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Correction of artifacts in the SeaWiFS atmospheric correction: removing discontinuity in the derived products

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Abstract

It has been found that, at the certain solar and sensor-viewing geometry and for certain atmosphere conditions, discontinuity lines appear in the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) retrieved atmospheric and ocean color products. Such discontinuity lines, which do not happen very often, are apparently artifacts from the atmospheric correction scheme that uses the lookup tables to process SeaWiFS data. In this paper, a brief description of the SeaWiFS atmospheric correction algorithm, in particular, the technique that is used in retrieving the aerosol models and aerosol radiance contributions in the visible wavelengths, is provided. Results from some specific simulations that explain the causes of the discontinuity lines in the derived products are presented. We show that these discontinuities appearing in the derived SeaWiFS products are the result of the atmospheric correction due to aerosol model effects. To remove the discontinuities, a simple modification to the current atmospheric correction algorithm is proposed and tested with both simulated and real SeaWiFS data. The modification has been implemented in the SeaWiFS fourth data reprocessing in August 2002.

Keywords: Remote sensing; Ocean color; Atmospheric correction

1. Introduction

Since it was launched on August 1, 1997, the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) (Hooker, Esaias, Feldman, Gregg, & McClain, 1992) has been continuously providing global ocean color and atmospheric products (McClain et al., 1998). It has been found, however, that for some atmospheric conditions and at certain solar and sensor-viewing geometry, discontinuity lines appear in the SeaWiFS-retrieved atmospheric and ocean color products, e.g., the aerosol Ångström exponent, the aerosol optical thickness, the surface normalized water-leaving radiances, and the chlorophyll-*a* concentration. Such discontinuities do not happen often in the SeaWiFS-derived products. Fig. 1 provides examples of such cases for the SeaWiFS-derived aerosol Ångström exponent from 510 to 865 nm, $\alpha(510,865)$, and the normalized water-leaving radiance at 412 nm, $[L_w(412)]_N$. These images were derived from SeaWiFS data (file name S2000172165500), which were acquired on June 20, 2000 along the Northeast coast of the US near 42°N of latitude and 67°W of longitude. Fig. 1(a) and (b) are images corresponding to the aerosol Ångström exponent $\alpha(510,865)$ (scaled from 0 to 1.5) and the normalized water-leaving radiance at wavelength 412 nm $[L_w(412)]_N$ (scaled logarithmically from 0.01 to 2 mW cm^{-2} μm^{-1} sr^{-1}), respectively. Both Fig. 1(a) and (b) show two discontinuity regions (two of discontinuity lines are indicated in the images). In these regions, values of $\alpha(510,865)$ and $[L_w(412)]_N$ are slightly lower and higher than those at the nearby regions, respectively. These discontinuity lines are obviously not real. They are artifacts resulting from imperfect performance of the SeaWiFS atmospheric correction. In this paper, I describe an effort to study and understand the atmospheric correction artifacts resulting in the discontinuities in the SeaWiFS-retrieved atmospheric and ocean color products. First, a brief description of the SeaWiFS atmospheric correction algorithm is provided. Next, simulations, which demonstrate the imperfect atmospheric correction due to some aerosol model effects, are presented. This explains the discontinuities in the SeaWiFS

