Tile drainage causes flashy streamflow response in Ohio watersheds

Samuel Miller[1] and Steve Lyon[1]

[1]The Ohio State University

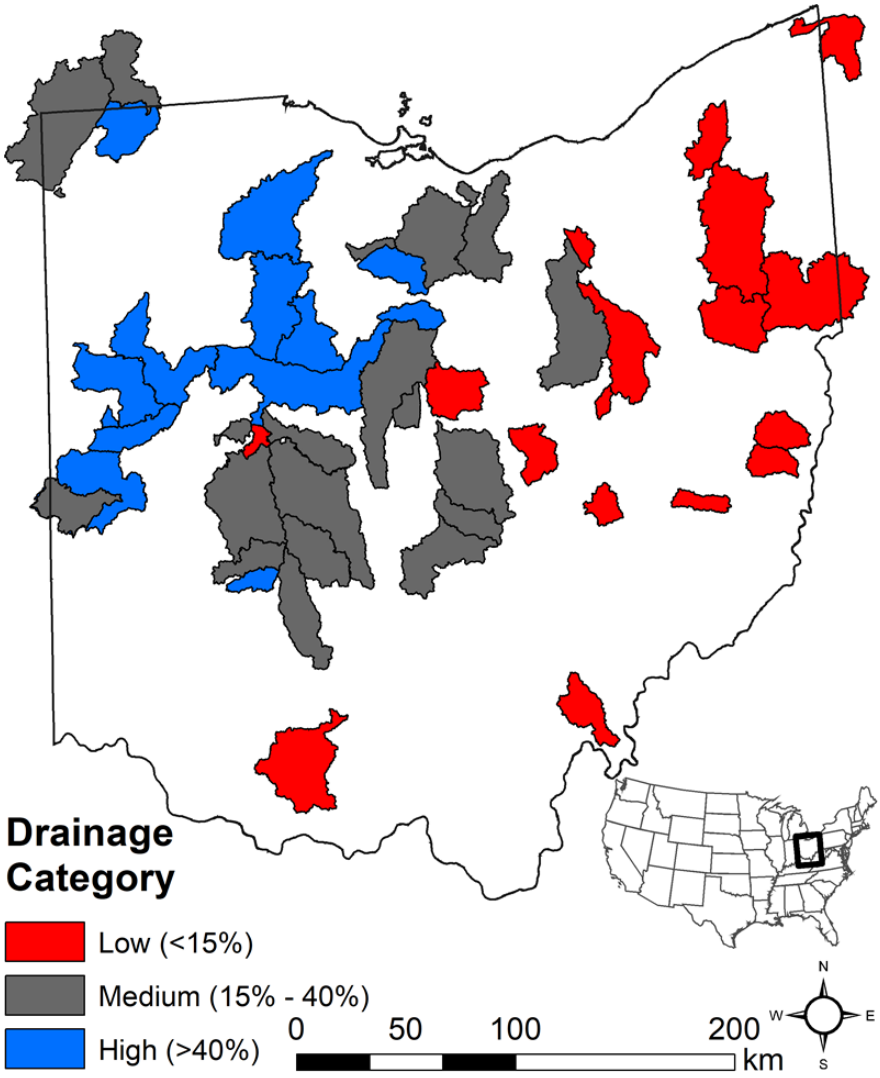
March 19, 2021

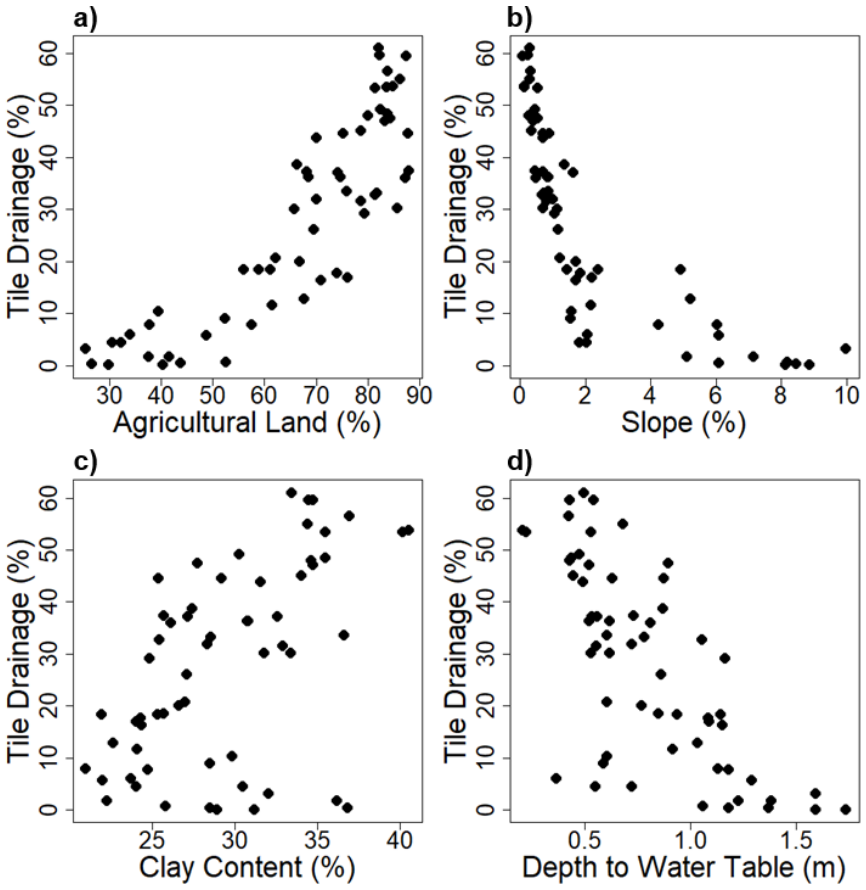
Abstract

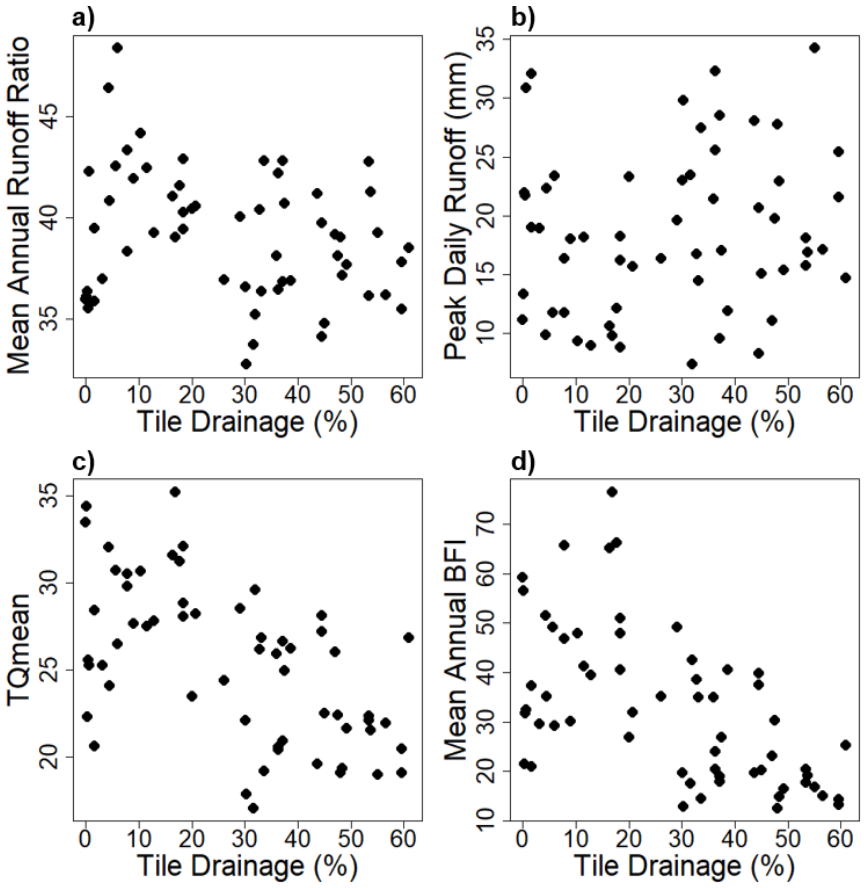
Artificial subsurface (tile) drainage is used to increase trafficability and crop yield in much of the Midwest due to soils with naturally poor drainage. Tile drainage has been researched extensively at the field scale, but knowledge gaps remain on how tile drainage influences the streamflow response at the watershed scale. The purpose of this study is to analyze the effect of tile drainage on the streamflow response for 59 Ohio watersheds with varying percentages of tile drainage and explore patterns between the Western Lake Erie Bloom Severity Index to streamflow response in heavily tile-drained watersheds. Daily streamflow was downloaded from 2010-2019 and used to calculated mean annual peak daily runoff, mean annual runoff ratio, the percent of observations in which daily runoff exceeded mean annual runoff (TQmean), baseflow versus stormflow percentages, and the streamflow recession constant. Heavily-drained watersheds ($>$ 40 % of watershed area) consistently reported flashier streamflow behavior compared to watersheds with low percentages of tile drainage ($<$ 15% of watershed area) as indicated by significantly lower baseflow percentages, TQmean, and streamflow recession constants. The mean baseflow percent for watersheds with high percentages of tile drainage was 20.9 % compared to 40.3 % for watersheds with low percentages of tile drainage. These results are in contrast to similar research regionally indicating greater baseflow proportions and less flashy hydrographs (higher TQmean) for heavily-drained watersheds. Stormflow runoff metrics in heavily-drained watersheds were significantly positively correlated to western Lake Erie algal bloom severity. Given the recent trend in more frequent large rain events and warmer temperatures in the Midwest, increased harmful algal bloom severity will continue to be an ecological and economic problem for the region if management efforts are not addressed at the source. Management practices that reduce the streamflow response time to storm events, such as buffer strips, wetland restoration, or drainage water management, are likely to improve the aquatic health conditions of downstream communities by limiting the transport of nutrients following storm events.

