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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Assessment of China's virtual air pollution transport embodied in trade by a consumption-based emission inventory" *by* H. Y. Zhao et al.

Anonymous Referee #2

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GENERAL COMMENTS:

The manuscript presents a well-designed analysis of questions related to Chinese pollution intensity, as it captures the reader's attention from the introduction. The description of the environmental situation in China, linked to its social and economic consequences, is a perfect starting point when we talk about the Asian giant. The paper provides the scientific community with more evidences, for a better and deeper analysis about the reasons behind the rise of China as the biggest pollutant in recent years. It is easy to identify similar papers that try to contribute to this open debate. In this sense, and as a researcher in the study of international responsibility criteria (producer,

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consumer or shared), I regard the proposal by the authors as very interesting. The questions tackled in the paper can be likened to some of the consequences of developed countries signing of the Kyoto Protocol for emerging economies like, for example, China. This paper presents the global Chinese environmental situation, understood as the increase in global emissions due to the presence of highly pollutant production processes in emerging regions (rather than countries) inside China. Rich regions (such as the coastal areas) could represent those developed countries that have implemented more and more restricted environmental and energy policies in recent years. Those regions/countries, by means of offshoring processes to other regions/countries with weaker environmental policies, have avoided territorial or producer responsibility for emissions (as accounted under the Kyoto Protocol), but have caused, supposedly, an increase of Chinese/global emissions. From my point of view, the identification of the question, the relation to social and economic costs, and the characterization of some policy implications, are the most interesting contributions of the paper. The model proposed is not new, as the consumption-based approach in a MRIO framework is a well-recognized model. However, the selection of the air pollutants and the detailed analysis of the Chinese interregional trade relationships, also provides the scientific community with useful tools and evidences. In this sense, I would say that the paper could had been a little bit more ambitious, once the scope is presented and the implications and objectives are defined. Some of these ideas are commented in the next section.

SPECIFIC COMMENTS:

There is a vast literature analysing very similar topics for the case of China. In this line, I miss much more connections to related literature, not in order to expand the paper to unsuspected limits, but only to connect and relate it to the scientific frontier on the topic. In the next lines I will provide some possible extensions/connections that come to my mind:

- Related to the allocation criterion chosen in this paper (the consumption-based per-

ACPD
14, C8894–C8898, 2014

spective): It would have been interesting to prove or, at the very least, to cite the implications of the implementation of other criteria based on sharing emissions between agents. The application of a shared responsibility criterion like the one proposed by Lenzen and Gallego (2005), Cadarso et al. (2012) or Hoekstra and Wiedmann (2014) could help northern and central Chinese regions to assume the increase of costs derived from mitigation policies. Sharing emissions between agents participating in the pollutant activity could contribute to a better solution of the problem as producers and consumers are both involved in emissions reduction.

- Eco-Labels: The introduction of an Eco-Labelling system could be another alternative, looking for incentives to improve the efficiency of both existing and new technologies not only from the perspective of technology transfer, but also involving consumers and their decisions. In this case, the consideration of global production chains implies some limitations. O'Rourke (2014) highlights some of them: limitations on sustainability measurements of the supply chains, limitations of data supplied to decisions-makers (consistent and proved models) or disincentives for firms to pay the full costs of supply chains (key limitation). The third point is the most relevant as firms are the agents that decide to outsource their production chains. The implication of firms assuming their share of responsibility is needed, following the line presented in Skelton (2014), already quoted by the authors, or in the control criterion proposed by López et al. (2014).

- Emissions Trading Scheme: Another potential improvement for the paper could have been to take into account or at least cite the Chinese Emissions Trading Scheme (ETS), similar to the European Union Trading System, that is currently under evaluation in China (Guan et al. 2014). Like Barrett et al. (2014) suggest, and given the consumer orientation of the paper, the future evaluation of this ETS under the consumer perspective could be interesting.

- Technology transfer: From my point of view, the technology transfer is not the only option that can contribute to solve the problem. The establishment by policy makers of

ACPD
14, C8894–C8898, 2014

some limitations to specific new installations which exceed a fixed benchmarking could also be part of the solution. There are some examples for the European Union. The case of the restriction to the use of coal in electricity generation in Spain and some European Union countries is an example (Zafrilla 2014).

- Taxes: Another interesting solution or alternative could be the transfer of environmental impacts to consumers via environmental taxation. Consumers can guide the economy to a sustainable path changing their consumption patterns. In the case of one country (China), it is possible to highlight some advantages of the establishment of those taxes for international trade. Trade wars are not possible between regions after the implementation of the tax. And there is no risk of carbon leakage as only one government designs, collects and redistributes the environmental tax.

- Pollution haven hypothesis: After reading the paper, the reader could conclude that the pollution haven hypothesis (PHH) exists among Chinese regions due to the differences between their pollution intensities. Nevertheless, and following Zhang et al. (2014), this evidence is not proved for CO2 emissions; in fact, they find the opposite. The estimation of the Balance of Avoided Emissions (BAE) shows an almost negligible positive figure (PHH) for the electricity sector. For the whole economy, the sign of the BAE is negative, as a consequence of the industrial relocation to inland provinces. This result shows that there are not relevant differences in pollution structures between Chinese regions. The relocation of parts of the production chains does not imply an increase in emissions. Understanding this, the most interesting conclusion of this paper should be the evaluation of how location, concentration and subsequent atmospheric transportation of pollutant particulates affect health. A potential extension using an Atmospheric Chemical Transport model would improve the usefulness of the paper.

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ACPD

14, C8894–C8898, 2014

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