SIMPLE SCENARIOS FOR SIMULATING SEVERE SPACE WEATHER IMPACTS ON POWER GRIDS

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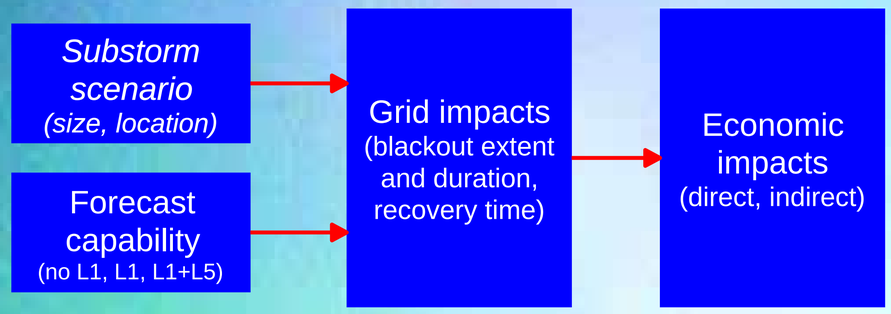
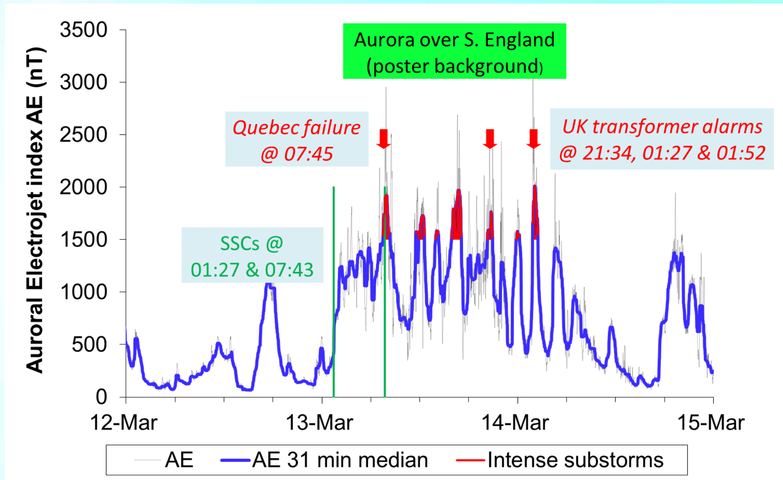
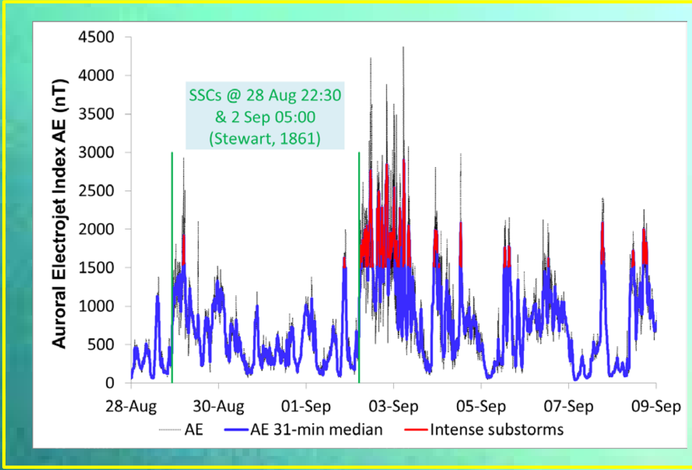


It is now critical to assess the socio-economic impacts of space weather: to justify investment in research and operations. **We need space weather scenarios** to drive models of economic impact as in figure to left.

Substorm-based scenarios built from AE index from March 1989 & October 2003 storms:

- Smoothed with 31-min running median
- Take peaks > 1,500 nT as intense substorms
- 1989 plot right; intense peaks in red
- Reported grid/transformer failures & aurora observations match substorm peaks
- Take 1989 as 1-in-30 year scenario & 2003 (AE not shown) as 1-in-10 year scenario





For **1-in-100 year scenario** scale up AE index from March 1989 to Sep 1859 (Carrington)

- Scale by *Dst* ratio between 1989 & 1859 (latter from Siscoe, 2006), and match SSC times
- Add 28 Aug 1859 storm based on copy of 12/13 March 1989
- Smooth & threshold as usual
- Plot left shows resulting 1859 simulation

What is the grid impact?

- Simple model assumes main impact in zone at 1 to 3 hrs local time (as Quebec)
- Vary universal time of SSC over 24 hrs
- Gives 24 instances of each scenario
- Table below shows number of instances giving very intense substorms over UK

Risk-level	Number of very intense substorms over UK		
	0	1	2
1-in-10	22	2	0
1-in-30	20	4	0
1-in-100	7	12	5

- We can now estimate likelihood of UK hit by 0, 1, or 2 very intense substorms:

Risk-level	Number of very intense substorms over UK		
	0	1	2
1-in-10	92%	8%	0%
1-in-30	83%	17%	0%
1-in-100	29%	50%	21%

Some ideas for next steps:

- Explore uncertainty using AE data from other large storms
- Study impacts over wider LT range
- Look for intense localised events