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Probabilistic catastrophe loss modelling and the new risk markets

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Probabilistic catastrophe loss modelling is a major commercial activity generating hundreds of millions of Euros in revenues in support of the global catastrophe insurance market. While catastrophe modelling companies employ many research geoscientists, the subject is not generally taught or researched in Universities, principally because it demands cross-departmental teams of geoscientists, structural engineers, risk statisticians, economists and software developers to create the models, but also because the principal source of loss calibration is obtained through partnering with client insurance companies. The original catastrophe models were for earthquake and hurricane but have now expanded to include windstorms, icestorms, severe thunderstorms, wildfires, inland and coastal floods, volcanic eruptions, tsunamis, pandemics, industrial accidents and terrorism. The demand for technical risk pricing information on catastrophe losses thrives where insurers provide coverage for the principal perils (including flood) and are free to differentiate risk costs (as in the UK – but not in many other European countries). However, the ability to access high resolution information on the hazard and risk from the principal perils deserves to become a fundamental right across the globe, to inspire mitigative action at all levels of society.

Catastrophe loss modelling creates stochastic representations of the underlying extreme events – the equivalent of running 100,000 versions of next year. Each event in the simulation is realised at high resolution, so that it becomes possible to preserve the multi-dimensional loss correlation structure. Loss modelling needs to consider the full 'cascade of consequences', including failure of flood defences, landslides, the spread of fires, power outages, the consequences of evacuations and how increased demand

for repairers raises the costs of the repairs. There is also the non-independence of events – such as seasonal flood recurrence, earthquake stress transfer, or hurricane clustering, as well as the climatological controls on catastrophe occurrence. The fundamental model output is the loss 'exceedance probability' (EP) relation - which is employed to structure and price individual contracts, measure capital adequacy and apply the diversification benefits when insuring new business.

Catastrophe models help set the price of traded catastrophe risk and also underpin the creation of the 'new risk markets', in which risk is transferred into the capital markets. Since 2005 there has been a dramatic increase in the issuance of parametric Catastrophe Bonds involving indices designed and tuned to mimic collective insurance loss, in which a loss to a bond is triggered by the measured parameters of the event. Such parametric structures have been implemented for transferring earthquake, tropical cyclone, windstorm and (in 2007) river flood risk and are beginning to be used to provide risk transfer solutions in the developing world.