory-based simulations to look at seed dispersal and germination. Most (89%) fresh fruit and vegetables were clear of propagules, while the rest were either infected with fungi (9%) or had evidence of the presence of insects (2%).

As a result, the team recommended that certain produce should not be accepted within the Australian Antarctic program in future. Ultimately, the information will be used to improve conservation and protection practices in the Antarctic region and other sensitive areas around the world.

Sea Ice Physics and Ecosystem eXperiment (SIPEX)

SIPEX,[2] which involved 45 scientists from 12 countries, has improved understanding of the relationship between sea ice physical processes and the biological environment within and under the ice. During the 55-day voyage through the sea ice, led by the Australian Antarctic Division and the Antarctic Climate and Ecosystems Cooperative Research Centre, scientists took a series of measurements at 15 'ice stations' to characterise the sea ice environment.

Among the research conducted were field measurements of snow properties and sled-based radar measurements, which provided valuable insights into 'radar returns' (returning signals) from the snow surface, ice/snow interface and intermediate layers within the snow pack. Coupled with airborne radar and laser altimetry measurements, this information will play a pivotal role in the interpretation of satellite altimetry data and the development of global ice and snow thickness maps.

SIPEX formed part of a larger IPY project titled 'Antarctic Sea Ice in the IPY' which drew together research programs across many countries, including the United States-led Sea Ice Mass Balance in the Antarctic (SIMBA) program. Together, SIPEX and SIMBA formed a major, simultaneous study of much of the Antarctic sea ice zone.

Solar Linkages to Atmospheric Processes

Solar Linkages to Atmospheric Processes[3] investigated the links between changes in solar output and weather and climate. Scientists from the Australian Antarctic Division and the Arctic and Antarctic Research Institute in Russia measured the atmospheric electric circuit (a current that flows around the world, between the ground and lower reaches of the ionosphere) high on the Antarctic plateau at Vostok, near the centre of East Antarctica. Instruments were also deployed at three sites in West Antarctica by the British Antarctic Survey and at the French–Italian station, Concordia (at Dome C), by international collaboration.

The scientists found evidence of an active link between the electric circuit, solar variability and weather. This supports a new link between solar variability and climate in addition to solar irradiance and UV ozone modulation described in the Intergovernmental Panel on Climate Change Fourth Assessment Report. Understanding this interaction is important because changes in the global electric circuit, caused by solar variability, could alter the conditions under which thunderstorms develop.

Census of Antarctic Marine Life (CAML)

The CAML and its north polar counterpart project, Arctic Ocean Diversity, have pioneered new understandings of the evolution and diversity of life. Led by the Australian Antarctic Division, CAML[4] coordinated 18 major research voyages to Antarctica and the Southern Ocean during the IPY.

Australian scientists participated in three voyages focusing on waters adjacent to East Antarctica, and investigating seabed communities and the deep pelagic (open ocean) zone. As a result of these voyages, two areas of the Southern Ocean were declared Vulnerable Marine Ecosystems by the Commission for the Conservation of Antarctic Marine Living Resources in 2008. This declaration protects these unique areas from indiscriminate fishing practices.

Altogether, CAML revealed that Antarctica is a single bioregion united by the Antarctic Circumpolar Current. The region is unexpectedly rich in biodiversity, and molecular techniques show Antarctica to be the birthplace of many species, driven by glacial cycles over millions of years.

The major legacy of CAML is the 'SCAR-MarBIN' (Scientific Committee on Antarctic Research Marine Biodiversity Network) database,[5] which contains data collected on some 14 000 species – a benchmark against which future change in marine communities around Antarctica can be assessed.

In the footsteps of the IGY

The International Polar Year 2007–09 took place on the jubilee of the 1957–58 International Geophysical Year (IGY). The IGY, in turn, followed the international polar years of 1932–33 and 1882–83.

The IGY was, however, the first major international scientific effort with a dedicated Antarctic component. It set in place the modern *modus operandi* in the Antarctic, including internationally coordinated scientific and logistic programs and long-term observational studies.

It also addressed the need for stations in Antarctica to support the research effort, with several nations expanding their footprint.

The IGY led to the negotiation of the Antarctic Treaty, which this year celebrates the 50th anniversary of its signing, as well as the establishment of the Special (now Scientific) Committee on Antarctic Research to coordinate multilateral science in Antarctica.

Climate of Antarctica and the Southern Ocean (CASO)

The ongoing CASO program,[6] led by the Antarctic Climate and Ecosystems Cooperative Research Centre and CSIRO Marine and Atmospheric Research, is working towards obtaining a circumpolar snapshot of the physical environment of the Southern Ocean. This will enhance understanding of the role of the Southern Ocean in past, present and future climate, and improve climate predictions from models that incorporate a better understanding of southern polar processes.

CASO consists of 25 individual projects involving scientists from 18 nations. In collaboration with other IPY programs, CASO has so far measured a range of physical, chemical and biological properties of the Southern Ocean. The measurements covered the circumpolar extent of the Southern Ocean, from the surface to the sea floor and from the Antarctic continental shelf to the Subtropical Front. Scientists used a wide variety of tools, including ship transects, profiling floats, satellites, moorings and oceanographic sensors attached to marine mammals. The integrated, multi-disciplinary observations made with these tools provide a 'proof of concept' for the long-term Southern Ocean Observing System presently under development by the international community.

Observations showed that water sinking from the surface to the deep ocean near Antarctica is becoming fresher and less dense, demonstrating that changes in high latitude climate are being communicated rapidly to the deep ocean.

1 www.aad.gov.au/default.asp?casid=33946

2 www.sipex.aq

3 http://globalcircuit.phys.uh.edu/SLAP/index.htm

4 www.caml.aq

5 www.scarmarbin.be

6 www.clivar.org/organization/southern/CASO/index.htm