Seismic Risk Modelling:
Do Insurances and the Scientific Community talk about the same?

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MunichRe - Geo
28th August 2006

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Motivation

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From “Aim of the MERCI workshop”:

“The potential of synergy between the present research initiatives by exchange of research ideas, results, data and tools is tremendous and could significantly improve future developments in the area. However, a prerequisite for this is that a certain common basis for the underlying modelling is established and that the communication between the involved research groups is strengthened.”

EQ Risk Modelling

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Why are university risk models only used for a very limited extend in insurance business?

- **EQ models for insurances have a kind of standard which meets the requirements of the business.**
- **There seam to be misunderstandings about the possibilities and requirements of insurances.**
- **Do we use the same language?**

Definition of Terms

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Stan Kaplan's Theorems of Communication

From the plenary Address at the 1996 Meeting Society for Risk Analysis

Theorem 1: 50% of the problems in the world result from people using the same words with different meanings.

Theorem 2: The other 50% comes from people using different words with the same meaning.

Usage of the Word RISK

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Colloquial
Danger
Venture
Opportunity

Technical
Hazard
Probability
Consequence

Insurance
Chance
Uncertainty

Jardine and Hrudley, 1997. “Mixed Messages in Risk Communication”

Definition of Risk

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- **Total Risk = Impact of Hazard * Elements at Risk * Vulnerability of Elements at Risk**

  (Blong, 1996)

- **Risk = Probability * Consequences**

  (Helm, 1996)

- **Risk = Hazard * Vulnerability * Value (of threatened area), Preparedness**

  (De La Cruz-Reyna, 1996)

- **$Risk_{(total)}$ = Hazard * Elements at Risk * Vulnerability**

  (Granger et al., 1999)

- **Risk is "Expected Losses (of lives, persons injured, property damaged, and economic activity disrupted) due to a particular hazard for a given area and reference period. Based on mathematical calculations, risk is the product of hazard and vulnerability".**

  (UN DHA, 1992)

Definition of Risk used by Munich Re

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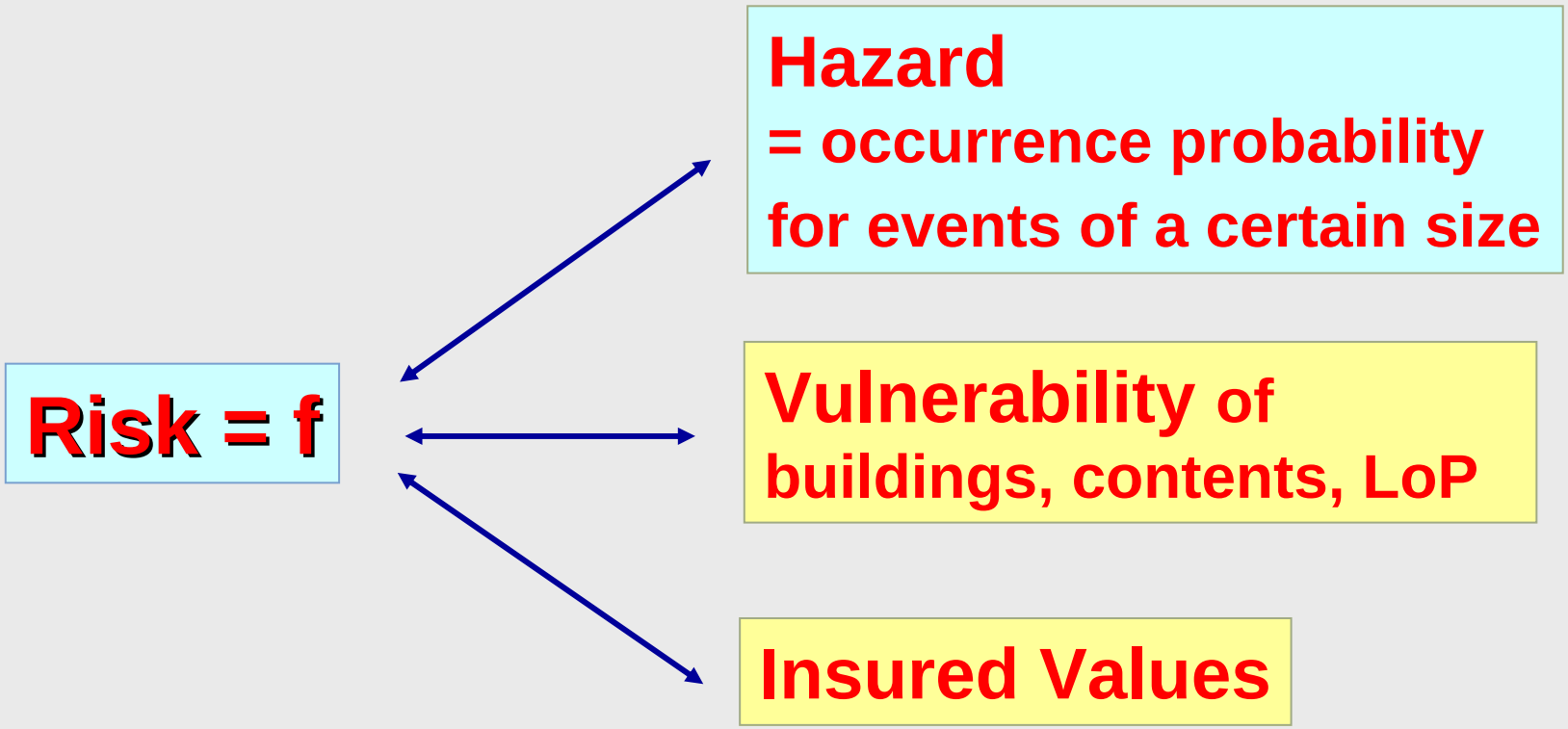

