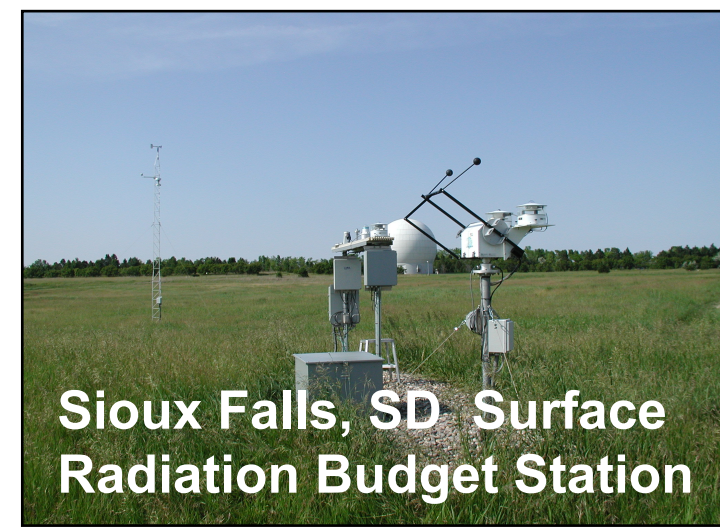
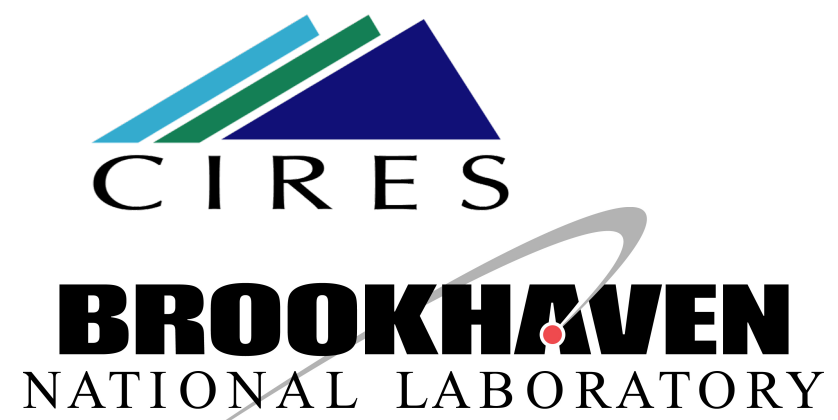
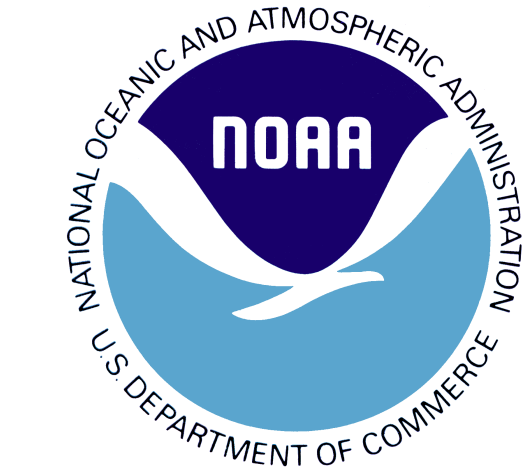


