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Towards an experiment to investigate N_2O_5 uptake to aerosol particles at ambient conditions using the radioactive tracer ^{13}N

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N_2O_5 is an atmospheric trace gas which plays an important role as a reactive intermediate in the nighttime NO_x tropospheric chemistry [1]. N_2O_5 can function in a dual role: as a NO_3 radical reservoir and as a sink for NO_x species thanks to the reaction of heterogeneous hydrolysis on aerosol, water and ice surfaces. Therefore N_2O_5 can have a direct impact on tropospheric ozone production and the oxidizing capacity of the troposphere [1, 2]. Laboratory studies have also shown that uptake of N_2O_5 to aerosol particles depends on meteorological parameters like temperature and relative humidity as well as aerosol composition [1, 2].

In our experiments we have used the ^{13}N short-lived radioactive tracer technique [3] developed at the Paul Scherrer Institute coupled to an aerosol flow tube reactor. This method allows for the study of N_2O_5 uptake kinetics to aerosols under realistic conditions, e.g., at ambient pressure and low trace gas concentrations as well as high relative humidity values. Furthermore it allows to observe behavior in a wide temperature range (tropospheric conditions) and the influence of concentration effects on uptake (nitrate effect).

Radioactively labeled ^{13}NO is produced in a gas target attached to the Isotope Production Station IP2 at a branch of Injector II at Paul Scherrer Institute and mixed with O_3 in the reactor to give $^{13}N_2O_5$. The ^{13}N labeled species formed were monitored by trapping them in a narrow parallel plate diffusion denuder system that allows for selective separation of the gaseous species present and observing the radioactive decay of ^{13}N therein. Activity of N_2O_5 taken up on aerosol was monitored on a particle filter positioned at the exit of the denuder system. Several denuder coatings were tested for N_2O_5 and citric acid was selected because of lower interference with NO_2. Measurements performed have confirmed formation of ^{13}N labeled N_2O_5, consistent with predictions obtained via computer modeling. A preliminary study using a citric acid aerosol (whose hygroscopic properties are well known) at relative humidities of 50-80% RH has shown uptake of radioactively labeled N_2O_5 on the aerosol particles.

References

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