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To Downscale or not to Downscale? That's the question. A flood forecasting perspective.

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There is a growing body of literature investigating the subject of rainfall downscaling. The research subject has been sparked by the need to link the predictions of climate models, that are typically ran on tens of kilometer grids, to distributed watershed models, that typically require input at the sub-kilometer scale. This obvious disparity seems to imply that techniques and algorithms need to be developed to scale down the coarse grid information keeping as much of physical reality of the reconstructed fine grid fields. However, the benefits or downscaling rainfall may be less important than previously expected. Our group has been developing and testing multiscale distributed watershed models for flood predictions for several years and we consistently find that finer resolution rainfall may not imply better flood prediction capabilities. At the heart of this issue is the existence of the self-similar network that aggregates flows in the landscape and that ultimately determines the occurrence of floods in a particular basin outlet. We present examples of how rainfall inputs with different resolution impact our flood prediction accuracy across multiple spatial scales. We show for example, using precipitation fields on a daily 12 km grid and a 5 minute 500 m grid, that basins larger than 1000 km2, are insensitive to the resolution of the input product. We show that the sensitivity to the input product is largely determined by the equations that describe the rainfall runoff transformation (linear vs nonlinear). However, we also show that prediction accuracy, with different input grids, increases with increasing scale of the basin (e.g. 30,000 km2). The answer to the question for downscaling or not in flood prediction becomes, "what size is your basin?"