EGU General Assembly 2020
Online | 4–8 May 2020

Soil degradation following the conversion of native grasslands into croplands in the Pampa biome – (Southern Brazil) and the impact on suspended sediment supply to the rivers

Rafael Ramon[1,2*], Olivier Evrard[1], Tales Tiecher[2], Sylvain Huon[3], Felipe Bernardi[4], A. Augusto Batista[5], Tadeu Tiecher[6], Véronique Vaury [3] and Jean P.G. Minella[4]

Figure 1. Pampa biome (Tropical and Subtropical Grasslands, Savannas and Shrublands) and study site location.

Introduction - **land use change in the Pampa Biome** (Southern Brazil) (Figure 1) by the conversion of the natural grasslands (Figure 2) into cropland may lead to an **increase in soil erosion rates and sediment delivery to the rivers**. Grasslands represent a significant sink of carbon, and according to the literature, 59% of the soil organic carbon (SOC) is lost when pastures are converted into cropland. It makes soils even more vulnerable to water and land degradation.

Objective - to evaluate the impact of land use change on the river sediment composition by calculating the sediment contribution of each potential sediment source with a composite sediment fingerprinting approach.

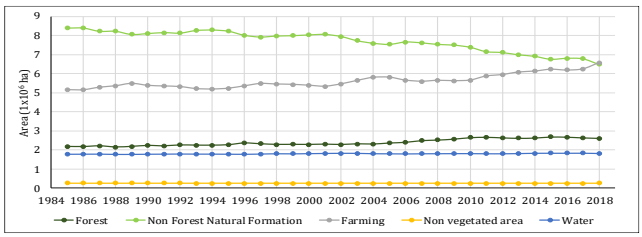


Figure 2. Land use change in the Brazilian Pampa biome over the years. Non forest natural formation is composed by the Native Grasslands. Farming are here nominated as Croplands, which is composed by grain crops (rice and soybean mainy) and cultivated pastures.

Methodology - **Study site** - Ibirapuitã river catchment – 5,942 km² (Figure 3). **Main soils:** sandy and shallow soils predominate derived from basalts and sandstones. **Altitude range:** 80 – 370 m a.s.l., with 90% of the catchment area characterised by slopes lower than 15%. **Sampling** – 119 source samples were taken from the soil surface layer of croplands and grasslands, as well as from the top layer of exposed sites of gullies, channel banks and unpaved roads. Suspended sediment samples were collected using time integrated samplers (TISS) deployed in the bottom of the river, and during rainfall runoff events (RR) at the outlet of the catchment. Samples were oven dried (50 °C), gently disaggregated and dry sieved to 63 µm to avoid particle size effects prior to further analysis. **Parameters analysed** - total organic carbon - TOC, total nitrogen - TN, $\delta^{13}C$, $\delta^{15}N$, ^{137}Cs, $^{210}Pb_{xs}$ and 33 parameters derived from the Ultra-violet-visible spectra. **Statistical analysis** - Tracers were selected following a three step procedure, including: (i) a conservative range test, (ii) a Kruskal–Wallis H-test, and (iii) a linear discriminant function analysis. The selected tracers were introduced into a mass balance mixing model to estimate the source contributions to in-stream sediment by minimizing the sum of square residuals.

Results – TOC, TN and radionuclides present significant differences between cropland and native grassland, while the isotopes $\delta^{13}C$ and $\delta^{15}N$, presented lower discriminant potential (Figure 4). Sediments samples values were within the source range for most parameters and all parameters hold potential to discriminate between at least two sources (KW H test with $p < 0.1$). TN, h, $^{210}Pb_{xs}$, A1, IRGB, RI and A2 were the parameters selected by the LDA for the final model, resulting in 83% of the samples correctly reclassified.

