Observing deep ocean convection with gliders

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Deep ocean convection in the Gulf of Lions (Mediterranean) has received a relatively great deal of attention, both theoretical and experimental. Several extensive measurement campaigns have been carried out over the years. Traditionally, CTD measurements and water velocity measurements with acoustic Doppler current profilers have been done either from a research vessel or using moorings.

In the present research project a network of so-called gliders is used to observe the characteristics of convection. In particular we focus on the length scales and vertical velocity scales of the plumes during a convection event, and the lateral mixing after active convection.

Gliders are autonomous underwater vehicles (AUV's) that are driven by a buoyancy engine rather than a propeller. By changing the buoyancy, gliders dive and climb to specified depths down to 1000 m, whilst simultaneously moving horizontally. Due to their low energy consumption, gliders can zig-zag through the ocean for one month or more. The order of magnitude of the velocity is 0.4 m/s, which corresponds to covered distances of the order of 1000 km per deployment.

The gliders we use are equipped with a CTD device, which allows us to map salinity and temperature of the ocean in greater detail then possible using conventional means. Besides salinity and temperature data, vertical water velocities provide essential information with respect to convection. A model for the dynamics of a glider is developed which relates the velocity of a glider with respect to the ambient water mass to glider data such as measured pitch and buoyancy. Subtracting this velocity from the velocity inferred from depth measurements yields the vertical water velocity.

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The glider model is also used to calculate the motion and the measurements of a glider in a simulated ocean using data from a numerical model. We have used the MITgcm model to simulate deep convection together with the glider model to investigate to what extent the characteristic length and velocity scales for convection can be estimated from glider measurements. The actual measurements take place in the period January - March 2007.