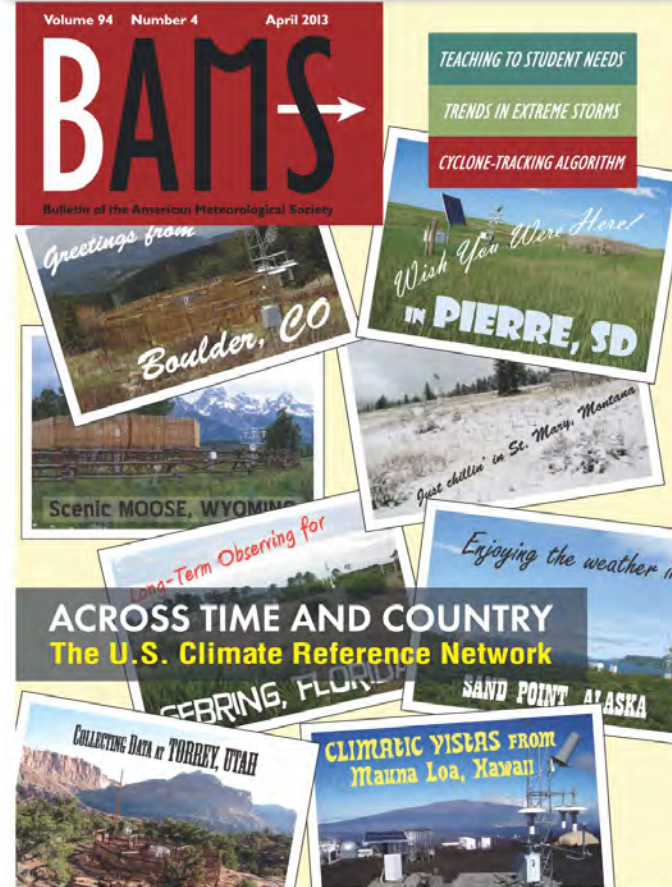


# Long Term Measurements and Science In Support of Land/Atmosphere Interactions

Diamond et al (2013)

doi: 10.1175/BAMS-D-12-00170.1

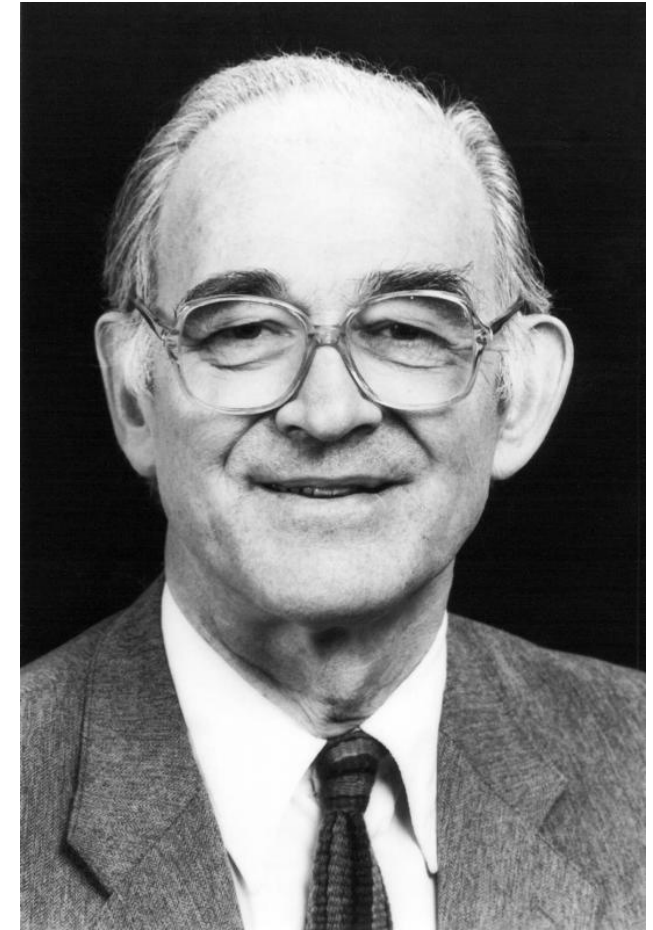


Howard J. Diamond, PhD  
NOAA Air Resources Laboratory  
March 24, 2022



# The Criticality of Sustained Observations

*“The current global observational network is declining. If this decline is not stopped we may, say, twenty years from now, be in a worse situation than today, when trying to determine to what extent and how climate is changing. We will have less capability of clarifying to what extent an ongoing climate change might be the result of human activities or be an expression of natural variability in the climate system. A continuous close observation of the climate system is an absolute requirement for dealing adequately with the climate issue.”*



The late Professor Bert Bolin, who was the Head of the Intergovernmental Panel on Climate Change, 1997.





