Atmos. Chem. Phys. Discuss., 13, C1649–C1652, 2013
www.atmos-chem-phys-discuss.net/13/C1649/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimate of surface direct radiative forcing of desert dust from atmospheric modulation of the aerosol optical depth" *by* A. di Sarra et al.

A. di Sarra et al.

alcide.disarra@enea.it

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Reviewer's comment: This work attempts to correlate variations in downwelling solar flux with those of aerosol optical depth AOD and hence derive the corresponding radiative forcing of aerosols on the solar radiation. The paper is reasonably well written but the English can be improved.

My general comment is that the authors have assumed that only the aerosol layer is the cause of the radiation modulations. It is possible that part of the radiation modulation is due to gravity wave modulation of atmospheric ozone.

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Interactive Discussion

Discussion Paper

Answer: The effect of atmospheric ozone is negligible in this case. The radiative impact is primarily due to the effect of the absorption in the UV (Hartley and Huggins bands), and a smaller absorption in the visible (Chappuis bands). Minor absorption is also present in the near IR (Wulff band). A vary large total ozone variation would be required to produce a measurable effect on the SW radiation. In addition, the total ozone is largely dominated by the stratospheric contribution, and we expect that a tropospheric oscillation produces a small effect on total ozone, and consequently on SW irradiance. This is confirmed by the total ozone measurements made at Lampedusa during the event; the total ozone evolution during the morning of September 7, 2005, as measured by the Brewer spectrophotometer operational in Lampedusa, is shown in figure 1. In order to support this conclusions we perfomed radiative transfer calculations of the downward SW irradiance for different total ozone values (267, 287, and 307 DU, i.e., $\pm$ 20 DU around the observed value). The downward irradiance change associated with the 20 DU variation is less that 1 W/m^2 at 25° and 60° solar zenith angle. Since the observed variations re much smaller than 20 DU, the ozone effect is totally negligible.

A short discussion of this aspect, as well as possible influences by other atmospheric gases (SO_2, which is also measured with the Brewer) and NO_2 (whose amounts are considered very low at Lampedusa, due to the small local sources and short atmospheric lifetime), will be added to the revised paper.

The English has been re-checked and improved in the revised version.

Reviewer's comment: Further, little has been explained regarding the link between gravity wave effects and the modulations observed.

The authors may wish to explore the literature on the subject and include references to existing work on gravity waves and aerosols.

Equation 1 should be removed as it is neither used or validated.

ACPD

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Answer: We have removed equation 1 in the revised version. A discussion of the mechanisms linking the gravity wave and the evolution of the boundary layer was also added. As also stated in the paper, however, the main topic is the determination of the dust radiative effects, and the detailed description of the gravity wave requires further studies and can not be included in this study.

To our knowledge, there are few studies discussing the evolution of atmospheric aerosols and tropospheric water vapour during the propagation of a gravity wave. The most relevant (e.g., Reinking et al., 2000; Raymond and Fuchs, 2007) are already cited in the paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 527, 2013.

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Interactive Comment

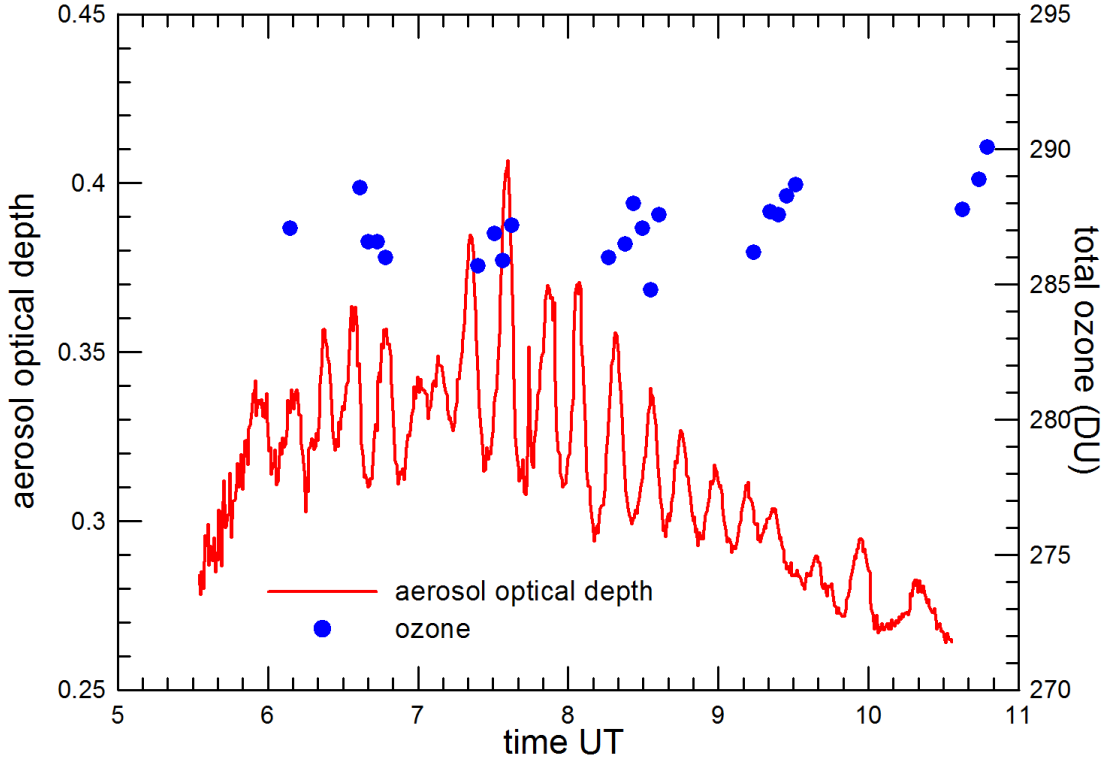

Fig. 1.

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