

# Response to referee comments and suggestions on acp-2018-323 by C. Pöhlker et al.: “Land cover and its transformation in the backward trajectory footprint region of the Amazon Tall Tower Observatory”

## Manuscript format description:

Black text shows the original referee comment, red text shows the authors response, and blue text shows quoted manuscript text. We used bracketed comment numbers for referee comments (e.g., [R1.1]) and author's responses (e.g., [A1.1]). Line numbers refer to the discussion/review manuscript.

## Bart Kruijt as Referee #2

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### General comment:

Before anything else, I have to declare my lack of detailed knowledge on back-trajectory methods and large-scale meteorology, as well as knowledge on many of the topics discussed in relation to the land surface over which the trajectories pass. On the whole, this seems an extremely useful contribution to the interpretation of current and future ATTO science. It can potentially serve as a standard reference to most other publications and thus be highly cited. The methodology to establish the back trajectories seems sound and comprehensive, but again, I am not an expert on this. The manuscript provides an analysis of almost everything that happens along these trajectory paths, now and in the projected future.

Author response: We appreciate that Referee #2 considers the study “an extremely useful contribution to the interpretation of current and future ATTO science”. We further appreciate the constructive criticism that helped to improve the quality of the manuscript.

### Specific comments:

[R2.1] The paper is very (overly) long.

[A2.1] We are aware that the length of the study can be a burden for its (linear) reading. Therefore, we paid particular attention during writing to short and concise formulations throughout the entire text as well as a clear overall structure with generic subtitles for all sections. Moreover, the figures have been prepared carefully to make them appealing and informative even while browsing over the study. The figure captions are comprehensive enough to clarify key aspects of the study without reading the entire text. In particular, Sect. 3.3. has been structured in seven subsections (3.3.1 to 3.3.7) that can be read independently from each other and, thus, facilitate nonlinear reading for those readers looking for specific aspects.

In response to the referee's comment, we reworked the opening paragraph of the results and discussion part by adding a dedicated statement of the organization and structure of the text. We anticipate that this paragraph may act as a guideline, helping to make best use of this study as a resource and look-up reference. The following text section has been implemented into p. 17, l. 1:

The results and discussion part of this manuscript consists of two major parts:

- **Sections 3.1 and 3.2** summarize the large-scale geographic patterns and seasonal variability of the ATTO BT ensembles as well as their links to precipitation regimes and selected teleconnections.
- **Section 3.3** defines a BT-based footprint region of the ATTO site and relates it to the current state and anticipated future change of the covered land use mosaic.

Particularly, Sect. 3.3 is meant to be a resource and look-up reference summarizing ATTO-relevant land cover information subdivided into the following categories:

- **Sect. 3.3.1:** Climatic conditions, biomes, ecoregions and the “last of the wild”
- **Sect. 3.3.2:** Land cover
- **Sect. 3.3.3:** Deforestation and agro-industrial expansion
- **Sect. 3.3.4:** Fires
- **Sect. 3.3.5:** Infrastructure, cities, traffic and mining
- **Sect. 3.3.6:** Protected areas
- **Sect. 3.3.7:** Deforestation and climate change scenarios

All seven sections 3.3.1 to 3.3.7 begin with a concise literature synthesis section and then relate the discussion to its specific relevance for the ATTO research. Due to its length, the entire Sect. 3.3 has been structured and written in a way that facilitates non-linear reading of specific aspects of interest.

[R2.2] There are several extensive literature reviews embedded in the analysis that to my taste dig too deep into the backgrounds, which often carry whole science debates with them. E.g., where it concerns deforestation, citations refer to the impact of road building (and not everyone is convinced that roads are the main controls of deforestation); (lack of) seasonality is addressed in relation to the sometimes disputable notion that trees have very deep roots; Amazon 'die-back' is addressed as a potential future impact on the footprint properties, while this phenomenon is highly uncertain. I am sure this also holds for the other issues covered where my knowledge of the field is more limited. This carries the risk of being rather uncontrollable, hard to verify for bias. The manuscript does not set out a clear and rigorous strategy for review, so is not completely suited for the status of review paper. Also, there is no need to discuss the underlying science of these impacts in this manuscript, as it distracts from the main purpose: to serve as a reference for future ATTO science.

