

Modulation of Marine Heatwaves on Tropical Cyclones in the Western North Pacific

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Introduction

Marine heatwaves (MHWs) are events characterized by prolonged anomalously warm sea surface temperature seen in many regions of the world's oceans .Over the past several decades, these events occur more often and become more extreme and longer-lasting due to global warming.

Motivation

We are all familiar with heatwaves occurring in the atmosphere, However, relatively little about We know heatwaves that happen in the ocean, MHWs have a significant impact on both society and ecological systems.



MHWs with a warm ocean thermal structure can interact with many atmospheric phenomena such as the El Niño-Southern Oscillation, tropical cyclones. It is crucial to understand how and by which process MHWs affect marine weather systems.

show that sea surface Figure temperature(SST) anomaly have been gradually increasing year by year.

Data and Methods

This study use OISST version 2 with a spatial resolution 0.25° data from NOAA to detect MHW events. The data temporal coverage daily values from 1981/09 to 2024/06. We follow the previous research written by Hobday, which provides methods to detect marine heatwaves and use the same sea surface temperature (SST) data for the Northern Mediterranean region. It shows similar results, indicating that the most extreme marine heatwave occurred in June 2003 as shown in Figure 2, red filled area is the most extreme MHW events.



Fig.2. The red filled area indicates the most extreme MHW. The orange indicates another identified over this year.







Fig.5. The most extreme MHW in 2022

1992 1982 1984 1986 1988 1990 1994 1996 1998 2000 2002 2004 2006 2010 1996 2008 2022 2010 2012 2014 2016 2018 2020 2024

Fig.6. MHWs time series from 1982 -2024 in MHW region

Since my summer program primarily focuses on the impact of MHWs on tropical cyclones. Many tropical cyclones originate in this region(128–154°E, 5–20°N) in Figure 4. We consider an anomalously warm event to be a MHW if it lasts for five or more days, with temperatures warmer than the 90th percentile based on a 30-year historical baseline period. There were 93 total MHW events occurred during this period. The time series of MHWs spans from 1982 to 2024, with the most extreme occurring in 2020.

Discussion (2)-Long term trend

Discussion (1)-High frequency



and the ENSO index

ENSO consists of two The phases: El Niño and La Niña. La Niña is associated with more frequent heatwaves, as seen in the blue areas of the diagram. In La Niña, increased trade winds contribute to more intense and prolonged MHWs. This results in previously regions warm becoming even warmer, leading to more severe occurrences of MHW events.



Global warming consists of two variability key phases Warming and hiatus. It has shown a clear long-term trend of rising

global of the rate The rise. temperature Warming recent phase (2013 - 2024)has shown more frequent MHWs.

Fig.8. MHWs time series from 1999 to 2024

Reference

Eric c.j. oliver. (2021). Marine Heatwaves. Annual Review of Marine Science. Alistair j. hobday. (2018, May 15). *Categorizing and Naming Marine Heatwaves*. Oceanography. Michael g. jacox. (2022, April 21). Global Seasonal Forecasts of Marine Heatwaves. Nature. Alex sen gupta. (2018, September 9). Drivers and Impacts of the Most Extreme Marine Heatwave Events. Scientific Reports. Hao-jhe hong. (2023, March 14). Remote Tropical Central Pacific Influence on Driving Sea Surface Temperature Variability in the Northeas

Future work

We will explore the impact of tropical cyclones by several key aspects: genesis longitude and latitude, lifetime, lifetime maximum intensity, and the power dissipation index. These elements will help us understand how tropical cyclones operate and the role of factors in their behavior.