Heat transport associated with gravitational sedimentation of condensed particles in cloud layers where convection is suppressed

*Kensuke Nakajima[1], Ko-ichiro SUGIYAMA[6], Masatsugu Odaka[2], George HASHIMOTO[7], Yoshiyuki O. Takahashi[3,4], Masaki Ishiwatari[2], Shin-ichi Takehiro[5], Yoshi-Yuki Hayashi[3,4]

1.Department of Earth and Planetary Sciences,Faculty of Sciences, Kyushu University, 2.Department of Cosmoscience, Graduate School of Science, Hokkaido University, 3.Center for Planetary Sciences, 4.Department of Planetology, Graduate School of Science, Kobe University, 5.Research Institute for Mathematical Sciences, Kyoto University, 6.Institute of Space and Astronautical Science, JAXA, 7.Graduate School of Natural Science and Technology, Okayama University

In Earth’s atmosphere, condensation of H2O enhances convection by the release of latent heat. However, in planetary atmospheres in general, there are cases where convection is suppressed in the condensing layer. For example, in the case when major constituent condenses, buoyancy can hardly be allowed because density of condensing parcel is constrained by the saturation relation between pressure and temperature (Colaprete et al 2003; Yamashita et al, in revision). We propose that, even where convection is suppressed in association with condensation, gravitational sedimentation of condensed phase can contribute to vertical heat transport; the combination of the downward gravitational sedimentation of lower entropy condensed phase and the mean upwelling of higher entropy gas phase can result in the net upward transport of entropy without convective motion in gas phase. In this presentation, we demonstrate the plausibility of the above mechanism in numerical experiments. Possible application of the same mechanism to H2O, NH3, or NH4 condensation layer in hydrogen rich atmospheres of gas giant planets, where convection tends to be suppressed due to heavier molecular weights of the condensible components (Guillot, 1995), will also be discussed.

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