MAST-806 Final Exam - Fall 2005

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Open notes, open book

The conservation "law"

$$D_0/Dt\{ \zeta_0 + \beta_0 y + \partial/\partial z[(f_0/N)^2 \partial/\partial z(\psi)] \} = 0$$

is fundamental to the analysis of geophysical fluid motions. Please answer the questions below in carefully written responses:

1. State the fundamental meaning of the equation in physical terms.

2. Summarize the assumptions and restrictions that are required for its validity, emphasizing their physical interpretation. Use non-dimensional parameters where possible, e.g., Ro<<1.

3. Give a physical interpretation of the dynamics associated with the operation of the substantial derivative D_0/Dt on <u>each</u> of the three quantitives inside the curly braces, e.g., $D_0/Dt(\zeta_0)$.

4. What other dynamical equations are associated with the above equation? State these in their lowest order in Ro and a provide a summary of the physical meaning of each.

5. Describe qualitatively how the dynamics represented in the above equation operate for a fluid as it <u>enters</u> the Gulf Stream from the subtropical gyre. (Omit discussion of the shoreward region where the isopycnals approach the surface.) Use a sketch to illustrate your reasoning.

6. Give a simplified form of the above equation applicable to the interior of the subtropical gyres away from frictional boundary layers. Justify your results.

[adapted from an exam given by Dr. Garvine, 1988]