Editorial

Weather and climate extremes: impacts on water quality

Recent data released by the National Oceanic and Atmospheric Administration show that 2013 was one of the hottest years on record for the planet equaling 2003 as the world's fourth warmest year since record keeping began in 1880. In fact, all of the top 10 warmest years on record have occurred since 1998. The warmest year on record was 2010. Along with the warming, in the last few decades there has been anecdotal evidence that low-probability extreme events (floods, droughts, heatwaves, wildfires, etc.) are recurring more frequently, at greater intensity, and are affecting different regions than in the past.

Extreme events are of primary concern to water providers since they could affect supply availability and quality, treatability, and infrastructure integrity/function, which may in turn affect water service reliability and complexity, drinking water quality, regulatory compliance, consumer perception, and overall costs. They include altered precipitation patterns (e.g., floods, heavy snowfall, droughts), wildfires, and major storm-related events affecting power and infrastructure integrity (e.g., floods, wind, lightning, heating/freezing, coastal tidal surges and atypical water runoff/erosion).

This special issue on 'Weather and climate extremes: impacts on water quality' in *the Journal of Water Supply: Research and Technology – AQUA* highlights how extreme events such as drought and flood may impact microbial and chemical quality of water including but not limited to turbidity, taste and odor, pathogen concentrations, and disinfection byproduct precursors.

Wright *et al.*'s (2014) paper on 'Managing water quality impacts from drought on drinking water supplies' presents results from six case studies on the effects of extreme weather on drinking water quality in order to help utilities prepare for vulnerabilities under future climate change. A key finding from their study is that droughts can fundamentally alter nutrient cycling and biota within both watersheds and reservoirs that influence water quality for months or years after the event. A few of the critical management actions for responding to degraded water quality related to droughts as recommended by the study include awareness of potential impacts, increased monitoring during and after the event, and capacity to quickly adjust treatment processes.

In the event of flood, source water microbial quality may be compromised due to overload of sewer systems and emergency discharges. Sokolova *et al.*'s (2014) paper 'Hydrodynamic modeling and forecasting of microbial water quality in a drinking water source' examines how hydrodynamic modeling can help to predict the short-term forecasts of the microbial water quality in drinking water sources. They used actual observations from Lake Rådasjön, Sweden and simulated the spread of *Escherichia coli* within the lake using a three-dimensional hydrodynamic model. They run their model for a period of 4 months using the observed data, and for a period of 9 days using meteorological forecast data. The modeling results showed how much every contamination source contributed to the total *E. coli* concentrations at the water intakes. The results of their study helped the decision makers to use the lake for drinking water production.

Heavy rainfall and flooding can also impact turbidity and dissolved organic matter concentration in water and challenge water treatment processes, particularly when this occurs out of the range of their design criteria for expected water quality. Pifer *et al.* (2014) sampled Beaver Lake in Arkansas, USA after a 28-cm of rain event occurred in April 2011. Their paper 'Assessing UV- and fluorescence-based metrics as disinfection byproduct precursor surrogate parameters in a water body influenced by a heavy rainfall event' shows water quality changes that drinking water

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treatment personnel can expect after a heavy rainfall event and how those changes may impact the treatment processes.

Weather conditions such as hot and dry periods as well as cold periods may lead to an increased pipe failure as described by Wols & van Thienen's (2014) paper 'Impact of weather conditions on pipe failure: a statistical analysis'. They performed a statistical analysis to study the correlations between weather parameters and pipe failures in drinking water distribution networks in the Netherlands. Their study showed that failures in asbestos-cement steel pipes increase at high temperatures, which can partly be attributed to higher water consumptions. For cast iron pipes failures increased at low temperatures. The relationships developed by their study can be used to assess the risk of effects of long-term variations in weather conditions on pipe failure.

Extreme climate and weather events can also impact groundwater quantity and quality. In their paper titled 'Responses of groundwater vulnerability to artificial recharge under extreme weather conditions in Shijiazhuang City, China', Su *et al.* (2014) discuss how artificial recharge may impact groundwater contamination under extreme weather conditions, importance of the quality of recharged water and importance of monitoring. Using Han River Basin in China as a case study, the authors tested five different scenarios with extreme weather conditions and showed the importance of groundwater depth on vulnerability.

This special issue on 'Weather and climate extremes: impacts on water quality' provides information from around the world on how climate and weather extremes can and are impacting water quality, and identifies issues water providers will need to pay attention to in future risk planning. Water utility infrastructure and operations procedures are generally designed to enable utilities to reduce the risks from typical, region-specific, extreme events based upon previous experience and history to an acceptable level, but a thorough understanding of the potential risks from atypical, extreme weather, combinations of extreme events at higher frequency, and unexpected trends in weather patterns is necessary for proper planning for the future.

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