



Helicopter-triggered lightning strike forecasting

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CAA Helicopter Safety Research Management Committee — 21 May 2013



Contents

This presentation covers the following areas

- What is Helicopter-triggered lightning?
- Using science to predict triggered lightning risk.
- Report on the 2011-2012 and 2012-13 trials.
- Conclusions and Future work.

What is helicopter-triggered lightning?

- Wintertime, North-Sea Phenomena. Occurs October-early April.
- Quite rare (1-4 strikes per year; about 100 helicopter movements from Aberdeen per day).
- Helicopter encounters lightning where lightning was not observed/expected.
- In most cases, it is thought that the helicopter 'triggers' the strike by flying into or near a region of charged cloud.
- Issues
 - Safety
 - Expensive
 - Inconvenient

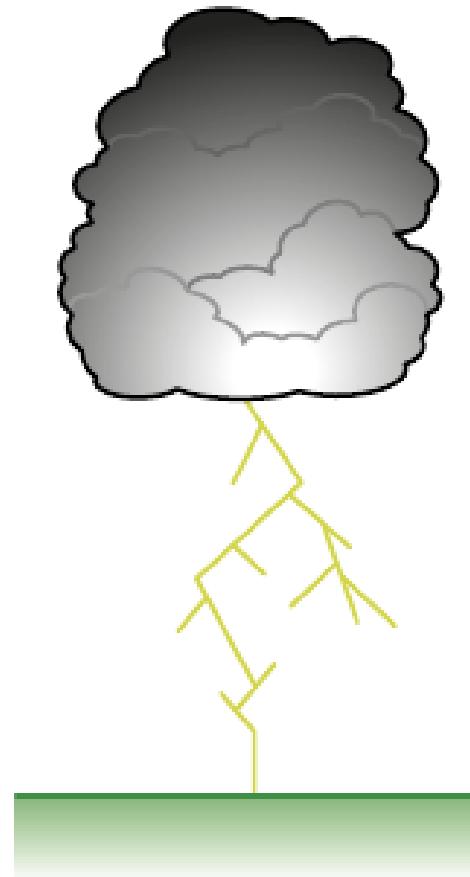


Photo: AAIB

Bristow Helicopter registration G-TIGK, ditched (and later sank) after a triggered lightning strike in the East Shetland Basin; 19 January 1995

Active Thunderstorm

- Typical of many parts of the UK mainland (e.g. Thames Valley in Summer).
- Collisions between hail and ice cause thunder clouds to acquire electric charge.
- Over time, the charge builds up.
- Eventually it reaches a 'critical level', and charge is released in the form of lightning.



Winter North Sea Thunderstorm

- Charge builds up as before.
- Charge not strong enough to form lightning (or forms very little visible lightning).
- Cloud is, in effect a 'floating charged blob'.

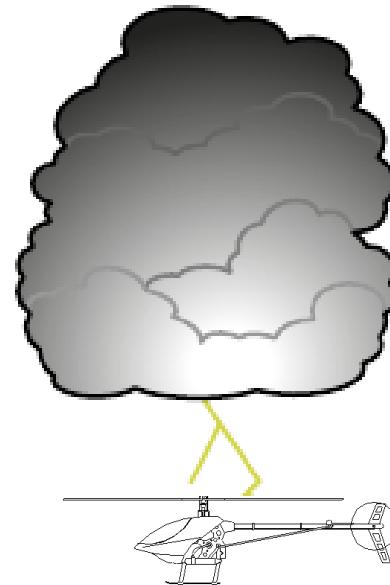




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Triggered Lightning Strikes

- All aircraft (including helicopters) become charged during flight.
- When a helicopter comes close to or within a cloud with the opposite charge, it becomes much easier for thunderstorm to discharge on to, or through the helicopter.





