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Computation and characterization of local sub-filter-scale energy transfers in atmospheric flows

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Atmospheric motions are governed by turbulent motions associated to non-trivial energy transfers at small scales (direct cascade) and/or at large scales (inverse cascade). Although it is known that the two cascades coexist, energy fluxes have been previously investigated from the spectral point of view but not on their instantaneous spatial and local structure.
We compute local and instantaneous sub-filter scale energy transfers in two sets of reanalyses (NCEP-NCAR and ERA-Interim) in the troposphere and the lower stratosphere for the year 2005. The fluxes are mostly positive (towards subgrid scales) in the troposphere and negative in the stratosphere reflecting the baroclinic and barotropic nature of the motions respectively. The most intense positive energy fluxes are found in the troposphere and are associated with baroclinic eddies or tropical cyclones. The computation of such fluxes can be used to characterize the amount of energy lost or missing at the smallest scales in climate and weather models.