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Insights from Isotopomers on the Pathways of Nitrous Oxide (N_2O) Accumulation in the Tropical Pacific Ocean

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Nitrous oxide (N_2O) is a climatically important greenhouse gas. The tropical Pacific Ocean is a region where several water masses converge, and various biogeochemical processes occur, producing a globally significant N_2O flux to the atmosphere. Westward-flowing water masses, the Equatorial Subsurface Water (ESSW) and Equatorial Intermediate Water (EqIW), connect this region to the Eastern Tropical North & South Pacific (ETNP & ETSP) oxygen-minimum zones (OMZs) where high rates of N_2O production occur. We use isotopic and isotopomeric measurements in the central equatorial and tropical Pacific to disentangle signals coming from OMZ-influenced distal processes as well as local production. Ten sampling stations (20°N–20°S, 152°W) were analyzed for N_2O concentrations and isotopomers. All N_2O concentration maxima coincided with the bases of the oxycline and nitracline. The highest concentration maxima (88.9 nM and 69.2 nM) were observed at 11°N and 2.5°S, respectively. These maxima roughly coincided with Site Preference (SP) minima, ranging from 9.0–13.9 ‰. Isotopic mass balance revealed a single N2O source at the near-surface maximum within 11°N–11°S, while Keeling plot analysis of the outer two stations revealed two N_2O sources near their maxima. Water mass contributions to the observed N_2O isotopic values were determined using their geographic origins and associated isotopic values. Considering the expected SP values for various N_2O -related processes and fractions of water masses, isotopic signals near the N_2O maxima at stations within 11°N–11°S indicated a strong signal from denitrifying sources advected by the ESSW and EqIW from the Eastern Tropical Pacific's OMZs, while the near surface (above the N_2O maximum) were dominated by archaeal nitrification. At the outer two stations, near-surface N_2O was dominated by denitrification while the N_2O maxima were likely contributed by archaeal nitrification, with overprinting signals of remote N_2O consumption.