

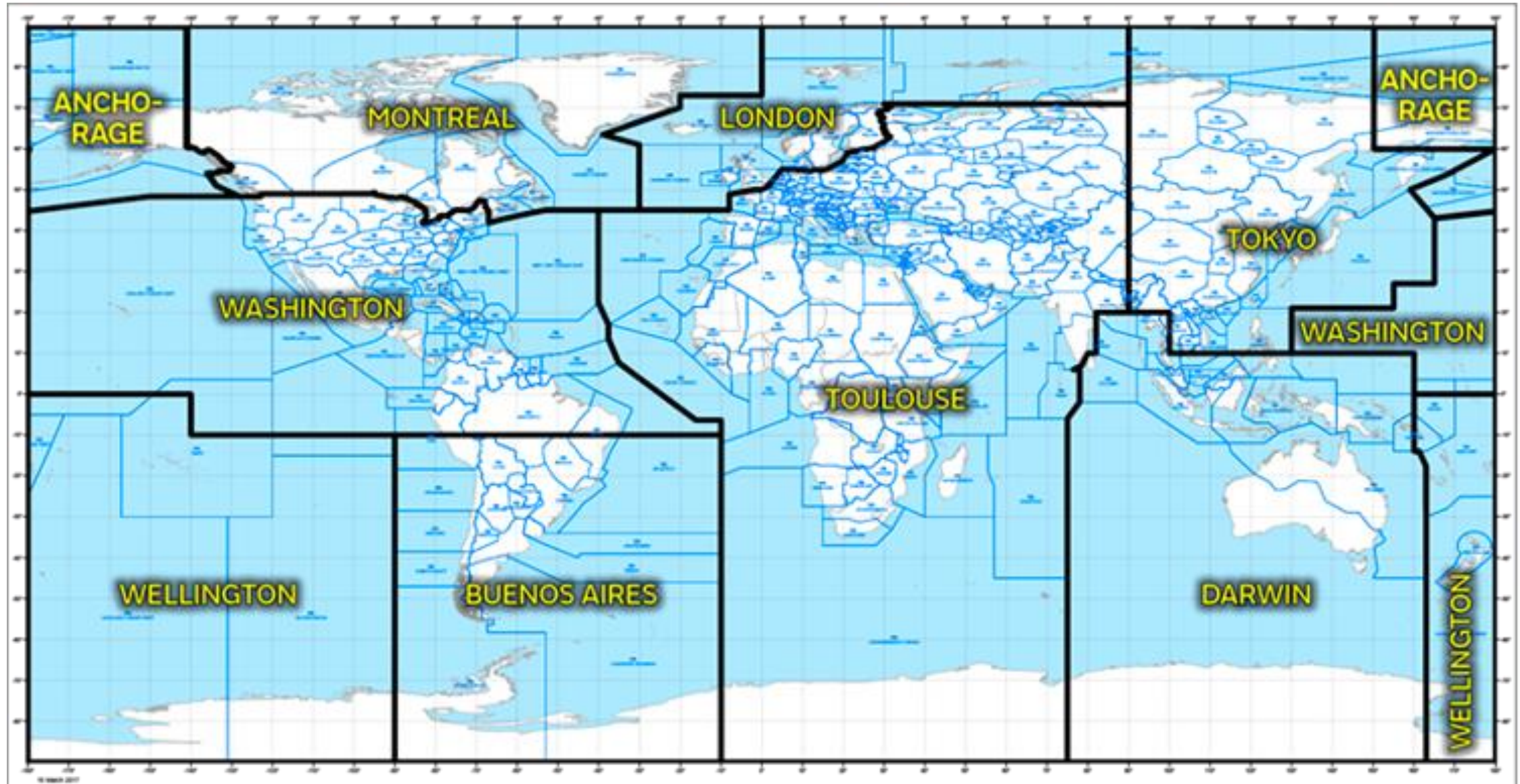


Quantitative Volcanic Ash A new operating requirement

London VAAC Case Study

Dr Frances Beckett, Dr Matthew Hort
Met Office, UK

With Thanks To
Atmospheric Dispersion + Air Quality Team
Aviation Data Services (Technology)
Aviation Business
London VAAC Operational Meteorologists
VAAC Modellers Community



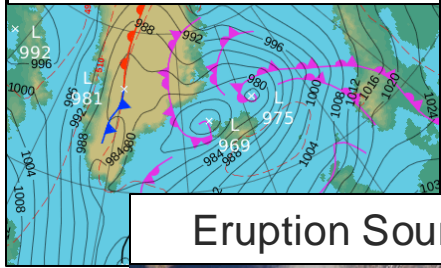
Inputs

Model Simulation

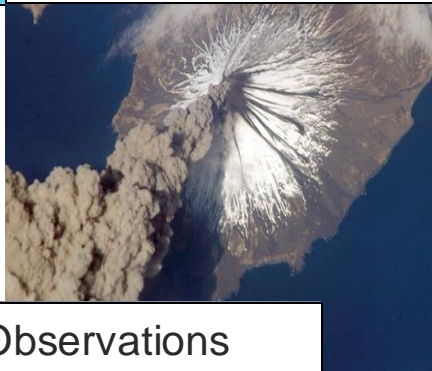
Evaluation + Forecast Generation

Final Product

Weather Forecast



Eruption Source



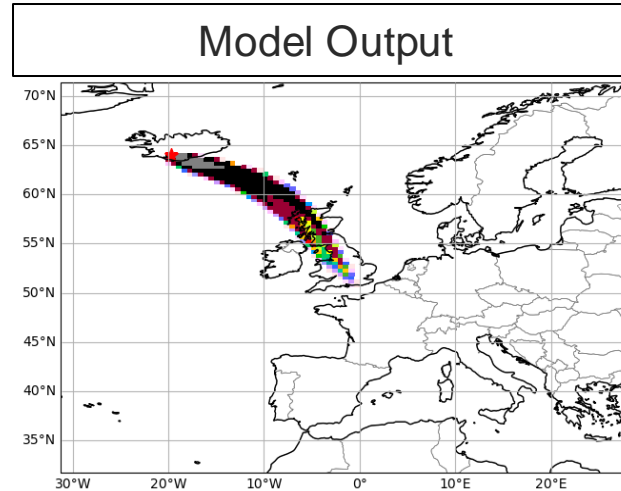
Observations



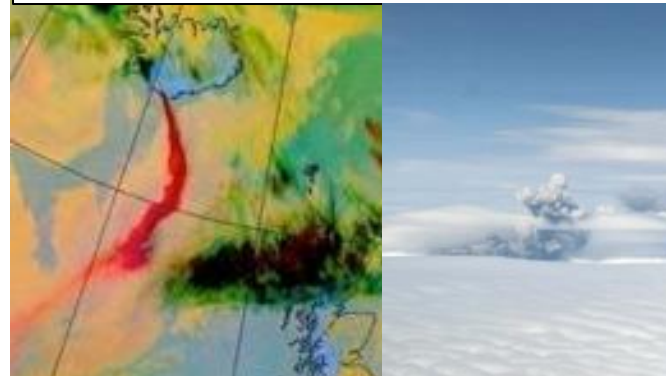
Dispersion Model



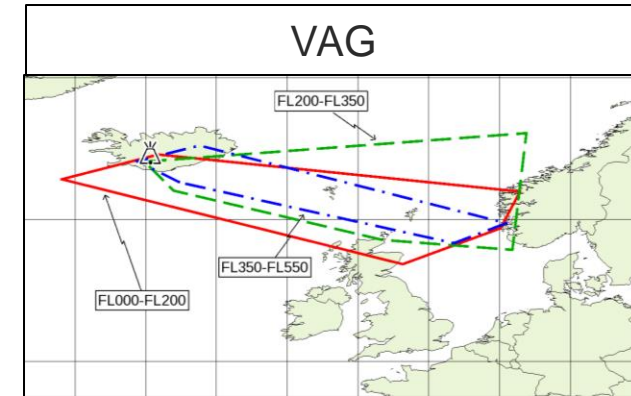
Model Output



Observations



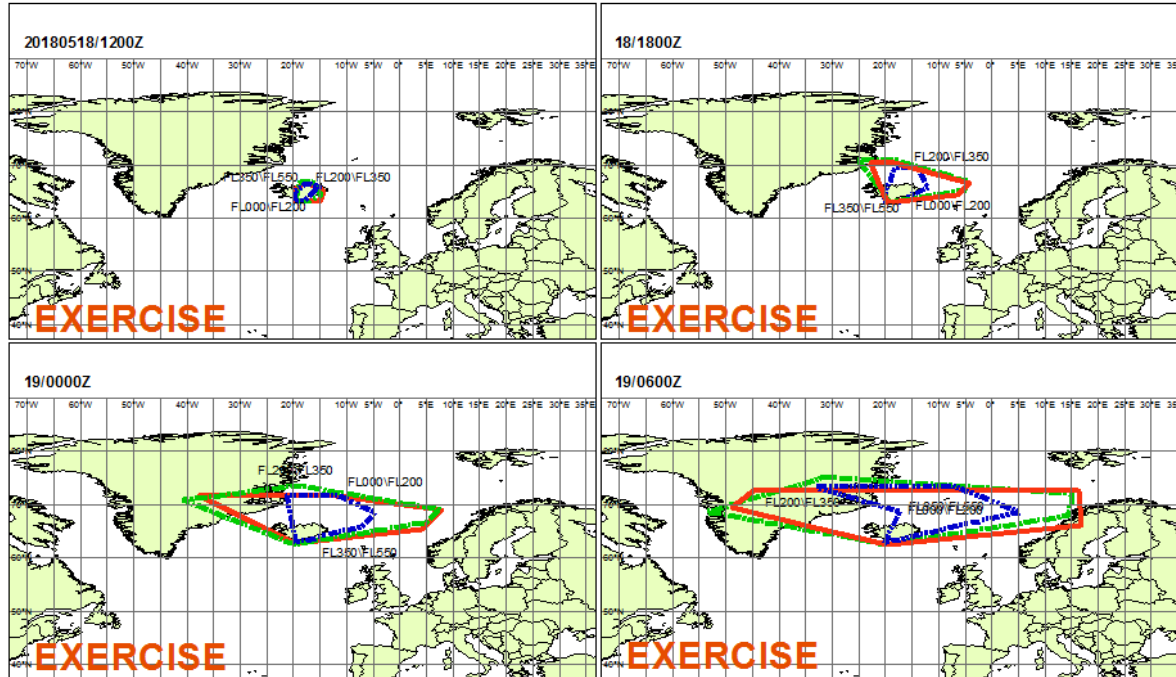
VAG



Volcanic Ash Graphic – All VAACs

Volcanic Ash Graphic (VAG)

FL000 to FL200 FL200 to FL350 FL350 to FL550



VA ADVISORY
DTG: 20180518/1120
VAAC: LONDON
VOLCANO: KATLA 372030
VOLCANO_NO: 372030
PSN: N6338 W01907
AREA: ICELAND

SUMMIT_ELEV: 1490M
ADVISORY_NO: 2018/003
INFO_SOURCE: ICELAND MET OFFICE
COLOUR_CODE: RED
ERUPTION_DETAILS: EXERCISE EXERCISE EXERCISE.
VOLCICE 1805.

RMK: EXERCISE. KATLA CONTINUES TO ERUPT, WITH
PLUME UP TO 14KM CONFIRMED BY MOBILE RADAR.
EXERCISE.
NEXT_ADVISORY: WILL BE ISSUED BY
20180518/1500Z
WMO_SUFFIX: 01

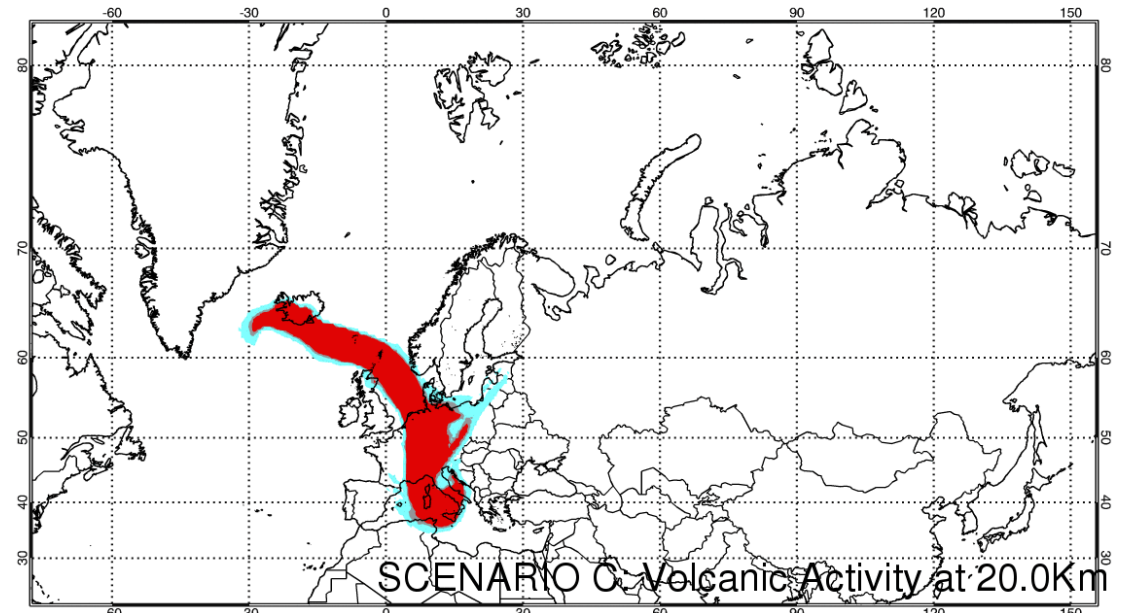
Supplementary Concentration Charts – Europe



Modelled Ash Concentration from FL000 to FL200
Valid 1800 UTC 26/11/2017 to 0000 UTC 27/11/2017
This is a guidance product, supplemental to the official VAAC London Volcanic Ash Advisory and Volcanic Ash Graphic products.
Issue time: 201711250600

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200-2000 micrograms per cubic metre 2000-4000 micrograms per cubic metre >4000 micrograms per cubic metre
All concentrations are subject to a level of uncertainty relative to errors in the estimation of the eruption strength

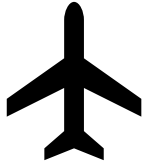


© Crown Copyright 2017. Source: Met Office

Webpages are here: www.metoffice.gov.uk/services/transport/aviation/regulated/vaac

Quantitative Volcanic Ash (QVA) - A new quantitative service has been agreed by ICAO

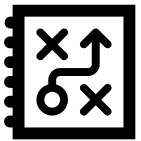
QVA Forecasts are higher resolution and more informative, representing improved scientific and technical capabilities, to provide a more useful and useable product for the industry



QVA information offers operators the opportunity to move away from traditional discernible/visible ash criteria and instead use certified engine susceptibility for flight route planning and inflight replanning



Operators with approval and procedures/practices will be able to use QVA information to fly more efficient routes in accordance with their safety management program



Operators will be able to use additional probabilistic QVA information in conjunction with their safety management program to further optimize airspace and plan more efficient routes during significant volcanic ash cloud events.

