



Met Office

Lightning Forecast Verification

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EWGLAM 30th September 2014



Why lightning?

Every year in Britain around 300,000 ground lightning strikes occur.

Lightning poses a great danger to people and aviation.

In recent years there has been several cases where aircraft have been struck by lightning.

Accurate lightning forecasts are important to ensure safety for the aviation industry.



UKV Lightning Risk

UKV 1.5km post-processed forecast

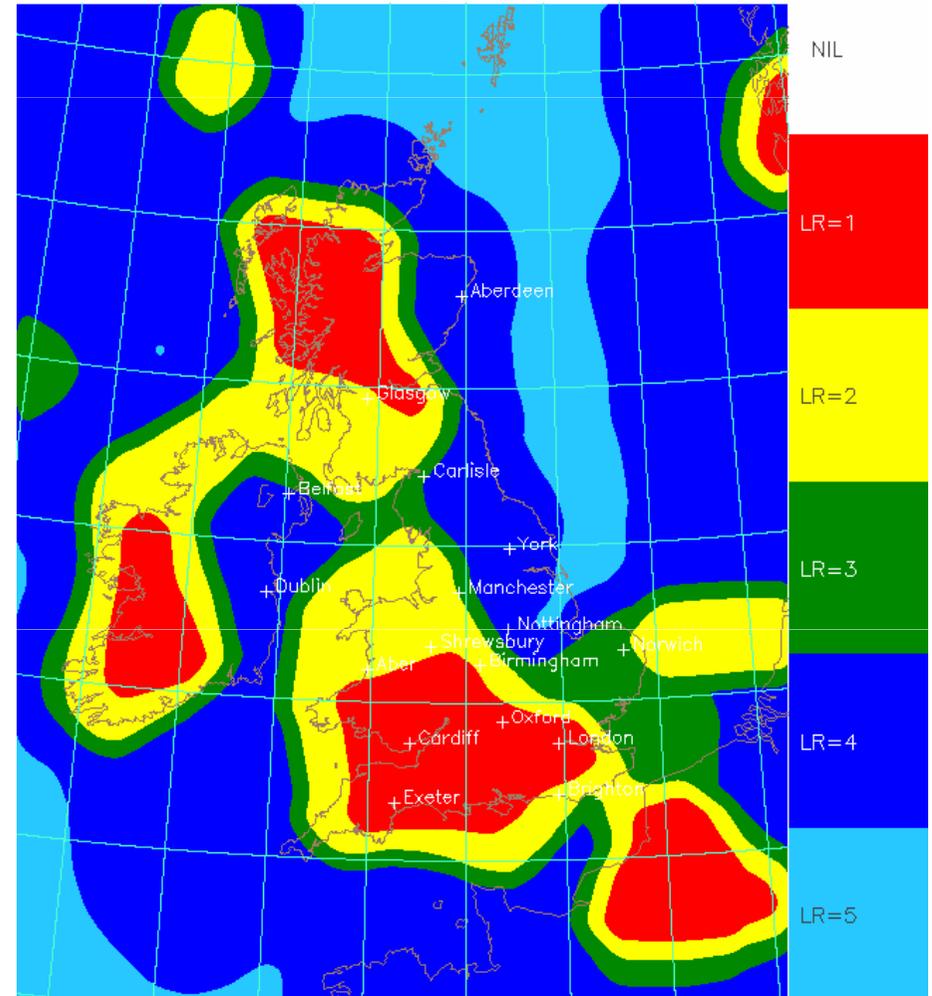
The risk of lightning occurring within a radius of 50 km from a location:

- LR1 → lightning expected
- LR2 → lightning probable
- LR3 → lightning possible but unlikely
- LR4 → lightning very unlikely
- LR5 → lightning not expected

Convection Diagnosis Procedure (CDP) calculates lightning risk using:

