Surface Climate Reference Networks

C. Bruce Baker
ARL, Atmospheric Turbulence and Diffusion Division
ARL Laboratory Review
Silver Spring, MD
May 3-5, 2011

CLIMATE OBSERVING NETWORK GOALS

- Answering the question at mid-century: “How has the climate of the United States changed over the last 50 years?”
- Making science quality climate observations adhering to the Ten Climate Monitoring Principles of GCOS, NRC/NAS, and USGCRP
- Serving as a reference standard for other networks, while evaluating new technologies
- Leveraging knowledge and infrastructure to support new climate observing systems

A Scientific Approach for Climate Monitoring

This requires a state-of-the-art Climate Observing System with:

- Observations that define the time series of a critically important variable of the climate system.

- Observations with an accuracy traceable to known standards such that future generations can verify the quoted accuracies.

- Observations which are not compromised by interruption.

- Observations that are tested for systematic error by at least two independent techniques and preferably three.

Climate monitoring requires a long-term commitment to quality and stability.

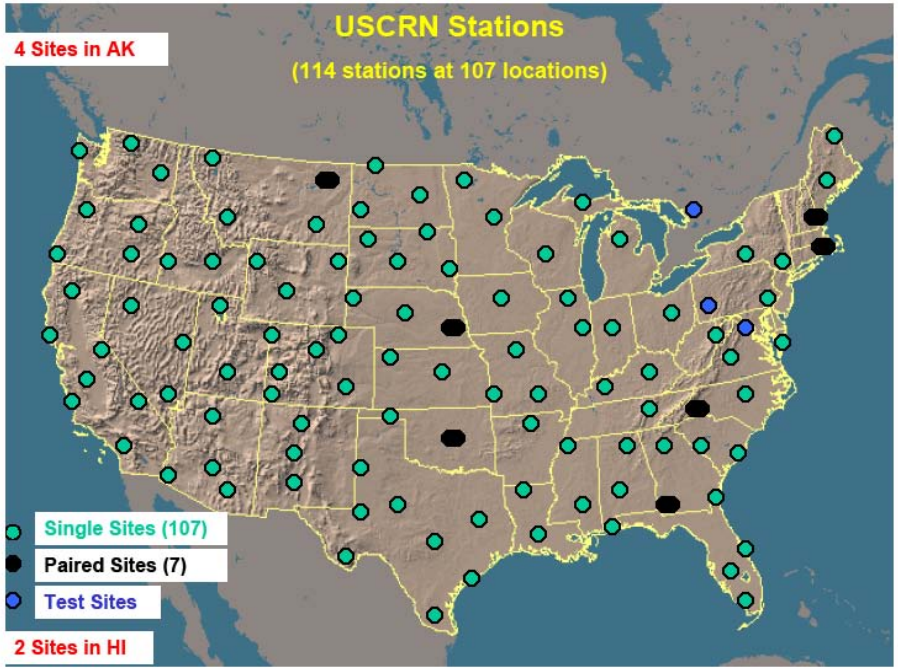
- Many of the climate-related signals are small, obscured by natural variability.
- There must be an active program of research and analysis utilizing climate data sets to ensure the data are state-of-the-art and meet requirements.
- Climate research and monitoring requires an integrated strategy of land/ocean/atmosphere observations, including both in situ and remote sensing platforms, and modeling and analysis.