Products Requirement:

- Ash concentration datasets
 - IWXXM Objects (polygons)
 - Probabilistic datasets
- [VAACs are also intending to provide graphics]

Horizontal	0.25 degrees latitude and longitude.
Vertical	12 Levels, 50FL Depth, Mean sea level to FL600
Temporal	0, 3, 6, 9, 12, 15, 18, 21 and 24 hours

Descriptor	Concentration thresholds and ranges
Very high	$\geq 10 \text{ mg/m}^3$
High	$\geq 5 \text{ and } < 10 \text{ mg/m}^3$
Medium	$\geq 2 \text{ and } < 5 \text{ mg/m}^3$
Low	$\geq 0.2 \text{ and } < 2 \text{ mg/m}^3$
Very low	$< 0.2 \text{ mg/m}^3$

Products Requirement:

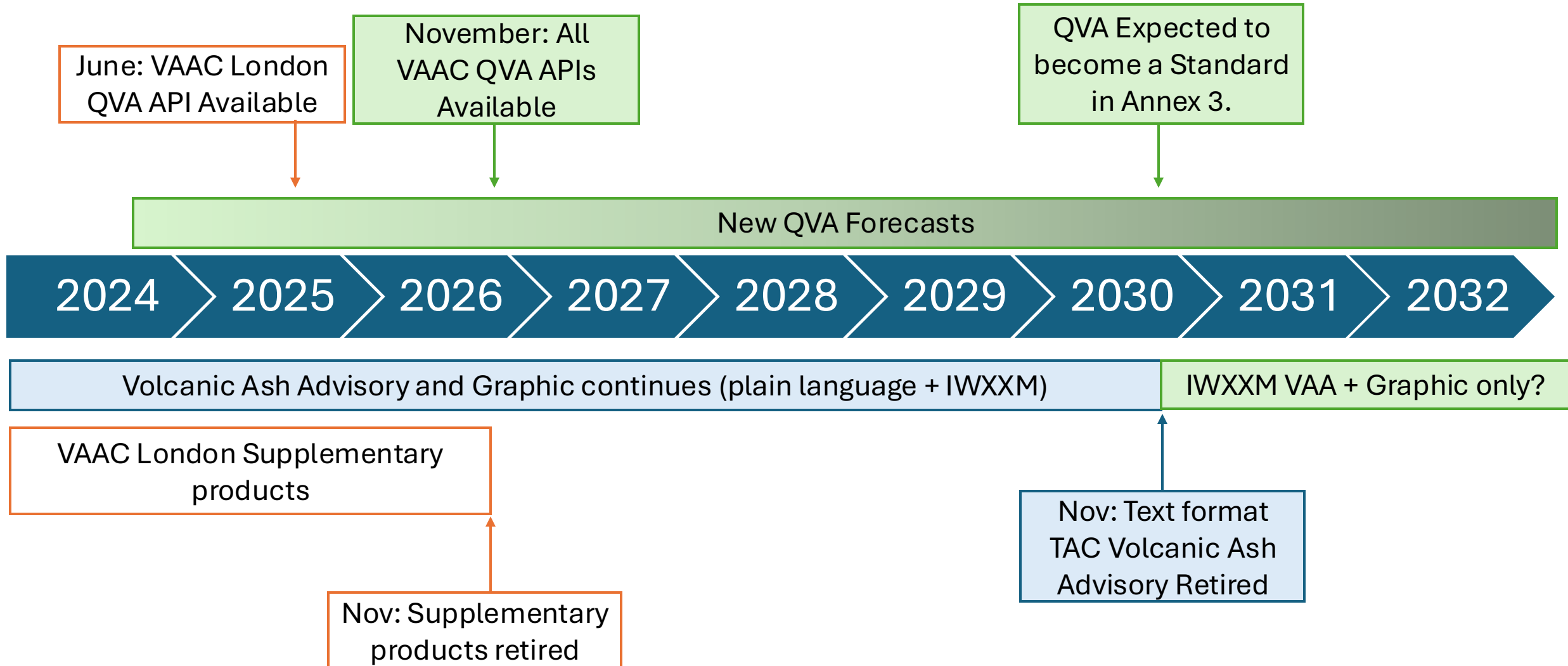
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Very low	$< 0.2 \text{ mg/m}^3$

What does this mean?

- All VAACs will be forecasting **how much ash** is expected to be in the atmosphere - not just its location
- Forecasts will be at a **higher resolution** – more time steps, vertical levels, and concentration thresholds
- IWXXM Objects - **sophisticated polygons** - will indicate low, medium, high and very high concentrations
- For the first time All VAACs will be generating **probabilistic forecasts**
- The raw **concentration + probabilistic data** will be provided to aviation customers for the first time



From November 2026 the provision of a QVA for significant volcanic ash clouds will be a recommended practice

An Example of New London VAAC QVA Products

Scenario – Volcanic Eruption in Iceland

Volcano: Hekla

Eruption Start: 09:00 UTC 07/08/2024

Plume Height: 15 km

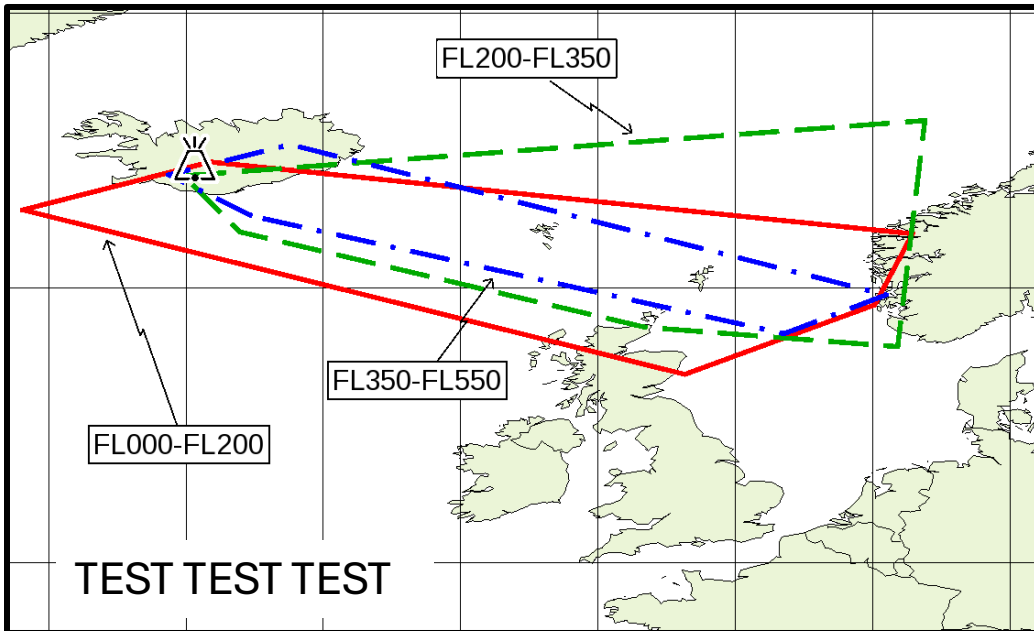
Source Strength: 1.2×10^{12} g/hr

A moderate sized eruption at a known active volcano



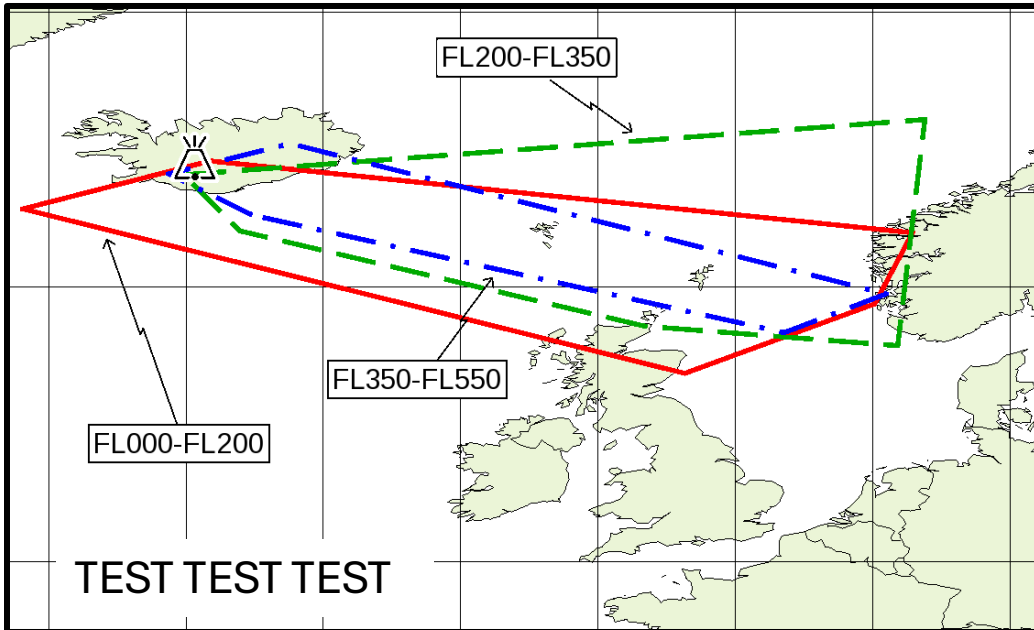
Image from an eruption at Hekla volcano on 17th August 1980. Photo courtesy of Gudmundar Sigvaldason (Nordic Volcanological Institute), 1980, Image GVP-05165, Smithsonian Institute, Global Volcanism Program

Volcanic Ash Graphic (VAG)



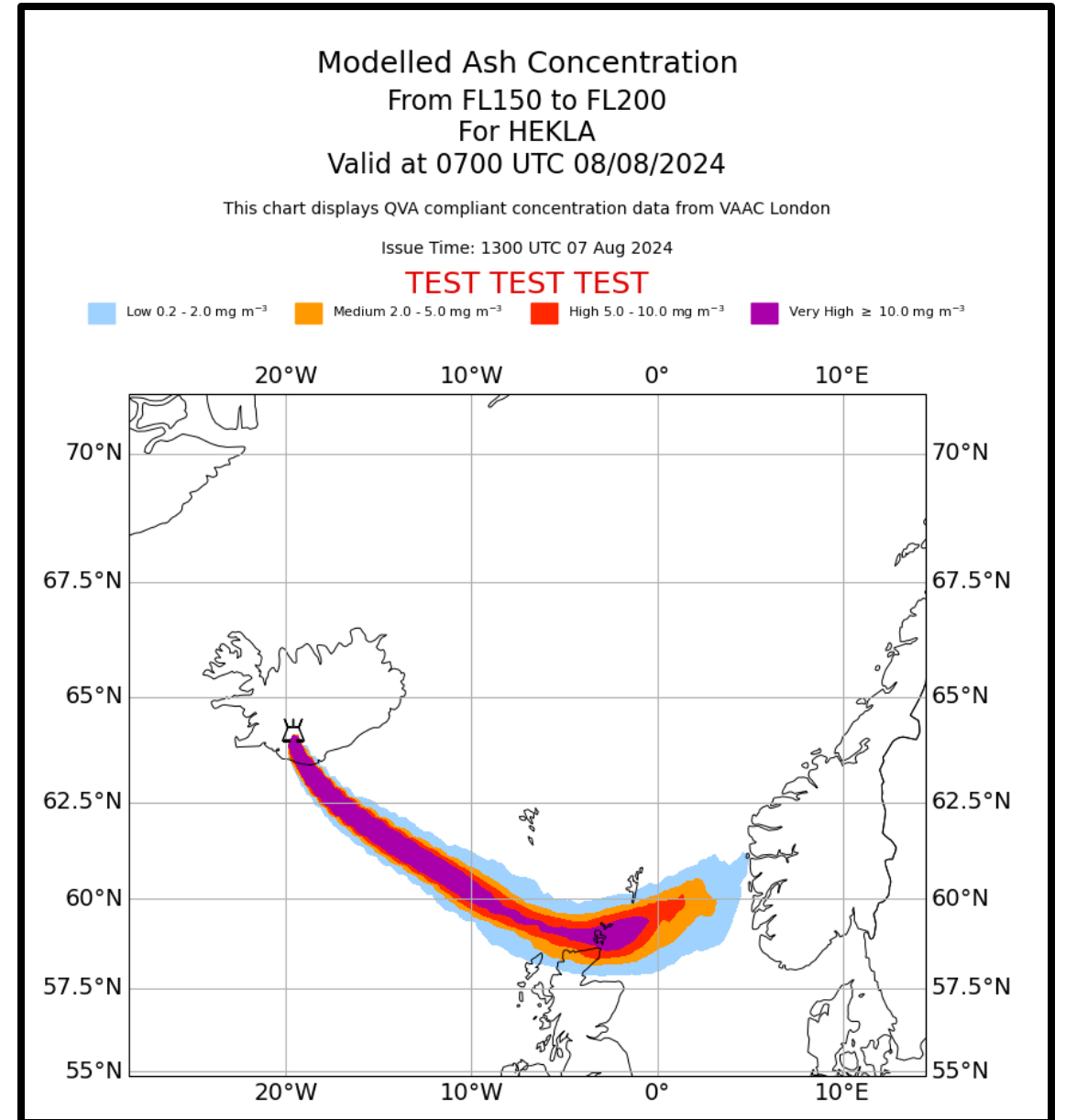
VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

Volcanic Ash Graphic (VAG)

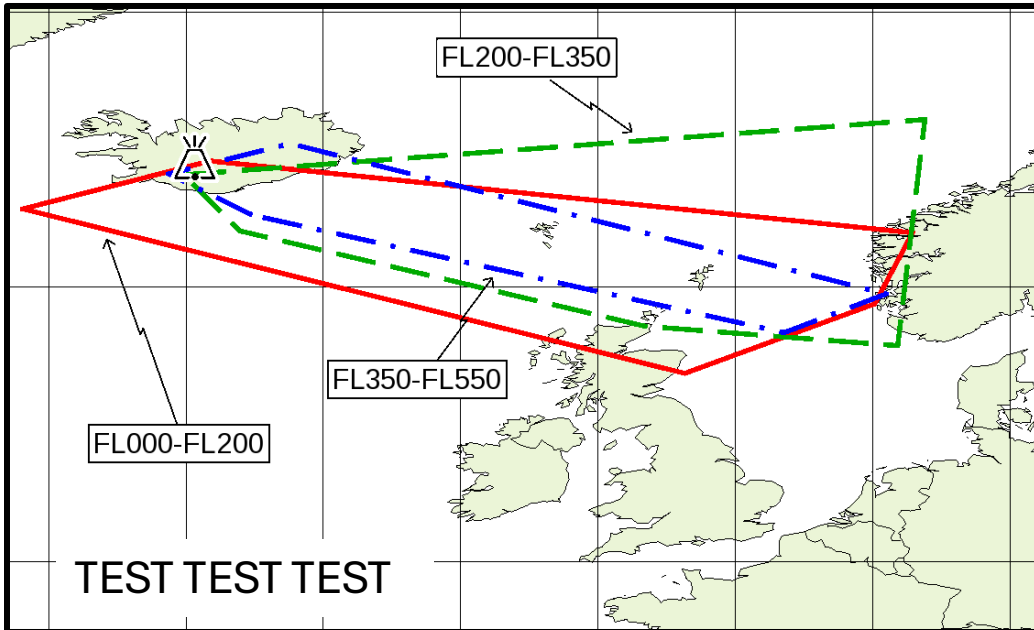


VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

New QVA Product
Shows you variability in concentration

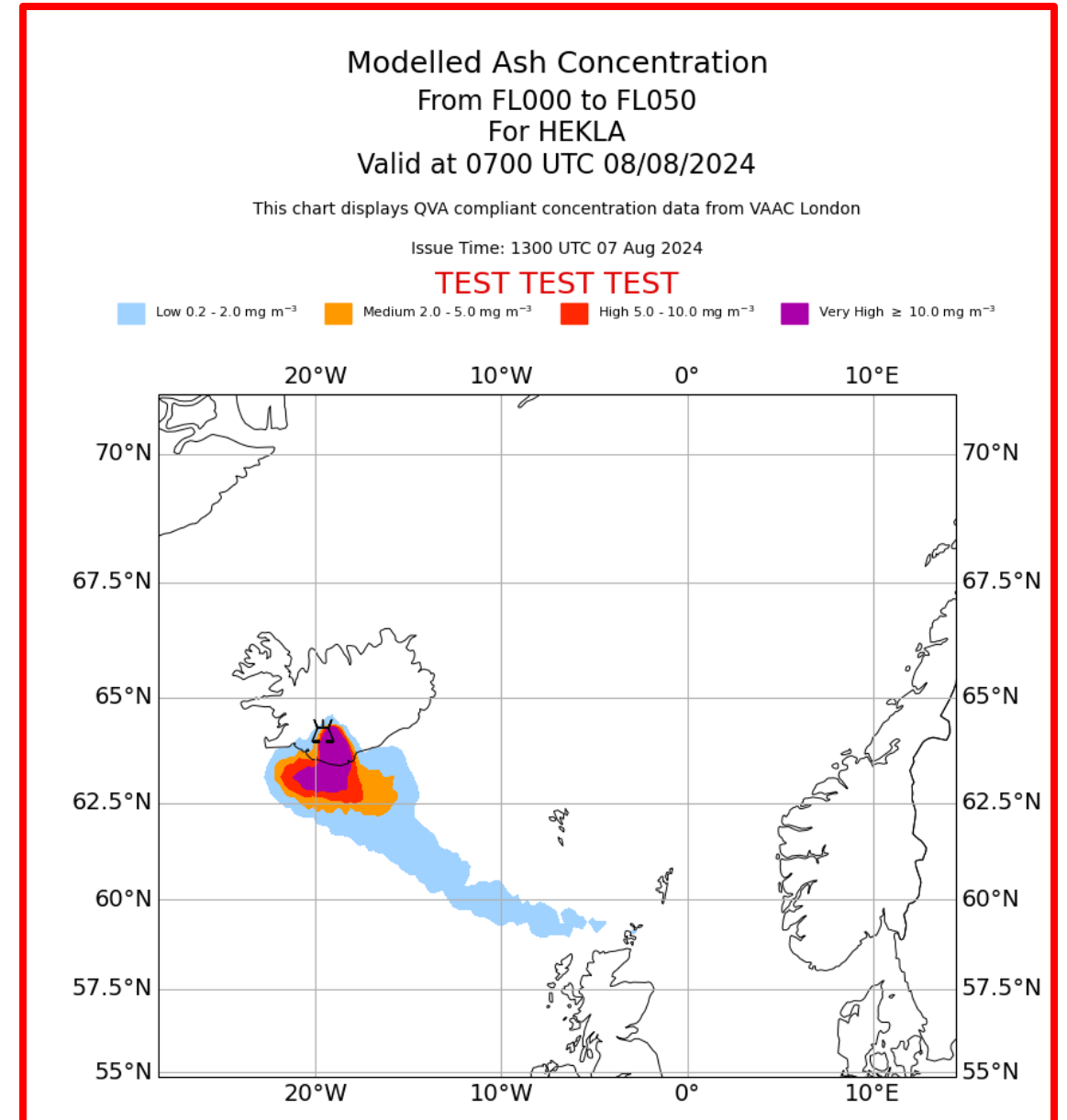


Volcanic Ash Graphic (VAG)

