

## Zooplankton diel vertical migration database.

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Zooplankton diel vertical migration, being widespread in a marine and freshwater environment, remains a challenge for researchers: biologists, chemists and acousticians.

The database to support research on vertical migration of zooplankton (ZMD) has been developed in Shirshov Institute of Oceanology, Russian Academy of Sciences. ZMD contains long-term data from the Black Sea observations since 2009 and from the Baltic Sea since 2011 obtained with anchored autonomous Aqualog profilers, ship observations and satellite remote sensing.

The vertical migration of zooplankton depend on many environmental factors such as density, light, oxygen, temperature, salinity, chlorophyll, etc.

The Aqualog moored profiling carrier collects regular time series of vertical profiles of marine environmental data at a fixed geographic position over extended periods of time.

The profiler is equipped with oceanographic sensors and makes repeated round trips up and down a taut mooring wire between the subsurface flotation and the anchor, while maintaining a stable orientation with respect to the direction of current.

When compared to traditional moorings, which use multiple instruments at fixed depths, the profiler acts as a lift for a single set of third-party sensors, thus increasing the vertical resolution of the data while decreasing operational costs and optimizing value.

Aqualog profiler was equipped by high frequency 2MHz ADCP. It provided a higher spatial resolution for the measurements of the migrators velocity and volume backscattering strength than in the previous hydroacoustic studies.

Hydroacoustic methods, enabling sufficiently cheap, neither time consuming nor labor-intensive data collection and permitting the synoptic coverage of a large area, could provide information valuable for biologists and chemists. It could include: a zooplankton migration magnitude (upper and lower boundaries of the depth range covered during the migration), zooplankton migration velocities, biomass and spatial distribution.

The synchronous measurements of temperature, salinity, pressure, dissolved oxygen, Chlorophyll, turbidity were made using a Seabird SBE 52MP or Idronaut 319 CTD sensors interacting with a Seabird SBE 43F or AANDEREA Optode oxygen sensor, Seapoint Chlorophyll Fluorometer and Turbidity sensor. Simultaneously, the vertical profiles of horizontal current velocity components were measured.

To identify the influence of various parameters on the zooplankton vertical migration, especially temperature, salinity and oxygen concentration, the calibration data of these sensors are stored in the database. The data passed quality control according various criteria.

Additionally, the data collected by the Terra, Aqua, Landsat 8 and Sentinel satellites were used to obtain the information on chlorophyll a (Chl a) surface concentration and diffuse attenuation coefficient (K490), depending on the surface suspended matter concentration.

ZMD also stores data from ship observations near profiler deployment points. Temperature, salinity, oxygen, chlorophyll, turbidity profiles were measured by CTD Rosette System from the ship. Water samples were taken using bathometers from different depths in the water column for chemical analyses. The database also stores data of concentration and species composition of zooplankton was obtained by biological nets.

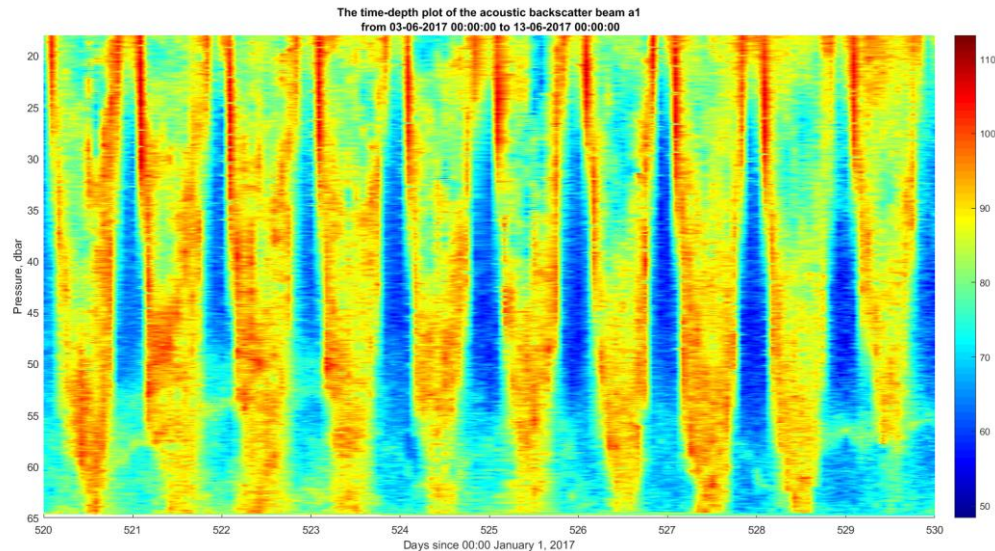


Figure 1: Zooplankton diel migration plot

ZMD allows to request data using observation period, geographical point of observation and sensors set. Output format can be in CVS, ODV, XML, NetCDF. Sensors data are synchronized in time, depth. Figure 1 shows an example of the migration of zooplankton in the Baltic Sea obtained from the ZMD system.

ZMD was developed using Oracle Database Server and Tomcat application server; Matlab is used for data processing.