Met Office Hackathon 2022

Aon Projects

28th April 2022

Real-time event return periods

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Background

- Aon are brokers for primary insurers (who you and I insure with) and reinsurers. We use historical events to estimate the risk of a given hazard, to calculate the risk to the insurance industry.

- We use catastrophe models, provided by risk modelling companies, to provide that estimate of the risk.

- During an event we provide an estimate of how severe the event may be, to guide our clients as to what their financial loss may be.

- Calculating the likely return period of a current event allows us to estimate how severe it may be, and thus what the loss may be to the insurance sector.

- The estimation of the return period is going to be dependent on the reference period used, and how observation and forecast data is used.

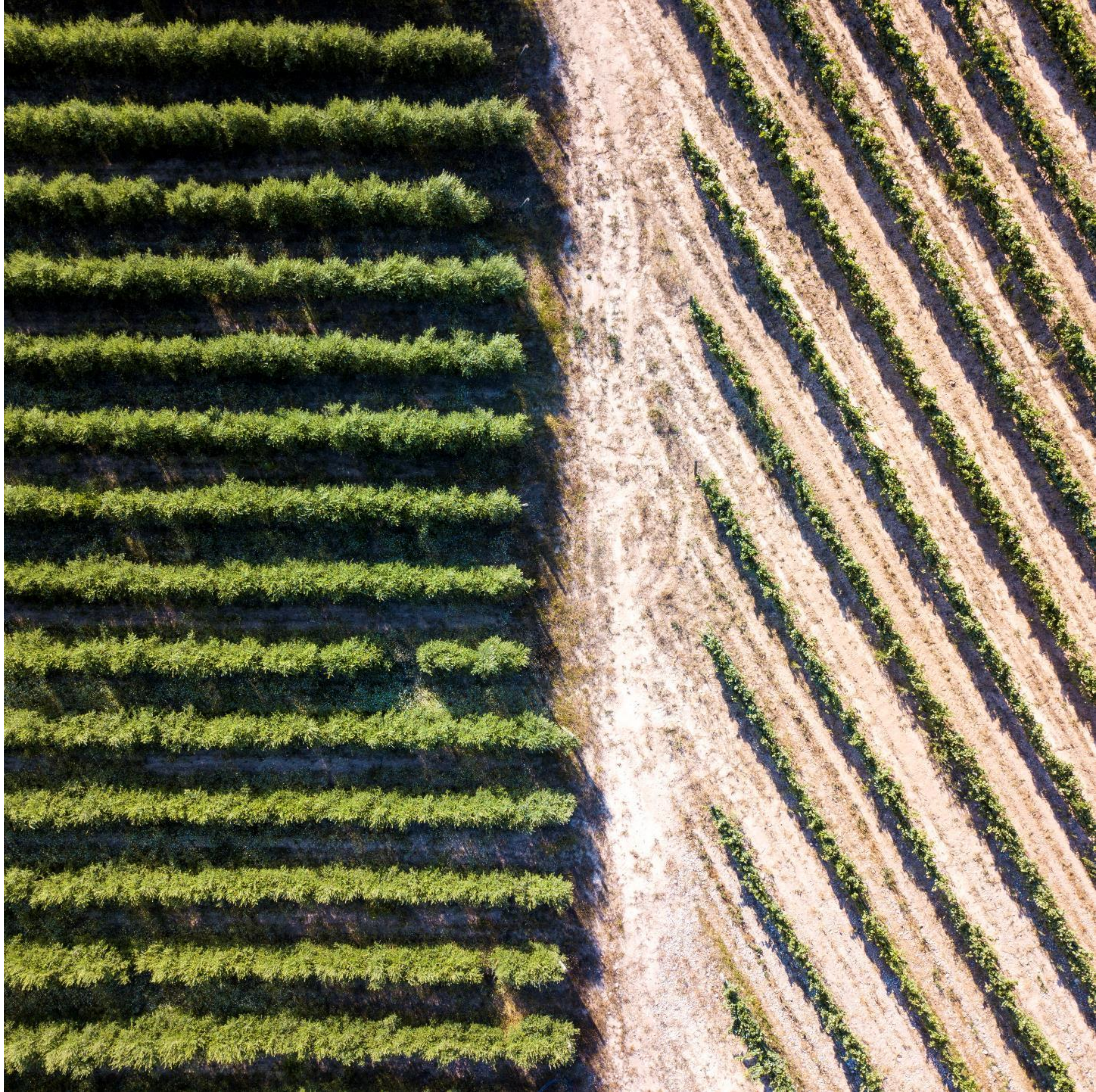
Challenge

Real-time event return periods

- Use observation and forecast data, can the return period for an event be calculated?
- How can the uncertainty associated with the following be communicated:
  - Forecast lead-time/uncertainty
  - Base period chosen
- Is there a role for global climate model data in improving the return period estimation?
- Event definitions TBC by Aon.
- Regions of interest:
  - UK
  - Europe
  - Global

Point of Contact: Adrian Champion, Chris Webber

Drivers of uncertainty in future loss projections



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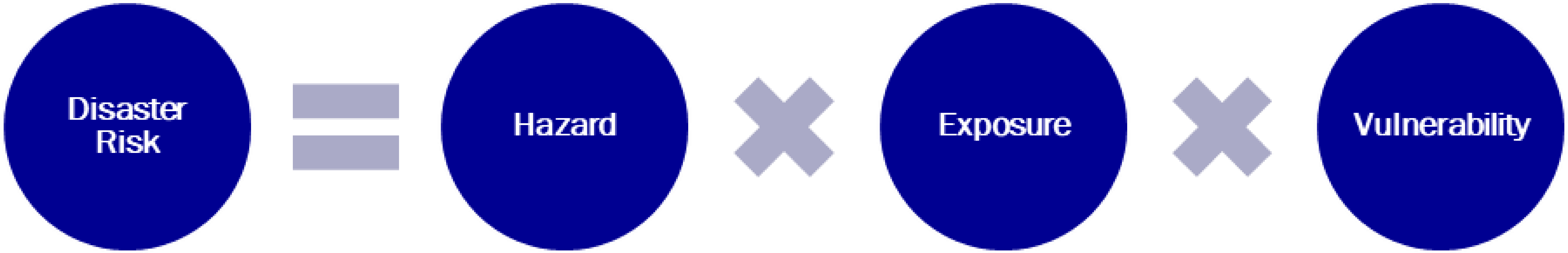
Background

- The risk of an event can be expressed as:



- All components of this equation will change in future:
  - The hazard may change due to climate change.
  - The exposure will change, naturally but also potentially also due to climate change.
  - The vulnerability will change as we improve our understanding.
- Using climate models we can get an estimation of the change in the hazard, however is the uncertainty in the hazard projection a larger component to the future risk uncertainty, or uncertainty in changes in the exposure?

Challenge

Drivers of uncertainty in future loss projections

- In a future climate scenario, what is the bigger uncertainty in the changes in risk – the uncertainty in the hazard or the uncertainty in the exposure?

- As an industry we currently keep the exposure constant, modifying only the hazard to account for climate change.

- Aon will provide a stochastically generated current and future projection hazard dataset, along with a current Europe-wide exposure dataset. The challenge will be to modify the exposure dataset in line with different climate change projections.

- Aon will run both the current and future projections through a catastrophe model.

- Will climate change drive further exposure change as habitable zones become unhabitable, and vice versa?
  - Which locations will change from unhabitable to habitable?
  - What hazards affect these regions?
  - Can we link these changes in exposure to the SSPs?

Driving Factors in Urban Land Change Models

Table 2. List of predictor variables in the reviewed LCM articles *.

