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Rossby wave propagation in a zonally-varying basic flow

Theoretical studies of the propagation of barotropic Rossby waves are generally based on the assumption that the basic flow is a function of latitude only, with no variation in the longitudinal (zonal) direction. In this configuration the linear and nonlinear dynamics of Rossby waves have been studied extensively in the past few decades, with a great deal of focus being on the interactions of the waves with the basic flow at critical latitudes. It is well known that the "surf zone" around a critical latitude acts as a barrier to the propagation of Rossby waves from the mid-latitudes to the tropics. This would lead one to expect the equatorial region to develop independently of the mid-latitude zones, at least as far as wave dynamics and momentum and energy transport are concerned. However, analyses of upper tropospheric data have found evidence of zonal variations in the time-averaged zonal wind, as well dynamic links between the mid-latitudes and the tropics, which would suggest that there is some degree of equatorward transmission of transient waves from the mid-latitudes. A possible explanation for these observations is that the basic flow varies in the zonal direction. We shall examine these issues in the context of a beta-plane configuration in which the basic flow velocity has a zonally-varying component. The mathematical problem, as we define it, is governed by three small parameters, which define the amplitude of the waves relative to the basic flow, the magnitude of the zonally-varying component of the basic flow relative to the zonally-uniform part, and the zonal extent of the zonally-varying component. Linear analyses and nonlinear numerical simulations will be presented.

This is joint work with former MSc student Mariam Tariri.