

In this paper, authors present measured ambient PM, BC, CO, and O₃ concentrations in Lumbini during an intensive measurement campaign from April – June, 2013. They also conducted a regional WRF-STEM modeling to simulate the meteorology and air pollutant concentrations, as well as to examine the aerosol chemical composition. The authors conclude that there is high pollution in Lumbini and that a network of long-term air quality monitoring stations is needed in the greater Lumbini region. I agree with the authors that it is important to collect observational data in this area and the set of observations presented in the paper is extremely useful for understanding the magnitude of the air pollution problem and the potential sources. However, the language is very vague and the scientific discussion is limited. I find that improvements are essential before the manuscript can be published in ACP. I list some of the concerns below.

I am unsure if what we are most interested in is the comparison of Lumbini measurements with those of other cities. For example, they state that “BC observed at Lumbini was higher by a factor of ~6 and ~4.5 compared to that at Mt. Abu, India and near the base of Mt. Everest, Nepal, respectively (l. 323-326)” but how do we know what to make of these comparisons. What do we learn from these comparisons? To me, it is logical that Lumbini has higher BC concentrations compared to those remote places. Similarly, I do not find interesting that the ozone concentrations were higher at Lumbini than in the Mt. Everest (l. 332). I would rather be more interested to know how the monthly concentrations change and when the highest and lowest concentration levels were and if there was any difference in the three months or over time among the species. Also, examining the period when the model is able to reproduce observations and contrasting that to the times when the model fails would be a good way to make use of both measurements and the model. Such assessment should also provide a good basis for what needs to be improved in the model. I find the argument that the authors put forward on l. 261-262 that the “[D]iscrepancy on model results might have occurred due to various factors inherently uncertain in a weather model” to be hand-waving and not really helpful. With this data set, they should be able to understand the discrepancy between the model and the observations a little better.

Why is PM₁ concentration not discussed in the study (l. 282-283)? If it is discussed elsewhere, please mention it. If there was a problem with the data, then I think this should not be included in this manuscript at all. If there was no problem with the data, I think that can provide an additional insight into the measurements and is worth exploring more than just the average concentrations mentioned in l. 281.

I am quite confused about WRF-STEM model simulations. Authors state: “A comparison of model calculated average concentration along with the minimum and maximum concentrations of various pollutants (with observation) is shown in Table 3 (l. 340-342).” However, right after this sentence, they write that “[T]he model based concentrations used here are instantaneous values for every third hour of the day (l. 342-343).” Can authors clarify which one that is and if the latter, why did they use the instantaneous values?

There are many places where authors state in a very qualitative manner, which obviously is not helpful for the reader to understand the issues being discussed. I list some of the sentences here:

1. l. 298-299 “BC to CO ratio in Lumbini was found to be different from that observed at other urban and rural sites and those affected by forest fire/biomass burning.” What was the ratio observed at Lumbini and at other places? What can we infer from this? What is the criterion for “different”?
2. l. 299-302 “a suburban site, Pantnagar, in IGP also observed similar BC to CO ratio.” What value is considered “similar” and how is that determined? What do we learn from this?
3. l. 318-321 “PM_{2.5} concentration in Lumbini have been found to be lower than the megacity like Delhi and north-western IGP regions due to higher level of emissions over those regions.” How did they come up with this conclusion? I do not see any comparison of emissions, especially at the sector level. Also, I understood that changing emissions in Lumbini and surrounding regions did not lead to a large concentration difference in the model when they conducted a sensitivity analysis (l. 474-488). Doesn't this conflict with what is argued here?
4. l. 321-323 “BC concentrations observed in Lumbini during pre-monsoon season was lower than the urban Asian cities like Kathmandu and Delhi, slightly higher than in Kanpur but high compared to the remote locations in the region.” Are the authors comparing the measurements during the same period between cities? What does “slightly higher” and “high” mean? What is the definition of these? More importantly, what do we learn from this?
5. l. 355-359 “STEM model performance can be significantly improved via better constraining anthropogenic emissions inventory, emissions of open biomass burning and improvements in meteorological output from WRF amongst many other uncertainties inherent in regional chemical transport model.” How did they get to this conclusion?
6. l. 526-529 “The curve during the prime cooking time is much close to the biomass curve of published data whereas that during non-cooking time is inclined towards the fossil fuel curve.” How is “much close” determined, as well as “inclined”?

For the two events when authors found an elevated BC and CO concentrations, what were the PM and O₃ levels? Did they find an elevated PM on any other days? Did they find an elevated potassium level during those days? I think that focusing on the analysis of these two events and clearly explaining the details of the regional contribution assessment presented in the manuscript would definitely strengthen the paper. The regional contribution assessment could be also extended by quantifying the monthly differences and also considering other species. This then could be linked to the chemical composition to assess if the regional contribution has anything to do with the chemical composition difference that they can potentially see in different months.

Minor comments:

1. rain guage → rain gauge (l. 239)
2. I'm not sure if the authors really meant the way they wrote the sentence: "But, to our expectation, we could not observe any significant influence of forest fires within the specified grid (l. 419-420)." Did the authors really expect that they would not be able to observe influence? Or is this a typo?
3. Others region → other regions (l. 469)