

***Interactive comment on* “Effect of ecological restoration programs on dust pollution in North China Plain: a case study” by Xin Long et al.**

Anonymous Referee #2

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Effect of ecological restoration programs on dust pollution in North China Plain, China by Xin Long, Xuexi Tie, Guohui Li, Junji Cao, Tian Feng, Li Xeng, and Zhisheng An, submitted for publication in Atmos. Chem. Physics.

The effect of the Ecological Restoration Programs initiated by the Chinese government at reducing air pollution has been analyzed using the regional WRF-DUST model. This is an interesting subject, which is worth publication in Atm. Chem. Phys. A dust episode is first simulated to evaluate the model performances. Then, two experiments are performed each one corresponding to distinct periods of the restoration programs. Their idea is to assess any effect of these programs at reducing suspended dust. Their simulations indicate indeed a sharp decrease of dust, which is quite remarkable. Unfortunately, the authors stops there, and did not explain the physical reasons beyond it.

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So, more work is needed here.

An apparent detail but in fact misleading the reader is the tendency of the authors to place dust in the category of pollutants. Dust being produced mechanically by wind erosion (neglecting dust emitted from construction, agriculture, or off-road vehicles) it does not belong to the category of pollutants, which are anthropogenically produced. The manuscript needs a major revision to improve its clarity because poor English. Hopefully my long hours at making suggestions to improve it will help.

In summary, the paper needs major improvements before being publishable but is a potentially interesting paper.

Detailed comments

Line 51: “have wide impacts on the Earth’s radiative forcing budget” => “influence the Earth’s radiative budget”
Line 51: replace “Liao et al., 2005” reference by the more appropriate “Miller and Tegen, 1998”

Line 55: “Distinguished from . . .(Moulin et al., 1997)”. It depends which period you look at. From 1980 to 2009, there has been a “decreasing dust trend in the tropical North Atlantic is most closely associated with the decrease of Sahel dust emission and increase of precipitation over the tropical North Atlantic, likely driven by the sea surface temperature increase.” (Chin et al., 2014). If you look at longer period of Barbados data, you will notice a decrease since 2000.

Line 60: “. . . and beyond North America to Europe (Grousset et al., 2003)”

Line 61: “There are two dominant source regions of East Asian dust storms locate in China”=> “There are two major sources of dust in China”

Line 63: You may want also to mention dust sources from desertification, agricultural practices (Ginoux et al., 2012), and construction (Long et al., 2016).

Lines 63-65: Remove this sentence as you already mentioned dust influence on air

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quality (Line 53).

Line 66: “dust pollution” is not really adequate. Dust is essentially produced mechanically by wind erosion, which have for the most part not been disturbed by human activities. On the other hand, precursors of pollutants are emitted by human activities.

Line 70: When did the “Green Wall of China” started?

Line 74: “However...ERPs.” Unclear. Reformulate.

Lines 86-88 should be moved at the beginning of the Introduction, and check for repetition of dust impacts.

Lines 89-90: Unclear and seems unrelated to the present work

Lines 91-92: Unclear, reformulate. Do you mean?: “Few studies have been so far dedicated to estimate the effectiveness of ERPs in controlling dust erosion”

Line 93 “in regional scale” => “on regional scale” Lines 91-103: To help posing the problem more clearly I suggest starting the paragraph with a sentence like “One of the main difficulty in evaluating the effectiveness of ERPs is to separate vegetation change by ERPs from other factors, including climate change or CO₂ fertilization.”

Line 105: remove “first-hand sources”

Line 106: “WRF-DUST model” => “regional WRF-DUST model”.

Line 107: “MODIS land cover”. You may want to justify your choice by referring to Wu et al. (2008) in section 2.2

Line 110: “We selected two regions..” It took me a while to figure where were these 2 regions in Figure 1. It would greatly help to use two different colors to differentiate them.

Line 120: “has commenced” => “started”

Line 125: “detailed”=> “speciation of”

Line 127: “utilized” => “used”

Line 129: “model” => “mode”

Line 130: “can effectively decrease the uncertainty of anthropogenic fine particulate matter” => “is an efficient way to avoid contribution from anthropogenic fine mode particles”

Line 133: “research domain” => ROIs

Line 135: “the most measurement sites (. . .) locate” => “most measurements sites (. . .) are located”

Line 137: “provides a good opportunity. . . evolution” => “provides sufficient spatial coverage to follow the evolution of dust plumes”

Line 145: Add a few words about the evaluation of different land cover datasets over China by Wu et al. (2008).

Line 154: “mosaicked” => “mosaic”

Line 156: “We conducted the geospatial processing..” => “We processed MCD12Q1 data to fit with WRF-CHEM resolution”

Line 158-174: These are too technical, and not helpful for our understanding. Remove or move it too supplemental material. On the other hand, it would be informative to justify the use of a linear relationship between LUF and dust emission relative to previous studies. Some studies have also used linear relationship (e.g. Werner et al., 2003), but other chosen instead an exponential dependency (e.g. Evans et al., 2016), or threshold (Kim et al., 2010).

Line 175: “WRF-DUST model and configuration” => “Model description”

Section 2.3: You should mention if in the model interactions of dust particles with radiation and cloud microphysics are included, and what are the optical properties used.

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We need to know if you are using strongly absorbing or scattering dust optical property, as it will affect the hydrological cycle and subsequently dust deposition. More fundamentally, you need to let the reader know if feedbacks are possible but have not been analyzed in the present study.

Section 2.3: It should describe the base case and the experiments (before and during the ERPs)

Line 179: “Chin et al., 2000” => The description of GOCART is by Chin et al. (2002) and dust scheme by “Ginoux et al., 2001”

Lines 195-198: “Because the dust emissions are strongly dependent on different categories of land cover, to better . . . category.” => Split into 3 sentences. To help you: “Dust emission depends on surface properties, such as vegetation cover and soil types, such that we include a dependency on land cover in the emission scheme (Eq. 2).”

