



ToRC – Towards mOre flood Resilient Cities

Jorge Leandro, Bruno Santos, Joao Leitao, Christian Urich
and Thomas Siekmann

ToRC – Towards mOre flood Resilient Cities

▶ Outline

- ▶ Why do we need to move Towards more Flood Resilient Cities?
- ▶ How does the future look like?
- ▶ What is TORC about?

- ▶ “Does the flap of a butterfly's wings in Brazil sets off a tornado in Texas?”
- ▶ “If it happens, do we know what to do?”
- ▶ “We will be affected by major flooding events in the future.”
- ▶ “We must be willing to work together and share information.”
- ▶ The PPRR concept

- ▶ Final conclusions





Why do we need to move TORC?

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They cause more than **1/2 of all fatalities** due to natural catastrophes;

Loster, 2000



Need 4 ToRC

▶ 2008 Bihar (India)

- ▶ standard operating procedures and evacuation plans had to be modified to fit the unprecedented situation - Paras Nath Rai (Special secretary at the department of Home and Disaster Management in Bihar)

1. **Bihar, India, August 2008**
2. Across UK, June and July 2007
3. Grand Turk, Turk and Caicos Islands, September 2008
4. Henan, China, June 2010
5. Mexico, Mexico, November 2007
6. Santa Catarina, Brasil, November, 2008
7. Ghardaia, Algeria, October, 2008
8. Islamabad, Pakistan, July 2010
9. Brisbane, Australia, December 2010
10. Krasnodar, Russia, July 2012
11. Beijing, China, July 2012

Crisis Response



They cause more than **1/2 of all fatalities** due to natural catastrophes;

Loster, 2000



Need 4 ToRC

▶ June/July 2007 UK

- ▶ 300 emergency calls in just over an hour.
“We will be affected by major flooding events in the future. How well are we able to respond to will depend on our willingness to learn from these events and commit to working together more closely than ever before”- Paul Hayden, Chief Fire Officer of Rescue Service UK

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Crisis Response



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Loster, 2000



Need 4 ToRC

▶ September 2008 The Grand Turk

- ▶ “The Department of Disaster Management and Emergencies (DDME) was not equipped with adequate vehicles for off-terrain, or with enough capacity.” - Jamell Robinson, Director-Counterpart at the DDME

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Crisis Response

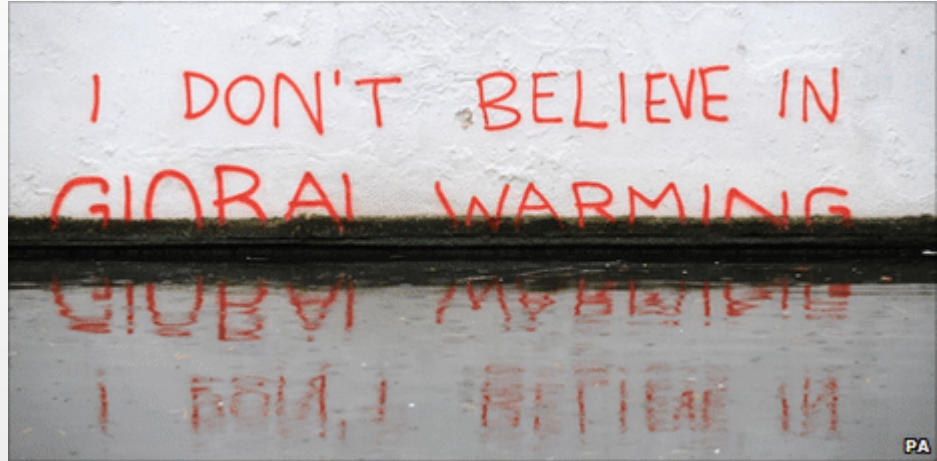


Current Research



- ▶ Large international projects in Flood Resilience
 - ▶ SMARTest
 - ▶ PREPARED
 - ▶ CORFU
 - ▶ TRUST
 - ▶ CORONA
 - ▶ FRMRC
 - ▶ DANCE4WATER
 - ▶ DYNAKLIM
-





