Added values of multi-year studies in MFA: the phosphorus budget in Austria from 1990 to 2011

Friday, 10th July 13.30 - ISIE 2015

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Up to now Substance Flow Analysis (SFA) has been mostly applied to depict annual snapshots of the systems under study. Although this approach has delivered a significant body of new information and knowledge, it has offered a limited understanding of the systems, in that it has failed to capture essential shifts and trends in time as well as changing relationships between flows and stocks. This contribution highlights the added values of carrying out multiple-year analyses, by presenting a time series (1990-2011) of the Austrian phosphorus budget. The degree of change was systematically assessed, showing that even within a relatively short and stable period the budget recorded extreme changes in individual flows and stocks as well as in efficiency or recycling ratios, with important implications for either resource and waste management or environmental protection. The analysis was reiterated applying different ranges of uncertainty, which greatly impacted the capability of distinguishing between no change and moderate change, especially when short-term variations were investigated. These outcomes provide a relevant overview of the actual capacity of monitoring phosphorus flows with the current schemes of data collection. The need of depicting together 22 different years of the budget also led to a model that comprehends both flows of the past that do not exist any longer as well as newly developed flows or processes. This would not occur with a static annual study, but it is important to provide decision makers with a more far-reaching and exhaustive representation of the system. Lastly the data reconciliation process applied by the software STAN to balance the system was analyzed over time to explore whether the flows were altered systematically (always in the same direction) or randomly (alternately in both directions). The majority showed a random behavior, but less than 10% of the flows were altered in a regular manner. This analysis helped identifying systematic problems and inconsistencies in the data, which provide useful feedback to data producers. In conclusion, this work has proven that multiple-year SFAs are feasible and that their introduction as routine schemes by authorities could be highly beneficial.