Singular perturbation problems arising in geophysical fluid dynamics

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In this talk, we review some recent results about singular perturbation problems for systems of PDEs describing the dynamics of geophysical flows. The primitive system we consider is given by the density-dependent incompressible Navier-Stokes equations, supplemented with the action of a strong Coriolis force. The goal is to understand the asymptotic dynamics in the fast rotation (*i.e.* low Rossby number) limit.

We will show convergence in two qualitatively different regimes: the quasi-homogeneous regime and the fully non-homogeneous regime. We will also discuss how the mathematical results are able to capture well-known physical observations, like the Taylor-Proudman theorem and the Ekman pumping phenomenon.

This talk is based on joint works with *Isabelle Gallagher*, *Dimitri Cobb* and *Marco Bravin*.