Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Non-robustness of the two-dimensional turbulent inverse cascade
RICHARD SCOTT, Northwest Research Associates — The inverse energy cascade in two-dimensional Navier-Stokes turbulence is examined in the quasi-steady regime, with small-scale, band-limited forcing at scale k_f^{-1}. It is found that the forcing Reynolds number, $Re \sim k_{max}^2/k_f^2$, where k_{max} is the maximum resolved wavenumber, plays a crucial role in determining the energy distribution at larger scales. The strength of the inverse energy cascade, or fraction of energy input that is transfered to larger scales, increases monotonically towards unity with increasing Re. Moreover, as Re increases beyond a critical value, for which a direct enstrophy cascade to small scales is first realized, the energy spectrum in the energy-cascading range steepens abruptly from a $k^{-5/3}$ to k^{-2} dependence. The steepening is interpreted as the result of a greater tendency for coherent vortex formation in cases when forcing scales are adequately resolved, and is consistent with a small but nonzero net upscale enstrophy flux associated with near inviscid vortex merger. The results suggest the need for a review of the traditional interpretation and analysis of the inverse cascade.

Richard Scott
Northwest Research Associates

Date submitted: 03 Aug 2006 Electronic form version 1.4