DYNAMICS OF AN UNCONFINED AQUIFER

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Key words groundwater, flood hydrograph

During a rain event, water infiltrates into the ground where it flows slowly towards rivers. We use a tank filled with glass beads to simulate this process in a simplified laboratory experiment. A sprinkler pipe generates rain, which infiltrates into the porous material. Groundwater exits this laboratory aquifer through one side of the tank. The resulting water discharge increases rapidly during rainfall, and decays slowly after the rain has stopped. A theoretical analysis based on Darcy's law and the shallow-water approximation reveals two asymptotic regimes. At the beginning of a rain event, the water discharge increases linearly with time, with a slope proportional to the rainfall rate at the power of 3/2. Long after the rain has stopped, it decreases as the inverse time squared, as predicted by [1]. These predictions compare well against our experimental data. Field measurements from two distinct catchments exhibit the same asymptotic behaviors as our experiment. This observation suggests that river floods are primarily controlled by the dynamics of groundwater flow.

References

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