Dear Reviewers,

Thank you very much for your constructive comments. Below please find our responses to your comments.

Reviewer 1

The manuscript presents a sediment source tracking approach using several techniques; most notable are newer spectrophotometric approaches. I have included an annotated pdf with comments and editorial marks.

Reviewer's comments	Replies
Identifying your approach that you use as "truth" in your analysis to compare other analyses too is critical here. I think you missed an opportunity here to convince the reader what truth is. Your Geochem approach appears to be the best approach alone; your two tables convince me of that alone. *Line 508: But what is your truth....which analysis are you hanging your hat on has the one truly discriminating differences?* *Line 532: This is your best source of truth in this paper and this result should come first in results and discussion. all other results should be compared to this.* *Line 606: I would not phrase your conclusion this way. The color/gechem is your truth that all other models are being compared to...but frankly your geochem model is the best model...the color addition really does not add much in my opinion.* *Line 628: No. Your tables show geochem alone is your best data...no need for color.*	We consider that the sediment tracing carried out with the geochemistry approach provides very satisfactory results. We acknowledge that when comparing the results found in Tables 4 and 5, the differences between the results obtained with the geochemistry and the geochemistry + colour approaches are very limited (around 5 % on average). These consistent results may be explained by the fact that most of the mining contributions estimated by the models are above 60 % for these two events in 2015 and 2017. Above 60 %, the estimations of mining contributions modelled by the both models have been experimentally validated with artificial mixtures (7% of error for both models). Below 60 %, the geochemistry approach proved to be less efficient, less stable with a higher level of potential error (~15%) than for the "geochemistry + colour" approach (~7%) (Figures 5.a and 5.b, Tables 4: example of sampling point n°5, 41% vs. 59% of mining contributions estimated respectively by the geochemistry and the geochemistry + colour approaches, i.e. a difference of 18%). Obtaining multiple lines of evidence is, in our opinion, the best way to check the consistency of our results so that we think that it is valuable to compare the results obtained with the geochemistry and the geochemistry + colour approaches
I would check for normality and run a two sample test on your Geochem versus Geochem and color result. Second, I think much more could be done to use element to element comparisons with tributaries and sources noted on scatter plots (different colors or symbols). Table 2 begs for such an approach. Element rations can also be useful here too. A Kruskal Wallace or ANOVA (depends on normality) of elements by trib or	The objective of the article was to compare two distinct sediment tracing approaches, i.e. a 'conventional' approach proposed by Collins et al. 1996 (i.e. statistical analysis and use of a mixing model) and an alternative approach based on the partial least-square regression models. The statistical analysis proposed by Collins et al., 1996 consists of (1) a range test, (2) the Mann-Whitney U test (n=2 sources) or the

land use could id significant differences too. It is not clear how your Mann Whitney test was used? *Line 549: Maybe an ANOVA or Kruskal Wallace test of K by trib/land use could discern a significant result. Need more than one value of K per trib.*	Kruskal-Wallace test ($n \geq 3$ sources) and (3) a stepwise discriminant function analysis (DFA). The suggestions that you made are very interesting because it would indeed be more relevant for future analyses to perform an ANOVA to observe whether subgroups of source samples may be distinguished. This would require that normality be verified in both groups. Nevertheless, in the practice, the normality of two populations is rarely verified, which is why sediment tracing approaches are mostly based on non-parametric tests. In this case, normality is not verified at the level of the two source samples (i.e. mining and non-mining sources) in our study. The other condition that would eventually allow us to get rid of the non-normality of the source samples and that would allow us to use parametric tests (t-test, ANOVA, ...), i.e. $n \geq 20$ is not verified (n = 16 for mining sources, n = 7 for non-mining sources). The use of Mann-Whitney U test ($\alpha = 0.05$), a non-parametric test, is therefore relevant in our opinion in the current research, it allows us to verify that the two source samples are statistically different. The use of the Kruskal Wallace test is recommended when the sediment tracing approach involves at least 3 sources in the study ($n \geq 3$). As far as elemental ratios are concerned, tests have already been carried out on several elemental ratios to check whether they provide a more powerful discrimination than elemental concentrations, but the results obtained with these ratios were not conclusive. The difficult conditions of accessibility to the sampling areas (i.e. restricted access, no access roads) did not allow for a more detailed sampling. Each source sample is nevertheless composed of 5 to 10 sub-samples (see Materials and Methods) which provides a good representativeness of river material transiting in the tributary.
I worry your data is suffering from some multicollinearity, especially with the Stepwise approach. How was this handled/addressed? *Line 240: how mas multicollinearity dealt with?*	DFA was carried out with the *Statistica* software that automatically eliminates the collinear variables at the time of analysis. This information has been added (Lines 381-383).