USCRN Vision: Sustain a national climate observing network that in the future, with the highest degree of confidence, can answer the following question:

*How has the climate of the U.S. changed over the past 50-100 years?*

*Many studies have indicated that surface air temperature and precipitation are signature atmospheric variables that are a net result of boundary layer processes and interactions, and are most often used to define climate norms and assess climate trends.*



# Relevance to NOAA/OAR's Mission

## **OAR Goals (OAR Strategy Plan 2020-26):**

### **2. Detect Changes in the Ocean and Atmosphere**

**2.1** *“Sustain and optimize observation system management and use”*

### **3. Make Forecasts Better**

**3.1** *“Design tools and processes to forecast high-impact weather, water, climate, ocean, and ecosystem events”*





# History of Climate Observing Systems in the U.S.

Sn  
U.S. Arm

Diaries, logs



1800

1900

2000

2022



# USCRN - Designed to answer questions about National Air Temperature, Precipitation, Soil Temp and Moisture Changes with the Highest Confidence

- **Siting (139 stations):**

- 114 CONUS and ultimately 29-30 Alaskan stations by 2026 (23 as of now) at pristine sites; shouldn't change in >50 years - plus 2 stations in Hawaii; 1 in Tiksi, Siberia; and 1 in Ontario, Canada
- Effective national spacing of approx. 265 km (165 mi)

- **Surface observations every 5-minutes**

- Hourly transmission via GOES

- **Standards**

- Meets or Exceeds GCOS Climate Monitoring Principles
- Follows NIST calibration standards

- **Instrumentation:**

- Triple configuration air temperature and precipitation sensors; and soil measurements

- **Product and System Contributions:**

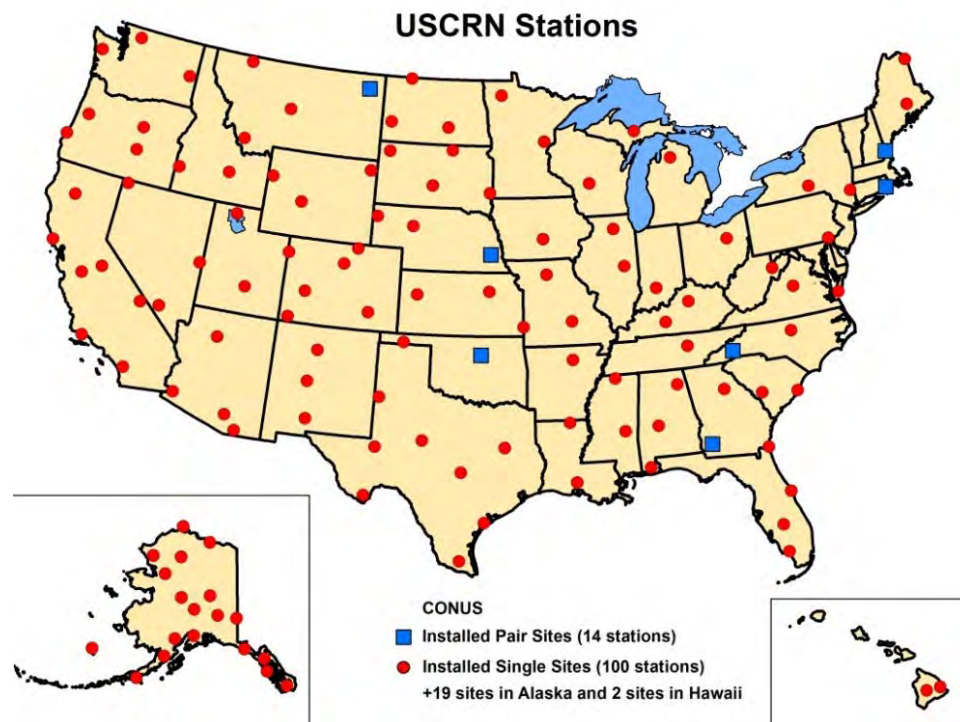
- Weekly Drought Monitor
- National Coordinated Soil Moisture Monitoring Network
- Annual State of the Climate Reports
- CPC Gridded Temperature and Precipitation Data
- 30-Year Climate Normals
- Reference Network for Regional Mesonets (e.g., National Temperature Index)
- Used by NWS Weather Forecast Offices particularly in data sparse areas (e.g., Alaska)





