VITA (revised NOV 2016)

Eric Kunze 13 JUN 1956

Education

BSc in Honors Physics/Mathematics, UBC, 1979.
non-thesis Masters in Physical Oceanography (Tom Sanford, advisor), 1982,
"Observations of Near-Inertial Waves in a Front".
PhD in Physical Oceanography (Tom Sanford, advisor), 1985,
"Near-Inertial Wave Propagation in Geostrophic Shear".

Work Experience

1983 Summer: WHOI GFD summer fellow, Woods Hole Oceanographic Institution (advisor: Francis Bretherton).
1985 - 86: WHOI postdoctoral fellow, Woods Hole Oceanographic Institution (advisor: Raymond W. Schmitt).
1986 - 87: postdoctoral research scientist, Woods Hole Oceanographic Institution (collaborating with Raymond Schmitt, Sandy Williams and Melbourne Briscoe).
1987 - 2014: U of Washington.
2004 - 2011: Canada Research Chair.
2010 - 2016: affiliate professor, College of the Environment, U of Washington.
2014 - present: senior scientist, NorthWest Research Associates

Awards

WHOI Summer GFD fellow, 1983, Woods Hole Oceanographic Institution
WHOI Postdoctoral Fellowship, 1985, Woods Hole Oceanographic Institution.
Killam Postdoctoral Fellowship, 1985, Dalhousie U, Halifax, NS (declined).
Father James B. Macelwane Medal for Young Investigators, 1992, American Geophysical Union.
Sverdrup Lecturer: American Geophysical Union Fall Meeting, 1992.
Canada Research Chair in Physical Oceanography, 2004 - 2011.

Research Interests

Oceanic phenomena that contribute to mixing and stirring with particular attention to the interactions of meso- to microscale processes such as fronts, eddies, internal waves, potential-vorticity-carrying finestructure, turbulence, double diffusion and surface forcing.

Parameterization of the impact of these subgridscale processes on larger scales through dynamical understanding.

Publications

1. Kunze, E., and T.B. Sanford, 1984: Observations of near-inertial waves in a front. *J. Phys. Oceanogr.*, **14**, 566-581. (133)
2. Kunze, E., 1985: Near-inertial wave propagation in geostrophic shear. *J. Phys. Oceanogr.*, **15**, 544-565. (501)
3. Kunze, E., and T.B. Sanford, 1986: Near-inertial wave interactions with mean flow and bottom topography near Caryn Seamount. *J. Phys. Oceanogr.*, **16**, 109-120. (27)
4. Kunze, E., and R. Lueck, 1986: Velocity profiles in a warm-core ring. *J. Phys. Oceanogr.*, **16**, 991-995. (17)
5. Kunze, E., 1986: The mean and near-inertial velocity fields in a warm-core ring. *J. Phys. Oceanogr.*, **16**, 1444-1461. (55)

6. Kunze, E., 1987: Limits on growing, finite-length salt fingers: A Richardson number constraint. *J. Mar. Res.*, **45**, 533-556. (134)
7. Kunze, E., A.J. Williams III, and R.W. Schmitt, 1987: Optical microstructure in the thermohaline staircase east of Barbados. *Deep-Sea Res.*, **34**, 1697-1704. (52)

8. Kunze, E., 1990: The evolution of salt fingers in inertial wave shear. *J. Mar. Res.*, **48**, 471-504. (51)
9. Kunze, E., A.J. Williams III and M.G. Briscoe, 1990: Observations of shear and vertical stability from a neutrally-buoyant float (Part 1). *J. Geophys. Res.*, **95**, 18,127-18,142. (104)
10. Kunze, E., M.G. Briscoe and A.J. Williams III, 1990: Interpreting shear and strain finestructure from a neutrally-buoyant float (Part 2). *J. Geophys. Res.*, **95**, 18,111-18,125. (43)

