Response to Anonymous Referee #1

We would first like to thank the anonymous referee for his or her constructive comments. In this response we will try to answer all the comments and the indicated changes will be applied in the revised manuscript.

General comment: *"However, I have a suggestion that the global results should be presented and compared in a clearer manner. Currently, global erosion estimates were presented only in Table 7; no global map of erosion estimations were presented (only specific factors)."*

Answer: We did not present a global map of soil erosion rates, due to the fact that the other RUSLE factors (K, C and P) are not adjusted to the coarse resolution for global scale application as the S and R factors. We wanted to stress the improvements made by adjusting the S and R factors, rather than focusing on the final soil erosion rates. However, we agree that providing global maps of erosion rates can help making the statistics in table 7 point out the improvements made in this study in a clearer way. So, additional to table 7, we will include in the revised version of this article 4 maps of global soil erosion rates (see below). One map showing the erosion rates for the fully adjusted RUSLE model (Fig. 8A). The second map will show a difference plot between the fully adjusted and unadjusted RUSLE model (Fig. 8B). The third map will show a difference plot between the RUSLE model with only adjusted S factor and the unadjusted RUSLE model (Fig. 8C). And finally the last map will show a difference plot between the RUSLE model with only adjusted R factor and the unadjusted RUSLE model (Fig. 8D). These maps should highlight the different contributions of the adjusted S and R factors on erosion rates for the global scale. In section 4.2, we change the text between line 409 and 411 as following: "From the global map showing the difference between the erosion rates of the S adjusted RUSLE and the unadjusted RUSLE versions (Fig. 8C) one can see that erosion rates are in general increased and mostly pronounced in mountainous regions. This feature is 'dampened' by adjusting the R factor. Looking at the global map showing the difference between the R adjusted RUSLE and unadjusted RUSLE versions (Fig. 8D), one can see that the erosion rates are overall decreased in regions where the adjustments are made. When combining both adjustments of the RUSLE model in the fully adjusted RUSLE version and subtract the unadjusted RUSLE erosion rates (Fig. 8B), one can see that the erosion rates are slightly decreased in areas where the R factor is adjusted. However, in the tropics for example there is an increase in erosion rates by the fully adjusted RUSLE due to the lack of adjusting the R factor there. This indicates that these two factors balance each other, and that it is important to have a correct representation of all the RUSLE factors on a global scale in order to predict reliable erosion rates"

On page 3007, line 24, we add after " $7tha^{-1}yr^{-1}$ " (Fig. 8A)

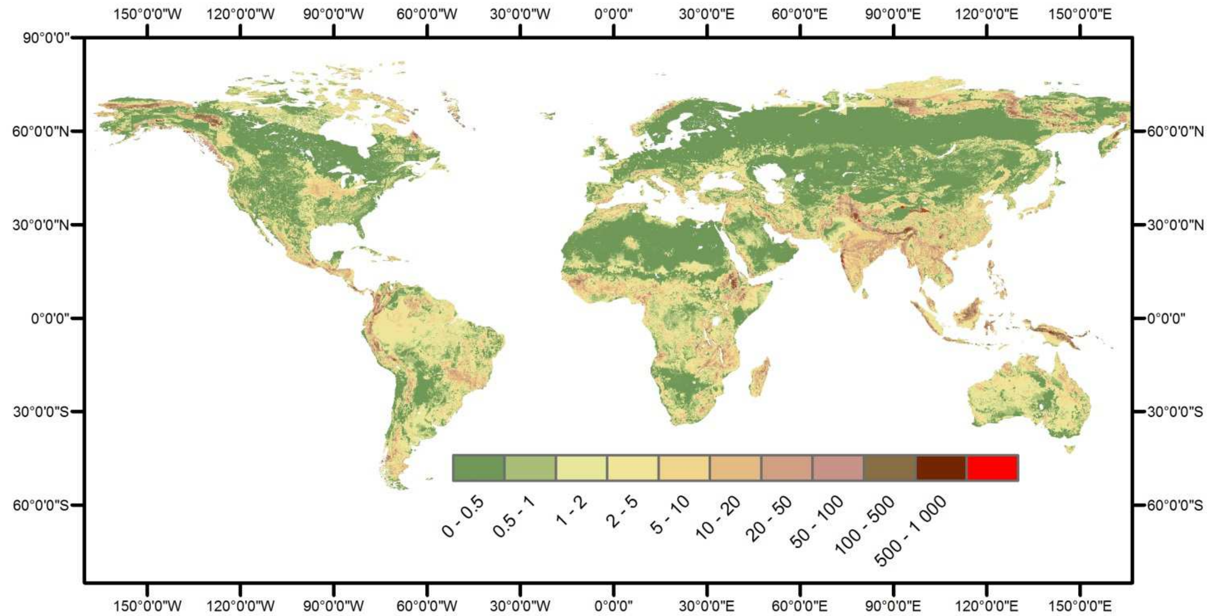

Figure 8A: Global average erosion rates for the current period from the "fully adjusted RUSLE model" in t ha^{-1} yr^{-1}.

