Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Analysis of cascades in space and in scale for rotating and stratified Boussinesq flows SUSAN KURIEN, HUSSEIN ALUIE, Los Alamos National Laboratory — We use high-resolution simulations of Boussinesq flows, forced in the large-scales, with fixed rotation and stable stratification along the vertical axis, to study the downscale cascades of energy and potential enstrophy in three different regimes of stratification and rotation. (1) For strongly stratified flows with moderate rotation, we observe anisotropic fluxes of energy and potential enstrophy into Fourier modes with large vertical component k_z, predominantly due to a highly non-local transfer from the large-scales directly to the smallest scales. The energy cascade is predominantly due to three vortical-mode interactions. (2) For strongly rotating flow with moderate stratification, there are anisotropic fluxes to modes with large k_h, due to a "diffusely" local transfer much like in isotropic Navier-Stokes turbulence. The energy cascade is primarily due to three vortical-mode interactions, as in the strongly stratified case, although wave-vortical-wave and vortical-wave-vortical interactions also make a noticeable contribution. (3) In the third case of equally strong rotation and stratification, there are only slightly anisotropic fluxes, mostly to modes with large k_h, due to an ultra-local transfer in which the energy gained by an inertial scale comes almost exclusively from the adjacent larger scales. We confirm that the cascades in the third regime are primarily due to wave-vortical-wave interactions, in agreement with previous work.

Hussein Aluie
Los Alamos National Laboratory

Date submitted: 04 Aug 2011 Electronic form version 1.4