

Interactive comment on “The concentration, source apportionment and deposition flux of atmospheric particulate inorganic nitrogen during dust events” by Jianhua Qi et al.

Anonymous Referee #1

Received and published: 24 March 2017

General Comments:

The manuscript titled ‘The concentration, source apportionment and deposition flux of atmospheric particulate inorganic nitrogen during dust events’ written by Jianhua Qi presented the dust impacts on particulate inorganic nitrogen by analyzing the aerosol samples collected at Qingdao, China. The authors divided dust pattern into three parts, and investigated the dry deposition flux. To estimate the source, PMF receptor model was also used. Based on the above approaches, the authors tried to answer the questions of ‘dust event always increase the atmospheric input of nitrogen to the ocean?’. The topic is interested ones because the impact of dust as atmospheric input on ocean ecosystem has been still unclarified. However, throughout the manuscript, it is not

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well organized and hard to follow and understand. Overall, this manuscript will not be acceptable taking into account the high journal quality of Atmospheric Chemistry and Physics.

Before the discussion, first, the definition of “dust events” cannot be understood well. In L99-101, the authors explained that ‘Samples were collected on dust days and selected ND days in spring from March 2008 to May 2011, with sampling duration of 4h for each sample. We refer to the ND days as sunny and cloudy days before and after dust events in the following discussion’. The authors should add the appropriate reference of the Meteorological Information Comprehensive Analysis and Process System (MICAPS) which defined the weather conditions (and also, the subsection 2.4 should be reorganized partly into this explanation). What is the definition of “dust events” here? Visibility? More information of how the dust events are defined in this system should be announced in detail. Total of 14 samples (sample numbers in Table 3) during dust events were analyzed throughout this study. The sampling duration was 4 hrs, so which data are used in the corresponded date in Table 3? All samples in the day? Moreover, what is the sample numbers of ND? The current information in Section 2.1 is severely lacked in the information which the readers can follow the authors methodology. Because this study discussed the dust impact, the explicit and detailed information regarding dust is required. In this sentence, I am worried about the explicit division of dust and non-dust samples. It is well known that some dust events are continued a few days. For example, the samples used in this study during 28-29 May 2008, 20-21 March 2010, 15 and 18 April 2011, and 1-2 May 2011 showed continuous dust events. In such cases, do the authors have confidence to the clear separation of dust and non-dust samples? How about the AI concentration definition (L171-172) of non-dust days samples? Why were other days samples not collected to clearly separate the dust impacts? The definition of ND is ambiguous. According to the definitions of dust and non-dust, the discussion on dust impact might be changed. The reconsideration of dust impact is needed based on the clear definitions of dust.

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The second concern is the “dilution effect” which the authors claimed as the key factor for the discussion of inorganic nitrogen. Again, without the explicit definition of dust and non-dust, the dilution effect cannot be understood well. In this discussion, although the authors introduced the air mass speed, there were no implications on the intensity of dust events itself. Why the upwind (i.e., near desert) information was not used here to describe the dust intensity? The dilution is not so simple, hence more information are required to reinforce the authors finding. The authors discussed the inorganic nitrogen behavior. In these cases, what is the counter ion of NH_4^+ and NO_3^- ? Are the main counter ions metal elements? If NH_4NO_3 are formed, due to its chemical unstability according to the temperature and relative humidity, it is not simple to discuss only the viewpoint of “dilution effect”. In addition, the authors used NO_2 data to investigate the inorganic nitrogen, but how about NH_3 ? Only from NO_2 data, it is insufficient to estimate the inorganic nitrogen variation. On the above reasons, the reconsideration is required to publish this manuscript from Atmospheric Chemistry and Physics.

Specific comments:

L35-36: This conclusion does not match to the manuscript contents. The authors stated that input of nitrogen to the ocean depends on the dust events.

L57-L67: In this paragraph, the authors used “ND days” simply. However, this wording should be used carefully; because the definition of non-dust days will be different in each study. Please consider to carefully define this wording.

L146: Some information should be replaced on Section 2.1 appropriately.

L162: “atmospheric particulate” is “TSP”?

L165: I cannot follow the calculation of “1.8-14.0 times (mean: 5.9)”. The mean concentration have not been stated for dust days.

L167: The EF of Ca is 14.0 in Table 2.

L168: The statement of “decreased to less than three” cannot be followed from the

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valued listed in Table 2.

L171: Again, I cannot follow the calculation of “1.7-21.9 times (mean: 6.9)”.

L173-L174: To clarify the separation of dust and non-dust days, the information of criterion for samples on non-dust days will be needed.

