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Tropical instability waves (TIWs) near the ocean surface are present in all oceans and are known to be important for air-sea interactions and climate variability. Recent studies based on observations in the Pacific Ocean found that apart from TIWs at the surface, there also exist subsurface TIWs (subTIWs). Such subTIWs can induce vertical mixing and may alter TIW induced mixing within the thermocline. To assess vertical mixing in the upper ocean, namely above the thermocline depth, improved understanding of the vertical structure of TIWs and the influence of subTIWs is needed. In this study, we show the existence of subTIWs in the Atlantic Ocean for the first time using PIRATA mooring observations along 23W. Further, we characterize subTIWs in the tropical Atlantic Ocean with a focus on subTIW spatial and temporal variability and their effect on mixing. For this, we analyze 16 years of model output, generated from the comprehensive, global, high-resolution ocean model ICON-O, forced by ERA5 reanalysis data. We find subTIWs between 40 m depth and the thermocline depth in both model and observations. Unlike TIWs, subTIWs in the Atlantic Ocean are frequently active both north and south of the Equator. Our results suggest that subTIWs induce a vertical multi-layer shear structure above the thermocline depth, which has the potential to destabilize the mean flow and thereby cause mixing. These effects are strongest north of the Equator where both TIWs and subTIWs act simultaneously. We conclude that subTIWs are a feature of the tropical Atlantic Ocean with regionally varying implications for vertical mixing and heat fluxes. In addition, we find that subTIWs differ from TIWs in their temporal and regional occurrences. Hence, we suggest that future assessments of upper ocean dynamics should not be limited to the effect of TIWs, but also include subTIWs, particularly in subTIW dominated regions.
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