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25 years of continuous CO_2 and CH_4 measurements at Izaña Global GAW mountain station: annual cycles and interannual trends

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Izaña Observatory, which is a Global GAW WMO station, is located at 2360 m above see level, on Tenerife (Canary Islands). During the night period (20UTC-08UTC), in situ measurements at this mountain site are representative of free troposphere background conditions (e.g. see Gomez-Pelaez et all, 2006). Carbon dioxide and methane atmospheric mixing ratios have been continuously measured at Izaña since June 1984. The instrumentation and raw data processing schemes (see Gomez-Pelaez et all, 2006, Gomez-Pelaez & Ramos, 2009, and references therein) follow the GAW WMO recommendations (e.g. GAW Report No. 186). In this presentation, methane mixing ratio is reported in the NOAA04 scale using *nmol/mol* units (denoted here as *ppb*); whereas carbon dioxide mixing ratio is reported in the scales: WMO X87 for the period 1984-1994, WMO X93 for 1995-2006, and WMO X2005 for 2007-2009 (these scales are very close each other), using $\mu mol / mol$ units (denoted here as *ppm*).

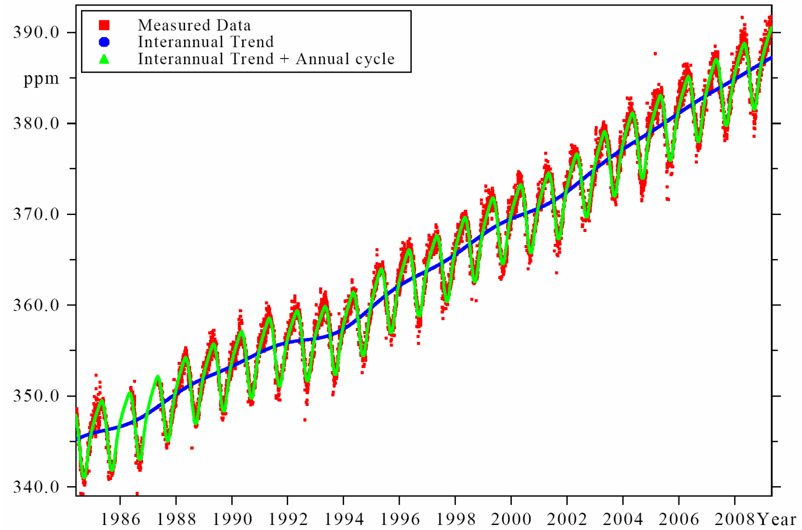

Figure 1. Carbon dioxide daily night mean mixing ratio at Izaña Observatory (AEMET).

Carbon dioxide (June 1th, 1984-April 30th, 2009) and methane (July 1th, 1984-May 31th, 2009) night daily mean mixing ratio time series are analyzed using a decomposition in three terms: interannual trend, annual cycle, and residual. We carry out a least squares fit of the daily data to the function

$$f(t) = a_1 + a_2 t + a_3 t^2 + \sum_{i=1}^{p} \left[b_i \cos(\omega_i t) + c_i \sin(\omega_i t) \right] + \sum_{j=1}^{4} \left[d_j \cos(k_j t) + e_j \sin(k_j t) \right]$$

where: t is the time in days (t=1 for January 1th, 1984); a_1, a_2, a_3, b_i and c_i are the parameters of the *interannual trend* to be determined; $p = 7$; d_j and e_j are the parameters of the *annual cycle* (which is assumed constant) to be determined; $\omega_i = 2\pi i / N$ with N equals to the number of days in the period 1984-2009 (N=9497); $k_j = 2\pi j / T$ with T=365.25 days. See Gomez-Pelaez et all (2006) for a detailed interpre-

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tation of this function (note that here we also use a quadratic term in time, to allow a non-periodic growth rate).

Figures 1 and 2 show, for carbon dioxide and methane respectively, the measured mixing ratio, and the computed interannual trend and interannual trend+annual cycle. Figure 3 shows the annual cycle for carbon dioxide and methane. For carbon dioxide, the standard deviation of the residuals is 0.87 ppm, the interannual mean growth rate for the period 1984-2009 is 1.7 ppm/year, and for the period 1999-2009 is 1.9 ppm/year; the peak-to-peak annual cycle amplitude is 7.9 ppm; the annual cycle has its maximum at the beginning of May and its minimum at middle September. For methane, the standard deviation of the residuals is 18.2 ppb; the interannual mean growth rate is very variable; the peak-to-peak annual cycle amplitude is 31.6 ppb; the annual cycle has its maximum at the beginning of December (with a plateau in winter) and its minimum at the beginning of August.

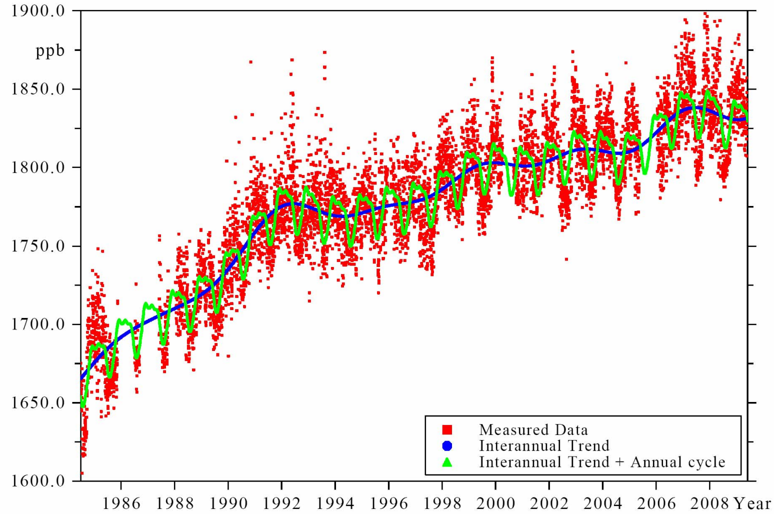

Figure 2. Methane daily night mean mixing ratio at Izaña Observatory (AEMET).

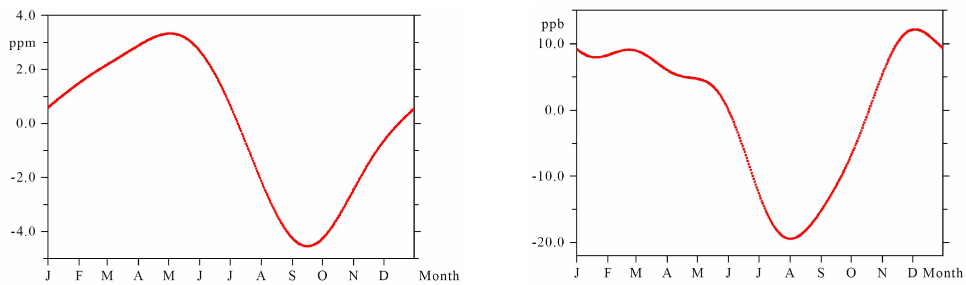

Figure 3. Annual cycle for carbon dioxide and methane (Izaña Observatory), respectively.

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