L175: I cannot follow “10.3 times” for Fe. It can be calculated as 7.90 from the values in Table 2.

L175: In Figure 2, nss-Ca was shown, but nss-Ca was not listed in Table 2. What is the authors intention to introduce nss-Ca here?

L176: “3.6-fold” will not be followed from Fig. 2. It should be listed in Table 2.

L177: The EF of Ca on dust days is also greater than 10.

L183: The increasing ratio of concentration between dust days and non-dust days will be helpful to understand the discussion on Section 3.1.

L189: What is the comparison method on some dust days? The sample date are shown in Figure 3, so why the authors explicitly mention the date? I cannot follow the calculation of “a factor of 1.2-5.7”.

L190: What means “less than 20% of that on ND days”? Averaged data over ND days?

L191: Again, what is the comparison method on some dust days? I cannot follow the calculation of “a factor of 1.4-9.2”.

L194-L195: In this sentence, the authors stated “the effect of dust on inorganic nitrogen differed during different types of dust events”. Why the authors suddenly focused on inorganic nitrogen here? In L192-193, it was mentioned “inorganic ion SO_4^{2-} exhibited concentration variations that were similar to those of nitrate”.

L197: The figures for inorganic nitrate will be helpful information here, if the authors focused on inorganic nitrogen.

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L207: (respectively less than 50 ug/g and 6 ug/g) will be the correct expression for ammonium.

L211: So what is the source of atmospheric particulate nitrogen? The location of Duolun and Zhurihe Sand Desert is very close.

L214-L216: Without more information of the intensity of dust, the discussion on 'dilution effect' seems to be lacked in scientific understanding. This part should be fully revised based on not only dilution effect but also dust intensity.

L217: Averaged information were listed here, however, will the each sample information be valuable? The equation shown in summary column cannot be understood form (e.g., IN and ND were not comparable index).

L219: It seems that the discussion on this paragraph (e.g., "700 ug/m³ in Case 1" and "higher than 1100 ug/m³ in Cases 2 and 3") are based on Table 3. Please reorganize the paragraph, or please refer appropriate information here. It is hard to follow these values.

L219-L222: So what is the local source? What is the definition of the wording of "local" here? There was no information of the emissions here. It is hard to understand the "reaction" without the information of emissions intensity around dust source and downwind regions.

L224: "particulate" is "TSP"?

L227-L228: The favorable condition to form ammonium cannot be discussed without the information of NH₃. In addition, Table 3 indicated the aerosol samples in the coastal region of the Yellow Sea. How about the status over air mass path? Is it sufficient to conclude only from the downwind information to the formation of inorganic nitrogen?

L230: "strong dust storm" cannot be discussed without any information on dust intensity here.

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L233-L234: But NO_x concentration was high in Case 3. I cannot follow why the authors concluded "the strong dilution effect" on Case 3.

L244-L246: Because the Table 5 was lack in the information of ND days, we cannot follow the authors conclusion. The information of ND days on Table 5 will be required.

L254-L255: The authors simply mentioned "local emissions" here. Because the samples were collected on downwind regions in the coastal region of the Yellow Sea, I guess that the discussion on emission characteristics of each (or, at least, some categorized) air mass should be discussed in detail. The inorganic nitrogen concentrations are highly related to the local conditions both on emissions strength and meteorological parameters, so the discussion only on air mass speed and air mass path over ocean are insufficient.

L256: RH and NO_x information are not shown in Table 5.

L260: The colors are overlapped, hence we cannot distinguish each trajectory. Some paths (e.g., thick green color: 2008/5/22 or 2011/4/15) are apparently indicated the west or south part of China. Are these events really related to dust events?

L278-L280: The source of coal combustion have increased compared to non-dust days. Short explanation will be needed here.

L305: If the authors discuss the dry deposition flux of "IN", the information should be inserted in Table 7. Table 7 only contained NO₃⁻ and NH₄⁺ independently.

L306: I cannot follow the calculation of "a factor of 1.1-5.8" and "a factor of 1.8-6.3".

L307: "the dry deposition flux" of what?

L309: What is the calculation method of "63%" and "46%"?

L310: What is the calculation method of "14%"?

L317: I cannot follow the calculation of "a factor of 2-25".

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L339: "aerosol particles" is "TSP"? In Table 7, please confirm the significant digits for each specie.

Technical Corrections:

L31: Comma is needed on '2800'.

L199: 'IN' should be defined in L194.

L236: Need appropriate comma for all numbers.

L301: Comma is needed on '2800±700'.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1183, 2017.