- Lightning index
- Total precipitation rate
- CAPE
- Lifted index

18:00 Friday 25/07/2014 (T+09:00) Lightning Risk



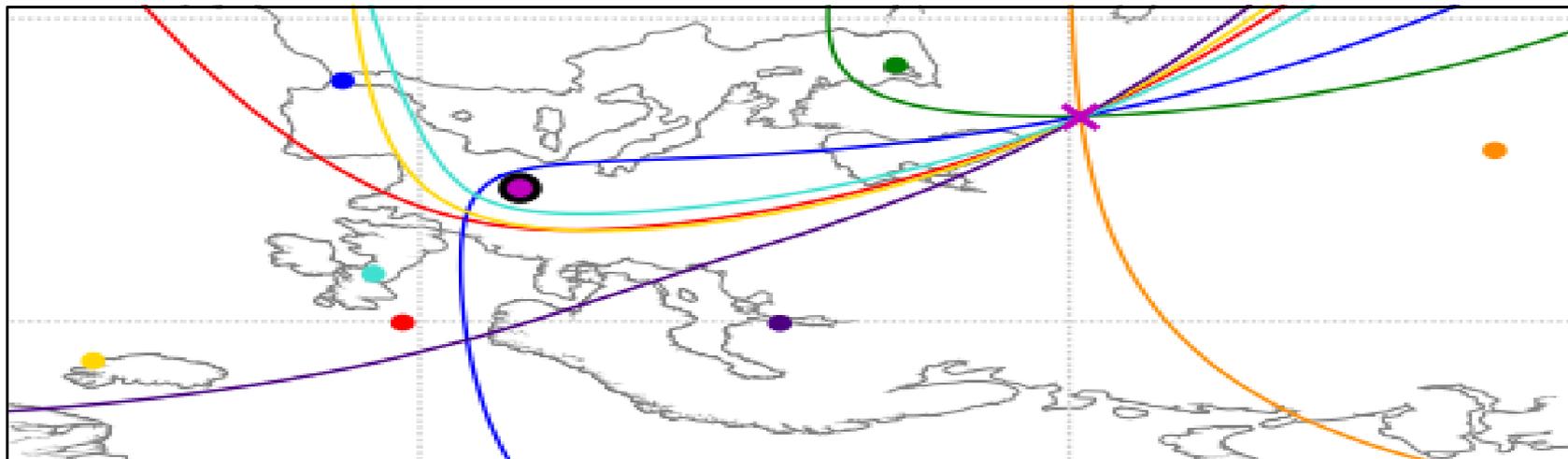


ATDnet System

ATDnet is the Met Office's Arrival Time Difference network system.

It is an automatic lightning location network that senses lightning flashes over a geographical area.

By timing the arrival of unique very low frequency radio waves ('Sferics') that are generated by individual lightning strokes the location of every stroke can be calculated.



Hyperbola plot - the potential locations of the lightning source from every pair of stations, the intersection of all the hyperbolae is the lightning location.



Site Specific

Observations

A stroke count is the number of strokes within a 50km radius of each airport in a given forecast period. A lightning event is classified by the detection of 2 or more strokes.

Forecasts

A single T+24 forecast value is processed using the closest model grid point to the airport.

