Advancing Ocean and Atmospheric Research through Polarimetric Remote Sensing Innovations

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The accurate retrieval of aerosol and water constituents from polarimetric ocean color satellite measurements is crucial for advancing our understanding of atmospheric and oceanic processes. This research presents the development and application of two novel algorithms: the Intelligent Polarization Atmospheric Correction (IPAC) and the Glint-Free network (GFNet), which contribute to the field of polarimetric ocean color remote sensing.

The IPAC algorithm addresses the challenge of atmospheric correction for polarized radiances by efficiently processing multiangle, multispectral, and polarimetric satellite observations. It utilizes the Vector Radiative Transfer Simulation (VRTS) model and precomputed lookup tables to derive polarized water-leaving reflectance and aerosol properties in open-ocean waters. The algorithm demonstrates improved accuracy in retrieved ocean color products, with mean absolute percentage errors below 34.43% for polarized apparent water-leaving reflectance and 37.66% for chlorophyll concentration [1].

The GFNet algorithm introduces a polarization-enhanced approach for glint-free segmentation of shallow water targets, such as Unmanned Underwater Vehicles (UUVs), on the water surface. By integrating polarization imaging features, GFNet effectively suppresses sun glint and enhances target segmentation under various lighting conditions. The network's two-stage learning scheme, incorporating GFNet and the Correlation-Driven Feature Decomposition Fusion (CDDFuse) network, achieves mean intersection over union (mIoU) scores of 86.39 and 70.47, respectively, indicating a robust performance in UUV segmentation [2].

Additionally, this research includes the exploration of aerosol vertical distribution retrieval [3] and underwater target detection using polarization imaging [4], further showcasing the potential of polarization measurements in enhancing remote sensing applications.

References

[1] He, X., Pan, T., Bai, Y., Shanmugam, P., *et al.*, 2024: Intelligent Atmospheric Correction Algorithm for Polarization Ocean Color Satellite Measurements Over the Open Ocean. *IEEE Transactions on Geoscience and Remote Sensing*, **62**, 1-22.

[2] Pan, T., He, X., Bai, Y., Shanmugam, P., *et al.*, 2024: Polarization-Enhanced GFNet for Glint-Free Water Surface Object Segmentation. (*Undergoing review*)

[3] Pan, T., He, X., Bai, Y., Shanmugam, P., *et al.*, 2024: Retrieval of the Aerosol Scale Height over the Ocean Based on Near-infrared Multiangle Polarization Measurements. (*Undergoing review*)

[4] Pan, T., He, X., Zhang, X., Liu, J., *et al.*, 2022: Experimental Study on Bottom-Up Detection of Underwater Targets Based on Polarization Imaging. *Sensors*, 22, 2827.

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