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Targeted observations of chemical constituents

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Adaptive observations taken in well defined targeted areas can -in combination with data assimilation techniques- reduce the initial condition uncertainty and decrease forecast errors. Reasonable target areas are unstable system modes, which can be detected with the help of singular vectors. The singular vectors of a numerical model identify the directions of fastest perturbation growth over a finite time interval and are therefore associated with dynamically sensitive model states. In order to determine unstable chemical species, a singular vector algorithm was implemented into the three-dimensional chemical transport model EURAD-IM (which features 3- and 4-dimensional data assimilation). Since the evolution of chemical species is not only sensitive to initial conditions but also to emissions, the singular vector technique was utilised to study the influence of both emissions and initial conditions of different species.

The singular vector algorithm was first applied within a box model to investigate the influence of initial perturbations in volatile organic compounds and nitrogen oxydes on the final concentration of ozone. Moreover the dependence of singular vectors on the initial conditions and the length of the simulationsinterval was analysed. The results demonstrate that the algorithm clearly identifies sensitive chemical constituents. Furthermore the 4-dimensional singular vector technique was evaluated using data from the ZEPTER-2 campaign. The study states a positive impact of targeted observations.