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Guest editorial

Plumbing the depths - the waters of the Ross Sea

The first oceanographic measurements in the Ross Sea were made by its discoverer James Clark Ross, from the Erebus, on 18 January 1841. Since that time its continental shelf, seasonally ice free in most years, has proved a magnet to explorers and scientists, if not to fishermen and tourists. Nevertheless, our knowledge of this environment is rapidly being outpaced by our ignorance of its variability. For example, the Ross Sea contains two of the largest, most persistent polynyas on the Antarctic coastline, but its sea ice extent has increased over recent decades while its salinity has steadily declined. Are regional winds now stronger, the ocean circulation faster, and the ice thinner now than at the time of the IGY? Are its winter polynyas characterized more by upwelling driven by offshore winds, or downwelling due to brine release when sea ice is formed? How are polynya surface layers stabilized and iron-enriched, reportedly enhancing summer productivity, if the ice cover is blown away before it can melt *in situ*?

If biological productivity in the Ross Sea is high, why do the *Euphausia superba* leave all that food to the more diminutive *E. crystallorophia*? And why do the whales and seabirds often appear to be few and far between? What has caused the Ross Island penguin population to predict the behaviour of the New York stock market? If the emperors and Adélies are now threatened by recent major changes in ice patterns, have similar impacts occurred in the past? Why do these big bergs seem to calve one after another, anyway, followed by long periods of quiescence? Do they enhance productivity by melt-driven upwelling or retard it by cooling, slowing sea ice export and shortening the open water season? Is the Ross Sea a CO_2 sink for the atmosphere resulting from summer productivity or aa annual source due to the upwelling of deep water?

The bottom topography can also be confusing, if judged by discrepanceis between currently available charts and digital archives (best version at present: Plate 1 in *Antarctic Research Series,* vol. 68, 1985). Can the volume of proto-bottom water that flows down and along the continental slope of that sea floor be much less than what emerges from a small East Antarctic polynya downstream? How do the properties and production of Ross Sea bottom water vary with the multiyear cycles that throb across our troubled planet? Indeed, have oceanographers been led astray by focusing too closely on the sinking limb of the global thermohaline circulation? Denizens of the deep blue sea may be grateful, but circumpolar deep water, the mother of all other water masses in the Southern Ocean, arguable plays a larger role. Strongly influencing the overall physical and 'biogeochemical' environment, its impact on the cryosphere may now be limited to attenuated intrusions onto the broad continental shelf. But as the ocean warms, will the open Ross Sea grow at the expense of a more rapidly melting ice shelf?

Perhaps it only seemed easier to understand the regional ocean forcing and response when less data were available. But it was with these thoughts in mind that the 2nd International Conference on the Ross Sea, organized by the CLIMA project of the Italian Programme for Antarctic Research (PNRA), was convened on Ischia in October 2001. Even though attendance was reduced by the terrorist attack of 11 September, more than 60 papers and posters were presented on a wide variety of chilly topics. A subset of those presentations has since been distilled into the articles that appear in this issue. Models, observations and combinations of both have yielded several new insights, but again raise more questions than are answered. Of course, that is the nature of the enterprise, as now practiced by the increasingly multidisciplinary, and sometimes international, projects such as JGOFS, ROAVERRS, CLIMA and ANSLOPE in the dynamic and evolving Ross Sea.

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