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- The 2009 Victorian Bushfires Royal Commission released its Interim Report on Monday the 17th August
- Risk Frontiers' Seminar Series 2009

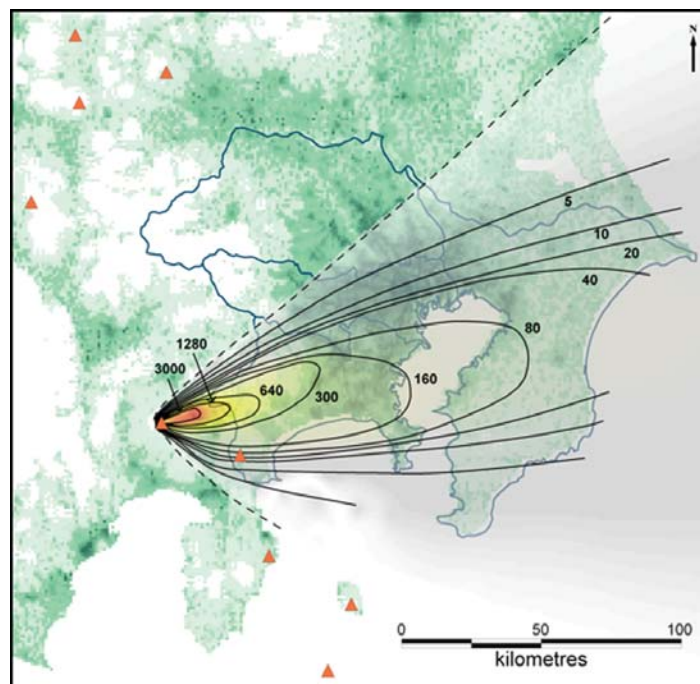
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## *TokioKazanRisk* - Modelling Volcanic Risk in Japan

The 1707 Hiei eruption of Mount Fuji deposited four centimetres of tephra in central Tokyo with much larger thicknesses falling in Western Kanagawa (Figure 1). A repeat of this event would have severe economic consequences for the Greater Tokyo area, causing flow-on effects to Japanese and global economies. But what is the probability of such an event? Should Tokyo prepare for more likely scenarios? And what resources will be required to manage future volcanic crises? Risk Frontiers, in conjunction with TokioMarine & Nichido risk consulting Co., Ltd, and the International Center for Urban Safety Engineering, University of Tokyo, have developed *TokioKazanRisk*, a volcanic hazard and risk model that provides a framework for investigating questions such as these.



**Figure 1.** Isopachs of the 1707 Hiei Eruption of Mt Fuji (modified from Miyaji 2002)

*TokioKazanRisk* incorporates a catalogue of tephra dispersal simulations from six volcanic centres - Fuji, Asama, Hakone, Haruna, Kusatsu-Shirane and Kita-Yatsugatake - located to the west of Greater Tokyo (Figure 2). To calculate building damage and to estimate clean-up requirements and costs, hazard information is combined with a building, road and land-usage database describing Tokyo, Kanagawa, Saitama and Chiba prefectures. New visualization techniques allow hazard and risk results for these areas to be viewed within mapping applications such as Google Earth. In what follows, we briefly discuss some of these features.

### Tephra dispersal modelling using *TEPHRA2*

The tephra dispersal catalogue contained within *TokioKazanRisk* was developed with the use of *TEPHRA2* – an analytical tephra advection and dispersion model developed at the University of Southern Florida. Using stratified wind speed and



**Figure 2.** The six volcanoes and four prefectures considered within *TokioKazanRisk*

direction information, *TEPHRA2* calculates particle diffusion, transport, and sedimentation and estimates tephra accumulation at specified locations surrounding the source location (for more information see Bonadonna et al. 2005; Connor et al. 2001).

Extensive calibration was carried out to refine the constants used in *TokioKazanRisk*. In particular, the Hiei eruption was intensely studied. Parallel computing techniques were utilised to simulate large numbers of eruptions for each volcanic centre. Wind speed and direction profiles with height were sampled randomly and volcanological parameters selected from magnitude/frequency curves developed to describe previous activity, current eruption trends and to account for the volcanoes inherent future unpredictability. Hazard results with corresponding probabilities are stored within *TokioKazanRisk* on a 1 km mesh grid.

### Sampling extreme events

Volcanic centres are capable of producing explosive volcanic events that may vary by up to five orders of magnitude. Traditional hazard modelling samples a fixed

time period and simulates the expected events within this period. Using this approach, all events are assigned an equal probability of occurrence and therefore small magnitude events are sampled preferentially.

