Variability of the Total Surface Radiation Budget and Its Components Over the United States from 1996 Through 2011

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Sixteen years of high quality Surface Radiation Budget (SRB) measurements from seven U.S. SRB stations are summarized. The network average total surface net radiation increases by +8.2 Wm^{-2} per decade from 1996 to 2011. An upward trend in downwelling shortwave of +6.6 Wm^{-2} per decade dominates the total surface net radiation increase. This shortwave brightening, which has been documented worldwide, is attributed to a decrease in cloud coverage, while a slight decrease in aerosol optical depth plays a minor role. Increasing downwelling longwave radiation of +1.5 Wm^{-2} per decade, which dwarfs the expected contribution from the 30 ppm increase of CO_2 during the analysis period, and decreasing upwelling longwave of -0.9 Wm^{-2} per decade produce a +2.3 Wm^{-2} per decade increase in surface net-longwave. The surface net radiation excess should have stimulated surface energy fluxes, but the U.S. temperature trend is flat and specific humidity has decreased over the 16-year analysis period. The enigmatic nature of longwave-down, temperature, and moisture may be a chaotic result of very large interannual variations. The El Nino/Southern Oscillation (ENSO) ONI index is shown to be moderately correlated with temperature, moisture, and longwave down. Thus, anomalous advective or convective circulations associated with ENSO may be responsible for manipulating the excess SRB energy.

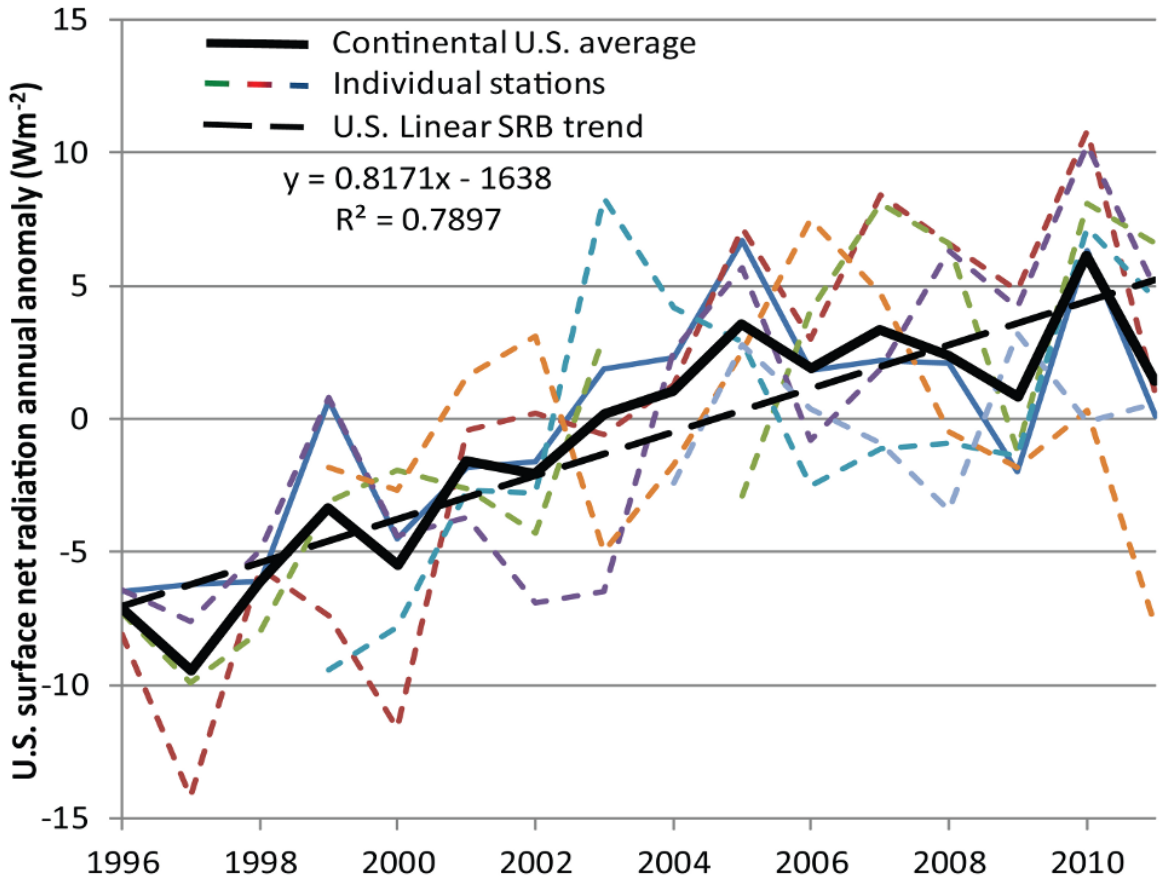

Figure 1. Annual anomaly time series of U.S. surface net radiation. Solid and dashed black lines represent the U.S. average and linear trend, respectively, and dashed color lines denote discrete stations.