Line 320: still a potential to have correlated variables here.	
Can you use linear discriminant analysis with cross validation to predict membership in a trib or land use? *Line 239: Could try linear discriminant analysis with cross validation?* *Line 542: linear discriminant analysis with cross validation, and other elements besides K, might do better.*	To carry out a linear discriminant analysis with cross validation, we would have to split our source sample group into two subgroups: the 'learning' and 'testing' sets. We did not have sufficient source samples to conduct cross-validation (n=24). For example, we only have 8 non-mining tributary samples. It would not benefit the model to remove one or half of them for testing. The model would lose considerably in reliability (learning). Moreover, we remain in a relatively simple case study with two sources with statistical results that are already excellent (Table 3). Your suggestion is relevant but this approach would be feasible with a larger number of samples and would probably be more appropriate in a more complex sediment tracing case (n≥3 sources)

Reviewer's comments	**Replies**
INTRODUCTION	
Line 64: Cite	Citations have been added (Line 90)
Line 69: Cite	Citations have been added (Line 90)
Line 85: Lack of clarity between these two sentences	This remark has been taken into account.
Line 86: Cite	Citations have been added (Line 110)
Line 120: Cite	Citations have been added (Line 177)
MATERIALS AND METHODS	
Figure 1: green and red colors can be hard to discern for color blind people.	Figure 1 => Figure 2 This figure has been modified
Line 153: Cite	This information was determined from data provided by Météo France. Accordingly, this government agency is the source of this data
Line 173: Cite	Personal communication with the software designer
Line 183: why not a fixed number and volume?	The number of subsamples of fine sediment was determined according to the amount of observed sedimentary material (added at line 276). The difficult conditions of accessibility to the sampling areas (i.e. restricted access, no access roads) did not allow for a more extensive sampling on some tributaries.
Line 198: grammar and usage is off in this sentence.	This sentence was rewritten.
Line 199: was there sample prep?	No, there was no new preparation of the samples at this step.
Line 227: Cite	Personal communication with the software designer.

RESULTS	
Line 299: 'conservative' meaning what?	The notion of conservation has been reinforced in the Introduction (Lines 124-128) and Materials and Methods. (Lines 279-286)
Table 2: *Adjust column headings per journal norm.* *Are these means (or medians) and standard deviations?? Should be explained in Table caption.*	These are mean values. This information has been better explained in Table 1 (inside and in the table caption)
Line 322: you do mean potassium here, right? Would be good to explain the mineral K is present in, the range in percent it is present, how this changes with land use and, stream gradient, distance, etc.	The differences observed in terms of K contents between the two sources originate from the differences in geochemical compositions observed by Sevin (2014) between the two dominant geological formations in New Caledonia: peridotite massifs and volcano-sedimentary formations: volcano-sedimentary rock formations naturally contain high K elemental contents whereas peridotite massifs are depleted in this element in New Caledonia. K is commonly used as a lithological tracer in similar studies (Zebracki et al., 2015). This information has been added in the introduction section (Lines 136-147)
Line 364: confirmation with XRD is ideal when using spectra signatures for extrapolation.	The first spectrocolorimetric results are consistent with the information found in the literature on the soil-geological profiles observed in New Caledonia. The source rocks of the two main lithologies are not the same across all the regions of the main island of New Caledonia. Therefore, although they are both altered, they do not show the same pedogenic profile. The formation of a laterite profile is observed on the peridotite massifs whereas a pedogenic profile composed of clay horizons (up to ~45 cm deep) and in deeper layers weathered horizons is described on the volcano-sedimentary formations. The depths are given as an indication, and vary according to the slope profile. The flatter the landform, the greater the weathering or development of the soil. The peridotite massifs contain more Fe than the volcano-sedimentary formations, so that there is a greater accumulation of Fe and therefore of hematite (the last stage of alteration). This does not mean that there is no hematite in the altered horizons of the volcano-sedimentary formations; it means that this mineral is present in smaller quantities. Denis (1988) showed that goethite is particularly present in the fine fraction of altered horizons.

