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Numerical Study of motion of Falling Conical Graupel[1] CHIH-CHE CHUEH, Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan, PAO K. WANG, Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison, WI 53706, USA, TEMPEI HASHINO, Research Institute for Applied Mechanics, Kyushu University, Japan — Each year, large hailstones falling from a thunderstorm cause massive loss of crops and properties, pose a serious threat to aviation, and, on occasion, some deaths in the world. Graupel particles often serve as hailstone embryos, and are frequently observed forms of convective precipitation almost everywhere. And it is sufficiently evident that the major factor that determines collision efficiency for ice accretion is the flow field. In the present study, the attitudes of freely-falling conical graupel particles with a realistic range of densities are investigated numerically by solving the transient Navier-Stokes equations and the body dynamics equations representing the 6-degrees-of-freedom motion, allowing us to determine the position and orientation of the graupel in response to the coupling of the hydrodynamic force and torque of the flow fields, gravitational force, as well as Magnus force due to self-rotation. The results show significant horizontal movements (on the order of 1 km in one hour) and also show that when Reynolds number is small, a typical damped oscillation occurs, whereas when Reynolds number is high, amplifying oscillation may occur which leads to more complicated and unpredictable flying attitudes such as tumbling.

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