Ocean Observations Using Autonomous Vehicles in Challenging Environments

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Abstract

Autonomous platforms offer the opportunity to make crucial scientific observations in challenging environments. One such environment is in the cavity beneath floating Antarctic ice shelves. The ocean is implicated in the basal melting of ice shelves in the Amundsen and Bellinshausen Seas, which leads to thinning of the ice shelf, and subsequent acceleration of the glacier upstream. To constrain projections of sea level rise, better understanding is needed of the ocean circulation beneath the ice shelf, and the interactions between the ocean and the ice base. I will present some recent observations collected from two autonomous underwater vehicles deployed beneath the Dotson ice shelf in the Amundsen Sea. These reveal new information about the ways that relatively warm ocean waters circulate within the cavity, cause melting, and impact on the ice shelf itself. I will discuss the challenges that need to be overcome to successfully undertake such missions.

Other challenging environments might include the ocean in front of a calving glacier front, or a region beset by piracy or war. An area might be challenging simply because it is remote, or because it has poor weather or sea ice conditions. I will discuss the possibilities for autonomous platforms, such as ocean gliders, to obtain multidisciplinary ocean observations in such locations. For example, we have used a wave-propelled autonomous surface vehicle to carry and deploy an ocean glider into a remote location. Such robotic technologies will revolutionise our future ocean observing system.

Karen Heywood is Professor of Physical Oceanography at the University of East Anglia (UEA), Norwich, where she has spent more than 30 years undertaking research and teaching in ocean processes. Her research investigates physical processes in our oceans that underpin climate, such as ocean currents, eddies and turbulent mixing and she has revealed new insights into the interactions between the ocean, atmosphere and cryosphere (floating ice shelves and sea ice). She has designed and led major field programmes at sea to observe and measure ocean characteristics, particularly in polar regions such as Antarctica. She has pioneered the use of autonomous vehicles, such as profiling ocean gliders, to make critical measurements in challenging environments. She is an enthusiastic mentor of early career scientists. She is a Fellow of the Challenger Society for Marine Science (2000) and was awarded the Challenger Medal (2016). She was elected a Fellow of the American Geophysical Union (2019) and a Fellow of the Royal Society (2021). She has served as President of the Ocean Sciences Division of the European Geosciences Union (2017-2021).