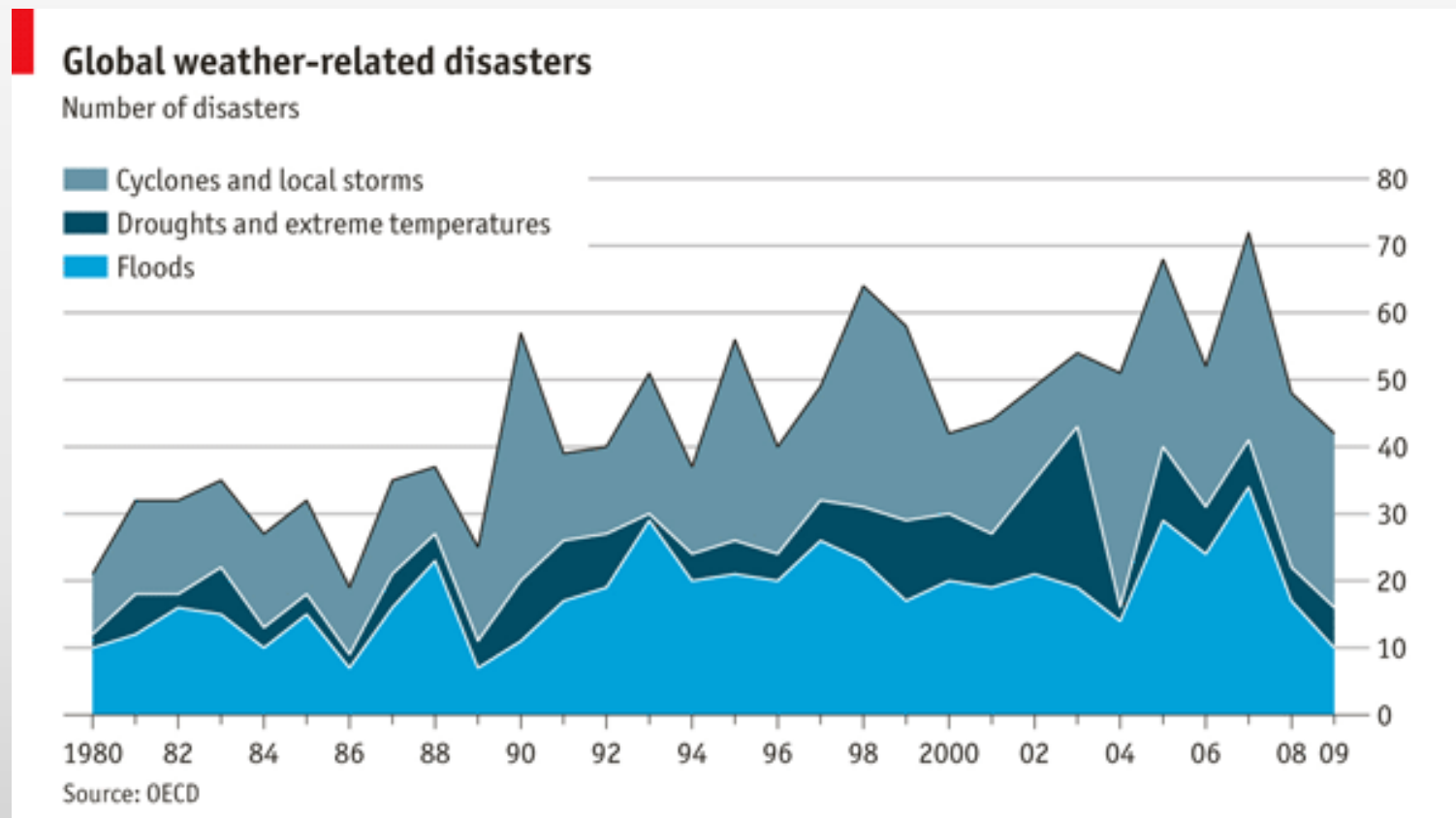
How does the future look like?

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How does the future look like?



- ▶ Global weather-related disaster, OECD- Environmental Outlook 2050





What is TORC about?

