Open-source implementation of the IPCC guidelines for national greenhouse gas inventories: and its contribution in developing a global input-output database

Topic: Advances in Open Source Software for Input-Output Compilation, Analysis and Quantitative Impact Assessment
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Open-source software is becoming more and more important for reproduceable scientific work. Also, in the field of Input-Output Economics and Industrial Ecology ongoing efforts have been made to provide open science infrastructures.

Several input-output (IO) datasets have been published under open-source license, e.g. EXIOBASE3, WIOD. The development of those datasets requires detailed and comprehensive data. Many data transformation steps are involved. However, if publicly available as open source, usually only the final IO dataset is provided. The code for data collection, data cleaning and data calibration is mostly not provided.

Within the â€œgetting the data rightâ€• project (https://www.en.plan.aau.dk/getting-the-data-right/) we develop a global IO database to calculate consequential carbon footprints. All data and code shall be published under open-source licenses. The database aims to include at least more than 1000 activities and products per region. Furthermore, several (monetary and physical) layers shall be provided.

When developing global IO datasets with high product and geographical resolution, a major challenge is to retrieve data. To address the challenge of increasing product resolution, one way we follow is to develop parametrized tools. These tools shall determine inventories for different production and waste treatment activities, which are then used by other steps of the IO dataset development workflow (e.g., balancing).

One of the tools is a python package for the implementation of the IPCC guidelines for national greenhouse gas inventories (https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html).

These guidelines provide equations and default data that can be used to carry out country-based greenhouse gas inventories, considering different production and treatment activities as well as the characteristics of the produced (treated) commodity. The guidelines cover the greenhouse gas (GHG) relevant areas Energy, Industrial Processes, Agriculture, and Waste. Furthermore, sequences (tier 1, tier 2 and tier 3) define the order on how to apply the equations to calculate the GHG inventory. The three tiers differ in the level of detail, with tier 1 as default method and tier 3 as most detailed method. This also affects the requirements for data collection, when applying the guidelines. Tier 1 sequences calculate GHG inventories based on generic country data (e.g., population) and other default parameters, whereas tier 3 sequences require detailed information on the applied technologies of a country.

The python package is an ongoing project. The aim of the package is to allow users:
â€¢ To determine GHG inventories for production and treatment activities
â€¢ To carry out uncertainty analysis
â€¢ To submit own data

The implementation of the volume Waste has been finalized. Uncertainty in data can be considered by analytical error propagation and Monte-Carlo simulation. Its application for IO database

developments would allow the differentiation of the following waste treatment activities:
â€¢ 2 biogenic waste treatment activities,
â€¢ 10 waste incineration activities,
â€¢ 8 solid waste disposal activities, and
â€¢ 24 wastewater treatment activities.

A differentiation of waste types would be possible in the following manner:
â€¢ 23 solid waste types,
â€¢ 1 type of domestic wastewater, and
â€¢ 18 types of wastewaters based on the industry.

To make use of this package in the development of the projectÂ´s global IO dataset, data shall be collected for the base year and for different countries, fulfilling the requirements of tier 1 and, if possible, tier 2 methods.

Future efforts shall also be put in the implementation of the three remaining volumes Energy, Industrial Processes, and Agriculture.