How can we defend ourselves from the hazard of Nature in the modern society?

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Stefano Tinti is Full Professor of Geophysics at the University of Bologna, Italy

Former Chairman of the ICG/NEAMTWS of the IOC/UNESCO

Member of the International Tsunami Commission

President of the EGU Natural Hazards Division

Member of the Editorial Board of *Natural Hazards and Earth System Sciences* (NHESS)

Involved in tsunami research since '70s

Author of over 240 publications, with more than 150 papers in scientific journals and books of international interest

Research Lines:
Tsunami generation. Numerical Modeling. From Hazard to Risk Assessment. Monitoring Networks and (Early) Warning Systems

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Basic Questions

- What are Natural Hazards ?
- Are they unavoidable?
- Is the XXI century society (or societies) more vulnerable?
- What are the best strategies to mitigate the effects?
- What is the possible contribution of scientists and of teachers?

What are Natural Hazards?

A basic definition

Natural Hazards are "those elements of the physical environment, harmful to man and caused by forces extraneous to him." (1)

(1) I. Burton, R.W. Kates and G.F. White

The Environment as Hazard (New York: Oxford University Press, 1978)

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An extension of the definition

"Natural Hazard" refers to all atmospheric, hydrologic, geologic (especially seismic and volcanic), and wildfire phenomena that, because of their location, severity, and frequency, have the potential to affect humans, their structures, and their activities adversely.

By saying "natural" one eliminates manmade phenomena as war, pollution, and chemical contamination.

Though infectious diseases can be viewed as a natural phenomenon usually they are excluded from consideration when treating natural hazards.

Two Elements

"Natural Hazards" involve always two elements

Nature and **Society**

A natural phenomenon that occurs in a populated area is a **hazardous event**. And if it causes a large numbers of fatalities and/or great property damage is a **Natural Disaster**

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Classification of Potentially Hazardous Natural Phenomena

Atmosphere

Storms, Hailstorms, Windstorms, Hurricanes
Lightning, Tornadoes, Tropical storms

Earth

Earthquakes, Ground fissures, Ground shaking, Soil liquefaction, Debris avalanches, Landslides, Rockfalls, Subsidence

Volcanic eruptions, Tephra (ash, cinders, lapilli), Projectiles and lateral blasts, Gas emissions, Pyroclastic flows, Mudflow and Lahar

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Classification of Potentially Hazardous Natural Phenomena (2)

Sea and Ocean

Wave storms, Rogue waves, Seiches, Storm surges, Tsunamis, Coastal flooding, Salinization, Erosion and sedimentation

Hydrology

River flooding, Erosion and Sedimentation, Drought Desertification, Snow avalanches