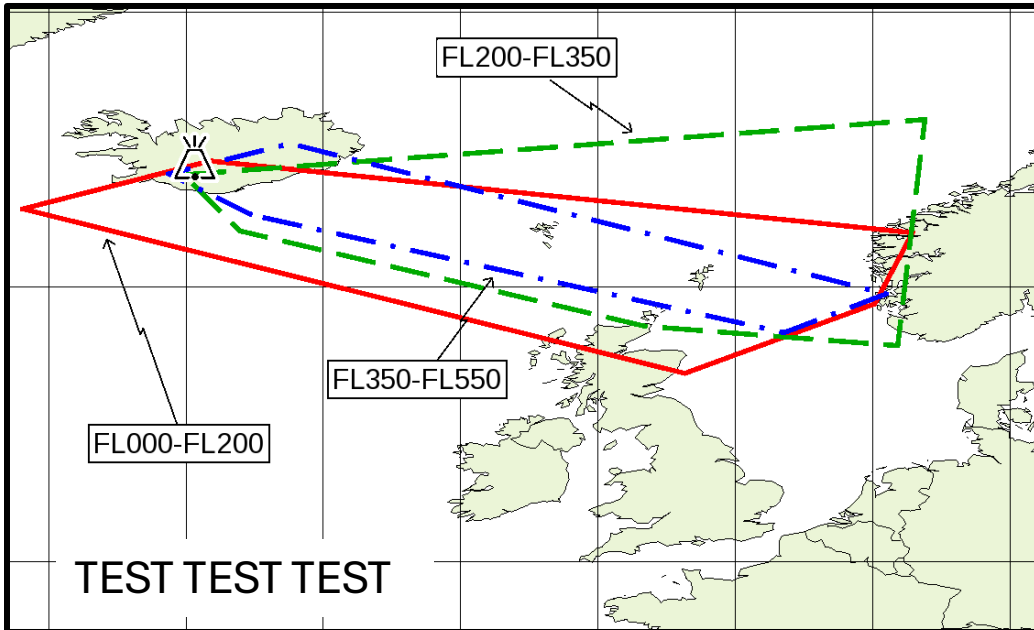


VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

New QVA Product
Gives you the detail of where ash is in the
vertical

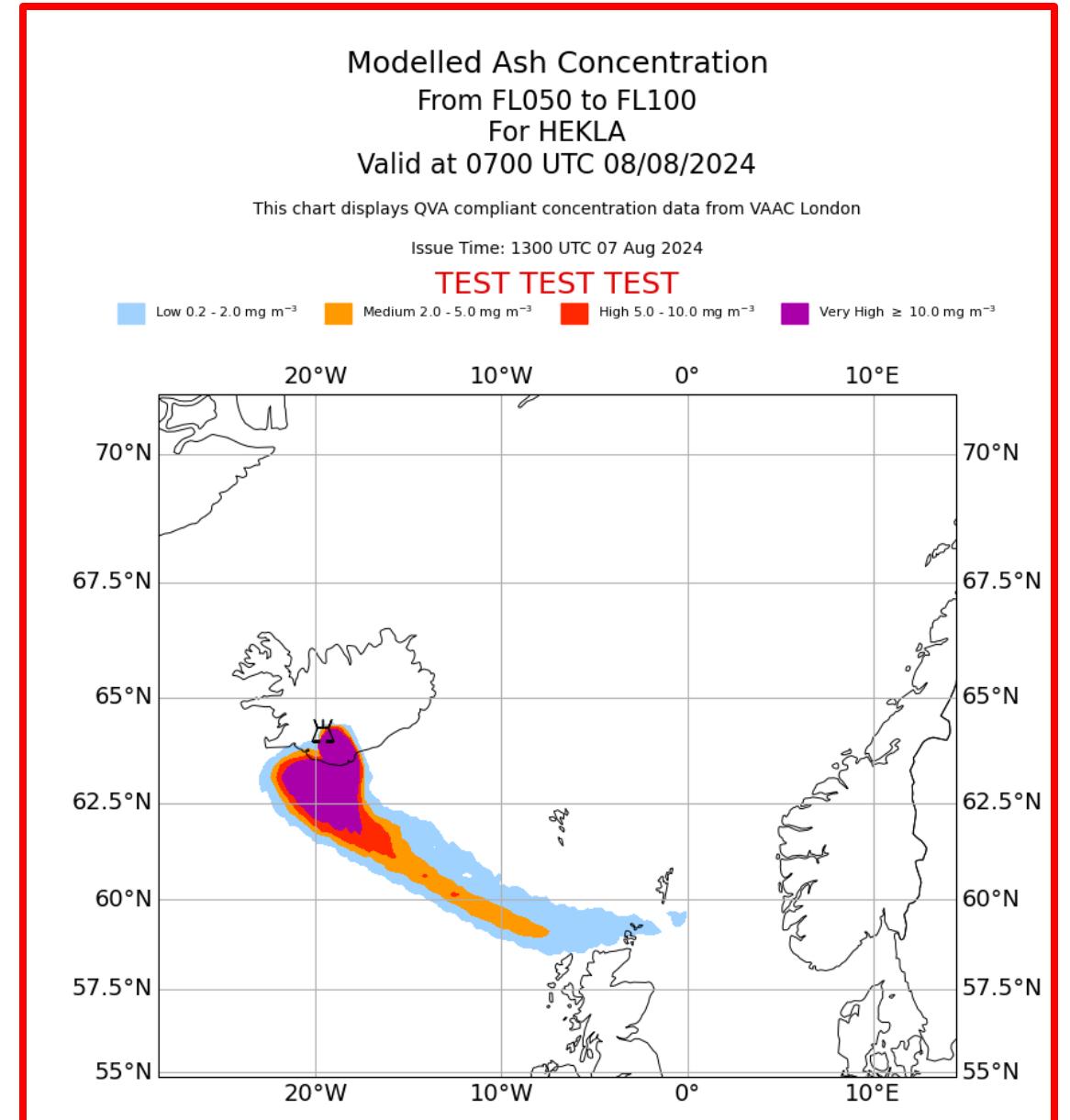


Volcanic Ash Graphic (VAG)

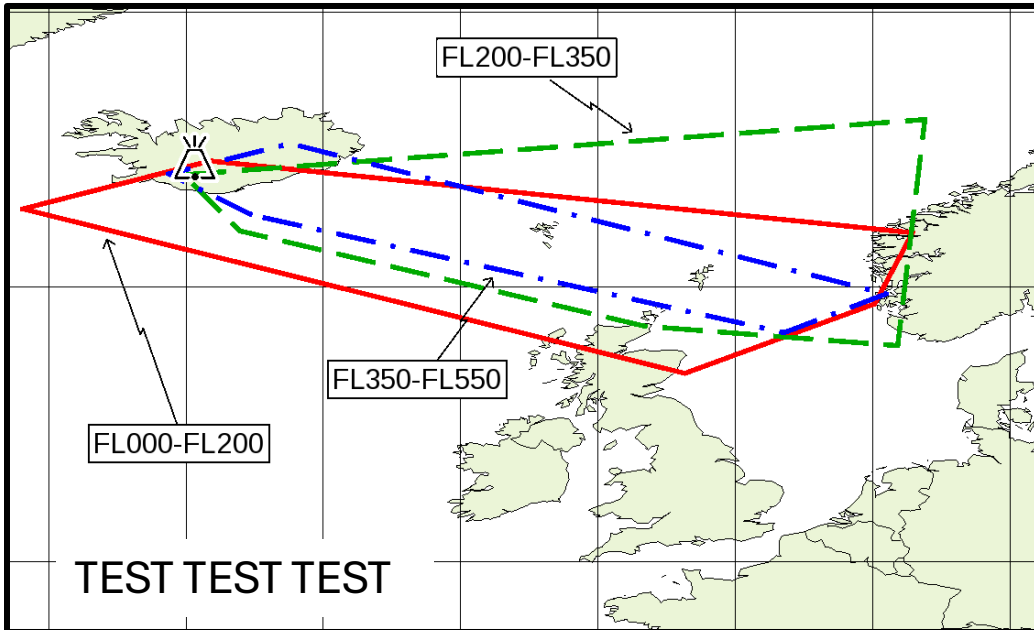


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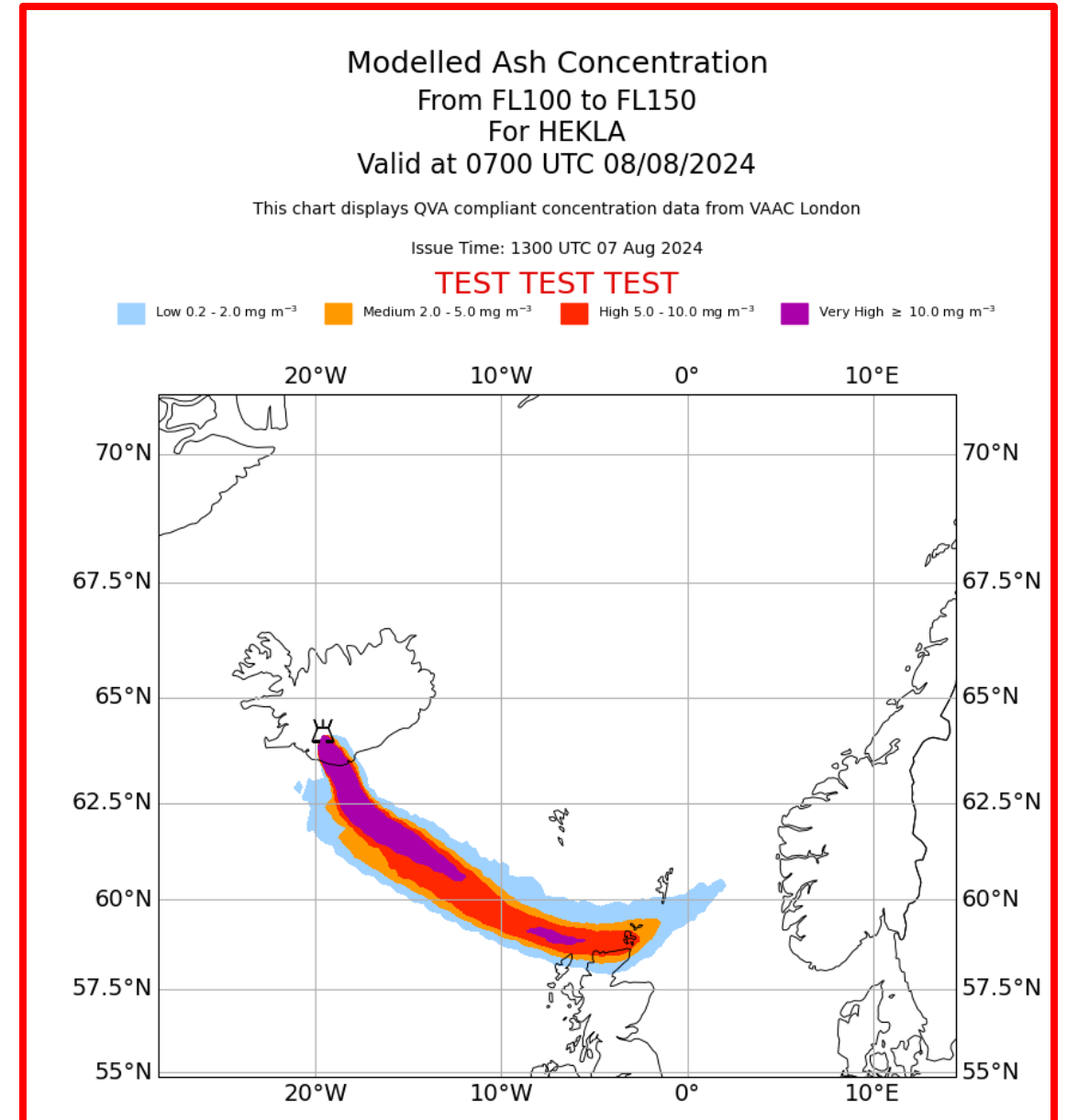


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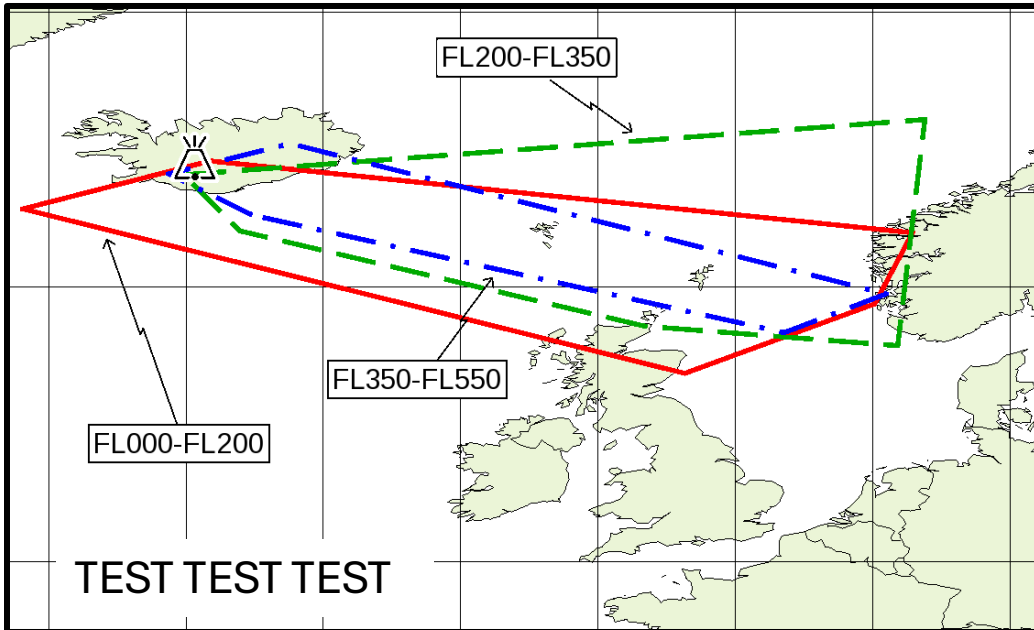


