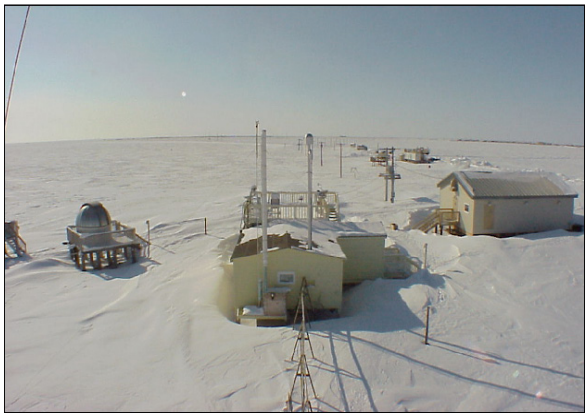
Earth System Research Laboratories
Global Monitoring Laboratory
Taking the pulse of the planet

Research Questions Driving Long-Term Monitoring of Atmospheric Composition

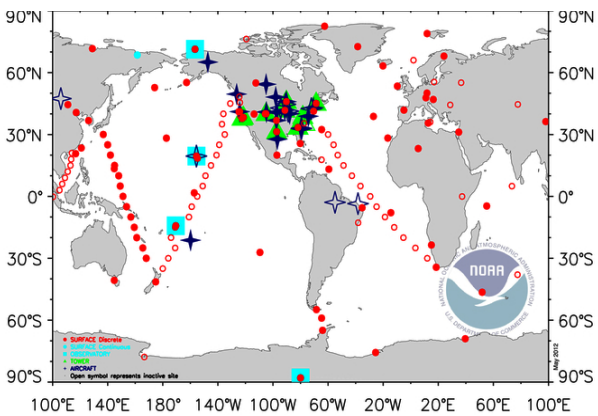


GML operates atmospheric baseline observatories in four locations, including Utqiaġvik (Barrow), Alaska. (NOAA photo)

- **Tracking Greenhouse Gases and Understanding Carbon Cycle Feedbacks** - The Global Monitoring Laboratory (GML) is a world leader in producing regional to global-scale, long-term measurement records that allows quantification of the most important drivers of climate change today.
- **Monitoring and Understanding Trends in Surface Radiation, Clouds, and Aerosols** - GML makes long-term, continuous, high frequency, climate-quality measurements of the surface radiation budget and its components at several locations across the continental U.S. and around the globe.
- **Guiding Recovery of Stratospheric Ozone** - GML's unique long-term observational records have led to improved understanding of the production and fate of stratospheric ozone and the compounds and processes that influence ozone's abundance, addressing a key element of the Clean Air Act.

What NOAA's Global Monitoring Laboratory does for the nation

- **Long-term reference networks of atmospheric composition provide measurements of:**
  - Greenhouse gases for understanding climate variability and change.
  - Stratospheric ozone, ozone-depleting gases, and UV radiation measurements to ensure timely recovery of stratospheric ozone.
  - Aerosols and black carbon, which influence radiation at Earth's surface where weather and climate begin.

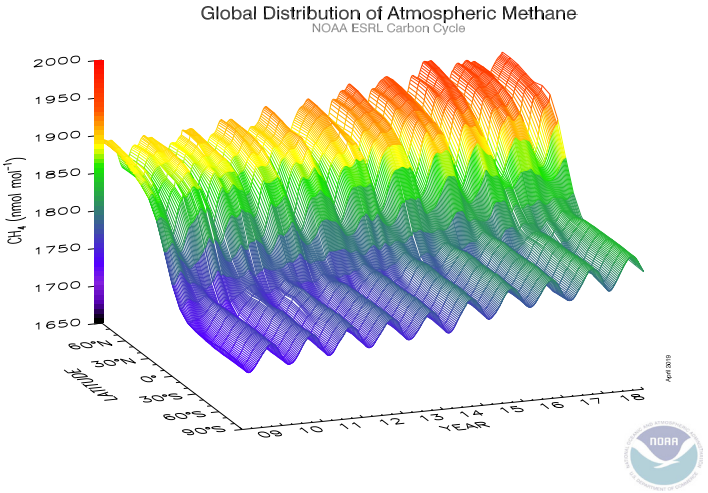


Measurement sites in GML's atmospheric carbon cycle monitoring network (NOAA image)