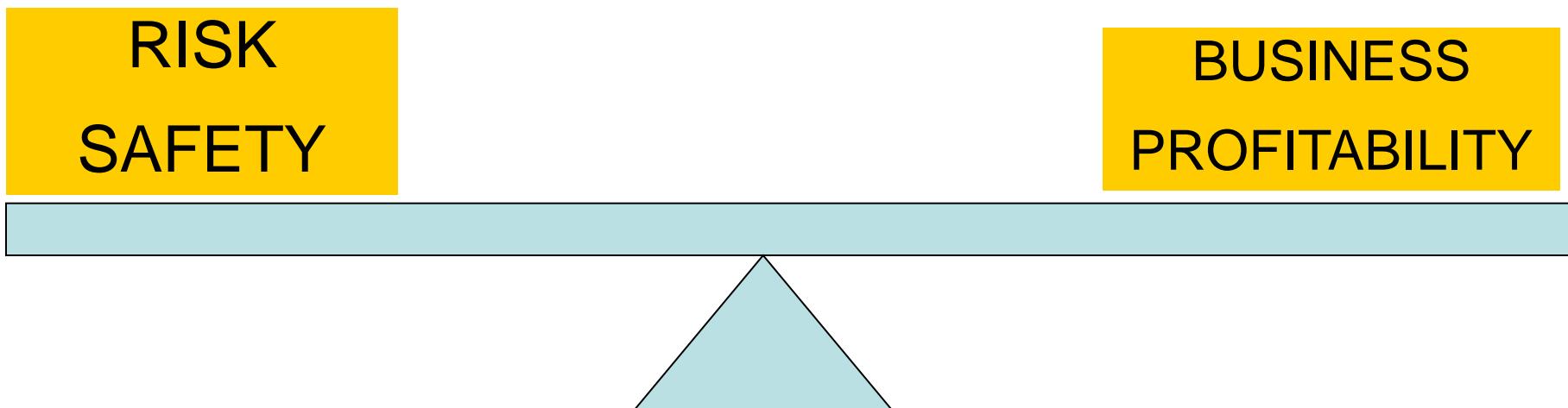
Most likely points of entry/exit



Generating a forecast product: A Balancing Act

Aim: develop a forecast which can be used by flight crews to avoid triggered lightning strikes.

The forecast should balance the risk and safety impacts with the impacts on business.





Predicting Helicopter-Triggered Lightning

- In 2011, the Met Office, under contract to the CAA designed a system for triggered lightning risk.
- Generated risk when all the following criteria were met:
 - Flight level (2000ft-3000ft) temperature between -6 and -2 Celsius.
 - Precipitation level above 4 mm per hour.
 - Freezing level height between 1000 and 3000 ft
- Correctly forecast the timing and location of 8/10 previous helicopter-triggered lightning strikes.
- Correctly forecast 8/9 occasions when 'natural' lightning was observed in the North Sea during winter 2010-11.
- This work has been written up and published as a peer-reviewed scientific paper in the journal *Meteorological Applications*:
<http://dx.doi.org/10.1002/met.1314>



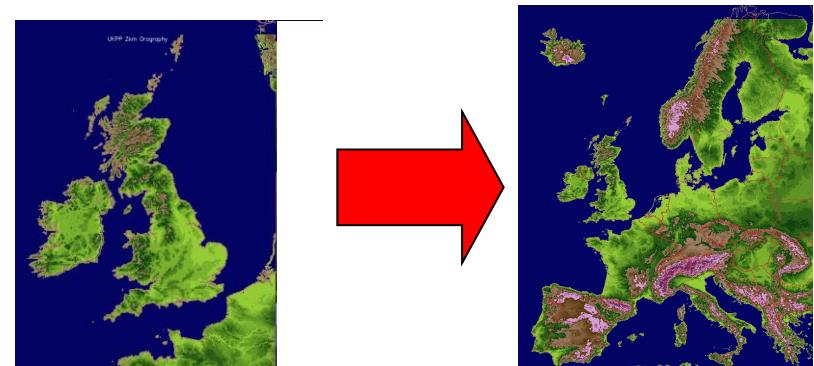
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- Operators tested original algorithm as a trial product from October 2011 to January 2012, when the trial was suspended. The biggest issue was with forecast risk areas rapidly changing.

- New algorithm designed with the following changes:

- Multiple risk levels: Low, medium and high.
- Lagging/Hysteresis and smoothing to avoid jumpy forecasts.
- Increased area to cover more of operating area.