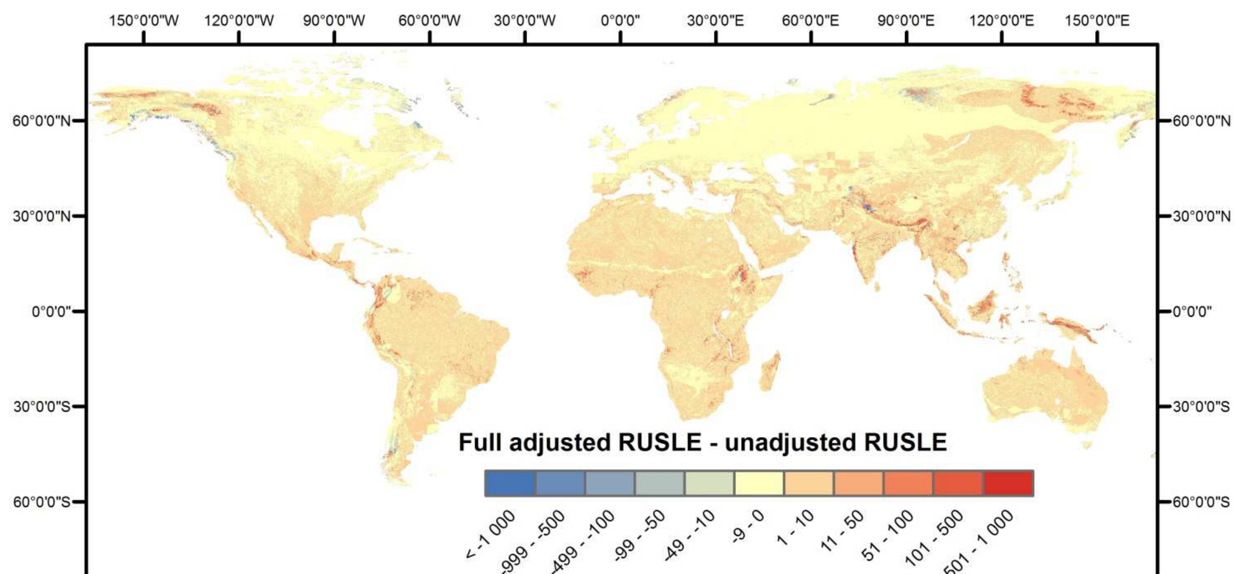

Figure 8B: Difference plot between global average erosion from the "fully adjusted RUSLE model" and the "unadjusted RUSLE model" in t ha^{-1} yr^{-1}. Reddish colors show an overestimation by the "fully adjusted RUSLE model" and yellow to bluish colors show an underestimation.

