Polarized discrete ordinate adding approximation (POLDDA) for radiative transfer

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Abstract. The polarization characteristics of atmospheric scattering are important and should not be ignored in radiative transfer simulations. In this study, we propose a polarized adding method of discrete ordinate approximation (POLDDA) to solve the plane-parallel polarized radiative transfer equation including solar and thermal sources of radiation. This method can calculate the radiance in a vertically inhomogeneous atmosphere under cloudy conditions. The single-layer solutions are obtained using the discrete ordinate method (DOM). From the invariance principle, the adding method is applied to deal with the radiative transfer process in the multiple layers. Combining the advantages of DOM and the adding method, the Stokes vector (including the I-, Q-, U-, and V -components) calculated by POLDDA is evaluated by comparing the results with those computed from the exact doubling-adding method. The high agreement is shown for the radiance result for all satellite viewing angles under different streams. Meanwhile, the POLDDA has a higher computational efficiency, particularly for an atmosphere with a large scattering optical depth. Unlike RT3, the computation time of the proposed method does not increase with increasing optical depth.