Wildfire

Forest fires, Grass fires, Savannah fires, Brush fires

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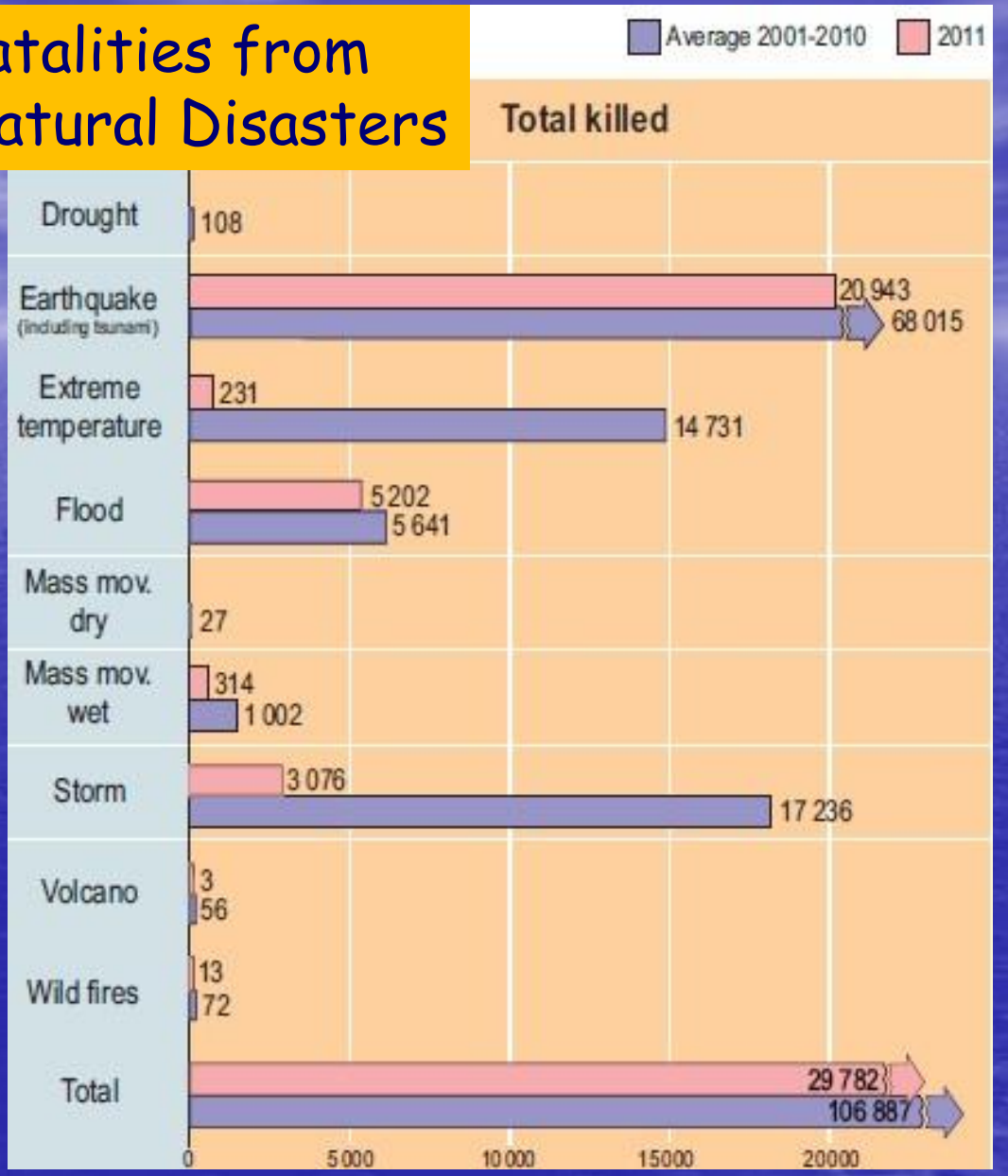
Fatalities from Natural Disasters

The total number of deaths in the decennium was more than 1 million.
In 2011 slightly less than 30000 with most of the victims attributable to the 11 March 2011 Tohoku tsunami, affecting Japan.
Tsunamis are included in the category of the earthquakes



After "2011 Disasters in Numbers", a joint document of UNISDR, www.unisdr.org/, USAID, and CRED, www.cred.be/, published in www.preventionweb.net).

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Are Natural Hazards Unavoidable?

Is the XXI century society more vulnerable?

