Three+ Decades of Continuous Monitoring of Long-lived Halocarbons

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In the mid-1970s, the National Oceanic and Atmospheric Administration’s (NOAA) Geophysical Monitoring for Climate Change (GMCC) program made a commitment to measure and monitor trace gases including carbon dioxide, nitrous oxide, and halocarbons including chlorofluorocarbons (CFCs). Over the next three decades GMCC grew into the Global Monitoring Division (GMD), and many trace gas measurement programs evolved into separate projects with different instrumentation. We present a statistical method developed to combine measurements from independent NOAA measurement programs to construct continuous long-term global records that are used to estimate global growth rates and top down emission estimates of these important gases.

The Problem

- Lots of data!
- From many locations
- At different times
- From different measurement programs
- Low (flask) and high (in situ) frequency measurements
- Potential scale issues

Solution

Developed a statistical method to combine co-located measurements into a global data set.
- Place all data sets on a common scale
- Linearly interpolate gaps for each program
- Weighted means based on instrumental precision
- Savitski-Golay smoothing applied at each location
- Robust algorithm (works on different data sets)
- Uncertainties are estimated at all locations

Contour map of CFC-12 global history shows the predominant sources in the northern hemisphere. Mixing ratios were in growth from the 1970s to 90s, where the southern hemisphere lagged behind the north. Growth rates of ozone depleting gases such as CFC-12 have declined as countries phased out production and use.

Emissions and climate indices (AGGI and ODGI) are a couple of GMD results calculated with the combined data sets.

Global means of some of the halocarbons measured at GMD, where HCFCs and HFCs are replacement CFCs.

Conclusion

- Combined data set benefits from multiple co-located measurements, flask and in situ.
- Independent calibration scale helps to resolve differences.
- Comparison with other independent networks is improved.

- Updated semi-annually at:
  http://www.esrl.noaa.gov/gmd/hats/combined/X.html

Web

Comparison of GMD CFC-12 to an independent network, Advanced Global Atmospheric Gas Experiment (AGAGE). There is a mean difference (AGAGE-GMD) related to scale differences.

The original and combined data sets for CFC-11, CFC-12, CFC-113, CH3CCl3, CCl4, N2O and SF6 can be found on the NOAA/ESRL ftp and web sites. ftp://ftp.cmdl.noaa.gov/hats/.

Intro

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