Response of South China Sea nitrogen fixation to shelf nitrogen loss over glacial cycles

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Of the mechanisms by which the ocean loses biologically available nitrogen ("fixed N"), conversion to N_2 in coastal sediments appears to dominate. Due to the disappearance of continental shelves, coastal sedimentary N loss has been hypothesized to decrease during ice ages. This change may have driven a compensating decrease in N fixation, the greatest source of the ocean's fixed N. Here we reconstruct N fixation changes in the South China Sea over the last 860 kyr (8 glacial cycles) using the $\delta^{15}N$ of foraminifera-bound N (FB-$\delta^{15}N$). FB-$\delta^{15}N$ is higher during glacials and lower during interglacials, suggesting an increase in N fixation in the interglacials. Time series analysis indicates that N fixation varied more strongly with sea level than with any other potential influence. This finding is best explained by strong coupling of South China Sea N fixation to ice age reductions in N loss along the western Pacific margin due to the disappearance of currently extensive continental shelves, including the nearby Sunda shelf. If this applied globally, then the ice age ocean hosted lower rates of fixed N input and loss, a longer residence time for fixed N, and less biogeochemically dynamic ocean margins.