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Interactive comment on "Estimations of anthropogenic dust emissions at global scale from 2007 to 2010" *by* Siyu Chen et al.

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This paper is touching an ongoing effort in the dust modeling community to better characterize the anthropogenic part of dust emission. I want to address some major issues with their methodology as well as incorrect statements.

Human activities may contribute directly to dust emission through traffic, off-road vehicles, construction or some industry such as cement factory. They can also disturb soils due to agricultural practice or overgrazing. In a study published in 2012 in Reviews of Geophysics with my co-authors we estimated dust emission from agriculture based on MODIS Deep Blue satellite products at 0.1o resolution. The present study is pretty much following our methodology but with different input datasets.

As their datasets have different grid resolution and they did not describe which grid is considered for the final product, I have to assume that the values they reported are on the coarser grid or 1ox1o. In our 2012 work, we showed that major uncertainties arise from selecting the threshold of wind erosion, and to a lesser extend to the minimum fraction of land use required to attribute an anthropogenic origin. This last uncertainty is much more critical in the present study due to their coarser (100 times) resolution. The first uncertainty is brushed aside in the present study, as they used a fixed value globally and for all surface conditions without providing any justification or making sensitivity study.

Concerning the formulation of the direct anthropogenic emission, the authors propose without justification an empirical economical formula, which depends on population density, urbanization, and economic development. How dust emission from traffic, construction or cement factory is related to these factors are not justified or explained. On the other hand, there is a long list of studies related to in-situ measurements, and modeling of dust generated by traffic on paved and unpaved roadways. They only need to type "dust traffic" with Google Scholar to get more than 60k results.

I found a few statements which are unfounded and incorrect:

1. "Ground observations can not capture the anthropogenic dust emission well because observed dust loading is a mixture of natural dust and anthropogenic dust." (Lines 123 to 125). This is incorrect. Ginoux et al. (Atm. Chem. Phys., 2012) showed that anthropogenic dust from agriculture is often mixed with ammonia and has a distinctive optical signature observed with AERONET sunphotometers.

2. "However, their retrieval method was only applicable over bright surfaces . . ." (lines 130-131). This is incorrect. MODIS Deep Blue aerosol products used by Ginoux et al (Rev. Geophys. 2012) are provided daily globally (except for gaps between orbits in equatorial regions) over land except over snow, under clouds, and during radiometric calibration.

3. "... and was unable to properly exclude natural dust aerosols..." This is incorrect as shown by Ginoux et al. (Atm. Chem. Phys., 2012) where they collocated dust and NH3 plumes over agricultural areas using 2 distinct satellite instruments.

4. "Observations have shown that anthropogenic dust mass loading is stronger than natural dust loading in densely populated regions with a high level of human activity." (Lines 161 and 162). I am unaware of any data showing such results. To the contrary, AERONET sunphotometer data don't show any increasing trend of coarse mode optical depth over big cities but surely an increase of fine mode aerosol optical depth.

5. "For example, anthropogenic dusts accounts for more than 91.8% and 76.1% of the total dust loading in east China and India, respectively (Huang et.al., 2015)." (Lines 163 to 165). If I understand this correctly, it means that the Taklimakan and Mongolian deserts are negligible source of dust. This goes against common knowledge.

6. "To isolate the role of meteorology from the land surface effects, Marsham et al. (2011) simplified the dust emission scheme developed by Marticorena and Bergametti (1995). The scheme neglected differences from using wind speed at 10 m rather than at threshold velocity (Marsham et al., 2011). Instead, they substituted the threshold wind velocity by a constant of 7 m s$-$1. Although this approach neglected the second-order effects of stability and roughness, it is a simple and easy method to better quantify the effects of meteorology on dust emissions at global scale over long time periods (Cakmur et al., 2004)." (Lines 189 to 196). These 3 sentences are really unclear, but if I understand correctly they suggest using a constant threshold of wind erosion because atmospheric stability as well as surface roughness can be neglected. This contradicts what they formulate above, that is to say to include vegetation changes as key parameter. Vegetation cover is the main roughness element on the surface.

7. "Therefore we used the simplified dust emission scheme by Marticorena and Bergametti (1995)..." (Lines 201-202). I got quite confused here as Marticorena and Bergametti (1995) have developed one of the most sophisticated schemes.

8. "Here, we chose ut = 6.5 m s$-$1 according to Tegen et al. (2004) because human disturbances make the soil more susceptible to erosion." (Lines 211 to 213). This is incorrect. Tegen and co-authors used 6.5 m/s for undisturbed soils but scaled it down for disturbed soils.

9. "..high vales of soil moisture were excluded" (line 270). What do you consider a high value for soil moisture? Where did you get such fields? Same for snow cover, where did you get the fields and what maximum value did you use?

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