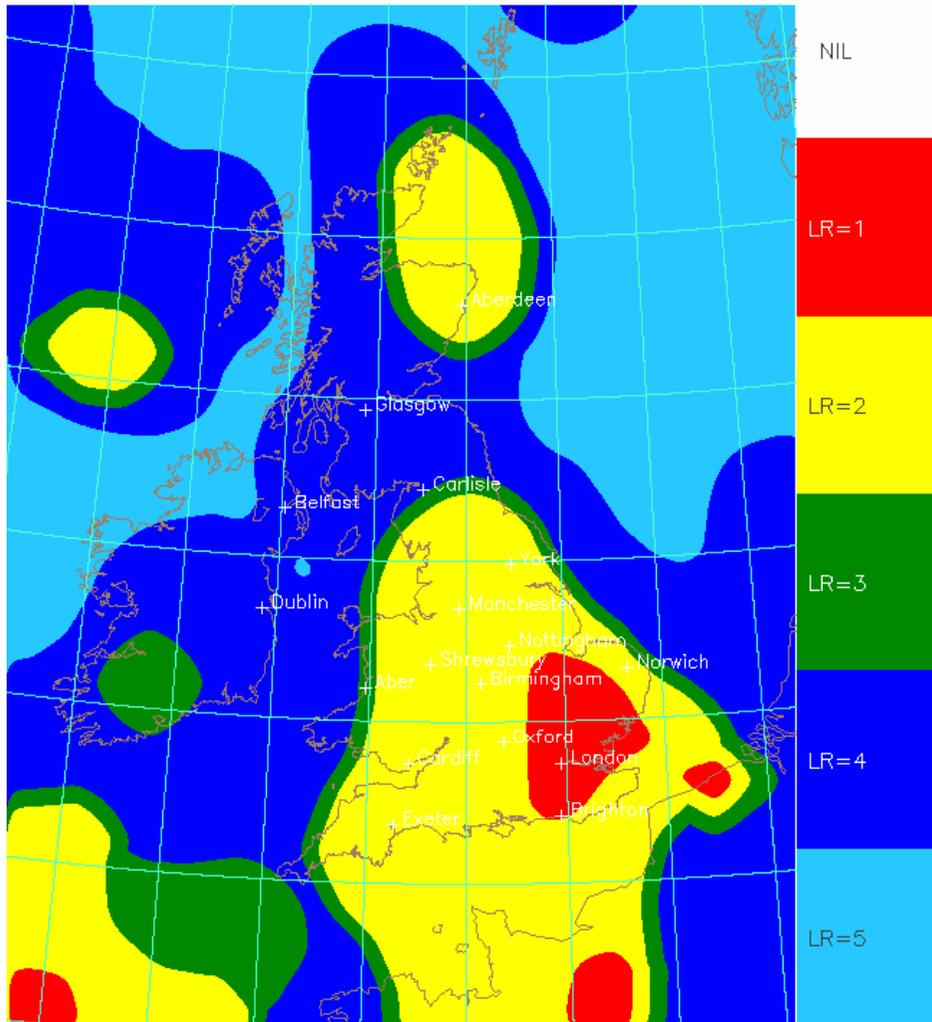
Verification

12 monthly accumulated statistics (Sept 2013 – Aug 2014) for 204 UK civil and defence airports.

