WEATHER INDEX-BASED INSURANCE IN CHINA:

THE CHALLENGES OF DEALING WITH DATA

Tong JIANG, Lucie VAUCEL, Marco GEMMER, Thomas FISCHER,

Buda SU, Lige CAO, Xiucang LI

National Climate Center, China Meteorological Administration
46 Zhongguancun Nandajie, Haidian, Beijing 100 081, PR China

Abstract

Challenges arise when designing weather index-based microinsurance. Information on the density of weather stations, data availability and quality, population density and reliable economic loss data are required and multi-trigger risks have to be excluded. In 2008, the German Technical Cooperation agreed and cooperated with the China Insurance Regulatory Commission to implement a project on weather-index based insurance in China. The National Climate Center of the China Meteorological Administration is responsible for delivering expertise on meteorological data, analysis and applications.

This paper introduces the challenges and practical solutions in obtaining respective weather/climate and loss data in China and in defining a trigger. The coastal Fujian province (south east China) has been heavily hit by typhoons over the last years resulting in large-scale economic losses was selected as pilot study area.

Weather and climate data is collected for the period 1961-2009, and Weather phenomenon need to be analysed for their different intensity and frequency. In the present case study, typhoons require the collection of daily and hourly wind and precipitation data. The next step is to collect economic loss data related to extreme weather events. It is important to combine weather data and past direct economic loss data to determine the trigger, i.e. which parameter causes losses. In Fujian, wind speed and maximum daily precipitation data were overlaid with the direct economic loss data. It was found that economic losses were very high (with typhoon damages getting costly) when the maximum daily precipitation and the maximum

daily wind speed during a typhoon event were high at the same day. In Lianjiang county, whenever the maximum precipitation exceeds 110mm and the maximum wind speed exceeds 16m/s at the same day high economic losses are triggered. Based on the estimated thresholds, a six-year return period for the trigger was determined.

It remains a challenge to obtain comprehensive, reliable and harmonized loss data (e.g. on county-level or area-averaged). Weather events might have direct impact (e.g. typhoon) or lead to reduced agricultural output several months later (e.g. spring drought). This is why data had to be collected from various sources such as Ministries, sometimes very costly, or in time-consuming field trips in order to include the local knowledge on the economic losses and their relation to the weather risk. This allowed us to cross-check the information in a Geographical Information System (GIS) with land-use maps. Multiple-correlations of neighbouring climate stations were determined to establish back-up stations which are able to provide data if the primary station fails to provide data during a typhoon event but clients claim an insured event. Generally, the homogeneity of data has to be checked. Change of station's location or instruments might affect time-series. Weather data might have to be interpolated between stations of different altitude. Without knowing how and when economic losses occur, e.g. by getting hits from local farmers, it is impossible to identify the respective risk in the time-series.

Keywords: microinsurance, weather, climate, losses, risk, data, index, trigger, China

Introduction

The growing frequency and severity of extreme weather events such as typhoons, droughts, floods, and snow storms due to climate change have resulted in an increase in financial losses, and thus threaten the economic basis of households and enterprises – especially those in rural areas and at the lower end of the income spectrum – in many developing countries.

The Chinese (rural) population currently has very limited options to protect their assets and incomes against natural perils. Existing agricultural insurance schemes rely heavily on government subsidies and do not fully address the demand of small farmers. Furthermore, municipalities and large enterprises are often insufficiently insured against weather risks. Such entities face very high economic losses when hit by natural disasters, but lack modern risk management mechanisms to cope with these perils. The development of a sound rural financial sector is an important prerequisite when trying to close the income gap between rural and urban populations and to ensure socially balanced development. This includes supporting rural households and enterprises in coping with climate risks by creating access to affordable and economically viable weather insurance products.

A Sino-German weather insurance project (funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Security, BMU) was launched in 2008 and aims at improving the capabilities of the Chinese insurance sector in the weather insurance segment which will result in better access to modern risk management tools, as well as increased transparency and stability of the Chinese financial sector. The German Technical Cooperation (GTZ) agreed and cooperated with the China Insurance Regulatory Commission (CIRC) to implement a project on weather-index based insurance in China. Partner organisations are Chinese and foreign insurance and re-insurance companies, and the National Climate Center (NCC) of the China Meteorological Administration (CMA) which is responsible for delivering expertise on meteorological data and analysis. The project identifies and analyses weather perils in all provinces of China. Through a thorough analysis of past weather events and the economic and social losses resulting from those weather events, the exposure of different households and enterprises to weather perils are analyzed. Through household surveys and client studies the potential demand for weather insurance products is assessed. All this extensive research will then result in the development of suitable weather insurance products, on the basis of parametric triggers, meaning that e.g. farmers will receive insurance payouts once a certain trigger (such as a certain precipitation or water levels for a flood insurance) is reached.

