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Iceland Catastrophe Insurance and Earthquake Risk Assessment

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Iceland Catastrophe Insurance (ICI) was founded in 1975 as a public undertaking by a special Act of the Althing (parliament) of Iceland. ICI is a government owned agency that reports under the Ministry of Finance and Economic Affairs. ICI functions as an insurance company. The purchase of catastrophe insurance for earthquake, volcanic eruption, snow avalanches, landslides and floods is compulsory for all buildings; as well as for contents insured against fire. Buildings are insured according to their valuation for fire as assessed by the Registers Iceland (State Land Registry). Since fire insurance of buildings is compulsory in Iceland, all buildings are likewise insured against natural perils covered by the programme. Infrastructure lifelines - waterworks, geothermal heating systems, sewage systems, electric installations, bridges and harbour installations - not normally insured against fire, are separately insured with the Corporation.

In the aftermath of the May 2008 Ölfus earthquake, which caused serious damage in the western part of the South Iceland lowland, it was obvious that a major revision of the inherent earthquake risk and loss probabilities was required. After the 2008 quake as well as after the two destructive earthquakes in June 2000 in the South Iceland, all damaged houses and facilities were inspected and the loss evaluated by technical experts (engineers and surveyors). This loss data combined with the property database from Registers Iceland has resulted in a unique database where detailed information about the buildings, year of construction, size, materials etc., and the damage incurred by the earthquakes, has been compiled and classified in number of subcategories of structural and non-structural loss.

For the last years, ICI has put an emphasis on Earthquake Risk Assessment and has constructed a fully probabilistic model. The model is based on a seismic hazard module constructed by Dr. Mohammad Zolfaghari (Cat Risk Solutions), an exposure module, provided by the Registers Iceland, including detailed information of all buildings in Iceland and finally, vulnerability module with empirical vulnerability functions, processed by working with the collected data from the damage surveys following the 2008 earthquake (Bessason, Bjarnason, Guðmundsson, Sólnes and Stedman 2012; 2014). There is also an ongoing work in analysing the loss data from the two South Iceland earthquakes in June 2000 where some first results have already been published (Bessason and Bjarnason, 2016) In addition to the probabilistic model, ICI has developed a quick response deterministic model that can model scenarios or specific events such as all major historical earthquakes and can also be used to verify by sampling the results of the probabilistic model.

Since the hazard module was constructed by an external expert and access to most of the data is limited, ICI has for the last months been working on a new hazard module i.e. a Probabilistic

Seismic Hazard Analysis (PSHA). The first part of the study has been a seismic source definition of Iceland in order to represent the distribution of future earthquakes in space, time and size (Figure 1). The method of the zonation is based on two main components, firstly, a catalogue of observed seismicity in Iceland back to the year 1706 and secondly, detailed information about seismic potential of causative faults and active areas in Iceland, i.e. processes including transform faulting, rifting, dike injection and other form of volcanic activity (Einarsson, 1991). The second component is of great importance, since the observed seismicity for the last 300 years can only yield limited information about future potential major earthquakes. The catalogue of observed seismicity is a compilation of three sub-catalogues, with different observation periods for different magnitudes, including 2159 events (Table 1).

Table 1. Three sub-catalogues of observed seismicity within the 32 seismic source zones

Sub-catalogue	Period (years)	Magnitude range	Count of events
1 – historical	1706-2014	$M \geq 6$	29
2 – Recorded	1926-2014	$4 \geq M > 6$	553
3 – Recorded	1991-2014	$3 \geq M > 4$	1577

A list of historical earthquakes back to the year 1706 (sub-catalogue 1) is given in Sólnes, Sigmundsson and Bessason (2013) and Einarsson (2015). Sub-catalogues 2 and 3 are provided by the Iceland Meteorological Office (Kristín Vogfjörð).

