

Verification of WPC's Day 3-7 Hazards Outlook for Extreme Heat (2019-2024)



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INTRODUCTION: Over the past few decades, extreme heat has been having a growing impact on the general population. Everything from heat related illnesses and water insecurity can be attributed at least in part to extreme heat. In order to mitigate these impacts in the United States, the Weather Prediction Center (WPC), which is a part of the National Oceanic and Atmospheric Administration (NOAA), began to identify the potential for extreme heat in the Day 3-7 Hazards Outlook (Fig 1). For the past six years, this product has been used by local National Weather Service (NWS) Weather Forecast Offices (WFOs) to aid in the timely issuance of Heat Advisories and Excessive Heat Warnings. As a result, the public has had more time to prepare for these events, ensuring the safety of many. The purpose of this project is to verify the accuracy of the WPC's Day 3-7 Hazards Outlook for extreme heat to help locate areas that need improvement.

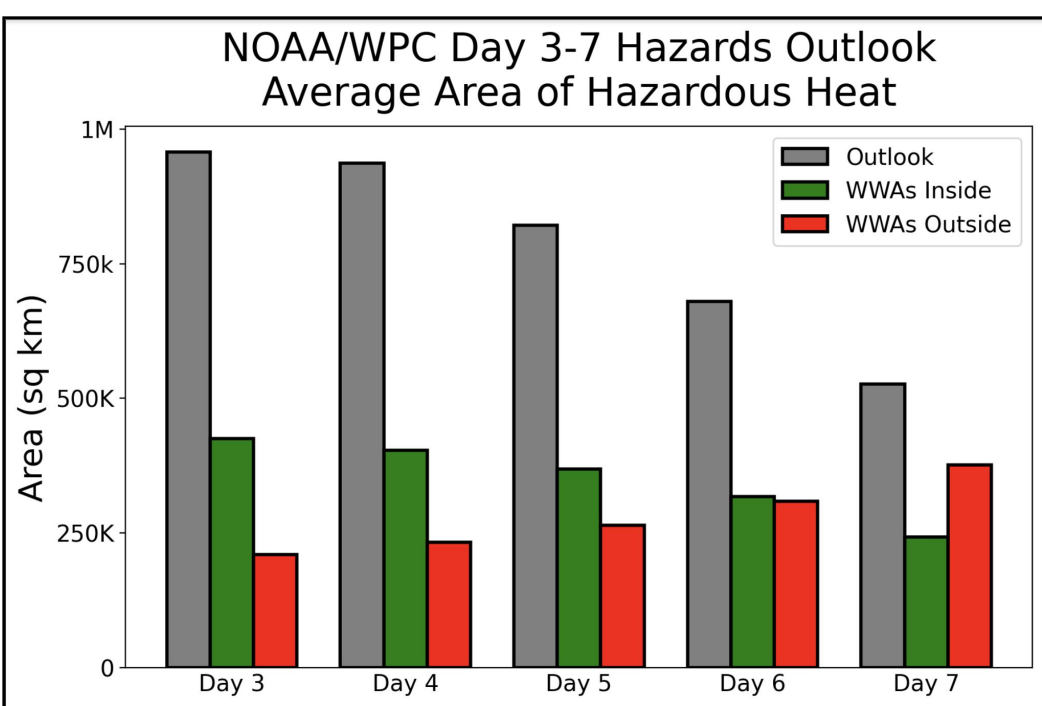


Fig. 2.

