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Discussions

Interactive comment on "Separating the effects of changes in land cover and climate: a hydro-meteorological analysis of the past 60 yr in Saxony, Germany" *by* M. Renner et al.

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We appreciate the comments of reviewer #2 which helped to clarify our methodology. Below we provide a detailed response to the remarks of the reviewer.

- **From the manuscript it is unclear the derivation of eq. 5 which provides the water par- titioning coordinate qb. How fb disappears of eq. 5 when eqs. 3 and 4 are combined?** The y-coordinate f_b can be substituted through $f_b = q_b\ f_0/q_0$. We added this note.

- **Is P0 in eq. 6 right or it should be Pb, or is that P0=Pb?** P_0 is correct as the aridity index is constant at both points and hence $P_b = P_0$. We added a sentence after this step.
- **Although the methodology is simple: provided that the coordinates (q0, f0) and (q1, f1) are known by using eq. 5 one can obtain qb. This value will be used in eq. 6 to get ET,b and thereby the changes in ET related to land-surface changes (eq. 7) and to climate changes (eq. 8). However, the basis of the method such as the definition of climate changes as perpendicular to the original aridity index is not clear by just referring to the symmetry of water or energy limitation. This needs some additional explanations.** We revised our argumentation and discussion of the simple method. Please see also our reply to reviewer #1 in the interactive author comment www.hydrol-earth-syst-sci-discuss.net/10/C4053/2013/.
- **What would be the advantage of this method compared to the one employed by Jaramillo et al. (2013) where changes in ET due to climate are calculated as a function of changes in P and E0 and the difference between this ET value from the climatic variables and the ET from the water balance (P-Q) is attributed to changes in land use?** First thank you for pointing us to this reference. Jaramillo et al. employ different Budyko functions to compute the change in E_T due to climatic changes. Differences are then attributed to land-surface changes. Their methodology is straight-forward and similar to Wang and Hejazi (2011). We reflect on the differences in our author comment www.hydrol-earth-syst-sci-discuss.net/10/C4053/2013/ and rephrased parts of section 2.2. The proposed method differs insofar as it does not need a (specifically parametrized) Budyko function.
- **Why the runoff data is subject to a homogenization test procedure as pointed out in lines 17-20? Are the runoff data and the precipitation data**

reported initially as daily values? The homogenization procedure was applied to a larger set of stations with runoff data. The 68 stations presented in this analysis did pass the tests. We rephrased these parts to avoid confusion. The base data used in this study were reported as daily observations. We added this information in the revision.

- **Lines 5-8 on pg. 8547 needs a reference to the study the authors are mentioning.** The referee refers to the statement that the best interpolation scheme was selected by a cross-validation. The cross-validation of spatial interpolation schemes was part of the data preparation of this study. We omitted these results from this manuscript as this was not the major focus.
- **In section 3.4 the authors explain the calculation method of potential evapotranspiration from reported monthly average data of the stations shown in Fig. 3b. However, they do not explain how they interpolated the point data to obtain the spatial variability of E0 shown in the Figure.** We added the following note: "The aggregated annual totals were then spatially interpolated with an automatic Universal Kriging procedure with station elevation as local trend variable (Hiemstra et al., 2009)."
- **Line 20. Pg. 8557. I do not agree with the authors when they write the statement that there has been a significant reduction in potential evapotranspiration from 1950-1980.** In figure 4 of the manuscript we show time series of E_0 and P and the non-stationary trend reversal of E_0 is maybe not visible due to the small range in the y-axis. Therefore, we added Fig.1 to this reply which shows the time series for all basins and the decadal means. Additionally the argument of significant reduction of potential evapotranspiration with strongest effects in the 1980s is based on a stationarity test using the simple CUSUM test procedure. This test is based on the cumulative sum of standardized residuals of the mean. The test statistic is defined by a stationary Brownian motion process

(Zeileis et al., 2002) and are shown as vertical lines in Fig. 2 of this reply. The test results for all basins are shown in Fig. 2 of this reply. In total 40 out of 68 basins show a significant non- stationarity at $\alpha < 0.05$.

- **Fig 1 legend. Change P0= 1400 mm by P1** Done
- **Fig 5 legend. The authors say "The thin grey lines show . . .." but in reality they plot lines in green and red colors.** Done
- **Fig. 7 legend. Add in the legend the explanation about the pie charts, the map with forest damages and the Corine data.** We added necessary information to the caption of Fig. 7.
- **Line 16 on page 8560. In the sentence "Similar increases in ET have been found in the U.S. by (Walter et al., 2004. . .)". Change the location of the parenthesis for the references.** Done

Hiemstra, P., Pebesma, E., Twenhöfel, C., and Heuvelink, G.: Real-time automatic interpolation of ambient gamma dose rates from the dutch radioactivity monitoring network, Computers & Geosciences, 35, 1711–1721, 2009.

