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Land-use, climatic, and hydrological controls on faecal contamination of the surface-ground water system in a paddy farming karst region

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Contamination of drinking water with human and animal faecal matter is the leading cause of waterborne disease worldwide. Populations in developing regions are at highest risk, often lacking an improved source of water and relying directly on catchment water resources. Water resources in karst geological terrain, which provides approximately 25% of the world's drinking water, are particularly susceptible to contamination. The southwest China karst region contains some of the poorest provinces in China, making this a high priority area to advance the knowledge base underpinning water resource management. Land-use, climatic, and hydrological variables are known to be key controls on faecal contamination levels. Faecal contamination is commonly measured via faecal indicators such as *E. coli*; however, there is inadequate availability of data to assess the relationship between the suite of potential predictor variables and *E. coli* across the range of land-use and geological scenarios relevant to contamination of water resources. Mixed land-use catchments present a particularly complex environment in which to quantify the controls on *E. coli* dynamics due to the mosaic of land-use types and range of potential faecal sources. The objective of this study was to investigate how land-use, antecedent climate and meteorological conditions, and hydrology influence *E. coli* concentrations in receiving waters in a mixed land-use karst catchment in southwest China.

E. coli concentration was used as a measure of recent faecal contamination levels. Samples were collected at 30 sites at a bi-weekly interval between April and October 2018 providing a long-term dataset over seasonal and agricultural cycles. Field parameters were also collected for all samples, informing on residence times and water sources, and meteorological data was available from a weather station within the catchment. *E. coli* concentration ranged from below detection at epikarst springs on forested hillslopes to 8 $\log_{10}$CFU/100 mL (colony forming units/100 mL) at a contaminated site below a sewage treatment plant. The variation in *E. coli* concentration between sites was greater than the temporal variation during the monitoring period; the range of mean values between sites when all time points were compiled for each site was 4.29 $\log_{10}$ CFU/100 mL, compared with 0.8 $\log_{10}$ CFU/100 mL when values from all sites were compiled for each time point. Multi-variate regression modelling indicates karst hydrology and land-use explain the majority of variation in *E. coli* levels between sites, while meteorological variables explain some of the temporal variation (work ongoing). The results of this study are important because they suggest that land-use and hydrology are the most important controls on faecal contamination levels in this environment, but that climatic variation can also cause periods of increased risk. This has optimistic implications for improving management across the extensive karst farming region of China, and potentially other karst regions of the world. *E. coli* sampling programmes combined with hydrological, land-use, and meteorological datasets could be used to identify where mitigation strategies are required and the ability to predict periods of increased risk of high *E. coli* concentrations within catchments.