The development of a weather-index based insurance (or parametric trigger based insurance) implies collecting and analysing weather/climate and loss data in order to find a trigger (i.e. distinct weather parameter conditions when a given weather event becomes costly). Hence, dealing with data is a very important part when developing a weather-index based insurance. Quite a few challenges and difficulties related to data might occur. A significant number of weather stations must be able to provide regular data. The availability and reliability of weather and loss data must be as high as possible. Moreover, the requirement of high population density (to have a large number of potential clients) or the development of multiple-trigger risks may also be challenges to take up.

Main Objectives

This paper presents a case study for typhoons in Fujian province, south east China, as it has been heavily hit by tropical cyclones over the last decades resulting in large-scale economic losses. A screening regarding the availability and reliability of data for an index-based insurance product against weather risks has been conducted. Based on that, this paper introduces some of the challenges experienced in the process of data collection and trigger estimation. Practical solutions are shown on how to obtain and handle respective weather and loss data in China and to define an appropriate trigger.

1 Data screening to determine Pilot area

A pre-feasibility study on province level which aimed at identifying potential areas in China for the development and introduction of parametric trigger based insurance products in China was conducted. Several criteria were taken into consideration such as climate station density, length of data records, hazard stricken areas per weather/climate risk (Heavy Rainfall, Drought, Hail and Gale, Tropical Cyclones, Snow and Frost), high levels of economic losses caused by the hazard (total and in percentage of GDP), population density, and high numbers in affected population. CMA provided the location and availability of climate stations, while the economic loss and demographic data (for each climate risk) were taken from CMA statistical yearbooks. Fujian province was chosen as pilot area since this region has been severely hit by typhoons over the last years resulting in heavy economic losses, largely affected population and a relatively dense weather station network with long data records.

2 Data collection

Weather data

The CMA conducted a screening of Fujian weather and climate data regarding its availability and reliability, consisting of two major steps: data collection and data analysis. Typhoons require the collection of wind and precipitation data, as they are the two weather elements characterising a typhoon event. Daily wind and daily precipitation data were collected for the period 1961-2009 for the 66 climate stations of CMA located in Fujian province. Each station covers an area of approximately 1,800 sq km. Apart from the 66 CMA climate stations; other sources provide weather and climate data such as the Office of Flood Control and Drought Relief that has several hydrological stations (mainly providing information on water level and precipitation), the Agricultural Bureau, or the Forestry Bureau. Nevertheless, we essentially focused on CMA climate station data as they are considered as being the most accurate, the most reliable, and covering the longest observation period since the CMA is the highest authority responsible for weather data collection.

According to CMA, the provided weather and climate data has been checked on homogeneity and is quality-controlled. The reliability of the weather and climate data was checked for each climate station regarding daily precipitation and daily average wind speed (6-hourly measurement) for the period 1984-2007. The data coverage for daily wind speed is mostly above 99%, whereas data coverage for daily precipitation data in the eastern part of Fujian, which is usually the typhoon affected region, is 88-90%. Data gaps mainly stem from the early years of daily data collection and winter season when precipitation records are less relevant. Hourly weather data during typhoon events are accessible from the local climate centers. However, as will be pointed out later, a focus on daily data sets is required and there is no requirement to work on an hourly basis.

Based on the 49-year-long daily wind and precipitation time-series and their specific station coordinates, a geographical information system (GIS) is established.

