On the relationships between macrobenthos activities and sediment oxygen dynamics - A case study in the Scheldt estuary

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The aim of this work was to propose an empirical scaling framework of bioturbation effect in sediment oxygen dynamics, by building population density - benthic functioning relationships in the estuarine ecosystem. Density-dependent microcosm experiments were carried out in three dominant bioturbators and bio-irrigators in the Schelde estuary: *Corophium volutato*r, *Limecola balthica*, and *Hediste diversicolor*. Their contrasting feeding, burrowing, and irrigation methods represent a broad range of taxonomic groups, functional effects and functional responses within benthic communities. The body size allometry scaling law was tested, and robust macrobenthos-mediated sediment oxygen consumption models were constructed. Population density contributed to 47%-98% of total oxygen consumption variation, and accounted for 26%-88% of bio-irrigation variation. For the combined dataset, metabolic rate contributed significantly (56.2%) to the overall stimulatory effect and predictive power increased to 76% with the inclusion of geographical variability. Eventually we linked the model functions to bioturbators/bio-irrigators population maps in the Schelde Estuary, to extrapolate benthos-mediation effects to sediment geochemistry at landscape scales. Our results revealed that the effect of bioturbators on sediment oxygen dynamics can be described simply in terms of bioturbators' population metabolic rate, and the same rule are shared cross-taxa and cross-abiotic gradients.

Keywords: sediment oxygen consumption; bio-irrigation; population density; metabolic theory; allometric laws