Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-158-AC2, 2016

Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Rainfall erosivity factor in the Czech Republic and its Uncertainty" *by* M. Hanel et al.

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Received and published: 24 June 2016

We thank to pointing us towards some further explorations and discussion. The response to the specific comments is included bellow. The modified manuscipt is attached.

Specific comments:

In general, I agree with the authors that the rainfall erosivity index is a good indicator of areas subjected to soil erosion. However, I do not believe that using only 14-15 years of measurements it is possible to obtain a good estimate of long-term rainfall erosivity, everywhere. The period covered by the datasets is short and may (or may not) contain outliers which generally affect the mean values. Even if some authors are inclined to remove the outliers from the series

(see Janecek et al., 2013), I do not think it is a correct approach because these outliers often are the major contributors (up to 80%) of the total amount of soil eroded from an area (see for example Martinez-Casasnovas et al., 2002; Fang et al., 2013). In this respect, the authors based their long-term analysis on a single dataset (C2TREB01, with 80 years available). As I understand, this station shows a value of R = 669 (MJ ha-1 mm h-1) which falls perfectly around the mean value calculated for the entire region (ca. 640). The same consideration can be extended to the CV value (CV = 21.6 for C2TREB01, considering 15 years, and CV=23.3 for the entire region – see natural variability for 96 stations in Table 2). In other words, this station is indicative of the average conditions of the region and it is not surprising that the bootstrap analysis indicated in section 3.3.1 and appendix b gives no strong differences if periods of different length are considered. It would be interesting to look at another station, with similar length, but showing a higher variability of the rainfall erosivity factor. If the authors have this information, this can be added to improve the paper. If not, please, add some comments that emphasise this uncertainty.

Thank you for pointing this out. Indeed the coverage probability and the width of the confidence interval is influenced by variability of the erosivity index at a location. Since the only station with similar record length that is available to us is located close to C2TREB01 and has similar characteristics, we demonstrate this effect using simulated data. At most sites (including C2TREB01), the annual erosivity index ($EI30$) can be described by gamma distribution (assessed by the Anderson-Darling test), i.e. $EI30 \sim \Gamma(\alpha, \beta)$, with α and β the shape and rate parameter, respectively. It can be shown, that in order to change the coefficient of variation by factor k, the parameters have to be modified as follows:

$$\alpha^* = R\frac{\beta}{k^2}, \beta^* = \frac{\beta}{k^2}$$

(with α^* and β^* the modified shape and rate), provided the R-factor ($R =$ mean $EI30$)

remains constant. We estimated α and β using the whole record from the C2TREB01 station and modified these parameters considering $k = 0.5, 1$ and 2. The scheme from appendix B was used to assess the coverage probability and confidence intervals, except point 2, where the sample of length l was generated from the modified distribution. The results are shown in the right panel of Fig. 1. It is clear, that the confidence intervals as well as the coverage probability for $k = 1$ correspond reasonably with those from the left panel of the same figure. It is also clear (and expected) that the confidence interval width increases with coefficient of variation. For instance for 15 year record and doubling of coefficient of variation it ranges from 0.5 to 1.57. For increasing record lengths the coverage probability increases and the width of the confidence interval decreases. Note that the confidence interval for erosivity index with large coefficient of variation remains large (>50%) even for 80 years of data. The coverage probability, on the other hand, decreases only slightly with CV.

In reaction to your comment we extended Fig. 6 of the manuscript and added a paragraph at the end of section 4.3.

During the last 2-3 decades, an increase in the rainfall erosivity factor is documented in different areas of the world due to climate change (see among the others Fiener et al., 2013; Nearing et al., 2004; Porto et al., 2013; Capra et al., 2015; Zhang et al., 2005). This is documented also by the first author in a previous contribution (see Hanel et al., 2016) for some stations in Czech Republic. I suggest to show a figure with the 80 values of R (calculated for C2TREB01) vs time (years) in order to see if no increasing trend can be detected during the period 1989-2003. If there is an increasing trend in this period, it means that the 96 values of R are not stationary and this needs some more comments.

