Deposition, dispersion, and re-suspension of radiocesium in East Japan

Mizuo KAJINO (1), Tsuyoshi Thomas SEKIYAMA (1), Kouji ADACHI (1), Takeshi KINASE (2), Yuji ZAIZEN (1), Yasuhito IGARASHI (3)
(1) Meteorological Research Institute, Japan (2) Japan Agency for Marine-Earth Science and Technology, Japan (3) Kyoto University, Japan

1. Introduction

福島と海 Fukushima and the Ocean

- There are much more observation data available over land with compared to the ocean. In order to understand what happened to the ocean, detailed analysis of deposition, dispersion, and re-suspension of radio-Cs over land is important, because the rest of deposition to the land was transported toward the ocean.
- Numerical analysis on the deposition and dispersion of radio-Cs in March 2011 and its re-suspension in 2013 was conducted by using Japan Meteorological Agency's meteorology-chemistry model and field observation results which obtained over the land in this study.

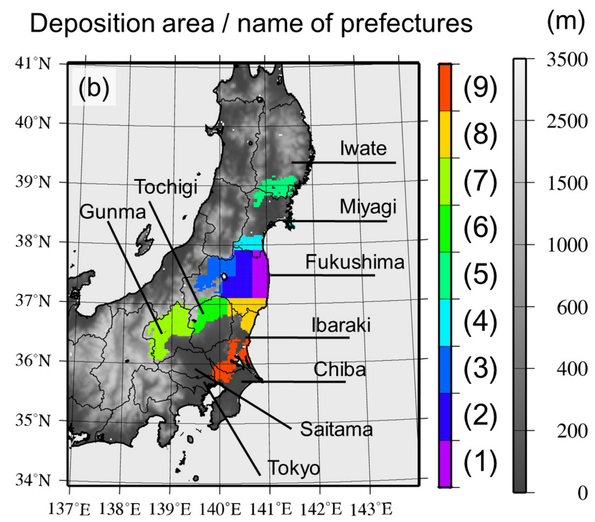
2. Method

(a) Meteorological models and physical modules compared

① NHM
② NHM-LETKF
WRF
③ WRF-WSM6-MYJ
④ WRF-WDM6-MYJ
⑤ WRF-MORR-MYJ
⑥ WRF-MORR-MYNN25
⑦ WRF-MORR-MYNN30
⑨ Met_Ensemble
Meteorological ensemble to see difference in meteorology
See difference in cloud Microphysics schemes
See difference in PBL turbulence scheme
WRF ensemble

(b) Chemical transport simulations offline-coupled with meteorology

① NHM/Chem
② NHM-LETKF/Chem
③ WRF-WSM6-MYJ/Chem
④ WRF-WDM6-MYJ/Chem
⑤ WRF-MORR-MYJ/Chem
⑥ WRF-MORR-MYNN25/Chem
⑦ WRF-MORR-MYNN30/Chem
⑧ CTM_Ensemble
⑨ Met_Ensemble/Chem



Name of deposition areas: (1) Hamadori, (2) Nakadori, (3) Aizu, (4) South-Miyagi, (5) Iwate-Miyagi, (6) Tochigi, (7) Gunma, (8), Iwaki-Ibaraki, (9) Ibaraki-Chiba

Fig. 1 (left) Meteorological ensemble, (right) model domain (Δx=3 km) and deposition area (see details in Kajino et al., 2019 and 2021).

