

# Prof. Giuseppe T. Aronica

## Flood Risk, Resilience and Resistance



Università degli Studi di Messina  
DIPARTIMENTO DI INGEGNERIA

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### Introduction



A flood is defined by the Oxford English Dictionary as "An overflowing or irruption of a great body of water over land in a built up area not usually submerged."

**Issue No. 48**

**"Disaster Data: A Balanced Perspective"**

**Natural disasters over the first semester of 2017**

During the first semester of 2017, EM-DAT preliminary data shows that 149 disasters occurred in 73 countries. The impact of which resulted in 3,162 deaths, affected more than 80 million people and caused more than US\$3.4 billion (A).

The major disasters were floods and landslides occurring in Asia, South America and Africa (B). Eight of the 10 natural disasters that exceeded the highest number of people affected are droughts, that were still ongoing in 2017. Those events are above-normal, spatially extensive and prolonged, that could last for up to 4 years for some events (C).

It is a drought that is also the most costly disaster, occurring in Vietnam since 2015 and with economic damages of 6.75 billion US\$ (D), an excessive amount for this country.

Figures from the first half of 2017 are much lower compared to the average of the first semester in the last 10 years when major disasters occurred (Haiti earthquake in 2010, Cyclone Nargis in Myanmar in 2008, the tsunami in Japan-Fukushima in 2011 and the Nepal earthquake in 2015) (A). Due to the impacts of natural disasters for 2017, floods and landslides that were particularly deadly this year in Asia and Africa. The hurricane and cyclone season is also currently ongoing, which will rise the value of economic damages (E). Even if Asia continent is the most prone to natural disaster in terms of occurrence, number of deaths and economic damages (E). Even if Asia did not suffer major disasters with high death tolls, the continent still regularly suffer floods and landslides. Africa is carrying the weight of the highest total population affected, mainly due to long lasting droughts.

Three of the 10 deadliest disasters occurred in United States, with a

**A) Natural disasters summary**

	2017 1 <sup>st</sup> semester	2007-2016 1 <sup>st</sup> semester average
No. of country-level disasters	149	123
No. of countries affected	73	65
No. of deaths	3,162	4,367
No. of people affected	80.6 mil	127.4 mil
Economic damages (US\$)	3,374 mil	4,100 mil

**The 10 natural disasters of semester of 2017**

Disaster	Month
Flood	May
Landslide	March-April
Flood	June-August
Flood	June-August
Flood	March
Landslide	June

**F) 2017 first semester natural disaster occurrence and impacts: disaster type comparison**

Disaster Type	Occurrence	No. Deaths	No. Total affected	Economic damages
Drought	16%	2%	2%	3%
Earthquake	3%	2%	4%	3%
Extreme temperature	11%	15%	2%	15%
Flood	44%	52%	66%	44%
Landslide	14%	25%	6%	38%
Storm	8%	2%	2%	1%
Wildfire	3%	4%	2%	1%

## Introduction



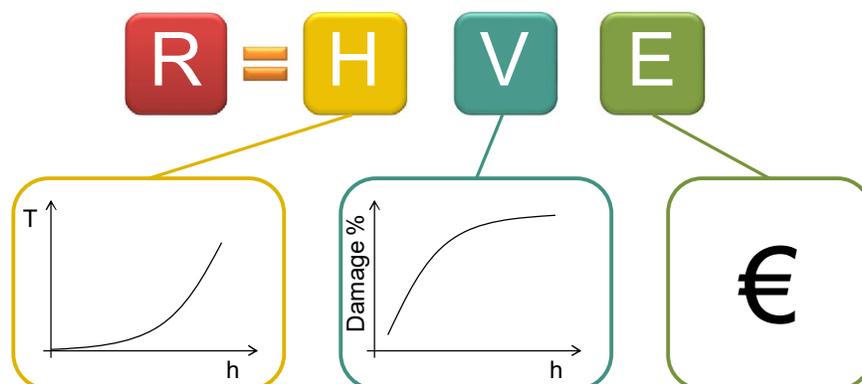
### From flood defence to flood risk management