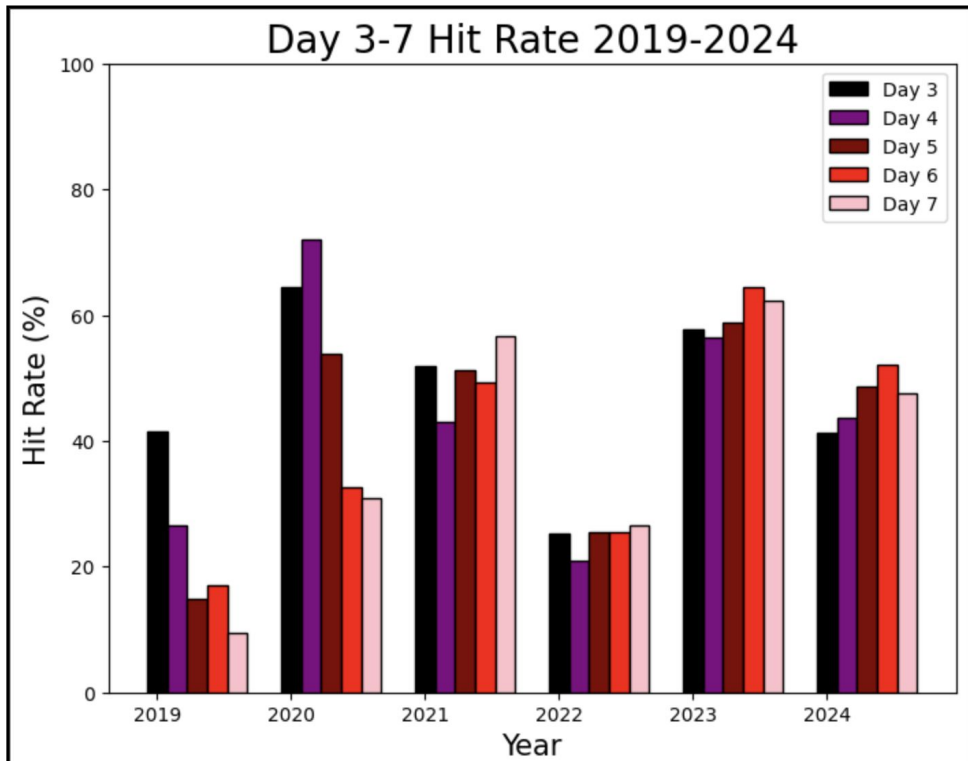


Fig. 3.

METHODS: The criteria that was used to verify the Day 3-7 Hazards Outlook for extreme heat was based on the average hit rate (formula explained in the bulk statistics section) for the year in which the event occurred. If the hit rate of the outlook day in question was greater than or equal to the average hit rate for that day of that year, the outlook was deemed 'accurate.' To better visualize the results of these calculations, each outlook day for the event in question was plotted on a map of the U.S. where a line represents the outlook area and shaded areas represent the Heat Advisories/Warnings that were issued during the event. Additionally, a bar chart was created to visualize the process of comparing hit rates.

