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Impact of soil erosion on chlordecone insecticide transfers in a tropical volcanic cultivated subcatchment

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Between 1972 and 1993, in the French West Indies, chlordecone – a toxic organochlorine insecticide – was applied to control the banana weevil. In the late 1990s, the intensification of agricultural practices (i.e. intensive ploughing, herbicide application) under banana plantations is expected to have led to accelerated soil erosion and sediment transfers (Bizeul et al., 2023) to aquatic systems and, ultimately, to marine environments (Sabatier et al., 2021). Due to the high affinity of chlordecone for organic matter and its hydrophobicity, these sediment transfers are associated with chlordecone remobilization (Mottes et al., 2021) and pesticide transfers along the land-to-sea continuum. Nevertheless, the links between soil erosion, sediment and chlordecone transfers are not well understood. The investigation of these processes is therefore essential to manage chlordecone transfers along the land-to-sea continuum.

To this end, three sediment cores were collected in an agricultural reservoir (Saint-Esprit, Martinique) and five soil cores (one-meter depth) were sampled along a transect in a banana plantation draining to the reservoir.

Regarding sediment cores, age-depth models were drawn for each core using short-lived radionuclide activities (Bruel et Sabatier, 2020). Furthermore, dry bulk density was measured to calculate mass accumulation rates. Moreover, chlordecone and organic carbon contents were measured on three cores. Overall, results show a correspondence between the increase of sediment supply to the reservoir and that of chlordecone and organic carbon fluxes. In particular, chlordecone fluxes showed an increase since 1999 (± 4 years, depending on the cores) from 200 $\mu g.kg^{-1}$ to 600-750 $\mu g.kg^{-1}$.

Regarding soil cores, radiocesium activities were measured in 5-cm increments and chlordecone contents were measured in a selection of 2 cores (uplslope and downslope of the transect). On the upper hillslope part, chlordecone contents showed a strong increase at 20 cm, from 255 $\mu g.kg^{-1}$ to 591 $\mu g.kg^{-1}$, in line with radiocesium activity increase, from 0.5 $Bq.kg^{-1}$ to 1.4 $Bq.kg^{-1}$. On the lowest hillslope part, chlordecone contents showed a strong increase at 70 cm, from 520 $\mu g.kg^{-1}$ to 1220 $\mu g.kg^{-1}$. Based on these results, we assume that chlordecone distribution follows erosion pathways and can accumulate on the foot slope of this banana plantation. Furthermore, in contrast, constant chlordecone contents observed in the upper part of the profile in each core (i.e. 20 and

70 cm) suggest an homogenization of the soil profile, probably due to ploughing operations carried out every 6-8 years for cyclical banana re-plantation.

Overall, these results confirm the transfer of chlordecone with soil particles along a cultivated hillslope and, ultimately, in the sediment deposited in the reservoir. We assume that these processes also reflect land use changes and the occurrence of erosive tropical climatic events. Further work is needed to confirm the validity of these results to other cultivated catchments across the French West Indies.