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An improved ice cloud formation parameterization in the EMAC model

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Cirrus clouds cover about 30% of the Earth's surface and are an important modulator of the radiative energy budget of the atmosphere. Despite their importance in the global climate system, there are still large uncertainties in understanding the microphysical properties and interactions with aerosols. Ice crystal formation is quite complex and a variety of mechanisms exists for ice nucleation, depending on aerosol characteristics and environmental conditions. Ice crystals can be formed via homogeneous nucleation or heterogeneous nucleation of ice-nucleating particles in different ways (contact, immersion, condensation, deposition).
We have implemented the computationally efficient cirrus cloud formation parameterization by Barahona and Nenes (2009) into the EMAC (ECHAM5/MESSy Atmospheric Chemistry) model in order to improve the representation of ice clouds and aerosol-cloud interactions. The parameterization computes the ice crystal number concentration from precursor aerosols and ice-nucleating particles accounting for the competition between homogeneous and heterogeneous nucleation and among different freezing modes.
Our work shows the differences and the improvements obtained after the implementation with respect to the previous version of EMAC.