

Interactive comment on “Distribution and Sources of Air pollutants in the North China Plain Based on On-Road Mobile Measurements” by Yi Zhu et al.

Anonymous Referee #2

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Y. Zhu et al., Distribution and sources of air pollutants in the North China Plain based on on-road mobile measurements, for ACP

The authors have conducted five campaigns (plus an earlier pre-test) along identical routes across the North China Plain (NCP) and measured NO_x, CO, SO₂, ultrafine particles and black carbon on a mobile laboratory. The route covered a nice perimeter of the NCP and at least two roughly east-west transects. The mobile sampling was conducted on expressways from 0900-1400 each day. The authors discuss the observations in the context of wind/trajectories (e.g. from cleaner regions such as the mountains or sea). Overall, the manuscript is well-written.

My concern with this manuscript is that the analyses of the measurements, by the very nature of mobile laboratory measurements without supporting other measurements

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such as aircraft, ground-based networks, satellite, etc., are quite limited. Specific comments:

1. Most seriously, I have concerns about the representativeness of the dataset, given that the measurements were only on expressways. Just because vehicle emissions aren't major sources in the regional inventory, they are very important when sampling in the aggregate exhausts of other vehicles. Therefore, arguments stating that they are small regionally do not hold for these measurements. Indeed, the NO_x values are argued as being influenced by vehicles – why wouldn't SO₂, CO, and black carbon be impacted? CO has a two month lifetime on average, yet measurements of CO on a highway are typically much higher than, say, at a park 1 km away. It is the enhancements above the regional background that matter, and trying to separate local (road) vs. regional background measurements is not clear without extensive, other data. Did the authors drive off-expressway to examine how their measurements changed when off-expressway and (ideally) away from other vehicles (parks)? How much traffic was around the mobile laboratory? Were higher concentrations reported while in traffic jams (surrounded by cars)? The extent to which the mobile vehicle measures “expressway” versus more “regional background” levels will vary depending on the traffic density, winds, and stability. Consider the two extreme cases: 1) on a road with no other vehicles, the mobile lab will measure the regional background; 2) while stuck in traffic in a multi-lane city expressway, the measurements are clearly just vehicle emissions. How this measurement footprint changes versus location/day/traffic/wind is difficult to quantify without more measurements (see comment 3 below for more details). WFR-CHEM or FLEXPART can't model at roadway scales, of course, so there has to be some criteria applied to assess such influences. On p. 7, it is stated that traffic jams were avoided – this is rather ambiguous. How was this defined? In all this driving, there was never a traffic jam?

2. A large number of values are reported, and too often this reads as a “data dump” with little insight besides vague generalizations. Tables comparing select case studies

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may be helpful, particularly highlighting the different spatiotemporal domains of the comparisons.

3. Some comparisons to ground-based sites were noted (also to literature), but even these were rather trivial and limited. Comparing a transect along a nearby road to a nearby stationary site (e.g. “YC” in text), it is unclear if the mobile laboratory stopped there for a certain length of time or if it just passed by the site as part of the drive. How close to the site was the vehicle located and for what time domain for the comparisons listed (e.g. Fig. 2, p15, lines 300-310, etc.)? By knowing the mean wind, one should be able to link space-time scales at some level. Instead, just a date is given – did the authors integrate for the entire day for both measurements? Given the contamination / variable contribution of vehicle exhaust in their data set, quantifying agreement is fraught with uncertainties.

4. As the manuscript noted, concentrations are impacted by wind direction (source regions upstream), local sources (which are never really specified – just stating “urban” area), location (e.g. in the central region wind direction plays less of an influence than at the margins) and boundary layer height (e.g. p. 21, line 421-425). It is hard to interpret the variations observed in Fig. 2 – which are caused by which of the above factors and which ones dominate (and when)? Reasonable examples are provided in the following text of all of the above, but in the end, I have difficulty interpreting the importance of each of these processes in the full dataset.

Other: - Experimental methods: what are the precisions and uncertainties in the measurements (e.g. NO_x precision; CO precision and accuracy; SO₂ precision and accuracy; BC same thing), only NO_x had an uncertainty noted (but no precision). Did the laboratory studies/calibrations done on non-driving days agree or disagree with stated manufacture specifications?

- To what extent was the data coverage for the 5 campaigns? 100%? Rain is mentioned on p. 8, line 152 – what about other data dropouts (if they existed)?

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- p. 12, “low levels of SO₂”: 10 ppbv SO₂ is not low, perhaps compared to the past in China. But I’m not sure how this mobile lab study over a very limited time/space can verify that SO₂ has decreased and confirmed policy desulphurization devices. No comparison to past SO₂ measurements in these locations is noted, so this seems unsubstantiated from this study.

- Some data should be made available to the community on a website, not “on request”, given the political sensitivity of Chinese air pollution data. What metadata will be provided, e.g. GPS, vehicle information (speed), met data, etc.?

- I like the FLEXPART trajectory attribution, but again this is a qualitative comparison as the upwind values were not measured. So while it makes sense that northerly winds off the mountains will decrease values nearby, I don’t think this was particularly profound.

Overall: The limitations of mobile laboratory deployments by themselves are apparent in this study. Unless the authors can address some the ambiguities noted above in a quantitative way (or refocus onto vehicle emissions, or restrict data analyses/measurements to certain conditions that are representative of regional backgrounds), I’m struggling to see how this study adds significantly to the literature in a journal such as ACP.

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