

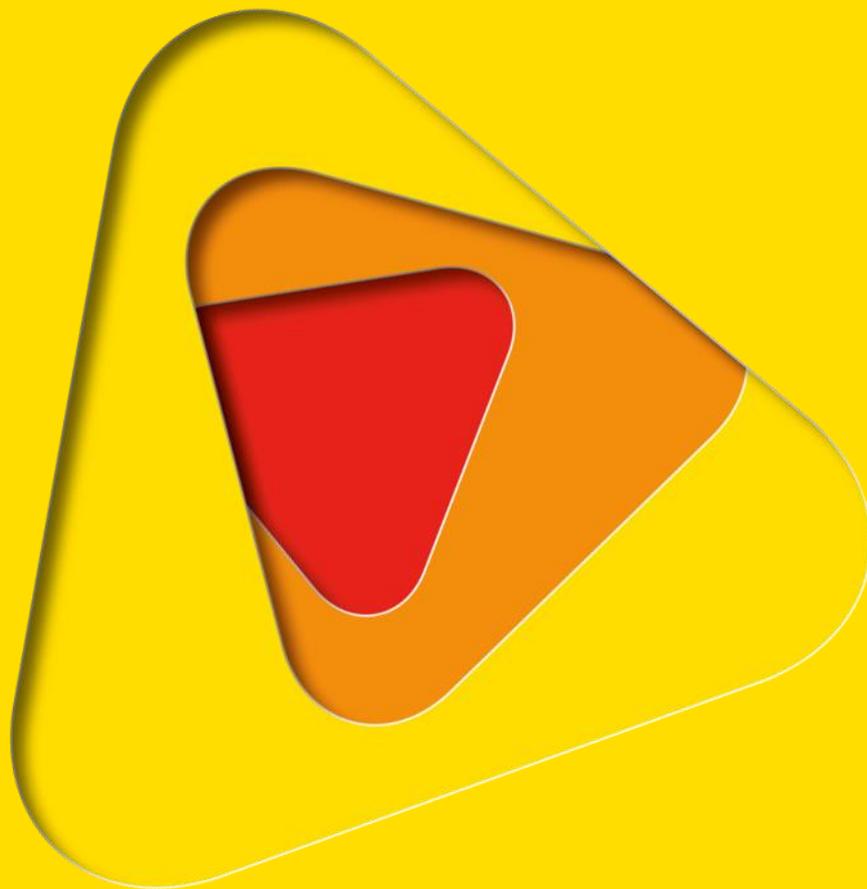


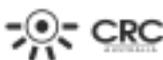
# PRE-DISASTER MULTI-HAZARD AND ECONOMIC LOSS ESTIMATION MODEL

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Bushfire and Natural Hazards CRC

**Annual Report 2014**





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## Project Summary

The economic impacts are often overlooked in management planning as they are not immediately felt and focus is put onto emergency response systems. In Australia, the disaster management arrangements across all stages (mitigation, preparedness, response and recovery) have proven to be very successful at saving lives and property. However, in terms of the adverse economic impacts of the natural disasters, less attention and resources have been allocated. In Australia, natural disasters are estimated to cost an average of AU\$1.14 billion annually. This makes natural disasters a significant issue for policy makers.

One of the substantial problems identified which increases this problem is the inability to estimate the full economic impact of natural hazards, considering all the affected sections of the economy. This effort should take into account not only the primary effects of the natural disasters, but also its lingering, all-important secondary effects due to the pervasive losses throughout the economy emanating from various sectors within the economy.

To address this problem this project has identified at least two major requirements that seek immediate attention to bridge the related gap. Firstly, a disaster risk assessment system needs to be developed which provides adequately quantifiable potential damages as a result of different types of disasters for regions of Australia. Secondly, a framework needs to be established to estimate the indirect economic losses. With the identification of the disaster-specific potential damage and losses, policymakers at different levels will be able to formulate disaster risk reduction-inclusive development policies to mainstream disaster resilience practices. Hence, modelling the potential impacts of a full range of natural disasters remains highly critical towards designing more informed national economic policies.

