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Comment on hess-2021-551

Anonymous Referee #1

Referee comment on "Extraction of roughness parameters from remotely-sensed products for hydrology applications" by Charlotte Marie Emery et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-551-RC1>, 2022

General comments

The intention of the paper is to show how Manning river roughness coefficients derived from a geomorphological space borne data base methodology can be of use, for the estimation of river discharge and related to the framework of the SWOT mission.

In fact three different studies are described where the roughness coefficients obtained through the procedure are applied.

- Deriving water levels in the Po and Garonne river through a 1 dimensional Mascarat hydraulic model
- A data assimilation (DA) application based on observations at a number of gauging sites in the Po river, using the roughness coefficients obtained through the "new method" as a starting point.
- A SWOT application, modelling discharges for a particular year in the Garonne, Po and Brahmaputra river.

The results of study 1 are discussed in the chapter 2 "method and materials" and in the same chapter the "new method" that in fact applies to all three studies is extensively explained. Chapter 3 describes the background of the other two studies and in a very condensed way background, results and discussion for the DA application (chapter 3.1) and SWOT discharge algorithm (chapter 3.2).

A more logic structure would be to have the general applicable explanations in a method and materials chapter, including the area descriptions. The chapters 3.1 and 3.2 are so condensed that required background and explanations are sometimes missing. Results could be more extensively discussed.

The conclusions provided in this paper are fair in stating the severe limitations of the studies. This aligns with the aim of the research to “introduce an automatic methodology to derive physically based, model prior values of friction coefficients”. Nevertheless, modelling results are presented and performance of the “new method” is evaluated against the performance of the “reference model”. It would be fair to state the limitations from the approach as mentioned in the conclusions also in the abstract, and not claim that the friction coefficients were evaluated (as stated in the abstract).. In fact, it would have been valuable to provide more attention to the obtained roughness coefficients in e.g. the Data Assimilation procedure.

The paper is compiled by contributions from different authors. It would become more readable if they team up and standardize in wordings, expressions, and handling captions of tables and figures.

Specific comments (per chapter)

Abstract

The abstract mentions “that the evaluation of those (i.e. physically based) roughness coefficients showed that they allow model performance comparable to calibrated models”, line 11-12. It are not the roughness coefficients that have been evaluated, what indeed would have been a valuable addition to the research conducted. When this sentence is rephrased, please be aware that evaluation took place not against “calibrated models” in general, but to the model as applied in this research.

Information of applicability to types / sizes of rivers is missing as well as any information to the geographical setting of this research.

Introduction:

Line 32: to give a complete overview of recent developments, measurements based on LSPIV (large scale particle image velocimetry) with camera monitoring and hence options for validation of discharge and verification of the roughness coefficients could be mentioned as well. The same applies to line 70 where LSPIV can be mentioned. Examples of publications referring to discharge camera monitoring are:

-) Tauro, F., Olivieri, G., Petroselli, A., Porfiri, M., & Grimaldi, S. (2016). Flow monitoring with a camera: a case study on a flood event in the Tiber river. *Environmental Monitoring and Assessment*, 188(2), 1-11. --

-) Fujita, I., Watanabe, H., & Tsubaki, R. (2007). Development of a non-intrusive and efficient flow monitoring technique: The space-time image velocimetry (STIV). *International Journal of River Basin Management*, 5(2), 105-114.

Methods and materials

The chapter combines too much. It gives theory, method, explanation of deriving at geomorphological river roughness coefficients, definition of the reference model, comparison of performance results for water levels at gauging sites (and conclusions) for the Po and Garonne in one the same chapter. It was already mentioned to separately provide the general applicable theory and method. Then next the specific background information, performance results and discussions for the three different studies can be handled (waterlevel modelling PO and Garonne , the DA experiment and SWOT application).

The explanation and theory behind the Manning formula equation (1), line 92, in this chapter is very limited, and is never referred to in the paper. This theory would be a handle to explain the definition of A_0 , as used in the introduction. It also shows that the hydraulic head loss I is a factor in hydraulic models, surprisingly it is not described in the paper how this is determined and applied in the models.

The performance results for the Garonne and Po river are based on comparison of water levels at gauging stations. The study would be more complete if the performance was also evaluated on discharges. Deriving at discharges is a justification for this research, as the abstract and introduction mentions.

In addition, in the Po river, with several gauging stations, the reference model could have been set up with more than one uniform roughness (distinguishing between main channel

and floodplain) for the whole 100km of river. It would give insight in the sensitivity of performance results to different ways of applying roughness coefficients in the reference model.

Data Assimilation experiment

The DA experiment is interesting as it updates model parameters in the DA procedure. It is applied on data at the different gauging stations over 7 zones in the Po river. It would have been useful to see the result of the updating process for the roughness coefficients, and also other parameters that were updated for both reference model and the "new method" modelling. Unfortunately this information is not provided and only information is given on improvement of the performance on water level for each of the modelling methods.