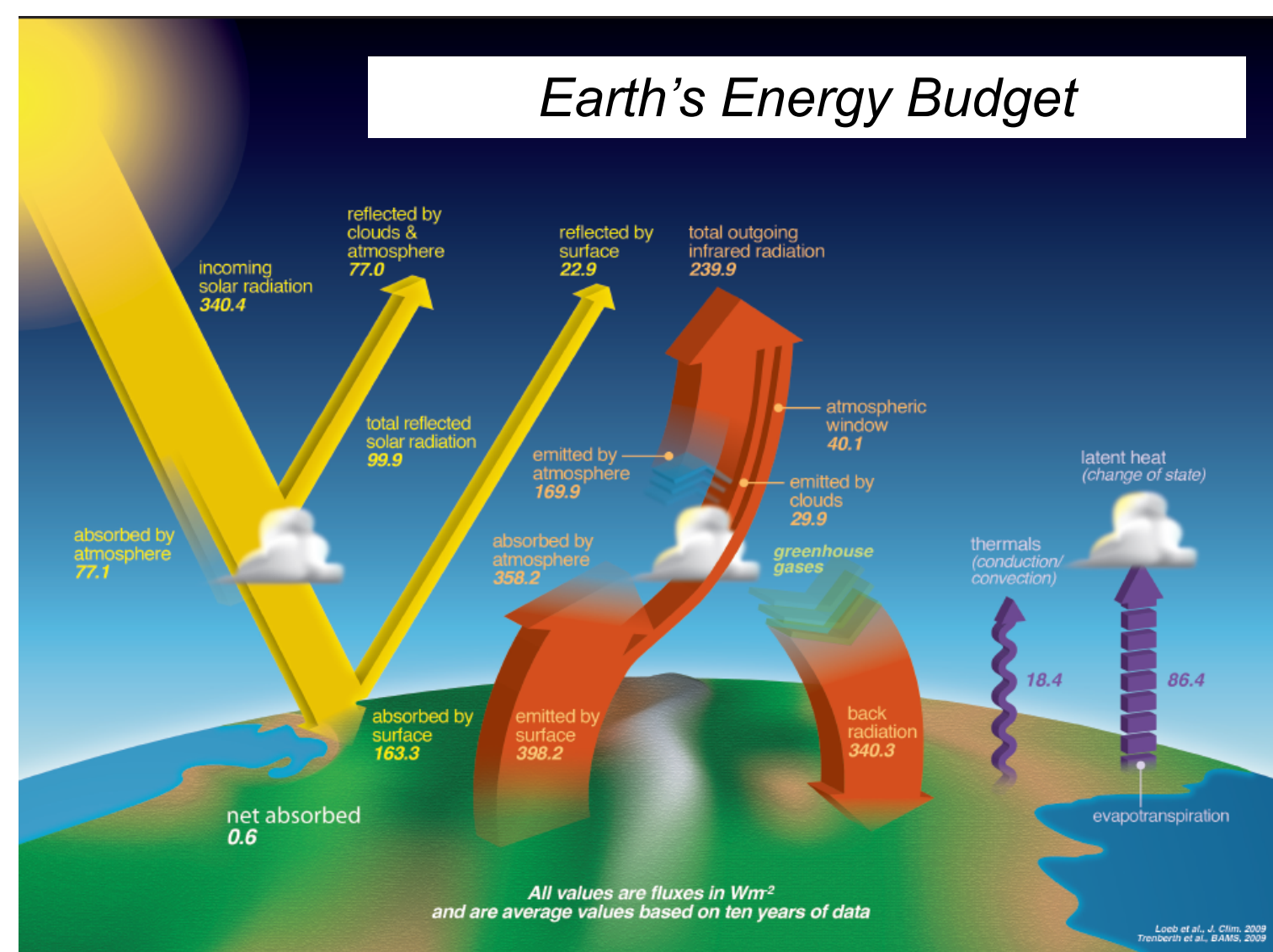
The Need for a Surface Energy Budget Network and Increased Surface Radiation Measurements to Improve Weather and Climate Forecasting

John Augustine¹, Diane Stanitski¹, Tilden Myers², Stan Benjamin³, Allison McComiskey⁴

¹NOAA Earth System Research Laboratory, Global Monitoring Division, Boulder, CO, USA; ²NOAA Air Resources Laboratory, Boulder, CO, USA; ³NOAA ESRL Global Systems Division, Boulder, Colorado, USA; ⁴Environmental and Climate Sciences Department, Brookhaven National Laboratory, Upton, NY, USA

