Book Review

Double-Diffusive Convection by Timour Radko, Cambridge University Press, 2013;
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In the ocean, the water density is not sufficiently characterized by the salt content or temperature alone, but rather both. Throughout much of the tropics, the top portion of the ocean is warm and salty, while the lower part is cold and fresh. In this configuration, a beautiful instability can occur if heat diffuses faster than salt. Consider a small parcel of warm, salty fluid that falls down slightly, the heat escapes from the parcel but it stays salty, thus it is still heavier than the surrounding fluid and continues to fall. This instability forms what are known as salt fingers. If the situation is flipped, with salty warm water below fresh cold water as in the arctic, a convective instability can form: a cold fresh parcel is displaced slightly downward, it quickly heats up without gaining salt and becomes buoyant and rises, leading to double-diffusive convection.

Timour Radko's book, *Double-Diffusive Convection*, describes the character and mathematical features of salt fingers and double-diffusive convection. These ideas are then immediately put into practice. Numerical simulations, laboratory experiments, and oceanographic observations are described in detail. The intimate connection between theory and data is a strength of this text. For example, the Turner angle is introduced to show the parameter ranges of the instability modes and at the same time the distribution of the Turner angle in all oceans is also shown (Sect. 1.6). In other places in the book, such as Sect. 4.2 on salt finger interfaces, laboratory

experiments and numerical simulations are presented in concert. This approach mirrors the great number of tools oceanographers have at their fingertips and shows that great insight can come from comparisons. This text gives a more complete description of double diffusion because it illustrates all aspects of the science.

Radko also brings together literature on applications of double diffusion outside of oceanography, in fields such as astrophysics, material science, and geology. The field of double diffusion is relatively new and there are many opportunities to find applications in new fields or in new places. A section is also included about scientific communication. While it is devoid of equations and plots, it is an important reminder that the relevance of any scientific discipline must be communicated effectively—even one as beautiful and applicable as double diffusion!

The content of this text could be effectively communicated in a classroom. While it is best suited for advanced graduate students in fluid dynamics or physical oceanography, students in other related fields would certainly learn a lot from this text. Also, the frequent use of oceanographic observations, laboratory data, and beautiful pictures provides the opportunity to present the ideas in a section on double-diffusive convection in an undergraduate or graduate course on physical oceanography.

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