Natural Catastrophe Modelling

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Why do we use risk models?

- Representation of natural phenomena
  (severity, location, probability)
- Calculate the consequences of these phenomena
- Risk management (preparedness, mitigation)
- Estimate loss potentials

EQ Risk Modelling

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- **The methodology and parameters to be used vary with the purpose of risk modelling (i.e. mortality, disaster management, risk reduction, financial risk)**
- **In many cases, the losses to be modelled are not proper defined (i.e. Structural Loss (Percent of Damage or Rebuilding Costs?), Market Loss, Insured Loss, Economic Loss (including Live-Lines and LoP?)**

Player in EQ Risk Modelling

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EQ Risk Modelling is done by:

- **Consultants**
- **(Re)Insurances**
- **Brokers**

} **‘Insurance Business’**

- **Geol. surveys and public agencies**
- **Scientific groups/universities**

} **‘Science’ and public**

NatCat Risk Modelling for Insurance Business

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Insurance business uses NatCat risk models since the 80th

Some examples:

- **AIR since 1987**
- **Munich Re since 1987**
- **RMS since 1988**
- **EQECAT since 1994**
- **Benfield since 1999**

NatCat-Models at Munich Re

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Earthquake (25)

Australia
Belgium
Chile
Germany
Dominic.Rep.
Greece
India
Israel
Italy
Jamaica
Japan
Jordan
Canada
Colombia
Mexico
New Zealand
Philippines
Portugal
Puerto Rico
Slovenia
Taiwan
Turkey
China
Venezuela
Cyprus

Storm (12)

Belgium
Denmark
Germany
France
Great Britain
Hong Kong
Japan
Luxemburg
Netherlands
Austria
Puerto Rico
Switzerland

Flood (4)

Germany
Great Britain
Poland
Czech Republic

Storm Surge (3)

Great Britain
(Caribbean)
(USA)

