We would like to thank Anonymous Referee # 3 for reviewing this manuscript. The following response aims to address the comments provided.

Referee # 3: This paper proposes a methodology for estimating instantaneous discharge using observations of water surface elevation from radar altimeters and a rating curve. This aim should be of interest to readers of HESS and is accomplished by the methods proposed in the paper. The paper also finds that the method can be used to monitor discharge in ungauged regions. However, in ungauged regions the method essentially depends on simulated discharge from a hydrological model, which often results in large errors in the discharges estimated from the altimetry. In fact, the NS for experiment 1 (ungauged case) appears to get worse when using the altimetry data relative to the hydrological model on its own.

Reply: We agree that, in some cases, averaged performance coefficients for Experiment 1 are worse when using the altimetry data relative to model outputs. But this is only true for stations draining small catchments (A<105km2). Rating curves provided better overall discharge estimates for the rest of the stations.

Referee # 3: P7593 L15: "...have combined virtual swath altimetric measurements with hydrodynamic models using data assimilation methods in order to improve modeled depth and discharge on river reaches (e.g., Andreadis et al., 2007).These studies show the potential of upcoming altimetrc measurements, but the application of the proposed techniques implies that bathymetry must be known." I found this sentence was quite confusing. Assimilation methods are introduced as a way to estimate bathymetry and discharge, before you state how the techniques imply bathymetry is known. The key difference with a swath altimeter is that by providing information on dh/dx, in addition to the dh/dt information provided by current altimeters, it may be possible to estimate bathymetry and discharge (and maybe even friction) from the data. The altimeter based method used in this paper requires observations of either bathymetry or discharge to create the rating, so to work in an ungauged site you need to either know the bathymetry or simulate the discharge. Furthermore, depth was not estimated by Andreadis et al., (2007) so it would be better to add some of the papers that do such as those by Durand et al.

Reply: We agree with this comment. The sentence will be rephrased and Durand's et al. papers will be cited in the revised manuscript.

Referee # 3: P7594 L4: Are the altimeter measurements being used to forecast or just make instantaneous estimates of discharge? Given an estimate of discharge it probably would be possible to forecast into the near future but I don't think this was done here unless I have missed something? If this is the case, describing the estimated of discharge as forecasts should be changed throughout the paper.

Reply: The altimeter measurements are used to make instantaneous estimates of discharge. The term 'forecast' will be replaced by 'estimate' in the revised manuscript.

Referee # 3: L25: Could you provide a reference here for the interpretation of a and b.

Reply: More details about the interpretation of a and b can be found in

Rantz, S.E. et al., 1982. Measurement and computation of streamflow: Volume 1. Measurement of Stage and Discharge. US Geological Survey Water Supply Paper, 284p.

This reference will be added to the revised manuscript:

Referee # 3: P7595 L5: The slope of the water surface may also change leading to hysteresis in the stage-discharge relationship. This can be particularly important in areas of diffusive flow where backwater effects are significant. Given the river slopes in this region I suspect much of the Amazon is diffusive and that at least some of the rating used by gauges will include slope components.

Reply: To our knowledge, slope observations are not sufficiently (or not at all) available in the Amazon basin to derive slope-based rating curves for this study. This is the reason why there is no gauge in the lower reaches of main rivers in the basin. However, we acknowledge that rating curves located in these particular locations may not work appropriately and there is nothing we can do by now considering the current data availability. This issue will be better discussed and solutions using the data from the future SWOT mission will be proposed.

Referee # 3: L15-20: My main concern with the method in ungauged catchments is that it offers no real improvement over existing data. When a gauging station is not available the method depends on an estimate of discharge from a hydrological model (in which case why not just use the hydrological model).

Reply: The approach depends on an hydrological model in a first phase, where rating curves are calibrated for a certain period using simulated discharges and radar altimetry. Once you have the rating curves calibrated, the hydrological model becomes unnecessary and discharge estimates can be obtained from space with the simple use of altimetry measurements.

