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Modeling the marine nitrogen cycle dynamics during the warm Miocene

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The Miocene epoch (23.03 to 5.33 Ma) was characterized by a warmer climate and moderately elevated CO_2concentrations (~400 to 850 ppm) compared to the present day. As a result, Miocene has been widely viewed as a viable analog for future climate scenarios. Recent isotope observations from the Middle Miocene Climatic Optimum (MMCO, 17.5 to 14.5 Ma) indicate a contraction of oxygen-deficient zones and a reduction of water-column denitrification in the Pacific, suggesting a fundamentally different marine nitrogen cycle under warmer conditions. However, the mechanisms driving these changes remain elusive. In this study, we use the University of Victoria (UVic) Earth system model 2.9, implementing Model of Ocean Biogeochemistry and Isotopes (MOBI) that simulate carbon and nitrogen isotopes explicitly to unravel the nitrogen cycle dynamics during the Miocene. We use the iCESM derived wind fields to drive four CO_2 scenarios (400, 416, 560, and 832 ppm), varying topography, and rates of nitrogen fixation and denitrification to test the sensitivity of these parameters on the distribution of nutrient and nitrogen isotopes globally and regionally. We will discuss these results and its implications for the response of the marine nitrogen cycle to warmer climates.