Explicit nonlinear waves of fluid models on extended domains and unbounded growth with backscatter

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Large scale motions in geophysical fluid models are often characterised by linear waves, which are obtained by linearising the equations. But there are also many explicit solutions of the fully nonlinear equations when posed the full space. The exact solutions we are investigating often characterise Rossby waves, since they are in geostrophic balance. They also can be compositions of waves, some are interacting with each other and some do not, showing wave interactions as explicit solutions in the fully nonlinear problem.

In this talk I will briefly introduce the idea behind these explicit nonlinear waves and show some of their properties, and their occurrence in different fluid models in extended domains.

As an application, we especially focus on a rotating shallow water model with simplified backscatter. In this case one finds not only geostrophic explicit solutions, but also ageostrophic ones. Moreover, here energy accumulates in selected scales due to the backscatter terms and causes exponentially and unboundedly growing ageostrophic nonlinear waves. This also relates to instability of coexisting stationary waves and is an instance of the role of nonlinear waves in energy transfer, and illustrates their role in preventing energy equidistribution for general data.