Examples of Calculation by COART

The following figures present some examples of calculations. Observation data, when available, are also shown for comparison. All the radiation measurements are taken over the Chesapeake Lighthouse platform or over aircraft at NASA's CERES Ocean Validation Experiment (COVE) site, which is 25km east of the Virginia Beach in the Atlantic Ocean. The aerosol optical properties, precipitable water (PW), wind speed, Chl and the absorption properties for soluble and particulate materials in the ocean, which are used for model input, are also from in-situ measurements at COVE.

Fig. 2. Modeled and measured narrow band ocean surface albedo in the six MFRSR channels.
Fig. 3. Modeled and measured spectral downwelling irradiances.
Fig. 4. Modeled and measured spectral ocean surface albedo.
Fig. 5. Modeled and measured broadband ocean surface albedo.
Fig. 6. Wind effects on ocean surface broadband albedo.
Fig. 7. Modeled flux penetration to various depths of the ocean.
Fig. 8. Flux attenuation in the upper ocean.
Fig. 9. Shortwave absorption as ocean depth.
Fig. 10. Remote sensing reflectance for ocean with different Chl.
Fig. 11. AirMISR measured reflectance at 20 km above the ocean and model simulation.
Fig. 12. Anisotropic reflectance or BRDF at TOA and ocean surface for different wind speeds.

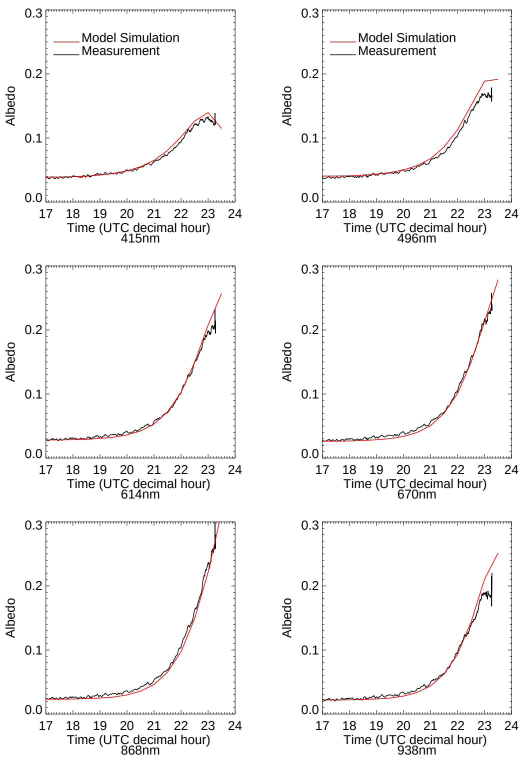

Fig. 2. Modeled (red) and measured (black) ocean albedo in the six MFRSR channels at COVE on July 31, 2001.

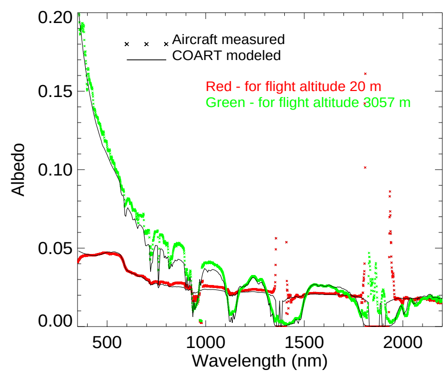

Fig. 4. A comparison of the modeled and aircraft measured albedo over the ocean in the vicinity of COVE on August 12, 2002.

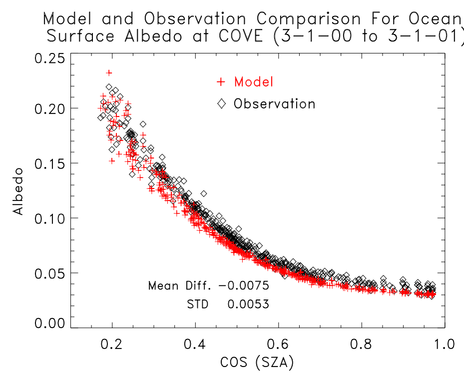

Fig. 5. Modeled and measured broadband ocean surface albedo at COVE under clear skies for a whole year.

