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Tracing sediment dynamic at the water-sediment interface of the Thau Lagoon using Be-7 and Th-234: time-series and modelling

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We present an investigation of the bioturbation at the water-sediment interface of the Thau Lagoon. This shallow basin, located on the French Mediterranean coast, is of notable interest related to economic activities: tourism, industry and shellfish production. Results are based on detailed depth profiles of two short-lived radionuclides, Th-234 (24.1 days) and Be-7 (53 days), in sediment cores collected at different seasons from December 2001 to November 2005. These data are interpreted in order to provide bioturbation rates (Db). This work is a contribution to the French PNEC Microbent and Chantier Lagunes Méditerranéenes programmes. Several sites were selected in order to cover the diversity of the Thau lagoon: C4 and T11 in the middle of the lagoon, C5 nearby oyster farming, T2 in the western edge, T12 in the eastern part closed to industry. Radionuclides of interest were determined by gamma spectrometry. Sedimentation rates derived from Pb-210indicate a coherent and persistent picture from about 0.10 cm yr-1 at the edge of the basin (site T2) to 0.25 cm yr-1 at the central site (C4, T11). Th-234 in excess, i.e. supplied to sediment by settling particles, and 7Be both show seasonal variations in activities and in penetration within sediment, that indicates variable mixing of upper sediments. Steady-state bioturbation rates, calculated assuming bioturbation as a diffusive process occurring at a constant rate within a surface mixed layer under steady state, are moderate for most sites (1-20 cm2 yr-1) with a weak seasonal signal. Site C5 presents however a greater range (1 - 31 cm2 yr-1) with a marked seasonal signal may be in relation with the proximity of shore and oyster cultivation. Steady-state simulation also provide the opportunity to calculate radionuclides flux to the sediment Seasonal signal is observed for both C4 (between 1 Bq m-2 d-1 and 10 Bq

m-2 d-1) and C5 (between 3 and 28 Bq m-2 d-1). Such time-series are rather unusual and provide the opportunity to develop a transient model to test the sensibility of the biodiffusion coefficient to seasonal perturbation of the radiogenic fluxes. Significant deviations appear between the apparent Db computed from perturbed radionuclides profiles and the expected one initially introduced into the transient model. Simulations exhibit a negative correlation between the apparent bioturbation coefficient and the radionuclide flux. Consequently, it would be expected that the seasonal biological mixing observed from Db computation is possibly underestimated by seasonal flux to the sediment-water interface.