

Lessons learned from the operation of the United States Climate Reference Network at high elevations and/or in severe environments

Pavel Groisman

UCAR Project Scientist at NOAA National Climatic Data Center, Asheville, North Carolina, USA

Michael Palecki

NOAA National Climatic Data Center, Asheville, North Carolina, USA

Climate Reference Network. The U.S. Climate Reference Network (CRN) stations are designed to yield high quality and continuous in situ climate observations at highly stable sites for the next 50 years, without the need for frequent human intervention. The overall goal of the Network design is to secure reliable and precise information about climate change, focusing on temperature and precipitation, but also measuring surface air humidity, soil moisture, soil temperature, wind and solar and infrared radiation with near-real time monitoring and adequate spatial coverage. Currently such coverage has been secured for the conterminous United States and efforts are under way to expand this type of network to Alaska, Canada, and the Russian Arctic. The CRN approach (precision requirements, triplication of major sensors, quality control procedures) has been adopted by the Global Climate Observing System Program as a recommended standard for the next generation of the climate monitoring systems. In particular, innovative use of systems that produce three independent measurements of temperature and precipitation simultaneously at each site, rigorous cross-checking quality control, calibration tied to reference standards, and timely maintenance procedures have been secured throughout the Network (NOAA/NESDIS National Climatic Data Center, 2008: The United States. Climate Reference Network (USCRN) Annual Report for Fiscal Year 2008. 24 pp. Available on line from http://www1.ncdc.noaa.gov/pub/data/uscrn/documentation/research/FY08_USCRN_Annual_Report.pdf). As part of the CRN program, several stations were installed at high altitude locations across the United States. Seven of them are located above 2,000 m in elevation, including stations at Mauna Loa, Hawaii (3407 m), and at Niwot Ridge above Boulder, Colorado (2996 m). Moreover, a broad range of CRN stations are located in places with extreme winter environments, including Alaska. A number of these stations in extreme physical environments have been operating for 4-6 years. These stations (while some of them being at lower altitudes) have been subject to extreme cold (-50°C at Barrow, Alaska) and heavy precipitation (4700 mm year^{-1} at Quinault, Washington State). Currently, a further CRN expansion into a harsh environment is under way. The work is near completion to install a CRN station in Tiksi, the Russian Arctic, at 72°N and a broad network of 30 CRN stations will cover the entire State of Alaska in the next five years.

Challenges of climate monitoring in harsh environment and the crn experience in addressing harsh environment problems. The need for climate change monitoring in harsh environments (including high elevations) is paramount because changes in these regions are frequently the largest globally and/or may cause disasters downstream (e.g., landslides). Low temperatures, high radiation, strong winds, icing, stepwise weather changes, and difficulty to quickly reach and fix/replace the malfunctioning instrumentation impose strong challenges to the robust operation of the monitoring system. In our presentation, the function of the CRN stations under extreme weather conditions will be examined, mitigation procedures used to secure an uninterrupted data flow will be described, and preliminary climate analyses for these stations will be discussed. Our conclusion is that CRN observations are usually of very high quality in these challenging environments and that the CRN model may be useful for gathering accurate climate observations in extreme environments likely to be encountered in high mountain regions. Currently being spread across North America and the Arctic, the CRN approach is recommended for use in other regions of the world with harsh environment such as Eurasia and South America. However, it has not yet been tested in Antarctic and/or the highest mountainous ranges such as Himalayas.

Corresponding Author:

Name: Pavel Groisman

Organization: University Corporation for Atmospheric Research

Address: National Climatic Data Center,
Federal Building, 151 Patton Avenue
Asheville, NC 28801
USA

Email Address: Pasha.Groisman@noaa.gov