VAG is any ash above ~0.2 mg m⁻³

New QVA Product
Gives you the detail of where ash is in the
vertical

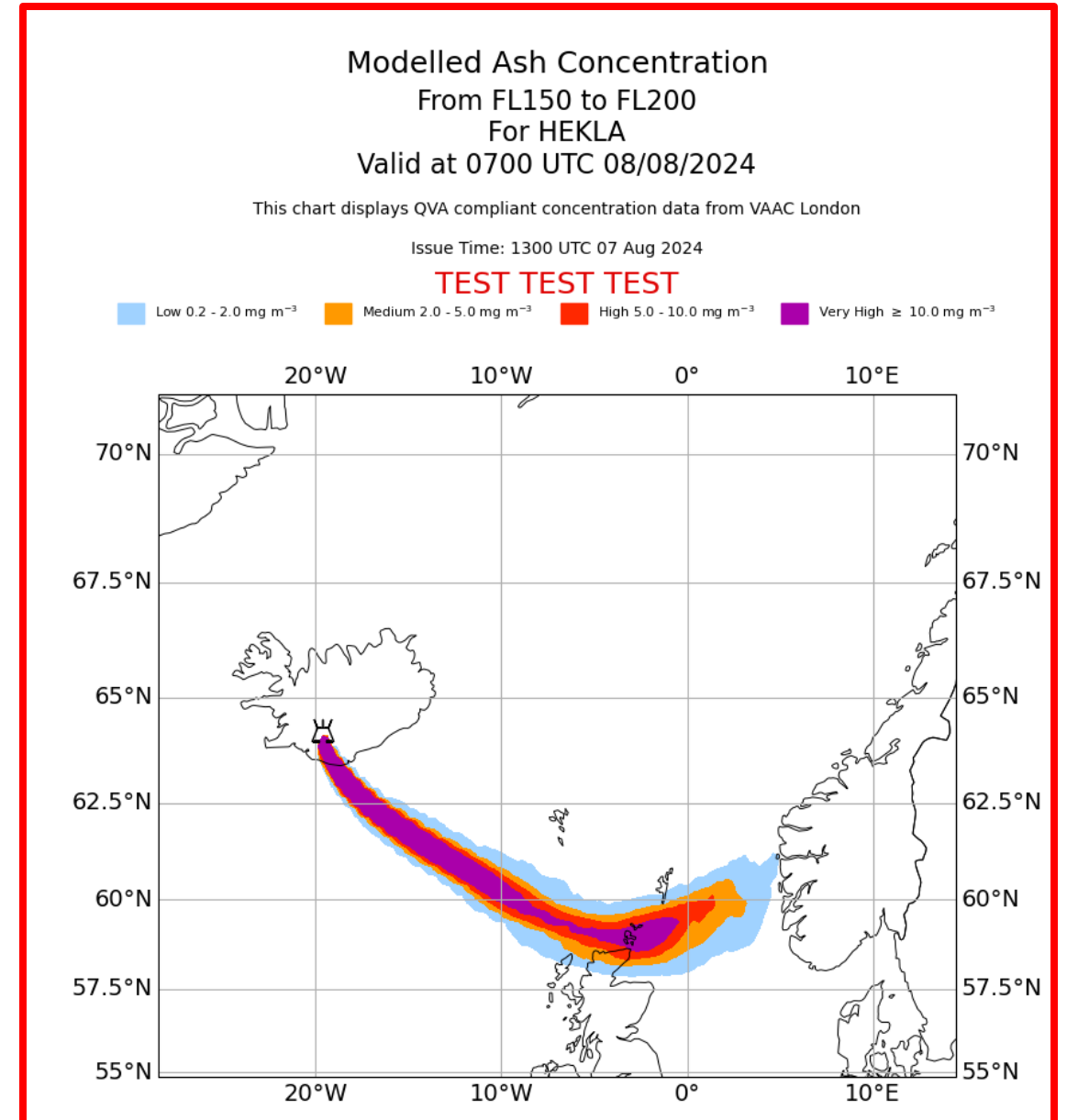


Volcanic Ash Graphic (VAG)

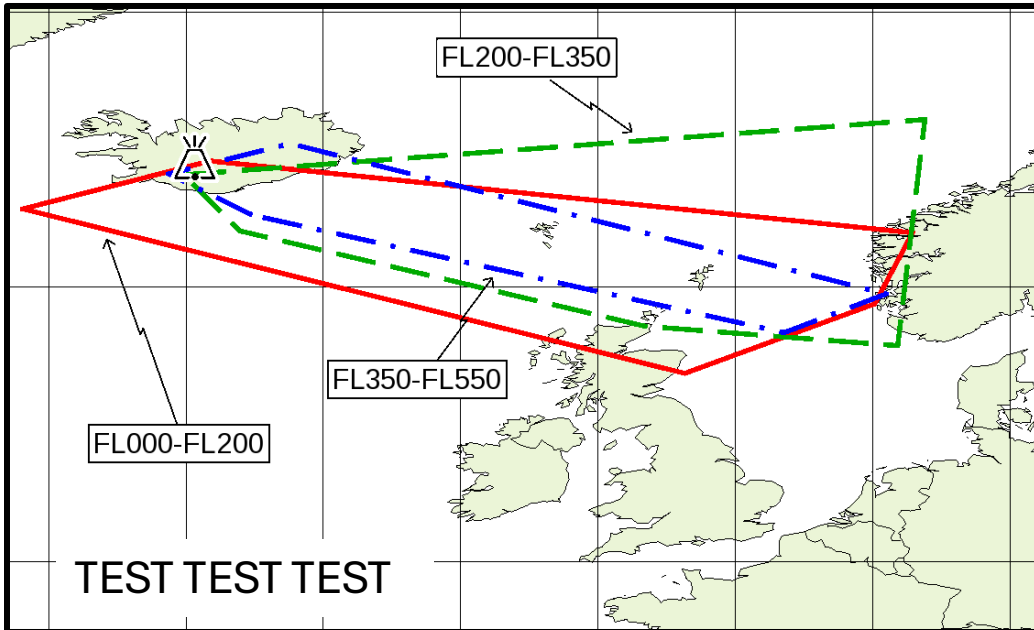


VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

New QVA Product
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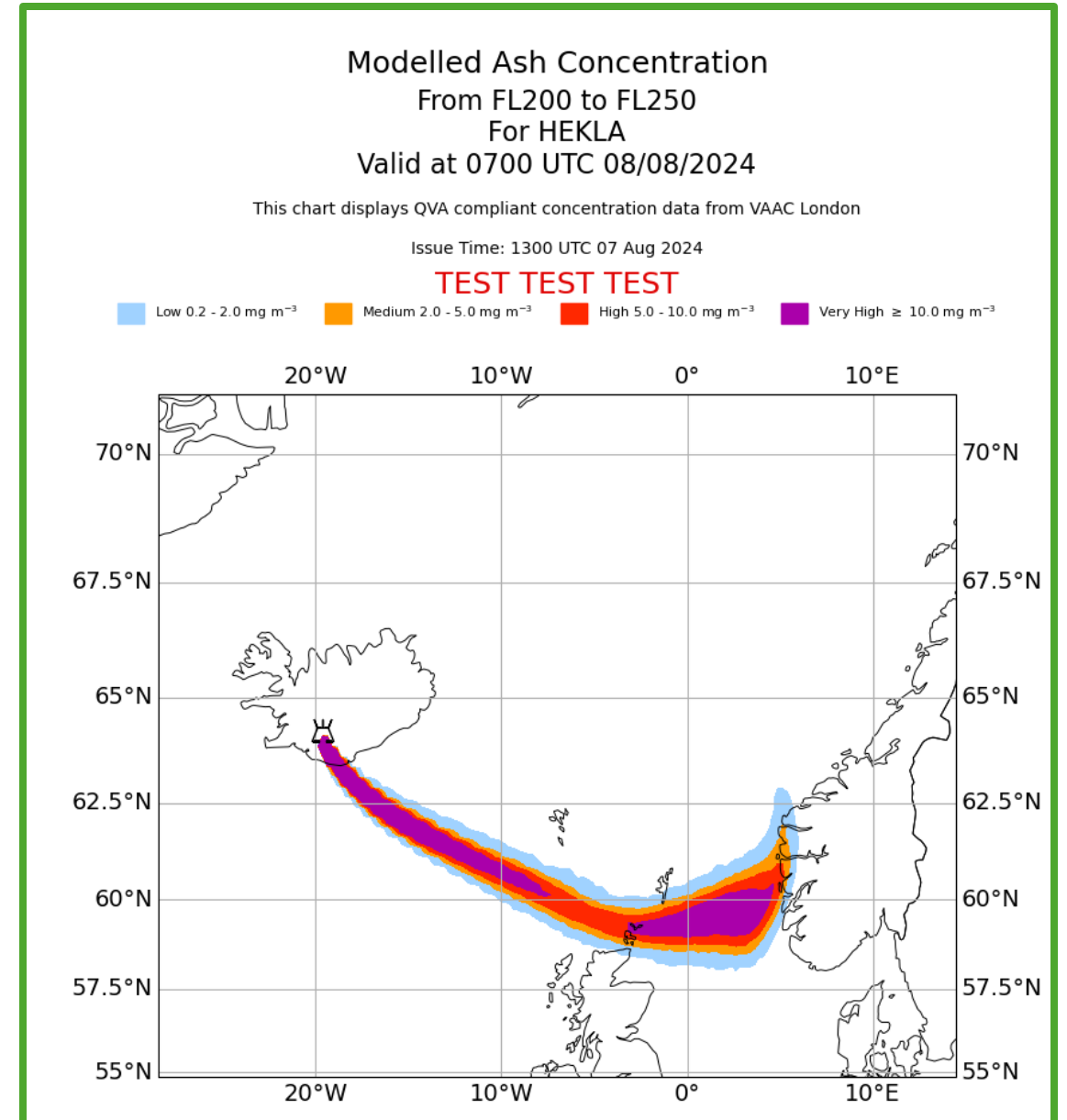


Volcanic Ash Graphic (VAG)

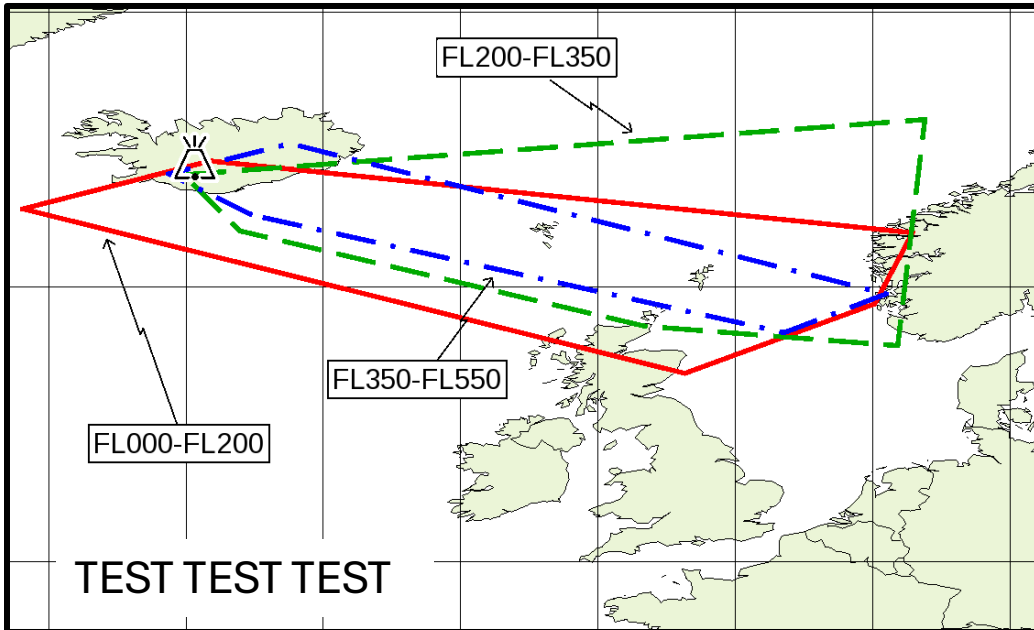


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New QVA Product
Gives you the detail of where ash is in the
vertical

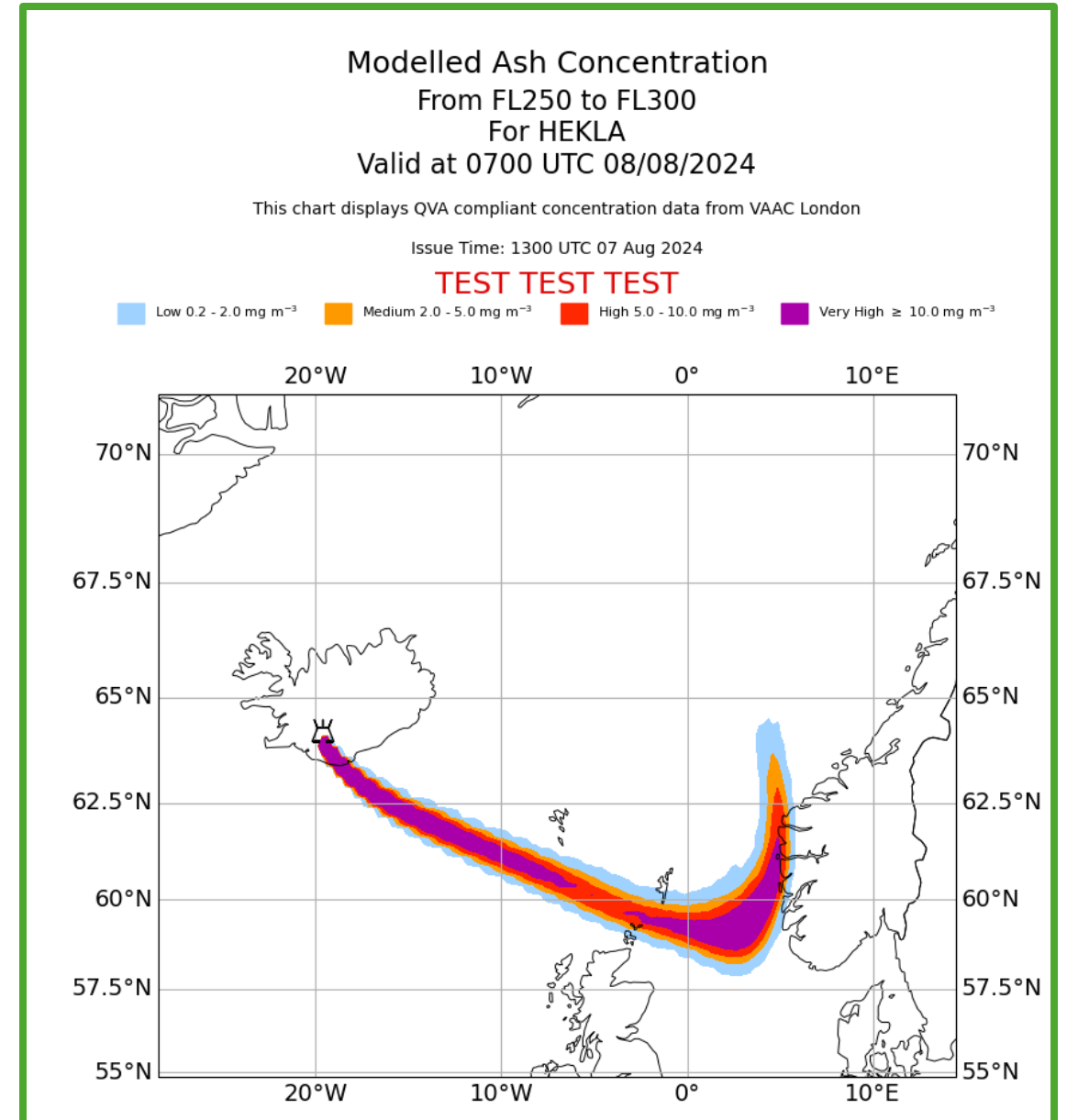


Volcanic Ash Graphic (VAG)