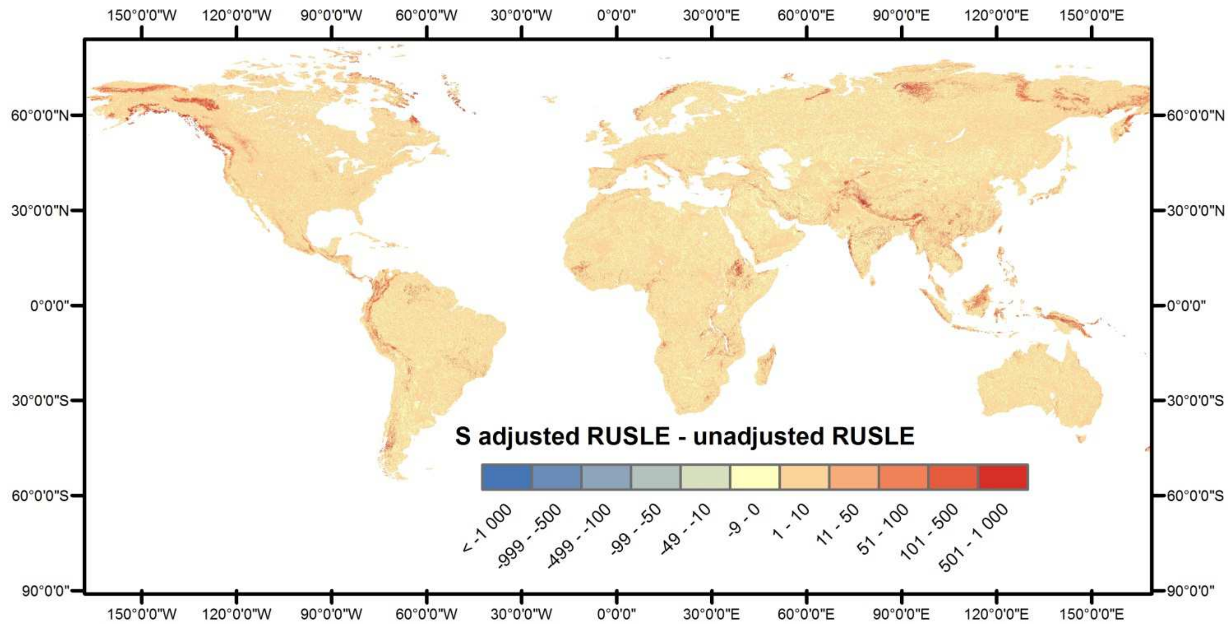

Figure 8C: Difference plot between global average erosion from the "S adjusted RUSLE model" and the "unadjusted RUSLE model" in t ha^{-1} yr^{-1}. Reddish colors show an overestimation by the "S adjusted RUSLE model" and yellow to bluish colors show an underestimation.

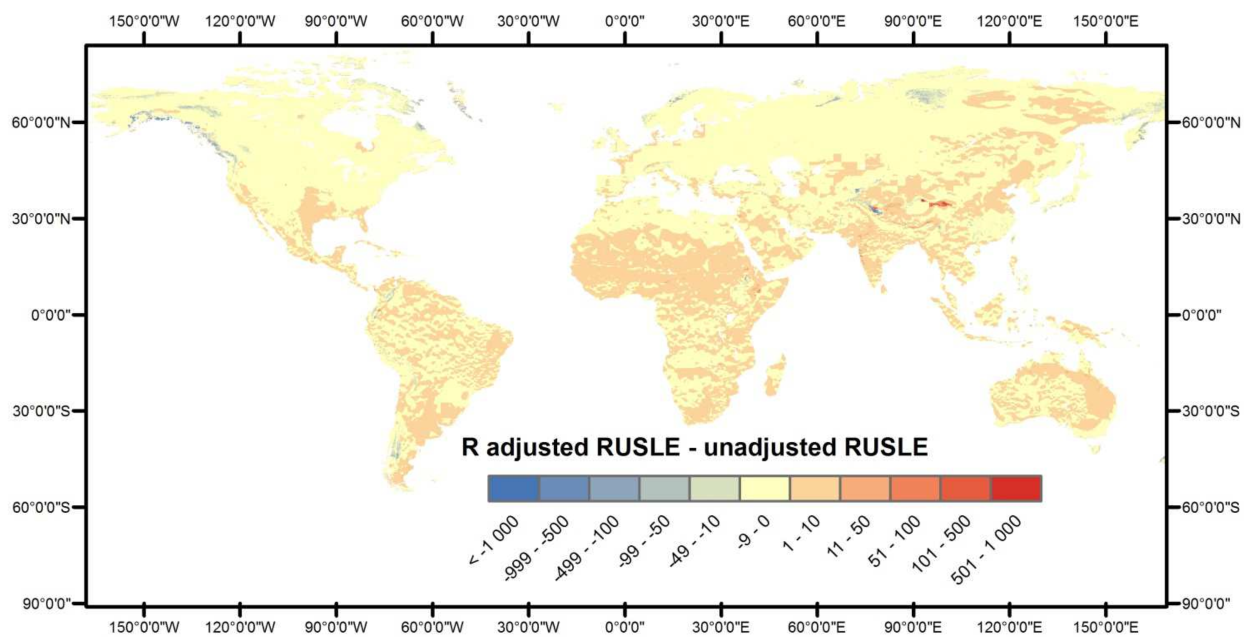

Figure 8D: Difference plot between global average erosion from the "R adjusted RUSLE model" and the "unadjusted RUSLE model" in t ha^{-1} yr^{-1}. Reddish colors show an overestimation by the "R adjusted RUSLE model" and yellow to bluish colors show an underestimation.

