Geophysical Research Abstracts
Vol. 13, EGU2011-4461, 2011
EGU General Assembly 2011

A high-resolution baroclinic model of Loch Linnhe

Vladimir Ivanov (1,2,3), Andrew Dale (3), and Mark Inall (3)

(1) Arctic and Antarctic Research Institute, Ocean-air interaction, St.Petersburg, Russian Federation (vladimir.ivanov@sams.ac.uk), (2) International Arctic Research Center University of Alaska fairbanks USA, (3) Scottish Marine Institute (SAMS) Oban UK

A baroclinic model of Loch Linnhe has been developed to provide the physical background for a general ecosystem model of an inshore area of the west of Scotland. This task has been being accomplished through application of POLCOMS, a 3-D hydrodynamic coastal ocean model developed at the Proudman Oceanographic Laboratory (POL). POLCOMS has been previously adapted to other Scottish fjords and has a proven ability to simulate realistic patterns of wind-driven circulation. The model was set up for the entire Loch Linnhe (outer and inner lochs) with open boundaries across the Firth of Lorn and the strait between the Isle of Mull and the mainland. The horizontal model resolution is 100m, which adequately resolves the heterogeneity in the distributions and fluxes of surface layer properties. The vertical resolution is variable with smaller steps (less than to 2.5 m) in the surface and bottom boundary layers. Key drivers of the model are tides, freshwater inputs and winds. Initial and boundary conditions for model experiments were approximated from climatology. Model runs were carried out on the SAMS Linux cluster. Available observations and publications on the subject provide a factual basis for model validation. Observed heterogeneity has spatial scales of about 2-3 km while the internal Rossby radius is 0.9-2.5 km, i.e. less than the mean width of the loch ($\sim$ 4 km). Surface distributions of temperature and salinity respond to tides, local wind forcing and fresh water input from rivers and adjoining lochs. Ponding events, in which winds hold the brackish surface layer against the head of the loch, are a common feature of the system behaviour. A pronounced transverse asymmetry develops when the wind drives an Ekman transport with a significant cross-loch component. Tidal flows over complicated bathymetry and around the irregular shoreline lead to the development of surface fronts and essentially three-dimensional circulation. Rapid variation of the thermohaline structure resulting from tidal/ atmospheric/freshwater forcing makes it difficult to use snap-shot synoptic surveys for the generation of the reliable initial conditions required for application of POLCOMS in baroclinic mode. To overcome this problem we spin the model up for 4 years using mean seasonal forcing in order to generate consistent density-velocity arrays. These arrays could be further used as initial data for short-term (up to 1 month) experiments with observation-based meteorological data or typical forcing (specific wind, runoff etc.). Several results from the 4th year run are presented. The major conclusion of these experiments is that the seasonal cycle in external forcing is well translated in the model without substantial drifts of calculated properties (temperature, salinity and currents) from a periodic pattern.