

Author comments to referee 2 comments on “An autonomous and low-power instrument platform for monitoring water and solid discharges in mesoscale rivers” by Nord et al.

In the following, the reviewer comments appear in black italic and our answers are provided in blue. When there are quotations from the text of the article, they appear in quotation marks and the new or corrected parts are highlighted in yellow.

gi-2019-33-RC2.pdf

The authors present a setup for a gauging station to monitor water and sediment transport in high temporal resolution. The station is designed for fast responding, mountainous, mesoscale rivers in remote areas. Both processes – water and sediment transport - are difficult to measure especially in these environments and subject to lots of efforts and uncertainties. Thus, the development of appropriate and robust monitoring techniques as well as their combined application is highly recommended and needed. This is also of special interest for process understanding and model parameterization regarding sediments. Several sensors are assembled in one monitoring system, measuring different parameters which serve as proxies or auxiliary variables to derive water and sediment discharge. The system also aims for data storage and analysis (some measures of primary statistics), data transfer, and remote supervision and control. Also a user web-interface is provided. The manuscript is very good organized. The technical presentation of the RIPLE system with its several components is comprehensive and supported by meaningful figures and tables. However, a comprehensive presentation of the monitoring results is missing or only available partly. Here it would be good to give the reader an impression, what he/she could expect and how the (raw) measurements look like at least for one flood event. Sure, figure 8 shows some of them, but there are more graphs inside than explained and the legends are not self explaining. It would be beneficial if the authors show more results for the same event for other sensors/variables especially regarding the bedload. Figure 9 to 12 are less informative in this regard since they show other periods in time or aspects of minor interest like Figure 12. Furthermore, I have a few doubts about the English language. I am not a native speaker but some phrases sound a bit strange for me.

Answer: we sincerely thank referee #2 for his/her careful reading of the paper and the ways proposed to improve it. We have added a new figure (see below **Figure 14**) showing the raw data measured by 6 sensors for the event of 8 to 9 August 2017 in Bourg d’Oisans (Romanche river). The data are provided by the following sensors: water level radar, surface velocity radar, susix MJK turbidity sensor, conductivity probe, echo sounder and hydrophone. This figure complements Figure 9 of the paper which showed incomplete results since extracted from a snapshot of the user web-interface. This new figure is inserted at the end of the document in section 6 “Case study” (see below specific comment 22-20).

Additionally, for the period from 8 to 9 August 2017, the videos (provided by the Large Scale Particle Image Velocimetry digital camera), photos (provided by the control camera), the two text files “Riple_DATA.txt” (data from all instruments) and “Riple_SAV.txt” (data that enable to remotely control the proper functioning of the platform), and the raw data of the hydrophone are in open access via the following perennial link: https://doi.osug.fr/data/public/RIPLE_8to9August2017/

This provides a comprehensive picture of the data produced by the station in terms of formats, file sizes and data quality.

