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Impact of cirrus clouds on tropopause structure and tracer distributions

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From many measurements we know that cirrus clouds and the tropopause are closely related. Cirrus clouds occur quite regularly in the tropopause region, leading to widely horizontally extended regions filled with ice crystals; the tops of cirrus cloud layers are often very close to the thermal tropopause. On the other hand, it is not clear how cirrus clouds could modify the structure of the tropopause region or even the distribution of trace gases in this region.
In our work we investigate this question in idealized 2D and 3D simulations using the EULAG model together with a state-of-the-art bulk ice microphysics scheme and passive tracers. Here, we concentrate on a specific case, namely patchy cirrus clouds, driven by convective instabilities. As known from measurements, potentially unstable layer can occur in the tropopause region leading to shallow convection inside cirrus clouds. It was shown in former studies that shallow convection in cirrus layers could modify the cloud structure massively. However, the sharpness of the tropopause, i.e. the temperature profile determines the possibility of overshoots into the stratosphere and thus possible troposphere-stratosphere exchange. We investigate this process using different idealized temperature profiles and different tracers (idealized and realistic tropospheric tracers).