

# 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  $2 \text{ mg/m}^3$ . 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 are also presented. All eruptions were set to start on the 14th of April 2010 and were ran 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

### Hekla ERS 2000-type eruption

Concentration probability	3
Mean arrival time	4
Standard deviation of arrival time	5
Probability of arrival time > 24 h	6
Mean persistence time	7
Standard deviation of persistence time	8
Probability of persistence time > 12 h	9

### Hekla ERS 1947-type eruption

Concentration probability	10
Mean arrival time	11
Standard deviation of arrival time	12
Probability of arrival time > 24 h	13
Mean persistence time	14
Standard deviation of persistence time	15
Probability of persistence time > 12 h	16

### Katla LLERS eruption

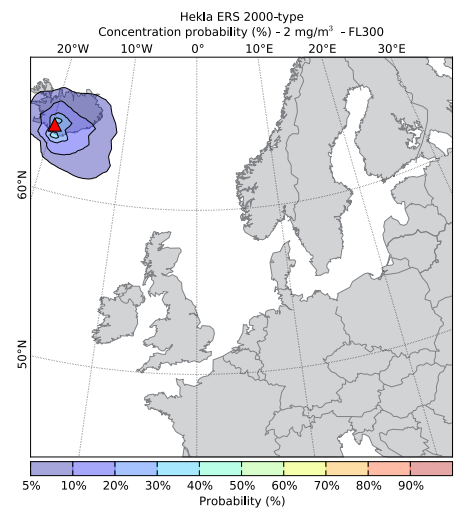
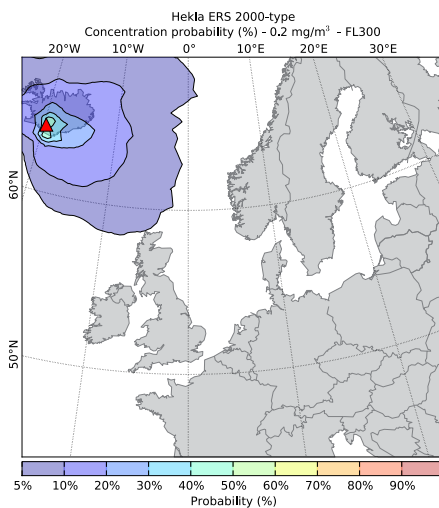
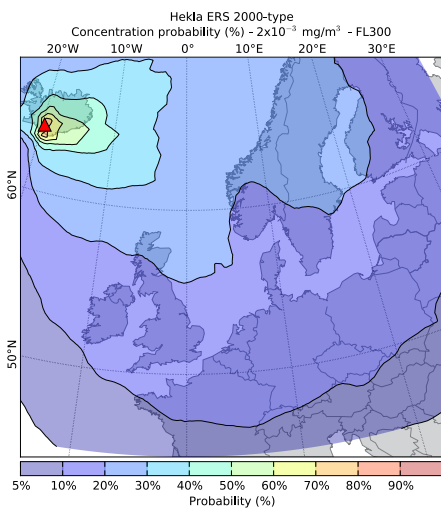
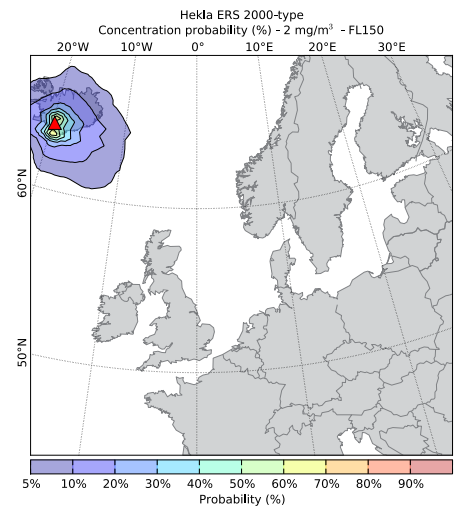
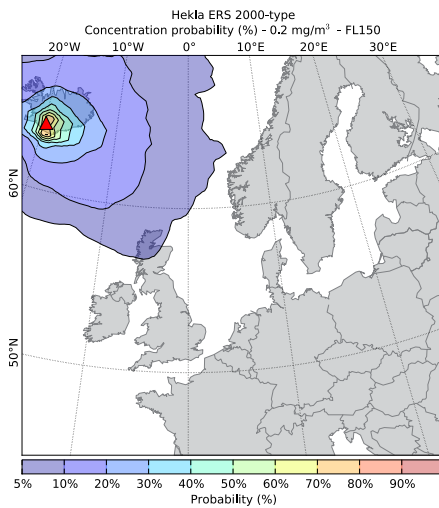
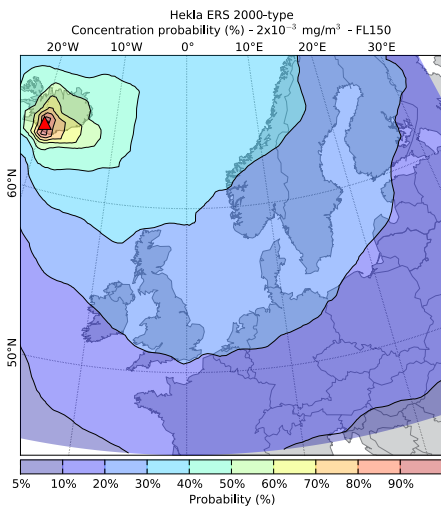
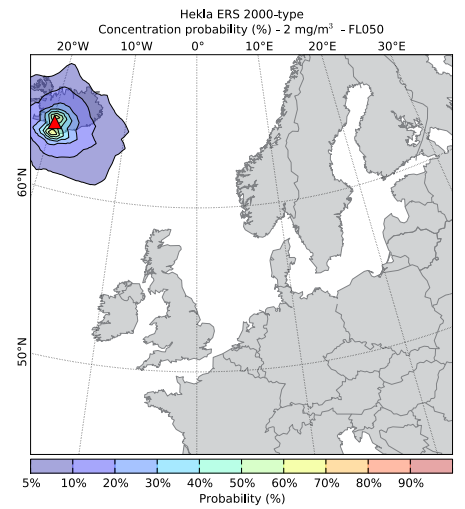
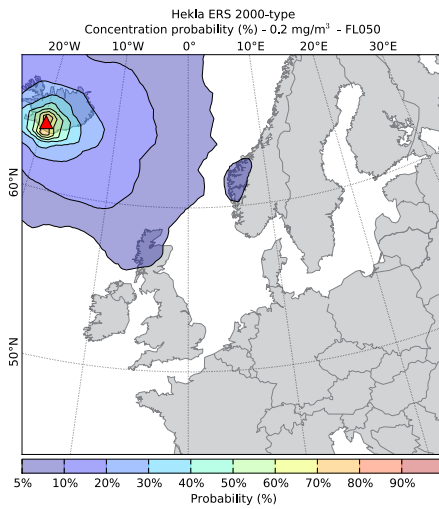
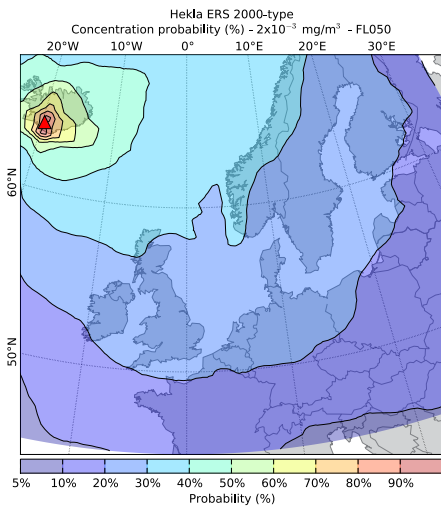
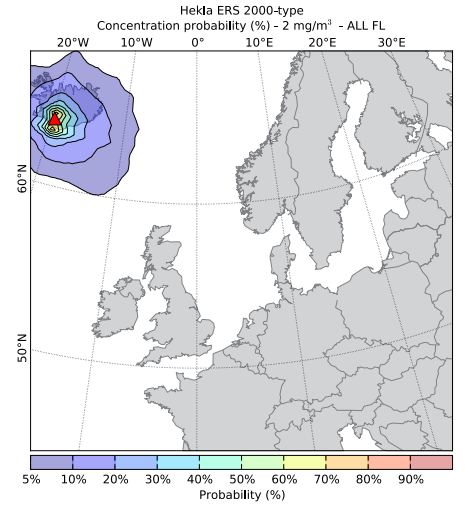
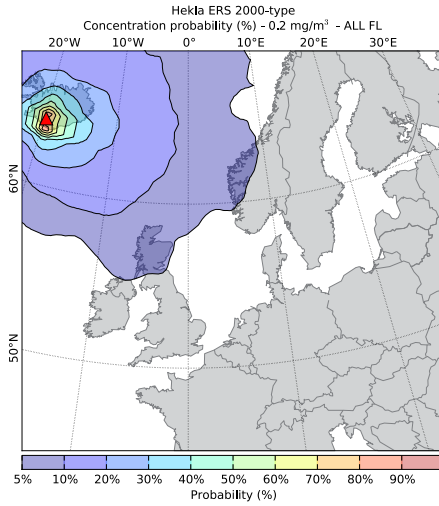
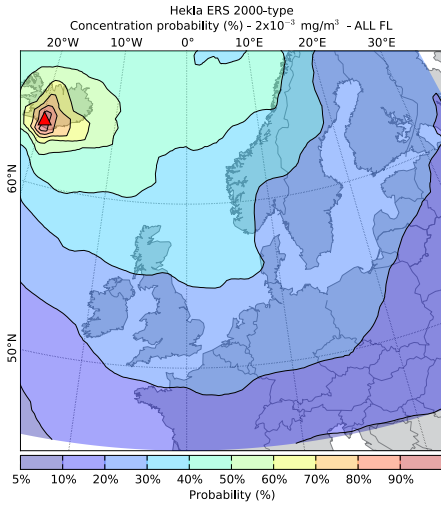
Concentration probability	17
Mean arrival time	18
Standard deviation of arrival time	19
Probability of arrival time > 24 h	20
Mean persistence time	21
Standard deviation of persistence time	22
Probability of persistence time > 12 h	23

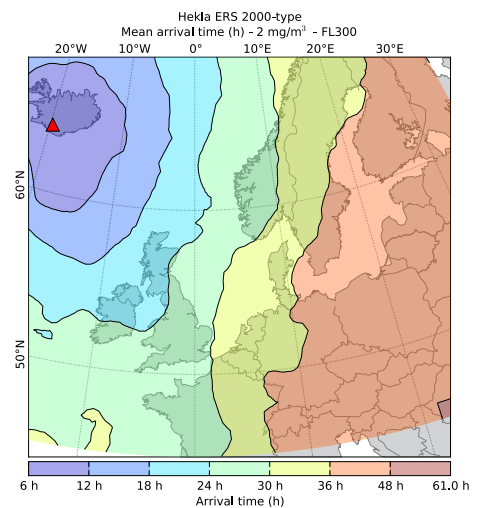
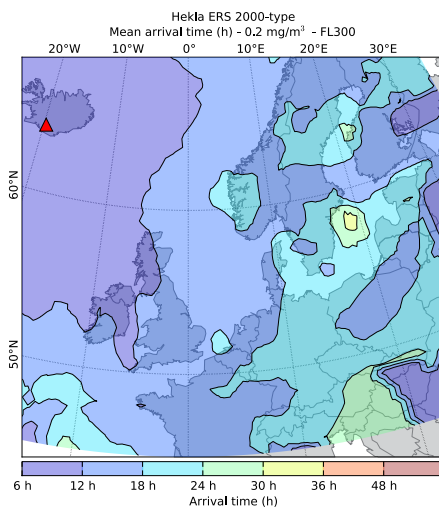
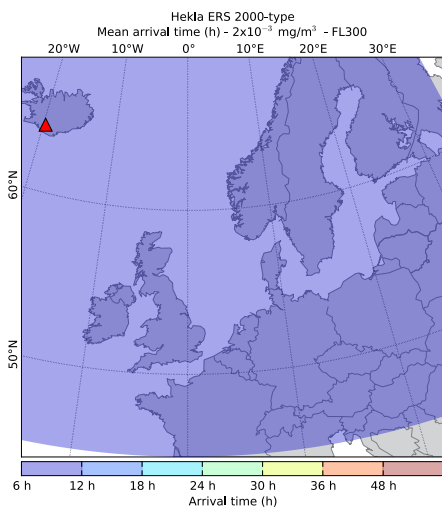
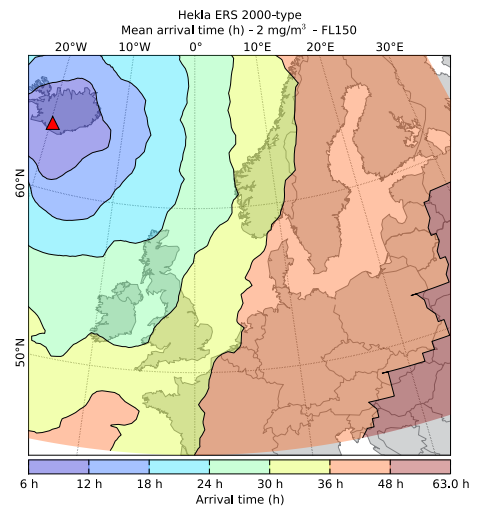
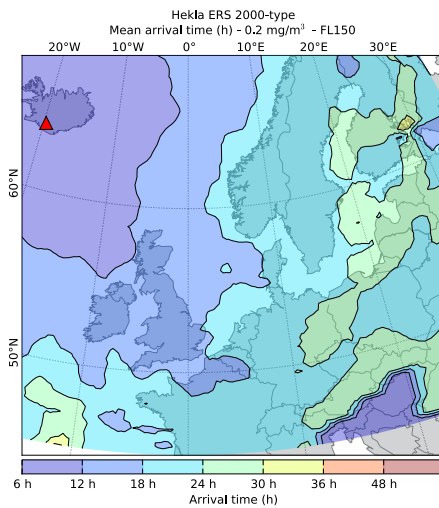
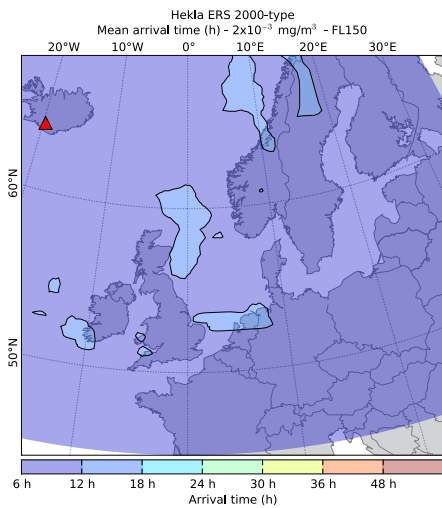
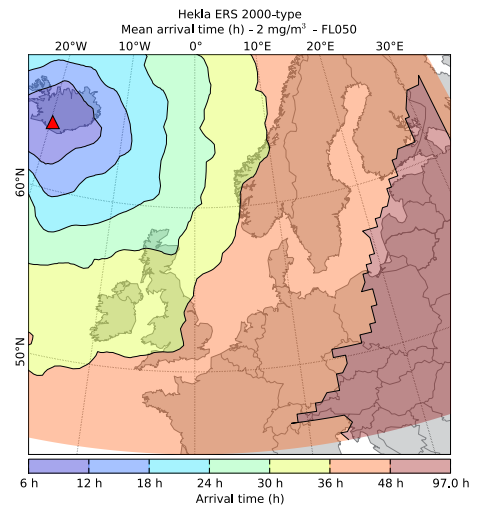
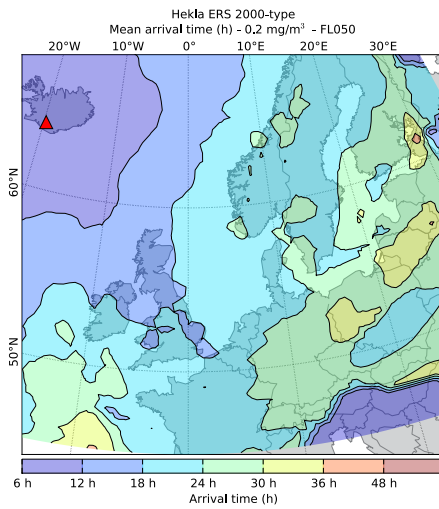
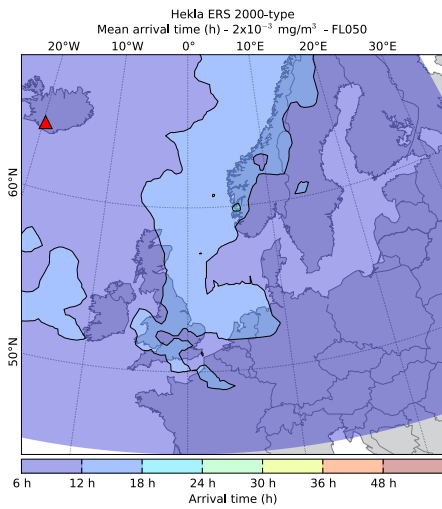
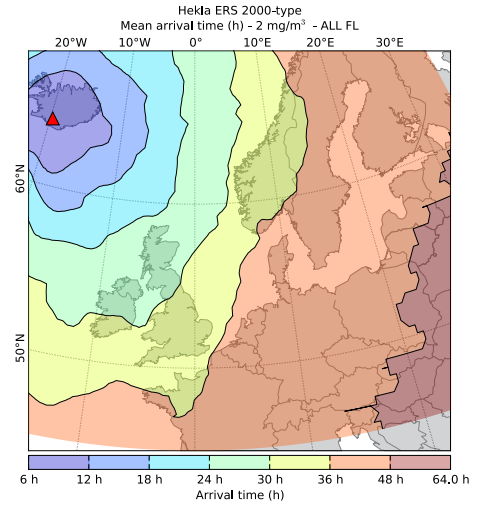
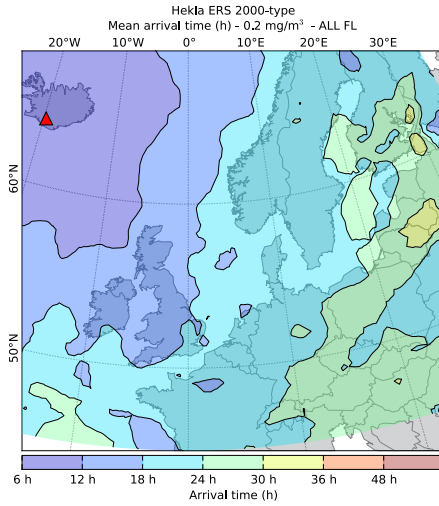
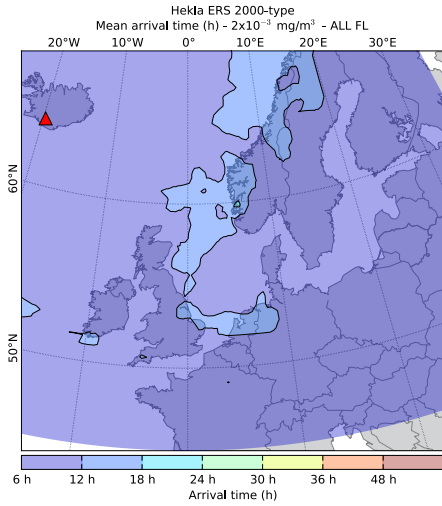
### Askja OES 1875-type eruption

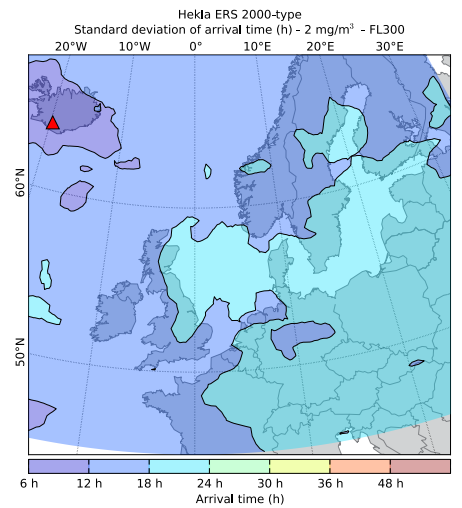
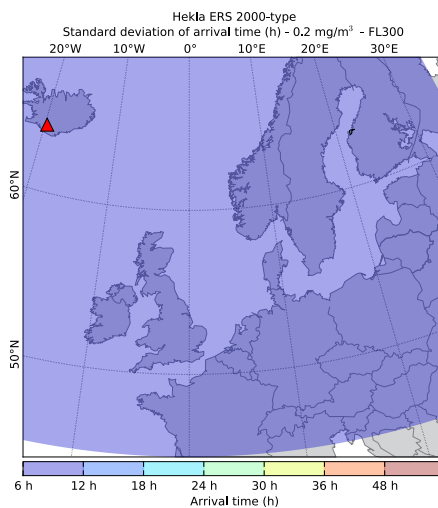
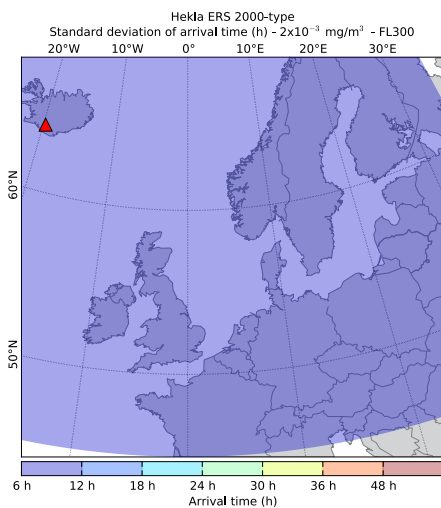
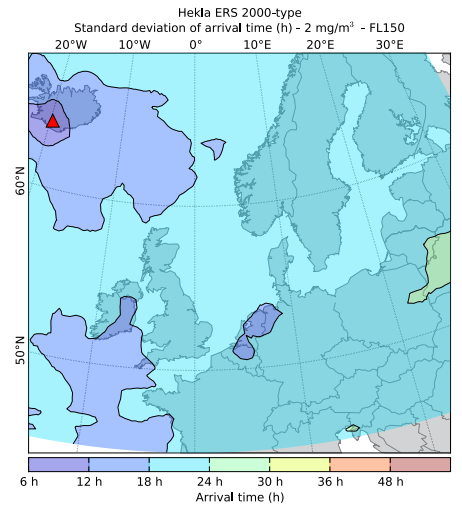
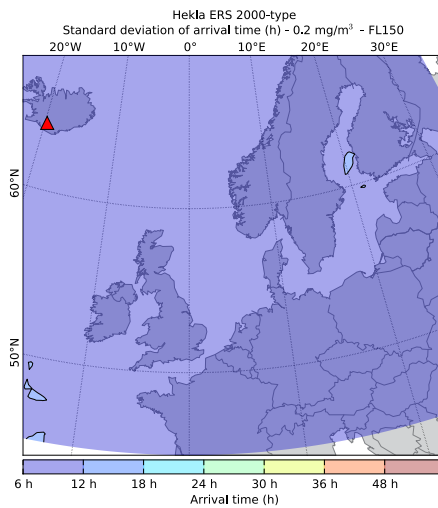
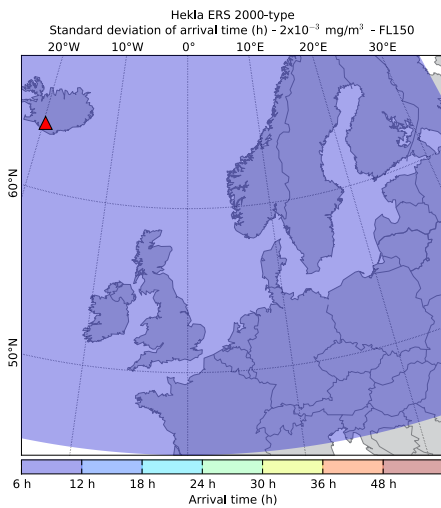
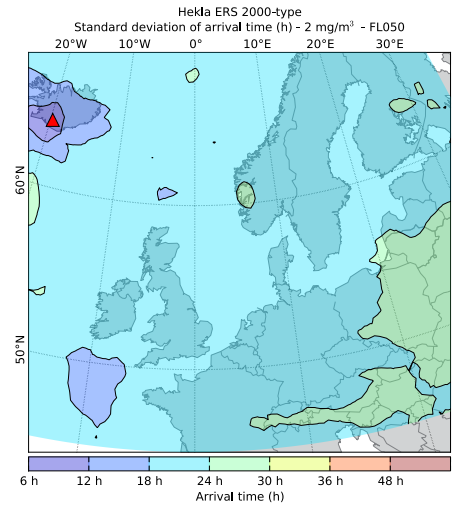
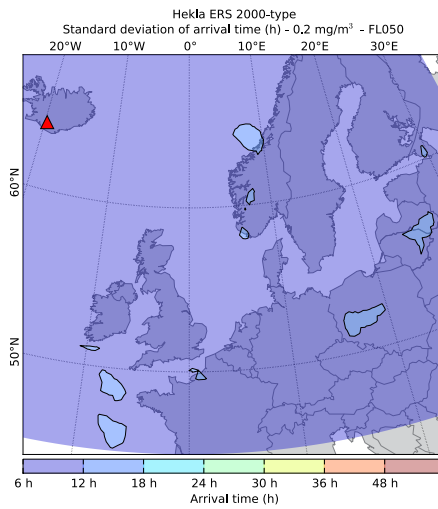
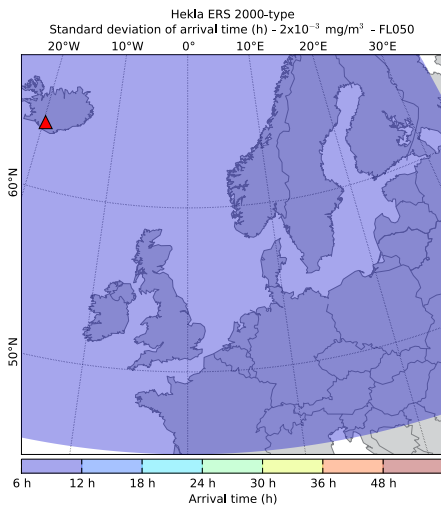
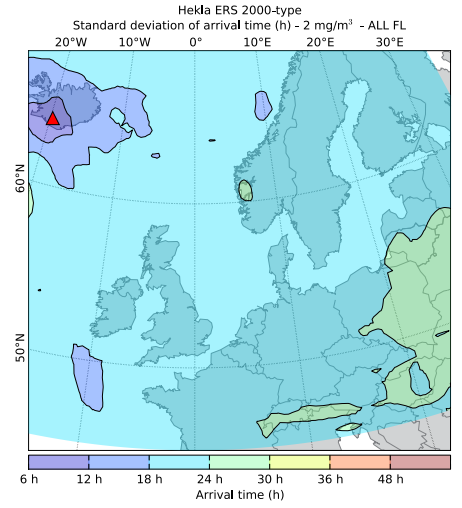
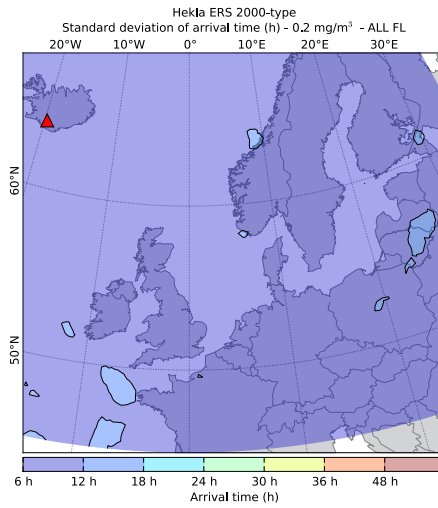
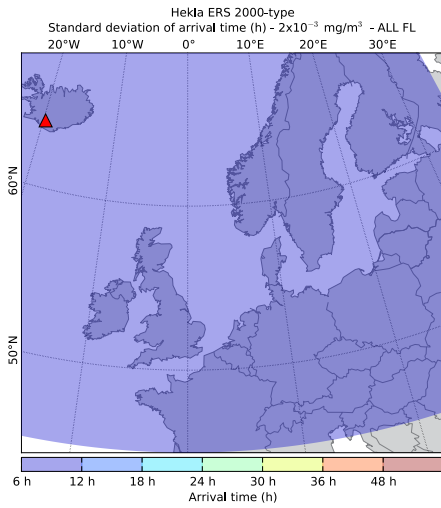
Concentration probability	24
Mean arrival time	25
Standard deviation of arrival time	26
Probability of arrival time > 24 h	27
Mean persistence time	28
Standard deviation of persistence time	29
Probability of persistence time > 12 h	30

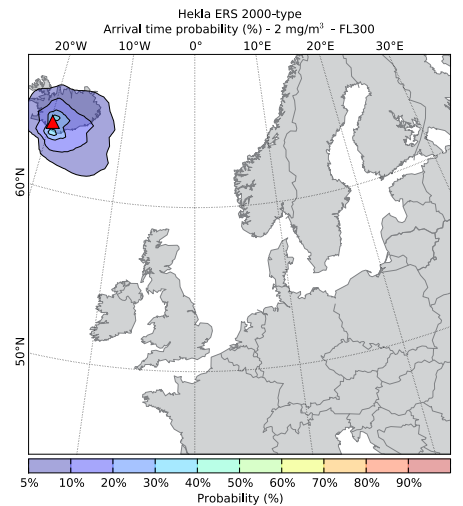
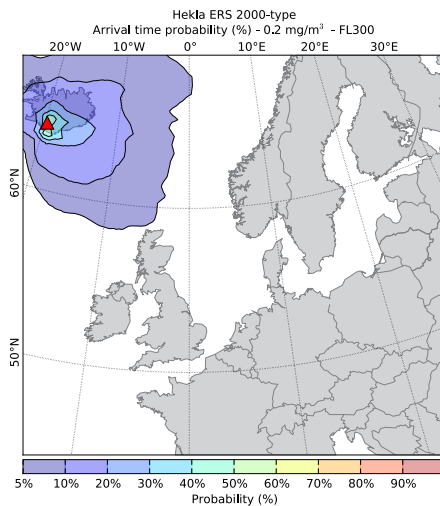
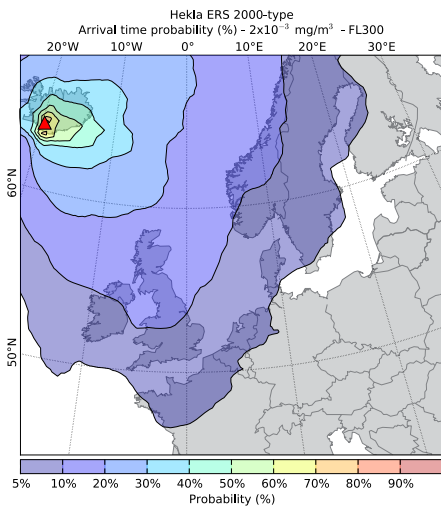
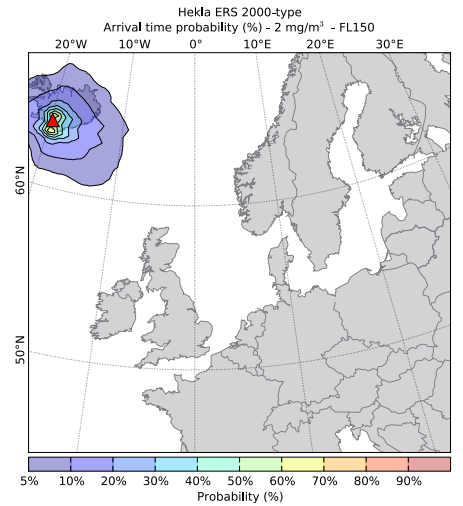
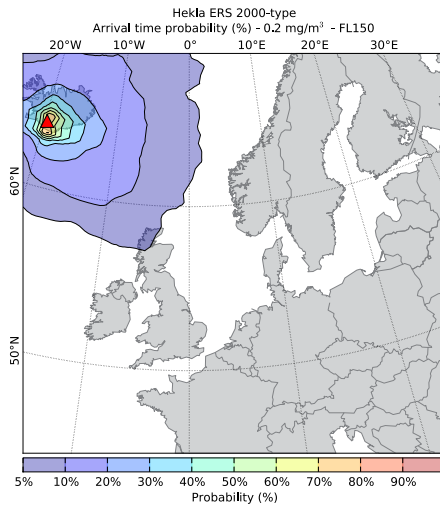
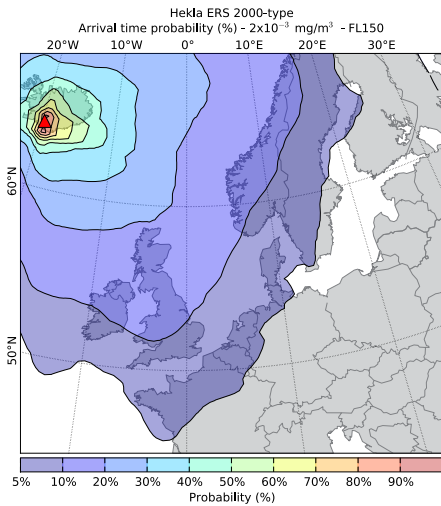
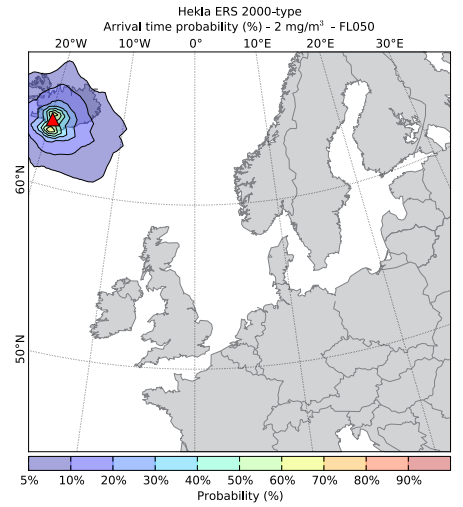
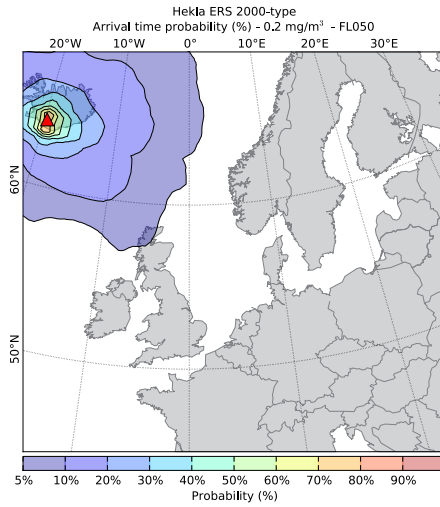
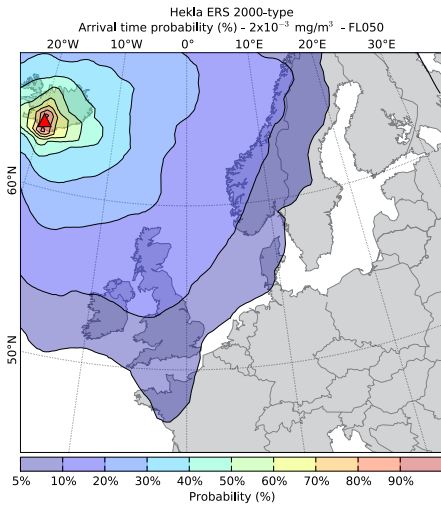
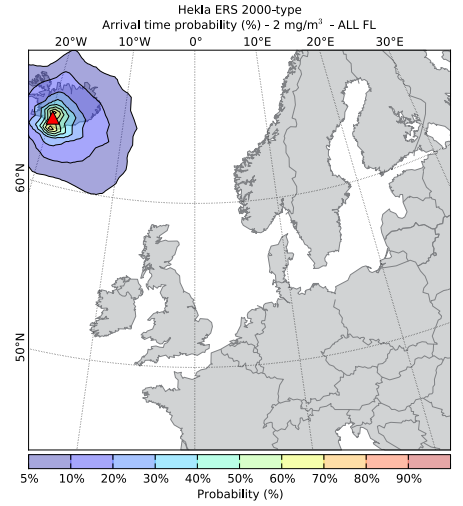
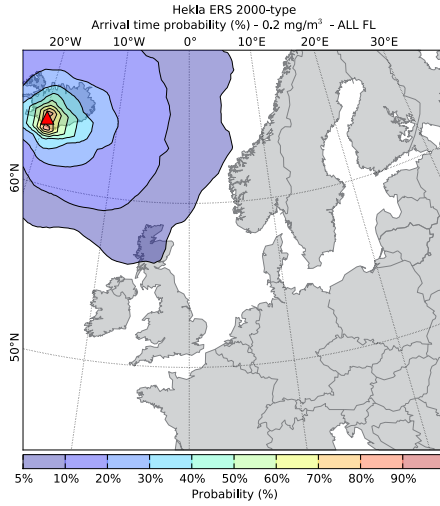
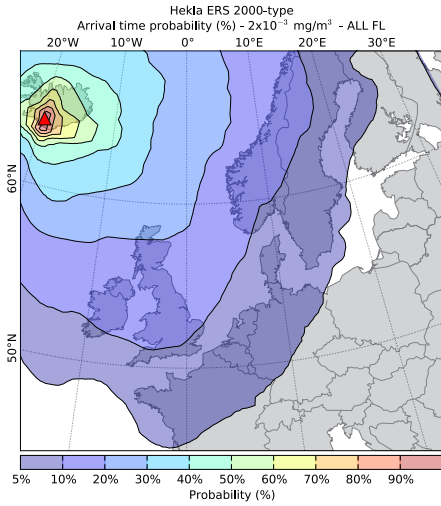
## Deterministic scenarios