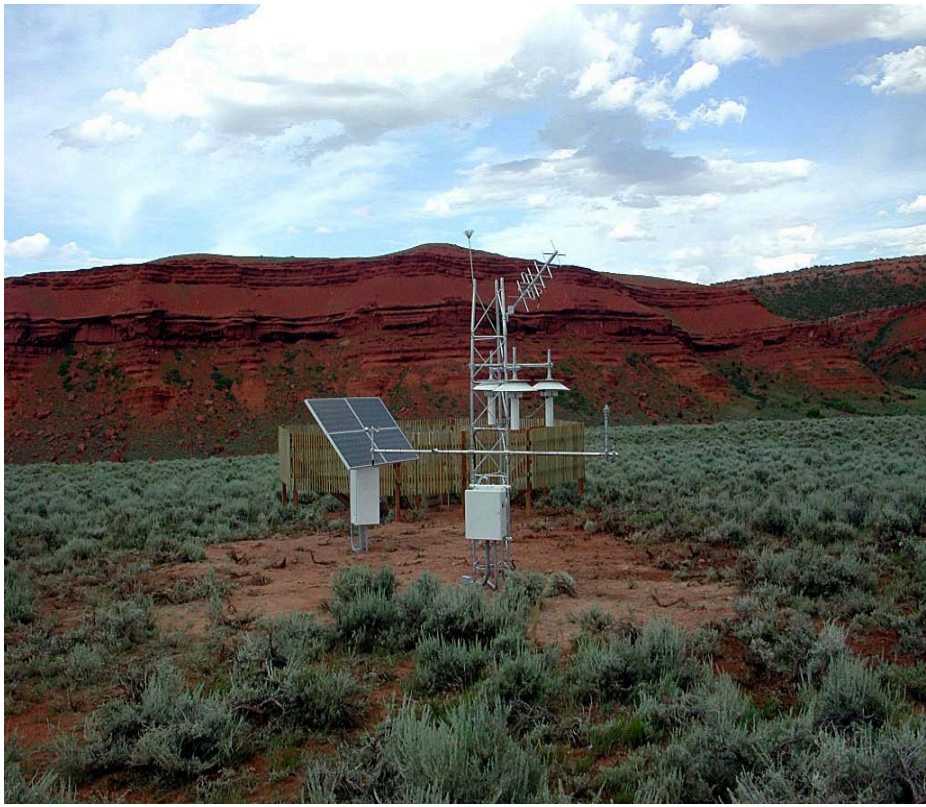
Ten Climate Monitoring Principles

- Management of Network Change
- Parallel Testing
- Metadata
- Data Quality and Continuity
- Integrated Environmental Assessment
- Historical Significance
- Complementary Data
- Climate Requirements
- Continuity of Purpose
- Data and Metadata Access

U. S. Climate Reference Network (USCRN)

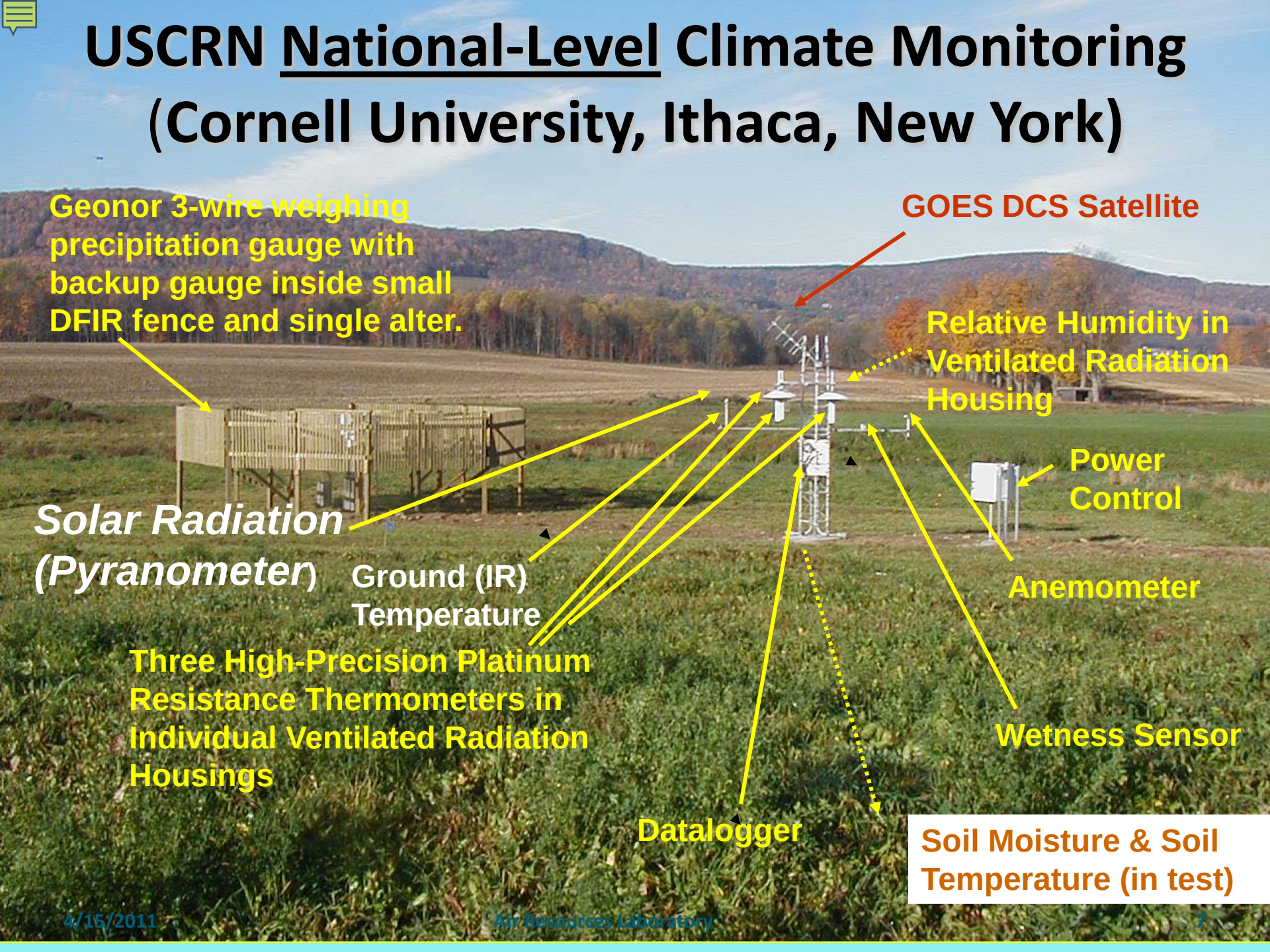
FY 08 Completed Lower 48 states
(114 sites commissioned)



