

## REFERENCES

- Abe, T., 1962, "On the stable foam formation of sea water in seas," *J. Oceanogr. Soc. Japan*, **20**, 242-250.
- Adamson, A. W., 1982, "Physical chemistry of surfaces," John Wiley&Sons, New York, p. 649.
- Andreas, E. L., J. B. Edson, E. C. Monahan, M. P. Rouault, and S. D. Smith, 1995, "The spray contribution to the net evaporation from the sea: a review of recent progress," *Boundary-Layer Meteor.*, **72**, 3-52.
- Asher, W. E., L. M. Karle, B. J. Higgins, and P. J. Farley, 1996, "The influence of bubbles plumes on air-seawater gas transfer velocities," *J. Geophys. Res.*, **101**, 12027-12041.
- Baldy, S., 1988, "Bubbles in the close vicinity of breaking waves: statistical characteristics of the generation and dispersion mechanism," *J. Geophys. Res.*, **93**, 8239-8248.
- Batchelor, G. K., 1967, "An introduction to fluid mechanics," Cambridge University Press, p. 367.
- Bendat, J. S., and A. Piersol, 1966, "Measurements and analysis of random data," John Wiley&Sons, New York, p. 383.
- Blanchard, D. C., and A. H. Woodcock, 1957, "Bubble formation and modification in sea and its meteorological significance," *Tellus*, **9**, 145-158.
- Blanchard, D. C., and L. Syzdek, 1972, "Variations in Aitken and Giant nuclei in marine air," *J. Phys. Oceanogr.*, **2**, 255-262.
- Blanchard, D. C., 1983, "The production, distribution and bacterial enrichment of the sea-salt aerosol," in "*Air-Sea Exchange of gases and particles*," P. Liss and G. Slinn, eds., Reidel, Dordrecht, 407-454.
- Blanchard, D. C., 1985, "The oceanic production of atmospheric sea salt," *J. Geophys. Res.*, **90**, 961-963.

- Bondur, V. G., and E. A. Sharkov, 1982, "Statistical properties of whitecaps on a rough sea," *Oceanology*, 274-279.
- Brahtz, J. F., 1968, "Ocean engineering: goals, environment, technology," John Wiley&Sons, New York, p. 720.
- Brennen, C. E., 1995, "Cavitation and bubble dynamics," Oxford University Press, New York, p. 282.
- Burger, S. R., and Blanchard, D. C., 1983, "The persistence of air bubbles at a seawater surface," *J. Geophys. Res*, **88**, 7724-7726.
- Clay, C. S., and H. Medwin, 1977, "Acoustical oceanography: principles and applications," John Wiley&Sons, Inc., New York, p. 544.
- Clift, R., J. R. Grace, and M. E. Weber, 1978, "Bubbles, drops, and particles," Academic press, New York, p. 369.
- Cointe, R., and M. P. Tulin, 1994, "A theory of steady breakers," *J. Fluid Mech.*, **276**, 1-20.
- Crawford, G. B., and D. M. Farmer, 1987, "On the spatial distribution of ocean bubbles," *J. Geophys. Res.*, **92**, 8231- 8243.
- Dahl, P. H., and Jessup, A. T., 1995, "On bubble clouds produced by breaking waves: an event analysis of ocean acoustic measurements," *J. Geophys. Res*, **100**, 5007-5020.
- De Leeuw, G., and L. H. Cohen, 1995, "Bubble size distributions in coastal seas," in "Air-Water Gas Transfer," B. Jähne and E. C. Monahan, eds., Verlag&Studio Hanau, 325-336.
- Detsch, R., and R. N. Sharma, 1990, "The critical angle for gas bubble entrainment by plunging liquid jet," *Chem. Eng. J.*, **44**, 157-166.
- Dobson, F., L. Hasse, and R. Davis, 1980, "Air-sea interaction: instruments and methods," Plenum Press, New York, p. 775.
- Duce, R. A., and E. J. Hoffman, 1976, "Chemical fractionation at the air/sea interface," *Ann. Rev. Earth Planet. Sci.*, **4**, 187-228.
- Duncan, J. H., 1981, "An experimental investigation of breaking waves produced by a towed hydrofoil," *Proc. R. Soc. Lond.*, **A 377**, 331-348.

