

Comments to Editor

Authors: We would like to thank the editor for his insightful comments. We have made changes to the manuscript to address those comments.

Editor: Line 13-46: Abstract is too long, it would be good if you can shorten this.

Authors: We have deleted few sentences to shorten the abstract.

Editor: Line 21: variability

Author: we changed it

Editor: Line 34: agreement on what?

Authors: we changed it to “In addition, PM_{2.5} concentrations derived from the CHIMERE model have been evaluated against surface measurements from the Airparif network over Paris, for which agreement was found (r^2 of 0.56) with however an underestimation during spring pollution events.”

Editor: Line 38: the importance of long-range transport

Authors: we modified this.

Editor: Line 42: use spring instead of springtime

Authors: we changed it

Editor: Line 44: factors such as

Author: It has been modified

Editor: Line 29: In terms of, in the case of, with respect to, Regarding are the alternatives of this “
In term of”

Authors: we changed to “With respect to”

Editor: Line 64: protocol on reduction of ammonia? If yes, then please specify that.

Authors: we specified this in the sentence.

Editor: Line 178: mean relative difference will not show the seasonal or any other bias in the measurements

Authors: we agree so we have added this to the sentence: “and an underestimation by IASI ranging from 10 to 50 %”

Editor: Line 196-199: I do not understand this sentence. Please rephrase

Authors: This sentence has been rephrased such as: ‘To account for any a priori information used in the retrieval (i.e. observation operator) in air quality model comparisons and data assimilation into models, the CRPR provides the retrieved error covariance and averaging kernels.’

Line 223-224: the sentence is not complete

Authors: We have rephrased this sentence: “The model computes hourly concentrations for more than 180 species, including the regulated pollutants such as ozone, PM10, and NH3.”

Editor: Line 226: use “precipitation” and at other places

Author: It has been changed throughout the manuscript

Editor: Line 234: "This makes a reasonable assumption ..."

Author: we changed the sentence accordingly

Editor: Line 298, line 539: Use "Note that" or "It should be noted that" something like this

Author: We modified the sentence

Editor: Line 314: main region of mineral.

Author: We changed it

Editor: Line 348: monthly mean anomaly is calculated with respect to the ten-year average data

Author: We changed the sentence accordingly

Editor: Line 353: To further examine the analyses,

Author: we changed this sentence

Editor: Line 367: What is fertilizer spreading?

Authors: we have changed this sentence to 'Springtime is a fertilizer application period'

Editor: Line 368: when the temperatures are relatively lower as in the case of 2012

Authors: It has been changed

Editor: Line 374: factors account for the higher NH₃... (not parameters, but the factors or processes)

Author: We have changed it to "Overall, our results suggest that variability in meteorological (precipitation and temperature) and farming practices (fertilizer and manure applications) may play an important role in driving the large inter-annual variability in NH₃ column observed by IASI and CrIS in the domain of study."

Editor: Line 413: model results is

Authors: Changed to "If we only consider months of high NH₃ in the domain from March to August, the correlation between the observational datasets and the model results is weaker with r^2 values between IASI (CrIS) and CHIMERE of 0.29 (0.14) and is not significant ($p > 0.1$) against CrIS, as shown in Figure 7."

Editor: Line 431: "First one can note that"? Write something like "It can be noted that" or "Note that."

Authors: we changed to It can be noted that

Editor: Line 471: outputs are

Author: Changed to "outputs in"

Editor: Line 481-485: difficult to understand, please rephrase

Authors: We have rephrased to "To investigate the impact of intensive agriculture practices on the Paris megacity air quality, we need to better understand the role of NH₃ in the formation of PM_{2.5}. This process depends, among others, on specific meteorological conditions such as atmospheric temperature and humidity that alter the gas-particle partitioning."

Editor: Line 483: "slight underestimation"

Author: we modified this sentence

Editor: Line 494: Using the 10-years of

Author: Changed

Editor: Line 531: difficult to quantify the "enough" here

Authors: We have modified to "This time period was selected to have the most IASI observations (combining Metop-A and B) in the IdF region."

Editor: Line 534: and case B

Author: Changed

Editor: Line 536: 3 March, 19 March like that (in lines 540, 543, 544 too)

Authors: we changed all the dates.

Editor: Line 546: a detailed analysis is made for the study period (not for the whole data sets)

Authors: We changed it.

Editor: Line 556: What are rare precipitations?

Author: We have changed it to 'almost no precipitation'

Editor: Line 557: northeast wind.

