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How do ocean heat uptake changes influence decadal trends in Earth's energy budget and global mean surface temperature?

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Idealized models suggest that, under some circumstances, fluctuations in ocean heat uptake can trigger changes in Earth's surface energy budget, causing decadal timescale trends in global mean surface temperature (hiatus or surge events). On other occasions ocean heat uptake changes may be a passive response to changes in other parts of the climate system (greenhouse gases, clouds, aerosols). Here we modify ocean heat uptake in a climate model by increasing oceanic vertical diffusion to twice its unperturbed value for one decade, after which it is restored to its original value. The modified heat uptake cools the sea surface, creating a hiatus with a similar (Pacific Decadal Oscillation-like) spatial pattern to that observed in the 2000s. Excess heat is stored below the mixed layer (i.e. between 150 and 800m) in the tropics. The induced hiatus persists for 6-8 years after which some of the trapped heat begins to return to the surface. We find that there are limits to the capacity of the deep ocean to trap excess heat for timescales longer than this due to breakdown of vertical stratification. The trapped heat ascends to the surface much more slowly than the rate at which it descended to depth resulting in a prolonged surge in global mean surface temperature. Our simulations suggest that decadal changes in ocean heat uptake may have a relatively short lived (< decadal) direct effect, but a subsurface legacy which may continue to affect global climate on a longer timescale (more than a decade) after the initial heat uptake.