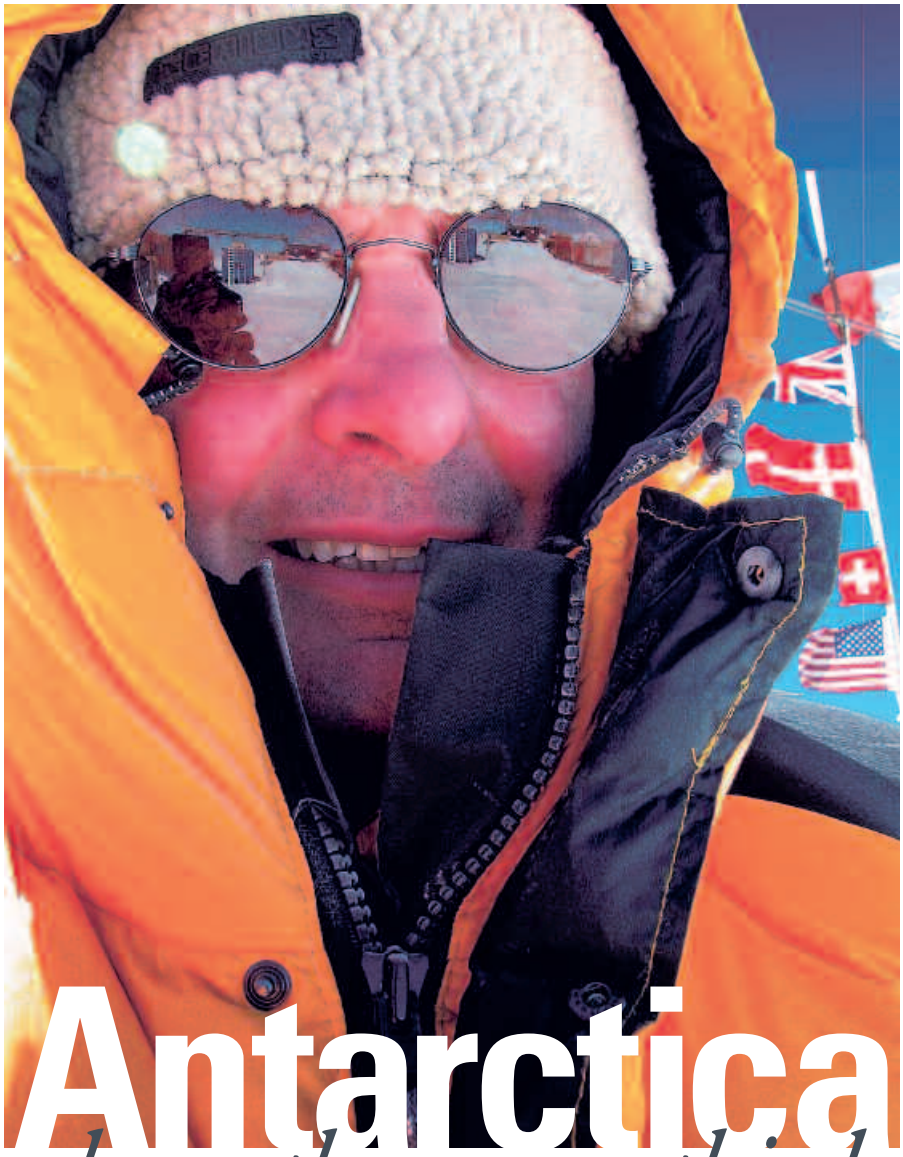

Antarctica
closer than you think

British Antarctic Survey director **Chris Rapley** (above) first conceived the idea of an International Polar Year back in early 2003. It has now grown into the world's largest coordinated science programme in 50 years. While IPY will refine our knowledge of both the Arctic and Antarctic, here Chris explains the importance of Antarctica to the whole Earth system and why the planet needs IPY now more than ever.

In a warming world ice melts. The evidence for human-induced climatic warming grows daily, and the zones of most rapid temperature rise lie in the polar regions, with the Antarctic Peninsula warming fastest of all – some 3°C in 50 years. Climate scientists anticipated that the poles would be the 'miner's canary' of global warming, since the loss of ice and snow increases the absorption of solar heat. However, no one anticipated the magnitude and rate of the icy response. Satellite observations using microwave and gravity instruments, as well as direct measurements, show that the melting and sliding of polar ice is occurring faster than glaciologists had thought possible.

Why should we care? Well for one thing, reductions in the mass of the Earth's ice will add to rising sea level, at some point compromising the ability of sea defences to protect against flooding. The cost to London of a single major overtopping of the Embankment, according to government figures, would be £45 billion or 2 percent of the UK's GDP. But this represents just one example of the potentially catastrophic impact of rising sea levels on coastal peoples, cities, and infrastructures worldwide. So for this reason alone, the polar regions deserve special attention. In truth, of course, there are many other critical ways in which the polar regions connect to the planetary machinery, making the case for their study even more compelling.

