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# *Interactive comment on* "Impact of ozone observations on the structure of a tropical cyclone using coupled atmosphere–chemistry data assimilation" *by* S. Lim et al.

**Anonymous Referee #1**

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This study examines the impact of total column observations of O3 to represent the atmospheric state (dynamic and composition) during the Nabi tropical cyclone (TC) using data assimilation of OMI with the WRF-Chem model. It is found that assimilation of OMI total O3 improves O3 analysis but also NO2 and SO2 at 200 hPa as well as wind, temperature and relative humidity at 850 and 200 hPa. I found the paper relatively well written although, as usual, some area can be improved. This type of study is also very relevant. I have, however, one major concern: the entire study relied on the analysis of only one assimilation cycle of 6 hours. In the end, I am wondering how this study is conclusive and I think that the complete episode of the Nabi typhoon

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need to be addressed.

General comments:

1. The fact that only one assimilation cycle is used reduced the scientific impact of this study. The authors argue that OMI data are only available in the morning so only one DA cycle was done, on 3 September in the morning. The period of the Nabi cyclone is between 29 August and 8 September, 2005. The switch of OMI from normal to zoom mode occurred on September 2 where no OMI data were available over the TC region for that day. If I understand well, OMI data is then available for the other days during the Nabi cyclone but only in the morning (around 4 UTC).

To me, the entire period of the Nabi cyclone could be addressed. Cycles without OMI data (between 6 and 24 UTC) might be replaced by a forecast run. In this way, the performance of DA experiment could be evaluated by measuring the skill of the system to forecast OMI data of the next days. This is one question to which the current state of the study does not answer: is DA of OMI data improve the forecast of the cyclone. Also, increasing the number of cycle would reinforce the results of section 3.4.

2. In the paper the terminologies "atmosphere chemistry model" or "atmospheric and chemical variables" is used. The chemical composition is part of the atmosphere state so I would change these terminologies by, e.g., "circulation chemistry model" and "physical (or dynamical) and chemical variables"

Technical corrections:

P11576-L7: I would not use the term "blending" to describe DA method because it is too subjective while DA methods are an objective way to use model, a-priori and observation information, as well as their error covariances to produce an analysis. Please, update the sentence.

P11576-L10-13: This sentence is not very clear. They are many reasons to assimilate ozone which are reviewed in Lahoz et al. (2007) for the stratosphere. Please, clarify

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the sentence.

P11579-L11-17: Some readers will probably not know the locations of Saipan, Kyushu, South Korea and Hokkaido. Would it be possible to mark these locations in Figure 1?

P11580-L17-19: "It contains . . ." The description of the observation operator that transforms modelled Ozone volume mixing ratio to total column is very short. Can you add more information; in particular are the averaging kernels used in the observation operator?

P11582-L13: "(ii) 200 hPa (lower stratosphere)". 200 hPa is usually in the upper troposphere lower stratosphere (UTLS) so I would replace "lower stratosphere" by "upper troposphere lower stratosphere".

P11582-L18-19: "These are . . ." This sentence is not clear in particular after ". . . and the control forecast . . ." Please, clarify.

P11583-L25-26: ". . ., provided total . . ." This latter part of the sentence lack of clarity. Please, rephrase.

P11584-L16: Do you mean Fig. 4b (instead of d)?

P11584-L19: I would replace ". . . while the correlation is mixed . . ." by ". . . while no clear correlation is found for . . ."

P11585-L10: The term "validation" is in general used when the analyses are "validated" w.r.t. independent observations. Here, it is more a verification. Please, update the title of Sect. 3.4.

P11587-L2: ". . . at the time" The meaning of this sentence is not clear. Please, rephrase.

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