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CAT 360

Catastrophe Risk from Every Perspective

The **CAT 360** is a quarterly newsletter that features articles developed by our Research and Development Team and covers topics that relate to Catastrophe Modeling, Natural Perils and Information Technology on a global basis. Please feel free to contact the editors if you have any questions or comments regarding any of our publications.

Eds.

Catastrophe Modeling in Emerging Insurance Markets

CAT models are a staple in many developed Insurance markets (North America, Western Europe, Japan, Australia, New Zealand, Caribbean, etc.). Models for these regions have been refined since the early 1990s and are virtually part of every Insurance / Reinsurance organization that insures risks in those regions. But what about emerging insurance markets where the severity potential of natural catastrophes are significant, and models do not exist? Areas such as China, India, the Czech Republic and Romania have two things in common, a growing insurance market, and a limited capability to model natural perils.

China - A Case Study

China is one of the world's most important economies. While its insurance market is very small compared to the U.S. and Europe, its rapid economic growth and market potential make it a clear candidate for expansion. The main natural perils in China are earthquake and typhoon; however, other natural perils such as snowstorm, tornado, sandstorm, flood, mudslide, and drought can significantly affect this country.

China earthquake modeling was first introduced in 1998, with new earthquake and typhoon models released to the insurance industry in 2007. The CAT modeling vendors, AIR, EQECAT, and RMS, made significant efforts to showcase their models by holding free seminars on the modeling methodology in China's major cities of Beijing and Shanghai. This article will discuss issues surrounding catastrophe modeling in China, including the accuracy and reliability of the historical events record, understanding the quality of building construction and data capture with respect to insurance exposures.

China's Historical Earthquake Catalogue

The historical record for China earthquakes dates as far back as 1177 BC, however, the vast majority of events are only documented with descriptions of damage in the aftermath of the event. Modern instruments have only existed over the past 75 years (similar to the U.S.), providing us with reliable and consistent information for only a fraction of the total historical record. This creates a significant challenge in the development of an earthquake model as the historical record is just as important as the modern geological studies in developing the earthquake simulation catalog. How confident are we on knowing where earthquakes will occur in China, and how well do we understand how large an earthquake can be? The uncertainty surrounding these issues must be well understood and accounted for in the model's earthquake catalog.

The most significant events that have taken place in China include the following:

Event	Year	Magnitude	Deaths
The Great China Earthquake	1556	Mw 8.0 – 8.3	830,000
China Anxian	1622	Mw 7.0	150,000
China – Beijing	1731	Not Listed	100,000
China – Sichuan	1850	Mw 7.5	300,000
The Haiyuan Earthquake	1920	Mw 7.8	234,000
China T- Tangshan	1976	Mw 7.3	243,000
The Wenchaun Earthquake	2008	Mw 7.9	69,000

The following diagrams illustrate the seismic risks in China along with the population density. From these graphics you can see that much of the earthquake prone areas in the north west section of the

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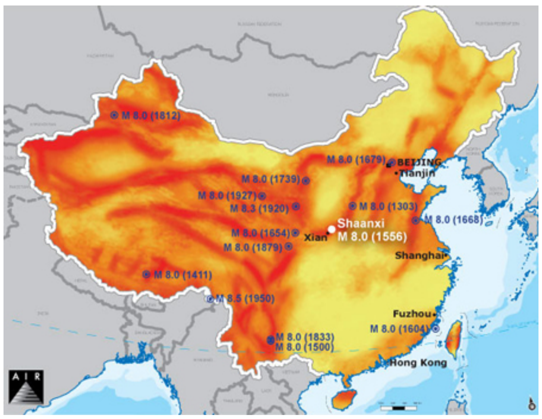
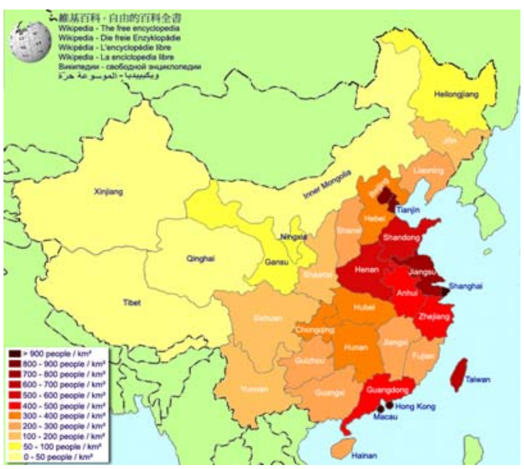
country have a very low population density. However, one of the key areas of earthquake aggregation potential is near the capital city of Beijing.



