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The impact of ice supersaturated regions and thin cirrus clouds on radiation

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One of the most challenging problems in Atmospheric Science is the prediction of future climate change. So far, the role of clouds is very uncertain, especially, the role of cirrus clouds, which could contritute to a warming of the Earth-Atmosphere system. However, there are only few studies about the impact of cirrus clouds on radiation and (to our knowledge) no studies about the impact of ice-supersaturated regions (ISSRs) on the radiation budget. ISSRs are cloud free airmasses that are supersaturated with respect to ice. They are the potential formation regions for cirrus clouds and persistent contrails. In this study we use idealized vertical profiles and humidity corrected radiosonde profiles (containing ice supersaturation, see Spichtinger et al., 2003) to estimate the radiative impact of ice supersaturation. Especially, the local heating rates inside the supersaturation layer (in cloud free air) could be noticable different from the rates obtained in subsaturated layers at the same altitude. This could affect the local dynamics, because ISSRs can be sustained for a long time at the same altitude and the induced cooing can produce ice crystals. For estimating these effects we used the cloud resolving model EuLag with an ice microphysics parameterisation and a recently implemented radiation transfer model. First results show that thin cirrus clouds can form due to radiative cooling within the ISSRs and the formation process can be intensified by changing the local dynamics due to the radiative impact.

Additionally, we estimate the errors due to the insufficient implementation of the formation of cirrus clouds from ISSRs: To our knowledge there are only two global circulation models (GCMs) which consider the formation of cirrus clouds in a physical way. Therefore we estimate the impact of incorrectly formed cirrus clouds on the radiative budget compared to persistent ISSR in the real atmosphere. From this study we can draw some conclusions on the importance of implementing more correct parameterisations for cirrus cloud formation in GCMs.

References:

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