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Interactive comment on "Non-agricultural ammonia emissions in urban China" *by* Y. H. Chang

Anonymous Referee #2

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Ammonia, a gas that is rather difficult to measure at atmospheric concentrations, is a compound of considerable interest. Contributing to the formation of particles and in this way able to travel long distances, it is part of health relevant PM2.5 but also a factor for eutrophication and acidification (after nitrification in soil converts ammonia to nitrate). Ammonia has received too little attention in the past, studying this compound in more detail will be important to meet the challenges of adverse air quality especially in areas where huge exceedance of thresholds is being observed.

This is what, in parts, Y.H. Chang is providing in the manuscript discussed in this review. This author claims that ammonia emissions from urban areas have so far been neglected, and that these very emissions contribute more to urban PM than agricultural emissions in China. These are important claims – are these claims justified?

The author uses series of measurements from Europe and the U.S. (one from China) that indicate elevated ammonia concentrations in the urban atmosphere which thus cannot be attributed to rural (agricultural) sources. Based on U.S. and European emission factors, Chinese statistical information on 113 cities is used to estimate non-agricultural emissions. This assessment is neither comprehensive (these 113 cities comprise about one sixth of the Chinese population, or maybe one fifth of total population when considering non-registered city dwellers) nor complete (industrial ammonia emissions are not included, which e.g. in European reports as in http://www.eea.europa.eu/data-and-maps/indicators/eea-32-ammonia-nh3-emissions-1/assessment-4 account for a sizable fraction of the non-agricultural ammonia sources).

Especially for the thematic maps shown, it becomes clear that a considerable amount of information is available, worth to be published despite of the shortcomings of applying European/U.S. emission factors (except for waste) to somewhat unclear Chinese activity data. However, data analysis could be done in a more elaborate way in order to provide a service of first level data interpretation to a reader. The current way of presentation is not too helpful, as it does not allow to identify/separate clusters of different conditions. Such clusters could be identified by presenting emission density (emissions per area – yes using the "municipal area" is the approach to take here) or specific emission (by inhabitant). It would quickly become apparent that one class of emissions is more or less strictly accounted to population, another one to energy (possibly this becomes more prevalent in the north of the country) and a third to transport. Waste emissions, due to the way they are assessed, possibly go closer to population numbers than to climate – which probably is unrealistic, but I do not see a temperature/wetness factor considered here.

Altogether, rendering the data presented useful for a reader will be needed for a revised version of the paper. This should include a statement on industrial emissions, an order-of-magnitude extrapolation to the whole Chinese population (note a considerable

amount of the emission factors used is population oriented anyway) and a comparison to existing emission estimates from agriculture (here just singling out those very urban provinces Beijing and Shanghai is just misleading – Table 3) – the idea being not to extend the scope of the study, but to put the study results into the right perspective.

With respect to the claim that urban NH3 would contribute stronger to urban pollution than agricultural ammonia, this would require atmospheric modelling (chemical transport modelling or receptor modelling) using Chinese data. I do not see any of this here. If the author wishes to keep the argument for the introduction, it needs to be substantiated and clearly referred to other scientific literature (then obviously referring to other world regions, like Europe).

Potential errors:

*) industrial emissions are not presented;

*) it is unclear how migrant workers and other non-registered population are considered – are there considered at all? Are they considered to reside in cities year-round or only for specific periods? How are infants of migrant workers accounted for in the birth rates?

*) Are transport emissions estimated from provincial level car registrations? Or from province-operated datasets compiling registration numbers for the respective cities? Are cars driven inside city limits only?

*) Waste treatment: section discusses only waste water, which seems to be just the minor share compared to landfills

*) green urban area: Probably the statement that the 'favourable climate' of southern China fosters NH3 emissions from green areas is not substantiated – the effects shown here may just reflect larger areas for this land use type in the cities mentioned. Considering the potential overall size of golf courses (using the estimated numbers presented this might be 250 km^2 - compared to 12500 km^2 green urban area covered over the

113 cities) seems quite irrelevant even if emission density were much higher, and thus not worth being discussed

*) Maps (figures 2, 3) are misleading: polygons do not at all reflect the 'municipal area' used to assess emission intensities. Moreover, as long as the spatial significance is not explained to the reader, these maps are rather meaningless.

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