

VOLCANIC ASH DOSAGE CALCULATOR



An interactive web-tool to calculate along-flight volcanic ash dosage
IAVCEI, Portland, 14–18 August 2017

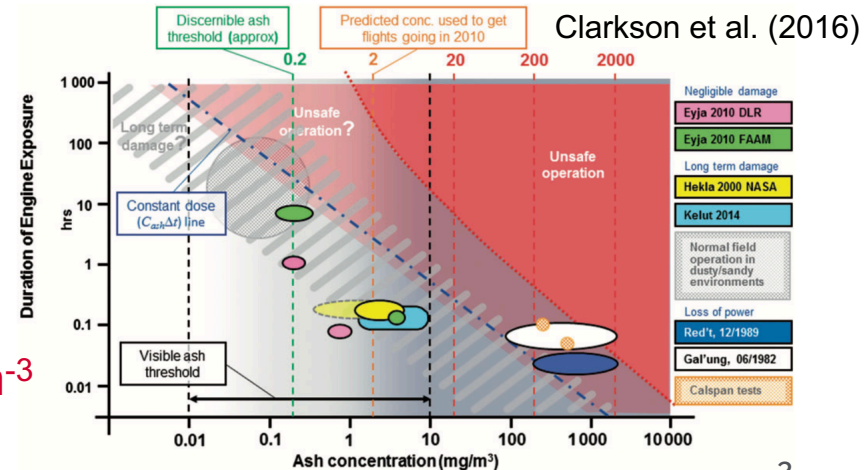
Andrew Prata, Helen Dacre, Keith Shine, Emma Irvine & Eric Mathieu

University of Reading

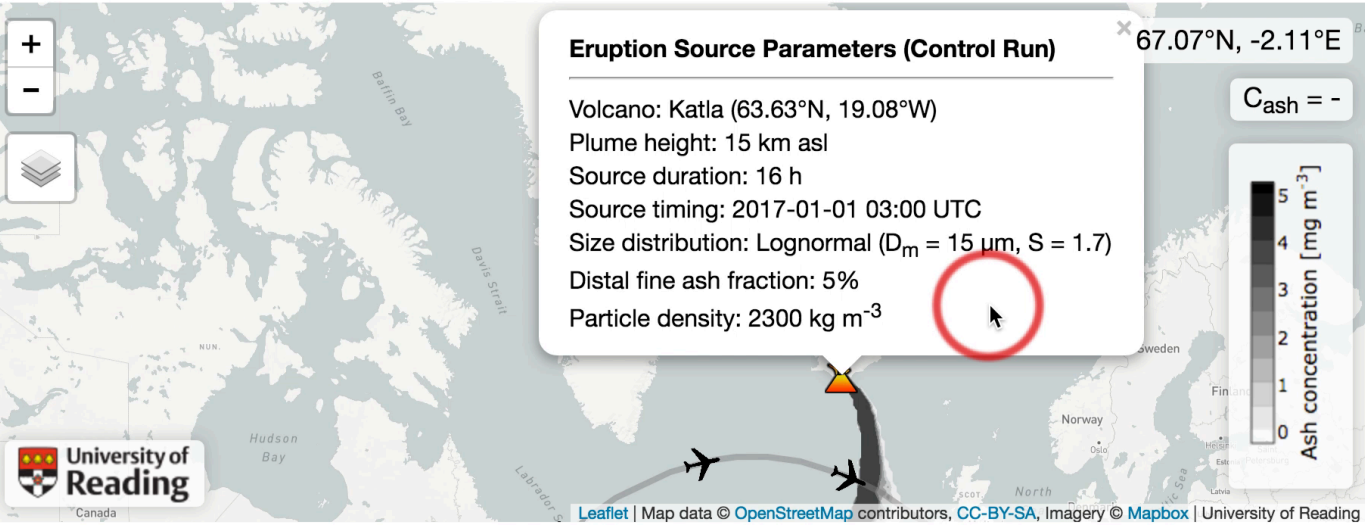
ASH DOSAGE PROJECT

- Funded under the NERC Environmental Risks to Infrastructure Innovation program
- Official partners are the **Civil Aviation Authority** and **British Airways**
- Goal of delivering a proof-of-concept, interactive web-tool to calculate volcanic ash dosages

- Rolls-Royce have announced new dosage threshold: **$14.4 \text{ g m}^{-3} \text{ s}$**
- Equivalent to flying in 2 mg m^{-3} for 2 hrs
- No peak concentrations above **4 mg m^{-3}**

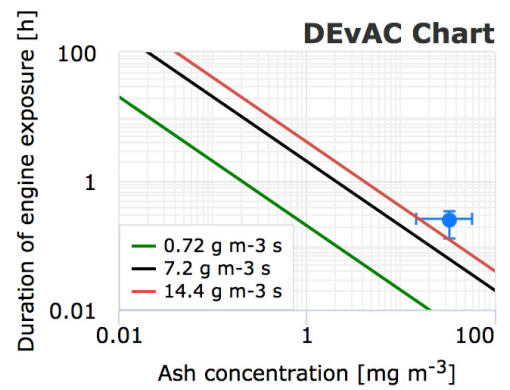


INTRODUCTION & ESPS

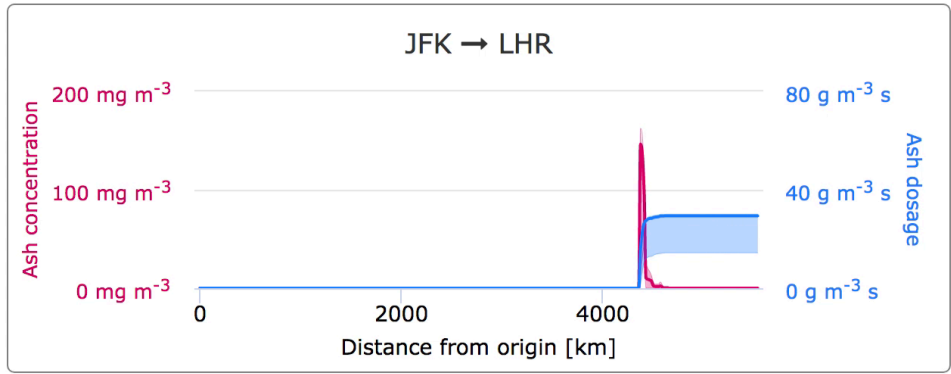
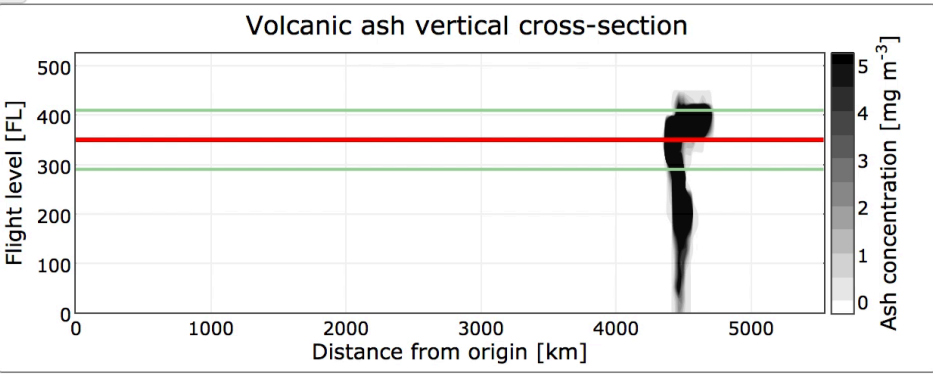


Optimal Route

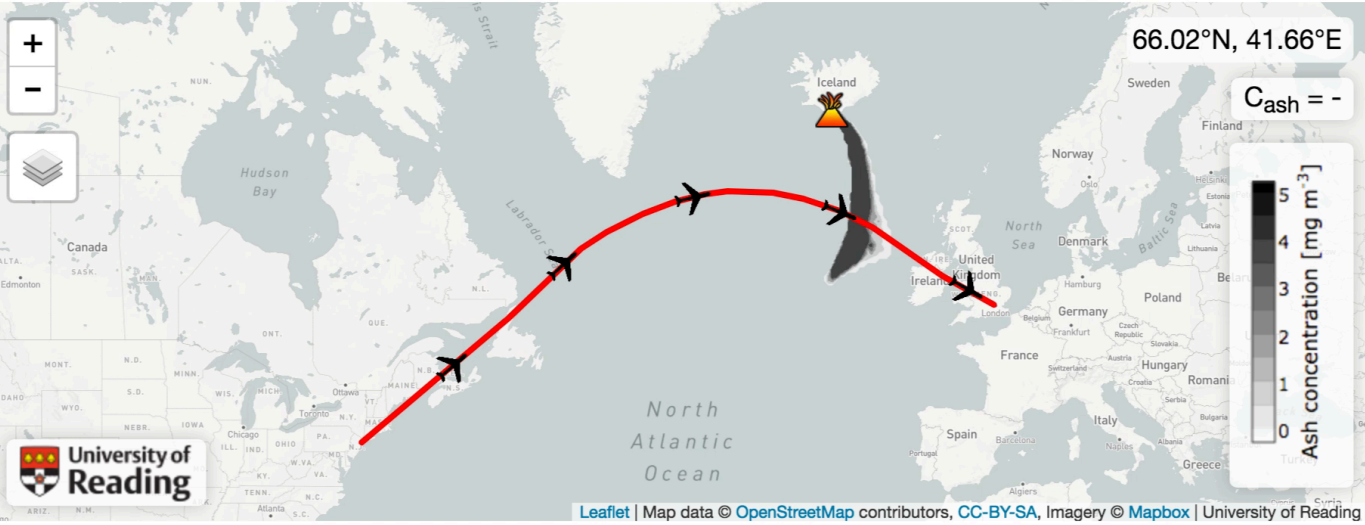
Flight time [h] = 5.81
 Time penalty [h] = +0.00
 Dosage [$\text{g m}^{-3} \text{ s}$] = 29.4 [14.4, 30.1]
 Exposure time [h] = 0.25 [0.12, 0.32]
 Peak conc. [mg m^{-3}] = 146.3 [41.4, 162.4]



