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New outcomes on critical behaviour of soil moisture dynamics

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Recently we have proposed a novel approach (Di Domenico et al., 2007), which deals with soil moisture organization on the basis of concepts of the percolation theory such as cluster size, percolation probability, and occupation probability. The soil moisture spatial patterns in their seasonal time dynamics, when changing from spatially random to spatially connected appearances as conditions become wetter, show a behaviour similar to phase transition processes. Once determined its *critical point behaviour*, the phase transition results in a scale-invariant process.

In order to assess the generality of the methodology we decided to perform further applications on other river basins. Indeed, we considered the soil moisture data provided by the hydrological model TOPMODEL-based land-surface-atmosphere transfer scheme (TOPLATS) on the Red and Arkansas basins in the south-central United States (Crow and Wood, 2002). From the 1 km grid covering the entire 575000 km2 Red-Arkansas basins, we selected several sub-basins, then we processed one year of daily soil moisture maps. We verified the critical behaviour and we determined the critical probability for each sub-basin.

Some additional studies were carried out in order to understand whether any dependence between the critical point value and climatic or morphologic features of drainage basin exist. In particular, with reference to morphology, some river network features, such as drainage density, informational entropy, fractal dimension were calculated. The great deal of soil moisture data from Red-Arkansas, which include basins with different climate, from arid to humid, and different morphology, from rough to

smooth, allowed to pursue this purpose.

Crow, W. T. and Wood, E. F. The value of coarse-scale soil moisture observations for surface 20 energy balance modeling. *Journal of Hydrometeorology*, 3, 467–482, 2002.

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