## 1. Introduction

History portrays numerous natural disasters that not only reshaped topographical settings but also have bearings on the economic structures of many countries, including Australia. The economic impacts are often overlooked in management planning as they are not immediately felt and focus is put onto emergency response systems. In Australia, the disaster management arrangements across all stages (mitigation, preparedness, response and recovery) have proven to be very successful at saving lives and property. However, in terms of the adverse economic impacts of the natural disasters, less attention and resources have been allocated.

In Australia, natural disasters are estimated to cost an average of AU\$1.14 billion annually (BTE, 2001). This statistic, which includes the costs carried by individuals, governments, businesses etc., along with the rapid economic growth in Australia, makes natural disasters a significant issue for policy makers. One of the substantial issues identified in this connection is the inability to estimate the full economic impact of natural hazards, considering all the affected sections of the economy. This effort should take into account not only the primary effects of the natural disasters, but also its lingering, all-important secondary effects due to the pervasive losses throughout the economy emanating from various sectors within the economy.

At least two major research gaps have been identified that seeks immediate attention to bridge the related gap. First, a disaster risk assessment system needs to be developed which provides adequately quantifiable potential damages as a result of different types of disasters for regions of Australia. Second, a framework needs to be established to estimate the indirect economic losses. With the identification of the disaster-specific potential damage and losses, policymakers at different levels will be able to formulate disaster risk reduction-inclusive development policies to mainstream disaster resilience practices. Hence, modelling the potential impacts of a full range of natural disasters remains highly critical towards designing more informed national economic policies. An immediate intervention in this regard is indispensable to increase the level of disaster risk resilience of the Australian economy.

To move from reactive response to a proactive risk reduction culture, this research program will be a pioneering effort in mainstreaming disaster risk reduction (DRR) measures into the economic development process. The overall objective of the research project titled- 'A pre-disaster multi-hazard damage and economic loss estimation model for Australia' is to build a scenario-based pre-disaster multi-hazard damage and economic loss estimation model to support decision makers in reducing disaster risks.

Australia is the primal beneficiary of this research on a number of levels. First, at the national level, the research will investigate the economic impact of natural disasters on the growth of sectors in the Australian economy such as agriculture, forestry and fishing, mining, manufacturing, utilities, construction, retail trade, transport, health care etc. At the state level in Victoria, in addition to the national benefits, the research will assess the multi-hazard risks for the three natural disasters of bushfires, floods, and earthquakes and will estimate the potential damages and economic losses created by these events. This will enable the identification of optimum economic policy options to recover or minimise such adverse effects.

## 2. The Project

The overall goal of this research program is twofold. First, it will estimate the heterogeneous effects of different types of natural disasters (i.e., bushfires, floods, storms, and earthquakes) on both national and state level economic growth in Australia. Second, it aims to conduct a pilot study to compile the multi-hazard and vulnerability maps of the State of Victoria, which will facilitate quantifying potential disaster damage and losses and their relationships with the regional economic growth parameters in Australia. In particular, the proposed research program consists of the following two components:

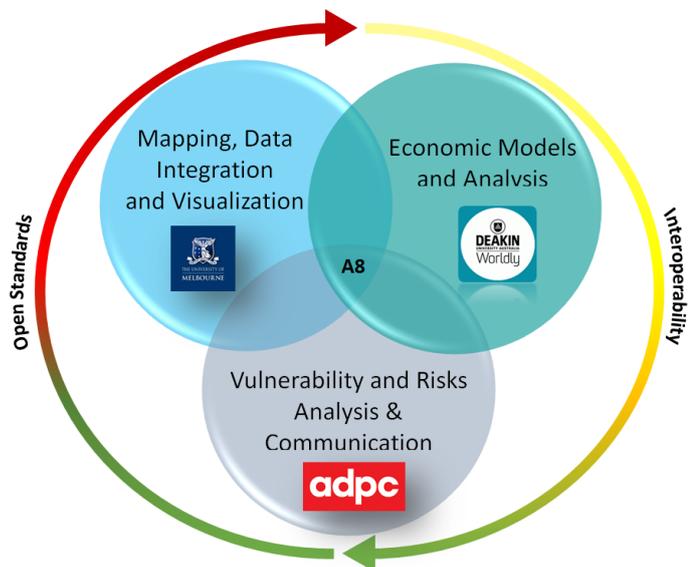


Figure 1: Project Consortia- Synergies between the Research Partners;