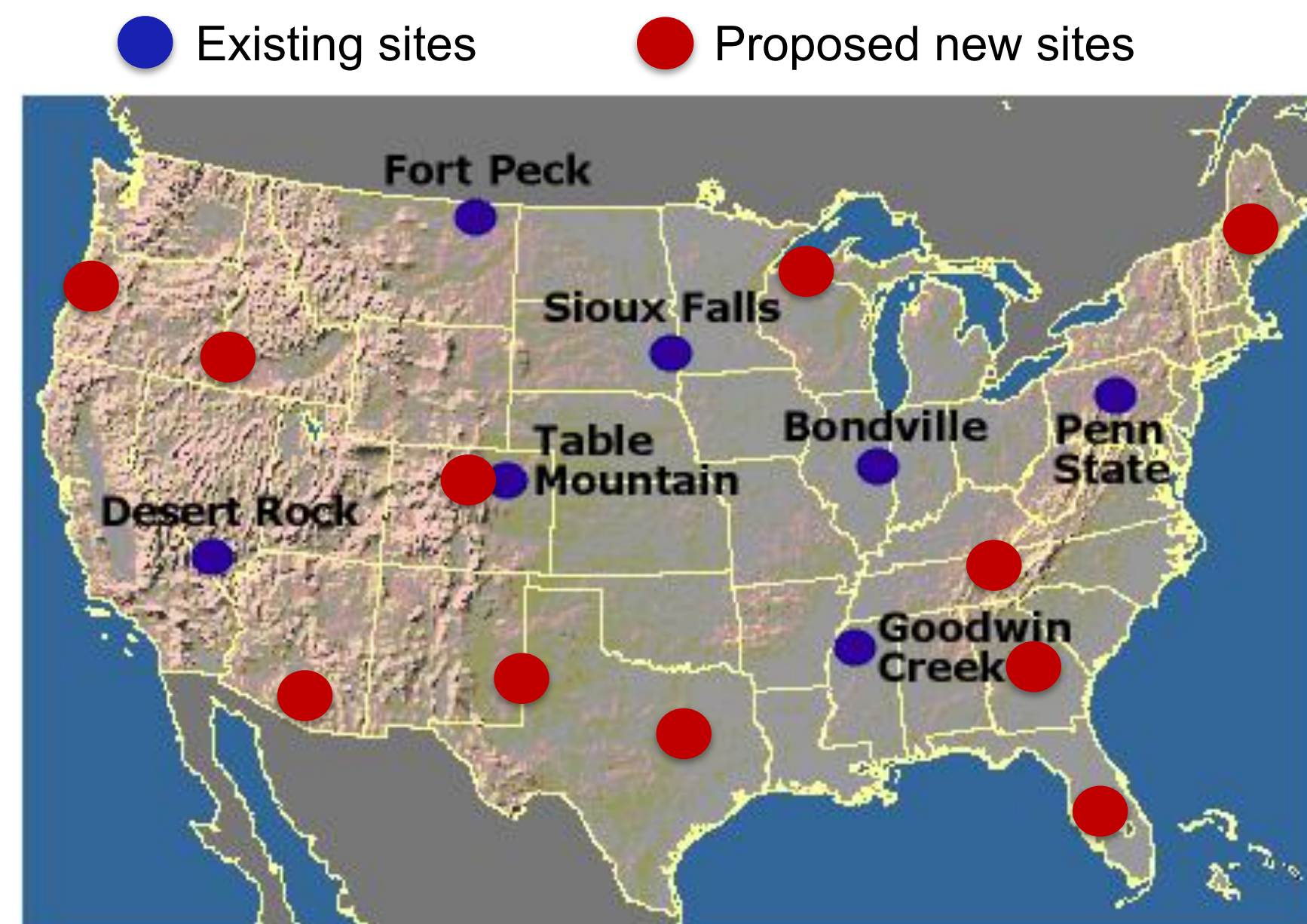


A national Surface Energy Budget Network (SEBN) will provide the foundation to improve NOAA climate models and assessments, weather forecasts, reanalysis, NASA and NOAA satellite products, significantly aiding the National Environmental Satellite Data and Information Service (NESDIS), the National Weather Service (NWS), and the general atmospheric science research community.



