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## Hierarchical Hybrid modelling

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# Hierarchical Hybrid modelling

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**Abstract:** Environmental systems are complex systems. They are composed of many heterogeneous agents interacting in nonlinear ways within environment. Consequently, capturing the dynamics and understanding these systems are often similarly complex. To understand complex systems, hierarchy theory proposes to decompose these systems to levels (vertical structures) and subsystems (horizontal structures). Hierarchical perspectives could help in understanding complex environmental systems. However, existing modeling platforms lack of an appropriate abstraction which supports hierarchical structuring of systems. Consequently, the application of hierarchy theory has been limited to observational purposes. In this paper, we present a hierarchical simulation platform and a software package developed to facilitate the development of hierarchical dynamic models. This platform is not restricted to one simulation approach. Agent-based, system dynamics and Discrete-event sub models can be dealt with as well as hybrid models. In this platform every system can be conceptualized as levels and subsystems which can contain agent, stock and flow, queue and process structures. Modelers can model the process involved at each level using either agent-based or system dynamics formulations. We demonstrate different aspects of this hierarchical simulation platform with an example related to energy transition.

**Keywords:** Environmental Systems, Hierarchy Theory, Hybrid simulation, System, Dynamics, Agent-based Modeling