ELDAM: A Python software for Life Cycle Inventory data management

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Summary

Life Cycle Inventory (LCI) data are the backbone of Life Cycle Analysis (LCA). They reflect modelling choices made by the LCA practitioner that can strongly influence the results of environmental impact calculations. The high sensitivity of these data are the reason why they must be accurately documented and tend to the highest possible quality. High quality, well documented LCI data can also be shared between LCA practitioners, allowing productivity gains and better research reproducibility, in particular between practitioners who do not work on the same life cycle inventory database. Unfortunately, SimaPro (PRé Sustainability B.V., 2020), one of the most used LCA software solutions, has only limited features to document, review and exchange LCI data. ELDAM has been developed to fill this gap.

Statement of need

ELDAM is constituted by an LCI documentation and review procedure, a visualization and editing spreadsheet format and a feature-rich utility software written in Python.

Metadata used to document LCIs are extended with a focus on data quality characterization (Biard et al., 2015). A review procedure inspired from scientific peer review helps to improve the quality of LCIs (Figure 1). The use of a spreadsheet based format for LCI editing, documentation and visualization has several advantages. It is a well known interface for most users and can be easily shared with non LCA experts (Coste et al., 2018). It also allows easy versioning of the LCIs with a separate sheet for each version. This versioning system is at the basis of the review procedure but can also be used to track changes made by a single user.

The main feature of the utility software is the conversion between ELDAM's spreadsheet format and SimaPro import and export formats. It can be used as a Python package or through its Qt (The Qt Company, 2020) based graphical user interface (Figure 2). Its object-oriented design makes it very modular and easy to extend.

ELDAM has been used in various research projects ((Gentil et al., 2020), (Risch et al., 2020)), helping to improve and characterize LCI data quality. Its review procedure has proven very helpful for auditing the LCIs produced by LCA beginners such as interns.

Use case scenario

The following use case scenario illustrates the workflow proposed by ELDAM.