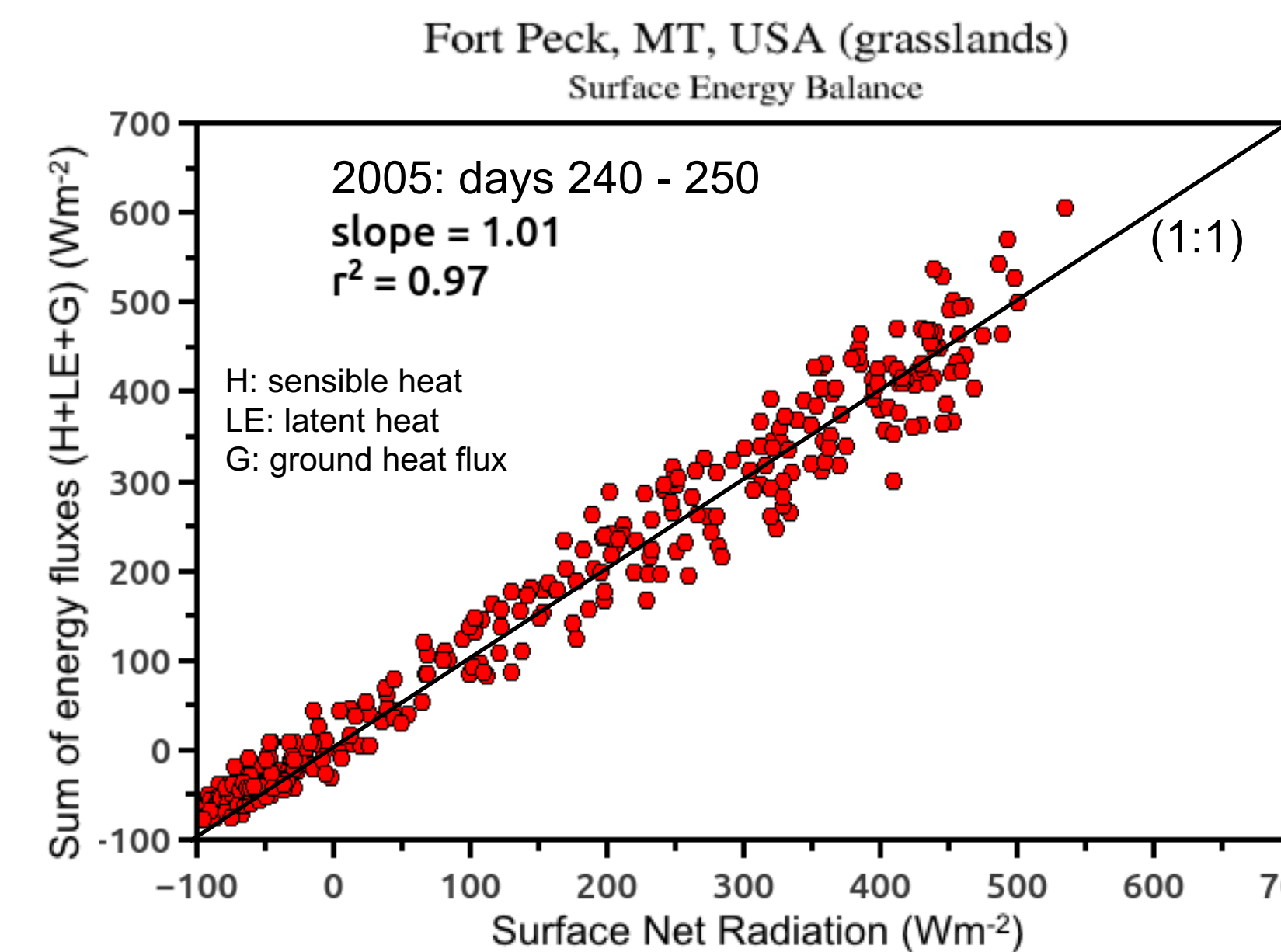
Energy exchange at Earth's surface is the key driver of weather and climate. The SEB, which is the surface net radiation plus ground and atmospheric heat fluxes, represents the primary available energy at the surface for driving atmospheric boundary layer processes. **It is essential that these processes be simulated well in numerical models.**