	4 km	12 km
Low	2.0 mm hr^{-1}	1.1 mm hr^{-1}
Med	4.0 mm hr^{-1}	2.7 mm hr^{-1}
High	10.0 mm hr^{-1}	4.0 mm hr^{-1}





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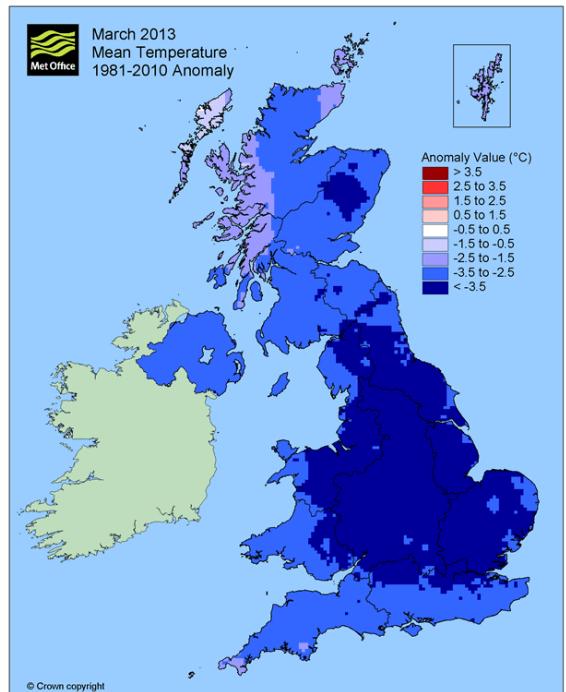
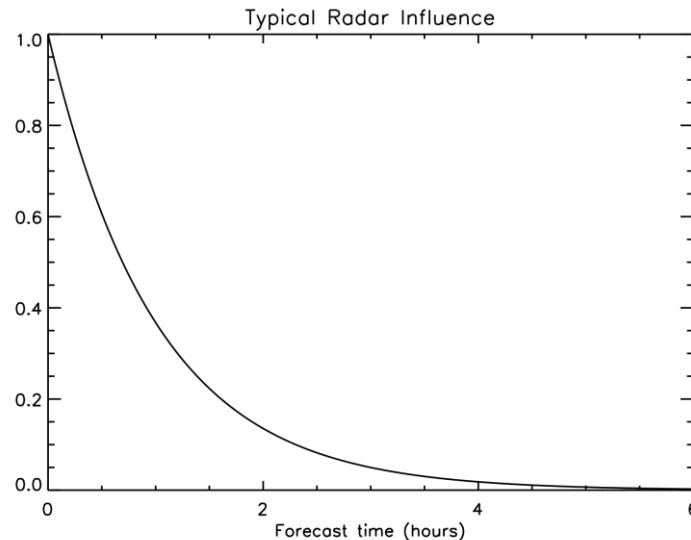
2012-13 Trial

- Weather forecast models have a horizontal grid scale; the smaller this scale is, the more small-scale features (e.g. thunderstorms, effect of mountains) can be represented.
- Original paper and 2011-12 trial used a 4 km model, but only over the UK (did not cover all of Aberdeen operations).
- We had hoped to start the trial with a 4 km scale model over all of Europe, but this was not available in October. Instead we started with a 12 km model, to give European-wide coverage and allow Norwegian/Danish involvement in the trial.
- Eventually switched from 12km to 4km model on 27 Feb 2013.