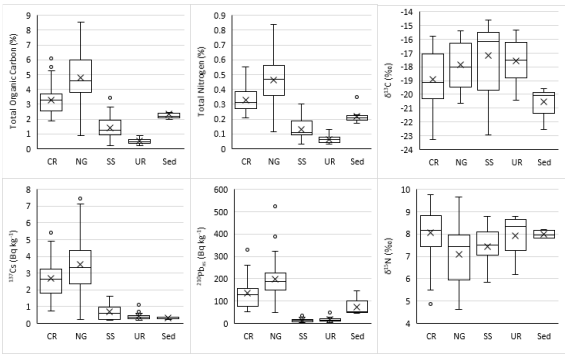
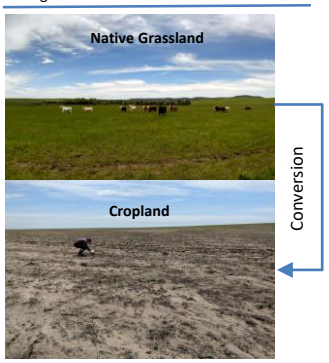


Figure 4. Sources and sediment concentration for organic parameters and radionuclides. (CR – croplands, NG – Native Grasslands, SS – subsurface sources, UR – Unpaved Rods, Sed – Sediment Samples).



Cropland (36%) is the main sediment source in the Ibirapuitã river catchment, followed by the NG (33%) (Figure 5). The area occupied by CR is approximately 8 times smaller and the sediment contribution is 1.1 times more than NG, showing that erosion processes have been intensified by the conversion of NG into CR. The contribution of SS and UR sources seems to be more importante for TISS samples, while surface sources (CR and NG) are the main sediment source during RR events.

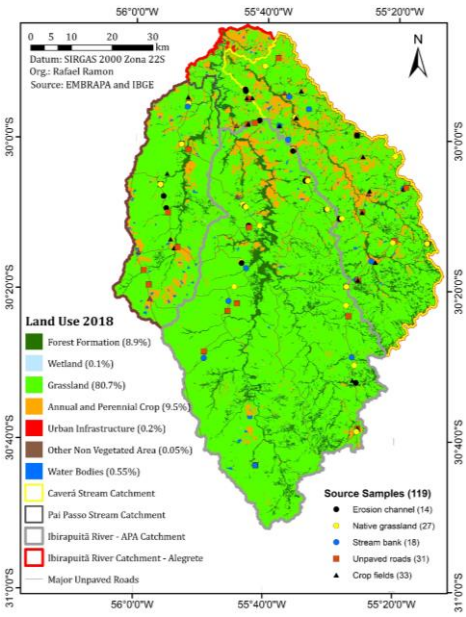


Figure 3. Land use and source samples.

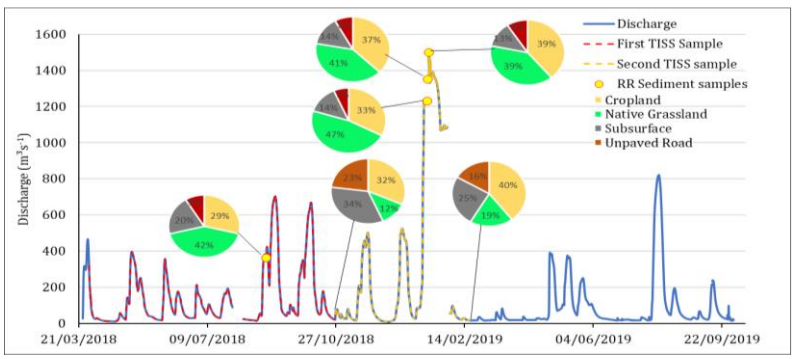


Figure 5. Source contribution to sediment samples.

Conclusions

- ✓ Erosion processes have been intensified by the conversion of native grasslands into croplands.
- ✓ The absence of riparian forest observed in the field, and the results show that erosion in channels is also important.
- ✓ The sediment fingerprinting apportionment, the total organic matter composition and the radionuclides activity of the sources samples, shows that cropland present a higher level of soil degradation and consequently result in a higher contribution of sediments to the river.
- ✓ The conversion of native grasslands into farming areas, tends to reduce the soil organic carbon content, reducing its quality, and also increasing the degradation of water resources delivering more sediments and associated contaminants to the river.

[1]Laboratoire des Sciences du Climat et de l'Environnement; [2]Federal University of Rio Grande do Sul; [3]IEES Paris; [4]Federal University of Santa Maria; [5]IFFar Alegrete; [6]IFRS - Restinga *contact: rafaramon11@gmail.com. Acknowledgment to CAPES for the fist author scholarship – COFECUB – Process number 88887.196234/2018-00