	This information has been added in the Introduction (Lines 156-168), and in the Discussion (Lines 687-695).
Figure 6: pie charts too small. Pull charts out to right side of figure and use a line to point where on the map they apply. Make charts 4x as big a s now. Careful of red and green together.	The figure has been modified.
Line 420: A spatial comparison to the watershed area extent to the geochemical contribution from each watershed with mining would perhaps produce a strong association?	It is difficult to determine the sediment contribution of each of the sub-catchments. Upstream, this is feasible down to the confluence with the Kouaré tributary, but beyond that, it is not possible. The sediment tracing approach is conducted as an integrative approach along the Thio River.
Line 443: 'Mué tributary' what land use is dominant in this watershed...See why looking at spatial extent of land use kind in relation to geochemistry could improve data interpretation?	Mué tributary is one of the tributary draining the Thio Plateau mine. Yes, we understand the interest of this approach but it is not feasible with our sediment fingerprinting approach. See our reply to the previous comment.
Line 469: awkward phrasing	This sentence was rewritten
Line 472: Awkward start	This sentence was rewritten
Line 476: Would be useful to remind the reader here what this analysis is suppose to achieve and how a result could be interpreted as inferring the source.	Explanations have been added to outline the interest of this analysis. Lines 629-638
Line 478: but what does this mean? what should we see?	Ideally, artificial mixture samples should cover all source samples. When we look at Figure 11, we see for example that a group of mining samples is not well covered by the artificial mixtures. In other words, the artificial mixture sample built with the 100% mining sources is not representative of all actual samples. In reality, the signature of this type of source samples is 'stronger' than what the model is able to recognize. It will therefore tend to estimate contributions above 100% in terms of mining contributions and below 0% in non-mining sources. Nevertheless, as we can see from this figure, the source samples and the artificial mixtures follow a linear line. There is therefore a form of proportionality. If a sample has a contribution from mining sources of 140% then it will tend to have a contribution from non-mining sources of -40%. The purpose of this paragraph is more to describe our results and explain why some samples of river material have negative contributions or proportions above 100%.

	However, the only points that do not follow this line are the mining samples collected on the Koua tributary. There is a concern for two reasons about these samples. (1) The sum of their contributions is not close to 100 ± 20%, so there is no 'balance'. (2) They are not recognized as mining samples by the model, although they are. The model has a real problem recognizing the signature of these samples. The main hypothesis is that the particular signature of these samples was lost when the mining source pole was formed. This signature represents less than 20% in terms of representativeness of the mining source pole (i.e. a mixture of 16 mining samples in equivalent quantity of which 3 were collected on the Koua tributary). However, the Koua tributary contributes most of the sediment input in the upstream part of the catchment.
Line 496: What's the K mineral source...could it be a pinkish color mineral the spectra is detecting as reddish? *Figure 11: I would think element to element comparisons or element ratio to ratio* *Line 521:* *grain size analysis, coupled with mineralogy, could yield stronger results. quartz presence alone perhaps?*	K is a lithological tracer discriminating the contributions of the peridotite massifs (mining activities) and the volcano-sedimentary formations: volcano-sedimentary rock formations naturally contain high K elemental contents whereas peridotite massifs are depleted in this element in New Caledonia (Sevin, 2014). The alteration of peridotite massifs has generated the formation of more hematite than the alteration of volcano-sedimentary formations. This is due to the composition of the source rock itself, which is richer in Fe in the peridotite massifs than in the volcano-sedimentary formations (Quantin et al., 1997; Denis, 1988). This excessive presence of hematite gives a particularly red colour to the soils on the peridotite massifs. The parameter a* is an indicator of this red colouring. The objective of this figure (Figure 13) is therefore to analyze more specifically our source samples by having this information in mind. Peridotite massifs: Low K contents, high values of a* Volcano-sedimentary formations: High K contents, low values of a*
DISCUSSION	
Line 526: This is simply location discrimination....useful? *Too much speculation in this paragraph.*	Peridotite massifs are composed of different parent rocks: serpentines, peridotites, harzburgites. Although they are composed of

