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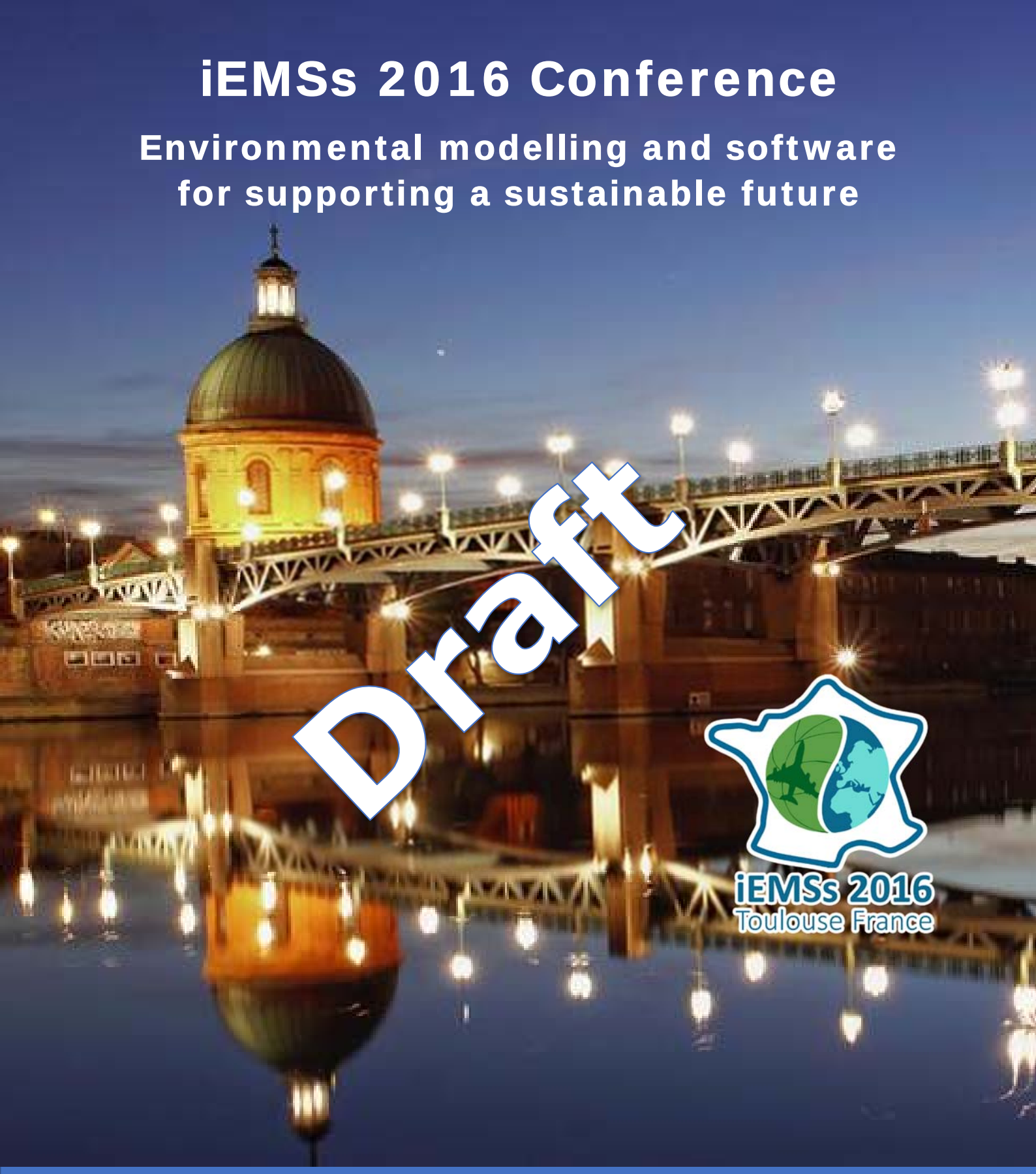

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An agent-based model to analyze the ecological functioning of agro-silvo-pastoral landscapes in West Africa

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Abstract

Biomass recycling plays a major role in the functioning and sustainability of agro-silvo-pastoral ecosystems in West Africa. However, farming systems must adjust rapidly to changing landscapes. This abstract describes an Agent-Based Model (ABM) that analyzes nutrient (N) cycles within the village "terroir" agro-ecosystem to assess how changes in land use and farming practices affect crop-livestock integration and spatial heterogeneity.
The ABM is implemented on the GAMA platform (Generic Agent-based Modelling Architecture). Each simulated household is classified according to a farm type with a pre-defined biomass management strategy (use of crop products, manure, etc.). The model is spatially explicit, with biomass being moved across landscape units and through different ecosystem components: soil, plants, animals, humans, etc. Biomass flows are converted into N flows which are then used to calculate indicators such as N balance, N use efficiency, and the diversity and recycling indexes that characterize N cycles.
The model was parameterized through on-farm measurements of crop and livestock productions (for the biophysical sub-system) and participatory workshops with farmers (for the decision sub-system). The model was validated on the basis of biomass flows observed in two villages in the Senegalese groundnut basin.
The model is original in its multi-scale analysis of N cycles occurring at different organizational levels: plot, herd, household and landscape. For instance this highlights the consequences of households' choices at the plot scale for spatial heterogeneity at the landscape scale. This ABM is potentially generalizable for designing ecological intensification pathways in West African village "terroirs".

Keywords: Agent-based-model, agro-silvo-pastoral ecosystem, biomass flows, multi-scale analysis