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Climatic effects on the emission of Volatile Organohalogens from saline soils - Study sites in Southern Africa and Central Asia -

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Regional effects of the proposed global warming will vary from place to place, in which most regions will face increased mean temperatures, whereas only few regions will experience a cooling effect. Depending on the regional characteristics an increasing ground level temperature will lead to elevated evaporation, which, sometimes enhanced by decreasing precipitation, promotes land degradation and desertification. Due to their negative water budget most semi-/arid regions are characterized by vast evaporates (salt lakes) and salty soils. During the DFG Research Unit 763 HALOPROC (Natural Halogenation Processes) we identified those (hyper-)saline environments as novel source for a number of volatile halogenated organic compounds (VOX), such as halomethanes (e.g. CHCl3, CH3Cl, CH3Br) or halogenated alkenes (e.g. C2H2Cl2, C2H3Cl3).
For a long time VOX have been considered of industrial origin only, but to-date more than 4,700 naturally produced organohalogens are known, originating from various bio- and geochemical processes. For example, the natural production of chloromethane (5 MT/a) exceeds the anthropogenic production of 50 KT/a by the factor 100. Natural halogenation is a widespread phenomenon in the terrestrial environment, including biota (fungi), halophilic bacteria and archaea, plants, animals and insects as de-novo producers of (semi-) volatile or polar organohalogens.
Since volatile organohalogens affect the ozone budget of the planetary boundary layer and play a key role in the production of aerosols, they are of outstanding importance. They are effectively linked to atmospheric chemistry cycles, leading to potentially significant feedbacks on cloud formation, Earth's albedo and eventually the regional and global climate. The emission and deposition of VOX to and from the atmosphere can strongly influence terrestrial ecosystems due to the phytotoxic potential.
Climate models consistently predict an increase in the variability of summer temperatures. In some regions climate change will lead in consequence of higher temperature, lower rainfall and higher evaporation to an increase in quantity and scale of desertification and degradation. Those effects can already be observed in Central Asia, the Middle East, Northern and Southern Africa and Australia.
Since number and size of saline ecosystems will increase from the time when deserts and semi-deserts start spreading, the formation of naturally produced organohalogens will tremendously increase. Elevated fluxes to the atmosphere are conceivable in the 21st century, resulting in additional climate feedbacks and phytotoxic effects.

This poster presents data on potential VOX emission from different saline soils in Southern Africa and Central Asia, sampled and determined during HaloProc. The applied setup reproduces short-term changes in climatic conditions starting from dried-out saline soil instantly humidified during rain events. Using a custom build purge-and-trap GC-MS system the spontaneous emission of several C1 and C2 halocarbons was followed up.
Since there was minor or no emission under almost dry condition soil humidity must play a major role in VOX production schemes. Furthermore, by interpreting main soil characteristics additional driving forces behind the VOX production have been identified as pH-level and salt composition (halite, sulphate, carbonate).