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"Compression": An Approach Filling a Gap Between Super-Parameterization and Conventional Parameterizations

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An approach called super-parameterization, a use of an explicit model, albeit in a limited manner, at each grid box in place of convectional parameterizations appears to be obtaining more and more of popularity. This is completely understandable considering inherent difficulties with current parameterizations doing ostensibly-easy descent jobs. However, a major drawback with super-parameterization is its prohibitive cost. We also have to recognize that the current super-parameterization still does not resolve many important physical processes especially those in the boundary layer.

Hence, we need to go beyond a super-parameterization. With these issues in mind, the present talk propose a numerical approach that fills a gap between the super-parameterization and convectional parameterizations.

The basic idea of the approach is to use "compression" in the sense defined in the multiresolutional analysis. The best example for applications of "compression" is in its combination with wavelets, but the same principle can equally be applied to any mode decomposition, as long as the chosen set of modes is efficient in representing the original full system.

We take a set of massflux modes as a base of "compression" in order to keep a close link with convectional convective parameterizations. From a mathematical point of view, the massflux representation can be considered as an approximation of the full system by a set of segmentally-constant modes. Hence, the more specific procedure is apply a segmentally-constant approximation (SCA) to a cloud-resolving model

(CRM), leading to CRM-SCA, or compressed super-parameterization.

Under a strong truncation with two segments, CRM-SCA reduces to a bulk mass-flux model but with no additional approximation or closure assumptions, thus it can be considered as a fully-prognostic prototype for standard bulk massflux parameterizations. Unfortunately, the plumes are highly transient under this configuration, thus they must be re-activated once for while.

In order to overcome this difficulty in a numerically straightforward manner, a procedure is introduced automatically adding and removing constant segments with time by following the evolution of plumes. Tests have been performed both the case with dry boundary-layer convection as well as for moist deep convection with a diurnal cycle. These results are presented with liable animations along with compression test results.