Hazards at Colima, Casita, Popocatepetl, and Pico de Orizaba

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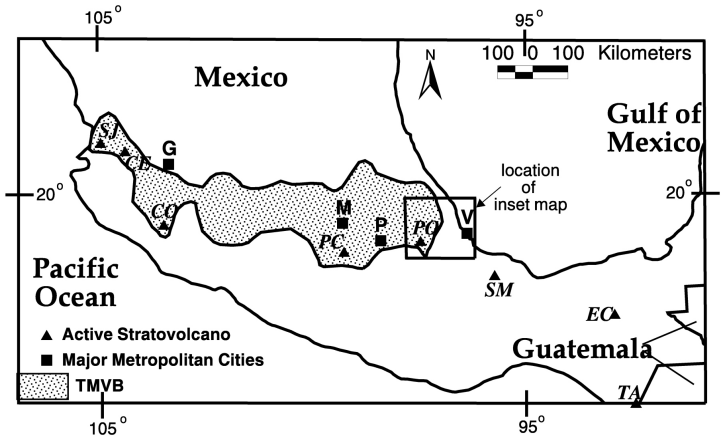

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Hazards

- Volcanic gas
- Lava flows & domes
- Ash fallout
- Pyroclastic flows
- Debris flows & floods
- Debris avalanches

1999

Volcan Colima

- Many villages
- Several studies
- Hazard map published
- 100-yr. cycle known
- Catastrophic eruptions
- Simulated crises
- Volcano observatory
- Strong government

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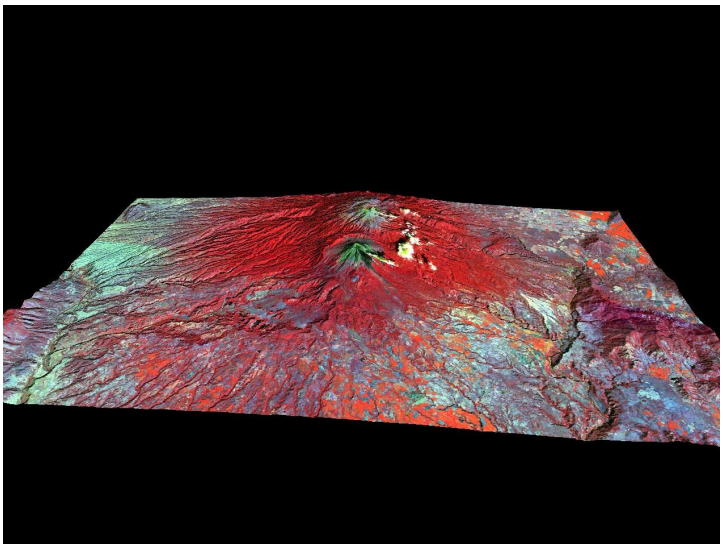

Frequency of Hazards

Hazard	# of events	frequency
Edifice Collapse	3-10	~1/2000 yr
Large Mudflow	several	~1/100 yr
Plinian Fall	4	~1/100 yr
Pumice Flow	4	~1/100 yr
Block-and-ash Flow	numerous	~1/20 yr
Small Mudflow	numerous	~1/20 yr
Lava Flow and Dome	many	~1/10 yr
Rock Fall	thousands	constant

1999

Hazard Distribution

Hazard	Location	Distance
Edifice Collapse	South of Fuego	25 to 100 km
Large Mudflow	Armeria and Tuxpan Rivers	25 to 80 km
Plinian Fall	Central Mexico	100 to 1000 km
Pumice Flow	90 degree arc south of Fuego	10 to 20 km
Block-and-ash Flow	90 degree arc south of Fuego	5 to 10 km
Small Mudflow	Barancas south of Nevado	10 to 25 km
Lava Flow and Dome	Fuego cone	2 to 8 km
Rock Fall	Fuego cone	1 to 4 km

