EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-602, 2009
9th EMS / 9th ECAM

9th EMS Annual Meeting
9th European Conference on Applications of Meteorology
High resolution meteorology
- applications and services

Turbulent diffusion of momentum and scalar in flows with internal and Rossby waves

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Most geophysical flows encompass turbulence and internal and/or Rossby waves. It will be shown that these two different classes of waves cause remarkably similar anomalies in the turbulent transport of momentum and scalar. While all scales in both types of flows contribute to the momentum diffusion, the vertical (diapycnal) scalar diffusion in stratified flows and lateral diffusion in -plane turbulence can be carried out only by turbulent eddies whose size is smaller than the thresholds of turbulence anisotropization. Beyond these thresholds, both flows become dominated by waves that provide no contribution to the scalar diffusion. Stably stratified flows exhibit enhanced isopycnal diffusion of both momentum and scalar which is unaffected by waves. These results shed new light on the Osborn-Cox mixing model, diapycnal and isopycnal viscosity and diffusivity, and large scale meridional transport.