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Hydrology and Earth System Sciences Discussions

Interactive comment on "Discharge estimation in a backwater affected meandering river" *by* H. Hidayat et al.

Anonymous Referee #3

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General comments

This study focusses on a backwater affected gauging station (Mahakam river at Melak, Indonesia) that is equipped with a H-ADCP. Overall, this is a valuable study, nicely presented, and addressing an important hydrological issue.

The most interesting and convincing conclusion is to evidence that, likely due to variable backwater effects, the stage-discharge relation is much more scattered than what could be explained by transient flow effects, as assessed using the Jones formula. In such conditions, a fixed device continuously recording representative velocities (here, a H-ADCP) is very helpful to improve the accuracy of discharge time series.

However, the other main conclusion stating that DSM yields better results than IVM is highly questionable, due to a number of methodological problems. Information is missing on H-ADCP velocity errors, on data processing and on the proposed method (DSM). Moreover the application of the Jones formula and of the index velocity method (IVM) are not correct.

As a consequence, in my opinion the paper should be published eventually, but it requires major revisions and further reviewing. The following points should be addressed, along with the necessary corrections of the results, and conclusions should be revised accordingly.

Specific comments

DSM (Section 3.2)

Which reference water level is considered is not clear (I understand it is the lowest known water level). Moreover, notations are not consistent in some equations (Eq. 6, Eq. 8) where H is written instead of $H + \eta$.

Eq.9: the right-hand term should be integrated over the width (β from 0 to 1). As visible in Fig.2, a large portion of the river width is not seen by the H-ADCP at both right and left sides. It seems that the main lobe hits the bed at n=170m, but side-lobe reflections are likely to occur at a shorter range. The effective measuring range should be indicated precisely. Nothing is said on how is computed the discharge in edge subsections without H-ADCP measurements. These subsections are large. Therefore, I don't know how the total discharge can be computed from Eq. 9 only.

The need for an amplification factor $f(\beta)$ is not justified. It appears to be a correction factor, accounting for errors in the DSM assumptions and/or errors in the H-ADCP measurements. Since the total width value used to normalize beta is not mentioned, it is difficult to position the results shown in Fig. 7 in the section shown in Fig. 2. However, the dramatic increase in f for $\beta > 0.8$ is consistent with a huge underestima-

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tion of HADCP velocity measurements due to acoustic reflections from the bed, and potentially also the free-surface. Eq.1 and the accompanying text ignore that acoustic reflections from the free-surface induce underestimated, usually near-zero, velocity measurements, which cannot be directly corrected (cf. e.g., Moore et al. 2010). Please add to Fig.7 the corresponding velocity (ADCP+HADCP) and intensity (HADCP) profiles, in order to clarify this issue.

IVM (Section 3.3)

The index velocity method (IVM) is not applied correctly by the authors. First, the IVM lies on a usually linear fit of the section-averaged velocity against an index velocity, here defined as the average of all HADCP velocities. In their regression, the authors used the discharge instead of the section-averaged velocity, as stated p.2671 l.20 and shown in Fig. 8, and inconsistently with what is stated in Section 3.3. The discharge-index velocity relation is usually more complex than a linear function, due to the area-velocity relation included. Second, the IVM results would be certainly improved if only the first HADCP cells would be used, since the velocity measurements in the last cells are likely underestimated and affected by reflections from bed and free-surface. Last, the separation of 'cal' and 'val' discharge data used to assess both IVM and DSM methods is unclear (not explained, and 'val' campaigns are not introduced in the text). The quite constant Qivm/Qbs ratios reported in Table 2 indicate that the IVM is not properly calibrated and could be corrected, just as the DSM is corrected with the amplification factor.

Section 3.4

While applying the Jones (1916) formula, it should be more accurate to compute the flood wave celerity as $dQ/dA = 1/b \times dQ/dd$ if $d = A/b$. With this correction, the computed stage-discharge relation may change significantly, however likely not enough to reproduce the observed scatter. Please give the value of bed slope, and rework the computation accordingly.

P. 2679 and in several other sections, hysteresis (due to transient flow effects) and variable backwater are not clearly distinguished, possibly misleading some readers. For instance, 'hysteretic' should be used only for transient flow effects, and highlighting some representative events with solid lines in Fig.10 would be helpful to reveal whether we are facing nice hysteresis loops or variable backwater trajectories. The scatter cloud does not provide information on such trends. The results of the Jones formula (once corrected as previously discussed) are the best way to show that the observed stage-discharge relations cannot be explained by transient flow effects. This should be stated more clearly.

Conclusions (Section 5)

Instead of 'the invalidity of the kinematic wave assumption', the main problem is variable backwater effects. The judgement on the performance of IVM and DSM is questionable as long as the above mentioned drawbacks of the study are not addressed.

Technical corrections

W and b are both used to denote the river width. Please choose only one notation.

The term MSf and the whole first sentence of page 2680 are not clear to me.

effected $\rightarrow$ affected (p.2681, l.2)

meaning of 'a.o.'? (amongst others?)

References

Backscattered Intensity Profiles from Horizontal Acoustic Doppler Current Profilers (2010), S.A. Moore, J. Le Coz, D. Hurther, A. Paquier, in River Flow 2010, Braunschweig, Germany

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 2667, 2011.

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