What about the Antarctic? What priority should we place on studying an unpopulated frozen wilderness, at the geographic extreme of the planet?

Well, the 'ozone hole' taught us that human activities, such as the production and release of industrial chemicals, can impact even this most remote location, with implications for resident life-forms ranging from lichens and mosses to the penguins, seabirds, seals and whales. The signature of lead from automobile fuel in Antarctic ice cores provides another example of a measurable long-distance human impact.

But the Antarctic is not simply on the receiving end of its global connections – it makes its presence felt too. For example, the Antarctic ice sheet and surrounding sea ice dominate the southern hemisphere

climate system. Water processed under the Antarctic sea ice and ice shelves sinks beneath and refrigerates some 40 percent of the world's oceans. The Southern Ocean plays a major, possibly predominant, role in the global carbon cycle, drawing down atmospheric carbon dioxide, including that emitted by humans. And, of course, the Antarctic ice locks up some 60 metres of global average sea level rise, so that even small percentage changes have a significant global impact.

These linkages alone would justify careful monitoring and study of the Antarctic and its surrounding ocean. But in addition, Antarctic ice, sediments and rocks preserve a logbook of past Earth system behaviour. Antarctic terrestrial and marine species enshrine a treasure trove of information on evolutionary processes and extreme biological adaptation. The Southern Ocean around South Georgia is the marine 'Serengeti' and hosts a major commercial fishery – managed using a science-based, ecosystem approach. The geology and geophysics of the Antarctic are key to the understanding of global tectonic processes, whilst the Earth's magnetic field lines guide charged particles from geospace and the Sun into the Antarctic upper atmosphere, making the study of its auroral phenomena, in combination with those of the Arctic, the means by which we can understand and predict the interaction of the planet with its near-space environment. And the high Antarctic plateau provides astronomers with their clearest surface view of the universe, rivalling that from space, and with the additional advantage of long uninterrupted periods of winter darkness or, for solar studies, summer light.

So it is not surprising that approximately half of the approved International Polar Year science projects address the Antarctic and its connections with the planet. The subject matter covers the gamut of the geological, physical, biological and astronomical sciences. Examples of major projects include 'The census of Antarctic marine life', which aims to open up a new window on deep-sea-living creatures in the Southern Ocean; 'Subglacial lake environments', which will address the mysterious world of water bodies under the ice sheet; and 'Polar snapshot from space', through which the world's major space agencies aim to characterise the state and changing nature of both polar regions to an unprecedented degree.

UK scientists are involved in around 95 of the IPY science projects, of which approximately one third address the Antarctic and one third are bipolar or 'global' (the remainder focus on the Arctic). UK scientists lead two Antarctic and four bipolar projects, reflecting the UK's traditional strength and track record in these areas. British Antarctic Survey scientists Eric Wolff and Eugene Murphy respectively are the principal investigators of a 9-nation bipolar initiative on improving our understanding of polar air-ice chemical interactions (to better interpret ice core signals), and a 14-nation effort to measure and model the interplay between the physical dynamics of the Southern Ocean, its marine ecosystem and the link with climate. Under a 13-nation project 'Surface accumulation and discharge', in which the UK is participating strongly, a major effort will be invested in improving ice sheet dynamic models. This is an urgent priority, since the recent observational results of accelerating ice discharge have shown the current models to be incapable of providing reliable predictions of ice sheet behaviour, and hence of a major component of future sea level rise.

However, IPY 2007-2008 is more than just a science initiative, massive though its scale may be. It also includes a major and determined effort to reach, interest and inspire children and the general public worldwide. This will be achieved through some 52 education and outreach projects of which the UK is involved in 11, and is leading 2. An exciting example is the Ice Station Antarctic Touring Exhibition, which is a joint venture between the UK Natural History Museum and the British Antarctic Survey. This blockbuster event will run from May 2007 to April 2008, and is aimed at families with children from seven years upwards. It will offer an inspiring and educational contemporary view of UK research in the Antarctic and how it is carried out.

In summary, then, the Antarctic is a very special part of our 'spaceship' Earth, which, despite its physical distance, connects intimately with our daily lives. International Polar Year 2007-2008 aims to deliver a quantum leap in our knowledge and understanding of the Antarctic at a critical time. For it is becoming ever clearer that we humans have to recognise and respond to the planetary limits of our behaviour, and adjust our lifestyles accordingly. The UK contribution to IPY 2007-2008 will provide key evidence on how this is to be achieved.

■ Chris Rapley, CBE, has announced he will retire as director of BAS in August 2007. NERC's chief executive, Alan Thorpe, said, 'Chris has been hugely influential in taking BAS from strength to strength during his nine years as director. BAS is internationally recognised as a world-class, scientific research centre, and Chris has been instrumental in leading that. Chris has also made an important contribution as a member of the NERC Executive Board in managing and developing NERC as a whole.'

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