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The GREAT-ER model in China: Evaluating the risk of both treated and untreated wastewater discharges and a consideration to the future.

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As a result of rapid economic development, the production and usage of chemicals in China has risen significantly. This has resulted in China's environment becoming degraded. The Chinese government has attempted to ease these problems with significant investment towards upgrading the wastewater network. These efforts have initially focused upon large cities; progressing towards smaller populations within the most recent 5 year plan. However rural populations were largely overlooked, ∼90% of rural settlements do not have treatment facilities for their wastewater. The next (13th) five year plan is a great opportunity to improve upon wastewater infrastructure. This transition is particularly important and it is essential for the government to prioritise settlements to provide treatment facilities and to improve water quality in receiving waters.

This study focuses upon the use of a catchment model in order make progress towards this goal. A reliable model which can capture the complexity of the catchment is needed, but one without complexity in itself, in order for it to be developed and validated without an excessive requirement for data.

The Geo-referenced Regional Exposure Assessment Tool for European Rivers (GREAT-ER) model is a catchment-scale stochastic-deterministic GIS model. It is primarily used for higher-tier chemical risk assessment. Emissions are from point source only and are calculated based upon population and calculated emission rates per capita. Dilution and transportation are determined using low-flow statistics within each stretch; calculated based upon catchment soil and topographic properties. Removal of the contaminant can occur prior to emission and in-stream. The lowest tier methodology applies a simple 1st-order removal rate and a flat percentage removal for in-stream and sewage treatment work removal respectively. The data requirements are relatively low, although still challenging for many situations. Many authors have reported reasonable agreement between modelled and observed concentrations. Unlike many other water quality models, GREAT-ER is relatively simple to setup and use. This provides value for catchment managers, and for chemical end-users and manufacturers alike. As of yet, GREAT-ER has not been used in Chinese catchments, but there is much potential.

Our study involves the creation and validation of a model for the Dongjiang catchment, South China. The Dongjiang catchment is a highly populated area, draining into Guangzhou and the Pearl River delta. The catchment area is 25,325 km2 (above Boluo gauging station), of which approximately 90% resides in Guangdong Province. The downstream section of the catchment is densely populated, whilst upstream there is a more significant rural population.

This study focuses upon chemical ingredients found in personal care products and pharmaceuticals and the potential risk they may impose upon the catchment. The relative impact of rural discharges has also been examined along with the potential effect of a range of future wastewater upgrade scenarios. The model has been validated with measurement data collected over a number of sampling campaigns. We believe that this study provides insights into the challenges faced by China as it drives to improve water quality.