Atmos. Chem. Phys. Discuss., 14, C4793–C4799, 2014
www.atmos-chem-phys-discuss.net/14/C4793/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Detailed source term estimation of the atmospheric release for the Fukushima Daiichi Nuclear Power Station accident by coupling simulations of atmospheric dispersion model with improved deposition scheme and oceanic dispersion model" *by* G. Katata et al.

Anonymous Referee #2

Received and published: 14 July 2014

The manuscript presents the new source term estimation of I-131 and Cs-137 released into the atmosphere from the Fukushima Dai-ichi Nuclear Power Station (FNPS1) in Japan by inversion analysis combining measurement data and offline coupling model of the atmospheric and oceanic dispersion models. Also, the manuscript evaluates

the new source term by comparing the simulation using different atmospheric dispersion model with measured atmospheric concentration and surface deposition. At the present time, the multi-media environmental pollution caused by the massive release of radionuclides to the atmosphere from the FNPS1 is still severe natural and social issues, while the total amount of source term and its temporal variation has a large uncertainty. In this situation, the author's work brings very valuable and timely information to the international society. The topic of manuscript certainly is suitable for ACP. The new source term was validated by comparing the modified WSPEEDI-II simulation using the new source term and the previous WSPEEDI-II simulation using the previous source term with measurements. As a result, both effects due to improved deposition scheme and improved source term are mixed in the discussion for validation of the new source term. This is a weakness in this manuscript. In the analysis, it is very important to separate two effects of deposition scheme and source term. For example, the authors compare the simulations using the new source term and the previous source term based on the modified WSPEEDI-II model and then analysis the differences between two simulations. Additionally, there are many points which should be clarified. The reviewer recommends publishing this paper with major revisions in response to the following questions and comments.

< Major comments >

1. Validation of new source term Most important progress in author's study is to determine the new and detailed source term of I-131 and Cs-137 combining measurement data and offline coupling model of the atmospheric and oceanic dispersion models. Hence, it is important to compare the modeled results of new and previous source terms using the modified WSPEEDI-II model based on measurement data (air concentration, air dose rate, and surface deposition) and then demonstrate the advantage of the new source term quantitatively. From this viewpoint, the authors need to add analysis and discussion. Additionally, for the air concentration, the authors should use the measurement data at not only JAEA-Tokai but also other sites.

ACPD
14, C4793–C4799, 2014

2. Validation of new deposition scheme In this paper, a new deposition scheme, which deals with dry and fogwater depositions, CCN activation and subsequent wet scavenging for radioactive iodine gas and other particles, was incorporated into WSPEEDI-II. However, this new deposition scheme wasn't validated objectively based on measurement data, though authors discussed about it in section 4.2. The authors should compare the modeled results with old and new schemes in fixed source term and then demonstrate the advantage of the new scheme.

3. Ratio of gaseous and particulate I-131 The ratio of gaseous and particulate I-131 is one of critical parameters in the inverse estimation for I-131 source term. It is well known that the ratios of gaseous and particulate I-131 have large variability in time and/or space. It is considered that the ratio depends on the source condition as well as the history of air mass (especially, washout or not). In fact, the ratio of gaseous to total I-131 varies in the range of 0.2 to 0.8 in space and/or time (Tsuruta et al., 2012, 2014). The authors should discuss the impacts of the ratio determined from the data collected at only one site (JAEA-Tokai) on the I-131 source term estimation.

<ref.> Tsuruta, H., Takigawa, M., & Nakajima, M., Summary of atmospheric measurements and transport pathways of radioactive materials released by the Fukushima Daiichi Nuclear Power Plant accident. In Proceedings on the 1st NIRS Symposium on Reconstruction of Early Internal Dose in the TEPCO Fukushima Daiichi Nuclear Power Station Accident. (eds Kurihara, O. et al.) 101-111 (National Institute of Radiological Sciences, 2012), 2012.

http://www.ied.tsukuba.ac.jp/hydrogeo/alltsukuba/documents/20140316WS/20140316WS_group01.pdf (last access: 14 July 2014), 2014 (in Japanese)

< Individual comments >

1) Page 14735, lines 14-15: Why does the use of peak value reduce the impact of discrepancies in arrival time? If the modeled arrival time differs from the measured time, the modeled peak concentration should be different from the measurement. Ad-

ACPD
14, C4793–C4799, 2014

ditionally, the use of peak values, which is not statistically stable, may cause higher uncertainty in the reverse estimation. Why did the authors use peak value, not average value?

2) Page 14736, lines 15-16: This part is not clear. The authors should explain more detail.

3) Page 14737, lines 11-12: The authors should explain how to classify the affected points from the un-affected points.

4) Page 14739, line 2: It is better that “Fig.2” is changed to “Fig.2d”.

