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Enhancing emerging organic compound degradation: applying chaotic flow to managed aquifer recharge

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The coupling of Managed Aquifer Recharge with soil aquifer remediation treatment, by placing a reactive layer containing organic matter at the bottom of the infiltration pond, is a promising technology to improve the rate of degradation of EOCs. Its success is based on assuming that recharged water and groundwater get well mixed, which is not always true. It has been demonstrated that mixing can be enhanced by inducing chaotic advection through extraction-injection engineering. In this work we analyze how chaotic advection might enhance the spreading of redox conditions with the final aim of improving degradation of a mix of benzotriazoles: benzotriazole, 5-methyl-benzotriazole, and 5-chloro-benzotriazole. The first two compounds are better degraded under aerobic conditions whereas the third one under nitrate reducing conditions. We developed a reactive transport model that describes how a recharged water rich in organic matter mixes with groundwater, how this organic matter is oxidized by different electron acceptors, and how the benzotriazoles are degraded attending for the redox state. The model was tested in different scenarios of recharge, both in homogenous and in heterogenous media. It was found that chaotic flow increases the spreading of the plume of recharged water. Consequently, different redox conditions coexist at a given time within the area affected by recharge, facilitating the degradation of EOCs.