Long Term Ozone Observations at Izaña Atmospheric Observatory (1988-2009)

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The distribution of ozone in the troposphere is highly variable in time and space because of the numerous sources and sinks, as well as the several production/destruction reactions with other atmospherics constituents. It is also affected by downward transport from the upper troposphere-lower stratosphere (Rodríguez et al., 2004) and regional photochemistry (Crutzen, 1995; Lelieveld and Dentener, 2000). All these features make difficult to asses ozone trends in the free troposphere, in fact, different patterns of long-term changes are found in N.H. (Oltmans et al., 2008).

Daily cycle of surface ozone at Izaña Observatory (IZO; 2370 m a.s.l.) shows a minimum during daylight caused by upslope flow from lower levels by the coasts of the Tenerife Island. This local influence is eliminated using only night period data. Yearly mean ozone values at Izana during in the period 1988-2008 show three different tendency periods. A slight negative trend until 1995 was followed by a large positive trend until 1998. After that a significant decrease in growth rate is observed (figure 1). A slight positive trend in the annual mean data, as well as a statistically significant jump (at α <0.01) in 1996 is observed, being mean ozone value smaller in the first period than in the second one. Taking into account the three tendencies found during the 20 years of recording data, a less difference between mean night and mean day values is found during the last period 1999-2008, that is, more intensive daily cycles were observed during the two first trends (1988-1995 and 1996-1998). However, no significant changes have been observed on the annual seasonality for the different trends, with a maximum and a large variability in spring (Apr-Jun) and summer (Jul-Sep), and a less fluctuating minimum in autumn (Oct-Dec) and winter (Jan-Mar, figure 2).

Ozone levels at Izaña is also influenced by the large-scale subsidence, an important meteorological feature in this region, which is driven by the descending branch of the Hadley cell and the proximity of the Azores high, associated with fair weather. Above the inversion layer, in the free troposphere, the atmospheric circulation consists of subsiding air masses which are typically originated on the North Atlantic mid latitudes which are related to increasing ozone levels at Izaña (Rodríguez et al., 2004). During the night, the measurements at IZO are representative of pure middle free troposphere. Long range transport also varies levels concentrations. Transport from Europe (at IZO) is infrequent except by way of North Africa. Such events are characterized by hazy (dust-laden) air masses which also contain relatively high concentrations of pollutant aerosols (e.g., sulphate, nitrate) and low levels of ozone (Prospero et al., 1995). As a consequence, air masses with different physical and chemical properties impact Izaña, depending on its

original geographical region. In other to assess the atmospheric transport in modulating tropospheric ozone in this region, an air mass back trajectory analysis for the period 1988-2008 is presented in this study. This long-term record provides unique insights into the several processes that affect ozone concentrations in the subtropical free troposphere.

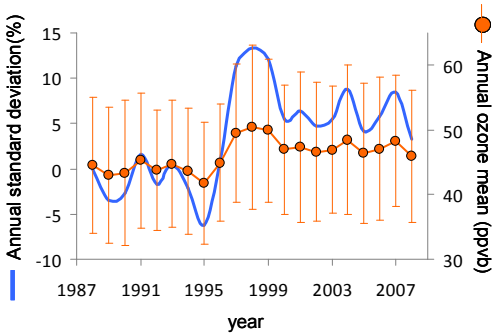

Figure 1. Ozone annual means and corresponding annual standard deviation with regard to the ozone mean value in 1987.

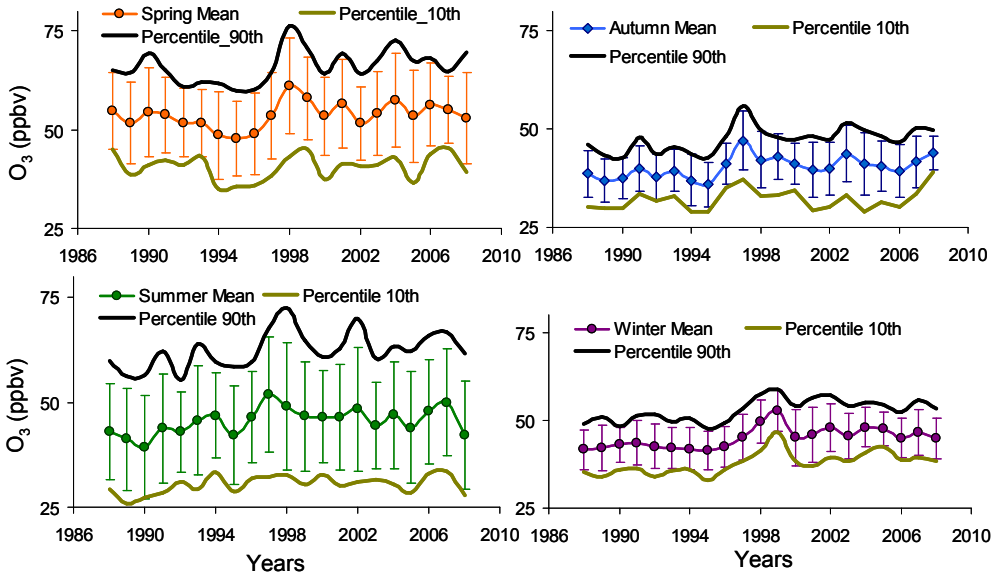

Figure 2. Long term ozone records for the period 1987-2009: spring (Apr-Jun), summer (Jul-Sep), autumn (Oct-Dec) and winter (Jan-Mar).

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