

Diazotrophs: an overlooked sink of N₂O in the coastal waters

**ARVIND SINGH¹, HIMANSHU SAXENA², SHREYA MEHTA¹, SIPAI NAZIRAHMED³, JITENDER KUMAR¹
AND SANJEEV KUMAR¹**

¹Physical Research Laboratory

²University of Bologna

³Gujarat University

The ocean is the second-largest source of nitrous oxide (N₂O). However, its role as an N₂O sink is severely overlooked. N₂O fixation by diazotrophs has lately been proposed as a new pathway of N₂O consumption in aquatic environments. We investigated diazotrophic N₂O consumption and examined the anthropogenic influence on N₂O dynamics in the coastal northeastern Arabian Sea, a hotspot of N₂O emissions. Our findings reveal that unperturbed waters, unlike anthropogenically perturbed waters, are a modest net N₂O sink ($98 \pm 29\%$ saturation), contrary to previous reports. N₂O fixation remains active in anthropogenically perturbed waters in contrast to N₂ fixation. We additionally evidence that the absence of control incubations leads to incorrect fixation rate estimates, further implying that oceanic biogeochemical metabolic rates might be overestimated. We estimate that N₂O fixation not only directly sequesters N₂O but may correspond to 0.3 Tg C y⁻¹ of global ocean net primary production. The established negative feedback of N₂O fixation with N₂O concentrations, and by extension to N₂O emissions, underscores its potential as a natural climate regulator. Future research and marine N₂O budgets should thus incorporate N₂O fixation as an N₂O sink, as it holds the potential in climate mitigation strategies.