Corrections to 2006 Edition of Fundamentals of Geophysical Fluid Dynamics
James C. McWilliams
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Note: Some corrections were made in the 2008 printing, and more were made in the 2011 printing. The only known corrections to the 2011 printing are listed at the end.

• Page 9, last line: replace the clause "and mxa is momentum" with "the time derivative of velocity v, and mv is momentum".

• Page 10, second line before (2.3): change "acceleration of a fluid parcel" to "time derivative"

• Page 20, Fig. 2.4: the sign symbol should be changed from "+" to "-" in the center of the right panel and "positive χ" should be changed to "negative χ" in the caption.

• Page 28, line 5: the pressure unit is equal to "10^5 Pa" not "1 Pa".

• Page 54, equation (3.17), last line, and equation (3.18): insert minus sign on right-hand side.

$$\begin{aligned} \frac{dC}{dt} &= -\int_{\mathcal{C}} \frac{1}{\rho}\boldsymbol{\nabla} p \cdot \mathbf{ds} \;+\; \cdots \\ &= -\int\int_{\mathcal{A}} \hat{\mathbf{n}} \cdot \boldsymbol{\nabla} \times \left[\frac{1}{\rho}\boldsymbol{\nabla} p\right] \, d\mathcal{A} \;+\; \cdots \\ &= -\int\int_{\mathcal{A}} \frac{1}{\rho^2}\hat{\mathbf{n}} \cdot \boldsymbol{\nabla} p \times \boldsymbol{\nabla}\rho \, d\mathcal{A} \;+\; \cdots \; . \end{aligned} \tag{3.17}$$

$$\frac{dC}{dt} = -\int\int_{\mathcal{A}} \frac{\hat{\mathbf{z}}}{\rho_0^2} \cdot \boldsymbol{\nabla}_h p \times \boldsymbol{\nabla}_h \rho \; dx\, dy + \cdots \; . \tag{3.18}$$

• Page 65, equation (3.60): the final right-hand parenthesis in the third line should be deleted to become:

$$\begin{aligned} \zeta(\mathbf{x},t) &= \sum_{\alpha=1}^{N} C_\alpha \delta(\mathbf{x} - \mathbf{x}_\alpha) \\ \psi(\mathbf{x},t) &= \frac{1}{2\pi}\sum_{\alpha=1}^{N} C_\alpha \, \ln|\mathbf{x} - \mathbf{x}_\alpha| \\ \mathbf{u}(\mathbf{x},t) &= \frac{1}{2\pi}\sum_{\alpha=1}^{N} \frac{C_\alpha}{|\mathbf{x} - \mathbf{x}_\alpha|^2}[-(y - y_\alpha)\hat{\mathbf{x}} + (x - x_\alpha)\hat{\mathbf{y}}] \; . \end{aligned} \tag{3.60}$$

[This correction was made in the 2008 Edition.]

• Page 66, equation (3.67): replace it with

$$p_\alpha = |\, C_\alpha \,|^{1/2} \; x_\alpha, \quad q_\alpha = |\, C_\alpha \,|^{-1/2} \; C_\alpha \, y_\alpha \; . \tag{3.67}$$

and make the prefactor for H be $1/4\pi$ in (3.69), instead of $1/2\pi$.

• Page 73, first line after equation (3.72): the sentence should begin "Introducing (3.72) into (3.30) and ..."; i.e., the reference previously was (3.24), but should be (3.30).

• Page 74, equation after (3.77): delete one of the r factors in the right-side integral:

$$\int_0^\infty g^* \partial_r [r \partial_r g] \, dr = - \int_0^\infty r (\partial_r g^*) \, (\partial_r g) \, dr$$

• Page 74-75, bottom and top lines: replace parenthetical remark with "(since the point in x where $\partial_x \overline{\zeta} = 0$ in a parallel flow is an inflection point for the velocity profile, $\partial_{xx} \overline{v} = 0$)"

bullet Page 76, equation (3.85), the factor of 2 in γ^2 should be in the numerator not denominator:

$$\gamma^2 \;=\; \frac{2}{r^3} \overline{A} \, \frac{d\overline{A}}{dr}\Big|_{r=r_o} \, . \qquad (3.85)$$

