A. Preface[1]

The 2011 off the Pacific coast of Tohoku Earthquake (Great East Japan Earthquake) and tsunami occurred on 11 March 2011 and caused severe damage in Japan. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was asked to produce a scientific report for the General Assembly on the levels and effects of radiation exposure caused by the accident at the Fukushima Daiichi Nuclear Power Plant, and UNSCEAR requested the World Meteorological Organization (WMO) to develop a set of meteorological analyses for assessing the atmospheric transport, dispersion, and deposition of radioactive materials. In response to UNSCEAR's request, the WMO's Commission for Basic Systems convened a technical task team of experts from five countries (Austria, Canada, Japan, United Kingdom, and the United States) in November 2011. The primary aim of this team was to examine how the use of meteorological analyses could improve atmospheric transport, dispersion, and deposition model (ATDM) calculations.

As the Regional Specialized Meteorological Center of the country in which the accident occurred, the Japan Meteorological Agency (JMA) collaborated with the WMO Task Team by providing its mesoscale analysis based on operational four-dimensional variational data assimilation and radar/rain gauge-analyzed precipitation (RAP) data in the standard WMO format (GRIB2). To evaluate the quality of the meteorological analyses, the WMO Task Team conducted test simulations with their regional ATDMs and different meteorological analyses. JMA developed a regional ATDM for radionuclides by modifying its operational regional atmospheric transport model, which had been previously used for photochemical oxidant predictions and volcanic ashfall forecasts. The modified model (hereafter referred to as JMA-RATM) newly implemented dry deposition, wet scavenging, and gravitational settling of radionuclide aerosol particles. The preliminary and revised calculations of JMA-RATM were conducted with a horizontal concentration and deposition grid resolution of 5 km and a unit source emission rate, in accordance with the Task Team's protocols.

This technical report describes JMA's contribution to the WMO Task Team and summarizes the Task Team activities and relevant ATDM modeling carried out at the Meteorological Research Institute (MRI) of JMA.

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[1] K. Saito

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The report is organized as follows. Section B presents an overview of the WMO Task Team and the Task Team meetings. Section C reports on JMA's contributions to the WMO Task Team. The operational mesoscale analysis and RAP data, including a data conversion tool prepared by JMA to facilitate their use by the scientific community, are described. In Section D, the ATDM experiments conducted by the Task Team members are presented. Section E describes the JMA-RATM and the modifications implemented to support the Task Team activities. Experiments conducted to test the sensitivity of the JMA-RATM calculations to some of the ATDM parameters (release height, number of computational particles, wet scavenging coefficient and application height, and dry deposition application height) are also described. Section F introduces the ATDMs of each of the Task Team member countries, and the results of those ATDM calculations are presented and verified against ^{137}Cs deposition measurements and the air concentration time series. In Section G, relevant ATDM modeling conducted at MRI and JMA is introduced, including an ATDM intercomparison performed by the Science Council of Japan and an emission source estimation made by using an inverse model. A special contribution from Prof. Toshiki Iwasaki of Tohoku University illustrates the necessity to utilize ATDM modeling in the nuclear power plant accident. Section H is the list of references. Section I, the appendix, contains copies of the WMO Task Team meeting reports, courtesy of the WMO.