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# SIMBIOS Project 2002 Annual Report

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# *Chapter 20*

# Assessment, Validation, and Refinement of the Atmospheric Correction Algorithm for the Ocean Color Sensors

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## 20.1 INTRODUCTION

The primary focus of this proposed research is for the *atmospheric correction algorithms evaluation and development* and *satellite sensor calibration and characterization*. It is well known that the atmospheric correction, which removes more than 90% of sensor-measured signals contributed from atmosphere in the visible, is the key procedure in the ocean color remote sensing (Gordon and Wang, 1994). The accuracy and effectiveness of the atmospheric correction directly affect the remotely retrieved ocean bio-optical products. On the other hand, for ocean color remote sensing, in order to obtain the required accuracy in the derived water-leaving signals from satellite measurements, an on-orbit vicarious calibration of the whole system, i.e., sensor and algorithms, is necessary. In addition, it is important to address issues of (i) cross-calibration of two or more sensors and (ii) in-orbit vicarious calibration of the sensor-atmosphere system. The goal of these researches is to develop methods for meaningful comparison and possible merging of data products from multiple ocean color missions. In the past year, much efforts have been on (a) understanding and correcting the artifacts appeared in the SeaWiFS-derived ocean and atmospheric produces; (b) developing an efficient method in generating the SeaWiFS aerosol lookup tables, (c) evaluating the effects of calibration error in the near-infrared (NIR) band to the atmospheric correction of the ocean color remote sensors, (d) comparing the aerosol correction algorithm using the single-scattering epsilon (the current SeaWiFS algorithm) vs. the multiple-scattering epsilon method, and (e) continuing on activities for the International Ocean-Color Coordinating Group (IOCCG) atmospheric correction working group. In this report, I will briefly present and discuss these and some other research activities.

## 20.2 RESEARCH ACTIVITIES

- It has been found that, at the certain solar and sensor-viewing geometry and for certain atmosphere conditions, discontinuity lines appear in the 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. A study has been carried out to understand these 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 (Wang, 2002a). 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. 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 two aerosol models, the discontinuities appearing in the derived ocean color and atmospheric products can be effectively removed. This modification scheme has been implemented in the SeaWiFS $4^{th}$ data reprocessing in August 2002.
- An efficient method for the multiple radiative-transfer computations is developed (Wang, 2002b). The purpose of this work is for generating the aerosol lookup tables (e.g., for SeaWiFS) more efficiently. Therefore, it is easy to test for various aerosol models. The method is based on the fact that, in the radiative-transfer computation, most of the CPU time is used in the numerical integration for the Fourier components of the scattering phase function. With the new method, the lookup tables, which are usually needed to convert the spaceborne and the airborne sensor-measured signals to the desired physical and optical quantities, can be generated efficiently. The CPU efficiency of a factor of more than 6 can be achieved using the new method in generating the SeaWiFS lookup tables. The new scheme is useful and effective for the multiple radiative-transfer computations.