Some Recent Scientific Results from the AGAGE Network

R.G. Prinn[1], J. Huang[1], X. Xiao[1], R. Weiss[2], D. Cunnold[3], P. Fraser[4], and P. Simmonds[5]

[1]Massachusetts Institute of Technology (MIT), Cambridge, MA 02139; 617-253-2452,
E-mail: rprinn@mit.edu
[2]Scripps Institute of Oceanography, La Jolla, CA 92093
[3]Georgia Institute of Technology, Atlanta, GA 30332
[4]Commonwealth Scientific and Industrial Research Organisation, Aspendale, Australia
[5]Bristol University, Bristol, U.K.

The Advanced Global Atmospheric Gases Experiment (AGAGE: 1993-2006), and its predecessors (Atmospheric Lifetime Experiment, ALE: 1978-1981; Global Atmospheric Gases Experiment, GAGE: 1981-1993) have measured the composition of the global atmosphere continuously since 1978. AGAGE is distinguished by its capability to measure globally, at high frequency, some 45 trace gases including all of the important species (except CO_2) in the Montreal and Kyoto Protocols. The ALE/GAGE/AGAGE stations are: (a) on Ireland's west coast, first at Adrigole (52ºN, 10ºW, 1978-1983), then at Mace Head (53ºN, 10ºW, 1987 to present); (b) on the U.S. west coast, first at Cape Meares, Oregon (45ºN, 124ºW, 1979-1989), then at Trinidad Head, California (41ºN, 124ºW, 1995 to present); (c) Ragged Point, Barbados (13ºN, 59ºW, 1978 to present); (d) Cape Matatula, American Samoa (14ºS, 171ºW, 1978 to present); and (e) Cape Grim, Tasmania, Australia (41ºS, 145ºE, 1978 to present). AGAGE also collaborates with the System for Observation of Halogenated Greenhouse Gases in Europe (SOGE), through transfer of AGAGE calibrations and technology. SOGE includes mountain sites at Jungfraujoch (Switzerland, 47°N, 8°E; 3.57 km), Monte Cimone (Italy, 44°N, 11°E, 2.17 km) and Zeppelinfjellet (Ny-Alesund, Norway 79°N, 12°E; 0.47 km). The AGAGE network also includes Hateruma Island, Japan (24ºN, 123ºE), through a co-operative agreement with the National Institute for Environmental Studies (NIES, Japan), and a new station at Gosan, Jeju Island, Korea (33ºN, 126ºE) operated by Seoul National University (SNU).

Conclusions from three recently completed analyses of AGAGE and other network data show:

(1) Optimal estimation of the soil uptake rate of molecular hydrogen from AGAGE and other measurements has been carried out. We conclude that soil uptake (84 ± 8 Tg yr^{-1}) represents the major loss process for H_2 and accounts for 81% of the total destruction. Strong seasonal cycles are deduced for the soil uptake of H_2. The soil sink is a maximum over the northern extra-tropics in summer and peaks only two to three months earlier in the Northern Hemisphere than in the Southern Hemisphere.

(2) We have optimally estimated nitrous oxide emissions from eleven globally distributed regions, using multi-network measurements, a chemical transport model, and a Kalman filter. Compared to the GEIA 1990 estimates, emissions from 0º to 30ºN are significantly larger, emissions from 30ºS – 90ºS are significantly smaller, and the global ocean emissions (23 +7/-6 percent of total) are slightly smaller.

(3) We provide evidence against a significant polar oceanic methyl chloroform source based on AGAGE measurements, HYSPLIT back trajectories, and chemical transport modeling. Specifically, at the time of expected peak southern polar oceanic emissions in December – February 1999, air masses measured at Cape Grim from 60ºS – 70ºS showed no statistically significant differences in mole fractions from those originating from 30ºS – 60ºS.

Table 1. Mole fraction (ppt) of methyl chloroform in the Southern Hemisphere by latitudinal bands.

LATITUDE BAND	MOLE FRACTION (ppt)
30ºS – 40ºS	58.1 ± 1.1
40ºS – 50ºS	58.1 ± 1.3
50ºS – 60ºS	58.2 ± 1.1
60ºS – 70ºS	58.1 ± 1.2