Classification		** Driving Factors	Count
Natural Environment (32)	Topography (14)	slope	121
		elevation	50
		distance to water surface	37
		distance to river	35
		aspect	17
		soil type	11
		soil quality	8
		erosion	6
		soil pH	5
		soil permeability	3
		altitude	2
		silt content	2
		soil depth	2
		terrain	1
	Amenity (4)	distance to forest	20
		distance to coastline	14
		distance to green spaces	6
		distance to natural scenery	4
	Climate (4)	precipitation	10
		temperature	8
		hours of sunshine	4
		moisture	1
	Risk (7)	flood risk (floodplain)	7
		distance to wetland/salt marsh	5
		seismicity	3
		distance to dike	1
		distance to tsunami affected area	1
		flood retention areas	1
		water contamination	1
	Ecology (3)	vegetation/env. value	3
		tree type	2
		endangered species	1

Classification		Driving Factors	Count
Built Environment (53)	Land Use (13)	distance to town centers	13
		likelihood to change	11
		land use suitability	3
		availability of irrigation facility	1
		density of crop land	1
		density of developed lands	1
	Development (4)	distance to infra (water/sewer)	8
		available land	8
		cost of land use change	2
		recent development	2
	Job (12)	distance to agriculture	21
		distance to commercial	17
		distance to business	8
		distance to industrial	7
		distance to farm	6
		job location	3
		agricultural production	2
		distance to economic corridors	2
		employment no.	2
		industrial production	2
		density of oil and gas wells	1
		unemployment rate	1
	Service (3)	distance to institution	14
		distance to hospital	3
		distance to convention	1
	Housing (3)	floor space entropy index	2
		housing density	2
		floor space dissimilarity index	1
Socio-Economy (25)	Population (9)	population density	42
		population	14
		race	2
		household number	1

Source: Kim Y, Newman G, Güneralp B. A Review of Driving Factors, Scenarios, and Topics in Urban Land Change Models. *Land*. 2020; 9(8):246. https://doi.org/10.3390/land9080246

Driving Factors in Urban Land Change Models

Table 2. *Cont.*

Classification		** Driving Factors	Count
Built Environment (53)	Transportation (18)	distance to major roads	135
		distance to highways	24
		distance to railways	20
		distance to national/express highways	13
		distance to airport/harbor	12
		distance to railway station	11
		distance to minor roads	8
		distance to subway station	7
		distance to road junction	6
		distance to county roads	5
		distance to motorway exits	5
		distance to bus station	4
		distance to provincial roads	4
		road density	4
		distance to metro station	3
		distance to tollgate	2
		distance to bus route	1
		transportation noise	1
	Land Use (13)	distance to settlement	74
		distance to urban center (CBD)	52
		land use (land cover)	49
		distance to residential	35
		distance to (big) city	25
		distance to open land/recreation	15
		distance to district centers	13

Classification		Driving Factors	Count
Socio-Economy (25)	Population (9)	housing growth rate	1
		job density	1
		job housing balance	1
		literacy	1
		urban population density	1
	Plan (6)	distance to protected area	13
		land use plan/policy	8
		distance to city boundary	4
		distance to historic sites	3
		county boundary	1
		state boundary	1
	Economy (10)	GDP	17
		property/land value	12
		income	5
		employment rate	3
		poverty	2
		rent	2
		industrialization rate	1
		investment	1
		investment on agri. research	1
		per capita foreign direct investment	1
Others (3)		easting parameter	5
		northing parameter	5
		crime	1
Total Driving Factor (113)			1,215

* Drivers in SLEUTH model are counted as four (e.g., slope, land use, urban, and transportation) because hillshade and exclusion layers do not influence prediction results. Stochastic and duplicated neighborhood drivers are excluded in count. ** Drivers include factors affecting urban land uses (e.g., residential, commercial, industrial).

Source: Kim Y, Newman G, Güneralp B. A Review of Driving Factors, Scenarios, and Topics in Urban Land Change Models. *Land*. 2020; 9(8):246. https://doi.org/10.3390/land9080246

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Further reading

Point of Contact: Gizem Mestav Sarica (Mornings only), Alex Alabaster

Suggested reading:

- Flood risk and adaptation strategies under climate change and urban expansion: A probabilistic analysis using global data, https://doi.org/10.1016/j.scitotenv.2015.08.068
- Integrating Climate and Socioeconomic Pathways to Calculate the Future Cost of Catastrophes, https://doi.org/10.5194/egusphere-egu2020-3058
- A Review of Driving Factors, Scenarios, and Topics in Urban Land Change Models, https://doi.org/10.3390/land9080246

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Thank You