Requirements

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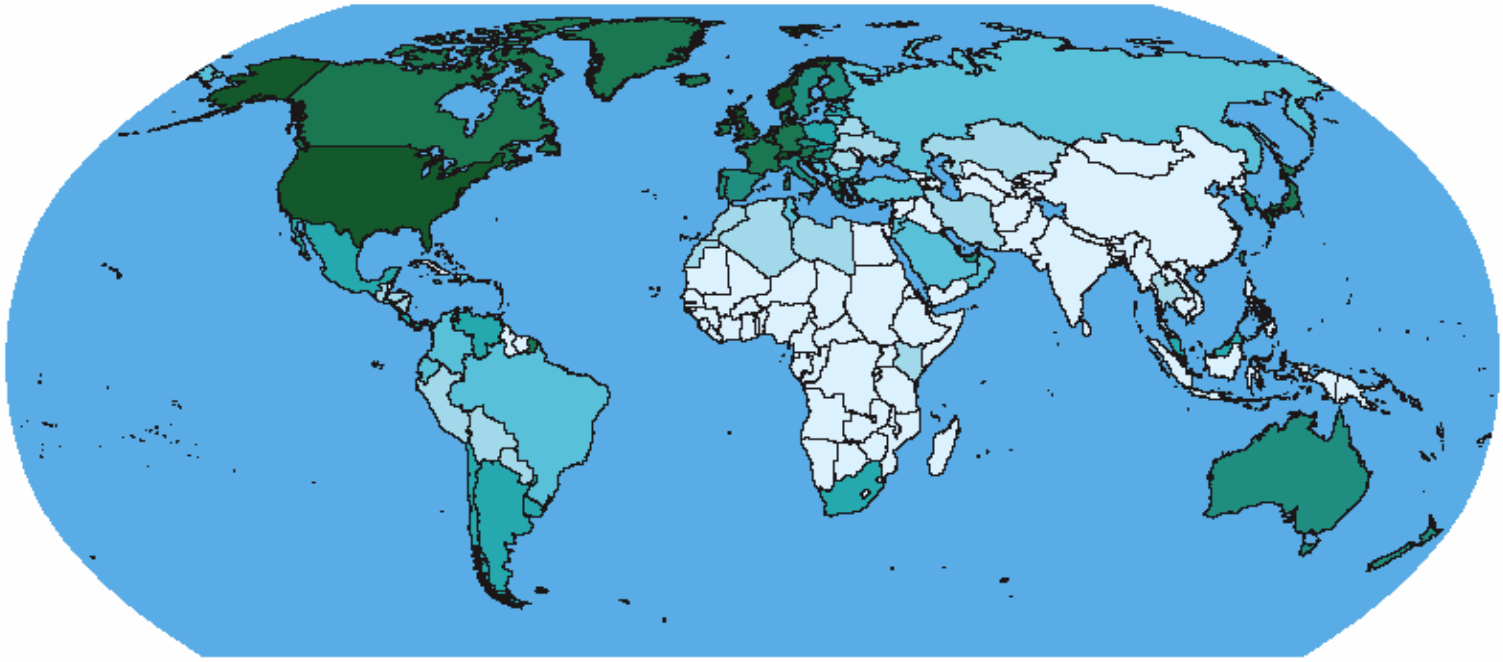
Development of Insurance Markets



Uninsured group
- US$ 0–5

Basically insured group
- US$ 6–25
- US$ 26–50

Well insured group
- US$ 51–100
- US$ 101–500
- US$ 501–1,000
- US$ 1,000+

Property insurance premium (non-life including health) per capita per year in US$
Source: MR Economic Research/NatCat*SERVICE*®

Detailed Risk Information

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In many cases research models require:

- **(GPS) coordinates**
- **Geotechnical information**
- **Building characteristics**
  - **Age**
  - **Height**
  - **Occupancy**
  - **Construction type**

CRESTA – An Insurance Standard

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CRESTA was set up by the insurance industry in 1977 as an independent organisation for the technical management of natural hazard coverage.

CRESTA's main tasks are:

- Determining country-specific zones for the uniform and detailed reporting of accumulation risk data relating to natural hazards and creating corresponding zonal maps for each country
- Drawing up standardised accumulation risk-recording forms for each country
- Working out a uniform format for the processing and electronic transfer of accumulation risk data between insurance and reinsurance companies