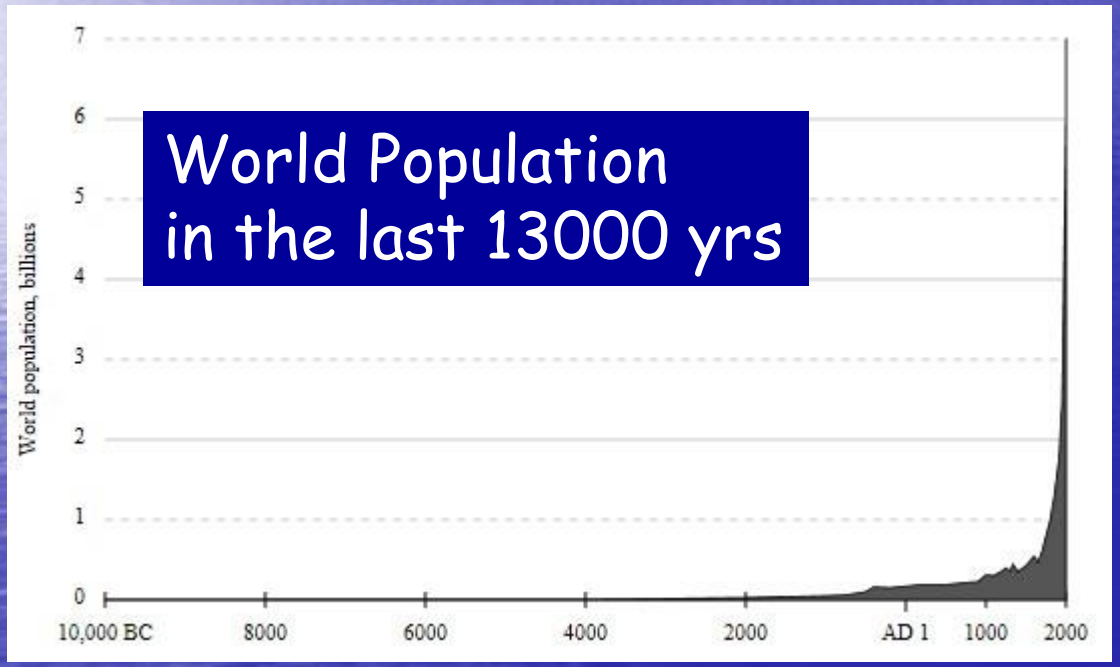
Global population growth

Concentration in the plains and along the coast

Urbanization and megacities

Increased society dependence on lifelines and critical structures and infrastructures

Global Population Growth



Population[1]		
Years Passed	Year	Billion
-	1800	1
127	1927	2
33	1960	3
14	1974	4
13	1987	5
12	1999	6
12	2011	7
14	2025*	8
18	2043*	9
40	2083*	10

* UNFPA
United Nations Population Fund
estimate 31.10.2011

After Wikipedia

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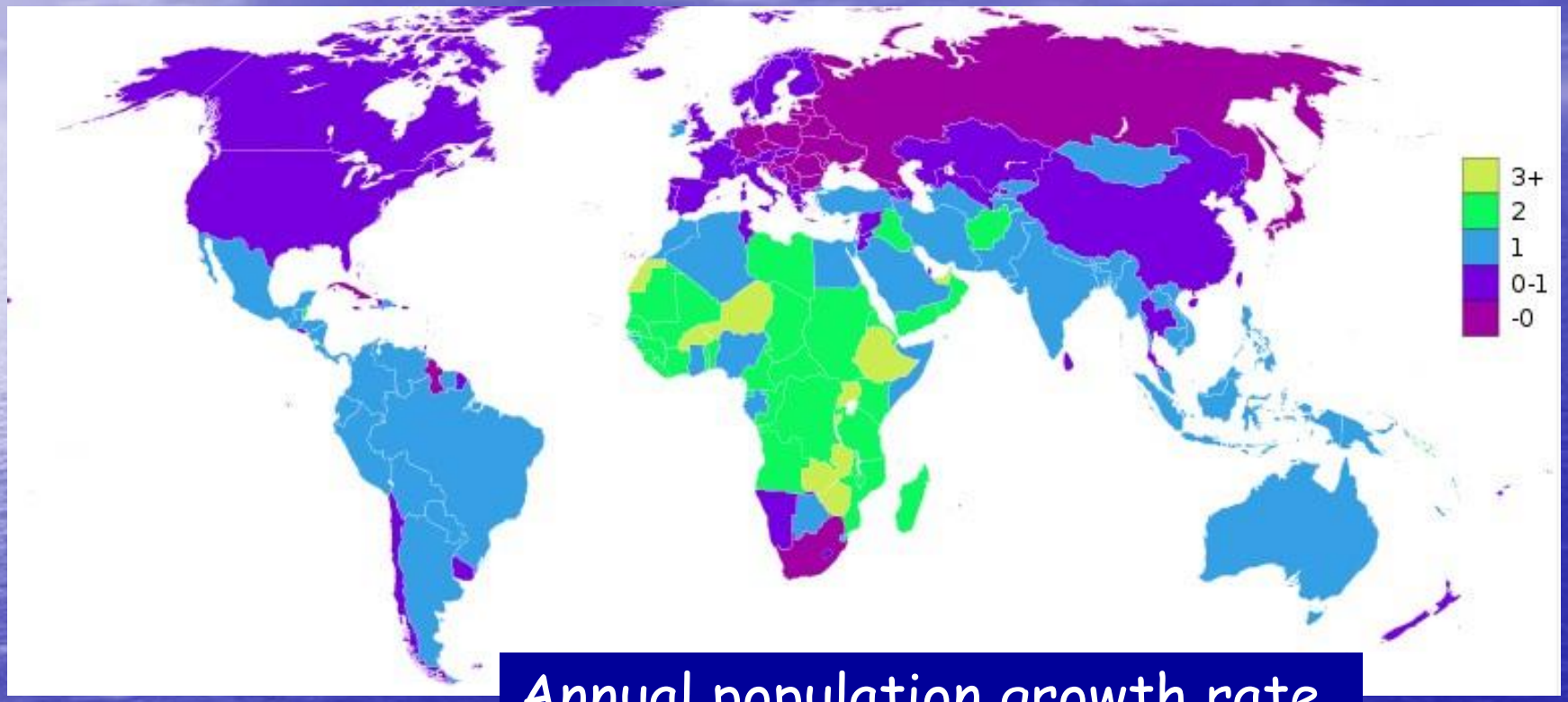
Global Population Growth



