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Vorticity production in rotating and stratified turbulence

L. Liechtenstein (1), K. Schneider (1) and C. Cambon (2)

(1) MSNM-CNRS & CMI, Universite de Provence, Marseille France, (2) LMFA, Ecole Centrale de Lyon, Ecully, France (lukas@l3m.univ-mrs.fr

Rotating and stratified turbulence is ubiquitous in geophysical flows. Linear mechanisms in rotating and stratified turbulence are well known, characterizing the velocity field by internal traveling waves with an angular dispersion relation, generally known as inertio-gravity waves.Nonlinearly, rotating and stratified turbulence leads to an angularly dependent, reduced energy transfer, as nonlinear wave-wave and wave-turbulence interactions rival for the dominant energy transfer mechanisms. This can be complicated in a flow field including coherent vortices, where a certain instantaneous non-homogeneity appears, leading to locally different values of rotation and stratification, This has been seen for dominantly stratified flow fields with weak rotation. The appearance of small scale structures with intensified vorticity production out of a coherent vortex field without obvious mechanism of origin has been observed. The multi-scale character as well as the coherent structures leads us to analysing the flow fields with the coherent vortex extraction method based on an orthogonal wavelet decomposition of the vorticity field.

Results of phenomena observed by DNS of rotating and stratified turbulence will therefore be presented with a subsequent refined analysis of the phenomena based on the coherent vortex extraction. In particular, the interaction of coherent structures and waves with the flow field will be analysed. We conjecture that the coherent vortices are responsible for the nonlinear dynamics of the flow.