The CRESTA Format

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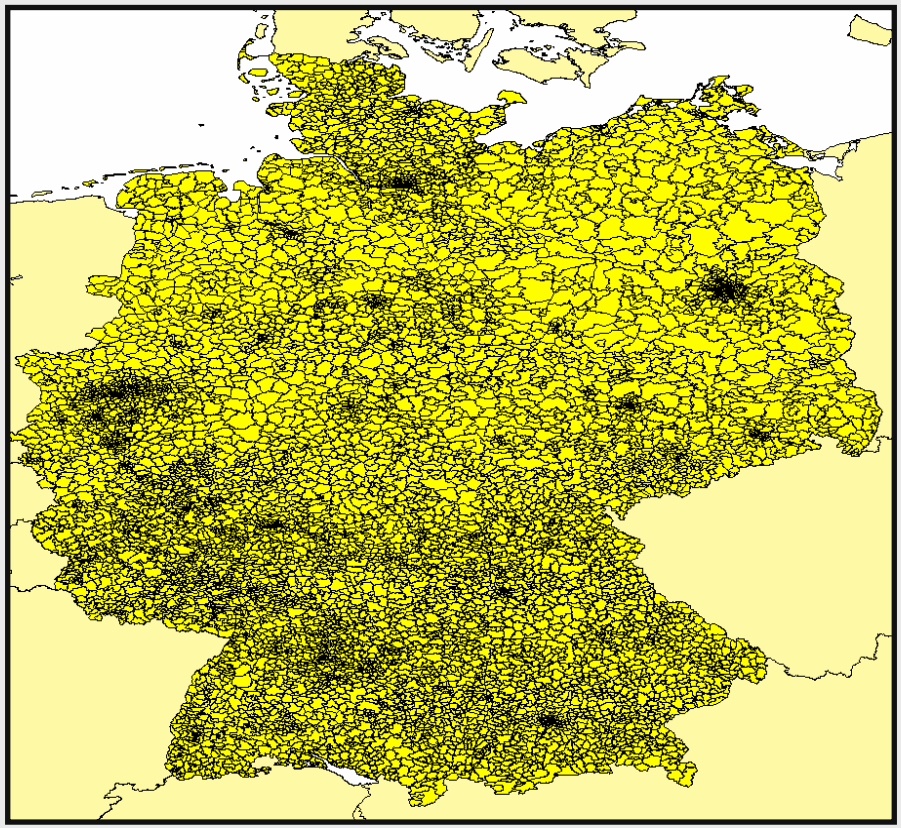
Germany – 8270 Zones



Greece – 16 Zones

Earthquake - Risk 1.0

Manual input of accumulation data (Modify-based): Japan

F	Oil+Petro Buildings	Oil+Petro Contents	Com.+Ind. Buildings	Com.+Ind. Contents	Loss of Profit	First Loss Oil+Petro(B)	First Loss Oil+Petro(C)	First Loss Com.+Ind.(B)	First Loss Com.+Ind.(C)	*Sum / Area:*
1 Hokkaido	20	15	40	40				40		*155*
2.1 Aomori	100	75	250	200				30		*655*
2.2 Akita	150	100	300	200				70		*820*
2.3 Yamagata	350	250	50	40						*690*
2.4 Niigata	130	100	400	300				60		*990*
3.1 Iwate	700	300	150	300				80		*1530*
3.2 Miyagi	150	100	600	500				80	45	*1475*
3.3 Fukushima	450	240	600	400						*1690*
4.1 Gumma	400	250	180	160						*990*
4.2 Tochigi	400	100	250	240						*990*
4.3 Saitama	200	40	14	12						*266*
4.4 Ibaraki	300							453		*753*
5.1 Chiba	4300	2300	4400	4200	500	100		4850		*20650*
5.2 Tokyo M.	2500	1000	3000	1500	300	50		850		*9200*
5.3 Kanagawa		800	1500	1300						*3600*
5.31 Kawasaki	2600		1500	1200	150	1500		8700		*15650*
5.32 Yokohama	1200		300	500	100	150		1600		*3850*
5.33 Rest Kan.	900	300		350	50	200		880		*2680*
6.1 Gifu	20	30		40	20			100	80	*290*
6.2 Nagano	350	200		800	60			250	200	*1860*
6.3 Yamanashi	140	100		1500	30			200	150	*2120*
6.4 Shizuoka	550	100		1200				1300	1000	*4150*
6.5 Aichi	700	400		1110	70			600	400	*3280*
6.6 Mie	300	100		1500	40			500	100	*2540*
Total sum:	16910	6900	13534	25592	5070	2000	0	20643	1975	**92624**

OK | Previous Page | Next Page | Calculate Sum | Currency Unit | Adjust % | Cancel All

Manual input of accumulation data. Press <Esc> to Quit.