Time: 2017-01-01 09:00 UTC | Altitude: FL350

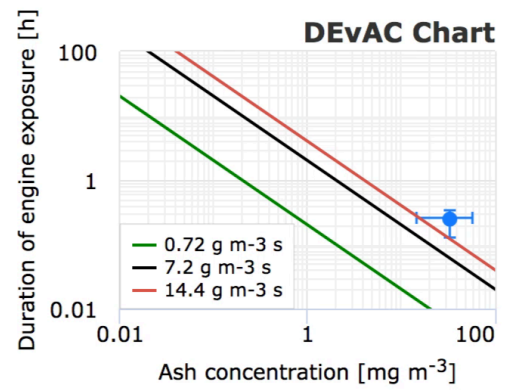


FLIGHT INFORMATION

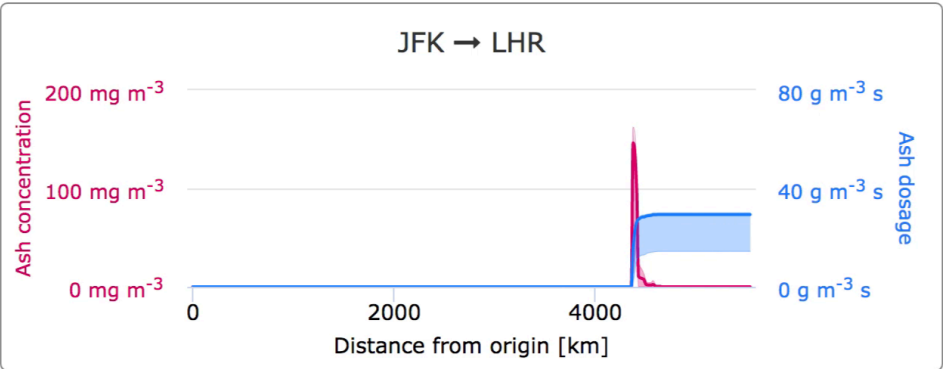
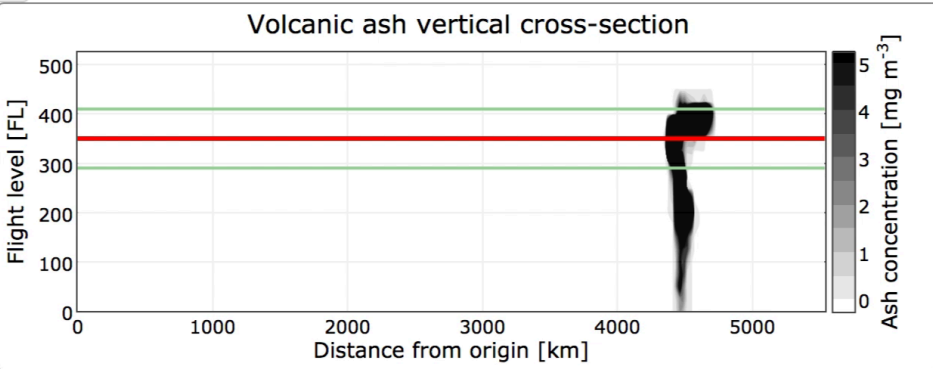


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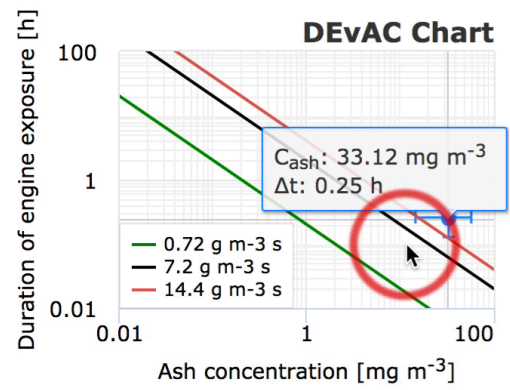


DEVAC CHART

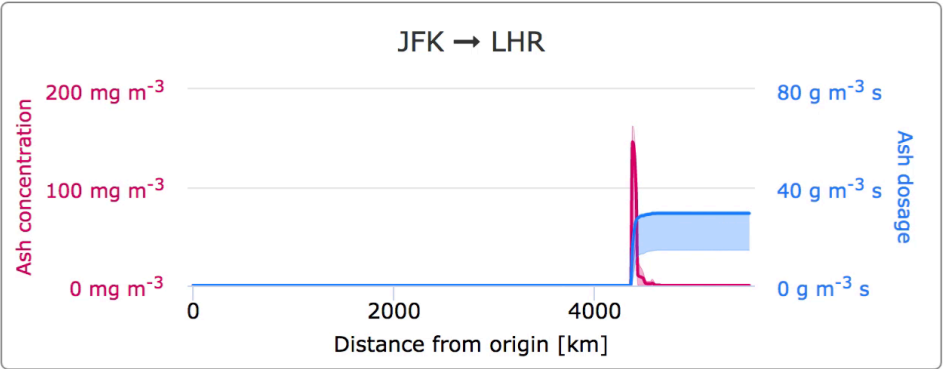
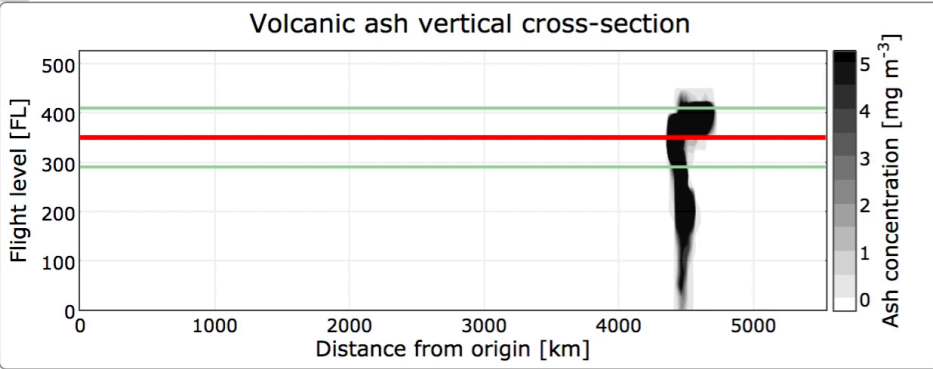


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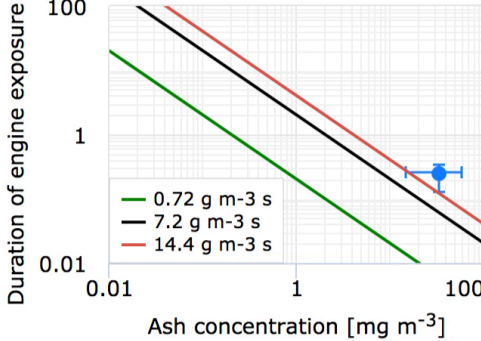
ALONG-FLIGHT INFORMATION



