

README

Using the method of Ecological Resource Availability (ERA)

Description

The ERA method is designed to calculate global sustainable resource budgets based on Earth system boundaries (ESB). A resource budget represents the amount of a specific resource that the socio-economic metabolism can consume per year without transgressing ESB.

Getting started

These instructions help you to use the ERA method on your local computer. After having downloaded the additional open-source files, which included this Readme, you need to download the [Exiobase](#) database version 3.4 separately. Exiobase requires you to register first, but the registration and download is free. You find different versions of the database. You need the monetary input-output tables, clustered industry by industry (ixi). Exiobase currently provides data for the years 1995 – 2011. Select the year you are interested in. Once downloaded, please select the entire folder (IOT_year_ixi) and move it into the ERA folder under **SoSOS_lxI/ Files**. Note, that the below mentioned files each

Running

To determine the resource budgets you are interested in you have to execute the following steps:

1. Insert your selected boundaries in the folder ESB. There you find an Excel file (**ESB_translation.xlsx**). Insert one boundary per row (row 6 – 20) including the control variable, unit, and its minimum, mode, and maximum value (a mode is not necessarily required. If not available leave this cell free). Additionally, specify the type of distribution in column **G**. The numbers 1 – 6 each define a specified distribution as indicated in row 1 – 3. The ESB need to be in units that can be measured with LCA as well as EE-IOT (see supplementary materials for details). Do not forget to save your document when you are done. You need to run the Matlab code "ESB_translation.m" in the same folder, which creates a Matlab file (ESB.mat) that is automatically saved in the ESB folder.
2. Now you need to include the resources you would like to investigate. Open the folder **UI_SoP** and use the Excel file within. You find seven spreadsheets. Start from left to right with the one named **dimensions**. On the right side of this spreadsheet, you can insert the selected ESB again. On the left side, you must include the resources you want to investigate. Note, that the resources you include must be of the same resource class (metals, plastics, ceramics, etc.). Give each resource a number in the column **Idx**. Moving to the second spreadsheet **S**, you find a list of the 163 global industries of Exiobase. Please go through this list and select those industries that play a role in the extraction, production, or disposal of your resources by putting a **1** into the yellow marked cells. Leave the others blank. Next, you have to select the spreadsheet **UI** in the Excel

file. There you have to include the unit impacts (UI) of each resource. UI are provided by LCA databases such as ecoinvent. Please provide again an uncertainty range (min. and max. values at least) and the distribution type (1 – 6). The distribution types have the same numbers as for the boundaries before. Please include all UI per boundary category. Note, that the UI must comprise the UI of resource extraction, production, and disposal as specified in the ERA paper. Lastly, you need to fill out the spreadsheet **SoP** which stands for Share of Production (SoP). Here you must include the current global production volume of each resource. You should use the most recent available data. Please provide as well a reasonable deviation range from your selected production volume. We use a generic uncertainty range of 10 %. It is important, to name and save the file as ERA_XYZ where XYZ must be the name of your sector (metals, plastics, ceramics, etc.).

3. Now you have provided all data necessary for the Matlab calculation procedure. You can open the MatLab Code **SoSOS.m** in the ERA method folder. This file depicts the selected ESB together with the global environmental impacts of the year you have selected in Exiobase and shows the Share of Safe Operating Space (SoSOS) of each resource sector. You simply need to provide a name for your target segment (metals, plastics, ceramics, etc.) and the year that you have selected in Exiobase in line 14 and 15 of the Code. Click the *Run* bottom. Once the program is completed, Once the program is completed (which takes several minutes), it saves 10 different Matlab files in the folder **SoSOS_lxl/results/materials**.
4. For the last step of the calculation, you need to open the MatLab code **ERA_calculation_wdc.m** in the ERA folder. Make sure that you specify your sector name in line 9 of the code according to the name you have given to the UI Excel file under step 2. Click the *Run* bottom. After a few seconds, you find now the exact resource budgets in the same Excel file in the folder **UI_SoP** that you have used in step 2. The Excel file holds two spreadsheets with the names *result* and *reduction factor*. Under result you find the resource budgets in kg/a. The reduction factor spreadsheet shows how much the current production volume needs to decrease to respect all boundaries selected.

Questions

Please direct all questions to the authors of the paper directly.