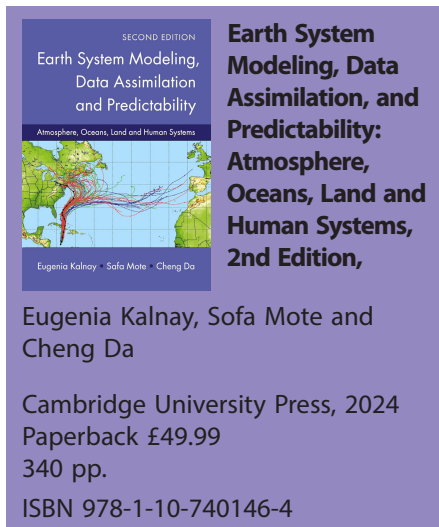




This book builds on Kalnay's 2002 book, 'Atmospheric Modeling, Data Assimilation, and Predictability', published by the same publisher. The title suggests broad Earth system coverage, but the focus remains on the atmosphere. The book suits upper-level undergraduate or Master's students with strong backgrounds in atmospheric physics, fluid dynamics, mathematics and statistics, or related fields – I would highly recommend reading Holton and Hakim (2013) beforehand. The writing is clear and engaging, and high-quality colour plots and practical examples enhance understanding.

The use of colour plots and figures in Chapter 1, 'An Overview of Numerical Weather Prediction', especially enhances engagement. The expanded comparison between this edition and Kalnay (2002) is a welcome addition that improves the overall presentation. The chapter gives a good introduction to the subject and the rest of the book.

Chapter 2, 'The Continuous Equations', provides a strong introduction to fluid mechanics, essential for understanding atmospheric dynamics. It covers different types of waves, oscillations, approximation and filtering, and concludes with special cases of atmospheric motion equations. The newly added discussions on tropical regions and Kelvin waves are valuable improvements.

Chapter 3, which covers 'The Numerical Discretisation of the Equations of Motion', is

fluent and straightforward. It includes good discussions on numerical analysis, a key skill in this field. Ill-posed, initial- and boundary-values problems and their numerical implementations are also explained well.

Chapter 4, 'Introduction to the Parametrisation of Sub-grid Scale Physical Processes', discusses the use of high-resolution data in numerically discretised models with lower resolutions. It presents mathematical parametrisation processes for some dynamic models as well. As this chapter is relatively short, I think it could have been merged with Chapter 3.

Chapter 5, 'Data Assimilation', is considerably long but comprehensive. The expanded discussion on ensemble Kalman filtering (EnKF, e.g. Evensen, 2003), square root EnKF and other methods is highly relevant and reflects recent developments in the field. However, given the chapter's length, splitting it into two parts – one for general data assimilation concepts and another for advanced methods – would improve readability. Additionally, introducing coupled data assimilation (weakly and strongly), which is relevant in research in this field, would further enhance the book. Otherwise, I think Chapter 5 is well-structured and quite informative and attractive: I enjoyed reading this chapter and used some parts in my own work!

Chapter 6, 'Atmospheric Predictability and Ensemble Forecasting', offers an excellent review of atmospheric prediction methods. Concepts around chaotic systems, sensitivity, and ensemble forecasting are explained well. The discussion on ocean–atmosphere coupling is also valuable.

Including a printed Fortran computer code example for computing tangent linear and adjoint models is good, but a link to the code in an online repository would have been enough. There are modern resources and online repositories which I think could have been mentioned, for example 'Data Assimilation with Python: a Package for Experimental Research' (DAPPER¹, Raanes et al., 2024).

I was somewhat disappointed by the inconsistent use of abbreviations and the

presentation of certain mathematical formulae. For example, some abbreviations are introduced but not consistently used throughout the text, with certain sections omitting them while others include them without prior definition. Not all parameters of a few formulae are defined, and, in some cases, identical symbols have been used for different quantities.

I would have welcomed a little more detail on other Earth systems; perhaps something like <https://education.nationalgeographic.org/resource/earths-systems/>, given the book is focused on the atmosphere. The reference list is extensive and includes recent publications. Format unification and checking citations are beneficial. For example, some in-text citations do not appear in the reference list.

Generally, the book is a valuable resource for students and researchers with a good background in atmospheric dynamics, physics, fluid mechanics, mathematics and statistics. It is best suited for postgraduate and advanced undergraduate students, and I think it is well worth its price.

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Mehdi Eshagh 

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¹<https://github.com/nansencenter/DAPPER>