



Has the frequency of Mediterranean Marine Heatwaves really increased in the last decades?

Salvatore Marullo¹, Vincenzo De Toma³, Alcide di Sarra⁴, Roberto Iacono², Angela Landolfi³, Francesca Leonelli³, Ernesto Napolitano², Daniela Meloni⁴, Emanuele Organelli³, Andrea Pisano³, Rosalia Santoleri³, and Damiano Sferlazzo⁵

¹ENEA, Climate and Modelling Laboratory, Frascati, Italy

²ENEA, Climate and Modelling Laboratory, Rome, Italy

³CNR - Istituto di Scienze Marine - Rome, Italy

⁴ENEA, Laboratory of Observations and Measurements for the Environment and Climate, Rome, Italy

⁵Laboratory for Observations and Measurements for Environment and Climate - ENEA Laboratori di Ricerca Lampedusa - Italy

Marine Heat Waves (MHWs) are events of prolonged anomalously warm water, in portions of the oceans, which may have severe impacts on the local marine ecosystems. In a climate change scenario, with increasing temperatures and more frequent atmospheric extreme events, the frequency and intensity of the MHWs are expected to increase. However, in a warming ocean, the choice of the long-term baseline used to compute SST anomalies becomes a critical issue, since it can significantly affect the frequency and intensity of the events. It may be argued that this climate change signal should be removed, in some way, to allow for a correct detection of MHWs.

Here, we critically address the problem of how to characterize and define MHWs in the present warming climate scenario by evaluating the impact of different SST climatic baselines, and the effects of removing climate trends from the original SST time series. We focus on the Mediterranean Sea, a hot spot region for climate change, where a strong mean SST increasing trend (about 0.045 °C/year) has been observed in the last 40 years. Specifically, we use the Mediterranean SSTs, a satellite-based daily gap-free (level-4) SST provided in near real time at 1 km grid resolution and distributed through the Copernicus Marine Service (<https://doi.org/10.48670/moi-00172>).

We then examine the strong Mediterranean MHW of 2022, which started in May and is not yet extinguished at the time of this writing (December 2022). The MHW extended its presence through the summer and autumn seasons, with a sequence of intense events that interested between 30% to 60% of the Mediterranean area. The intensity of the 2022 MHW was comparable to that of the famous 2003 event, but the durations of the two MHWs have been quite different: in 2003 the areal threshold of 30% was exceeded from May to August (4 months) while in 2022 that threshold was exceeded from May to December and continues in January 2023. The evolution of the 2022 MHW is also discussed in relation to the corresponding atmospheric events occurred over the western portion of Europe and of the Mediterranean Sea and complemented with in situ data

acquired at the ENEA station for climate observation of Lampedusa.

This work is funded in the framework of project "Detection and threats of marine heat waves -CAREHeat" of the European Space Agency - ESA - OCEAN HEALTH program.