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A fuzzy logic approach for the prediction of sapid compounds concentration in a water supply system under climate change

Alberto Garcia-Prats[1], Ferran Llario[1], **Hector Macian-Sorribes**[1], Adria Rubio-Martin[1], Javier Macian-Cervera[2], and Manuel Pulido-Velazquez[1]
[1]Universitat Politècnica de València, Research Institute of Water and Environmental Engineering (IIAMA), Spain (agprats@upv.es)
[2]Global Omnium

Climate change is expected to have a significant impact on water resource systems, affecting both water quantity and quality. Among other probable impacts on raw water, the increase of sapid compounds such as geosmin and MIB (2-methylisoborneol) is one of the most challenging for urban water supply, as it alters both water taste and odour. Water managers and water utility companies need to anticipate events that increase the concentration of sapid compounds. Proper methods and tools are necessary to design adaptation strategies for future drinking water supply. In this research we analyse the drivers of MIB and geosmin growth, and study the consequence that an increasing occurrence and intensity of sapid compounds events will have on the required water treatments. The research has been developed for a Mediterranean reservoir used for water supply to the city of Valencia, the 3rd largest city in Spain.

The methodology applies a chain of models that integrates water quantity and quality processes in the same modelling framework. The modelling framework includes climate models, hydrological and water resource management models at the basin scale, and a reservoir management and quality models. Key environmental variables were selected using statistical analysis and expert criteria. Fuzzy logic systems were then applied to predict MIB and geosmin concentration under different time periods and climate change scenarios. Two representative concentration pathways (RCP 4.5 and 8.5) and two-time horizons (short term 2020-2040, and mid term 2041-2070) were considered.

Results show a significant increase of MIB and geosmin under climate change, especially during spring and summer. Concentrations of MIB would steadily rise until they double, reaching peaks of up to 0.50 µg/l by 2070 for all scenarios, while the World Health Organization maximum safe concentration is 0.01 µg/l. Geosmin concentrations also increase in all scenarios, reaching 0.05 µg/l by 2070. The microbiological data shows that benthic cyanobacteria Aphanocapsa delicatissima could be associated with MIB. Decreasing water storage, higher nitrate

concentrations, and higher temperatures would stimulate MIB production, favoured by a likely increased of light penetration and resuspension of cyanobacteria present in the benthos of the reservoir. These environmental conditions appear mainly during drought events and force water treatment plants to change their processes to face the higher concentration of sapid compounds in raw water.

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