Model inter-comparison of atmospheric Cs-137 from the Fukushima Daiichi Nuclear Power Plant accident

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After the Fukushima Daiichi Nuclear Power Plant (FDNPP) accident in March 2011, atmospheric simulation models played important roles in understanding the atmospheric behaviors of radionuclides. For the evaluation of the validity and variability of model results, model inter-comparison provides valuable and useful information. In this study, we compared results of seven atmospheric transport models to simulate atmospheric ^{137}Cs released from the FDNPP. All of model results used in this analysis were submitted for the model inter-comparison project of Science Council of Japan (2014). Model reproducibility was assessed from comparison with the observed hourly atmospheric concentrations of ^{137}Cs at 90 sites in Tohoku and Kanto regions (Tsuruta et al., 2014).

Tsuruta et al. (2014) identified 9 plumes (P1 –P9) which passed over Tohoku and/or Kanto regions. P1, P5 and P6 passed through the northern coastal area of Fukushima prefecture to the Pacific Ocean from FDAPP in the night of March 13, morning of 18th and afternoon of 19th, respectively. P2, P4, P7 and P9 reached Kanto region in the morning of 15th, morning of 16th, afternoon of 20th and morning of 21st, respectively. P3 and P8 widely spread over Fukushima prefecture in the afternoon of 15th and night of 20th, respectively.

On average, performance of the models was the best for P2 with FA2 (fraction of simulated data that reproduced the observations within a factor of 2) of 10% ~ 40%. Model performance for P1, P3 and P8 was moderate with FA2 of 0%~10%. The models generally reproduced the observed ^{137}Cs concentrations in plumes which widely spread inland of Tohoku or Kanto regions (P2, P3, and P8). By contrast, the models largely underestimated the observed ^{137}Cs concentrations for P4, P5, and P6, which passed coastal areas of Japan.

Ensemble average of seven models showed reasonable performance for most of plumes, and no individual models reproduced better that the ensemble average for all the plumes. These results suggest that ensemble average is effective for reliable and stable simulation of radioactive plumes.

References

Science Council of Japan, September 2, 2014.

Tsuruta et al., Scientific Reports, 4:6717, 2014.

Fig. (top) Observed and simulated average concentrations of ^{137}Cs in nine radioactive plumes ([Observed-^{137}Cs] 10 Bq m^{-3}). (bottom) Fraction of simulated data that reproduced the observations within a factor of 2, 5, and 10 (FA2, FA5, FA10, respectively).

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