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Effects on surface atmospheric photo-oxidants over Greece during the total solar eclipse event of 29 March 2006

P. Zanis[1], E. Katragkou[2], M. Kanakidou[3], B. E. Psiloglou[4], S. Karathanasis[5], M. Vrekoussis[3,*], E. Gerasopoulos[4], I. Lisaridis[2], K. Markakis[2], A. Poupkou[2], V. Amiridis[4], D. Melas[2], N. Mihalopoulos[3], and C. Zerefos[4]

[1]Department of Meteorology and Climatology, Aristotle University of Thessaloniki, Greece
[2]Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, Greece
[3]Environmental Chemical Processes Laboratory, Department of Chemistry, University of Crete, Greece
[4]National Observatory of Athens, Athens, Greece
[5]Region of Central Macedonia, Thessaloniki, Greece
[*]now at: Institute of Environmental Physics and Remote Sensing IUP/IFE, University of Bremen, Germany

Abstract. This study investigates the effects of the total solar eclipse of 29 March 2006 on surface air-quality levels over Greece based on observations at a number of sites in conjunction with chemical box modelling and 3-D air-quality modelling. Emphasis is given on surface ozone and other photooxidants at four Greek sites Kastelorizo, Finokalia (Crete), Pallini (Athens) and Thessaloniki, which are located at gradually increasing distances from the path of the eclipse totality and are characterized by different air pollution levels. The eclipse offered the opportunity to test our understanding of air pollution build-up and the response of the gas-phase chemistry of photo-oxidants during a photolytical perturbation using both a photochemical box model and a regional air-quality offline model based on the modeling system WRF/CAMx. At the relatively unpolluted sites of Kastelorizo and Finokalia no clear signal of the solar eclipse on surface O_3, NO_2 and NO concentrations can be deduced from the observations while there is no correlation of observed O_3, NO_2 and NO with observed global radiation. The box and regional model simulations for the two relatively unpolluted sites indicate that the calculated changes in net ozone production rates between eclipse and non eclipse conditions are rather small compared to the observed short-term ozone variability. Furthermore the simulated ozone lifetime is in the range of a few days at these sites and hence the solar eclipse effects on ozone can be easily masked by local and regional transport. At the polluted sites of Thessaloniki and Pallini, the solar eclipse effects on O_3, NO_2 and NO concentrations are revealed from both the measurements and modeling with the net effect being a decrease in O_3 and NO and an increase in NO_2 as NO_2 formed from the reaction of O_3 with NO while at the same time NO_2 is not efficiently photolysed. This result is also supported by a positive correlation of observed global radiation with O_3 and NO and a negative correlation with NO_2. It is evident from the 3-D air quality modeling over

Greece that the maximum effects of the eclipse on O_3, NO_2 and NO are reflected on the large urban agglomerations of Athens, and Thessaloniki where the maximum of the emissions occur.

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