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Interactive comment on "Paleofires and the dynamics of carbon cycling in Chinese Loess Plateau over the last two glacial cycles" *by* X. Wang and Z. L. Ding

Anonymous Referee #2

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The paper entitled "Paleofires and the dynamics of carbon cycling in Chinese Loess Plateau over the last two glacial cycles" by Wang and Ding treats very interesting topic related to the carbon budget and its change in the past raised from biomass burning on the Chinese Loess Plateau. Emission of trace gases and deposition of refractory carbon during fire is our significant concern and authors' strategy to reconstruct the fire history of grassland using the Loess records is reasonable and great. Their estimations of carbon emission as trace gases and deposition as BC for the past require too many assumptions. However, authors did not successfully prove the reasonableness of their estimation in this current manuscript. Fair evaluation of the uncertainty is necessary. Lack of direct measurement of d13C of soil organic matter below LGM section is an-

other deficit of this paper, which requires unnecessary assumptions. Though authors have aimed the better calculation of carbon budget in this paper than ones by computer simulation, it does not seem to be successful at this stage.

Abstract and Introduction are well written.

2 Material and methods Authors should show the uncertainty for each emission factor in Table 1. Ranges of estimation error for TGMER and BBF should be shown in Fig. 3 to 5. BCMSR also has its own uncertainty due to the errors in BC measurement, dry bulk density, and linear sedimentation rate (LSR). Authors should be also notice that, roughly speaking, TGMER and BBF are function of LSR due to its large variation. There could be more uncertainties in authors' assumption other than emission factors. In equations (1) and (2), determination of f (relative abundance of C3 plants) is essential. The f is calculated from d13C of soil organic matter by the equation (3) assuming fixed d13C end-member values of C3 and C4 plants. These end-member values could be changed from time to time. Though the f is calculated from d13C, authors directly measure or cite the d13C data only for the interval from LGM to recent. Alternatively, authors chose to calculate the d13C by the equation (an empirical relationship between d13C and GSP) described in Fig. 2. The GSP is assumed to be proportional to MAP of each location. The proportion of GSP to MAP could be changed from time to time. MAP is calculated from MS using the equation (4). This means that, for the most of the stratigraphic intervals, the d13C is just a function of MS. Authors should calculate d13C for the interval since LGM using the same method and show the comparison between the calculated value and the measured data. This might give the uncertainty of the proportion of GSP to MAP.

Error bars are also necessary for ANPP profile (Fig. 6). For calculation of ANPP, authors chose to use Thornthwaite Memorial Model to know net primary productivity with inputs of MAP and MAT. Authors used the equations (4) and (5) to calculate MAP and MAT from MS. However, their requirement of the equations (4) and (5) at the same time means that MAP and MAT have a fixed relationship as; MAP = (ln 11.18 - ln

8.8078 + 0.1908 MAT) / 0.0042 . Such a relationship could be changed from time to time. Authors also assume the fixed R/S ratio as 3.7 to calculated ANPP from the net primary productivity. However, R/S could be also changed from time to time depending on the climate (e.g. water availability). Again authors should show the relationship between calculated ANPP and measured (observed) one in the modern condition. This might give the uncertainty of the ANPP calculation.

3 Results and Interpretation It is very difficult to judge if the description here is reasonable without an evaluation of uncertainties for their calculations. But, repeatedly, authors should be careful because most of their estimation tends to be affected by (or mealy functions of) linear sedimentation rate and MS significantly. Assumptions (equations (4) and (5)) might be too strong.

4 Discussion and Conclusions It is also difficult to judge if the description here is reasonable without the examination of their methods. However, their discussion itself seems to be biased by their assumption in their method. In Page 4473 – Line 1, authors estimate the anthropogenic fire emission during late Holocene, which is comparable to the emission difference between glacial and interglacial periods. However, because authors calibrated their algorithms that relates carbon emission to climate using modern condition under anthropogenic perturbation, it might not be appropriate to use such a relationship for past carbon emission reconstruction.

In Page 4474 - Line 13, author attributed over 100% BBF/ANPP to below-ground biomass burning. However, it might be explained by the change in root / shoot ratio.

Fig. 1 No explanation for broken lines.

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