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

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Since Jim is not able to post these himself, we are taking the liberty of listing errors that have been identified in the 4th Edition. We miss you Jim.

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

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

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

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

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

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

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 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. 53, line 1: should be $N \sim 1.2 \times 10^{-2}$

P. 57, eqn (3.1): should be ∇p (rather than ∇_p (Tim Merlis)

P. 87, eqn (4.1) ∇_p should be ∇p. Also as noted by Mathew Barlow and Laurie Agel, since (4.1) is written for an inertial reference frame, the centrifugal force should not be included in the gravitation acceleration. The geopotential ϕ should therefore be replaced by the geopotential associated with true gravity alone $\phi^* = \phi - \Omega^2 \mathbf{R} \cdot \mathbf{R}/2$. The symbols are defined in (1.7); note that $\nabla \phi^* = \mathbf{g}^*$. Since we still have gravity as the gradient of a potential, the first equation after (4.2) still holds and the derivation remains essentially the same.

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

P. 101, eqn (4.16) The equals sign in the first line should be removed.

P. 117, eqns (5.1)-(5.3). As noted by John Nielson-Gammon, p is the departure of the total pressure from its hydrostatic reference-state value $p_0(z)$ defined in (2.26). It is the same quantity as p' in (2.27).

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

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. 167, Fig. 6.12, caption, should read "($w < 0$ dash-dot lines, $w > 0$ dotted lines)" and "downward motion occurs where vorticity increases moving left to right along an isotherm"

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).

p. 392, As noted by John Nielsen-Gammon, in (11.17), the partial derivative $\partial q_s/\partial z$ is the rate of change of q_s within an ascending parcel following a pseudoadiabat, so technically it's a partial derivative in the sense that θ_e is held constant. However, in the succeeding analysis, it is treated as a spatial partial derivative, with x, y, and t held constant. The consequence of this, after some mathematics, is the erroneous absence of a factor Γ_m/Γ_d (the ratio of the moist-adiabatic lapse rate to the dry adiabatic lapse rate) in the first line of the unnumbered equation after (11.19). Skipping the math, a plausibility argument that (11.17)-(11.19) are wrong as written is that (11.17) would imply that an ascending saturated air parcel would retain all its water vapor if the local lapse rate happened to be parallel to a constant saturated mixing ratio line on a pseudoadiabatic diagram.

Further details may be found in Nielsen-Gammon, J. W., and D. Keyser, 2000: Effective stratification for pseudoadiabatic ascent. *Mon. Wea. Rev.,* **128,** 3007-3010 or Durran, D.R., and J.B. Klemp, 1982: On the effects of moisture on the Brunt-Väisälä frequency. *J. Atmos. Sci.,* **39,** 2152-2158.