- I. *Component A-* on the nexus between different types of natural disasters and sector-specific economic growth in Australia:
  - Compilation of natural disasters related dataset for Australia
  - Collecting sector-specific dataset on economic activity at the state level
  - Specification of the estimation framework and preparation of the estimation results
  - Preparation of the research paper
- II. *Component B-* on the development of Pre-Disaster Multi-Hazard Damage and Loss Estimation Model that involves the following steps:
  - *Step 1-* Compilation of multi-hazard maps for Victoria: A thorough literature survey along with a series of consultations with government agencies as well as technical institutions and specialists will be conducted at an early stage of the project implementation to ensure that the most up-to-date and widely accepted hazard maps for earthquakes, bushfires, and flooding for Victoria are utilized.<sup>1</sup>
  - *Step 2-* Exposure Database Development: An initial consultation and data collection from secondary sources (such as the Australian Bureau of Statistics and the Department of Planning and Community Development, Victoria State) will be done in order to build a geographic database of the exposed elements within Victoria. Ground-truthing activities will also be carried out on a random, but systematic basis to verify the data collected from secondary sources and to obtain any missing data.
  - *Step 3-* Vulnerability Assessment: The vulnerability often is defined by a mathematical relationship between the hazard intensity and the expected degree of damage, hence the

<sup>1</sup> The earthquake hazard maps by Geoscience Australia (2012), bushfire hazard studies by Blong (2000, 2005) and the Victorian Bushfires Royal Commission (2009), and the flood hazard maps and other information from the National Flood Risk Information Program (NFRIP) by Geoscience Australia represent examples of available research studies.

term “fragility curves” or “damage functions.” Our research team will review these existing damage functions and determine if they are applicable to the context under which the proposed research for Victoria will be conducted.<sup>2</sup>

- *Step 4- Risk Assessment:* The hazard, exposure, and vulnerability will be combined geographically and analytically. The results will be a presentation of the risk, in terms of physical and direct monetary damage, pertaining to administrative units of Victoria.
- *Step 5- Integration of Risk Assessment Data into the Macroeconomic Model:* This program will identify an ideal macroeconomic model for incorporating natural hazard induced indicators that will enable estimating the potential economic losses caused to different sectors including production, infrastructures, social and cross-cutting sectors (e.g., environment, culture, public administration, banking and finance). This macroeconomic model will facilitate long term economic policies addressing DRR.

As a result, in order to achieve a paradigm shift from reactive response to a proactive risk reduction culture, this research program is a pioneering effort in mainstreaming disaster risk reduction measures into the economic development process.

Given its multi-disciplinary nature, this research borrows scientific methods from Engineering and Economics disciplines. First, it takes a geographic information system (GIS) as a tool to develop a multi-hazard risk assessment map for Victoria. In this regard, we are likely to use the IDDSS as a geospatial platform to store, update, analyse, and visualise data including hazard perception and vulnerability maps for bushfires, floods, storms and earthquakes in order to obtain a multi-hazard vulnerability map of the state of Victoria, which will provide estimates on potential physical *damage* against a set of possible disaster scenarios. This platform is also capable of displaying the indirect economic *losses* that would be derived from a macroeconomic model. In particular, we follow a *four-step-procedure* to develop this multi-hazard risk assessment platform.