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Scientific Risk Modelling

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- **Risk modelling requires input from a broad range of disciplines like earth sciences, civil engineering as well as from social, human and economic sciences, which makes it difficult to find a common sense.**
- **Research projects are often designed for a small area (i.e. one city), with a high resolution and/or focused on a detailed problem:**
    - **High computational requirements (run-time, memory)**
    - **Results are often difficult to adapt for insurance purposes**
- **There is a general tendency in modelling to increase the resolution and the number of parameters:**
    - **Does this really increase the quality of the models?**

Uncertainties in Risk Modelling

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- Event (location, size)
- Intensity (attenuation, directivity)
- Local influence (amplification, frequency)
- Risk information (building quality, location)
- Vulnerability (average damage, distribution)
- Loss (estimation of values, demand surge)

Damage Estimation

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Damage Estimation

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Vulnerability: Single Location

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Vulnerability: Material and Workmanship

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Verification and Comparison of Models

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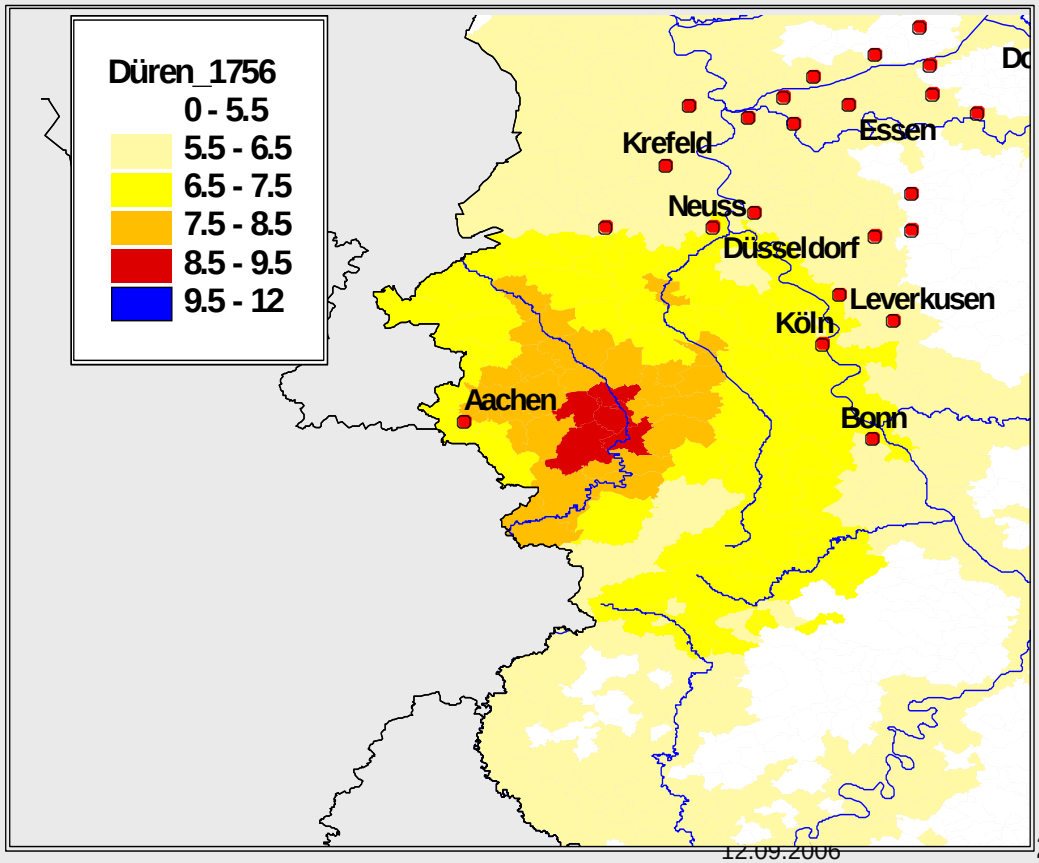
Modelling standards and earthquake scenario calculations are needed to verify and compare models:

- **Historic events**
- **Actual events**
- **Stochastic events**
- **Common sense**
- **Loss analysis after earthquakes**



Final Statements

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- All modelling groups benefit from a close cooperation
- Insurance modeller need new ideas from scientific groups to improve EQ risk modelling
- Scientific groups can benefit from the experiences of ‘insurance modeller’
- A better knowledge of the requirements, possibilities, and purposes of the other group would be helpful
- We need to reduce uncertainties in risk modelling
- We need to find modelling standards and better ways to verify and compare the modelling results

Thank you for your attention!