Specific comment 1: *Page 3003 Line 15–16 It seems that the two variables, annual precipitation and precipitation intensity, are not independent each other. Did you check independence among the variables used in the regression analysis?*

Answer: We checked the independence of these variables and they are in some extent correlated, because the precipitation intensity is inferred from the long term total precipitation on wet days. We found an r squared of 0.5 when plotting the two variables against each other. However, these two variables contain different information. For example the precipitation intensity is shown to be crucial in a lot of climate zones (see for example the case of the Ebro basin in Spain). Also, the annual total precipitation provides additional information which makes the regression more accurate. Without the annual precipitation, the performance of the multiple regression approach is lower. So we decided that both variables play an important role in the multiple regression approach.

Specific comment 2: *Page 3007 Line 14 I have some concern about the statement that "... and support practice (P) factors do not contribute significantly to the variation in soil erosion at the continental scale." As you know, much efforts of soil management practice have been made to prevent erosion. In other words, I'm worrying about over-fitting in this study by putting too much focus on S and R factors.*

Answer: We understand that this sentence may be misleading, management contributes a lot in preventing soil erosion in agricultural areas; however, the uncertainty in estimating the P factor due to the lack of data is large. Including this factor in the erosion estimations would mean including an additional large source of uncertainty. And as we want to keep the model simple and focus on presenting the improvements made to the S and R factors, we left this factor out of the calculations. We reformulate the sentence and add additional information explaining in a more detailed way like above why we ignored the L and P factors in our calculations.

Page 3007, line 14 is reformulated in the revised manuscript as: "Doetterl et al. (2012) showed that the slope length (L) and the support practice (P) factors do not contribute significantly to the variation in soil erosion at the continental to global scale, when compared to the contribution of the other RUSLE factors (S,R and C). However, this does not mean that their influence on erosion should be ignored completely. They may play an important role in local variation of erosion rates. In our erosion calculations we do not include these factors, because we have too little to no data on these factors on a global scale. Including them in the calculations would only add an additional large uncertainty to the erosion rates, which would make it more difficult to judge the improvements we made to the S and R factors.

Specific comment 3: *Page 3007 Line 23–15 As mentioned above, presentation of the global results is not adequate for me. I suggest adding further comparisons among the simulations, such as global map and latitudinal distribution.*

Answer: See answer to general comment

Specific comment 4: *Page 3018 Table1 The column "Temporal resolution" does not provide temporal resolution (e.g., daily, monthly, annual) but show only temporal period. Please correct the label or data in the column.*

Answer: The label in table 1 in column 5 is changed in the revised manuscript from "Temporal resolution" to "Time-period"

Specific comment 5: *Page 3022 Table 5 Can you show R results by the unadjusted model for comparison?*

Answer: Yes, we provide in the revised manuscript in Table 5 the R values as originally calculated by Renard and Freimund (see table below)

Table 5. Mean high resolution *R* values from the USA and Switzerland and mean modelled *R* values with uncertainty range for each addressed climate zone

climate	description	observed *R* mean	old method *R mean*	adjusted method *R* mean	Adjusted method uncertainty range
BWk	arid, desert, cold	284	533	291	158-495
BSh	arid, steppe, hot	2168	1356	2207	1723-2828
BSk	arid, steppe, cold	876	884	885	749-1046
Csb	temperate, dry warm summer	192	1136	192	133-292
Cfa	temperate, without dry season, hot summer	5550	5607	5437	4830-6123
Cfb	temperate, without dry season, warm summer	1984	5359	1971	1431-2715
Dsa	cold, dry hot summer	172	445	171	86-340
Dsb	cold, dry warm summer	175	896	168	151-187
Dsc	cold, dry cold summer	115	374	115	91-145
Dwa	cold, dry winter, hot summer	1549	1444	1551	1280-1879
Dwb	cold, dry winter, warm summer	1220	1418	1214	1057-1395
Dfa	cold, without dry season, hot summer	2572	2983	2582	2346-2843
Dfb	cold, without dry season, warm summer	1101	1798	1124	922-1371
Dfc	cold, without dry season, cold summer	483	701	483	423-552
ET	polar, tundra	1352	6257	1249	23-68088
EF+EFH	polar, frost + polar, frost, high elevation	1468	5469	1450	16-132001
ETH	polar, tundra, high elevation	945	5580	832	0-6314918