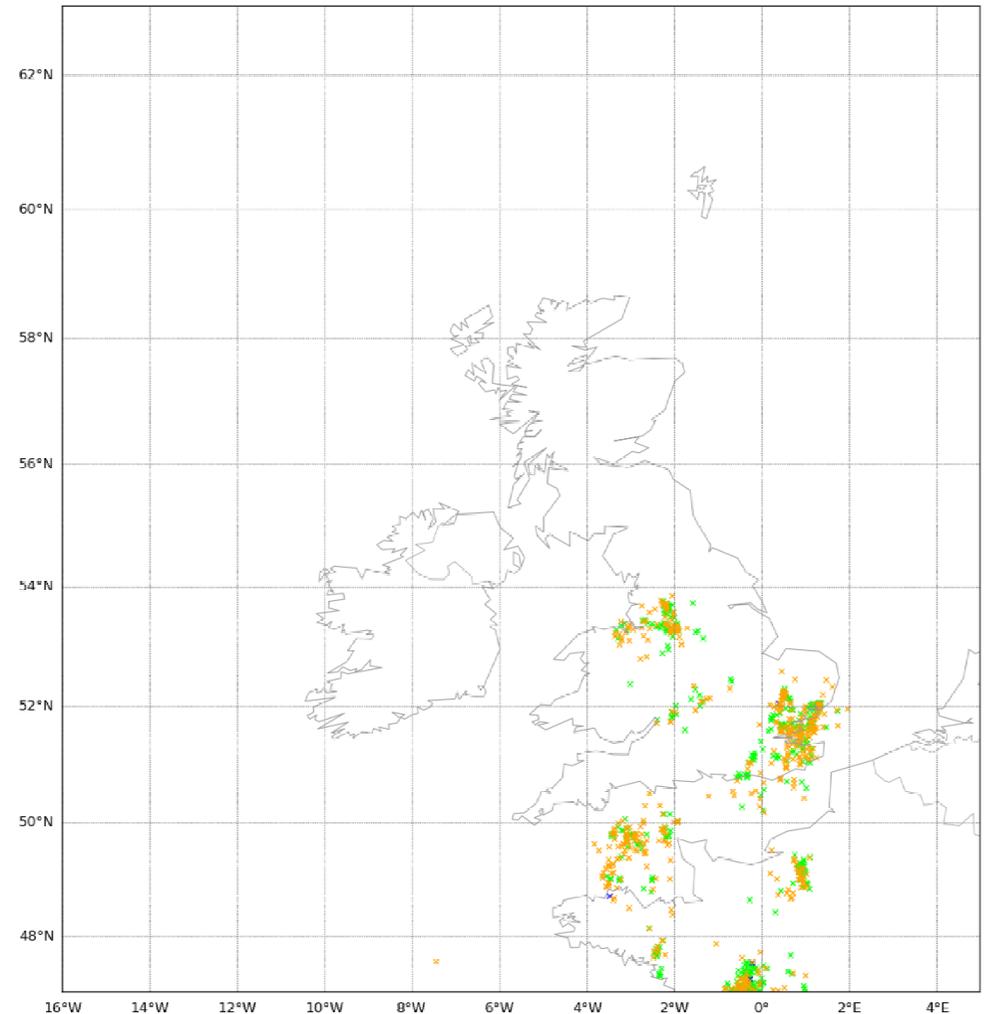


Case study: 19th July 2014

03:00 Saturday 19/07/2014 (T+45:00) Lightning Risk



ATDnet goodlog data for the hour preceding 0300 UTC on 19/07/14
Total = 924

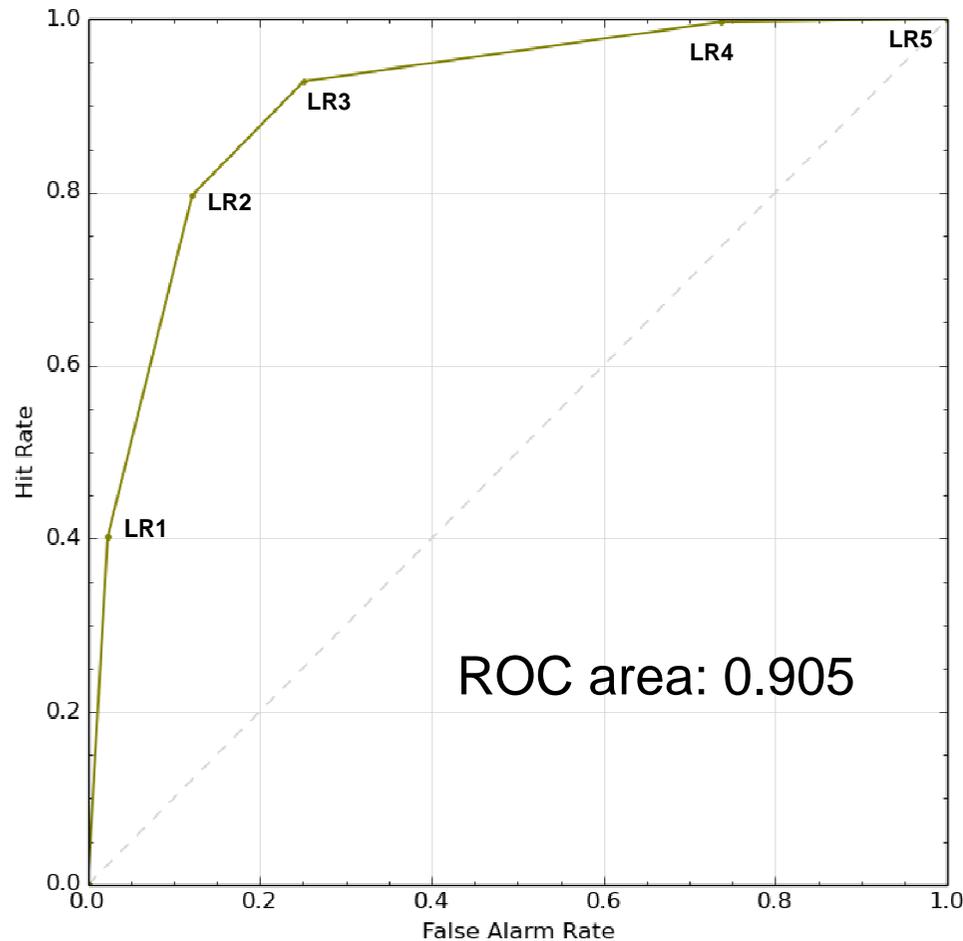




Verification of UKV Lightning

ROC curve

