A new method for direct measurement of polarization characteristics of water-leaving radiation

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The polarization characteristics of water-leaving radiation, which contain rich information on oceanic constituents, have often been neglected. Due to the lack of suitable instruments and practical difficulties in removing strong contamination by polarized sky light, direct measurement of the polarization of water-leaving radiation remains a challenge. In this study, we designed an above-water instrument to directly measure the polarization of water-leaving radiation (named POLWR) and examined its field application in Qiandao Lake, China. Results showed that the Stokes components of water-leaving radiance (L_w) measured by POLWR were consistent with the radiative transfer (RT) simulations, with a determination coefficient (R^2) and mean relative error of 0.67 and 18.86%, respectively. The Qiandao Lake results revealed that the degree of polarization (DOP) of Lw varied from 0.05 to 0.5 within the 412–865 nm range. Moreover, a good relationship between the polarized remote sensing reflectance (R_{rsp}) and DOP and chlorophyll-a (Chla) concentration was found at 368 nm in this productive lake, indicating great potential for the inversion of oceanic constituents from polarization signals. With its small size and direct measurement ability, the POLWR instrument should be widely applicable, and could help improve our understanding of the polarization characteristics of water-leaving radiation and the underwater light field.

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