Equatorial wave attractors and inertial oscillations

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The Laplace Tidal Equations (LTE) have been extremely succesfull in their description of external waves of Kelvin, Poincaré and Rossby type in thin spherical shells, and local f and β-plane approximations thereof. However, the neglect of the horizontal component of Coriolis terms (traditional approximation) and the use of the hydrostatic approximation in the LTE have been recognized as omitting a class of cellular, hyperbolic type of waves, that may be focused by non-cylindrical geometry onto limit cycles (wave attractors). Here, a very simple stratified, equatorial beta-plane model is introduced,in which the traditional and hydrostatic approximation are defied, which will illustrate analytically certain aspects that have emerged in global models by Friedlander and Siegmann (1982) and Dintrans, Rieutord and Valdettaro (1999). As this is the stratified extension of Stern's (1963) model, it will be referred to as the Stratified Stern Equation. The associated characteristic equation for axially symmetric waves, shows the appearance of bent characteristics (as in the Stern Equation) and turning latitudes, very close to the inertial latitude (as in the global models). Iterating the characteristics, to find webs of connected characteristics, shows the emergence of equatorial wave attractors and, in particular, point attractors, at the intersection of turning latitude and bottom, which are therefore interpreted as (near)inertial oscillations, possibly of relevance to the ubiquitously observed spectral peak at the inertial frequency.

References

Dintrans, B., Rieutord, M. & Valdettaro, L. 1999 Gravito-inertial waves in a rotating stratified sphere or spherical shell. *J. Fluid Mech.* **398**, 271–297.

Friedlander, S. & Siegmann, W. L. 1982 Internal waves in a rotating stratified fluid in an arbitrary gravitational field. *Geophys. Astrophys. Fluid Dynamics* **19**, 267–291.

Stern, M. E. 1963 Trapping of low frequency oscillations in an equatorial 'boundary layer'. *Tellus* **15**, 246–250.

Maas, L. R. M. 2001 Wave focusing and ensuing mean flow due to symmetry breaking in rotating fluids.*J. Fluid Mech.* **437**, 13-28.