

Review of

“The Amazon Tall Tower Observatory (ATTO) in the remote Amazon Basin: Overview of first results from ecosystem ecology, meteorology, trace gas, and aerosol measurements”,

by Meinrat O. Andreae and fifty-five other authors.

Reviewed by: David R. Fitzjarrald, Atmospheric Sciences Research Center, University at Albany, SUNY

General comments.

Having labored in the Amazon rainforest environment at intervals during a period of 30 years, I can well appreciate the remarkable effort that went into the making of this facility. I have worked personally with many of the authors on other projects.

I think that too many topics and indeed, many separate potential papers or notes, were combined in this mighty one-hundred-and-twenty-seven-page manuscript. This is more than an “Overview”, but less than a proper publication for each topic. Releasing these half-results now runs the risk of preventing the original scientists from presenting their specialized work separately. This is compounded by the distinct impression this journal gives that the paper is essentially already accepted, even as it remains in some odd limbo as it awaits some correction and blessing.

One mystery about this paper it may be too soon to report on results from ATTO, since no data has been obtained from the ATTO centerpiece, the 325 m tower. Why is this paper with preliminary results coming out before the tall tower is commissioned? Why not simply describe the project, *justify* its siting, instrumentation and height, and pass lightly over both the boilerplate justification and early finding from the smaller towers?

The justifications as to why there is a need for long-term continuous measurements in the first thirteen pages are not clearly focused on the ATTO concept. The authors take side trips to explain details of the importance of the Amazon Basin to global biodiversity and climate change; these should be dealt with by references to other review articles already in the literature.

The reader deserves a more specific argument—more than generalities highlighting the importance of the Amazon Basin—that defends the idea that a 328-m tall tower be installed in such a hostile environment. It is necessary, but not sufficient to note that there are other tall towers monitoring the lower atmosphere at other parts of the world. The reader deserves to know *why* the ATTO tower was sited at this particular, relatively remote site. What is the purpose of the smaller towers around the tall one? (The local canopy data presented in this paper all come from these towers.) Why is the local topography and map of adjacent water bodies only included deep into the manuscript, as part of one finding about gravity waves? These topics need to be presented right at the beginning, so that this paper can serve its rightful purpose as a reference to papers that follow, so that this information need not be endlessly repeated.

To repeat: The authors would be well served to make a short description of the vertical structure of the atmosphere—and its diurnal variability—is presented. Such at least would allow the reader to understand *why* one has to make such a tall tower. The reader sees no reference to the successes and difficulties that have occurred at other tall tower installations (BAO, Cabauw, ZOTTO in Russia).

One important issue is the likely percentage of good turbulence data that has been obtained from tall towers in other ‘remote’ sites. This reader sees no reference to what degree the preliminary measurements have been continuous. (In the preliminary results, many findings based on 2-3 weeks of work are presented at representative.)

What this reader found here resembles a forced marriage collection of ‘white papers’ written over some time to accompany meetings planning this tower and/or (perhaps) selling the concept to funding agencies.

In short, the reader gets a heavy dose of interesting, perhaps important facts, but facts that are tangential to the issue at hand. The authors need to describe the site, explain why it was placed where it was, and what *peculiarities* it exhibits. I’m thinking of vegetation diversity, geographical diversity, and behavior of local wind systems. As one example, does proximity to the large Balbina dam and reservoir perturb any measurements? How would the authors know?

Perhaps the size of the text is merely a symptom of the enthusiasm that led to the tower’s construction, but the finds ought to be restrained a little, to avoid the *hubris* that leads to ‘monumental science’. There is not yet enough output to justify a celebration. The reader deserves to receive an overview that discusses ATTO, not an encyclopedia of everything all shoved together as it would be in a loosely gathered notebook. If the fifty-six authors want to write such a tome, they should write a book, with chapters for the sundry specialties OR they should commandeer a journal for a dedicated issue.

