Mathematical Modeling, Computation and Simulation of Predicting Methane Concentrations in the Atmosphere

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Abstract

The mathematics of sustainability is a current research area that generates global interest. Methane is an important greenhouse gas with a warming radiative forcing that is 25 times greater than carbon dioxide. It is present both in human resources and natural resources (including industrial emissions, fossil fuel production, livestock farming, biomass burning, rice agriculture, wetlands, termites, oceans etc.). Over the last several decades methane levels have been doubling and there has been a lot of discussion on its impact on global warming and the need to understand the growth of levels of methane in the atmosphere. In this work, we present the mathematical modeling of methane concentration in air. We use a benchmark problem to study the convergence rate of the numerical schemes. The numerical solution of the advection-diffusion equation is solved numerically using finite difference theta-method and implemented for constant and varying diffusion cases. A parameter estimation code is implemented in order to simulate best experimental data to be obtained. Finally, the model proposed is applied to a benchmark advection-diffusion problem in three-dimensions and solved using finite element methods using FEniCS.

References

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