	similar minerals, the proportion of minerals varies from one type of rock to another (e.g. olivine, the main carrier mineral phase of nickel). Alteration by definition will not be the same all across the peridotite massifs. Moreover, other factors such as relief can influence this alteration. Hydrological (e.g. valley shape) or tectonic (e.g. tectonic fracture) factors can influence alteration of the peridotite massifs in New Caledonia (Sevin, 2014). This information has been added. Lines 707-716
Line 556: What's your truth here...you need to link mineralogical color to the red.	See previous comment. Additional information on soil pedology in New Caledonia has been added throughout the article to make it easier the link between the colour and minerals (e.g. red = hematite)
Line 561: hunting down this 15% is key.....did you look at your data...odd sample result...lab error...math error somewhere? Was the choice of sampling location to be a cause?	The 'geochemistry' model has difficulties to discriminate sediment contributions from sub-catchments with mixed lithologies (i.e. with higher K concentrations compared to K concentration found in the 'traditional mining tributary samples). It classifies these types of samples as originating from mining tributaries, such as the Watou River sample. As a result, as the K concentrations increase in the samples analyzed, the model will tend to overestimate the contributions of mining sources by default compared to their actual contributions. This information has been added. Lines 760-764
Line 611: This conclusion is unsubstantiated. You have too many other factors that could explain the variability you have not presented.....watershed gradients, storm sizes and intensity and duration, land use differences, etc.	Additional information has been added in this section (Lines 817-821).
Line 613: 'rainfall distribution' THis is not in the methods or results Line 614: If you are making this a conclusion you need to present the data.	We have chosen to present this data in the discussion and not in Materials and Methods to avoid overloading this already dense section. We believe that potential readers will be sufficiently familiar with the Thio River catchment (e.g. names of sub-catchments) in the Discussion section to be able to more easily retain and understand this new information (i.e. rainfall distribution).

References

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Reviewer 2

The manuscript “Combining colour parameters and geochemical tracers to improve sediment source discrimination in a mining catchment (New Caledonia, South Pacific Islands)” by Virginie Sellier et al. presents a fingerprinting study in the Thio River catchment in New Caledonia using colour and element concentrations individually and combined as tracers, as well as a conventional fingerprinting approach and partial least square regression (PLSR) models based on the entire visible spectrum. The study includes interesting findings, is well described, and fits within the scopes of SOIL (soil and method/ degradation), although I think the soil part could be enhanced in the manuscript (please find detailed comments in the pdf and below). The manuscript represents a statistical approach to compare tracer performance and fingerprinting approaches. Artificial mixture samples help validate results and increases the validity of the paper. Methods are not new but the manuscript elicits well the different results obtained in one catchment and is worth being published after major revision. I attach the pdf with detailed comments (98).

Reviewer’s comments	**Replies**
Generally, I would encourage to use less parentheses. In quite a few cases I had the feeling there is more information in the parentheses than in the actual sentence. In my opinion it disrupts the reading flow and the information should be included into the text	This syntax problem has been taken into account in the revised version of the manuscript.
ABSTRACT	
Abstract: The Abstract mentions the methodological question of the paper and hints a management advice “focus on the contributions of mining tributaries to reduce sediment inputs”, which is not really observed at the end and seems obvious knowing mining case studies. I would suggest not distract from the methodological focus of the paper with these “lonely” and obvious statement.	The abstract has been modified in line with this comment in order to further highlight the methodological aspect of the study.
Line 15: The beginning is too broad in my eyes, why not start out with the impact of open mining pits to sediment flux	This remark has been taken into account. Lines 15-17
Line 17: what concerns?	The concerns have been detailed. Lines 18-21
Line 18: Hyper-sedimentation? And overburden? I have admit I never stumbled over this term in Geomorphology, but it might be a language issue	The terms 'hyper-sedimentation' and 'overburden' have been replaced with ‘siltation’ in the revised version of the manuscript
Line 18: I would include the information in the parentheses into the as these are the interesting processes	This remark has been taken into account.
Line 21: Your aim is to test different methods if I understand right. However, this paragraphs suggest a case study	This remark has been taken into account. Lines 24-26
Line 34 – 35: Do you mean fingerprinting approach 3 (colour parameters coupled with geochemical properties)? or which model? If	This sentence has been rewritten. Lines 43-46

