Atmospheric Dispersion of Various Types of Iodine in UAE in February and August

Sung-yeop Kim[a,b*], Soon Heung Chang[b], Kun Jai Lee[b], Philip A. Beeley[a]
[a]*Khalifa University of Science, Technology & Research, P.O. Box 127788, Abu Dhabi, United Arab Emirates*
[b]*Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon, 305-701, Republic of Korea*
[*]*Corresponding author: sung.kim@kustar.ac.ae*

1. Introduction

There are three representative types of iodine released to atmosphere:

- Gaseous type
  - Elemental Iodine (I_2, Reactive)
  - Organic Iodine (CH_3I, Non-reactive)
- Particle (Aerosol) type

The distribution ratio of these three types of iodine being released to the atmosphere under accident scenario is still not clearly reported because of its complex kinetics of chemical and physical process in the accidental condition. [1, 2] In this research, the dispersion behaviors of three kinds of iodine in the atmosphere have been considered in the UAE environment in winter and summer situations.

2. Methods

ADMS5 (Atmospheric Dispersion Modelling System 5) has been installed and used for the numerical calculation of atmospheric dispersion as an advanced Gaussian plume model. [3] The graphical results have been plotted by using Surfer Demo 11.

1 TB/h of I-131 was assumed to be released as a point source. The Aerosol Mean Aerodynamic Diameter (AMAD) of particle type of I-131 has been set as 0.48 μm referring to Baklanov et al. (2001) [4] Table 1 shows the average meteorological data acquired from Al Mifra climate station in the data collecting interval of 3 hours in February and August, 2012 [5]

Table 1. Average meteorological data from Al Mifra climate station in February and August, 2011

	Average in Feb.	Average in Aug.
Wind velocity	5.8 m/s	4.2 m/s
Wind direction	North dominant	North dominant
Temperature	20.9 ℃	37.3 ℃
Cloud amount	1.1 okta	3.5 okta
Rainfall	0	0

Long-term simulations have been carried out considering 3 hours sequentially varying meteorological conditions in a month (Feb., Aug.) by using ADMS5.

3. Result and Discussion

The average ground level concentrations [Bq/m^3] of three kinds of I-131 in February and August are described in figure 1-6.

Because of the higher wind speed in winter, radionuclides in the air are transported and spread by wind following the downwind direction from source more than summer and lower ground level concentration in same distance from the source appears in winter than that of summer.

Pasquill atmospheric stability class is estimated to be C-D in winter and B-C in summer. σ_y is higher at unstable class (class close to A) and figures of summer show the wide lateral spreading of the vertical downwind directions.

Particle type shows the highest ground level concentration, and organic gas type shows higher concentration than elemental gas type. Concentrations for a non-reactive gas (organic iodine) will be higher than for a reactive gas (elemental iodine) because less material is removed from the plume and deposited on the ground meaning more remains in the plume.

4. Conclusion

Higher ground level concentration on the same downwind distance from the source appears in summer because of lower wind speed than that of winter. More lateral spreading of vertical downwind direction in summer has been confirmed because of less stable air than that of winter. Higher ground level concentrations have been appeared in order of particle type, organic gas type and elemental gas type of I-131 with given assumptions.

REFERENCES

[1] B. Clement, L. Cantrel, G. Ducros, F. Funke, L. Herranz, A. Rydl, G. Weber, and C. Wren, State of the Art Report on Iodine Chemistry, Nuclear Energy Agency / Committee on the Safety of Nuclear Installations Report, 2007

[2] J.C. Wren, Radioiodine Chemistry: The Unfinished Story, The first European Review Meeting on Severe Accident Research (ERMSAR-2005), Nov.13-16, 2005, Aix-en-Provence, France

[3]Cambridge Environmental Research Consultants (CERC), ADMS5 User Guide Version 5.0, Cambridge Environmental Research Consultants Ltd., pp.35, 2012.

[4] A. Baklanov and J. H. Sorensen, Parameterisation of Radionuclide Deposition in Atmospheric Long-Range Transport Modelling, Physics and Chemistry of the Earth, Vo1 26, No. 10, pp. 787-799, 2001.

[5] WindGURU: http://www.windguru.cz/

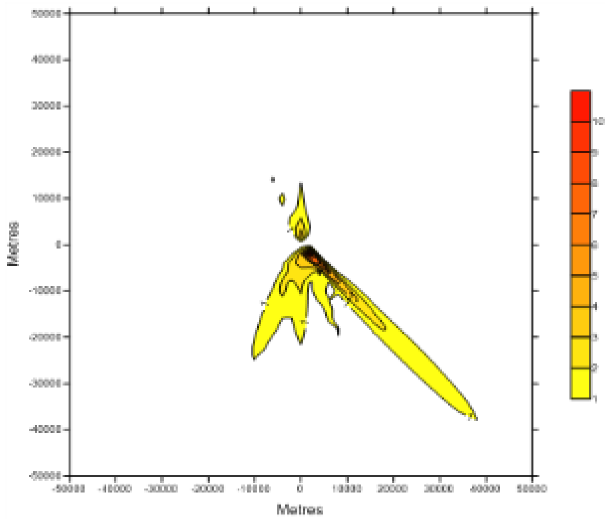

Figure 1. Average ground level concentration [Bq/m^3] of I-137 (elemental gas type) with 1TBq/h point source release in February