11. Gregg, M.C., and E. Kunze, 1991: Internal wave shear and strain in Santa Monica Basin. *J. Geophys. Res.*, **96**, 16,709-16,719. (130)
12. Kunze, E., M.A. Kennelly and T.B. Sanford, 1992: The depth dependence of shear finestructure off Point Arena and near Pioneer Seamount. *J. Phys. Oceanogr.*, **22**, 29-41. (16)
13. Kunze, E., and T.B. Sanford, 1993: Submesoscale dynamics near a seamount: I. Measurements of Ertel vorticity. *J. Phys. Oceanogr.*, **23**, 2567-2588. (34)
14. Kunze, E., 1993: Submesoscale dynamics near a seamount: II. The partition of energy between internal waves and geostrophy. *J. Phys. Oceanogr.*, **23**, 2589-2601. (12)
15. Muench, J., E. Kunze and E. Firing, 1994: The potential vorticity structure of equatorial deep jets. *J. Phys. Oceanogr.*, **24**, 418-428. (25)
16. Kunze, E., 1994: A proposed flux constraint for salt fingers in shear. *J. Mar. Res.*, **52**, 999-1016. (39)
17. Kunze, E., 1995: Quantifying salt-fingering fluxes in the ocean. *Double-Diffusive Convection, AGU Chapman Conference Proc. Geophysical Monograph 94*, A. Brandt and J. Fernando, Eds., 313-320. (5)
18. Kunze, E., R.W. Schmitt and J.M. Toole, 1995: The energy balance in a warm-core ring's near-inertial critical layer. *J. Phys. Oceanogr.*, **25**, 942-957. (86)

19. Sun, H., E. Kunze and A.J. Williams III, 1996: Vertical heat-flux measurements

from a neutrally-buoyant float. *J. Phys. Oceanogr.*, **26**, 984-1001. (15)

20. Kunze, E., and T.B. Sanford, 1996: Abyssal mixing: Where it isn't. *J. Phys. Oceanogr.*, **26**, 2286-2296. (131)
21. Kunze, E., and J.M. Toole, 1997: Tidally-driven vorticity, Diurnal shear and turbulence atop Fieberling Seamount. *J. Phys. Oceanogr.*, **27**, 2663-2693. (179)
22. Toole, J.M., R.W. Schmitt, K.L. Polzin and E. Kunze, 1997: Near-boundary mixing above the flanks of a midlatitude seamount. *J. Geophys. Res.*, **102**, 947-959. (141)
23. Kunze, E., and E. Boss, 1998: A model for vortex-trapped internal waves. *J. Phys. Oceanogr.*, **28**, 2104-2115. (25)

24. Muench, J.E., and E. Kunze, 1999: Internal wave interactions with equatorial deep jets. Part I: Momentum-flux divergences. *J. Phys. Oceanogr.*, **29**, 1453-1467. (17)
25. Muench, J.E., and E. Kunze, 2000: Internal wave interactions with equatorial deep jets. Part II: Acceleration of the jets. *J. Phys. Oceanogr.*, **30**, 2099-2110. (20)
26. Sun, H., and E. Kunze, 1999: Internal wave/wave interactions: Part I. The role of internal wave vertical divergence. *J. Phys. Oceanogr.*, **29**, 2886-2904. (22)
27. Sun, H., and E. Kunze, 1999: Internal wave/wave interactions: Part II. Spectral energy transfer and turbulence production rates. *J. Phys. Oceanogr.*, **29**, 2905-2919. (42)

28. Polzin, K., E. Kunze, J. Hummon and E. Firing, 2002: The finescale response of lowered ADCP velocity profiles. *J. Atmos. Oceanic Techno.*, **19**, 205-224. (90)
29. Kunze, E., L.K. Rosenfeld, G.S. Carter and M.C. Gregg, 2002: Internal waves in Monterey Submarine Canyon. *J. Phys. Oceanogr*, **32**, 1890-1913. (286)
30. Johnson, G.C., E. Kunze, K.E. McTaggart and D.W. Moore, 2002: Temporal and spatial structure of the equatorial deep jets in the Pacific Ocean. *J. Phys. Oceanogr.*, **32**, 3397-3407. (22)
31. McPhee-Shaw, E.E., and E. Kunze, 2002: Boundary-layer intrusions from a sloping bottom: A mechanism for generating intermediate nepheloid layers. *J. Geophys. Res.*, **107**, doi: 10.1029/2001JC000801. (79)
32. Polzin, K.L., E. Kunze, J.M. Toole and R.W. Schmitt, 2003: The partition of finescale energy into internal waves and geostrophic motions. *J. Phys. Oceanogr.*, **33**, 234-248. (55)
33. Kunze, E., 2003: A review of salt-fingering theory. *Prog. Oceanogr.*, **56**, 399-417. (77)
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35. Rudnick, D.L., T. Boyd, R.E. Brainard, G.S. Carter, G.D. Egbert, M.C. Gregg, P.E. Holloway, J. Klymak, E. Kunze, C.M. Lee, M.D. Levine, D.S. Luther, J. Martin, M.A. Merrifield, J.N. Moum, J.D. Nash, R. Pinkel, L. Rainville and T.B. Sanford, 2003: From tides to mixing along the Hawaiian Ridge. *Science*, **301**, 355-357. (280)
36. Kunze, E., and S.G. Llewellyn Smith, 2004: The role of smallscale topography in turbulent mixing of the global ocean. *Oceanography*, **17**(1), 51-60. (89)
37. Nash, J.D., E. Kunze, J.M. Toole and R.W. Schmitt, 2004: Internal tide reflection and turbulent mixing on the continental slope. *J. Phys. Oceanogr.*, **34**, 1117-1134. (183)