SWOT Discharge Algorithm

The SWOT discharge algorithm compares results of discharge modelling on the basis of roughness according to reference model and the "new method". The background and results are provided so condensed that too often it remains guessing what is demonstrated or meant. E.g. although roughness coefficients from the reference method and "new method" are applied, the discharges are only estimated in the main channel. There is no explanation how this is compared to observations. In addition, the presented graphs of estimated discharges should have clear legends.

To summarize, the part describing the SWOT discharge hardly good conclusions can be drawn from this exercise to proof that good enough roughness coefficients are obtained from the new method. This part needs lot of attention in providing background information, wording, figures and tables..

Technical corrections (per chapter)

Introduction

Line 36: It is not clear in the sentence "5 current algorithms being developed" where this refers to. Correct "relies" to "rely".

Line 37: "more or less" is a soft statement, should be clear and concise.

Line 39: "unobserved bathymetry, denoted A_0 " is "the underwater cross sectional area A_0 ".

Line 48: missing word " A_0 as it a physically ..." should read " A_0 as it is a physically ..."

Line 71: "no acceptable methodology to estimate flow velocities" can be rephrased in mentioning the perspectives of applying LSVIP at gauging sites.

Methods and materials

Line 90: the present study aims at automatically derive deriving the friction parameters such as etc. "Such as" should be removed as the study only deals with the Manning coefficient.

Line 92/93: provide units for the terms used in the equation (1), "A is the wetted cross sectional area"

Line 111: "on the field" should read "in the field"

Caption of tables (and graphs) should be self-explaining, to avoid the reader has to search in the text what is meant

Table 1: Better e.g. Availability of global scale datasets used to derive river roughness coefficients.

Line 122: Avoid use of spoken language, better e.g. The following global scale products have been used in the approach to derive river roughness coefficients, also see table 1.

Table 2: Better e.g. Aggregated land cover classes considered to derive river roughness coefficients.

Table 3: Indicators and values of n_b (bed material) for both the main channel and the floodplain, by Acrement and Schneider (1989).

Table 4: same as above, include reference

Line 167,168: "Note that currently the threshold values were picked to match our knowledge of the study domains". Comment: strange sentence, which threshold values and does this mean the process is not fully automatic ?

Line 178, 179: same remark applies as for line 167,168

Line 182-184: "Since the scope of the proposed method is framed by the SWOT mission, its goal is to estimate the value of n for large rivers, for which obstructions within the channel are rare and can be neglected. The value of n^3 is therefore assumed to be equal to $0.0 \text{ s.m}^{1/3}$ in the channel." As this is not necessarily true in general, better refer to the cases in this paper that are examined.

Line 185, Table 7: n^3 for the floodplain: The conversion of obstructions into a n value can be disputed. The values are quite high and therefore contribute a lot to the final n . E.g. artificial surfaces according to IOTA (column 1) are always considered appreciable obstructions(column 2) and have n^3 of 0.025. However it would make a difference whether it is just a paved surface, or a building.

Line 189 effect of vegetation for the main channel is $n^4=0$. Can this claim be substantiated.

Line 198: "This method aims at ...", Better: "Our method to obtain river roughness parameter n based on a geo morphological classification aims at being applicable globally."

Table 10: is the classification specific for the Garonne, as it is under 2.2.1. Garonne domain.

Line 232: Table C2 of appendix C (C2 and C1 have the same caption, there seems a mix up of C1, C2, C3)

Line 264-265: Its results are compared to the same observed data and the method is deemed validated if the estimation performance is close to the reference performance. Comment: "close" is very subjective, better to mention only that the results are compared in terms of RMSE etc.

Line 268-269: This procedure needs further clarification.

Figure 4 and figure 8 are of the wrong river. Figure 4 belongs to the Po river and Figure 8 the Garonne.

Line 291-292: "It also showed that the model was far less sensitive to the floodplain roughness coefficient value than the main channel one". Comment: This claim is not supported by any evidence.

Table 11. For clarity, the table could also compare MRE and SD. These values are shown in figure 10 but not in table 11. Note that RMSE has a unit, which is not provided.

Table 12: same applies as comment for table 11

Data Assimilation experiment

Each of the application chapters 3.1 and 3.2 give background, method, results and discussion in one and the same chapter, and very condensed for both applications. It is clearly written by (a) different author(s) than the one(s) for the previous chapters. The advice is to team up with all other authors to standardize wordings. Example is table 14. where Exp#1 calibrated roughness was called the reference model previously and in table 13 K_{smin} and K_{smaj} are headers for the main channel and floodplain respectively. Also terms like former method, reference method, calibrated roughness to indicate the same method could be standardized throughout the document.

Table 13: in addition to above, K_{smin} and K_{smaj} units have been omitted

Table 14: in addition to the above, the caption gives two different explanations for what is written in front and after a slash sign.

SWOT Discharge Algorithm

Table 15: In the column “the former value” the values of the roughness coefficient in the Garonne and Po deviate from what is written in the text in chapter 2.3.2. line 281 and line 291, without explanation.

Figure 16: The caption does not inform to which gauging site in the Po river the results refer to.