Python-Based Recursive Climate Damage Simulator

Capstone Project

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All data and materials can be found on: https://github.com/icecodesred/recursive-iam/

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Project Summary

The project presents a python-based, extensible tool to help users estimate economic damage from climate change. Inspired by the structure of an Integrated Assessment Models (IAM), it is designed to simulate a feedback loop between output, measured in GDP, carbon emissions and temperature. It evaluates how these mechanisms interact with each other under different, pre-defined economic conditions, based on data from Shared Socioeconomic Pathways, which are commonly used in climate modeling.

The core of the model incorporates emissions forecasting, temperature estimations from emissions, and a damage function, designed to simulate assumptions of lost output based on temperature.

To assess the uncertainty of chosen parameters, the model presents a Monte Carlo simulation, probabilistically resampling these based on literature. All features are user-adjustable, and fit to simulate different assumptions, like future climate policy based on the selected scenario and parameters representing certain features of the economy. Outputs include annual projections of GDP, carbon dioxide emissions, projected temperature, aggregated to a country and continent level.

All code is written in Python, and the tool is fully reproducible with full data preprocessing. The tool is extensible, inputs and assumptions can easily be modified by users, and it is useful for modeling and quantifying possible policies in the future, or for extending other economic models.

The project was a unique opportunity to engage with a relevant topic, and to transform academic literature into a practical and usable modeling method. It also helped me make sense of complex systems of forecasting data, and simplifying them to a core method, improving my problem-solving skills in unfamiliar environments.

Author's Declaration

I, the undersigned, **Enikő Palkó**, candidate for the **MSc** degree in **Business Analytics** declare herewith that the present thesis titled "**Python-Based Recursive Climate Damage Simulator**" is exclusively my own work, based on my research and only such external information as properly credited in notes and bibliography.

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I also declare that no part of the thesis has been submitted in this form to any other institution of higher education for an academic degree.

Vienna, 09 June 2025

Enikő Palkó

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