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

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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 O₃, NO₂ and NO concentrations can be deduced from the observations while there is no correlation of observed O₃, NO₂ 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 O₃, NO₂ and NO concentrations are revealed from both the measurements and modeling with the net effect being a decrease in O₃ and NO and an increase in NO₂ as NO₂ formed from the reaction of O₃ with NO while at the same time NO₂ is not efficiently photolysed. This result is also supported by a positive correlation of observed global radiation with O₃ and NO and a negative correlation with NO₂. It is evident from the 3-D air quality modeling over

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Greece that the maximum effects of the eclipse on O₃, NO₂ and NO are reflected on the large urban agglomerations of Athens, and Thessaloniki where the maximum of the emissions occur.

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