

High accuracy measurement of non-CO₂ greenhouse gases and application in China

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Since 1980s, CMA/CAMS has put in place seven atmospheric background stations – Waliguan in Qinghai (WLG), Shangdianzi in Beijing (SDZ), Lin'an in Zhejiang (LAN), Longfengshan in Heilongjiang (LFS), Shangri-La in Yunnan (XGL), Jinsha in Hubei (JSA) and Akedala in Xinjiang (AKD), which represent a number of typical climatic, ecological and economic zones in China. Non-CO₂ greenhouse gases have been observed by network stations in a standard and consistent routine in response to the Kyoto Protocol and the Montreal Protocols. CH₄ is one of the major GHGs that affect the Earth's radiation balance, contributes ~17% to radiative forcing by long-lived GHGs. CMA began to collect samples and make observations at Waliguan in 1990. Through 2013, there are seven stations collecting air samples and five stations making in-situ observations. Due to the rising impact of human activities, the globally averaged and the Waliguan averaged mole fractions of atmospheric CH₄ in 2013 stood at 1824± 2ppb and 1886± 3ppb, with the mean annual absolute increases during last 10 years at 3.8ppb and 5.1ppb. In 2013, valid monthly CH₄ mole fractions at 6 regional stations are all higher than those of year in 2012 and the observations made at Waliguan over the same period, with yearly average of 1911± 6ppb, 1971± 18ppband 1960 ± 6ppbat Shangdianzi, Lin'an and Longfengshan station, respectively. N₂O is the third most influential GHGs in the atmosphere, contributes ~ 6% to radiative forcing by long-lived GHGs. The globally average and the Waliguan averaged mole fractions of atmospheric N₂O in 2013 stood at 325.9± 0.1ppb and 326.4± 0.4ppb, with the mean annual absolute increases during last 10 years at 0.82ppb and 0.81ppb. In 2013, valid monthly N₂O mole fractions at 6 regional stations are mostly higher than those of year in 2012 and the observations made at Waliguan over the same period, with yearly average of 326.8± 0.6ppb at Shangdianzi station. Halogenated greenhouse gases refer to a group of GHGs that contain halogen atoms (fluorine, chlorine etc) in their molecules. In total they contribute ~12% to radiative forcing by long-lived GHGs, including SF₆, HFCs and PFCs regulated by the Kyoto Protocol, and CFCs, HCFCs, etc, regulated by the Montreal Protocol. CMA began to collect samples and making observation of SF₆ at Waliguan in 1996. The in-situ observation of halogenated GHGs was begun at Shangdianzi in 2006 and weekly sampling at five stations since 2010. The ozone-depleting substances (ODS), which are being phased out in China, include CFCs, Halons, CH₃CCl₃ and CCl₄. These have all begun to decline, while their replacements, e.g. HCFCs and HFCs are increasing rapidly in the atmosphere. Among them, the atmospheric SF₆ mole fractions observed at Waliguan and Shangdianzi reached 8.10 ± 0.12 ppt and 8.12 ± 0.10 ppt in 2013 - the highest ever records observed at the two sites.