well calibrated, so that radiance measurements are reliable and accurate in an absolute sense, not just a relative one. Also, you have to carefully account for the variable angle and intensity of solar illumination.

Recall from (5.9) that the reflected intensity $I^{\uparrow}$ viewed by the satellite depends on the viewing direction (θ_r, ϕ_r), on the direction of incidence (θ_i, ϕ_i), and on the bidirectional reflectance function (BDRF) $\rho(\theta_i, \phi_i; \theta_r, \phi_r)$. While the various directions can be easily calculated, given the satellite's position, the scene location on the earth's surface, and the sun position (Fig. 5.5), the details of the BDRF are highly variable and, for many natural surfaces, are poorly known.

It is therefore not possible to reliably estimate the overall albedo of a surface from a radiance measurement made in only one direction and with one direction of solar illumination. Thus, a high radiant intensity observed by a satellite sensor at a particular point on the surface could imply either a) a high-albedo surface, such as snow, or b) a lower-albedo surface for which the BDRF happens to be sending a large fraction of the total reflected radiation in the direction of the satellite. Sun glint from a water surface is a good example of the second case: the *overall* albedo of water is quite low, but the reflected image of the sun can be very bright if you happen to be looking in exactly the right direction.

Problem 5.4: A certain meteorological satellite passes over the equator at a longitude of $\phi_{\mathrm{sat}} = 40^\circ$W and time 1200 Greenwich Mean Time (GMT) on March 21, at which time the sun is directly overhead at the intersection of the equator and the Greenwich Meridian. At which geographic location is an imager on board the satellite most likely to observe sun glint? The satellite has an altitude above the surface of $H = 1000$ km, and the sun can be regarded as being infinitely far away from the earth (i.e., rays from the sun are parallel). The radius of the earth is $R_E = 6356$ km. *Hint:* This problem requires you to dredge up some old trig identities. If you can't find an analytic solution, then at least try to find a numerical one by the method of successive approximation.

Some satellite sensors have channels at two or more visible and/or near-IR wavelengths. Since the shape of the BDRF of most

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