Differences in understanding risk

The case of early warning for Volcán de Fuego.

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PhD Research project
Volcanic risk management

IF PRECURSOR THAN ERUPTION THEREFORE EVACUATION!

UNCERTAINTY

IF PRECURSOR THAN MULTIPLE POSSIBLE SCENARIOS… THEREFORE MULTIPLE POSSIBLE OPTIONS?
# Risk’s Wager

<table>
<thead>
<tr>
<th>Evacuation?</th>
<th>Eruption?</th>
<th>Cost</th>
<th>Benefit</th>
<th>Net outcome</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Trivial</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Evacuation resources / livelihood disruption</td>
<td>Large number of lives saved</td>
<td>Positive</td>
<td>Valid alarm (best case)</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Evacuation resources / livelihood disruption</td>
<td>Nothing</td>
<td>Negative</td>
<td>False alarm (intermediate case)</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Large number of lives lost</td>
<td>Nothing</td>
<td>Negative</td>
<td>Failed alarm (worst case)</td>
</tr>
</tbody>
</table>
Risk acceptability

COST

ACCEPTABLE RISK

BENEFIT
Two contrasting views…

Benefit of an evacuation
(civil protection and volcanologist?)

Mutual understanding and communication

Cost of an evacuation
(population in risk?)
Compare and contrast…

I want to do two things:

1. Formal probabilistic risk assessment
2. Risk perception and definition of acceptable risk
**Risk due to pyroclastic flows at Volcán de Fuego**

**Hypothetic example of an event tree**

<table>
<thead>
<tr>
<th>Does the eruption happen?</th>
<th>Size of the eruption (VEI)</th>
<th>Do the pyroclastic flows reach the community?</th>
<th>Are the people in the community?</th>
<th>Do the people die?</th>
<th>Total death probability:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (0.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 (0.85)</td>
<td></td>
<td>Yes (0.0001)</td>
<td>No (0.01)</td>
<td>End</td>
<td>Yes (0.85) 7 x 10^{-6}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No (0.9999)</td>
<td></td>
<td>End</td>
<td></td>
</tr>
<tr>
<td>3 (0.1)</td>
<td></td>
<td>Yes (0.001)</td>
<td>No (0.1)</td>
<td>End</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No (0.999)</td>
<td></td>
<td>End</td>
<td></td>
</tr>
<tr>
<td>4 (0.05)</td>
<td></td>
<td>Yes (0.1)</td>
<td>No (0.25)</td>
<td>End</td>
<td>Yes (0.95) 4 x 10^{-4}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No (0.9)</td>
<td></td>
<td>End</td>
<td></td>
</tr>
<tr>
<td>5 (0.00001)</td>
<td></td>
<td>Yes (0.5)</td>
<td>No (0.01)</td>
<td>End</td>
<td>Yes (0.99) 3 x 10^{-7}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No (0.5)</td>
<td></td>
<td>End</td>
<td></td>
</tr>
</tbody>
</table>

Total risk: $\sum (P) = 4.15 \times 10^{-4}$
Why Fuego?

Eruptions VEI since 1500 AD

Moderate eruptions since 2002

Cumulative number of eruptions
Preliminary tree analysis…

Annual risk of death vs. potential number of fatalities for different exposure scenarios.
However...
Process based modeling

Monte-Carlo simulation of ash dispersal using numerical dispersion code ASHFALL (code kindly provided by T Hurst)
Pyroclastic flows and surges
2001 - 2007
Pyroclastic flows and surges
1970’s
Barranca Taniluya cross sections

Channels cross sectional areas mapped
FLOW 3D MODEL (KINETICS)
Relevance of the model:
Considers:
- Inertia
Does not consider:
- Sedimentation
- Mass flux vs. x-sectional area
Decision model…

Global optimization = joint minimization of costs/impacts for different scenarios NOT only the worst case (eruption)!
Semi-structured interviews and focus groups

- Random sample of population, Civil defense officials, and local authorities

- Risk perception and expectations on potential early warnings and evacuation

- How are decisions made and what are the most relevant factors?
Future directions and ideas for discussion…

- Improve modeling efforts on pyroclastic flows
- Include lahars
- Conduct workshops, further interviews and surveys (Agreement with CONRED)
- Participant observation of a crisis?