Oceanography of the Indonesian Seas

THE GLOBAL OCEAN is composed of parts—its regions—each playing a role in the global scheme of the ocean and climate systems. Each region has its intrinsic interest and uniqueness. Of course, the same physics applies to all, but by virtue of position, topographic constraints, and coupling to the atmosphere, some regions attract more interest than others; some are more central to the larger-scale systems. The tropical seas of Indonesia are such a place. There, Pacific water flows into the Indian Ocean amid a complex array of islands and of deep and shallow seas connected by narrow passages of varied depths. Stratification is subject to intense tidal-induced mixing, all under an atmosphere regulated by the Asian-Australian monsoons and subject to the whims of the El Niño Southern Oscillation. Understanding the interplay of these variables provides a challenge that oceanographers can't resist.

I often wonder what oceanographers of the first half of the 20th century would think of their quest to map the ocean if they could see the data that we now have. Their maps of ocean properties were drawn from hydrographic stations 100 km apart, with samples at depth intervals of tens or hundreds of meters, with little regard for the time of year. Each data point was obtained with enormous effort. No doubt that the value placed on each precious data point made them look harder at their scant data. They had no choice but to assume steady state, an assumption they knew was weak, but it was a practical assumption that did allow for some exciting discoveries. But if they would see the swirls and intricate texture of the ocean properties as revealed by a few good images from space of sea surface temperature, wind, chlorophyll, or sea-level heights, or if they could see the temporal variability exposed by arrays of moorings packed with sensors, would they have just given up making their maps? Of course not. It's not in the nature of explorers to wait for better apparatus the future might eventually provide. One goes forth with the tools at hand.

This special issue of *Oceanography* attempts to convey the uniqueness of the Indonesian seas and of the progress that has been made in recent years in understanding their oceanography, with what will eventually be viewed as the crude tools of the opening years of the 21st century.

The advances brought about by remote sensing from space is a central theme of many of the contributions, but to better appreciate these new views, a bit of the history of ocean exploration of the Indonesian seas is presented. Progress is built upon the hard work and ideas of our predecessors.

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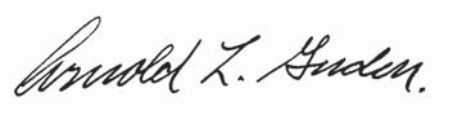

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The Indonesian seas play a fundamental role in the coupled ocean and climate system with the Indonesian Throughflow (ITF) providing the only tropical pathway connecting the global oceans. Pacific warm pool waters passing through the Indonesian seas are cooled and freshened by strong air-sea fluxes and mixing from internal tides to form a unique water mass that can be tracked across the Indian Ocean basin and beyond.Â 1 Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, United States. 2 Lamont Doherty Earth Observatory of Columbia University, Palisades, NY, United States. 3 Department of Physical Oceanography, Woods Hole Oceanographic Institution, Woods Hole, MA, United States. The territorial waters of Indonesia are defined according to the principles set out in Article 46 of the United Nations Convention on the Law of the Sea. Their boundary consists of straight lines ("baselines") linking 195 coordinate points located at the outer edge of the archipelago ("basepoints"). The current baselines were established by Government Regulation 38 of 2002 which defined by 183 coordinate points as basepoints. The baselines were modified by Government Regulation No 37 of 2008 which... OCEANOGRAPHY OF THE INDONESIAN SEAS Like a braided river running through many pathways within the Indonesian seas, the ITF headwaters are in the Pacic and their mouths lie in the multitude of passages within the Sunda archipelago. En route, the inowing Pacic water is converted by the â€œmix-masterâ€ into a uniquely Indonesian tropical stratica-tionâ€”one of a strong, though relatively. Local variability of the Indonesian Seas may influence ENSO by governing the transfer of the warm tropical water between the Pacific and Indian Oceans. Furthermore, advective and tidal induced mixing may influence the SST and sea-air coupling, with feedback on ENSO. The Arlindo Project is a joint oceanographic research endeavor of Indonesia and the United States.Â Furthermore, there was also the Infrastructure Development of Space Oceanography (INDESO) project developed for the Government of Indonesia in an attempt to build an accurate monitoring and forecasting ocean system by using the physical and biogeochemical coupled models (Nugroho et al. 2018). The Indonesian Throughflow and its Impact on Biogeochemistry in the Indonesian Seas. Key questions regarding Indonesian seas oceanography that are likely to be tackled in the future include (in order of interest): 1. ITF (Indonesian throughow): How do you monitor the ITF with reason-able accuracy by means of affordable and reliable instruments and tech-niques? What is the magnitude of the contribution of upwelled water in the Banda Sea to the ITF? How crucial is the role of ITF on the inter-oceanic heat transfer?Â More detailed studies of part of the Indonesian seas have already begun in the opening years of the 21st century. ACKNOWLEDGEMENTS We gratefully acknowledge Drs. Arnold Gordon and Ellen Kappel for their con-structive comments, which greatly im-proved this article.