you mean the approach, I would suggest to stick with same or similar wording! Sentence not clear to me	
Line 39: I would stick with the methodological question of the paper and not include a management advice that seems obvious from many studies before!	This remark has been taken into account. The sentence has been removed. Lines 47-49
INTRODUCTION	
Introduction: The introduction seemed to be to be a compromise between a case study, a management advice, and a methodological exploration. I would focus on the latter. The potential extrapolation of the method is repeated in one sentence in Abstract, Introduction and Conclusion. I would suggest stating it once (or twice with Abstract and elaborating a bit more the criteria (comments in the pdf in Conclusion)	The methodological aspect of the article is crucial and will be further highlighted in the introduction. Nevertheless, the 'management' aspect of the study should not be neglected, as the objective of this type of study is to provide guidance to carry out this environmental monitoring on-site. The choice of the selected methods was also based on the equipment that could be deployed on site (e.g. choice of spectrocolorimetry, portable, fast and inexpensive in terms of analysis). The extrapolation potential of the method has been more detailed in the conclusions of the revised version of the manuscript.
Line 51: Can you explain in two sentences why are they prone to erosion?	This remark has been taken into account. Additional information has been added to the paragraph. Lines 61-68
Line 58: Triggered? I am not a native English speaker so you might want to check for a better word, but transformed sounds bulky to me	The word ‘transferred’ has been replaced with ‘triggered’. Line 77
Line 60-64: The information in these lines is very thin: People have to deal with storm consequences! The more specific info is in parentheses. You might want to rewrite, or maybe leave out the paragraph. I suggest strongly to focus on the consequences based on sediment inputs and not widen the spectrum	Parentheses have been removed to simplify reading. We are not sure that we understand the following comment: ‘focus on the consequences based on sediment inputs and not widen the spectrum’. The sedimentary inputs have induced morphological modifications of the rivers generating increased risks of flooding and consequently of destruction of private property or public infrastructures. However, the transfer of sediments enriched in heavy metals also represents a threat from an ecotoxicological point of view for aquatic organisms but also for the local population (through fishing). The idea of this paragraph is to target the main problems and worries raised by the local populations. However, to further engage the reader, we address this issue of sediment pollution by also discussing the heritage aspect of what coral reefs represent in New Caledonia and for the world and how they could be degraded by these sediment inputs.
Line 69: I would go from the global to the more specific New Caledonia cases	In this introduction, only the first paragraph is more general/global. The following paragraphs have been designed to be more focused on New Caledonia.

Line 73: Perennial sediment control measures? I know perennial only in combination with streams or vegetation	Perennial has been replaced with 'long-term'. Line 94
Line 76-82: I am not sure that this paragraph helps the reader to understand the relevance of your fingerprinting approach test. I am sure if you look more deeply into every erosive activity on the island you will find much more	The objective of the manuscript is to carry out a sediment fingerprinting study, so it seems essential to us to present all the potential sediment sources in the introduction. However, this paragraph has been slightly simplified in order to keep only the most relevant information (Lines 115-120)
Line 86: I think you should make clear that has been proven in many studies before that mining catchments have a higher sediment export	This remark has been taken into account. This point has been further detailed in the first paragraph of the introduction. Erosion in a mining context is further developed and references have been added. Lines 61-68
Line 90: If they are developed since the 70ties you should cite literature from this era	Citations have been modified (Lines 122-123)
Line 95: Very old literature for the 'most frequently' used tracer. I would include her much newer studies from the last 10-15 years	Citations have been modified (Lines 128-130)
Line 111: Goethite and hematite are both oxidised Fe without Ni	Red laterites composed mainly of hematite do not contain Ni but this is not the case for yellow laterites composed mainly of goethite which are mined in New Caledonia. In goethite, the Ni atom can substitute for the Fe atom (Trescases, 1973). To avoid confusion, the clarification 'Ni and Fe rich' has been removed. Lines 161-162
Line 113: If the metals are in the geology, they are also in the cover beds and soils. A quick research supports this assumption of NC soils. How do you distinguish between eroded soils and the mining sources when only looking at colour?	Additional information on soil types found in New Caledonia has been added to the Introduction (Lines 156-168) The sediment tracing hypothesis is that if river material is red then there is a greater contribution from mining tributaries. However, as shown with geochemical tracers (Sellier et al., 2019), this hypothesis is not sufficient. It is based on the study of Garcin et al (2017) which showed that mining erosion dominates 95% of the peridotite massifs in the Thio River catchment. In other words, tracing the red colour of the sediments indirectly quantifies the contributions of the mining tributaries. This information has been added to the Introduction so that it is implicitly understood that this condition (i.e. dominant mining erosion on the peridotite massifs) is necessary to apply the different sediment tracing approaches (Lines 140-143) In addition, a supplementary figure (Figure 1) have been added to illustrate the strong colour contrast between both sources.
Line 122: Here, I understand you tested different tracers with the conventional FG approach (statistical analysis and mixing	This remark has been taken account. The sentence has been rewritten. Line 191-195

