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The state of greenhouse gases in the atmosphere using global observations through 2009

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The Global Atmosphere Watch Programme of the World Meteorological Organization is the only existing long-term international global programme providing a framework for observing and assessing the state and development of environmental issues related to atmospheric composition, including greenhouse gases. The WMO/GAW Global Greenhouse Gas Monitoring Network, a comprehensive network of the Global Climate Observing System (GCOS), integrates the observations from different platforms (surface-based, aircraft and satellite). Surface observations are made at more than 100 stations worldwide for the key greenhouse gases (CO_2 and CH_4) and at a smaller number of stations for the other greenhouse gases. The results of the latest analysis are presented in the WMO/GAW Greenhouse Gas Bulletin published in November 2010. The globally averaged mixing ratios of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) reached new highs in 2009, with CO_2 at 386.8 ppm, CH_4 at 1803 ppb and N_2O at 322.5 ppb. These values are greater than those in pre-industrial times (before 1750) by 38%, 158% and 19%, respectively. Atmospheric growth rate of CO_2 in 2009 was 1.6 ppm, which is higher than the average for the 1990s ($\sim$ 1.5 ppm/yr), but lower than the average for the past decade. The growth rate of N_2O in 2009 was 0.6 ppb which is also less than the one averaged over the last 10 years (0.77 ppb/yr). Both grow rate deviations from the 10 years averaged are due to natural interannual variability. After nearly a decade of no growth, atmospheric CH4 has increased during the past three years. The reasons for renewed growth of atmospheric methane are not fully understood, but emissions from natural sources (from northern latitudes and the tropics) are considered potential causes. The NOAA Annual Greenhouse Gas Index (AGGI) shows that from 1990 to 2009, radiative forcing by all long-lived greenhouse gases increased by 27.5%, with CO_2 accounting for nearly 80% of this increase. The combined radiative forcing by halocarbons is nearly double that of N_2O. GAW is supporting the atmospheric component of the Integrated Global Carbon Observation System that assesses routinely the state of the global carbon budget and is aimed at better understanding atmospheric carbon sources and sinks through top-down inverse modelling.