Advection-condensation of Atmospheric Moisture: Lagrangian Versus Eulerian Models

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Large-scale circulations play a crucial role in controlling the distribution of water vapour in the atmosphere. Here, we introduce a stochastic Lagrangian advection-condensation model in which moist parcels are advected by a cellular flow and condense according to a prescribed saturation profile. This model shows features reminiscent of the Hadley circulation in the atmosphere such as boundary layers, a region of intense precipitation and a relative humidity minimum, thus providing a framework for theoretical investigation of atmospheric moisture. On the other hand, as Lagrangian models are computational expensive, all practical weather and climate models adopt the Eulerian approach in which moisture is represented by a coarse-grained field instead of individual parcels. In the second part of the talk, we show that because the coarse-graining operation and the condensation process do not commute, small-scale variability are lost in the Eulerian formulation. We then propose a parametrization to bring back local fluctuation into an Eulerian atmospheric model.

27 April 2018

11:30 a.m.

Conference Room, 3/F, Mong Man Wai Building

EARTH SYSTEM SCIENCE PROGRAMME

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