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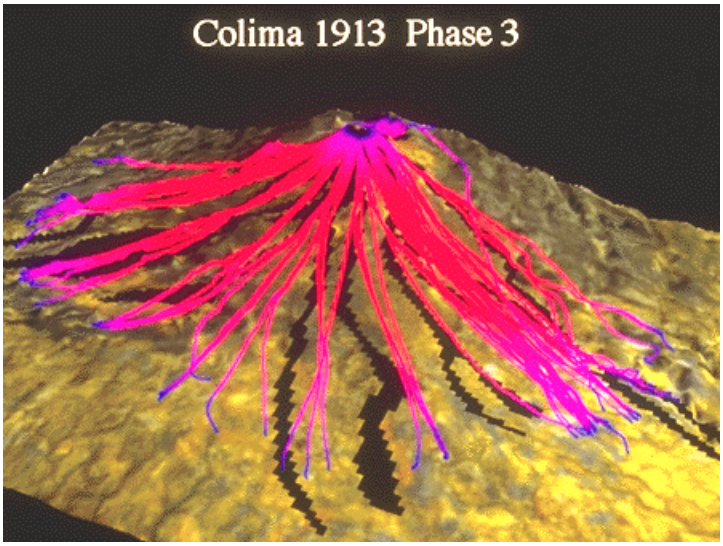

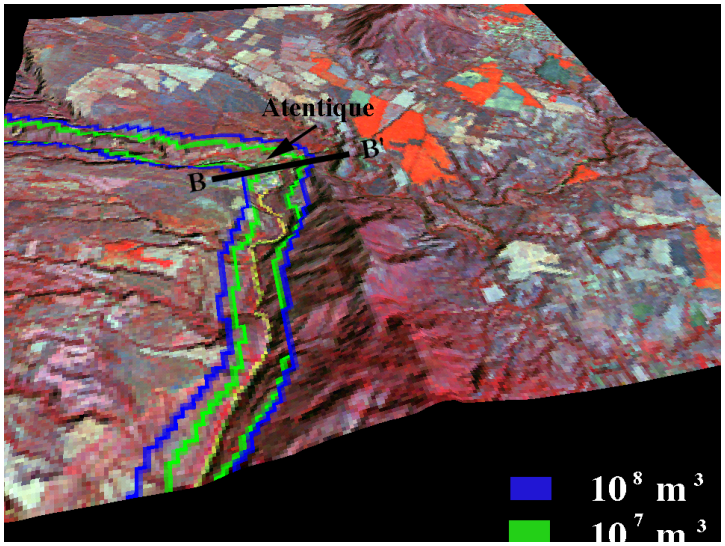

Risk

Hazard	Risk	Probability
Edifice Collapse	All habitation S of Fuego	low
Large Mudflow	Armeria and Tuxpan Rivers	low
Plinian Fall	Fuego NE to Central Mexico	high
Pumice Flow	Queseria, Tonila, San Marcos, etc.	high
Block-and-ash Flow	Small villages near Fuego	high
Small Mudflow	Barrancas on flanks of Fuego, Nevado	high
Lava Flow and Dome	Steep slopes of Fuego	high
Rock Fall	Steep slopes of Fuego	high

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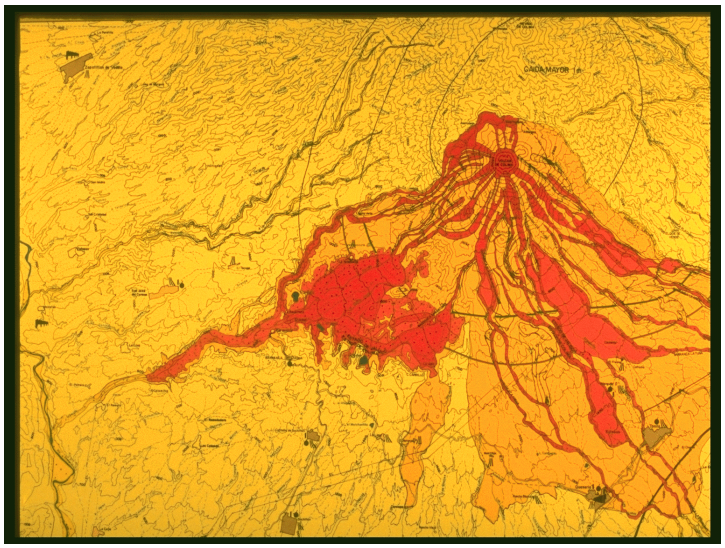


