

Karl R. Helfrich

Senior Scientist
Department of Physical Oceanography
Woods Hole Oceanographic Institution
Woods Hole, MA 02543, USA

Education

B.S.E., Duke University, 1979
S.M., Massachusetts Institute of Technology, 1982
Ph.D., Massachusetts Institute of Technology, 1985

Research Interests

Theoretical and laboratory studies in geophysical fluid dynamics: stratified flows and internal waves, hydraulic phenomena, abyssal circulation in the presence of topography, geological fluid dynamics.

Employment

Postdoctoral Investigator, 1985, Department of Civil Engineering, Massachusetts Institute of Technology.
Postdoctoral Fellow, 1985–86; Postdoctoral Investigator, 1986–87; Assistant Scientist, 1987–91; Associate Scientist, 1991–2000, tenure awarded, 1995; Senior Scientist 2000–present, Department of Physical Oceanography, Woods Hole Oceanographic Institution.

Memberships

American Geophysical Union, American Meteorological Society, American Physical Society

Honors

Fellow of the American Physical Society (2001)

Educational Activities

J. S. Johnson Chair as Educational Coordinator, Department of Physical Oceanography, 2001–present.

Courses taught (MIT catalog number):

Advanced Applied Mathematics (18.075)

Fluid Dynamics of the Oceans and Atmosphere (12.800)

Waves in the Oceans and Atmosphere (12.802)

Steady Circulation of the Oceans and Atmosphere (12.801)

Publications

Helfrich, K. R., W. K. Melville, and J. W. Miles, 1984. On interfacial solitary waves over variable topography. *Journal of Fluid Mechanics*, **149**, 305–317.

Helfrich, K. R., and W. K. Melville, 1986. On long nonlinear internal waves over slope-shelf topography. *Journal of Fluid Mechanics*, **167**, 285–308.

Whitehead, John A., and Karl R. Helfrich, 1986. The Korteweg-de Vries equation from laboratory conduit and magma migration equations. *Geophysical Research Letters*, **13**, 545–546.

Melville, W. K., and K. R. Helfrich, 1987. Transcritical two-layer flow over topography. *Journal of Fluid Mechanics*, **178**, 31–52.

Helfrich, Karl R., and Uwe Send, 1988. Finite-amplitude evolution of two-layer geostrophic vortices. *Journal of Fluid Mechanics*, **197**, 331–348.

Whitehead, John A., and Karl R. Helfrich, 1988. Wave transport of deep mantle material. *Nature*, **336**, 59–61.

Helfrich, Karl R., and John A. Whitehead, 1989. Solitary waves on conduits of buoyant fluid in a more viscous fluid. *Geophysical and Astrophysical Fluid Dynamics*, **51**, 35–52.

Adams, E. E., D. J. Cosler, and K. R. Helfrich, 1990. Evaporation from heated water bodies: predicting combined force plus free convection. *Water Resources Research*, **26**(3), 425–435.

Whitehead, J. W., and K. R. Helfrich, 1990. Magma waves and diapiric dynamics. *Magma Transport and Storage*, Michael L. Ryan, editor, John Wiley & Sons, Chichester, pp. 53–76.

Helfrich, K. R. and W. K. Melville, 1990. Review of dispersive and resonant effects in internal wave propagation. *The Physical Oceanography of Sea Straits*, L. J. Pratt, editor, NATO/ASI Series, Kluwer Academic Publishers, Dordrecht; pp. 391–420.