- Eriksson, E., 1959, "The yearly circulation of chloride and sulfur in nature: meteorological, geochemical and pedological implications. Part I," *Tellus*, **11**, 375-403.
- Farmer, D. M., and S. Valge, 1989, "Waveguide propagation of ambient sound in the ocean-surface bubble layer," *J. Acoust. Soc. Am.*, **85**, 1897-1908.
- Frouin, R., M. Schwindling, and P.-Y. Deschamps, 1996, "Spectral reflectance of sea foam in the visible and near-infrared: In situ measurements and remote sensing implications," *J. Geophys. Res.*, **101**, 14361-14371.
- Garrett, W. D., 1967, "Stabilization of air bubbles at the air-sea interface by surface-active material," *Deep-Sea Res.*, **14**, 661-672.
- Geernaert, G. L., 1990, "Bulk parameterizations for the wind stress and heat fluxes," in *Surface Waves and Fluxes*, vol. 1, G. L. Geernaert and W. J. Plant, eds., Kluwer Academic Publishers, 91-172.
- Geißler, P., and B. Jähne, 1995, "Measurements of bubble size distributions with an optical technique based on depth from focus," in "Air-Water Gas Transfer," B. Jähne and E. C. Monahan, eds., Verlag&Studio Hanau, 351-362.
- Hammit, F. G., 1980, "Cavitation and multiphase flow phenomena," McGraw-Hill Inc., New York, p. 413.
- Handbook of chemistry and physics, 1986-1987, Weast, R. C., ed., CRC Press, Boca Raton, FL.
- Hasse, L., and P. S. Liss, 1980, "Gas exchange across the air-sea interface," *Tellus*, **32**, 470-481.
- Hoffman, E. J., and R. A. Duce, 1977, "Organic carbon in marine atmospheric particulate matter: concentration and particle size distribution," *Geophys. Res. Letters*, **4**, 449-452.
- Hwang, P. A, Y.-H. Hsu, and Jin Wu, 1990, "Air bubbles produced by breaking wind waves: a laboratory study," *J. Phys. Oceanogr.*, **20**, 19-28.
- Hwang, P. A, Y.-K. Poon, and Jin Wu, 1991, "Temperature effects on generation and entrainment of bubbles induced by a water jet," *J. Phys. Oceanogr.*, **21**, 1602-1605.
- Jerlov, N. G., 1976, "Marine optics," Elsevier Scientific Publishing Company, Amsterdam, p. 227.

- Johnson, B. D., and R. C. Cooke, 1979, "Bubble populations and spectra in coastal waters: a photographic approach," *J. Geophys. Res.*, **84**, 3761 - 3766.
- Johnson, B. D., 1986, "Bubble population: background and breaking waves," in "*Oceanic Whitecaps*," E. C. Monahan and G. M. Niocaill, eds., Reidel, Dordrecht, 69-74.
- Kalvoda, P. M., 1992, "Macrobubble clouds produced by breaking wind waves," M.S. Thesis, 80 p., University of Delaware, Graduate College of Marine Studies.
- Keeling, R. F., 1993, "On the role of large bubbles in air-sea gas exchange and supersaturation in the ocean," *J Marine Res.*, **51**, 237-271.
- Kitaigorodski, S. A., M. A. Donelan, J. L. Lumley, and E. A. Terray, 1983, "Wave-turbulence interactions in the upper ocean. Part II: Statistical characteristics of wave and turbulent components of the random velocity field in the marine surface layer," *J. Phys. Oceanogr.*, **13**, 1988-1999.
- Koga, M., 1982, "Bubble entrainment in breaking wind waves," *Tellus*, **34**, 481-489.
- Kolovayev, P. A., 1976, "Investigation and statistical size distribution of wind produced bubbles in the near-surface ocean layer," *Oceanology*, **15**, 659-661.
- Koepke, P., 1986, "Remote sensing signatures of whitecaps," in "*Oceanic Whitecaps*," E. C. Monahan and G. M. Niocaill, eds., Reidel, Dordrecht, 251-260.
- Lamarre, E., and W. K. Melville, 1991, "Air entrainment and dissipation in breaking waves," *Nature*, **351**, 469-472.
- Lamarre, E., 1993, "An experimental study of air entrainment by breaking waves," Ph. D. Thesis, 329 p., MIT/WHOI.
- Latham, J., and M. H. Smith, 1990, "Effect on global warming of wind-dependent aerosol generation at the ocean surface," *Nature*, **347**, 372-373.
- Levich, V. G., 1962, "Physicochemical Hydrodynamics," Prentice Hall, Englewood Cliffs, NY, 451-452.
- Leifer, I. S., W. E. Asher, and P. J. Farley, 1995, "A validation study of bubble mediated air-sea gas transfer modeling for trace gases," in "*Air-Water Gas Transfer*," B. Jähne and E. C. Monahan, eds., Verlag&Studio Hanau, 269-283.
- Ling, S. C., and H. P. Pao, 1988, "Study of micro-bubbles in the North sea," in "*Sea Surface Sound*," B.R. Kerman, ed., Kluwer Academic Publishers, 197-210.

