Parameter Study with the Atmospheric Dispersion Model ADPIC

HARMO15, 6th May 2013
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Motivation

- ADPIC no longer up to date, specifically with respect to visualisation of results
- ADPIC is an “island solution”
- Knowledge rests on few shoulders

⇒ Project “RADUK” to replace ADPIC (see poster by Giuseppe Testa)
Motivation

Some parameters have to be fixed for all runs, but (may) have strong effect on duration of run:

- horizontal spatial grid resolution
- time resolution of input meteo wind fields
- number of particles emitted

⇒ parameter study
Boundary conditions

Source term: 3.0E18 Bq noble gases
1.0E16 Bq iodine
1.0E15 Bq aerosols

8 scenarios:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release duration [h]</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Simulation duration [h]</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Start time for meteorology</td>
<td>11.1.2011, 17:30</td>
<td>11.1.2011, 17:30</td>
<td>9.1.2011, 22:00</td>
<td>9.1.2011, 22:00</td>
<td>9.1.2011, 00:00</td>
<td>9.1.2011, 00:00</td>
<td>8.2.2011, 16:30</td>
<td>8.2.2011, 16:30</td>
</tr>
<tr>
<td>Activity release time dependence (first half and second half of release duration time)</td>
<td>2/3</td>
<td>1/5</td>
<td>2/3</td>
<td>1/5</td>
<td>2/3</td>
<td>1/5</td>
<td>1/4</td>
<td>1/5</td>
</tr>
<tr>
<td>Release height [m] (first half and second half of release duration time, if different)</td>
<td>70</td>
<td>20</td>
<td>70</td>
<td>20</td>
<td>70</td>
<td>20</td>
<td>70</td>
<td>20</td>
</tr>
<tr>
<td>Thermal release energy [MW]</td>
<td>0</td>
<td>0.01</td>
<td>0</td>
<td>0.01</td>
<td>0</td>
<td>0.01</td>
<td>0</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Parameters varied

• Horizontal spatial grid resolution: 250 m, 500 m, and 1’000 m.
• Time resolution of input wind fields: 10 min, 30 min, and 60 min.
• Number of particles emitted per time: 1’024’000/h, 256’000/h, 64’000/h, 16’000/h, and 4’000/h.
Analysis methods

a) Maximum resulting dose within a specific distance ring (relative to “highest quality” run)

b) Dose map plot
Results: horizontal grid resolution

External cloud dose
Maximum dose within distance ring relative to 250 m
Variation of horizontal grid resolution; time resolution 10 min; highest number of particles

- External cloud dose graph showing the maximum dose within distance rings relative to 250 m.
- The graph displays variations in grid resolution with different distance ranges, showing a decline in dose with increasing distance.
- The data points are color-coded for different grid resolutions: 1000 m (blue diamonds) and 500 m (red squares), with mean values indicated by lines.
- Distance ranges include 0.2 - 1 km, 1 - 4 km, 4 - 10 km, 10 - 20 km, and 20 - 35 km.
Results: horizontal grid resolution

Inhalation dose (iodine)
Maximum dose within distance ring relative to 250 m
Variation of horizontal grid resolution; time resolution 10 min;
highest number of particles

Parameter study w. ADPIC | HARMO15 | Cyrill v. Arx (ENSI)
Results: horizontal grid resolution

Dose map plot (next slide): external cumulative cloud & ground dose at end of simulation

D > 100 mSv
100 mSv > D > 10 mSv
10 mSv > D > 1 mSv
1 mSv > D

Colouring according to Swiss concept for visualisation
Results: horizontal grid resolution
Results: time resolution of wind fields

External cloud dose
Maximum dose within distance ring relative to 10 min
Variation of time resolution; horizontal grid resolution 250 m; highest number of particles
Results: time resolution of wind fields

Inhalation dose (iodine)
Maximum dose within distance ring relative to 10 min
Variation of time resolution; horizontal grid resolution 250 m; highest number of particles

Parameter study w. ADPIC | HARMO15 | Cyrill v. Arx (ENSI)
Results: time resolution of wind fields
Results: number of particles emitted

External cloud dose
Maximum dose within distance ring relative to highest number of particles
Variation of number of particles; time resolution 10 min; horizontal grid resolution 250 m

Parameter study w. ADPIC | HARMO15 | Cyrill v. Arx (ENSI)
Results: number of particles emitted

Inhalation dose (iodine)

Maximum dose within distance ring relative to highest number of particles

Variation of number of particles; time resolution 10 min; horizontal grid resolution 250 m

Parameter study w. ADPIC | HARMO15 | Cyrill v. Arx (ENSI)
Results: number of particles emitted

1'024'000/h
Conclusions

• horizontal spatial resolution critical in small-scale orography

• time resolution of wind fields important in small-scale orography

• number of particles relevant but not critical
Conclusions

For RADUK, we therefore stipulate:

- 250 m spatial grid resolution with nested grid for larger distances
- 10 min time resolution of wind fields
- Appropriate number of particles to ensure sufficient statistics; at least 16’000/h
Questions

Collaborators: Hanspeter Isaak, Benno Bucher, and Giuseppe Testa