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Modeling Geogenic Groundwater Contamination Risk with the Groundwater Assessment Platform (GAP)

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Abstract : One-third of the world's population relies on groundwater for its drinking water. Natural geogenic arsenic and fluoride contaminate ~10% of wells. Prolonged exposure to high levels of arsenic can result in various internal cancers, while high levels of fluoride are responsible for the development of dental and crippling skeletal fluorosis. In poor urban and rural settings, the provision of drinking water free of geogenic contamination can be a major challenge. In order to efficiently apply limited resources in the testing of wells, water resource managers need to know where geogenically contaminated groundwater is likely to occur. The Groundwater Assessment Platform (GAP) fulfills this need by providing state-of-the-art global arsenic and fluoride contamination hazard maps as well as enabling users to create their own groundwater quality models. The global risk models were produced by logistic regression of arsenic and fluoride measurements using predictor variables of various soil, geological and climate parameters. The maps display the probability of encountering concentrations of arsenic or fluoride exceeding the World Health Organization's (WHO) stipulated concentration limits of 10 µg/L or 1.5 mg/L, respectively. In addition to a reconsideration of the relevant geochemical settings, these second-generation maps represent a great improvement over the previous risk maps due to a significant increase in data quantity and resolution. For example, there is a 10-fold increase in the number of measured data points, and the resolution of predictor variables is generally 60 times greater. These same predictor variable datasets are available on the GAP platform for visualization as well as for use with a modeling tool. The latter requires that users upload their own concentration measurements and select the predictor variables that they wish to incorporate in their models. In addition, users can upload additional predictor variable datasets either as features or coverages. Such models can represent an improvement over the global models already supplied, since (a) users may be able to use their own, more detailed datasets of measured concentrations and (b) the various processes leading to arsenic and fluoride groundwater contamination can be isolated more effectively on a smaller scale, thereby resulting in a more accurate model. All maps, including user-created risk models, can be downloaded as PDFs. There is also the option to share data in a secure environment as well as the possibility to collaborate in a secure environment through the creation of communities. In summary, GAP provides users with the means to reliably and efficiently produce models specific to their region of interest by making available the latest datasets of predictor variables along with the necessary modeling infrastructure.

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