# USCRN Station Coverage

## CONUS – Completed in 2008



## On-Going USCRN Work in AK (2010-2026)



- 23 stations installed in AK as of Sep 2019 (blue dots)
- New stations on hold due to COVID-19
- 7 more stations to be installed from FY22-25 (yellow dots)





# USCRN Station Configuration

## Primary Measurements

- Air temperature (3 aspirated PRT's)
- Precipitation (3 vibrating wires)

## Secondary Measurements

- Solar radiation
- Relative humidity
- Land surface temperature
- Wind speed

Power: AC/DC (wind/solar)

Soil Moisture/Temperature

- 5, 10, 20, 50, and 100 cm
- 3 reps

Typical soil sensor installation



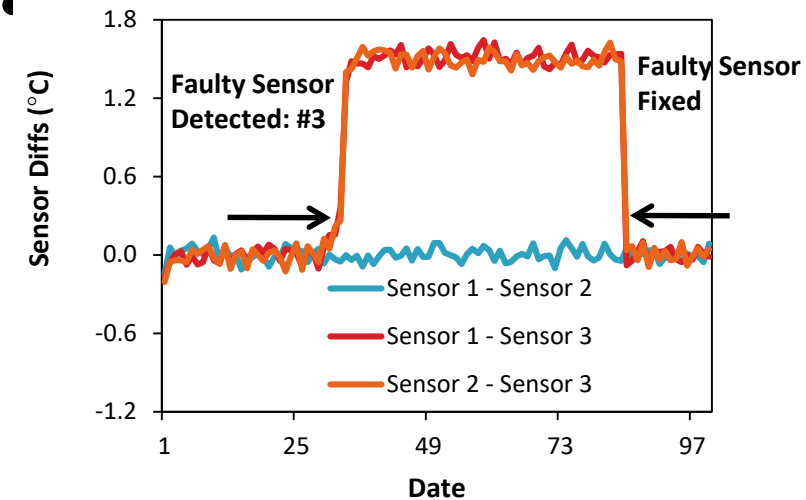


# The Basics: How USCRN Works

Grand Teton USCRN Station  
Triplicate Temperature Sensors



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



# USCRN Data Access and Reference Standard Comparison

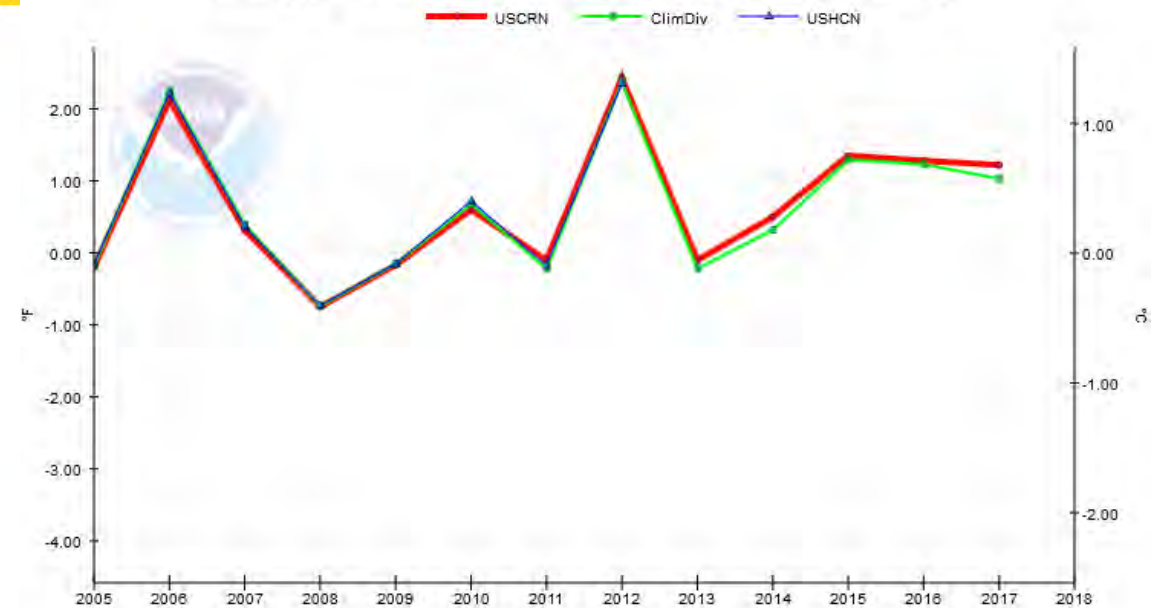


The screenshot shows the NOAA National Centers for Environmental Information website. The header includes the NOAA logo and navigation links like Home, Climate Information, Data Access, Customer Support, Contact, and About. A search bar is also present. Below the header, there's a section titled "U.S. Climate Reference Network" with a description of the network and a photo of a mountain landscape. At the bottom, there are three columns: "Program Information" with links like "USCRN Overview" and "Detailed Documentation"; "Datasets" with links like "Get Datasets" and "See Latest Observations"; and "News" with links like "Snowy in Hawaii" and "Record Hails at Lafayette, LA".

