**Assessing the Correlation Between Marine Heatwave Events and Tropical Cyclone Climatology in the Atlantic Basin**

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**Submitted to Dr. Yao Zhou for GEO402**

**1. Introduction**

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***Figure 1:*** From Hu (2021), their Fig. 2a. The markers show the central locations and maximum MHW intensity (°C) for 1982–2019. The arrows indicate ocean currents.

**2. Data and methods**

1. *Data*

We will identify our Europe MHW events using SST anomalies from the NOAA Optimum Interpolation SST (OISST) dataset (Banzon et al. 2016), which has global data back to 1982 and a 0.25° horizontal resolution. To identify and analyze associated extreme heat and precipitation events over Europe, we will use the ECMWF ERA5 reanalysis (Hersbach et al. 2020), which has a spatial resolution of approximately 0.25° x 0.25°, and data from 1950– present. Specifically, we will examine ERA5 fields such as thermal comfort indices, 500-hPa geopotential height, sea-level pressure, 850-hPa temperature, precipitable water, total precipitation, and convective available potential energy (CAPE). The backward trajectory analysis described in section 2b will be performed using a combination of the LAGRANTO Lagrangian Analysis Tool (Sprenger and Wernli 2015) and NOAA’s Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model (Stein et al. 2015).

1. *Methods*

The time period for identifying events for our climatology will be climatological summers (June-July-August) during 1982–2022, to correspond with the OISST data. Although there is no universal definition of MHWs, Hobday et al. (2016) stated that regional SST

**3. Results**

1. *SSTs*

To show the MHW events, we plotted NOAA OISST anomalies in Fig. 2. Using our anomaly definitions in section 2b, MHWs occurred in the North and Mediterranean Seas in 2003 (Fig. 2a), Black Sea in June 2019 (Fig. 2c), North Atlantic in July 2019 (Fig. 2d), the Baltic Sea in July 2021 (Fig. 2e), and the Baltic, Mediterranean, and Barents Seas (Fig. 2f) in July 2022. No region met the aforementioned threshold in June 2017 (Fig. 2b), but the Mediterranean and parts of the Northeast Atlantic were anomalously warm.

**4. Discussion and conclusions**

Based on our results, we can conclude that all six events featured MHWs/anomalous warmth over waters adjacent to Europe (section 3a) and associated continental heat waves over Europe (section 3b). The continental heat waves were largely concurrent with the MHWs/anomalous warmth in the adjacent waters. Backward trajectory analysis (section 3d) showed widespread adiabatic warming associated with large-scale ridging/blocking patterns that likely helped cause the continental heat waves.

Although some precipitation occurred after every continental heat wave (section 3c), the rainfall events were not extreme except for July 2021. Furthermore, in the July 2021 event, we cannot definitively conclude that precipitation amounts were larger due to the MHW, although some trajectories did ascend from the MHW region. We will investigate these points further in the coming weeks using diabatic tracers on the backward trajectories.

Overall, the precipitation occurred once the longwave ridge/blocking patterns broke down, and synoptic-scale troughs moved in from the west, into regions of larger moisture and instability. The heavier precipitation events (e.g., July 2021) were associated with slower-moving troughs and closed/cutoff lows.

We conclude that the links between MHWs and continental heat waves are generally stronger than the links between MHWs and heavy precipitation. This may be because continental heat waves in Europe tend to be dry (e.g., Black et al. 2004), which is evidenced by the adiabatic descent throughout our trajectory analysis.

*Acknowledgments.*

Thanks to ECMWF for providing access to the ERA5 data and NOAA NCEI for access to the OISSTv2 data. We also thank Dr. Shawn Milrad for assisting with ERA5 data access and providing some Gempak plotting scripts.

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