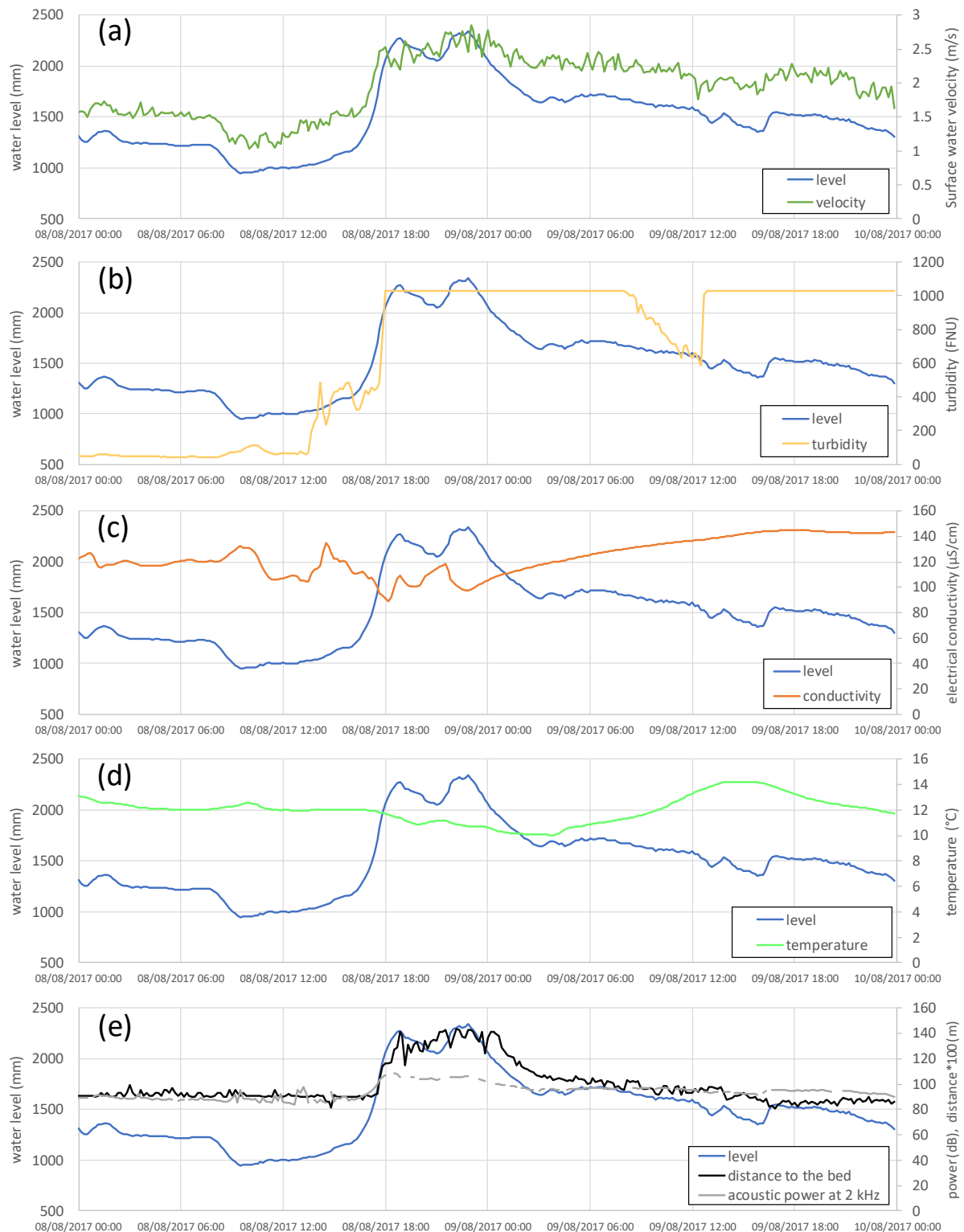


Figure 14: Raw data derived from the “Riple_DATA.txt” file for the 8 to 9 August 2017 in Bourg d’Oisans (Romanche river). (a) Time series of water level and surface water velocity. (b) Time series of water level and turbidity (susix MJK). Due to an inappropriate parameterization of the sensor, there is saturation of the signal above 1000 FNU. (c) Time series of water level and electrical

conductivity. (d) Time series of water level and temperature. (e) Time series of water level, distance from the echosounder to the river bed and acoustic power at 2 kHz measured by the hydrophone.

Regarding the remark about the English language, a large number of corrections proposed by referee #1 John Gray, who is a native English-speaker, as well as other corrections proposed by referee #2 have been taken into account.

Here are some details:

1-19: You can shorten the abstract by removing the information in brackets.

Answer: we would like to remain the information in brackets in the abstract as we believe it provides important clarification to readers, before eventually starting a more in-depth reading of the entire paper. We have only removed information on the geographical coordinates and elevations of the test sites.

1-23: "The RIPLE platform has been designed... " - I don't understand the meaning of this sentences.

Answer: we agree that this sentence is unclear and does not provide relevant information. We have deleted it.

1-28/29: information in brackets not needed in the abstract.

Answer: As mentioned above, we have removed this information from the abstract.

3-4: split the sentence after "... the cross section"

Answer: we agree, the sentences have been corrected as followed: "In turbulent rivers, it is assumed that the SSC is relatively homogeneous within the cross section. Therefore point measurement of turbidity from the river bank is acceptable."

3-6: Maybe, start sentence with "But this assumption..."

Answer: we agree, the sentences have been corrected as followed: "However this assumption is questionable for sand-sized particles (Camenen et al., 2019) and there is no reference method for sand-sized particles to date."

3-9: without returned? -> "... are analysed in the laboratory to measure..."

Answer: we agree, the sentences have been corrected and complemented as followed: "Samples collected at regular intervals or when thresholds are exceeded (e. g. water level, turbidity) are manually retrieved during site visits and brought to the laboratory. They are then analysed to measure..."

3-23: aDcp or ADCP?

Answer: as recommended also by referee #1, we have applied aDcp everywhere.

3-27: "record" instead of "consist in recording"

Answer: we agree, "consist in recording" has been replaced by "record".

4-1: "Up to date, whatever the indirect method used,..." -> I think an english revision is required.