The existing SURFRAD Network will provide the foundation of the proposed Surface Energy Budget Network (SEBN)



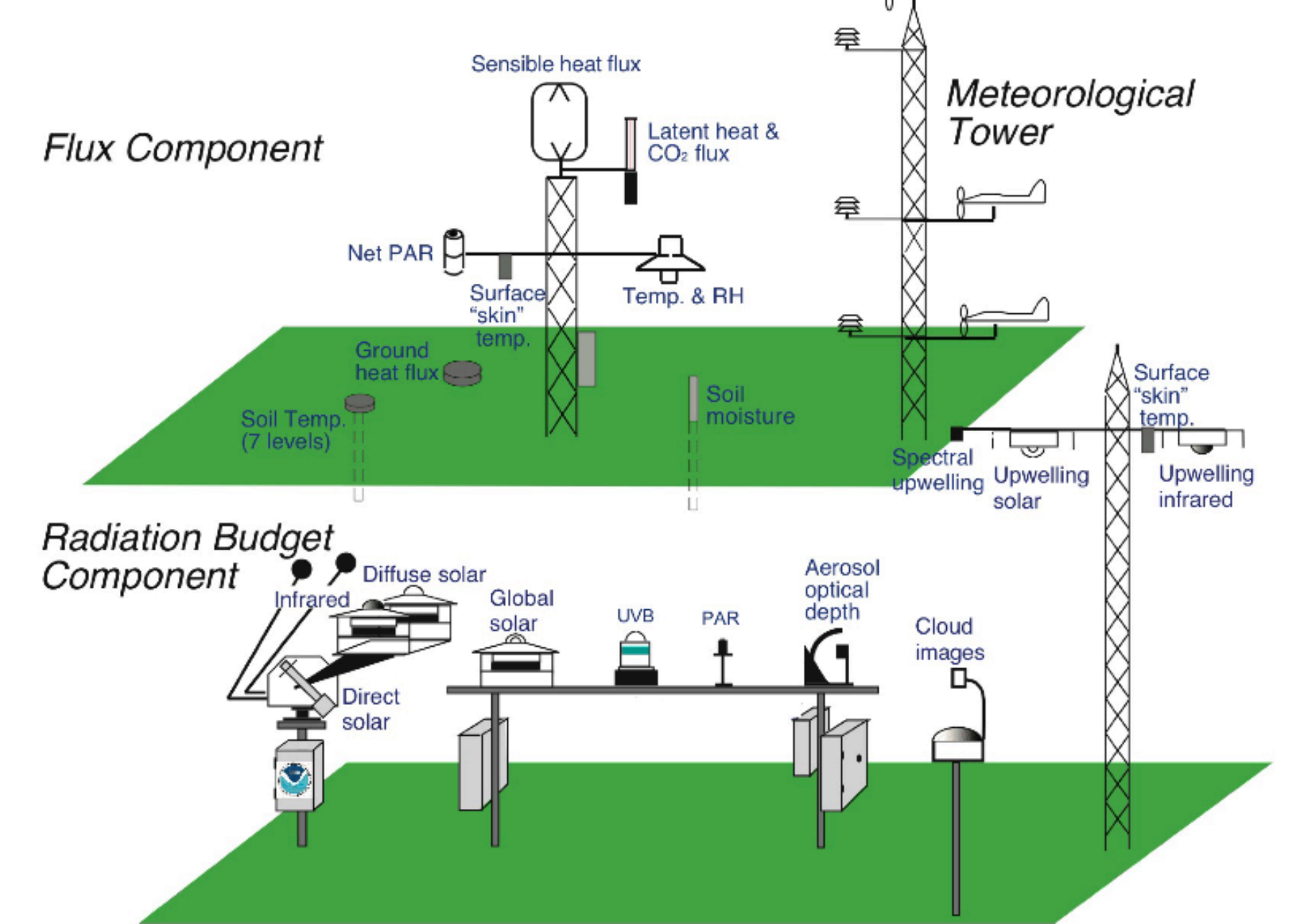
A surface energy budget network will document synergies among a wide range of weather and climate forcing parameters including surface radiation energy fluxes, and cloud and aerosol properties.