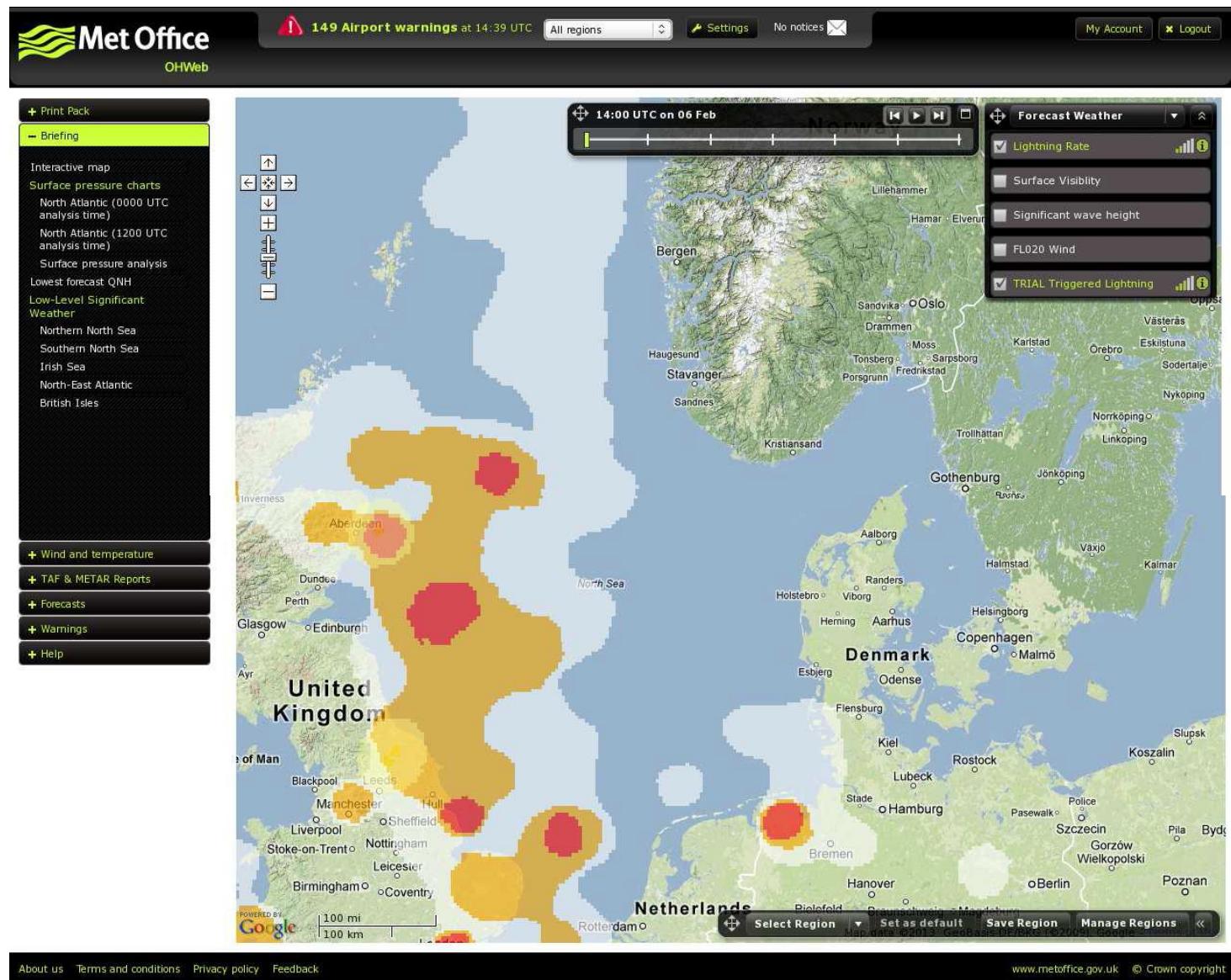


2012-13 Trial

- Product uses a precipitation rate generated from a blend of model and radar data (radar most active at short lead times T+0 to T+2).
- Trial ran 1 October 2012 to 30 April 2013.
- Statistically a cold winter, with March much colder than average.
- 4 helicopter-triggered lightning strikes were recorded.
 - Will show shortly how the algorithm fared.
- Difficult to tell if any strikes were averted (you need a helicopter to be present for it to be a helicopter-triggered lightning strike).



Product screenshot





Performance for previous strikes until 27 Feb 2013 using 12km model.

	No	Low	Med	High
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	T+0	T+1	T+2	T+3	T+4	T+5	T+6	In Radar Coverage ?
2 Feb 2010	No	No	No	No	No	No	No	No
18 Feb 2010	Med	Med	No	No	No	No	No	Yes
22 Nov 2011	No	No	No	No	No	No	No	No
20 Jan 2012	High	Med	Med	No	No	No	No	Yes
22 Feb 2012	No	No	No	No	No	No	No	No
5 Dec 2012	High	High	Med	Med	No	No	No	Yes
6 Feb 2013	High	Med	No	No	No	No	No	Yes