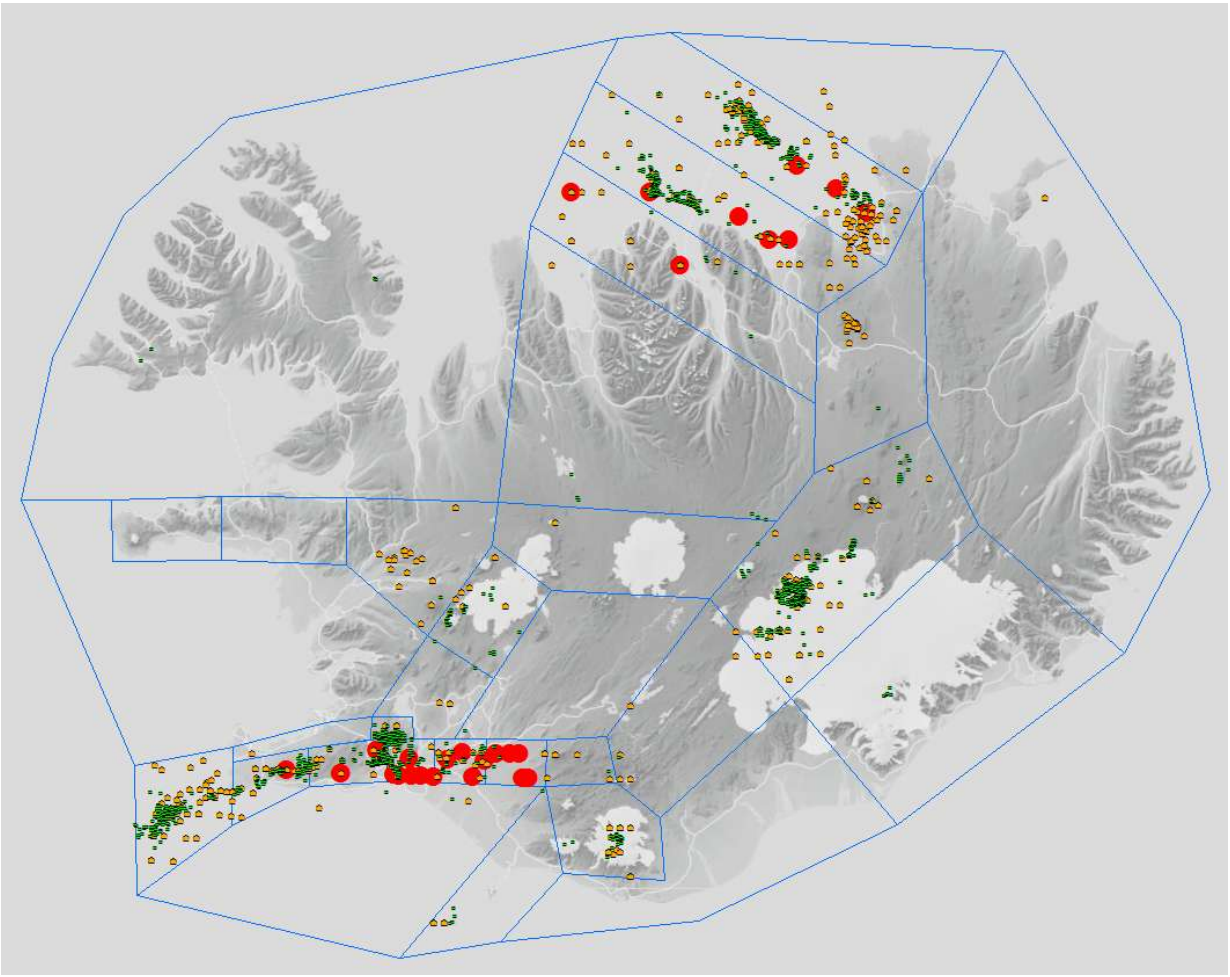

Figure 1. The 32 seismic source zones of Iceland, $M \geq 6$, 1706-2014 (red dots), $4 \geq M > 6$, 1926-2014 (orange dots) and $3 \geq M > 4$ 1991-2014 (green dots).

Over 70% of the total aggregates insured by ICI, is located on the SW part of Iceland, thereof, about 55% in the Reykjavík capital area. In terms of earthquakes and monetary losses, the Reykjavík capital area is by far the most sensitive area in Iceland. Therefore, a special emphasis has been put on the Reykjanes Peninsula and the seismicity in the area south and east of Reykjavík (Figure 2).