Closing the Surface Energy Budget



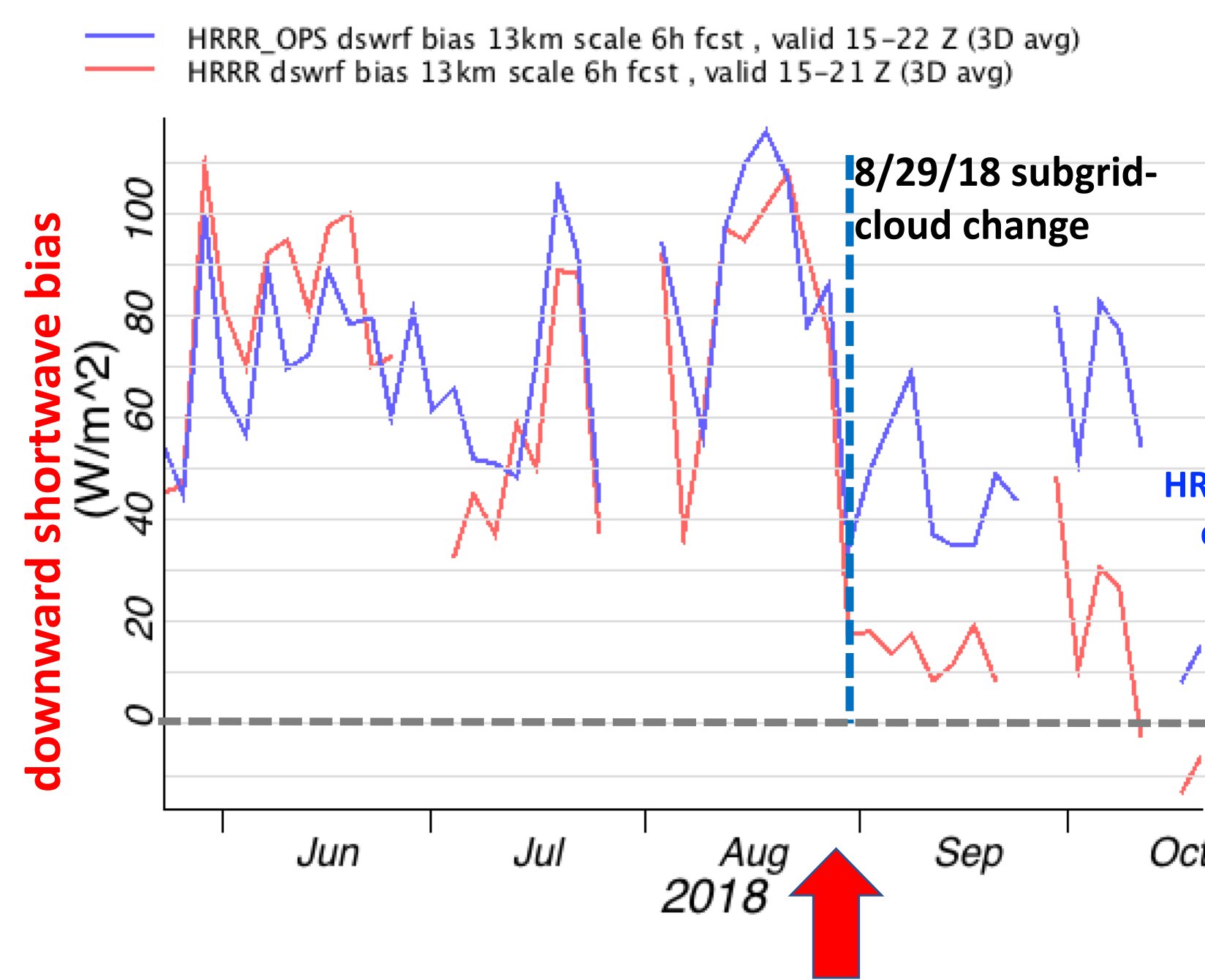
Accurate measurements of the surface radiation budget and energy fluxes should balance at a given location. The agreement shown attests to the quality of radiation and flux instruments that will be used at SEBN sites.

