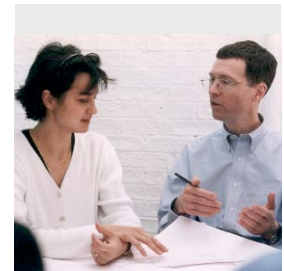
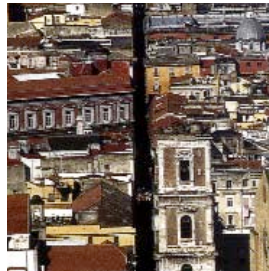
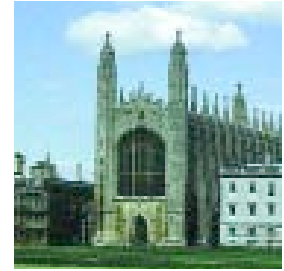


# GEVES

Global Earthquake Vulnerability Estimation System



CAMBRIDGE  
ARCHITECTURAL  
RESEARCH  
LIMITED

# CAR

# An Innovative System

GEVES is a model for estimating losses to property portfolios from earthquake ground shaking. Designed for insurance and reinsurance applications, GEVES currently provides country-specific estimates for 32 countries and territories of primary interest to the industry. GEVES is designed to be integrated with clients' existing earthquake occurrence models to upgrade their loss estimation capability, or to be used on a stand-alone basis to estimate losses from a given event.

## What is special about Geves?

Seismic hazard modelling has over the years developed a high degree of standardisation across different territories to meet the needs of companies with multinational portfolios. However, when it comes to vulnerability modelling, standardisation has often been achieved only by limiting detailed country-specific data. CAR believes that as a result of this the wealth of data available on building stock vulnerability worldwide, and the important differences between countries, have not been fully exploited by catastrophe modellers. GEVES is designed to address this deficiency by incorporating detailed information on local building characteristics and seismic performance within a uniform loss estimation methodology and a standardised format.

## The GEVES approach

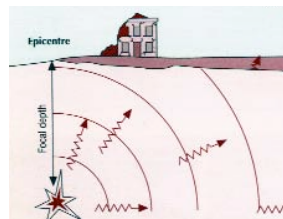


EEFIT Damage Survey Team

GEVES is primarily based on observed damage rather than calculated damage, and uses Modified Mercalli Intensity (MMI) as the principal measure of ground motion rather than spectral displacement. The reason for this is that while observed damage data are available from many countries and many historic events, the structural data needed for the calculated approach are not widely available. Recent evidence also suggests that the calculated damage approach tends to over-estimate losses significantly. By using the observed damage approach, the GEVES model is robust across the range of territories covered, as well as differentiating itself from many other models on the market, allowing users to compare results and adopt different insurance pricing strategies.

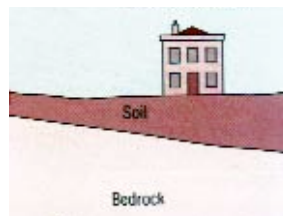
## Model elements

*GEVES brings together 5 principal elements to produce loss estimates for buildings, contents and aspects of business interruption, with estimates of uncertainty:*



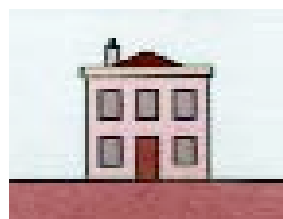
### GROUND MOTION ATTENUATION

A description of the tectonic environment of each country to fit user-defined earthquake scenarios.



### SOIL CLASSIFICATION

Information on ground conditions for the main cities within each country and their effect on ground motion.



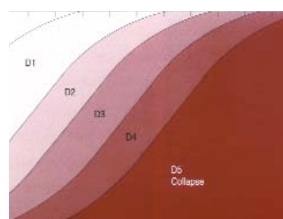
### CONSTRUCTION TYPOLOGY

A classification and description of the building stock, with up to 28 construction typologies for each country.



### USE CLASS MATRIX

A distribution for each of 14 residential, commercial and industrial use classes across the range of construction typologies.



### VULNERABILITY FUNCTIONS

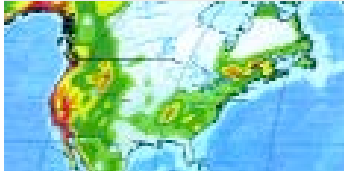
A mean damage ratio and a distribution among different damage states for each construction typology.

# Products and Services

## Regions, countries and territories

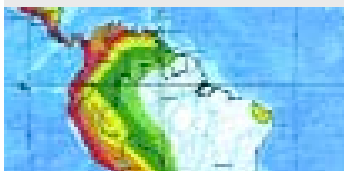
GEVES currently covers 32 countries and territories grouped into 7 regional sets:

### NORTH AMERICA



▶ CANADA  
USA  
CALIFORNIA  
HAWAII  
NEW MADRID  
WASHINGTON & OREGON

### LATIN AMERICA



▶ CHILE  
COLOMBIA  
MEXICO

### CARIBBEAN



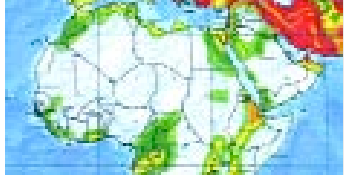
▶ CUBA  
DOMINICAN REPUBLIC  
JAMAICA & CAYMAN ISLANDS  
LEeward ISLANDS  
NETHERLANDS ANTILLES  
PUERTO RICO  
SOUTHERN LESSER ANTILLES  
TRINIDAD & TOBAGO