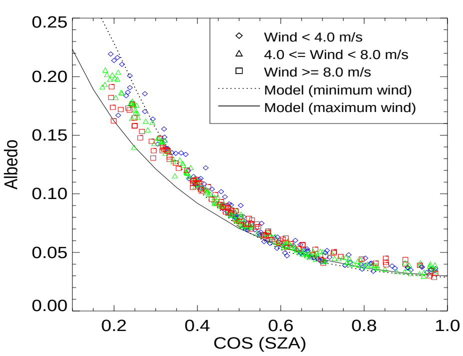

Fig. 6. Wind effects on ocean surface albedo. The observed albedo as a function of the cosine of SZA are plotted in three wind categories. The dashed line and the solid line are the modeled albedo with the minimum wind (0.48 m/s) and maximum wind (14.0 m/s) of the observations, respectively. The mean AOD and PW of measurements were used in model calculations.

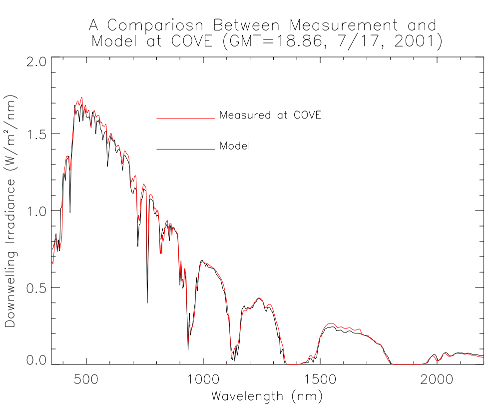

Fig. 3. An example of modeled and measured downwelling spectral irradiances.

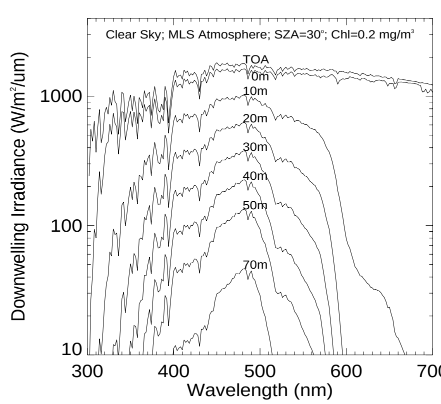

Fig. 7. Modeled downwelling irradiances at the TOA, surface and various depths in the ocean under clear sky conditions

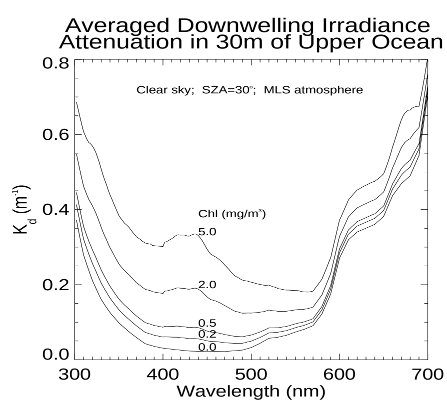

Fig. 8. Modeled downwelling flux attenuation coefficients averaged in the 30 m of upper ocean for different chlorophyll concentrations.

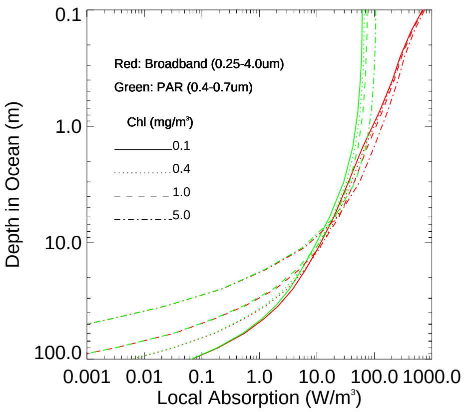

Fig. 9. Modeled local solar absorption as a function of depth. Note that the absorptions for the broadband and the PAR are overlapped at depth of about 10 m, indicating that most of radiation outside of PAR is absorbed in the few meters of the top layer. Clear sky; SZA=30^{o}; MLS atmosphere.

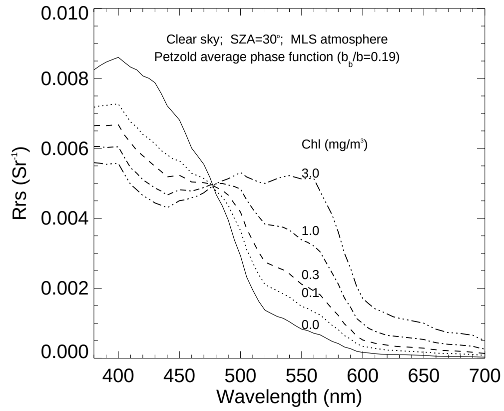

Fig. 10. Model simulated remote sensing reflectance (Rrs = Lw / Ed) for different Chls. Note that the optical properties for ocean particles are based on the parameterization of Gordon and Morel (1983), which are chlorophyll related only. The actual absorption and scattering may be very different, which could result in very different Lw and Rrs, especially in the blue.