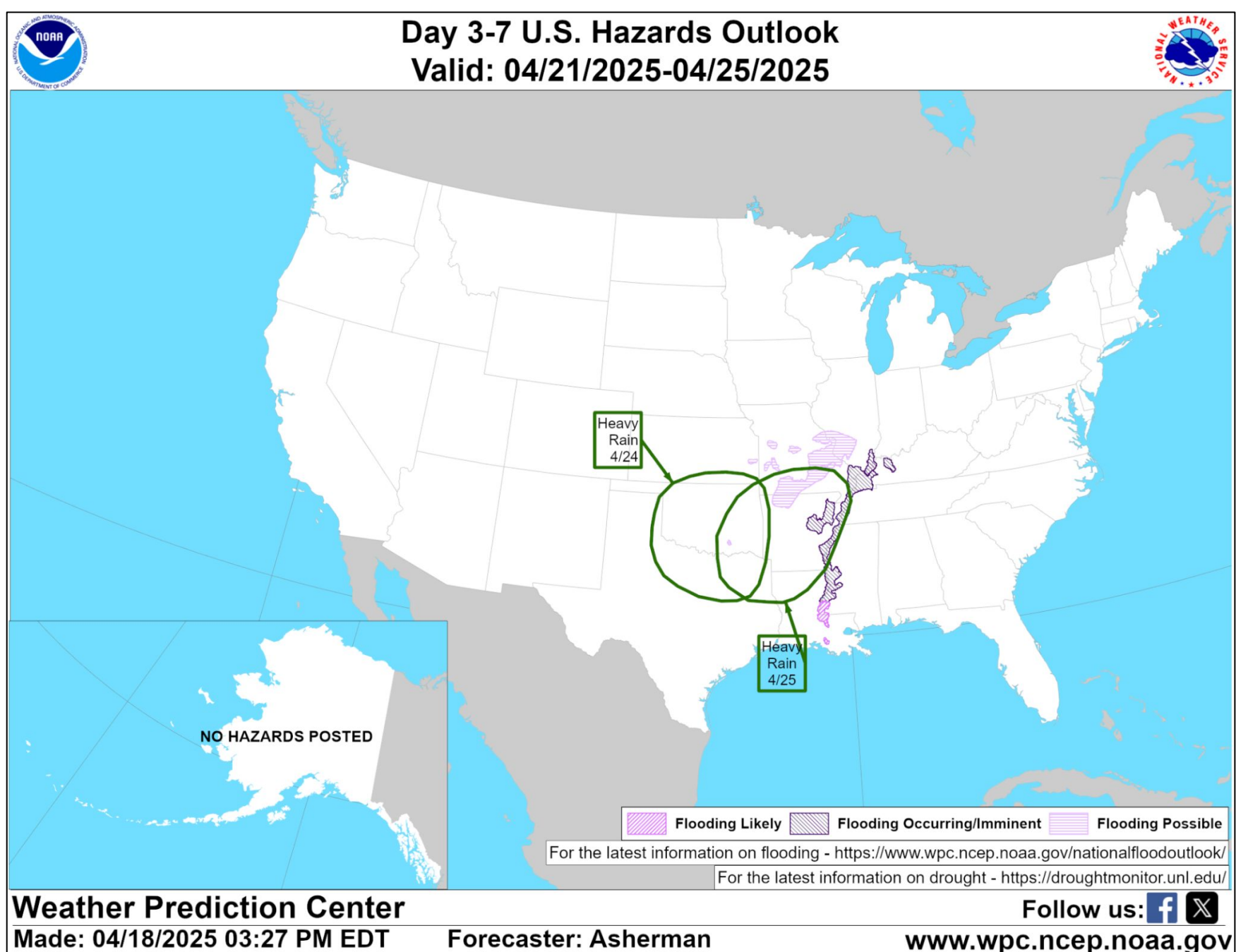


Fig. 1. Example of NOAA/WPC Day 3-7 Hazards Outlook.