### EUROPE



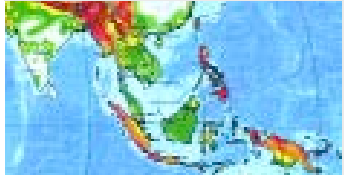
▶ GERMANY  
GREECE  
ITALY  
PORTUGAL  
ROMANIA  
SWITZERLAND  
TURKEY

### MIDDLE EAST & AFRICA



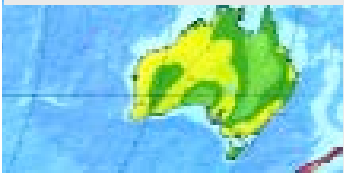
▶ ALGERIA  
ISRAEL  
SOUTH AFRICA

### EAST ASIA



▶ INDONESIA  
JAPAN  
PHILIPPINES  
TAIWAN

### AUSTRALASIA



▶ AUSTRALIA  
NEW ZEALAND

Seismic hazard maps derived from GSHAP

## A modular product



GEVES is a modular product. Clients may select individual country modules and build up their territorial coverage as their needs evolve. The model is

transparent and all data incorporated within it are accessible and can be copied by the user and then modified if required. The product is delivered with a comprehensive methodology manual, allowing all assumptions, algorithms and sources to be verified. CAR is committed to keeping its products up-to-date and will make damage data from new events available to its clients.

## A flexible contract

CAR offers straightforward contracts based on a single fee in return for an indefinite user licence. Country modules can be licensed individually, with discounts on the module price available for regional sets and additional savings for the system as a whole. The licence terms are liberal, allowing customers maximum flexibility to integrate GEVES with other in-house models and offer services to their clients under their own modelling brand.

## Consultancy services



CAR Directors Stephen Platt (right) and Luca Leone

GEVES is designed to be easily integrated with a wide range of in-house and proprietary earthquake occurrence models. Alternatively, CAR can develop such models on a consultancy basis. As a consultancy group, CAR can

respond flexibly to individual client needs by expanding the range of building use classes or construction types, developing new country modules, or modelling other perils. As well as earthquake, CAR has extensive experience of modelling a wide range of natural and man-made perils, including flood, volcanic eruption, tropical and temperate windstorm, subsidence, crime and unexploded ordnance.

# CAR Expertise

## CAR's risk management experience

CAR was founded by a group of experts from the Martin Centre for Architectural and Urban Studies, a research unit within the University of Cambridge. The Martin Centre has many years experience of research on the vulnerability of the built environment to natural hazards. Through its close links with the University, CAR is part of a global network of research institutions specialising in the risk management field, allowing CAR to access the most authoritative sources swiftly and economically and to achieve a truly global reach in its data gathering and risk analysis capability.

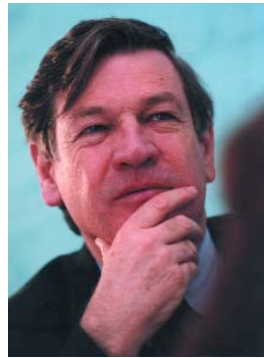


EEFIT Reports

CAR's established reputation in earthquake vulnerability studies has been founded on gathering performance data on buildings and infrastructure after major earthquakes. CAR experts have been prominent within the UK's Earthquake Engineering Field Investigation Team (EEFIT), which has carried out damage surveys worldwide. The first-hand data gathered throughout these surveys has allowed CAR to build up a databank of construction types and earthquake vulnerability around the world, a vital resource for CAR's many vulnerability modelling projects, culminating in GEVES.

CAR has over the years built up a prestigious and international client base, working on projects in some 25 countries and 5 continents. Private sector clients range from primary insurers, reinsurers and brokers to multinationals in the petrochemical, aerospace and transport infrastructure sectors. Public sector clients include national, regional and local governments, as well as international organisations such as the EU, UN and World Bank.

## The GEVES project team



Professor Robin Spence,  
Project Director for GEVES

GEVES was developed by CAR in collaboration with an international team of specialist consultants and regional experts, bringing together some of the best earthquake vulnerability expertise in the world. The GEVES project team was led by CAR Director Robin Spence, who is a structural engineer and a specialist in earthquake engineering. He is also Professor of Architectural Engineering at the University of Cambridge and President of the European Association of Earthquake Engineering (EAEE). Working to a reinsurance industry brief, the GEVES project team has produced a model which is finely tuned to the needs of the industry, and offers underwriters and risk managers a major refinement to earthquake loss estimation.

## About CAR



Cambridge Architectural Research Limited is an independent consultancy which provides specialist advice for a broad range of public and private sector clients involved in the development and management of the built environment. Founded in 1987 by architects, engineers, software developers and research-based academics at the University of Cambridge, CAR has established an international reputation for consultancy in a range of complementary sectors: Risk Management; Energy and Environment; Building Design and Use; and New Media Applications.

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Tel: +44 (0)1223 460475 Fax: +44 (0)1223 464142 Internet: <http://www.carltd.com/>  
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