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Exposure-Based Cat Modeling, Available data, Advantages, & Limitations

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This paper discusses the advantages and disadvantages of exposure data for cat-modeling and considers concepts of scale as well as the completeness of data and data scoring using field/model examples.
Catastrophe modeling based on exposure data has been considered the panacea for insurance-related cat modeling since the late 1980's. Reasons for this include:
• The ability to extend risk modeling to consider data beyond historical losses,
• Usability across many relevant scales,
• Flexibility in addressing complex structures and policy conditions, and
• Ability to assess dependence of risk results on exposure-attributes and exposure-modifiers, such as lines of business, occupancy types, and mitigation features, at any given scale.
In order to calculate related risk, monetary exposure is correlated to vulnerabilities that have been calibrated with historical results, plausibility concepts, and/or physical modeling.

While exposure based modeling is widely adopted, we also need to be aware of its limitations which include:
• Boundaries in our understanding of the distribution of exposure,
• Spatial interdependence of exposure patterns and the time-dependence of exposure,
• Incomplete availability of loss information to calibrate relevant exposure attributes/structure with related vulnerabilities and losses,
• The scale-dependence of vulnerability,
• Potential for missing or incomplete communication of assumptions made during model calibration,
• Inefficiencies in the aggregation or disaggregation of vulnerabilities, and
• Factors which can influence losses other than exposure, vulnerability, and hazard.
Although we might assume that the higher the resolution the better, regional model calibration is often limited to lower than street level resolution with higher resolution being achieved by disaggregating results using topographic/roughness features with often loosely constrained and/or varying effects on losses. This suggests that higher accuracy might actually be achieved at resolutions lower than the maximum available in current exposure cat models and as yet undefined. Further, dominance of a few models, associated consensus results, and preeminence of exposure concepts can lead to the subjective interpretation of inaccuracies in exposure distribution/attribution that can result in biased model results. More extreme solutions have resulted in input exposure data being calibrated with model results in order to achieve pre-determined and self-fulfilling outcomes. These outcomes could be avoided by allowing realistic uncertainty ranges rather than restricting interpretation of risk results to misleading "consensus nutshell" numbers.

The paper concludes by considering new concepts in the use of exposure models and describes potential scenarios for the future use of input data in cat models.