THEORETICAL ANALYSES OF BAROCLINIC FLOWS

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Work has been completed on the three-dimensional, linear stability analysis of the baroclinic Hadley cell. These analyses lead to significant new theoretical results concerning the symmetric modes of baroclinic instability. Most important of these, is the discovery that the symmetric modes occur at far lower values of the Richardson number than has been previously anticipated. This conclusion was obtained from growth rates results. It was also found that these values of the Richardson number are not very sensitive to moderate values of the Prandtl number. This work also clarified the problem of the horizontal tilt of the symmetric waves. It was found that the most unstable symmetric modes are inclined at an angle to the zonal direction, but that angle was extremely small. Due to the significance of these results, I was invited to present my work at a symposium on double diffusion convection (this symposium is reviewed in J.F.M., 138, 1984). Also this work was published in the December 1983 issue of the Journal of Fluid Mechanics.

Work has been completed on the numerical modelling of the baroclinic flow between two rotating concentric spheres. The analysis models axisymmetric flow in the AGCE configuration. A mixed Spectral-Finite Difference method was used, which resulted in moderately fast convergence rates. Results were obtained for a limited number of parameter values. This work led to a dissertation for the PhD degree in Engineering Science and Mechanics at the University of Tennessee Space Institute.

Work is proceeding on the code development to solve the strongly nonlinear stability problem for the Eady basic state. No results have yet been obtained. However, we anticipate the successful running of the code in the very near future.

I have not received any supporting funds from NASA towards the tasks described above for FY-84. The University of Tennessee Space Institute has been extremely generous in its financial support of this research.

The plans of FY-85 is to complete and extend the third task element described above.

Publications prepared since June 1983:

1 Three-Dimensional Baroclinic Instability of a Hadley Cell for Small Richardson Number. Journal Fluid Mech., 137, 423-445, 1983.

2. Numerical Model of the Axisymmetric Flow in a Heated Rotating Spherical Shell, PhD Dissertation by Michele Macaraeg, 1984.