USCRN Web Site:

<https://www.ncei.noaa.gov/access/crn/>

Contiguous U.S. April - June Average Temperature Anomaly



Data Available as follows:

- Current Hourly
- Monthly
- Daily
- Hourly
- Sub-Hourly

National Temperature Index Site

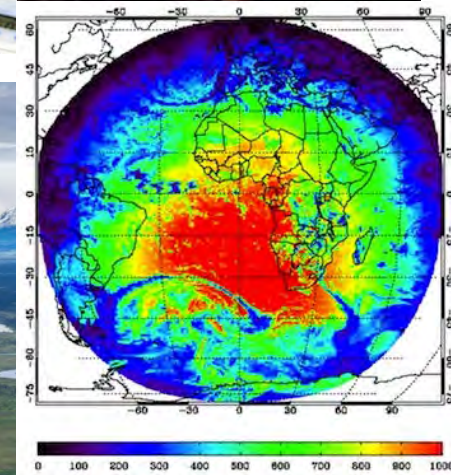
<https://www.ncdc.noaa.gov/temp-and-precip/national-temperature-index/>





# In addition to providing a Climate Reference Standard, USCRN Data are Used to:

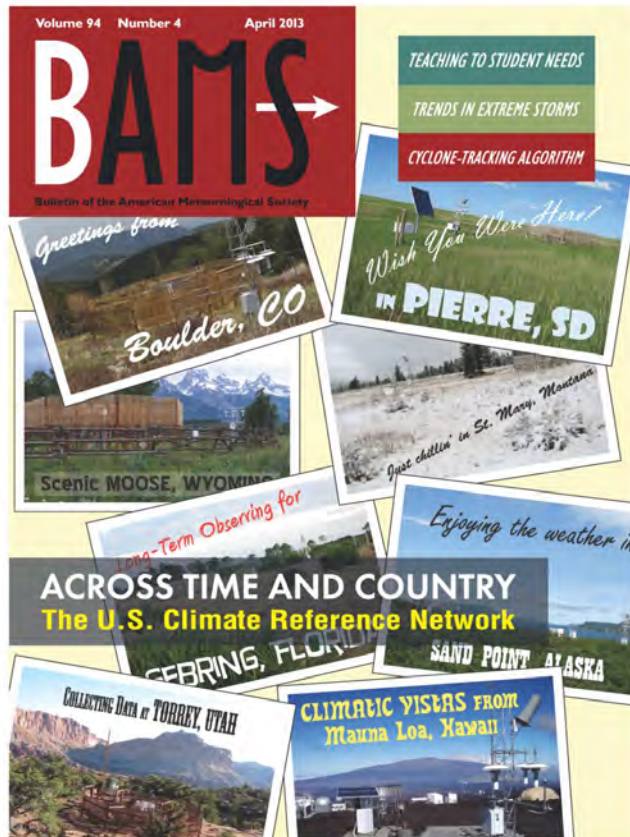
- Support forecast and warning operations at **NWS Weather Forecast Offices** as well as climate researchers from across the federal Govt and private sector
- Provide **cal/val estimates** of incoming solar irradiance from GOES satellites
- Provide the highest quality soil moisture data for the **National Coordinated Soil Moisture Monitoring Network (NCSMMN)**
- Address questions concerning **enhanced precipitation rates in a changing climate**
- Support **satellite cal/val activities for surface or “skin” temperature**
- Provide high-quality climate data to a number of sectors including: **(1) public resource managers (National Parks, Wildlife Refuges, water managers, etc.); (2) agriculture; (3) insurance and re-insurance; (4) legal; and (5) the general public**



