

“A roadmap for Antarctic and Southern Ocean science for the next two decades and beyond”

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Antarctic and Southern Ocean science has been, and will continue to be, vital to understanding natural variability, the processes that govern change and the role of humans in the Earth system. The potential for new knowledge from Antarctic science yet to be conducted is substantial. Recognizing this promise, the international Antarctic community came together to scan the horizon to identify the highest priority scientific questions that Antarctic researchers should aspire to answer in the next two decades and beyond. Wide consultation was a fundamental precept to developing a collective, international view of future directions in Antarctic science. From the many possibilities suggested, the Horizon Scan identified THE 80 most important scientific questions through methodical debate, discussion, revision and elimination by voting. Related questions were assembled into seven topical clusters: (i) “Antarctic Atmosphere and Global Connections” and (ii) “the Southern Ocean and Sea Ice in a Warming World” – questions that explore the behavior of the Antarctic atmosphere, ocean and sea ice as drivers of global climate and their connectivity to the Earth system, and improve climate predictions; (iii) “The Ice Sheet and Sea Level” – knowledge that will improve decadal-to century-scale forecasts of sea level, and more accurately portray “ice sheet-ice shelf” dynamics and sensitivities to atmospheric and oceanic forcing in models; (iv) “The Dynamic Earth beneath Antarctic Ice” – study of the deep-time history of Earth to improve understanding of plate tectonics, the evolution of life and the history of planetary ice, and validate climate, ice sheet and sea level models; (v) “Life on the Precipice” – exploration to better understand the interplay of evolutionary adaptation and ecological drivers crucial to forecasting biotic responses to change, and advance life sciences knowledge through censuses and process studies; (vi) “Near-Earth Space and Beyond - Eyes on the Sky” – observing space from Antarctica to develop unique insight into the origins and structure of the universe, the nature of Dark Universe, the evolution of galaxies, the birth of stars, and the dynamics of the ionosphere, and to identify planets capable of sustaining life; and (vii) “Human Presence in Antarctica” – research to better understand the impacts of humans in Antarctica, and the challenges this presents to governance regimes.

Answering these questions will require innovative experimental designs, new applications of technology, invention of next generation field and laboratory methodologies and development of innovative observing systems and networks. Unbiased, non-contaminating procedures will be required to retrieve the requisite air, biota, sediment and rock, ice and water samples under challenging conditions. Sustained year-round, access to Antarctica and the Southern Ocean will be essential. Improved models are needed that realistically represent Antarctica and the Southern Ocean as an integral part of the Earth system, and provide predictions at spatial and temporal resolutions that support decision-making. A coordinated, portfolio of cross-disciplinary and bipolar science, based on new models of international collaboration and funding, will be essential as no one scientist, program or nation can realize these aspirations alone.