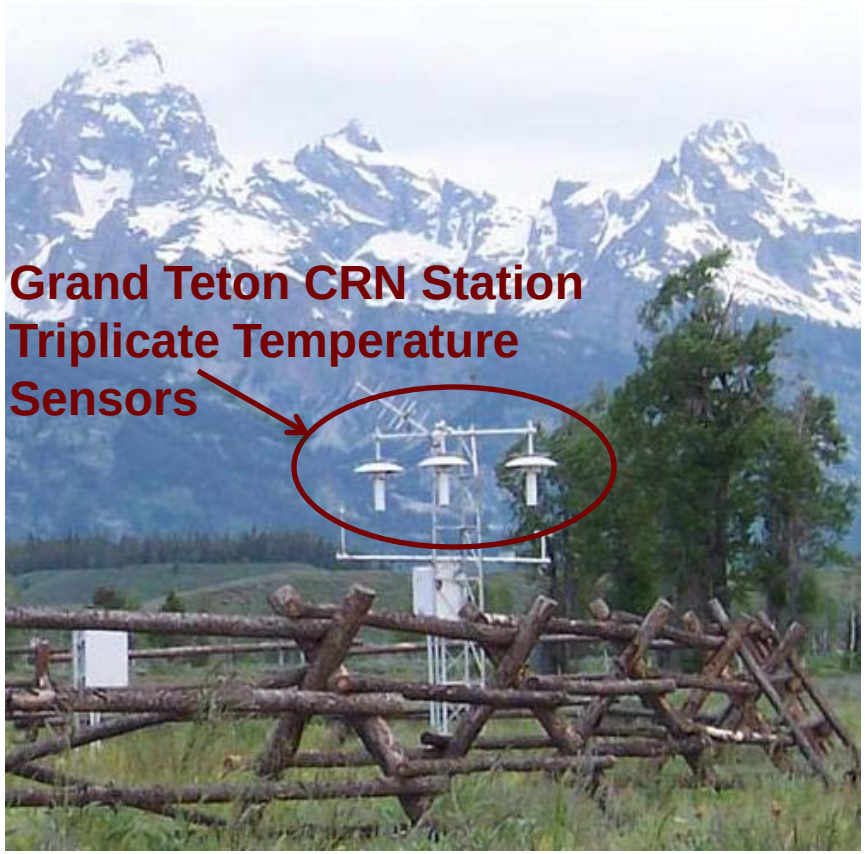


Lander, WY

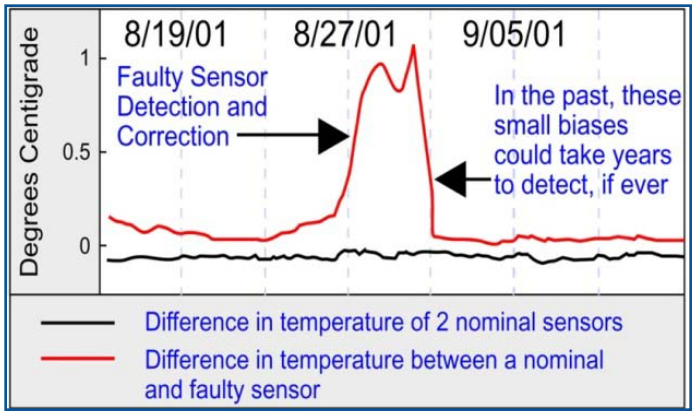
USCRN National-Level Climate Monitoring (Cornell University, Ithaca, New York)



The Basics: How USCRN Works



Primary variables are measured with triplicate configurations that allow for intercomparisons:
- 3 PRTs measure T
- 3 wires measure P



USCRN in Alaska Configuration

CRN sites (current -2)
GCOS sites (current -2
GCOS sites (proposed - 29)

