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Weekly periodicities of Aerosol Optical Thickness over Central Europe – evidence of an anthropogenic direct aerosol effect

D. Bäumer, R. Rinke, and B. Vogel

Institut für Meteorologie und Klimaforschung, Forschungszentrum Karlsruhe/Universität Karlsruhe, Karlsruhe, Germany

Abstract. Statistical analyses of data from ground-based sun photometer stations in Central Europe are presented. All stations are part of the Aerosol Robotic Network (AERONET), and only data of the highest data quality level 2.0 has been applied. The averages by weekday of Aerosol Optical Thickness (AOT) at a wavelength of 440 nm of 12 of the 14 stations in the investigation area show a weekly periodicity with lowest values on Sunday and Monday, but greatest values from Wednesday until Saturday, that is significant at least on a 90% level. The stations in Germany and in Greater Paris show weekly cycles with ranges of about 20% on average. In Northern Italy and Switzerland this range is about 10% on average. By applying several checks, we exclude that the weekly cycles were caused by a maintenance effect or by different retrieval conditions as a consequence of a weekly cycle in cloud cover. The corresponding weekly cycle of anthropogenic gaseous and particulate emissions leads us to the conclusion of the anthropogenic origin of the weekly AOT cycle. Since these AOT patterns are derived from the reduction of the direct sun radiation by the columnar atmospheric aerosol, this result represents strong evidence for an anthropogenic direct aerosol effect on shortwave radiation. Furthermore, this study makes a first contribution to the understanding and explanation of recently observed weekly periodicities in meteorological variables as temperature in Germany.

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