Answer: we have read again the sentence and it does not seem problematic to us.

4-5: Suggest reversing the sentence: "Knowledge of..."

Answer: this correction was also proposed by referee #1 and it has been taken into account as followed: "Knowledge of water discharge is essential whether it is for estimating suspended sediment fluxes, dissolved matter fluxes, nutrient or contaminant fluxes associated with fine particles."

5-9: Suggest: "There are studies ..." instead of

Answer: we agree, "There has been studies..." has been replaced by "There are studies..."

6-21: Suggest: "Therefore, they..." instead of "They therefore..."

Answer: we agree, "They therefore ..." has been replaced by "Therefore, they ..."

7-28: Suggest: "The camera is an AXIS P1427-E. Its selection based on various criteria such as image quality,..."

Answer: we agree, the text has been corrected as followed: "The selected camera is an AXIS P1427-E. Its selection was based on various criteria..."

8-25-32: You are using a standard method for deriving discharge from surface velocity measurements. You can also refer to USGS guidelines or ISO norms.

Answer: we agree, thank you for this remark. The text has been complemented as followed: "A transect of surface velocity along the cross section of the river is extracted and converted to a transect of depth averaged velocity over the vertical using a coefficient that relates the depth averaged velocity to the surface velocity. Such coefficient commonly ranges between 0.75 and 0.85 (Hauet et al., 2008; Le Coz et al., 2010; Welber et al., 2016) but it is preferable to define it from aDcp or current meter measurements in accordance with ISO 748 and USGS guidelines."

The reference to the norm ISO 748 has also been added to the list of references:

“International Organization for Standardization, 2007: Hydrometry — Measurement of liquid flow in open channels using current-meters or floats. ISO 748:2007, Geneva.”

8-29: “depth averaged velocity” sounds a bit crazy since you measure only surface velocities

Answer: yes, we understand your comment. It was also highlighted by referee #1. That is why we have reformulated the text as presented in the previous comment. We have added specifically the following recommendation **” but it is preferable to define it from aDcp or current meter measurements in accordance with ISO 748 and USGS guidelines.”**

However, we should keep in mind that for steep rivers, with slope typically greater than 1%, and particularly in the case of mobile bed rivers, it is almost impossible to maintain conventional stage-discharge rating curves and to measure velocity distributions within the cross section during floods.

9-14: see comment 7-28

Answer: we agree, the text has been corrected as followed: **“The selected camera is an AXIS P1435-LE. Its selection was based on various criteria...”**

9-18: What is meant by “bitter points”? Do you mean “control point”?

Answer: yes, thank you. “bitter points” has been replaced by **“control point”** in the text.

9-25: What is meant by “sides of flow”? Do you mean “river bank”?

Answer: yes, thank you. “sides of flow” has been replaced by **“river bank”** in the text.

9-32: “... the interval ... is constant ...” instead of “be”

Answer: we have read again the sentence and it does not seem problematic to us.

9-34: “... it is not taking movies.” instead of “pictures” Or do you use single pictures from this camera too?

Answer: yes, “pictures” has been replaced by **“movies”**.

10-9: “... to illuminate the water surface.” Without “up to”

Answer: we agree, “up to” has been removed from the text.

10-11: “exceeded” instead of “overcome”

Answer: yes, thank you. “overcome” has been replaced by “exceeded” in the text.

10-15: “... processing steps are executed in the laboratory ...”

Answer: we agree, “will be” has been replaced by “are” in the text.

10-28: suggest “target area” instead of “area targeted”

Answer: we agree, “elliptical area targeted” has been replaced by “elliptical target area” in the text.

10-34: suggest to remove “... with no connection to the data logger.”

Answer: yes, thank you. “with no connection to the data logger” has been removed.

11-25: “... the radar derives the distance separating the radar from the water surface.” Sentence is not understandable. Please revise. And what is its relation to the “blind area” mentioned afterwards?

Answer: we agree, we have rewritten these two sentences as follows: “Accounting for this time of flight and the velocity of the wave in the air, which depends on the air temperature, the radar calculates the distance from the sensor to the water surface. Distances of less than 0.15 m cannot be measured, this is known as the blind zone.”

12-27: Please add a reference to “PASS”.

Answer: we agree, two references “(Huon et al., 2017; M-Tropics, 2017)” have been added in the text and in the list of references:

“Huon S., Evrard O., Gourdin E., Lefèvre I., Bariac T., Reyss J.L., des Tureaux T.H., Sengtaheuanghoung O., Ayrault S., and Ribolzi O.: Suspended sediment source and propagation during monsoon events across nested sub-catchments with contrasted land uses in Laos, J Hydrol: Regional Studies, 9, 69–84, 2017.”