Referee # 3: No attempt is made to take advantage of correlations in space or time between observations of discharge and altimetry heights in order to improve the discharge estimate or make a forecast (e.g. you could probably forecast discharge at a gauge downstream of a virtual station using a transfer function that relates altimeter level to observed discharge x days ahead).

Reply: To our knowledge, the idea of forecasting discharge at a gauge downstream of a virtual station has been first suggested and applied by Coe and Birkett (2004) to forecast downstream discharges and levels in the Chad Lake. Then, similar approaches have been applied in a few other studies to forecast downstream discharges in the Mekong River (Birkinshaw et al., 2010) and downstream water levels in the Ganges-Brahmaputra Rivers (Biancamaria et al., 2011). It could be a good idea to evaluate a similar methodology in the Amazon River and tributaries. However, it is out of the context of this study which is to evaluate the accuracy of the rating curve method at the large scale.

Referee # 3: So while it is possible to create a rating between altimeter level and discharge this tells you nothing about discharge in ungauged basins because simulated discharge is needed, on top of which deviations in level could be due to changes in slope rather than discharge.

Reply: The reviewer correctly points out a potential limitation of this approach, because the accuracy of simulated discharge at ungauged sites is unknown, and the rating curve derivation depends on the accuracy of the discharge simulations. However, as mentioned before, discharge estimates derived from rating curves in Experiment 1 (ungauged case) performed overall better than model outputs at stations with medium and large drainage areas. Also, the approach only depends on an hydrological model in a first phase. Then, discharge estimates can be retrieved uniquely from

radar altimetry.

Referee # 3: P7596 L21: As a kinematic model I'd be surprised if this routing scheme is able to simulate flow velocity in the Amazon with much skill. When evaluating the discharge estimates from the altimetry against gauge data it would be worth including a more detailed evaluation of the equivalent hydrological model discharge estimates, particularly in respect to timing of flow peaks.

Reply: The flow velocity is not used to calibrate rating curves. River discharge is the only model output used in this approach. More information on the evaluation of discharges simulated by HyMAP will be provided in the revised manuscript. Readers should refer to Getirana et al. (2012) for a full evaluation of the model, including simulated flow velocities, water storage and floodplain extents.

Referee # 3: P7597 L3-4: "Altimetric data was combined..." I didn't understand what was done here.

Reply: This phrase is not correctly placed and will be removed from the text.

Referee # 3: L7-11: What data assimilation method was used? It reads as if the model discharge at the gauge locations were simply set using the gauge data and then allowed to flow downstream. If this is the case then I'm not sure this is really data assimilation, which implies some combination of model and observation to create an analysis of the state variables. It might be more accurate to say that gauge data were used to set an up-stream boundary for the routing model where available. Then remove all reference to data assimilation from the paper.

Reply: We called assimilation the direct replacement of simulated discharges by observations at grid cells. In order to avoid misunderstandings, this process will be renamed and the term "assimilation" will be removed from the manuscript.

Referee # 3: P7600 L23-27: Is there any information on the typical errors introduced by using a single rating rather than a slope dependent rating at gauges? It would be nice to include this in the discussion.

Reply: To our knowledge, this information is not available for the Amazon basin since slope is not frequently measured at stations. However, we recently found a couple of studies comparing standard stage-discharge rating curves against more complex formulations considering slope. A discussion on this subject and recommendations for future studies will be addressed in the revised manuscript.

References:

Biancamaria, S. et al., 2011. Forecasting transboundary river water elevations from space. Geophys. Res. Lett., 38, L11401, doi:10.1029/2011GL047290.

Birkinshaw, S.J. et al., 2010. Using satellite altimetry data to augment flow estimation techniques on the Mekong River. Hydr. Proc., 24(26), 3811-3825. doi: 10.1002/hyp.7811

Coe, M.T., Birkett, C.M., 2004. Calculation of river discharge and prediction of lake height from satellite radar altimetry: Example for the Lake Chad basin. Water Resour. Res., 40(10), W10205.1–W10205.11.

Getirana, A.C.V. et al., 2012. The Hydrological Modeling and Analysis Platform (HyMAP): evaluation in the Amazon basin, J. Hydrometeorol., 10.1175/JHM-D-12-021.1.