• Page 77, equation (3.91): there is a typographic error, and after its removal the formula is

$$s^2 \;=\; \left(\frac{kU}{2}\right)^2 \left(2 \, \frac{1 + (1 - [kD]^{-1}) \tanh[kD]}{kD(1 + \tanh[kD])} - 1 \right) \, . \qquad (3.91)$$

• Page 85, equation (3.106): a $\boldsymbol{\nabla}$ symbol needs to be inserted into the second left-side term to become:

$$\frac{\partial \overline{\tau}}{\partial t} + \overline{\mathbf{u}} \cdot \boldsymbol{\nabla} \overline{\tau} \;=\; - \boldsymbol{\nabla} \cdot (\overline{\mathbf{u}' \tau'}) \, .$$

[This correction was made in the 2008 Edition.]

• Page 85, equations (3.107)-(3.108): move last line in the former to start of latter and put a factor of 1/2 into the final line to become:

$$\begin{aligned} \overline{\mathbf{u}' \tau'} \;&\approx\; - \overline{\mathbf{u}' (\mathbf{r}' \cdot \boldsymbol{\nabla}) \overline{\tau}} \\ &=\; - \overline{\frac{d\mathbf{r}'}{dt}} (\mathbf{r}' \cdot \boldsymbol{\nabla}) \overline{\tau} \, . \end{aligned} \qquad (3.107)$$

and

$$\overline{\frac{dr^{i\,\prime}}{dt} r^{j\,\prime}} \;=\; \frac{1}{2} \frac{d}{dt} \overline{r^{i\,\prime} r^{j\,\prime}} \;=\; \kappa_e \, \delta_{i,j} \, , \qquad (3.108)$$

• Page 90, equation (3.116): For Δk_E the KE divisor belongs inside the square root:

$$\begin{aligned} k_E \;&=\; \int d\mathbf{k} \, |\mathbf{k}| \, KE(\mathbf{k}) \Big/ KE \\ \Delta k_E \;&=\; \left(\int d\mathbf{k} \, (|\mathbf{k}| - k_E)^2 \, KE(\mathbf{k}) \Big/ KE \right)^{1/2} \Big/ KE \, . \end{aligned} \qquad (3.116)$$

• Page 124, Fig. 4.11: The two dotted sloping lines connecting the middle equal-height points on the front and rear side of the wave form have the same propagation velocity $V_+(\xi_+)$, hence the same slope. The revised figure below depicts this feature more accurately.

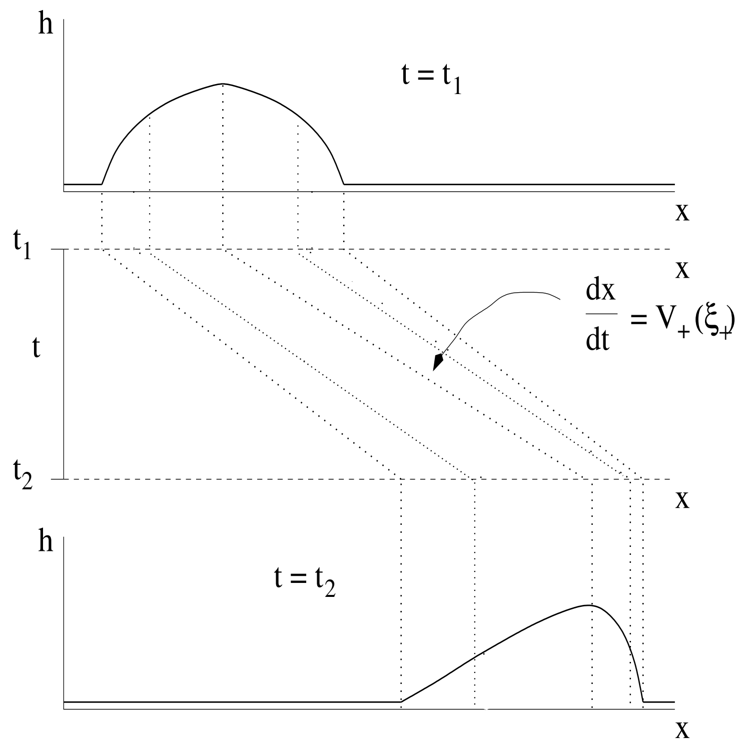

Fig. 4.11. Nonlinear evolution for an isolated, shallow-water, gravity wave of elevation. The wave shape at the earlier time ($t = t_1$; top) evolves into the shape at a later time ($t = t_2$; bottom) that has a shallower slope on its backward face and a steeper slope on its forward face. This example is for a rightward propagating wave. The characteristic coordinate, ξ_+, remains constant for each point on the wave, but its associated velocity, V_+, is larger where the elevation is higher (shown by the line slopes in the middle diagram).

