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Pattern-based subgrid-scale representation approach

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The present talk does not seek an answer on a pattern formation, but it proposes an approach for representing the subgrid-scale processes assuming coherent pattern structures.

Due to a limit of spatial resolution in geophysical modelling, the information on the processes of the scales less than the model resolution is not readily available. The problem of inferring information on these subgrid-scale processes may be collectively called the subgrid-scale representation problem.

Traditionally, the subgrid-scale representation problem is separated into two completely separate problems. The first is an issue of inferring the subgrid-scale information directly (e.g., subgrid-scale spatial pattern of a variable), called "downscaling". The second is an issue of inferring the feedbacks of these subgrid-scale processes onto the resolved scales, called "parameterization". The proposed pattern-based subgrid-scale representation approach enables to deal with these two problems simultaneously.

We specifically pay an attention to the fact that these subgrid-scale pattern structures represents a scaling law associated with isolated coherent structures. Thus, the multiresolutional analysis techniques such as wavelet can efficiently represent these patterns with a heavy truncation of the modes in phase space, or compression. Such a compression provides a parameterization. Then the decompression of the phase space information back to the real space provides a downscaling.

However, a minor twist is required for this general strategy, because most of the physical processes can efficiently be calculated only in the real space, thus the phase-space transformation makes the model description rather awkward. Here, the idea of multiresolutional approach is replaced by a finite volume approach, but keeping the basic spirit of the former approach. That leads to a highly-flexible time-dependent mesh-refinement model.

An atmospheric demonstration of this approach will be presented.