05 Décembre 2022, 16h00-17h00 (CEST)

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Reconciling and improving formulations for thermodynamics and conservation principles in Earth System Models (ESMs)

This presentation provides a comprehensive derivation of the total energy equations for the atmospheric components of Earth System Models (ESMs). The assumptions and approximations made in this derivation are motivated and discussed. In particular, it is emphasized that closing the energy budget is conceptually challenging and hard to achieve in practice without resorting to ad hoc fixers. As a concrete example, the energy budget terms are diagnosed in a realistic climate simulation using a global atmosphere model. The largest total energy errors in this example are spurious dynamical core energy dissipation, thermodynamic inconsistencies (e.g., coupling parameterizations with the host model) and missing processes/terms associated with falling precipitation and evaporation (e.g., enthalpy flux between components). The latter two errors are not, in general, reduced by increasing horizontal resolution. They are due to incomplete thermodynamic and dynamic formulations. Future research directions are proposed to reconcile and improve thermodynamics formulations and conservation principles.