

Secretary of the Navy Professor of Oceanography

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LONG-TERM GOALS

Wind stress is responsible for most of the ocean dynamics. Wind stress is largely associated with steep waves shorter than a meter. We are continuing to study this short band in the wave spectrum in the hope that it will lead to better understanding of momentum transfer from atmosphere to oceans. Ambient noise level in the (not so) silent abyssal ocean at 1 to 40 Hz is dominated by a nonlinear generation process associated with the short surface waves,

OBJECTIVES

To understand the transition spectrum from classical gravity waves to capillaries.

APPROACH

Surprisingly measurements of pressure and displacement on the deep sea floor give a wealth of information about the transition spectrum. I have collaborated with Charles Cox and William Farrell.

WORK COMPLETED

Farrell W. E., W. Munk (2008) What do deep sea pressure fluctuations tell about short surface waves?. *Geophys. Res. Lett.*, **35**, L19605, doi:10.1029/2008GL035008.

Munk, W. (2009) An Inconvenient Sea-Truth: Spread, Steepness and Skewness of Surface Slopes. *Annual Review of Marine Science*, **1**: 377–415, 10.1146/annurev.marine.010908.163940.

Farrell, W. and W. Munk, (2010). Booms and Busts in the Deep. *Journal of Physical Oceanography*, **40**, 2159-2169.

RESULTS

Three octaves of surface waves (from 2 to 16 Hz) are quite distinct from the classical Phillips spectrum at lower frequencies: their spectrum is not saturated. Virtually nothing is known about the generation of their generation. They play a leading role in the momentum transfer from wind to ocean.

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IMPACT/APPLICATIONS

Measurements of wind stress based on physical principles rather than empirical relations.

TRANSITIONS

The gravity to capillary wave transition spectrum may offer some spectral “gaps” with the opportunity for listening to ocean events with a favorable signal to noise ratio. This could have a bearing for the study of marine mammals. There are interesting opportunities for ASW.

RELATED PROJECTS

Meetings and Invited Talks

- Ocean Leadership Talk at Monterey Bay Aquarium Research Institute (MBARI) **Invited Lecture:** *How Can We Learn About Short Surface Waves from Measurements on the Deep-Sea Floor?*, Monterey CA, 04 November 2009
- JASON Winter Study and 50th Anniversary Celebration, Washington DC, 20 – 22 November 2009
- MEDEA Ocean Panel, Washington DC, 20 November – 01 December 2009
- National Academy of Sciences Annual Meeting, Washington DC, 25-27 April 2010
- Crafoord Prize Symposium, **Award Lecture:** *The Sound of Climate Change*, The Royal Swedish Academy of Sciences, Stockholm, Sweden, 10 May 2010
- Crafoord Prize Symposium, **Award Lecture:** *The Sound of Climate Change*, Lund University, Sweden, 12 May 2010
- Nansen Environmental and Remote Sensing Center (NERSC) **Nansen Guest Lecture:** *The Sound of Climate Change*, Bergen, Norway, 18 May 2010
- Institute of Theoretical Geophysics, **Invited Lecture:** *The Sound of Climate Change*, University of Cambridge, United Kingdom, 20 May 2010
- MEDEA Spring Meeting, **Invited Lecture:** *Acoustic Tomography*, Washington DC, 15-17 June 2010
- Land-Ice Contribution to Future Sea Level Workshop, **Invited Lecture:** *Exploring an under-ice ocean cavity with sound*, Sterling VA, 11-14 July 2010
- Courant Institute of Mathematical Science, Center for Atmosphere Ocean Science Colloquium, **Invited Lecture:** *Exploring an under-ice ocean cavity with sound*, New York University, 04 November 2010

REFERENCES

Farrell W. E., W. Munk (2008) What do deep sea pressure fluctuations tell about short surface waves?. *Geophys. Res. Lett.*, **35**, L19605, doi:10.1029/2008GL035008.

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Farrell, W. and Munk, W. (2009). Booms and Busts in the Deep. *in preparation*.

PUBLICATIONS

Pendarvis, C. & W. Munk (2009). Where the Swell Begins: An Interview with Walter Munk. *The Surfer's Journal*, **18(6)**: 92-99.

Munk, W. (2009). On Roger Revelle. *Roger Revelle Centennial Symposium Report*, Scripps Institution of Oceanography, 17.

Worcester, P. F., and Munk, W. H. (2009) The role of acoustics in ocean observing systems. D. Glickson (Ed.), The National Academies Press, Washington, DC, *Oceanography in 2025*, 58–62.

von Storch, H. and K. Hasselman (2010) Seventy Years of Exploration in Oceanography: A Prolonged Weekend Discussion. Heidelberg, Germany: Springer, 137 pp.

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Munk, W. and C. Pendarvis (2010) Where the Swell Begins. *Groundswell Publication Annual Publication*, **5**, 242-257, in press.

Dushaw, B. D., W. W. L. Au, A. Beszczynska-Möller, R. E. Brainard, B. D. Cornuelle, T. F. Duda, M. A. Dzieciuch, A. M. G. Forbes, L. Freitag, J.-C. Gascard, A. N. Gavrilov, J. Gould, B. M. Howe, S. R. Jayne, O. M. Johannessen, J. F. Lynch, D. Martin, D. Menemenlis, P. N. Mikhalevsky, J. H. Miller, S. E. Moore, W. H. Munk, J. Nystuen, R. I. Odom, J. A. Orcutt, T. Rossby, H. Sagen, S. Sandven, J. Simmen, E. Skarsoulis, B. Southall, K. M. Stafford, R. Stephen, K. J. Vigness-Raposa, S. Vinogradov, K. B. Wong, P. F. Worcester, and C. Wunsch (2010). *A global ocean acoustic observing network*. J. Hall, D. E. Harrison and D. Stammer (Eds.), ESA Publication WPP-306, Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society, Venice, Italy, in press.

Munk, W. (2010) Walter Munk Day, *San Diego City Council*.

Munk, W. (2010) A Brief Review of My Career. *Hohenems*, submitted.

Munk, W. (2010) The Sound of Climate Change: Crafoord Prize Scientific Lecture, *Tellus*, submitted.

HONORS/AWARDS/PRIZES

Walter Munk, Crafoord Prize in Geosciences 2010, Royal Swedish Academy of Sciences, “for his pioneering and fundamental contributions to our understanding of ocean circulation, tides and waves, and their role in the Earth’s dynamics.”

Walter Munk, Österreichisches Ehrenzeichen für Wissenschaft und Kunst (The Austrian Decoration for Science and Art) 2010, The National Council of the Republic of Austria