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44b. Kunze, E, J.F. Dower, R. Dewey and E.A. D'Asaro, 2007: Mixing it up with krill. Response to A. Visser *Science Perspective "Biomixing of the Oceans?"*. *Science*, **318**, 1239. (12)
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51. Rousseau, S., E. Kunze and R. Dewey, K. Bartlett and J. Dower, 2010: On turbulence production by swimming marine organisms in the open ocean and coastal waters. *J. Phys. Oceanogr*., **40**, 2107-2121. (25)

52. Lelong, M.-P., and E. Kunze, 2010: Generation of an internal tide by surface tide/eddy resonant interactions. *Turbulence in the Atmosphere and Oceans*, Ed. David Dritschel, Springer-Verlag, 39-49.
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55. Kunze, E., 2011: Fluid mixing by swimming organisms in the low-Reynolds-number limit. *J. Mar. Res*., **69**, 591-601. (19)
56. Kunze, E., C. MacKay, E.E. McPhee-Shaw, K. Morrice, J.B. Girton and S.R. Terker, 2012: Turbulent mixing and exchange with interior waters on sloping boundaries. *J. Phys. Oceanogr*., **42**, 910-927. (37)
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63. Waterhouse, A.F., J.A. MacKinnon, J.D. Nash, M.H. Alford, E. Kunze, H.L. Simmons, K.L. Polzin, L.C. St. Laurent, O.M. Sun, R. Pinkel, L.D. Talley, C.B. Whalen, T.N. Huussen, G.S. Carter, I. Fer, S. Waterman, A. Naveira Garabato, T. Sanford and C.M. Lee, 2014: Global patterns of mixing from measurements of the turbulent dissipation rate. *J. Phys. Oceanogr*., **44**, 1854-1872. (94)
64. Sato, M., J.M. Klymak, E. Kunze, R. Dewey and J.F. Dower, 2014: Turbulence and internal waves in Patricia Bay, Saanich Inlet, British Columbia. *Cont. Shelf Res*., **85**, 153-167. (3)
65. Kunze, E., 2014: The Relation between Unstable shear layer thicknesses and turbulence lengthscales. *J. Mar. Res*., **72**, 95-104. (5)
66. Frajka Williams, E., E. Kunze and J.A. MacKinnon: Bispectra of internal tides and parametric subharmonic instability. *arXiv,* 1410.0926v1. 23 pp. (2)

67. Kunze, E., J.M. Klymak, R.-C. Lien, R. Ferrari, C.M. Lee, M.A. Sundermeyer and L. Goodman, 2015: Submesoscale water-mass spectra in the Sargasso Sea. *J. Phys. Oceanogr*., **45**, 1325-1338. (11)