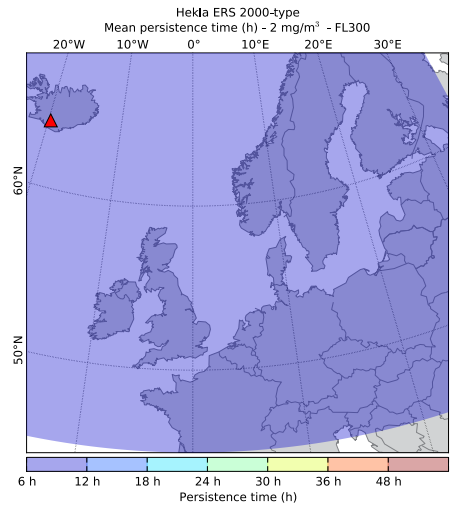
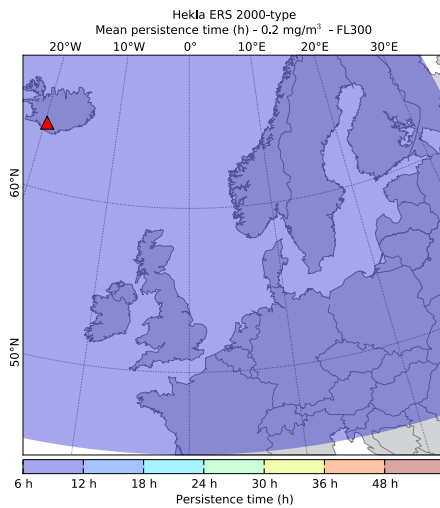
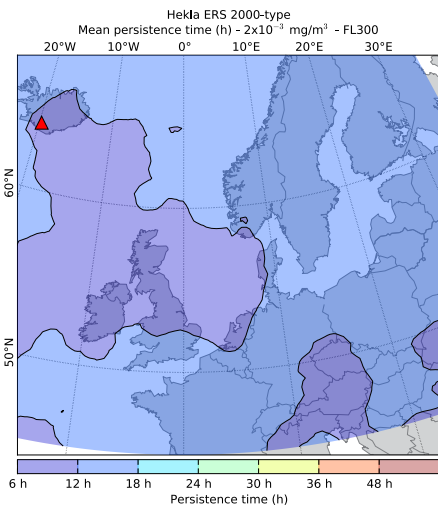
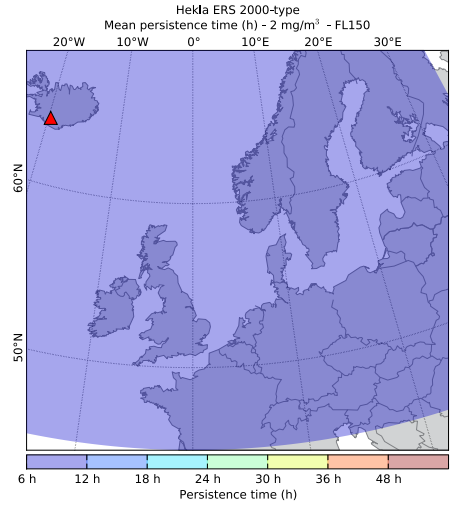
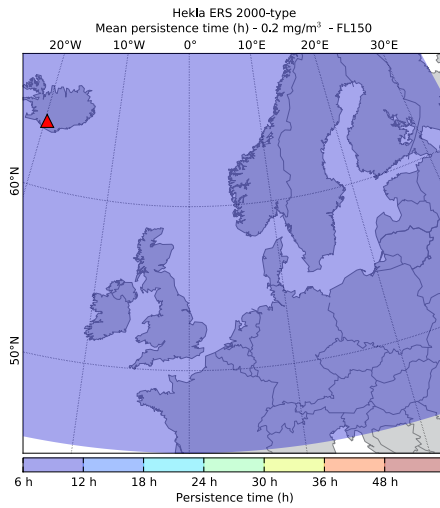
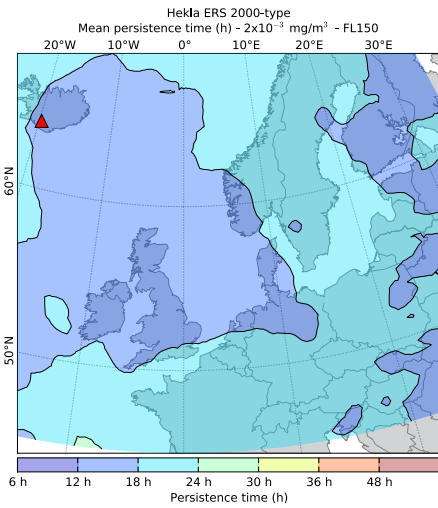
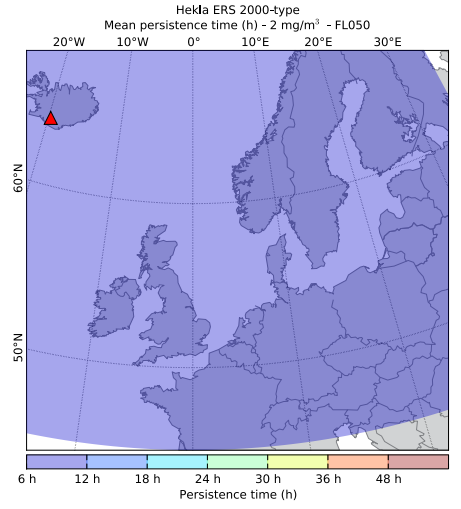
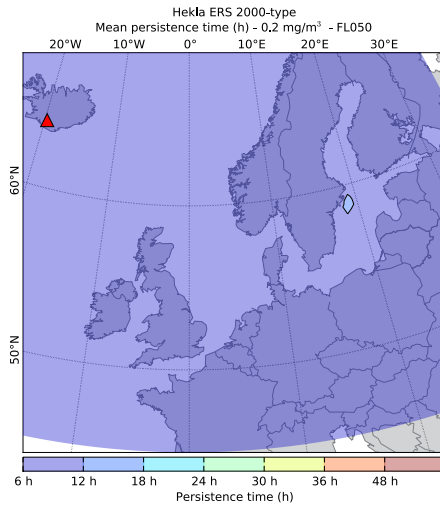
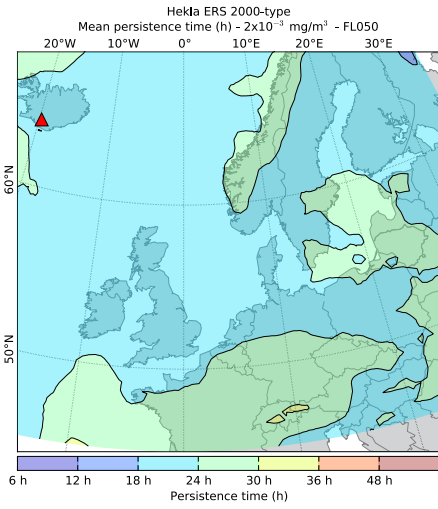
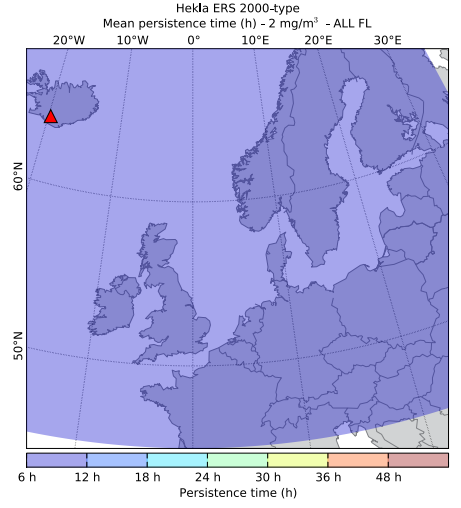
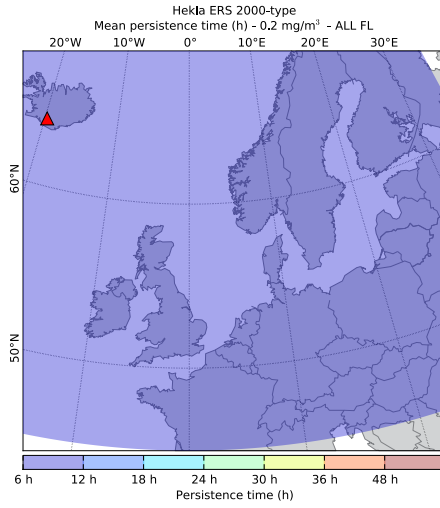
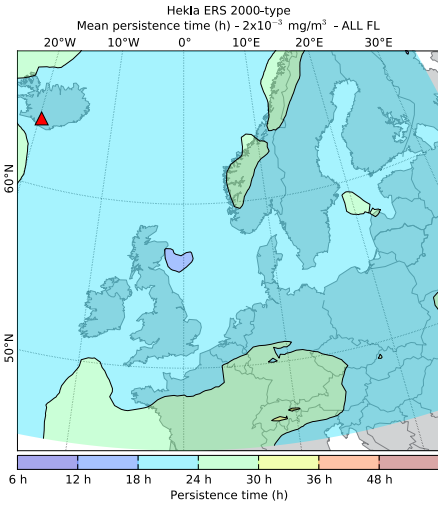
Hekla 1947	31
Katla 1918	33
Eyjafjallajökull 2010	35
Askja 1875	37
Concentration above airports at FL050	39
Concentration above airports at FL150	40
Concentration above airports at FL300	41

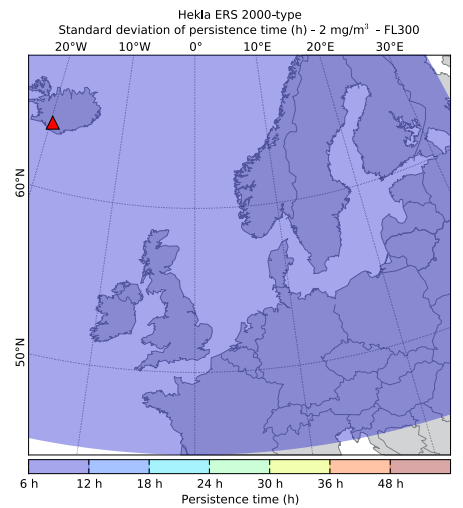
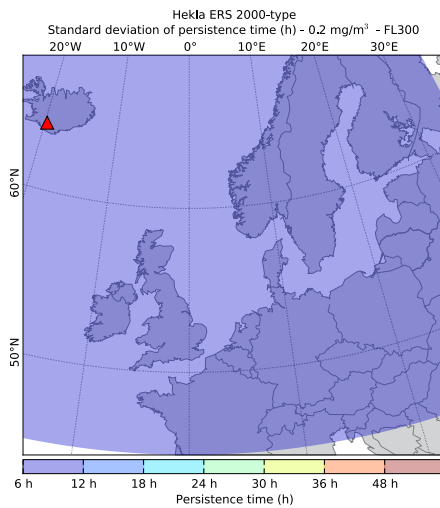
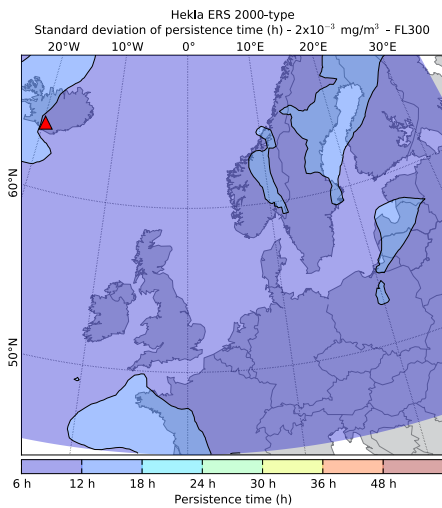
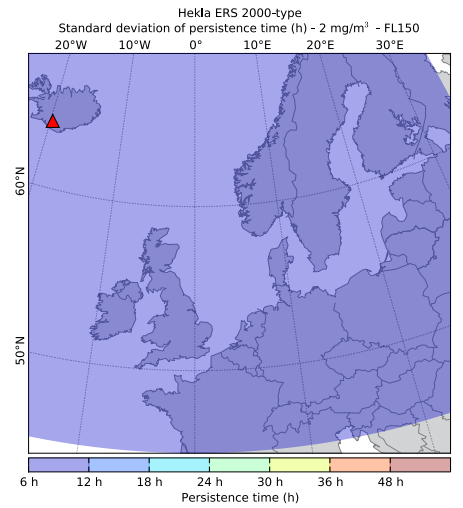
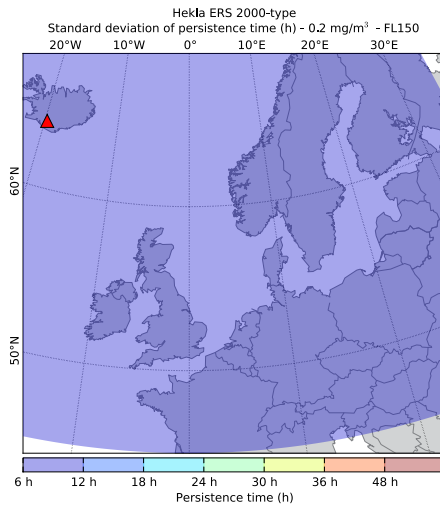
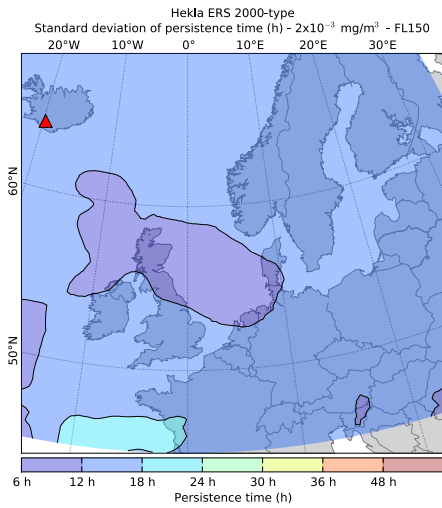
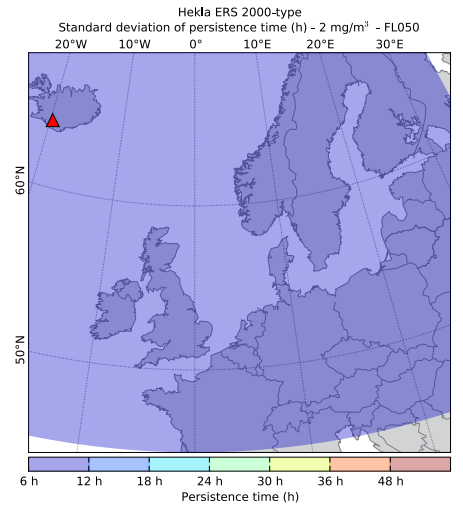
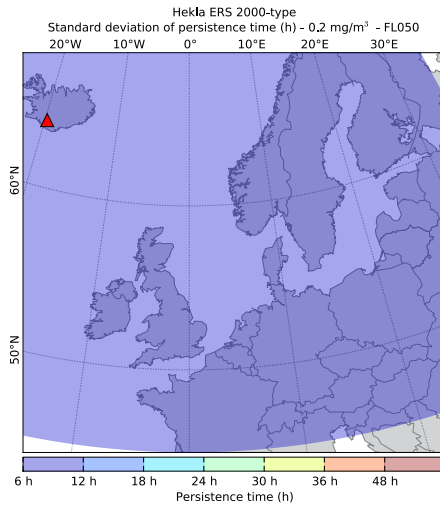
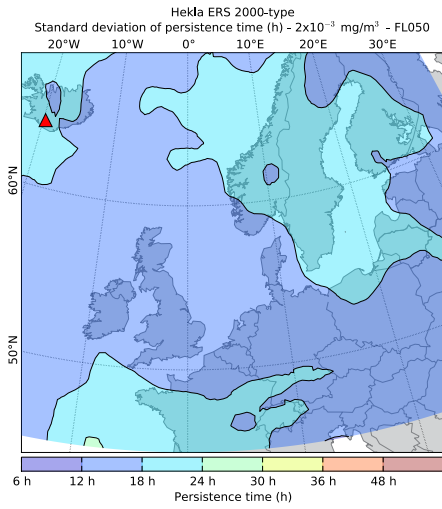
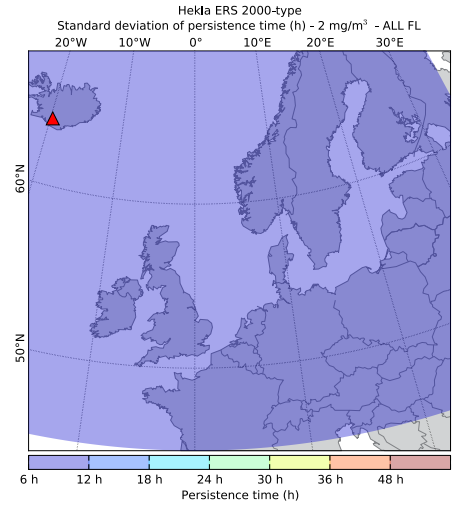
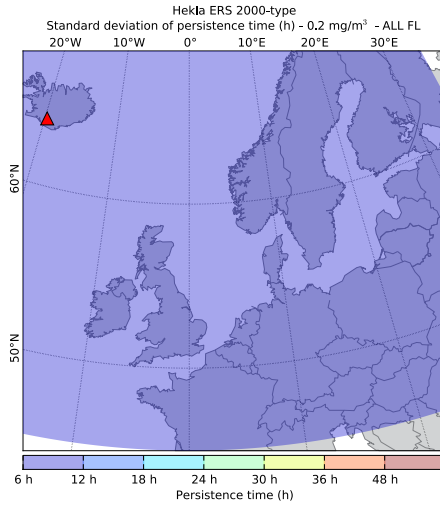
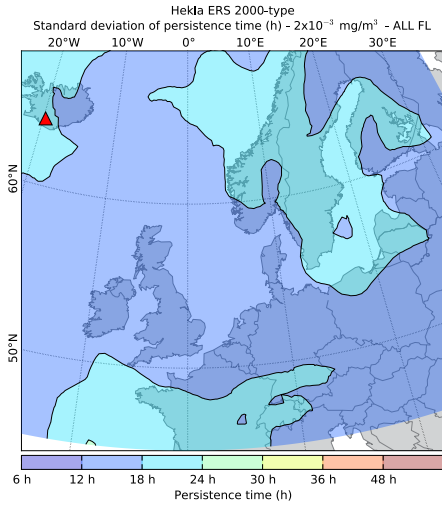






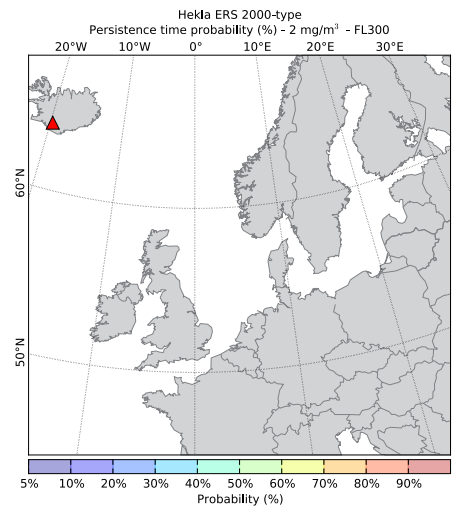
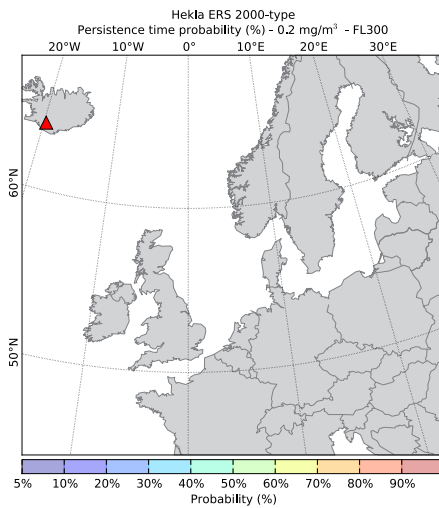
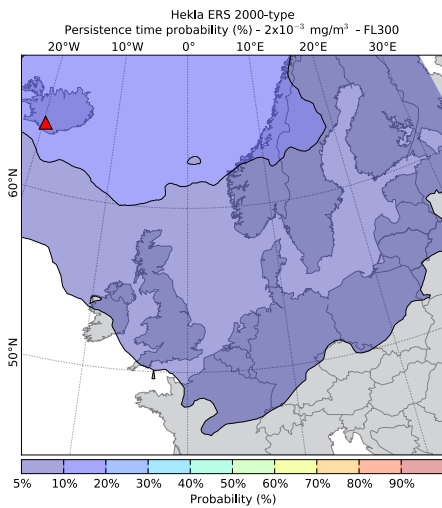
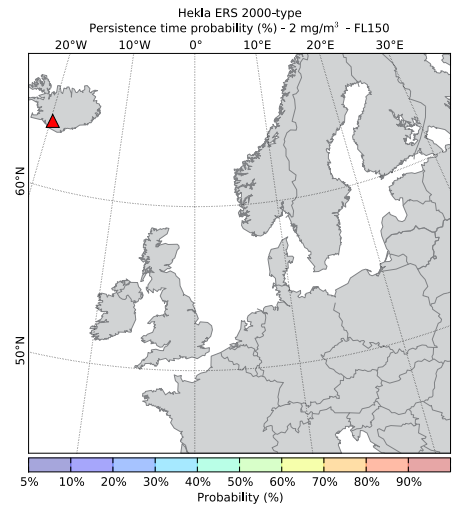
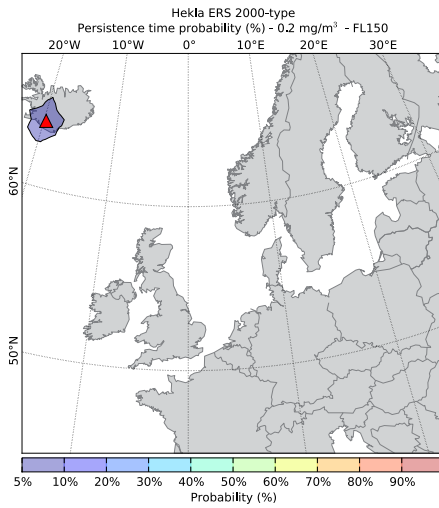
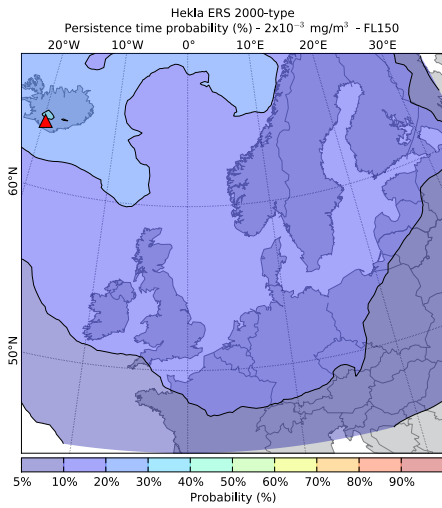
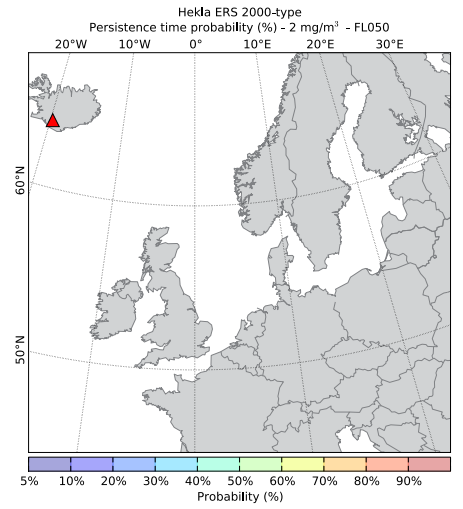
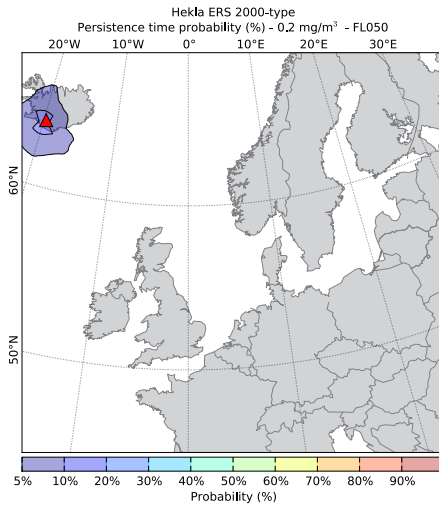
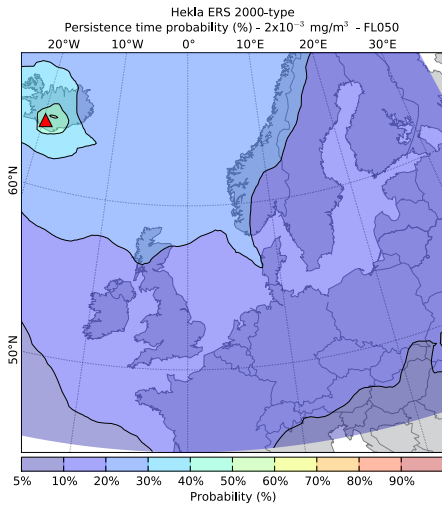
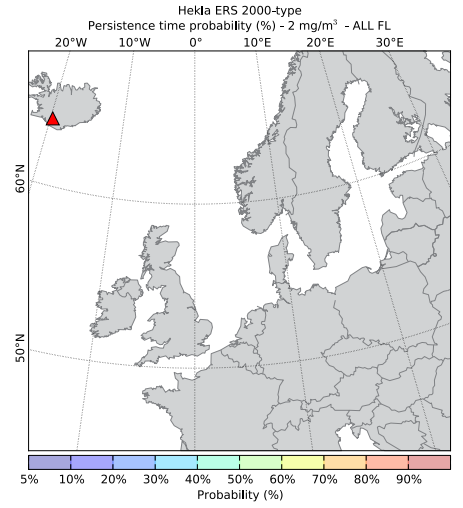
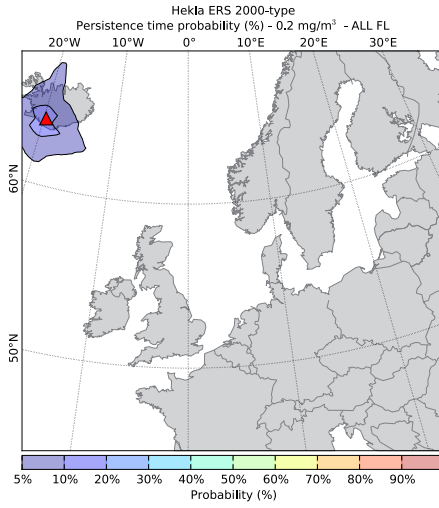
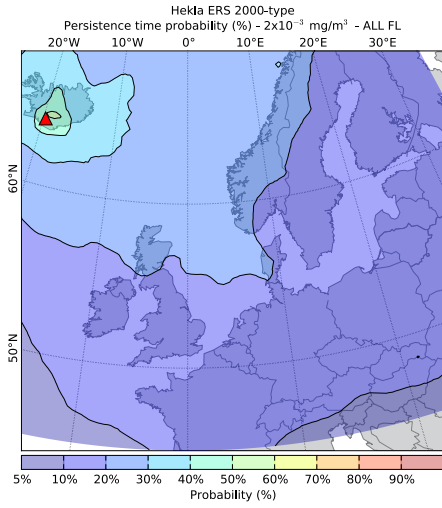


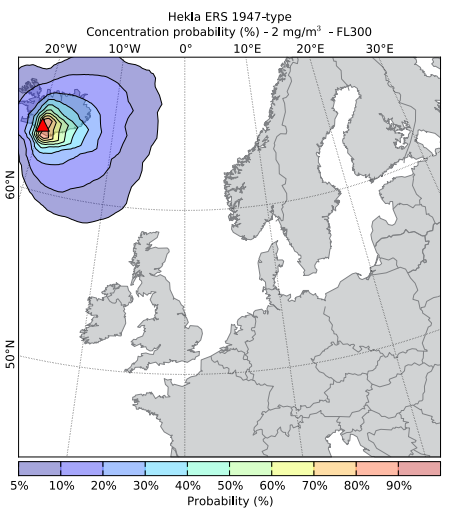
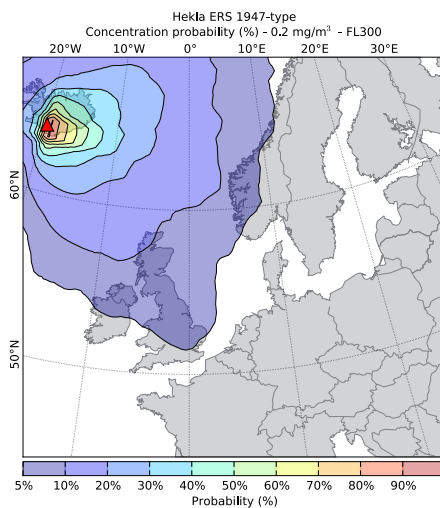
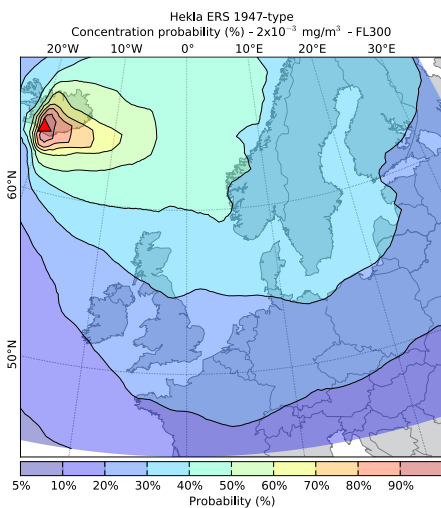
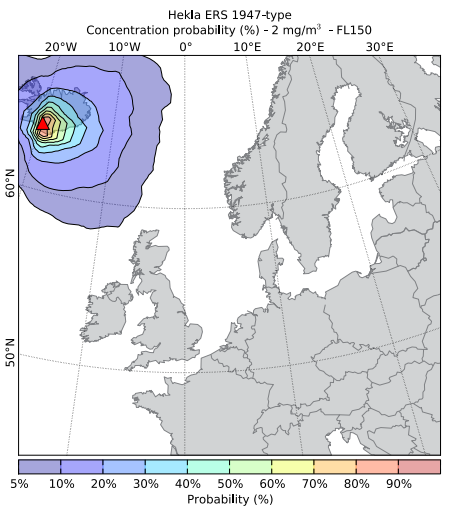
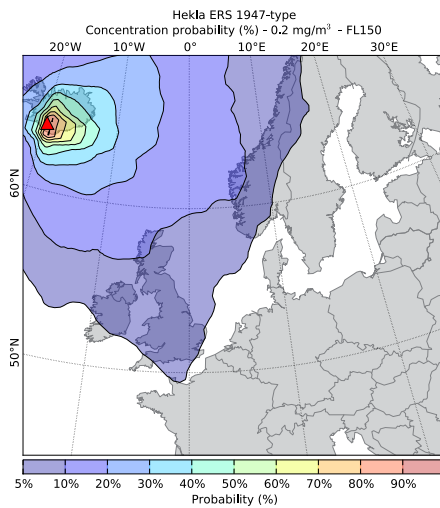
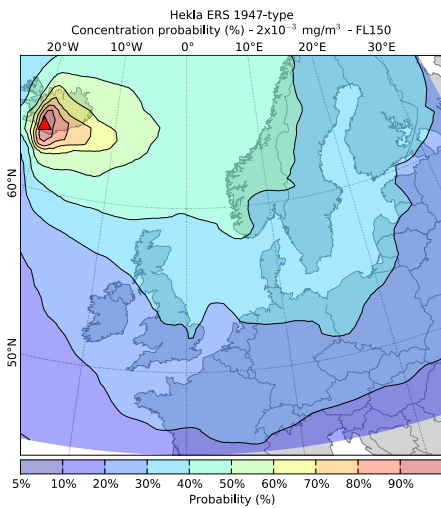
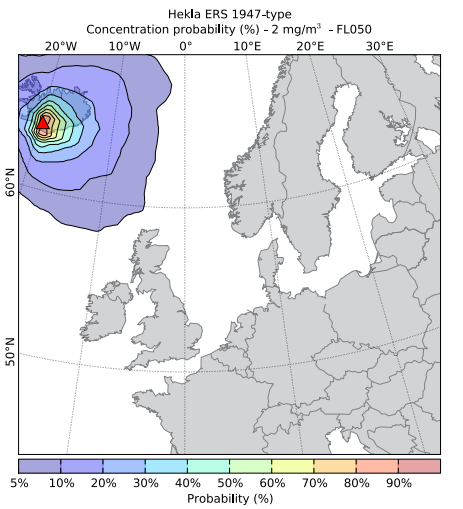
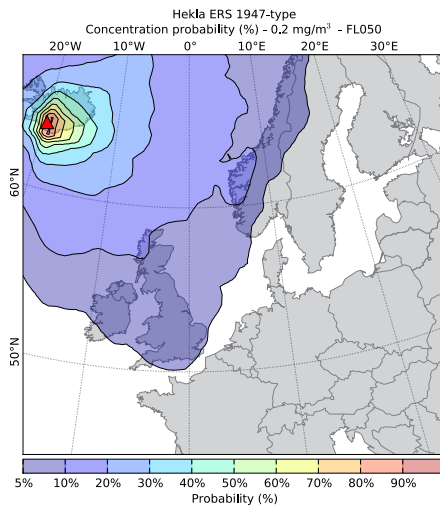
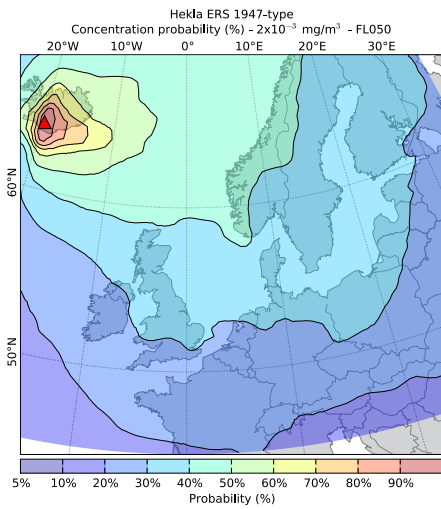
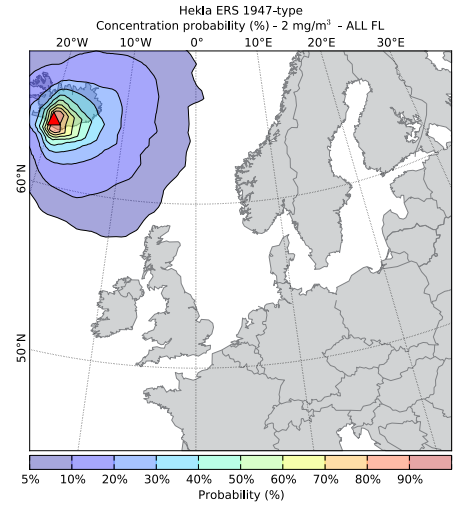
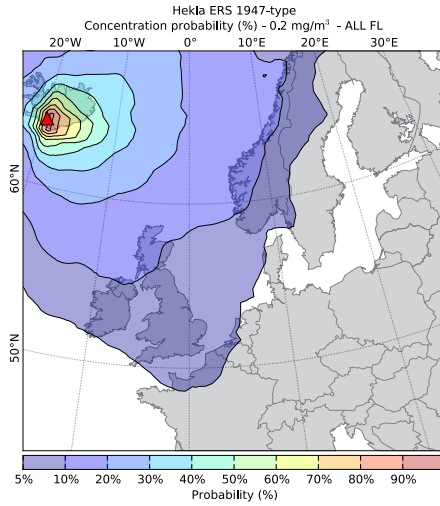
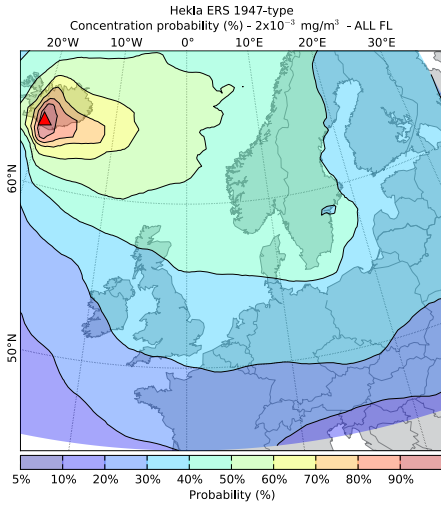


