WMO Global Atmosphere Watch Measurements of Greenhouse Gases: Quantifying the Main Driver of Climate Change

E.J. Dlugokencky[1], O. Tarasova[2]
[1]NOAA ESRL Global Monitoring Division, Boulder, CO, USA
[2]World Meteorological Organization, Research Department, Geneva, Switzerland

The WMO Global Atmosphere Watch Programme (GAW) provides a framework that ensures high-quality atmospheric measurements of long-lived greenhouse gases (LLGHGs) by participating laboratories. Essential components of this framework include common, stable standard scales maintained by Central Calibration Laboratories; science-driven data quality objectives (DQO); centres to ensure measurement quality; and a World Data Centre to archive data and distribute them to end users. Activities are coordinated by a Scientific Advisory Group and GAW-sponsored technical meetings. Taken together, these activities ensure data are of sufficient quality for climate research.

GAW global-scale measurements are used to accurately quantify the global burdens of LLGHGs, and they show that in 2014, their radiative forcing has increased by 2.94 W m^{-2} since 1750. Measurements of LLGHGs from GAW go beyond radiative forcing, though; they are also used to quantify GHG budgets of emissions and losses at global to regional scales, though further network improvements are required to support budget studies on smaller, policy-relevant scales.

GAW measurements of CO_2 and other related tracers show conclusively that atmospheric CO_2 is increasing as a result of fossil fuel combustion, and that about half the annual emissions remain in the atmosphere, while the remainder is partitioned between the oceans and the terrestrial biosphere. GAW observations help to understand the global methane budget and show no measurable increase in CH_4 emissions, so far, in the rapidly warming Arctic. They also show that bottom-up inventories for SF_6 reported to the UNFCCC largely underestimate emissions, with the important lesson that all GHG emission inventories must be evaluated with atmospheric measurements. WMO has proposed an Integrated Global Greenhouse Gas Information System that will quantify GHG fluxes and attribute emissions to specific source-types on policy relevant scales. The system will exploit spatial gradients in the observed abundance of GHGs using chemical transport models to quantify emissions, but this approach requires globally-harmonized observations and puts significant demands on measurement quality among laboratories. GAW provides the framework to ensure the appropriate level of quality.

LLGHGs are the main driver of climate change and of utmost importance to GCOS. As a result, GAW networks for measurements of CO_2, CH_4, and N_2O are designated global and comprehensive networks.