Understanding Harmful Algal Bloom Dynamics in a Mediterranean Hypereutrophic Reservoir insights from a Bayesian Network and a Structural Equation Model

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Cyanobacteria blooms, especially those involving Microcystis, are an increasing problem facing many freshwater systems worldwide. In this study, a Bayesian Network (BN) along with a Structural Equation Model (SEM) were concurrently developed through data-driven learning and expert elicitation in order to better delineate the main pathways responsible for the Microcystis dominance in a Mediterranean semi-arid hypereutrophic reservoir. The resulting two model structures were then compared with regards to the pathways they identified between the physical lake conditions and the nutrient loads on one hand and Microcystis dominance on the other. The two models were also used to predict the probability of bloom formation under different scenarios of climate change and nutrient loading. Both models showed that, given the eutrophic status of the study reservoir, direct temperature effects appear to be the primary driving force behind the Microcystis growth and dominance. Indirect temperature effects, which modulated water column stratification and internal nutrient release, were also found to play an important role in bloom formation. On the other hand, both models revealed that the direct nutrient pathways were less important as compared to the temperature effects, with internal nutrient loads dominating over external loads due to the seasonal variability in river flows, typical of Mediterranean rivers. Nevertheless, the BN model was unable to capture the recursive relationships between Microcystis and its forcings.