How machine learning approaches are useful in computing the optical properties of non-spherical particles?

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The single-scattering properties of atmospheric non-spherical particles are essential in atmospheric radiative transfer and downstream applications such as remote sensing, data assimilation, and climate studies. However, accurately and efficiently computing these properties remains a challenging research area that requires persistent efforts. Currently, a combination of computational methods that solve the Maxwell equations and physical-geometric optics approximation methods was commonly employed to compute the optical properties of non-spherical particles. Despite routine developments and updates of optical property datasets, several challenges persist. For example, the accuracy of physical-geometric optics approximation deteriorates as the size parameter decreases due to the exclusion of semi-classical effects. Although analytical formulas of semi-classical effects exist for spheres and spheroids, deriving them for arbitrarily shaped non-spherical particles is challenging. Additionally, the coarse parameter grid of databases, stemming from computational constraints, causes inaccuracies of Jacobian calculations required in remote sensing applications. Furthermore, the expanding volume of optical property databases hampers their practical application. In this talk, we summarize recent advancements of applying machine learning approaches for computing the optical properties of non-spherical particles and discuss how these approaches effectively address the aforementioned challenges.

References

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