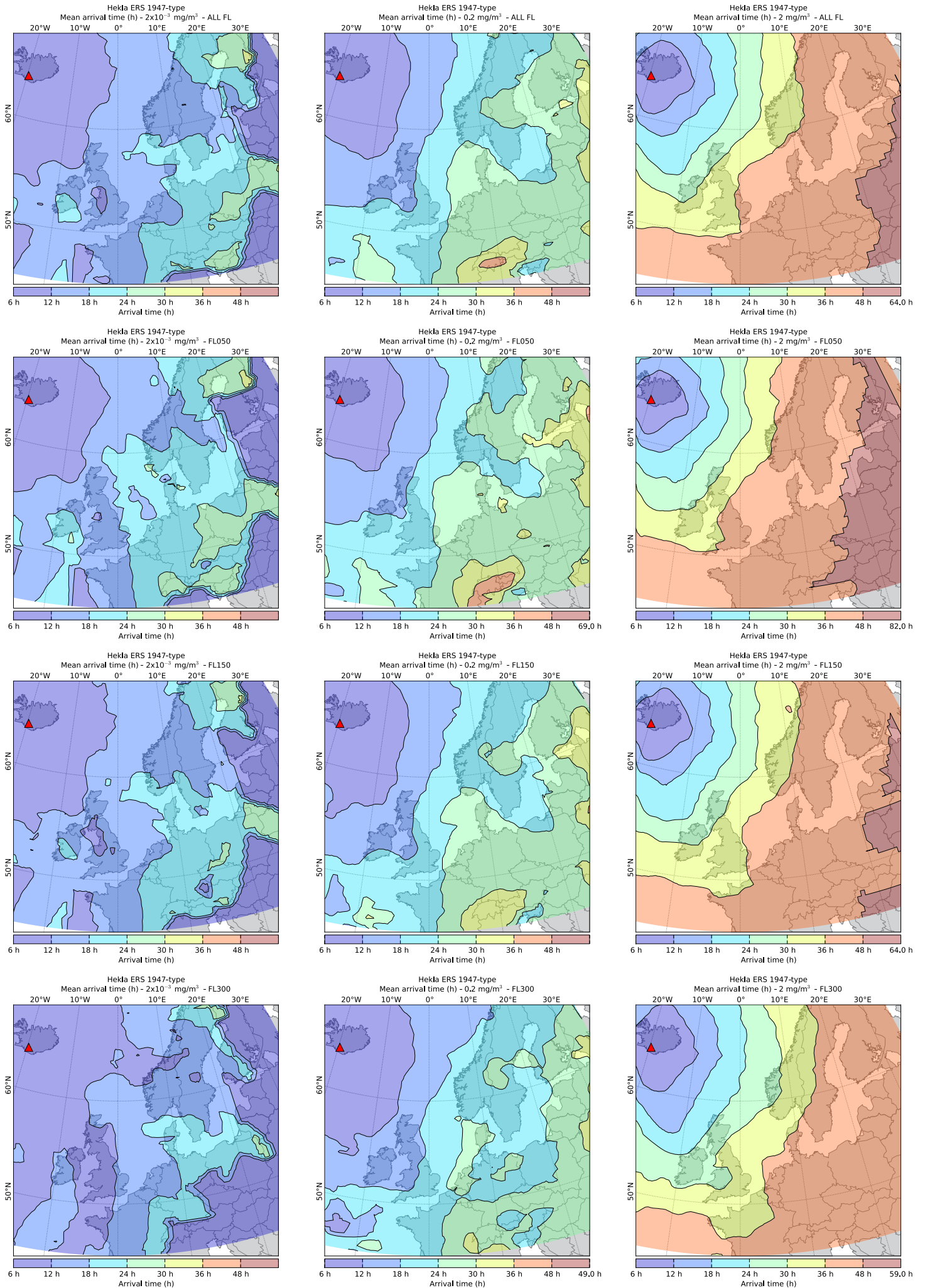


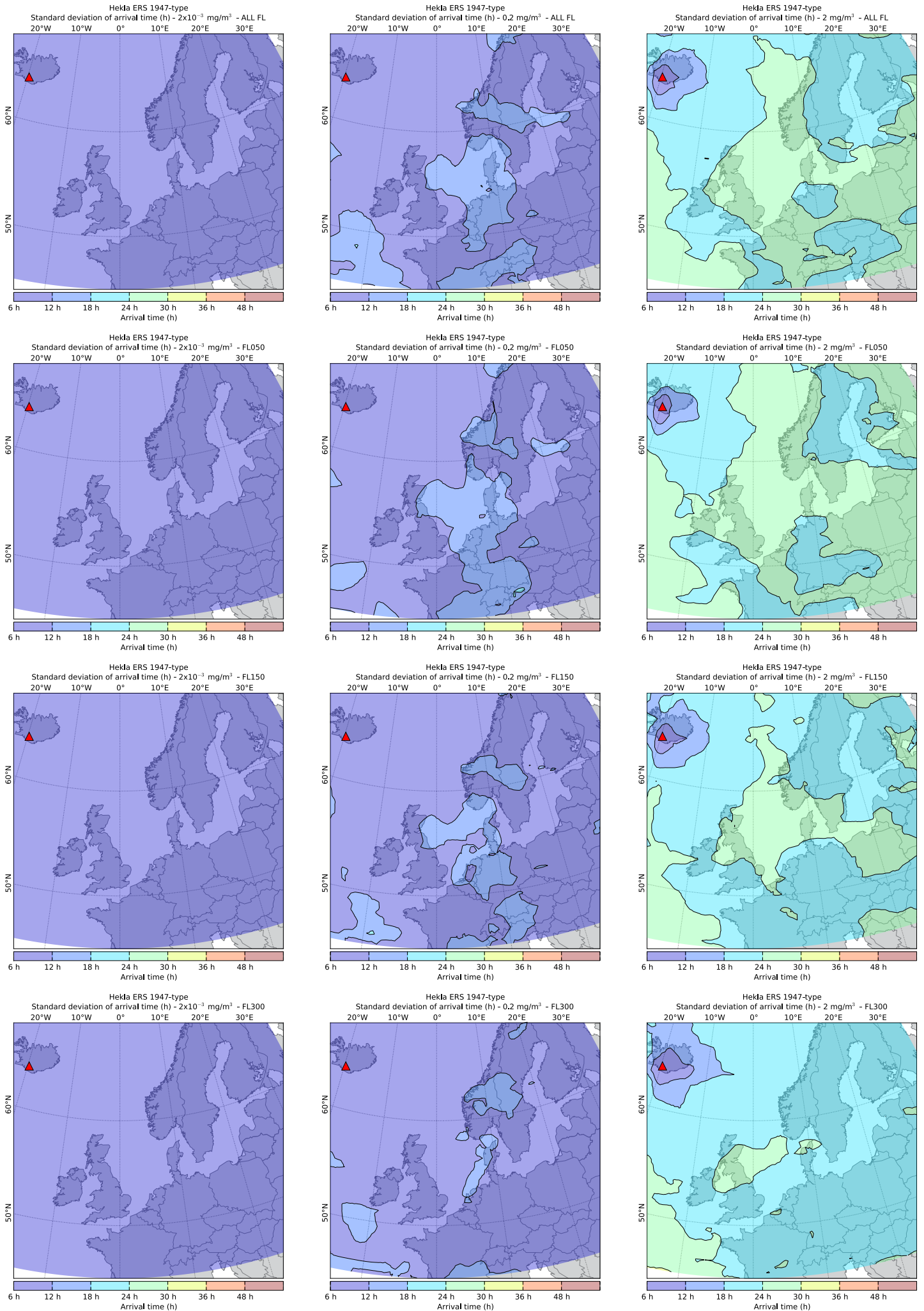


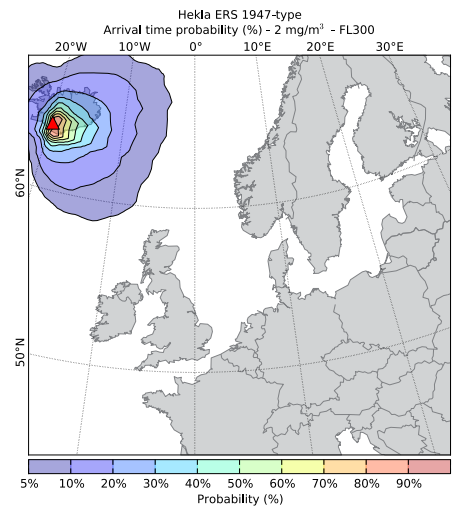
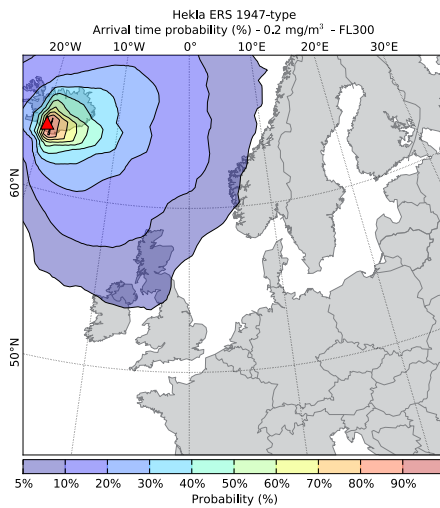
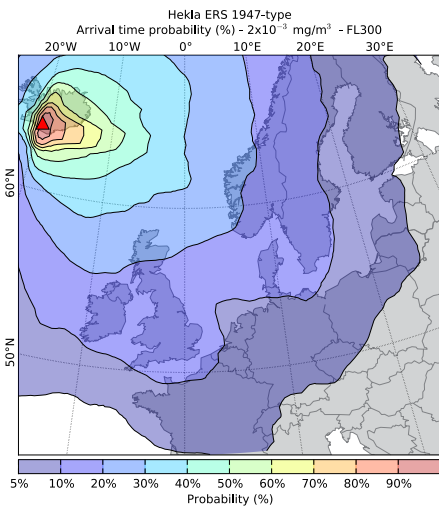
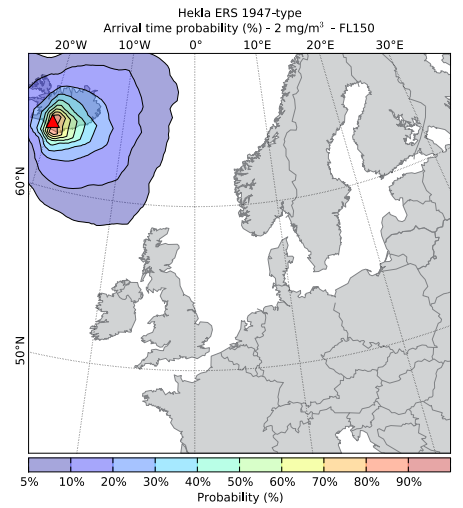
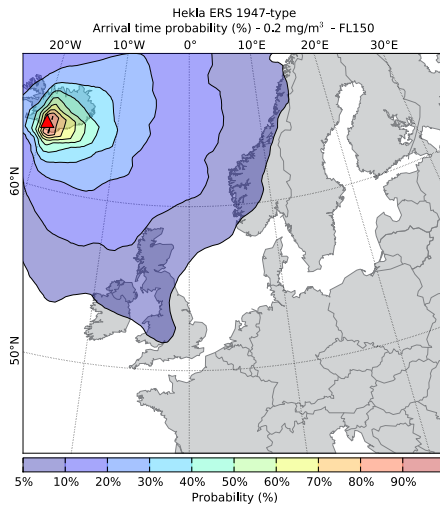
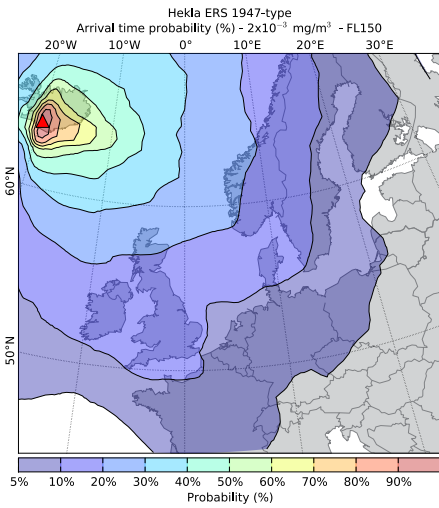
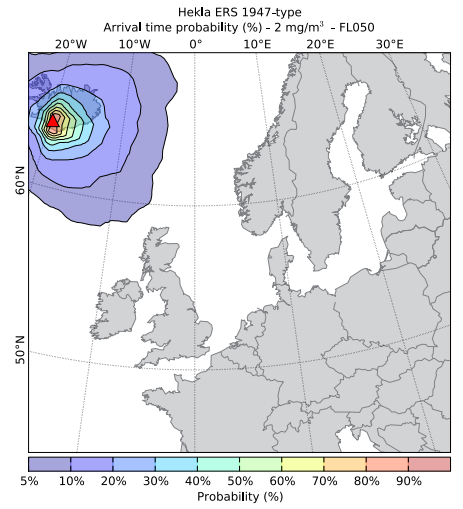
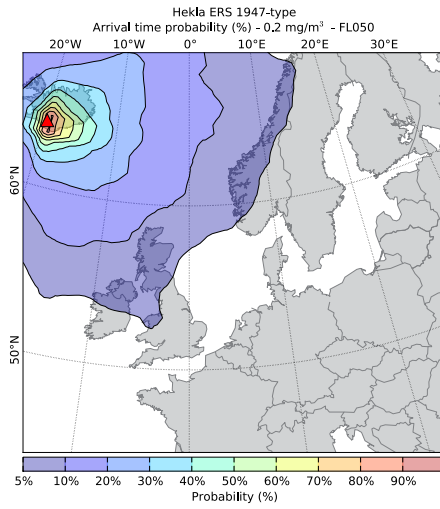
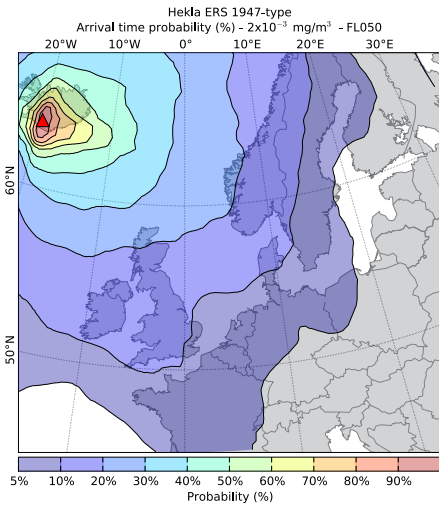
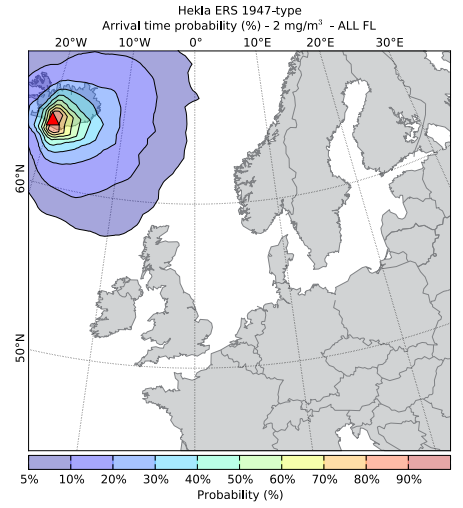
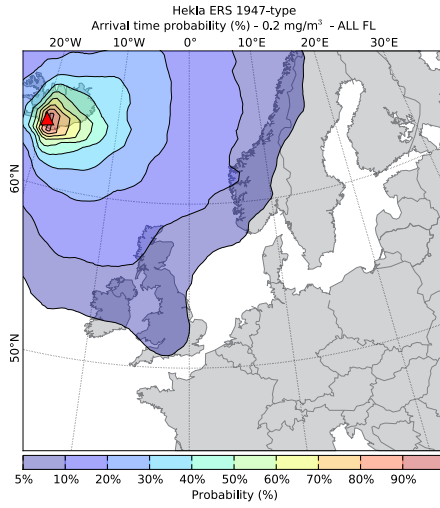
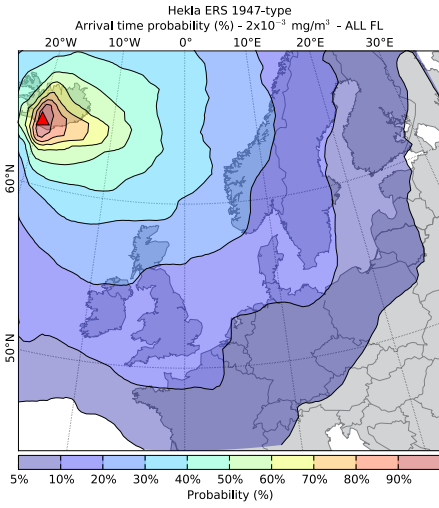
# Hekla ERS 2000-type - Probability of persistence time > 12 h (%)

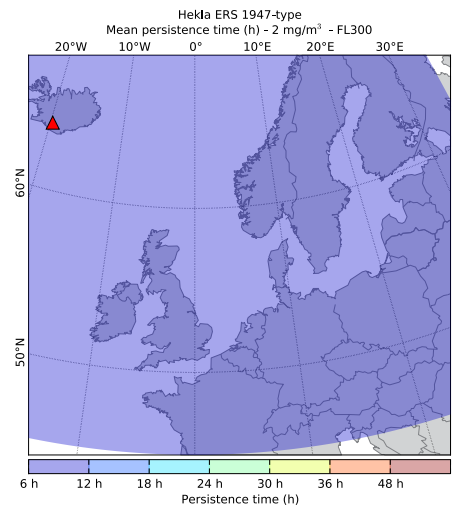
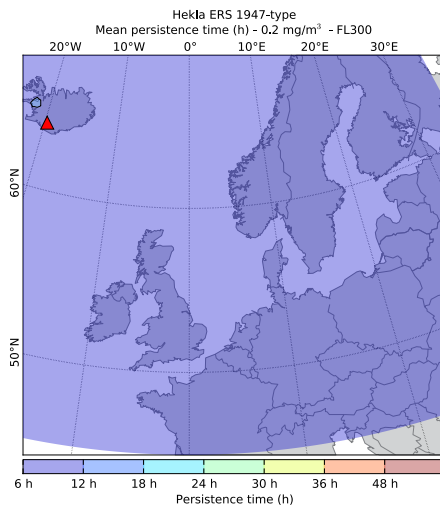
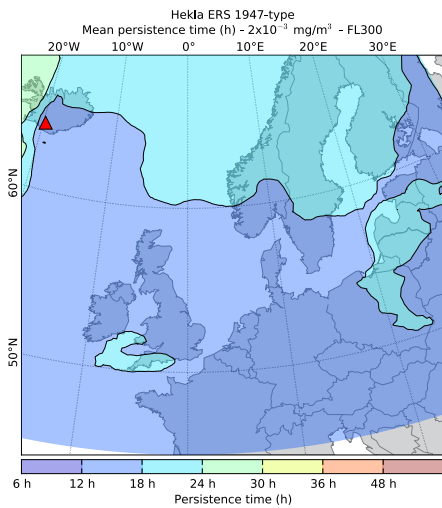
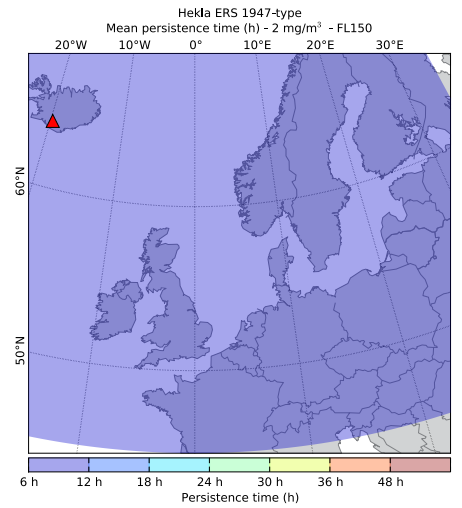
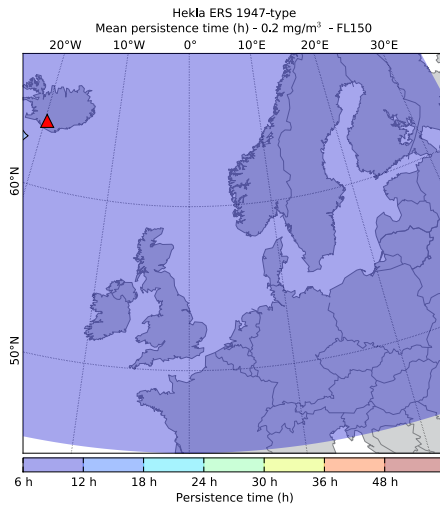
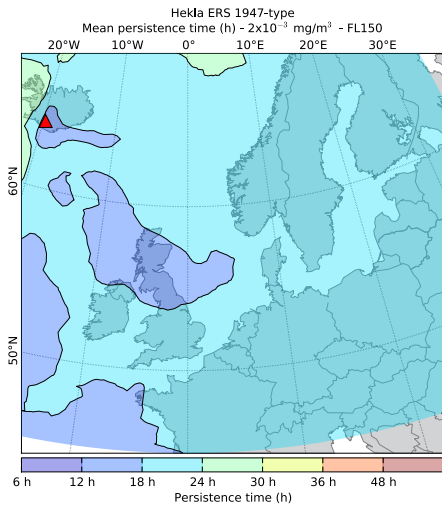
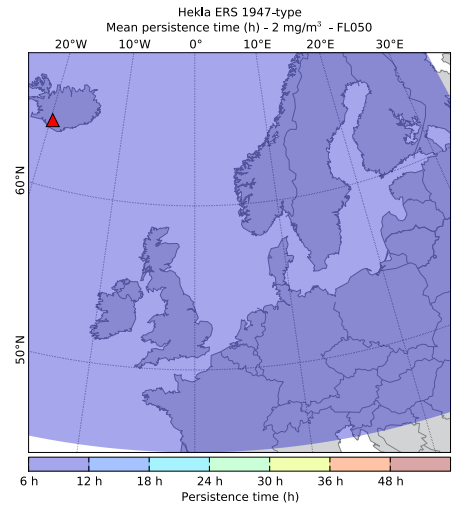
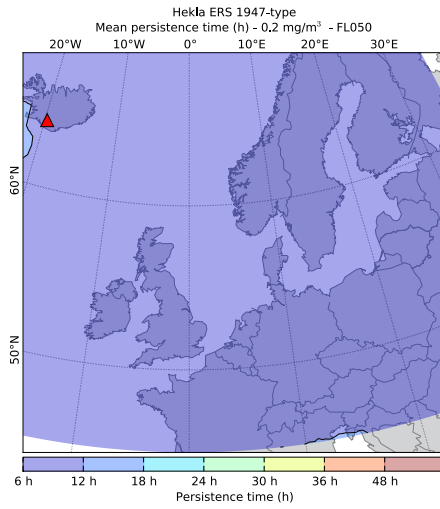
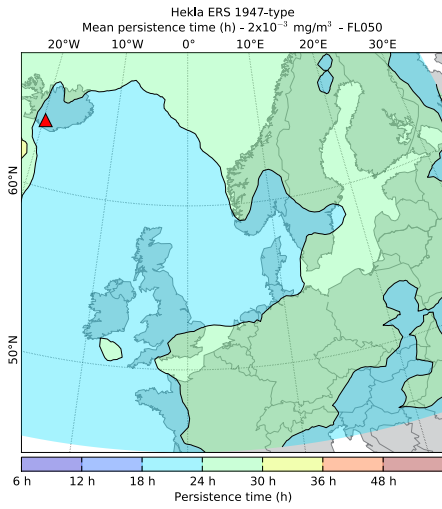
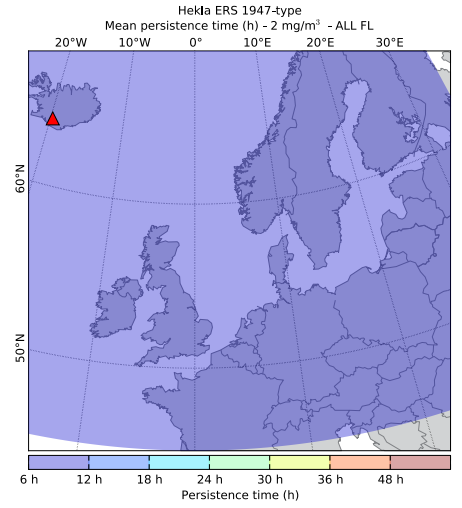
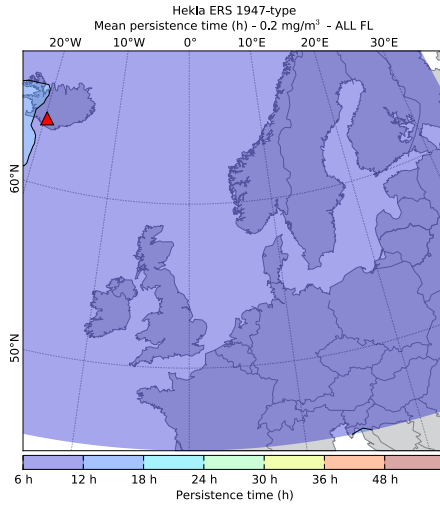
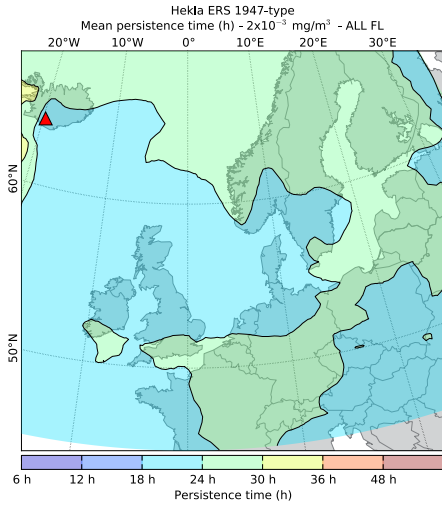


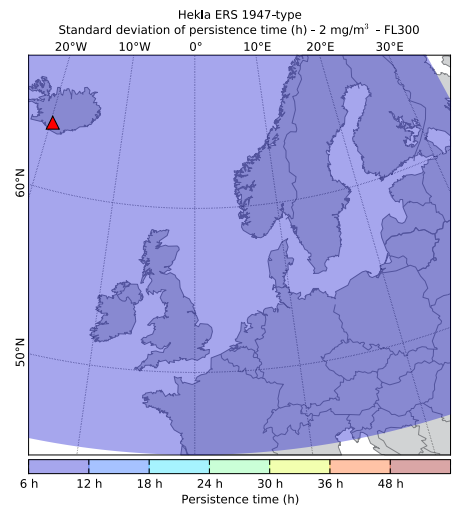
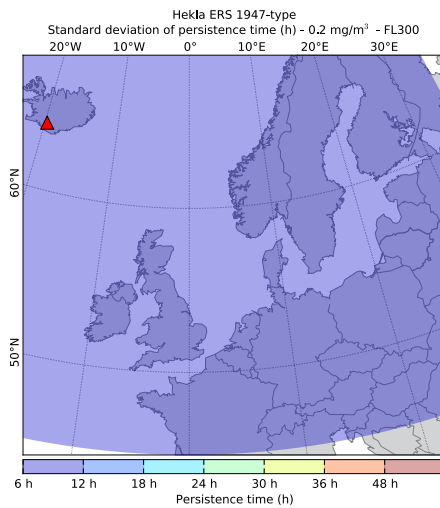
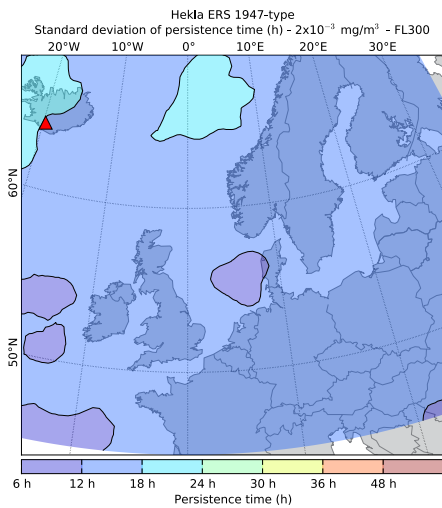
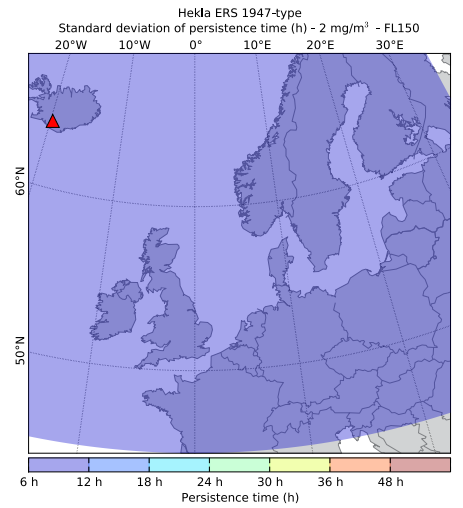
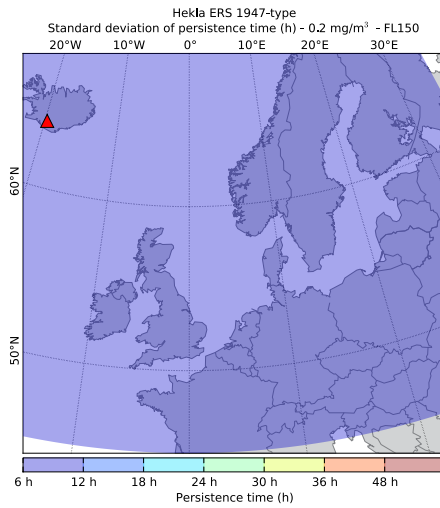
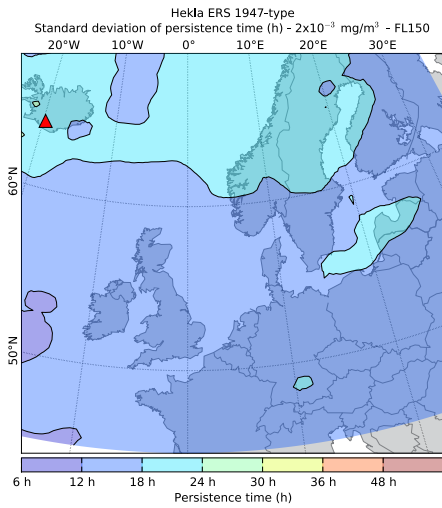
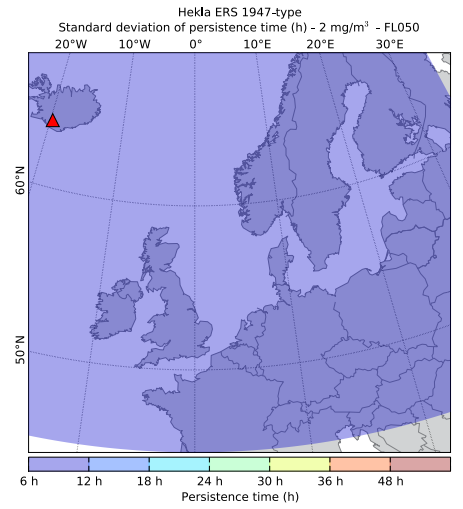
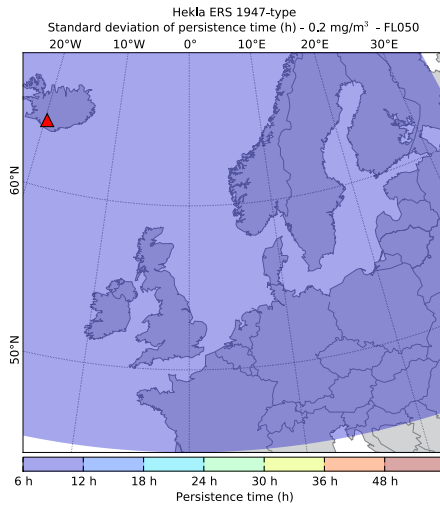
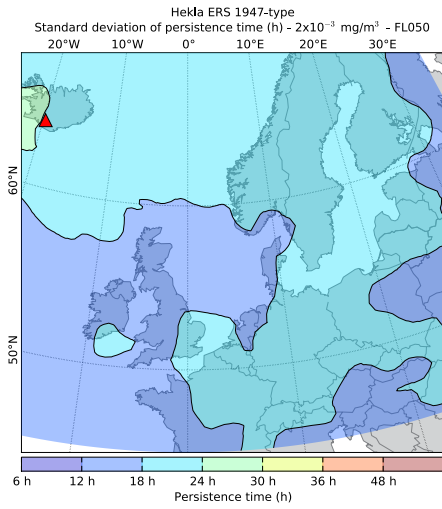
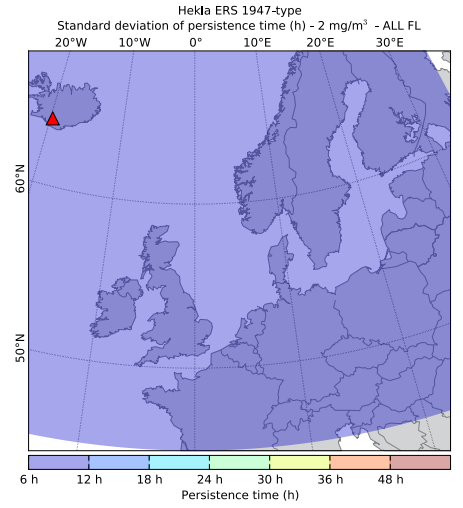
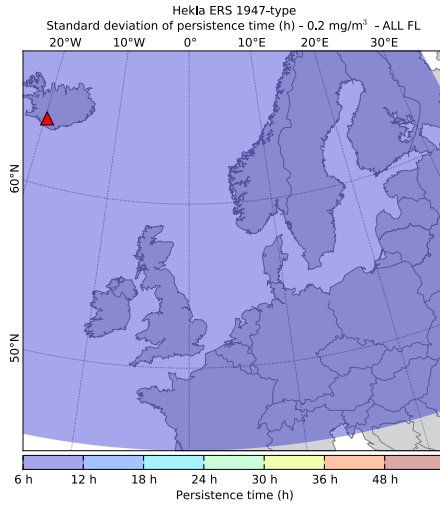
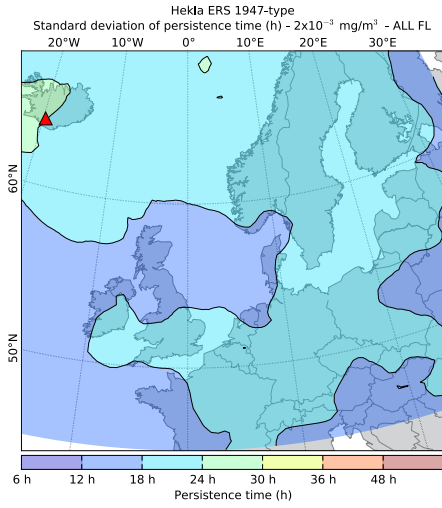


