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Evidence of zooplankton vertical migration from continuous Southern Adriatic buoy current-meter records (E2-M3A)

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The E2-M3A Station is deployed in the southern Adriatic Sea, at about 1200 m depth, in the center of the cyclonic gyre where deep convection process takes place, involving both the atmosphere and the ocean dynamics and forming new dense and oxygenated waters, thus triggering the solubility and the biological pump. In particular, the E2M3A is equipped with an upward looking 150 kHz RDI-Acoustic Doppler Current Profiler (ADCP) positioned between 265 and 320 m depth, with a vertical resolution of 5 m and a range of 250-300 m. The mooring line has been in water since November 2006, with an interruption from September 2010 until May 2011. ADCP backscattering signal is very useful in determining zooplankton distribution and variability at various time scales, including seasonal/annual behavior and diel vertical migration (DVM). From ADCP backscattering signal, backscattering strength (Sv) was calculated for the entire dataset. Sv permits to quantify qualitatively the scatters present in the water, i.e. the particulate and/or the phyto/zoo-plankton. Zooplankton distribution is dependent on phytoplankton presence and blooms, which on its own depend on nutrients availability (related to wind-induced vertical mixing), but also on sunlight. The variation in time of Sv together with vertical velocity allows for measuring DVM of zooplankton and its variability with seasons and years. Alternation of high and low values for Sv are present all year long with differences in intensities in particular in the surface layer. Quite high values for Sv are found in spring and summer; in spring they are found along a large part of the water column, while in summer they are detected prevalently in the upper part of the measurement range. This behavior is related to the conditions of the water column, i.e. mixing and nutrients availability, which influence phytoplankton blooms and therefore zooplankton growing and movements. Correlating Net Primary Production obtained from model and Mixed Layer Depth, a delay of two months in the bloom of phytoplankton with respect to deepest mixing is found. Power Spectra of Sv show a major peak at 24 h that corresponds to the classical nocturnal-diurnal migration, and a secondary important peak at the period of 12 hours that indicates a different type of DVM pattern, the twilight migration. The ultimate factor behind DVM seems to be the minimization of the risk of predation from fishes and other carnivorous groups. Calculating the monthly mean daily cycle of the Sv, it is evident that there is a decrease in Sv at sunrise, while it increases at sunset. The highest values in the derivative of Sv, as well as highest values in the vertical velocity (w), coincide in time with sunset and sunrise. In particular, w is negative (downward movement) at sunrise while it is positive (upward movement) at sunset, and in some cases absolute value of w (|w|) reaches 5 cm/s. The hour of occurrence of |w| greater than 4.5 cm/s follows the curves in time of the hours of sunset and sunrise, which are changing throughout the year.