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THE SEAOS PROGRAM (SOUTHERN ELEPHANT SEALS AS OCEANOGRAPHIC SAMPLERS): A NEW VIEW OF PHYSICAL AND BIOLOGICAL PROCESSES AND INTERACTIONS IN THE SOUTHERN OCEAN

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The Southern Ocean (SO) plays a central part in the Earth's system, affecting global climate dynamics and sustaining one of the world's most productive ecosystems. We have learned much through long-term cross-disciplinary programs about physical processes and how biophysical coupling mechanisms cause variations in primary productivity and higher trophic dynamics in space and time, but full appreciation of the complexity of this system are still largely beyond our grasp. The need for more detailed understanding of ocean dynamics and the response of SO organisms to environmental variability has become increasingly critical in the face of accelerating climate change. Practical systems of real time data gathering across all scales are urgently needed, particularly ones that can deliver continuous monitoring over extended times in logistically difficult areas. The SEaOS program deployed animal-borne CTD sensors on southern elephant seals at four breeding locations throughout the SO, and demonstrated convincingly that these instruments can deliver high frequency near real-time hydrographic data, collecting more than 21,000 profiles over 2 years (2004-2005), covering almost the entire SO from the Subtropical Front to the Antarctic coast. We also used these data to describe behavioural patterns of these important Antarctic predators in relation to their physical environment, identifying three distinct behavioural strategies: 1) Pelagic foraging along ACC fronts and zones, observed mainly in the Atlantic sector; 2) Coastal benthic foraging on the shelf west along the Antarctic Peninsula and East Antarctica; 3) Ice-edge pelagic foraging, mainly along the ice edge and within the pack-ice of the Ross Sea. Changes in diving drift rate, a proxy for body composition, we distinguished 'hotspots' where seals became relatively fatter. While most hotspots in the Atlantic sector were within the ACC, in the Indian Ocean and Pacific sector they were mainly restricted to coastal waters and the SIZ. This difference may explain the dramatic population declines the Indian Ocean and Pacific sectors during the period of rapid sea ice decline between the 1950s and 1970s, while populations in the Atlantic sector remained stable or increased. SEaOS illustrates the potential of animal-borne platforms as a cheap, large-scale yet detailed ocean monitoring system, while also providing detailed information about links between physical and biological processes in marine systems.