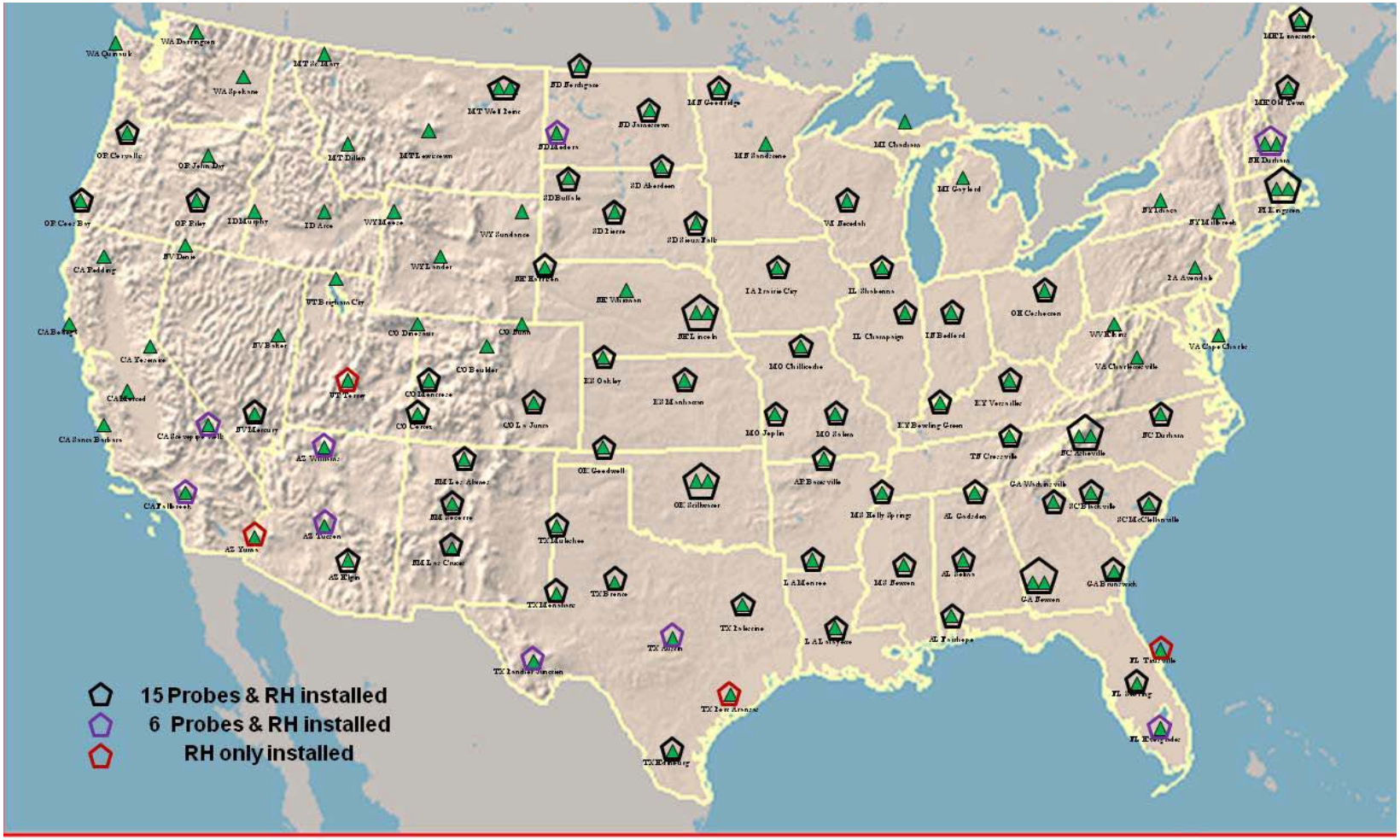
Future Directions for USCRN

- Deploy soil moisture / temperature probes and RH instruments across the USCRN network in cooperation with the National Integrated Drought Information System (NIDIS) program

- Develop new soil climate QC techniques made possible by using a triplicate configuration of probes

- Cooperate with satellite remote sensing experts and soil moisture modelers with regards to using USCRN data for calibration and/or verification

