Geophysical Research Abstracts
Vol. 13, EGU2011-10284, 2011
EGU General Assembly 2011

Modelling climate change impacts on deep water renewal in Lake Baikal

Sebastiano Piccolroaz and Marco Toffolon

University of Trento, Department of Civil and Environmental Engineering, Trento, Italy (sebastiano.piccolroaz@ing.unitn.it, marco.toffolon@ing.unitn.it)

Deep ventilation in deep, temperate lakes is an interesting physical phenomenon having important implication on the eco-biology of the whole freshwater basin. It is characterized by the sinking of cold and oxygenated surface waters down to high depths, resulting in a cooling and natural oxygenation of the hypolimnetic waters. The mechanism is triggered by thermobaric instability (i.e. the decrease of the temperature of maximum density of fresh water, which is about 4°C at the atmospheric pressure, with increasing depth and pressure) in presence of an external forcing (e.g. surface winds, thermal bars, river inflows) that is strong enough to move a portion of surface water down to a certain critical depth. Climate change can cause variations of the lake surface temperature and of the temporal and spatial wind field distribution, thus affecting the external forcing mechanisms and consequently the long term behaviour of deep water renewal in a freshwater basin.
Lake Baikal (Siberia), the deepest and largest lake in the world in terms of volume, is characterized by an intense annual renewal of deep waters that is able to reach the deepest layers up to 1642 m depth. Due to its dimension and the great amount of wide-ranging physical and eco-biological phenomena occurring in it, Lake Baikal has been greatly studied and monitored. Notwithstanding, estimates of the extension of the water volumes sinking downward to the bottom of the lake are often controversial.
In this work, deep mixing and ventilation occurring in the South Basin of Lake Baikal (1461 m deep) is numerically investigated by means of a simplified one-dimensional vertical model. Numerical simulations on single downwelling occurrences considering a typical annual temperature evolution have been carried out, comparing the results with the observational data (by courtesy of Prof. Alfred Wüest, EAWAG) in order to calibrate the model. In this phase, an estimate of current mean annual intrusion volume and temperature has been performed (with values respectively of 20 km^3 and of 3.15°C, approximately). Moreover, long time (i.e. centuries) simulations have been run aimed at: (1) understanding whether the actual profile is in equilibrium with the existing external conditions; and (2) simulating the effects of different climate change scenarios (e.g. global warming and wind variation). The results suggest that the current deep water temperature profile of Lake Baikal is an equilibrium configuration achieved during the past centuries. Furthermore, it seems that the deep water conditions are significantly resistant to climate change, and that possible variations of wind intensity are more significant than the warming of surface waters in altering the mechanism of downwelling. The resilience of the current configuration may be considered coherent with the geological age of the lake and of the peculiar ecosystem that has adapted to such conditions.