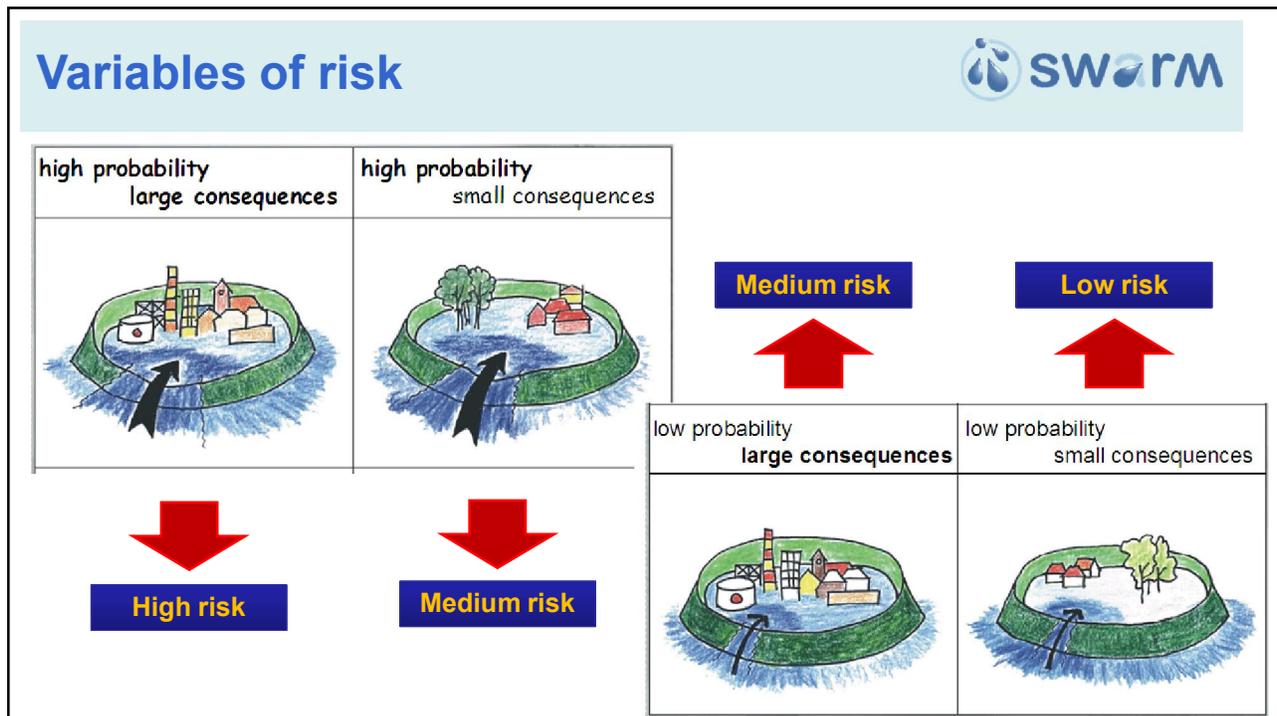
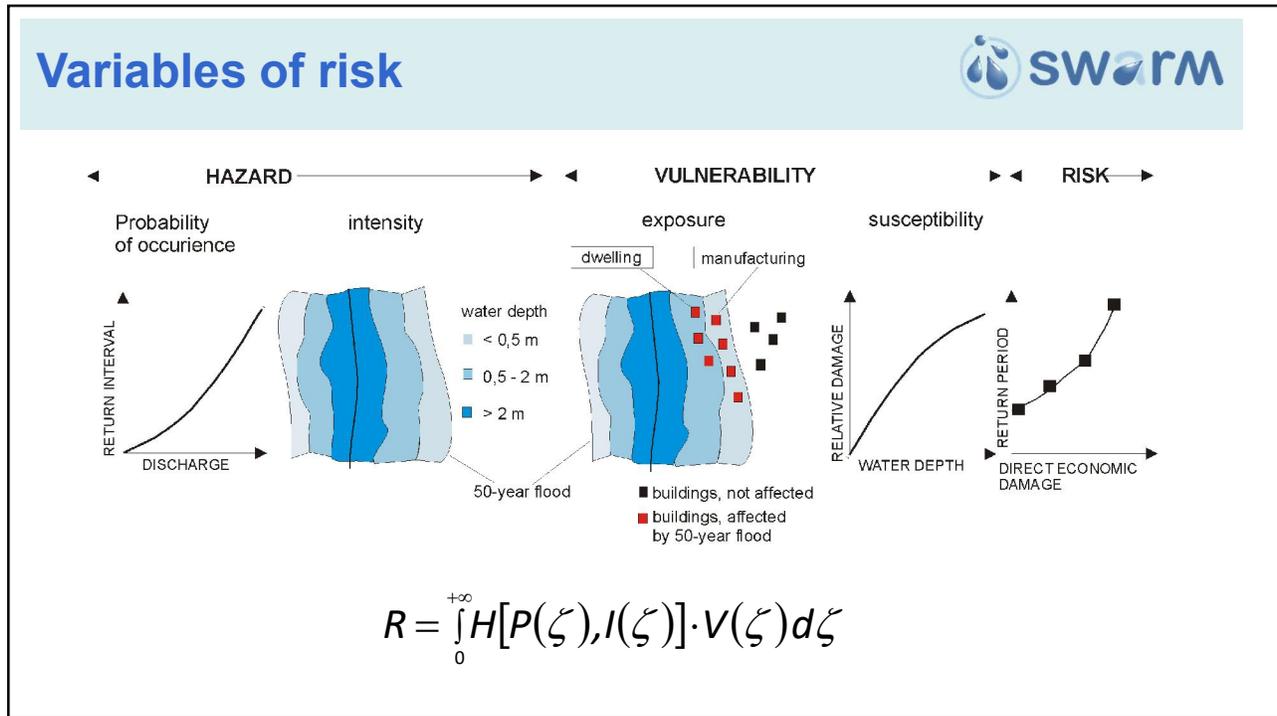
- Flood risk management can be defined as the “*continuous and holistic societal analysis, assessment and mitigation of flood risk*” (Schanze, 2006).
- Or as “*a process of continuous analysis, adjustment and adaptation of a flooding system (including both structural and non-structural actions) taken to reduce flood risk*” (FLOODsite, 2009a; HR Wallingford, 2007).

