Accuracy of Net Radiation Profiles from a Self-Leveling Balloon-Borne Platform

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Net radiation profiles near the earth's surface provide the means to assess the importance of radiative heating in the lower atmosphere and the effectiveness of lower atmospheric radiation parameterizations in global climate models. Pacific Northwest Laboratory has developed a self-leveling platform that carries short- and long-wave radiometers aloft using a tethered balloon. While the leveling mechanism is effective, it cannot be perfect. It is therefore necessary to determine likely errors that residual motions of the platform may introduce into the measured radiation field.

This poster describes tests of a model used to establish the likely errors from residual platform motion. The model uses a standard numerical integration scheme to calculate the irradiance measured by an ideal but tipped sensor in an arbitrary radiance field. Sky and surface radiances are determined using published parameterizations for short- and long-wave radiation. The model is useful both for determining the degree to which platform motion must be stabilized to reduce measurement errors to acceptable levels and for calculating errors due to actual platform motion. Its application is easily extended to ships, aircraft, or other moving platforms.

Field measurements to evaluate the parameterizations used in this model were carried out in May 1992 under clear skies using short- and long-wave radiometers mounted on a computer-driven platform. The platform repeatedly stepped through 360 degrees of azimuth and 20 degrees of elevation about the horizontal over a 24-h period. Radiosondes were released to account for the dependence of downwelling long-wave radiance on atmospheric water vapor.

These observations compare satisfactorily with model integrations. Using the parameterized radiances and Gaussian tipping in one dimension, we have shown that the balloon-borne radiometer platform will work satisfactorily if oscillations about level are on the order of a degree or two. However, the constraints on the mean departure from level are much more severe. To achieve errors less than a 10 W/m^2 under clear daytime skies, mean deviations from level must be on the order of a degree or less. In practice, mean deviations are those that persist for periods that are long compared to the time over which the radiance field changes significantly. Oscillations are departures from level whose durations are short compared with the time for significant radiance field changes.

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