

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2020-1307

Anonymous Referee #2

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Referee comment on "Opinion: Gigacity – a source of problems or the new way to sustainable development" by Markku Kulmala et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1307-RC2>, 2021

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The authors proposed a novel concept of gigacity, explains its great importance on regional air quality and global climate, and propose a large-scale research and innovation program to investigate its impact and the underlying mechanism. This is an important and very timely initiative and the answer to this question could be crucial for future planning of urbanization towards sustainable development.

Gigacity is a nice concept and the authors have taken the eastern part of China as an example. It would be helpful if the authors could also explicitly define what is a gigacity in analogy to a megacity. Then people can tell if there is any other region falls into this category, e.g., eastern US, Europe, Indo-Gangetic Plain?

The authors have emphasized the importance of high-resolution modeling (10 meters) in forecasting air quality and suggests expanding this into a gigacity scale (100 km to more than 1000 km). But is 10 meters really necessary? According to the citations of Huang et al. (2020a and 2020b), where spatial resolution of a few tens of km has been adopted, I guess the authors mean 10 km here? If yes, I don't think that the resolution is really the limiting factor here in order to study the interactions and links in a gigacity scale. But on the other hand, to study the impact of gigacity within itself and on global climate, a direct application of the Earth System modeling would be the future. There how to increase the spatial resolution of Earth System models and reduce its dependence on sub-grid parameterization can be very challenging.

For the challenges specific for the gigacity, the authors may want to point out what questions have already been solved and what are the remaining open questions. For example, the current regional and global models have already the capacity to simulate the Urban Heat Island effects in the gigacity scale. Maybe not perfect, but what would be processes and mechanisms that need to be improved or added there for the applications in a gigacity scale? Similar questions also apply to the aerosol-radiation-cloud interactions and other links.

For the proposed research program, the authors may want to further explain how it would differ from previous/current research programs on air quality studies in megacity or at a regional scale. For example, for the observation network, does it only differ by the number/density of stations?

“Since this gigacity has roughly 50 times more people and 60 times larger surface area than Beijing – a typical megacity – its future is crucial not only for local people but also globally. The area is a huge emitter of greenhouse gases and air pollution as well as a potential source for local, regional and global epidemiological diseases.” Due to the high population density, the region or rather the cities there might become potential hotspot, but not necessarily the source for local, regional and global epidemiological diseases. In view of the few cases and efficient control of COVID-19 in the region, as well as the significant improvement of the air quality there in recent years, I would like to second and add on to the statement from the other reviewer that the haze and/or the spread of an epidemic are not an inevitable consequence of the gigacity, although such extensive urbanisation and industrialisation makes the control challenge inevitably greater.

Minor:

“with increasing risks of cardiovascular diseases and diabetes, violence and injuries, outbreaks of infectious disease, like the current pandemic of COVID-19 (Huang et al., 2020a; Tian et al., 2020), and inequity between people living in urban areas.” The reference Huang et al., 2020a is not supporting the statement about increasing risks of diseases.

“It is already well known that reduced concentrations of nitrogen oxides will, under otherwise polluted conditions, increase ozone production and increase secondary aerosol particle concentrations (Ding et al., 2013, Liu and Tang, 2020).” Many studies show that reducing NO<sub>x</sub> will lead to a reduction of PM.

“If suitable observations are lacking, the option is to run the models using reanalysis data.” Observations are also needed to produce the reanalysis data. The authors may want to explain a bit more on this.

“We need to continuously harvest data (Kulmala, 2018), even if we do not yet know for sure that we need it.” This sentence should be reformulated. It sounds like we still need to do some measurements without a motivation, but I guess the authors does not mean that.