Geographical Information Systems (GIS) and their use in insurance underwriting

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Geo Risks Research Department
Munich Re, Munich

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Vigo, April 2006

Agenda

Munich Re’s Geo Risks Research Department
Risk Identification and Awareness
Risk Mapping
  - Geographical Information Systems (GIS)
  - Geocoding
Risk Analysis and Modelling
Using GIS for risk managing aquaculture
Tools and Services for Underwriters and Risk Managers
Summary/Discussion
Munich Re’s Geo Risks Research Department Organization (25 people)

CUGC 3 - Geo
Head: Prof. Dr. Höppe

CUGC 3.1 Earthquake and Flooding
Head: Dr. Smolka

CUGC 3.2 Storm/Weather/Climate
Head: E. Rauch

CUGC 3.3 Geoinformatics and Communication
Head: A. Siebert

Environment management
C. Wippich (Senior)

NatCatSERVICE
CatPMLSERVICE
MRRhazard

NATHAN
Geo-Data-Services (GDS)
Geo Risks Research Department – Main tasks

Research & Development

Risk Assessment and Damage Investigations
  • Consulting MR underwriters and clients regarding natural perils

Implementation of New Technologies in Risk Management
  • Geo-Information-Systems (GIS)
  • Geocoding

Tools and Services for Underwriters and Risk Managers
  • Know-how transfer to clients and markets
  • CD-ROM World of Natural Hazard
  • NATHAN (NATural Hazards Assessment Network)

Risk Identification and Awareness
Risk identification and awareness
Activities

- Collecting information on natural hazards and catastrophes to assess the influence on the insurance business
- Global network to the insurance industry and to (geo)scientists
- Statistics on historical events
- Damage investigations after major events
- „Screening“ information on emerging risks

Risk awareness
Identification of changes in threat and risk potential

Natural catastrophes

- Climate change
- Extreme weather conditions

- Megacities
- Increased accumulation problems due to enormous value concentrations
Great natural disaster statistics (1950–2005)
Losses are on the rise

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Geoscientific analysis and research
Significant increase in tropical storms in the Atlantic

Source: NOAA Coastal Services Center, Historical Hurricane Tracks/ http://hurricane.csc.noaa.gov/hurricanes
Hurricane Katrina: Loss examples
Casino Barges

Coastal storm and storm surge surveys – Field survey impressions using mobile GPS/GIS-units
New Orleans – Flood zones linked with insured risks using mapping tool

Impact Areas (as Defined by FEMA)
- Still Flooded as of Sept 09
- Flood Damage
- Catastrophic Damage
- Extensive Damage
- Moderate Damage
- Limited Damage
- Railroads
- Major Floods

Risks in Damage Zones
- Risks in Flood Zone
- Limited Damage
- Not FEMA Classified

Sources:
teleatlas.com
esri.com
digitalglobe.com
fema.gov

Coastal storm and storm surge damages – Field survey impressions
Risk Mapping

Geographical Information Systems (GIS)
Geocoding
### Principles of GIS
**Combining Maps and Databases**

#### Thematic Layer Model

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**Sum Insured**
- < 50 m. €
- 50 – 100 m. €
- > 100 m. €

**Themes**
- Exposure data
- Tornado
- Hailstorm
- Lightning
- Flood
Principles of GIS
Data Sources

Aerial and satellite imagery
Insurance data (liabilities distribution)
Socioeconomic data
Geocoding-tools (e.g. GPS)
Hazard data
Claims and event information

GIS technology

Improved risk transparency

Combining insurance and hazard data
Needs and roles

Insurers
Brokers
Reinsurers

Scientists
Consultants
(Reinsurers)
(Brokers)

Insurance data
- Exposures
- Losses

Hazard data
- Natural perils
- Man-made risks
Geocoding
The workflow of geocoding insurance risks

>> Structured cedant data
>> Geocoding
>> Mapping

Addresses in any spreadsheet or database can be geocoded
Automatic process to attach coordinates to an address
Illustrate where your risks (addresses) are located

Geocoding
Data quality – Different levels of risk granularity

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2-digit postcodes (yesterday)
5-digit postcodes (today)
Address level (today/tomorrow)
Geocoding
Data quality – Suitability for risk analyses

