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Balancing the (carbon) budget: Using linear inverse models to estimate carbon flows and mass-balance ^{13}C:^{15}N labelling experiments in low oxygen sediments.

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Over 1 million km^2 of seafloor experience permanent low-oxygen conditions within oxygen minimum zones (OMZs). OMZs are predicted to grow as a consequence of climate change, potentially affecting oceanic biogeochemical cycles. The Arabian Sea OMZ impinges upon the western Indian continental margin at bathyal depths (150 - 1500m) producing a strong depth dependent oxygen gradient at the sea floor. The influence of the OMZ upon the short term processing of organic matter by sediment ecosystems was investigated using *in situ* stable isotope pulse chase experiments. These deployed doses of ^{13}C:^{15}N labeled *organic matter* onto the sediment surface at four stations from across the OMZ (water depth 540 – 1100 m; [O_2] = 0.35 - 15 μM). In order to prevent experimentally anoxia, the mesocosms were not sealed. ^{13}C and ^{15}N labels were traced into sediment, bacteria, fauna and ^{13}C into sediment porewater DIC and DOC. However, the DIC and DOC flux to the water column could not be measured, limiting our capacity to obtain mass-balance for C in each experimental mesocosm.

Linear Inverse Modeling (LIM) provides a method to obtain a mass-balanced model of carbon flow that integrates stable-isotope tracer data with community biomass and biogeochemical flux data from a range of sources. Here we present an adaptation of the LIM methodology used to investigate how ecosystem structure influenced carbon flow across the Indian margin OMZ. We demonstrate how oxygen conditions affect food-web complexity, affecting the linkages between the bacteria, foraminifera and metazoan fauna, and their contributions to benthic respiration. The food-web models demonstrate how changes in ecosystem complexity are associated with oxygen availability across the OMZ and allow us to obtain a complete carbon budget for the stationa where stable-isotope labelling experiments were conducted.