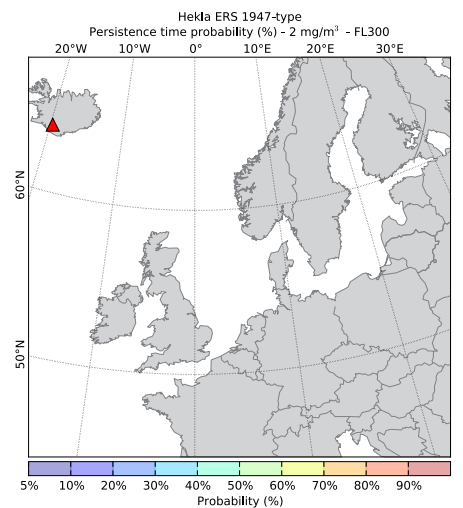
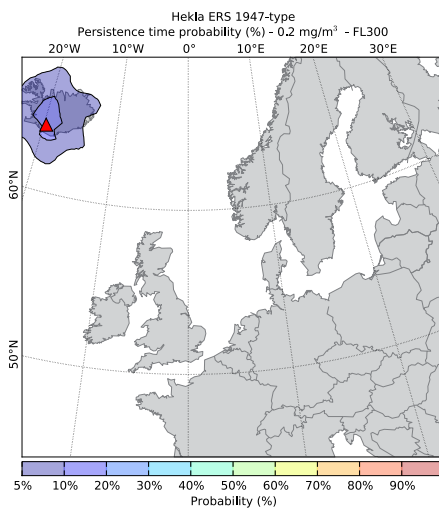
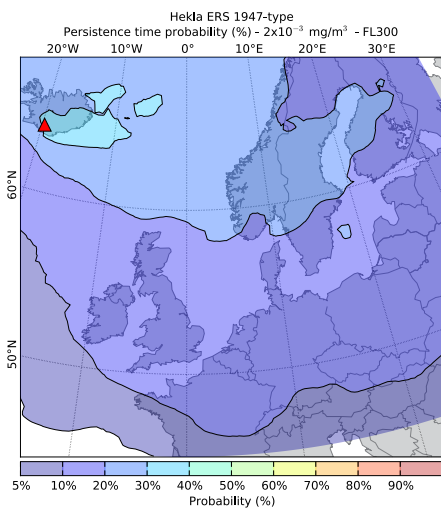
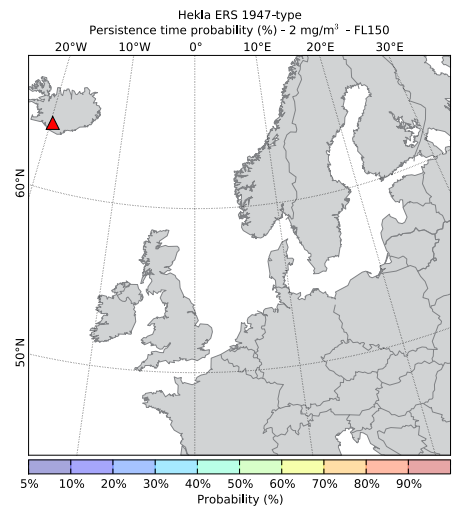
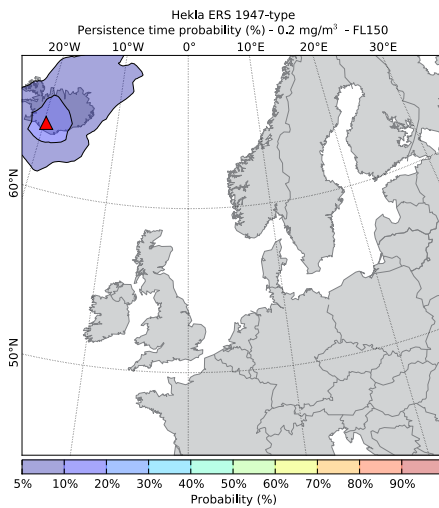
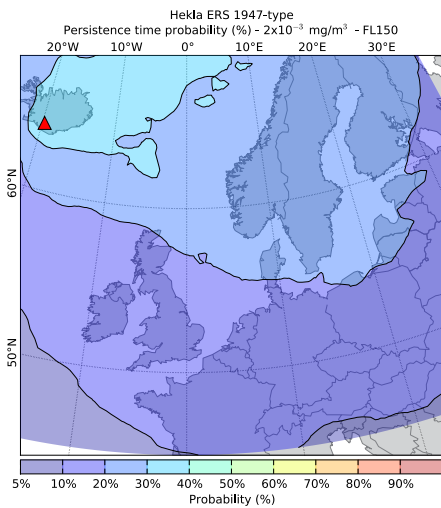
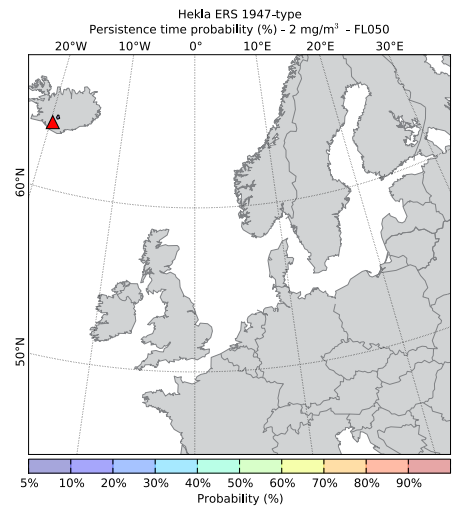
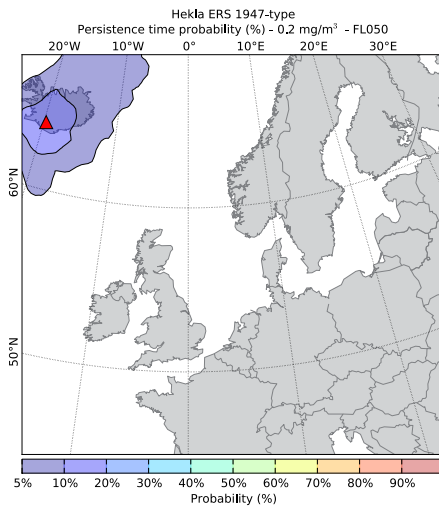
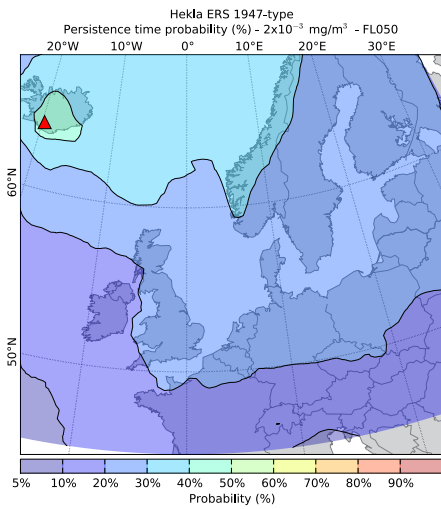
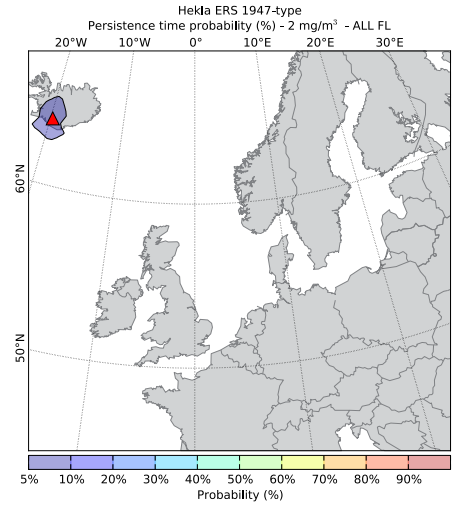
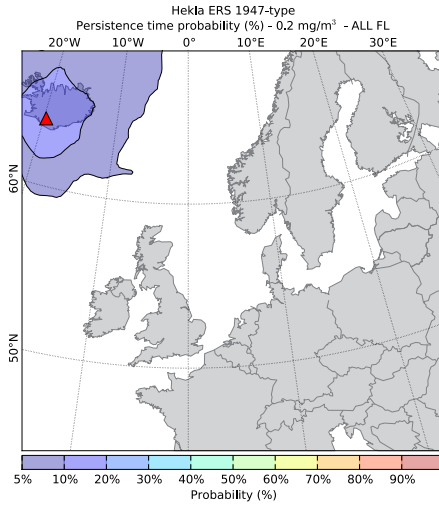
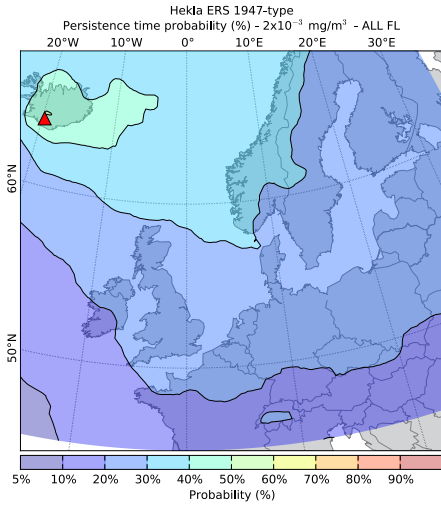




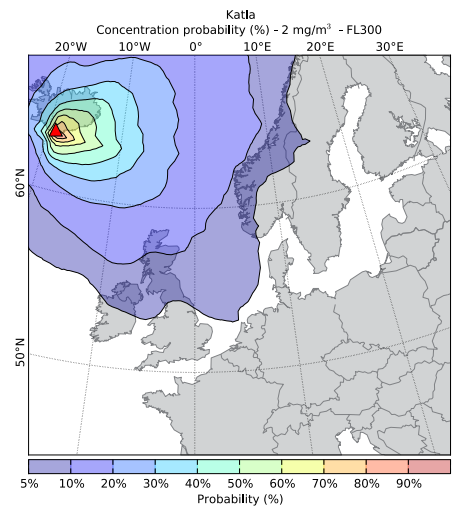
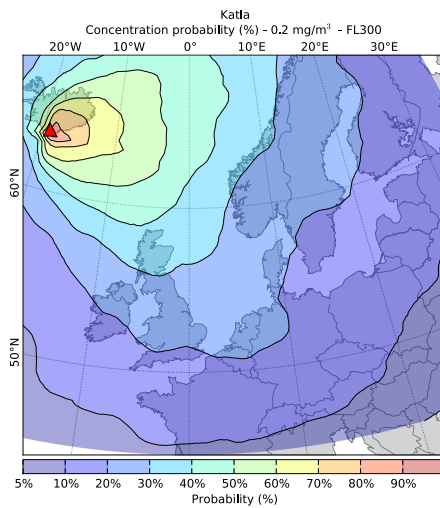
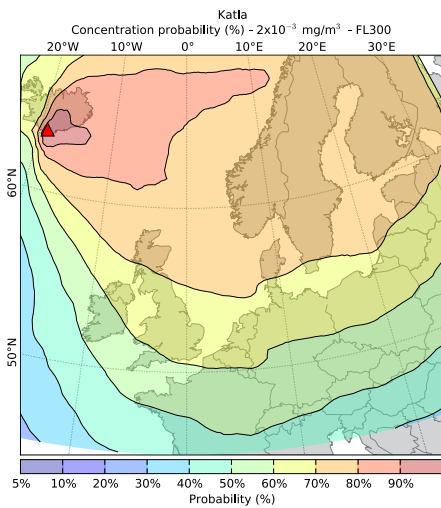
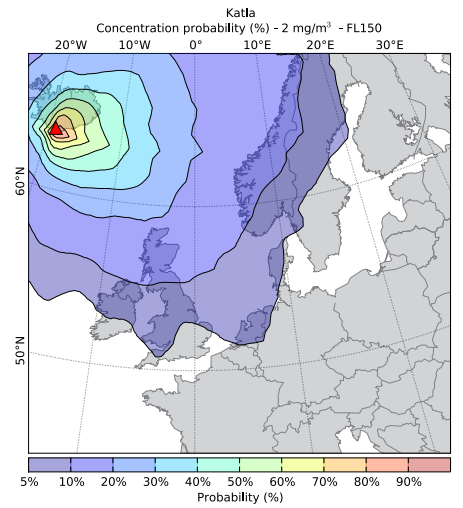
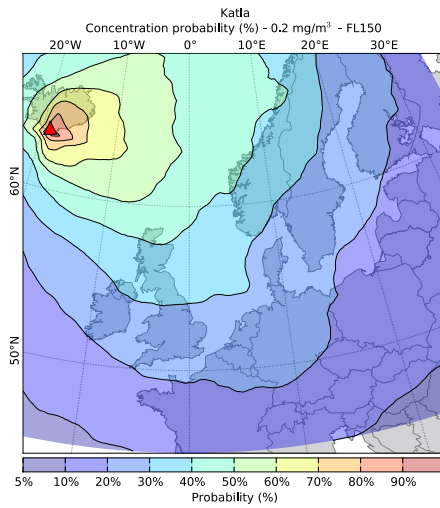
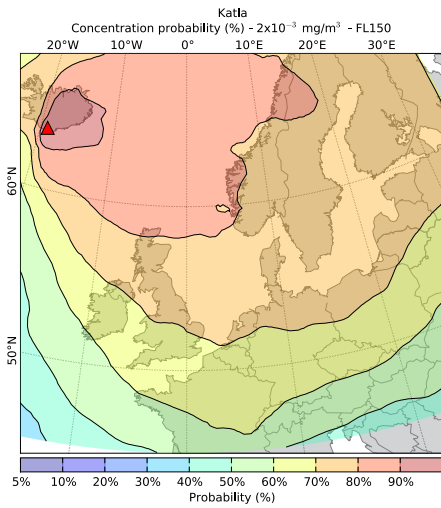
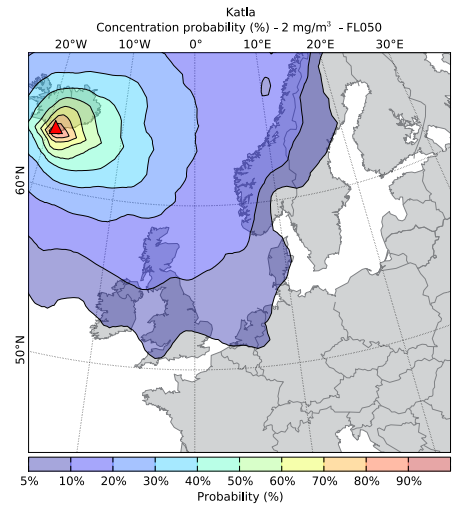
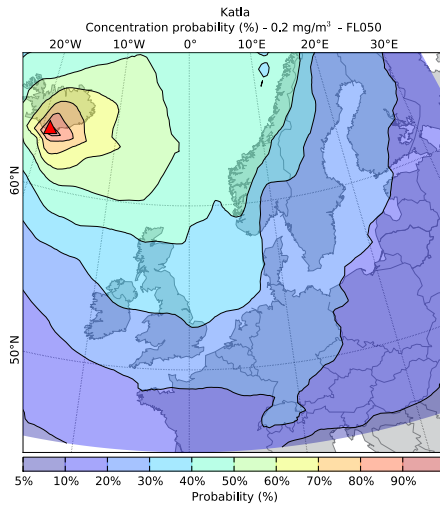
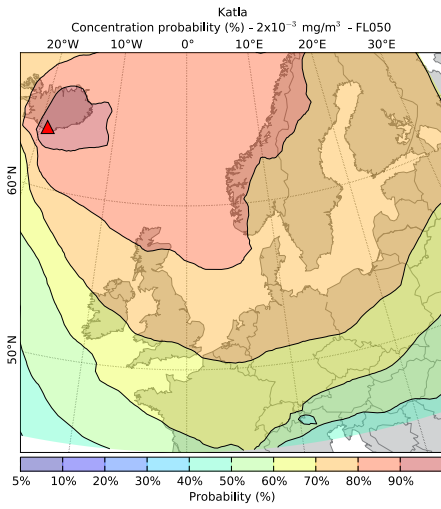
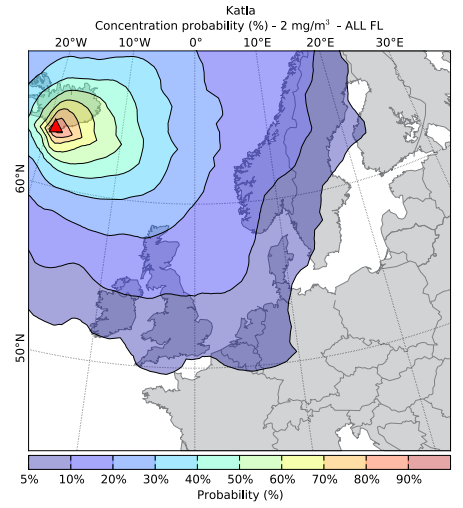
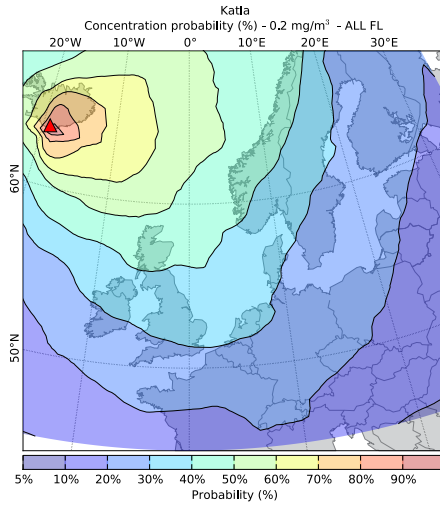
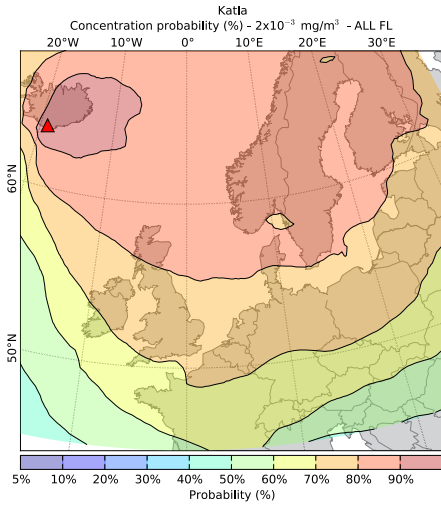


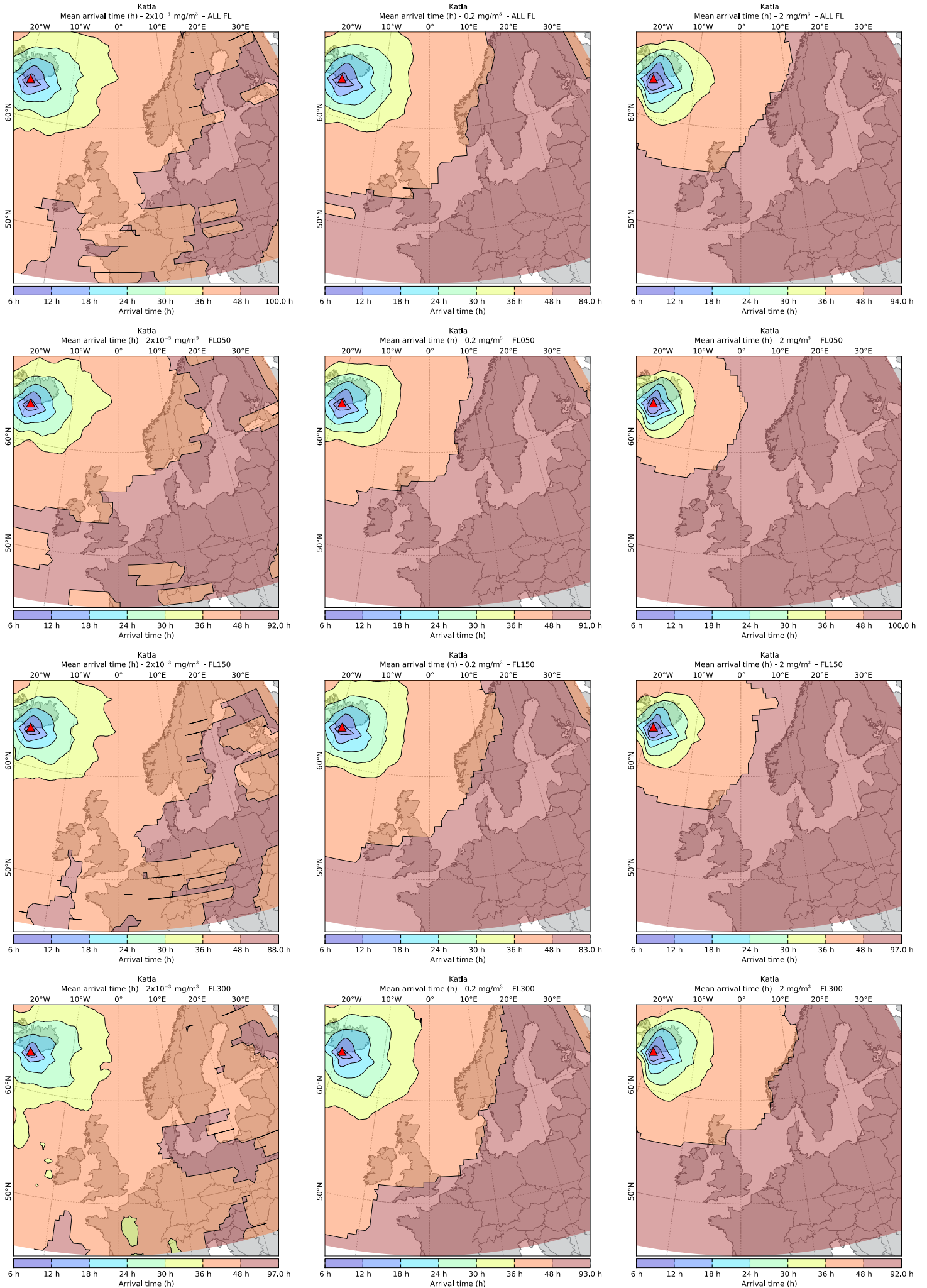


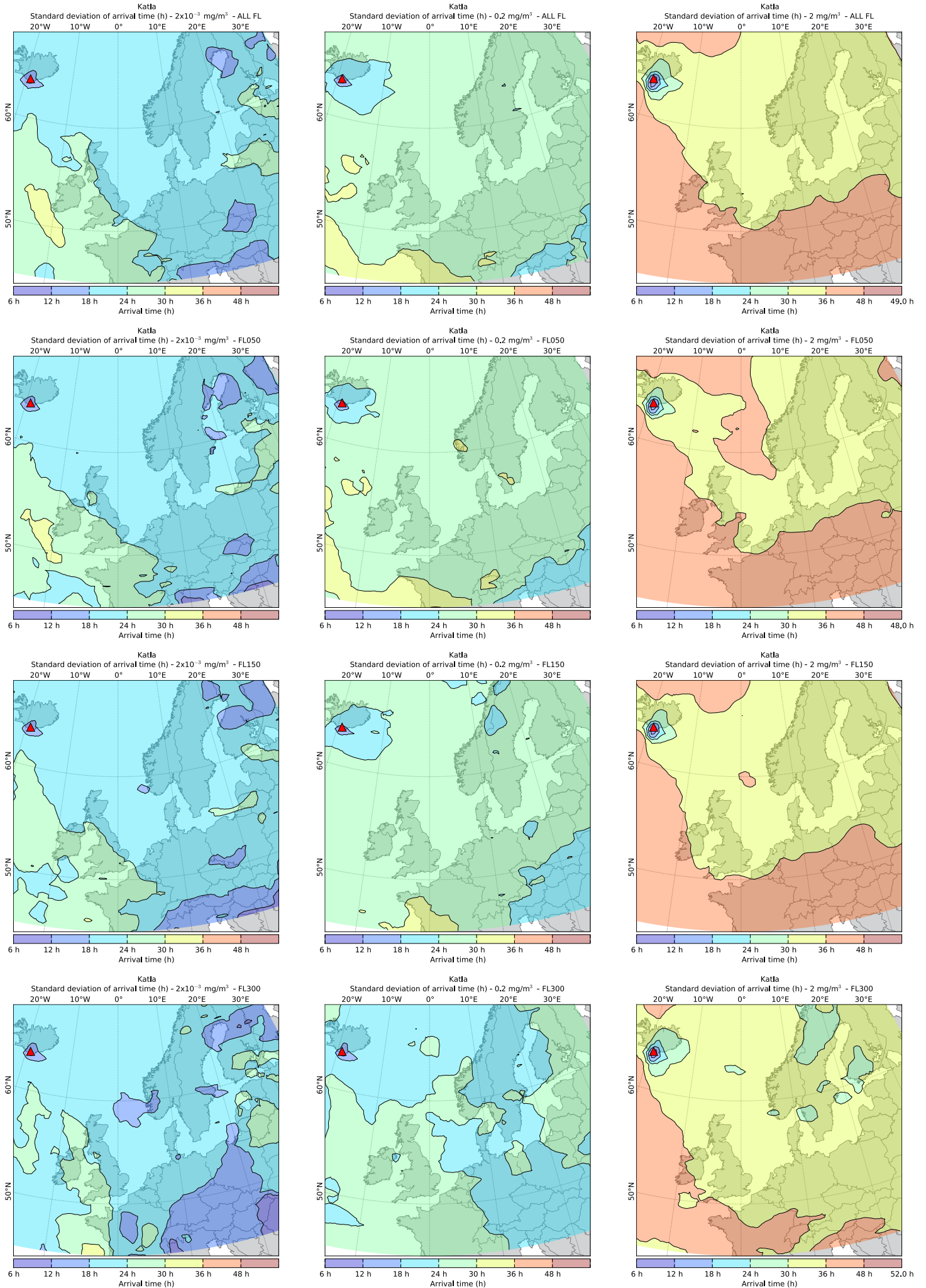


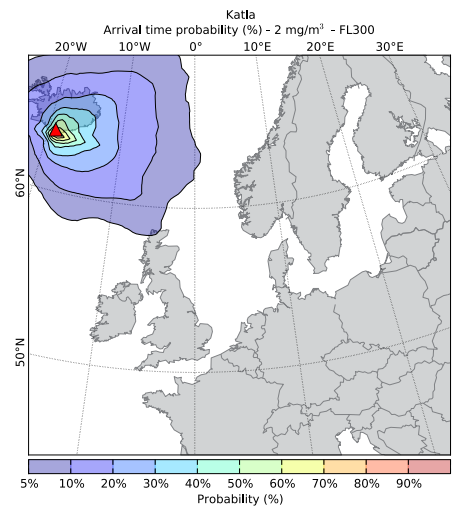
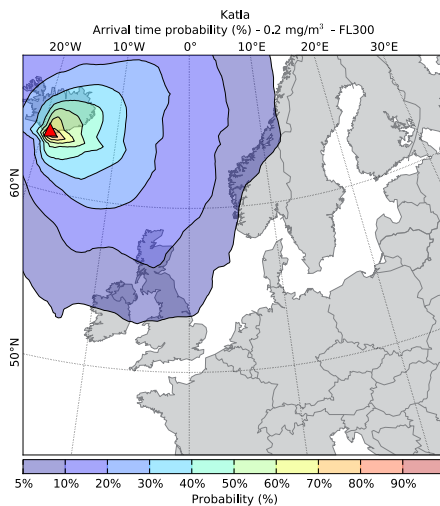
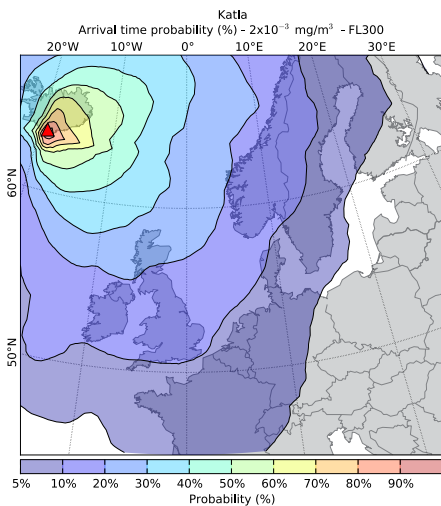
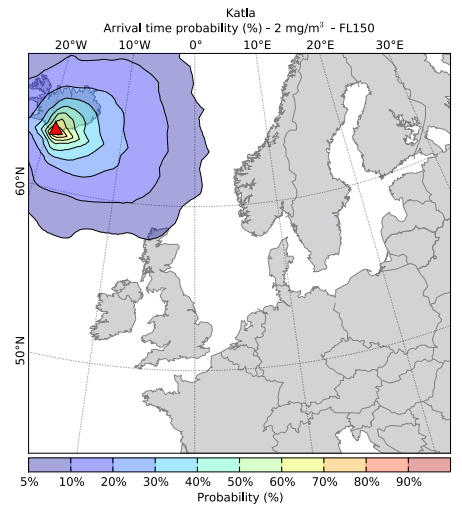
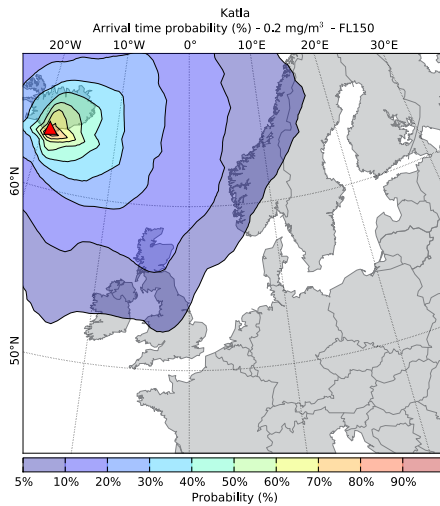
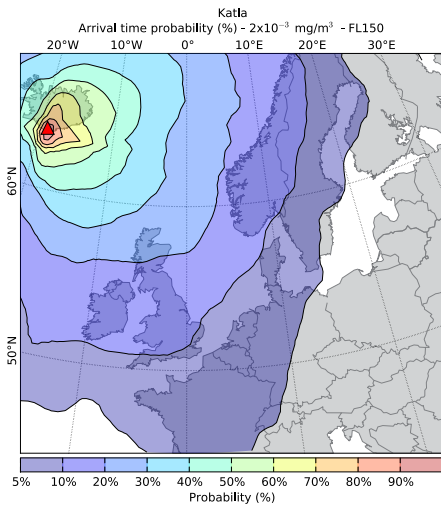
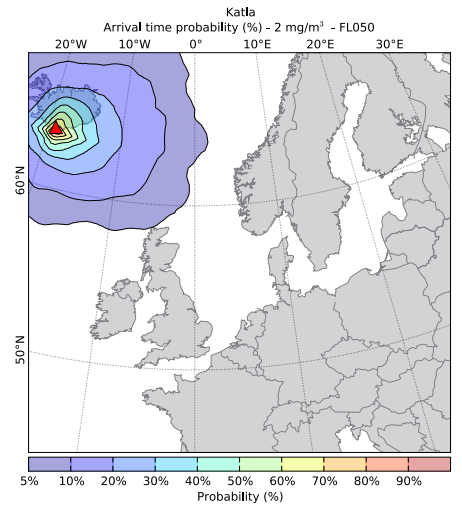
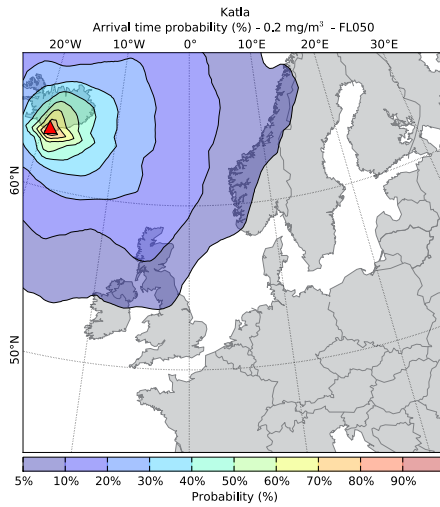
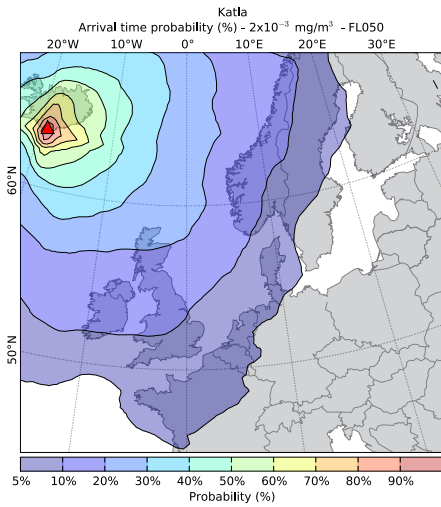
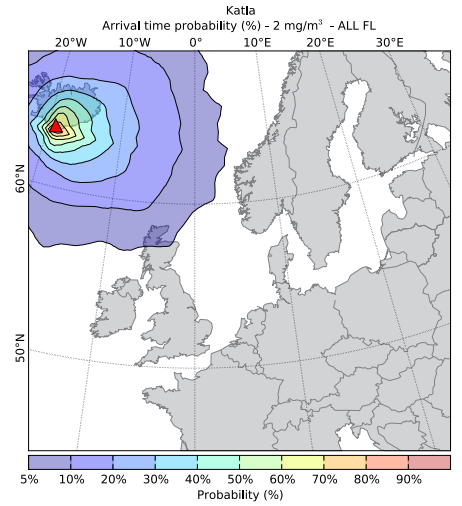
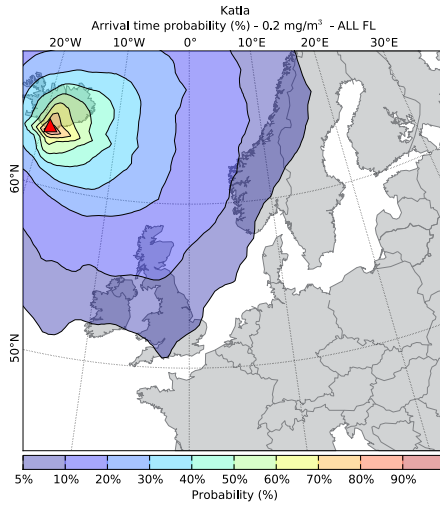
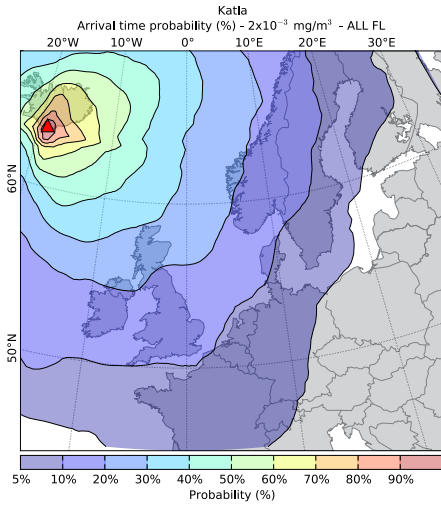


