Aerobot Measurements of the Vertical Distribution of Shortwave Irradiance

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We have used a reversible fluid helium balloon system to obtain measurements of global shortwave irradiance with height. A reversible fluid balloon is a type of robotic aerovehicle or "aerobot" that comprises a primary helium balloon and a secondary bag containing a reversible fluid. The reversible fluid is either a gas or a liquid, depending on ambient pressure and temperature, so the phase change of the fluid is used to control the buoyancy of the balloon system. For conditions in which the temperature decreases with increasing altitude, reversible fluids can be used that change phase within the altitude range that is to be samples. Hence, the aerobot cycles about the equilibrium altitude of the phase change.

A September 29, 1996, flight successfully demonstrated the stability of the aerobot when carrying shortwave instruments on top of the primary helium balloon. An objective of the test flight was to characterize the instrument response that resulted from platform motion, and radiometer orientation sensors were mounted near the shortwave sensors. The aerobot was launched from the Jet Propulsion Laboratory around 9:30 a.m. local time (PST), and achieved three cycles between 4 and 10 km over a range of about 200 km from launch; two of the cycles were completed during daylight hours. The data, corrected for effects of platform tilt, illustrate variation that would be expected in the shortwave irradiance as a function of height. Measurements of broadband irradiance (0.2 to 2.7 um) are compared with filtered shortwave irradiance, using an optical bandpass with a cut-on wavelength at 0.695 um. The purpose of this presentation is to illustrate the research potential of this emerging measurement technology for obtaining an improved understanding of radiative flux divergence.