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A new method for remote sensing assessment of water quality status based on ZY1-02D hyperspectral imagery—A case study of large lakes and reservoirs in China

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Water quality is crucial for human health and the sustainable development of the ecological environment. Traditional water quality monitoring methods rely on discrete in-situ measurements, limiting our understanding of water quality variations at large temporal and spatial scales. While remote sensing technology offers efficient water quality observation, it is mostly confined to monitoring optical active substances, making it challenging to assess water quality changes caused by chemical indicators. This study proposes a concept that changes in water quality status caused by chemical indicators within a certain range are responsive in terms of water-leaving reflection. To validate this hypothesis, water quality index (WQI) was initially calculated using data from water quality monitoring stations, resulting in water quality status data (ranging from excellent to severe pollution). Following this, an information extraction and classification inversion approach was proposed to establish a connection between ZY1-02D hyperspectral imagery and water quality status, leading to the development of a robust water quality status identification model. Validation results showed an average model accuracy of up to 82%, confirming the hypothesis of this study. Subsequently, this model was used to assess the water quality status of 180 large lakes and reservoirs (hereafter referred to as lakes) within China from 2019 to 2023 for the first time. The results indicated that 76.1% of the lakes exhibited excellent to good water quality conditions, with a spatial distribution pattern showing a "better in the west, worse in the east" trend. Over the 4-year period, 33.33% of the lakes showed improvement, while 50% remained stable, with the western and eastern regions primarily exhibiting stability and improvement, respectively. The long-term changes in water quality status are influenced by various interacting factors, with different patterns of influence existing in different time periods and regions. In the early years, natural factors (average elevation) played a dominant role. However, over time, the impact of meteorological factors (precipitation and wind speed) and anthropogenic factors (gross domestic product) gradually increased. These influences can be attributed to significant climate changes and effective management measures over the past two decades. The findings support rapid assessment of environmental conditions and sustainable resource management, highlighting the potential of remote sensing technology in water quality monitoring.