Long-term Characteristics of Cold Water by Coastal Upwelling along the Southeastern Coast of Korea

Many studies have focused on the occurrence of cold water in the southeastern coast of Korea due to the summer monsoon southwesterly winds. However, despite the regional differences in the appearance of cold water along the southeastern coast, there is a lack of research on the distinctive characteristics of cold water in this region. Particularly, due to the distinct differences in factors such as coastal orientation, bathymetry slope, currents, and background temperature gradients, it remains unclear whether cold water would form under identical wind stress conditions. In coastal areas where sea temperatures continue to rise due to climate change, phenomena that cause short-term, rapid temperature changes, such as cold water, can lead to various damages. These include primary damages (e.g., mortality of farmed fish), secondary damages (e.g., formation of sea fog), and tertiary damages (e.g., cancellation of ship operations, restriction of leisure activities) due to sea fog. Notably, the magnitude of temperature change following the occurrence of cold water, coupled with rising sea temperatures, has more lethal effects on aquaculture species. This study aims to understand the characteristics of cold water occurrences using long-term sea surface temperature observation data. This understanding could improve prediction capabilities from short-term to long-term, using both physics-based approaches such as numerical models and data-based approaches such as deep learning. In this study, we utilized 20 years of sea temperature observation data along the southeastern coast to identify the key factors influencing the formation of cold water. Firstly, an objective method for detecting cold water, defining its onset and termination, was proposed. This approach increased the objectivity of the analysis by detecting Yes temperature decreases instead of using proxies like the upwelling index. We meticulously examined the characteristics of cold water detected at stations by dividing them into upwelling and relaxation phases. Based on the detected onset times, we classified and analyzed the characteristics of various factors that induce cold water formation, including migratory low-pressure systems, tropical cyclones, monsoons, and topographical influences.

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