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Diel and lunar cycles of vertical migration extending to below 1000 m in the ocean and the vertical connectivity of depth-tiered populations

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ABSTRACT: We measured diel migration with 11 acoustic Doppler current meter profilers and consistently found diel and lunar cycles of vertical migration from 250 m down to the bathypelagic (> 1000 m). These measurements come from year-long deployments in eight locations within the Gulf of Mexico. Diel vertical migration could be characterized, in depth and time, by a pulse of maximum vertical migration activity (PMV), which has a nearly fix phase relation to sunrise and sunset modulated by the lunar cycle. The vertical velocity of migrating biota is in the same direction as the PMV propagation, but it is significantly slower. This difference in velocity implies that the PMV cannot represent the migration pattern of one single population. The lunar cycle is evident down to 1000 m, where the upward migration delays in phase with the full moon. The extension of the diel and lunar cycles over 1000 m depth together with the difference in vertical migration velocity indicate that the surface irradiance signal is transmitted to bathypelagic depth by synchronized depth-tiered populations. A model in which particulate organics are recycled at different depths, similar to a bucket brigade, is consistent with these observations. This daily vertical connectivity is expected to affect the vertical transport of carbon down to the bathypelagic.

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