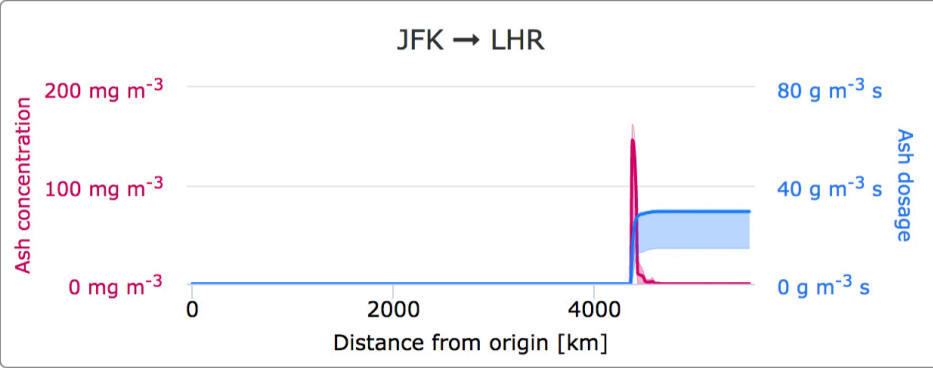
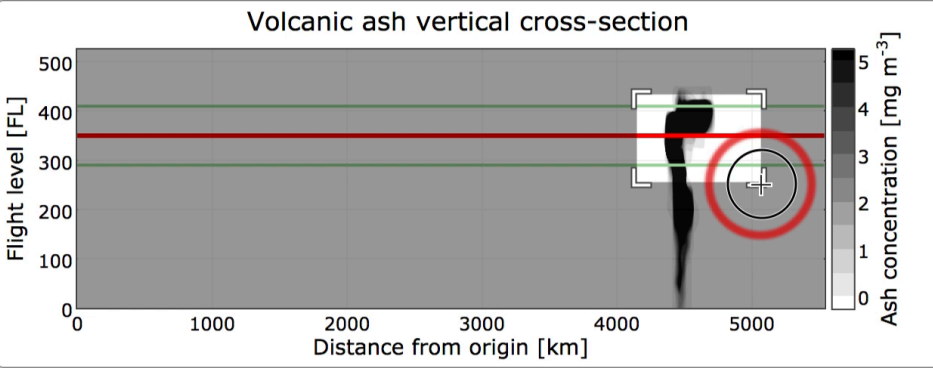
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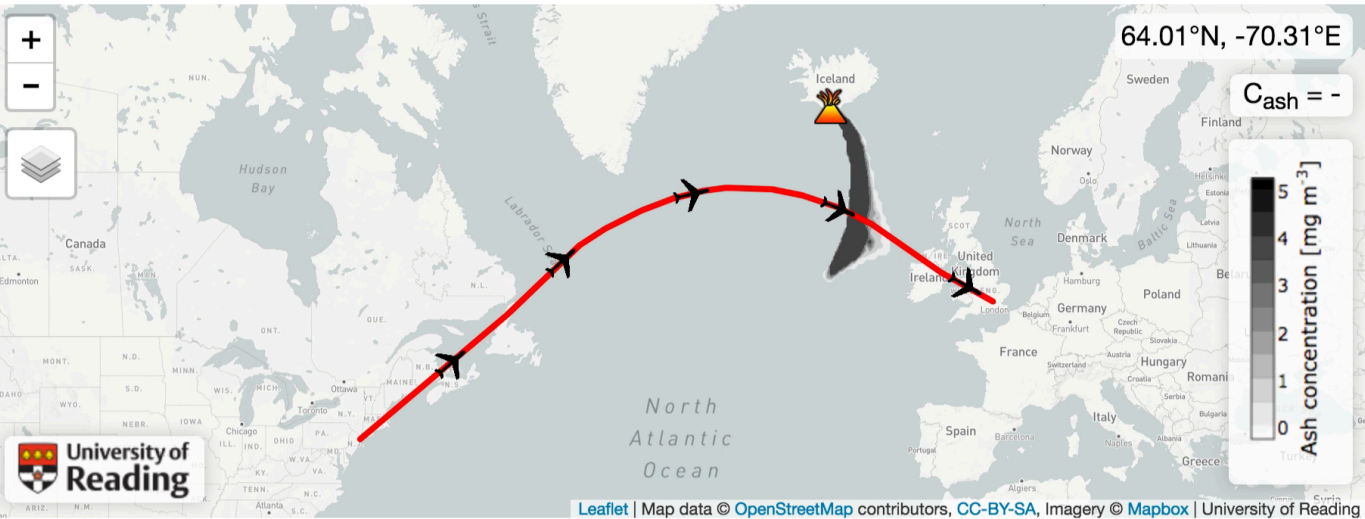
DEVAC Chart



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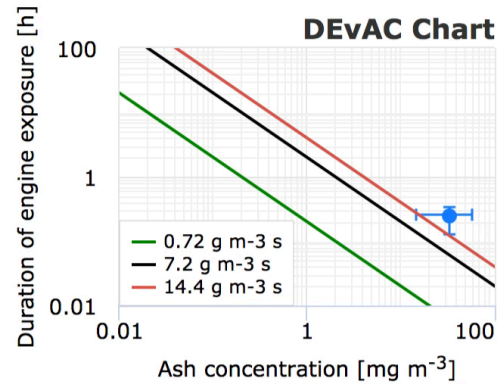


ALONG-FLIGHT INFORMATION

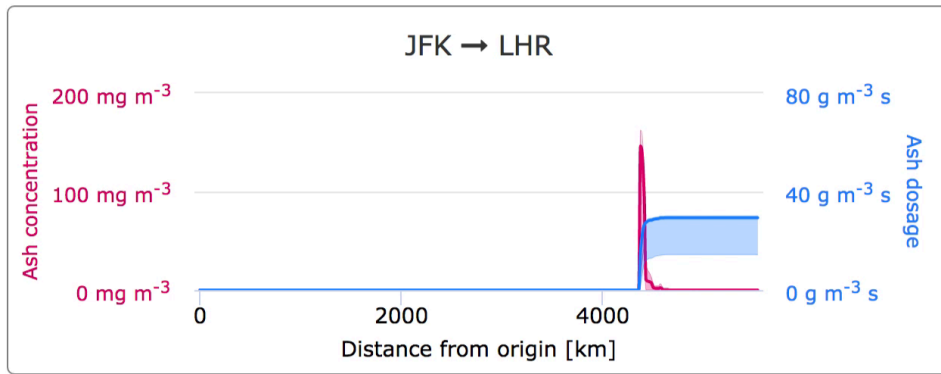
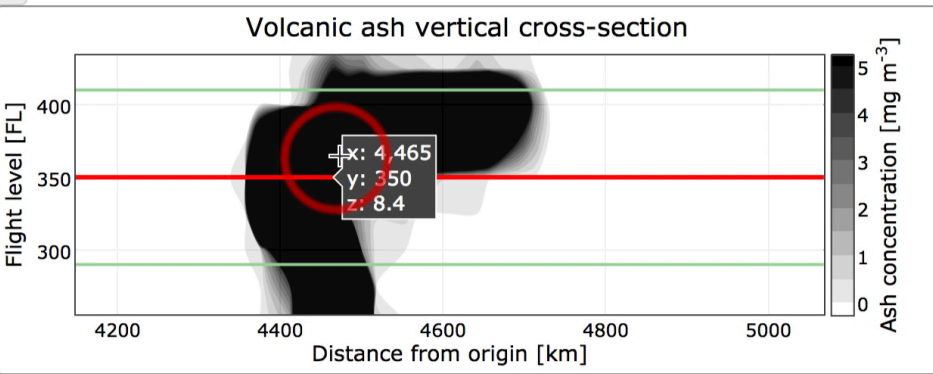


Optimal Route

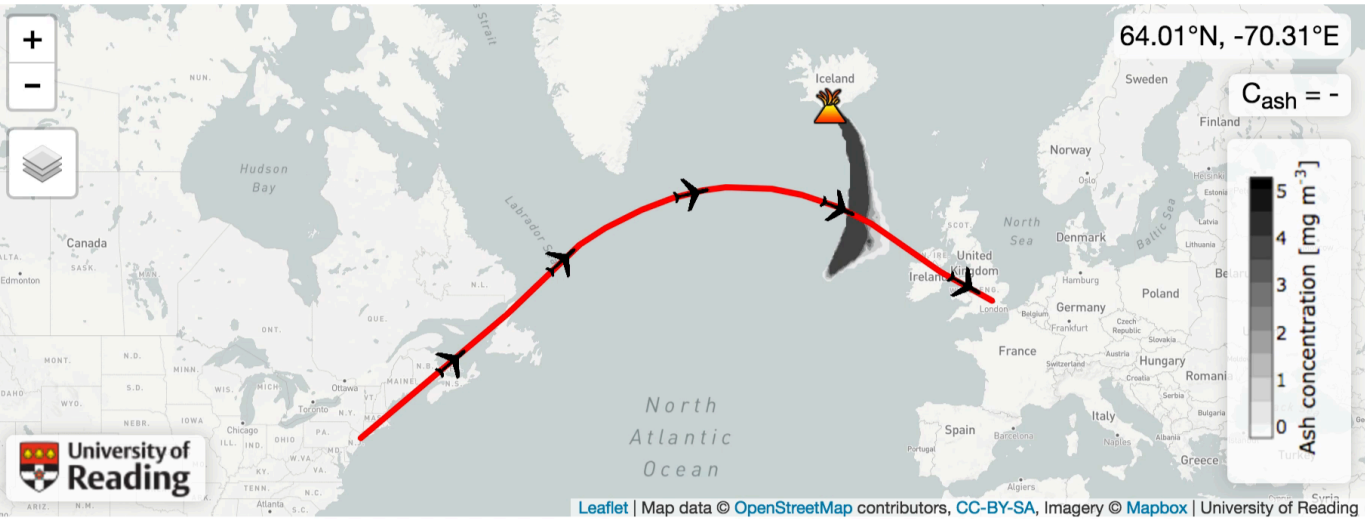
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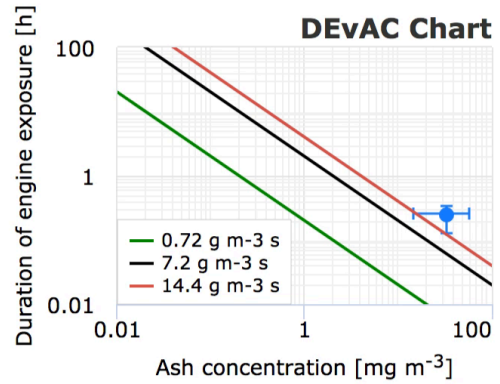