Status of Soil Moisture Temperature Sensors at USCRN Stations



U.S. Regional Climate Reference Network

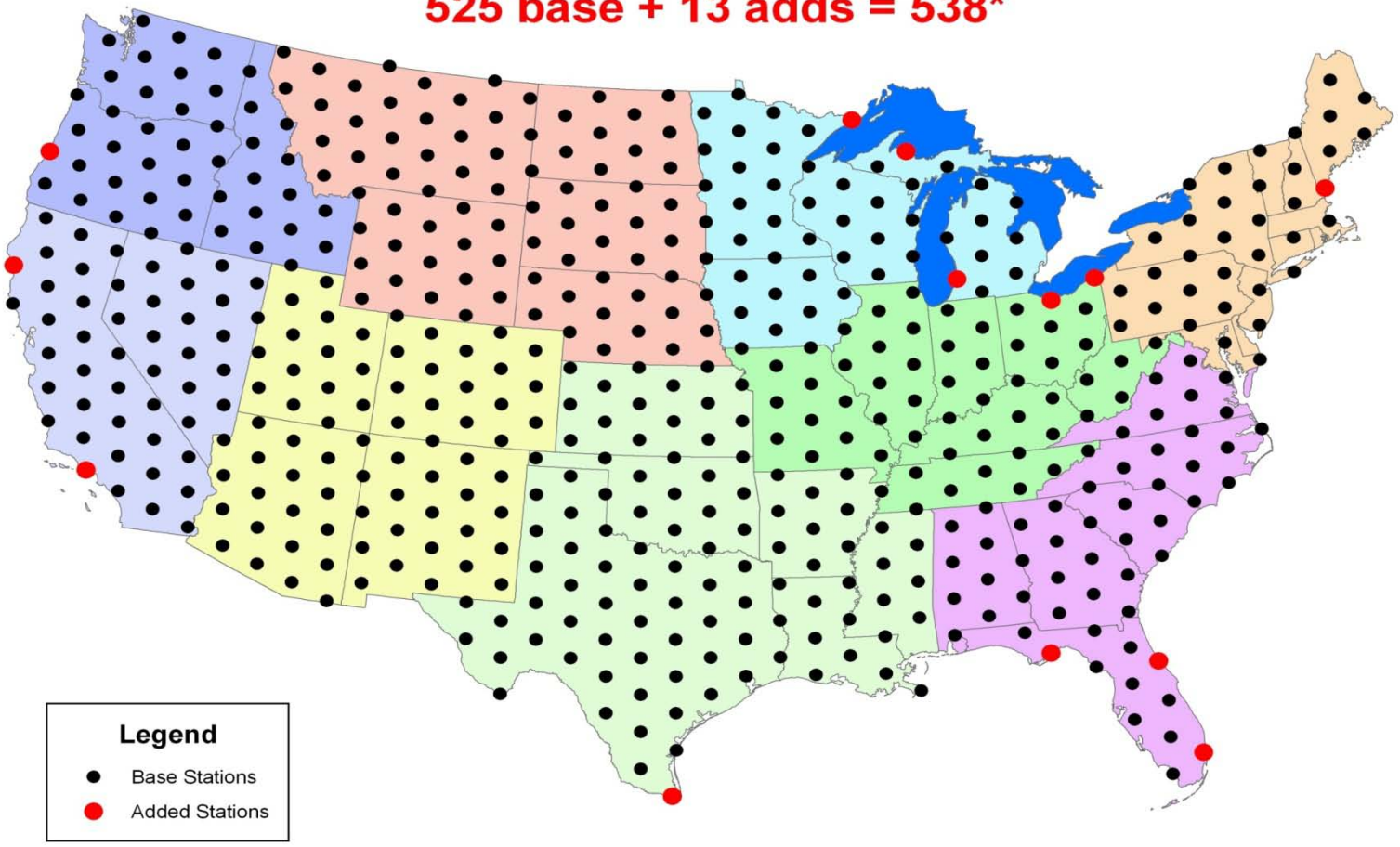
- USRCRN observing stations will provide high-quality hourly climate observations on a regional scale to all sectors of society and the economy.
- Experience gained by USCRN with the Alabama USRCRN prototypes proved very useful in assisting the full national USRCRN program
- A goal of ~500 stations for the U.S. is specified to provide sufficient spatial resolution to resolve regional climate trends in the continental U.S.