I hope that in revision the paper more closely resembles a reference work that allows the reader to understand why the tower was placed where it was, how the height of the tower was determined, what thinking went behind the construction of the smaller, satellite towers. I imagine that the revised paper will make a reasonable assessment of the percentage of time that continuous measurements can be achieved. Such a paper would lighten the load of the many authors who will follow and report on their new findings. The justification for the ATTO and how it came to be at this site can simply be referred to. Only some of these findings—perhaps long-term concentration measurements of trace gases and aerosols—will be relevant to the Basin as a whole; many more will be of necessity local area case studies.

Specific comments.

1. Any subsequent drafts should provide line numbers to aid the harried reviewer.

2. p. 7. “Efforts to upscale local measurements to larger scales have also lead to inconclusive and often contradictory results.” Where do the authors explain how adding a single point measurements will improve this situation?

3. p. 8. “Seen together, these studies suggest that the Amazon Basin teeters on a precarious balance...” Again, these generalizations would be interesting if they were not distracting from the mission at hand. They belong in an overview paper; perhaps they come from one.

4. p. 8. “While remote sensing can provide important information on the response of the Amazon forest to changing climate and ecological factors, the recent controversy about the effects of seasonal change and drought on the “greenness” of the forest illustrates how important long-term ground based observations are to our understanding of the Amazon system...” This is a true statement, as far as it goes. Much of this ‘green-up’ controversy has to do with the situation further east in the Basin, where the dry season is more intense and prolonged. The authors are ‘selling’ the utility of a tall tower in the central Basin. They are justifying it in much the same way as one would justify having a much smaller tower, of the type that is in use in this region already. What they need to do is emphasize the scientific riches that are in store for those who have long-term observations at 325 meters, about one fourth of the thickness of the daytime convective boundary layer.

5. p. 15. Suggested changes to the objectives, all designed to rein in hyperbole:

- 1) To understand the carbon budget of *one specific site* in the Amazonian rain forest under changing climate conditions and anthropogenic influences.
- 2) To continuously observe anthropogenic and biogenic greenhouse gases in the lower troposphere, *within the planetary boundary layer by day and outside it at night, in order* to help constrain inverse methods for deriving continental source and sink strengths and their changes over time.
- 3) To continuously measure trace gases and aerosols for improvement of our understanding of atmospheric chemistry and physics in the Amazon and further allow a continuous assessment of the effects of land use change *that occur upwind of ATTO* on the atmosphere and climate.
- 4) To simultaneously measure anthropogenic and biogenic trace gases, contributing to our understanding of natural and anthropogenic effects on the atmosphere and climate. Measurements of isotopic composition will be made to help distinguish anthropogenic~~ally~~ and biologically induced fluxes.
- 5) To investigate key atmospheric processes, with emphasis on the atmospheric oxidant cycle, the trace gas exchange between forest and atmosphere, and the life cycle of the Amazonian aerosol.
- 6) To determine vertical trace gas and aerosol gradients from the tower top to the ground to estimate biosphere-atmosphere exchange rates.
- 7) To study turbulence and transport processes in the *lower* atmospheric boundary layer, as well as to understand the extent and characteristics of the roughness sublayer over the forest.
- 8) To develop and validate dynamic vegetation models, atmospheric boundary layer models, and inverse models for the description of heat, moisture, aerosol, and trace gas fluxes.
- 9) *To provide single-point ground truth* to help evaluate satellite estimates of greenhouse gas concentrations and temperature and humidity profiles

6. p. 20. Are raw turbulence and trace gas data archived? Will these be available to the community?

7. p. 31. “The variation of the wind roses between daytime and nighttime was insignificant.” This reader doesn’t believe this. Please present hourly hodographs to show possible breeze influences.

8. p. 32. (Figure 6) I don't see that the vertical spacing of temperature sensors is adequate to describe the stability regimes within the canopy. One cannot properly resolve the stability at canopy top and near the forest floor with the observation levels shown. How will this be addressed in the long term?

9. p. 40. Text following: "*Figure 15a shows a topographic image of the experimental site with colors ranging from blue to red representing the altimetry values in meters above sea level.*" It turns out that the forest floor topography has an important influence on the CO₂ balance, at length scales well smaller than 30 km, as the work of co-author Julio Tóta has shown. Somewhere in the site description this information should show up. Indeed, one shouldn't have to wait until p. 40 to learn of this site peculiarity.