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Research Interests

Stratified hydrodynamics, turbulence and frontal dynamics, with specific emphasis on estuarine flows, river plumes, and industrial discharges; coastal and environmental engineering.

Current Research

Collaborative research: Mixing, Spreading, and Water Mass Modification in Near Field River Plumes. National Science Foundation. \$345,186 (\$521,094 total). March 2006 - February 2008. Observational and numerical study of mixing and spreading in a near field river plume in order to quantify and predict important changes in water mass structure across the first several kilometers of a river plume. Observations focus on the mouth of the Merrimack River (Newburyport, MA) and include velocity, density and turbulent microstructure surveys. The project requires detailed measurements of turbulence in the near field of the plume, as well as delineation of streamlines and spreading. Numerical modeling of the outflow will be carried out in collaboration with colleagues at Texas A&M University.

Other projects have included studies of the physics and ecology of Mt. Hope Bay (Massachusetts/Rhode Island), including detailed analyses of mixing and turbulence in a thermal discharge plume, and efforts to quantify residence time within the bay. In conjunction with the Mt. Hope Bay work, one of my graduate students also investigated habitat preferences of juvenile winter flounder.

Recent Publications

- MacDonald, D.G., and A.R. Horner-Devine, 2008. Temporal and spatial variability of vertical salt flux in a highly stratified estuary. *J. Geophys. Res.*, in press.
- Hetland, R.D., and D.G. MacDonald, 2007. Spreading in the Merrimack River plume. *Ocean Modeling*, in press.
- MacDonald, D.G., and K.R. Dyer, 2007. Estuarine Oceanography. *Encyclopedia of Science and Technology*, 6, 685-691, McGraw-Hill, New York.
- MacDonald, D.G., L. Goodman, and R.D. Hetland, 2007. Turbulent dissipation in a near-field river plume: A comparison of control volume and microstructure observations with a numerical model, *J. Geophys. Res.*, 112, C07026, doi:10.1029/2006JC004075.
- Chen, F., and MacDonald, D.G., 2006. Role of mixing in the structure and evolution of a buoyant discharge plume, *J. Geophys. Res.* 111(C11002), doi:10.1029/2006JC003563.
- MacDonald, D.G., and R.A. Rountree (eds.) 2006. *Natural and Anthropogenic Influences on the Mt. Hope Bay Ecosystem, Northeastern Naturalist 13*, Special Issue 4.
- MacDonald, D.G., and R.A. Rountree, 2006. Concluding remarks: *Natural and Anthropogenic Influences on the Mt. Hope Bay Ecosystem, Northeastern Naturalist 13*(Spec. Iss. 4), 199-204.
- Rountree, R.A., and D.G. MacDonald, 2006. Introduction to *Natural and Anthropogenic Influences on the Mt. Hope Bay Ecosystem, Northeastern Naturalist 13*(Spec. Iss. 4), 1-30.
- MacDonald, D.G., 2006. Estimating an estuarine mixing and exchange ratio from boundary data with application to Mt. Hope Bay (Massachusetts/Rhode Island). *Estuar. Coast. Shelf S.* 70(1-2), 326-332.
- MacDonald, D.G., and W.R. Geyer, 2005. Hydraulic control of a highly stratified estuarine front. *J. Phys. Oceanogr.* 35(3), 374-387.
- MacDonald, D. G., and W. R. Geyer, 2004. Turbulent energy production and entrainment at a highly stratified estuarine front, *J. Geophys. Res.* 109, C05004, doi:10.1029/2003JC002094.