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The state of greenhouse gases in the atmosphere using global observations through 2015

Oksana Tarasova (1), Alex Vermeulen (2), and Mikio Ueno (3)

(1) WMO, Atmospheric Environment Research Division, Geneva, Switzerland (otarasova@wmo.int), (2) Lund University, Lund, Sweden, (3) WMO World Data Centre for Greenhouse Gases, c/o Japan Meteorological Agency, Tokyo, Japan

We present results from the twelfth annual Greenhouse Gas Bulletin (http://www.wmo.int/pages/prog/arep/gaw/ghg/GHGbulletin.html) of the World Meteorological Organization (WMO). The results are based on research and observations performed by laboratories contributing to the WMO Global Atmosphere Watch (GAW) Programme (www.wmo.int/gaw).

The Bulletin presents results of global analyses of observational data collected according to GAW recommended practices and submitted to the World Data Center for Greenhouse Gases (WDCGG). Bulletins are prepared by the WMO/GAW Scientific Advisory Group for Greenhouse Gases (http://www.wmo.int/pages/prog/arep/gaw/ScientificAdvisoryGroups.html) in collaboration with WDCGG.

Observations used for global analysis are collected at more than 100 marine and terrestrial sites worldwide for CO_2 and CH_4 and at a smaller number of sites for other greenhouse gases. Globally averaged dry-air mole fractions of carbon dioxide, methane and nitrous oxide derived from this network reached new highs in 2015, with CO_2 at 400.0±0.1 ppm, CH_4 at 1845±2 ppb and N_2O at 328.0±0.1 ppb. These values constitute 144%, 256% and 121% of pre-industrial (before 1750) levels, respectively. It is predicted that 2016 will be the first year in which CO_2 at the Mauna Loa Observatory remains above 400 ppm all year, and hence for many generations (Betts et al., 2016).

The atmospheric increase of CO_2 from 2014 to 2015 was 2.3 ppm, which is larger than the increase from 2013 to 2014 and the average growth rate for the past decade (∼2.08 ppm per year), despite evidence that global anthropogenic emissions remained essentially static between 2014 and 2015. The higher growth rate in 2015 compared with the previous years is due to increased natural emissions of CO_2 related to the most recent El Niño event. According to the most recent data, increased growth rates have persisted far into 2016, consistent with the expected lag between CO_2 growth and the ENSO index. The average increase in atmospheric CO_2 from 2005 to 2014 corresponds to ∼44% of the CO_2 emitted by human activity with the remaining ∼56% removed by the oceans and the terrestrial biosphere (La Quéré et al., 2015).

For CH_4 the increase from 2014 to 2015 was larger than that observed from 2013 to 2014 and the mean growth rate over the past 10 years. The annual increase of N_2O globally averaged mole fraction from 2014 to 2015 was similar to that observed from 2013 to 2014 and greater than the average growth rate over the past 10 years. The National Oceanic and Atmospheric Administration (NOAA) Annual Greenhouse Gas Index shows that from 1990 to 2015 radiative forcing by long-lived greenhouse gases increased by 37%, with CO_2 accounting for about 80% of this increase. The radiative forcing by all long-lived greenhouse gases in 2015 corresponded to a CO_2-equivalent mole fraction of 485 ppm (http://www.esrl.noaa.gov/gmd/aggi).

Bulletin cover story explains the connection between CO_2 growth rates and El Niño phenomena. Bulletin contains brief introduction of the Integrated Global Greenhouse Gas Information System, which will be presented separately at the other session.

References

Betts, R.A. et al, 2016: El Niño and a record CO_2 rise. Nature Climate Change, 6(9):806–810, doi:10.1038/nclimate3063.

Le Quéré, C. et al. 2015: Global carbon budget 2015. Earth System Science Data, 7(2):349–396, doi:10.5194/essd-7-349-2015.