Atmospheric compensation algorithm for high-resolution satellite images with extreme oblique observations

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Compared with nadir observations, oblique observations from high-altitude platforms increase spatial coverage and temporal resolution at the cost of spatial resolution. However, large oblique angles introduce more heterogeneous atmospheric contamination to the image data. Current atmospheric compensation (AC) algorithms have been developed for nadir or smaller oblique angles [1,2], assuming that each pixel in the scene is affected by the atmosphere in a nearly uniform manner. This assumption is invalid for larger observation zenith angles, where atmospheric path radiance and transmittance change with increasing target distance, leading to atmospheric dispersion and a change in the coherence length of atmospheric turbulence. Additionally, the adjacency effect is strongly correlated with the observation zenith angle. This degradation in image quality renders traditional AC algorithms ineffective.

In this study, we propose an AC algorithm for high-resolution visible and near-infrared images based on three-dimensional radiative transfer for large oblique observation angles [3]. This algorithm is more effective in eliminating image blurring and retrieval errors in reflectivity caused by large oblique observation angles and atmospheric adjacency effects compared to traditional target-environment reflectance dichotomy neighboring pixel correction. It significantly reduces retrieval errors and improves image quality through AC, even when the observation zenith angle exceeds 70°. Finally, the quality of the images before and after correction is assessed using a method based on the image interpretability scale and a combination of objective image quality assessment parameters [4,5]. The results show a considerable improvement in visual quality with the correction method employed in this study.

References

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