

## An Introductory Global CO<sub>2</sub> Model

The model is intended to quantitatively introduce the CO<sub>2</sub> problem at a basic level, with particular emphasis on ocean acidification which has not received the same attention as global warming and climate change, but could be just as important.

We have revised the model so that it now has the following features:

- The structure of seven reservoirs (upper atmosphere, lower atmosphere, long lived biota, short lived biota, ocean upper layer, ocean deep layer and marine biosphere) has been retained. With complete mixing assumed in each reservoir, the model consists of just seven initial-value ODEs that are integrated numerically, typically over the interval 1850 (preindustrial) to 2100.
- The ocean chemistry calculations address acidification (with ocean pH typically ranging from 8.2 to 7.8). These calculations illustrate some basic numerical procedures, e.g., a Newton solver applied to a fourth order polynomial to calculate pH and spline interpolation to provide additional model outputs.
- A basic global warming component has been added based on CO<sub>2</sub> buildup in the lower atmosphere.
- The relative (dimensionless) ODE dependent variables (fractional changes from 1850) are now also expressed as absolute variables, typically GtC (gigatons of carbon), so that comparisons of the model output with reported (literature) values is possible. Some brief comparisons are provided in the documentation file.
- Projected anthropogenic CO<sub>2</sub> emissions can be varied as in the original model to investigate long-term responses, e.g., ppm CO<sub>2</sub> in the atmosphere and ocean pH.

The folder *CO2\_model* has the following subdirectories:

- *matlab*: The Matlab routines for the model; to execute the model, merely type *model\_1\_main* at the Matlab prompt for the *ncase* = 1 output. *model\_2\_main* executes four cases (*ncase* = 1, 2, 3, 4) as explained in file *model.pdf* (see below).
- *documentation* - a description of the model and the associated Matlab code is in file *model.pdf*. The figure files referenced by *model.pdf* are also included as *fig1.ppt* to *fig7.eps*; they have either the format ppt (Powerpoint) or eps (encapsulated post script).
- *references* - several papers from the scientific literature pertaining to topics such as ocean acidification; these papers are listed and briefly described in the file *read1st.pdf* in folder *references*.

If after reviewing this software and information, you have additional questions, we will be glad to respond by e-mail. Please direct any questions to wes1@lehigh.edu.

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