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Environmental Engineering Seminar

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Catchment Co-evolution: A Useful Framework for Improving Predictions of Hydrological Change?

The notion that landscape features have co-evolved over time is well known in the Earth sciences. Hydrologists have recently called for a more rigorous connection between emerging spatial patterns of landscape features and the hydrological response of catchments, and have termed this concept catchment co-evolution. In this presentation we present a general framework of catchment coevolution that could improve predictions of hydrologic change. We first present empirical evidence of the interaction and feedback of landscape evolution and changes in hydrological response. From this review it is clear that the independent drivers of catchment coevolution are climate, geology, and tectonics. We identify common currency that allows comparing the levels of activity of these independent drivers, such that, at least conceptually, we can quantify the rate of evolution or aging. Knowing the hydrologic age of a catchment by itself is not very meaningful without linking age to hydrologic response. Two avenues of investigation have been used to understand the relationship between (differences in) age and hydrological response: (i) one that is based on relating present landscape features to runoff processes that are hypothesized to be responsible for the current fingerprints in the landscape; and (ii) one that takes advantage of an experimental design known as space-for-time substitution. Both methods have yielded significant insights in the hydrologic response of landscapes with different histories. If we want to make accurate predictions of hydrologic change, we will also need to be able to predict how the catchment will further co-evolve in association with changes in the activity levels of the drivers (e.g., climate). There is ample evidence in the literature that suggests that whole-system prediction of catchment co-evolution is, at least in principle, plausible. With this imperative we outline a research agenda that implements the concepts of catchment co-evolution for building a holistic framework toward improving predictions of hydrologic change. We will illustrate some of these concepts using data from the institutional experiment currently in progress at the Landscape Evolution Observatory at Biosphere 2.

I graduated from the University of Ghent (Belgium) in Agricultural Engineering (1985), and obtained an MSc in Control Systems Engineering (1989). Meanwhile I worked as a research and teaching assistant at the Laboratory of Hydrology and Water Management and the Seminar for Applied Mathematics. From January to August 1992 I visited the Water Resources Program of Princeton University and assisted Dr. E.F. Wood developing remote sensing applications in hydrological modeling. In 1993 I got my PhD in Hydrology entitled "Conceptual Basinscale Runoff Process Models for Humid Catchments: Analysis, Synthesis and Applications". I was appointed assistant-professor (1993) and associate professor (1996) at the Department of Forest and Water Management of the University of Ghent. In 1999 I moved to the Netherlands to become full professor in Hydrology and Quantitative Water Management of Wageningen University. In November 2005 I joined the Department of Hydrology and Water Resources of the UA. I was associate-editor for Water Resources Research from 1999 to 2005 and I am member of the editorial board of Advances in Water Resources.