MARINE BIODIVERSITY EXPOSED TO PROLONGED AND INTENSE SUBSURFACE HEATWAVES

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Abstract:
The frequency and duration of marine heatwaves (MHWs) have been increasing over the past century and are anticipated to further intensify in the decades to come, driven by anthropogenic climate change. MHWs have caused substantial biological and socio-ecological impacts globally, ranging from rapid shifts in species distributions to mass mortalities, with particularly dramatic effects reported on coral reefs and kelp forests. However, our current understanding of MHWs relies heavily on sea surface temperature measurements due to data accessibility and little is known about their characteristics in the subsurface. Here, we provide the first global characterization of MHWs from the ocean surface down to 5000 m depth (from 1993 to 2019) and explore potential biodiversity exposure to their effects. Specifically, we estimated MHW metrics of maximum intensity, duration, occurrence and cumulative intensity at global and regional scales, for each depth layer and over time, following the well-established framework of Hobday et al., (2016) to allow direct comparison with previous studies. We contrasted species richness estimates with cumulative MHW intensity to pinpoint regions/depths of higher exposure. We find that MHWs are typically more intense in the subsurface ocean (50-200 m depth) than at the surface and their duration becomes longer with depth, particularly in the abyssal ocean where duration is on average 3 times longer than at the surface. The highest cumulative biodiversity exposure was detected between 75 and 150 m depth, remaining high down to

250 m. Regions of frequent and intense MHWs coincided mostly with sharp temperature gradients, such as those associated with boundary currents and fronts, extending down to 1000 m depth. Prolonged, recurrent and intense subsurface MHWs are hypothesized to produce cumulative detrimental consequences on marine biodiversity, with species expanding their distributions deeper, driving global changes in biodiversity patterns, with consequent effects on ecological interactions and ecosystem processes.

Keywords: subsurface marine heatwaves, MHW depth, extreme events, biodiversity exposure

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