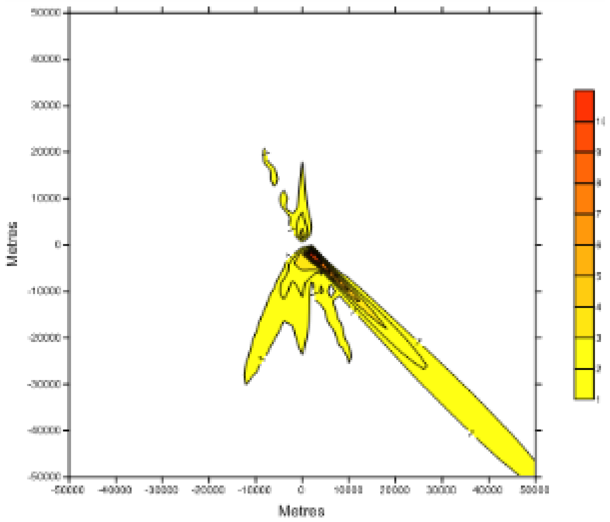

Figure 2. Average ground level concentration [Bq/m^3] of I-137 (organic gas type) with 1TBq/h point source release in February

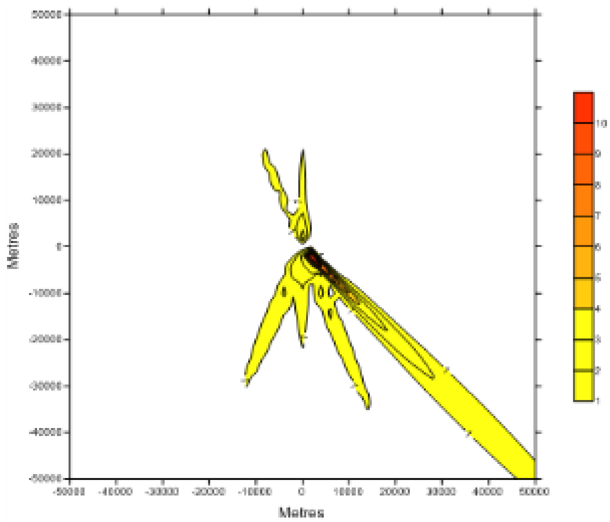

Figure 3. Average ground level concentration [Bq/m^3] of I-137 (particle type) with 1TBq/h point source release in February

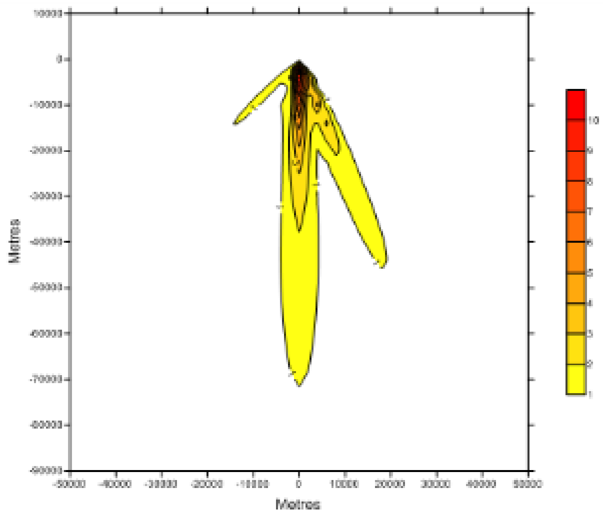

Figure 4. Average ground level concentration [Bq/m^3] of I-137 (elemental gas type) with 1TBq/h point source release in August

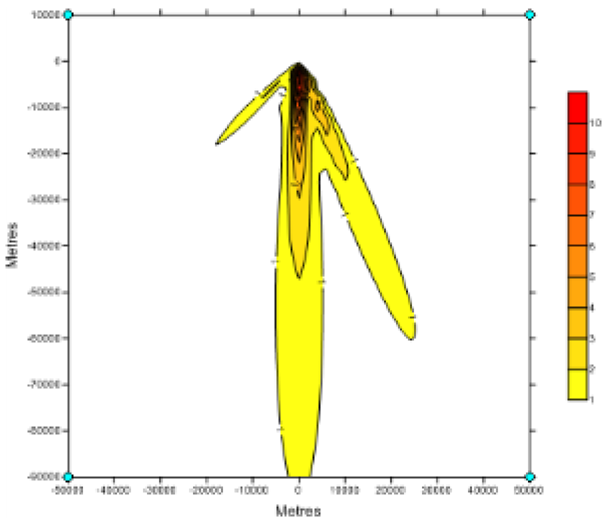

Figure 5. Average ground level concentration [Bq/m^3] of I-137 (organic gas type) with 1TBq/h point source release in August

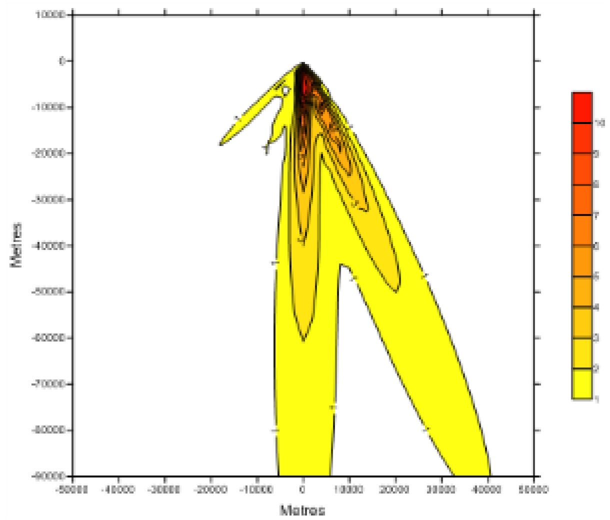

Figure 6. Average ground level concentration [Bq/m^3] of I-137 (particle type) with 1TBq/h point source release in August