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Hydrology and Earth System Sciences Discussions

Interactive comment on "Real-time remote sensing driven river basin modelling using radar altimetry" *by* S. J. Pereira-Cardenal et al.

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We would like to thank Dr. Schumann for his insightful and thorough review of the paper. The comments are addressed in the following response.

Dr. Schumann: Abstract: -Is the stated final RMS error of 6.7 m reasonable, when in some reservoirs the total water level variations over one year are 10 to 20 m max or so?

Reply: The RMSE value of 6.7 m is an average for all four reservoirs. For Charvak and Toktogul reservoirs (with seasonal level ranges above 50 m) the RMSE is 15 and 5 m, respectively. In Chardara Reservoir (seasonal level range of 11.5 m) the RMSE is

only 1.15 m, while in Kayrakkum (seasonal level range of 7.7) the RMSE is 5.85. The relatively large RMSE for Kayrakkum is due to the fact that no satellite altimetry data is available for this reservoir after 2003.

Dr. Schumann: -I have a slight issue with the sentence in line 26-27 in that given the revisit times of the altimeter data used (35 days) and the fact that the study is based on archived data, the study is not really pointing towards a near-real time operational forecast and as such it is difficult to make any conclusions about whether this could actually be provided operationally in real time forecasting mode. . .

Reply: As shown in Fig. 8, even though the revisit time of the altimetry data is 35 days, it can still reduce the modeling residuals considerably. Later in the paper (p. 8364, lines 13-20) we describe how this modeling approach is currently being used in a near–real time application in the basin. See also http://tethys.eaprs.cse.dmu.ac.uk/RiverLake/info/reservoir_main

Dr. Schumann: -The authors should state briefly, maybe in brackets, where Syr Darya basin is.

Reply: The Syr Darya is located in Central Asia. The manuscript will be modified accordingly.

Dr. Schumann: p. 8350: here the authors could also mention other data assimilation studies using remotely sensed data in the form of image derived water levels and hydrological modelling, such as e.g.: Neal, J. C., G. Schumann, W. Buytaert, P. D. Bates, P. Matgen, F. Pappenberger, 2009. An assimilation approach to discharge estimation from space. Hydrological Processes, 23, 3641-3649., or even: Montanari, M., R. Hostache, P. Matgen, G. Schumann, L. PïňĄster and L. Hoffmann, 2009. Calibration and sequential updating of a coupled hydrologic-hydraulic model using remote sensing-derived water stages. Hydrology and Earth System Sciences, 13, 367-380.

Reply: The suggested references will be included in the revised version of the

manuscript.

Dr. Schumann: p. 8356: More detailed explanation on the selection of areas of low or more signiïňĄcant runoff is needed here I think, i.e. was this done in a quantitative way or rather based on arbitrary threshold values?

Reply: The mapping of runoff-generating areas was done based on three criteria 1. Terrain slope (SRTM) 2. Geology 3. Observed river discharge

Flat areas outside the mountain ranges were assumed to produce negligible runoff. Areas covered by the sandy geology of the Kyzyl Kum desert were assumed to produce negligible runoff. The division into active and inactive subcatchments was cross-checked against an extensive discharge dataset provided by UzHydromet. This information will be included in the revised manuscript.

Dr. Schumannp. 8360: I am wondering whether the way the authors selected this 2.4 scaling factor is justiïňĄed (line 24: '3B42-RT was 2.4 times higher than the precipitation from 3B42')? Both products (research and RT) are satellite derived and could thus both be wrong???

Reply: We agree. Based on the evidence we have, it is hard to decide which product is better. Probably, neither the research nor the RT precipitation product provide accurate precipitation estimates in such a mountainous region (Fig. 4a and Fig. 5). However, using the research product, overall runoff coefficients for some of the subcatchments would be as high as 0.7 or above, which is clearly unrealistic. It could be argued that we should have used the scaling factor as a model calibration parameter. However, we decided to scale the research to the RT precipitation product in order to be able to apply the same modeling approach in a near–RT scheme.

Dr. Schumann: p. 8362: At the start of section 4 the authors only list very brieïňĆy possible reasons for the large variation in model performance. This should be more elaborated.

Reply: In the Discussion section (p. 8363 line 20 onwards) we elaborate further on the possible reasons for the large variation in model performance. We will complement this section by discussing the issues regarding the quality and resolution of the remotely sensed precipitation and temperature data and how this is important in a mountainous area. Furthermore, the outdated irrigation requirements data is also considered to add uncertainty to our model.

Dr. Schumann: p. 8363-8364: here it would be helpful to go into more detail and a possible explanation on why there is generally such a very poor performance of the RR model for the reservoirs Chardara and Kayrakkum. At Chardara the model seems to be missing any clear seasonal dynamics and at Kayrakkum there seems to be some sort of a phase shift.

Reply: The RR model performs well in upstream reservoirs (Toktogul and Charvak, see Fig. 7). Kayrakkum is downstream of Andijon (no altimetry data available) and Toktogul reservoirs, and downstream of the Fergana irrigation district, which is the largest in the basin . Due to upstream irrigation activity and reservoirs, it is difficult to adequately model a reservoir with only 46 days of mean residence time. Chardara reservoir is located downstream of all the other reservoirs and most of the irrigation districts. This introduces large uncertainties into the modeling results for this reservoir. Actually, it appears that we consistently over-estimate inflow to the Chardara reservoir in the baseline simulation which results in the water level being close to the maximum for most of the simulation period.

Dr. Schumann p. 8364: why is the altimeter error so large (only 15 cm or so short of 1 m) for this test site? Are there any particular reasons for this?

Reply: The accuracy of the altimetry measurements depends on several factors: the topography of the area, the along-track extent of the target, the ability to correct the signal for atmospheric effects, etc. For this site we report accuracies ranging from 0.37 at Chardara Reservoir to 1.8 at Charvak (Table 4). Charvak has by far the smallest

surface area, making it a difficult target for the automatic system used to generate the altimetry time series. We therefore believe that the accuracy of the altimetry product is acceptable, and it shows to be very useful for our modeling objectives.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 8347, 2010.