Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AAS22-P14 Room:Convention Hall Time:May 21 17:00-18:30

Evaluation of the molecular diffusion process in the stratosphere

SUGAWARA, Satoshi[1*], ISHIDOYA, Shigeyuki[2]

[1]Miyagi Univ. of Education, [2]AIST

It has been shown that the gravitational separation effect can be detected in the stratosphere from nitrogen, oxygen, and argon isotopic ratios and Ar/N2 ratio observed by balloon experiments. The gravitational separation has a possibility to be a new tracer of stratospheric circulation. In this study, theoretical model simulations are performed to validate an existence of the gravitational separation in stratosphere, as well as to evaluate the magnitude of isotopic discrimination of the atmospheric major components driven by molecular diffusion including the thermal diffusion. 2-D model of the middle atmosphere, SOCRATES, used in this study has a high altitude domain up to 120 km and includes molecular diffusion process above the mesosphere. In an original setting of SOCRATES, the thermal diffusion is calculated only for hydrogen atom in the mesosphere. We expanded a model domain affected by the molecular diffusion process to the stratosphere, and calculated the ratio of 32O2 and 34O2 concentrations. The molecular diffusion flux is calculated by applying a theory in Banks and Kockarts (1973). Thermal diffusion factor for the mixture of 32O2 and 34O2 is assumed to be 0.01 by considering the value previously reported in Grew and Ibbs (1952). We repeated model simulations with and without ordinary molecular diffusion and/or thermal diffusion, and compared the distributions of oxygen isotopic ratios. As a result, it is concluded that the magnitude of gravitational separation in stratosphere will be significant enough to be detected by the isotopic measurements. However, simulated magnitudes of the gravitation separation are considerably smaller than observed values. Possible effects of the thermal diffusion on isotopic ratio will be also discussed.

Keywords: stratosphere, molecular diffusion