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Interactive comment on "Historical Nitrogen Fertilizer Use in Agricultural Ecosystem of the Continental United States during 1850–2015: Application rate, Timing, and Fertilizer Types" *by* Peiyu Cao et al.

Anonymous Referee #1

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Cao et al. present a comprehensive spatial dataset of historical nitrogen fertilizer use in the United States. The authors are to be commended for undertaking an ambitious project and integrating new types of data useful to the agriculture and biogeochemical modeling communities, including fertilizer type and timing of application.

While the general methodological approach makes sense, my primary critique is that the rationale for the authors' specific choices is not always clear and the methodological description is confusing in some places.

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Discussion paper

A major limitation is that it appears fertilizer use by crop is spatialized to a cropland map that is not crop-specific. This needs to be made clear, and the limitations of the resulting spatial patterns discussed. Does state or county cropland area enter into the analysis? This could lead to some substantial biases in the data product.

Paragraph at 115: There is a reference here to eq. 1 as providing the state N fertilizer use rate of each crop, but eq. 1 is only total N consumption in each state.

Paragraph at 118: It's unclear what benefit is provided by the cubic spline approach, since it shows some strange values for Maryland in Fig. 2. Why bother with two different approaches?

Paragraph at 135: The specification of these regression models is unclear from the text - please show examples using equations.

Overall, it should be clearer if and how the derived rates are (or are not) consistent with state and national consumption estimates.

Pages 5-6: Is the Agronomy Guide only used to populate Table 1, whereas the timing maps are coming from the survey? This could be clearer. Also, is it fair to say the Agronomy Guide is providing recommended timing or is this based on any survey data? The table legend should be more explicit.

Section 2.4 - Please provide more background about the historical land cover dataset, and its coverage for different land cover and crop types (see earlier comment).

Paragraph at line 216: Histograms across total land area or agricultural area could be used to show graphically the change in distribution.

Since many numbers are reported as rates over all land area, the results are not immediately accessible to those who may be interested in how cropland application rates have changed over time (although these numbers could be backed out of the dataset). I think the authors could demonstrate the richness of the dataset by highlighting a case study, e.g. maize in Iowa, and then show how the rates (per maize area) have changed

over time, the timing, and fertilizer type.

Finally, it would be helpful to show more comparisons with other N fertilizer maps, including global products which may rely upon coarser land use maps. The authors have their own map that should be compared against, for example. For this, it would be good to put the datasets on a common grid and also include difference maps.

Line 10: "essential implications" - awkward wording

Line 208: "consumptions" -> "consumption"

Line 349: "maximizing crop production" -> "maximizing profit" would be more accurate

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