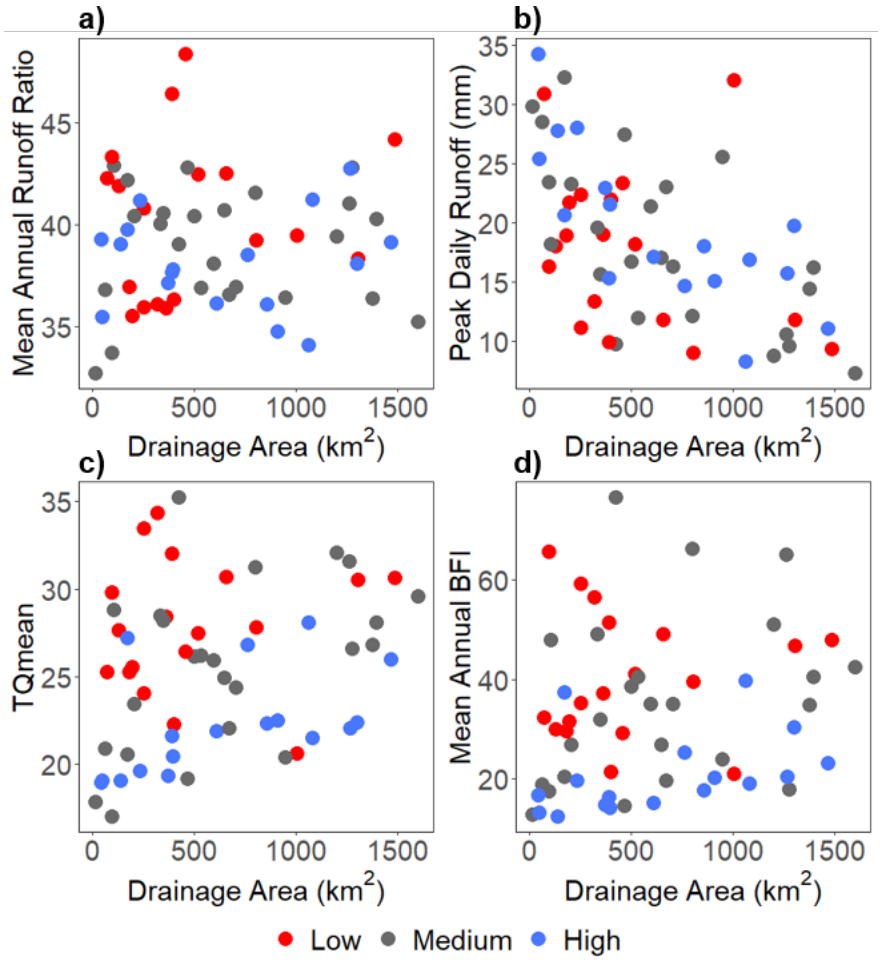
Hosted file

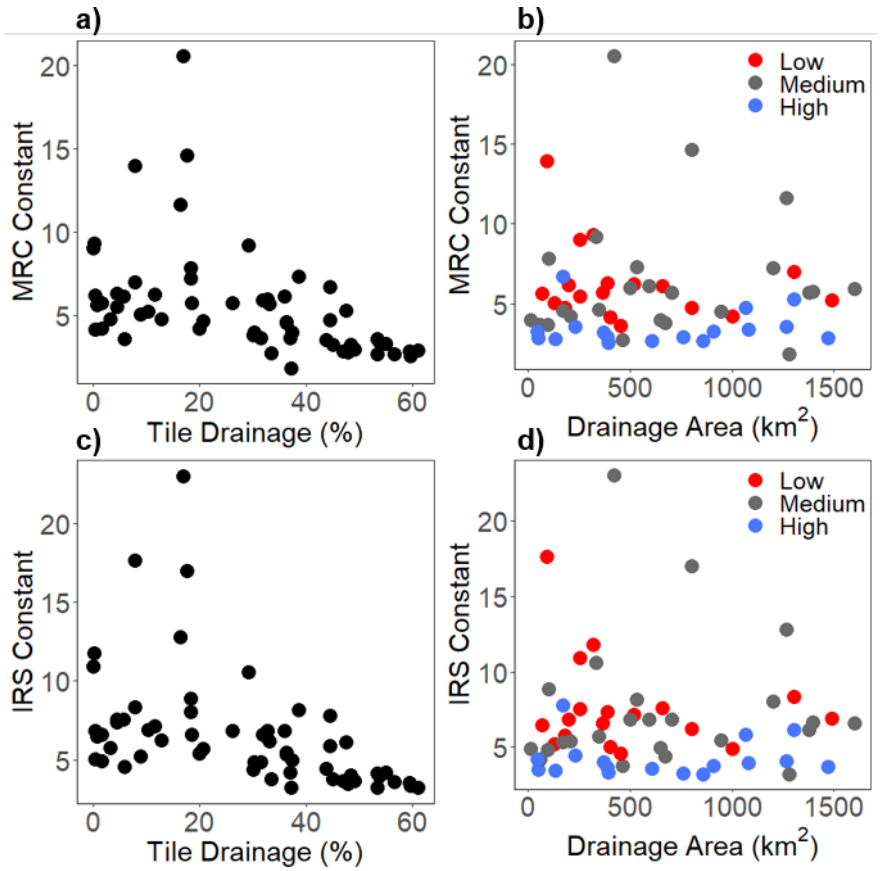
`Main Document Tile Drainage.pdf` available at https://authorea.com/users/341735/articles/514383-tile-drainage-causes-flashy-streamflow-response-in-ohio-watersheds

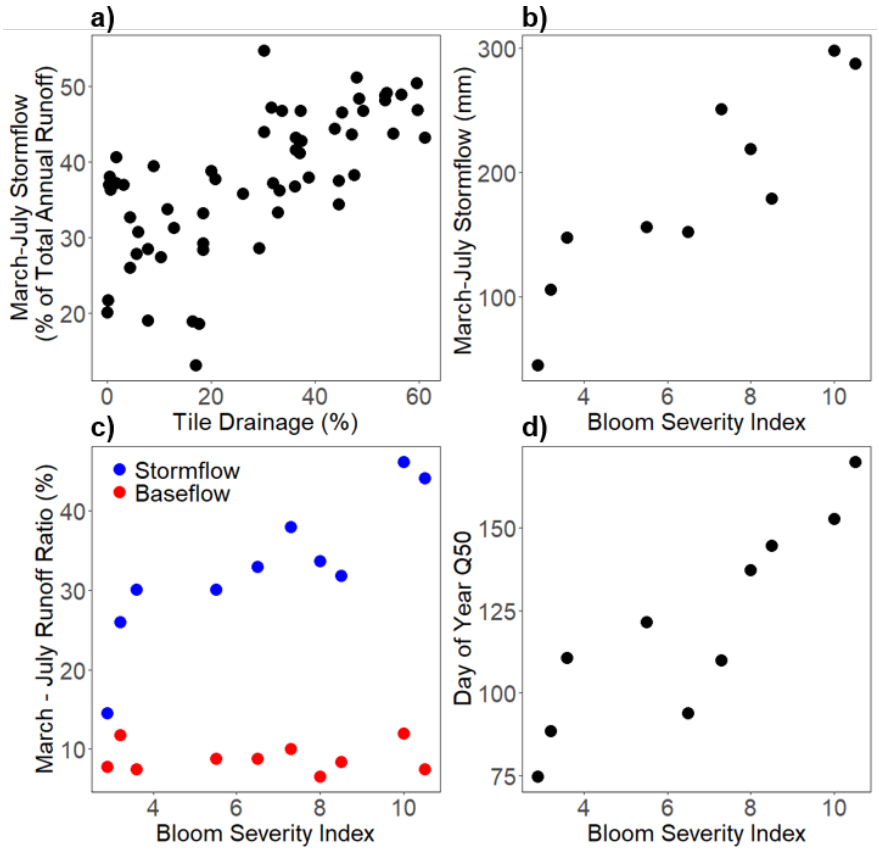












Hosted file

`Table 1.pdf` available at https://authorea.com/users/341735/articles/514383-tile-drainage-causes-flashy-streamflow-response-in-ohio-watersheds

Hosted file

`Table 2.pdf` available at https://authorea.com/users/341735/articles/514383-tile-drainage-causes-flashy-streamflow-response-in-ohio-watersheds