BEHAVIOR OF THE EARTH'S OZONE LAYER: POSSIBLE WAY OF THE FUTURE EVOLUTION

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A hypothesis on the possible way of future evolution of the planetary ozone layer is reported. It is based on the assumption of the existence of the secular variation of the total ozone content (TOC) as well as on the results of approximation of one of the longest time series of TOC observations in Arose (Switzerland) and ozonometric observations in Tomsk. According to this hypothesis, in the late nineties and in the early 2000's it is expected the stabilization of TOC which then will change for a gradual growth in the Earth's atmosphere that contradicts the conclusions following from the "freon" hypothesis.

Considerable and constant attention has been given to the study of the problem of destruction of the ozone layer since detecting the first ozone hole over the Antarctica in the early eighties. In practical work the results of observation in the middle and high latitudes of both hemispheres in the last decades point to a steady decrease of the total ozone content (TOC). As known, a version of the scenario based on the role of technogenic freons in the destruction of the ozone layer of the planet has been widely discussed to explain this tendency. This concept has laid a basis for a series of international agreements, including the agreement of discontinuation of the production of freons.

It should be noted that the majority of observations of TOC were made during thirty or maximum forty years. That means that the observations have been started in the 1950's–60's. There are only few series of observations available covering a longer period. The most representative series of observations make up the observations of TOC at the Arose observatory in Switzerland. Figure 1 shows the tine variation of TOC over this observation site.[1] The curve of 22 years-period sliding mean (double solar cycle) shows well the increase of TOC up to the 1940's and its decrease since the 1950's. In the early seventieth the rate of the TOC decrease per year, if the linear regression is calculated, is about −0.14 that agrees well with the tendency according to the "freon" concept.

Therefore, if we assume that the global variation of the TOC field, as well as the climatic cycles of meteorological quantities, is of quasi-cyclic character, then one may try to approximate this variation of the TOC field by a sine curve. For the time series of TOC that follows from observations in Arose the results of applying this procedure are shown in Fig. 1.

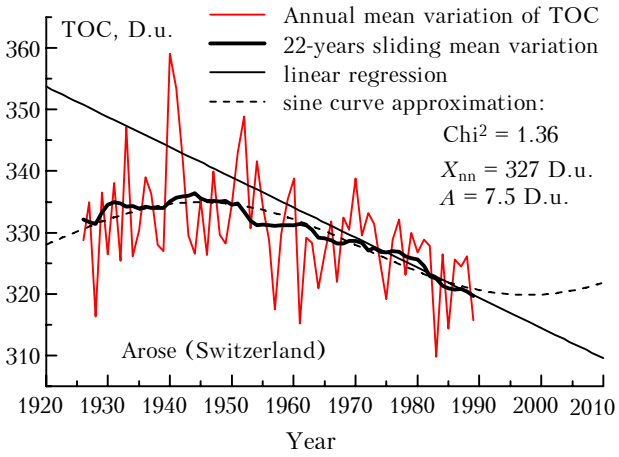

FIG. 1. Time behavior of TOC in Arose (Switzerland) from 1926 to 1989[1] and its approximation by a sine curve.

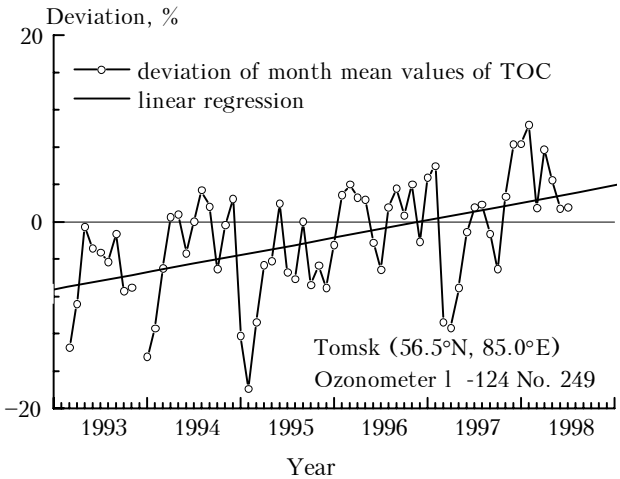

FIG. 2. Deviation of TOC month mean values relative to norm obtained from observations in Tomsk in 1993–1998.

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The period of sine curve proved to be equal to about 105 years that is close to the period of secular variation of the solar activity (80–90 years). Should this be the case then even since the end of 90's and in the first decade of the next century the TOC increase could be expected. According to the "freon" concept, on the contrary, the further destruction of ozone layer should be expected since the lifetime of technogenic freons already emitted into the troposphere is more than one hundred years.

The confirmation of the hypothesis of the further increase of TOC because of the long-period climatic ozone oscillation are the results of our observations performed at the Siberian High Altitude Lidar Sensing Station in Tomsk using a certified ozonometer.[2] Figure 2 shows the time series of the TOC variation over the period from March 1993 to July 1998 based on the data of these observations. Note that in the behavior of TOC a positive tendency is observed, which amounts to 1.88% per year. It is evident that even in the next 2 or 3 years we shall have a clear idea of the tendency in the behavior of the ozone layer.

In conclusion I would like to express my gratitude to my colleagues for their assistance in making calculations and fruitful discussions.

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