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69. Cole, S.T., C. Wortham, E. Kunze and W.B. Owens, 2015: Eddy stirring and horizontal diffusivity from Argo float observations: Geographic and depth variability. *Geophys. Res. Lett.*, **42**, 3989-3997. doi: 10.1002/2015GL063827. (16)
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71. Nagai, T., A. Tandon, E. Kunze and A. Mahadevan, 2015: Spontaneous generation of internal waves by the Kuroshio Front. *J. Phys. Oceanogr.*, **45**, 2381-2406. (18)
72. Shcherbina, A.Y., M.A. Sundermeyer, E. Kunze, E.A. D'Asaro, G. Badin, D. Birch, A.-M.E.G. Brunner-Suzuki, J. Callies, B.T. Kuebel Cervantes, M. Claret, B. Concannon, J. Early, R. Ferrari, L. Goodman, R.R. Harcourt, J.M. Klymak, C.M. Lee, M.-P. Lelong, M.D. Levine, R.-C. Lien, A. Mahadevan, J.C. McWilliams, M.J. Molemaker, S. Mukherjee, J.D. Nash, T. Özgökmen, S.D. Pierce, S. Ramachandran, R.M. Samelson, T.B. Sanford, R.K. Shearman, E.D. Skyllingstad, K. Schafer Smith, A. Tandon, J.R. Taylor, E.A. Terray, L.N. Thomas and J.R. Ledwell, 2015: The LatMix summer campaign: Submesoscale stirring in the upper ocean. *Bull. Amer. Meteor. Soc.*, **96**, 1257-1279. (27)
73. Kunze, E., and M.A. Sundermeyer, 2015: The role of intermittency in internal-wave shear dispersion. *J. Phys. Oceanogr.*, **45**, 2979-2990. (3)
74. Kunze, E., 2017: Internal-wave-driven mixing: Global geography and budgets. *J. Phys. Oceanogr.*, **47**, 1325-1345, doi: 10.1175/JPO-D-16-0141.1 (3)
75. Kunze, E., 2017: The internal-wave-driven meridional overturning circulation. *J. Phys. Oceanogr.*, **47**, 2673-2689.
76. MacKinnon, J.A., M.H. Alford, J.K. Ansong, B.K. Arbic, A. Barna, B.P. Briegleb, F.O. Bryan, M.C. Buijsman, E.P. Chassignet, G. Danabasoglu, S. Diggs, S.M Griffies, R.W. Hallberg, S.P. Jayne, M. Jochum, J.M. Klymak, E. Kunze, W.G. Large, S. Legg, B. Mater, A.V. Melet, L.M. Merchant, R. Musgrave, J.D. Nash, N.J. Norton, A. Pickering, R. Pinkel, K. Polzin, H.L. Simmons, L.C. St. Laurent, O.M. Sun, D.S. Trossman, A.F. Waterhouse, C.B. Whalen and Z.-X. Zhao, 2016: Climate Process Team on internal-wave-driven ocean mixing. *Bull. Amer. Meteor. Soc.*, accepted. doi: BAMS-D-16-0030. (2)
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78. Kunze, E., 2018: A unified model spectrum for anisotropic stratified and isotropic turbulence in the ocean and atmosphere. *J. Phys. Oceanogr.*, submitted.
79. Kunze, E.: 2019: Biologically-generated mixing in the ocean. *Ann. Rev. Mar. Sci.*, submitted.

Unrefereed Reports

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Kunze, E., and P. Müller, 1989: The Effect of Internal Waves on Vertical Geostrophic Shear. *Parameterization of Smallscale Processes, Proceedings, 'Aha Huliko'a Hawaiian Winter Workshop*, edited by P. Müller, Hawaii Inst. Geophys., 273-287. (9)

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Wortham, C., M.-P. Lelong, J. Early, E. Kunze and M.A. Sundermeyer, 2018: The Role of Intermittency in Internal-Wave-Driven Lateral Mixing. *Ocean Sciences*, FEB 2018, Portland, OR.

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Professional Activities

editor, *Journal of Marine Research* 1990 - 2003
member SCOR WG 108 on Double Diffusion -- 1996 - 2003
Student Ombudsman, School of Oceanography, U of Washington, 1992 - 2004
Chair, Ocean Physics Dept, Applied Physics Lab, U of Washington, 2002-2003
Participant, Bathymetry from Space Workshop, Scripps, 24-26 OCT 2002
(www.igpp.ucsd.edu/bathymetry_workshop)
Garrett Symposium organizing committee member, 2008.
CNC/SCOR eastern Canada 9-institute lecture tour, OCT 2008
"Ocean Abyssal Mixing and the Meridional Overturning Cell"
editor *Journal of Physical Oceanography*, 2009 – 2013.
Science Communication Fellow, Pacific Science Center., 2012 – present.
"The Influence of Polar Seas on the Global Ocean"