• Page 125, top line of text (below Fig. 4.12): The coordinate relations are "$x_1 < X < x_2$", not the reverse.

• Page 126-127, equations (4.92) and (4.97): In the expressions for $\mathbf{u}_h$ and $\mathbf{r}'_h$, cancel the g factors in numerator and denominator, and change the sign of the term $\propto f$.

$$\begin{aligned} \eta &= \eta_0 \cos[\Theta] \\ \mathbf{u}_h &= \frac{\eta_0}{HK^2} \left(\omega \mathbf{k} \cos[\Theta] + f \hat{\mathbf{z}} \times \mathbf{k} \sin[\Theta]\right) \\ w &= \frac{\omega \eta_0 z}{H} \sin[\Theta] \, , \end{aligned} \qquad (4.92)$$

and

$$\begin{aligned} \mathbf{r}'_h &= -\frac{\eta_0}{HK^2} \left(\mathbf{k} \sin[\Theta] - \frac{f}{\omega} \hat{\mathbf{z}} \times \mathbf{k} \cos[\Theta]\right) \, , \\ r^{z\prime} &= \frac{\eta_0 z}{H} \cos[\Theta] \, . \end{aligned} \qquad (4.97)$$

• Page 128, first unnumbered equation: The expression to the right of the arrow has a factor of 1/2, *i.e.*,

$$\mathbf{u}^{st} \;\to\; \sqrt{\frac{g}{H}}\,\frac{\eta_0^2}{2H}\left(\frac{\mathbf{k}}{K}\right) \;=\; \frac{u_{h0}^2}{2\sqrt{gH}}\left(\frac{\mathbf{k}}{K}\right) \,,$$

• Page 129, first line of equation (4.103): There are two horizontal gradient operators, *i.e.,*

$$\begin{aligned} -\,\overline{\mathbf{u}_h' \cdot \boldsymbol{\nabla}_h \tau'} &= \overline{\left(\mathbf{u}_h' \cdot \boldsymbol{\nabla}_h\right)\left(\int^t \mathbf{u}_h'\, dt\right) \cdot \boldsymbol{\nabla}_h \overline{\tau}} \\ &\approx -\,\overline{\left(\left(\int^t \mathbf{u}_h'\, dt\right) \cdot \boldsymbol{\nabla}_h\right) \mathbf{u}_h'} \cdot \boldsymbol{\nabla}_h \overline{\tau} \\ &= -\,\mathbf{u}^{st} \cdot \boldsymbol{\nabla}_h \overline{\tau} \,. \end{aligned} \qquad (4.103)$$

• Page 135, second line following equation (4.124): The symbol R should be formatted the same as the first symbol in (4.124) and as on the fifth line following equation (4.124), i.e., approximately drawn as $\mathcal{R}$. *[This correction was made in the 2008 Edition.]*

• Page 151, equation (5.37): the prefactors for $\tilde{\psi}_1$ should have square roots:

$$\begin{aligned} \psi_1 &= \tilde{\psi}_0 + \sqrt{\frac{H_2}{H_1}}\,\tilde{\psi}_1 \\ \psi_2 &= \tilde{\psi}_0 - \sqrt{\frac{H_1}{H_2}}\,\tilde{\psi}_1 \,. \end{aligned} \qquad (5.37)$$

• Page 156, first line in equation (5.52): The exponent should be n, not $n+1$:

$$\overline{\psi}_n \;=\; (-1)^n U y$$

• Page 161, Fig. 5.6: remove the tilde symbols from the two layer streamfunctions in the third row of the figure, so they are ψ_1' and ψ_2'.