At first, available multi-hazard maps for Victoria would be compiled. A thorough literature survey along with a series of consultations with government agencies as well as technical institutions and specialists will be conducted at an early stage of project implementation to ensure that the most up-to-date and widely accepted hazard maps for earthquakes, bushfires, and flooding for Victoria are utilized.<sup>3</sup>

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<sup>2</sup> For existing vulnerability studies for Australia, see, among others, the Department of Natural Resources and Mines, the State of Queensland (2002); and Australian Earthquake Engineering Society (2006).

<sup>3</sup> The earthquake hazard maps by Geoscience Australia (2012), bushfire hazard studies by Blong (2000, 2005) and the Victorian Bushfires Royal Commission (2009), and the flood hazard maps and other information from the National Flood Risk Information Program (NFRIP) by Geoscience Australia represent examples of available research studies.

In the second step, an initial consultation and data collection from secondary sources (e.g., Geoscience Australia for National Exposure Dataset- NEXIS, the Australian Bureau of Statistics, and the Department of Transport, Planning and Local Infrastructure, The Victorian Government) will be made in order to build a geographic database of the exposed elements within Victoria. Ground-truthing activities will also be carried out on a random, but systematic basis to verify the data collected from secondary sources and to obtain any missing data.

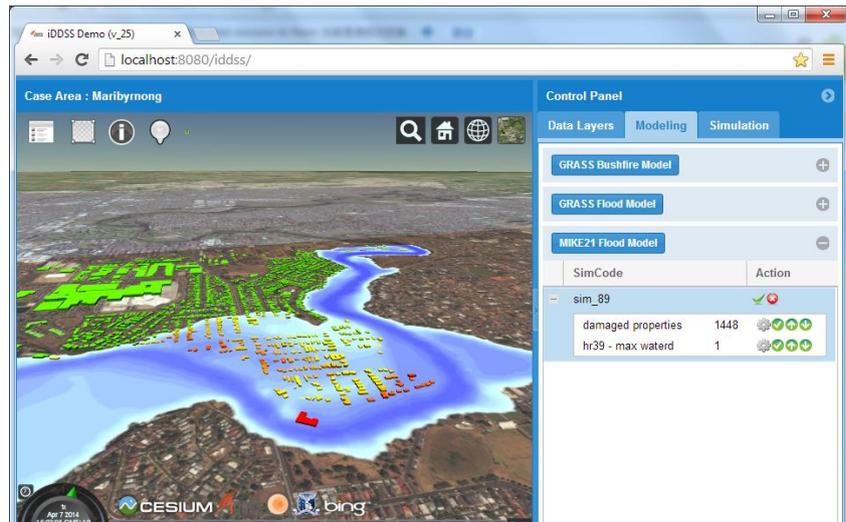


Figure 2: Screenshot of an Intelligent Disaster Decision Support System (IDDSS)

In the next step, the vulnerability assessment will be conducted in the context of Victoria. Finally, the hazard, exposure, and vulnerability information will feed the IDDSS platform through which a comprehensive “Vic-Multi-Hazard Risk Map” will be developed. The results will be a presentation of the risk, in terms of physical and direct monetary *damage*, pertaining to administrative units of Victoria.

### 3. Project Activities

- The final contract was signed in May 2014.
- As this project involves a joint collaboration of three parties including- University of Melbourne, Deakin University and Asian Disaster Preparedness Centre, an initial meeting was organised among all collaborators on 5-7 May 2014. In particular, we have discussed on the following issues:
  - ADPC colleagues presented the best practices on how to develop the hazard and vulnerability risk assessment map;
  - The University of Melbourne team presented on how the hazard and vulnerability risk assessment map can be incorporated into an intelligent disaster decision support system. This will enable the decision-makers to visualise the hazard-specific scenario based potential damage spatially;
  - The Deakin University team explored the possibility of retrieving necessary information to feed the possible macroeconomic model that will estimate the associated economic losses given the potential level of damage.
  - Once both the direct damage and indirect losses are estimated, the team will explore the possibility to show the overall impact of possible disasters using a spatial platform so that policymakers can get crucial insights on how to maximise social welfare by utilizing limited resources; and
  - The team discussed establishing a dedicated webpage for this project for reaching a wider audience and possibly coming up with a unique logo for the project.

