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Ecosystem Services in Life Cycle Assessment - Part 2: Adaptations to regional and serviceshed information

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Abstract

Regionalized life cycle assessment (LCA) is receiving more attention among LCA practitioners due to spatial variation in process efficiency of technological systems and current status of ecological systems. However, the role of ecosystem services (ES) in supporting technological activities is still ignored. Techno-Ecological Synergies in Life Cycle Assessment (TES-LCA) is a methodology that captures the interactions between and within technological and ecological systems, along a product's life cycle. It accounts for local and absolute environmental sustainability by comparing the demand and supply of ES at multiple spatial scales. To facilitate its wider adoption, the basic computational framework has been proposed in Part 1, which includes technologies and ecosystems in an integrated manner. To handle the complications induced by explicitly considering ES, which operate within servicesheds at multiple spatial scales, the TES-LCA computational structure is modified to account for spatial variation in technological and ecological systems in Part 2. The regionalized TES-LCA framework is demonstrated through an expanded case study to show its capability to capture different scenarios of regionalization, including variation in process efficiency, ecological carrying capacity (CC), characterization factors (CF), and the scales at which ES operate. The approach is then proved to be general and able to subsume existing approaches, such as regionalized LCA, GIS-LCA and recent extensions based on normalizing CF by ecological CC to calculate absolute sustainability metrics. It is recommended that the developed computational structure should be implemented in LCA software with the functionality for handling geographical information. Also, the regionalized information about ES demand and supply needs to be made available in future versions of life cycle inventory databases.

Keywords: Computational structure, Life cycle assessment, Ecosystem service, Environmental sustainability

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