Errata for Numerical Methods for Fluid Dynamics: With Applications to Geophysics*

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June 6, 2017

Chapter 1

- *p. 28, line 4:* "Chap. 2" should be "Chap. 3"

Chapter 2

- *p. 38, text line 14:* "t_n" should be "τ_n"
- *p. 39,* second line in first equation after (2.12) is missing an "("; it should begin

$$= (1 + \lambda\Delta t)[(1$$

- *p. 39,* last equality in (2.13) should be "$\leq$"
- *p. 40, line 10:* Replace "Define the *amplification*" with "For homogenous ODE, define the *amplification*"
- *p. 40, 1st line after (2.15)*, Replace "$\eta = \lambda$ is just the coefficient of ψ in the forcing $F(\psi, t)$." with "$\eta = |\lambda|$."
- *p. 45, first equation after (2.24)*, both instances of $(\omega\Delta t)$ should be $(\omega\Delta t/2)$
- *p. 53, first half of 2nd displayed equation:* should read

$$b_2 c_2^2 + b_3 c_3^2 = \frac{1}{3}$$

- *p. 53, center of page:* the time that appears in the equation for q_3 should be $t_n + \frac{3}{4}\Delta t$ (replacing $t_n + \frac{5}{12}\Delta t$)
- *p. 56, while not actually errata, I have been asked for the non-autonomous versions of (2.47)–(2.49). Here they are*

$$\begin{aligned} \phi_{(1)} &= \phi_n + \Delta t B(\phi_n, t_n), \\ \phi_{(2)} &= \phi_{(1)} + \Delta t B(\phi_{(1)}, t_n + \Delta t), \\ \phi_{n+1} &= \tfrac{1}{2}\left(\phi_n + \phi_{(2)}\right) \end{aligned} \qquad (2.47)$$

$$
\begin{aligned}
\phi_{(1)} &= \phi_n + \Delta t B(\phi_n, t_n), \\
\phi_{(2)} &= \tfrac{3}{4}\phi_n + \tfrac{1}{4}\left[\phi_{(1)} + \Delta t B(\phi_{(1)}, t_n + \Delta t)\right], \\
\phi_{n+1} &= \tfrac{1}{3}\phi_n + \tfrac{2}{3}\left[\phi_{(2)} + \Delta t B(\phi_{(2)}, t_n + \tfrac{\Delta t}{2})\right]. \qquad (2.48)
\end{aligned}
$$

$$
\begin{aligned}
\phi_{(1)} &= \phi_n + \tfrac{1}{2}\Delta t B(\phi_n, t_n), \\
\phi_{(2)} &= \phi_{(1)} + \tfrac{1}{2}\Delta t B(\phi_{(1)}, t_n + \tfrac{\Delta t}{2}), \\
\phi_{(3)} &= \tfrac{2}{3}\phi_n + \tfrac{1}{3}\left[\phi_{(2)} + \tfrac{1}{2}\Delta t B(\phi_{(2)}, t_n + \Delta t)\right], \\
\phi_{n+1} &= \phi_{(3)} + \tfrac{1}{2}\Delta t B(\phi_{(3)}, t_n + \tfrac{\Delta t}{2}), \qquad (2.49)
\end{aligned}
$$

- *p. 58, 4th line* to avoid ambiguity, the last equality is better written as $\alpha = 1 \pm \sqrt{2}/2$. (Thanks to Greg Hammett for noting this.)
- *pp.69-70:* The forcing in (2.80)–(2.83) should include explicit time dependence; for example, $F(\phi_n)$ should be replaced by $F(\phi_n, t_n)$
- *p. 70:* Replace h in (2.81)–(2.83) by Δt
- *p. 80:, top 5 lines:* Three instances of $1/2\sqrt{2}$ are less ambiguously written as $\sqrt{2}/2$
- *p. 81, 1st line:* $1/2\sqrt{2}$ is less ambiguously written as $\sqrt{2}/2$
- *p. 86, problem 5:* Replace text after the displayed equation with:

  Being centered in time, this method should be second order in Δt. Show that the truncation error is indeed zero through $O(\Delta t)$. *Hint:* note that if $\psi' = F(\psi, t)$,

  $$\psi'' = \frac{\partial F}{\partial \psi}\psi' + \frac{\partial F}{\partial t}.$$

