Decadal Variations in Surface Radiation Budget Observations: An Unexpected Trend for the U.S.

J.A. Augustine and E.G. Dutton

NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305; 303-497-6415, E-mail: John.A.Augustine@noaa.gov

For the past 35 years, NOAA ESRL Global Monitoring Division (GMD) and its predecessor organizations have been monitoring components of the Earth's surface radiation budget with the knowledge that changing atmospheric composition and state would impact those components, which in turn contribute to variations in the surface energy budget. Although the surface energy budget's primary roles in driving the Earth's atmospheric and oceanic circulations are well known, details of the various interactions of the energy components with: (1) The many elements of individual surface types, (2) The turbulent boundary layers, and especially (3) Changes over time, are much less understood. The intent of the surface radiation monitoring effort is to contribute a highly accurate observational record for diagnostic and predictive development purposes on climatological temporal and spatial scales. The observational methods are *in situ* surface-based, thereby providing the highest possible accuracy, but such that global coverage is not feasible, although these measurements have contributed extensively to development of satellite-based retrievals intended to provide reasonable worldwide coverage. We have established two small networks of remote, climatically diverse and representative observing sites on different spatial scales, global and continental U.S., to continuously sub-sample long-term variations of upward and downward flowing solar and terrestrial (or thermal infrared) broadband radiation. The summed radiation components, taking the downwelling as positive and upwelling as negative, constitute the net surface radiation, which is the energy available for heat gain or loss at the surface, resulting in changes to; surface temperature, convection, storage in the subsurface, surface water state (e.g., evaporation or melting), and/or photosynthesis. Interesting variations and suggestive trend tendencies exist in several of the GMD surface radiation records. Of particular note and highlighted here is the highly significant (at least statistically) upward trend in net surface radiation for one of those networks (SURFRAD, continental U.S.), as shown in the figure below. Contributions to the upward trend come from both the net solar and net infrared components. Unfortunately, longer or more extensive records to either evaluate this trend's prevalence, or to completely explain it do not exist, although it would be important for weather and climate models to include or replicate this change. Further investigations are underway as well as an effort to extend and expand the observational networks.

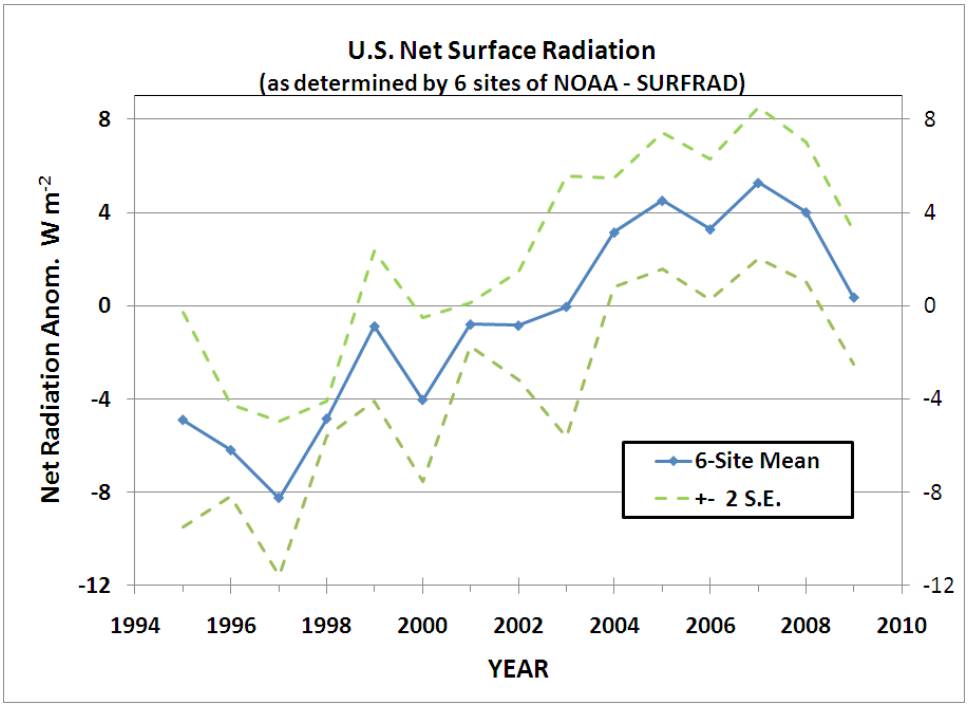

Figure 1. Net surface radiation annual anomalies, means and ± 2 Std. Err. for U.S. SURFRAD.