Many a mickle makes a muckle: truncation error in lifecycle assessment

Topic: 814Y LCA and Industrial Ecology (2)
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Quantifying environmental impacts using process life cycle assessment (PLCA) has become a standard procedure in modern sustainability research. Literature has identified relevant shortcomings in PLCA methodologies influencing results. Some referring to i) the application of cut-off criteria defined by the International Organization of Standardization (ISO) or ii) missing data that influence results lead to truncation errors (TE), which are suggested to be significant, even though the exact size remains debated.
In this paper we first review the literature on TEs and clarify conceptual foundations. We develop a topology of existing approaches that measure and classify TEs in PLCA using Input-Output LCA (IOLCA) and Hybrid LCA. We find that some factors influencing the size of error estimations are insufficiently investigated (e.g. cut-off criteria) or even ignored (e.g. network density, growth rate of flows to be investigated) in the existing literature.
Second, we investigate the identified shortcomingsâ€™ influence on TEs using and possible limits to TE quantification within IOLCA framework. We design and implement different scenarios to estimate influences on TEs by i) varying thresholding rules in order to comply with ISO norms, i) varying link densities in underlying data and applicants, and iii) neglected service sectors. We implement the scenarios in an IO database for the USA with over 400 sectors investigating embodied CO2 emissions. We find that how to model TEs has a significant influence on their magnitudes, challenging explicit statements made in the existing literature.
Depending on the specifications TEs can be significant in size depending on the scenario: i) neglecting specific sectors can lead to TEs of up 20%; ii) varying thresholding rules can increase existing TE estimates by 10 percentage points on average; iii) the network structure influences the TE significantly and hence needs to modeled explicitly in future estimates.