*Comparison of security approach and risk approach (Heintz et al., 2012; Wagner, 2008).*

Main characteristics	Security approach	Risk approach
<b>Aim</b>	protection against threat emanating from flood events	develop a strategy how to handle flood risk, define which level of risk is acceptable
<b>Terminology</b>	danger, threat, security, protection	risk, residual risk, risk evaluation, risk management, risk governance
<b>Scenarios</b>	medium-probability events as the standard level of protection	high-/medium- and low-probability events, priorities regarding level of protection
<b>Measures</b>	focus on structural measures	combination of structural and non-structural measures
<b>Involved parties</b>	sectorial planning (water authority), top-down, implementation gap	interdisciplinary, bottom-up elements
<b>Spatial focus</b>	local solutions for local problems, oriented at administrative borders	across administrative borders, catchment-based
<b>Time aspect</b>	short-term solutions, event-driven, “trial and error”	medium-/long-term solutions, prevention, regular revisions

## Variables of risk



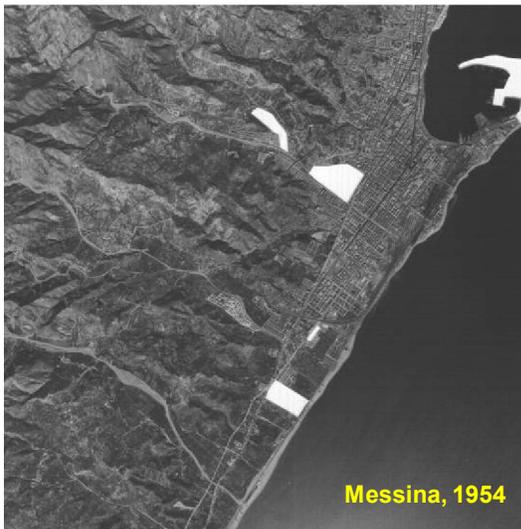


## Floods in urban environments



- Urban environments can be affected by river flooding, coastal floods, pluvial and ground water floods, flash floods, artificial system failures.
- Urban floods typically stem from a complex combination of causes, resulting from a combination of meteorological and hydrological extremes, such as extreme precipitation and flows. However they also frequently occur as a result of human activities, including unplanned growth and development in floodplains, or from the breach of a dam or an embankment that has failed to protect planned developments.

## Floods in urban environment



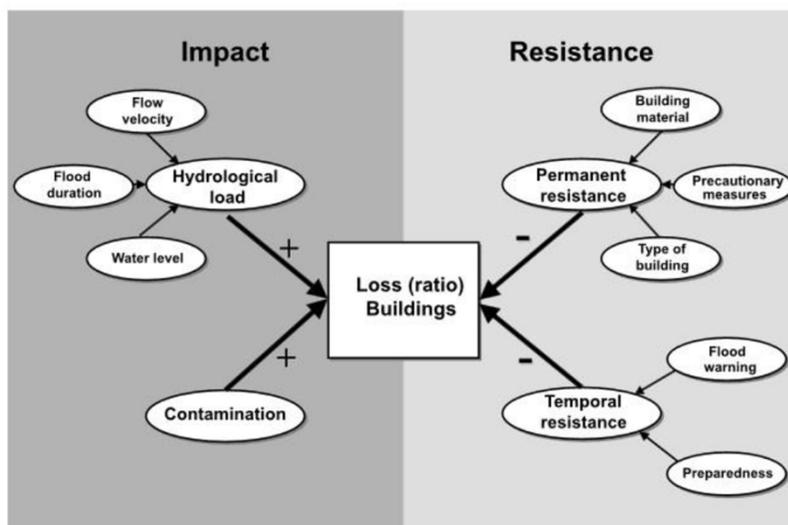
## Flood damages



- Damage assessment of natural hazards supplies crucial information to decision support and policy development in the fields of natural hazard management and adaptation planning to global changes.
- As flood risk management is becoming the dominant approach of flood control policies throughout Europe, the estimation of economic flood damage is gaining greater importance, but it still represents a challenge.

	Direct	Indirect
Tangible	Damage to buildings and contents; disruption of infrastructures; erosion of agricultural fields; costs of evacuation and rescue; interruption of economic activities inside the flooded area; clean-up costs.	Interruption of public services outside the flooded area; economic losses of companies outside the flooded areas; costs caused by the interruption of transport infrastructures; businesses migration.
Intangible	Casualties; accidents; loss of objects with an affective value; psychological uneasiness; damages to cultural heritage; environmental impact.	Anxiety; loss of trust in authorities.