[A2.2] That is true. Section 3 has several literature synthesis sections embedded. The purpose of embedding those sections was not to "dig" particularly deep into ongoing "science debates", but rather to explicitly link the ATTO research to the extended body of literature on land cover observations in Amazonia. As stated in p. 4, l. 12-13: "We envision that this work may serve as a helpful resource and look-up reference for the interpretation of current and future observations in the region." We aimed to make the literature synthesis sections as concise as possible to provide the interested readers a starting point on the issues/debates along with several references for further reading. We understand that this bears a certain risk of being biased. We are convinced, however, that all our statements in the literature synthesis sections are transparently connected to the corresponding references, facilitating further in-depth literature research by the readers.

Relating to the specific aspects criticized by the referee, we modified the corresponding text sections as follows:

In p. 26, l. 28:

(iv) major highways as key drivers for forest fragmentation and degradation  
has been replaced by:  
(iv) major highways as drivers for forest fragmentation and degradation

Moreover, in p. 27, l. 35, the following statement has been added:

However, it is still being debated to what extent roads have acted as main deforestation controls.

In p. 21, l. 16, the statement:

Apparently, the increasing drought stress in the dry season is buffered by the deep-rooting trees in the moist soils and, therefore, does not (significantly) affect the NDVI (Nepstad et al., 2008).

has been modified to:

Presumably, the increasing drought stress in the dry season is buffered by the comparatively deep-rooting trees in the moist soils and, therefore, does not (significantly) affect the NDVI (Nepstad et al., 2008).

In p. 31, l. 2, the statement:

In extreme scenarios, a large-scale rain forest die-back – i.e., a climate-driven substitution of moist forests by semi-arid and/or savanna vegetation – due to changing hydrological and seasonal regimes has been predicted (e.g., Cochrane and Laurance, 2008; Nepstad et al., 2008; Cochrane and Barber, 2009).

has been modified to:

In extreme scenarios, a large-scale rain forest die-back – i.e., a climate-driven substitution of moist forests by semi-arid and/or savanna vegetation – due to changing hydrological and seasonal regimes has been predicted, although these predictions still comprise large uncertainties (e.g., Cochrane and Laurance, 2008; Nepstad et al., 2008; Cochrane and Barber, 2009).

[R2.3] I did not strictly check, but it seems to me that even in the 'summary and conclusions' new issues are brought in. I suggest the authors reduce contents here and limit themselves to merely listing potential issues affecting the trajectory, with limited key references.

[A2.3] We appreciate this comment, which we took into account to shorten and streamline the summary and conclusions section. Moreover, we counterchecked whether new aspects are brought in here and can confirm that all aspects in the summary and conclusions section have been introduced and discussed in the main text already.

[R2.4] I wonder how directly useful the presented format will be to future ATTO science. Perhaps the authors can synthesise the range of issues affecting the various classes of BT's in a more systematic way: for each class, provide a map, table or matrix quantifying the impact of the (three or five) MAIN impacts (co-ordinates, future year, impacts 1...5). This could be more readily be implemented in future analysis of ATTO results.

[A2.4] Thanks for this suggestion. In a way, we have already tried to realize what the referee seems to suggest by strictly formalizing the scope and layout of the various maps throughout the text. Particularly in Sect. 3.3, the maps summarize the key aspects of the various land cover categories in direct relation to the ATTO-relevant BT information (i.e., BT clusters being plotted in each map for reference). Wherever possible, we further extracted quantitative information, resolved by the main BT directions (see for instance Fig. 11, Fig. 14, Fig. 16, Table S1, Table S2, Fig. S4, Fig. S15, Fig. S17). Beyond that, a quantification of impacts seems difficult for certain land cover classes. Ultimately, we have not found a better strategy how to further synthesize the range of issues presented.

[R2.5] For the rest, the MS is well-written and well-documented. Figures are many, and might perhaps also be reduced somewhat, to support a more concise synthesis.

[A2.5] In the course of writing the manuscript we moved several figures into the supplement already. We feel that the figures currently shown in the main text are required to support the main observations and conclusions. In general, most of the figures (15 out of 21) are maps, which are rather self-explanatory and easy to 'digest' for the readers. Accordingly, we prefer to refrain from further reducing the number of figures in the main text.

[R2.6] I wish the authors good luck with this extremely useful endeavour.

[A2.6] Thanks a lot!