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BIPc, an index to quantify the potential for bioirrigation as ecosystem function

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Bioirrigation – the animal-induced exchange of solutes between pore water and overlying water - is a key process in sediments with profound implications for biogeochemical processes such as nutrient cycling and organic matter regeneration at the sediment water interface. There is an urgent need to understand how a changing environment will affect the irrigation activity of macrofauna and vice versa. A shift in species composition (e.g. from deep burrowing species to smaller, more opportunistic and shallow burrowing species) will have large effects on bioirrigation and thus on ecosystem function (such as benthic pelagic coupling). Given that rates of bioirrigation cannot be directly measured in its complexity for all benthic species, a mechanistically-based approach is needed to predict relative intensities of bioirrigation activity based on the fundamental functional traits. We propose a conceptual framework to develop an index of bioirrigation that takes into account the biological mechanisms of bioirrigation and provides a simplified, yet functionally based approach to quantify the bioirrigation potential of benthic communities.

We developed the community bioirrigation potential (BIPc) that provides a biomass- and abundance-weighted scoring system considering functional traits related to pore water and solute exchange. It may be used to compare community effects and describe seasonal or interannual variability of marine soft sediments. In analogy to the particle-related community bioturbation potential of Solan et al. (2004), and as a further development of the functional group approach and the biological trait analysis, context dependent organismal traits that affect ventilation and bioirrigation (feeding type, morphology of burrows, and burrowing depth) are combined with the data on abundance and biomass of the respective species. These are subsequently summed up to a community bioirrigation potential (BIPc).

The presentation considers ecological traits relevant for bioirrigation and their classification into a bioirrigation index as well as advantages of the approach. On the other hand, the necessary simplifications in the index (e.g. limiting its applicability to interfacial nutrient fluxes) are discussed.