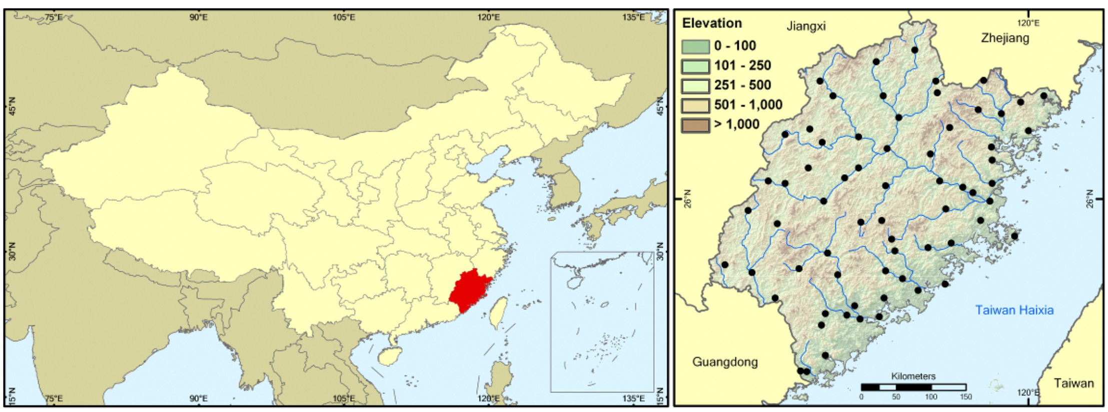

Figure 1: Location of Fujian Province and the 66 climate stations

Economic loss data

In China, damage and loss data related to weather/climate-induced disasters are recorded by CMA on county-level. For Fujian Province, the record of past typhoon events over the last fifty years has been compiled by the Fujian Climate Center, and information on the data collecting system was obtained during a field trip, in order to validate the data on typhoons and losses and get a better understanding of the data sources. The records of damages and losses are dominantly based on official reports from county governments. The period covering the years from 1984 to 2007 was provided in digital format (Microsoft Excel tables); earlier records were available in hardcopy only. Based on the digital records, the approximate availability of loss data was calculated for several types of economic losses (Direct economic losses, Agricultural losses, Livestock economic losses, Industrial economic losses, Economic losses related to specific sectors such as forestry, water, and traffic). Apart from the total direct economic losses, the availability of the different types of economic loss data is quite low. A subjective screening of the entire data revealed that not all counties were covered and/or inaccuracies in numbers of typhoon events causing losses are obvious. The absence of data can mean that the losses were not reported, or that the sector/area was simply not affected. The reporting of damages and losses by the county administrations can not be proven on accuracy as the information is not publicly available because of national security reasons. However, and as discussed during several meetings between the research team and the project partners, the data were used in order to get a general understanding of the directions of losses.

3 Data processing

Trigger estimation

In Fujian, wind and precipitation data were analysed with regard to the reported days when economic losses occurred. Wind speed and daily precipitation data were overlaid with the direct economic loss data. It was found that economic losses were very high (with typhoon damages getting costly) when the maximum daily precipitation and the maximum daily wind speed during a typhoon event were high at the same day. In Lianjiang county for instance, whenever the maximum precipitation exceeds 110mm and the maximum wind speed exceeds

16m/s at the same day, high economic losses are triggered. Based on the estimated thresholds, a six-year return period for the trigger was determined. The system was used to interpolate precipitation and wind data on different return periods and derive triggers and thresholds for typhoon losses for each of the counties in Fujian Province.

Back-up System

Multiple correlations for each weather station and the neighbouring stations were applied. From the insurance point of view, one question is important to answer: what if a climate station fails during a typhoon event (can the trigger and threshold be determined?). For each of the climate stations, a back-up station was identified that measures the same trigger (wind or precipitation) at the same day on the same threshold (e.g. 16m wind or 100 mm precipitation). The system of climate stations is therefore reliable and the correlation between climate station locations and losses is given.

Challenges

During the trigger estimation, the start and end date of reported total direct economic losses was of high value for understanding the onset of losses and the relation to precipitation and wind speed. The data coverage of total direct economic losses was therefore sufficient. Despite of the positive and interesting results that were found from this study in Fujian, quite a number of challenges of different types were encountered.

It remains a challenge to obtain comprehensive, reliable and harmonized loss data (e.g. on county-level or area-averaged). Weather/climate events might have direct impact (e.g. typhoon) or lead to reduced agricultural output several months later (e.g. spring drought). Generally, the homogeneity of data has to be checked. Change of climate station’s location or instruments might affect time-series. Weather/climate data might have to be interpolated between stations of different altitude. The density of climate stations might also play a crucial role, as the larger the distance between the stations the more uncertain are interpolation results and the reliability in backup stations. Without knowing how and when economic losses occur, it is impossible to identify the respective risk in the time-series.

In summary, the weather/climate data availability in Fujian is sufficient for developing a weather-index based insurance product. However, interaction with local stakeholders is most important in order to identify the local needs for an insurance product that supplements government subsidies. For the design of the final product, it is necessary to get information on the triggers and thresholds by the affected population. These might be different from the statistically determined triggers and thresholds as loss statistics are not representing all potential client groups. The weather/climate data, however, can be used to statistically determine return periods of insured loss events. These are the most important of the insurance product: return periods have to satisfy the farmer's need for financial protection against weather/climate risks (e.g. frequent insured weather event) and be the incentive for marketing of the product while satisfying the financial security aspects of the insurance providers.

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