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Convective transport and scavenging of trace species in the atmosphere - How to treat these two contrarian vertical transport mechanisms in global models?

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Deep convection represents the most effective upward vertical transport mechanisms for trace species in the troposphere. However, for some species the upward motion is counteracted by their uptake into hydrometeors, and subsequent downward transport within precipitation. Below the cloud levels a fraction of the dissolved species can be released into the gas phase, depending on the ambient mixing ratio. This represents a vertical downward transport in addition to the convective downdrafts and mesoscale subsidence.
In global chemistry-transport and chemistry-climate models it is difficult to design a simultaneous treatment of both these processes, since the upward transport depends on the input of air from the levels below a certain altitude, whereas the scavenging depends to a significant degree on the already dissolved material, i.e. information that originates from the layers above. We applied several approaches of operator splitting techniques to shed light onto this issue with the help of the atmospheric chemistry general circulation model ECHAM5/MESSy. These results are compared with each other and with observations.