A Coupled Stochastic Space-Time Intermittent Random Cascade Model for Precipitation Downscaling

Boosik Kang
Department of Civil and Environmental Engineering, Dankook University, Yongin-si, Gyeonggi-do, Korea

Jorge A. Ramírez
Department of Civil and Environmental Engineering, Colorado State University, Ft. Collins, CO

Abstract. Using NEXRAD precipitation data, we show that for the central United States rainfall exhibits a composite behavior with respect to its spatial and temporal scaling characteristics. Our data analysis shows that precipitation fluctuations at spatial scales smaller than a *reference scale* exhibit self-similarity and that at scales larger than the *reference scale*, precipitation fluctuations are scale-dependent and are governed by the large-scale climatic forcing.

Accordingly, we present a new methodology for downscaling large-scale precipitation consistent with this composite character of precipitation variability. The new downscaling model is a composite of a Stochastic Space-Time sub-Model (SSTsM) that preserves the spatial and temporal dependency characteristics at scales larger than the *reference scale* and an Intermittent Random Cascade sub-Model (IRCsM) that preserves the statistical self-similarity and spatial intermittency at scales smaller than the *reference scale.*

The new model is applied to downscale summer daily precipitation for the central U.S. from a scale of 256 *km* to a scale of 2 *km*. We show that the new model reproduces quite well the intermittency and self-similarity features, and the inter-scale and across-scale correlation structures of observed precipitation with a relatively low computational burden.

Keywords: statistical downscaling; stochastic modeling; precipitation; NEXRAD, self-similarity