A consistent framework for modeling inorganic pesticides: Adaptation of life cycle inventory models to metal-base pesticides

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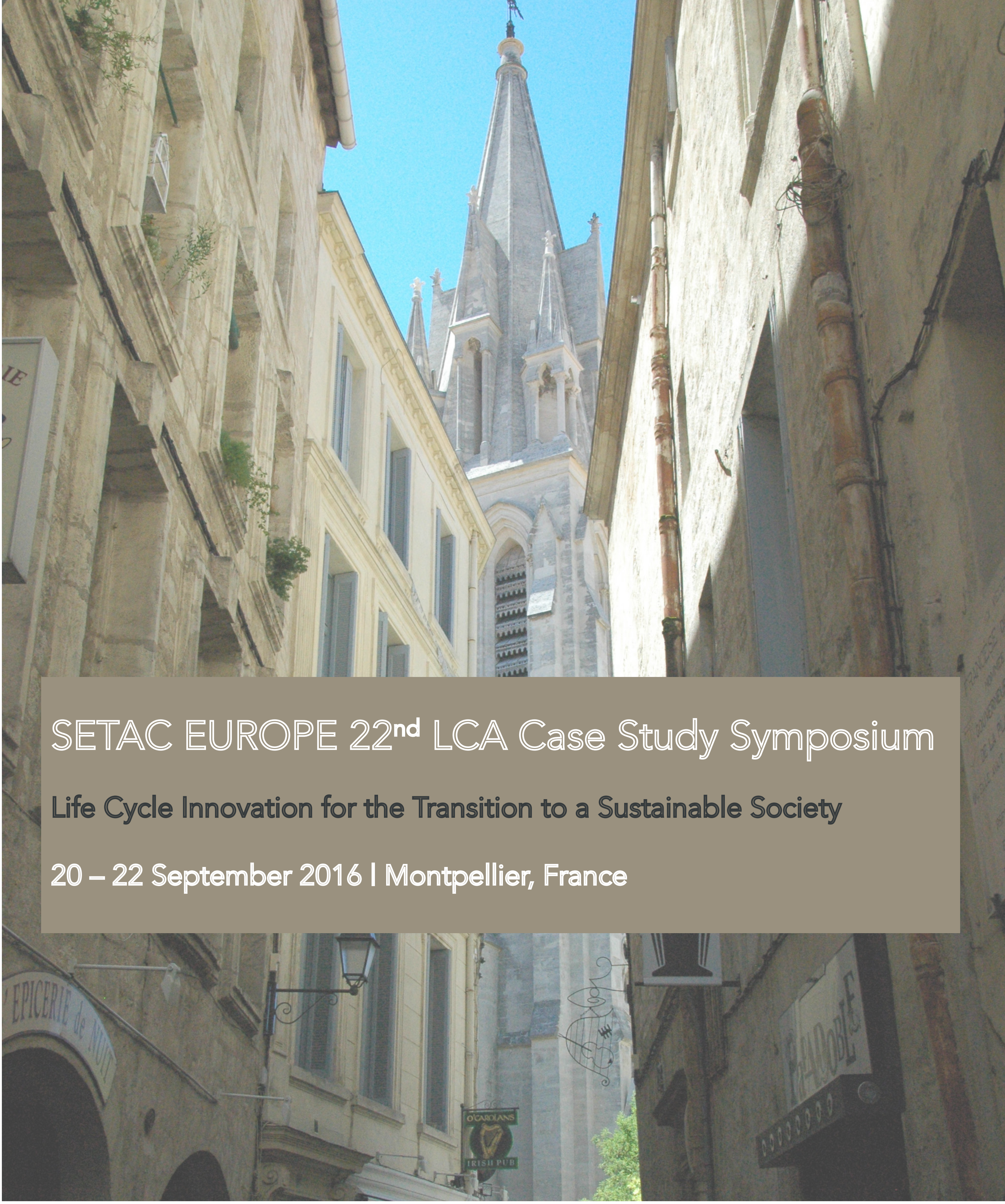

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A Consistent Framework for Modeling Inorganic Pesticides: Adaptation of Life Cycle Inventory Models to Metal-Base Pesticides

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Quantifying over the life cycle of a product or service the chemical emissions to the environment in the life cycle inventory (LCI) phase is typically based on generic assumptions. Regarding the LCI application to agricultural systems the estimation of pesticide emissions is often based on standard emission factors (percentages) or dynamic models base on specific application scenarios that describe only the behavior of organic pesticides. Currently fixed emission fractions for pesticides dearth to account for the influence of pesticide-specific function to crop type and application methods. On the other hand the dynamic models need to account for the variability in this interactions in emissions of inorganic pesticides. This lack of appropriate models to estimate emission fractions of inorganic pesticides results in a lower accuracy when accounting for emissions in agriculture, and it will influence the outcomes of the impact profile. The pesticide emission model PestLCI 2.0 is the most advanced currently available inventory model for LCA intended to provide an estimation of organic pesticide emission fractions to the environment. We use this model as starting point for quantifying emission of inorganic pesticides and customize it taking into account the complex chemistry of metals in order to properly reflect the their environmental fate behavior. We identified specific needs for metal-specific pesticides emission modeling looking at the current PestLCI structure and propose an approach for the different metal-related processes and interactions. The proposed framework takes into consideration the speciation of the metals to accurately describe the soil processes (runoff and leaching). The processes involving degradation are assumed not significant for metals and volatilization is only accounted for special cases (i.e. mercury). And finally, a new module of erosion is included in the modified PestLCI model, because the transport of soil particles to which the metals are bound needs to be considered as potential source of emissions to surface water. In conclusion, we provide a starting point to better estimate metal-specific pesticide emission fractions, addressing the issue of inorganic pesticides for inventory analysis in LCA of agricultural systems.

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Environmental and economic assessment of an eco-innovative Continuous Flow Integrative Sampler (CFIS) for pharmaceutical compounds measurement in waters

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The increasing concern for the presence of emerging compounds in water bodies has led the European Commission to lay down a strategy that involves the identification and monitoring of priority substances in waters (Directive 2000/60/EC). Water quality is conventionally monitored by spot sampling, although it is a time and workforce consuming approach and no complete information about the concentration of target compounds could be obtained. CFIS-ECOPHARMA is a project co-funded by the European Commission through the Eco-innovation initiative that aims to demonstrate the capability of the Continuous Flow Integrative Sampler (CFIS) for pharmaceuticals continuous monitoring in waters. This device solves the limitations of conventional spot sampling by allowing a time-averaged measurement of target compounds and the improvement of the quantification limits. **Life Cycle Analysis (LCA)** based on **ISO 14040** approach, and **Life Cycle Costing (LCC)** methodologies were used to assess the environmental and economic performance of the CFIS in comparison with conventional spot sampling. The LCA and LCC results were integrated in an eco-efficiency assessment based on the **ISO 14045**. For this study a common scenario for both sampling procedures was defined in terms of site distance, number of spot samples equivalent to CFIS and water body quality. LCA was carried out based on experimental data collected by the CFIS and spot sampling during several field monitoring campaigns. LCC analysis was based on economic data. As an innovative sampling procedure, no previous studies of eco-efficiency have been done for the CFIS and, to the best of our knowledge, neither for conventional sampling. Therefore, this study evaluates the eco-efficiency of both water sampling procedures for the first time.