Supplementary Material
Natural Hazards and Earth System Sciences

A multi-scale risk assessment for tephra fallout and airborne concentration from multiple Icelandic volcanoes - Part I: hazard assessment

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This supplementary material comprises all maps produced to compile the tephra hazard assessment presented in the article *A multi-scale risk assessment for tephra fallout and airborne concentration from multiple Icelandic volcanoes - Part I: hazard assessment* by Biass et al. First all maps for the probabilistic hazard assessment of far-range atmospheric concentrations are presented and include calculations for the thresholds of $2 \times 10^{-3}$, 0.2 and 2 mg/m$^3$. The first threshold is used to illustrate the 0-ash tolerance policy, whereas the second and the third are useful for the new threshold approach policy (refer to the text for more details). Conservative maps accounting for the occurrence of ash at any flight level (FL) as well as maps for FL050, FL150 and FL300 are also presented. Second, results of the deterministic model runs for historical and well-constrained eruptions are also presented. All eruptions were set to start on the 14th of April 2010 and were run for 10 days. Here are shown simulation results at FL050, FL150 and FL300 24, 48, 72, 96, 120, 144, 168 and 192 hours after the onset of the eruption.

### Probabilistic hazard assessment

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<thead>
<tr>
<th>Hekla ERS 2000-type eruption</th>
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<td>Concentration probability</td>
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<td>Mean arrival time</td>
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<td>Probability of arrival time &gt; 24 h</td>
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<td>Mean persistence time</td>
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<tr>
<td>Standard deviation of persistence time</td>
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<tr>
<td>Probability of persistence time &gt; 12 h</td>
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<th>Hekla ERS 1947-type eruption</th>
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<td>Standard deviation of arrival time</td>
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<tr>
<td>Probability of arrival time &gt; 24 h</td>
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<td>Mean persistence time</td>
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<td>Probability of persistence time &gt; 12 h</td>
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<th>Katla LLERS eruption</th>
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<td>Concentration probability</td>
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<td>Probability of persistence time &gt; 12 h</td>
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<tr>
<th>Askja OES 1875-type eruption</th>
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<td>Concentration probability</td>
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<td>Mean arrival time</td>
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<td>Standard deviation of arrival time</td>
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<td>Probability of arrival time &gt; 24 h</td>
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<td>Mean persistence time</td>
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<td>Standard deviation of persistence time</td>
<td>29</td>
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<td>Probability of persistence time &gt; 12 h</td>
<td>30</td>
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### Deterministic scenarios

| Hekla 1947 | 31 |
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| Concentration above airports at FL050 | 39 |
| Concentration above airports at FL150 | 40 |
| Concentration above airports at FL300 | 41 |
Hekla ERS 2000-type - Mean arrival time (h)

Mean arrival time (h): 2.0 mg/m³ · ALL FL

Mean arrival time (h): 0.2 mg/m³ · ALL FL

Mean arrival time (h): 0.02 mg/m³ · ALL FL

Mean arrival time (h): 0.002 mg/m³ · ALL FL

Mean arrival time (h): 0.02 mg/m³ · FL50

Mean arrival time (h): 0.2 mg/m³ · FL50

Mean arrival time (h): 2.0 mg/m³ · FL50

Mean arrival time (h): 2.0 mg/m³ · FL100

Mean arrival time (h): 0.2 mg/m³ · FL100

Mean arrival time (h): 0.02 mg/m³ · FL100

Mean arrival time (h): 0.002 mg/m³ · FL100

Arrival time (h)
Hekla ERS 2000-type - Probability of arrival time > 24 h (%)
Hekla ERS 2000-type - Standard deviation of persistence time (h)

Standard deviation of persistence time (h) = 2 × 10^7 mg/m^2 - FL130

Standard deviation of persistence time (h) = 0.2 mg/m^2 - FL150

Persistence time (h)

6 h 12 h 18 h 24 h 30 h 36 h 42 h 48 h
Hekla ERS 2000-type - Probability of persistence time > 12 h (%)
Hekla ERS 1947-type - Standard deviation of arrival time (h)

- Standard deviation of arrival time ($h \times 2 \times 10^{-3}$ mgm$^2$) - ALL FL
- Standard deviation of arrival time ($h \times 0.2$ mgm$^2$) - FL150
- Standard deviation of arrival time ($h \times 0.2$ mgm$^2$) - FL300

Arrival Time (h)

6h 12h 18h 24h 30h 36h 42h 48h
Hekla ERS 1947-type - Probability of arrival time > 24 h (%)
Hekla ERS 1947-type - Mean persistence time (h) 14
Hekla ERS 1947-type - Standard deviation of persistence time (h)

- Standard deviation of persistence time (h) = 2 x 10^{-7} mg/m^2

- Standard deviation of persistence time (h) = 2 x 10^{-7} mg/m^2 - FL150

- Standard deviation of persistence time (h) = 2 mg/m^2 - FL150

- Standard deviation of persistence time (h) = 2 mg/m^2 - FL310

- Standard deviation of persistence time (h) = 2 mg/m^2 - FL500
Hekla ERS 1947-type - Probability of persistence time > 12 h (%)
Katla LLERS - Mean persistence time (h)

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Katla LLERS - Standard deviation of persistence time (h)
Askja OES 1875-type - Mean arrival time (h)
Askja OES 1875-type - Standard deviation of arrival time (h) 26
Askja OES 1875-type - Mean persistence time (h)

Mean persistence time (h): 28
Askja OES 1875-type - Standard deviation of persistence time (h)
Askja OES 1875-type - Probability of persistence time > 12 h (%)
Hekla 1947 - Deterministic approach - Concentration (mg/m³)
Eyjafjallajökull 2010 - Deterministic approach - Concentration (mg/m³)
Deterministic approach - Concentration over airports at FL050

Concentration over the airports of London Heathrow (EGLL), Paris Charles de Gaulle (LFPG), Amsterdam Schipol (EHAM), Frankfurt (EDDF), Oslo Gardemoen (ENGM) and Copenhagen Kastrup (EKCH) at FL050.

- Hekla 1947
- Katla 1918
- Eyjafallajökull 2010
- Askja 1875
Concentration over the airports of London Heathrow (EGLL), Paris Charles de Gaulle (LFPG), Amsterdam Schipol (EHAM), Frankfurt (EDDF), Oslo Gardemoen (ENGM) and Copenhagen Kastrup (EKCH) at FL150.
Concentration over the airports of London Heathrow (EGLL), Paris Charles de Gaulle (LFPG), Amsterdam Schipol (EHAM), Frankfurt (EDDF), Oslo Gardemoen (ENGM) and Copenhagen Kastrup (EKCH) at FL300.