3. Results: deposition of primary emission

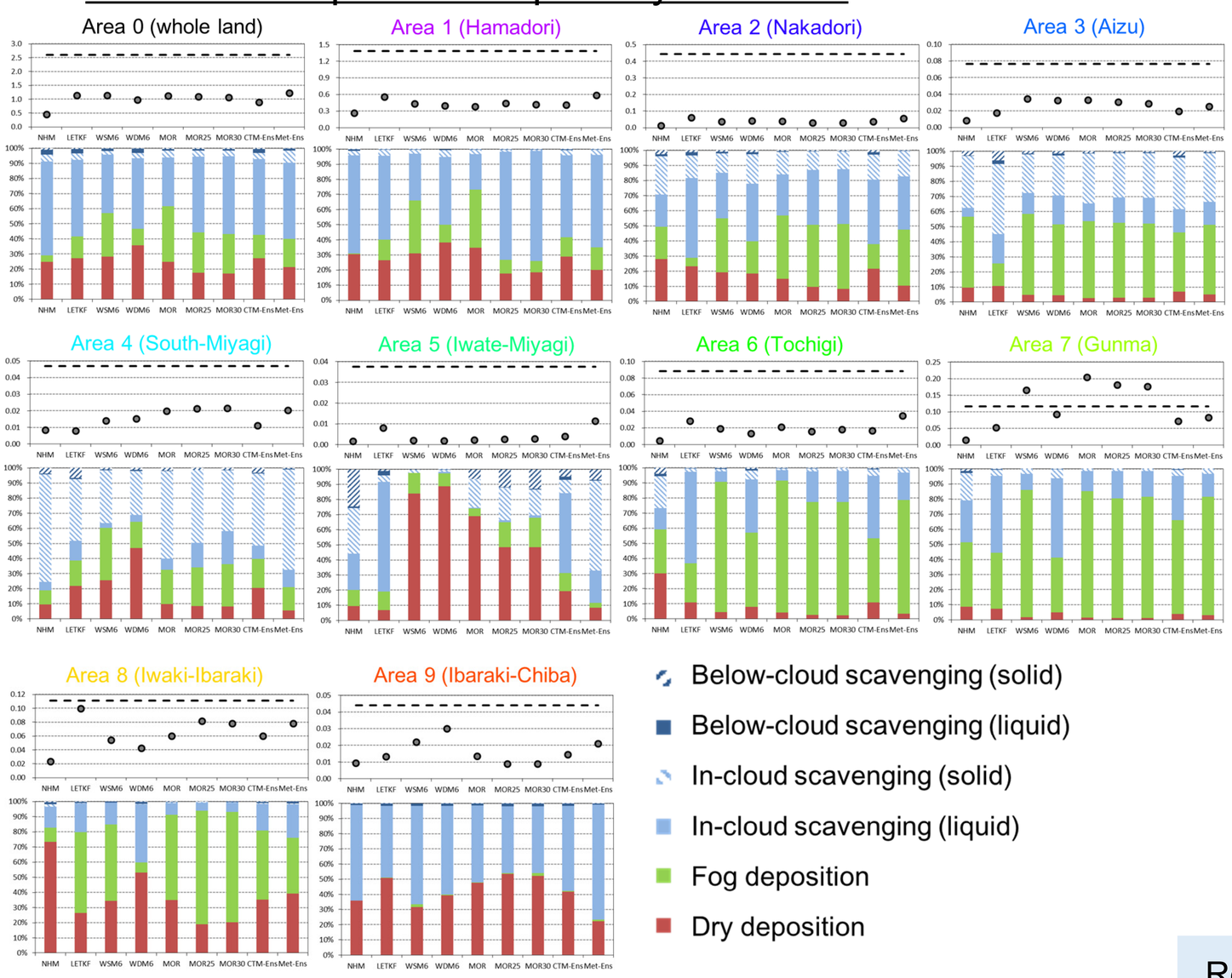


Fig. 2 (upper panels) Observed (dashed line) and nine-model simulated (circles) gross deposition of ^{137}Cs (PBq) for the entire land of Japan and the nine deposition areas. (lower panels) Simulated contributions of each deposition process to total deposition. (Kajino et al., 2019).