- Liss, P. S., 1983, "Gas transfer: experiments and geochemical implications," in "*Air-Sea Exchange of gases and particles*," P. Liss and G. Slinn, eds., Reidel, Dordrecht, 241-298.
- Loewen, M. R., M. A. O'Dor, and M. G. Skafel, 1995, "Laboratory measurements of bubble size distributions beneath breaking waves," in "*Air-Water Gas Transfer*," B. Jähne and E. C. Monahan, eds., Verlag&Studio Hanau, 337-349.
- Longuet-Higgins, M. S., and J. S. Turner, 1974, "An 'entraining plume' model of a spilling breaker," *J. Fluid Mech.*, **63 part 1**, 1-20.
- Longuet-Higgins, M. S., 1975, "On the joint distribution of the periods and amplitudes of sea waves," *J. Geophys. Res.*, **80**, 2688-2694.
- Longuet-Higgins, M. S., 1988, "Mechanisms of deep water wave," in *Sea Surface Sound*, B. R. Kerman, ed., Kluwer Academic Publishers, 1-30.
- Longuet-Higgins, M. S., 1990, "An effect of sidewalls on waves in a wind wave channel," *J. Geophys. Res.*, **95**, 1765.
- MacIntyre, F., 1986, "On reconciling optical and acoustical bubble spectra in the mixed layer," in "*Oceanic Whitecaps*," E. C. Monahan and G. M. Niocaill, eds., Reidel, Dordrecht, 75-94.
- Medwin, H., 1970, "In situ acoustic measurements of bubble populations in coastal ocean waters," *J. Geophys. Res.*, **75**, 599-611.
- Medwin, H., 1977a, "In situ acoustic measurements of microbubbles at sea," *J. Geophys. Res.*, **82**, 971-975.
- Medwin, H., 1977b, "Counting bubbles acoustically: a review," *Ultrasonic*, **15**, 7-13.
- Medwin, H., and N. D. Breitz, 1989, "Ambient and transient bubble spectral densities in quiescent seas and under spilling breakers," *J. Geophys. Res.*, **94**, 12751-12759.
- Medwin, H., and M. M. Beaky, 1989, "Bubble sources of the Knudsen sea noise spectra," *J. Acoust. Soc. Am.*, **86**, 1124-1130.
- Melville, W. K., and R. J. Rapp, 1985, "Momentum flux in breaking waves," *Nature*, **317**, 514-516.

