



The upper ocean response to a summer storm south of Iceland: using boundary layer models to assess chemical sources and sinks

A.J. Kettle (1), S.M. Turner (1), W. Broadgate (2), T.D. Jickells (1), and P.S. Liss (1)

(1) School of Environmental Sciences, University of East Anglia, (2) International Geosphere-Biosphere Programme, Royal Swedish Academy of Sciences

During a survey of upper ocean chemical and physical properties south of Iceland in June, 1998 the sampling routine of scientists on board the RRS Discovery was interrupted by a 2-day storm. When sampling was resumed at the same location after the storm, it was found that the mixed layer had deepened from 30 m to about 50 m and that there had been a significant vertical redistribution of the chemical tracers. The appearance of the storm over a fully-instrumented oceanographic research vessel engaged in chemical survey work presented an excellent opportunity to compare different parameterizations for air-sea fluxes and upper ocean boundary layer processes.

A selection of one-dimensional upper ocean models were run to simulate the ocean response to the storm using different parameterizations for surface fluxes. A series of virtual tracers were introduced at all model levels before the storm, and their redistribution was monitored until measurements were resumed after the storm. In some cases, the measured tracers were mixed conservatively, and the vertical distributions of the measured and virtual tracers could be compared directly to assess the skill of the mixing model. This was especially true of the nutrients. In other cases, the chemical tracers were not conserved. For example, most of the gases (methyl iodide, methyl bromide, isoprene, ethene, methane, and dimethyl sulfide) were depleted in the mixed layer through the action of surface outgassing during the high wind event. However, some of the gases showed near-surface maximum concentrations through the action of biological agents or near-surface photoproduction in the short time interval after the water column stabilized after the storm. With only biological sources and sinks, the nonvolatile compound dimethylsulfoniopropionate showed a depletion in the 0-30 m

depth range of the water column and an increase at deeper depths from 30-60 m.

The modelling approach pursued in this study permitted a formal statement of the strength of the sources and sinks of all of these nonconserved compounds through the application of an inverse model.