Comparison of 12km and 4km models at T+6

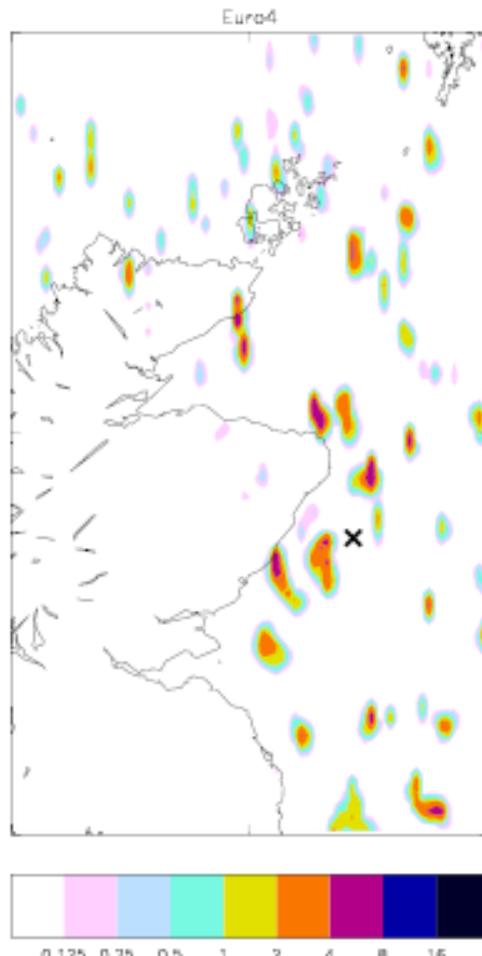
No	Low	Med	High
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	12 km	4 km
22 Nov 2011		
20 Jan 2012		
22 Feb 2012		
5 Dec 2012		
6 Feb 2013		
18 Mar 2013		
10 April 2013		

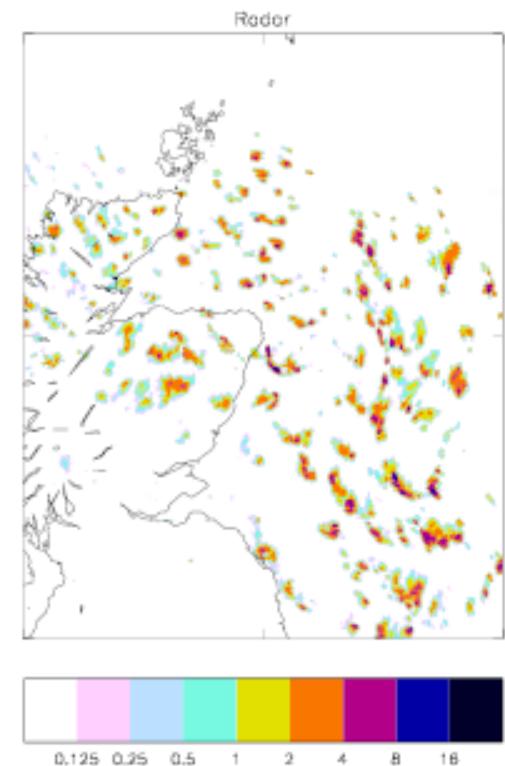


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Triggered lightning Strike on 6 Feb 2013: Model Precipitation Performance



12 km model



Radar

A large, abstract graphic of green and yellow wavy lines, resembling a stylized DNA helix or ocean waves, is positioned in the upper half of the slide, set against a black background.

Summary and Future Work



Summary of 2012-13 trial

- Started trial with a model with 12 km horizontal grid length; triggered lightning forecasts were somewhat sporadic.
- Moving to a 4km grid length over Europe significantly improves the product, with the best performance in Scottish operating area, especially around Aberdeen.
- Helicopter operators would prefer to have some warning of conditions rather than flying “blind”, with no knowledge of triggered lightning risk.
- Product will be maintained on OHWeb, with feedback being received from next winter as well. Future modifications can be made, if required.



Future Work

- Investigate skill at risk predictions at longer lead times (up to a couple of days).
 - Could allow operators to bring forward their flying programme if risk is likely in the next few days.
- Look at inclusion of Norwegian radar data, which will improve position of 'at-risk' areas over Norway.
- Investigate whether improved lightning data sources will assist triggered lightning forecasting.
 - Current methods typically only detect lightning once it has passed outside the thundercloud. Small in-cloud discharges, if present could allow us to determine likely risk areas. This could be possible using new satellite data.



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Questions and answers