- Melville, W. K., M. R. Loewen, and E. Lamarre, 1993, "Bubbles, noise and breaking waves: a review of laboratory experiments," in *Natural Physical Sources of Underwater Sound*, B. R. Kerman, ed., Kluwer Academic Publishers, 483-501.
- Melville, W. K., E. Terrill, and L. Ding, 1995, "Field measurements of air entrainment by breaking waves," in "*Air-Water Gas Transfer*," B. Jähne and E. C. Monahan, eds., Verlag&Studio Hanau, 285-295.
- Merlivat, L., and L. Memery, 1983, "Gas exchange across an air-water interface: experimental results and modeling of bubble contribution to transfer," *J. Geophys. Res.*, **88**, 707-724.
- Monahan, E. M., and Zietlow, C. R., 1969, "Laboratory comparisons of fresh-water and salt-water whitecaps," *J. Geophys. Res.*, **74**, 6961-6966.
- Monahan, E. C., and I. O'Muircheartaigh, 1980, "Optimal power-law description of oceanic whitecap coverage dependence on wind speed," *J. Phys. Oceanogr.*, **10**, 2094-2099.
- Monahan, E. C., and M. Lu, 1990, "Acoustically relevant bubble assemblages and their dependence on meteorological parameters," *IEEE J. Oceanic Eng.*, **15**, 340-349.
- Monahan, E. C., 1993, "Occurrence and evolution of acoustically relevant sub-surface bubble plumes and their associated, remotely monitorable, surface whitecaps," in *Natural Physical Sources of Underwater Sound*, B. R. Kerman, ed., Kluwer Academic Publishers, 503-517.
- Monahan, E. C., Q. Wang, and M. B. Wilson, 1995, "The temporal evolution of the bubble spectrum in the plume beneath a whitecap," in "*ONR Workshop on bubbly flows: abstracts*," Monahan, eds., Verlag&Studio Hanau, 305-311.
- O'Hearn, T. J., L. d'Agostino, and A. J. Acosta, 1988, "Comparison of holographic and Coulter counter measurements of cavitation nuclei in the ocean," *J. Fluids Eng.*, **110**, 200-207.
- Peltzer, R. D., and Griffin, O. M., 1987-88, "The stability and decay of foam in sea water," *Ocean physics and engineering*, **12**, 101-126.
- Pinet, P. R., 1992, "Oceanography," West Publishing Company, St. Paul, MN, p. 553.
- Prosperetti, A., 1988, "Bubble-related ambient noise in the ocean," *J. Acoust. Soc. Am.*, **84**, 1042-1054.

- Rapp, R. J., and W. K. Melville, 1990, "Laboratory measurements of deep-water breaking waves," *Phil. Trans. R. Soc. Lond.*, **A 331**, 735-800.
- Resch, F., and G. Afeti, 1991, "Film drop distributions from bubbles bursting in seawater," *J. Geophys. Res.*, **96**, 10681-10688.
- Rosen, M. J., 1978, "Surfactants and interfacial phenomena," John Wiley&Sons, New York, p. 295.
- Scott, J. C., 1975, "The role of salt in whitecap persistence," *Deep-sea Res.*, **22**, 653-657.
- Scott, J. C., 1986, "The effect of organic films on water surface motions," in "*Oceanic Whitecaps*," E. C. Monahan and G. M. Niocaill, eds., Reidel, Dordrecht, 159-166.
- Smith, S. D., 1988, "Coefficients for sea surface wind stress, heat flux, and wind profiles as a function of wind speed and temperature," *J. Geophys. Res.*, **93**, 15467-15472.
- Snyder, R. L., L. Smith, and R. M. Kennedy, 1983, "On the formation of whitecaps by a threshold mechanism. Part III: Field experiment and comparison with theory," *J. Phys. Oceanogr.*, **13**, 1505-1518.
- Soo, S. L., 1967, "Fluid Dynamics of Multiphase systems," Blaisdel Publishing Company, Waltham, MA, p. 524.
- Srokosz, M. A., 1986, "On the probability of wave breaking in deep sea," *J. Phys. Oceanogr.*, **16**, 382-385.
- Struthwolf, M., and Blanchard, D. C., 1984, "The residence time of air bubbles <400  $\mu\text{m}$  diameter at the surface of distilled water and seawater," *Tellus*, **36B**, 294-299.
- Su, M.-Y., S.-C. Ling, and J. Cartmill, 1988, "Optical microbubble measurements in the North Sea," in "*Sea Surface Sound*," B. R. Kerman, ed., Kluwer Academic Publishers, 211-223.
- Su, M.-Y., D. Todoroff, and J. Cartmill, 1994, "Laboratory comparisons of acoustic and optical sensors for microbubble measurements," *J. Atmos. and Oceanic Tech.*, **11**, 170-181.
- Su, M.-Y., and J. Cartmill, 1995, "Effects of salinity on breaking wave generated void fraction and bubble size spectra," in "*Air-Water Gas Transfer*," B. Jähne and E. C. Monahan, eds., Verlag&Studio Hanau, 305-312.