It is true, that positive trend was detected for some stations in the Czech Republic for the period 1961-2011 in our previous study. Looking at the period 1989-2003 no clear trend is obvious (Fig. 2). We added a sentence on that in the section 2.2.

The authors said (citing also Goovaerts, 1999; Angulo-Martínez et al., 2009) that using covariates like longitude, latitude and elevation or long-term precipitation it is possible to cover the existing gaps of direct evaluation of R. I want to emphasise here that such correlations are acceptable only where the R values are obtained using indirect methods that involve, for example, rainfall values at daily or monthly scale (see Capra et al., 2015). When short time steps are considered (and R requires time intervals shorter than 30 minutes) these correlations fail (see for example Porto, 2016), unless climatic conditions are uniform over large areas. But, as the authors recognise, R values are very much affected by local conditions and this complicates things. I am sure the authors want to add some more comments here.

The correlation between the Rfactor and various covariates is discussed in the beginning of section 4.2 (i.e. correlation between Rfactor and r_{mea} is 0.75, for r_{cv} it is 0.44, for r_{p95} 0.54, elevation 0.32, longitude 0.49 and latitude -0.25). Fig. 3 bellow show scatter plots of Rfactor and selected covariates. The relevance of these covariates for the Rfactor is also obvious from the cross-validation of different GLS models (see tab.) bellow. Finally, a GLS model considering r_{mea} can explain around 59% variability of Rfactor, r_{p95} around 31% and r_{cv} or longitude around 21% of variability. The elevation is, on the other hand, rather poor covariate (when not considered in combination with some characteristics of precipitation).

However, in line with your comment, we agree that the correlation between Rfactor and long term characteristics of precipitation, its variability and topographic indices, which is considerable in our dataset, might be very different in more complex regions as documented by Capra et al. (2015) or Porto (2016). A note on this was added.

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Table 1. Cross-validation of GLS models with different combinations of covariates.

GLS model	WI	RMSE	MAE	rMAE	AVst	SDst
R $\sim r_{mea}$	0.83	139.47	108.74	0.18	619.06	146.62
R $\sim r_{mea}$ + X	0.84	138.80	106.75	0.17	600.22	148.66
R $\sim r_{mea} + r_{p95}$ + Y	0.90	116.98	92.62	0.15	635.57	175.48
GLS_E	0.91	114.37	89.95	0.14	635.64	177.47
GLS_M	0.90	115.38	90.57	0.15	635.34	175.12

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Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-158/hess-2016-158-AC2-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-158, 2016.

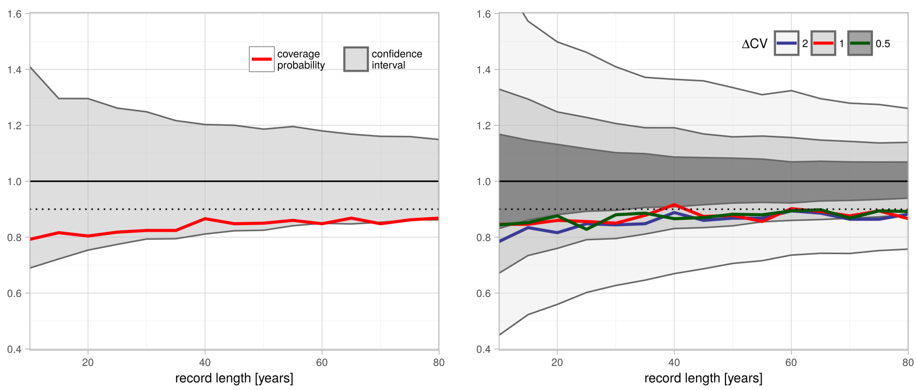

Fig. 1. The average confidence intervals (relative to the long-term mean R-factor, 669 MJ ha$ˆ{-1}$ mm h$ˆ{-1}$; gray area) and the coverage probability (thick lines) for different record lengths based on the

