Geophysical Research Abstracts
Vol. 21, EGU2019-6046, 2019
EGU General Assembly 2019
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A Comparative Framework Based on Socio-Natural Modeling Approach to Support Urban Greenhouse Gas Emission Mitigation Policies

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To achieve successful sustainable policy formation and implementation, the localization of scientific knowledge within a global framework are critical. In terms of GHG emissions policies, of particular concern are the interactions between human activity and the hydrologic cycle and its role in potential mitigation efforts. One obstacle is the place-based silos from which knowledge has traditionally been generated and applied through public policies. Working through these silos takes considerable coordination and the grounding of data and analytical approach. We argue that this can be accomplished successfully through the use of complex system model integration. This paper presents a comprehensive system modeling approach within a socio-natural context that can be used to identify GHG emissions resulting from urbanization processes and human activities within large and complex urban systems and their implications on the hydrological cycles. The model is a fine-scale (30x30m), coupled systems model of land use, urban planning policy and GHG emissions with multiple time steps and feedback for policy scenario analysis and stakeholder engagement and education. The model results are interpreted under a comparative framework towards sustainable policy formation and implementation for Chicago, USA and Stockholm, Sweden. The results substantiate the following arguments: 1) urban growth from socioeconomic activities and associated land use changes generate an increase in GHG emissions well above estimates under conventional climate planning processes for both cities; 2) physical and socioeconomic differences between two cities result in different GHG mitigation outcomes for similar policies, thus requiring localization and contextualization considerations for policies and; 3) place-based urban growth management policies based on model results are critical tools for mitigating climate impacts of urban development. The primary aim of this paper is to better identify the specific pathways and barriers to greenhouse gas (GHG) mitigation policy initiatives and actions in a socio-natural context.