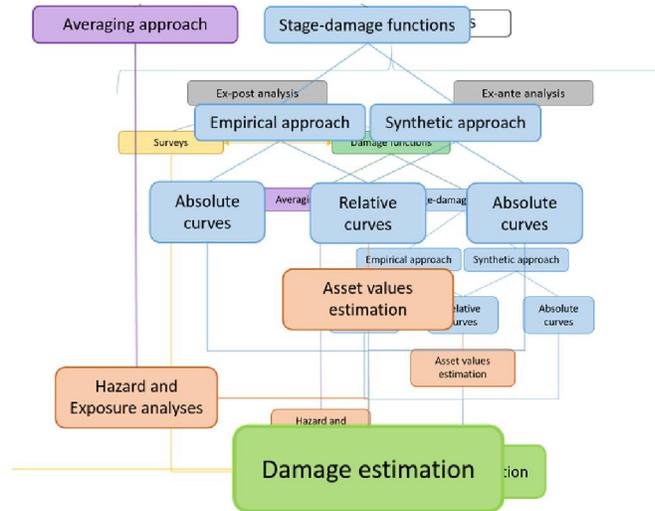
## Flood damages



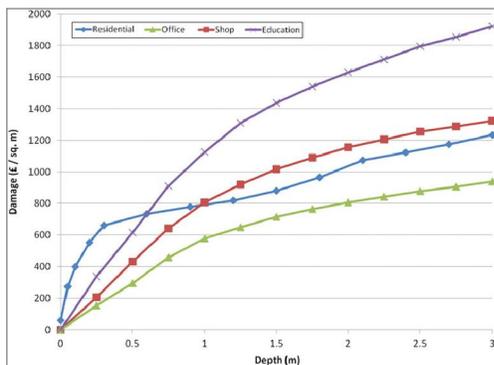
### Influencing variables in flood damage assessment

*Thieken et al. (2005). Flood damage and influencing factors: New insights from the August 2002 flood in Germany. Water Resources Research*

# Flood damage assessment

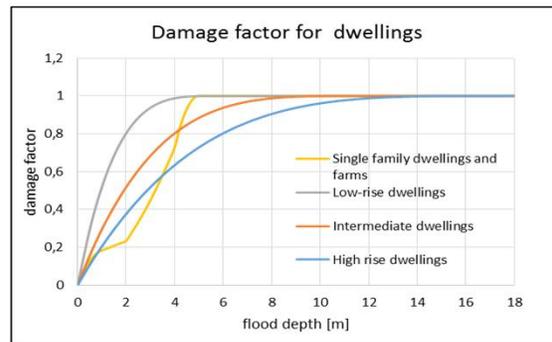


# Damage curves

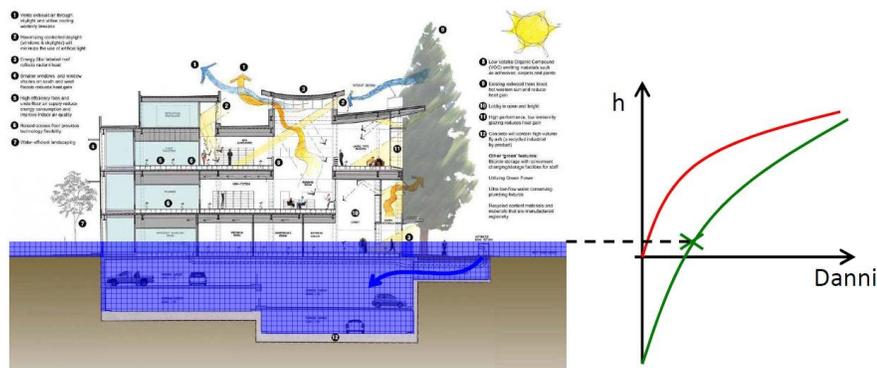


(Penning-Rowsell et al. (2005), *The benefits of flood and coastal risk management: a manual of assessment techniques*. London, UK: Middlesex University Press.)

(Kok, M., Huizinga, H.J., Vrouwenfelder, A.C.W.M, Barendregt, A., (2004). *Standard Method 2004. Damage and Casualties caused by Flooding*. Highway and Hydraulic Engineering Department.)



## Damage curves



Huge damages to basements can occur for small flood depths in the floodplain.  
Damages can have no correlation with the event severity in these cases.