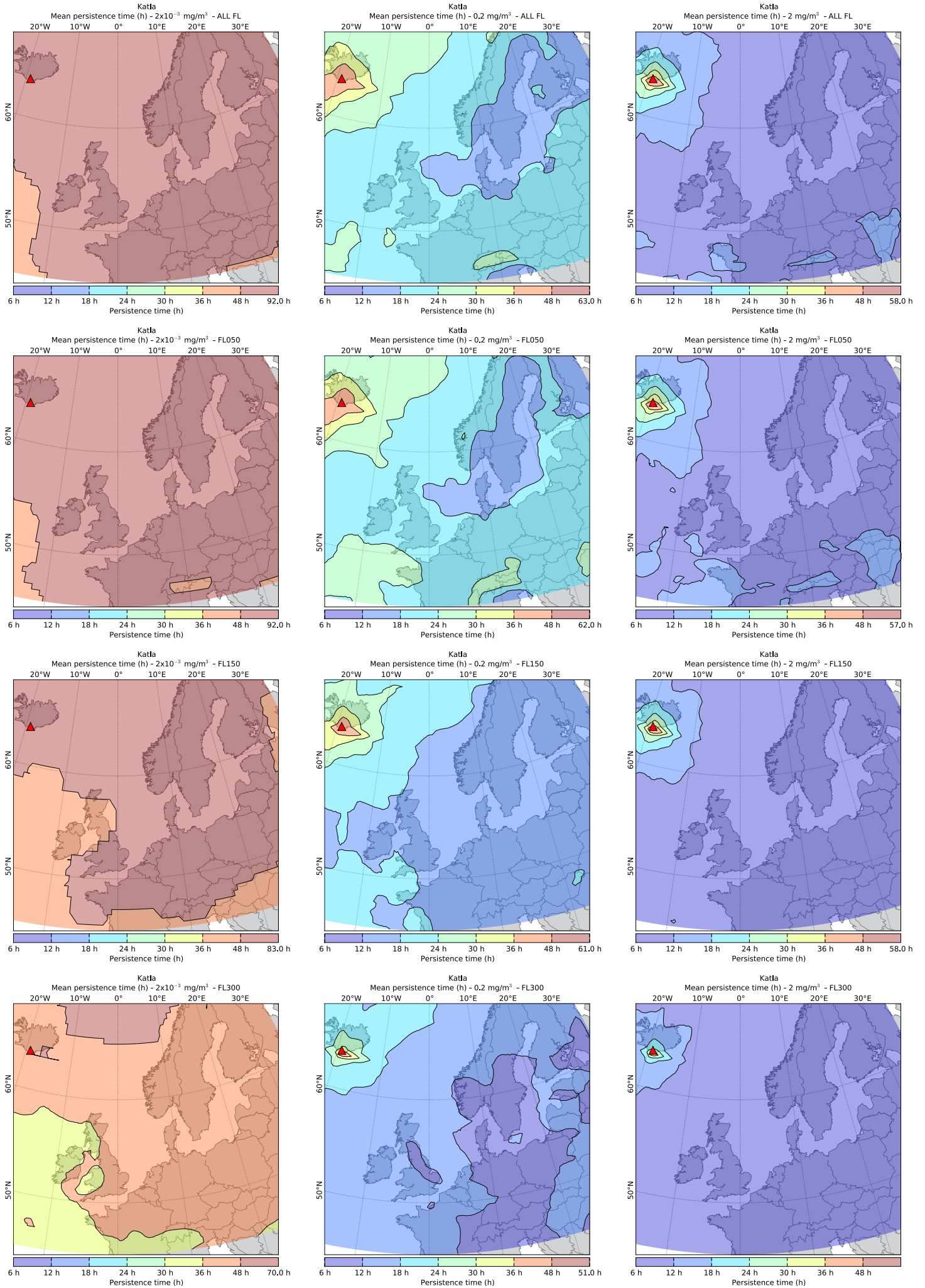


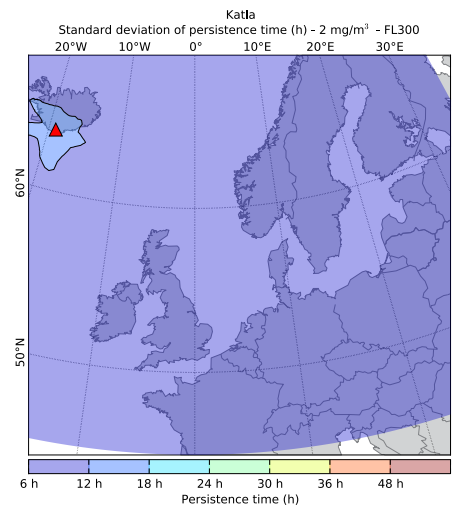
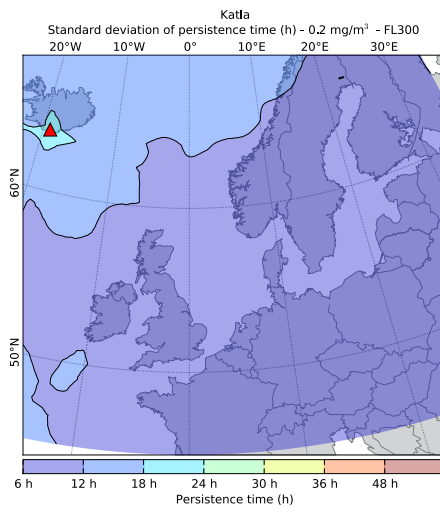
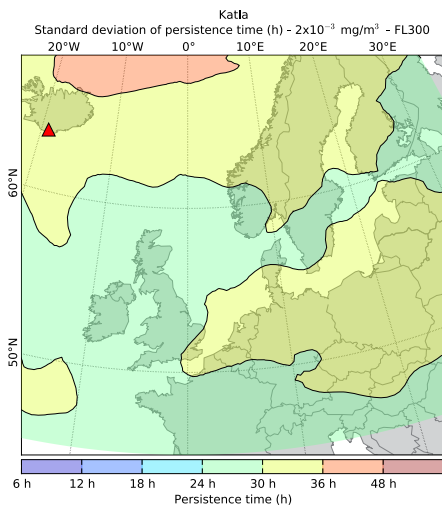
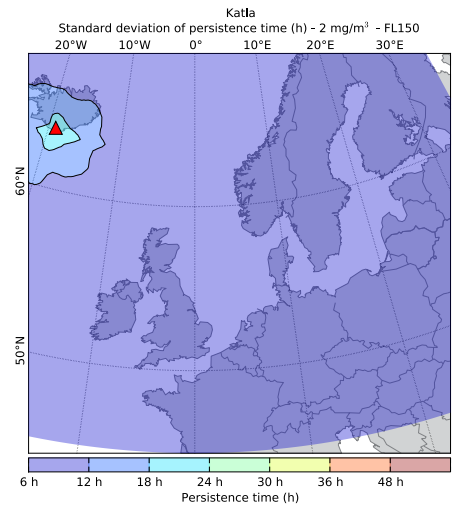
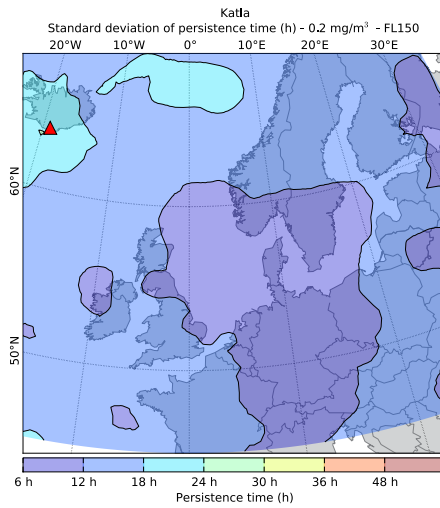
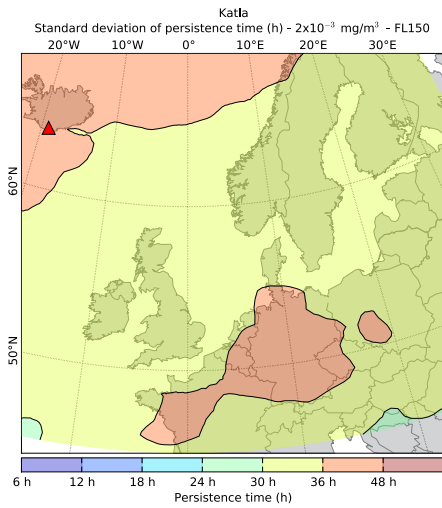
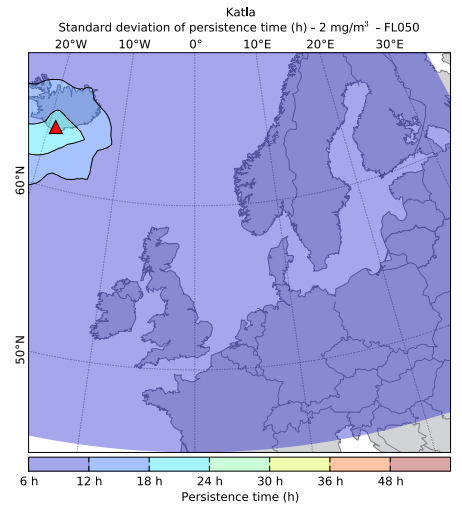
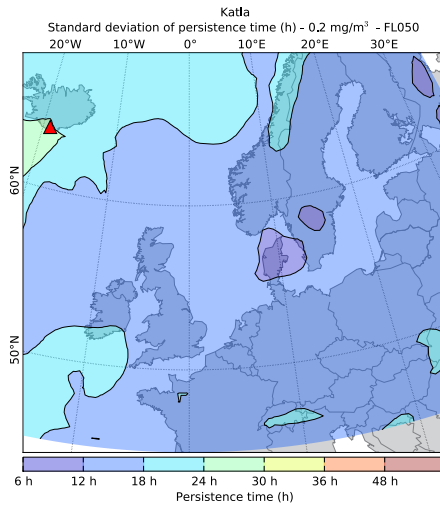
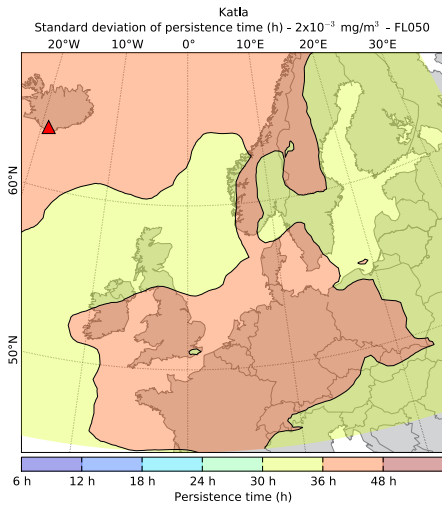
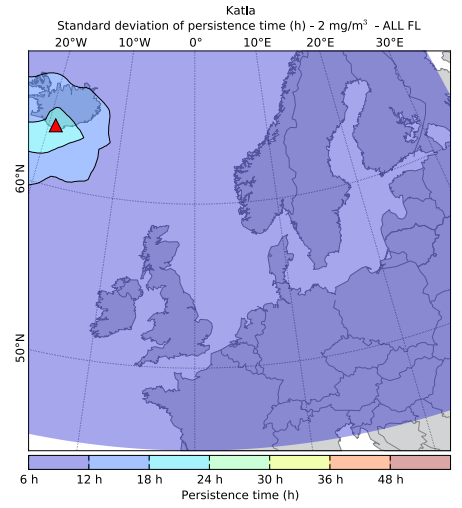
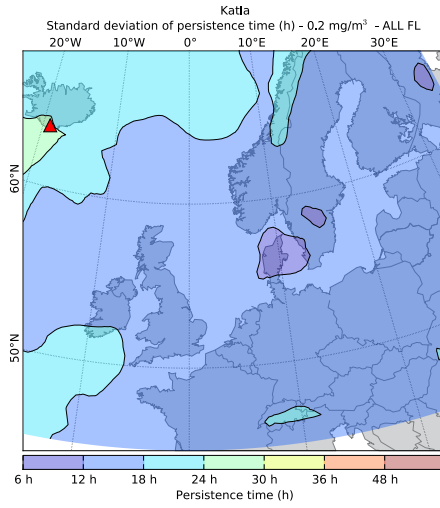
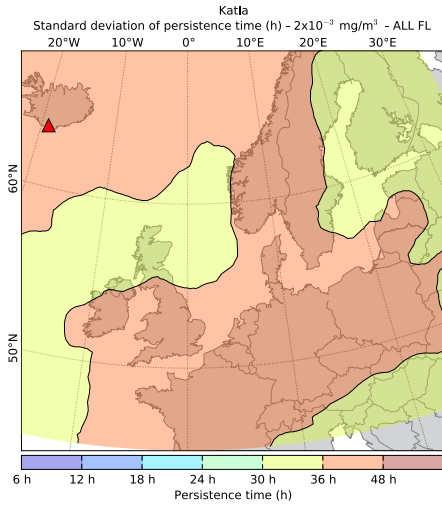


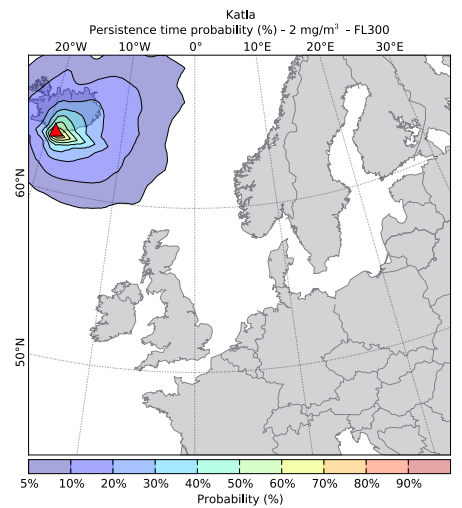
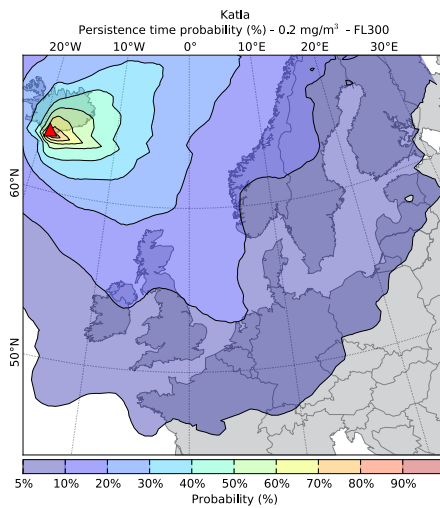
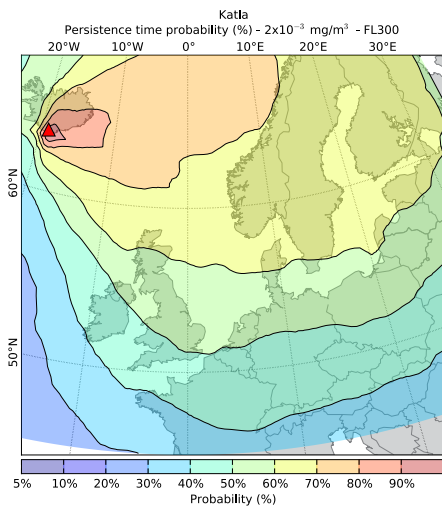
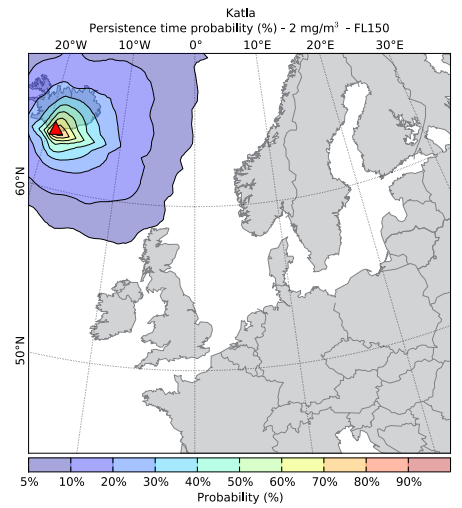
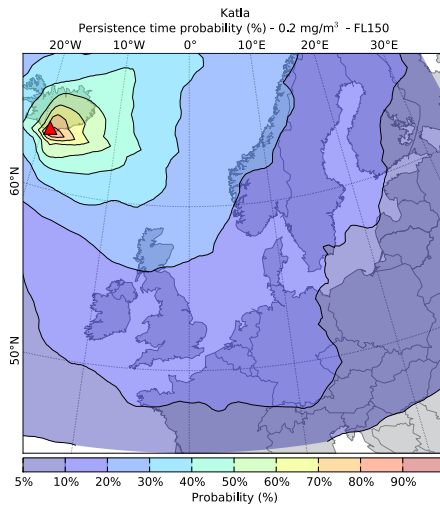
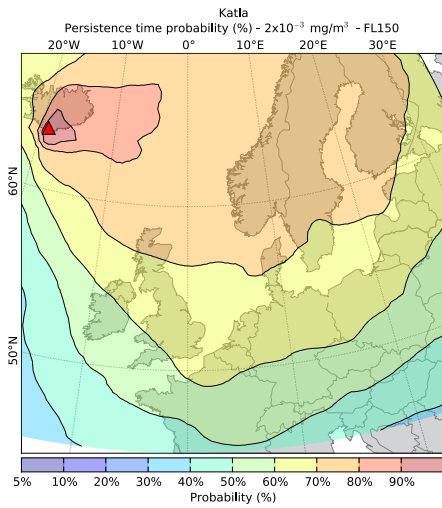
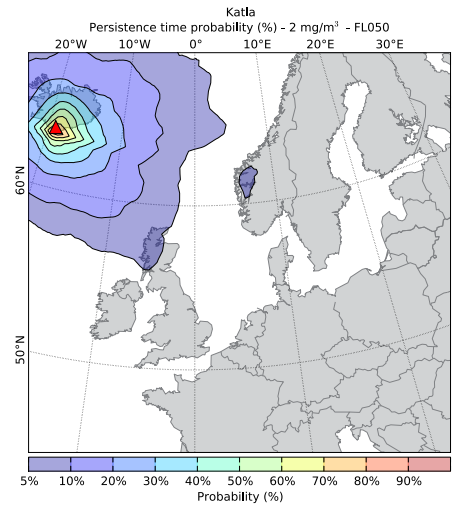
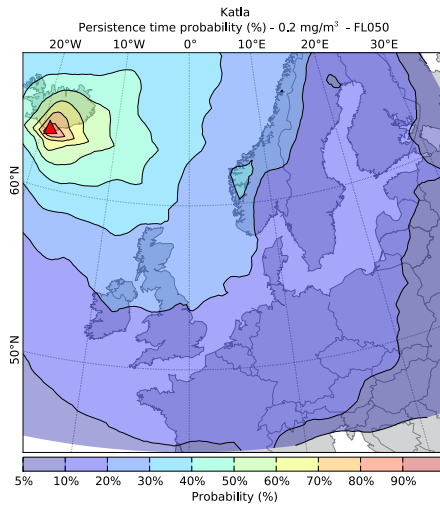
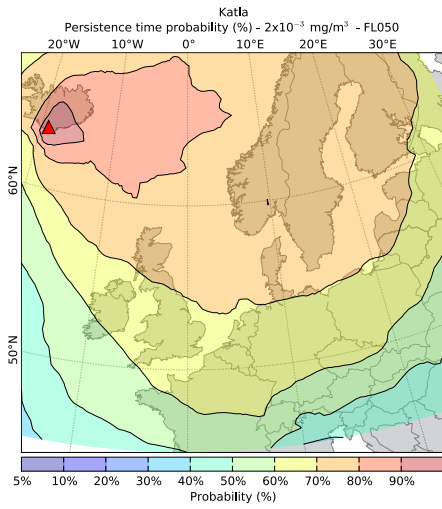
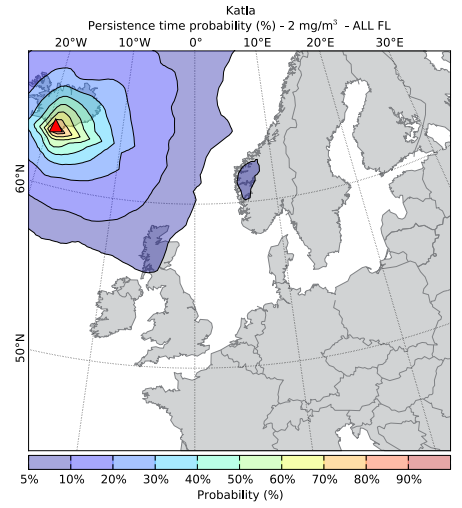
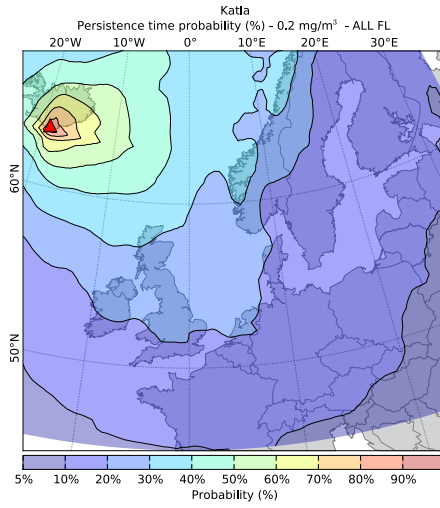
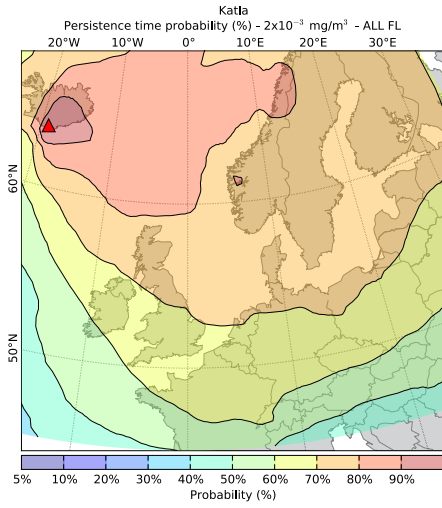


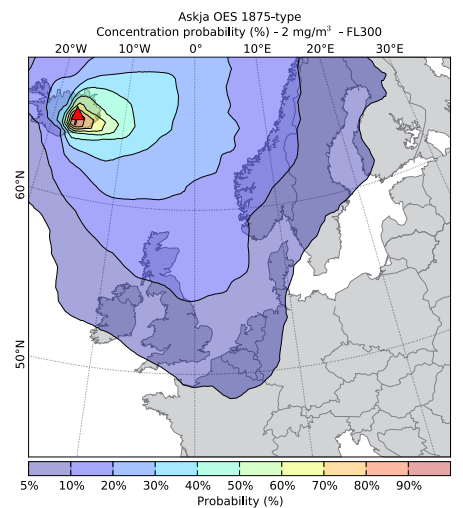
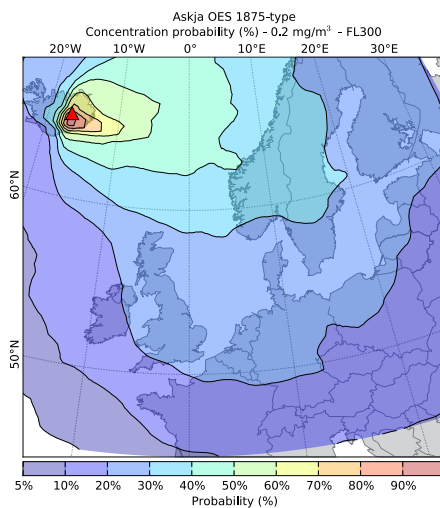
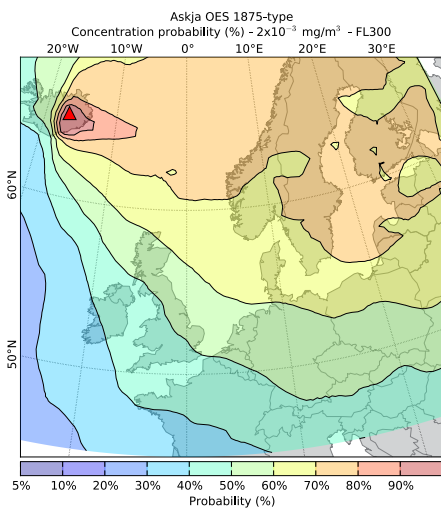
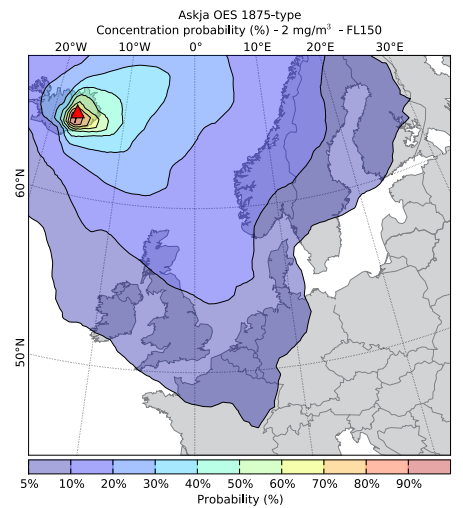
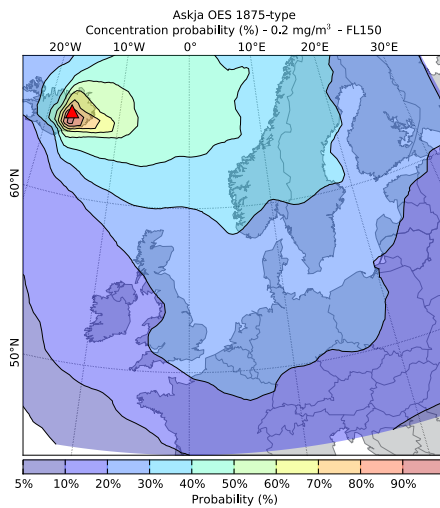
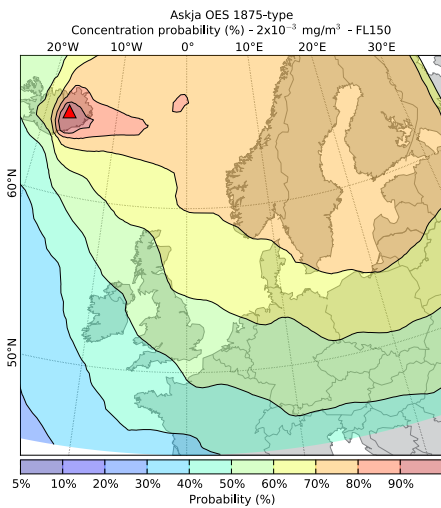
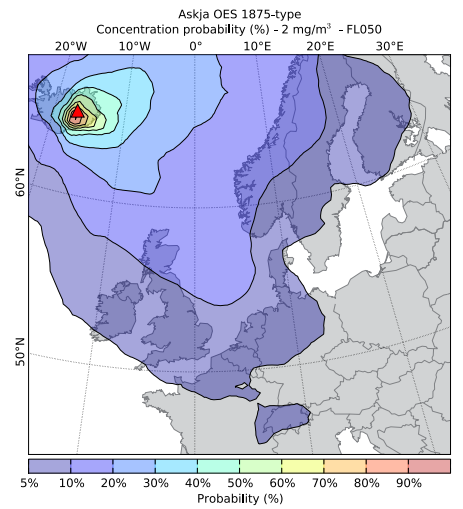
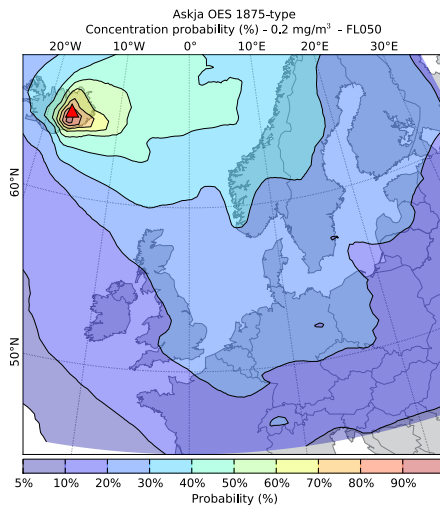
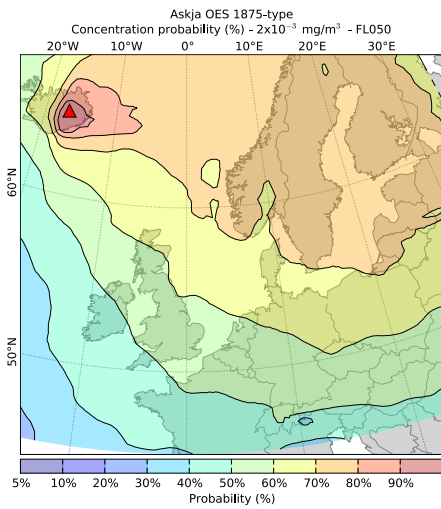
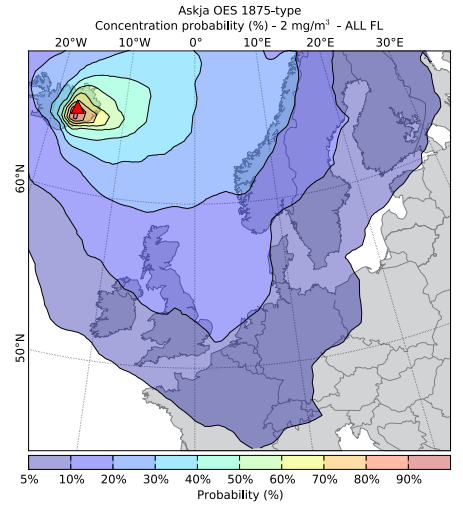
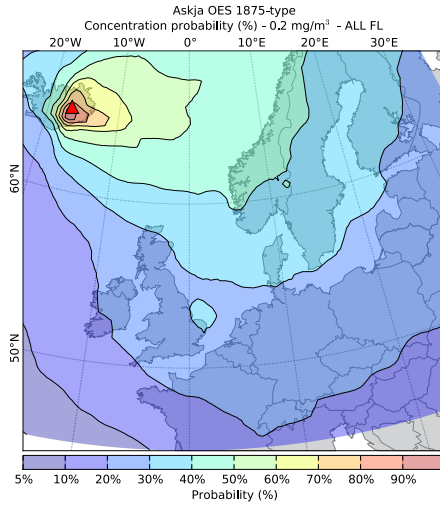
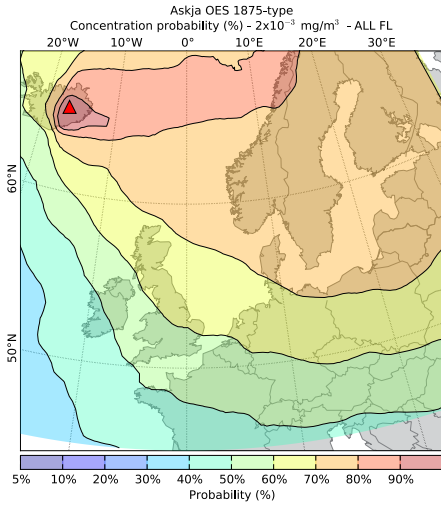




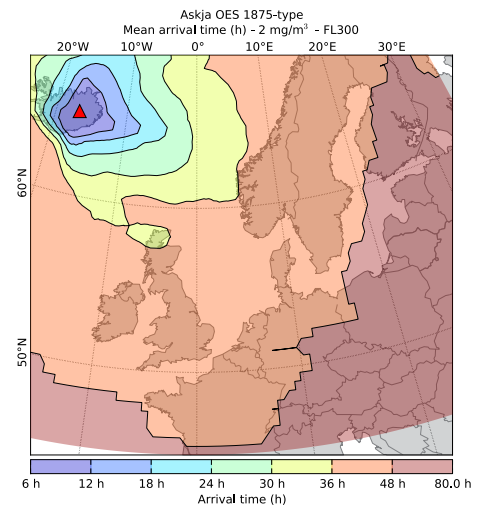
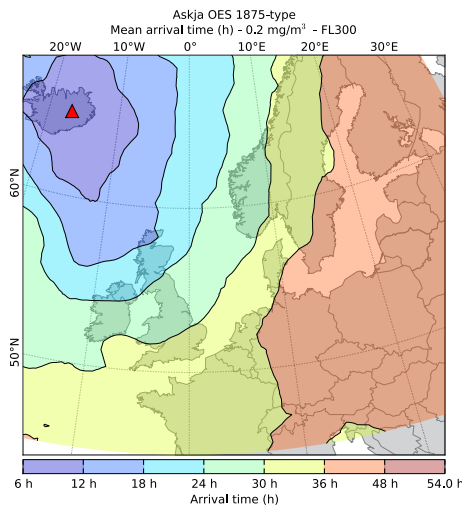
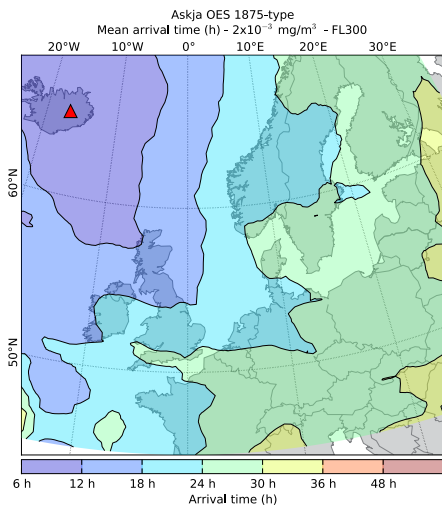
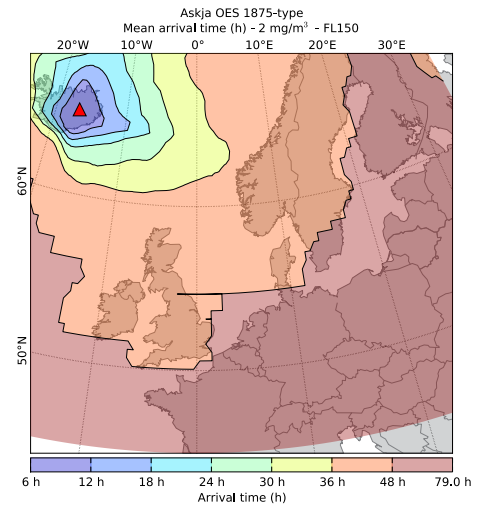
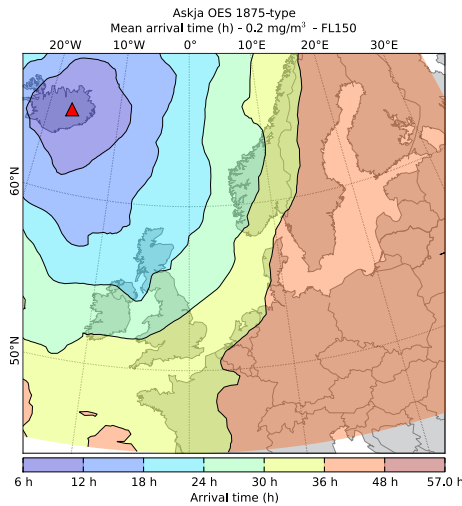
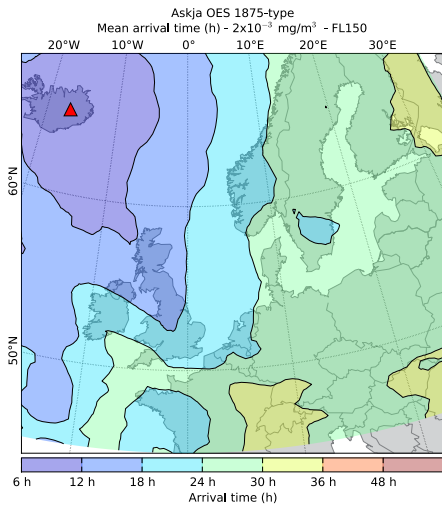
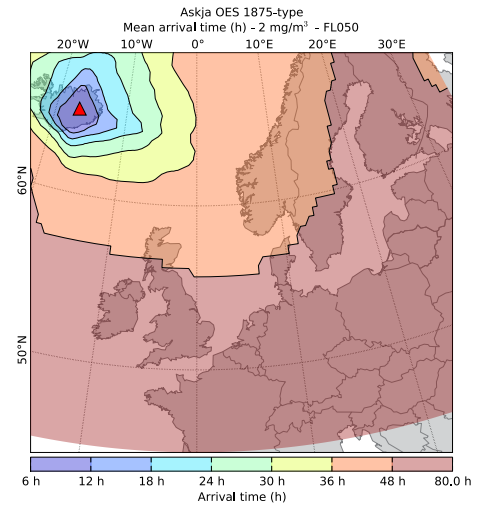
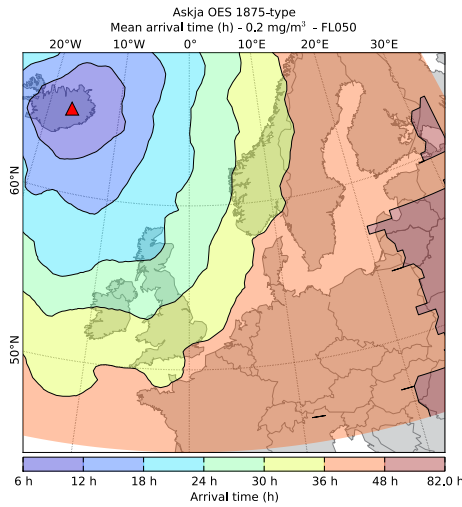
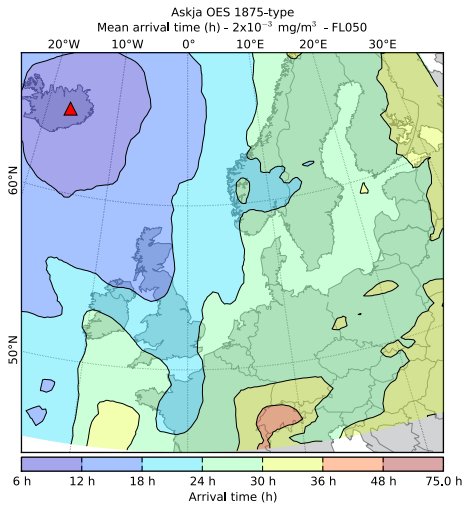
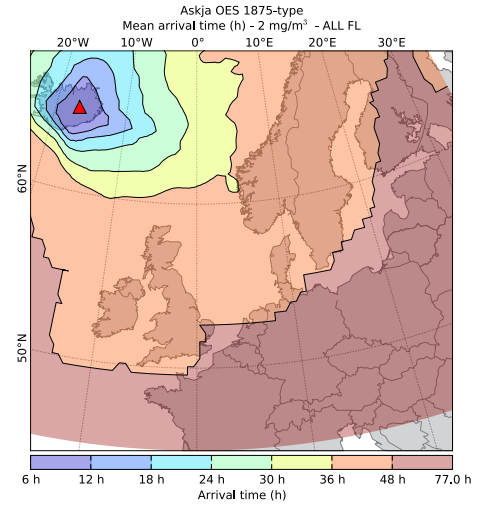
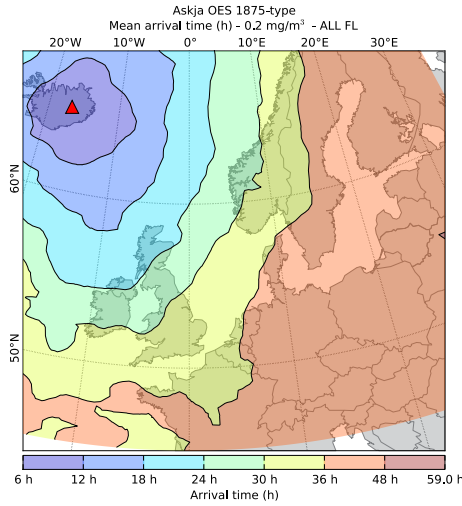
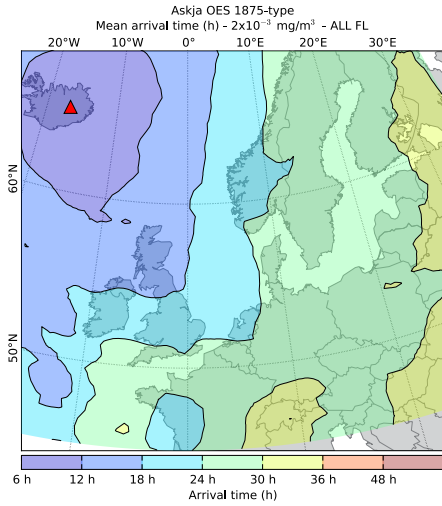