An LCA practitioner creates an LCI in SimaPro and exports it in the `.xlsx` format. Then, he converts it to an `Elda` file (the `.xlsm` based spreadsheet format used by ELDAM) either using the GUI or the Python API. Opening the `Elda` file with a spreadsheet software like Excel or LibreOffice, the practitioner documents the LCI dataset using the metadata fields provided by ELDAM. Once the documentation step is finished, he sends the `Elda` file to a reviewer that will ensure of the consistency of the dataset. The reviewer then creates a new version of the dataset that will be materialized as a new sheet in the file. She highlights all of her suggested modifications and returns the file to the original author. The original author addresses the reviewer's remarks in a new version and returns the file to her. This review loop continues until the dataset is considered valid by the reviewer. Once the review process is over, the author can convert the `Elda` file to a `.csv` file using the GUI or the Python API and import it back to SimaPro.

```python
from eldam.core.simapro import SimaProXlsxReader, SimaProCsvWriter
from eldam.core.elda import Elda

# SimaPro export file -> Elda spreadsheet
process = SimaProXlsxReader('path/to/xlsx/file').to_processes()[0]
elda = Elda()
elda.add_version(process)
elda.save('path/to/elda')

# Elda spreadsheet -> SimaPro import file
elda = Elda('path/to/elda')
process = elda.read_last_version().to_process()
SimaProCsvWriter(process).to_csv('path/to/csv')
```
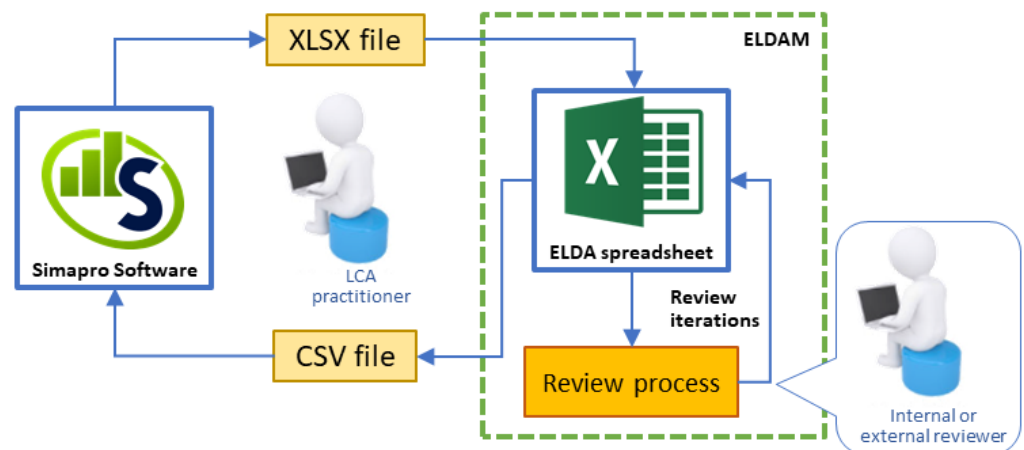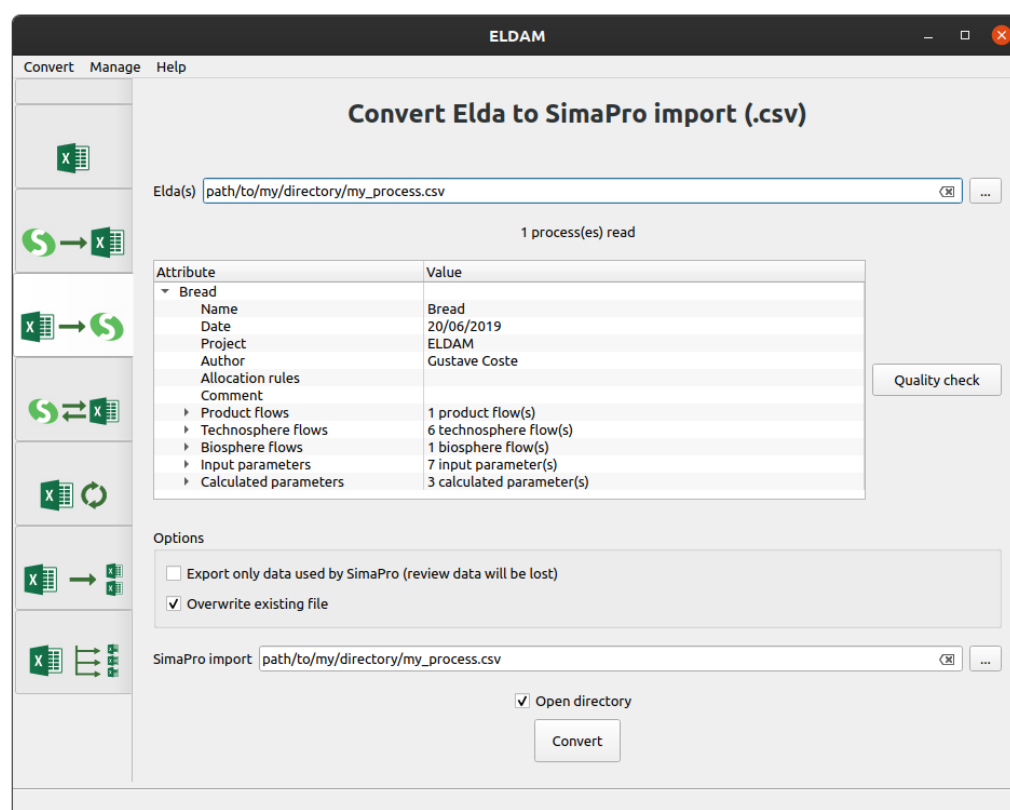

Figure 1: Review procedure.

Figure 2: ELDAM's GUI.

Acknowledgements

References

Biard, Y., Basset-Mens, C., Bessou, C., Tran, T., & Benoist, A. (2015). Developing a quality management system for LCA datasets : The case of the LCA - CIRAD platform for tropical products. *Life Cycle Management Conference 2015: List of Abstracts*, 121–122.

Coste, G., Biard, Y., Roux, P., & Helias, A. (2018). ELDAM , a new quality management system for LCI datasets exchange and review. In S. H. G. (ed.). Rattanawan Mungkung (ed.) (Ed.), *Book of abstracts of the 11th international conference on life cycle assessment of food 2018 (LCA food) "global food challenges towards sustainable consumption and production"* (pp. 58–58). Life Cycle Assessment. https://agritrop.cirad.fr/589978/

Gentil, C., Basset-Mens, C., Manteaux, S., Mottes, C., Maillard, E., Biard, Y., & Fantke, P. (2020). Coupling pesticide emission and toxicity characterization models for LCA: Application to open-field tomato production in martinique. *Journal of Cleaner Production*, *277*, 124099. https://doi.org/10.1016/j.jclepro.2020.124099

PRé Sustainability B.V. (2020). SimaPro: The world's leading LCA software. In *Company website*. PRé Sustainability B.V. https://simapro.com/

Risch, E., Boutin, C., & Roux, P. (2020). Up to what extent decentralised wastewater systems are more sustainable than centralised ones? Insights from a life-cycle assessment perspective. *Water Research*. Submitted.

The Qt Company. (2020). Qt: Cross-platform software development for embedded and desktop. In *Company website*. The Qt Company. https://www.qt.io/