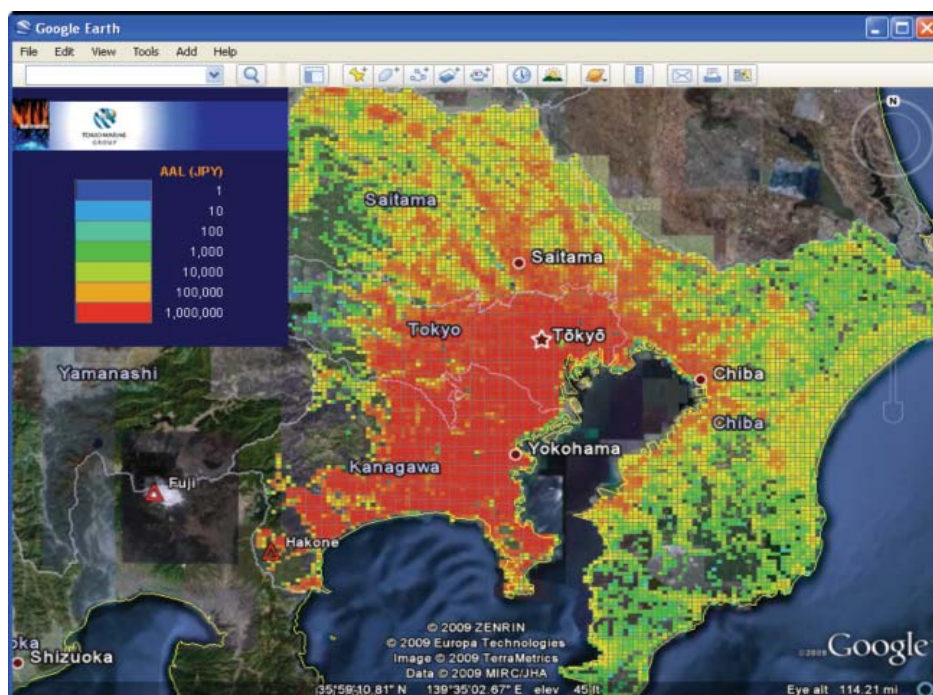
In developing magnitude/frequency relationships, event magnitude is represented by tephra volume, which we assume has a direct logarithmic relationship to the Volcanic Explosivity Index (VEI) scale (Newhall and Self 1982). In the modelling carried out to create the *TokioKazanRisk* tephra catalogue, VEI is sampled uniformly with probabilities retained and utilised in later calculations. This methodology is more economic in its storage requirements and provides better sampling of the entire range of eruption possibilities.

### Risk calculation

*TokioKazanRisk* currently focuses on two major outcomes from air-fall tephra – building damage and the necessity for clean-up activities. Exposure information is either a user portfolio or the included database that describes building characteristics, roads and land-use on a 1 km grid covering the entire Greater Tokyo area. This database incorporates an extensive survey of buildings, where characteristics including building condition and roof construction were collected by Risk Frontiers.

Building damage and associated losses due to three causes are calculated:

- structural damage - the partial or complete collapse of buildings due to the weight of tephra.
- non-structural damage - the corrosion and abrasion to walls, roof surfaces and exterior fittings caused by tephra particles.



**Figure 3.** Average Annual Loss mapped at 1000 m intervals

- clean-up costs - the removal, transport and disposal of tephra from properties and the cleaning of building exteriors.

### Visualising probabilistic hazard and risk

Probabilistic hazard and risk results for particular locations may be plotted against their annual probability of exceedance or average recurrence interval. Statistics, such as average annual loss (Figure 3) or expected annual probability for a given volume of tephra, can also be recovered and the output presented in Keyhole Markup Language (KML) allowing easy mapping within applications such as Google Earth.

### A platform for hazard management

As well as building damage, *TokioKazanRisk* calculates impacts to various land-usage types, e.g. the built environment, agricultural areas and roads. The probable volumes of tephra to fall on each of these land use categories are calculated and, in the case of roads and the built environment, the model estimates the personnel, equipment and hours needed for clean-up activities (Figure 4). Data analysed to allow these calculations were provided by the Kagoshima and Tarumizu City Halls who have experienced frequent tephra-fall events from Sakurajima volcano in Kyushu.

To aid in emergency management planning, individual eruption scenarios may be mapped with hazard presented on a mesh grid. This allows for various scenarios to be studied in detail.

The modular nature of *TokioKazanRisk* means that the model will be a useful tool for many future risk applications. By incorporating additional exposure and vulnerability information, probabilistic estimates of impacts to utilities, transport, agriculture, business and health can all be made.

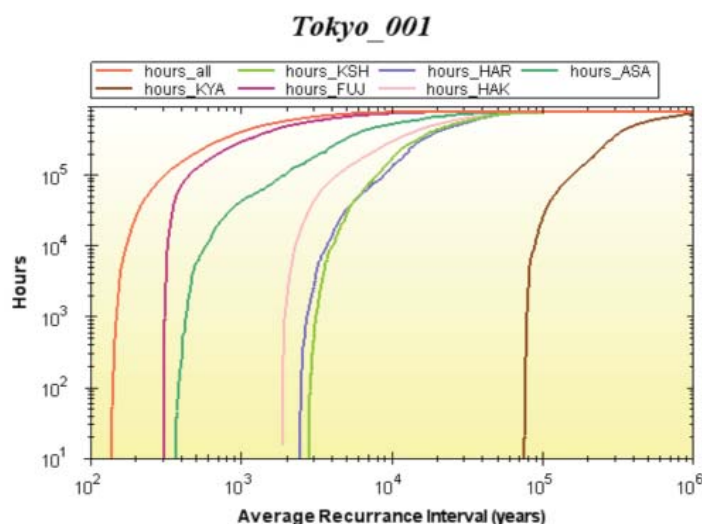
### References

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**Figure 4.** Vehicle hours for cleaning against Average Recurrence Interval by volcanic centre