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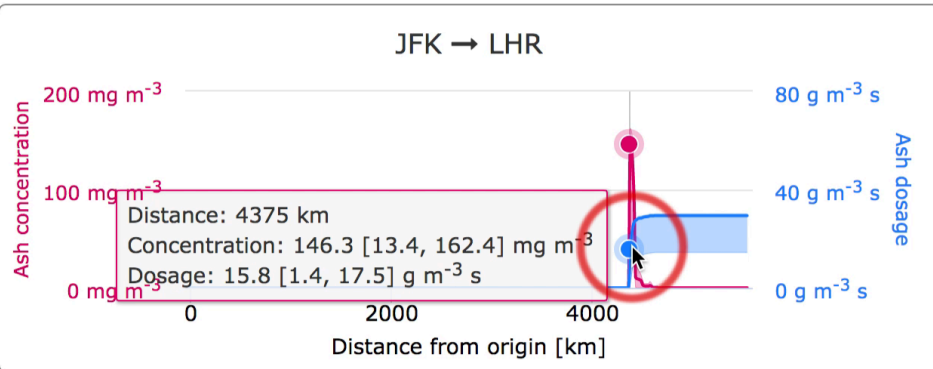
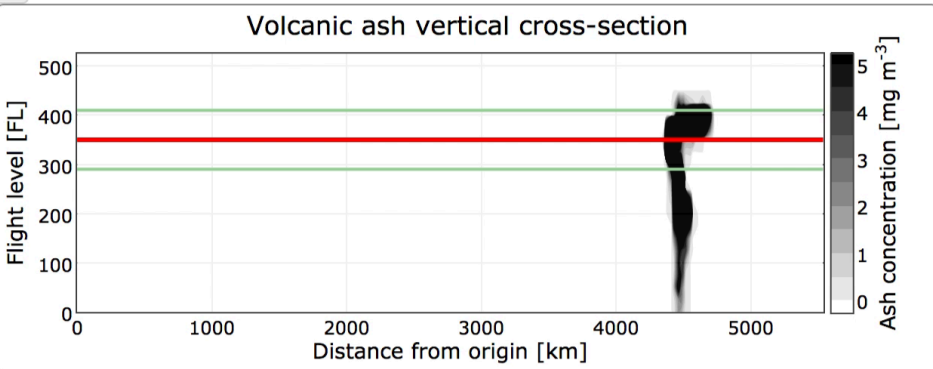


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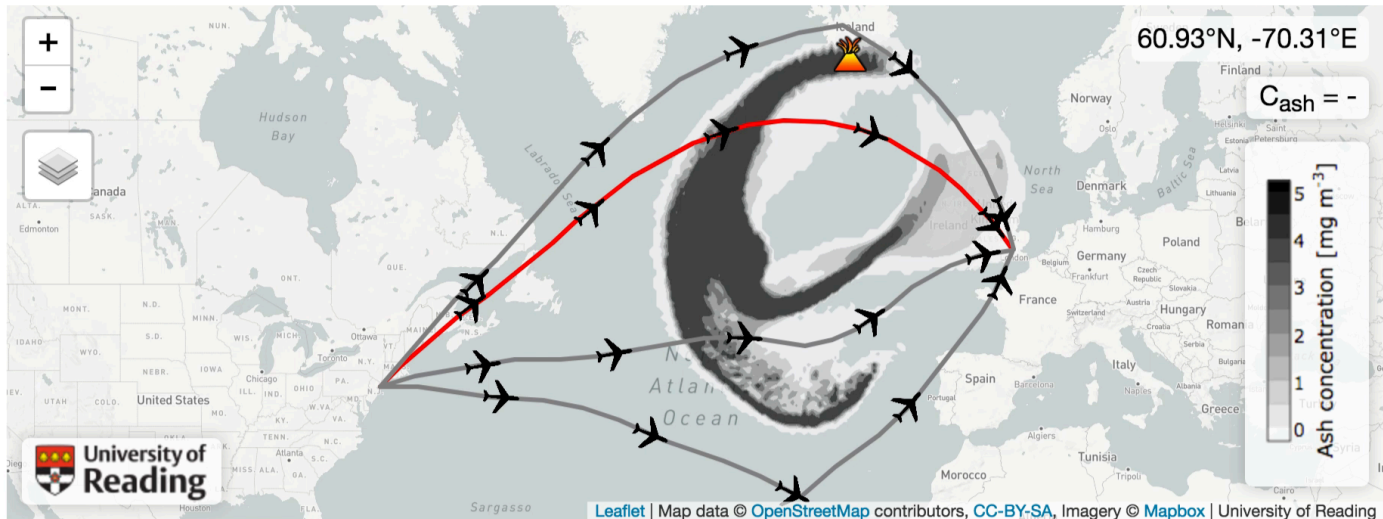
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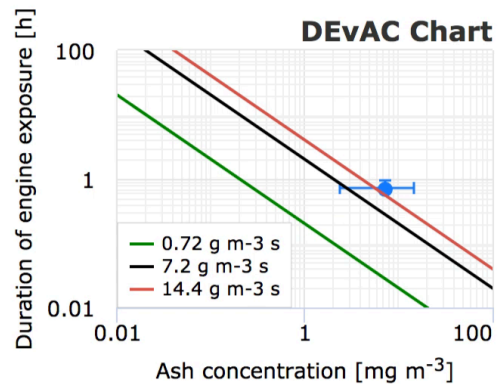


ROUTE OPTIONS

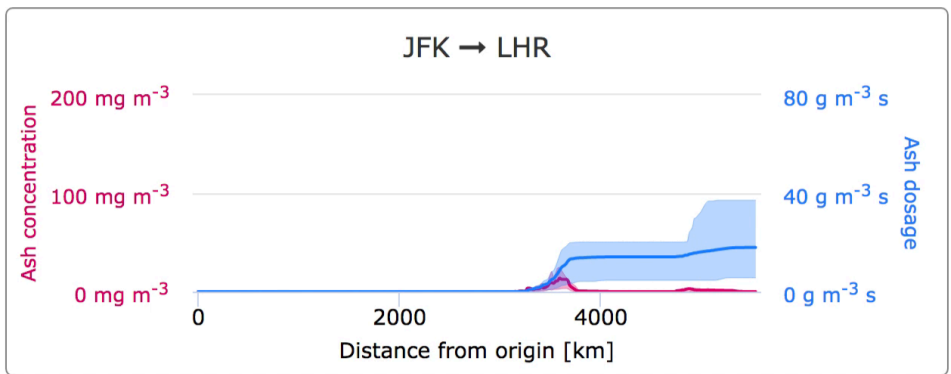
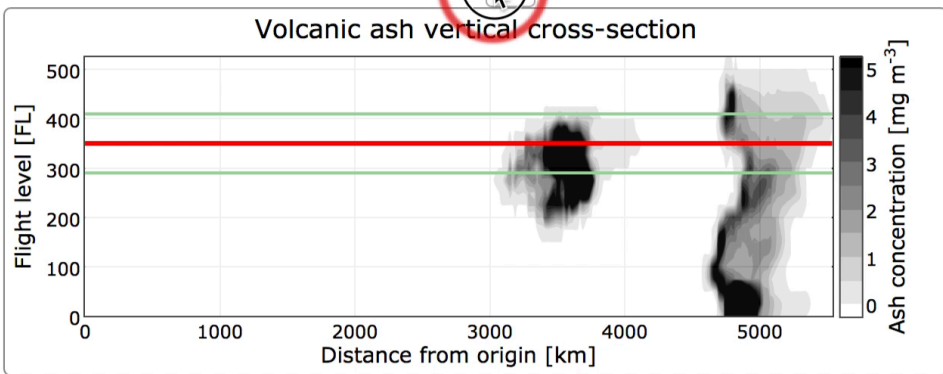