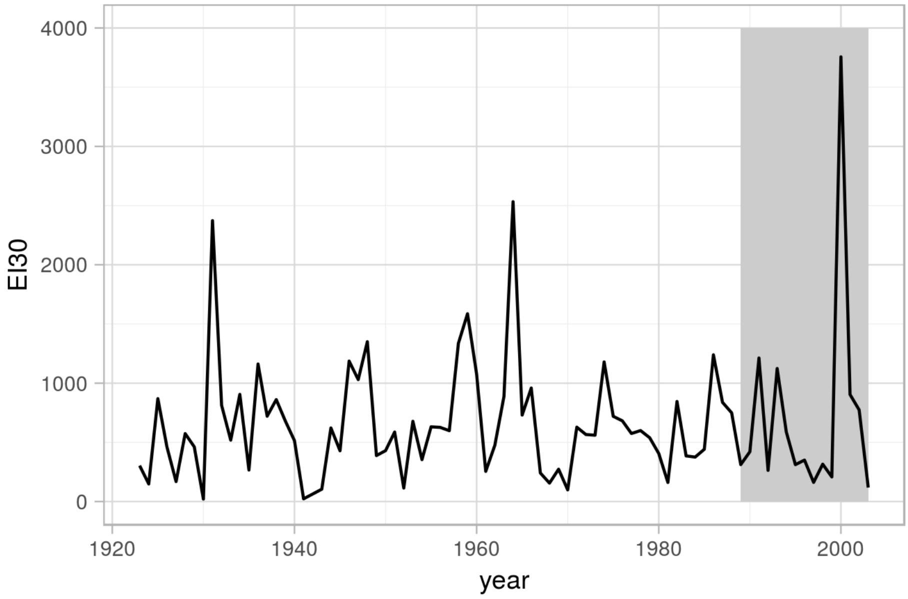

Fig. 2. Annual erosivity index (EI30) for station C2TREB01

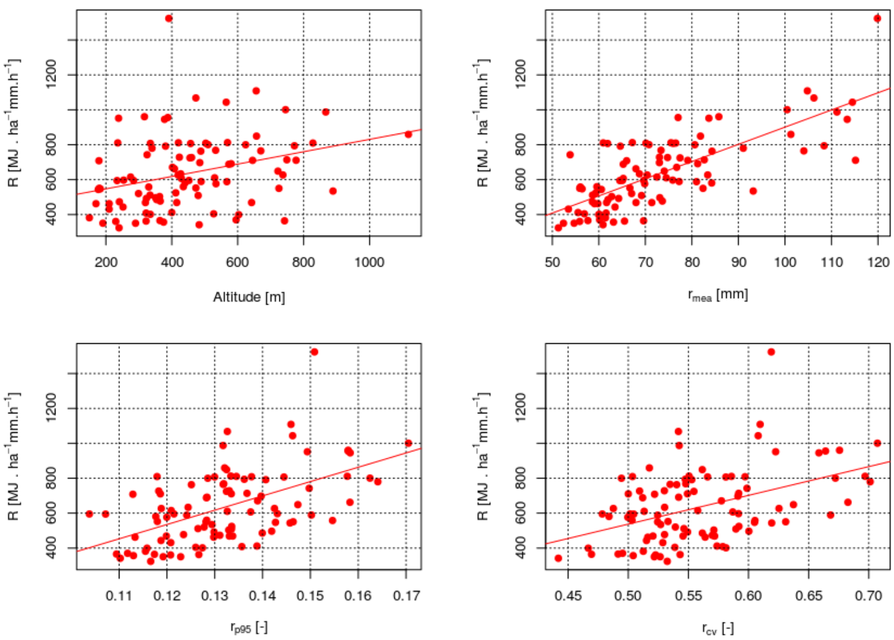

Fig. 3. Scatter plots for Rfactor and selected covariates.