

EGU21-5350

<https://doi.org/10.5194/egusphere-egu21-5350>

EGU General Assembly 2021

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Irish bathing sites closures and Stormwater Overflows: Precipitation forecasts, extremes analysis, and comparison with climate change projections

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During the summer of 2020, five bathing sites in Ireland were closed for the full season because of bad water quality, and 12 more received warnings and closed temporarily. Wastewater and sewage discharges, and Stormwater Overflows (SWOs) were the main causes. Although SWOs are not regarded as a management priority, they contributed to almost every bathing site's closure, sharpening other existing issues. In this study, the precipitation in Ireland was analysed to inform a national stakeholder forum (An Fóram Uisce/The Water Forum), which provides guidance on water management to the national government, and the national water utility on the rainfall-driven SWOs issues. A correlation analysis of the observations of the closest meteorological stations of each bathing site is presented, showing that there are significant variances across the country, and each area (bathing site) must be examined separately. The Greater Dublin Area (GDA)'s precipitation was then further analysed because eight bathing sites in the GDA are facing SWO problems. Daily, monthly, and annual timeseries (10 years) were studied for peaks, trends, and seasonality. A daily forecast was performed for 1-year, using five techniques, starting from the simplest to the more complex: Seasonal naïve, Seasonal ARIMA, Holt-Winters Seasonal Exponential Smoothing, Non-seasonal ARIMA using seasonality as an exogenous covariate, and Christiano-Fitzgerald filtering. The peculiarities of the observed GDA's precipitation timeseries are further highlighted through monthly, seasonal, and annual analyses. The trends showed that more extreme events (higher peaks) occurred over the last 30-20 years, thus, a brief extreme analysis was carried out using 120-year daily precipitation data. The Generalised Extreme Value (GEV) distribution was fitted to the historic precipitation using the L-moments method, and was compared to other theoretical distributions, commenting on their goodness of fit. Additionally, by comparing the historic data of temperature and rainfall from all the stations, with the respective reported projections of the future climate change scenarios, all stations we found to have already faced greater ranges than the predicted (e.g. the GDA has already experienced 45% higher temperature than forecast by the worst-case climate change predictions). Overall, the analysis indicates that water quality deterioration from SWOs caused by heavy rainfall events is forecast to become more frequent in the future. Consequently, managing authorities need to pay more attention to SWOs, instead of continuing to consider them as an occasional problem impacting water quality. This is the first study in the country approaching the issue of bathing water quality

from the perspective of precipitation analysis. Very few similar rainfall analyses have been carried out in Ireland, thus this work has also a significant added value to the Irish climate literature.