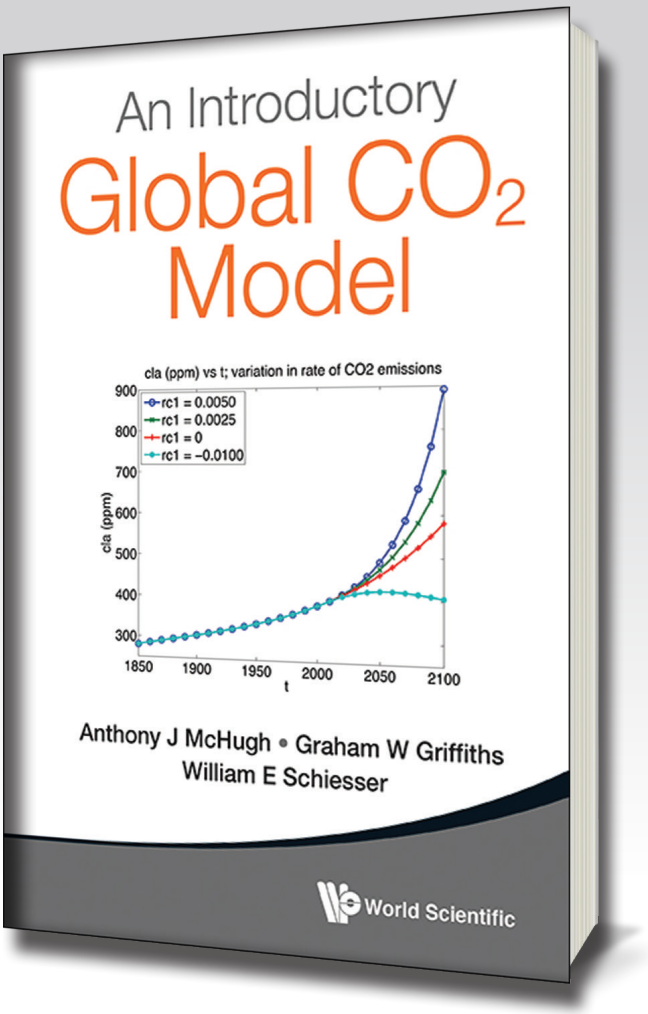

An Introductory Global CO2 Model

(with Companion Media Pack)

by **Anthony J McHugh** *(Lehigh University, USA)*, **Graham W Griffiths** *(City University London, UK)* & **William E Schiesser** *(Lehigh University, USA)*

The increasing concentration of atmospheric CO2 is now a problem of global concern. Although the consequences of atmospheric CO2 are still evolving, there is compelling evidence that the global environmental system is undergoing profound changes as seen in the recent spike of phenomena: extreme heat waves, droughts, wildfires, melting glaciers, and rising sea levels. These global problems directly resulting from elevated atmospheric CO2, will last for the foreseeable future, and will ultimately affect everyone. The CO2 problem is generally not well understood quantitatively by a general audience; for example, in respect of the increasing rate of CO2 emissions, and the movement of carbon to other parts of Earth's environmental system, particularly the oceans with accompanying acidification.

This book therefore presents an introductory global CO2 mathematical model that gives some key numbers — for example, atmospheric CO2 concentration in ppm and ocean pH as a function of time for the calendar years 1850 (preindustrial) to 2100 (a modest projection into the future). The model is based on seven ordinary differential equations (ODEs), and is intended as an introduction to some basic concepts and a starting point for more detailed study.

Quantitative insights into the CO2 problem are provided by the model and can be executed, with postulated changes to parameters, by a modest computer. As basic calculus is the only required mathematical background, this model is accessible to high school students as well as beginning college and university students. The programming of the model is in Matlab and R, two basic, widely used scientific programming systems that are generally accessible and usable worldwide. This book can therefore also be useful to readers interested in Matlab and/or R programming, or a translation of one to the other.

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978-981-4663-03-8 **US$48 / £32**

Readership: Students (undergraduate and above) and members of the public interested in/concerned with long-term environmental change.

Contents:
Model Structure; Model Equations; Model Parameters; Computer Routines; Main Programs; Plotting Routines; ODE Routines; Emissions Rate Routines; Base Case Model Output; Ocean Chemistry; An Interpretation of Dimensionless ODEs; Calculation of pH; Global CO2 Concentration

About the Authors:

Prof. Anthony J McHugh is the Ruth H and Sam Madrid Professor, in the Faculty of Chemical and Biomolecular Engineering, at Lehigh University, USA. His research centers on polymer science and engineering, membrane formation, and controlled-release drug delivery.

Dr. McHugh has published more than 200 technical articles and presented his work at more than 250 seminars at conferences around the world. He served on Lehigh's faculty from 1971 to 1979, and on the faculty of the University of Illinois at Urbana-Champaign from 1979 to 2002, before returning to Lehigh.

Prof. Graham W Griffiths is Visiting Professor at City University, London. His current research interests include: solutions to PDEs; high resolution solutions to evolution equations with sharp gradients; traveling waves; numerical methods; climate modeling; history of science.

Prof. Griffiths has worked extensively in the field of dynamic simulation of physical and chemical processes, spending over thirty years developing mathematical models and solution techniques. He has published 30+ papers in journals and in conference proceedings along with three books. He was a founder of Special Analysis and Simulation Technology Ltd. where he was managing director and actively directed simulation development — specifically developing dynamic models for multi-component distillation and multi-phase transport. The company was acquired by Aspen Technology in 1997 and following the merger, he became vice president of operations and technology within AspenTech. He previously managed scientific computing at Davy McKee. Graham Griffiths is a Fellow of the Institute of Measurement and Control, and a Chartered Engineer. He was granted Freedom of the City of London in 1995.

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Selected publications by Prof. Schiesser include: *The Numerical Method of Lines; Recent Developments in Numerical Methods and Software for ODEs/DAEs/PDEs; Computational Mathematics in Engineering and Applied Science; Computational Transport Phenomena; A Compendium of Partial Differential Equation Models; Partial Differential Equation Analysis in Biomedical Engineering; Differential Equation Analysis in Biomedical Science and Engineering, (1) ODE Applications in R, (2) PDE applications in R.*

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