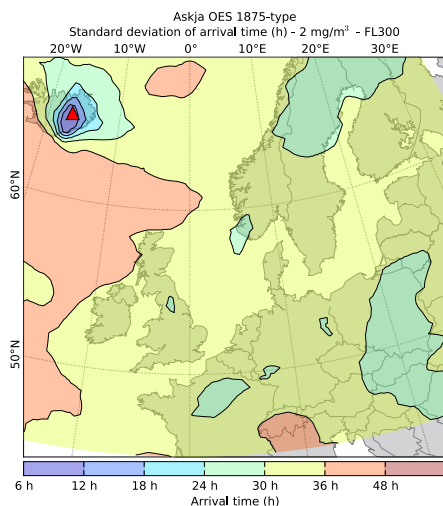
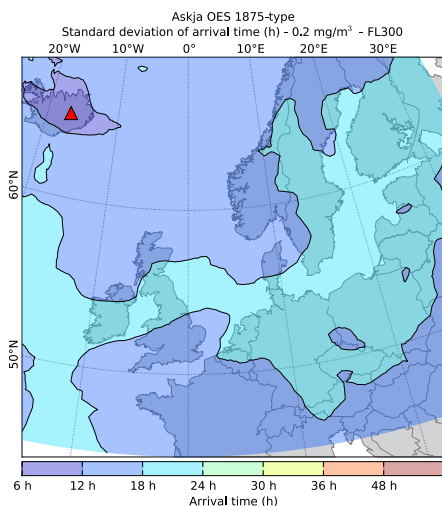
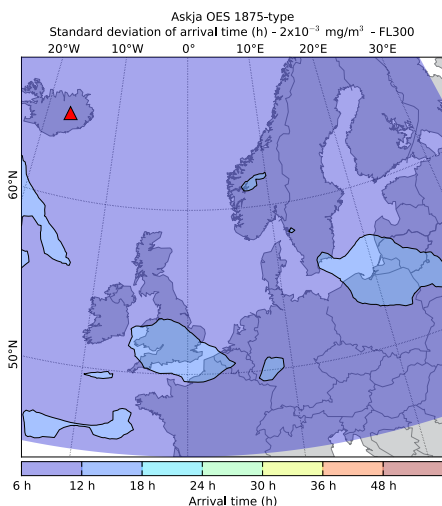
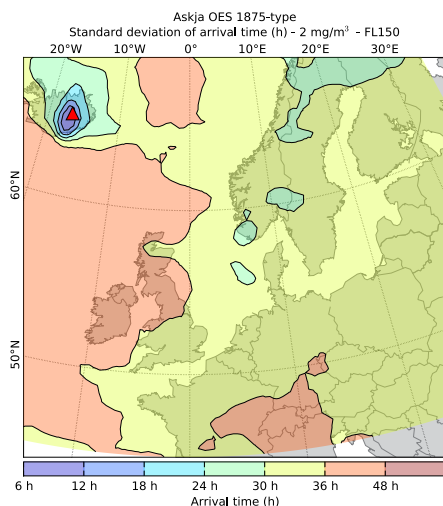
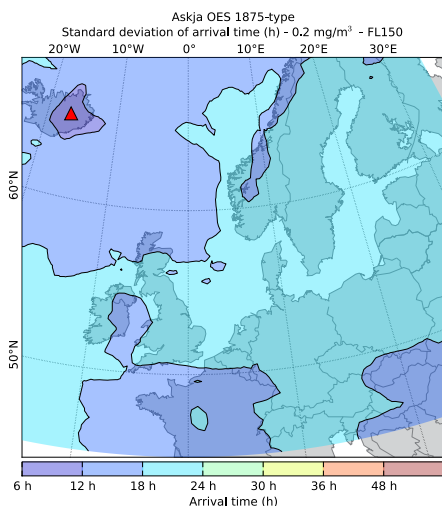
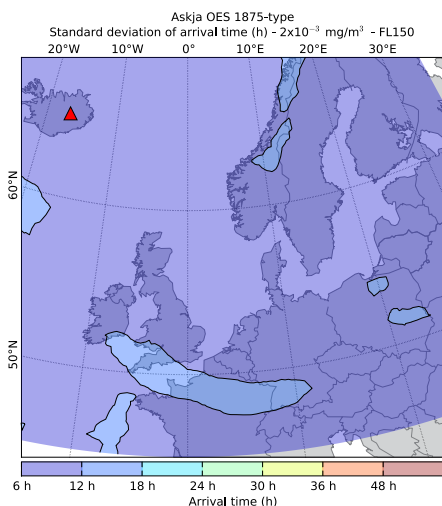
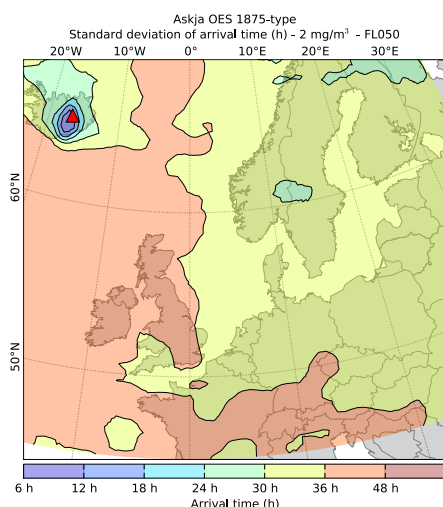
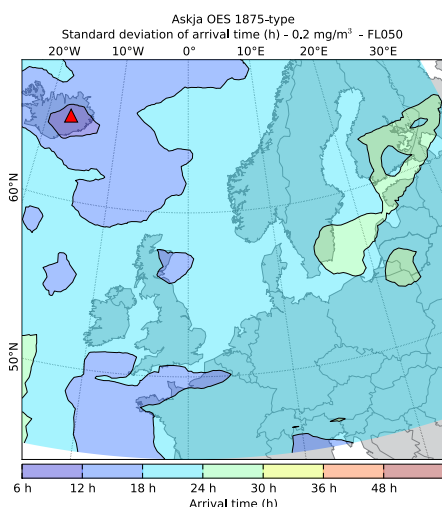
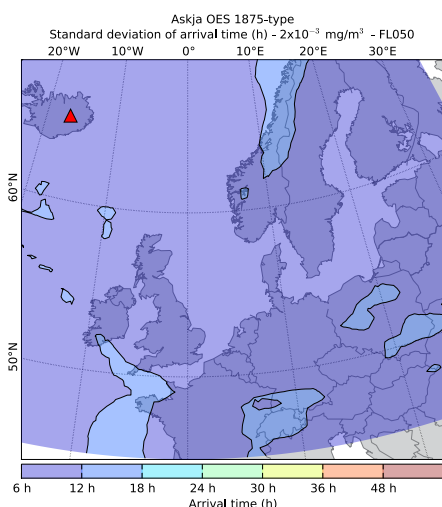
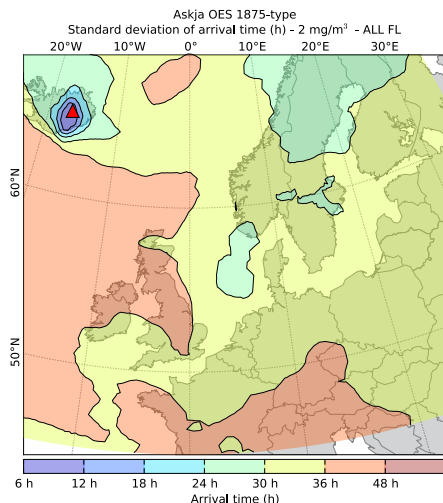
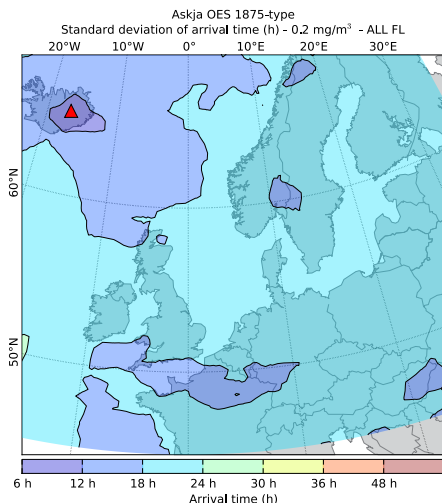
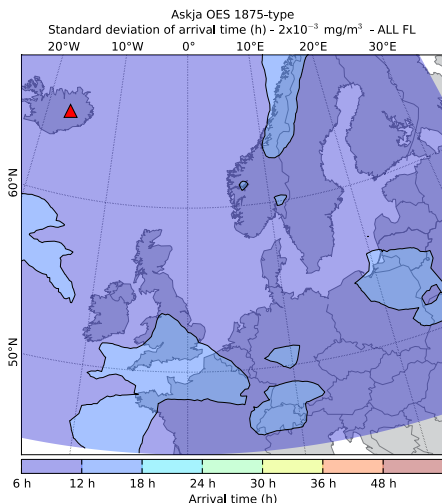


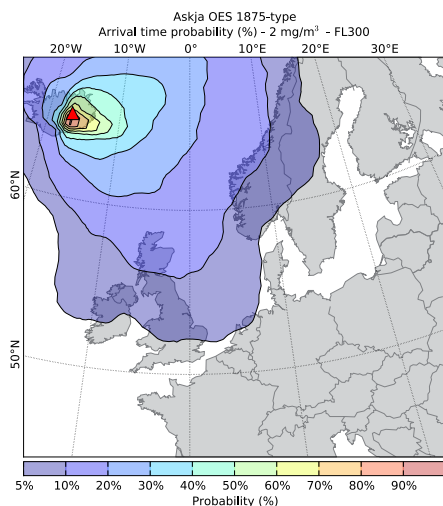
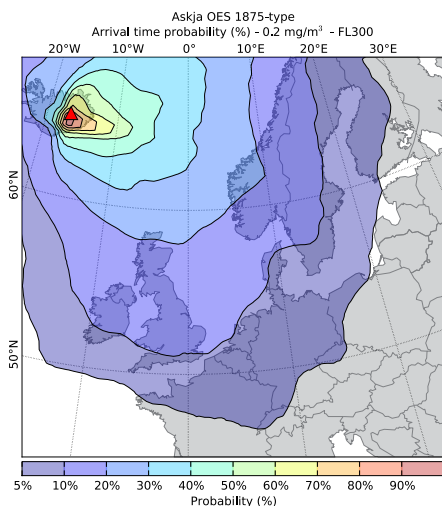
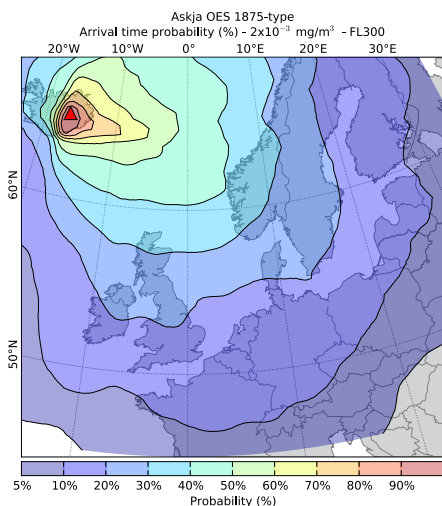
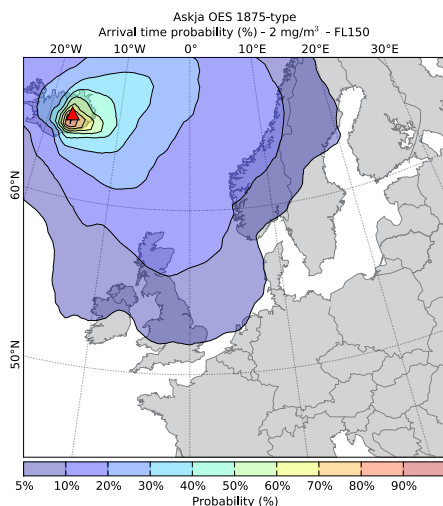
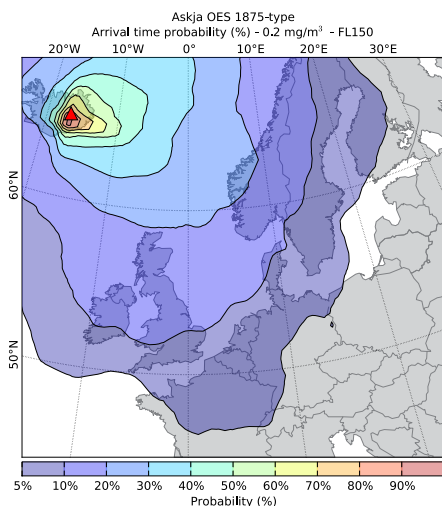
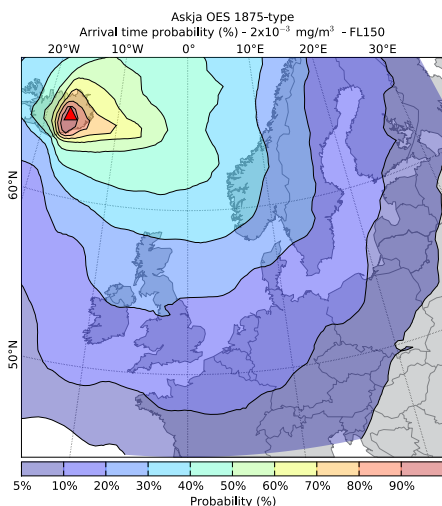
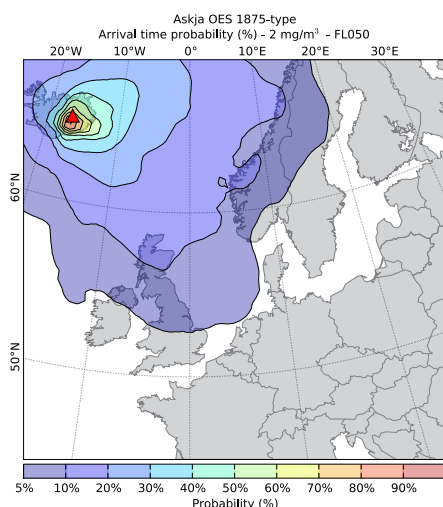
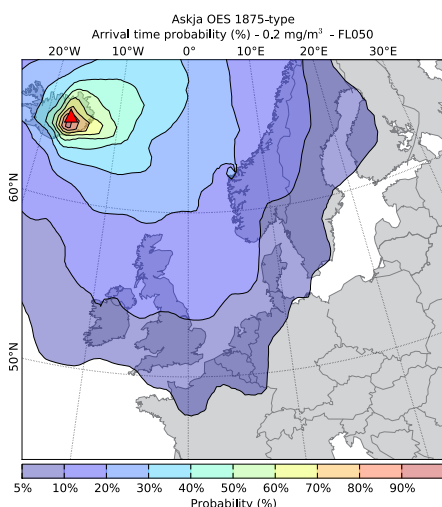
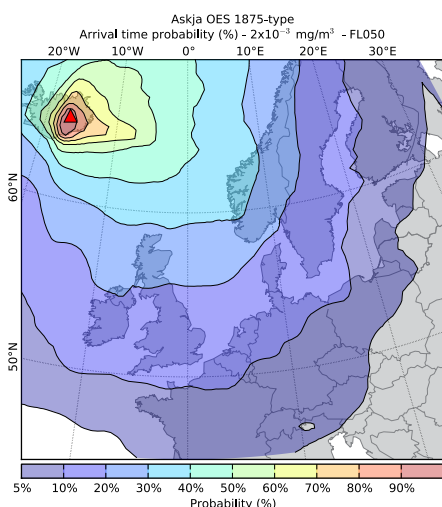
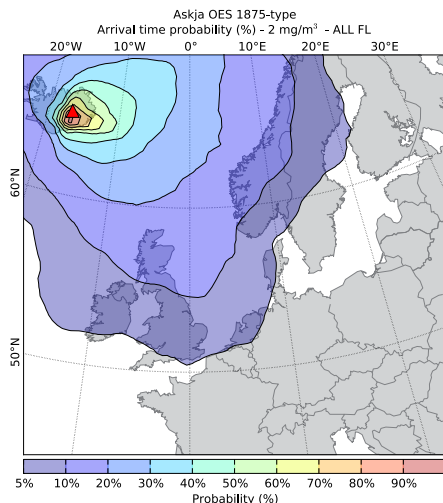
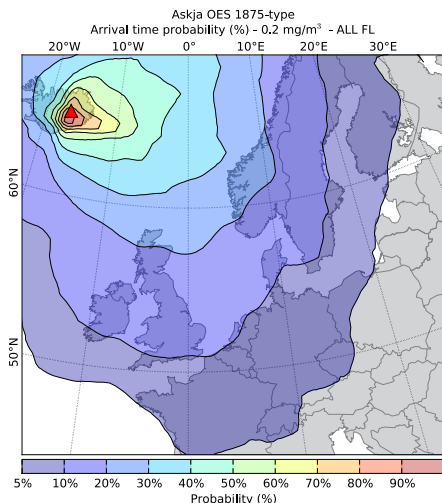
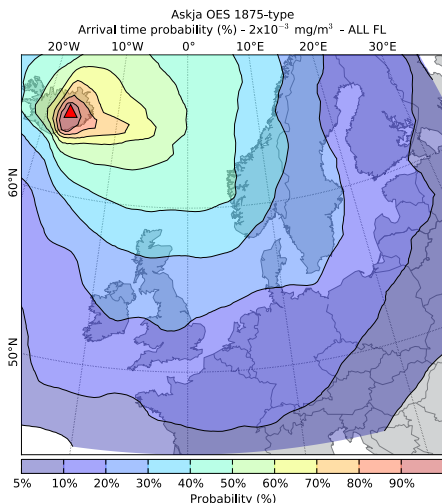


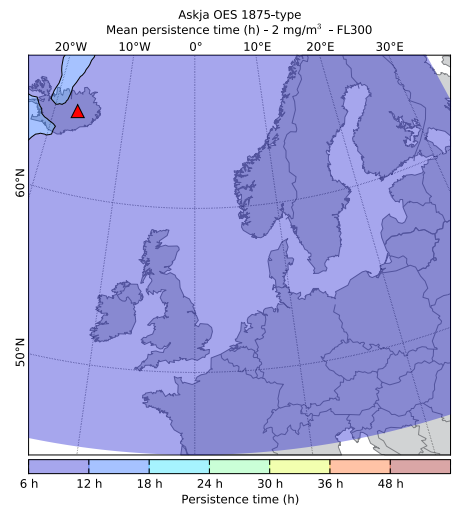
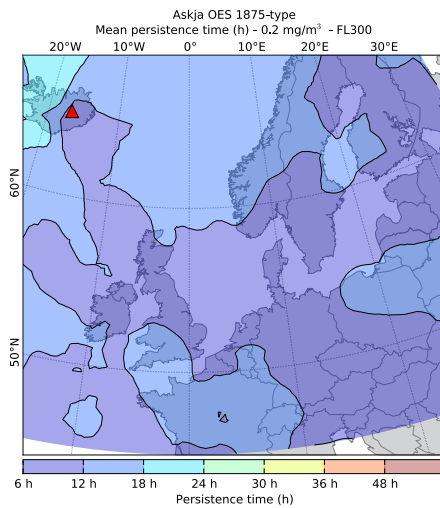
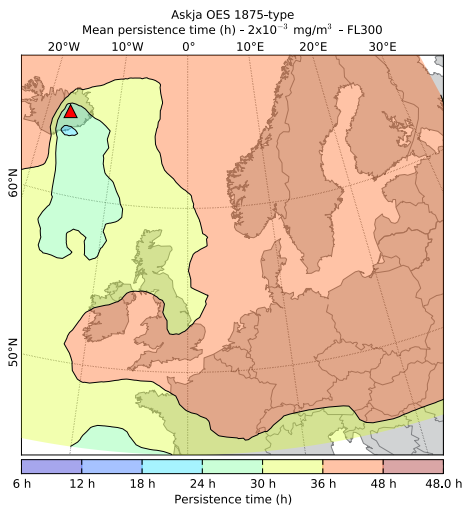
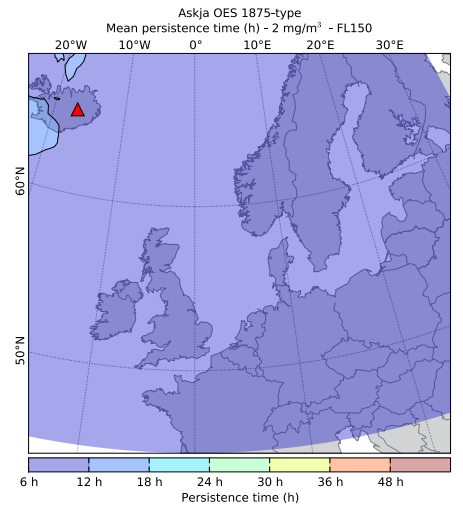
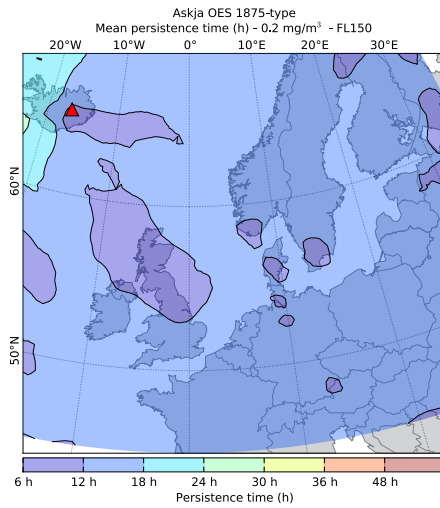
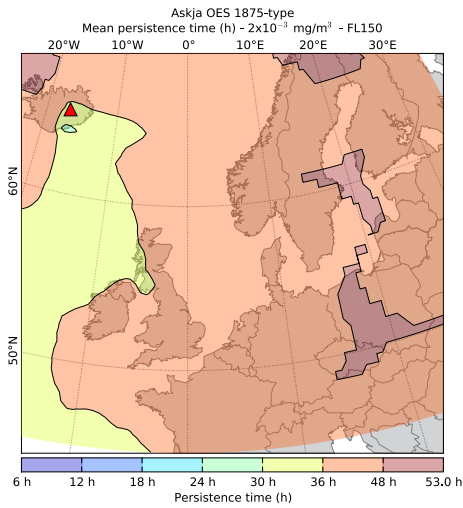
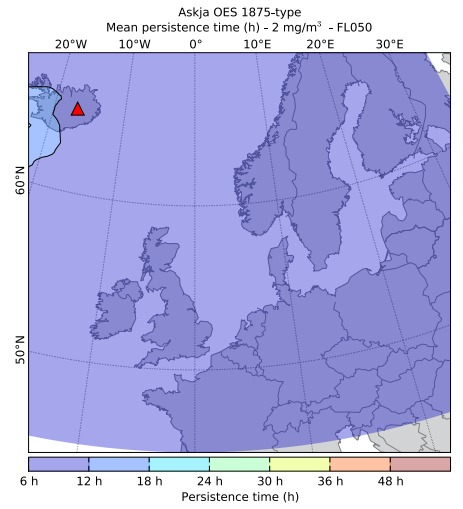
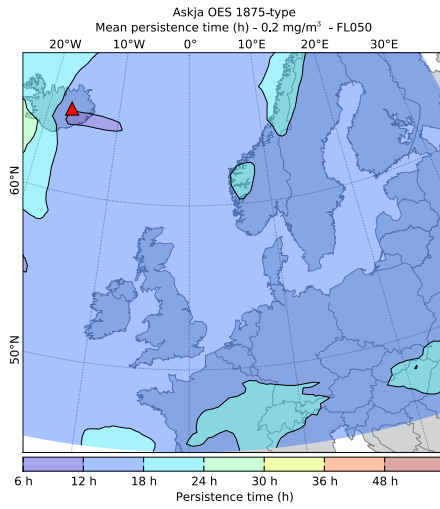
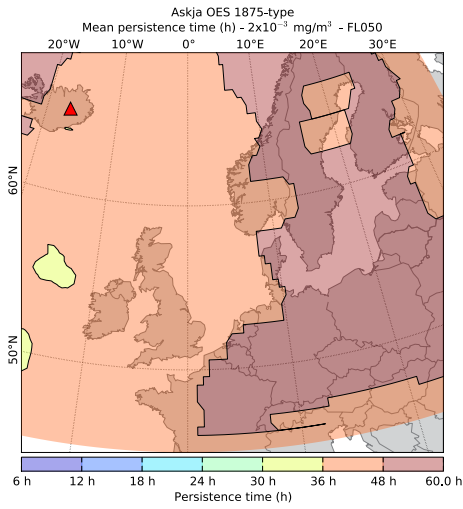
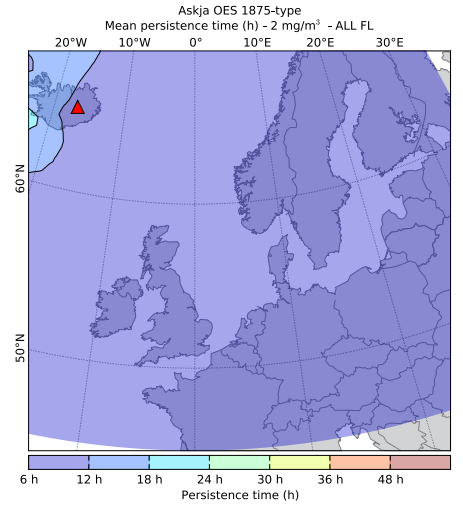
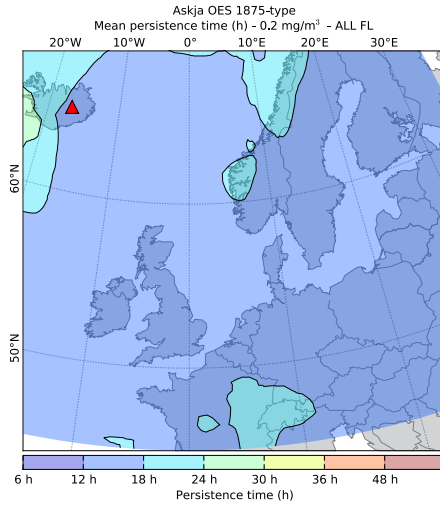
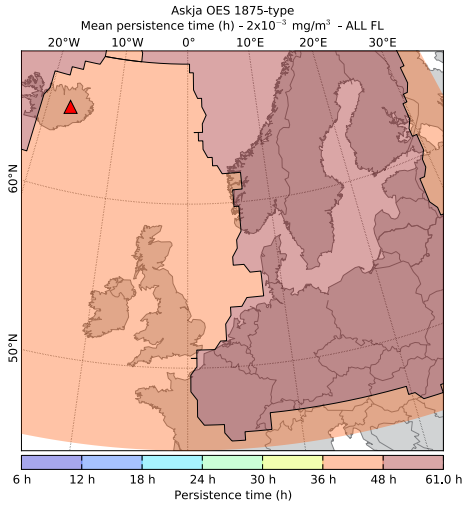


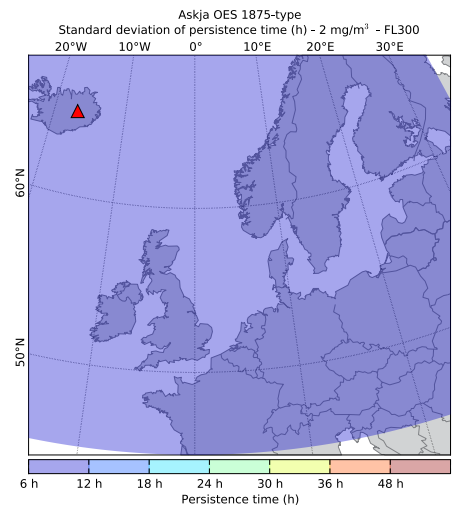
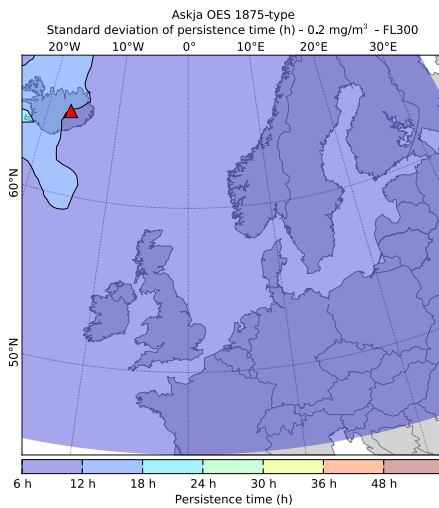
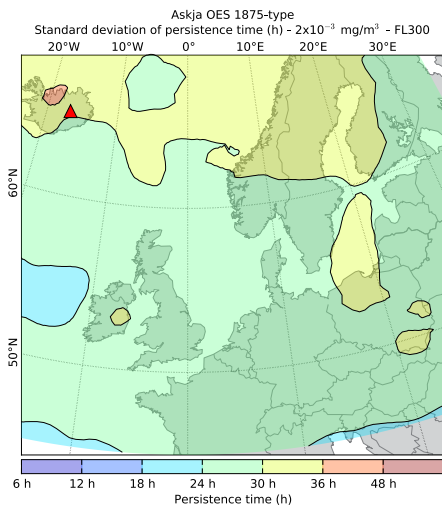
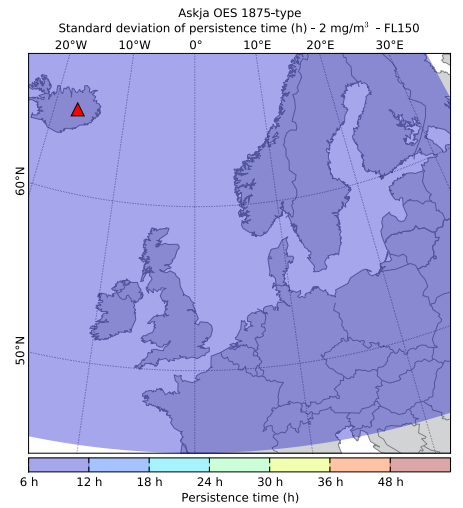
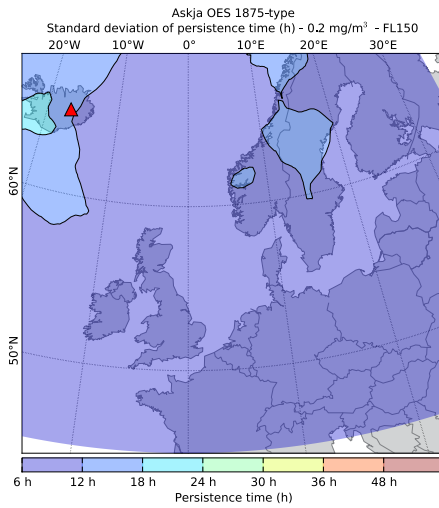
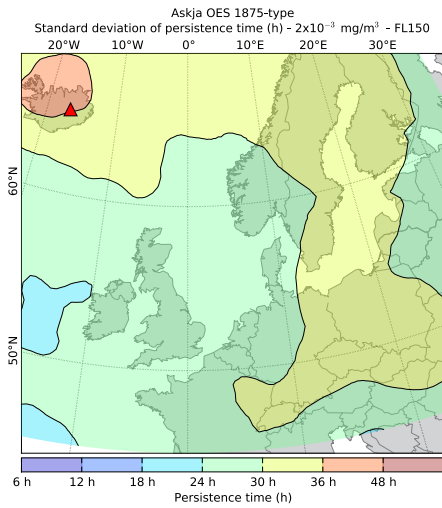
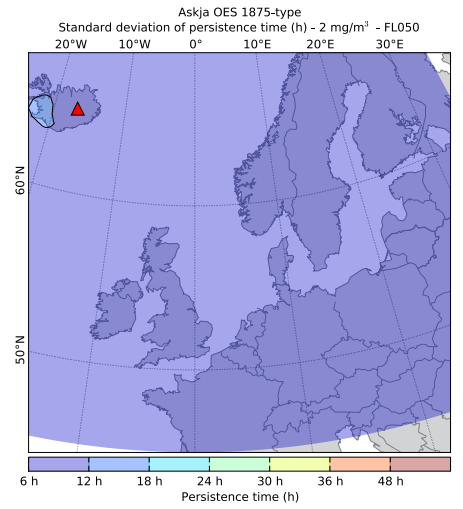
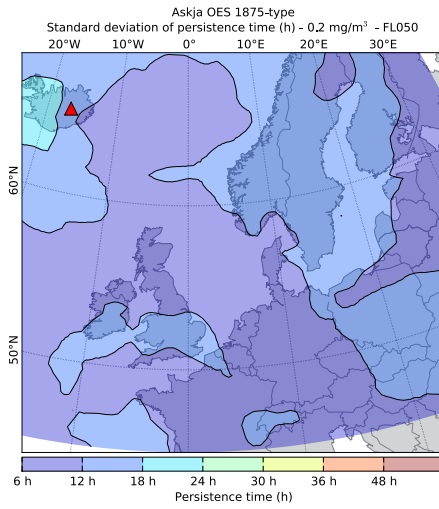
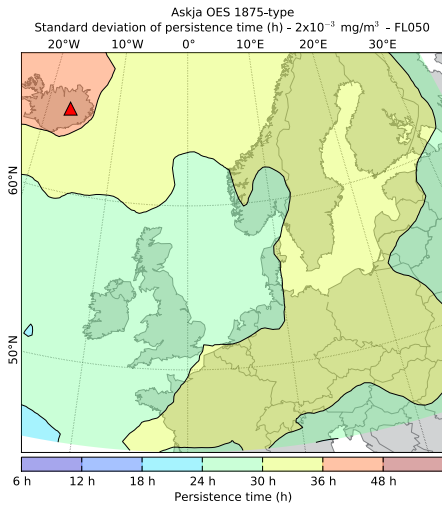
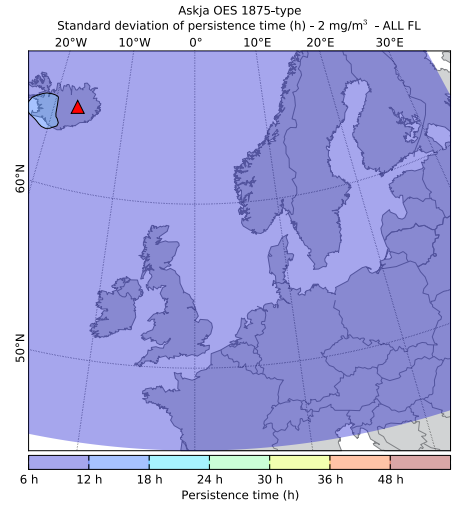
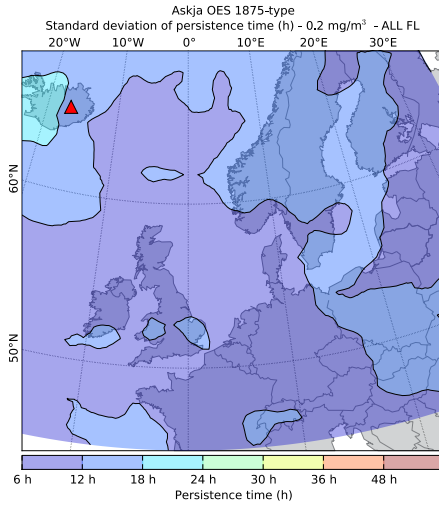
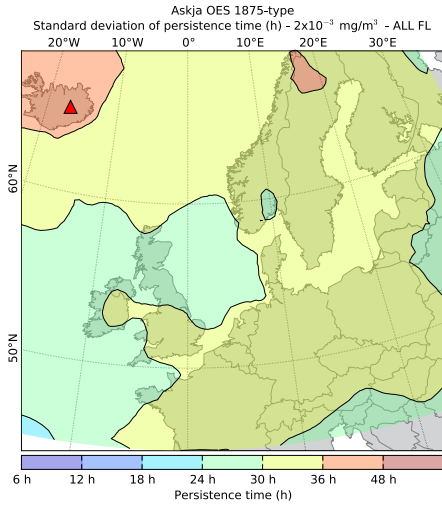