Annual population growth rate

After the CIA World Factbook (2011 estimate).[1]

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Population Density Distribution

Favourable Factors

- Moderate climate
- Fertile farming land
- Mineral resources - mines produce jobs, and provide raw materials for other industries
- Low land - with gentle slopes or flat ground
- .Coastal areas
- Good water supply
- Wealthier areas - people move to where jobs and money can be found

Unfavourable Factors

Extreme climate - too cold, hot, wet or dry
Extreme relief - too high and too steep
Extreme remoteness - places that are difficult to reach
Infertile land - need to have extensive (very large) farms

50% (66%) of the population lives within 200 (400) km from the coast

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The Largest 20 Megacities in the World

Rank	Megacity	Country	Continent	Population	Annual Growth
1	Tokyo	Japan	Asia	34,500,000	0.60%
2	Guangzhou	China	Asia	25,800,000	4.00%
3	Seoul	South Korea	Asia	25,600,000	1.40%
4	Jakarta	Indonesia	Asia	25,300,000	2.00%
5	Shanghai	China	Asia	25,300,000	2.20%
6	Mexico City	Mexico	North America	23,200,000	2.00%
7	Delhi	India	Asia	23,000,000	4.60%
8	New York City	United States	North America	21,500,000	0.30%
9	São Paulo	Brazil	South America	21,100,000	1.40%
10	Karachi	Pakistan	Asia	21,100,000	4.90%
11	Mumbai	India	Asia	20,800,000	2.90%
12	Manila[21]	Philippines	Asia	20,700,000	2.50%
13	Los Angeles	United States	North America	17,600,000	1.11%
14	Osaka	Japan	Asia	16,800,000	0.15%
15	Beijing	China	Asia	16,400,000	2.70%
16	Moscow	Russia	Europe	16,200,000	0.20%
17	Cairo	Egypt	Africa	15,700,000	2.60%
18	Kolkata	India	Asia	15,700,000	2.00%
19	Buenos Aires	Argentina	South America	14,300,000	1.00%
20	Dhaka	Bangladesh	Asia	14,000,000	4.10%

In 1950 New York and Tokyo were the world's only megacities with over 10 million residents. By 2025 the UN predicts the number of megacities will be 37. All but eight will be in the developing world

After Brinkoff: The Principal Agglomerations of the World, 2012

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What are Lifelines ?

Systems or networks that provide for the circulation of people, goods, services and information

They are vital for the health, safety and economic activity of the community

Platt, 1991

Typical Lifelines and Key Structures

Lifelines

Transport
Water
Power
Sewerage
Telecommunications
Fuel pipelines
Informatic networks

Key Structures and Facilities

Police
Fire brigade
Ambulances
Emergency coordination centres
Hospitals
General medical care
Food distribution networks
Schools
Emergency shelters

After Britton, 1997

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Vulnerability of Lifelines to Natural Hazards

	Earthquakes	Landslides	Storms	Floods
Power	●●●	●	●●●	●
Water	●●●	●	●	●●
Sewer	●●●	●	●	●●
Telecom	●●●	●	●●●	●
Roads	●●	●●●	●●	●●●
Rail	●●●	●●●	●●	●●
Bridges	●●●	●	●	●●
Airports	●●	●	●●	●●
Ports	●●●	●	●●	●

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Lifelines Interdependency

Failure of	Consequences to								
	Power	Water	Sewerage	Telecom	Roads	Rail	Bridges	Airports	Ports
Power		●●●	●●●	●●●	–	●●●	–	●	●
Water	●		●●●	–	–	–	–	●	●
Sewerage	–	●●●		–	–	–	–	●	●
Telecom	●●●	●●●	●●●		●	●●●	–	●●●	●●●
Roads	●	●	●	●		●	–	●	●
Rails	–	–	–	–	●		–	●	●
Bridges	●●●	●●●	●●●	●●●	●●●	●●●		–	–
Airports	–	–	–	–	–	–	–		–
Ports	–	–	–	–	–	–	–	–	