4. Results: re-suspension

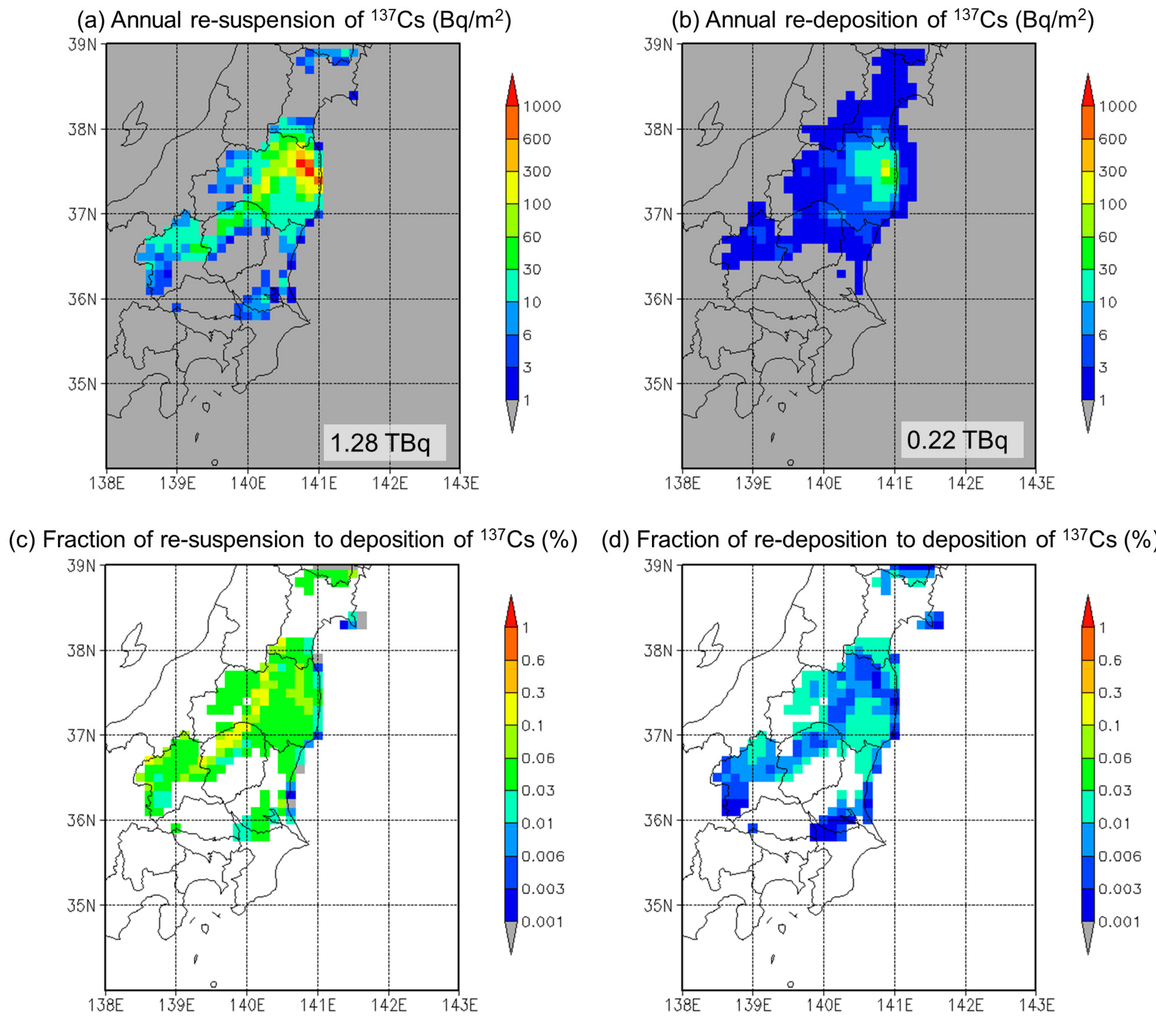


Fig. 3 Model domain (Δx~11 km). Annual total amounts of (a) the re-suspension and (b) the re-deposition of ^{137}Cs. The total activities are presented as numbers. Fractions of the re-suspension and the re-deposition to the observed ^{137}Cs deposited amounts are also shown in (c) and (d), respectively. (see details in Kajino et al., 2016).

5. Conclusion

- The ensemble analysis suggested that the deposition rate used in the model caused underestimation of simulated deposition amount, while estimated emission and simulated transport were reasonable.
- The in-cloud scavenging was the most significant process of Cs deposition over the land, and the dry and fog depositions were the next in our multi-met simulations.
- The simulated total re-suspended amount for the whole region was 1.28 TBq, equivalent to 0.048% of the aircraft-observed total deposited amount of 2.68 PBq. Reassessment is ongoing and thus the value will be changed in the future.

References:
Kajino et al. (2016) https://doi.org/10.5194/acp-16-13149-2016
Kajino et al. (2019) https://doi.org/10.1029/2018JD028998
Kajino et al. (2021) https://doi.org/10.1029/2020JD033460