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# Functional Adaptations of Diatoms to Different Environments in TARA Oceans Data

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Diatoms (Bacillariophyta) are key contributors to marine ecosystems and global biogeochemical cycles. Using data from the TARA Oceans project, we analyzed the environmental responses of a diatom subspecies across diverse oceanic regions. Community detection on metatranscriptomic datasets identified three distinct clusters corresponding to regions with varying temperature profiles. These clusters represent distinct ecological niches influenced by environmental gradients. To further investigate functional adaptations, we performed a cross-grained analysis by focusing on PFAM domains. Using a multinomial null model, we identified PFAM categories enriched in metagenomic (metaG) and metatranscriptomic (metaT) data within each temperature cluster, revealing differential functional dynamics. Principal Component Analysis (PCA) was applied to explore the displacement from metagenomics to metatranscriptomic data. By analyzing angular distributions within the PCA space, we uncovered associations between specific functional profiles and environmental parameters, shedding light on the mechanistic foundations of diatom adaptability across thermal gradients. This integrative approach highlights the power of combining community detection, functional analysis, and multivariate statistics to elucidate the ecological and functional strategies of marine microorganisms. These findings contribute to our understanding of how diatoms adapt to environmental changes, providing insights into their role in ocean ecosystems under varying climate scenarios.

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