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Atmos. Chem. Phys., 6, 5183-5191, 2006

www.atmos-chem-phys.net/6/5183/2006/

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The total ozone field separated into meteorological regimes – Part II: Northern Hemisphere mid-latitude total ozone trends

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Abstract. Previous studies have presented clear evidence that the Northern Hemisphere total ozone field can be separated into distinct regimes (tropical, midlatitude, polar, and arctic) the boundaries of which are associated with the subtropical and polar upper troposphere fronts, and in the winter, the polar vortex. This paper presents a study of total ozone variability within these regimes, from 1979–2003, using data from the TOMS instruments. The change in ozone within each regime for the period January 1979–May 1991, a period of rapid total ozone change, was studied in detail. Previous studies had observed a zonal linear trend of -3.15% per decade for the latitude band 25° – 60° N. When the ozone field is separated by regime, linear trends of -1.4% , 2.3% , and 3.0% , per decade for the tropical, midlatitude, and polar regimes, respectively, are observed. The changes in the relative areas of the regimes were also derived from the ozone data. The relative area of the polar regime decreased by about 20%; the tropical regime increased by about 10% over this period. No significant change was detected for the midlatitude regime. From the trends in the relative area and total ozone it is deduced that 35% of the trend between 25° and 60° N, from January 1979–May 1991 is due to movement of the upper troposphere fronts. The changes in the relative areas can be associated with a change in the mean latitude of the subtropical and polar fronts within the latitude interval 25° to 60° N. Over the period from January 1979 to May 1991, both fronts moved northward by 1.1 ± 0.2 degrees per decade. Over the entire period of the study, 1979–2003, the subtropical front moved northward at a rate of 1.1 ± 0.1 degrees per decade, while the polar front moved by 0.5 ± 0.1 degrees per decade.

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Citation: Hudson, R. D., Andrade, M. F., Follette, M. B., and Frolov, A. D.: The total ozone field separated into meteorological regimes – Part II: Northern Hemisphere mid-latitude total ozone trends, Atmos. Chem. Phys., 6, 5183-5191, 2006. ▣ [Bibtex](#) ▣ [EndNote](#) ▣ [Reference Manager](#)

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