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Monitoring of veterinary pharmaceuticals in the Bienne river (Jura Mountain, France)

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The Bienne river (Jura Mountain, France) drains a basin of medium altitude mountains characterized by extensive cattle breeding (mostly dairy cows). A monitoring of the contamination by veterinary pharmaceuticals was performed using passive sampling devices - POCIS (Polar Organic Chemical Integrative Samplers), between September 2019 and January 2020. Four hydrological conditions were analysed: a severe low-flow periods, two flood events and a winter situation close to the mean interannual flow. Each time, POCIS were exposed over 2 weeks at 2 stations located in the upper and downstream reaches of the river. 19 pharmaceuticals were selected from information given by local veterinarians and analysed by LC MS-MS: endo and ectoparasites treatments; antibiotics and non-steroidal anti-inflammatory drugs. The monitoring shows that most of these chemicals (12 substances) are quantified in all POCIS samples and the others show relatively high occurrences, between 25 and 88%. Average concentrations in water (calculated with the sampling rate i.e. considering the time of exposition of POCIS samplers in the river) are remarkably close between the 2 monitoring stations. Concentrations are high all over the studied period and reach a maximum during flood events. Thus, hazardous effects are expected on freshwater organisms, especially for macrocyclic lactones and pyrethroids and organophosphates pesticides. The antibiotics concentrations ranges can also disturb microbial communities existing in the river. Such results highlight an important impregnation by these pharmaceuticals at the catchment scale, involving diffuse sources as grasslands receiving contaminated cow dungs and manures. Veterinary compounds are strongly remobilized during rain episodes by run off and infiltration in soils. In the hydrogeological context of the Bienne basin, karstic flows emphasize the connectivity between grasslands and the river. Therefore, an important part of the contaminated leaching waters can rapidly reach the river via the soil drains and surface / subsurface flows. Rather than another part goes through less porosity pathways and delivers pollutants over a longer period. Wastewater discharges and sludges from rural and urban treatment plants can also contribute to this pollution for pharmaceuticals also used in human medications.