Complexity Quantifiers as Tools for Delineating the Possible from the Impossible in Catchment Modelling.

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In forested catchments hydrology and forest science employ two different modelling approaches. There are well-established monitoring practices and spatial and temporal scales (e.g. catchments as spatial unit, vegetation periods) of relevant variables in hydrology and forest science. Here, we pose the question, how to integrate them into an ecosystem model that covers biotic and abiotic aspects to the satisfaction of both perspectives. Currently, the modelling approaches in hydrology and forest science appear as mutual incompatible. In a catchment model of water transport, a forest often becomes a sink function (no strategies). In a forest growth model, tree growth is often characterized by a static site index. It is unclear, however, at which scale the above apparent incompatibility of models can be resolved. Here we use information and complexity quantifiers applied to a long-term monitoring site (Lange Bramke, Harz Mountains) as tools characterizing the phenomenology of the two perspectives. Hydrologists and forest scientists may already be using a respective resolution in monitoring that maximizes their knowledge gain about the system (e.g. runoff from the catchment, timber volume per forest stand). The complexity analysis of the corresponding time series shows that they collect data sets that pose maximum difficulty for modelers. When monitoring forest growth, the vegetation period poses a minimal temporal resolution whereas the spatial resolution can be selected to yield maximal complexity. First order catchment monitoring poses a minimal spatial resolution whereas the complexity of temporal resolution can be maximized. Additional internal measurements (soil water content, tree diameters) are often irrelevant to model the system output, contrary to the corresponding forcing data (precipitation, radiation, weathering). Thus, the compatibility problem may not be overcome by higher observation or simulation resolution. A new modelling language to bridge the two approaches seems to be required.