Line 200 Eq 3: I don’t understand this. First E should have an index k. Secondly, what will happen if within one grid box you have multiple land cover types. You should have a sum over all land covers. You should include the values of E_k in a Table.

Line 206: “The WRF-DUST model adopts one grid with horizontal resolution of 9 km”=>”The domain centered at (112E, 41 N) is composed horizontally of 500 by 300 grid points spaced with a resolution of 9 km, and vertically. . .”

Line 213: Reference missing: Kalnay et al. (1996)

Line 214:=> “Each case studies are simulated over X days with 3 days for spin-up.”

Line 214: “impacts” Which impact? Line 216: “include in the calculation” What calculation? Line 216: “detailed emission inventory” Inventory of what?

Line 221: “model calculation” => “model results” Line 224: You already provided the reasons for doing such analysis Line 220. Remove this repetition

Line 237: It is not sufficient to use satellite data to assert that ERP is responsible for

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lad cover changes. It may be as well due to changes in hydrological cycle. A reference using in-situ with satellite data would be more convincing.

Line 239: “northwester” => “northwestern” Figure 2: “Barrens” is incorrectly used. Change to “Bare soil” or “Bare surface”

Line 249-252: Reformulate this sentence more clearly. Also the increased forest cover is not related to a decrease of bare surface (Fig 2a), which means that it was not emitting dust initially. Therefore the forest acts as a barrier for dry deposition and not emission. You should precise this important point. Furthermore, the forest will impact dust load only if dust plumes evolve in the boundary layer. This is not always the case as they move up along cold fronts.

Line 257: “They share ...”=> “ These programs help at protecting grassland and reducing desertification.”

Section 3.2: You need to include some description of the vertical profile over the ERPs. Is the dust plume in contact with the surface or not? It is fundamental to know this if you one to study ERPs effect on dust.

Line 267: Figure 3. It is not possible to locate these sites on a map. I would suggest showing them on Figure 4 replacing black by red color the circles showing the location of all sites.

Line 311: “suggesting ... period.” => “Indicative of a good model skill at simulating the evolution of the dust plume”

Section 3.4: You should go beyond describing the figures. Why is dust decreasing? Is it an increased deposition: wet or dry? What about the emission? Are they the same? Vertical profiles? Are they similar? This section needs to be work out to provide some scientific content to the study.

Line 341: “The evaluation the model”=> “The evaluation of the model” Lines 341-344: You already said that the model performed well. You repeat yourself. Remove.

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Lines 345-348: This was already said in the Introduction. You repeat yourself. Remove.

Line 352-356: It would be better to move this descriptive part in the “WRF-DUST model and experiments”. Also, shorten this by saying: “We performed two experiments, one in 2001 before the implementation of the ERPs and the other in 2013 corresponding to its mature phase.” On the other hand, you need to provide more information about the simulation. Is this a full one-year simulation? What is the spin-up time? Are the initial conditions for the aerosols identical for both experiments?

Line 357: “from 2001 to 2013” means that you did a 13-year simulation. Is this what you did? You did not define the length of simulation for your experiments. And Figure 6 is poorly described. We have no idea what is the X-axis: year? Month? Day? Hour? Something else? We have no idea what is the y-axis? What are the units if any?

Lines 358-360: “The vegetation increase regions and downwind areas. . .” => “Regions with increased vegetation (cf. Fig 2b) and their downwind areas. . .” Line 360: “barren” => “bare surfaces”

Lines 405-410. Needs to be reformulated to use proper English

Line 411: “The WRF-DUST. . .pollutions” remove, as this is not a result.

Line 412: “The model calculations are intensively evaluated.” => “The model results have been evaluated by comparing with surface data.” But this is not a result and should be moved earlier in the section. Also the results of statistical analysis is crucial for any model, I would not define it as “important” as you are not the first modeler to use WRF-DUST.

Item 4 missing: You should add a physical explanation of the ERPs effect on dust. Is this due to increase deposition (wet or dry?) or emission? Is there any feedback?

Line 425: “dust pollutions” => “dusty episodes” Line 425: Awkward sentence: “The air pollution is severe . . . to the severe air pollutions”

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Line 426: “ERPs help reduce some air pollutions”. This is misleading. There is a clear difference between air pollution, which refers to aerosol particles produced by oxidation of anthropogenic precursors, and mineral dust particles mostly produced by wind erosion. Previous modeling study by Chin et al. (2014) shows a sharp decrease of pollution from 1990 to 2010 but an overall increase from 1980, while dust is staying pretty much constant over East Asia. You should check the entire manuscript for similar misleading definition of pollution.

Lines 430-432: Awkward sentence. Please reformulate and do not use the word “sketchy” to characterize your work. I don’t think that *Atm. Chem. Phys.* will publish “sketchy” work.

Line 655: “barrens”=>“bare soil” or “bare surface” and change in the Figure

Figure 3: What is the X-axis: day, month, and year? What are the units for the Y-axis? Replace “The model performance statistics o NMB and IOA are also shown” by providing the full name of NMB and IOA (I even cannot find it in the text!).

Figure 4 caption: What is the period covered by “episode average”? Figure 4 b is not a “correlation analysis”. Define circles and lines.

Figure 5 caption: “The correlation indices (R) between measurements and simulations are also presented”=> “The correlation coefficient (r) of the linear regression between simulated and observed surface concentration is indicated in red.”

Figure 6 caption: Need major improvement, as it is impossible to know what is shown on this Figure from the caption

Figure 7: Right panels are not defined properly as I have no clue what they are. The entire caption needs improvement for clarity.

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