Geophysical Research Abstracts
Vol. 21, EGU2019-8778, 2019
EGU General Assembly 2019

ARPEGES : a Bayesian Belief Network to help stakeholders assessing the risk of contamination of surface water by pesticides

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Pesticides are among priority concerns about water protection, due to their massive use, on-going development of new molecules and potential effects at short- and long-terms on aquatic life. The Water Framework Directive (WFD) at the European level thus incitates stakeholders to consider these pesticides in the water ecological quality assessment. Nonetheless, taking the large amount of molecules, their contrasted environmental behaviors (mobility, half-life time, solubility…) in different agro-pedo-climatic contexts was challenging them.
In this context, a Bayesian Belief Network has been developed in a cooperative process between researchers into Bayesian modelling, soil sciences, agronomy and diffuse pollutions to provide such a tool to stakeholders. For each local watershed of French territory, ARPEGES (Risk Analysis of Water Surface Contamination by Pesticides) model provides an assessment of the acute and chronic risks of being contaminated. To do so, it describes the intrinsic vulnerability as the distribution of probabilities for different transfer pathways (using data on physical ground and climatology), the acute and chronic specific vulnerabilities as crossings between these pathways probabilities and molecules chemical characteristics, and finally the risk of contamination as crossings between specific vulnerabilities and quantities of used molecules. To provide complete information to stakeholders, each indicator (as a most probable state for a variable) is associated to an estimation of its confidence and a sensitivity analysis has been performed to describe the mutual importance of the variables on the risks results.
Developed in 2012 and reworked since then, ARPEGES has been used by French stakeholders in the WFD assessment process in 2013 and 2019. Since 2017, a graphical friendly user version of ARPEGES is available to allow stakeholders to independently run the model with provided or newly acquired data, or to test for scenarios by introducing prospective datasets.