graduate student committee member -- Halley Dosser (PhD 2015)
graduate student committee member -- Byron Kilbourne (PhD 2015)
postdoctoral research advisor – Cimmaron Wortham (2013 - 2016)

honors thesis supervisor -- Patrick Conley (2011)
graduate student advisor -- Susan Barton (pre-doc 2010)
NSERC USRA supervisor -- Sara Fissel (summer 2010)
undergrad supervisor -- Emery Hartley (summer 2010)
graduate student co-advisor -- Mei Sato (PhD 2013)
"Variability in Diel Vertical Migration of Zooplankton and Characteristics of the Physical Environments in Saanich Inlet, British Columbia"
undergrad co-supervisor -- Evan Maynard (summer 2008)
graduate student co-advisor -- Jeannette Bedard (Masters 2011)
"Tidal Interactions with Local Topography Above a Sponge Reef"
NSERC USRA supervisor -- Cassandra Rosa (summer 2007)
graduate student co-advisor -- Shani Rousseau (Masters 2009)
"Influence of Swimming Marine Organisms on Turbulence in the Ocean from In Situ Measurements"
graduate student committee member -- Philip Benoit (PhD candidate 2004-2012)
graduate student committee member -- Wendy Callendar (Masters 2009)
graduate student advisor -- Reyna Jenkyns (Masters 2009)
"Momentum Transfer Between Semidiurnal Internal Waves and Subinertial Flow at a Dissipating Surface Reflection"

graduate student committee member -- Dilumie Abeysirigunawardena (PhD candidate)
graduate student collaboration -- Sam Kelly (OSU PhD 2010)
graduate student committee member – Katie Morrice (Moss Landing, Masters 2011)
graduate student committee member -- Samantha Terker (PhD 2012)
graduate student committee member -- Eleanor Frajka Williams (PhD 2009)
graduate student committee member -- Kim Martini (PhD 2010)
graduate student committee member -- Wayne Martin (PhD 2008)
external examiner -- Steve Jachec, Stanford University, CA (PhD 2007)

graduate faculty representative -- Else Shoop (Masters 2006 Psychology)
graduate advisory committee member -- Maya Whitmont (Masters 2006)
graduate faculty representative -- Andrey Skvortsov (Masters 2005)
graduate student committee member -- Irene Garcia Berdeal (PhD 2005)
visiting graduate student co-advisor -- Bruno Gomez visiting (PhD candidate 2005)
graduate student advisor -- Eleanor Frajka Williams (Masters 2005)
graduate student committee member -- Glenn Stuart Carter (PhD 2005)
graduate student acting advisor -- Marlene Jeffries (Masters 2004)
graduate student committee member -- Abdullah Bamasoud (Masters 2004)
graduate faculty rep -- Melanie Francis Fitzpatrick (- 2004, PhD candidate, Geophys.)
graduate faculty rep -- Mark Kenyon Renner (- 2004, PhD candidate, Music)
graduate student committee member -- Tina M. Drexler Lomnicky (Masters 2004)
graduate student committee member -- John Mickett (- 2004 PhD candidate)
graduate student committee member -- Jen MacKinnon (PhD 2002)
graduate student committee chairman -- Alana Althaus (Masters 2001)
"Internal Tide Radiation from Mendocino Escarpment"
--winner of 1st annual Dean A. McManus Excellence in Teaching Award, 2002
graduate student committee co-chair -- Erika McPhee-Shaw (PhD 2000)
graduate faculty representative -- Brooke Skelton (PhD1999)
external examiner -- Brian May, Dalhousie University, PhD thesis 1999
graduate faculty representative -- Blake Charles Chenevert (PhD 1998)
graduate faculty representative -- Neill Phillip Symons (PhD 1998)
graduate student committee chairman -- Sun Haili (PhD 1997)
"Ray-Tracing Internal Wave/Wave Interactions and Spectral Energy Transfer"
graduate student committee member -- Emmanuel Boss (PhD 1996)
graduate student committee member -- Daniel Codiga (PhD 1996)
graduate faculty representative -- Donald Slinn (PhD 1995)
graduate student committee member -- Craig Lee (PhD 1995)
graduate student committee chairman -- Joanna Muench (PhD 1995)
"Internal Wave Interactions with Equatorial Deep Jets"
graduate faculty representative -- Jen-E Wu (PhD 1995)
graduate student committee member -- Holly Fair (Masters 1994)
graduate student committee member -- Tracy Petroske (Masters 1993)
graduate student committee member -- Mark Prater (PhD 1991)
graduate student committee member -- Joel Wesson (PhD 1991)
graduate faculty representative -- Pascale Lelong (PhD 1988)
graduate student committee member -- Norge Larson (PhD 1987)