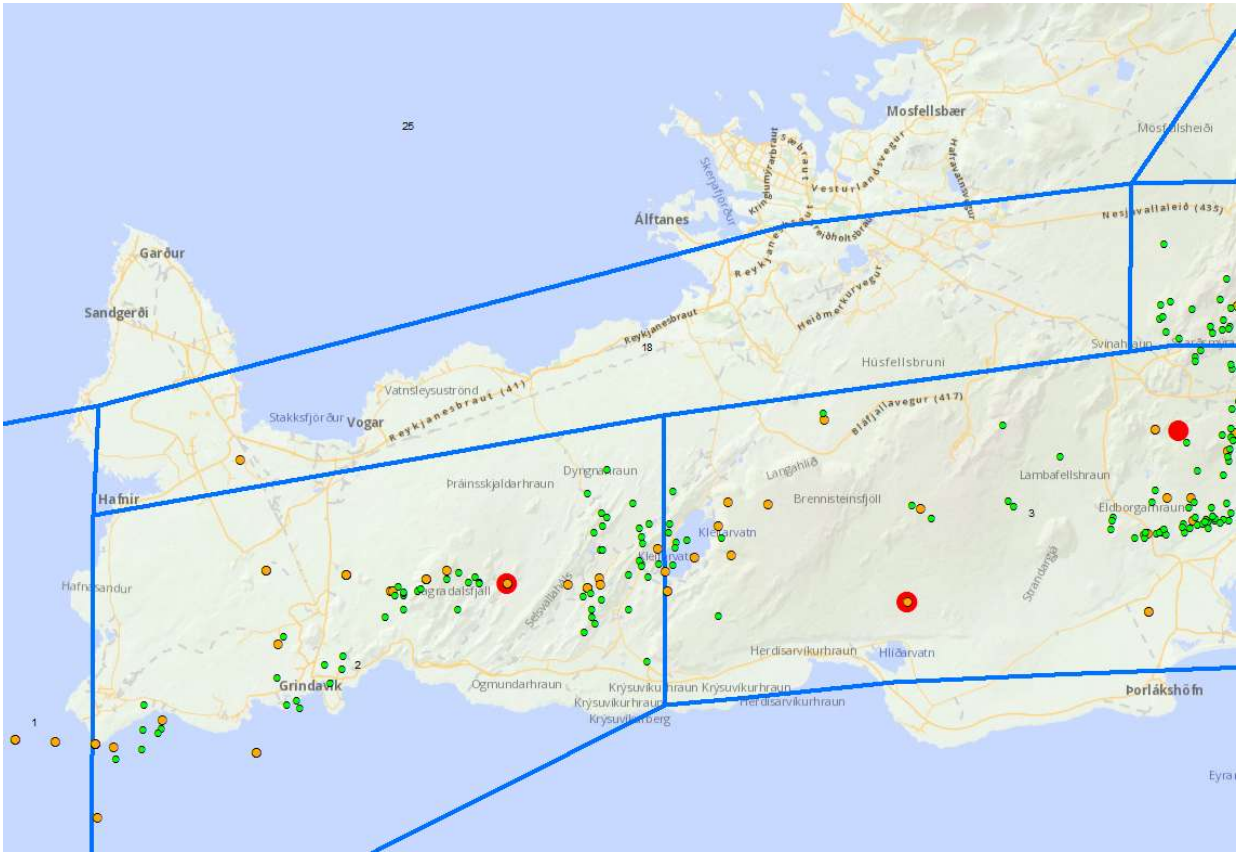

Figure 2. Seismic source zonation of the Reykjanes Peninsula, M ≥ 6, 1706-2014 (red dots), 4 ≥ M >6, 1926-2014 (orange dots) and 3 ≥ M >4 1991-2014 (green dots).

As shown in figure 2, little or no seismicity (M ≥ 3) has been observed in Reykjavík capital area according to the compiled catalogue, however, the northern part of the Reykjanes peninsula has a potential of seismicity (magnitude up to around M 4) due to dyke intrusions, related to the volcanic fissure swarms in the area.

The PSHA work will continue in the year 2016 and the aim is to publish the results of the whole study in more details, e.g. a table including a description of seismic properties of each of the 32 zones. Furthermore, the data will be implemented as an alternative to the existing hazard module in the ICI's probabilistic earthquake risk model.

References

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