Sensing the atmospheric ozone from space and in situ measurements - a comparative analysis

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Since the discovery in 1985 of an ozone (O_3) hole appearing every year in spring above Antarctica, the Montreal protocol and its amendments prohibited the consumption and production of chlorofluorocarbons, due to their ability to catalyze the O_3 breakdown reaction. The years that followed are known to be a pivot in O_3 trends: in the stratosphere, concentrations decreased from the 1970's to the 1990's, and are now expected to get back to their previous values by following an opposed trend. In this project, a model was created to analyze O_3 trends on in situ and satellite measurements.

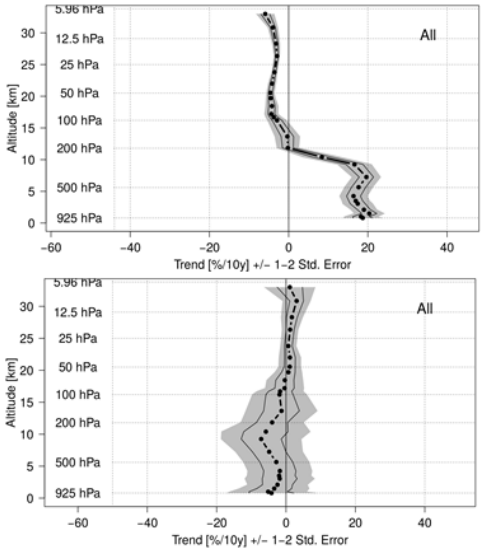

*Figure 1 : Model on annual means, 1970/1967 – 1990/1996 (**top**) and 1990/1996 – 2015 (**bottom**).*

By combining six explanatory variables, O_3 variations were reduced to the minimum and linear trends (Figure 1) were discerned from the noise. With this model, the determination of trends on short time series such as satellites data was also made possible by using the in situ measurements as reference. On satellite subsets centered on Payerne for the years 2002 to 2012, trends were computed for MIPAS, MLS, SCIAMACHY and SMR instruments (Figure 2).

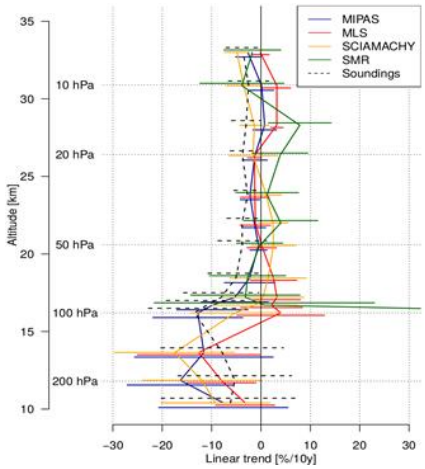

Figure 2 : O_3 trends obtained by satellite and ozonesonde, with models pre-calibrated on a long-term analysis of Payerne ozonesondes.

The trends found after 2000 present significant negative values in the lower stratosphere, and non-significant negative values in the mid-stratosphere. Some satellite instruments present positive trends of a few percent at specific levels, sometimes significant, but not in a coordinated manner between the different datasets. This summarizes well the difficulty of confirming or invalidating potential trends of small amplitudes on datasets with different specificities. The positive trends usually found in the upper stratosphere are not confirmed nor invalidated by these results, since the model is based on soundings measurements, which do not reach these heights. Further developments of this project would consist in using the model and code produced to perform similar analysis on other aerological stations and collocated satellite data.