Literature Review

UNIVERSITÀ DEGLI STUDI DI MILANO

Berra Lorenzo

Corso di Laurea in Fisica, course in Physics of the Hydrosphere and the Cryosphere. Report on paper: https://egusphere.copernicus.org/preprints/2025/egusphere-2025-571/, An Atlantic wide assessment of marine heatwaves beyond the surface in an eddy-rich ocean model

1 Modeling

Forcing conditions are applied to the model and presumably include heat, currents and air circulation, which are all mentioned in the study without explicitly reporting the full scope of said conditions.

Simulations are said to be performed using the VIKING20X following the OMIP-II protocol, prescribing six consecutive simulations spanning the 1958 to 2019 time-frame, with the first one initialising from WOA13 data and oceanic conditions at rest, while each of the following cycles are initialised using the final oceanic conditions of the previous cycle; each cycle is then extended up to 2023 to analyse the 1980 to 2022 time-frame. In particular, only the first and sixth cycle of each series are analysed: I infer this is done to observe an immediate response to the forcing conditions in the first cycle and the influence of model drift and model spin-up in the last cycle. While I believe this is needed due to the limited timeframe in which data is available I could not find evidence of the validity of this cycle-based approach for the simulations either in this paper or in the provided reference (Tsujino et al., 2020), as after a new cycle has started oceanic conditions at a certain time t in the time-frame provided (1958-2019) would instead be mapped in the simulation to a time $t' = t + (n-1)\Delta$, where n is the number of the cycle being computed and Δ is the length of the time-frame, to my understanding.

2 Results

The influence of geothermal activity on MHWs is not mentioned in the paper, and as such I would like to inquire if it is speculated to be noticeable, especially on bottom MHWs, or would stable geothermal activity not impact MHW formation due to their statistical definition?

The effects of model drift are shown to be greatly reduced in the linearly-increasing baseline. Being model drift defined as the adjustment of the simulated environment to unknown initial conditions, could it be argued that the primary effect of these unknown initial conditions is the temperature rise, thus reducing the model spin-up time needed, and that other lesser effects of said conditions are higher-order corrections?

The simulations performed with this new protocol are said to not be decidedly more realistic than previous ones. Since the main difference from previous models is the impact of mesoscale dynamics, which could either have a cumulative impact or be averaged out over larger portions of the ocean, could these lower scale dynamics be seen as higher-order terms in the model approximations? If so a convergence interval should be defined, where the model can be argued to be more realistic, while outside of it higher-order corrections may not yield better approximations.

Being MHWs defined as events lasting at least five days, and since MHWs divided by less than two days are considered the same MHW, would this merging of MHWs cause problems for the MHW frequency data in areas where they tend to have longer durations along the length of the simulations?

The heat budget present in this study doesn't contain, at least from what is shown, the influence of the night-day cycle. Since MHWs at shallow depths are shown to be highly responsive to external conditions it could be an interesting forcing condition, but it may very well be averaged out over the multi-decadal time-scales used for the simulations, and it would outgrow the focus of the study on greater depth MHWs.