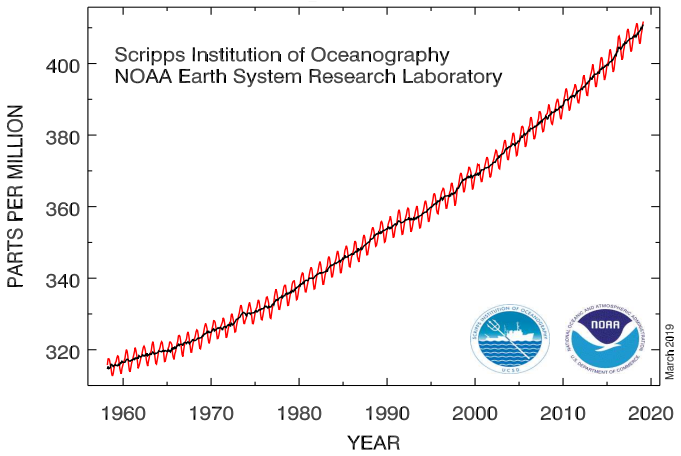
- **Improves research and modeling**
  - Reference Networks ensure quality of broader global observing systems.
  - Key information is readily available for initiating and validating models and satellite retrievals.
  - All data are available to partners and the public in near-real-time.
  - The long term records consist of calibrated data that are comprehensive and unassailable.
  - These records provide the basis for national and international assessments of the Earth System.

Recent Findings

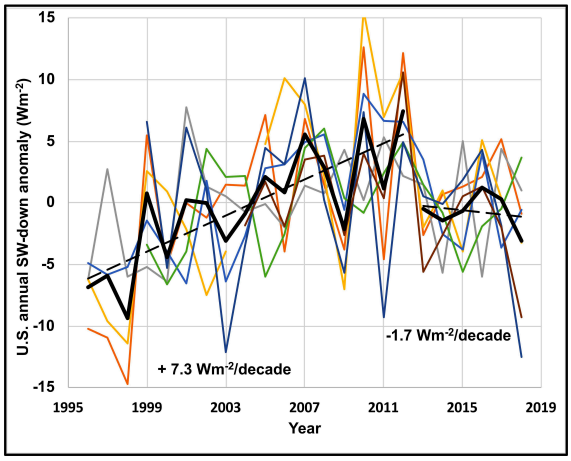
- **Greenhouse gases** are increasing in the atmosphere at unprecedented rates.
- **The ocean and land** continue to remove about half of CO_2 emitted each year despite rising emissions.
- **Ozone-depleting gases** continue to decline in the atmosphere but NOAA identified significant anomalous emissions from east Asia.
- **The ozone hole** over Antarctica appears to have stabilized and is expected to begin recovery soon, with inter-annual exceptions, (e.g., 2015).
- **Solar radiation** variability over the United States drives variability in climate/weather and influences crop yield.
- **Rising atmospheric methane** so far does not appear to be the sole result of arctic release or natural gas production.



Pole-to-pole growth rates of atmospheric methane (NOAA plot)



Atmospheric Carbon Dioxide at Mauna Loa, Hawaii (NOAA plot)



Solar radiation trend for the U.S. - the "0" horizontal line represents the national average from 1996 through 2018. Significant brightening at the surface occurred from 1996 to 2012, followed by a return to average solar for the next six years.

What's Next

- **Strengthen and enhance NOAA's Reference Network for atmospheric composition**
  - Reinforce and modernize NOAA's Atmospheric Baseline Observatories (e.g., Mauna Loa, Barrow, Samoa).
  - Expand spatial resolution to include regional, policy-relevant information.
  - Continue to support national and international observing systems with standards and quality assurance.
  - Continue to engage the scientific community in improving understanding of the Earth System.

Contact
Bryan Cole
Office of Legislative & Intergovernmental Affairs
National Oceanic & Atmospheric Administration
1315 East West Highway
Silver Sping, MD 20910-3282
Phone: 301 734-1126
Email: Bryan.Cole@noaa.gov

www.esrl.noaa.gov/gmd