National Oceanic & Atmospheric Administration
Air Resources Laboratory
Climate Variability and Change Analysis Research

What We Do

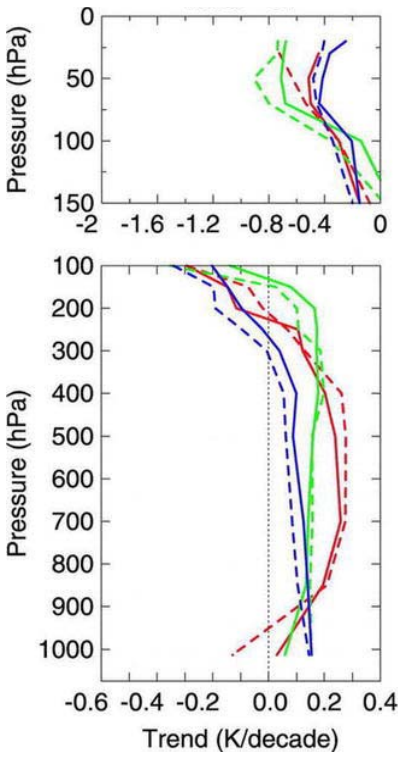
The Air Resources Laboratory (ARL) provides essential information and tools for decision-makers to understand how and why climate has changed and what changes might occur in the future. One component of this research is Climate Variability and Change Analysis. This program was initiated in the 1970's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

ARL's Climate Variability and Change research involves analysis of daily to multi-decadal atmospheric variations measured by many types of climate observation systems. A challenge to the analysis is using archived historical weather observations not designed or sited with climate change research in mind. Consequently, significant effort is directed toward understanding the observations *per se* and identifying any artificial signals that might mask, or masquerade as, true signals of climate variability.

While climate data may come from many sources, ARL scientists are internationally recognized leaders in analyzing radiosonde data—that is data on air temperature, humidity, and wind 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.

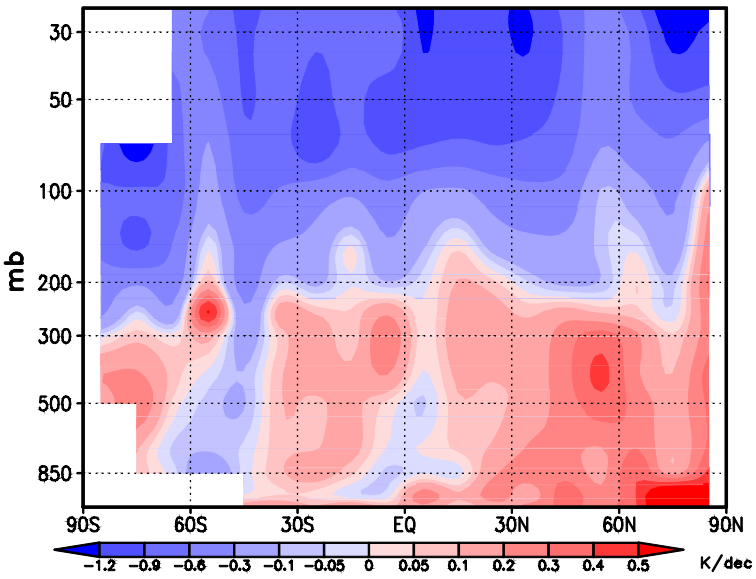
These new datasets allow more confident estimations of climate trends and more complete characterization of the uncertainty of those estimates. Through collaboration with climate modeling groups, ARL datasets are used to evaluate global climate models. ARL data products—such as global upper-air temperature, heat waves, and global ozone—are made publicly available to the scientific community and others through various data centers, most notably NOAA's National Climatic Data Center.

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)



The impact of adjusting radiosonde data to remove the effects of changes in instruments and observing practices can be significant. 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). The adjustments tend to reduce stratospheric cooling (top panel) and enhance upper tropospheric warming (bottom). These methods help better quantify past climate changes and their uncertainty, to allow more robust attribution of their causes. (Journal of Climate, Lanzante, Klein and Seidel, 2005)

The process of detecting climate change 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 increases our confidence in the detected signal.



The vertical and horizontal structure of atmospheric temperature changes is one of the key indicators of the causes of climate change. Shown here is the stratospheric cooling (blue) and tropospheric warming (red) for 1979-2004 (in degrees Celsius per decade) 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)

Why It Is Important

ARL's Climate Research and Development provides essential observations and analyses for monitoring climate changes and understanding why they are occurring. These are used by scientists around the world to evaluate climate models and to aid in understanding the nature of the climate system.

National and international climate scientists and decision-makers use this 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 U.N. Environment Program. 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
http://www.arl.noaa.gov/climate.php/
Radiosonde Atmospheric Temperature Products
http://www.ncdc.noaa.gov/oa/climate/ratpac/index.php
U.S. Heat Stress Index Data
http://www.ncdc.noaa.gov/oa/climate/research/heatstress/
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Last updated September, 2008