APPENDIX 5. ATMOSPHERIC CORRECTION MODIFICATION PROCEDURE

1. Process L1 HRPT image using SEADAS 4.5 (released in February 2004), with local wind, no NIR correction, and 2 pixels for stray light correction. Ozone data from Total Ozone Mapping Spectrometer aboard NASA's Earth Probe satellite (EPTOMS) instead of NOAA's TIROS Operational Vertical Sounder (TOVS) are used for consistency.
2. For each pixel in the processed image, output aerosol radiance $L_a(\lambda)$ at 765 and 865 nm, and solar zenith angle θ.
3. Retrieve mode values of (i) epsilon $\varepsilon^{cl}{}_{7,8}$, (ii) diffuse transmittance of the atmosphere from sea to sensor $T^{cl}{}_v(\lambda)$ at 765 and 865 nm, (iii) atmosphere optical thickness at 865 nm $\tau^{cl}(865)$, and (iv) aerosol radiance $L^{cl}{}_a(\lambda)$ at 765 and 865 nm, using image histogram plots of the above parameters for clear or non-turbid waters. Turbid waters are defined here as pixels for which at least one of the following SeaWiFS flags is raised: stray light, clouds, negative water-leaving radiance, turbid water flag, high aerosol, epsilon out of range, radiance above knee, and chlorophyll algorithm failure.
4. Retrieve aerosol models, their weights and percentage coverage, using image histogram plots of the above parameters for clear or non-turbid waters.
5. Convert aerosol radiance $L_a(\lambda)$ to aerosol reflectance $\rho_a(\lambda)$ at 765 and 865 nm for each turbid pixel and clear-water ($L^{cl}{}_a(\lambda)$ and $\rho^{cl}{}_a(\lambda)$, respectively) value as follows:

$$\rho_a(\lambda) = \frac{L_a(\lambda)\pi}{F(\lambda)\cos(\theta)}, \tag{A5.1}$$

   where $F(\lambda)$ is the mean solar irradiance (122.24 and 98.82 mW/cm^2/µm/sr for 765 and 865 nm, respectively), θ is the sun zenith angle, and λ corresponds to SeaWiFS NIR wavelengths 765 and 865 nm.
6. For each turbid pixel in the image, calculate new aerosol reflectance $\rho^n{}_a(865)$ through the epsilon of non-turbid waters $\varepsilon^{cl}{}_{7,8}$, clear-water diffuse transmittances of the atmosphere $T^{cl}{}_v(765)$ and $T^{cl}{}_v(865)$, local aerosol reflectances $\rho_a(765)$ and $\rho_a(865)$, and water absorption $a(\lambda)$ at 765 and 865 nm (derived from Pope and Fry 1997):

$$\rho_a^n(865) = \frac{\rho_a(865)T^{cl}{}_v(765)a(865) - 1.14\rho_a(765)T^{cl}{}_v(865)a(765)}{T^{cl}{}_v(765)a(865) - 1.14\varepsilon_{7,8}^{cl}T^{cl}{}_v(865)a(765)}. \tag{A5.2}$$

7. For each turbid pixel in the image, convert the new aerosol reflectance $\rho^{n}{}_{a}(865)$ to the new aerosol optical thickness (AOT) $\tau^{n}(865)$ using clear-water AOT $\tau^{cl}(865)$ and clear-water aerosol reflectance $\rho^{cl}{}_{a}(865)$:

$$\tau^{n}(865) = \frac{\tau^{cl}(865)\rho_{a}^{n}(865)}{\rho_{a}^{cl}(865)}. \qquad \text{(A5.3)}$$

   The conversion A5.3 is justified by the notion that for a given aerosol type, single-scattering aerosol reflectance would be proportional to AOT (Bryan Franz, on-line communication at Ocean Color Forum, http://ocforum.gsfc.nasa.gov/).
8. For each turbid pixel in the image, calculate atmospheric optical thickness at the remaining SeaWiFS wavelengths for the weighted combination of aerosol models (Wang 2000).
9. Process L1 HRPT image as in step 1 with the new input AOT. Maximum epsilon is raised from the default value of 1.35 to 3 because the average 765:865 nm ratio for water reflectance at various suspended sediment concentrations is circa 1.88 (bio-optical model calculations over the whole ranges of TSS and CHL). To account for possible cumulative sediment and aerosol signals in NIR, maximum aerosol optical thickness at 865 nm is increased from 0.3 to 0.7 (otherwise the pixel might be masked and hence not processed).
10. Output new water-leaving radiances for the eight SeaWiFS bands.