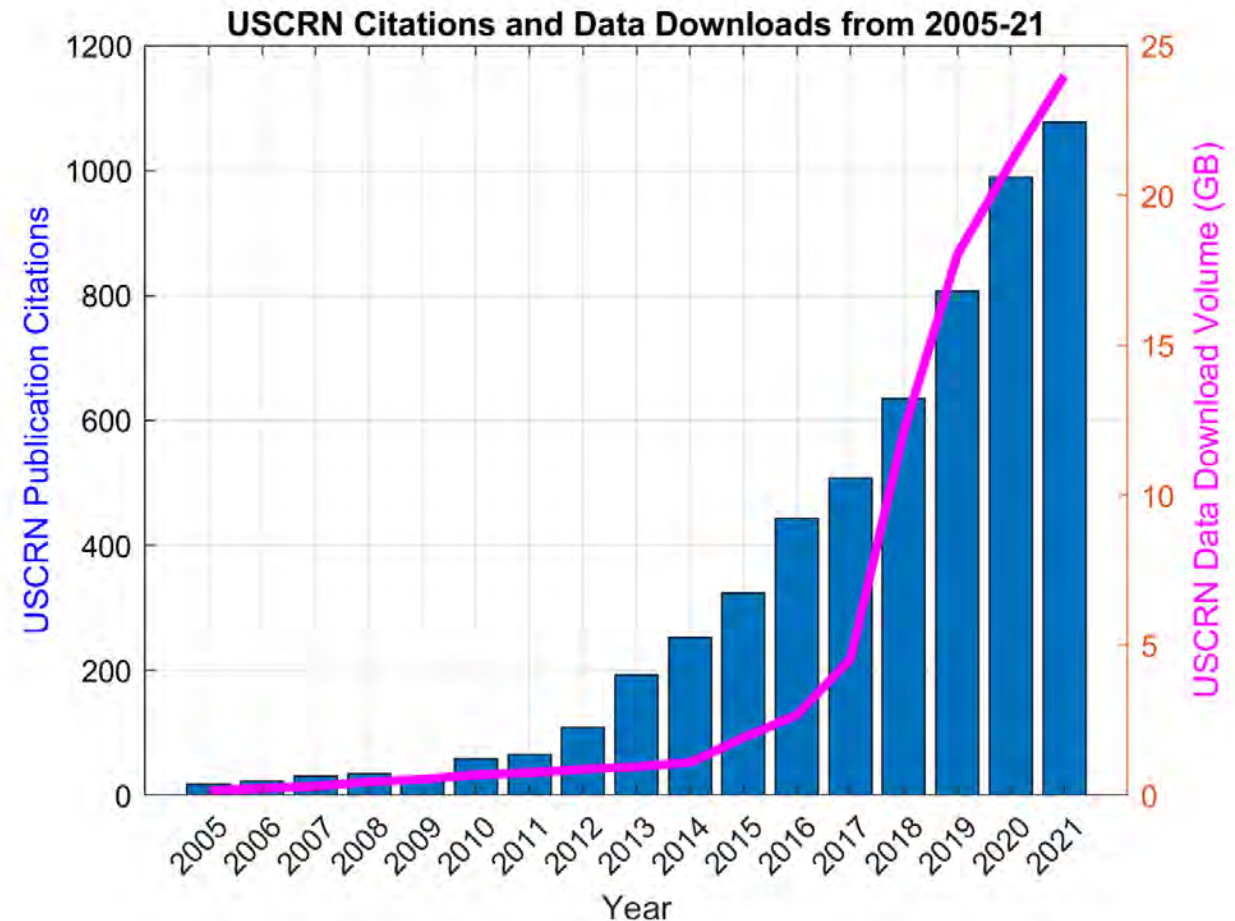
# USCRN Bibliometrics and Data Volume

Diamond et al (2013)