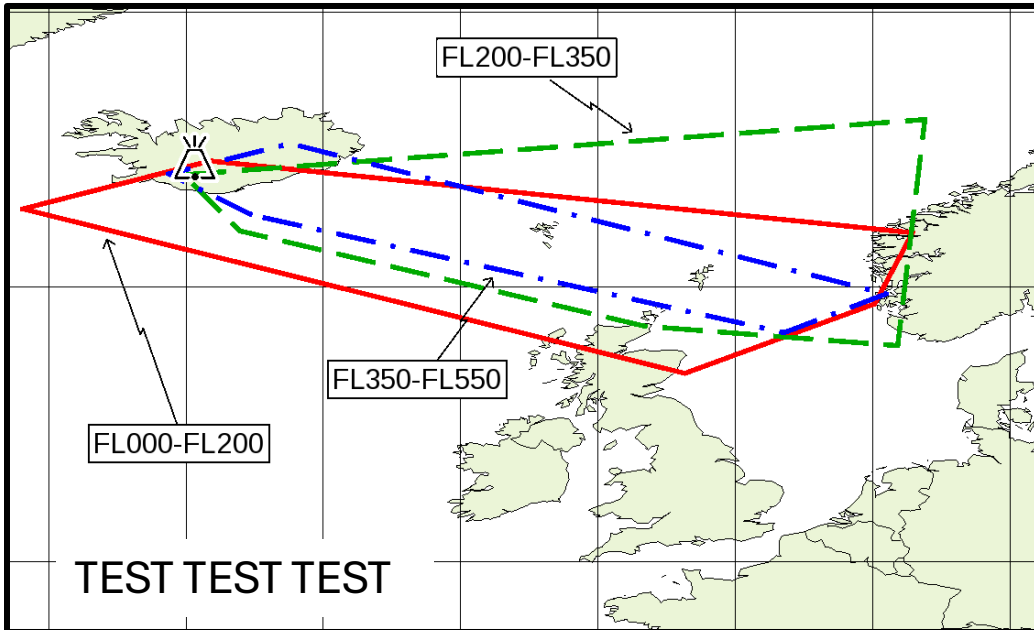


VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

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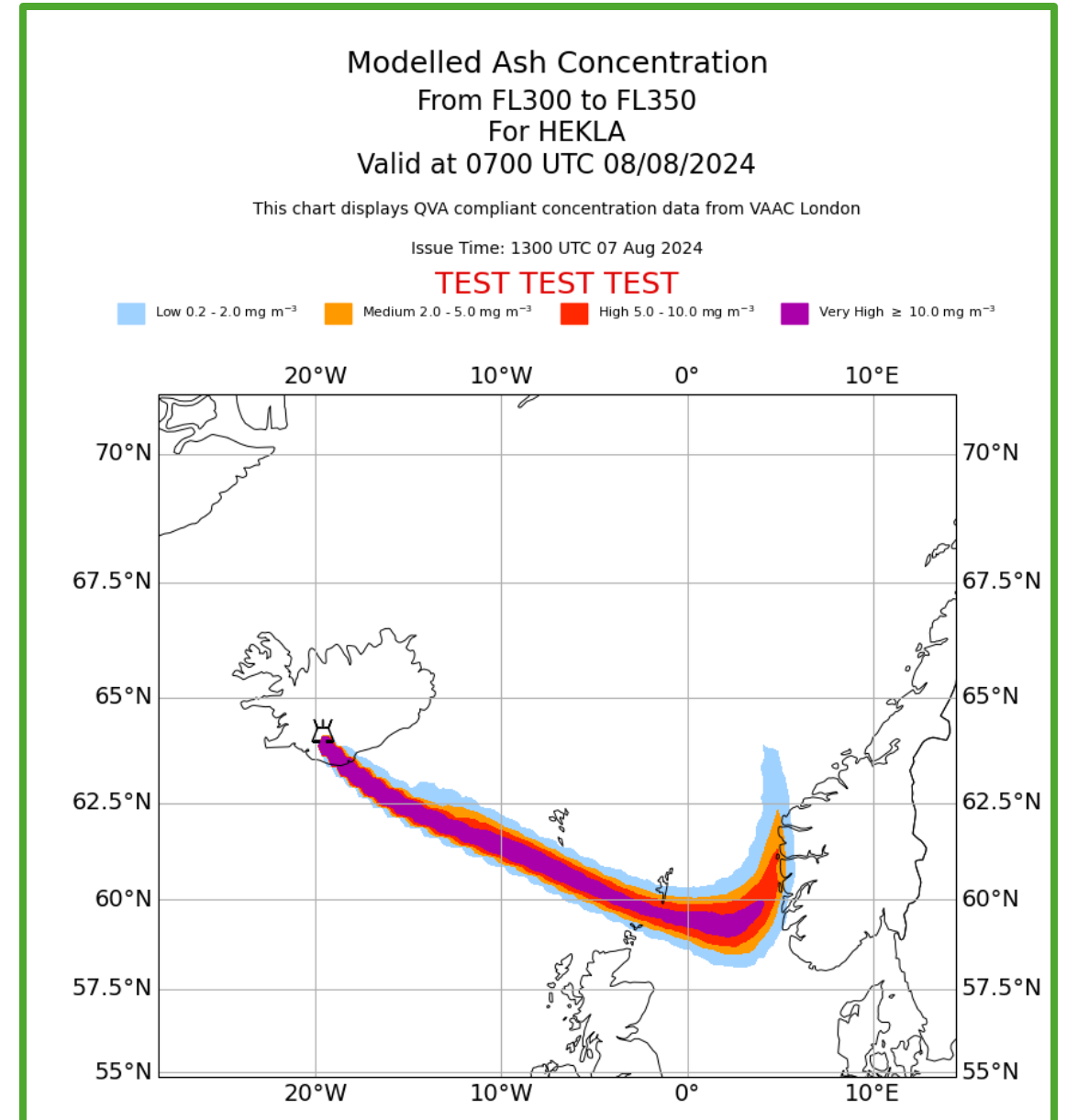


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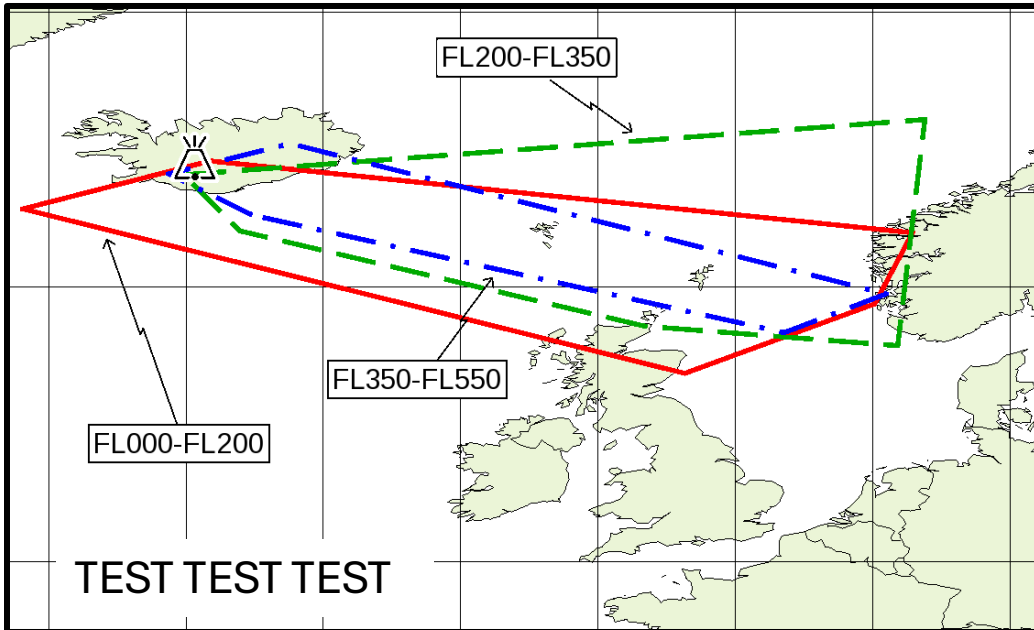


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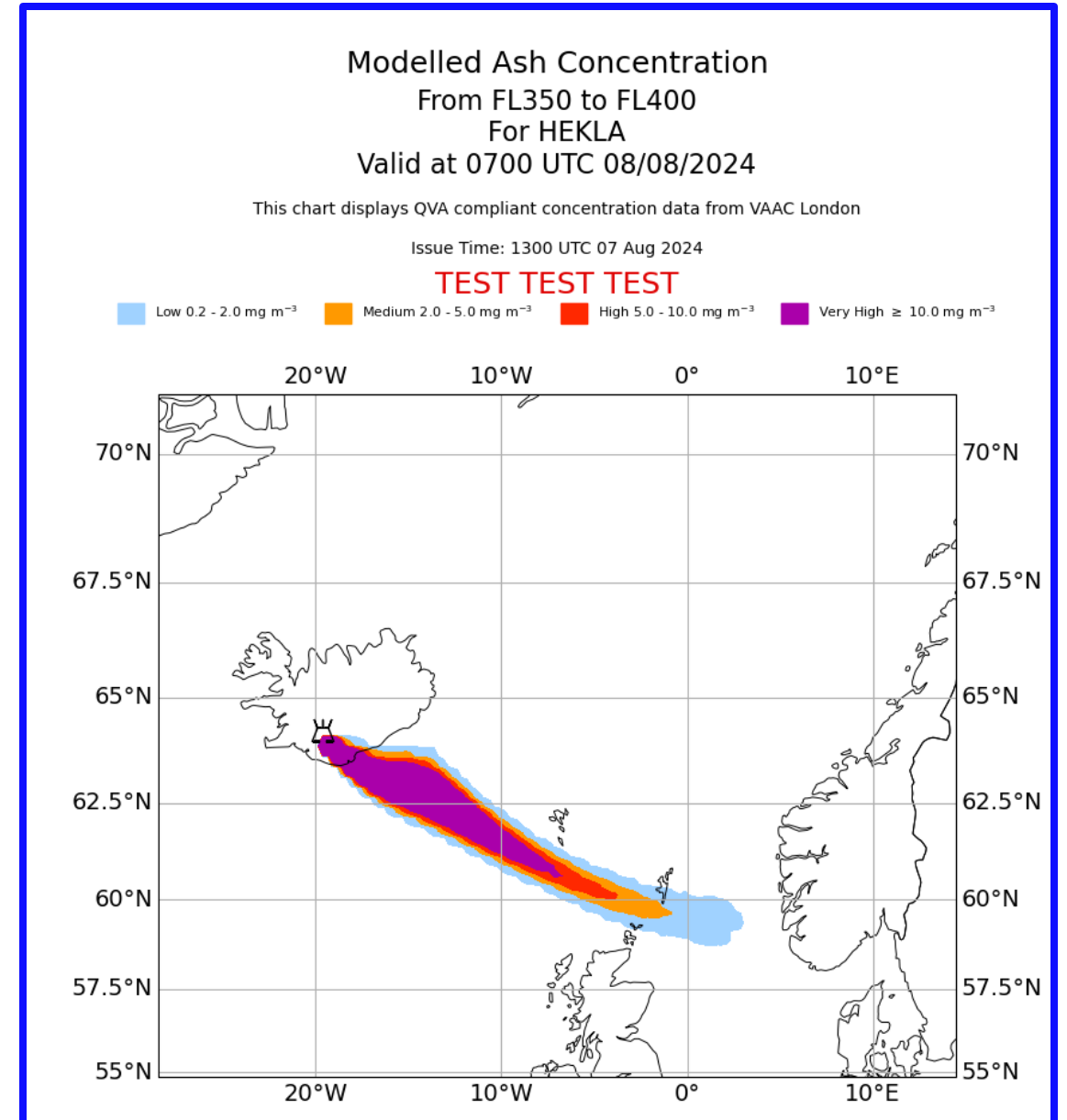


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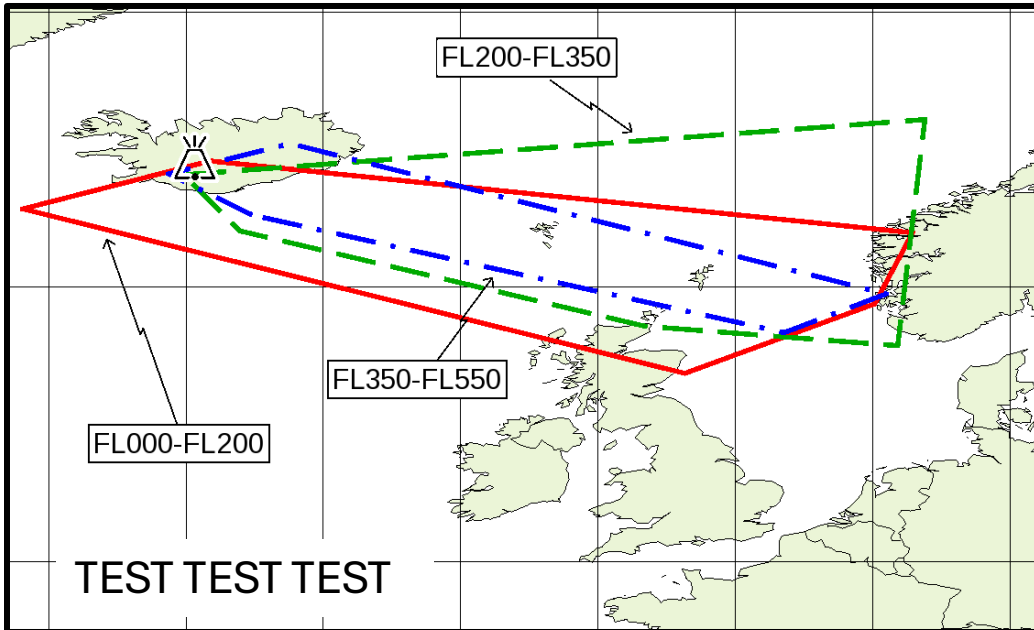


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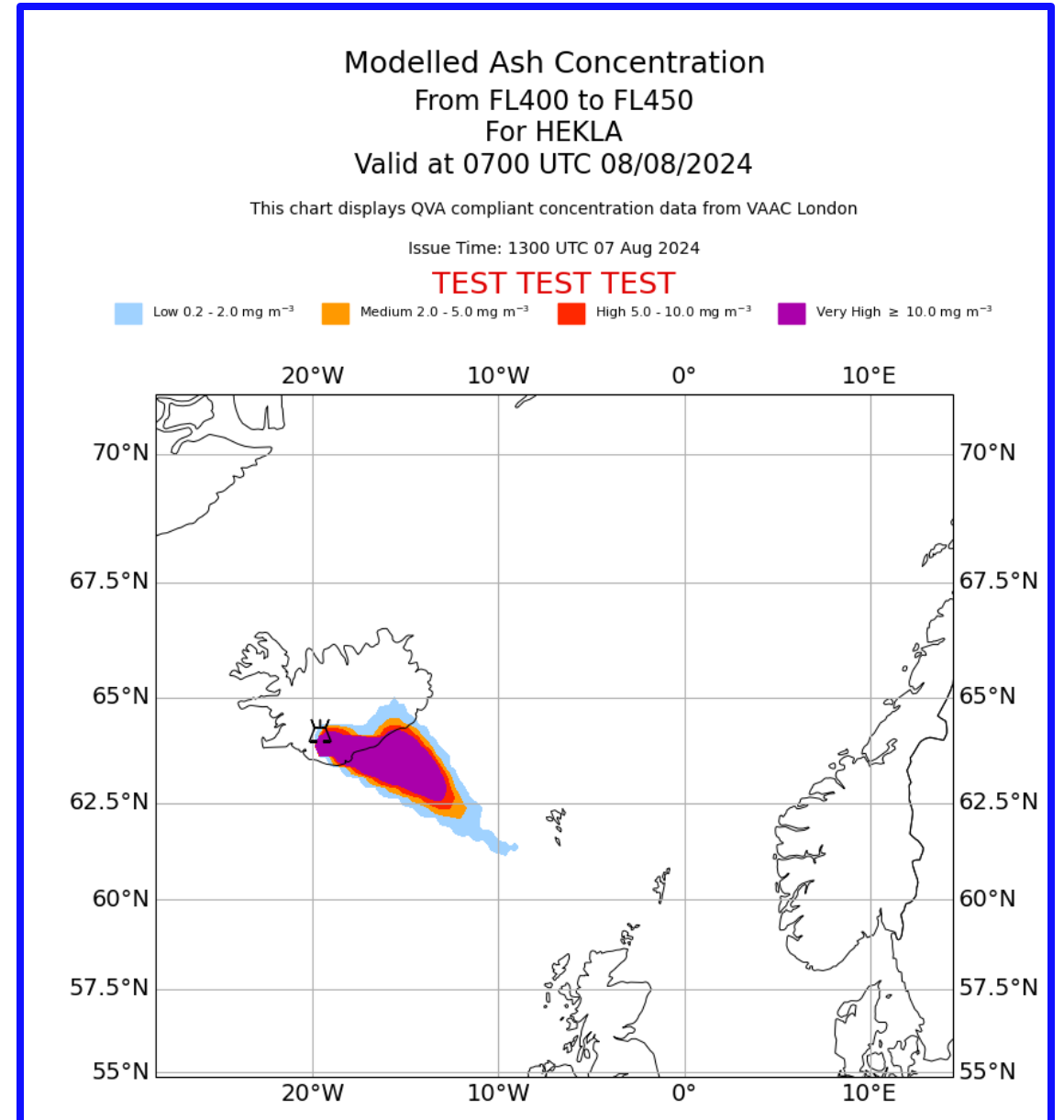


