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The global historical and future economic loss and cost of earthquakes during the production of adaptive worldwide economic fragility functions

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Over the past decade, the production of economic indices behind the CATDAT Damaging Earthquakes Database has allowed for the conversion of historical earthquake economic loss and cost events into today's terms using long-term spatio-temporal series of consumer price index (CPI), construction costs, wage indices, and GDP from 1900-2013.
As part of the doctoral thesis of Daniell (2014), databases and GIS layers for a country and sub-country level have been produced for population, GDP per capita, net and gross capital stock (depreciated and non-depreciated) using studies, census information and the perpetual inventory method.
In addition, a detailed study has been undertaken to collect and reproduce as many historical isoseismal maps, macroseismic intensity results and reproductions of earthquakes as possible out of the 7208 damaging events in the CATDAT database from 1900 onwards.
a) The isoseismal database and population bounds from 3000+ collected damaging events were compared with the output parameters of GDP and net and gross capital stock per intensity bound and administrative unit, creating a spatial join for analysis.
b) The historical costs were divided into shaking/direct ground motion effects, and secondary effects costs. The shaking costs were further divided into gross capital stock related and GDP related costs for each administrative unit, intensity bound couplet.
c) Costs were then estimated based on the optimisation of the function in terms of costs vs. gross capital stock and costs vs. GDP via the regression of the function. Losses were estimated based on net capital stock, looking at the infrastructure age and value at the time of the event.
This dataset was then used to develop an economic exposure for each historical earthquake in comparison with the loss recorded in the CATDAT Damaging Earthquakes Database. The production of economic fragility functions for each country was possible using a temporal regression based on the parameters of macroseismic intensity, capital stock estimate, GDP estimate, year and the combined seismic building index (a created combination of the global seismic code index, building practice factor, building age and infrastructure vulnerability).
The analysis provided three key results:
a) The production of economic fragility functions from the 1900-2008 events showed very good correlation to the economic loss and cost from earthquakes from 2009-2013, in real-time. This methodology has been extended to other natural disaster types (typhoon, flood, drought).
b) The reanalysis of historical earthquake events in order to check associated historical loss and costs versus the expected exposure in terms of intensities. The 1939 Chillan, 1948 Turkmenistan, 1950 Iran, 1972 Managua, 1980 Western Nepal and 1992 Erzincan earthquake events were seen as huge outliers compared with the modelled capital stock and GDP and thus additional studies were undertaken to check the original loss results.
c) A worldwide GIS layer database of capital stock (gross and net), GDP, infrastructure age and economic indices over the period 1900-2013 have been created in conjunction with the CATDAT database in order to define correct economic loss and costs.