60 USRCRN Sites in Southwest, US

17 Sites in Alabama

Recommendation for Conterminous United States

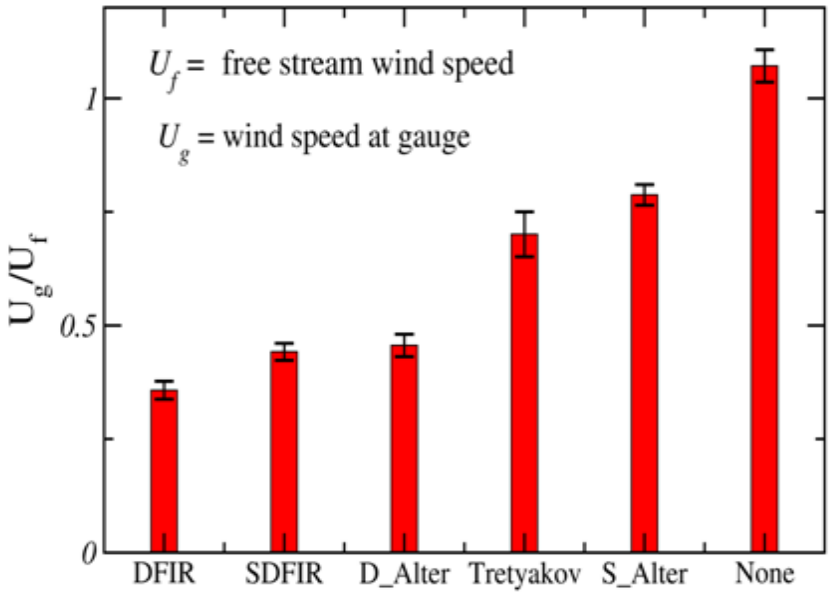
525 base + 13 adds = 538*



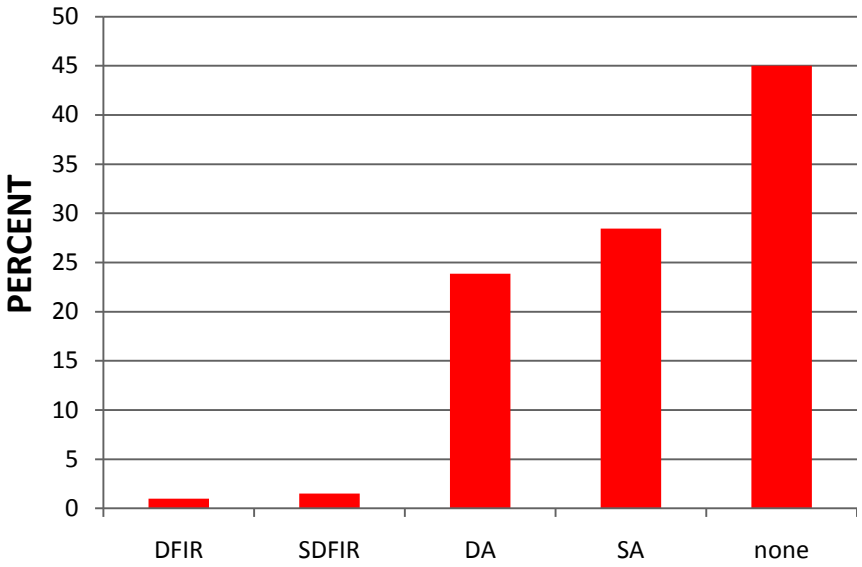
* Pending SW Adjustments

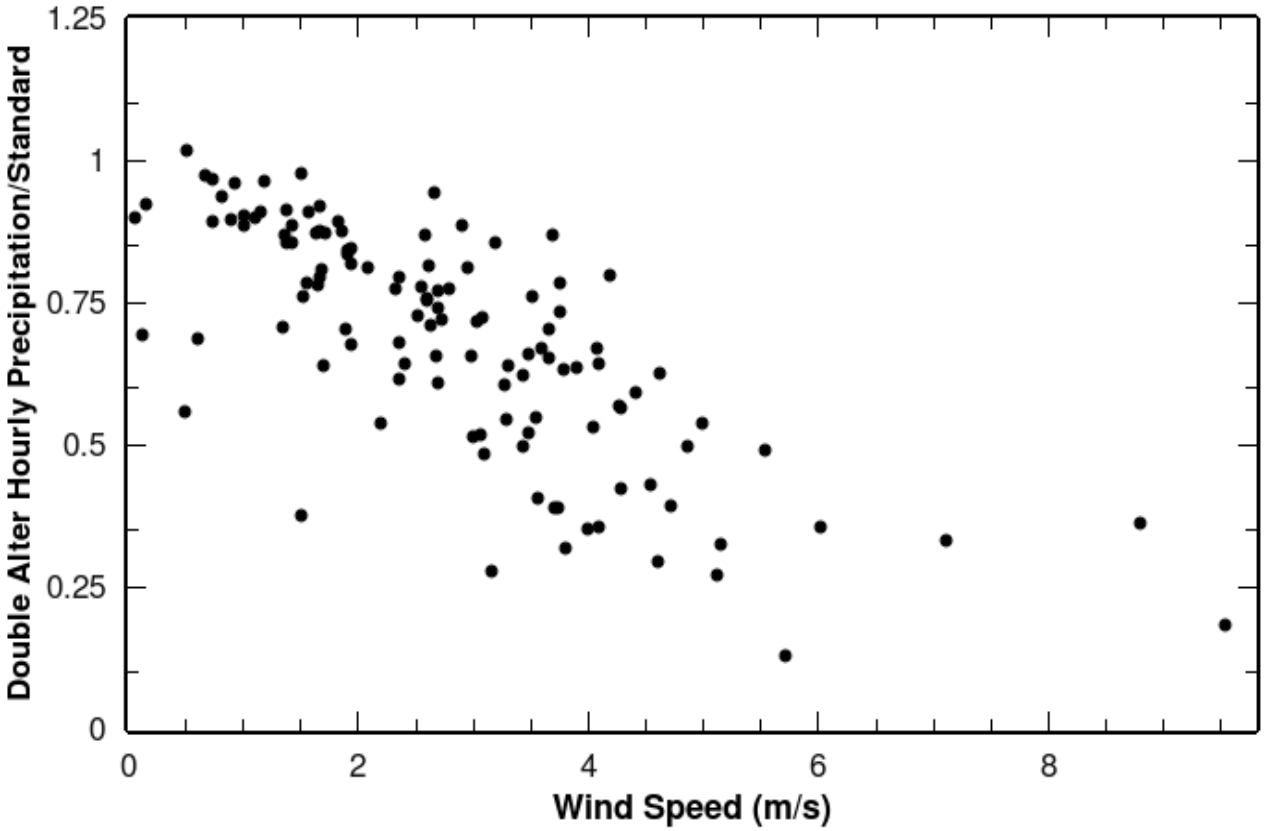

SEP 9 2009

Ratio of Windspeed at the gauge to Freestream speed



