[JJ] Evening Poster | M (Multidisciplinary and Interdisciplinary) | M-IS Intersection

[M-IS15]Geophysical fluid dynamics-Transfield approach to geoscience

convener:Keita Iga(Atmosphere and Ocean Research Institute, The University of Tokyo), Shigeo Yoshida(Department of Earth and Planetary Sciences, Faculty of Sciences, Kyushu University), Takatoshi Yanagisawa(海洋研究開発機構　地球深部ダイナミクス研究分野, 共同), Hidenori AIKI(Nagoya University)
Sun. May 20, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)
This session on geophysical fluid dynamics is open to discussions and researches on fluid phenomena in whatever fields of earth and planetary sciences, e.g., motions in the earth and planetary interior, oceans, atmospheres, volcanoes, and the ionosphere, conducted with whatever methods. Talks intending to stimulate exchange of ideas among multiple fields of researches or those identifying concepts that are commonly applicable to wide range of geophysical fluids are especially welcome.

[MIS15-P01]On penetration of compositional convection into a thermally stable stratified layer

*Shin-ichi Takehiro[1], Youhei SASAKI[2] (1.Research Institute for Mathematical Sciences, Kyoto University, 2.Department of Mathematics, Kyoto University)
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The situation that a stable stratified layer locates above or below a convection layer commonly appears in the natural world. For example, there exists a stable layer, called the radiative zone, below the convection zone in the Sun. There are the stratospheres above the tropospheres developing near the surfaces of the terrestrial planets. When stable and unstable stratified layers vertically adjoin each other, formation of final density stratification structure is significantly affected by extent of penetration of convection emerging in the unstable layer into the stable layer.
There is a similar problem in the central core of the Earth. It is suggested from recent high-pressure experiments and first principle calculations that the values of thermal conductivity under conditions of planetary cores are larger than those considered so far. By using 1-dimensional thermal balance models with the updated values of thermal conductivity, generation and existence of a stably stratified layer at the upper part of the Earth's outer core is discussed. However, mixing effect by compositional convection driven by light element release at the inner core boundary is not considered. It is an important hydrodynamical issue for determining structure of the outer core, whether compositional convection erodes and destroy the stable layer or not.
In this study, numerical experiments of two-components Boussinesq fluid system where a light element is injected from the bottom of a thermally stable layer are performed, and development and penetration height of compositional convection is observed.
We propose distribution of power induced by thermal and compositional buoyancy (rate of kinetic energy production) as a measure of occurrence of thermal and compositional convection. The power consists of the terms proportional to heat flux and compositional flux. The region with positive power is considered that convection is active there because kinetic energy can be produced by buoyancy force. On the other hand, in the region with negative power convection is suppressed and stably stratified layer may be produced. Numerical results show that the heights of developed compositional convection are well explained by positive kinetic energy production regions on the assumption that the whole layer is mixed up with convection.