

# CLIMATE MODELLING

Philosophical and  
Conceptual Issues

Edited by  
Elisabeth A. Lloyd  
and Eric Winsberg



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Editors

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palgrave  
macmillan

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ISBN 978-3-319-65057-9      ISBN 978-3-319-65058-6 (eBook)  
<https://doi.org/10.1007/978-3-319-65058-6>

Library of Congress Control Number: 2017963873

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Printed on acid-free paper

This Palgrave Macmillan imprint is published by Springer Nature  
The registered company is Springer International Publishing AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Preface

We have both been fascinated by models for our entire careers. Climate models are especially interesting, because they are the largest and most complex of models and also, in some sense, the most mysterious. The systems are completely filled with nonlinear equations and unpredictability, yet some climate models are valued for their predictive capacities. Others are appreciated for their abilities to represent causal forces within climate systems and their interactions, and yet others represent those systems simply, elegantly, and yet powerfully.

There are numerous philosophical questions involving representation, grounding, and reality itself that arise when using climate models, as well as conceptual issues concerning the models as tools themselves. Yet there is no book or collection available that addresses these issues. We have aimed to collect a set of essays here that discusses these and other philosophical and conceptual questions about climate models. We asked some of the best philosophers and some of the best modelers to contribute to the book, and they agreed, to our delight.

Our book is intended to be enjoyed by policy-makers, climate scientists, and philosophers alike, as well as the general public. Some essays, such as those concerning policy and robustness, in parts 2 and 3 of the book, are very accessible. There are sections of part 1 that are more technical, such as the Santer et al. paper, but that is explained in Lloyd's essay and in Santer et al.'s "Fact Sheet" in part 1.

Sadly, there is rampant disinformation circulating about climate models today, despite concerted efforts by climate scientists to correct the public record. The essays contributed to this book provide a foundation for an informed discourse concerning climate models, one based on theory, facts, and evidence.

We have both learned a great deal about climate modeling through editing this collection, and our hope is that anyone dipping into the book will experience the same benefit. Of course, modeling is an ongoing activity, and many of the facets explored in this book will continue to fascinate both modelers, philosophers, and policy analysts for some time to come.

Bloomington, IN, USA  
Tampa, FL, USA  
June 2017

Elisabeth A. Lloyd  
Eric Winsberg

# Acknowledgments

As usual for a book of this size, many people were involved in the creation of it, and we are able to thank just a fraction of those, here. We would start by thanking Linda Mearns, Jeffrey Kiehl, and Doug Nychka for making Lisa Lloyd's (EAL's) visits to the National Center for Atmospheric Research (NCAR) possible over the years. They and many climate scientists, including Caspar Amman, Melissa Bukovsky, Jim Hurrell, Brian O'Neill, Claudia Tebaldi, Kevin Trenberth, Tom Wigley, and others too numerous to name, introduced me (EAL) to the fundamentals of climate science and climate modeling and also introduced me to many more scientists who would help Lisa along my journey. Being an Affiliate Scientist at NCAR has also helped me meet many scientists from around the world who contributed enormously to her learning and to this book, such as Reto Knutti, Ricky Rood, Jonathan Rougier, Gabriel Hegerl, and her co-author Vanessa Schweizer, among many others. Her co-organization of a running session at the American Geophysical Union (AGU) allowed the opportunity to meet yet more climate scientists, such as Michael Mann, a key figure in understanding climate. She would also like to thank Ben Santer, to whom a debt is also owed for help, patience, and heroism in the face of adversity.

During my many years of research into the philosophy and foundations of climate modeling, Lisa was supported financially by two sources, my endowed chair and the National Science Foundation (NSF). The Arnold

and Maxine Tanis Chair of History and Philosophy of Science made my annual trips to NCAR possible, as well as the annual trips to the AGU. Lisa has had the privilege of knowing Bud and Maxine Tanis, and they are some of the finest and most lovely people She has met in my entire life. Lisa was also funded through two NSF Scholar Grants, “A case of objectivity in science: Climate change” (2007, #0646253) and “What is ‘Value Added’ in Regional Climate Modeling?” (2016–2017, #1632202). These grants helped make it possible for me to visit NCAR in Boulder for longer visits and to attend workshops and the AGU during those years. Lisa is indebted to Fred Kronz and the NSF for their support.

Finally, Lisa would also like to thank her research assistants, Chris ChoGlueck, Daniel Lindquist, and, most gratefully, Ryan Ketcham, for their patience and help over the several years that it took to get this book produced. She would also note that she owes much happiness and accomplishment to her beloved husband and partner, Teddy Alfrey. All of these people aided in overcoming the delaying effects of a car accident and spinal surgery on the production of this book. Lisa owes them a great deal indeed.

Eric Winsberg would like to thank the Institute of Advanced Study at Durham University, where he had the opportunity to learn about climate science from many of the practitioners affiliated with the university and to make climate science a focus of his philosophical study, and the Institute of Advanced Study on the Media Cultures of Computer Simulation at Leuphana University, which supported much of the work on this book. He would like to thank Jessica Williams for the support she gives him in all his endeavors.



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