Under catch of Solid precipitation for different shields compared to the DFIR





Hourly catch ratios of solid precipitation vs. 1.5 m height wind speeds

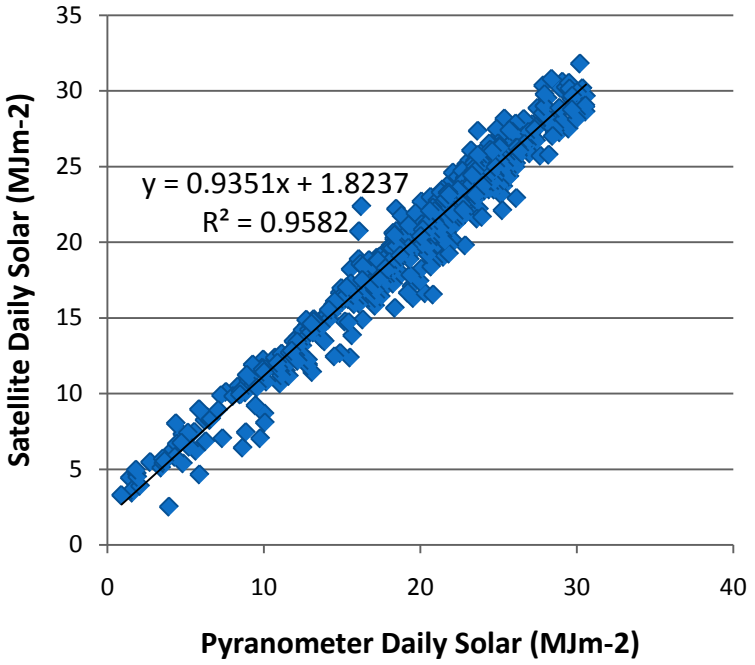
WMO Solid Precipitation Inter-Comparison Experiment 2011 - 2014

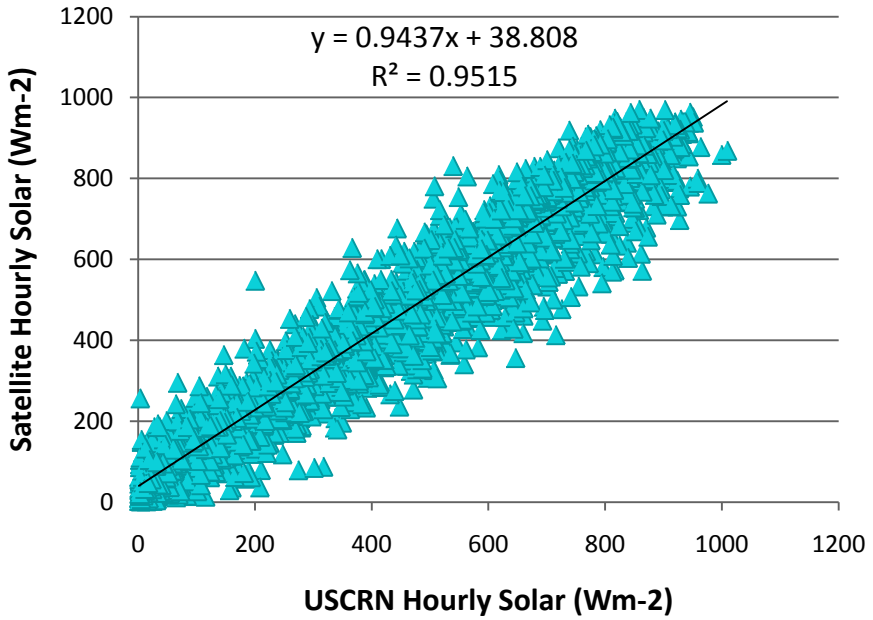
- To improve the understanding of the performance of various solid precipitation gauge/shield configuration