Conclusions

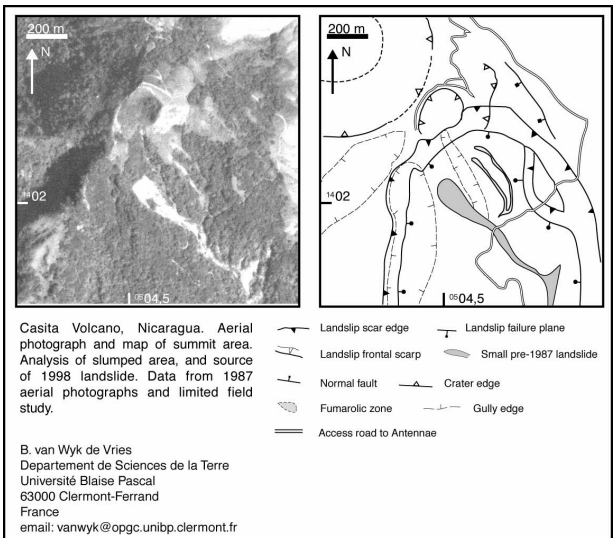
- Colima remains a very dangerous volcano
- The probability of a major event increases with time
- Edifice collapse should not be ignored
- Monitoring should be intense
- The risk mitigation plan should be continuously updated

1999

Casita

- Sparsely populated
- Not studied
- No published map
- Inactive volcano
- Mudslides in the past
- No mitigation plan
- Few scientists
- Politically fragmented

1999



Casita Volcano, Nicaragua. Aerial photograph and map of summit area. Analysis of slumped area, and source of 1998 landslide. Data from 1987 aerial photographs and limited field study.

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October 30, 1998

- Disastrous avalanche and lahar
- South flank of Casita Volcano

1999

Hurricane Mitch

- Rainfall reached 500 mm/day

1999

Landslide

- Source zone
- Strongly altered andesite lava cliff
- Initial slab ~ 2.0 10^5 m^3
- Disintegrated and slid for about 30 m

1999

Avalanche

- Broke into large blocks
- Continued for 3 km
- Remained in gully

1999

Lahar

- Originated within the avalanche deposits
- Rapidly spread across the terrain
- Eroded the soil
- Left a thin (40-60 cm) deposit
- Gravel, sand and silt in its wake

1999

Huge boulders at surface

- Composed of dark lava
- Average 2 m diameter
- Reach as much as 7 m in length
- Destroy everything in their path

1999

Loss

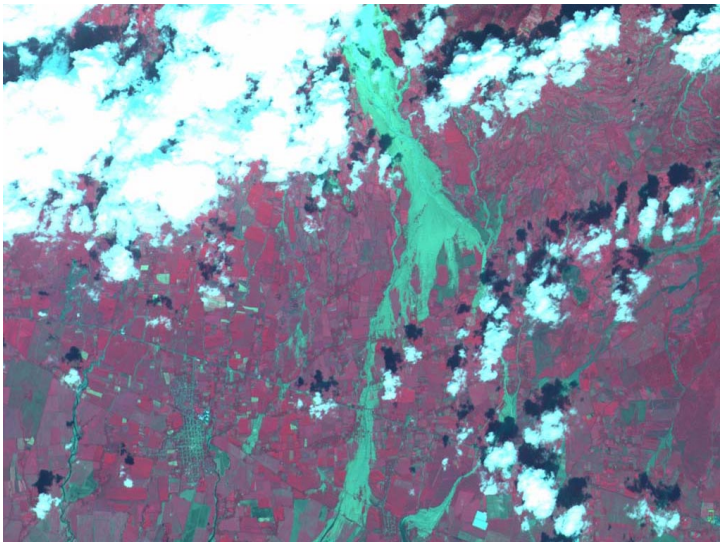
- Two medium-sized towns
- Between 1560 and 1680 people died
- Displaced hundreds more
- Destroyed several settlements
- Disrupted the Pan American Highway

1999

Extent

- Mapped on a classified SPOT image
- Surface area of about 1.2 10^7 m^2
- An average deposit thickness of about 0.5 m
- Volume ~ 6.0 10^6 m^3
- A 30-fold bulking ratio for the lahar

1999



Geological Factors

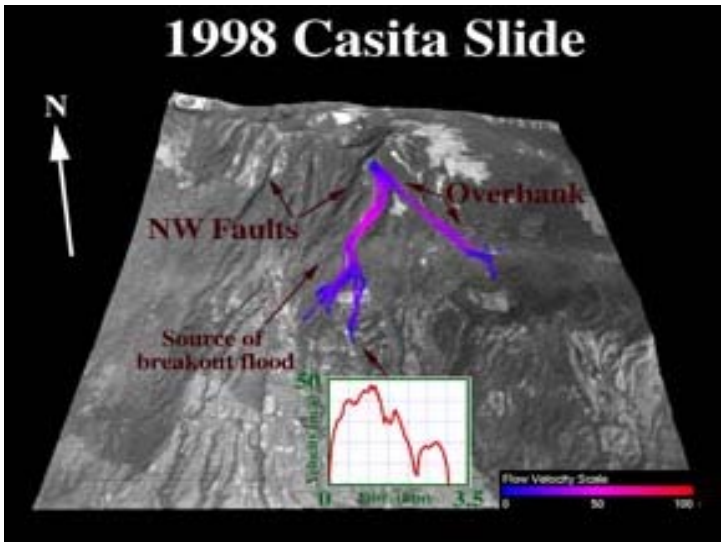
- Deep dissection of a red clay horizon
- Undercutting and headward erosion of lava
- Probable source for the large boulders

