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Hydrology and Earth System Sciences Discussions
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Interactive comment on "Projected changes in US erosivity" *by* M. Biasutti and R. Seager

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We thank Nir Krakauer for his comments. We hope that our response, together with the changes done in response to the second reviewer, will address all the issues he identified with our work.

Dr.Krakauer's main issue with the substance of our study is cited as follows: *1482: I would be concerned that to "estimate local R to F relationships for points in each 1 by 1 degree square" is essentially fitting interpolation noise, as neither field will have many actual observations within a typical square. This may explain the large variability in the regression coefficients seen in Figures 5 and 6. It may be better to estimate these relationships on a much larger scale, for example over each of the 9 climatic regions mentioned on p. 1472.* Thanks for the suggestion. We are fully aware that the regression on the spatial pattern is not optimal because it might be picking up the fine

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spatial structures of rainfall that underlie the PRISM interpolation of the erosivity field. We have tried your suggestion.

We have approximated the regional subdivisions of Palecki et al 2005 (see reproduced figure below) with 8 regions of simplified shapes (Palecki's regions 8 and 9, which are intermingled, but separated by elevation in the original study are merged into a single region for this analysis) and regressed the target erosivity R onto either the daily precipitation or the monthly modified Fournier index (we used a linear relation in this case).

Figure 1: Reproduced from Palecki et al 2005. Note that this map has a different projection from the standard lat-lon grid, so that the regions would appear of different shapes in Figures 1 and 2, even if we had not simplified them.

Figure 2 shows the target R (Fig 2a), the 8 regions (Fig. 2b), and the results of the two regression methods (the regressed R's are in Figs. 2c,d, while the coefficients of the regressions are in the lower panels). The results are not encouraging: the coefficients vary sharply across regional boundaries and the biases of the regressed R are substantial. For example, one can easily see that both methods underestimate R in Florida and overestimate it along the Northeast coast. This is of course to be expected, given that this method is a lot more parsimonious with regression parameters.

The regional regression is overall picking values similar to the local regressions, with the same overall gradients between the east and the west and the northeast and southeast. The clearest exception is for the non-linear regression with daily precipitation: the midwest has a high exponent (red colors in Figure 2g indicate values close to 2; see also Table 1), while the local regressions gives values closer to 1 as in the rest of the eastern US.

Overall, the regional regression biases are large enough (using either precipitation metric) to lead us to conclude that basing the regression on larger regions is not beneficial, compared to our original choice of a 1° x 1° grid. We mention this result in the revised version of the paper in the following paragraph:

> Another possible choice for building the regression between rainfall (either at daily frequency or aggregated into F) and erosivity would be to base it on larger regions that encompass broader variations in the relevant fields than what is seen in a 1° x 1° square. Taking inspiration from the regional clusters of Palecki et al (2005)—which select regions with fairly homogeneous mean storm characteristics—we have defined 8 regions and regressed rainfall and rainfall characteristics across the gridpoints within each region. The regressions are more biased in this case than in the case of the local regressions, independently of the choice of rainfall variable. This is as expected, given that we use much fewer parameters, and again underscores the uncertainty in the estimates or erosivity that are based on rainfall accumulation. In the rest of the study, we proceed using the estimates obtained by local regressions, mindful that these regressions should be interpreted more as a simple scaling than as a robust physical relationship.

1481: for observations of change in intense daily rainfall, can also now cite Asadieh and Krakauer (2015), Global trends in extreme precipitation: climate models versus observations, HESS, 19(2): 877-891
Done, thanks.

Figure 10b: Specify the intensity measure (e.g. "mean daily intensity").
Done, thanks

Figures 11-13: I suggest using fewer distinct colors to make them easier to distinguish (similar to the color scale of Figure 10).
We have used the color scale of Figure 10 for the new figure (see answer to the other reviewer), but for changes in erosivity we have chosen to leave the color scale unchanged. The reason is that changes in erosivity are mostly positive and need more

green shades to be able to show a similar amount of detail.

There are a few typos
We fixed the ones you mention and we read it through one more time to make sure there are no others.

We are attaching as supplement the current version of the manuscript (with degraded resolution, for the sake of file size).

Figure 2: Erosivity Regressions Using Regional Data. (a) Target erosivity R. (b) The definition of the 8 regions taken to approximate those chosen by Palecki et al, 2005;a value of 0 is assigned to ocean points and land points outside the continental US, values 1 to 8 are used to label the regions. (c,e,g) Regression based on daily values of precipitation. (d,f,h) Regression based on the monthly modified Fournier Index. (c and d) Regression estimates of R, (e and f) coefficient "a", (g and h) coefficient "b". See main article for the regression formulas. The regression coefficients are also given in tabular form below.