• Page 181, equation (5.103): The sign convention here for $\mathbf{E}$ is the opposite of that used in Andrews, D.G., J.R. Holton, and C.B. Leovy, 1987: *Middle Atmosphere Dynamics.* Academic Press. *[This is a remark not a needed correction.]*

• Pages 198 (equation (6.30)), 199 (equation (6.33)), and 202 (equation (6.38), first line): the symbol f should be replaced by $|f|$ in these specific formulas. Also, in equation (6.38), the equation for $\overline{v}(z)$ should swap $\cos[\lambda z]$ and $\sin[\lambda z]$.

$$h_{ek} \;=\; \lambda^{-1} \;=\; \sqrt{\frac{2\nu_e}{|f|}} \,. \qquad (6.30)$$

$$\epsilon_{ek,\,bot} \;=\; \sqrt{\frac{|f|\nu_e}{2}} \;=\; \frac{|f| h_{ek}}{2} \qquad (6.33)$$

$$
\begin{aligned}
U(z) &= (1 - i\mathcal{S}_f)\, \frac{\tau_s^x + i\tau_s^y}{\rho_o\sqrt{2|f|\nu_e}}\; e^{\lambda(1+i\mathcal{S}_f)z} \\
\overline{u}(z) &= \frac{1}{\rho_o\sqrt{2|f|\nu_e}}\; e^{\lambda z}\; \big(\, (\tau_s^x + \mathcal{S}_f \tau_s^y) \cos[\lambda z] \\
&\qquad + (\tau_s^x - \mathcal{S}_f \tau_s^y) \sin[\lambda z] \,\big) \\
\overline{v}(z) &= \frac{1}{\rho_o\sqrt{2|f|\nu_e}}\; e^{\lambda z}\; \big(\, (-\mathcal{S}_f \tau_s^x + \tau_s^y) \cos[\lambda z] \\
&\qquad + (\mathcal{S}_f \tau_s^x + \tau_s^y) \sin[\lambda z] \,\big)\ ,
\end{aligned}
\tag{6.38}
$$

- Page 238, Rotating shallow-water and wave dynamics, problem 7, fourth line: insert "zonal" before "velocity patch" so it becomes "; (c) a zonal velocity patch". *[This correction was made in the 2008 Edition.]*

- Page 239, Baroclinic and jet dynamics, problem 5, second line: insert "quasigeostrophic," before "baroclinic instability" so it becomes "quasigeostrophic, baroclinic instability of a mean flow." *[This correction was made in the 2008 Edition.]*

- Page 239-240, problem 8: We rotate the flow orientation to be consistent with the Answers. The equation in the third line should be changed from

$$
\mathbf{u} = Sz\hat{\mathbf{y}}, \qquad b = N^2 z + fSx\ ,
$$

to

$$
\mathbf{u} = Sz\hat{\mathbf{x}}, \qquad b = N^2 z - fSy\ ,
$$

The mean advection in the top two equations on p. 240 should be changed from $V\partial_y$ to $Sz\partial_x$, and the factor in the last term in the vertical boundary condition should be changed from $\partial_y\psi'$ to $\partial_x\psi'$. The new forms are

$$
[\partial_t + Sz\partial_x]q' = 0 \quad \Rightarrow \quad q' = 0\ ,
$$

and

$$
[\partial_t + Sz\partial_x]\partial_z\psi' - S\partial_x\psi' = 0
$$

- Page 243, reference Holland, W.R. (1986), second line: The editor's name should be J.J. O'Brien. *[This correction was made in the 2008 Edition.]*

I think that the corrections above were made in the 2011 printing.

Additional corrections are the following:

- Page 15: move remark about "$w = D_t z$" from below 1st eqn. in Sec. 2.1.4 to below (2.19).
- Page 66, equation (3.69): make the prefactor for H be $1/4\pi$, instead of $1/2\pi$.
- Page 76, equation (3.85), the factor of 2 in γ^2 should be in the numerator not denominator:

$$\gamma^2 \;=\; \frac{2}{r^3}\overline{A}\,\frac{d\overline{A}}{dr}\Big|_{r=r_o} \;. \qquad (3.85)$$