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The Meandering River

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We report some phenomenological studies of the dynamics of a meandering river in an alluvial plane. Considering the progress of a river as a random walk on a lattice it can be argued that the only moves that can cause intersection are the oxbow moves. The meander and the mechanism of oxbow formation make the non-intersecting trajectory of a river grow like a self-avoiding walk (SAW). There is apparently a direct connection between the critical properties of the SAW and the trajectory of a river. While the supercritical SAWs are plane-filling, the subcritical SAWs look like directed walks and are most appropriate for modeling the meanders of rivers. In the subcritical regime the trajectories are more or less straight within the statistical fluctuations and they are self-affine rather than fractal, whereas at the critical point they are fractal. The SAW model is different from eliminating loops from static random walk configurations, which give configurations with critical regime scaling. It is interesting to note that the oxbow mechanism drives meandering rivers to move straight.

Keywords: meandering; oxbow; self-avoiding walks; self-affine; fractal