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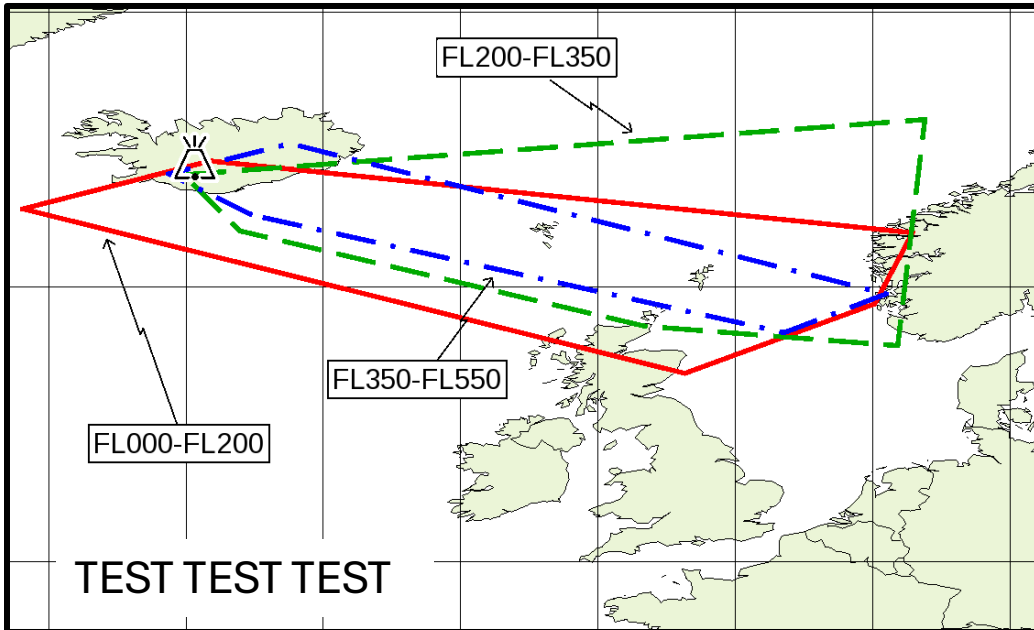


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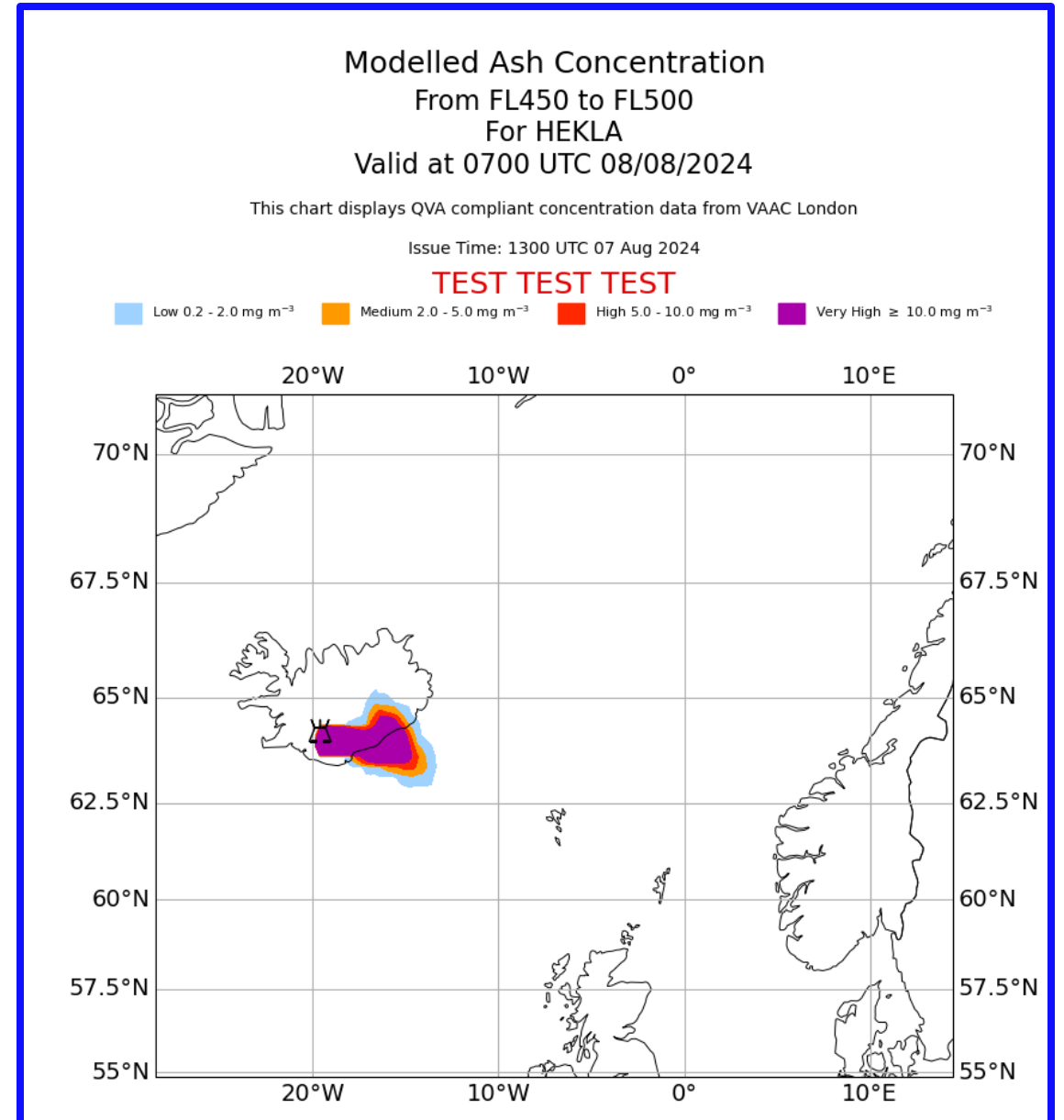


Volcanic Ash Graphic (VAG)

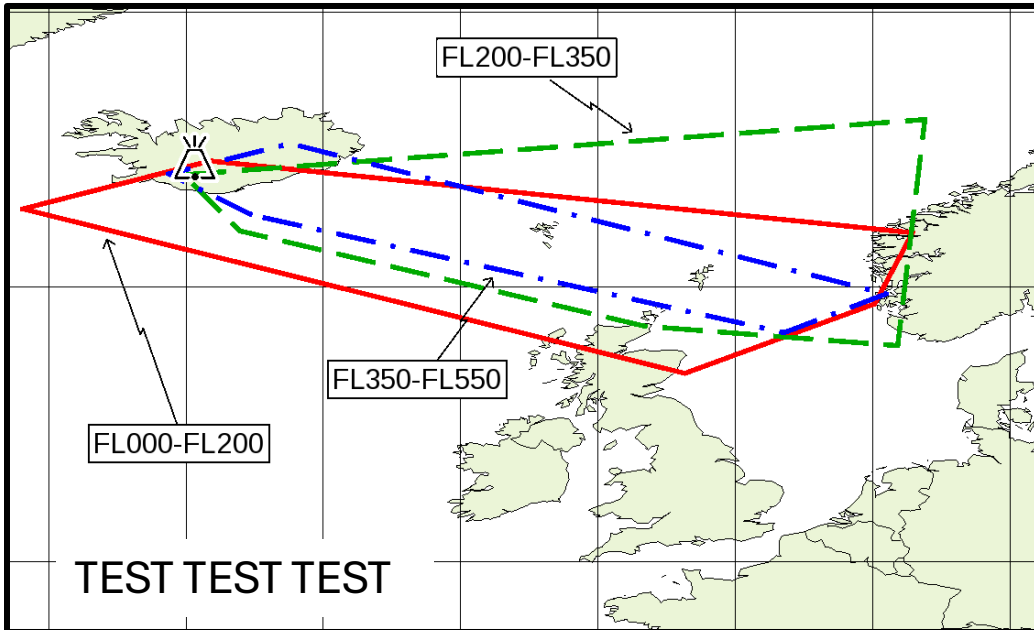


VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

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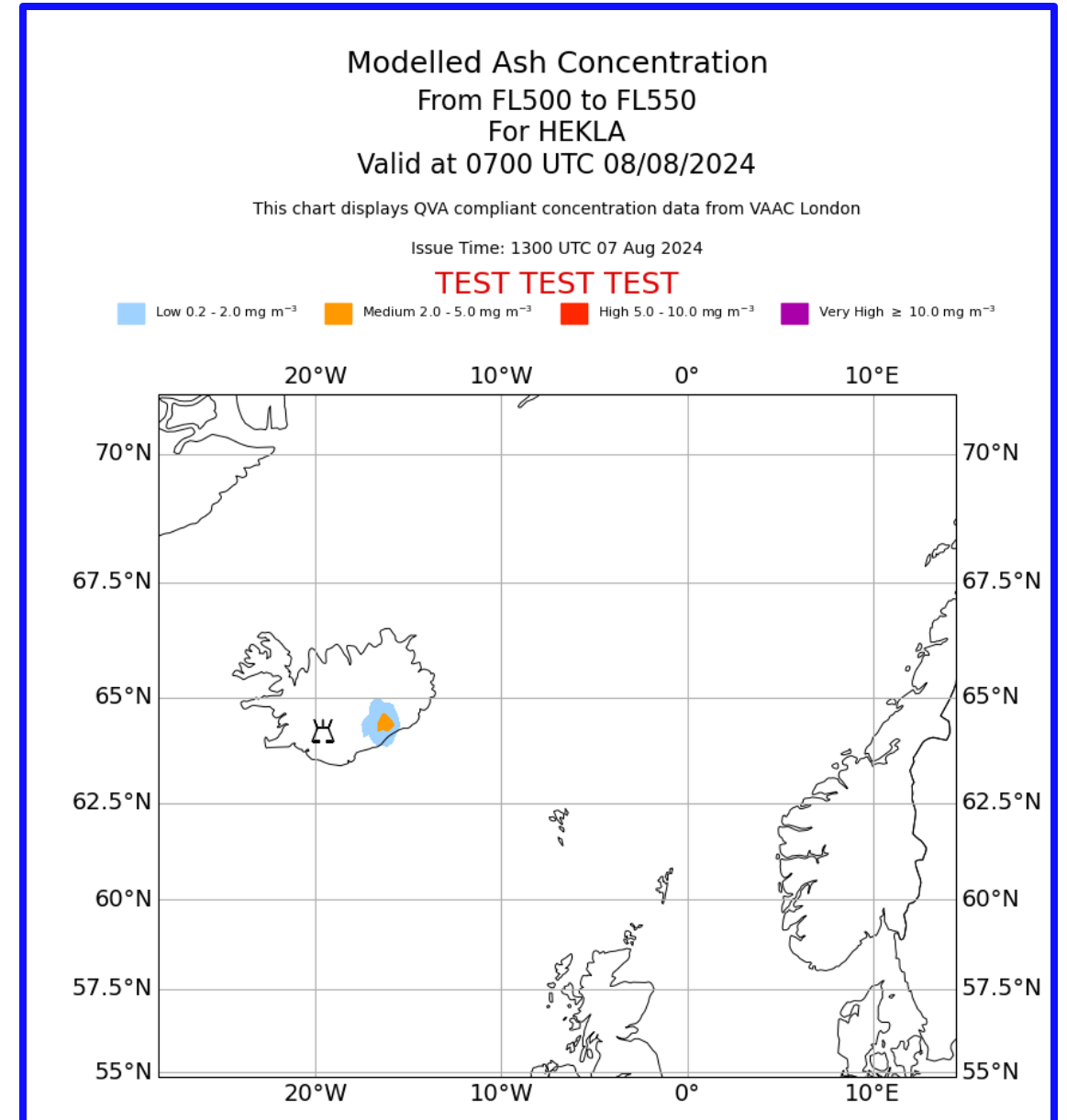


Volcanic Ash Graphic (VAG)

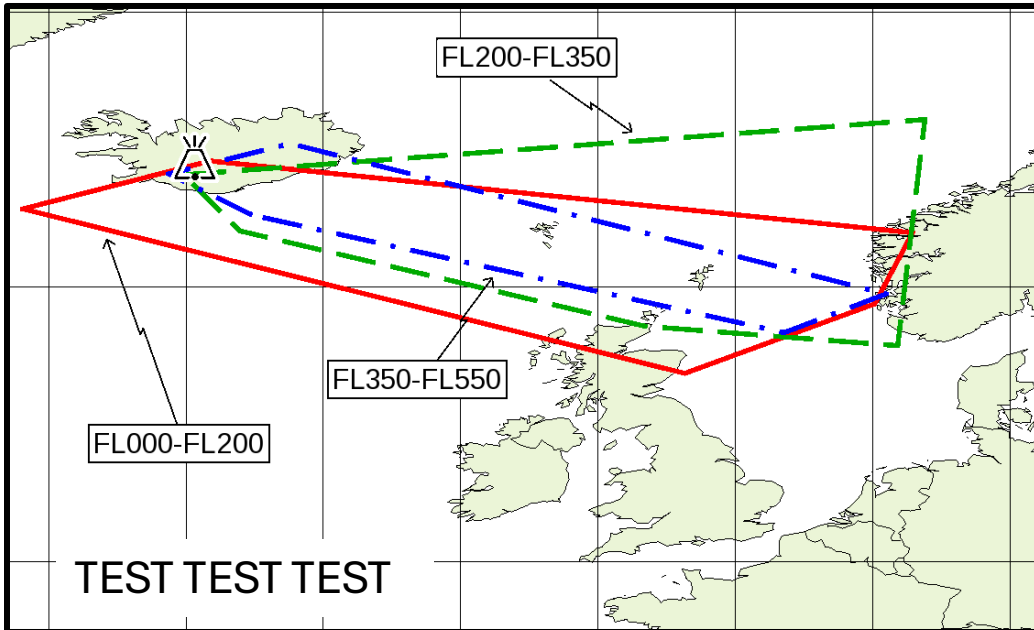


VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

New QVA Product
Gives you the detail of where ash is in the
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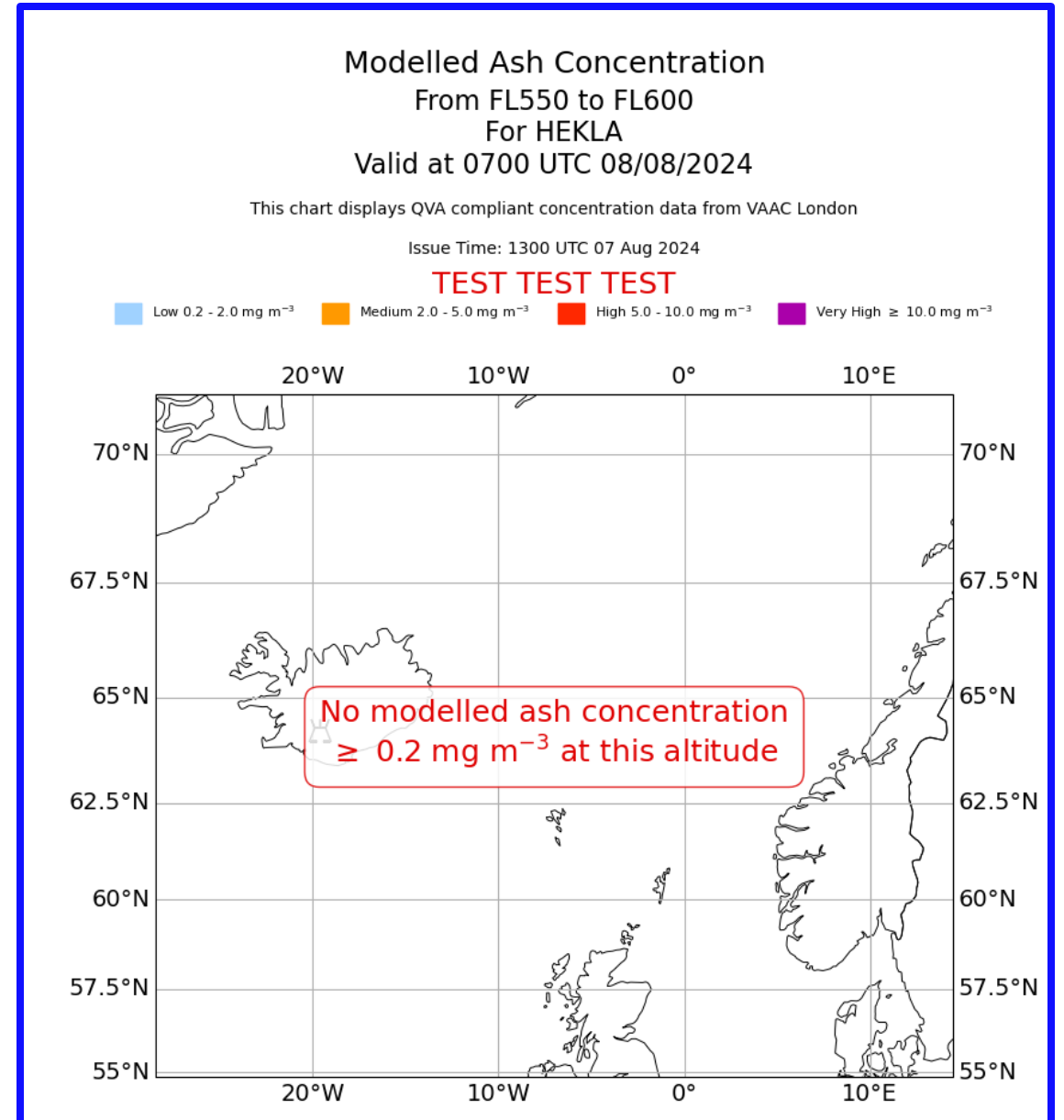


