ROBUSTNESS OF INSTABILITY OF TWO-LAYER QUASI-GEOSTROPHIC EQUATIONS

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Abstract. In this article, we investigate the instability of two-layer quasi-geostrophic equations, which is a prototypical geophysical fluid model. It is proved that any equilibrium which is sufficiently close to an unstable equilibrium is also unstable.

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REFERENCES

- [1] T. AUBIN, Nonlinear Analysis on Manifolds, Monge-Ampère Equations, Springer-Verlag, 1982.
- [2] C. BARDOS, Y. GUO, W. STRAUSS, Stable and unstable ideal plane flows, Chin. Ann. of Math., 23 (2002), 149–164.
- [3] Y. CHEN, L. WU, Second Order Elliptic Equations and Elliptic Systems, American Mathematical Society, 1998.
- [4] S. FRIEDLANDER, W. STRAUSS, M. VISHIK, Robustness of instability for the two dimensional Euler equations, SIAM J. Math. Anal., 30 (1999), 1343–1355.
- [5] A.GILL, Atmosphere-Ocean Dynamics, Academic Press, 1982.
- [6] I. GOHBERG, M. KREIN, Introduction to the Theory of Linear Nonselfadjoint Operators, American Mathematical Society, 1969.
- [7] Z. LIN, Nonlinear instability of ideal plane flows, 41 (2004), 2147–2178.
- [8] A. MAJDA, A. BERTOZZI, Vorticity and Incompressible Flow, Cambridge University Press, 2001.
- [9] A. MAJDA, X. WANG, Nonlinear Dynamics and Statistical Theories for Basic Geophysical Flows, Cambridge University Press, 2006.
- [10] M. MU, Nonlinear stability criteria for motions of multilayer quasi-geostrophic flow, Science in China B, 34 (1991), 1516–1528.
- [11] M. MU, Q. ZENG, T. SHEPHERD, Y. LIU, Nonlinear stability of multilayer quasi-geostrophic flow, J. Fluid Mech., 264 (1994),165–184.
- [12] A. PAZY, Semigroups of Operators and Applications to Partial Differential Equations, Springer-Verlag, 1983.
- [13] J. PEDLOSKY, Geophysical Fluid Dynamics 2nd ed., Springer-Verlag, 1987.
- [14] M. REED, B. SIMON, Methods of Modern Mathematical Physics, Vol I, Academic Press, 1972.
- [15] R. WANG, H. GAO, Nonlinear instability of Phillips model, accepted by Acta Mathematicae Applicatae Sinica (English Series), 2011.