1999

FLOW3D

- Traced the path of the avalanche
- Calculated its velocity history

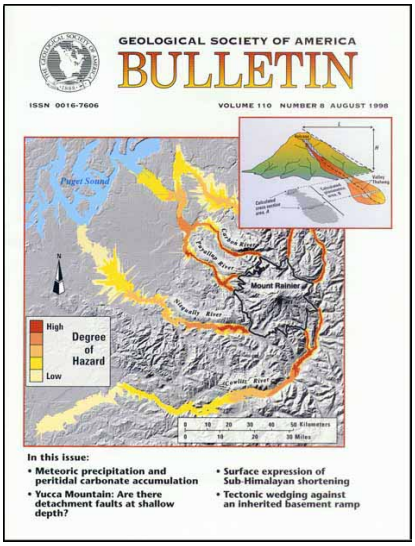
1999



LAHARZ

- Modeled the area covered by the lahar
- Computed the cross sectional area of its peak flow
- A model volume of 1.0 10^7 m^3 fits best
- Model has a planimetric area of 8.5 10^6 m^2
- Peak flow depths of 5 and 2 m
- Devastated Rolando Rodriguez and El Porvenir

1999



Conclusions

- Models compare well with field observations
- Computer simulations are useful to designate hazard zones

1999

Popocatepetl

- Eruption started in December 1994
- Hazard map created in January 1995
- FlLOW3D used for PF distribution
- Lahar paths traced along major drainages

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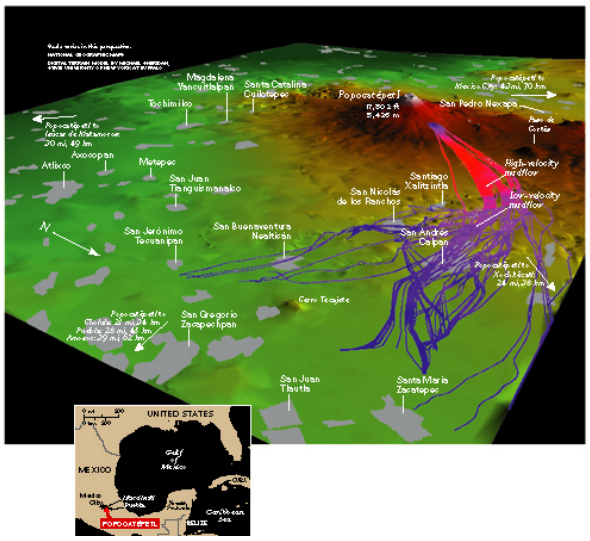

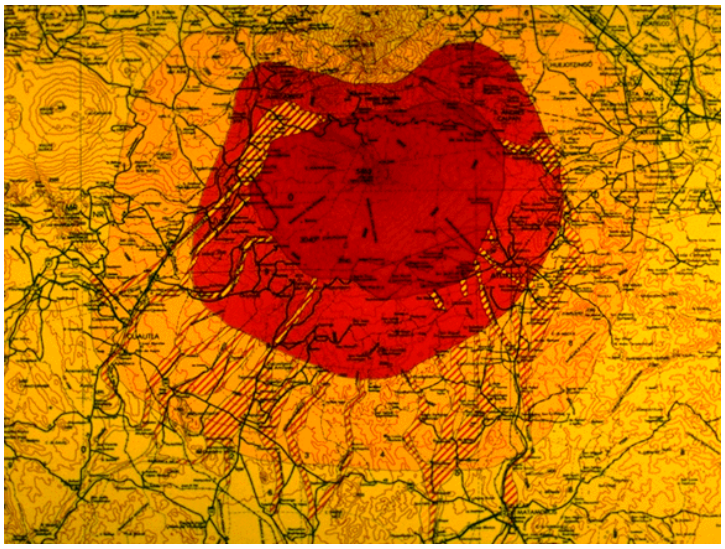

Pico de Orizaba

- Lahar models using LAHARZ
- Pyroclastic flow models using FLOW3D
- Plinian fall distributions

1999