Validation of Global Atmospheric Dispersion Model Using IMS data in CTBTO

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1. Introduction

- A long-range atmospheric dispersion model called LADAS (Lagrangian Atmospheric Dose Assessment System) has been developed to evaluate the dispersion patterns of the radionuclides released into the air after a nuclear accident. LADAS was used to evaluate the dispersion of the radionuclides released into the air from the Fukushima accident.

- In this study, the calculated concentrations in LADAS were compared with the measurements at IMS of CTBTO. From comparisons of simulations and measurements, the developed model was successfully validated, and it could then be used to understand the overall dispersion patterns of radionuclides spreading out in the world after the Fukushima accident.

2. Description of LADAS

- LADAS is a particle tracking model to calculate the air concentrations, dry and wet depositions.

$$X_j(t + \Delta t) = X_j(t) + v_j(t)\Delta t + v'_j(t)\Delta t$$

- Air concentration : $C(x,y,z) = \dfrac{N_p}{\Delta x \Delta y \Delta z}$

- Dry deposition : $C(t + \Delta t)_{dry} = C(t)[1 - \exp(-\dfrac{v_d \Delta t}{h_p})]$

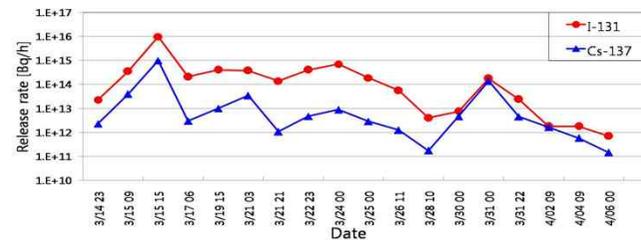- Wet deposition : $C(t + \Delta t)_{wet} = C(t)[1 - \exp(-\Lambda \Delta t)]$
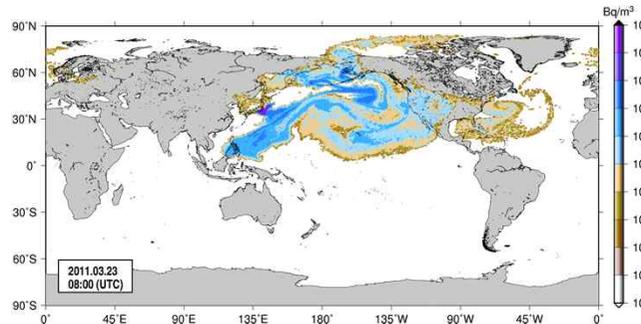
3. Source terms of radionuclides from the Fukushima accident

- Terada (2012) at Japan Atomic Energy Agency announced that the total amounts of ^{131}I and ^{137}Cs released into the atmosphere were 1.24×10^{17} and 8.83×10^{15} Bq, respectively.
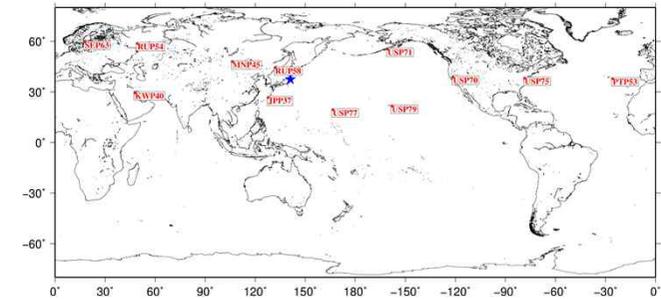

4. Results

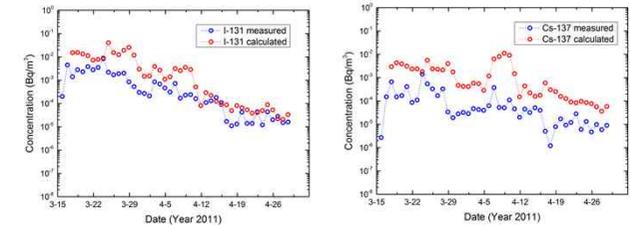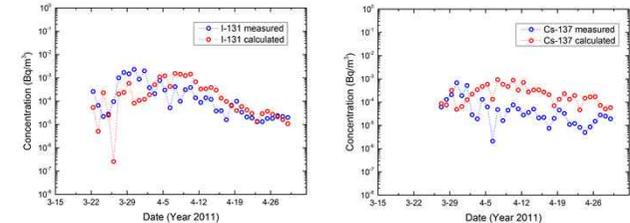### Calculated air concentration profiles of ^{131}I near a surface

Some sampling positions of CTBTO

UPS70 (38.7° N, 121.4° W) : Sacramento, USA

SEP63 (59.4° N, 17.9° E) : Stockholm, Sweden

JPP37 (26.5° N, 127.9° E) : Okinawa, Japan

5. Conclusions

- From comparisons of simulations and measurements, the developed model was successfully validated, and it could then be used to understand the overall dispersion patterns of radionuclides spreading out in the world after the Fukushima accident. The radioactive plume was transported to the east part off the Fukushima site by a Westerly jet stream. In addtion, it was detected in North America during March 17-21, in European countries during March 23-24, and in Asia during March 24 to April 6, 2011. This event was well represented in the numerical model and the simulation results generally showed a good agreement with the observations at IMS of CTBTO.