doi: 10.1175/BAMS-D-12-00170.1



Measure	Since 2005	Since 2016
Citations	5693	4475
h-index	37	33
I10-index	91	8





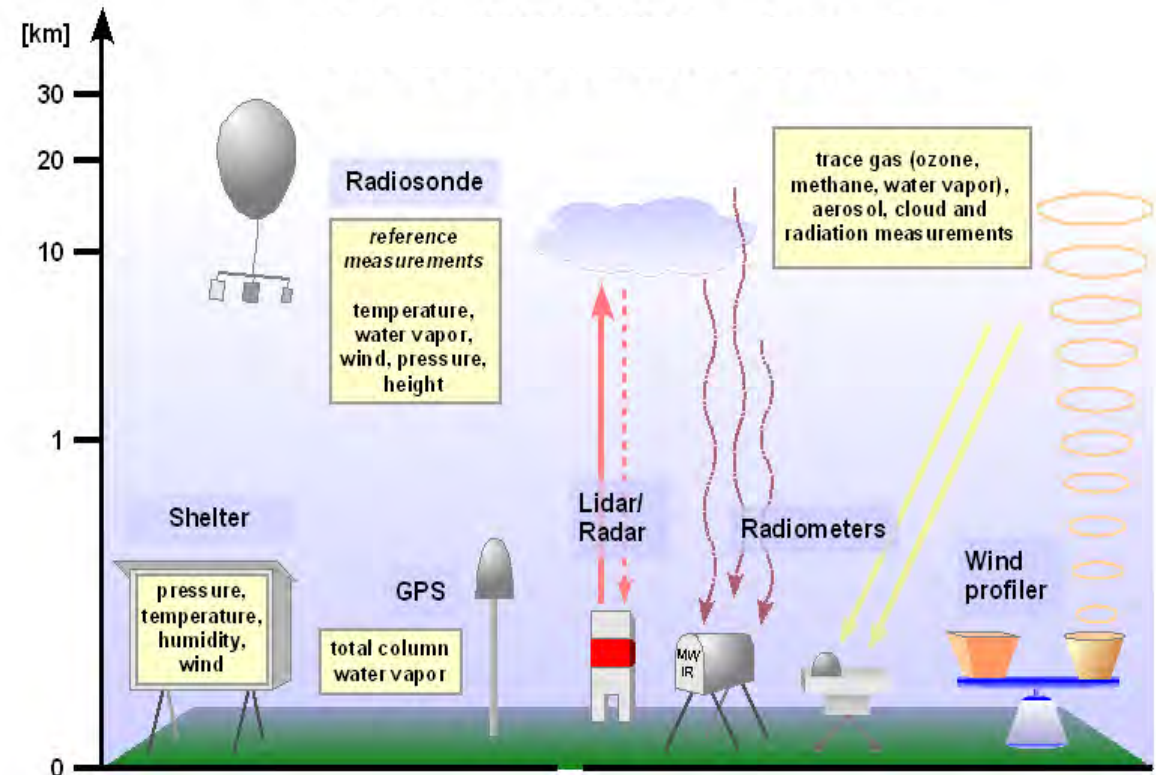
# What is GRUAN?

- Global Climate Observing System (GCOS) Reference Upper Air Network
- Origins date back to an ARL white paper by Dian Seidel in 2004; two workshops in 2005 and 2006
- First Implementation and Coordination Meeting held in Lindenberg, Germany in 2008
- Network for ground-based reference observations for climate in the upper atmosphere (UT/LS) in the frame of GCOS
- Currently 32 stations, envisaged to be a network of up to 40 sites across the globe
- See [www.gruan.org](http://www.gruan.org) for more detail



# The Goals of GRUAN

- **Maintain observations over decades**
- **Validation of satellite systems**
- **Characterize observational uncertainties**
- **Traceability to SI units or accepted standards**
- **Comprehensive metadata collection and documentation**
- **Long-term stability through managed change**
- **Validate observations through deliberate measurement redundancy**
- **Contributes to the baseline climatology work for the stratosphere by NOAA's Earth Radiation Budget Program**



**Priority 1: Water vapor, temperature, (pressure and wind)**

**Priority 2: Ozone, clouds, ...**





# Thank You – Any Questions??

## USCRN Web Site and Data Access

<https://www.ncei.noaa.gov/access/crn/> - Overall site

<https://www.ncei.noaa.gov/access/crn/qcdatasets.html> - Data site

<https://www.ncei.noaa.gov/access/crn/current-observations> - Current observations

<https://www.arl.noaa.gov/research/boundary-layer-characterization/blc-projects-climate-reference-network/> - ARL Boundary Layer

## GRUAN

<https://www.gruan.org/>

USCRN Station in Sand Point, AK  
USGS Shumagin Magnetic Observatory