5) Page 14740, lines 2-4: It is better that Fig. 6 is moved to section 3.1 because this figure is modeled results. Fig. 6 seems to show the modeled surface concentration of plume emitted in the event shown in captions for each panel. It is better that brief explanation of Fig. 6 is added.

6) Page 14742, line 7: According to Fig. 9a, the model extremely underestimates the peak at 15:00. The authors should add some comments on the reason and effects to source term estimation.

7) Page 14743, lines 1-3: The modeled narrow deposition band (Fig. 9) shifts around 30 degrees compared with measurement (Fig.10). The authors should add some explanations for the shift.

8) Page 14743, lines 4-5: What is evidence for “deposition area was far from the plant due to the elevated release from the stack”?

9) Page 14744, line 27: “Fig. 11b” should be changed to “Fig.8b”.

10) Page 14746, line 9: More detail explanation for “modifications of the deposition scheme” is needed.

11) Page 14746, lines 10-14: One possible reason for “a large increase in the air dose rates did not appear at Fukushima and Iitate areas” is that most of radionuclides

ACPD
14, C4793–C4799, 2014

deposited before the air mass arrived at these areas. The authors should analysis and discuss more carefully.

12) Page 14748, lines 13-23: Both ratio of I-131/Cs-137 and gaseous/particulate iodine on 16 March are higher than those on 15 March. These facts may suggest that particulate Cs-137 and I-131 were deposited by precipitation before arriving at JAEA-Tokai on 16 March while there was no precipitation on 15 March. Hence the authors should analysis and discuss based on the background that the changes in the ratios of I-131/Cs-137 and gaseous/particulate iodine are caused by not only source change but also history of air mass.

13) Page 14752, lines 19-22: Which is a larger factor in improvement of regional deposition, enhancement of the scavenging coefficient or revised source term?

14) Page 14753, line 22: The authors should show the source term for Te-132 and the evidence that the modification for Te-132 is reasonable.

15) Page 14753, line 27: Table 6 shows that the statistical scores of new results are lower than previous results in air dose rate in the north-west area of FNPS1.

16) Page 14755, line 6: Why was the measurement data at only one site (JAEA-Tokai) used?

17) Page 14755, lines 10-14: The authors should compare the modeled concentration using the new source term with that using the previous source term in Fig.18 and then demonstrate some advantages of the new source term.

18) Page 14755, lines 22-25: The score of FB in Table 7 shows that the modeled deposition using the new source term tends to underestimate and to be worse than the simulation using the previous source term.

19) Page 14757, lines 5-7: In Table 7, The NMSE and FB for I-131 concentration with the new source term was worse than those with the previous source term excluding FB for MLDP0 model. The authors need to make comment on these results.

ACPD

14, C4793–C4799, 2014

20) Page 14758, lines 4-10: The authors should compare the modeled concentration using the new source term with that using the previous one in Figs. 22 and 23 and then demonstrate the advantage of the new source term.

21) Page 14758, lines 20-24: This part is not clear and more explanation is needed.

22) Page 14758, lines 25-28: This is true? According to Table 8, the CCs for particulate I-131 and Cs-137 in the new source term case was slightly lower than that in the previous source term. Additionally, the NMSE became worse when the new source term was used. For other scores, the situation was case by case.

23) Page 14761, lines 3-4: From Fig. 26a, it is needed that the "then particulate iodine, and finally gaseous CH3I" is changed to "then gaseous CH3I, and finally particulate iodine".

24) Page 14761, lines 10-11: This is true? Fig. 26 shows the gas species of I-131 contribute to the contamination of East Japan though their contributions are lower than wet deposition of particulate I-131.

25) Page 14761, lines 18-20: The authors should show the appropriate reference indicating WRF-CMAQ model overestimated the observed precipitation amount over Tochigi and Gunma Prefectures.

26) References: There are some references in review. These references should be changed to alternative references which readers can access.

27) Fig. 8: The color scale bar is invisible and should be improved. In the title of figure, the "spatial distribution of accumulated surface deposition" may be better.

28) Fig. 9: The authors should answer the following questions about Fig. 9c. - The time of calculated air dose rate (12:00) is different from the time of measurement (from 6:00 to 15:00). Why did the authors use the data at different time for comparison? - The air dose rate has a peak around 15:00 on 12 March as shown in Figs. 9a and 9b. Why did the authors use data in the daytime on 13 March instead of data around 15:00

ACPD

14, C4793–C4799, 2014

on 12 March?

29) Fig. 13: The color lines in each figure are invisible and should be improved to be visible.

30) Fig. 17: The black and red lines and horizontal axis in each figure are invisible and should be improved to be visible.

31) Fig. 18: The vertical and horizontal axes in each figure are invisible and should be improved to be visible.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 14725, 2014.