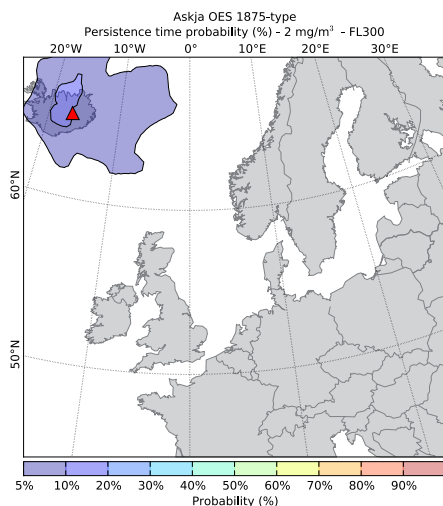
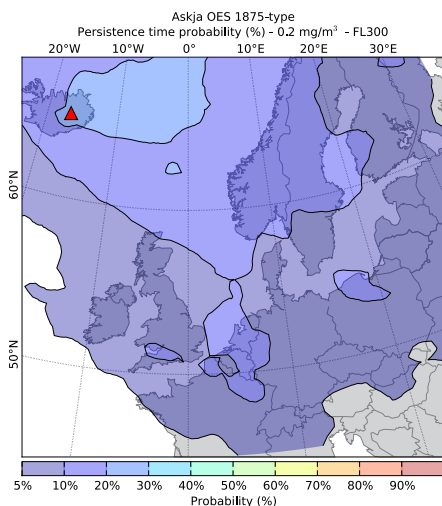
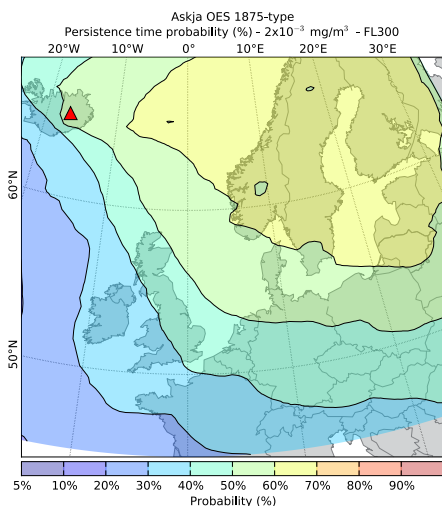
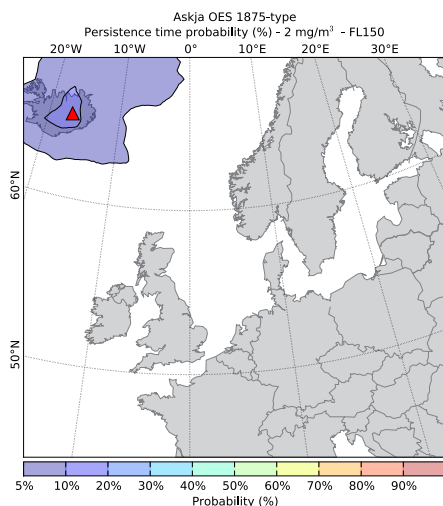
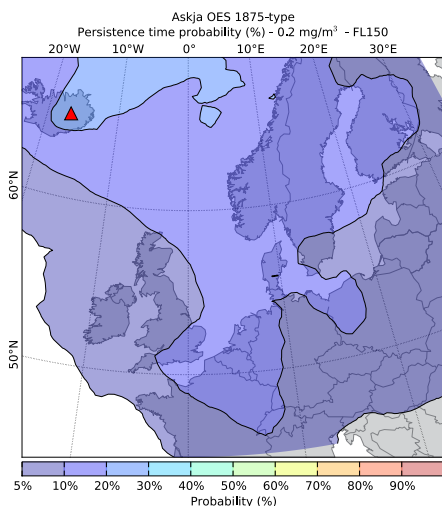
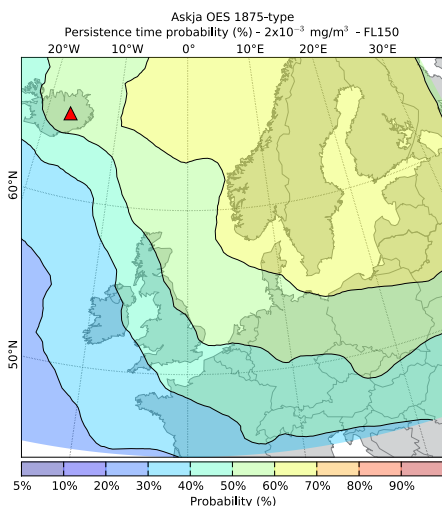
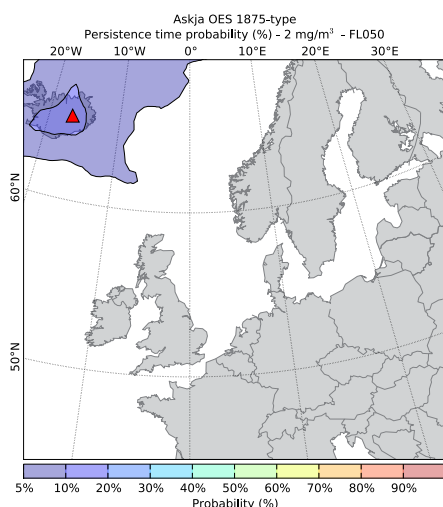
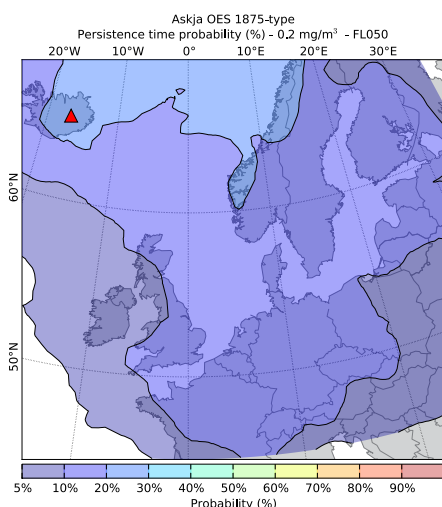
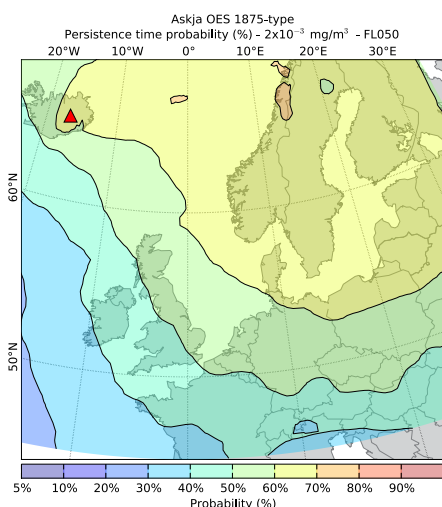
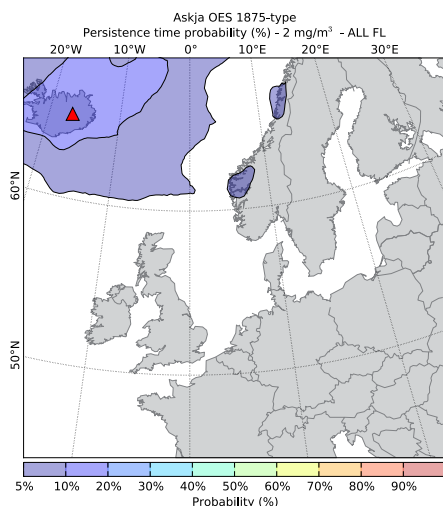
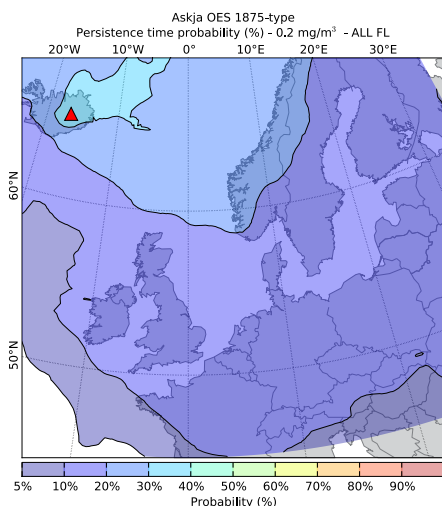
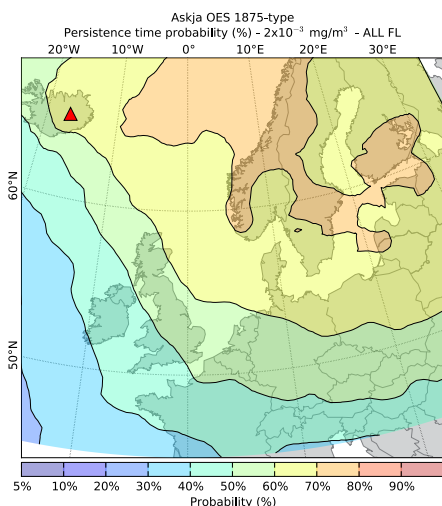


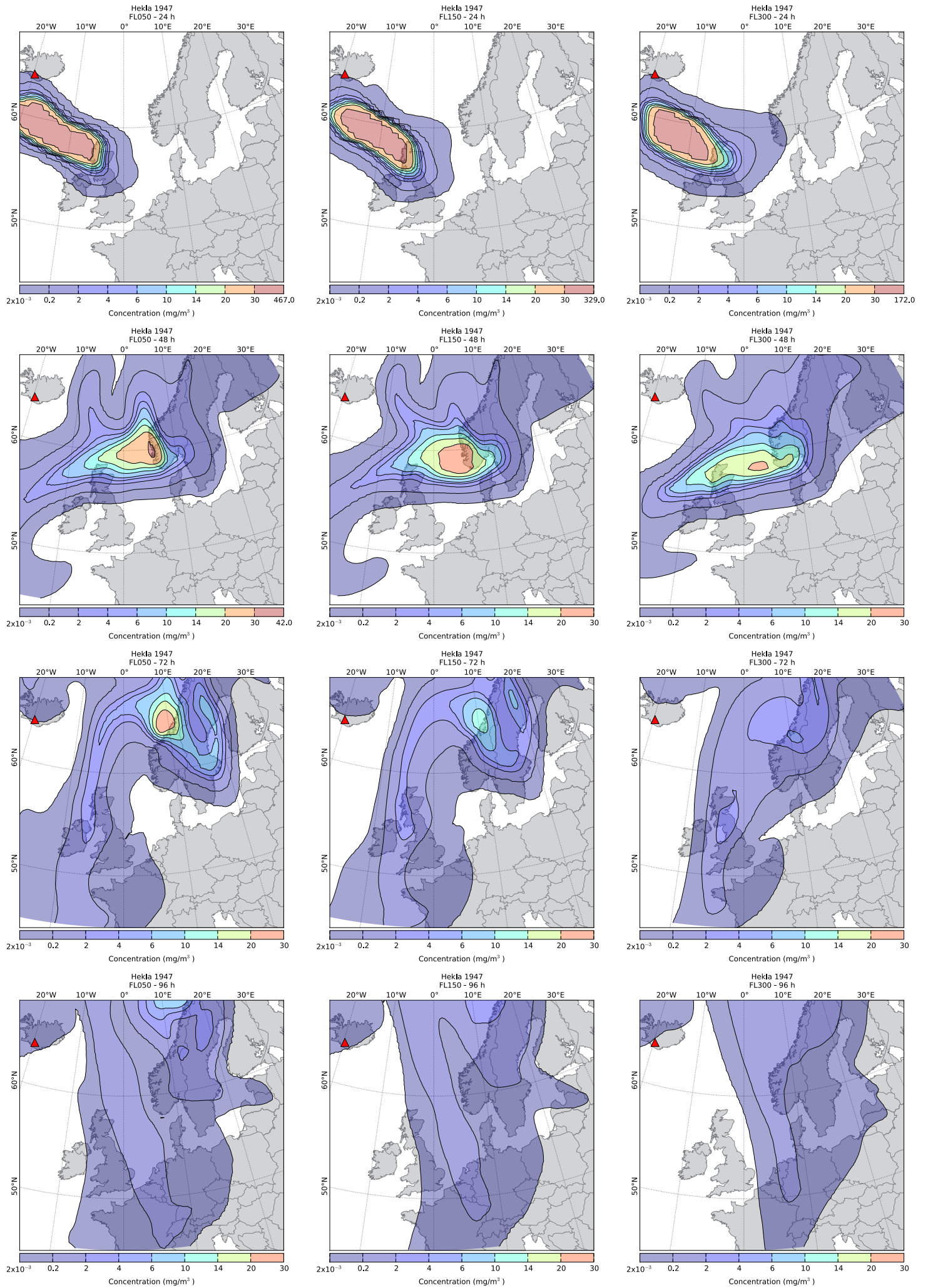




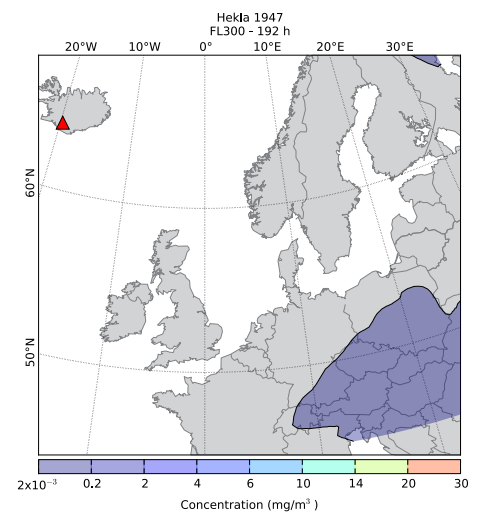
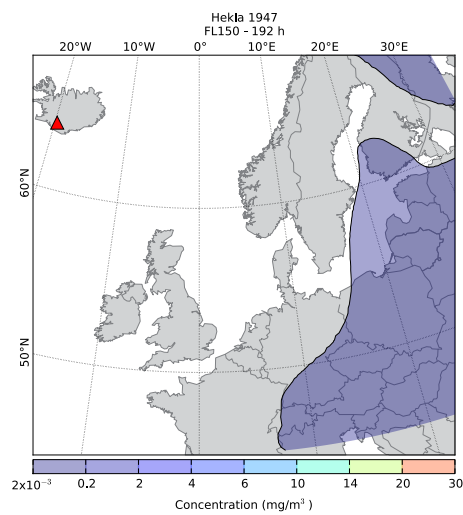
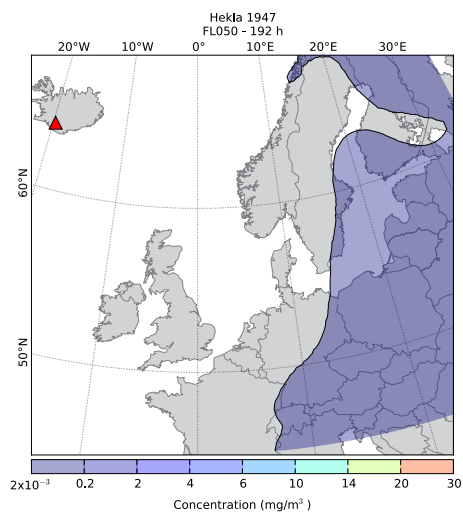
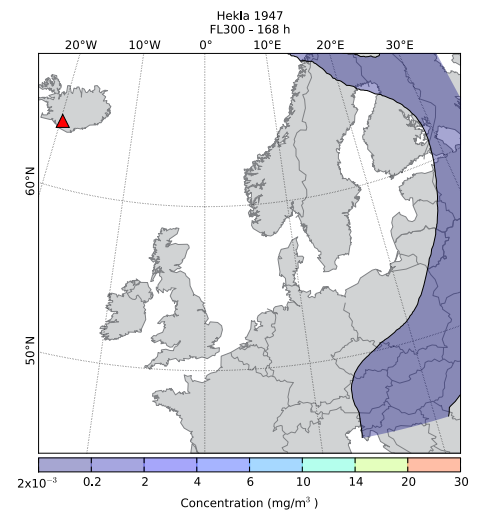
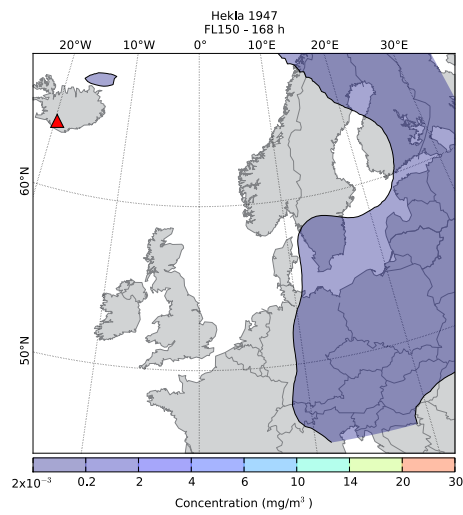
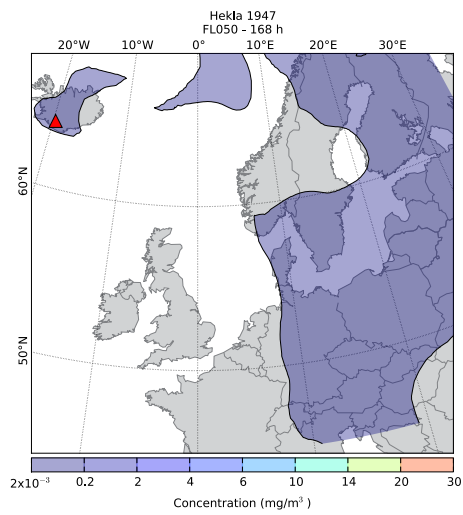
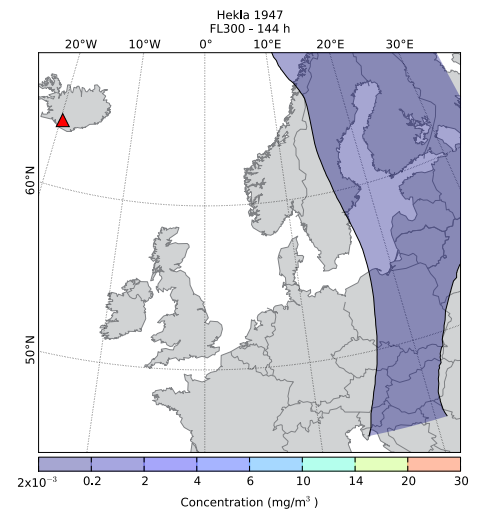
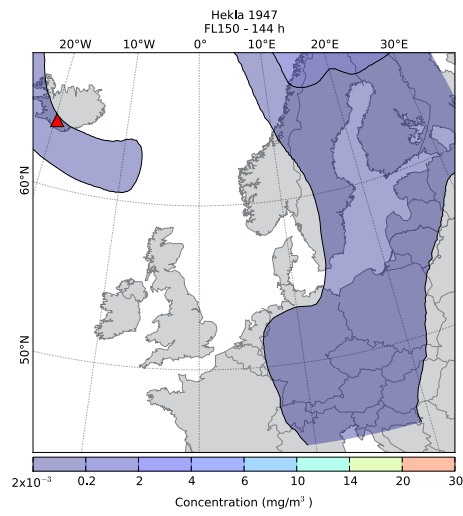
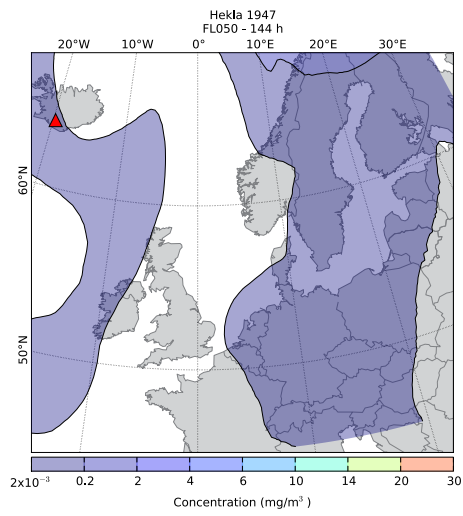
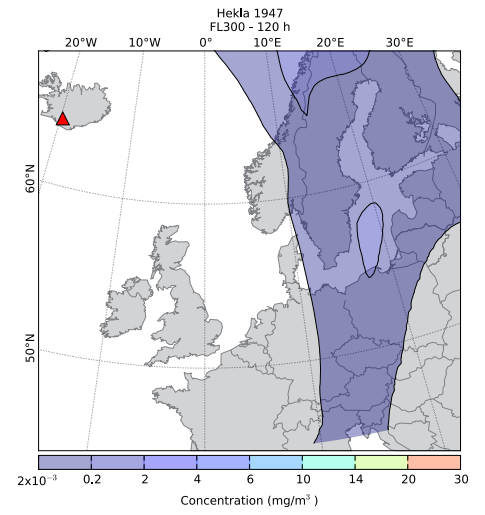
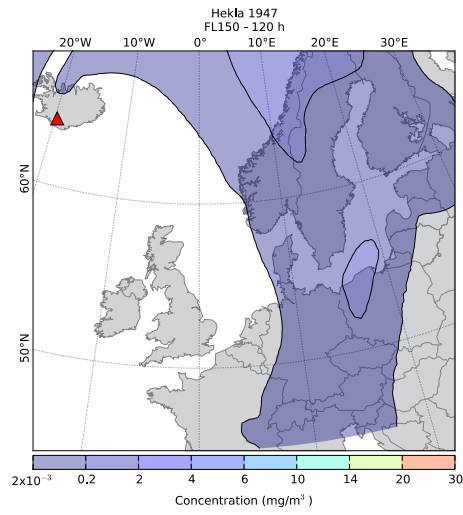
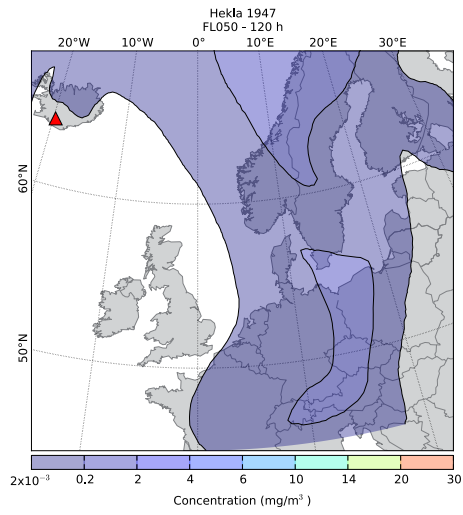






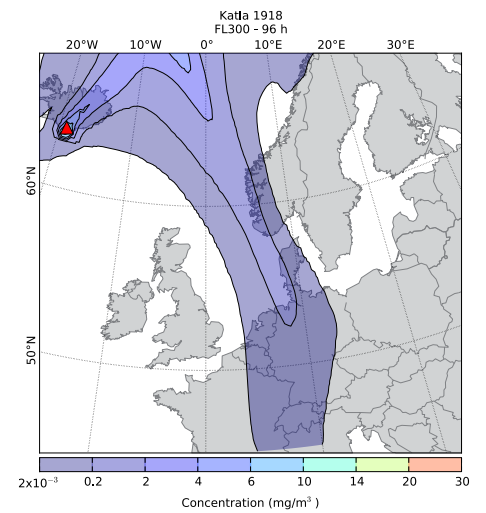
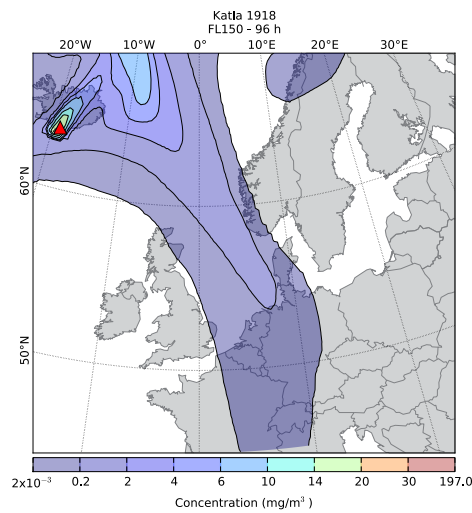
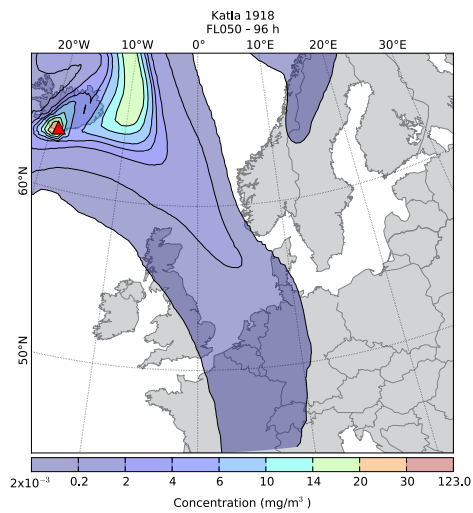
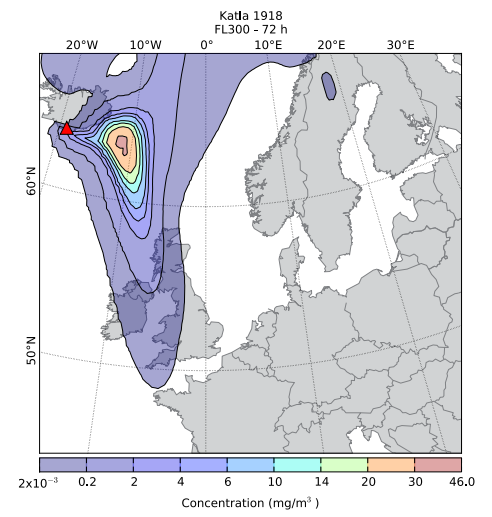
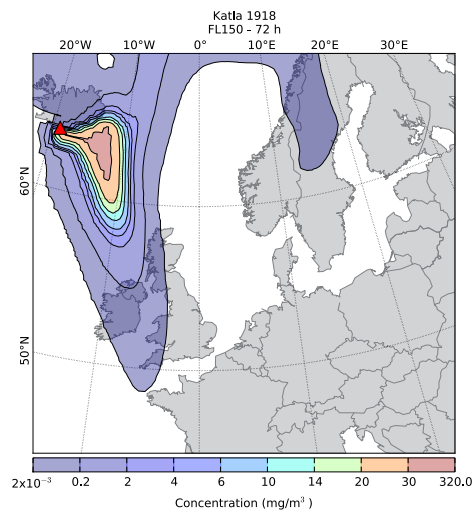
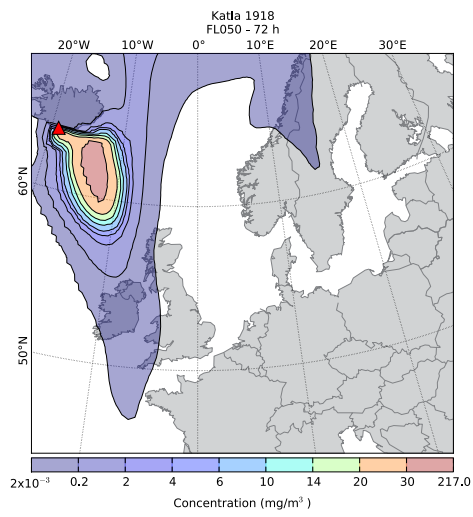
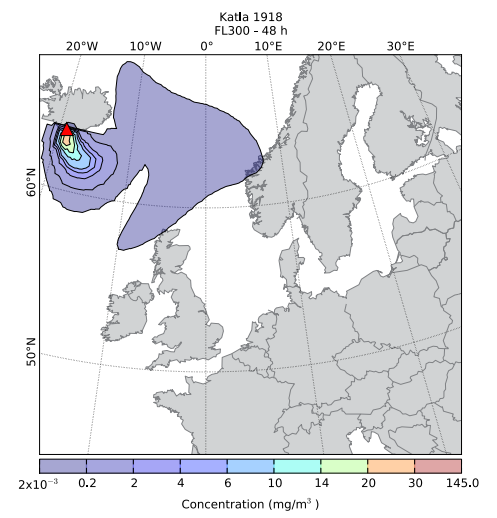
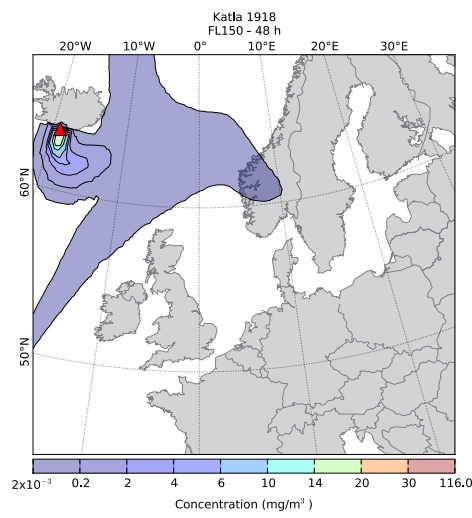
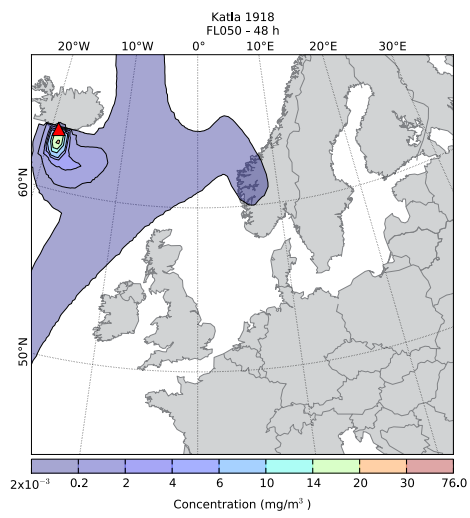
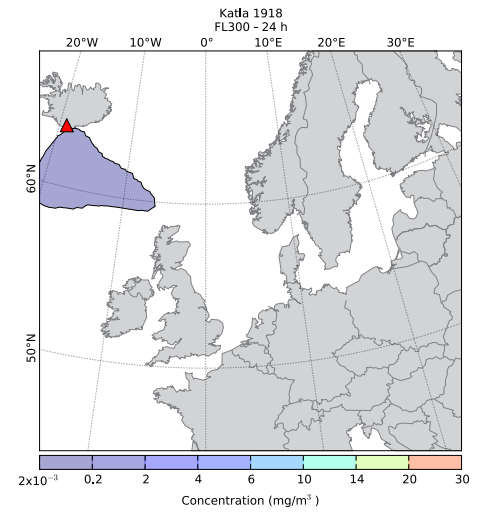
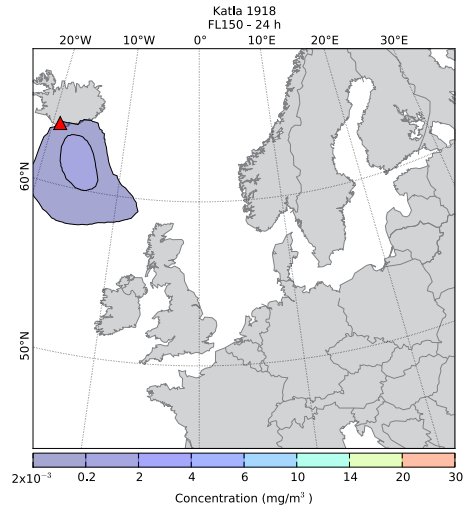
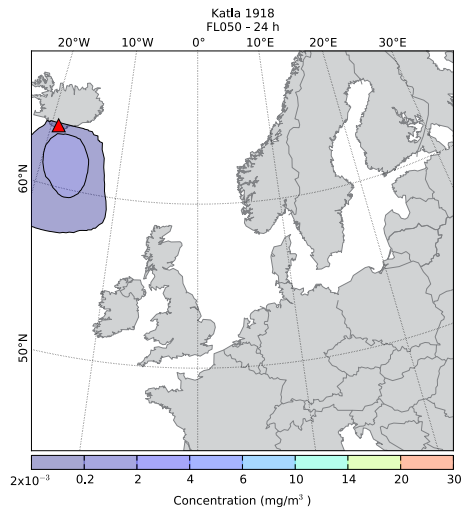


