



## Subgrid processes and coherent structures

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The dynamics, mixing processes and thermodynamics within characteristic flow structures and in the interactions between them provides the basis of parameterisations of many (but not all) aspects of subgrid modelling, (which has a sensitive influence on climate models (e.g. Collins *et al.* 2006). These structures, which evolve from instabilities of non-uniform flows and from interactions with homogenous and inhomogeneous random fields (such as those recently studied near interfaces between turbulent and non-turbulent flows, Hunt, Eames and Westerweel 2006), are generally characterized by their quasi-persistent spatial structure or by their time behaviour, whether intermittent, bifurcatory or oscillatory. Analytical and numerical models of interactions between idealized smaller and larger scale vortical structures show how up and downscale transfer depends on relative eddy orientations (as with blocked atmospheric structures (Shutts 1983)) and in some cases their helicity (consistent with the Andre, Lesieur, Lilley hypothesis 1983,1986). Schematic diagrams of length/time scales and morphology of atmospheric structures and a map of local/non-local eddy dynamics processes (following Smagorinski, Nieuwstadt & Hunt (2003) and Hunt & Savill (2005)) may provide concepts for improved subgrid modeling.