Frontiers in Hydrologic Science: Complexity and Organization in Hydrology

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Abstract. Much of the climate, weather and landscape of the Earth is shaped by the ever-present water. The hydrologic cycle and its related energy cycle are exquisitely intertwined in very non-linear fashion over a large range of scales. These non-linearities commonly lead to chaotic-like behavior but also to beautifully organized, surprisingly simple, systems. The talk illustrates the above ideas with a series of examples. First the dynamic impact on the atmosphere and climate of surface conditions like vegetation and soil moisture are illustrated. The ideas of multiple equilibriums in vegetation and soil moisture are presented. Similarly, potentially controlling principles like maximum entropy production and energy dissipation are discussed in the context of the estimation of surface fluxes of energy. Self-organization in landscape forms is the second topic. Organization in geometry and in surface texture of the river basin is achieved jointly and is a result of highly non-linear interactions at multiple scales. The talk ends with an analysis of how vegetation may be organized over a river basin under the influence of topographically mediated energy and soil moisture distributions; and vice-versa how the dynamic vegetation affects the hydrology over the basin over a variety of time and space scales.