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Smog chamber experiments to investigate Henry's law constants of glyoxal using different seed aerosols as well as imidazole formation in the presence of ammonia

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Aerosols play an important role in the chemistry and physics of the atmosphere. Hence, they have a direct as well as an indirect impact on the earth's climate. Depending on their formation, one distinguishes between primary and secondary aerosols[1]. Important groups within the secondary aerosols are the secondary organic aerosols (SOAs). In order to improve predictions about these impacts on the earth's climate the existing models need to be optimized, because they still underestimate SOA formation[2]. Glyoxal, the smallest α-dicarbonyl, not only acts as a tracer for SOA formation but also as a direct contributor to SOA. Because glyoxal has such a high vapour pressure, it was common knowledge that it does not take part in gas-particle partitioning and therefore has no impact on direct SOA formation. However, the Henry's law constant for glyoxal is surprisingly high. This has been explained by the hydration of the aldehyde groups, which means that a species with a lower vapour pressure is produced. Therefore the distribution of glyoxal between gas- and particle phase is atmospherically relevant and the direct contribution of glyoxal to SOA can no longer be neglected[3]. Besides this particulate glyoxal is able to undergo heterogeneous chemistry with gaseous ammonia to form imidazoles. This plays an important role for regions with aerosols exhibiting alkaline pH values for example from lifestock or soil dust because imidazoles as nitrogen containing compounds change the optical properties of aerosols[4].
A high salt concentration present in chamber seed aerosols leads to an enhanced glyoxal uptake into the particle. This effect is called "salting-in". The salting effect depends on the composition of the seed aerosol as well as the soluble compound. For very polar compounds, like glyoxal, a "salting-in" is observed[3]. Glyoxal particle formation during a smog chamber campaign at Paul-Scherrer-Institut (PSI) in Switzerland was examined using different seed aerosols such as ammonium sulfate, sodium chloride and sodium nitrate. The aim of this campaign was to investigate Henry's law constants for different seed aerosols. Additionally imidazole formation was studied. During the campaign filter samples were taken to investigate the amount of glyoxal and imidazole in the particle phase. After filter extraction and derivatisation of glyoxal, the compounds were measured using UHPLC-ESI-HR-MS. Additionally, gas-phase glyoxal has been analysed during the campaign. The results will be used to calculate the Henry's law constants.
In this work, results of the glyoxal study as well as imidazole formation are presented.

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