The Need for a Surface Energy Budget Network and Increased Surface Radiation Measurements to Improve Weather and Climate Forecasting

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The surface energy budget (SEB) represents the surface net radiation, or available energy at the surface, and its partitioning between atmospheric heating and evaporation—the basic fuel for weather. Enhanced observation of the SEB is one of the most fundamental needs to improve understanding and predictability of weather and climate. At this point, a systematic strategy for observing this fundamental energy source to best serve the needs of the climate and weather prediction and environmental satellite data communities is lacking. Without an adequate observation network, validation of model surface energetics will continue to be tied to just a few disjointed locations deficient in climatological diversity.

Surface net radiation, atmospheric heating and evaporation drive atmospheric boundary layer processes. At the very least, components of the SEB must be simulated accurately in models to achieve success in synoptic, sub-seasonal and seasonal forecasts. Recent work with foundational NWP models developed and used operationally by NOAA has shown that existing surface radiation budget measurements from the Surface Radiation Budget (SURFRAD) network can be used to detect, diagnose, and improve model biases. At least for some applications, to address the SEB gap this existing system of NOAA's surface radiation budget measurements across the conterminous U.S. should be enhanced with latent and sensible heat flux measurements. Co-locating heat flux and radiation budget measurements at the current seven sites would greatly improve their value. Further, expanding the number of the sites will provide the geographical and climate regime representativeness and more downward radiation measurements that weather forecast model developers desire most. This enhanced network would integrate downwelling direct, diffuse, and reflected solar irradiance, downwelling and upward directed thermal infrared, surface latent, sensible, and soil heat fluxes, and spectral direct and diffuse irradiance measurements for aerosol and cloud properties. The forecasting and predictability community would benefit from modest upgrades to instrumentation and long-term network management. A national Surface Energy Budget Network (SEBN) will provide the foundation to improve reanalyses, NOAA satellite products, NOAA climate models, weather forecasts, and climate assessments, significantly aiding the NOAA National Environmental Satellite, Data, and Information Service, the National Weather Service, and the general atmospheric science research community.

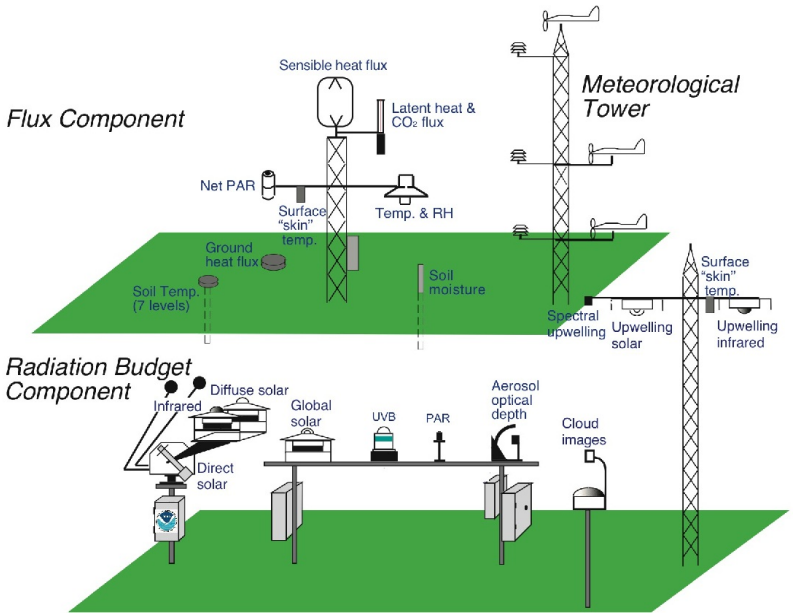

Figure 1. Details of a Prototype SEBN Station.