Volcanic Ash Graphic (VAG)

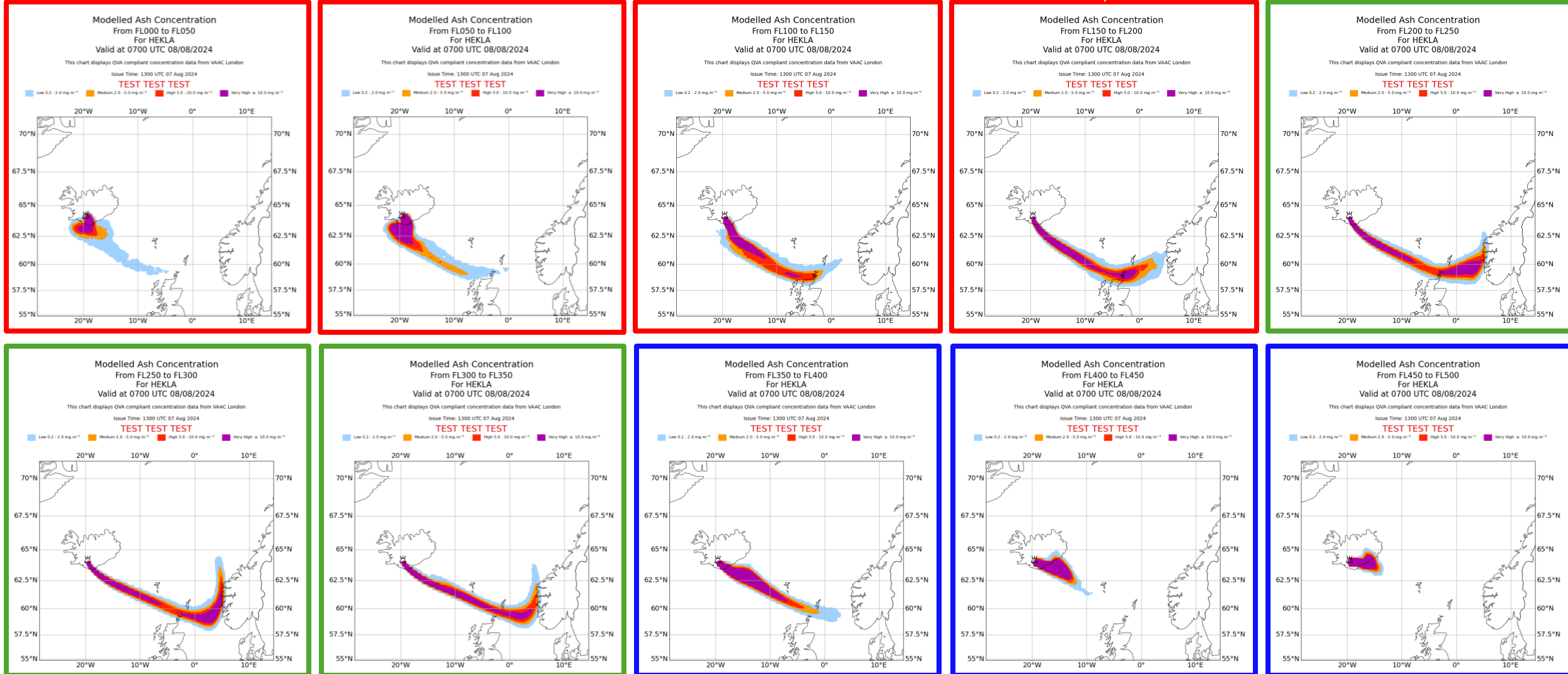


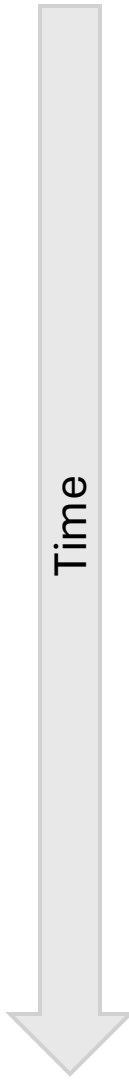
VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

New QVA Product
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vertical



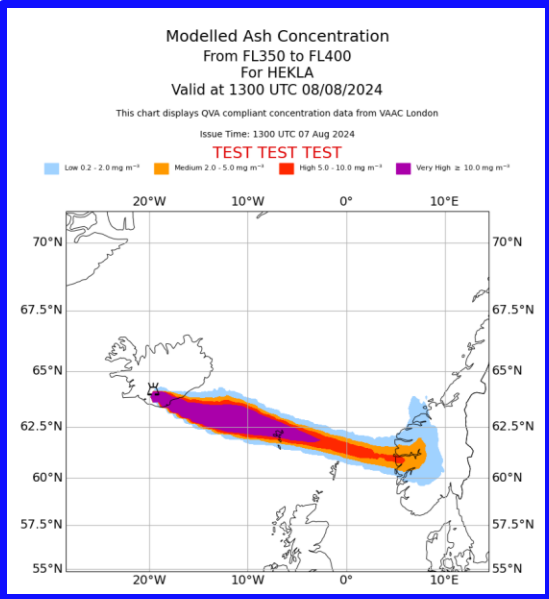
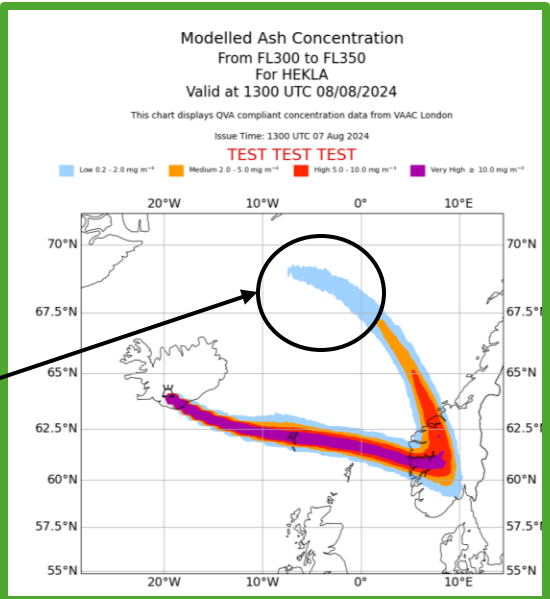
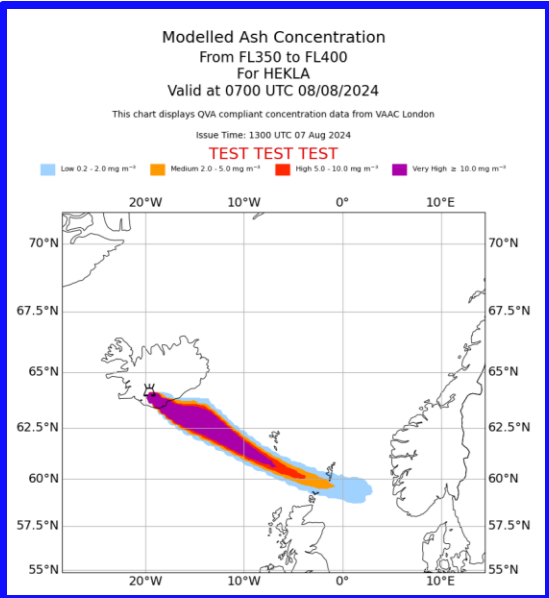
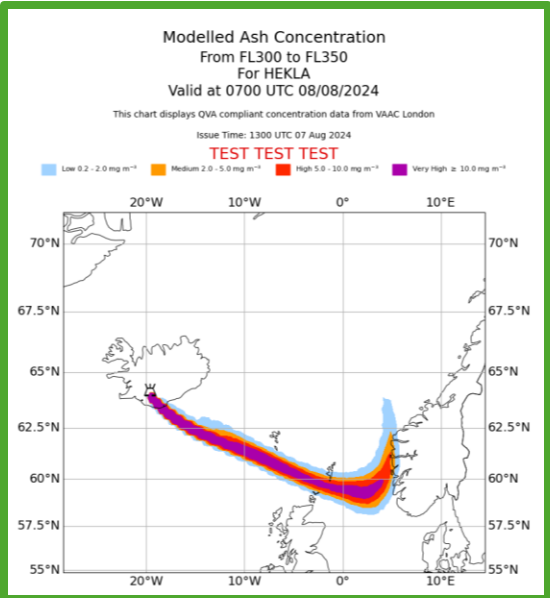
Height



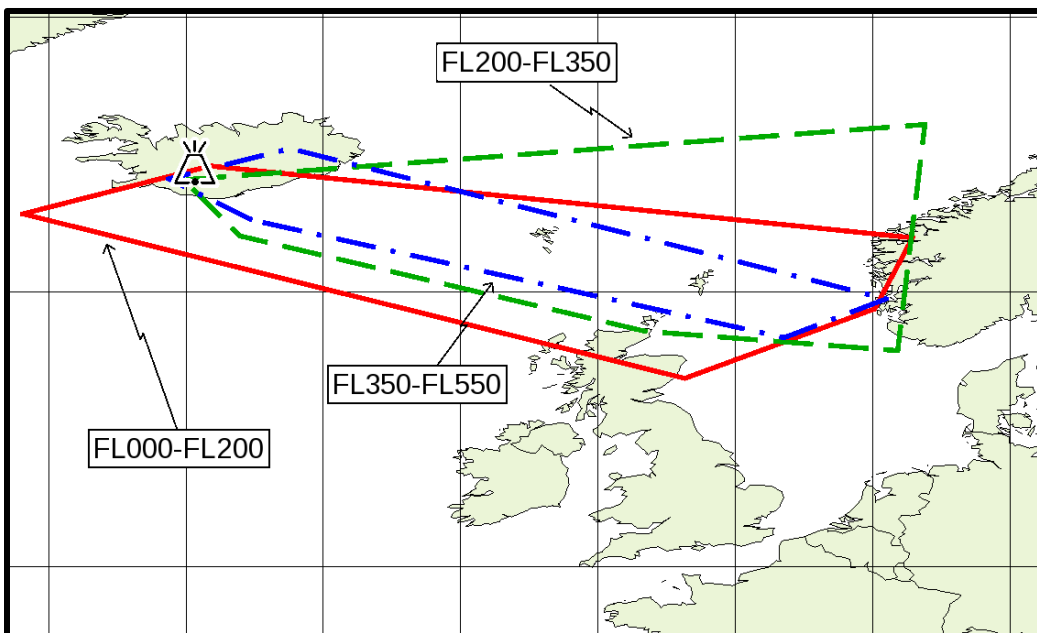


+ 6 h

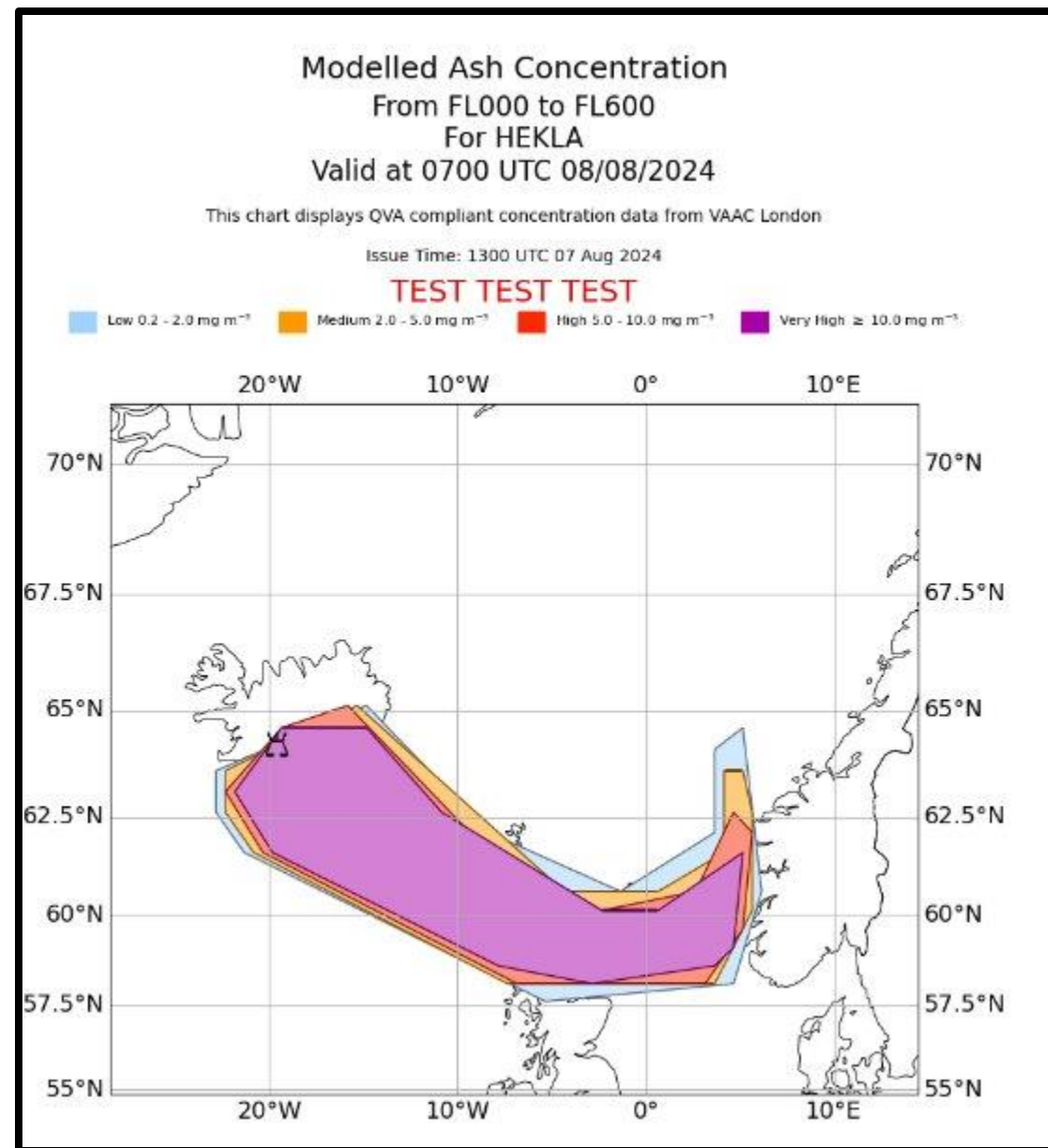
Here ash is less than 2 mg m^{-3}



Volcanic Ash Graphic (VAG)



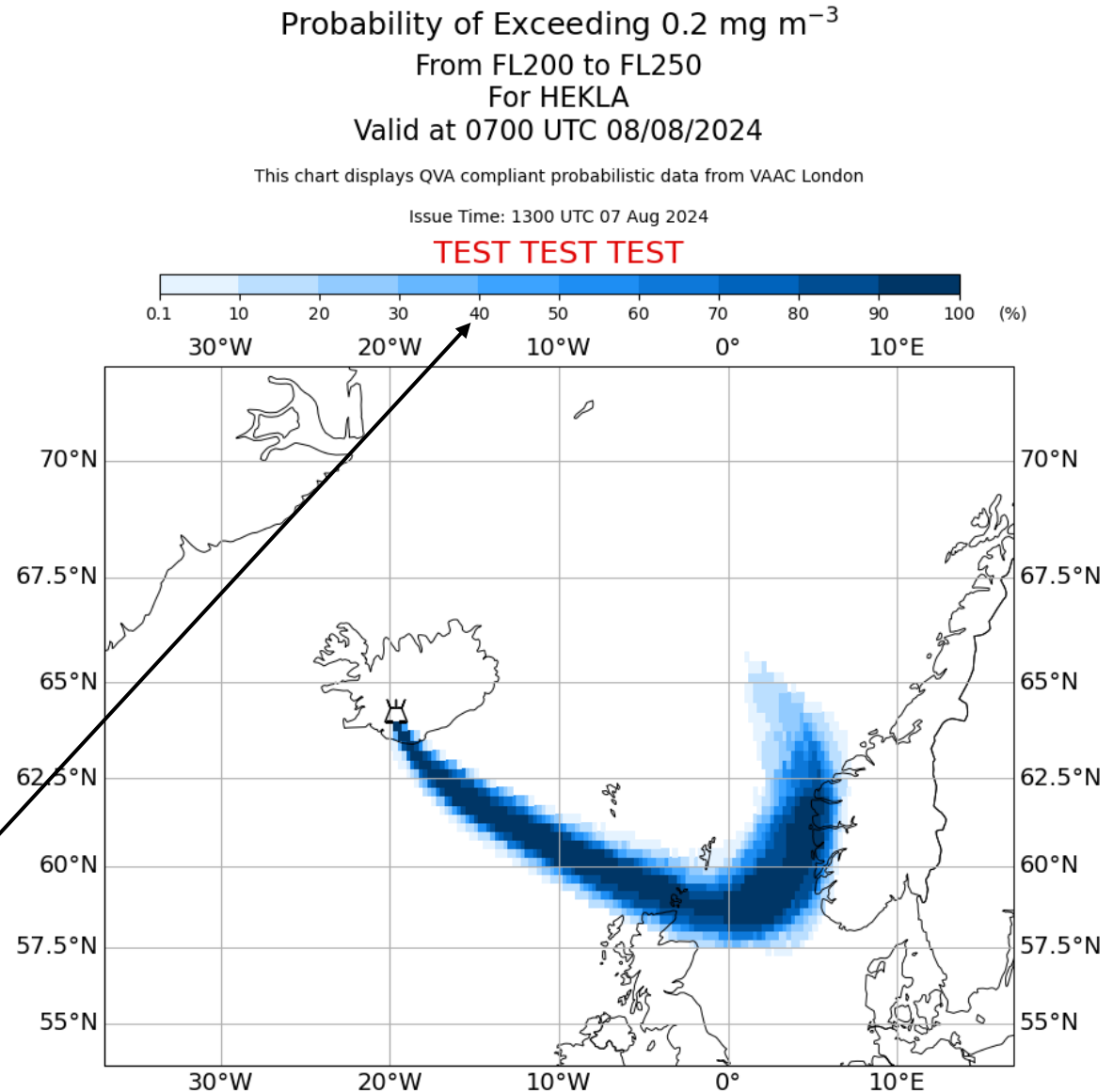
New QVA Product
Gives you more sophisticated polygons



