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# Coupling processes studies, field observations and surveys for identifying the main sources of pharmaceuticals contaminations and produce vulnerability maps in an agricultural Mediterranean basin

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Emerging contaminants have become ubiquitous in soils and surface waters. They include in particular pharmaceuticals (PPs) such as analgesics, antibiotics, antihistamines, hormones…, among a wide range of other products (personal care products, plasticizers, flame retardants, manufactured nanoparticles…). Although the fate of PPs in urban context has been quite well documented in relation with the domination of point-sources in these zones, the dissemination of PPs in rural zones remains poorly understood mostly because of the complexity and variety of PPs sources (animal breeding, application or storage of manure or waste water sludge, organic amendments…) and their temporal occurrence, in parallel with more common sources (e.g. waste water from treatment plants, WWTP…). The spatial distribution of PP input on one hand and soils reactivity to those molecules on the other hand are key factors that need to be better understood in order to improve the prediction of their transfer and fate at the catchment scale.

The objective of this study, conducted in the frame of a multidisciplinary project, was to produce vulnerability risk maps of an agricultural Mediterranean basin: the Claduègne river basin of 42 $km^2$, which is part of the OHMCV observatory, the French OZCAR research infrastructure, and the Zone Atelier Bassin Rhône (ZABR). A combined approach was conducted to produce these maps: 1/ survey of veterinaries and farmers to identify and semi-quantify the main PPs used yearly in the basin and the pasture parcels surface area, 2/ field campaigns for both soil and water properties characterization and for pharmaceutical screening (passive and point measurements) in surface waters, 3/ Literature review and laboratory experiments on PPs retention and degradation to establish mobility and persistence maps of PPs. This will allow establishing a spatially and temporally distributed quantification of the sources of 9 PPs, among which Sulfamethoxazole (antibiotic) and Ivermectin (insecticide), regularly used in the catchment. Along with these results on the potential input mass of PPs per surface, we will also produce PPs mobility and persistence maps by spatializing these properties at the catchment scale using pedotransfer functions. These maps will be combined using a GIS to produce vulnerability maps, which will be compared to the results of the PPs screening in surface waters. This ongoing work already permitted to evaluate the leaching potential (vulnerability maps) for two molecules using the groundwater ubiquity score (GUS), which accounts for the retention (solid – liquid distribution coefficient, Kd) and persistence (chemical half-life, T1/2) of PPs.