Optimal Route

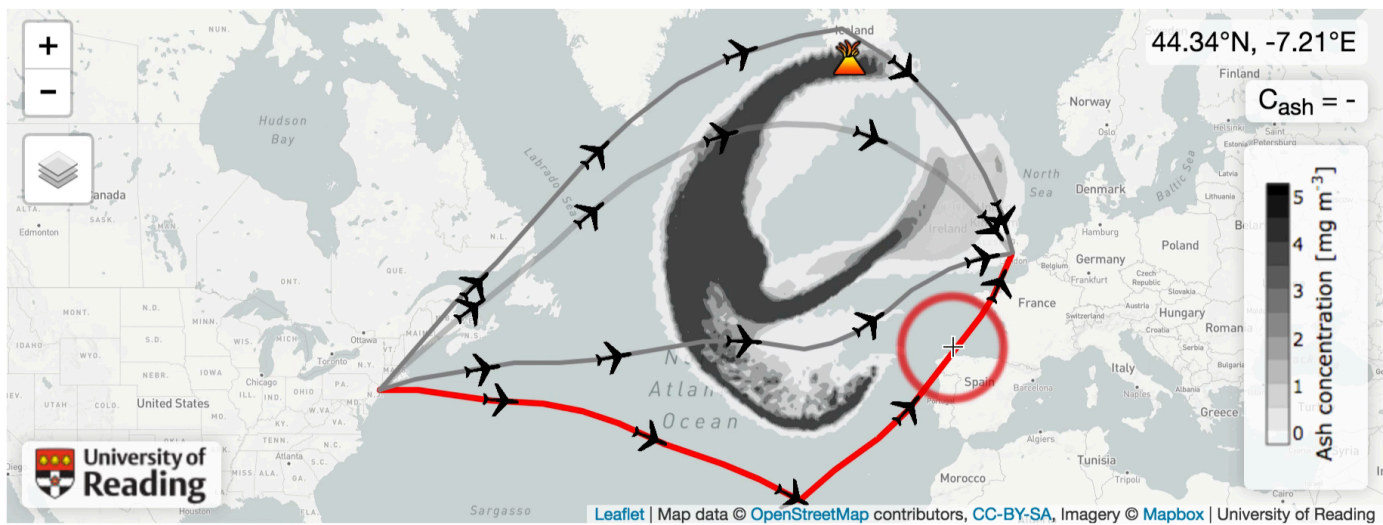
Flight time [h] = 5.72
 Time penalty [h] = +0.00
 Dosage [g m⁻³ s] = 18.0 [5.6, 37.2]
 Exposure time [h] = 0.69 [0.60, 0.91]
 Peak conc. [mg m⁻³] = 13.8 [3.3, 24.5]



Time: 2017-01-02 09:00 UTC | Altitude: FL350

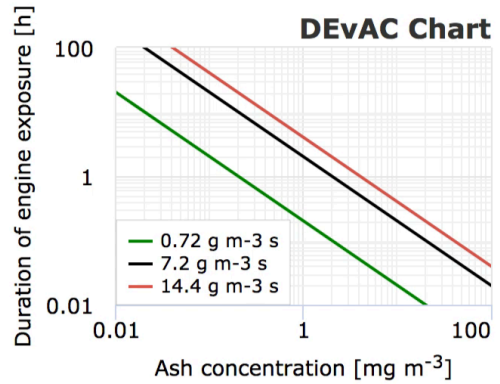


ROUTE OPTIONS

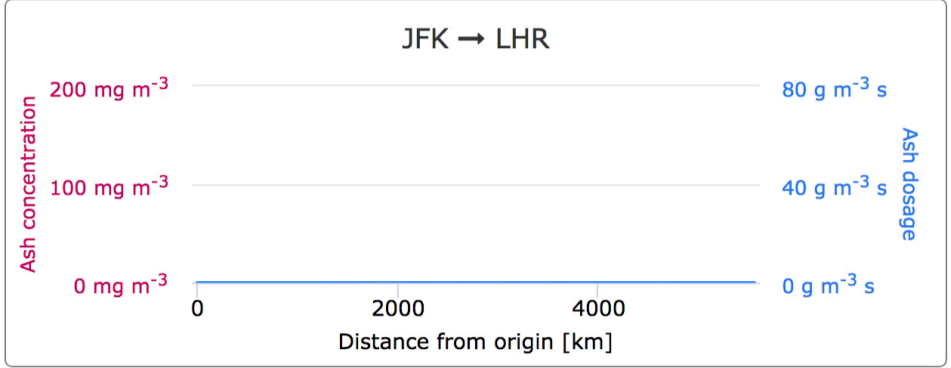
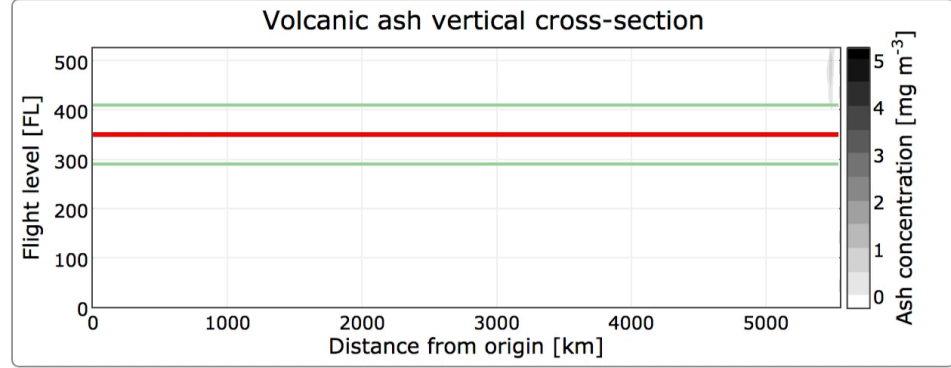


Avoidance Route 1

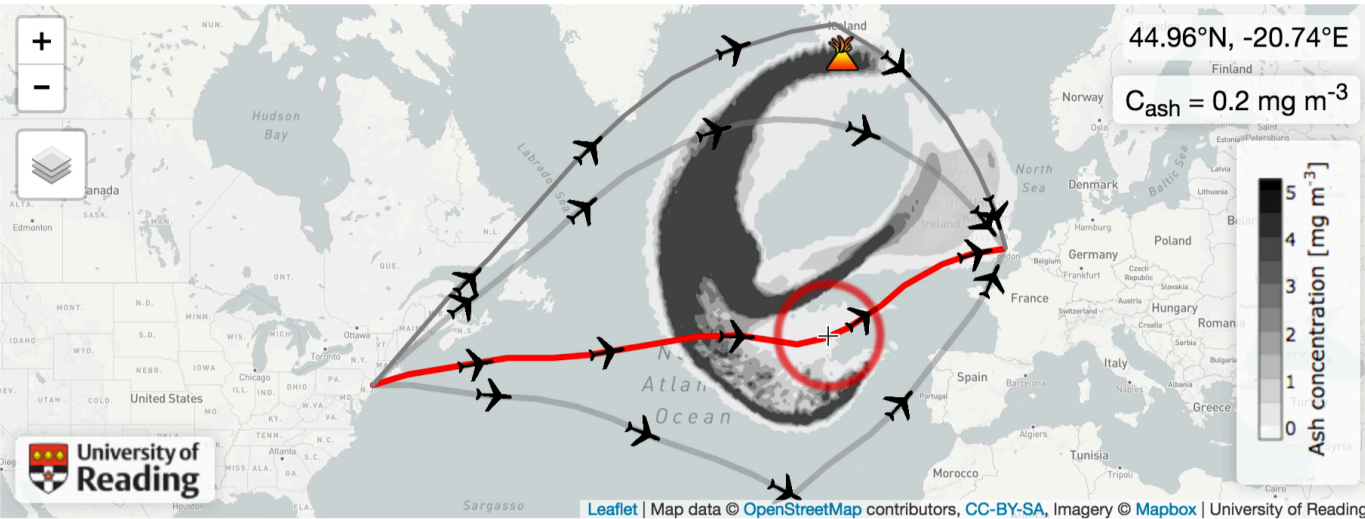
Flight time [h] = 7.94
 Time penalty [h] = +2.22
 Dosage [$\text{g m}^{-3} \text{ s}$] = 0.0 [0.0, 0.0]
 Exposure time [h] = 0.00 [0.00, 0.00]
 Peak conc. [mg m^{-3}] = 0.0 [0.0, 0.0]