model) and the PLSR method. However, the next sentence is somehow not clear to me.	
Line 126: What is a tributary design approach? Please refer to Laceby 2017	The 'tributary tracing design' has been defined and the reference has been added. Lines 186-189
Line 128: How was it evaluated?	This remark has been taken account. Line 193-195
Line 129-132: This is speculation at this point. I would leave this conclusion up for the Conclusion	This sentence has been removed. Lines 197-199
MATERIALS AND METHODS	
Research Area: The lateral and longitudinal sediment connectivity seems crucial for this work and is not well addressed in the chapter nor throughout the manuscript. How can you be sure that the contributions you calculate are not due the effect of different lateral and longitudinal connectivity throughout the sub-catchments instead of different erosion values on the slope? You write about channel banks and alluvial deposits (map) which let me doubt that the connectivity is as good as believed. Please provide information (text, maps, pictures etc.) proofing your point! Furthermore, the whole relevance of the study revolves around erosion and there is not one picture displaying the"extensive erosion processes" you mention. Please give us some insights here.	Previous results found in the grey literature (e.g. Immila project report, 2020) indicate that there is a strong remobilization of sediments in New Caledonian hydrosystems, particularly for low intensity floods (<200 m^3/s). However, the magnitude of this process could not be quantified. Tracers such as ^7Be (Le Gall et al., 2017) could be used to trace the contributions of "new" versus "old" sediments and provide more precise indications on the dynamics of sediment remobilization in New Caledonian river systems
Line 158 : 'extensive', How much is extensive? Please specify? *Lines 158-161: How does bare soil and roads affect the river network connectivity? Are you talking lateral, longitudinal or vertical connectivity? I assume lateral, but I'm not sure. More runoff does not mean more lateral connectivity especially since you write about channel banks, so the valley is not a v-shaped, right?*	This information has been added to the research area (Lines 237-248) and in the discussion section (Lines 821-828). The erosion processes have also been further detailed in this part of the text (lines 211-218). Finally, an additional figure has been added to illustrate the erosion processes in the Thio River catchment (Figure 3)
Line 162: widespread in the meaning also in the 96% permanent vegetation cover areas?	The sentence has been rewritten.
Figure 1: Please add an percentage information of the mining sites etc.	This information has been added.
Methods: Please argue conclusively that your sample size is sufficient for your objectives and the size of the catchment. I would argue that it is not accurate to talk about mining sources and non-mining sources, because you are not sampling sediment sources from mining areas	For consistency, the mining and non-mining sources will be referred to as « mining tributaries » and « non-mining tributaries » in the revised version of the manuscript.

or non-mining areas but you sample mixed sediment samples from tributaries predominantly connected to mining areas or non-mining area- if I understood correctly. so at least for the mining sources you will also have the influence of non-mining areas in the sub-catchment. I have no advanced know-how of the analysis techniques for the sediment samples and the PLSR modelling. Hence, I can not comment on these elaborations. However, this does not imply that I don't trust the authors explanations. *Line 188-192: It is not accurate to talk about mining sources and non-mining sources, because you are not sampling sediment sources from mining areas or non-mining areas but you sample mixed sediment samples from tributaries predominantly connected to mining areas and non-mining area - if I understood correctly. so at least for the mining sources you will also have the influence of non-mining areas in the sub-catchment.*	Several types of samples can be considered for sediment tracing including soil or sediment samples. The sampling of lag deposits has the advantage of being more representative of the entire drainage area, compared to local point-based sampling of soils that will be characteristic of a given more local area (Haddadchi et al., 2013). Moreover, at each sampling site, five to ten subsamples of fine sediment were collected across a 10 m² surface which increases the representativity of the sampling scheme. Sampling was based on the knowledge acquired in the catchment, on visual observations made during the two sampling campaigns (2015 and 2017) and on the conditions of accessibility to the sampling areas (i.e. restricted access, no access roads). Erosion zones were notably highlighted by Garcin et al. (2017) and sediment deposition zones were indicated by the inhabitants of Thio and mining engineers who accompanied us in the field to help us carry out the sampling. If we compare our study with sediment tracing studies carried out in other catchments of equivalent surface area, the number of source samples taken in our study (i.e. 2 sources, n1 = 8, n2 = 16) is consistent. For example, the study by Evrard et al. (2019) indicates that 37 source samples (3 sources, n1 = 12, n2 = 8, n3 = 6) were sampled in the study area (450 km²). The study by Brosinsky et al. (2014) collected 152 source samples (6 sources with a number of samples per source between 10-36) across a catchment area of 445 km².
Line 194: Table 1, I would label the "out of study" differently and explain the error, as it is always interesting to learn from ones mistakes.	M6 was withdrawn from this study because an error occurred at the time of its completion and we did not have enough material to do it again.
Line 197: Portable means you measured reflectance spectrophotometer in the field? What about influencing factors? Or did I get that wrong?	Spectroscopy in the visible measurements were carried out in the laboratory. However, this device is transportable in the field. We prefer to carry out the measurements in the laboratory because it is preferable to analyze the samples under identical experimental conditions to avoid that exterior parameters (e.g. luminosity) can influence the measurements.
Line 204: Why even four and the rest only three?	Two different experimenters carried out the measurement. This is an error made at the time of the measurements. However, it would have been arbitrary to remove one measurement instead of the other in order to have the three measurements initially requested, which is why we have kept the four

