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Accelerations of the discrete ordinate method for nadir viewing geometries

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Nowadays the amount of remote sensing data is increasing due to the high spatial and spectral resolutions of the instruments. In this regard, fast and accurate radiative transfer models are required. For a cloudy atmosphere and nadir viewing geometries, many techniques were developed based on the scattering phase function truncation or the anisotropy elimination. In this work we present several acceleration techniques for the discrete ordinate method including:

1. The computation of the inverse of the eigenvector matrix by first scaling the original matrix to yield a symmetric matrix, and then by calculating the inverse of the symmetric matrix by means of the left eigenvector matrix.

2. The use of the telescoping technique, which consists in the reduction of the linear algebra system to the active layers of the clouds and for azimuthal modes m>2.

3. The use of an additional discrete ordinate with zero weight in the direction of the line of sight in order to avoid the post-processing step of the conventional discrete ordinate method (source integration along the line of sight).

The numerical simulations evidenced that, for example, for 32 discrete ordinates the above acceleration techniques reduce by 50 % the computing time of the conventional approach.