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Modelling how environmental change affects benthic biodiversity with a biogeochemical model.

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We want to examine how climate change may affect marine benthic diversity. Typically, biogeochemical models classify benthic feeders as deposit feeders feeding from the benthic layer of the model or filter feeders, removing plankton and microbes from the lowest pelagic layer. The balance of filter and deposit feeders depends on the ratio of plankton to detritus. It is seasonal with an increase in filter feeding during the spring / summer bloom against a continual background of deposit feeding. The DIVERSEM model took the ERSEM model with these two components and replaced them with a filter-deposit continuum. In addition, it allowed benthic feeders to vary in size over a spectrum. The intraspecific competition term in the ERSEM model was extended by adding a niche competition model with intraspecific competition being a fraction where this fraction is
1-1/(k(log Ds) . 1/(jDf)) where Df is the feeding overlap and Ds is the size ratio.
We created a community of benthic organisms by combining a spectrum of organisms of deposit to filter ratios of 1:0, 2:1, 1:1, 1:2 and 0:1 with relative sizes of 1, 2, 4, 8, and 16. There were 25 in all. We compared a hindcast physical model driven by meteorological datasets between 1960 and 2015 with synthetic driving data comprised of synthetic datasets made up of repeats of the years with the warmest and coldest springs, summers autumns and winters.
Not surprising the biggest variations between filter and deposit feeders were between warm and cold springs and summers with the warmest synthetic data pushing the system towards filter feeders. The size spectrum was almost stable across the different meteorological years. However, whereas cold springs and summers led to a pattern dominated by pure filter and deposit feeders, with intermediate classes pushed out, warm conditions led to a filter feeder dominated system where deposit feeding was carried out by mixed mode feeders.
These results suggest that small shifts in climate may bring about large shifts in community structures as a result of competition processes. These may be missed in conventional biogeochemical models such as the standard ERSEM model.