Prototype SEBN Station



Realized model improvements resulting from the use of SURFRAD measurements

3km HRRR results – reduced downward shortwave bias



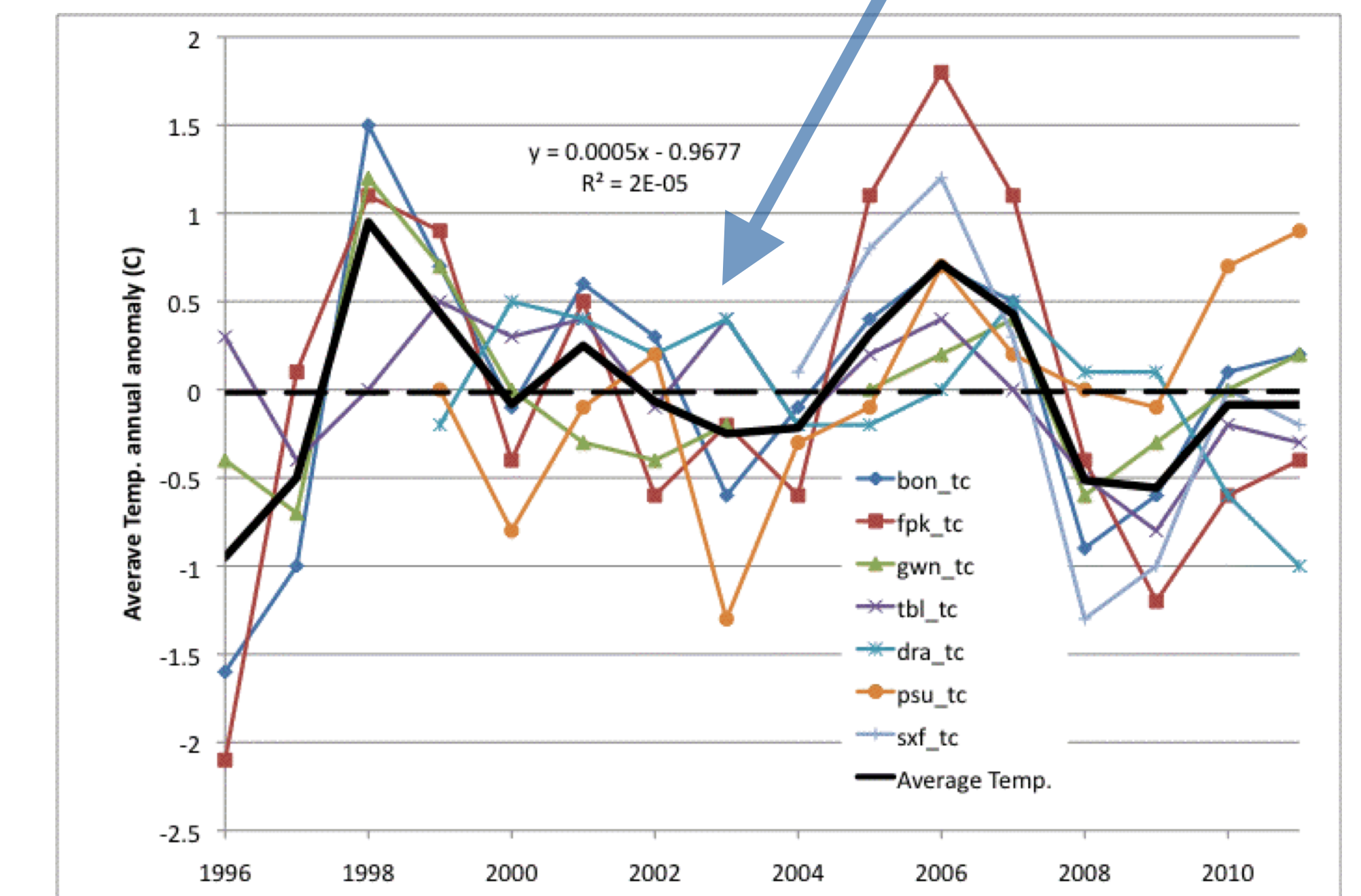
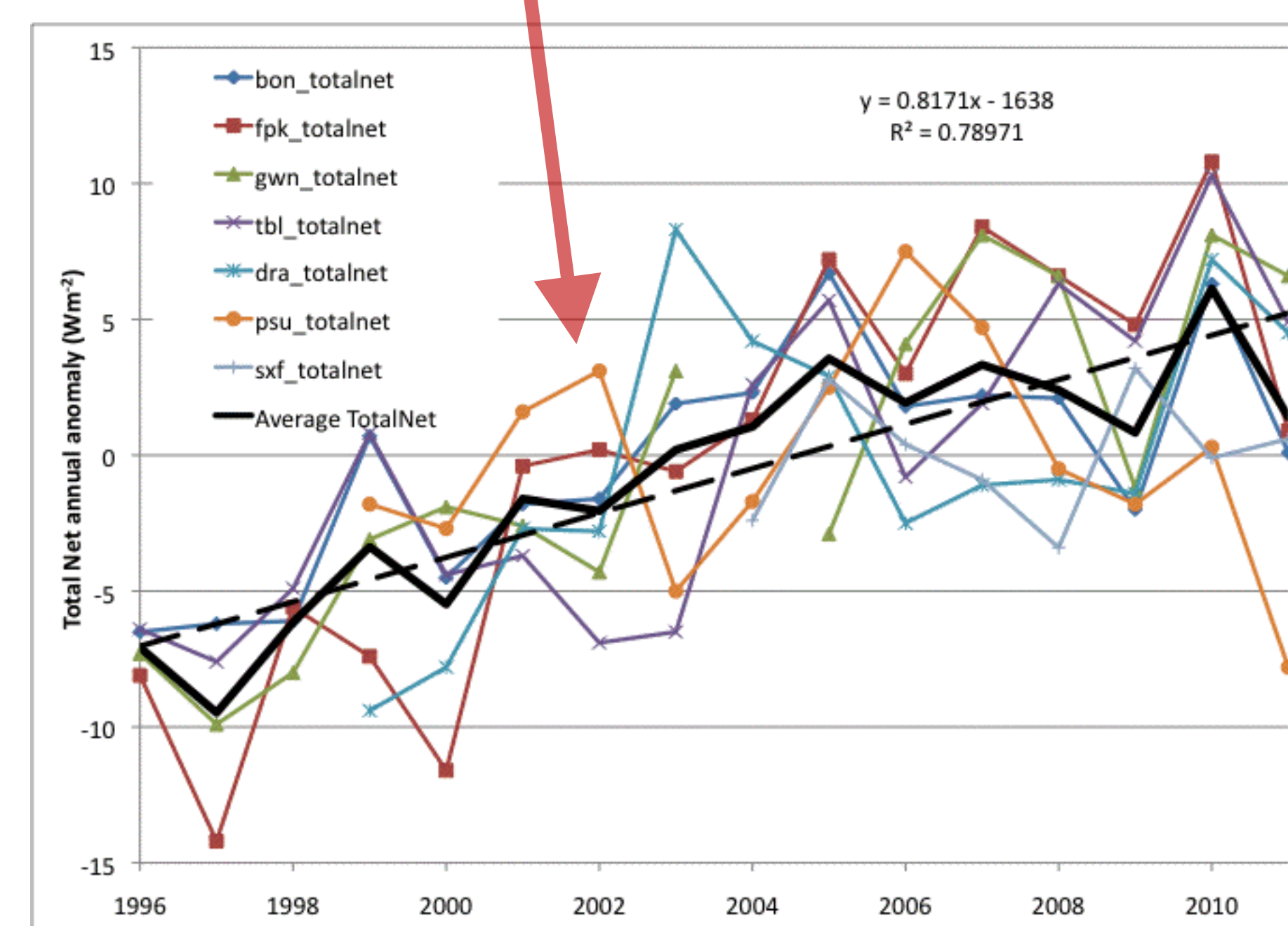
Recent work with NWP models developed by NOAA has shown that existing surface radiation budget data can be used to detect, diagnose, and improve model biases.