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## RISK FRONTIERS SEMINAR SERIES 2009

will be held on

**Tuesday 27th October, 2009**

at the Museum of Sydney  
(cnr Philip & Bridge Streets, Sydney)

from 2.30pm until 4.40pm  
(followed by light refreshments in the adjacent foyer)

The proposed topics this year are:

- Severe thunderstorm windfields  
*by Matthew Mason*
- Risk Frontiers' new modelling platform and FireAUS loss model  
*by Joel Maranhao & Felipe Dimer*
- Observations and lessons from the 2009 Victorian Fires  
*by Brian Ashe, Keping Chen & Katharine Haynes*
- New earthquake ground motion models for Australia  
*by Paul Somerville*



RISK FRONTIERS SEMINAR SERIES 2009

Registration Forms will be available from our website [www.riskfrontiers.com](http://www.riskfrontiers.com) late September if you don't receive one in the mail

# The 2009 Victorian Bushfires Royal Commission released its Interim Report on Monday the 17th of August

by Dr Katharine Haynes

The report contains no revelations, its aim is to present the initial and most salient findings for greater public safety prior to the 2009/2010 fire season. The final report is due in July 2010.

Copies of the Interim Report can be downloaded from: <http://www.royalcommission.vic.gov.au/Interim-Report>

Outlined below is a brief summary of the recommendations which relate directly to public safety.

## Warnings and Information

Fire agencies have been charged with greater responsibility to provide education and warnings to the public prior to and during bushfires. Criticisms after the 2009 fires centred on the need for more location specific, real time information on the bushfire and how people should respond.

The Bureau of Meteorology will be responsible for issuing a bushfire danger alert system, similar to that for cyclones. The scale will represent the potential for bushfire to cause deaths and property damage, which it is hoped will better inform people's decision to evacuate early or defend their homes.

The report recommends reintroducing the Standard Emergency Warning Signal to draw attention to broadcast warnings and to extend the warnings to commercial radio and television. Sirens will also be introduced into communities that wish to have them.

In addition agencies will be required to provide more detailed information to individual property owners on the defendability of their homes, with a particular responsibility to identify those which are undefendable.

## The "prepare stay and defend or leave early policy"

The policy position remains as is, however, there will be a greater emphasis placed on early evacuations as the safest response and also the considerable effort needed to prepare a property and make it defensible. The language used in the report is that of 'relocation' rather than 'evacuation'. It is hoped that the suggested improvements in warnings and clearer messages about fire severity levels will aid decision making and relocations. There is recognition of the need to inform people of the physical effort and emotional strain on those who defend and that often more than one person is required. The report states that the risks of defending should be spelt out more plainly, including the risk of death. Children, older people and the infirm are identified as vulnerable and it is suggested that they should relocate early.

The report notes that there was no state-wide bushfire policy requiring government schools to evacuate, close or use a fire refuge in event of fire. However, since 7 February, the Department of Education and Early Childhood Development (DEECD) has implemented significant policy changes which include a procedure for school closures on total fire ban days and days of extreme fire risk and a safety audit of refuges in schools in the Eastern and Northern Metropolitan Regions.

The report advises the use of community refuges, where people may shelter nearby if they are unable to evacuate early or defending becomes untenable. These may include areas of open ground or highly resistant structures. The State will now start identifying appropriate sites for the next bushfire season and will educate the public about the appropriate use of refuges. The CFA is recommended to give priority to defending these public refuges during the passage of a fire front.

Initial criticism of the report has mainly focused on what is not included, in particular the lack of 'finger pointing' for the deaths and damage on 7 February. From our point of view the recommendations are sensible and as expected. We particularly support the emphasis on raising awareness about the efforts needed in preparation for defence and the danger to be expected by those who stay to defend. While improving warning systems and the technology to deliver them is a logical and necessary approach, past experience shows us that they do not bring about the immediate changes in behaviour we hope for. For this we need a much longer term programme of risk reduction.

Encouraging early 'relocations', in the light of the black Saturday bushfires, is sensible. However, fires are dynamic, warnings are sometimes late or impossible to give, sirens will occasionally fail and people often wait until they are directly threatened before taking action. Previous bushfire tragedies have taught us that most people do not leave early and many are caught while attempting late evacuations. Therefore, people also need to recognise when this preferred option is no longer available. Community refuges are prudent, but will the CFA always be able to defend them? Will people always be able to get there? School closures will now occur, but would some children be safer at school, particularly if the school was a designated refuge?

The literature is filled with the lessons from past events where too much reliance on technology, warnings and emergency personnel led to even greater disaster. Australia is a world leader in community reliance and resilience; we hope this will not be lost.