Table 1. Regression coefficients for the 8 regions and 2 regression methods. Values in the first set of rows are "a" and "b" for the regression based on daily rainfall ($R \simeq \frac{a}{N}\sum_{n=1}^{N}\sum_{d=1}^{365} P_d^b$) . Values in the second set of rows are "a" and "b" for the regression based on the Fournier index ($R = aF + b$)

1	2	3	4	5	6	7	8
0.1533	0.3265	3.6950	0.1320	3.1929	0.1270	4.4898	1.0485
1.5237	1.3774	1	1.8841	1	1.8771	1	1
6.8674	5.0917	21.2874	18.7407	19.6682	26.3194	1	6.1067
-0.3252	0.0409	0.1307	-0.4255	0.8941	-0.9292	2.7112	0.3703

Please also note the supplement to this comment:

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http://www.hydrol-earth-syst-sci-discuss.net/12/C1465/2015/hessd-12-C1465-2015-supplement.pdf

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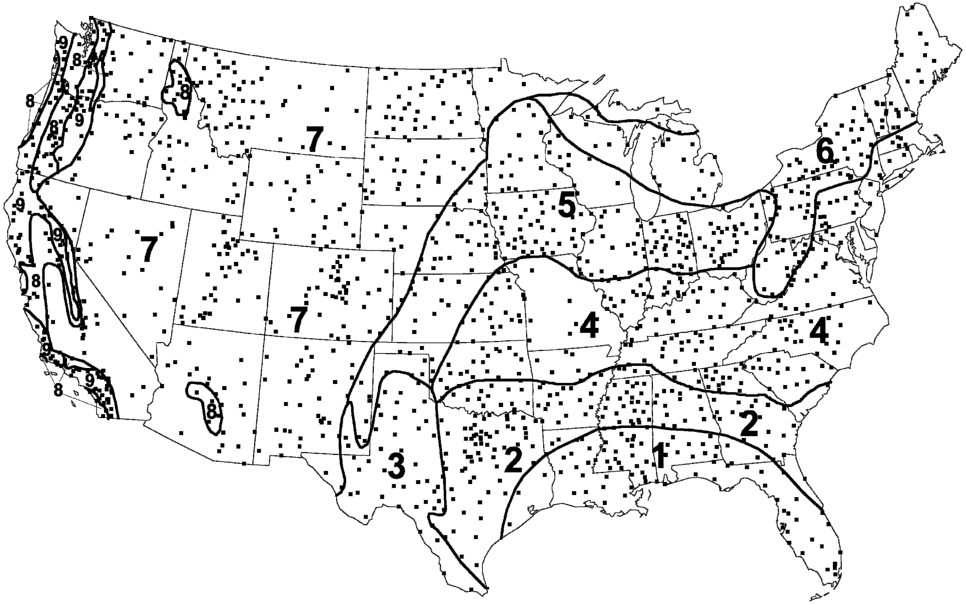

FIG. 1. Storm precipitation characteristic cluster zones. Squares indicate the locations of stations used in this study.

Fig. 1. Reproduced from Palecki et al 2005. Note that this map has a different projection from the standard lat-lon grid, so that the regions would appear of different shapes in Figures 1 and 2, even if we ha

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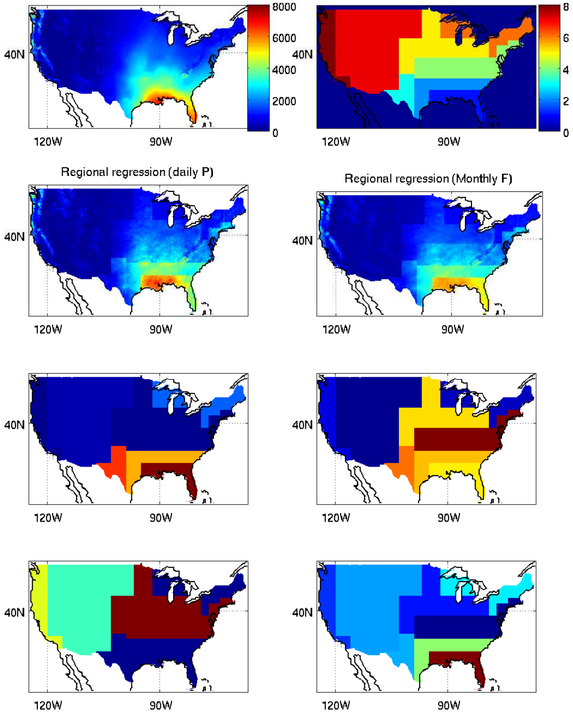

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