Modeling downward particulate organic nitrogen flux from zooplankton ammonium regeneration in the northern Benguela

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The vertical fluxes of particulate organic matter play a crucial role in the distribution of nutrients throughout the oceans. Although they have been the focus of intensive research, little effort has been made to explore alternative approaches that quantify the particle export at a high spatial resolution. In this study, we assess the downward nitrogen flux (F_N) in the northern Benguela from ocean depth profiles of zooplankton NH_4^+ excretion ($R_{NH_4^+}$) during the active upwelling season. The reduction of $R_{NH_4^+}$ as a function of depth was described by a power law fit, $R_{NH_4^+} = (R_{NH_4^+})_m\,(z/z_m)^b$, whereby the *b*-value determines the net particulate nitrogen loss with increasing depth. Integrating these excretory functions from the base of the euphotic zone to the ocean bottom, we calculated F_N at two stations located over the Namibian outer shelf. Estimates of F_N were compared with the sinking rates of particles collected in sediment traps. We found a reasonable agreement between the two approaches when fast-sinking particles dominated the ecosystem, but the F_N was somewhat at odds with the measured gravitational flux during a low-sedimentation regime. Applying our conceptual model to the mesozooplankton $R_{NH_4^+}$ we further constructed a section of F_N along a cross-shelf transect at 20° S, and estimated the efficiency of the epipelagic ecosystem to retain nutrients. Finally, we address the impact of the active flux driven by the migrant mesozooplankton to the total nitrogen export. Depending on the sedimentation regime, the active flux accounted for between 59 - 361% of the gravitational flux.

Keywords: Zooplankton, Dissolved inorganic nitrogen (DIN), Glutamate dehydrogenase (GDH), Ammonium excretion, Benguela upwelling system.

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