Marine heatwaves: shadow of the colossus

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The frequency, intensity, and duration of extreme ocean temperature events, known as marine heatwaves (MHW), are increasing globally. That this is caused primarily by the roughly linear increase to the mean state of temperatures via anthropogenic forcing begs the question: is a given MHW occurring due to a particular physical driver, or is it an artefact of the chosen baseline period and mean state warming, regardless of whatever air-sea interactions may be co-occurring? Simply put, do our current tools quantify real events, or are we seeing shadows? To complicate this question, it is also known that regionally specific drivers of MHWs play an important role in both their onset and decline, with certain regions of the global ocean also undergoing thermal and/or physical regime shifts due to the changing climate. This means that anomalously high temperatures may be due rather to the complete shift of a local temperature regime to a new stable state (e.g. the persistent influence of a shifting ocean current), rather than the influence of a short-term physical anomaly (e.g. aseasonal low wind stress with high latent heat flux), or long-term anthropogenic warming. An issue that cannot be addressed directly by the removal of the long-term warming signal alone. Arctic fjords are one such region in which advanced rates of warming, significant changes to the physical environment, and climatic regime shifts are all occurring simultaneously. The issue of accurate MHW detection and classification is also highly relevant because Arctic fjords serve as a confluence point between land and sea, making them highly important and productive ecosystems for Arctic species and human communities. In this study we detect and classify MHWs via a combination of reanalyses, satellite derived sea surface temperature (SST), and in situ temperature measurements at the surface and depth. Knowledge of thermal regime shifts is coupled with an analysis of the influence of known physical drivers of MHWs to elucidate whether the temperature signals are best classified as events, or are representative of a more broad scale and persistent change to the thermal regimes of these important ecosystems. To ascertain whether these detected events are indeed real, or shadows of the chosen methodology, we analyse first the anomalies in the known physical drivers to pair them with the presence (or absence) of detected MHWs. The implications that these mismatches have for the current MHW methodological approach is discussed.