- Whitehead, J. A. and K. R. Helfrich, 1991. Instability of flow with temperature-dependent viscosity: A model of magma dynamics. *Journal of Geophysical Research*, **96**(B3), 4145–4155.
- Helfrich, K. R. and T. M. Battisti, 1991. Experiments on baroclinic vortex shedding from hydrothermal plumes. *Journal of Geophysical Research*, **96**(C7), 12,511–12,518.
- Grimshaw, Roger H. J., Karl R. Helfrich, and John A. Whitehead, 1992. Conduit solitary waves in a visco-elastic medium. *Geophysical and Astrophysical Fluid Dynamics*, **65**, 127–147.
- Helfrich, K. R., 1992. Internal solitary wave breaking and run-up on a uniform slope. *Journal of Fluid Mechanics*, **243**, 133–154.
- Helfrich, Karl R. and Joseph Pedlosky, 1993. Time-dependent isolated anomalies in zonal flows. *Journal of Fluid Mechanics*, **251**, 377–409.
- Helfrich, K. R., 1994. Thermals with background rotation and stratification. *Journal of Fluid Mechanics*, **259**, 265–280.
- Kim, S. L., L. S. Mullineaux and K. R. Helfrich, 1994. Larval dispersal via entrainment into hydrothermal vent plumes. *Journal of Geophysical Research*, **99**(C6), 12655–12665.
- Helfrich, Karl R., 1995. Time-dependent two-layer hydraulic exchange flows. *Journal of Physical Oceanography*, **25**(3), 359–373.
- Helfrich, Karl R., and Joseph Pedlosky, 1995. Large-amplitude coherent anomalies in baroclinic zonal flows. *Journal of the Atmospheric Sciences*, **52**, 1615–1629.
- Helfrich, Karl R., and Kevin G. Speer, 1995. Oceanic hydrothermal circulation: mesoscale and basin-scale flow. *AGU Monograph 91, Seafloor Hydrothermal Systems Physical, Chemical, Biological, and Geological Interactions*, 347–356.
- Grimshaw, R. H. J., and K. R. Helfrich, 1995. Solitary waves on two-dimensional slab conduits of buoyant fluid in a more viscous fluid. *Geophysical and Astrophysical Fluid Dynamics*, **79**, 223–238.
- Helfrich, K. R., 1995. Thermo-viscous fingering of flow in a thin gap: A model of magma flow in dikes and fissures, *Journal of Fluid Mechanics*, **305**, 219–238.
- Speer, K. G., and K. R. Helfrich. Hydrothermal plumes: a review of flow and fluxes, 1996. In: *Hydrothermal Vents and Processes*, L.M. Parson, C.L. Walker and D.R. Dixon, Editors, Geological Society Special Publication No. 87, 373–386.

- Pedlosky, Joseph, Lawrence J. Pratt, Michael A. Spall and Karl R. Helfrich, 1997. Circulation around islands and ridges. *Journal of Marine Research*, **55**, 1199–1251.
- Helfrich, K., T. Joyce, G. Cannon and S. Harrington, and D. J. Pashinski, 1998. Mean hydrographic and velocity sections near Pipe Organ Vent at Juan de Fuca Ridge. *Geophysical Research Letters*, **25**, 1737–1740.
- Joyce, Terrence M., Glenn A. Cannon, Karl R. Helfrich, Stephanie A. Harrington and Dave J. Pashinski, 1998. Vertical and temporal vorticity observations at Juan de Fuca Ridge: hydrothermal signatures. *Geophysical Research Letters*, **25**, 1741–1744.
- Wylie, J., K. R. Helfrich, B. Dade, J. R. Lister and J. F. Salzig, 1999. Flow localization in fissure eruptions. *Bull. Vulcanology*, **60**, 432–440.
- Helfrich, K. R. Allen C. Kuo and L. J. Pratt, 1999. Non-linear Rossby adjustment in a channel. *Journal of Fluid Mechanics*, **390**, 187–222.
- Helfrich, K. R., J. Pedlosky and E. Carter, 1999. The shadowed island. *Journal of Physical Oceanography*, **29**, 2559–2577.
- Pratt, L. J., K. R. Helfrich and E. Chassignet, 2000. Hydraulic adjustment to an obstacle in a rotating channel. *Journal of Fluid Mechanics*, **404**, 117–149.
- Wells, J. R. and K. R. Helfrich, 2001. Circulation around a thin zonal island. *Journal of Fluid Mechanics*, **437**, 301–323.
- Miller, P. D., L. J. Pratt, K. R. Helfrich and C.K.R.T. Jones, 2002. Chaotic transport of mass and potential vorticity for an island recirculation. *Journal of Physical Oceanography*, **32**, 80–102.
- Deese, H. E., L. J. Pratt and K. R. Helfrich, 2002. A laboratory model of exchange and mixing between western boundary layers and sub-basin recirculation gyres. *Journal of Physical Oceanography*, **32**, 1870–1889.
- Lentz, S. J. and K. R. Helfrich, 2002. Buoyant gravity currents along a sloping bottom in a rotating fluid. *Journal of Fluid Mechanics*, **464**, 251–278.
- Stern, M. E. and K. R. Helfrich, 2002. Propagation of a finite amplitude potential vorticity front along the wall of a stratified fluid. *Journal of Fluid Mechanics*, **468**, 179–204.
- Helfrich, K. R. and J. Pineda. Accumulation of particles in propagating fronts. *Limnology and Oceanography*, submitted.

Helfrich, K. R. and L. J. Pratt. Rotating hydraulics and upstream basin circulation.
Journal of Physical Oceanography, submitted.