postdoctoral research advisor – Kurt Polzin (1993)
postdoctoral research advisor – Jonathan Nash (2001 - 2003)
postdoctoral research co-advisor – Ryuichiro Inoue (2004 - 2006)

lecturer WHOI summer GFD program, Summer 1987, 1995, 2010.
taught 3-credit advanced graduate course "Internal Waves in an Inhomogeneous Ocean" Autumn 1990, Winter 1998, Spring 2003, Winter 2011.
taught 3-credit core graduate course "Waves in the Ocean" Spring 1993.

taught 3-credit advanced graduate course "Upper-Ocean Dynamics" Spring 1995, Spring 1999, Winter 2001
taught 5-credit graduate core course Ocean 510 "The Physics of Ocean Circulation" Autumn 1995
taught UVic Physics 426 "Fluid Mechanics", Autumn 2005, 2006, 2007, 2008, 2009, 2010.
co-taught UVic EOS 350 "Understanding the World's Oceans", Autumn 2005, 2006
co-taught UVic EOS 534 "Ocean Mixing", Winter 2007
supervisor, CR/NC Ocean 519A "Student Seminar Series", Autumn, 1996
guest lecturer in EOS 525 “Research Frontiers in Earth and Ocean Science”, Autumn 2004
cited in *Science* Research News article (Kerr, R.A., 1997: Geophysicists Peer into Fiery Core and Icy Ocean Depths. *Science*, **275**, 160-161.)

Organizations
fellow American Geophysical Union
member American Meteorological Society

Current and Pending Funding

A. NSF
1. Storm-Driven Near-Inertial Waves and Mixing in the Western North Pacific (with Ren-Chieh Lien, APL-UW)
2. OCE-1459173 (NWRA PS336)
3. 1 JAN 2015 - 31 DEC 2019
4. $2,461,772
5. 1-, 3-, 3-, 3- and 2-mm effort for E. Kunze in FY15, 16, 17, 18 and 19
6. An EM-APEX float observational program to investigate the near-field fate of fall-winter storm wind internal power gain in the western North Pacific and its role in upper ocean mixing with fieldwork in FY16.

B. NSF
1. Collaborative Research: Numerical Modeling of the Internal-Wave Cascade and Submesoscale Lateral Dispersion (with Marie-Pascale Lelong, Northwest Research Associates; Miles Sundermeyer, UMass-Dartmouth)
2. OCE- 1536747 (NWRA PS325)
3. 1 JAN 2016 - 31 DEC 2018
4. $658,990 (NWRA component, PS325)
5. 3-, 2- and 2-mm effort for E. Kunze in FY16, 17 and 18.
6. Numerical simulations to understand the roles of internal waves and mixing-induced vortical mode through various proposed mechanisms in the internal-wave cascade and lateral mixing.

C. NSF
1. Collaborative Research: Submesoscale Mixed-Layer Dynamics: Isolating the Sub- and Super-Inertial SMILE (with James Girton and John Mickett, APL-UW; Tom Farrar, WHOI)
2. OCE-1536681 (NWRA PS329)
3. 1 OCT 2015 - 30 SEP 2020.
4. $333,862 (NWRA component, PS329)
5. 0.5-, 3-, 3-, 2- and 2-mm effort for E. Kunze in FY16, 17, 18, 19 and 20.
6. To repeatedly deploy arrays of up to 16 EM-APEX profiling floats while simultaneously conducting SWIMS towyo and ADCP ship surveys to understand mixed-layer restratification due to mixed-layer lateral variability following winter storms in the central North Pacific with a focus on filtering out near-inertial motions to determine the longer-term effect of mixed-layer instabilities.

