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Cirrus Parameterization for Global Models

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Motivated by the need to study the climatic impact of aerosol-related cirrus cloud changes, a physically-based parameterization scheme of ice initiation and initial growth of ice crystals in young cirrus clouds has been developed. The scheme tracks the number density and size of nucleated ice crystals as a function of vertical wind speed, temperature, ice saturation ratio, aerosol number size distributions, and preexisting cloud ice, allowing for competition between heterogeneous ice nuclei and liquid aerosol particles during freezing. Its implementation in a general circulation model is briefly outlined, and examples from pure homogeneous freezing and idealized heterogeneous ice nucleation simulations are presented. This new scheme establishes a flexible framework for a comprehensive assessment of indirect aerosol effects on and properties of cirrus clouds in global climate, chemistry transport, and weather forecast models.