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Ivermectin transfer through percolation and surface runoff from intact soil mesocosms under rainfall simulation

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Ivermectin (IVM) is one of the few pharmaceutics that are still used in a preventive, systematic manner in extensive cattle breeding in our study region in the Ardèche region (France), amongst others. It is an efficient antiparasitic agent with an extreme acute toxicity for most invertebrates, especially aquatic organisms like daphnia (ng/l), and is also highly toxic to different fish species (µg/l). Due to its strong sorption to soil and sediment and quick photodegradation, early environmental risk assessments (ERA) conclude a low risk for aquatic organisms. More recent studies conclude an inacceptable risk for daphnia and dung organisms. One of the critical parameters between these contradictory conclusions is IVM export from cow dung and transfer towards the streams.

The study region is characterized by a Mediterranean climate with a dry summer and intense convective storm events leading to regular flash flood events that coincide with the cattle treatment seasons in spring and autumn. The study region encompasses the Claduègne catchment which is part of the OHMCV observatory and the OZCAR and eLTER research infrastructures.

The key question concerning the risk for aquatic organisms is to what extent and in which conditions IVM is mobilized and transferred from cow dung to soil and river via surface runoff and percolation in this environment prone to rapid flow processes. We approach this question on the scale of 60*30*22 (L*W*D) cm3 intact soil mesocosms, for which we developed an adapted field sampling and laboratory experimentation case. Soil mescosms are collected in the Claduègne catchment. IVM is applied in form of spiked cow dung at realistic environmental concentrations before simulating several rainfall events, representative of this Mediterranean region. Runoff and drainage water are sampled for major anions (including Br- tracer), non-particulate organic carbon and IVM concentrations on a high temporal frequency in order to gain an insight on the intra- and inter-event dynamics of water and IVM transfer. Tested parameters include dung ageing, soils types, initial soil humidity and consecutive rainfall events.

The first results highlight the importance of runoff for the overall export of IVM on the event scale. Concerning the water flux, initial humidity is found to determine the runoff / drainage partitioning

as well as the rapidity of percolation through the occurrence of preferential flow. In this context, hydrophobicity seems to play an important role.