D. NSF
1. Collaborative Research: Isopycnal Spectra and Stirring on the Submesoscale and Finescale (in collaboration with Ren-Chieh Lien, APL-UW)
2. OCE-1734222 (NWRA G486P)
3. 1 SEP 2017 - 31 AUG 2020.
4. $328,198 (NWRA component NWRA G486P)
5. 2-, 4- and 4-mm effort for E. Kunze in FY18, 19 and 20.
6. CTD chain tows to measure submeso- and finescale water-mass variability on

isopycnals to smaller horizontal scales O(1 m) than previously resolved to capture the scales influenced by the outer scales of isotropic turbulence. Repeat O(1 km) surveys with the CTD chain and shipboard ADCP to capture the horizontal strains $(X_x, X_y, Y_x, Y_y) = \int(u_x, u_y, v_x, v_y)dt$ responsible for deforming the water-mass fields, and determining the dynamics of submesoscale straining for comparison with submesoscale theoretical predictions.

E. NSF
1. Collaborative Research: Internal Lee-Wave Dissipation in Mean Shear (in collaboration with Amala Mahadevan, WHOI, and Amit Tandon, U Mass-Dartmouth)
2. OCE-1756093 (submitted)
3. 1 JUN 2018 - 31 MAY 2022.
4. $245,996 (NWRA P498 component)
5. 2-, 1-, 1- and 2-mm effort for E. Kunze in years 1, 2, 3 and 4.
6. Numerical simulations of internal lee-wave generation, propagation, reabsorption and dissipation in sheared flows $U(y, z)$ will determine what fraction of lee-wave energy is reabsorbed vs. dissipated. Model simulations predict that lee-wave generation accounts for 20-50% of the wind input into the balanced largescale circulation, with half occurring in the Antarctic Circumpolar Current. However, DIMES and SOFINE microstructure measurements fall short of predicted dissipation rates by an order of magnitude. The proposed simulations will test whether energy reabsorption into the mean shear through action conservation can be the missing lee-wave sink. If this hypothesis holds true, lee-wave generation is more a mechanism for redistributing than dissipating balanced energy.

F. ONR
1. NISKINE DRI: Profiling Float Measurements of Near-Inertial Waves and Turbulence (in collaboration with Ren-Chieh Lien and Caitlin Whalen, APL-UW)
2. submitted
3. 1 JAN 2018 - 31 DEC 2022.
4. $384,338 (NWRA P513 component)
5. 1-, 2-, 2-, 3- and 3-mm effort for E. Kunze in years 1, 2, 3, 4 and 5.
6. Deployment of up to 15 chi-augmented EM-APEX profiling floats north of the Gulf Stream/North Atlantic Current to characterize the evolution of near-inertial wave energy from generation through interactions with the upper ocean balanced shear to turbulent dissipation rates and energy-fluxes out of the upper pycnocline as part of the NISKINE DRI.

Research Cruises

1. Student assistant on mooring deployment cruise on Oregon shelf, *Wecoma*, Barbara Hickey, chief scientist, OCT 1980.
2. Deployed XCPs in a Gulf Stream warm-core ring, *Bartlett*, Mike Gregg, chief scientist, JAN 1983.
3. Deployed XCPs in a Gulf Stream cold-core ring, *Lynch*, Tom Sanford, chief scientist, DEC 1983.

