Dear Admiral Klunder,

I wish to report on my activities from 01 October 2011 to 30 September 2012 as Secretary of the Navy Chair of Oceanography. This is in continuation of the Secretary of the Navy Chair in Oceanography 1985-90, and follows the same informal letter format designated by Admiral Brad Mooney and continued under Admirals Wilson, Miller, Palaez, Gaffney, Cohen, Landay and Carr. My 2011-12 efforts have been divided between acoustics and physical oceanography.

Starting with my first Chair in 1985, the UCSD Chancellor waived all overhead charges, and this waiver has been routinely renewed for the following 27 years. This year for the first time, in response to the economic situation, all overhead waivers have to be reviewed by the UC President's office. I am pleased that the waiver has again been granted.

ACOUSTIC OCEANOGRAPHY

Measurements by P. Wadhams from a British submarine have indicated a more rapid thinning of the Arctic ice cover than previous estimates, leading possibly to an ice-free summer by 2016 (*The Economist* estimated by the end of the century, Special Report on the Arctic in the 16 June 2012 issue). Disappearance of the ice cover and the attendant drop in polar albedo has first order consequences that should be monitored during the transition decade. We will study various schemes of polar tomography, possibly involving a polar source and peripheral receivers, with the acoustic sources doing double duty for navigating gliders and AUV’s. The ongoing Philippine Sea experiment has led to developments that will be useful in the more difficult polar environment. An attractive feature is the continued collaboration with the Nansen Institute in Bergen.

I have worked on the acoustic properties of the ocean wedge between the sea floor and a floating ice sheet, stretching from the continental grounding line to the ice front (for several hundred kilometers in the Ross Sea). These are the only ocean volumes not yet visited by men. Work is being done to lower instruments through holes drilled through the ice sheets, and by launching AUV’s from the ice edge into
the interior cavern. Navigation is difficult; GPS is not available under the ice cover. I have been working on a scheme for augmenting these efforts with an application of ocean acoustic tomography to the ocean caverns. Acoustic transponder arrays would be deployed just seaward of the ice edge radiating into the cavern. It is a known (but not well known) property of wedge-like caverns that acoustic rays are refracted away from the wedge apex back to the wedge opening (just as they are refracted away from the deep waters of the polar ocean back towards the surface). The broad Ross Sea ice shelf has the ideal geometry for such an experiment. For logistic reasons it is more likely it would take place in the arctic, and required acoustic receivers lowered through the ice sheet near the grounding line.

The principal cause of the global sea level rise is the melting of Antarctic and Greenland ice sheets floating on a relatively warm ocean; melting at the ice surface is a secondary consideration (This is a change from the accepted viewpoint of only a decade ago). Thermal expansion of the warming ocean is also a lesser factor. An acoustic under-the-ice experiment could led to an understanding the melting processes and hopefully the IPCC prediction for the rise in global sea level by the year 2100 is 0.3 to 2 meters. The error bars are so large as to make the prediction almost useless. A 1m rise would require the repopulation of more than 1 million people! Accordingly the global rise in sea level has been declared a national security issue.

PHYSICAL OCEANOGRAPHY

I have continued my work on sea surface roughness as related to wind drag. The relevant statistics are associated with mean square slope (not elevation). The principal contribution to slope variance is from waves shorter than 20 cm, a distinct part of the spectrum of waves shorter than the classical Phillips gravity wave spectrum. Given that so much of ocean dynamics is the result of a the variable wind drag, understanding the ultragravity (ug) waves is a first order problem in many ocean processes. Recent results are summarized in two papers: an analysis of the hydrophone measurements at the mid-Pacific H20 station on (rather surprisingly) the deep sea bottom (Farrell and Munk 2012) and a theoretical analysis (Young, Wolfe and Munk 2012), both in press. The overall situation is that there are still no good at sea direct measurements of the 2-D ug spectrum; laboratory measurements fall short regarding the surprisingly large crosswind slope components. We are left dependent on remote sensing from 500 km above and 5 km beneath the sea surface, with good enough statistics but unreliable interpretation. And we have as yet no theory for the ug wave generation. I am requesting continuation of support for my Navy Chair in the hope that we can put an end to this intolerable situation.

Yours sincerely,

Walter Munk