Air Resources Laboratory

Climate Variability and Change Analysis Research

What We Do

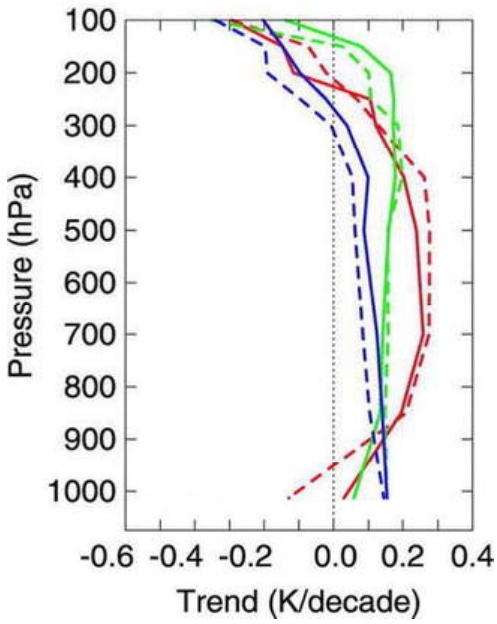
The Air Resources Laboratory (ARL) provides essential information and tools for decision-makers to understand how and why climate has changed and what changes might occur in the future. One component of this research is Climate Variability and Change Analysis. This research was initiated in the 1970s and is one of the longest-running observational climate research activities in the National Oceanic and Atmospheric Administration (NOAA).

ARL's Climate Variability and Change Analysis involves study of daily to multi-decadal atmospheric variations measured by many types of climate observation systems. One challenge is incorporating archived historical weather observations that were not originally designed or conducted with climate change research in mind. Consequently, significant effort is directed toward understanding the observations and identifying any artificial signals that might mask or imitate true signals of climate variability.

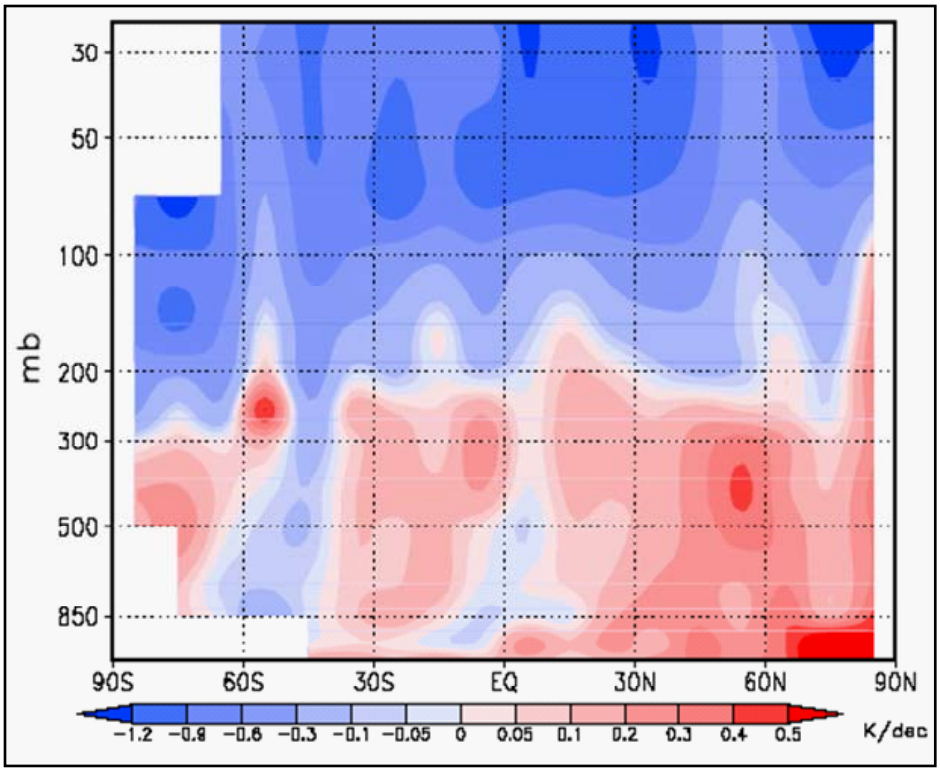
While climate data come from many sources, ARL scientists are internationally recognized leaders in analyzing radiosonde data—air temperature, humidity, and wind data collected by a balloon-borne instrument with radio transmitting capabilities. ARL's radiosonde research has led to methods for identifying data problems and producing new, improved datasets that remove artificial, non-physical signals from climate observations.