Earthquake Potential in China – Courtesy AIR-Worldwide



Population Density in China – Copyright www.wikimedia.org

The 7.9 Wenchaun Earthquake that devastated China's Sichuan province in May this year illustrates a major issue facing the earthquake modeler with respect to the uncertainty in the magnitude and location of an event. Before the earthquake occurred, the general seismic consensus was that earthquakes of this magnitude (Mw 7.9) could not occur in this region. As a result of this event, a regional revision was released by the Chinese Earthquake Administration (CEA) on June 11, 2008, which significantly increases the hazard potential in this region.

This is not an unprecedented event. A similar situation occurred in 1994 with the Northridge Earthquake in California which occurred on an "unknown" fault at the time of the event. Later classified as a blind thrust fault, its physical properties are below the surface and not visible using conventional land surveys at that time. The United States Geological Survey (USGS) did not identify the fault within their seismic catalog, so that event and any other unidentified faults for that matter, were not reflected in the CAT model's simulation event set. Since then, blind thrust faults have been identified, such as the Puente Hills blind thrust fault near Los Angeles, California. In addition, CAT models have incorporated "background seismicity" in their simulations to capture loss potential for unknown faults.

The CAT modeling companies have recognized that this issue could happen on a worldwide basis and have included "background seismicity" in their China earthquake model as well.

The Chinese Earthquake Administration is scheduled to release a fifth generation earthquake hazard map in 2010 (work began in 2007) and significant changes are expected. In order to keep pace with the latest available information, the vendor modeling companies must now re-analyze their models, with their local partners, in developing new seismic parameters. Until that time, a reasonable amount of uncertainty surrounds the hazard component of the models.

The Booming Construction in China

China's landscape is ever changing, with new high rises and commercial offices continually being completed. As showcased during the 2008 Olympics in Beijing, China is a hotbed for innovative architecture rivaling its western counterparts. New buildings are modern engineered marvels, such as the CCTV Tower in Beijing, and are designed to withstand the hazards in the regions where they are located.

The first earthquake building codes were enacted in 1978 as a response to the Tangshan earthquake (1976) which killed at least 240,000. In 1989, an amendment was enacted adopting hazard-based probability as part of the code. Most recently, a revision in 2002 was made which reflected advances in research, construction materials and practice during the current period of rapid growth. All new commercial structures are expected to meet or exceed these standards.

This is a photo of CCTV Tower being erected in Beijing, with a targeted completion date in 2009. This building is just one example of the innovative architecture being built to local seismic standards in China.

However, when the catastrophic Wenchaun earthquake (Mw 7.9) occurred this past May, several public schools collapsed, killing thousands of students. Even though the schools were built during the period when earthquake codes were in effect, they did not withstand the force of the event. However, buildings adjacent to the schools, built during the same time period, did not collapse. The immediate reaction was that these public buildings were not built to code, leading to rumors in the media of corruption in the government agencies responsible to enforcing building standards in the region. A public outcry rippled through the community, with many demanding answers as to why this had occurred. This controversy will continue for many years, however, one thing is clear, China is publicly stating that building codes specific to schools and hospitals will be enhanced.

Existence of and adherence to local building codes is one of the key assumptions that a CAT modeler makes when developing vulnerability curves. Was the structure built when seismic building codes were put into effect? Were building codes enforced during construction? These are considerations that contribute to uncertainty in CAT models, and can mean the difference between a building withstanding a major earthquake with relatively minor damage, or a complete collapse. This adds to the complexity in calibrating a model if the adherence to building codes are uncertain.

Quantifying Exposure

Developing a reliable and consistent portfolio of exposures in China compatible with the vendor models will be a challenge in the short term. By comparison, the U.S. market needed about 10 years before reliable and consistent data became a standard within the industry. It could conceivably take that long, or longer, before the insurance industry in China is able to produce reliable CAT modeling data. China, along with other Asian countries, faces an additional challenge in translating local data to a format designed around western standards. This additional data handling introduces chance for translation or interpretation error when analyzing an exposure data set.

Data challenges that hold true in the western market, will almost certainly be an issue in China as well. Key issues to consider are:

Valuation - Having the right Total Insured Value (TIV) is one of the most critical components in CAT modeling. Lessons learned in recent CAT events show that a building's actual valuation may not be properly captured, resulting in inaccurate modeling.

