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

Diamond et al (2013)
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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.
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.

1800-1900:
- Diaries, logs
- Smithsonian Network
- U.S. Army Forts
- U.S. Signal Corps

1900:
- Cooperative Observer Program Network & U.S. Historical Climatology Network Subset

2000:
- Attempts to modernize COOP

2022:
- USCRN
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 Hawai’i; 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

USCRN Stations

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

Soil Moisture/Temperature
- 5, 10, 20, 50, and 100 cm
- 3 reps

Power: AC/DC (wind/solar)
The Basics: How USCRN Works

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

Grand Teton USCRN Station
Triplicate Temperature Sensors

Faulty Sensor Detected: #3
Faulty Sensor Fixed

Sensor Diffs (°C)

Date

Sensor 1 - Sensor 2
Sensor 1 - Sensor 3
Sensor 2 - Sensor 3

Faulty Sensor Detected: #3
Faulty Sensor Fixed
USCRN Data Access and Reference Standard Comparison

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
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

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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 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

GRUAN
https://www.gruan.org/

USCRN Station in Sand Point, AK
USGS Shumagin Magnetic Observatory