Adjustment of the drinking water treatment process as a simultaneous response to climate and water quality variations has been a grand challenge in water resource management in recent years. This desired and preferred capability depends on timely and quantitative knowledge to monitor the quality and availability of water. This issue is of great importance for Lake Mead, the largest reservoir in the United States. The water quality in Lake Mead is impaired by forest fires, soil erosion, and land use changes in nearby watersheds and wastewater effluents from the Las Vegas Wash. In addition, more than a decade of drought has caused a sharp drop by about 100 feet in the elevation of Lake Mead. These hydrological processes in the drought event led to the increased concentration of total organic carbon (TOC) and total suspended solids (TSS) in the lake. TOC in surface water is known as a precursor of disinfection byproducts in drinking water, and high TSS concentration in source water is a threat leading to possible clogging in the water treatment process. Since Lake Mead is a principal source of drinking water for over 25 million people, high concentrations of TOC and TSS may have a health impact. Therefore, it is crucial to develop an early warning system which is able to support rapid forecasting of water quality and quantity.

In this study, the creation of the nowcasting water quality model lays down the foundation for monitoring TSS and TOC, on a near real-time basis, based on the integrated remote sensing data fusion and mining technique. Yet the novelty of this study lies in the development of a forecasting model to predict TOC and TSS values with the aid of remote sensing technologies on a daily basis. The forecasting process is aided by an iterative scheme via updating the daily satellite imagery in concert with retrieving the long-term memory from the past states with the aid of nonlinear autoregressive neural network with external input on a rolling basis. To account for the potential impact of long-term hydrological droughts, teleconnection signals were included on a seasonal basis in the Upper Colorado River basin which provides 97% of the inflow into Lake Mead. Empirical mode decomposition as well as wavelet analysis are utilized to extract the intrinsic trend and the dominant oscillation of the sea surface temperature (SST) and precipitation time series. After finding possible associations between the dominant oscillation of seasonal precipitation and global SST through lagged correlation analysis, the statistically significant index regions in the oceans are extracted. With these characterized associations, individual contribution of these SST forcing regions linked to the related precipitation responses are further quantified through the use of nonlinear modeling with the aid of extreme learning machine. Results indicate that the non-leading SST regions also contribute saliently to the terrestrial precipitation variability compared to some of the known leading SST regions and confirm the capability of predicting the hydrological drought events one season ahead of time.

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The public is welcome to attend.