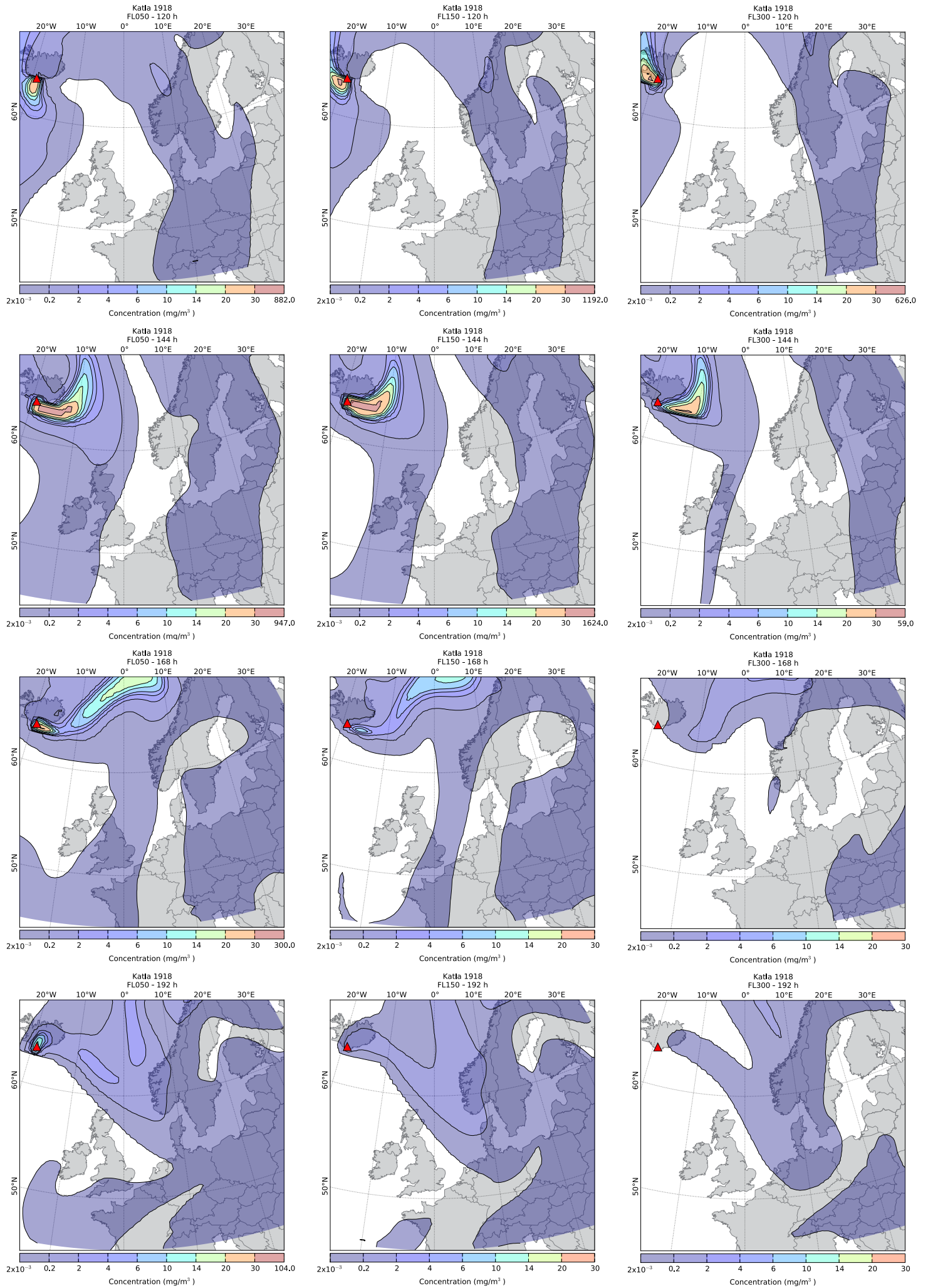
# Hekla 1947 - Deterministic approach - Concentration (mg/m<sup>3</sup>)

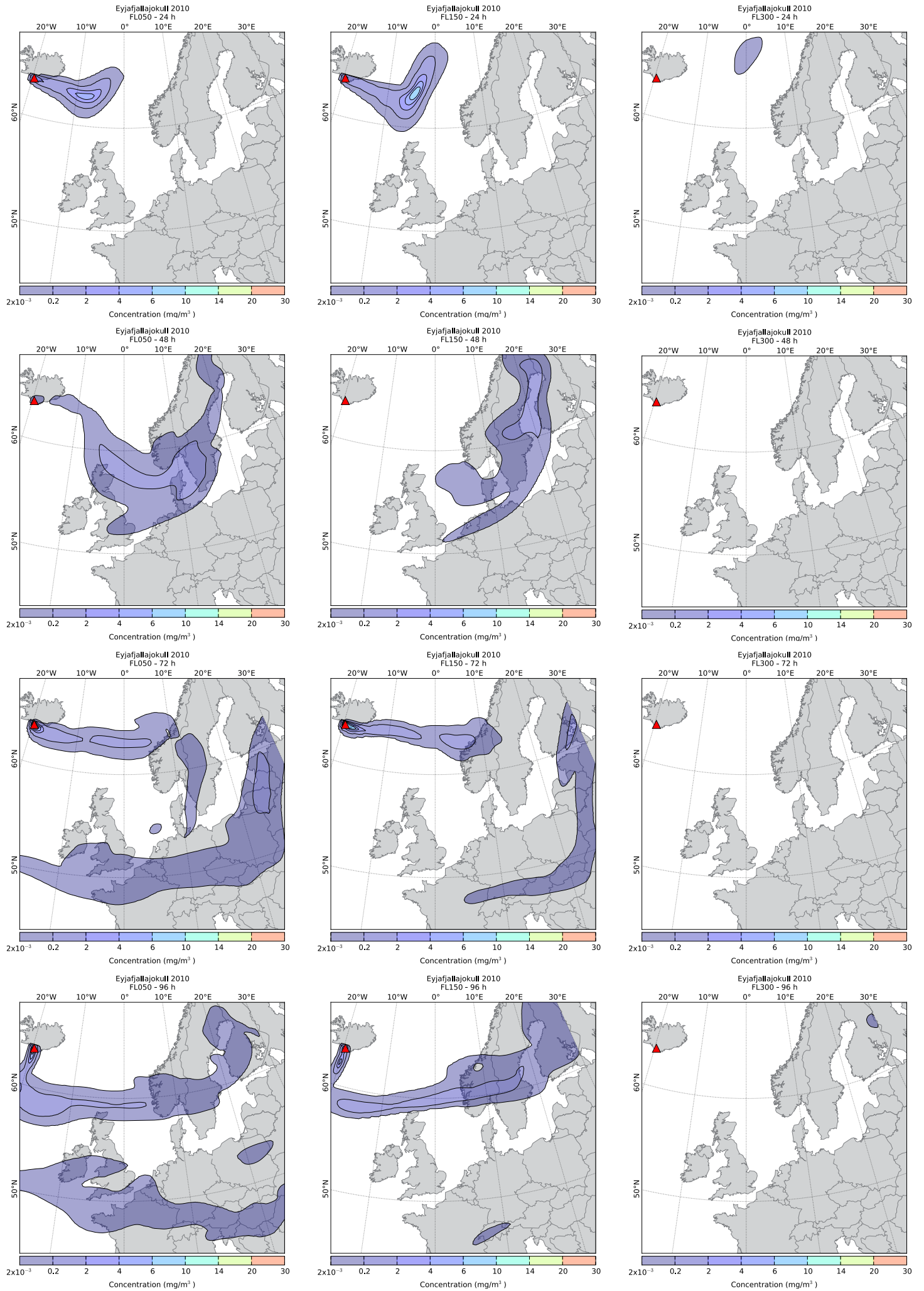


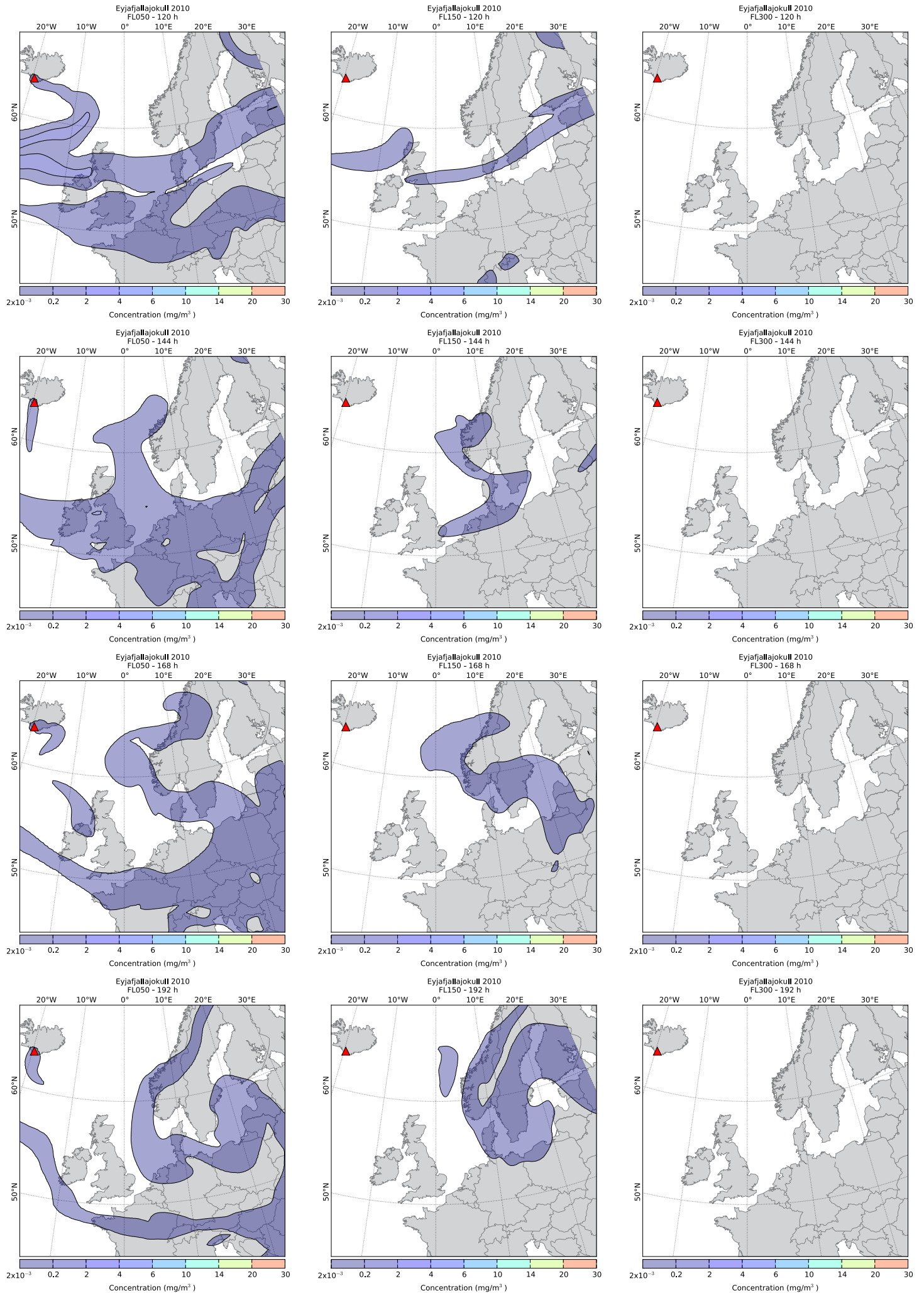


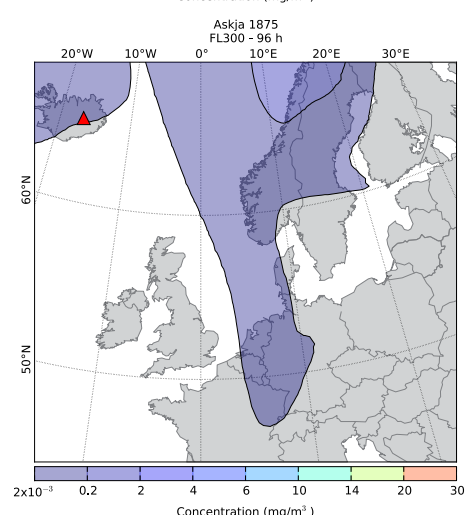
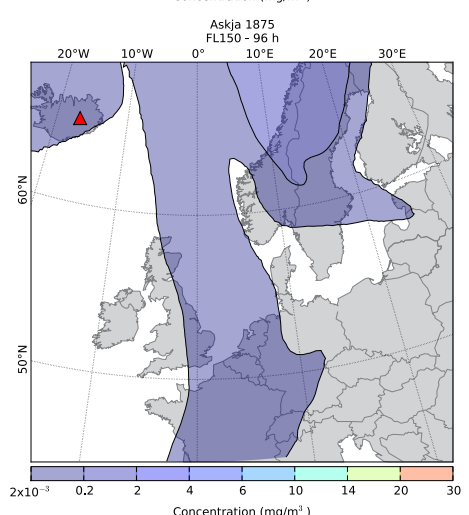
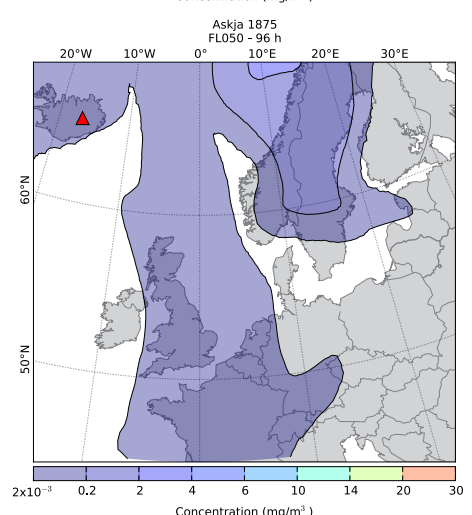
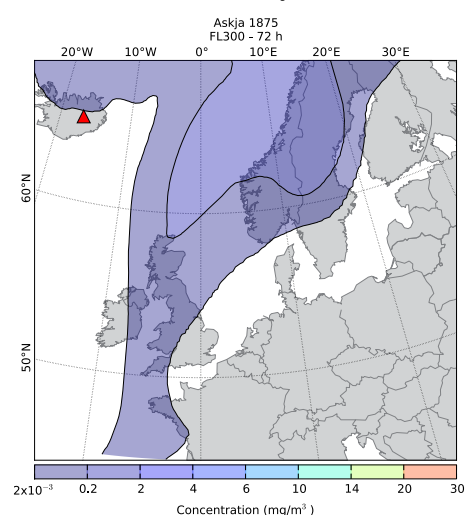
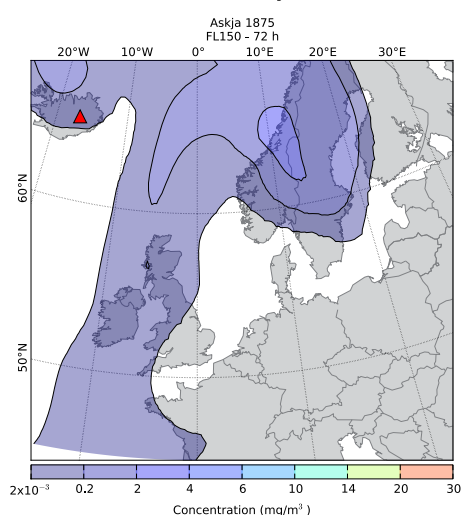
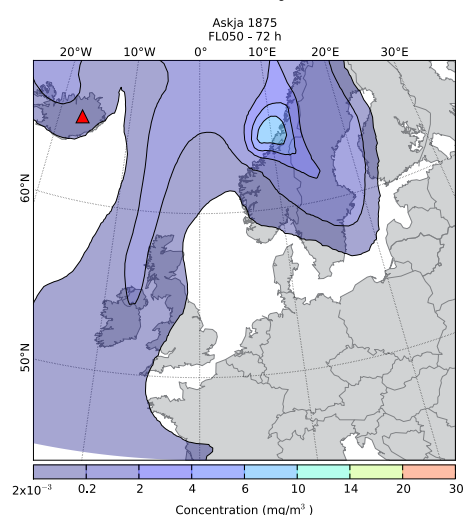
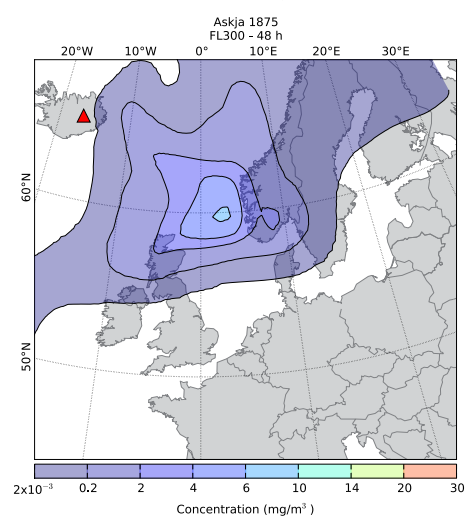
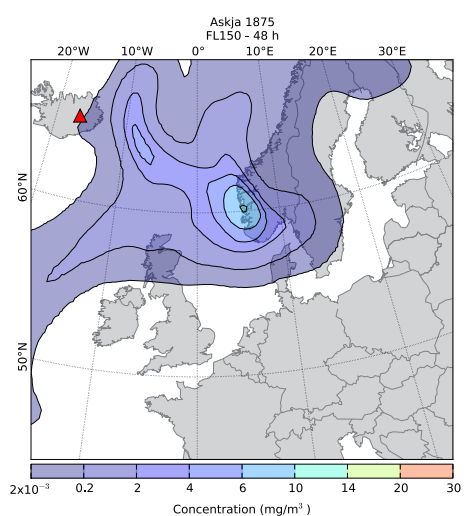
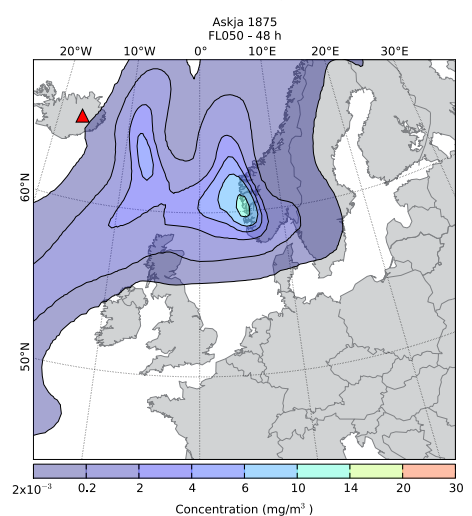
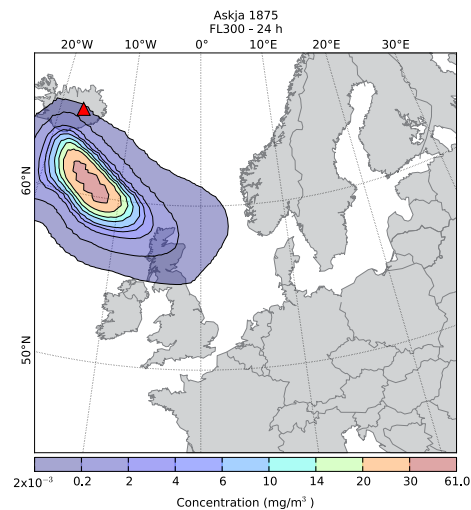
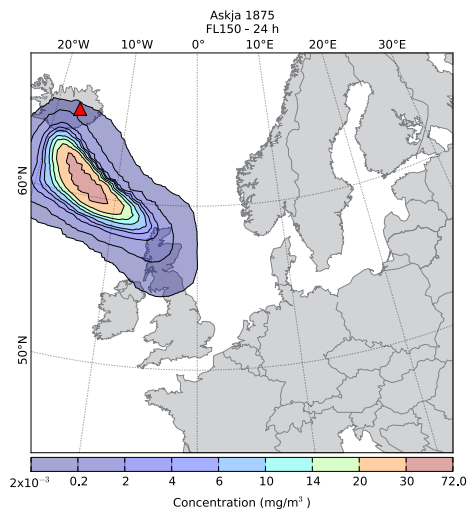
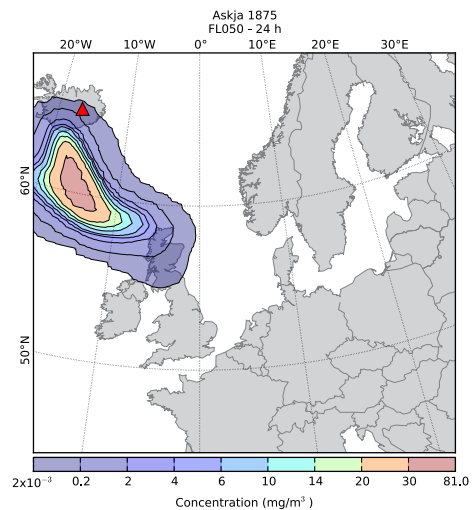
# Katla 1918 - Deterministic approach - Concentration (mg/m<sup>3</sup>)

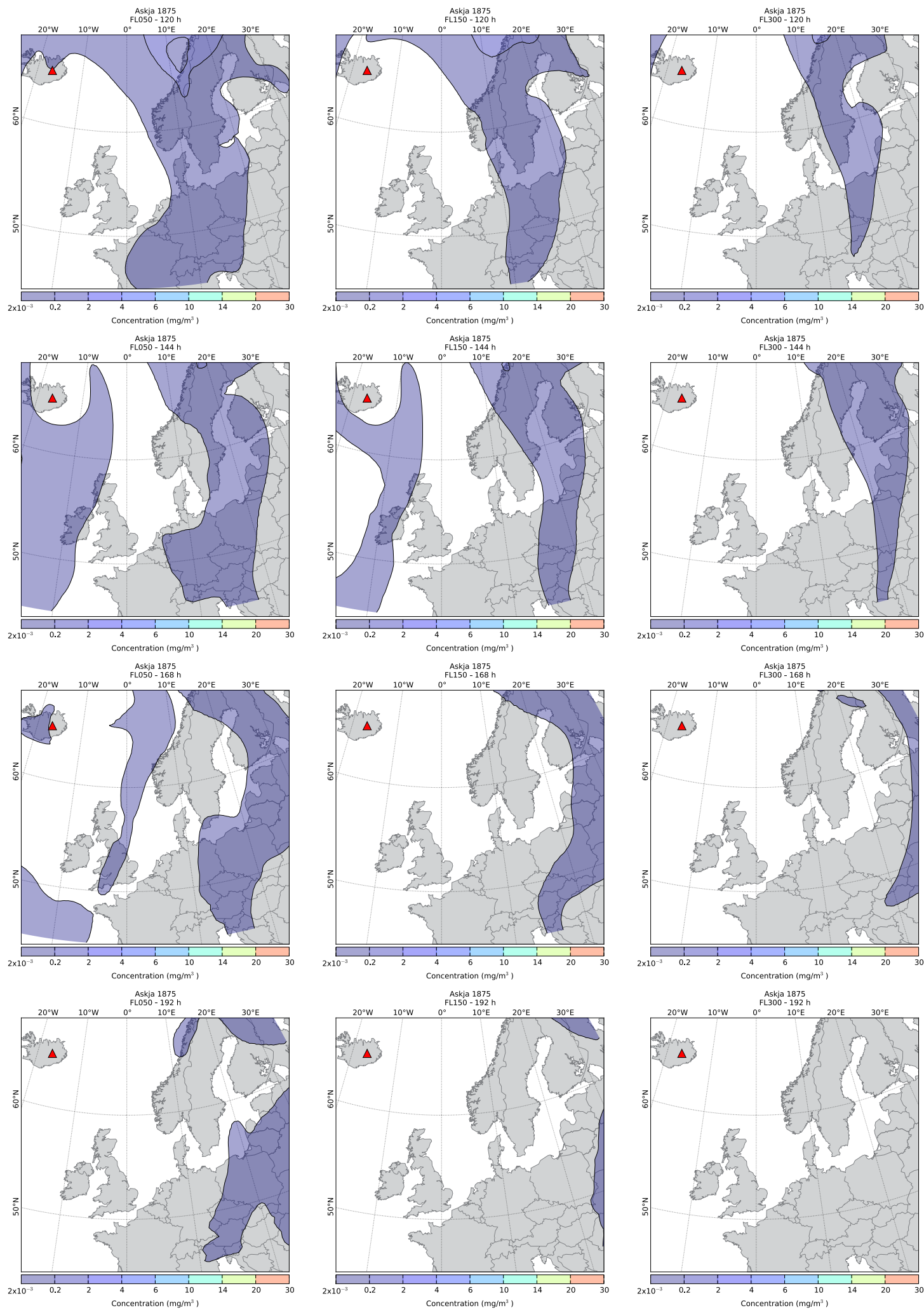


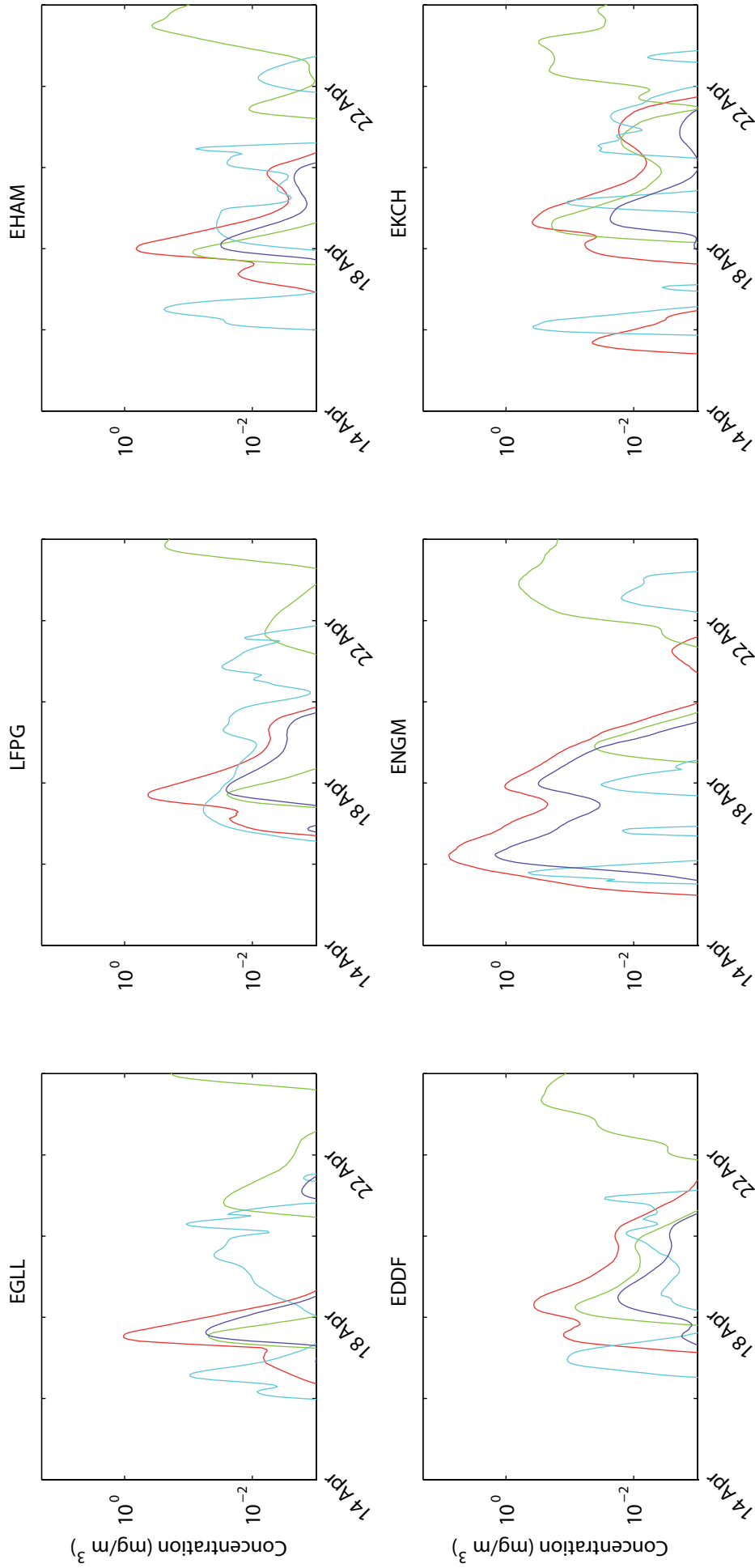




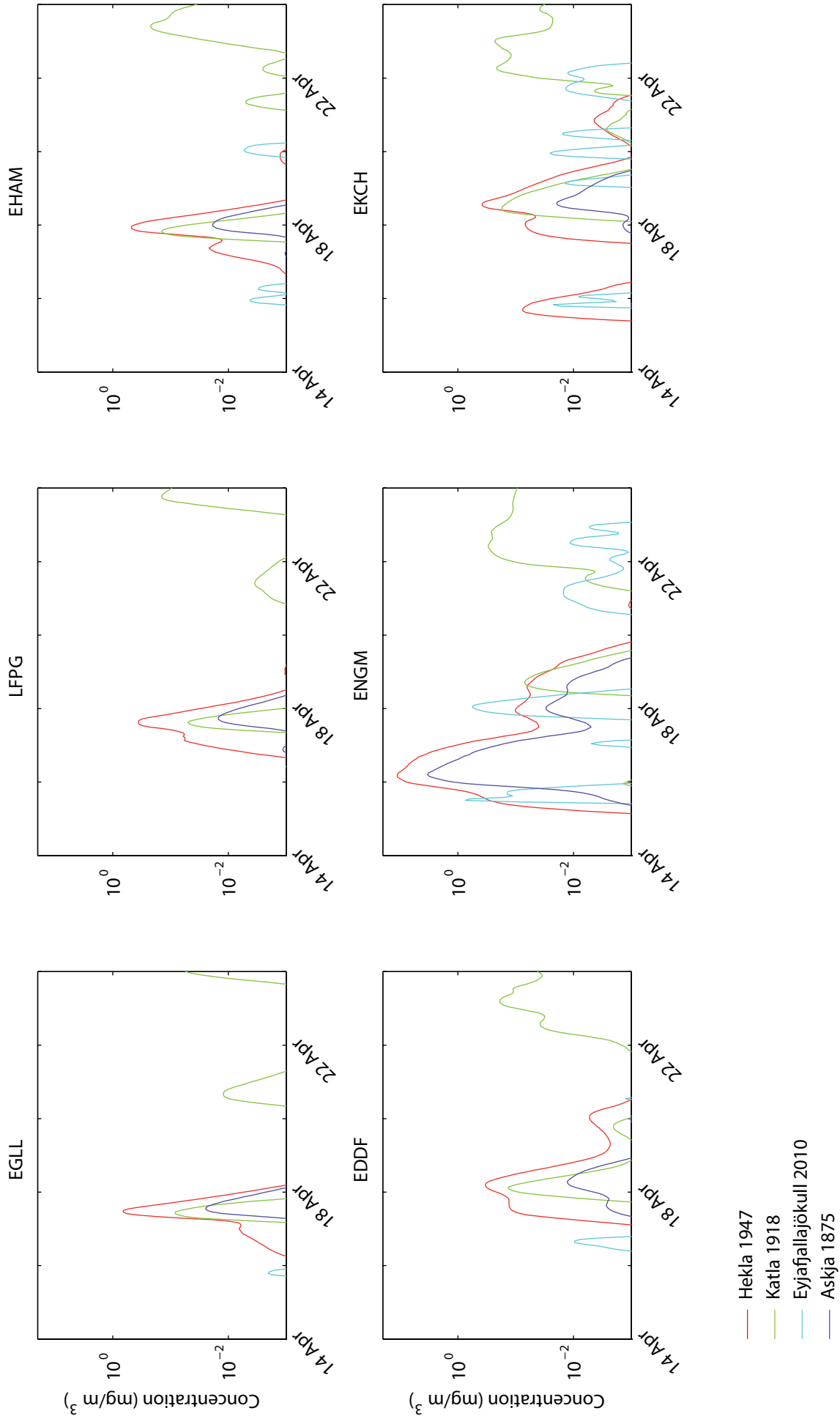






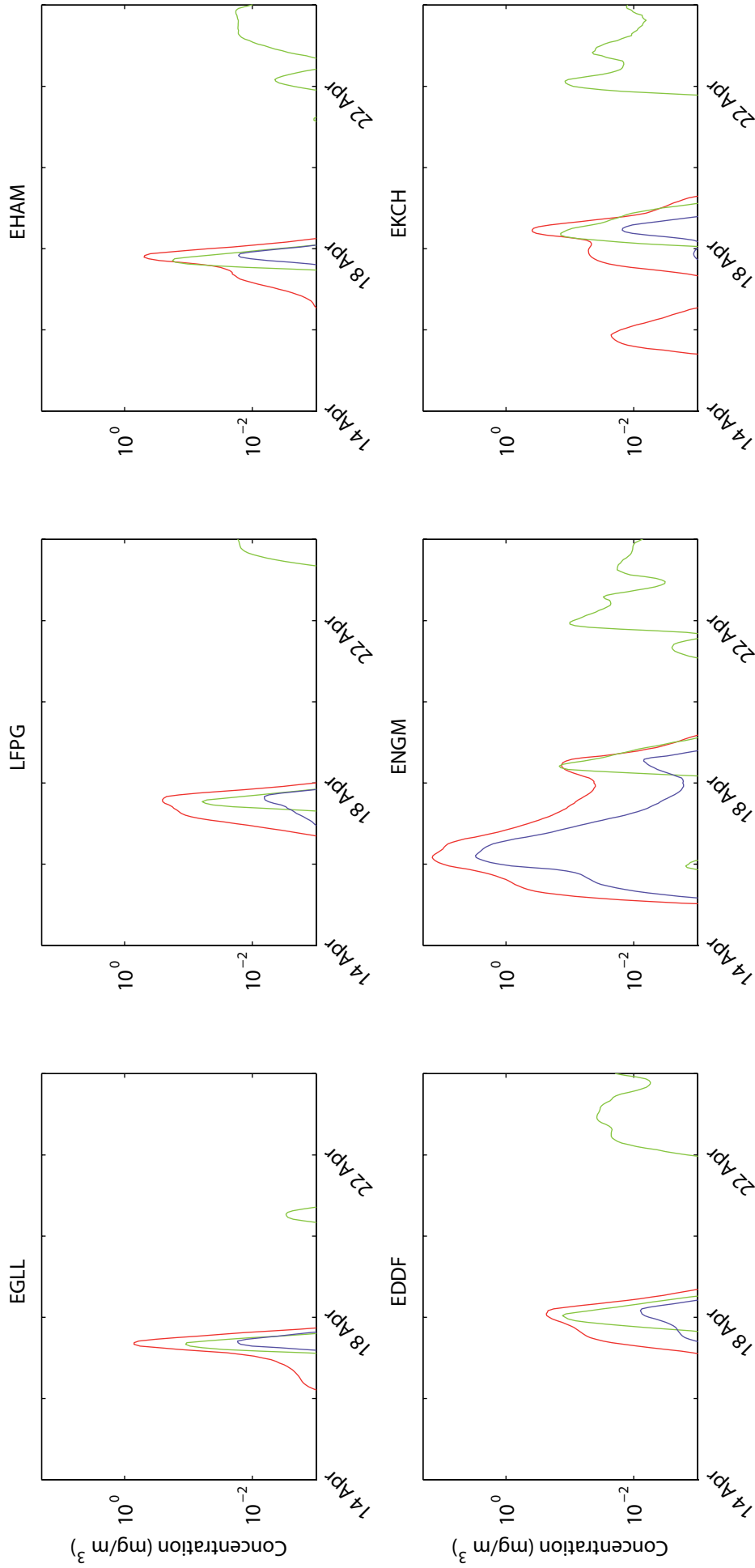


Concentration over the airports of London Heathrow (EGLL), Paris Charles de Gaulle (LFPG), Amsterdam Schiphol (EHAM), Frankfurt (EDDF), Oslo Gardemoen (ENGM) and Copenhagen Kastrup (EKCH) at FL050.



Concentration over the airports of London Heathrow (EGLL), Paris Charles de Gaulle (LFPG), Amsterdam Schiphol (EHAM), Frankfurt (EDDF), Oslo Gardemoen (ENGM) and Copenhagen Kastrup (EKCH) at FL150.





- Hekla 1947
- Katla 1918
- Eyjafallajökull 2010
- Askja 1875

Concentration over the airports of London Heathrow (EGLL), Paris Charles de Gaulle (LFPG), Amsterdam Schiphol (EHAM), Frankfurt (EDDF), Oslo Gardemoen (ENGM) and Copenhagen Kastrup (EKCH) at FL300.