- over 85% of insurance data has a local component
- monitor and identify accumulation of risks; supporting exposure budgeting
- improve risk assessment by modelling
- get more transparency to be able to make risk-adequate decisions
- risk adequate capital allocation and transparency of resource consumption
- demand oriented purchase of reinsurance (capacity and price)

Costumer Portfolio Management

- increase efficiency in loss adjustment (improving claims management)
- outline the extent of damage areas to survey losses
- detect crime misuse
- prevent claims and improve cost effectiveness

Sales and Marketing

- optimize sales territory
- identify market potential
- target marketing campaigns
Risk Analysis and Modelling

- Risk assessments for treaty and facultative property business
- Assessments for accumulation and loss potentials
- Improved results based on detailed exposure data
- Loss investigations after major events to support claims management
- Development and evaluation of internal and external risk modelling software
Modelling offshore oil platform losses
Distribution of insured value

Modelling offshore oil platform losses
Combination with the hurricane wind field
CatLossEstimation-Service - Modelling storm scenarios for improved claims management

**Improvement of loss experience (loss patterns)**

- Liabilities with windspeed > Bft 8

**Storm LOTHAR (km/h)**

- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100
- 110
- 120
- 130
- 140
- 150

**Accumulation control of exposure concentration (hot spot analysis)**

- Portfolio
- New risks
- Area of maximum accumulation with „epicentre“
- Risks included in calculation
Using GIS for Risk Managing Aquaculture

Modelling storms or oil spills
Global tsunami exposure
Risk monitoring with satellite imagery

Major threats for aquaculture business

- Pollution
  - Chemical spills
  - Oil spills
- Disease
- Weather related risks
  - Storms (hurricanes, winter storms, tropical cyclones)
  - Storm surge
  - Superchill / ice
  - Tsunami (geological effect)
- Marine organism
  - Blooms
  - Jellyfish
Modelling winter storms in Norway
Aquaculture data base

Losses:
- 540 Mio. NOK
- 70 Mio. EUR
- 40 Mio. GBP

Loss curve - Fishfarm vulnerability

Wind speed in km/h

Windspeed in km/h

Loss curve - Fishfarm vulnerability

As if - Scenario Storm ´92

Storm ´92
- < 80 km/h
- 80 - 120 km/h
- 121 - 160 km/h
- > 160 km/h
Estimation of the global tsunami exposure
Global earthquake map

Estimation of the global tsunami exposure
Runups by height (source: NOAA)
Estimation of the global tsunami exposure
Tsunami hazard zones (low -> high)

Earthquake activities in Canada
Earthquakes in the area of Vancouver Island – Puget Sound

Resonance effects at Vancouver Island (Alberni Inlet)

Assumed protected areas might also be prone to tsunamis!
Identification and mapping of cages using satellite imagery

Chile
Lago Llanquihue: Ikonos image with high resolution

Identification and mapping of cages comparing actual position versus lease / concession

Canada
British Columbia: Radar imagery
Satellite based monitoring of water quality (1)
Daily time series with a 1km x 1km resolution

Concentration of Chlorophyll

Secchi transparency

Satellite based monitoring of water quality (2)
Daily time series with a 1km x 1km resolution

Sea surface temperature

Suspended matter
Satellite based monitoring
Bloom event

A project supported by the European Space Agency (ESA)

Source: Hatfield 2005

Munich Re´s Tools and Services for Underwriters and Risk Managers
Latest publications on natural perils published March 2006

Development of Image and Service Products

World Map of Natural Hazards
NATHAN – Web based service products

NATHAN means „NATural Hazards Assessment Network“

NATHAN is available for our clients via the internet http://connect.munichre.com

A "light" version of NATHAN without insurance–market statistics or information on insured losses and insurance zones (CRESTA) can also be accessed at our website. http://www.munichre.com/nathan

NATHAN – Natural Hazard Maps
Insurance industry will manage their risks more efficiently and transparent.

More detailed risk and loss information will be required in the future.

Risk modeling for natural catastrophes and man-made perils will be improved in the next years.

Munich Re offers knowledge, services and tools to cedants to support the identification, evaluation and assessment of major threats.
Thank you very much for your attention.

Andreas Siebert