**(LARGE UNCERTAINTIES)**

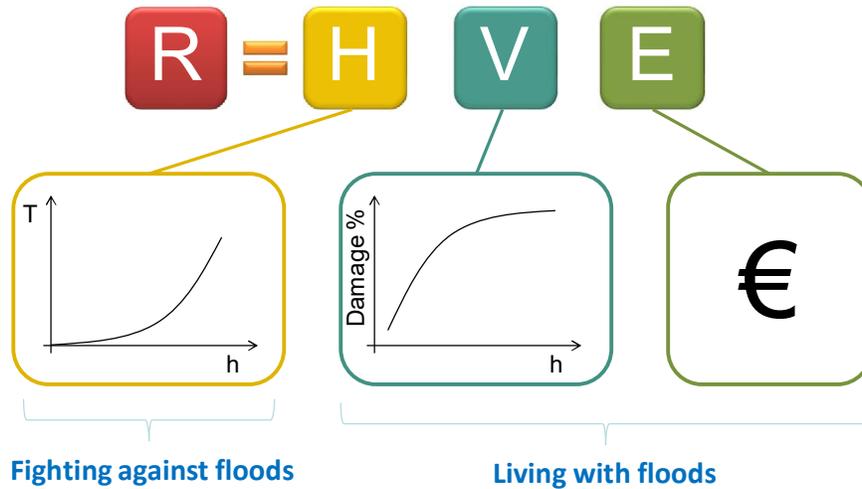
## Resilience



*Resilience is the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure (UNISDR, 2011).*

The new policy of flood risk management is to give more attention to non-structural measures, allowing people to “**living with floods**” rather than “**fighting against floods**”.

## Resilience



## Flood proofing



**Flood proofing** is defined as combination of structural and non-structural changes, or adjustments made in the building that reduces or prevents flood damage to the structure and/or its contents. It can also be stated as any structural or non-structural measures intended to prevent damage from flooding to a building.

## Flood proofing



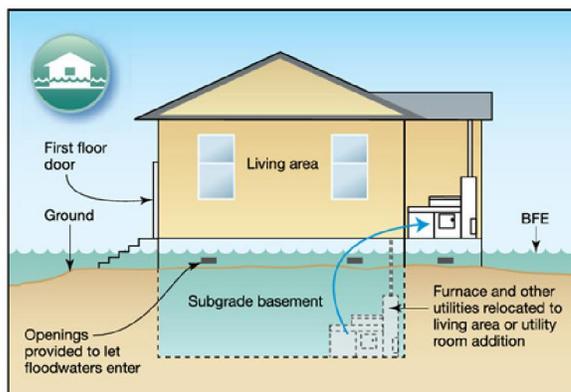
### Wet proofing

- Raise the buildings
- Use of water-resistant materials
- Elevate the electrical components and the inventory
- Valves for against backwater effects

### Dry proofing

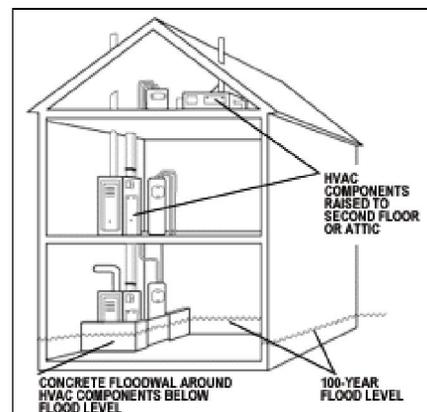
- Sealing openings and walls (SEALING)
- Use of flood barriers, installed at the entrance of the buildings (SHIELDING)
- Flood barriers along riverbanks or crossing a street (SHIELDING)

## Flood proofing



### WET FLOOD PROOFING

### Elevate the electrical components and the inventory



## Flood proofing



Use of flood barriers, installed at the entrance of the buildings (SHIELDING)



**DRY FLOOD PROOFING**

## Flood proofing



Use of flood barriers, installed at the entrance of the buildings (SHIELDING)

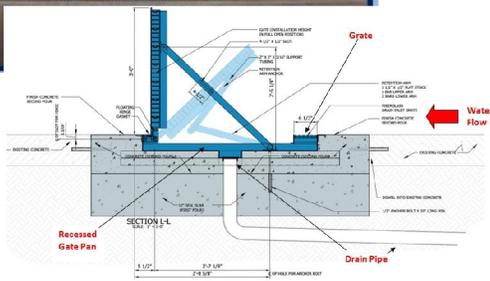


**DRY FLOOD PROOFING**

# Flood proofing



Use of flood barriers, installed at the entrance of the buildings (SHIELDING)



DRY FLOOD PROOFING

# Flood proofing



## DRY FLOOD PROOFING

Flood barriers along riverbanks or crossing a street (SHIELDING)





Germany, July 2021

***Thank you for your attention!***