- Develop transfer functions between the various solid precipitation gauge configurations to improve estimates of liquid water equivalent snowfall in support of real-time applications, hydrological models and data continuity in the climate record.

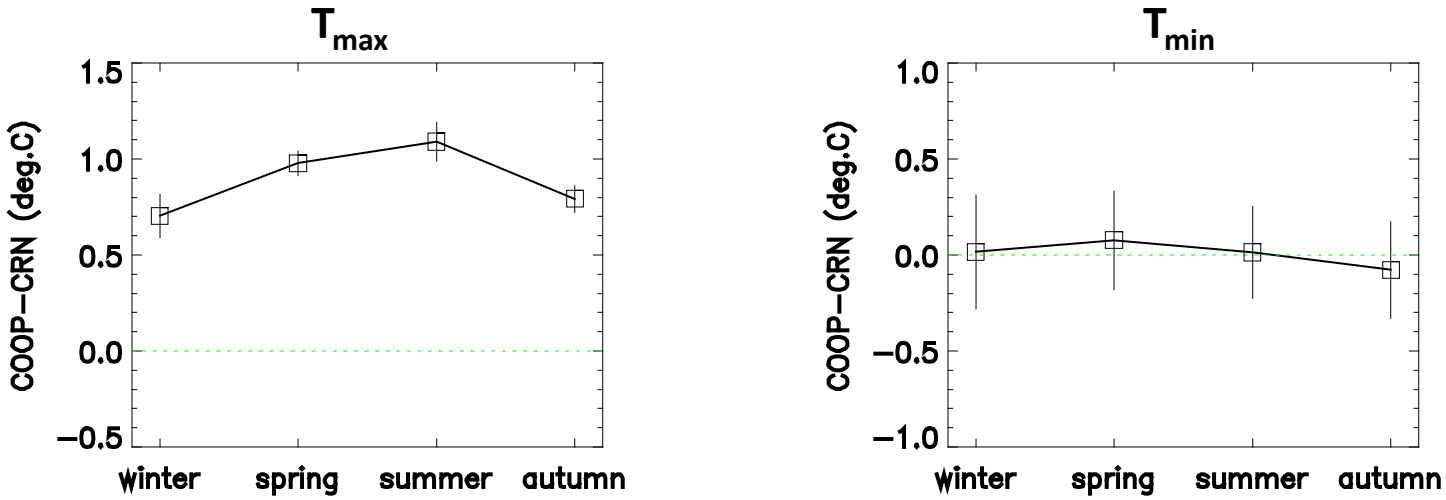
- Define a field standard for automated solid precipitation gauges.

USCRN provides satellite daily and hourly insolation estimates to calibrate the visible channel on GOES satellites via newly-developed techniques.





Seasonal Differences between COOP and CRN



T_{max} and T_{min} differences (COOP-CRN) between co-located stations (within 10 km). Error bars represent 95% confidence limits of the mean bias.

ACCOMPLISHMENTS

Scientific Conference Papers	22
Workshops	8
Journal Articles	5
Technical Reports	10

USCRN Data Receipt Rates %

FISCAL YEAR	Annual Average
2001	87.7
2002	97.0
2003	99.4
2004	99.9
2005	100.0
2006	99.3
2007	99.9
2008	99.9
2009	99.8
2010	99.8

The data receipt reflects ARL's innovative engineering and design of NOAA's climate observing systems and dedication to maintaining these systems to the highest degree possible to minimize gaps in the climate record.

COLLABORATORS

NIDIS

NCAR

NCDC

STAR Center for Satellite Applications and Research
formerly ORA — Office of Research and Applications

NASA

USDA

Harvard School of Engineering and Applied Sciences

Aurora FLIGHT SCIENCES

WMO

NSF

QUESTIONS??