NOAA Earth System Research Laboratory
Global Monitoring Division
Issue 4: April 2009

The Cooperative Global Air Sampling Network Newsletter

Greetings to our cooperating partners and network affiliates! Thank you for your diligent work in collecting air samples. We would like to welcome the newest addition to the global network: Cofre de Perote, Mexico.

Included with this newsletter is a six panel plot showing carbon dioxide (CO_2), $\delta^{13}C$ isotope of CO_2, methane (CH_4), carbon monoxide (CO), nitrous oxide (N_2O), and sulfur hexafluoride (SF_6) for 2000-2008 from your sampling location.

Also included is a plot showing statistics on agreement between the two simultaneously-filled air samples from your site. We have established a criterion that designates a "good" sample to be one in which the CO_2 concentrations in two flasks differ by no more than 0.5 parts per million (ppm). The network-wide average is 93% good pairs. Keep up the good work!

The Greenhouse Effect and Climate Change

Greenhouse gases, such as water vapor, CO_2, and CH_4, scatter infrared radiation emitted by the Earth's surface, which prevents heat from escaping our atmosphere. This process, known as the greenhouse effect, warms the lower stratosphere and the Earth's surface **(Figure 1**), and it is vital to the survival of many species on Earth. Without the additional heat provided by the greenhouse effect, our planet's temperature would be ~30^{o} C cooler, similar to the moon.

Although greenhouse gases have made the earth habitable, rapidly rising concentrations since the industrial revolution have brought about enhanced warming and global climate changes. With surface CO_2 concentrations rising from 280 ppm in the 1800s to over 380 ppm today, we have seen increasing land and sea temperatures, shrinking sea ice and glaciers, rising sea levels, changing precipitation patterns resulting in more floods and droughts, and endangered and threatened plant and animal species.

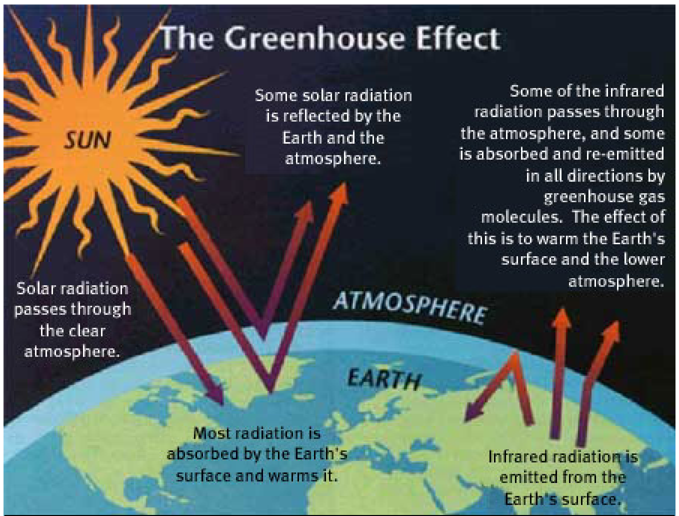

Figure 1: The basic principles of the Greenhouse Effect

Increasing CO_2 levels also cause changes in the oceans, the largest carbon sink on the planet. Large amounts of CO_2 entering the ocean change the pH of the water and can cause bleaching of coral reefs (**Picture 1**). Since coral reefs are vital to many different species, this can be devastating to marine ecosystems. Carbon-rich waters also reduce the ability of some species to maintain their hard shells. Since many of these species are on the bottom of the food chain, this affects the entire ocean system, as well as people who depend on the ocean for their livelihood.

Picture 1: Bleached coral
Source: NOAA

Since the late 1960s, NOAA has been measuring air samples from all over the world to monitor concentrations of greenhouse gases. Every sample collected helps us better understand how the gas concentrations are changing over time, where the greenhouse gases come from, and how they are removed from the atmosphere. In addition to our global surface sampling network, we have aircraft and tall tower networks in North America. These programs monitor atmospheric changes in the lower stratosphere and the troposphere, including the planetary boundary layer. Samples coming from all over the world from people like you make our monitoring program possible. We thank you for your efforts in helping to understand Earth's changing atmosphere and climate, and we encourage you to share this information with others.