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Contingency Table LR1&2

Hits 2.0%	False alarms 11.8%
Misses 0.5%	Correct rejections 85.7%

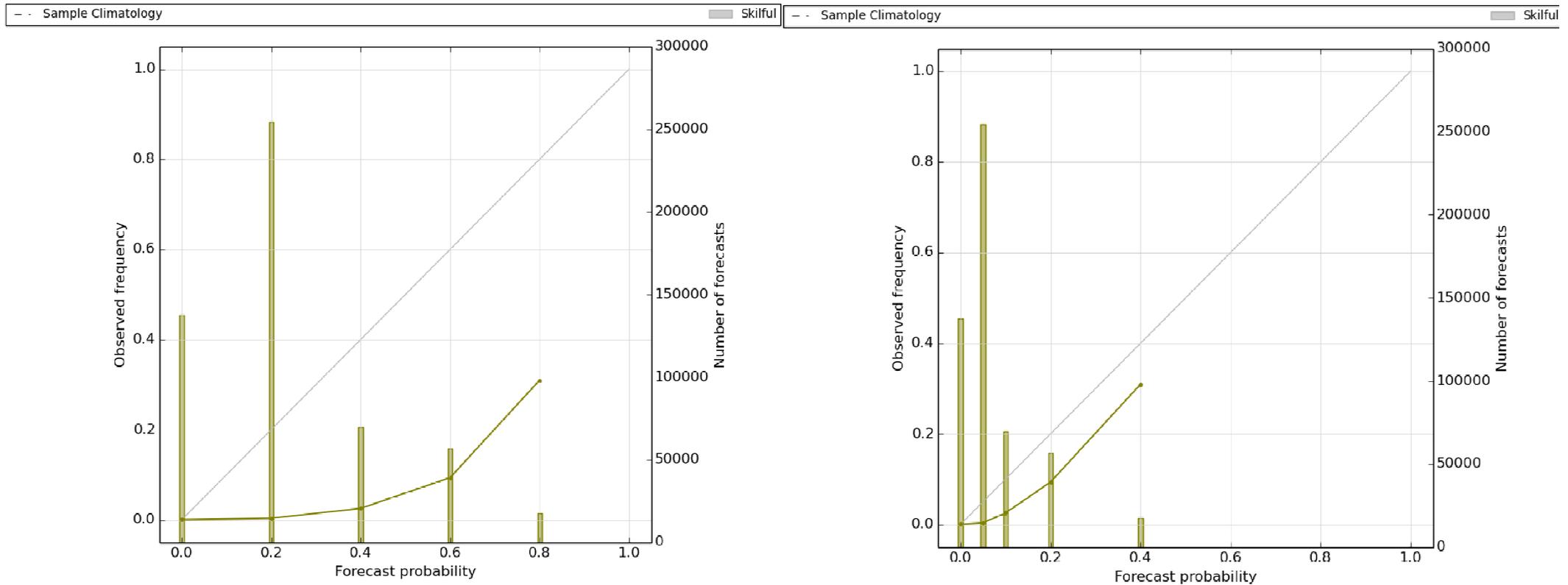


Verification of UKV Lightning

Reliability Diagram

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Calibrated Reliability Diagram