4. Deployed XCPs above Pioneer Seamount and in OPTIMA domain, *McArthur*, SEP 1984.
5. Assisted in test deployment of Richardson-number measuring float, *Knorr*, JUL 1987.
6. Deployed XCPs in the wake of Ampere Seamount and in the Mediterranean Outflow plume south and west of Portugal, *Oceanus*, Tom Sanford, chief scientist, SEP 1988.
7. Deployed XCPs in a Gulf Stream warm-core ring, *Oceanus*, Ray Schmitt, chief scientist, JAN 1990.
8. Deployed XCPs over Fieberling Guyot, *New Horizon*, John Toole, chief scientist, APR 1991.
9. Deployed XCPs, XCTDs and XDPs in Monterey Submarine Canyon, *Point Sur*, Mike Gregg, chief scientist, AUG 1997.
10. Deployed XCPs, made CTD casts and analysed AVP data across Mendocino Escarpment, *Wecoma*, Tom Sanford and Eric Kunze, co-chief scientists, OCT 1997.
11. Deployed XCPs and XCTDs on Virginia continental slope, *Oceanus*, Kurt Polzin, chief scientist, MAY 1998.
12. Deployed XCPs, made CTD casts and analysed AVP data along the Hawaiian Ridge, *Wecoma*, Tom Sanford, Craig Lee and Eric Kunze, co-chief scientists, OCT 2000.
13. Deployed XCPs and analysed AVP data along the Hawaiian Ridge, *Wecoma*, Tom Sanford, Craig Lee and Eric Kunze, co-chief scientists, OCT 2002.
14. Participation in one-day instrument test cruise in Saanich Inlet, *Strickland*, Lou St. Laurent, chief scientist, FEB 2005.
15. Participation in four-day instrument test cruise between Oahu and Molokai, *Wecoma*, Jonathan Nash, chief scientist, FEB 2005.
16. 3-day VMP test cruise in Saanich Inlet, Strickland, Eric Kunze, chief scientist, APR 2005.
17. Deployed XCPs and analysed data on Oregon continental slope, *Wecoma*, Jonathan Nash, chief scientist, SEP 2005.
18. 3-day VMP test cruise in Saanich Inlet, *Strickland*, Eric Kunze, chief scientist, JUN 2006.
19. 1-week VMP cruise off Point Sur, CA (AESOP), *Point Sur*, James Girton, chief scientist, AUG 2006.
20. 2-day VMP cruise in Saanich Inlet (ZOOM07), *Strickland*, Eric Kunze, chief scientist, MAY 2007.
21. 3-week VMP cruise to Ocean Station Papa (ZOOM07), *CCGS Tully*, Marie Robert, chief scientist, JUN 2007.
22. 1-day new Hammerhead towed body test cruise in Saanich Inlet, *Strickland*, Rolf Lueck, chief scientist, OCT 2007.
23. 2-week VMP, Hammerhead and ADCP cruise to survey Fraser Ridge in the Strait of Georgia , *CCGS Vector*, Eric Kunze and Richard Dewey, co-chief scientists, NOV 2007.
24. 2-day VMP cruise in Saanich Inlet (ZOOM08), *Strickland*, Shani Rousseau, chief scientist, MAY 2008.
25. 2-week VMP cruise to Monterey Submarine Canyon, *Point Sur*, Eric Kunze, Erika McPhee-Shaw and James Girton, co-chief scientists, AUG 2008.
26. 9-day Hammerhead/dye-release and -tracking cruise in Saanich Inlet, *Strickland*, Eric Kunze and Richard Dewey, co-chief scientists, MAY 2009.
27. 1-day VMP cruise in Saanich Inlet, *Strickland*, Eric Kunze, chief scientist, JUL 2009.

28. 2-day EM APEX float test cruise in Saanich Inlet, *Strickland*, Eric Kunze, chief scientist, AUG 2009.
29. 4-day mooring deployment on Fraser Ridge and VMP test cruise in Saanich Inlet, *Strickland*, Eric Kunze, Jeannette Bedard and Richard Dewey, chief scientists, JUN 2010.
30. 7-day VMP sampling in Barkley Canyon as part of Coastal Carbon 2010 cruise, *Tully*, Debby Ianson, chief scientist, AUG 2010.
31. 5 1-day mooring deployment and recovery cruises in Strait of Georgia and Saanich Inlet (ZOOM10+), *Strickland*, Eric Kunze, Mei Sato, Jeannette Bedard and Richard Dewey chief scientists, AUG-SEP 2010.
32. 5 1-day Hammerhead test cruise and sampling water-mass finestructure in Saanich Inlet, *Strickland*, Eric Kunze, chief scientist, APR 2011.
33. 3-week Hammerhead cruise as part of ONR's Lateral Stirring DRI, *R/V Oceanus*, Craig Lee, chief scientist, JUN 2011.
34. 8-day cruise to deploy 6 chi-augmented EM-APEX profiling floats with R.-C. Lien, *R/V Shinsei-maru*, Shin-ichi Ito, chief scientist, AUG 2016.
35. 5-week cruise to examine surface mixed-layer restratification using SWIMS and EM-APEX floats with James Girton, John Mickett and Tom Farrar, *R/V Sikuliaq*, James Girton, chief scientist, MAR 2017.
36. 10-day cruise to deploy 7 chi-augmented EM-APEX profiling floats with R.C. Lien, *R/V Shinsei-maru*, Shin-ichi Ito, chief scientist, AUG 2017.