Time: 2017-01-02 09:00 UTC | Altitude: FL350

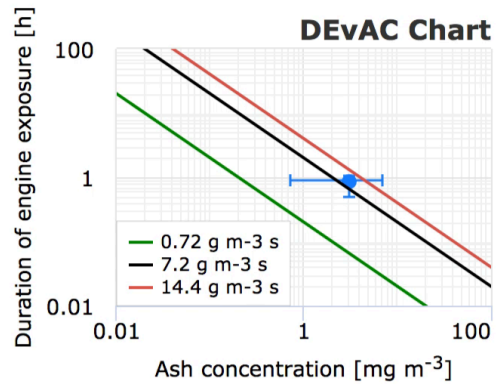


ROUTE OPTIONS

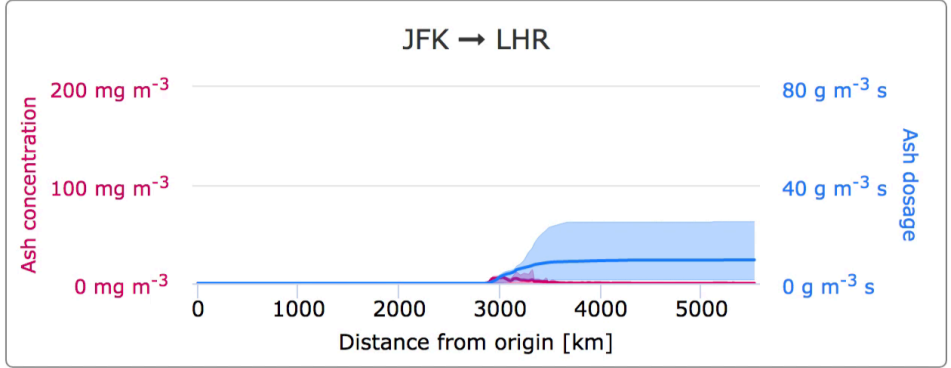
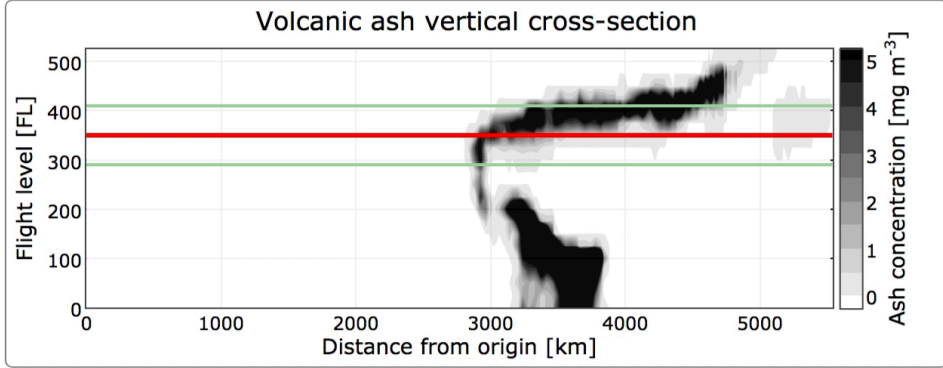


Avoidance Route 2

Flight time [h] = 6.94
 Time penalty [h] = +1.21
 Dosage [$\text{g m}^{-3} \text{ s}$] = 9.6 [1.4, 25.1]
 Exposure time [h] = 0.86 [0.47, 1.05]
 Peak conc. [mg m^{-3}] = 5.9 [0.5, 13.9]



Time: 2017-01-02 09:00 UTC | Altitude: FL350

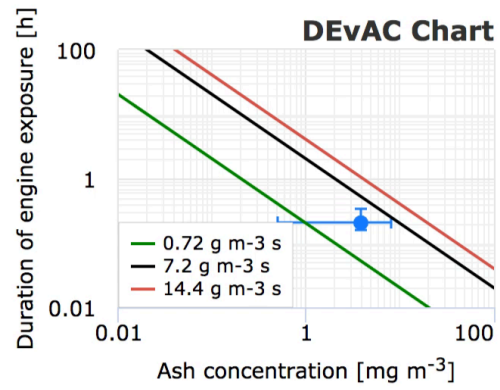


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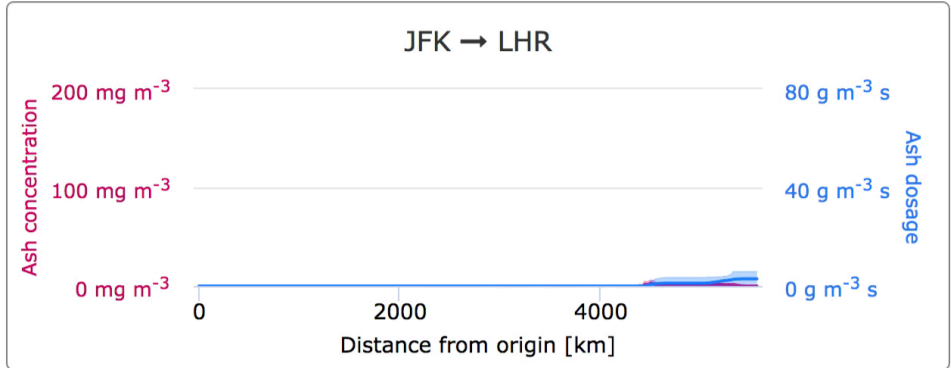
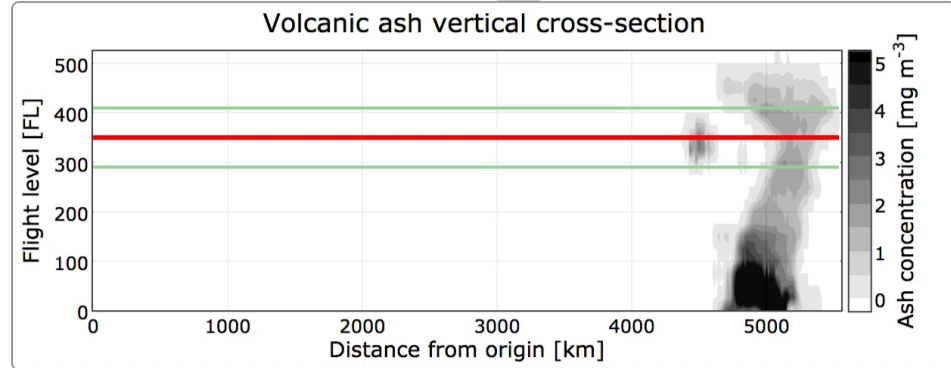


Avoidance Route 3

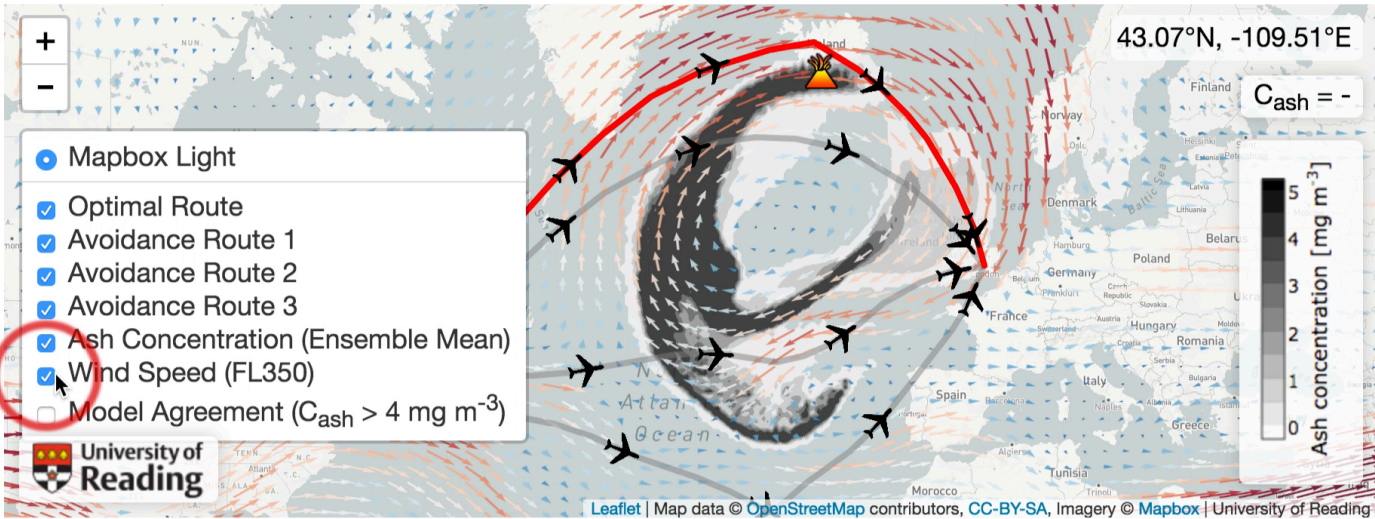
Flight time [h] = 5.97
 Time penalty [h] = +0.25
 Dosage [$\text{g m}^{-3} \text{s}$] = 2.9 [0.3, 5.8]
 Exposure time [h] = 0.21 [0.15, 0.32]
 Peak conc. [mg m^{-3}] = 2.7 [0.0, 5.9]



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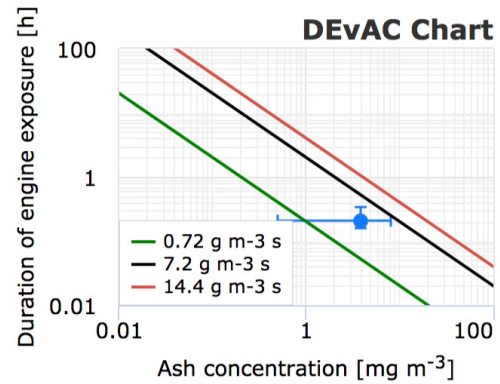