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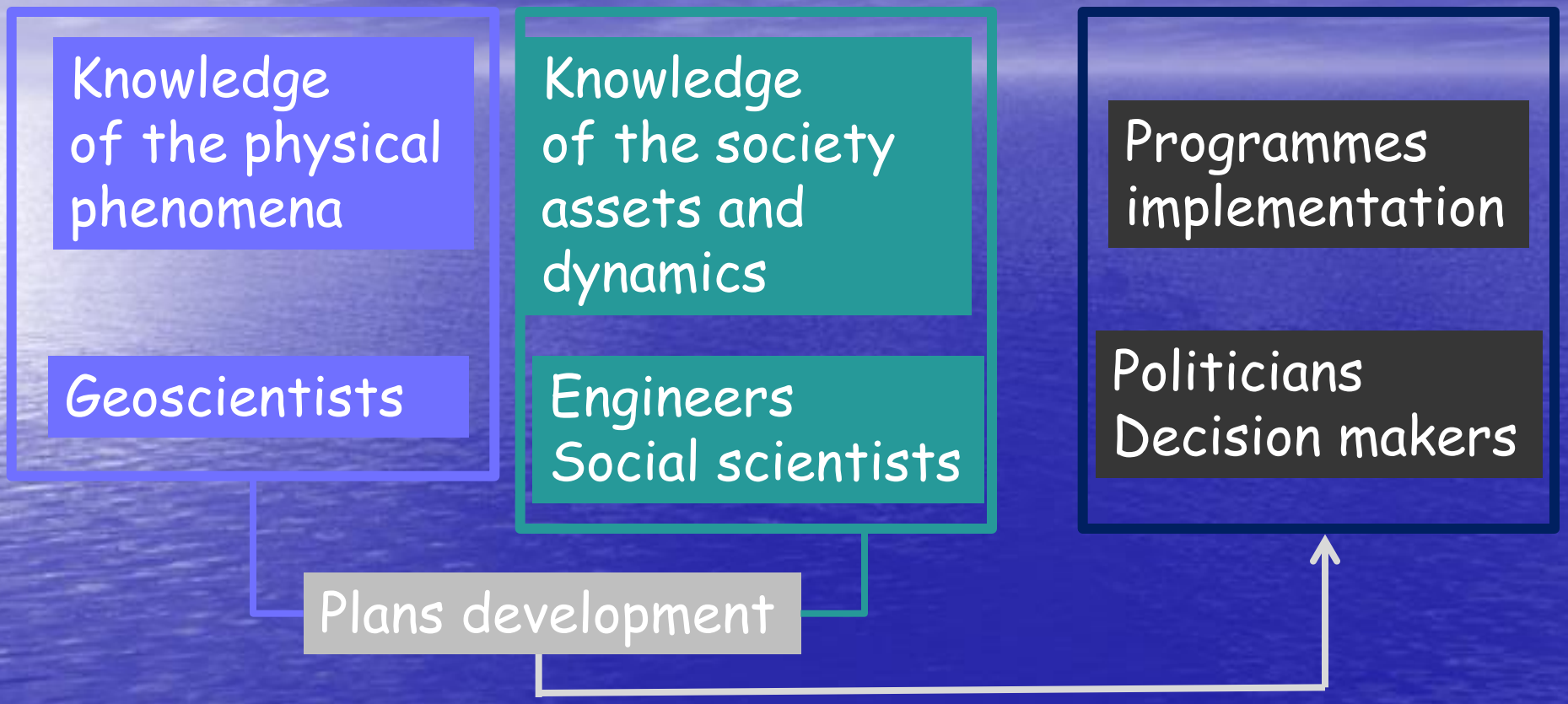
What are the best strategies to mitigate the effects?