Why do we need collocated surface radiation budget and energy flux measurements?

Surface net radiation over the U.S. increased systematically by 12 Wm⁻² from 1996 to 2011, but the 8-m air temperature was flat

Where did the increased surface energy go?

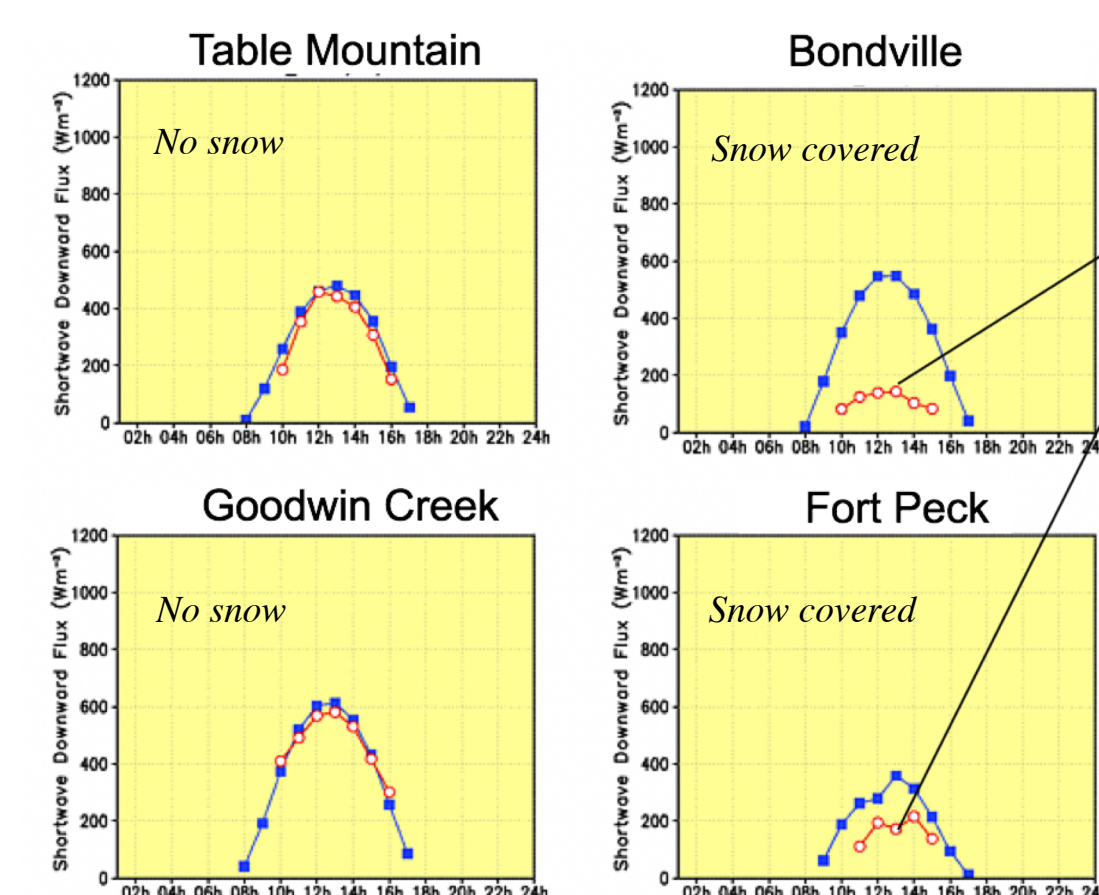
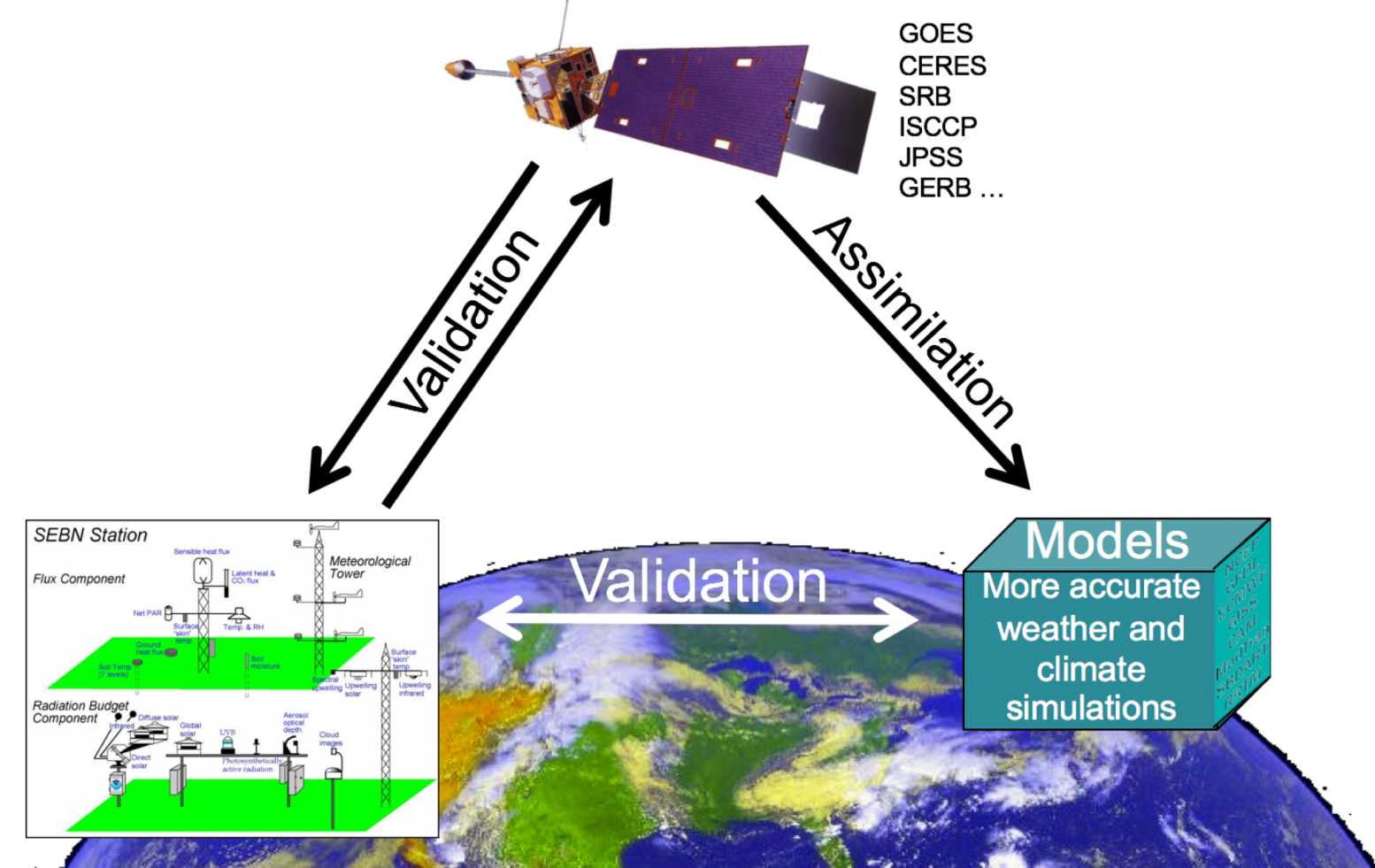
Collocated heat flux and radiation measurements would have helped to answer that question



Satellite retrieval improvements from SURFRAD observations

Satellite and model validation by SEBN is key to better models and climate assessments

SURFRAD data were key to demonstrating errors in NESDIS satellite-estimated surface radiation over snow



A Surface Energy Budget Network will:

- Help develop and improve Subseasonal to Seasonal (S2S) predictive capabilities
- Identify and reduce biases from data collected by other existing observing systems that were designed for purposes other than climate
- Provide focused reference and benchmark observations for satellite estimates of surface radiation and model predictions of the SEB
- Directly measure the effects of increasing greenhouse gases at the surface
- Extend and maintain a consistent long-term climate record
- Improve quality and quantity of climate observations, analyses, and interpretation
- Help form a physical basis as to why climate changes are occurring
- Fulfill NOAA's existing commitments to major international programs
- Provide climatologically diverse surface radiation measurements for renewable energy research