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ON THE USE OF WAVELETS AND CORRELATION TECHNIQUES APPLIED TO ATMOSPHERIC SPECTRA

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The accurate determination of the type and composition of different aerosols in the atmosphere is an unresolved problem at the present time. In this paper, we propose a method to estimate aerosol variations along the atmospheric layers. Our method is based on extracting information from spectroscopic atmospheric data, such as obtained by shuttle and satellite missions, and spectroscopic laboratory data, specific to the aerosols to be investigated, by means of a mathematical technique combining wavelets, 2D synchronous correlation and normalized 1D correlation.

The mathematical procedure is as follows. First, the initial atmospheric and laboratory spectra are reduced by applying on them the discrete wavelet transform [1] (DWT) and by retaining only the so-called smooth signal component, a fraction of the original spectrum of a much reduced size. This first step has two main goals: on one hand, to lessen the large number of spectral elements, and, as a consequence, make easier and faster all further calculations, and, on the other hand, to remove most of the gas signal present in the atmospheric spectra. However, some of the gas signal in the atmospheric data is still retained; thus, a second step is performed to select the spectral regions where signals of the aerosol to be studied appear to be predominant, free or almost free from distorting gas or aerosol interferences. This is done by analysis of the 2D synchronous correlation map.[2] The third and final step allows the estimation of the amount of aerosol present in each atmospheric layer by means of classical 1D normalized correlation.[3]

As an example of the application of the method proposed, we have analysed atmospheric spectra measured by the ATMOS shuttle mission, in years successive to the eruption of the Pinatubo volcano, in which a large amount of sulfate aerosol matter was ejected. This has been combined with laboratory sulfate spectra recorded in Waterloo. We have been able to draw qualitative conclusions about the shape of the vertical sulfate column and the variations observed in the time of the measurements.

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