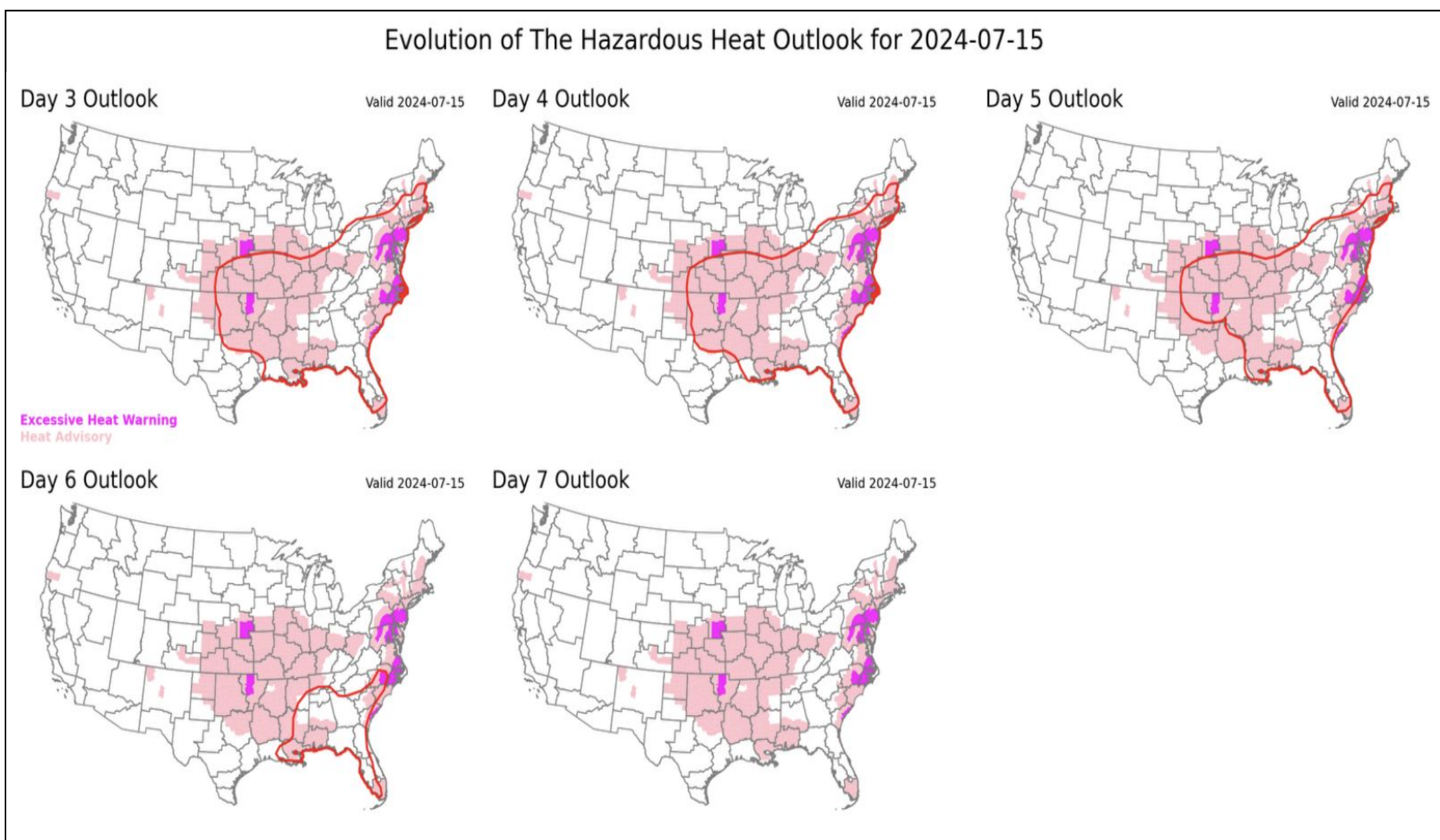


Fig. 4. A Visualization of how the Day 3-7 Hazards Outlook for Extreme Heat (using the 07/15/24 heat wave) Changes Over Time.

BULK STATISTICS: For this project, I used python to analyze hazards outlook provided by WPC as csv and shapefiles. This allowed me to create various graphics and bulk statistics to aid in the analysis and verification process. **Table 1 (Immediate Right)** displays general statistics regarding the size of the outlook and the amount of Heat Advisories/Warnings in and issued outside of that outlook. This was generated using a pandas library function called data.describe and was later formatted to be more visually appealing. **Figure 2 (Top Center Left)** is a bar chart, created using the matplotlib library, that displays the average size (in km²) of the hazardous heat outlook and the Heat Advisories/Warnings issued both in and outside said outlook. **Figure 3 (Top Center Right)** shows the hit rates for each outlook day during a particular year, going from 2019 to 2024. The hit rate represents the percent of area within an outlook which subsequently observed a Heat Advisory or Heat Warning issued. The hit rate for all events were computed with the median value depicted.

Table 1. Description here. All units in 1,000s km ² .								
Area	Count (# of Outlooks)	Mean (km ²)	Standard dev. (km ²)	Min (km ²)	25% (km ²)	50% (km ²)	75% (km ²)	Max (km ²)
Day 3 Haz. Outlook	406	957	866	0	257	711	1,429	5,111
WAWs In	406	425	474	0	28.8	233	686	1,983
WAWs Out	406	210	242	0	24.9	121	313	1,421
Day 4 Haz. Outlook	406	937	861	0	225	672	1,471	3,968
WAWs In	406	403	465	0	8.46	210	700	2,070
WAWs Out	406	232	264	0	29.5	130	333	1,549
Day 5 Haz. Outlook	406	821	822	0	122	533	1,283	3,686
WAWs In	406	369	446	0	0	171	679	2,115
WAWs Out	406	265	297	0	35.3	172	399	1,619
Day 6 Haz. Outlook	406	679	751	0	61.8	411	1,105	3,289
WAWs In	406	317	418	0	0	116	543	2,026
WAWs Out	406	309	355	0	39.5	189	431	1,825
Day 7 Haz. Outlook	406	526	706	0	0	190	853	3,284
WAWs In	406	243	392	0	0	19.5	382	2,013
WAWs Out	406	376	443	0	41.8	210	558	2,144

ANALYSIS: To provide an example of the verification process, I analyzed a heat wave that occurred on July 15, 2024 in the Northeastern US. Looking at **Figure 4**, the event is not noticed until six days out. Then, the outlook area reaches its full size by five days out. The hazard area encompasses most of the Advisories/Warnings issued. If we revisit **Figure 3**, we can infer that the hit rates for this event are comparable to the averages for 2024. Given this information, the Day 3-7 Hazards Outlook for extreme heat for July 15, 2024 was accurate.

CONCLUSION: The methods and results of my research indicate that there is room to improve the performance of the Day 3-7 Hazards Outlook for extreme heat. The average hit rates for all years alone, the highest of which is for Day 3 with 32.82%, greatly depict this need. Taking all of this into consideration, the WPC will use my findings to locate and make necessary improvements to their Day 3-7 Hazards Outlook product, helping build a Weather Ready Nation. However, this method of verification fails to account for several factors, such as forecaster bias and changes to outlook criteria. As such, more work must be done to ensure that the WPC can issue accurate products for the protection of life and property and enhancement of the national economy.

ACKNOWLEDGEMENTS:

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SERVICE SITE:

US Dept of Commerce/NOAA/NWS/NCEP

Weather Prediction Center

5830 University Research Court

College Park, MD 20740

Link to Website: <https://www.wpc.ncep.noaa.gov>

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