



## **Multi-day near-surface stratification in tropical waters**

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The near-surface layer of the tropical oceans is known for the occurrence of temporal stratification in the upper few meters, which can lead to vertical gradients in water properties and prompts questions about correct estimation of air-sea exchange of gases but similarly of momentum, heat, water vapour, and other matter. Here we present observations in the near-surface layer of the Peruvian upwelling regime and of the tropical Atlantic Ocean below the Intertropical Convergence Zone, which show near-surface stratification events that frequently have a lifetime of several days. This aspect extends the predominant notion of a diurnal near-surface pycnocline that appears, migrates and disappears in a diurnal cycle, and is superposed on a background surface mixed layer. Near-surface stratification suppresses turbulent mixing and subsequently isolates or traps overlying water, which eventually generates vertical gradients of water properties. Multi-day near-surface stratification and associated multi-day trapping of a thin near-surface layer may enhance such vertical gradients in comparison to diurnal trapping. We explore the implications of multi-day trapping, particularly for estimates of air-sea gas exchange. For example, in the Peruvian upwelling regime in austral summer 2012/13, strong near-surface vertical gradients of nitrous oxide concentration were observed which most likely resulted from multi-day trapping. Here, applying standard routines for air-sea gas exchange leads to a systematic overestimation of regionwide nitrous oxide emission by 30%.