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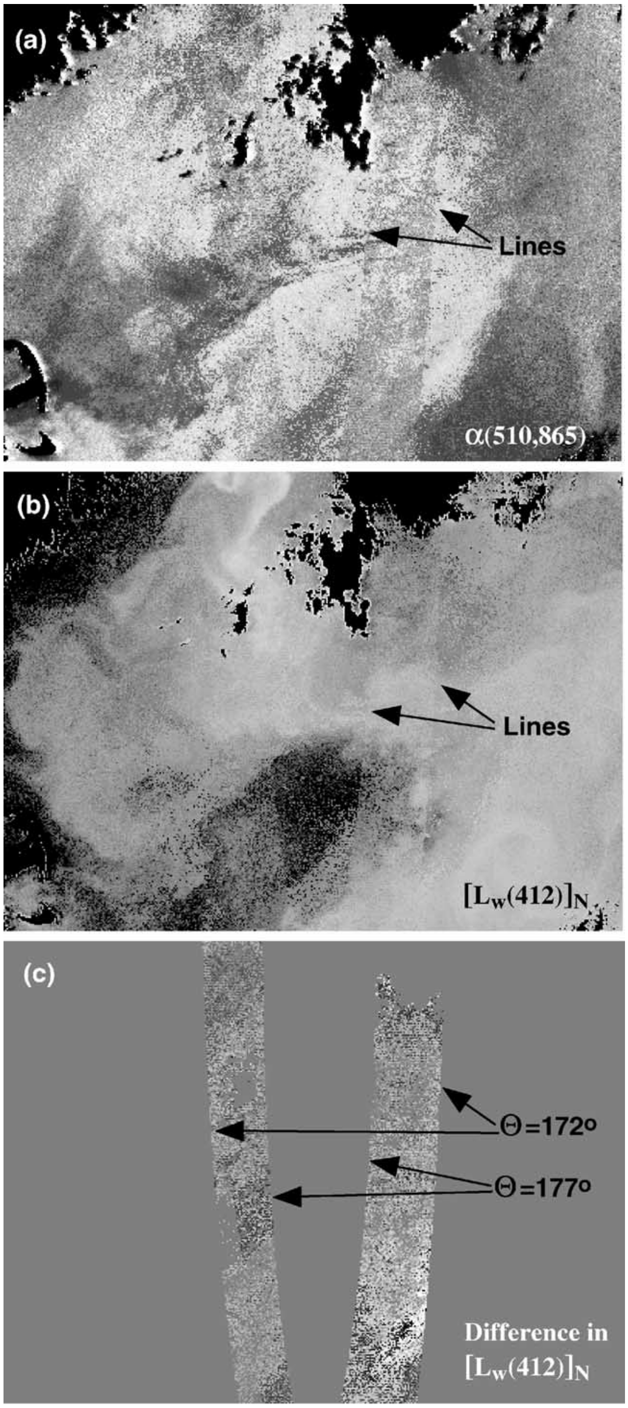

Fig. 1. Examples of the discontinuities appearing in the SeaWiFS-retrieved products for (a) the aerosol Ångström exponent $\alpha(510,865)$ (scaled from 0 to 1.5); (b) the normalized water-leaving radiance at 412 nm $[L_w(412)]_N$ (scaled logarithmically from 0.01 to 2 mW cm^{-2} μm^{-1} sr^{-1}); and (c) the difference in $[L_w(412)]_N$ between results of the uncorrected and corrected images (scaled from -0.2 to 0.2 mW cm^{-2} μm^{-1} sr^{-1}).

products. Finally, a simple modification to the current algorithm is proposed. Both simulated and the SeaWiFS-retrieved results from the modified algorithm are presented and discussed.

8. Conclusion

A study has been carried out to understand certain artifact effects of the SeaWiFS atmospheric correction algorithm, which result in discontinuities in the SeaWiFS-retrieved atmospheric and ocean color products at the certain solar and sensor-viewing geometry and for certain atmosphere conditions. It was found that the artifacts of the atmospheric correction are resulted from the model across in the epsilon values of two significantly different aerosol models, i.e., the aerosol reflectance contribution at the visible can not be well characterized by the corresponding single-scattering reflectance at the two NIR bands. Such artifacts do not happen often and only involve with the aerosol models C50 and T99 and a certain solar and sensor-viewing geometry.

To correct these artifacts, a simple modification to the current atmospheric correction algorithm is proposed and tested with both the simulated and the SeaWiFS data. Results show that, with a simple modification to the algorithm in the case of the model across with the C50 and T99 aerosols, the discontinuities appearing in the derived ocean color and atmospheric products can be effectively removed. This modification scheme has been implemented in the SeaWiFS 4th data reprocessing in August 2002.