Authors: we have modified the text

Comments to referee 2

Authors: We would like to thank the referee 2 for his insightful comments. We have made changes to the manuscript to address those comments.

Referee: line 41

when air masses are originated -> when air masses originate

Authors: We have changed this.

Referee: line 44

specify unit for the lag

Authors: we added 'day'

Referee: line 94

underestimates the NH₃ budget -> do you mean the NH₃ (surface?) concentration

We have changed the sentence to "CHIMERE model underestimates the NH₃ surface concentrations and emissions over Paris [Petetin et al., 2016; Fortems-Cheiney et al., 2016]".

Referee: line 120

limited in -> limited to

Authors: We have changed this.

Referee: line 233

It evaluates -> it simulates?

Authors: We have changed this.

Referee: There are other instances where sentences can be difficult to understand. Careful proofreading is needed.

Authors: we have carefully proofread the revised manuscript.

Referee: Line 372, 375. Please provide p values. Relatively->also

Authors: We have added p values.

Referee: Line 378. Please rephrase sentence.

Authors: we have changed it to "However, the values of the r² lower than 0.6 (0.2) indicate that the CHIMERE model only reproduces at most half (20%) of the monthly temporal NH₃ variabilities observed by IASI (CrIS) in the domain."

Referee: Line 385. I would suggest to rephrase along these lines.

Overall, our results suggests that variability in meteorological and farming practices may play an important role in driving the large inter-annual variability in NH₃ column observed by IASI and CrIS. We have changed these lines accordingly.

Referee: line 422 with low associated p-values of $1.5 \cdot 10^{-5}$ (0.06) reflecting the significance level of the fits (not shown here) -> ($p < 0.1$)

Authors: we have changed this.

Referee: line 425-426 rather good is not quantitative. Instead, you may want to convey that the correlation is weaker (0.29 and 0.14, respectively) and is not significant ($p < 0.1$) against CrIS

Authors: we changed it to : "If we only consider months of high NH_3 in the domain from March to August, the correlation between the observational datasets and the model results is weaker with r^2 values between IASI (CrIS) and CHIMERE of 0.29 (0.14) and is not significant ($p > 0.1$) against CrIS, as shown in Figure 7."

Referee: line 432. $r^2 = 0.18$ against CrIS. So it only captures $\sim 20\%$ of the monthly variability.

Authors : we changed it to "However, the values of the r^2 lower than 0.6 (0.2) indicate that the CHIMERE model only reproduces at most half (20%) of the monthly temporal NH_3 variabilities observed by IASI (CrIS) in the domain."

line 434. I don't understand what the authors mean here. What is the correlation between standard deviations (which is a scalar)?

Authors : This sentence is confusing, we choose to delete it.

Referee: line 495. associated with p-value of 6×10^{-133} . -> it's probably enough to just write ($p < 0.05$)

Authors: We changed this.

Referee: line 497. I assume that you are referring to the mean normalized bias?

Author: Absolutely, we changed the name accordingly.

Referee: line 526. Relatively correlated is not quantitative. If the correlation is significant (at $p < 0.05$ or $p < 0.1$), just state it.

Authors: We have changed the sentence. Since the number of observations for the CCF plot over the whole time period (2008-2016) is large ($N = 2735$), we assumed a normal distribution of CCF with a mean of 0 and a standard deviation of 0.0382. So the upper limit for the 95% interval level is fixed at 0.03748. Since all the CCF values in the plot ($-15 < \text{lag} < 15$) are above 0.03748, they are all significant at the 95% confidential level. However, this is not a hypothesis test, so we cannot calculate the p-value.

Referee: line 527. I am puzzled with the +/- lag. Given the hypothesis that NH_3 originates from Northern Europe, why consider +lag?

Authors: To support the idea that NH_3 originates from Northern Europe, and not the contrary, we have to compare the value of cross-correlation function (CCF) for both lag > 0 (i.e. enhancements of NH_3 concentrations observed over Northern Europe followed by enhancements over IdF) and lag < 0 (i.e. enhancements of NH_3 concentrations over Northern Europe preceded by enhancements over IdF).

Referee: line 562. Which test did the author use to establish the significance? The mean of B falls within 1sigma of the mean of A.

Authors: We have performed the Wilcoxon-Mann-Whitney test for which values were significant ($p < 0.01$). We have noted the p value in the text.

Referee: Fig. 13. I suggest you reiterate the definition of A and B in the caption and refer to Fig. 12. Also indicate the number of observations used for each case (N ensemble?)

Authors: we have changed the caption accordingly.