	measurements carried out on the artificial mixture samples.
Line 205: I would highly recommend to include the majority of your information in parentheses into the text. When reading the sentences without the parentheses it seems that information is very thin and hence the more important content is in there. The text is full of parentheses which also disrupts the reading-flow.	This remark has been taken account
Line 232: True, however, I would argue there is newer literature to cite and to follow!	Citations have been modified (Lines 361)
Line 265-267: Please explain this is unclear to me what you mean exactly.	The sentence has been rewritten.
Line 273: FDVS, Please explain the abbreviation, maybe I missed it	FDVS: First Derivative reflectance of the Visible Spectra This abbreviation has been detailed for the first time at line 318
RESULTS	
Line 294-299: What about the range test of the geochemical parameters?	The geochemical parameters were also conservative. This information has been better explained. Line 430-431
Table 2, is that average or median?	These are mean values. This information has been better explained in Table 1 (in the Table and in the table caption)
Line 322: K is very soluable in water starting at 20°C, so NC has perfect conditions for that! How can it be a conservative tracer in New Caledonia? What was the redox potential of the water and how deep did you sample?	These are lag deposits that have been collected to characterize the sources on the one hand and river sediments on the other hand. In all cases, these are materials that transited the river system and deposited on the channel banks (tributaries and/or the Thio River). From an experimental point of view, they have both been subjected to the same environmental conditions. Although K and Ca are soluble in water, according to our geochemical analyses, a fraction of these elements remain in the particulate phase. The differences observed in terms of K and Ca concentrations between the two sources come from the differences in geochemical compositions observed by Sevin (2014) between the two dominant geological formations of New Caledonia: peridotite massifs and volcano-sedimentary formations. This information has been added in the revised version of the manuscript (Lines 136-147 in the introduction), We cannot provide any further information on this point although we find this comment very relevant. Again, the statistical approach to tracer selection aims to remove non-conservative properties at the first stage (i.e. range test). In this case, these parameters were determined to be conservative, no depletion was found between the sources and the sediments. The notion of conservation of tracers has been reinforced, particularly in the introduction (Lines 124-128). K is a

	well-established lithological tracer in similar studies (Zebracki et al., 2015). It is even not affected by particle size effect (Sellier et al., 2019) and remains conservative over time (Sellier et al., 2021).
Line 330: At least two of them are certainly soluable in water and cannot be conservative during fluvial transport. Furthermore, Ca in the environment can have a diluting effect on the elemtal concentrations of a matrix, how is this taken account for?	See our reply to the previous comment
Line 353: Figure 3, please rewrite caption! please display the range for each predicted proportion.	Figure 3 => Figure 5 The range of predicted proportion is 0-3 %. This is too small to be significantly observable on the Figure 5. An indication has been added at line 478.
Lines 357-359: When weathered and after pedogenesis "normal" soils should be also red in this area containing goethit, hematite and organic matter (please refer to the WRB 2006). How do you make sure that you do not overestimate tailing erosion and underestimate soil erosion?	The sediment tracing hypothesis is based on the study of Garcin et al (2017) which showed that mining erosion dominates 95% of the peridotite massifs on the Thio River catchment. In other words, tracing the red colour of the sediments indirectly quantifies the contributions of the mining tributaries.
Lines 366-368: Do you have any explanation for this difference?	Additional information on soil types found in New Caledonia has been added to the Introduction (Lines 160-169), and the Discussion (Lines 687-699). The source rocks of the two main lithologies are not the same in New Caledonia. Therefore, although they are both altered, they do not present the same pedogenic profile. The formation of a laterite profile is observed on the peridotite massifs whereas a pedogenic profile composed of clayey horizons (up to ~45 cm deep) and below weathered horizons is described on the volcano-sedimentary formations. Here again, the depths are given as an indication, and vary according to the slope profile. The peridotite massifs contain more Fe than the volcano-sedimentary formations, so that there is a greater accumulation of Fe and therefore of hematite (the last stage of alteration). This does not mean that there is no hematite in the altered horizons of the volcano-sedimentary formations; it means that this mineral is present in smaller quantities. Denis (1988) showed that goethite is particularly present in the fine fraction of altered horizons.
Line 407: Figure 6, I'm trying to make sense of the source contribution development of the main river. It looks like at point 3 or the outlet suddenly the non mining contributions are raised again without a non-mining tributary close. Do I understand that right? Maybe it helps the grafik (and all others similar like this) to outline the tributarie's sub-catchments, a light hillshade in the back to get a feeling for	Point 3 corresponds to the sampling point collected after the confluence with the Kouaré tributary (i.e. non-mining tributary) and before the confluences with Nakaré and Nembrou (i.e. mining tributaries). This sudden increase in non-mining contributions is due to the consequent contribution of the Kouaré tributary. Changes have been made to the figure to make it easier to read.