- The Deakin University Team has appointed one of the Research Fellows for our project. Dr Habibur Rahman, who has an Economics background, has been appointed as RF and he will be part of the economics research team working in this project. As part of the work, Habib will spend one day a week in Melbourne University to work closely with the spatial research team. The Melbourne University Team has also nominated Dr Benny Chen with Spatial and strong programming background as another RF for this project.
- Now that we are able to appoint our researchers, we are planning to organise a meeting tentatively on 15 July 2014 with all our end users in the near future to familiarise you with the detail of project, and discuss the work program and what the project will deliver, and how the outcomes could be applied in the emergency management sector and your direct involvement. We will be in touch soon to coordinate a time for this meeting.
- We will make a presentation in the Australian Fire and Emergency Service Authorities Council (AFAC) conference 2014, which will be held in Wellington on 2-5 September 2014.
- On behalf of the project team, on 23 May 2014, A/Prof Mehmet Ulubasoglu and Habib have participated in a workshop of the Attorney General's Department and the CSIRO titled- 'Mitigation Investment Workshop'.
- The team has discussed with Prof Roger Jones the Lead Investigator of project "Mapping and understanding bushfire and natural hazard vulnerability and risks at the institutional scale" which is another project within our Economics and Decision Making Research Cluster, and we expect to set a meeting with the Experts of Centre of Policy Studies (COPS), who are now based at Victoria University. The main objective of this model is to learn and review what has been done in terms of integrating natural disaster shocks into the macroeconomic model.
- In the CSIRO workshop our team also met with some economists from the Productivity Commission, who contributed to the recent inquiry of the Commission on natural disasters, mitigation and recovery. Productivity Commission is the federal government agency dealing with policymaking on effective microeconomic reforms. We alerted them about our project, and they were keen to hear about it.
- The day before the CSIRO workshop, the research team also met with Dr Matthew Mason (from QUT) one of the Lead Researchers on the Disaster Scenario project within the same stream. We have discussed our projects and also potential collaboration between the two projects.
- On behalf of the team, on 11 June 2014, Prof. Abbas along with Habib have presented our project to an AFAC Business Management Group meeting.
- On Component A of the project, the team has accessed the Bureau of Infrastructure, Transport and Regional Economics (BITRE) dataset. In addition, the team has also collected the historical rainfall dataset for the period 1979 - 2010 from GPCP, NASA. The next step is to explore and extract the necessary information from various sources. This component will be executed in parallel to the Component B.

#### **4. Publication list**

- A paper titled- "A pre-disaster multi-hazard damage and economic loss estimation model for Australia" has been accepted for presentation in the upcoming AFAC 2014 conference that will be held on 2-5 Sep 2014 in Wellington.

## **5. List of current integrated project team members**

### **5.1 Researchers**

- Professor Abbas Rajabifard (Lead), The University of Melbourne
- Associate Professor Mehmet Ulubasoglu (Co-lead), Deakin University
- Associate Professor Nelson Lam, The University of Melbourne
- Dr. Mohsen Kalantari, The University of Melbourne
- Dr. Prasad Bhattacharya, Deakin University
- Dr. Benny Chen, The University of Melbourne
- Dr. Katie Elizabeth Potts, The University of Melbourne
- Dr. Muhammad Habibur Rahman, Deakin University
- Dr. Peeranan Towashiraporn, Asian Disaster Preparedness Centre (ADPC)

### **5.2 End users**

- Mr Ed Pikusa and Ms Vicki Cornell, South Australia Fire and Emergency Services Commission
- Ms Samantha Ward, Attorney-General's Department
- Dr Martine Woolf, Geoscience Australia
- Mr Stuart Midgley, New South Wales Rural Fire Service
- Mr David Launder, SA Metropolitan Fire Service

### **5.3 Students**

- TBA