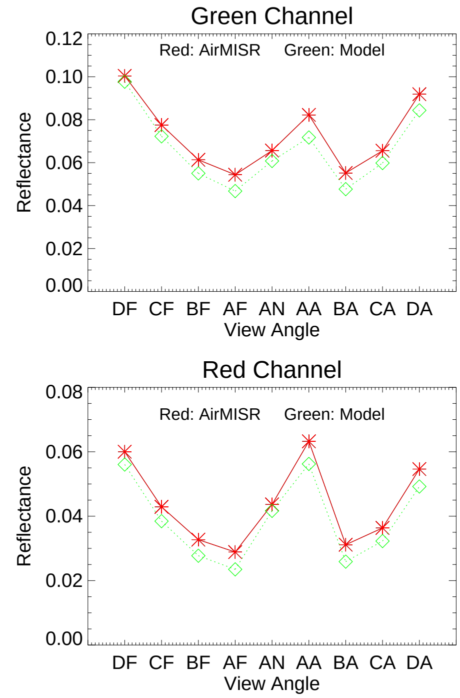

Fig. 11. The equivalent reflectance measured from nine view angles by AirMISR at 20 km above the ocean at COVE and comparison with model simulation. Note that the view directions ‘AA’ and ‘AN’ are right in the sun glint region.

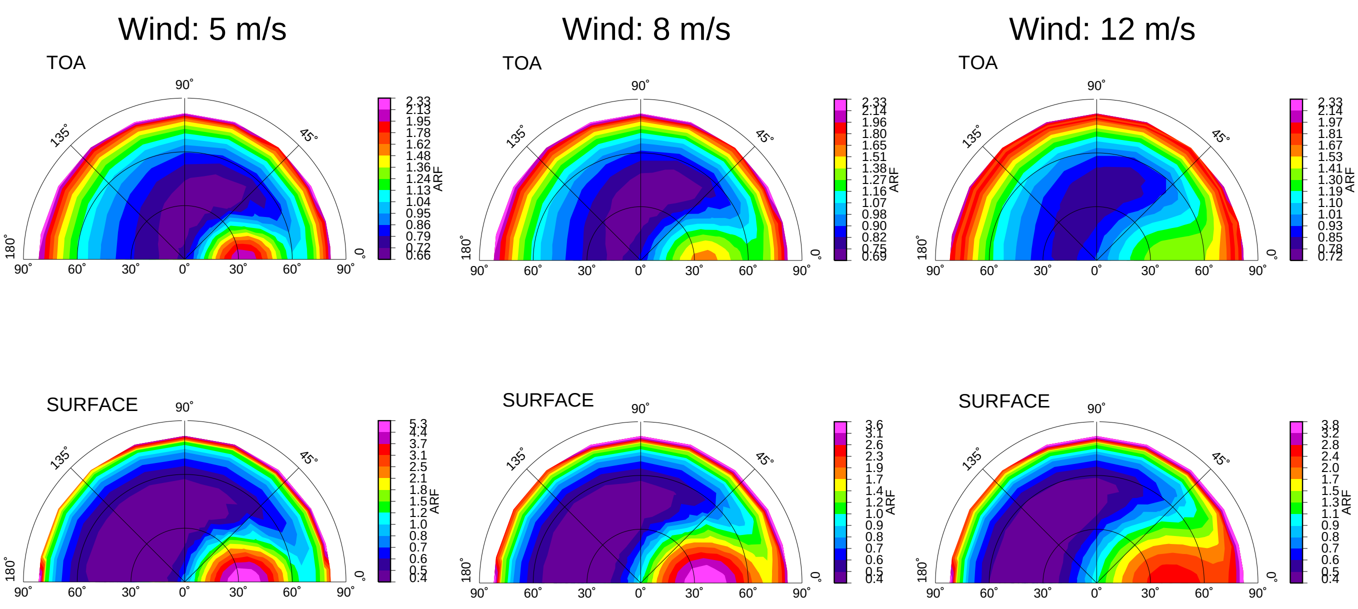

Fig. 12. Modeled BRDF at the TOA and the ocean surface for three different wind speeds. Clear sky; SZA=30^{o}; MLS atmosphere; no aerosol. Note the sun glint variations with wind speed.

COART (Coupled Ocean-Atmosphere Radiative Transfer) model online:

http://snowdog.larc.nasa.gov/jin/rtset.html