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TITLE: Big in the benthos: Future change of seafloor community biomass in a global, body size-resolved model

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ABSTRACT:

Abstract Deep-water benthic communities in the ocean are almost wholly dependent on near-surface pelagic ecosystems for their supply of energy and material resources. Primary production in sunlit surface waters is channelled through complex food webs that extensively recycle organic material, but lose a fraction as particulate organic carbon (POC) that sinks into the ocean interior. This exported production is further rarefied by microbial breakdown in the abyssal ocean, but a residual ultimately drives diverse assemblages of seafloor heterotrophs. Advances have led to an understanding of the importance of size (body mass) in structuring these communities. Here we force a size-resolved benthic biomass model, BORIS, using seafloor POC flux from a coupled ocean-biogeochemistry model, NEMO-MEDUSA, to investigate global patterns in benthic biomass. BORIS resolves 16 size classes of metazoans, successively doubling in mass from approximately 1 µg to 28 mg. Simulations find a wide range of seasonal responses to differing patterns of POC forcing, with both a decline in seasonal variability, and an increase in peak lag times with increasing body size. However, the dominant factor for modelled benthic communities is the integrated magnitude of POC reaching the seafloor rather than its seasonal pattern. Scenarios of POC forcing under climate change and ocean acidification are then applied to investigate how benthic communities may change under different future conditions. Against a backdrop of falling surface primary production (−6.1%), and driven by changes in pelagic remineralization with depth, results show that while benthic communities in shallow seas generally show higher biomass in a warmed world (+3.2%), deep-sea communities experience a substantial decline (−32%) under a high greenhouse gas emissions scenario. Our results underscore the importance for benthic ecology of reducing uncertainty in the magnitude and seasonality of seafloor POC fluxes, as well as the importance of studying a broader range of seafloor environments for future model development.

SOURCE: Global change biology

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