Interannual Temperature Variability in the Benthic Boundary Layer over the Black Sea Shelf

Fred Wobus (PhD Student at the School of Marine Science & Technology, UoP)

Georgy Shapiro (supervisor, UoP)
Dmitry Aleynik (collaborator, SAMS)

Area of Research: Physical Oceanography

Abstract

Long-term changes in the state of the benthic boundary layer (BBL) on the North-Western shelf of the Black Sea are assessed using analysis of intra- and interannual variations of temperature in the near-bottom water mass as well as their relations to physical parameters of both shelf and deep-sea waters. Large data sets of hydrographic observations over the 20th century are first compiled into high-resolution monthly climatology at different density levels. The temporal evolution of the BBL is then revealed via anomalies from the climatic mean, which are aggregated into spatial compartments and seasonal bins. For the purpose of this study the BBL water mass is defined as such shelf water below the seasonal pycnocline which is unable to mix vertically with oxygen-rich surface waters. This water mass is thus considered "locked" as it is isolated from the effects of atmospheric processes at the surface and the action of the "biological pump" is suppressed. During the summer half of the area of the shelf bottom is occupied by such locked waters, but the BBL can be ventilated horizontally with deep-sea waters through isopycnal exchanges. A long-term time series of summer temperature anomalies in the locked water mass reveals a warm period in the 1960s/70s, followed by cooling of the BBL during 1980-2001. The transition between the warm and cold periods coincides with a regime shift in the Black Sea ecosystem. Correlations between the temperature in the BBL on the shelf with the temperature of Cold Intermediate Waters in the deep sea indicate that isopycnal shelf-deep sea exchanges are more important for ventilation of the benthic boundary layer on the shelf than winter convection on the shelf itself.