Jaramillo, F., Prieto, C., Lyon, S. W., and Destouni, G.: Multimethod assessment of evapotranspiration shifts due to non-irrigated agricultural development in Sweden, Journal of Hydrology, doi:10.1016/j.jhydrol.2013.01.010.

Wang, D. and Hejazi, M.: Quantifying the relative contribution of the climate and direct human impacts on mean annual streamflow in the contiguous United States, Water Resources Research, 47, W00J12, doi:10.1029/2010WR010283, 2011.

Zeileis, A., Leisch, F., Hornik, K., and Kleiber, C.: strucchange: An R package for testing for structural change in linear regression models, Journal of Statistical Software, 7, 1–38, 2002.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 8537, 2013.

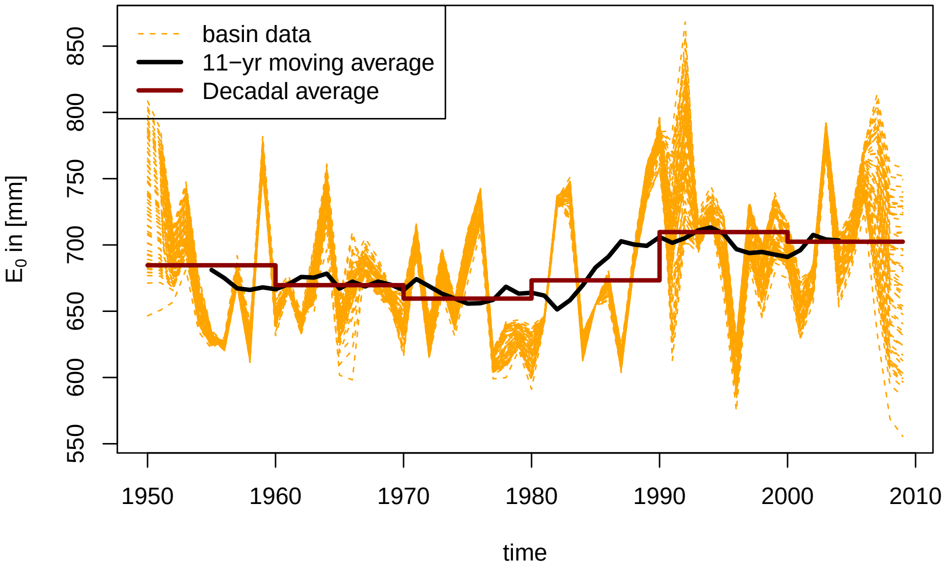

Fig. 1. Potential evapotranspiration time series for all basins and the all station decadal mean.

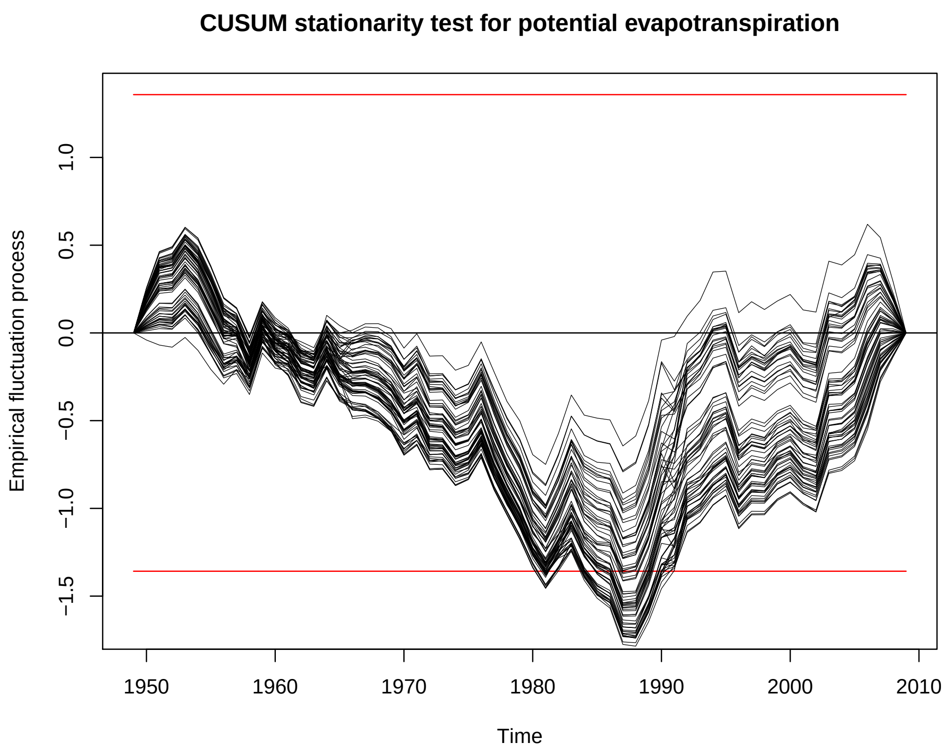

Fig. 2. CUSUM test procedure for E0 time series at each station. The horizontal boundary denotes the significance level (alpha = 0.05)