

Interactive comment on “Combining livestock production information in a process based vegetation model to reconstruct the history of grassland management” by J. Chang et al.

Anonymous Referee #1

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The manuscript estimates globally the historical management intensity of grasslands. Thereby, authors use the process-based vegetation model ORCHIDEE-GM in combination with globally derived maps on livestock density, wild herbivory density, nitrogen fertilization and atmospheric nitrogen deposition, and grass-biomass use. Authors can show that largest fractions of managed grasslands occur in regions of high livestock density. A comparison of grassland productivity between managed and unmanaged grassland simulations shows that management has largest impact in regions of high N fertilizer applications. Authors further examined a global increase of 116% of managed grassland area (from 5.1×10^6 km² in 1901 to 11×10^6 km² in 2000). The topic is interesting and scientifically relevant as more research focusses on the global impact of

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land use but historical data on land use is rare. Nevertheless, the manuscript requires large improvements.

I miss a clear statement on the hypothesis or goal of this study in the introduction. While reading the manuscript, it was confusing if authors focus on global management intensity, net biome productivity (NBP) or grassland productivity (NPP). Previous studies and intentions of the study presented in this manuscript are mixed so that it is confusing which parts of this study are novel and which parts are used from previous studies. Is the presented study just an extension of the Europe-study of Chang et al. 2015a? Which challenges arise by constructing a management intensity map for the globe instead of only Europe? Are there differences in the methodology? I highly recommend (1.) providing a clear statement on the goal of this study, (2.) highlighting challenges which arise and (3.) indicating the authors' own novel contribution for achieving this goal. The results and discussion section should also be more focused, following the hypotheses or goals that should be formulated clearly in the introduction.

Besides the motivation of this study, the methods section requires large clarification in a similar way. For the model description the authors write about applications of recent model versions (v1 and v2.1) and state that they use version 3.1 of ORCHIDEE-GM. However, I would expect (especially for readers who are not familiar with ORCHIDEE and ORCHIDEE-GM) to get basic information on the model (i.e. most important modelled processes, time step, spatial scale, important input and output of the model). Concerning the model parameters in section 2.2, only 2 parameters are mentioned. Information on where to find the other parameters of the model and their values should be provided. Moreover, this paragraph occurs a second time in the supplement (which is just redundant information). The text S1 in the supplement is, however, written much better and more concise than in the main manuscript. This applies also for the other text paragraphs in the manuscript of section 2.3 and their corresponding text in the supplement. Partly, introductory information occurs in the supplementary paragraph while it is needed in the paragraph of the main manuscript. In turn, technical information

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occurs in the main manuscript which is hard to understand without reading the supplementary text first. Following sections 2.4 and 2.5, it's difficult to understand which maps provide input for ORCHIDEE-GM simulations and which maps are combined with simulation output of ORCHIDEE-GM. In total, the entire methods section needs large improvements, i.e. clear, concise and comprehensive statements in order to be able to reproduce the results of this study.

Regarding the manuscript language and style, I highly recommend to shorten the manuscript and to be more concise and precise, but still comprehensive. The entire manuscript is too long. Sentences are too long to fluently read the manuscript, some paragraphs are too technical. There are grammar and spelling mistakes. References should be double-checked (e.g., page 4, line 12). The last sentences of the abstract (page 2, lines 13-21) are confusingly written and hard to understand without reading the entire article.

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