- *p. 89, left side of displayed equation:* denominator should be $2\Delta x$, not Δx

Chapter 3

- *p. 128, eqn 3.84:*, Δx^2 should be $(\Delta x)^2$
- *p. 129, text line 15:* "unconditional instability" should read "unconditional stability"
- *p. 133, eqn after 3.92, and following text line:* A_{lfb} should be A_{lft}

Chapter 4

- *p. 170, footnote:* Sect. 2.2.3 should be Sect. 2.1.2

- *p. 198, Hint for problem 3b:* Compare the direction of the paths along which energy propagates, determined by the ratio of the vertical to the horizontal group velocity, in the limit where the vertical wavelength approaches $2\Delta z$. The temporal and horizontal resolution should be assumed to be greater than $4\Delta t$ and $4\Delta x$, respectively.

Chapter 5

- *p. 231, 2nd line in caption:* "MS" should be "MC"

- *p. 256, first set of displayed equations should read:*

$$\begin{aligned} P^+_{i,j} &= \left[\max\left(0, A_{i-\frac{1}{2},j}\right) - \min\left(0, A_{i+\frac{1}{2},j}\right)\right]\Delta y \\ &\quad + \left[\max\left(0, A_{i,j-\frac{1}{2}}\right) - \min\left(0, A_{i,j+\frac{1}{2}}\right)\right]\Delta x, \\ P^-_{i,j} &= \left[\max\left(0, A_{i+\frac{1}{2},j}\right) - \min\left(0, A_{i-\frac{1}{2},j}\right)\right]\Delta y \\ &\quad + \left[\max\left(0, A_{i,j+\frac{1}{2}}\right) - \min\left(0, A_{i,j-\frac{1}{2}}\right)\right]\Delta x. \end{aligned}$$

- *p. 256, after last set of displayed equations add:*

$$Q^+_j = \left(\phi^{\max}_j - \phi^{\mathrm{td}}_j\right)\frac{\Delta x \Delta y}{\Delta t}$$

$$Q^-_j = \left(\phi^{\mathrm{td}}_j - \phi^{\min}_j\right)\frac{\Delta x \Delta y}{\Delta t}$$

- *p. 279, 2nd line of Prob. 10:* the zero is redundant, the line could read

$$\mathrm{sgn}(a)\max\left[\min(|a|, 2|b|),\ \min(2|a|, |b|)\right]$$

- *p. 279, 7th line from bottom:* "forward" should be "upstream"

Chapter 6

- *p. 345, 4th displayed equation should read*

$$w_k \frac{\Delta x_j}{2}\frac{da_k}{dt} = \sum_{n=0}^{N} F[\tilde{\phi}_j(\xi_n)]D_{k,n}w_n - \hat{F}(\tilde{\phi}_j, \tilde{\phi}_{j+1})\delta_{kN} + \hat{F}(\tilde{\phi}_{j-1}, \tilde{\phi}_j)\delta_{0k},$$

- *p. 349, line 1:* "$N = 5$" should be "5 nodes" (which is $N = 4$)

- *P. 349:* both instances of "0.67" should be "0.69"

Chapter 8

- *p. 419, (8.78):* replace du/dt by $\partial u/\partial t$
- *p. 419, (8.79):* replace dw/dt by $\partial w/\partial t$
- *p. 419, 4th line from bottom:* "$\alpha = 0.2$" should be "$\alpha = 0.5$ m^2 s^{-2}"
- *p. 420, displayed equation:* should read

$$\phi^{n+1} = [\mathcal{F}_2(\Delta t/M)]^{(M/2)}\, \mathcal{F}_1(\Delta t)\, [\mathcal{F}_2(\Delta t/M)]^{(M/2)}\, \phi^n,$$

- *p. 420, Fig. 8.2:* replace lower of the two contour labels reading "9.8" by "10.2". (The perturbation u is anti-symmetric about $z = 0$.) Also the units for Ψ should read "m^2 s^{-2}".
- *p. 421, Fig. 8.3:* The units for Ψ should read "m^2 s^{-2}".