WIND VECTORS

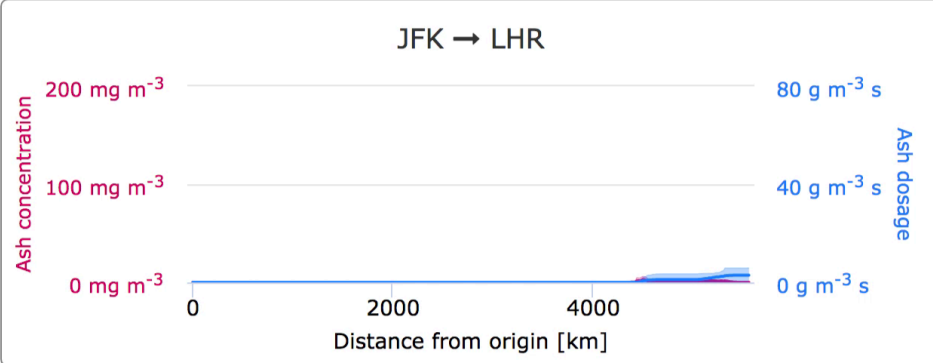
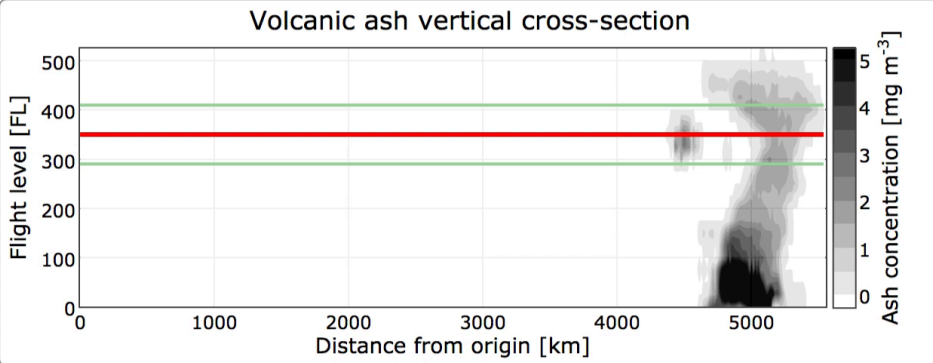


Avoidance Route 3

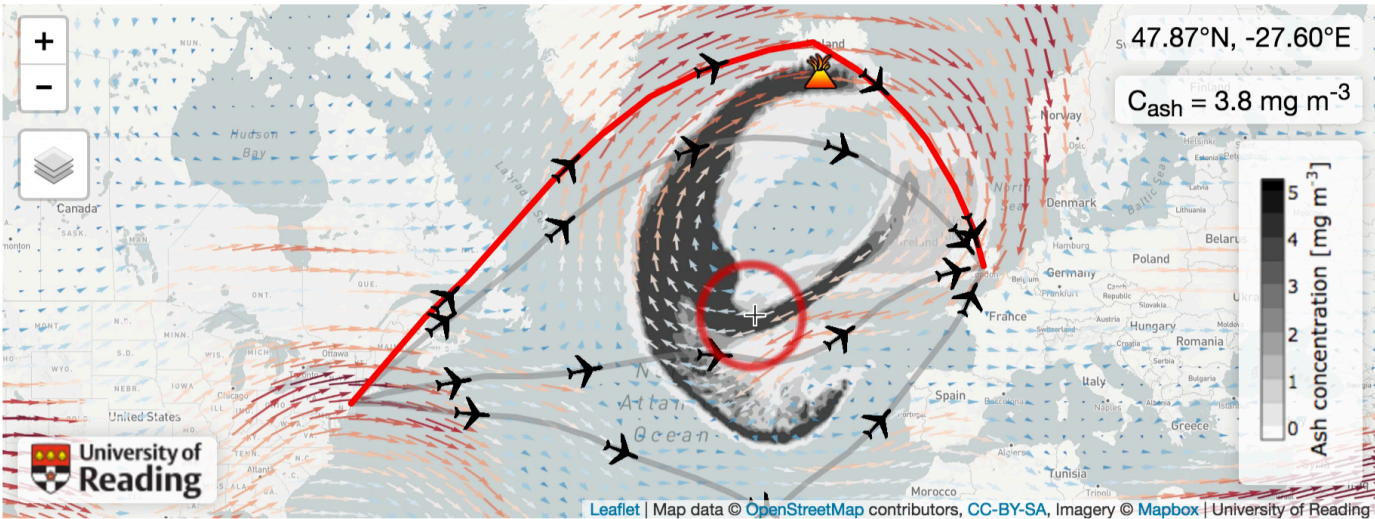
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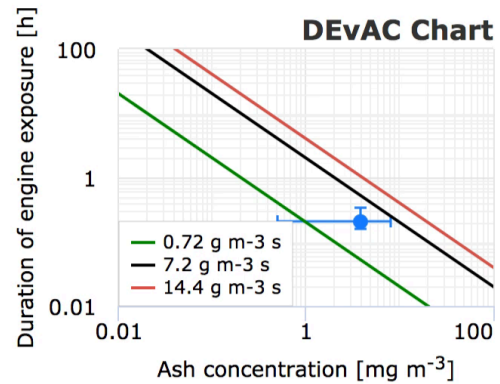


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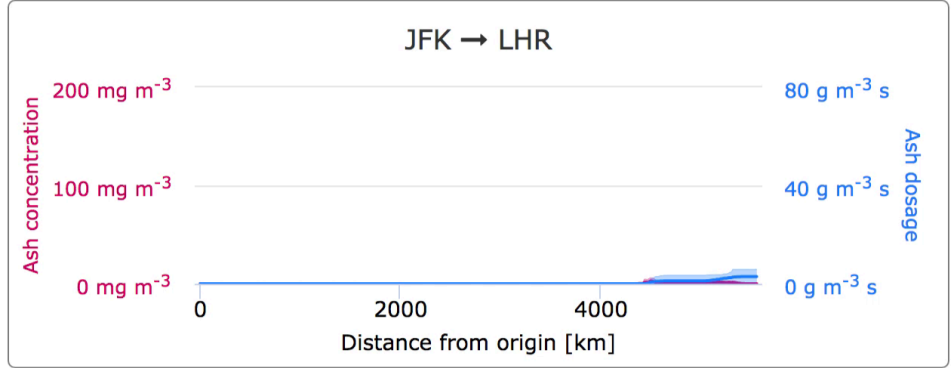
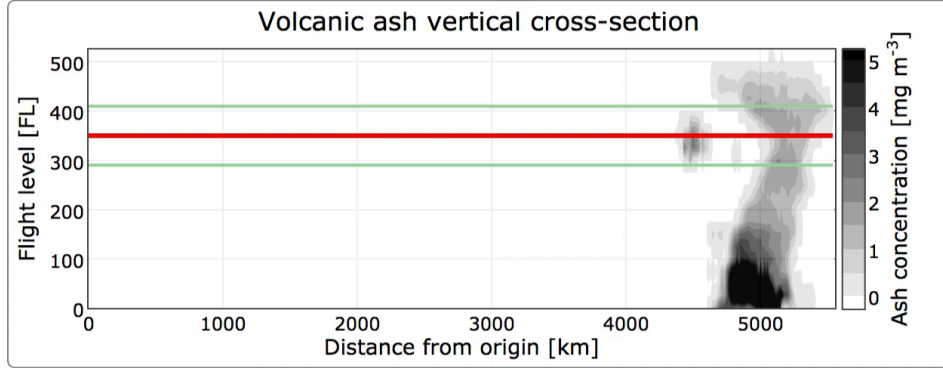


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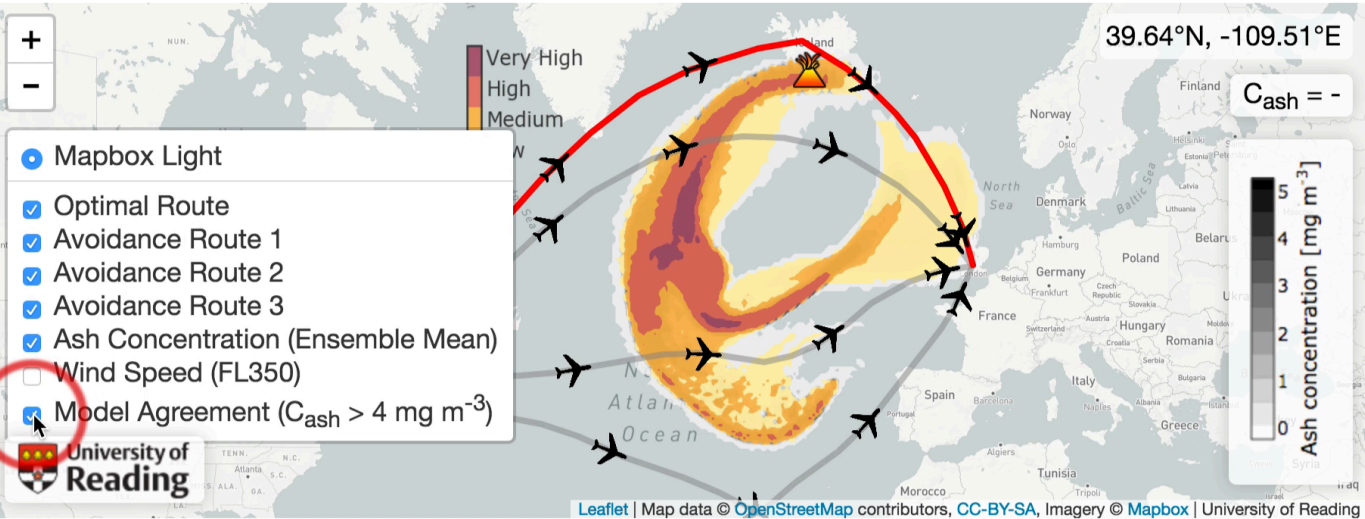
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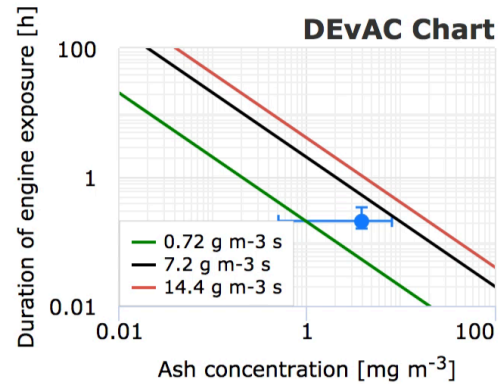