Assuming a linear scale:

LR1 = 0.8 LR4 = 0.2
 LR2 = 0.6 LR5 = 0.0
 LR3 = 0.4

LR1 occurs approx 30-40% of the time and LR3&4 indicate lightning is considerably less likely :

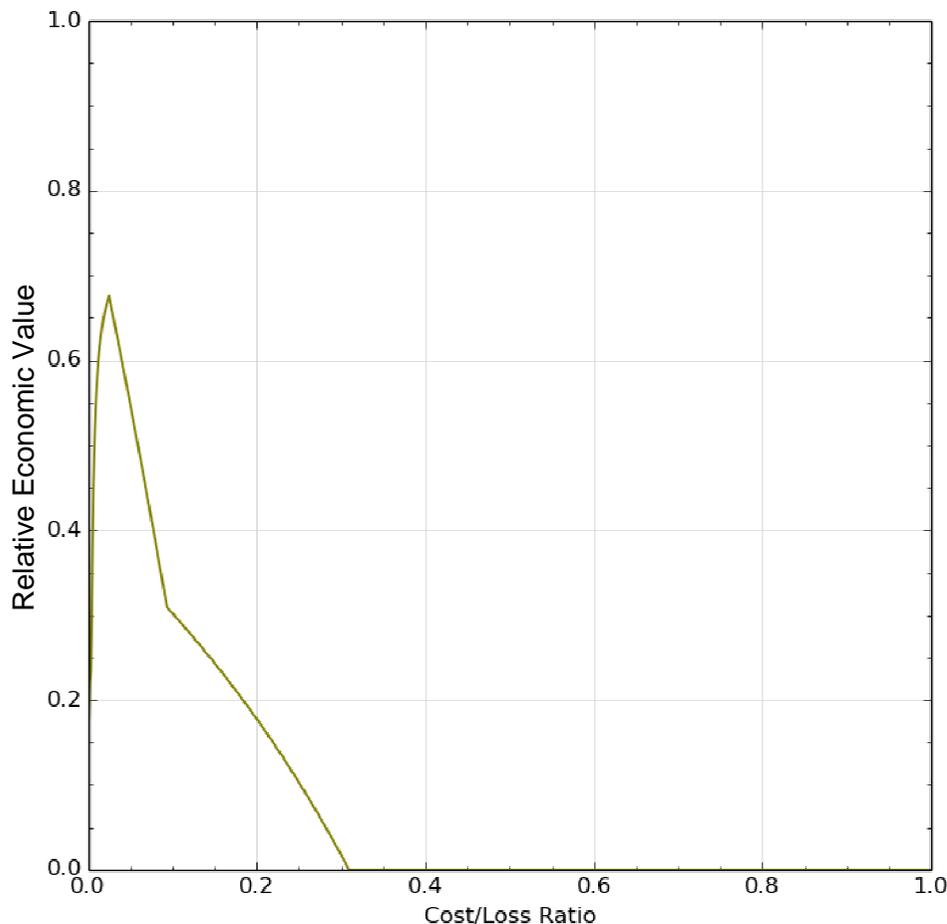
LR1 = 0.4 LR4 = 0.05
 LR2 = 0.2 LR5 = 0.0
 LR3 = 0.1