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What are the best strategies to mitigate the effects? (2)

Hazard Assessment

Geoscientists

Vulnerability and Risk Assessment

Engineers
Social scientists

Mitigation Plans

Politicians
Decision makers

What is the possible contribution of scientists ?

to provide knowledge-based hazard-to-risk assessment

to develop short-term mitigation plans including monitoring, forecast, warning systems

to develop long-term prevention plans including sustainable development concepts

Geoscientists

and
Engineers

and
Social scientists

need to speak with each others

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What is the possible contribution of teachers?

to cooperate with authorities to disseminate information on emergency plans

to stimulate the development of and to participate in drills programmes involving schools

to develop educational plans in natural hazards on preventions issues

to fill a cultural gap

to increase the awareness that natural disasters are not inevitable and that the main strategy we have is a sustainable development

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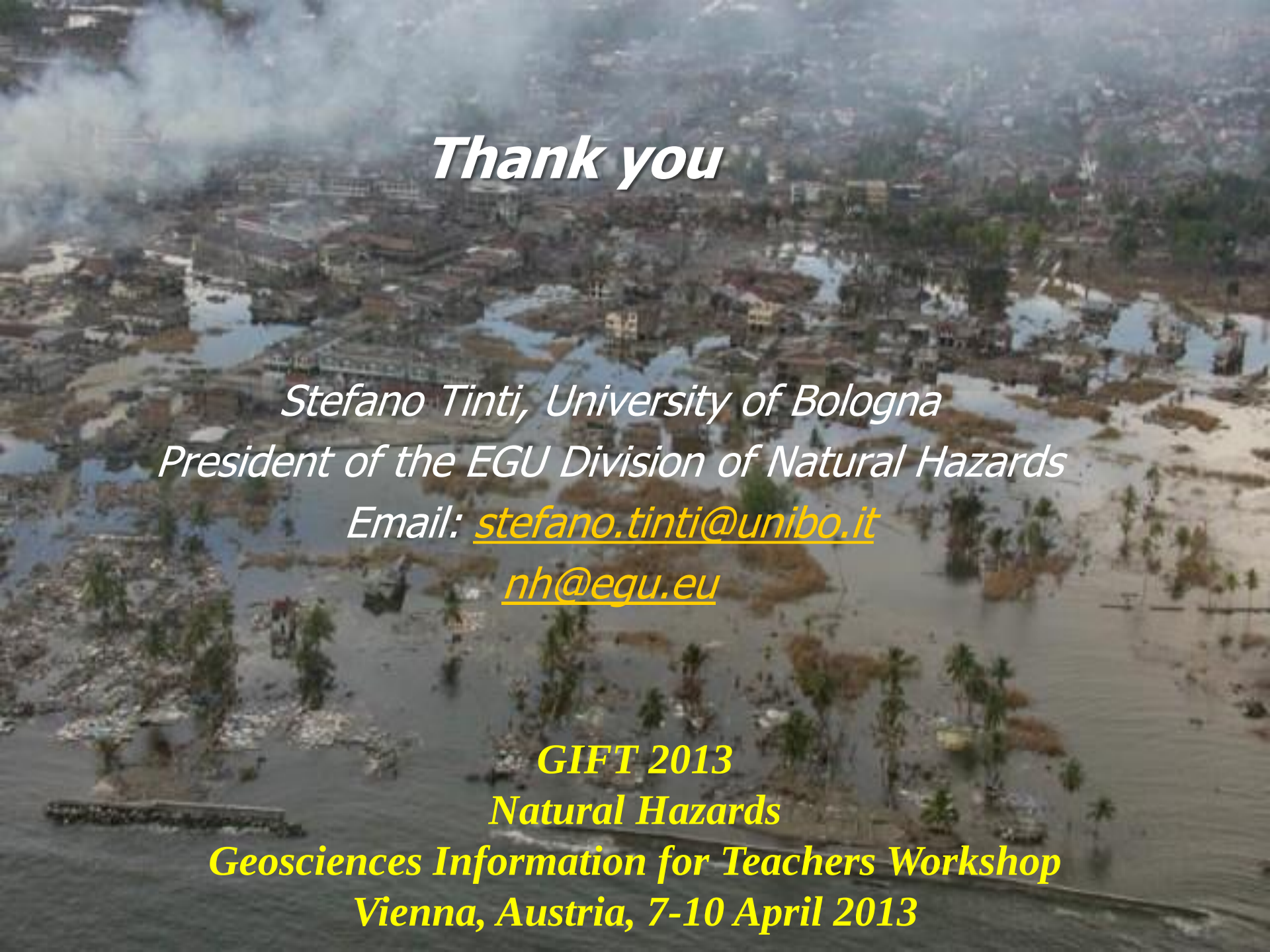

Thank you

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