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The topic of atmospheric correction perhaps belongs in Level 2 of the Remote Sensing Chapter. However, this is such an important and complicated topic that it warrants a chapter of its own.

The Level 1 pages of this chapter discuss the generic atmospheric correction problem. The first page formulates the atmospheric correction problem in terms of the various contributions to the top-of-the-atmosphere (TOA) radiance measured by a satellite-borne sensor. Those contributions come from solar radiance scattered by atmospheric molecules and aerosols, Sun and sky radiance reflected by the sea surface (either by the water surface itself or by foam from whitecaps), and finally from water-leaving radiance. The following page uses numerical simulations from a coupled ocean-atmosphere radiative transfer model to illustrate the nature and magnitude of these contributions. The details of how normalized water-leaving radiances and normalized reflectances are defined and how they should be interpreted are then given. Pages on vicarious calibration and the computation of diffuse transmittances close out the Level 1 material.

The Level 2 pages describe one by one the specific algorithms used by the NASA Ocean Biology Processing Group (as of 2016) to effect the various steps of the atmospheric correction process, namely the corrections for absorption and scattering by gases and aerosols, Sun and sky reflectance by the sea surface, whitecap reflectance, and finally corrections for sensor out-of-band response and polarization effects. The end result is an estimate of the "exact normalized water-leaving radiance," or its equivalent reflectance, which carries information about the water-column itself.

Once obtained, the normalized reflectance is the input to algorithms for retrieval of various quantities of scientific interest. These ocean-color products include—among others—the Chlorophyll-a concentration, the water-column diffuse attenuation for downwelling plane irradiance at 490 nm (Kd490, which is a proxy for water transparency), water-column absorption and backscatter coefficients, and particulate organic and inorganic Carbon. The algorithms for retrieval of specific products, given the normalized reflectance, are given in a series of reports found at NASA Algorithms. Those retrieval algorithms are not discussed here.

There are many other sources with additional information about atmospheric correction. The NASA ocean color web site contains a wealth of information about how NASA collects, processes, calibrates, validates, archives and distributes ocean color data from a variety of satellite sensors. That web site has many pages with links to various technical memos and other information about ocean color, and many of the data files underlying the atmospheric correction process can be downloaded there.

There are also many non-NASA sources of information on atmospheric correction. The Maine In-situ Sound and Color Lab website links to PowerPoint presentations of lectures given at the University of Maine summer courses, and to videos of the 2015 and 2017 lectures. The International Ocean Color Coordinating Group (IOCCG) has hosted summer lecture series during which the lectures were videoed. The IOCCG lectures delivered by Menghua Wang in 2012 and 2014 cover much of the material presented here; they can be found at IOCCG 2012 Lectures and IOCCG 2014 Lectures. IOCCG Report 10 compares the SeaWiFS-MODIS vs. MERIS vs. OCTS-GLI vs. POLDER atmospheric correction algorithms, but assumes that the reader is already familiar with the general process.

The material of this chapter is available as a single pdf document as Mobley et al. (2016).