Title: Zonal flow regimes in rotating anelastic spherical shells

The surface zonal winds observed in the giant planets form a complex jet pattern with alternating prograde and retrograde direction. While the main equatorial band is prograde on the gas giants, both ice giants have a pronounced retrograde equatorial jet.

We use three-dimensional numerical models of compressible convection in rotating spherical shells to explore the properties of zonal flows in different regimes where either rotation or buoyancy dominates the force balance. We conduct a systematic parameter study to quantify the dependence of zonal flows on the background density stratification and the driving of convection.

In our numerical models, we find that the direction of the equatorial zonal wind is controlled by the ratio of the buoyancy force and the Coriolis force. The prograde equatorial band maintained by Reynolds stresses is found in the rotation-dominated regime. In cases where buoyancy dominates Coriolis force, the angular momentum per unit mass is homogenised and the equatorial band is retrograde, reminiscent to those observed in the ice giants. In this regime, the amplitude of the zonal jets depends on the background density contrast with strongly stratified models producing stronger jets than comparable weakly stratified cases. Furthermore, our results can help to explain the transition between solar-like (i.e. prograde at the equator) and the ``anti-solar'' differential rotations (i.e. retrograde at the equator) found in anelastic models of stellar convection zones.