The effective source height (He) was 1. The release rate for each stability condition was calculated by a Gaussian plume model, using the effective height (He) under several atmospheric stability conditions. The release rate for each stability condition was estimated from the results calculated in (2). The effect of atmospheric stability can be simulated by adjusting the dispersion coefficients in the Gaussian plume model.

The accuracy of source intensity estimation was found to be noticeably improved by use of increased averaging times because lateral plume spread increases with averaging time of observations, as shown in Fig. 2.

Effective release height is unknown in accidents such as that at Fukushima (e.g. explosion, leakage from building envelope ...) Concentration distribution depends on plume height near a source but becomes independent of release height far downwind. Uncertainty can be reduced by only using data at large distances from a source.

Calculation scheme: (1) The effective source height (He) was determined from wind tunnel experiments of Mt. Tsukuba under neutral stability conditions. (2) The concentration distribution was calculated by a Gaussian plume model, using the effective height (He) under several stability conditions. (3) The release rate for each stability condition was estimated from the results calculated in (2). (4) Only use observations at large distances from the source.

It was found that the following methods can reduce the uncertainty in source term estimation:

1. **Methods for reducing uncertainty in source term estimation**
   - (1) Extend the average time of observations
   - (2) Use the drift specified by wind tunnel experiments in defining the Gaussian plume axis
   - (3) Fit the dispersion coefficients of the Gaussian plume model to field conditions
   - (4) Only use observations at large distances from the source

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**Wind direction used in calculation**

The observed concentration distribution and wind direction in calculation are shown in Fig. 1. The accuracy of source intensity estimation was found to be noticeably improved by use of increased averaging times because lateral plume spread increases with averaging time of observations, as shown in Fig. 2.

**Observed concentration**

- a) 3min-average: Release rate = True value * 0.03
- b) 60min-average: Release rate = True value * 0.76

**Fig. 2 Lateral concentration distributions at downwind distance of 2000m**

**2. Uncertainty in plume axis position due to terrain effects**

Drift of plume axis caused by complex terrain is shown in Fig. 3. Drift determined by wind tunnel experiments can be included through a simple adjustment to the Gaussian plume model, as below.

\[
\begin{align*}
\frac{\theta \cdot C}{Q} &= \frac{1}{2 \alpha_0 \sigma_0} \exp \left( \frac{y - Y_d}{\sigma_y} \right) \exp \left( \frac{H - H_0}{2 \sigma_z} \right) \\
\end{align*}
\]

- a) Without drift: Release rate = True value * 0.35
- b) With drift: Release rate = True value * 0.76

**Fig. 4 Lateral concentration distribution at downwind distance 2000m**

**3. Uncertainty in atmospheric stability**

Wind direction used in a calculation includes observation errors and uncertainty due to use of 16 categorizations of wind direction. The accuracy of source intensity estimation was found to be noticeably improved by use of increased averaging times because lateral plume spread increases with averaging time of observations, as shown in Fig. 2.

**Pasquill-Gifford dispersion curves**

**Fig. 5**

**Release rate1 (B) = True value * 1.07**

**Release rate2 (C) = True value * 0.45**

**Release rate3 (D) = True value * 0.28**

**Release rate3 (E) = True value * 0.51**

**Fig. 6** Concentration distribution on plume axis at ground level

**4. Uncertainty in emission release height**

**Fig. 7** Concentration distribution on plume axis at ground level

**Fig. 8** Axial ground-level concentration

**Concentration distribution depends on plume height near a source but becomes independent of release height far downwind.**

**Uncertainty can be reduced by only using data at large distances from a source.**

**Fig. 9 Source intensity estimated from data at each downwind location**

**Methods for reducing uncertainty in source term estimation**

- (1) Extend the average time of observations
- (2) Use the drift specified by wind tunnel experiments in defining the Gaussian plume axis
- (3) Fit the dispersion coefficients of the Gaussian plume model to field conditions
- (4) Only use observations at large distances from the source

**5. Conclusions**