Séminaire de Yunying Li au LMD

Nom : Séminaire de Yunying Li au LMD

Titre : The Cumulus and its Role in the Atmosphere over the Tibetan Plateau

Laboratoire :

Nom du conférencier :

Son affiliation :

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Résumé : The Cumulus and its Role in the Atmosphere over the Tibetan Plateau

Cumulus (Cu) can transport heat and water vapor from the boundary layer to the free atmosphere, leading to the redistribution of heat and moist energy in the lower atmosphere. This paper uses the fine-resolution CloudSat?CALIPSO product to characterize Cu over the Tibetan Plateau (TP). It is found that Cu is one of the dominant cloud types over the TP in the northern summer. The Cu event frequency, defined as Cu occurring within 50-km segments, is 54% over the TP in the summer, which is much larger over the TP than in its surrounding regions. The surface wind vector converging at the central TP and the topographic forcing provide the necessary moisture and dynamical lifting of convection over the TP. The structure of the atmospheric moist static energy shows that the thermodynamical environment over the northern TP can be characterized as having weak instability, a shallow layer of instability, and lower altitudes for the level of free convection. The diurnal variation of Cu with frequency peaks during the daytime confirms the surface thermodynamic control on Cu formation over the TP. The thermodynamic effects of Cu on the atmospheric environment and impacts on the large-scale atmospheric circulation are also studied using the Community Atmospheric Model, version 5.3. It is found that the model can reasonably simulate the unique distribution of diabatic heating and Cu over the TP. Shallow convection provides the dominant diabatic heating and drying to the lower and middle atmosphere over the TP. A sensitivity experiment indicates that without Cu over the TP, large-scale condensation and stratiform clouds would increase dramatically, which induces enhanced low-level wind and moisture convergence toward the TP, resulting in significantly enhanced monsoon circulation with remote impact on the areas far beyond the TP. Cu therefore acts as a safety valve to modulate the atmospheric environment that prevents the formation of superclusters of stratiform clouds and precipitation over the TP.

Cloud Vertical Structures Associated

with Northward Advance of the East Asian Summer Monsoon

Based on the CloudSat dataset, the vertical structures of the cloud water content and cloudiness associated with the northward advance of the East Asian summer monsoon (EASM) are investigated by using composite analysis method with 22 northward-advancing EASM events selected by extended empirical orthogonal function analysis. The positive anomaly of the liquid water content exhibits an apparent vertical tilting structure on the north side of the convective center during the northward advance of the EASM, tilting northward from the upper to the lower atmosphere over 7 degrees of latitude. However, the positive anomaly of the ice water content overlaps with the convective center without obvious vertical tilting structure. The positive anomaly of the cloud fraction also demonstrates an obvious northward tilting structure. This tilting structure is composed of the different spatial positions of various cloud types from the upper to the lower atmosphere. Deep convective clouds are located in the convective center and can be regarded as the reference of the convective center. High clouds occupy the upper troposphere and lag behind the convective center by nearly 4 degrees of latitude. Altostratus appears in the middle troposphere with a maximum cloud fraction core lagging behind the convective center by about 2 degrees of latitude. Altocumulus and cumulus mainly occur in the lower troposphere with maximum cloud fraction cores leading the convective center by approximately 3 degrees of latitude. These northward tilting structures of the liquid water content and cloudiness may facilitate the northward advance of the EASM.

Contact :

marie-pierre.lefebvre@lmd.jussieu.fr