

## Numerical Calculations of the Scalar Transmission Function in a Plane-Parallel Atmosphere

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Recently published surface-based measurements of diffuse zenith radiance associated with sunlit clouds have demonstrated the importance of the transmission function in deducing cloud optical depth and effective particle size. The transmission function can be rapidly calculated for the azimuth-independent (zenith viewing) mode using the doubling method and can be accurately calculated for the non-zero off-zenith, azimuth-dependent modes using the principles of invariance. Here, numerical calculations of the transmission function using the principles of invariance are presented for the Rayleigh and stratus cloud phase functions in a plane-parallel atmosphere. The scalar results are displayed as a function of optical depth, the associated Legendre series expansion order, and the intensity-incident and -viewing angles. The positive sign of the non-zero order transmission functions and its monotonically decreasing amplitude with increasing order make it a suitable parameter for optical depth determination in a homogeneous layer for both zenith and azimuth-dependent viewing. In contrast to the changing sign of the reflection function between higher order modes, the transmission function is positive for all orders and is less subject to numerical error compared to the reflection function when summed over its cosine series expansion.

Keywords: transmission function, cloud optical depth, principles of invariance

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