Interested in learning more about GMD's projects? Check out these Web links:

GMD home page: www.esrl.noaa.gov/gmd

CCGG home page: www.esrl.noaa.gov/gmd/ccgg

Cooperative Air Sampling Network: www.esrl.noaa.gov/gmd/ccgg/flask.html

Interactive Data Visualization: www.esrl.noaa.gov/gmd/ccgg/iadv

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Sampling Tips

- **Please send back broken flasks -** most can be repaired and parts can be reused
- **Please use the flasks in the order you receive them -** this will help keep our records up to date and your site supply accurate

Detecting the Impacts of Climate Change on Arctic Methane Emissions

Arctic regions are warming at a rate twice that of the global average. While a bit more warmth in a very cold place may seem harmless or even beneficial, the warming so far is dramatically affecting the Arctic environment. The annual minimum sea ice extent in September of 2007 and 2008 were the lowest since 1979 and more than 30% below the long-term average (**Figure 2**). These changes are a strong positive feedback on climate, because snow and ice surfaces reflect solar radiation back to space but open ocean absorbs that radiation and add to Arctic warming. Arctic permafrost is also melting, which impacts Arctic infrastructure and offers another potentially strong positive climate feedback. Buildings and pipelines built decades ago on permafrost are collapsing as the permafrost beneath them melts. Also, Arctic permafrost is believed to hold an amount of carbon equivalent to that in recoverable coal reserves. In the short term, as the permafrost melts and forms lakes, some of this carbon is converted to methane and released to the atmosphere. Methane is a strong greenhouse gas and melting permafrost has the potential to add significant amounts of methane to the atmosphere.

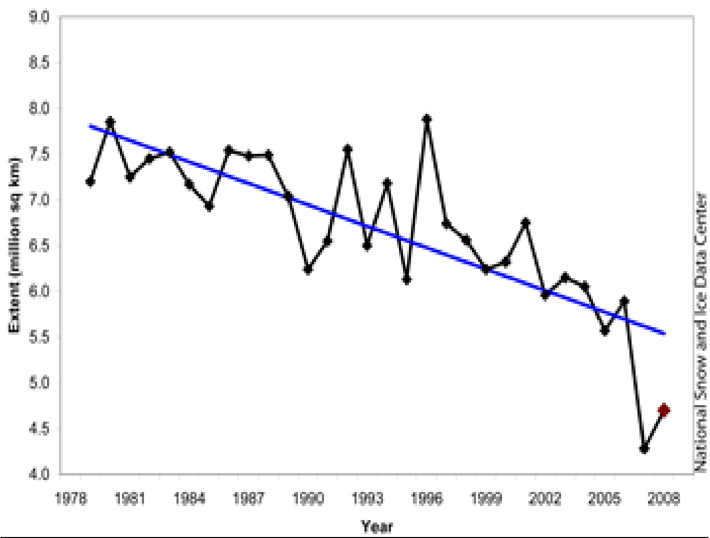

Figure 2: September Arctic sea ice extent from 1979-2008
Source: National Snow and Ice Data Center

At NOAA, we are watching the Arctic very closely for signs of increased methane emissions from melting permafrost. One way to track this is to look at CH_4 amounts in the Arctic relative to the Antarctic region, where there are virtually no methane emissions. **Figure 3** shows this difference (in blue), which we call the "inter-polar difference", or IPD, from 1984 until 2007. The IPD was increasing early in our measurement record, and then it dropped dramatically in 1992. This drop occurred when the economy of the former Soviet Union collapsed and methane emissions decreased from fossil fuel exploitation and other emissions sectors. Our understanding of this, as tested with a model (shown in red), is reasonably good. Since 1992, the IPD has continued to decline, but superimposed on that decline is variability from year to year. This variability results from changes in weather (e.g., a warmer and wetter year increases methane emissions from wetlands), and it can mask slow changes from climate change. But based on the IPD, it seems Arctic emissions of methane have not yet increased dramatically because of climate change.

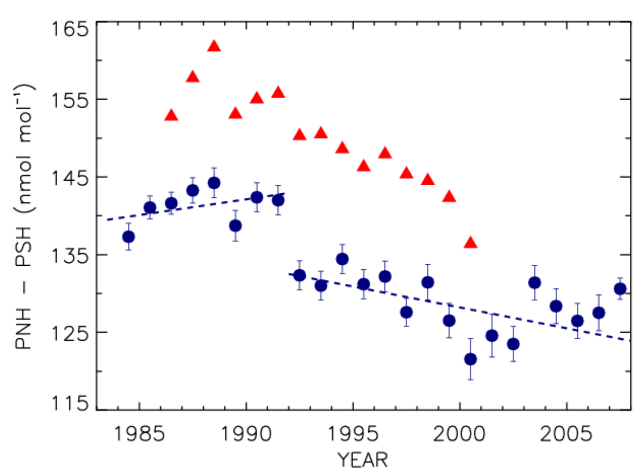

Figure 3 Blue: The difference in methane concentrations between the polar northern hemisphere and the polar southern hemisphere from 1984- 2007. Red: Model predictions for that same time period.

Thank you sample collectors and network affiliates!