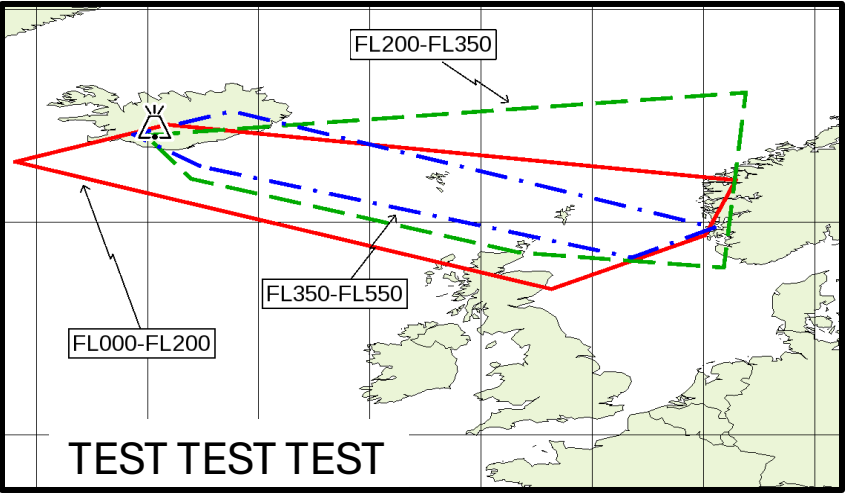
How the Probabilistic Forecasts are generated + How to Interpret Them

- Multiple sources of uncertainty behind a forecast:
 - The Source (Plume Height + Release Rate)
 - Meteorological Data (weather forecast)
 - Observations
- London VAAC are generating probabilistic forecasts which represent our confidence in the weather forecast
- This leads to variability in the expected location and concentration of ash in the atmosphere
- All VAACs continue to develop capability to represent all sources of uncertainty

This is telling you that there is a 40% **chance** that volcanic ash will exceed concentrations of 0.2 mg m^{-3}

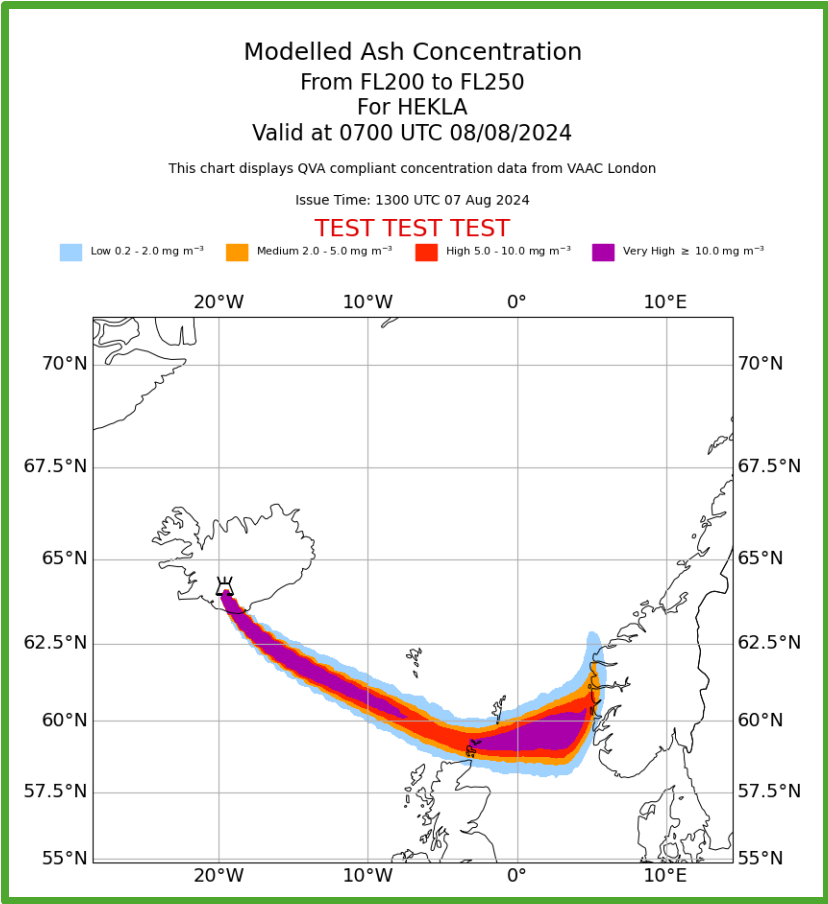


Volcanic Ash Graphic (VAG)

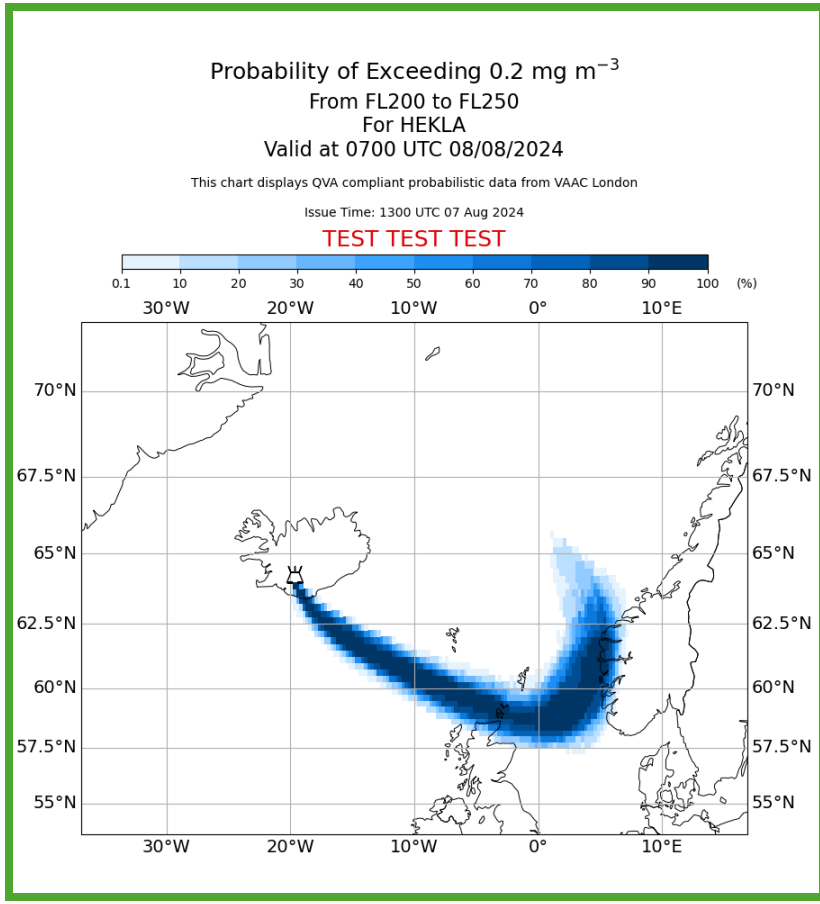


VAG is any ash above $\sim 0.2 \text{ mg m}^{-3}$

New QVA Products



Concentration Forecast



Probabilistic Forecast

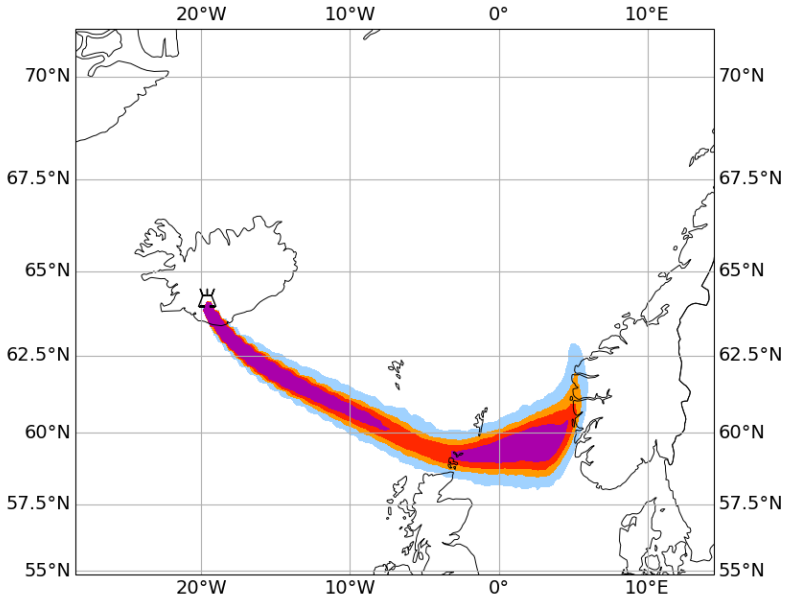
Modelled Ash Concentration
From FL200 to FL250
For HEKLA
Valid at 0700 UTC 08/08/2024

This chart displays QVA compliant concentration data from VAAC London

Issue Time: 1300 UTC 07 Aug 2024

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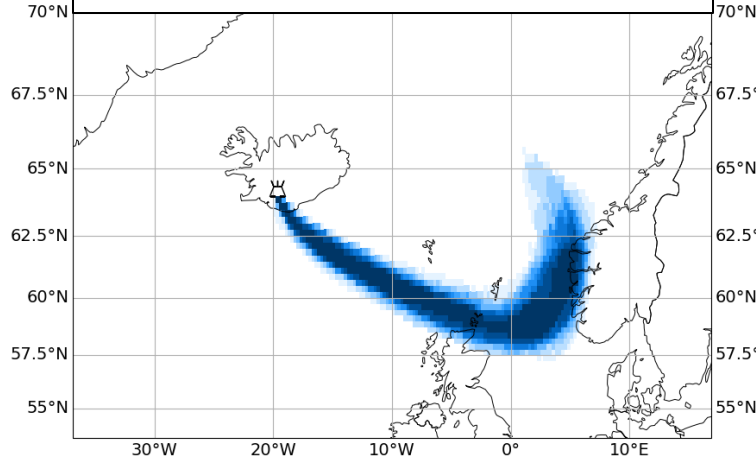
Low 0.2 - 2.0 mg m⁻³ Medium 2.0 - 5.0 mg m⁻³ High 5.0 - 10.0 mg m⁻³ Very High ≥ 10.0 mg m⁻³



TEST TEST TEST

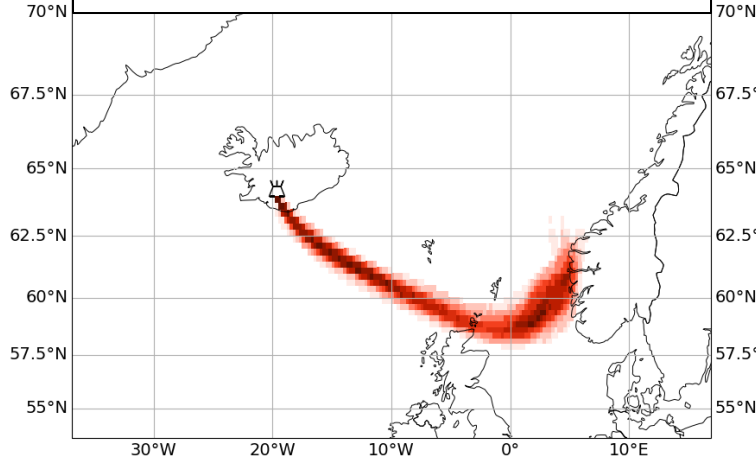
0.1 10 20 30 40 50 60 70 80 90 100 (%)
30°W 20°W 10°W 0° 10°E

Probability > 0.2 mg m⁻³



0.1 10 20 30 40 50 60 70 80 90 100 (%)
30°W 20°W 10°W 0° 10°E

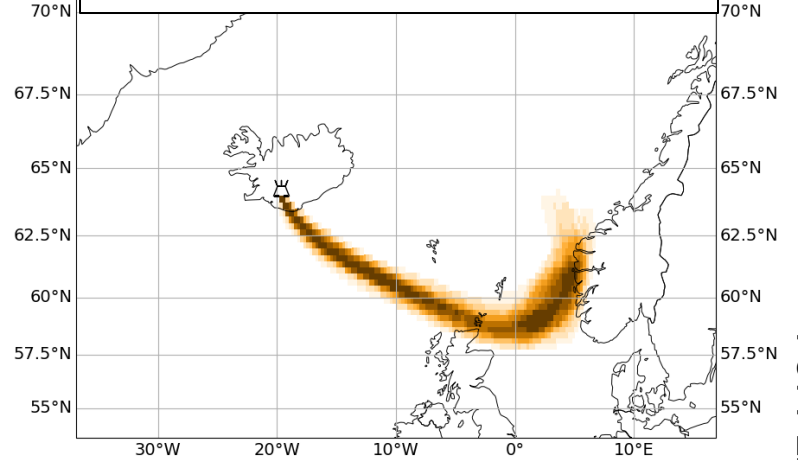
Probability > 5 mg m⁻³



TEST TEST TEST

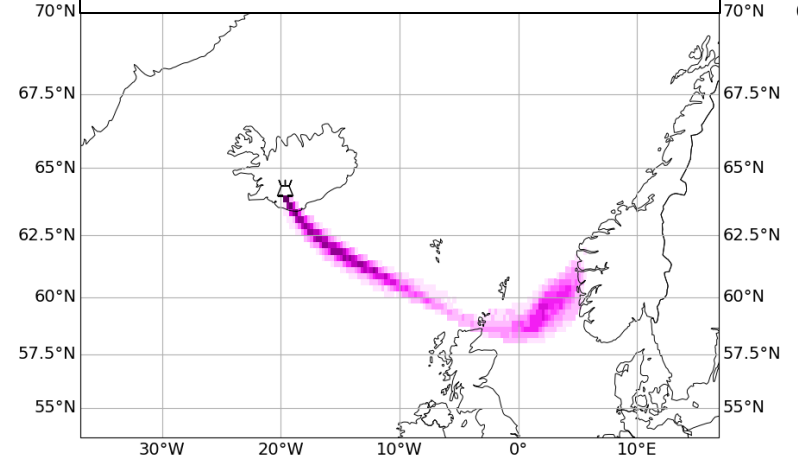
0.1 10 20 30 40 50 60 70 80 90 100 (%)
30°W 20°W 10°W 0° 10°E

Probability > 2 mg m⁻³



0.1 10 20 30 40 50 60 70 80 90 100 (%)
30°W 20°W 10°W 0° 10°E

Probability > 10 mg m⁻³



Summary

The VAACs are moving to new Quantitative Volcanic Ash Forecasts as defined by the ICAO

The changes reflect improved scientific and technical capabilities, to provide a more useful and useable products

- Concentration Forecasts
 - IWXXM Polygons
- Probabilistic Forecasts

The new QVA forecasts will give you better information on where ash is the atmosphere, and how much

Gridded Datasets of the Forecast will be provided directly to customers through the API, this will allow you to extract/query only the information you need

We will continue to provide VAA/VAG alongside the new products

END OF PRESENTATION