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

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Chapter 1

• p. 28, line 4: “Chap. 2” should be “Chap. 3”

Chapter 2

• p. 38, text line 14: “tn” should be “rn”
• p. 39, second line in first equation after (2.12) is missing an “(”; it should begin
  \[ = (1 + \lambda \Delta t) \]
• p. 39, last equality in (2.13) should be “≤”
• 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 \( \psi \) 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. 56, while not actually errata, I have been asked for the non-autonomous versions of (2.47)–(2.49). Here they are
  \[ \phi_{(1)} = \phi_n + \Delta t B(\phi_n, t_n), \]
  \[ \phi_{(2)} = \phi_{(1)} + \Delta t B(\phi_{(1)}, t_n + \Delta t), \]
  \[ \phi_{n+1} = \frac{1}{2} \left( \phi_n + \phi_{(2)} \right) \]  

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\[ \phi(1) = \phi_n + \Delta t B(\phi_n, t_n), \]
\[ \phi(2) = \frac{3}{4} \phi_n + \frac{1}{4} \left[ \phi(1) + \Delta t B(\phi(1), t_n + \Delta t) \right], \]
\[ \phi_{n+1} = \frac{1}{3} \phi_n + \frac{2}{3} \left[ \phi(2) + \Delta t B(\phi(2), t_n + \Delta t) \right]. \] (2.48)

\[ \phi(1) = \phi_n + \frac{1}{2} \Delta t B(\phi_n, t_n), \]
\[ \phi(2) = \phi(1) + \frac{1}{2} \Delta t B(\phi(1), t_n + \Delta t), \]
\[ \phi(3) = \frac{2}{3} \phi_n + \frac{1}{3} \left[ \phi(2) + \frac{1}{2} \Delta t B(\phi(2), t_n + \Delta t) \right], \]
\[ \phi_{n+1} = \phi(3) + \frac{1}{2} \Delta t B(\phi(3), t_n + \Delta t). \] (2.49)

- **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 \( \Delta t \)
- **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 \( \Delta t \). Show that the truncation error is indeed zero through \( O(\Delta t) \). **Hint**: note that if \( \psi' = F(\psi, t) \),
  \[ \psi''' = \frac{\partial F}{\partial \psi} \psi' + \frac{\partial F}{\partial t}. \]

**Chapter 3**
- **p. 128, eqn 3.84:** \( \Delta x^2 \) 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**: \( A_{1fb} \) should be \( A_{1ft} \)

**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:

\[ P_{i,j}^+ = \left[ \max \left(0, A_{i-\frac{1}{2},j} \right) - \min \left(0, A_{i+\frac{1}{2},j} \right) \right] \Delta y 
+ \left[ \max \left(0, A_{i,j-\frac{1}{2}} \right) - \min \left(0, A_{i,j+\frac{1}{2}} \right) \right] \Delta x, \]

\[ P_{i,j}^- = \left[ \max \left(0, A_{i+\frac{1}{2},j} \right) - \min \left(0, A_{i-\frac{1}{2},j} \right) \right] \Delta y 
+ \left[ \max \left(0, A_{i,j+\frac{1}{2}} \right) - \min \left(0, A_{i,j-\frac{1}{2}} \right) \right] \Delta x. \]

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

\[ Q_j^+ = (\phi_{j}^{\text{max}} - \phi_{j}^{\text{td}}) \frac{\Delta x \Delta y}{\Delta t} \]

\[ Q_j^- = (\phi_{j}^{\text{td}} - \phi_{j}^{\text{min}}) \frac{\Delta x \Delta y}{\Delta t} \]

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

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

p. 279, 7th line from bottom: “forward” should be “upstream”

Chapter 6

p. 345, 4th displayed equation should read

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

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 “$\alpha = 0.5 \text{ m}^2 \text{s}^{-2}$”

• 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 $\Psi$ should read “$\text{m}^2 \text{s}^{-2}$”.

• p. 421, Fig. 8.3: The units for $\Psi$ should read “$\text{m}^2 \text{s}^{-2}$.”