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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling chemistry over the Dead Sea: bromine and ozone chemistry" *by* L. Smoydzin and R. von Glasow

E. Tas

erant@mpch-mainz.mpg.de

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I would like to congratulate the authors for their study on reactive bromine species (RBS) activity in the area of the Dead Sea. As has been demonstrated in previous research, the Dead Sea can use as a natural laboratory for improving our understanding of RBS activity. Currently, the active mechanisms at the Dead Sea are far of being fully resolved. Therefore, applying model simulations with detailed multiphase mechanisms and transport for studying RBS chemistry at this area may be of high importance for our overall understanding of RBS activity.

A basic assumption applied in the present study is that the aerosol chemistry is always active if the ambient relative humidity is above the relative humidity of deliquescence (RHD) of sea salt (75%) or sulfate (70%) aerosols, but is not active (except for the

lower most level) under the crystallization point of the aerosols, which assumed by the authors to be 40% for sulfate and 42% for sea salt aerosols. This assumption has an extremely high impact on the results and conclusion presented in the paper and therefore should be treated carefully.

- It is not clear to me to what extent and in what way aerosol calculations are performed for RH values range between the deliquescence point and the crystallization point. This information is missing in the text.

- It should be taken into account that RHD of sea salt aerosols can be estimated by about 32% (e.g., Metzger et al., 2007), which is significantly lower than the value assumed by the authors.

- The authors may also take into account that the results published by Levin et al. (2005), indicate a layering of haze at heights of about100m and 250m above the Dead Sea surface, during daytime. The results further show that large particles (even $>$2um) were found in the lower haze layer.

- Recycling of RBS via heterogeneous processes on sulfate aerosols is expected to play significant role in RBS activity at the Dead Sea area. For instance, studies have shown that the dependence of the rate of heterogeneous decomposition of BrONO2 on sulfate aerosols is essentially very weak (Hanson et al., 1996). The uptake coefficient for this reaction is only slightly dependent on particle size, composition of sulfuric acid and temperature, and is very efficient under dry conditions (Hanson and Ravishankara, 1995), such as exist at the Dead Sea. Taking into account the high levels of sulfate aerosols over the Dead Sea (Tas et al., 2006; Andreae et al., 2002; Wanger et al., 2000; Formenti et al., 2001), it should be important to include this heterogeneous reaction, as well as other reactions involving sulfate aerosols active in the model, in order to avoid significant deviations from RBS activity that occur in reality at the area.

Moreover, the efficient heterogeneous decomposition of BrONO2 at the Dead Sea is also supported by measurements performed at the Dead Sea, which show a sharp

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depletion in NO2 concentrations together with significant increase in NOz concentrations (Tas et al., 2005; Tas et al., 2006), which expected to account for the formation of HNO3 due to the heterogeneous decomposition of BrONO2 (Fig. 9 in Tas et al. (2006)).

Variable diurnal profile of NO2:

(P 4548, lines 19-22) The authors suggest that in addition to the variable wind direction over the southern part of the Dead Sea, the potentially very variable bromine source strength due to variable bromine release strength of each single pond might explain the irregular pattern of BrO mixing ratios as detected at the evaporation ponds.

-This hypothesis, suggested by the authors, was thoroughly investigated by our research group based on measurements performed at the evaporation ponds. Defiantly, the jugged shape of the BrO profile was found to be insensitive to wind direction. An alternative explanation for the sharp decreases and increases in the diurnal profile (i.e., jugged shape) of BrO at the evaporation ponds is related to the periodic increases and decreases of O3 below and about the threshold level of about 1-2 ppb (Tas et al., 2006).

NO2 levels and agreement with measurements:

- According the measurements performed at the Dead Sea NO2 concentrations shouldnt be high during the whole day (e.g., 0.8 nmol/mol, during STAT simulation), especially over the southern part of the Dead Sea (Tas et al., 2005; Tas et al., 2006). This is mainly the result of the heterogeneous decomposition of BrONO2 on sulfate aerosols (Fig. 9 in Tas et al. (2006)).

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