M-Tropics, Service de données OMP (SEDOO): Stations and acquisition parameters, [online] Available from: https://mtropics.obs-mip.fr/stations-and-acquisition-parameters/laos-lak-sip-catchment/?noredirect=en_US (Accessed 16 January 2020), 2017.”

13-10: “Above some ... “ ??? Suggest to rephrase: “If ... thresholds are exceeded,

Answer: we agree, “above some” has been replaced by “In case of exceeding” in the text.

13-34: “display unit” instead of “Display Unit”

Answer: yes, it has been corrected.

14-28: *That's not possible since you write before that the sensor is installed above low flow water levels.*

Answer: this sentence was not clear. It has been rewritten as followed: "It was therefore decided to install it at a higher position than the Susix sensor so that it is immersed for a shorter period of time than the Susix sensor, i.e. generally only during the central part of the floods, around the peak of the flood."

15-1: *Please avoid abbreviations in headlines.*

Answer: we agree, "SCAF" has been replaced by "System characterizing aggregates and flocs" in the text.

16-2: *suggest "... of angles less ..." instead of "... with angles of less ..."*

Answer: we have decided to remain the initial formulation.

16-5: *0.007m -> Diameter of 7mm would be really nice. Is this right?*

Answer: good remark. "0.007 m" has been replaced "0.07 m".

18-1: *Suggest: "All procedures ... are presented ..."*

Answer: we agree, the proposition has been applied.

19-18: *Am I right that the echo sounder is mounted next to the lowest water level looking towards the bottom?*

Answer: not really. In the case of the Romanche river in Bourg d'Oisans, the echo-sounder is installed on the central pier of the bridge, about 1 m above the river bed looking down. The echo-sounder is inclined at an angle of about 20° from the vertical. As can be seen in Figure 9 and in the added figure (Figure 14), the distance from the echo-sounder to the river bed varies between 0.9 and 1.4 m during the flood event of the 8 to 9 August 2017.

21-19: *Suggest: "... the FTP-server" instead of "FTP"*

Answer: we agree, "FTP" has been replaced by "FTP server"

22-20: You write "... the platform has worked properly, recording a large data set that will be of great interest for the understanding of sediment transport processes in alpine rivers." Please show an example of this data set at least by visualization of all measured variables for one flood event.

Answer: As presented above, a new Figure has been added. The end of section 6 was complemented as followed: "Figure 14 shows the raw data measured by 6 sensors for the event of 8 to 9 August 2017 on the Romanche river in Bourg d'Oisans. The data are provided by the following sensors: water level radar, surface velocity radar, Susix MJK turbidity sensor, conductivity probe, echo sounder and hydrophone. Figure 14 focuses on the same flood event as Figure 9 which was only a screenshot of the user web-interface. Additionally, the videos (provided by the Large Scale Particle Image Velocimetry digital camera), photos (provided by the control camera), the two text files "Riple_DATA.txt" (data from all instruments) and "Riple_SAV.txt" (data that enable to remotely control the proper functioning of the platform), and the raw data of the hydrophone are in open access for this flood event through this link: https://doi.osug.fr/data/public/RIPLE_8to9August2017/

This provides a comprehensive picture of the data produced by the station in terms of formats, file sizes and data quality."

22-29: Please revise "much". Maybe: "... it is also adjustable and transferable ..."

Answer: we agree, the sentence has been corrected as followed: "The platform has been designed to be applied preferably to rivers in mountainous areas, but it is adjustable and transferable to lowland rivers."

23-15: Suggest: "These measurements must be performed under conditions that are close to the in situ environment in order to avoid subsequent flocculation/disaggregation processes."

Answer: we agree, "most closely resemble those of" has been replaced by "are close to".

24-8: You write "... of the same variables as those measured by RIPLÉ platform at other points ..." How can bedload and suspended sediments be measured by drone? Please revise this paragraph or remove it. You can also place your hints on improvements in remote sensing in the paragraphs before.

Answer: we do not really understand this remark because the aquatic drone can carry submerged instruments to make measurements at any point in the river. Nevertheless, one sentence has been changed to make the things clearer: "The aquatic drone can thus carry submerged instruments (e.g. conductivity probe, turbidimeter, echo-sounder, hydrophone, automatic sampler) to perform measurement campaigns..."

A new sentence was also added concerning the point on remote sensing: "Remote sensing instruments (e.g. radiometers) could also be added to perform non-intrusive turbidity measurements."