Verification of UKV Lightning

Relative Economic Value

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Relative economic value highlights the value of a given forecast for all cost loss ratios. A horizontal line of relative value 1.0 would be a perfect forecast.

UKV lightning forecast have high value at low cost lost ratios.

These ratios are important for aviation as loss far outweighs the cost.



Forecasting Lightning Globally

MOGREPS-G Probability of Lightning

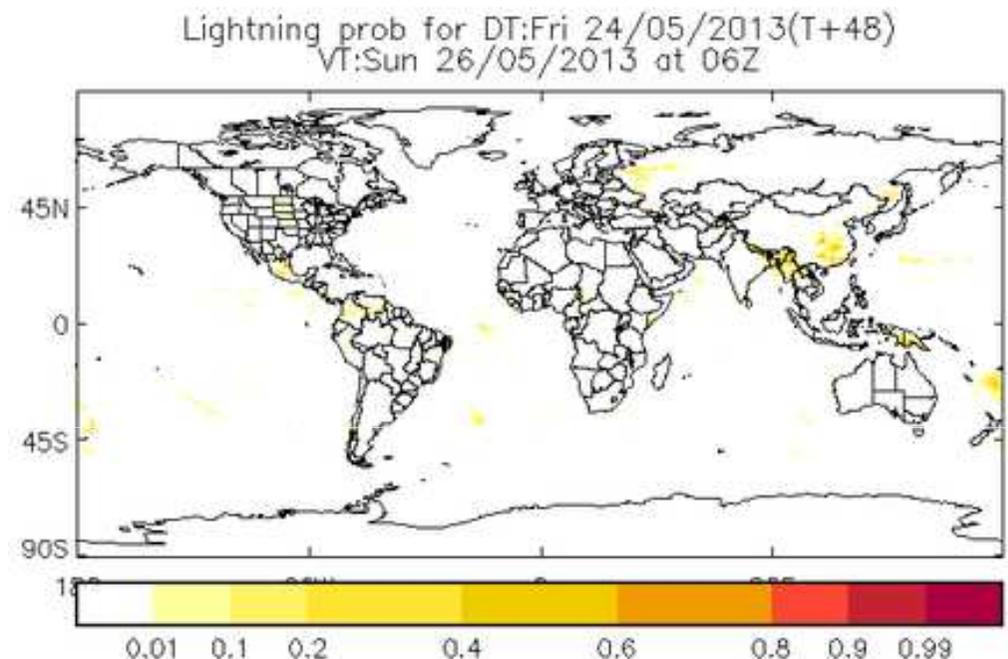
33km resolution

12 member ensemble

Probability of Lightning Index
exceeding a value of 1 or 10

LI 10 → Lightning possible,
deep convectively unstable
environment

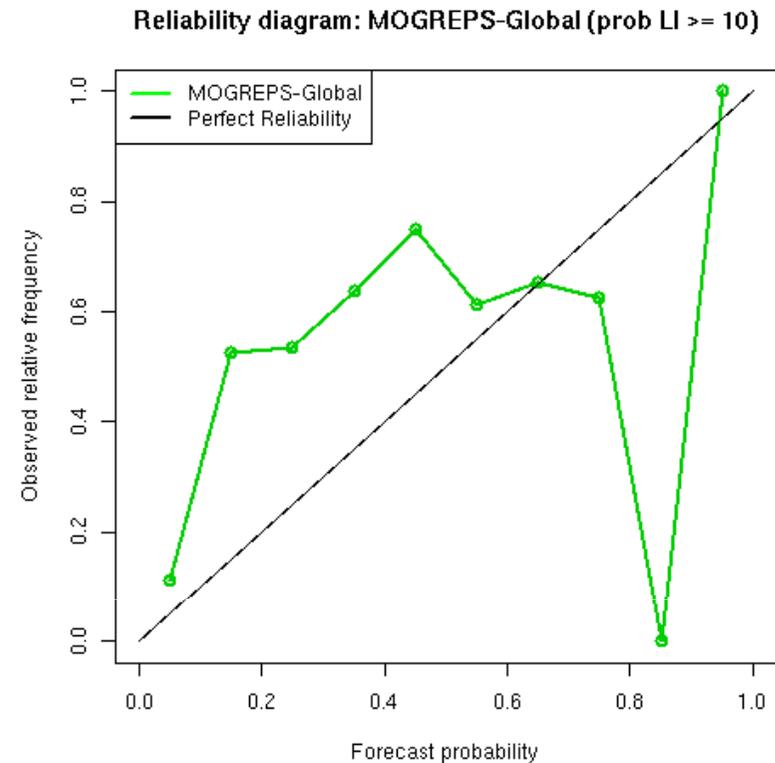
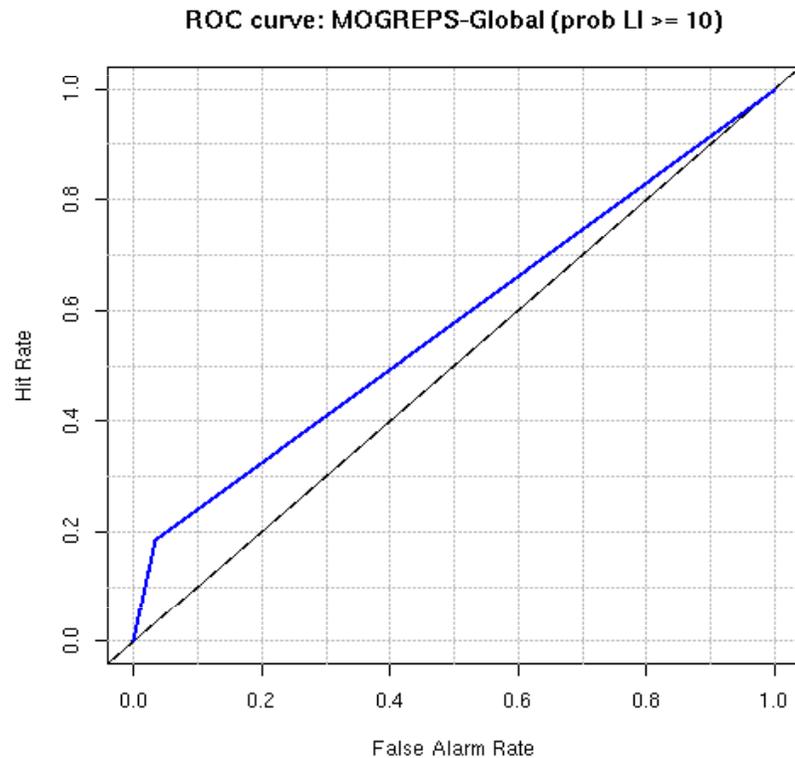
LI1 → Risk of lightning





Forecasting Lightning Globally

Verification results for Summer 2013 at 1116 civil airports across Europe



Good given global model and rare nature of lightning.

Skill at longer lead times – providing early warnings of global hazardous weather.

Work in progress to verify forecasts from this summer.



Future Work

Assess results using different radii around an airport.

Verify a variety of lead times – most significant to aviation.

Compare Euro4 CDP forecasts to global CDP.

Verify new lightning forecasts:

- MOGREPS-UK probabilistic lightning risk
- UKV physically-based lightning flash diagnostic



Met Office

Questions?

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