Under Reporting - Under reporting of insured structures has also been an issue in recent years. It's possible that not all policies are captured electronically and even if they were, all of the needed data elements may not be captured. The addition of a new building or an acquisition of a new business increases the risk, but is often not discovered until after a loss has been incurred.

Other Natural Perils in China

As with any region where there is catastrophe insurance risk, both the modelable and un-modeled perils need to be considered. In addition to the peril of earthquake in China, catastrophes from other perils can greatly affect the country.

Secondary Perils Linked to an Earthquake Event

The risk of a devastating tsunami after an earthquake is well known, especially in Asia (2004 Indian Ocean Tsunami), but earthquake-induced landslides have caused changes to the river beds and lakes in the region. New flood basins form, and the river beds can have a significant loss in flow capacity, creating a potential for flooding that did not exist before the earthquake occurred. This elevated threat against flooding can last for decades, as towns struggle to re-build in the aftermath of a major event.

Typhoon

From a severity perspective, typhoons are second only to earthquakes. One of the strongest storms in recent history was Typhoon Saomai, which made landfall as a CAT 4 storm in 2006, killing 458 and causing over $2.5 BN USD in damages. While not nearly as destructive as earthquakes, typhoons frequently occur on an annual basis. On average, 9 named storms make landfall along the 8,000 miles of coastline subject to typhoons each year.

Modeling typhoon losses in China can be very tricky as well due to the local topography. The wind speed of a typhoon does not necessarily correlate well with the damage it produces. Weak storms can generate significant rainfall, which can cause extensive flooding and trigger mud/landslides. These weaker storms contributed more to insured typhoon losses in China than land falling storms with high winds.

Flooding and Mud / Landslides

Flooding in China can come from two sources; from the heavy rains that accompany a post land falling typhoon (as stated previously), or from seasonal monsoons that occur during the distinctive flood season of May to September. Mud / landslides can often accompany a flood and can add significant damage to an event. These events can be massive in nature and have engulfed entire villages. An example occurred in August of 2002; a massive mudslide in the south western province of Yunnan buried 600 homes and killed at least 30 people.

Snowstorms

In January and February of 2008, the central and southern regions of China experienced their worst snowstorms in a half century affecting 21 provinces. Heavy snow, ice and freezing temperatures caused extensive property damage, destroying 485,000 homes, and disrupting China's transportation rail infrastructure for thousands of passengers, and caused 129 deaths. Economic losses have been published as ~22Bn USD, with insured loses projected at ~531M USD. While the frequency of catastrophic snowstorms is relatively low, this event illustrates the potential severity of the peril which is currently un-modeled.

Tornado / Hail

Tornadoes are most frequent in the U.S., but occasionally occur in other countries, including China. Until just recently, political barriers have prevented the free-flow of accurate disaster information from China. In the past decade, there has been about one reported multiple-death killer tornado a year in China. Some, perhaps most, seem to be typhoon spawned tornadoes. These micro events that occur in the North Pacific basin, can cause extensive, but localized damage in moderate typhoon wind events.

Sandstorm

Sandstorms have recently become a significant threat in China. These storms are a result of 20 years of desertification with the northern grasslands in retreat. The Gobi Desert is creeping southwards and the grasslands are being swallowed by sand.

The most severe sandstorm in the China's history occurred on April 17, 2006. In one night, 300,000 tons of sand dropped on Beijing and shocked even sandstorm-hardened Beijing residents. On May 12, 1993, a sandstorm in Gansu province killed at least 47 people and injured 153. According to news reports of this event, 41M USD in economic losses were incurred.

Summary

Understanding the natural perils risks in an emerging market is a great challenge. Understanding it in one of the largest countries in the world only adds to the complexity. While the modeling parameters of natural hazards do not vary greatly from country to country, the variability in the peril's characteristics (historical record, magnitude, frequency, local geography) and an appreciation of a risk's attributes (insured values, policy terms, construction quality and building codes) will determine the amount of uncertainty associated with an insurable risk. CAT modeling in most emerging markets is in its infancy; however, in countries like China, the CAT modeling companies are partnering with local experts to integrate the latest information into the commercial models. Until the uncertainty in the data and tools can be narrowed, a conservative approach in analyzing the risk is in order. This view will mature and refine over time as more information is developed and models are enhanced, not just in China, but in all emerging markets around the world.