



Tackling complexity of pesticide persistence and transport at the catchment scale with multi-choice game

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Teaching complex environmental scenarios, such as the persistence and transport of pesticides in catchments, may fail with traditional lectures and tutorials because they involved the interplay between soil, land use, compounds properties, hydroclimatic context and biogeochemical processes. Virtual worlds (i.e. computer-based simulated environment) and serious games (i.e. applied games with added pedagogical value) may help tackling this complexity to improve knowledge and know-how of future water stakeholders and scientists. We developed an e-learning teaching unit with a multi-choice game using an experimental 47-ha catchment dataset and an original distributed hydrological models to challenge Master's students. Progressive steps in the gameplay highlight specific risks of off-site pesticide transport along the crop growing season. Students can interactively define and combine climatic and crops scenarios with different pesticides used in EU to explore components of worst-case situations. They can also propose best-management practices depending on involved environmental compartments, i.e. atmosphere, soil, surface water or groundwater. Stable isotope fractionation was incorporated in the distributed hydrological models to relate $^{13}\text{C}/^{12}\text{C}$ ratios of pesticides to dissipation processes within the catchment. By using and interpreting compound-specific isotope analysis (CSIA) data, students address the subtle but decisive difference between non-destructive (e.g. sorption) and destructive (e.g. bio and abiotic degradation) dissipation processes ongoing at catchment scale. This CSIA tool applied to agricultural catchments also allows to distinguish effects of dilution from effect of degradation in agricultural catchment receiving pesticides. Altogether, this novel e-learning teaching unit will be deployed for the first time in fall 2019 to support future water managers in their efforts to understand pesticide impacts and mitigation options offered at the catchment scale.