

Errata for *Introduction to Dynamic Meteorology, 4th Edition*

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Since Jim is not able to post these himself, I have taken the liberty of listing the few errors I have found in the 4th Edition. We miss you Jim.

P. 12, eqn (1.6): needs an \hat{r} on the r.h.s.

P. 13, Fig. 1.6 caption: Should read ... For an idealized homogeneous spherical earth, \mathbf{g} would be directed toward the center of the earth. In reality, \mathbf{g} does not point exactly to the center except at the equator and the poles.

P. 16, just below eqn (1.10b): should read $v = Dy/Dt$.

P. 26, Exercise M1.1: (Not strictly an error, but misleading.) The Matlab scripts provided suggest that the neglect of curvature terms in the inertial oscillation produces a nonphysical eastward migration of the inertial circle. This is because of the arbitrary retention of spherical effects in the equation for the rate of change of latitude λ with time. The subroutine xprim2.m, which produces the nonphysical eastward propagation, solves the system

$$\frac{Du}{Dt} = 2\Omega(\sin \phi)v \quad (1)$$

$$\frac{Dv}{Dt} = -2\Omega(\sin \phi)u \quad (2)$$

$$\frac{D\lambda}{Dt} = \frac{u}{a \cos \phi} \quad (3)$$

$$\frac{D\phi}{Dt} = \frac{v}{a}. \quad (4)$$

Correct westward propagation and, for small-amplitude oscillations, very good quantitative agreement with the full spherical solution computed by xprim1.m maybe obtained by replacing the variable ϕ in (3) with the fixed initial latitude of the parcel ϕ_0 . Using a fixed value for ϕ in (3) is consistent with the treatment of north-south displacements in the standard mid-latitude β -plane approximation.

P. 31, 2/3 down page: should read

$$\frac{D\mathbf{A}}{Dt} \equiv \mathbf{i}\frac{DA_x}{Dt} + \mathbf{j}\frac{DA_y}{Dt} + \mathbf{k}\frac{DA_z}{Dt}.$$

That is, the \mathbf{A} on the l.h.s. should be bold.

P. 32, just below first unlabel eqn: should read $\mathbf{\Omega} = (0, \Omega \cos \phi, \Omega \sin \phi)$

P. 87, Eq. (4.1) ∇_p should be ∇p

P. 97, Unnumbered Equation. To be consistent with previous page M should be δM

P. 136, Problem 5.5 To get the answer in the back of the book requires $K_s = 0.015 \text{ m}^{-1}\text{s}$.

P. 178, Problem 6.5 Needs additional information: let $\partial\Phi_o/\partial p = 0$.

p. 165, eqn (6.35b) and following discussion: When second derivatives are involved, the product rule of differentiation yields three terms as in the example

$$\frac{\partial^2 ab}{\partial x^2} = a \frac{\partial^2 b}{\partial x^2} + 2 \frac{\partial a}{\partial x} \frac{\partial b}{\partial x} + b \frac{\partial^2 a}{\partial x^2}.$$

Thus (6.35b) should have the additional term

$$-\frac{2}{\sigma} \left[\frac{\partial u_g}{\partial x} \frac{\partial^2}{\partial x^2} \left(\frac{\partial \phi}{\partial p} \right) + \frac{\partial v_g}{\partial x} \frac{\partial^2}{\partial x \partial y} \left(\frac{\partial \phi}{\partial p} \right) + \frac{\partial u_g}{\partial y} \frac{\partial^2}{\partial x \partial y} \left(\frac{\partial \phi}{\partial p} \right) + \frac{\partial v_g}{\partial y} \frac{\partial^2}{\partial y^2} \left(\frac{\partial \phi}{\partial p} \right) \right]$$

This is the term that Trenberth (1978: *Mon. Wea. Rev.*, **106**, 131-137) suggests is small in the middle troposphere. The first term in (6.35b) is not small, but rather is equal to the advection of relative vorticity by the geostrophic wind. Using the nondivergence of the geostrophic wind,

$$\nabla^2 u_g = -\frac{\partial^2 v_g}{\partial x \partial y} + \frac{\partial^2 u_g}{\partial y^2} = -\frac{\partial \zeta_g}{\partial y},$$

$$\nabla^2 v_g = \frac{\partial^2 v_g}{\partial x^2} - \frac{\partial^2 u_g}{\partial x \partial y} = \frac{\partial \zeta_g}{\partial x},$$

and the first term may be written

$$-\frac{1}{\sigma} \left[-\frac{\partial \zeta_g}{\partial y} \frac{\partial}{\partial p} (f_0 v_g) + \frac{\partial \zeta_g}{\partial x} \frac{\partial}{\partial p} (-f_0 u_g) \right] = \frac{f_o}{\sigma} \left[\frac{\partial \mathbf{V}_g}{\partial p} \cdot \nabla \left(\frac{1}{f_0} \nabla^2 \phi \right) \right].$$

The first terms in (6.35a) and (6.35b) differ only by the presence of the planetary vorticity inside the advective operator, and both imply that upward motion is forced by the advection of vorticity by the thermal wind.

As noted by Ed Bensman, carefully accounting for this advection of relative vorticity by the thermal wind would require the right side of (6.36) to have the form

$$\frac{1}{\sigma} \left[\frac{\partial \mathbf{V}_g}{\partial p} \cdot \nabla \left(\frac{2}{f_0} \nabla^2 \phi + f \right) \right].$$

Nevertheless for conceptual purposes, this forcing term is simply described as the advection of vorticity by the thermal wind (without bothering to distinguish between the factor-of-two difference in the weights applied to the relative and planetary vorticity).

p. 318, eqn (10.9), as noted by Nathan Gillett, the first term on the right side should be

$$\rho_0 \frac{\overline{D}}{Dt}(\overline{A})$$

(the ρ_0 belongs outside the convective derivative).