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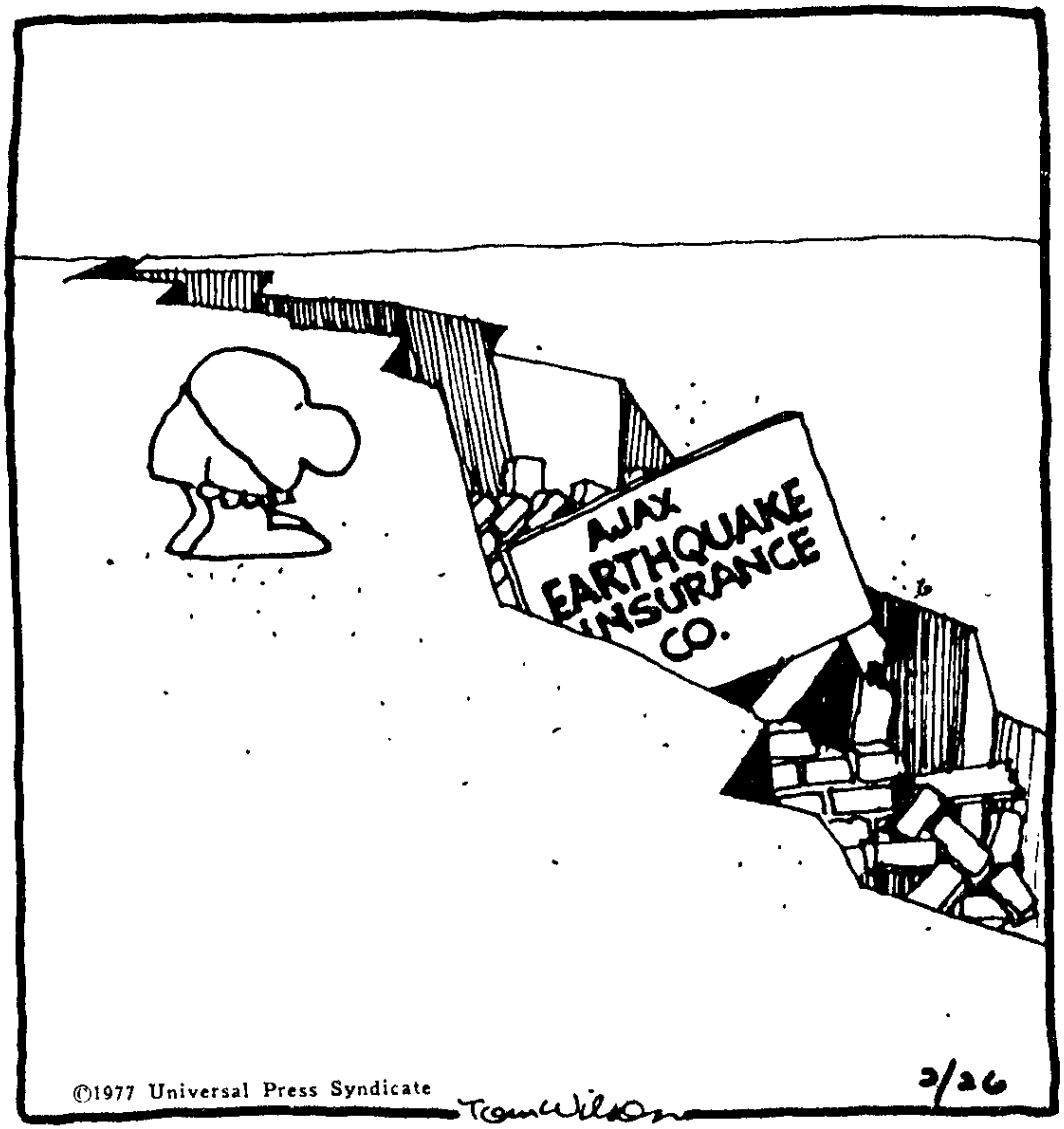

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