the relief, and display the cake diagramms on the right connected to the sample location with lines.	
Line 415: Kouaré Tributary, What is happening here?	During the 2015 flood event, the Kouaré River sub-catchment received twice more rainfall than observed in the rest of the Thio River catchment, which may explain a higher contribution of non-mining tributaries for this event compared to the 2017 flood event where rainfall was more intense on the eastern part of the catchment in the vicinity of the mines currently in operation (Thio Plateau, Camps des Sapins). In addition, the inhabitants of Thio stated that bushfires had occurred in the Kouaré and Fanama sub-catchments in 2015, which could have led to an increase in soil erosion processes, particularly landslides, in these sub-catchment. This could also explain why the sediment contributions of the Kouaré tributary are higher in 2015 compared to the 2017 flood event. This information has been added in the revised version of the manuscript. (Lines 817-821).
DISCUSSION	
Lines 523-524: Here you reference the soil formation! Very good, but this is not only the case for plateau nickel ores but for every geomorphological stable position in the relief. The more stable the more weathering or soil development happens and that changes the colour of the soil. Additionally, hametatite can be returned to goetite under certain conditions! Please look at this and revise your discussion accordingly. Only discussing the nickel ores seem one-dimensional here.	Peridotite massifs are composed of different parent rocks: serpentines, peridotites, harzburgites.. Although they are composed of similar minerals, the proportion of minerals varies from one type of rock to another (e.g. olivine, the main carrier mineral phase of nickel). Alteration by definition will not be the same everywhere on the peridotite massifs. Moreover, other factors such as relief can influence this alteration as you have mentioned it. Hydrological (e.g. valley shape) or tectonic (e.g. tectonic fracture) factors can influence alteration of the peridotite massifs in New Caledonia (Sevin, 2014). This information has been added. Lines 707-716
Line 538: K, But it is soluable! Maybe the range test did not show that but K is most probably NOT a conseravtive tracer. Did you check the water samples? How could it perform so well. Please explain!	See our reply to the previous comment
Lines 560-561: sentence structure!	The sentence has been rewritten
Line 565: see comments on tracer conservatism from before	See our reply to the previous comment
Lines 609-615: what about considering other factors such as relief, erosion features etc. that might influence the variability of mining tributary contribution	Additional information has been added. Lines 817-821
Lines 625-630: I understand the pattern of your data supports this conclusion, what about your knowledge of the environment? You argumentation is purely statistical which -as	Additional information on soil types found in New Caledonia has been added in the Introduction (Lines 136-147, 156-170), in the Discussion (Lines 687-699) to

shown for the FDVS-PLSR model- might not always make sense. What processes, geological or gedogenetic background values, etc. are responsible for these differences?!	explain the results obtained with the statistical approaches.
CONCLUSIONS	
Line 649: What about the differences in area that contribute?	It is difficult to determine the sediment contribution of each of the sub-catchments. Upstream, this is feasible up to the confluence with the Kouaré tributary, but beyond that, it is no longer possible. The sediment tracing approach is conducted as an integrative approach along the Thio River.
Lines 658-669: In my opinion your discussed factors influencing colour and element concentrations are just one out of many more possible ones (as stated before). It is very well imagineable that K (if it is really conservative) is not the best tracer when areas with Ni oxidized ores based on peridotite massifs come along with extensive agriculture around. Hence, the criteria that the method is suitable for all areas with Ni ores and peridotite massifs might work for NC but seems not sufficient to extrapolate to the world! Please revise that throughout the manuscript and in the conclusion!	Additional information has been added about the land uses in the Thio River catchment. Peridotite massifs have been exploited exclusively for their nickel resources. Peridotite massifs naturally enriched in heavy metals have a low soil fertility, which explains why farming or pasture activities are not favoured on these soils in New Caledonia (Quantin et al., 1997). Lines 219-222.

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