These new datasets allow more confident estimations of climate trends and more complete characterization of the uncertainty of those estimates. Through collaboration with climate modeling groups, ARL datasets are used to evaluate global climate models. ARL data products—such as global and national upper-air temperature and humidity, heat waves, ozone concentrations, cloudiness, and special features including the planetary boundary layer (the air layer closest to and most influenced by the ground) and the tropopause (the boundary

This Finnish postage stamp honoring the World Meteorological Organization shows a radiosonde (weather balloon) launch. Radiosondes have been in use around the world for more than 50 years and provide data on upper-air temperature, humidity and winds. (Image: D. Seidel, NOAA/ARL)



Changes in radiosonde instruments and observing practices can have a significant impact on the climate record. ARL scientists produce adjusted data sets that remove such artificial, non-physical signals from climate observations. Shown here are vertical profiles of 1959-1997 temperature trends in unadjusted (dashed) and adjusted (solid) data, for the Tropics (green), Northern Hemisphere Extratropics (blue) and Southern Hemisphere Extratropics (red) at different atmospheric pressures (hPa). Adjustments tend to enhance upper tropospheric warming. These methods help better quantify past climate changes and their uncertainty, to increase confidence in identifying causes of climate change. (Journal of Climate; Lanzante, Klein and Seidel, 2005)



The vertical and horizontal structure of atmospheric temperature changes over time is one of the key indicators of the causes of climate change. Shown here is the stratospheric cooling (blue) and tropospheric warming (red) trend over the period 1979-2004 (in Kelvin per decade) for latitudes from 90 degrees south to 90 degress north (x-axis) and altitudes from the surface to 30 millibars of pressure (y-axis) obtained from Radiosonde Atmospheric Temperature Products for Assessing Climate Change (RATPAC), a NOAA/ARL climate data product. (Journal of Geophysical Research, Free et al., 2005)

between the tropospehere and the stratosphere)—are made publicly available to the scientific community and others through various data centers, most notably NOAA's National Climatic Data Center.

Climate change research involves identifying trends that cannot be explained by known sources of natural climate variability, or by observational uncertainty. Identifying corroborating evidence for a given climate trend helps to increase confidence of a detected signal.

Why It Is Important

ARL's Climate Variability and Change Analysis Research provides essential observations and analyses for monitoring climate change and understanding why changes are occurring. This information aids in understanding the nature of the climate system and is used by scientists around the world to evaluate climate models.

For example, national and international climate scientists and decision-makers use ARL's information to understand climate trends and the need for mitigating and adapting to climate change. ARL's research has contributed to a number of climate change assessments, including the work of the Intergovernmental Panel on Climate Change, the U.S Climate Change Science Program, the World Climate Research Programme, the World Meteorological Organization, and the United Nations Environment Programme. Also, by comparing model simulations of past climate changes with observations, scientists can better assess the validity of model projections of future climate changes.

For More Information:

ARL Climate Research and Development
www.arl.noaa.gov/climate.php
Radiosonde Atmospheric Temperature Products
www.ncdc.noaa.gov/oa/climate/ratpac/index.php
U.S. Heat Stress Index Data
www.ncdc.noaa.gov/oa/climate/research/heatstress/
Air Resources Laboratory
www.arl.noaa.gov

NOAA, Air Resources Laboratory
1315 East West Highway, R/ARL
SSMC #3, Rm. 3316
Silver Spring, MD 20910
Phone: 301.713.0295 ext 100
FAX: 301.713.0119
Email: arl.webmaster@noaa.gov

Last Updated July 2009