Geophysical Research Abstracts
Vol. 19, EGU2017-19549, 2017
EGU General Assembly 2017

Explosive Ice Multiplication Induced by multiplicative–Noise fluctuation of Mechanical Break–up in Ice-Ice Collisions

Jun-Ichi Yano (1) and Vaughan Phillips (2)

(1) CNRM, Meteo-France and CNRS, UMR 3589, 31057 Toulouse Cedex, France, (2) Department of Physical Geography and Ecosystem Science, University of Lund, Lund, Sweden

The number of ice fragments generated by break–up of large graupel in collisions with small graupel fluctuates randomly due to fluctuations in relative sizes and densities of colliding graupel particles and the stochastic nature of fracture propagation. This paper investigates an impact of the stochasticity of break–up on ice multiplication.

When both the rate of generation of primary ice and the initial number concentration of ice–crystals are low, the system most likely loses all the initial ice and graupel due to a lack of sustaining sources. Even randomness does not change this mean evolution of the system in its phase-space. However, a fluctuation of ice break–up number gives a small but *finite chance* that substantial ice crystal fragments are generated by break–up of large graupel. That, in turn, generates more large graupel. This multiplicative process due to fluctuations potentially leads to a small but finite chance of explosive growth of ice number. A rigorous stochastic analysis demonstrates this point quantitatively.

The randomness considered here belongs to a particular category called "multiplicative" noise, because the noise amplitude is proportional to a given physical state. In order to contrast the multiplicative-noise nature of ice break–up with a standard "additive" noise process, fluctuation of the primary ice generation rate is also considered as an example of the latter. These processes are examined by taking the Fokker–Planck equation that explicitly describes evolution of the probability distribution with time. As an important conclusion, stability in the phase-space of the cloud-microphysical system of break-up in ice-ice collisions is substantially altered by the multiplicative noise.