- Tennekes, H., and J. L. Lumley, 1972, "A first course in turbulence," MIT Press, Cambridge, Mass., p. 272.
- Thorpe, S. A., 1982, "On the clouds of bubbles formed by breaking wind-waves in deep water, and their role in air-sea gas transfer," *Phil. Trans. R. Soc. Lond.*, **A304**, 155-210.
- Thorpe, S. A., and A. J. Hall, 1983, "The characteristics of breaking waves, bubble clouds, and near-surface current observed using side-scan sonar," *Continental Shelf Res.*, **1**, 353-384.
- Thorpe, S. A., 1992, "Bubble clouds and the dynamics of the upper ocean," *Q. J. R. Meteor. Soc.*, **118**, 1-22.
- Trevena, D. H., 1987, "Cavitation and tension in liquids," Adam Higler, Philadelphia, p. 123.
- Valge, S., and D. M. Farmer, 1992, "The measurements o bubble-size distributions by acoustical backscatter," *J. Atmos. Oceanic Tech.*, **9**, 630-644.
- Van de Hulst, H. C., 1957, "Light scattering by small particles," John Wiley&Sons, New York, p. 470.
- Walker, R. E., 1994, "Marine Light Field Statistics," John Wiley&Sons, New York, p. 661.
- Walsh, A. L., and Mulhearn, P. J., 1987, "Photographic measurements of bubble population from breaking waves at sea," *J. Geophys. Res.*, **92**, 14553-14565.
- Wanninkhof, R., W. Asher, and E. Monahan, 1995, "The influence of bubbles on air-water gas exchange: results from gas transfer experiments during WABEX-93," in "*Air-Water Gas Transfer*," B. Jähne and E. C. Monahan, eds., Verlag&Studio Hanau, 239-254.
- Woodcock, A. H., 1972, "Smaller salt particles in oceanic air and bubble behavior in the sea," *J. Geophys. Res.*, **77**, 5316-5321.
- Woolf, D. K., and S. Thorpe, 1991, "Bubbles and the air-sea exchange of gases in near-saturation conditions," *J. Mar. Res.*, **49**, 435-466.
- Wu, Jin, 1977, "Fast-moving suspended particles: measurements of their size and velocity," *Appl. Opt.*, **16**, 596-600.
- Wu, Jin, 1981, "Bubble population and spectra in near-surface ocean: summary and review of field measurements," *J. Geophys. Res.*, **86**, 457-463.



- Wu, Jin, 1988a, "Bubbles in the near-surface ocean: a general description," *J. Geophys. Res.*, **93**, 587-590.
- Wu, Jin, 1988b, "Variations of whitecap coverage with wind stress and water temperature," *J. Phys. Oceanogr.*, **18**, 1448-1453.
- Wu, Jin, 1992a, "Bubble flux and marine aerosol spectra under various wind velocities," *J. Geophys. Res.*, **97**, 2327-2333.
- Wu, Jin, 1992b, "Individual characteristics of whitecaps and volumetric description of bubbles," *IEEE Transc. Ocean Eng.*, **17**, 150-158.
- Wu, Jin, 1994, "Bubbles in the near-surface ocean: their various structures," *J. Phys. Oceanogr.*, **24**, 1955-1965.
- Xu, D., P. A. Hwang, and Jin Wu, 1986, "Breaking of wind generated waves," *J. Phys. Oceanogr.*, **16**, 2172-2178.
- Young, F. R., 1989, "Cavitation," McGraw-Hill Book Company, London, p. 412.
- Zheng, Q. A., V. Klemas, and Y.-H. L. Hsu, 1983, "Laboratory measurements of water surface bubble life time," *J. Geophys. Res.*, **88**, 701-706.