MODEL AGREEMENT

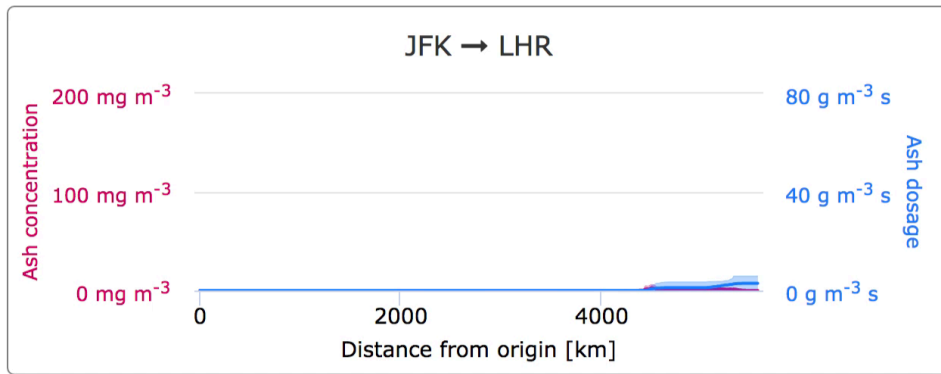
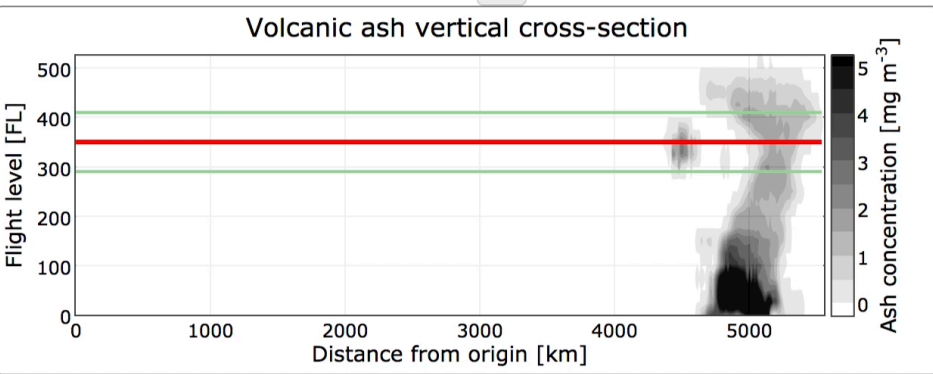


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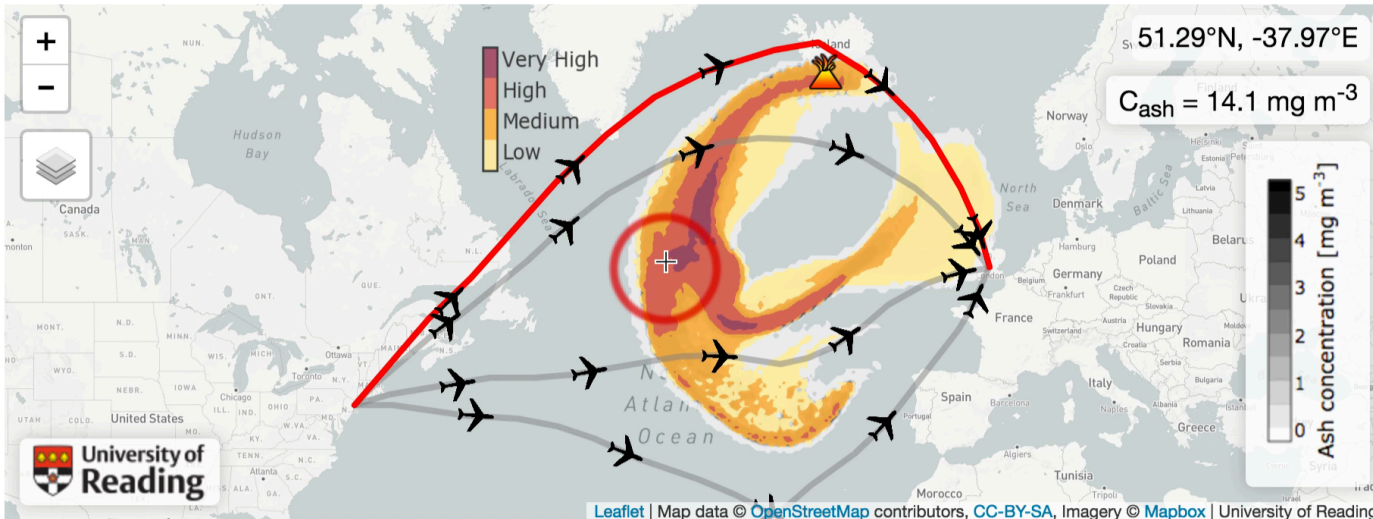
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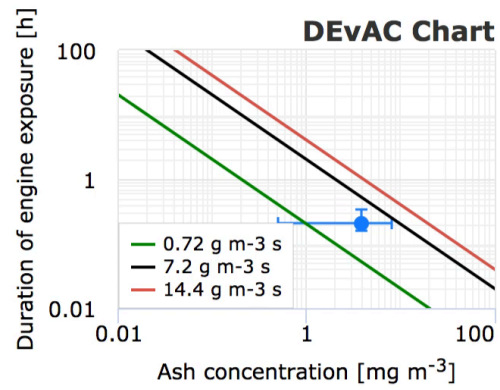


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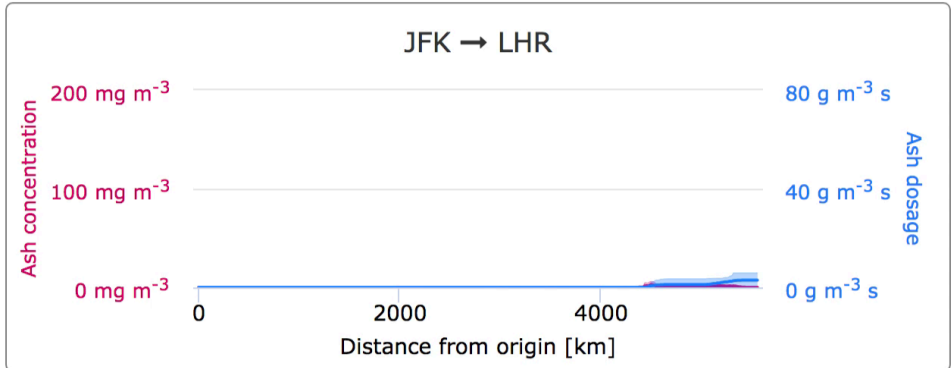
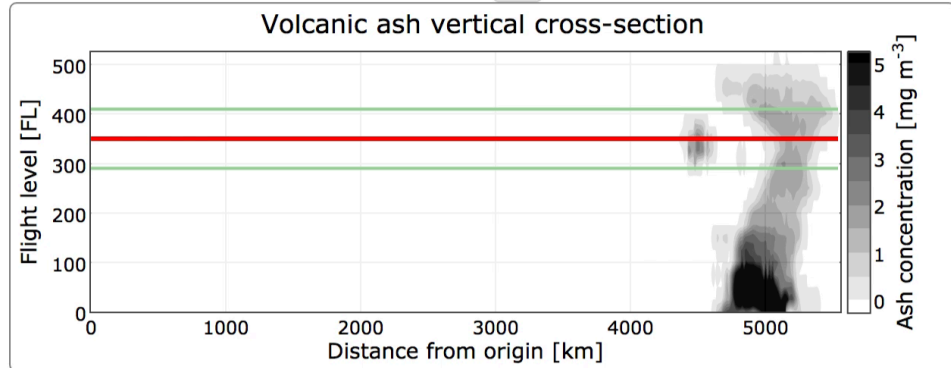


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SUMMARY

- Uncertainties can be asymmetric around the ash cloud
- Representing ensemble spread can help to visualise confidence
- Outliers (rather than the ensemble mean) may be particularly relevant for aviation safety

FUTURE AND ON-GOING WORK

- Introduce meteorology and internal parameter uncertainty
- Explore changes in the vertical for avoidance flight routes
- Extend to volcanic SO₂ dosages
- Use the tool to look at historical eruptions (e.g. Eyja 2010, PCC 2011, Kelut 2014)