Recent Ozone Investigations over Bulgaria by Remote Sensing: Ground-based and Satellite Data

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The ozone is a very specific substance, which is present in the whole earth's atmosphere from the ground level to the mesosphere. On the one hand, the natural stratospheric ozone prevents the harmful solar ultraviolet radiation to reach the earth's surface, but on the other hand in the atmosphere surface layer the natural and anthropogenic ozone is an air pollutant, dangerous for the living organisms. Since in the latest years ozone content changes are observed, unfavourable for the biosphere, the atmospheric ozone is the object of intensive research.

The aim of the paper is the investigation of the total and surface ozone dynamics over Bulgaria, South-Eastern Europe using *in-situ* and remote sensing methods (ground-based and satellite).

For analysis of the total ozone content (TOC) we have used measurements performed by the ground-based spectrophotometer Photon and data from the experiment TOMS - Earth Probe satellite. The spectrophotometer measures the direct sun light in the range 290-360 nm with 1 nm resolution. The algorithm, which calculates the total ozone content, involves a combination of measured solar radiation intensities, attenuating according to the Bouguer – Lambert's law. The irradiance ratio at two wavelengths, one of which strongly absorbed by the ozone and the other - outside the ozone absorption range, is sensitive to the ozone total column amount. The TOC data show seasonal variations, which are typical for the middle latitudes. The TOC values received from the ground-based and satellite observations are compared. The ozone changes for different months in the period 1996-2005 are examined. The biggest fluctuations of the TOC monthly average values are in February and the smallest – in July. There isn't a statistically significant trend in the ozone column for the last three years.

Surface ozone concentrations were measured with an fast-response and sensitive (1ppb) ozone analyzer operating by the chemi-luminescent method of ozone detection. A ground-based aerosol LIDAR was used for the analysis of the aerosol structure

within the planetary boundary layer and the mixing height, which in a considerable degree defines the ozone concentration near the ground. A preliminary review and a comparison of the LIDAR and ozone concentration data reveal the following: the vertical mixing, representing the matter of the convective boundary layer development, affects the ground level ozone concentration. The latter increases during/after the residual layer destruction. That increase is slight in the case of an advection presence and is most powerful in the case of cloudiness.

The complex investigations with using in-situ and remote sensing techniques are extremely useful for the more depth understanding of the processes defining atmospheric ozone dynamics.