Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Laboratory experiments with a buoyancy forced circulation in a rotating basin CATHERINE VREUGDENHIL, ROSS GRIFFITHS, BISHAKHDATTA GAYEN, Australian National University — We consider the relative influence of buoyancy forcing and Coriolis effects on convection forced by a differential in heating at a horizontal surface in a rectangular basin. Laboratory experiments with water are reported for a rotating f-plane basin and a range of Ekman number $E = 2 \times 10^{-7} - 1 \times 10^{-5}$. Heating is applied over half of the base as a uniform flux and cooling applied over the other half as a uniform temperature, resulting in a flux Rayleigh number $Ra_F = O(10^{14})$ large enough to ensure turbulent convection, where Ra_F defined in terms of domain length L. Compared to the non-rotating circulation where Nusselt number (a measure of the convective to conductive heat transfer) scales as $Nu \sim Ra_F^{1/6}$, the strongly rotating regime is determined by a geostrophic balance of the larger scales of horizontal flow in the inviscid thermal boundary with $Nu \sim Ro^{1/6}$, where $Ro = B^{1/2}/(f^{3/2}L)$ is the natural Rossby number (B is buoyancy flux per unit area and f is Coriolis parameter). We also find evidence for a further transition into a regime where the circulation is dominated by deep 'chimney' convection in a field of small vortical plumes and Nu is more weakly dependent on rotation.

Catherine Vreugdenhil
Australian National University

Date submitted: 28 Jul 2016 Electronic form version 1.4