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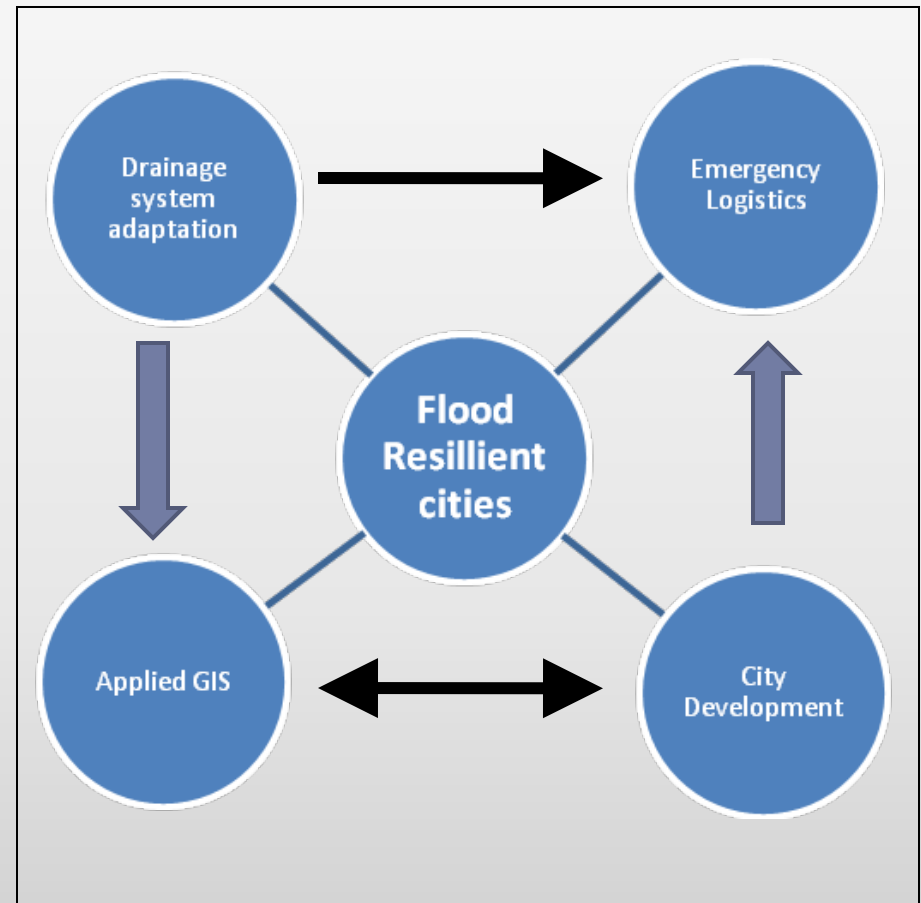
What is **TORC** about?

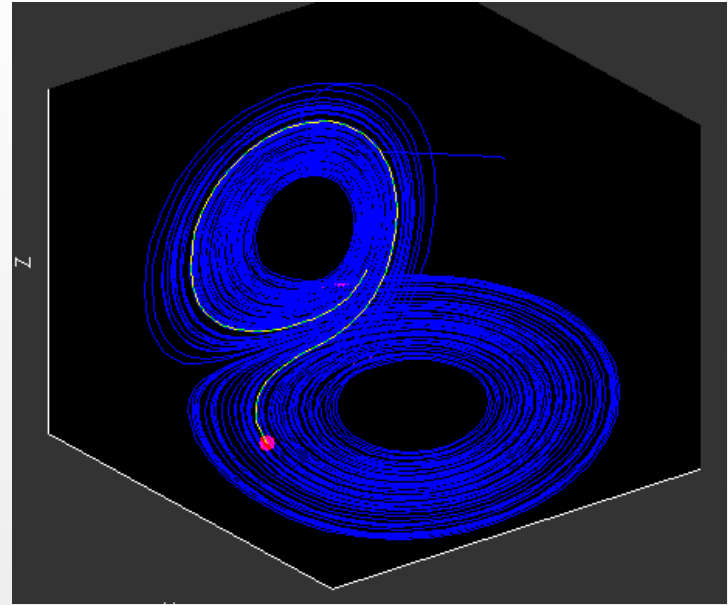


Global Framework

- ▶ 4 Areas
 - ▶ Drainage Modelling/System Adaption
 - ▶ Emergency Logistics
 - ▶ City Developments
 - ▶ Applied GIS

ToRC structure



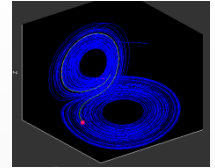


Drainage systems design and flood modelling – “*Does the flap of a butterfly's wings in Brazil sets off a tornado in Texas?*”

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Jorge Leandro

Drainage systems design and flood modelling



Edward Lorenz

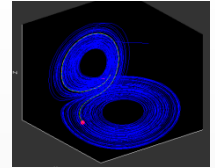
- ▶ *Butterfly effect*
 - ▶ initial conditions
- ▶ Diverging points
 - ▶ Different attractors

Design and Planning

- ▶ Driving engines of Uncertainty
 - ▶ Urban development changes
 - ▶ Societal changes
 - ▶ Climate changes
- ▶ Tipping points



Drainage systems design and flood modelling



Flood Modelling

- ▶ Which model to use?
 - ▶ Case study
 - ▶ Objective
 - ▶ Who's doing the modelling
- ▶ Different Governing Equations
 - ▶ Navier-Stokes
 - ▶ Saint-Venant
 - ▶ Diffusive model, etc.
- ▶ Different approximations
 - ▶ 1D, 2D and 3D
 - ▶ 1D/1D and 1D/2D





**Emergency logistics -If it happens,
do we know what to do?**

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Bruno Santos

Evacuation Logistics



- ▶ Motivation
 - ▶ If it happens, do we know what to do?
- ▶ Disaster Management
 - ▶ 4 phases approach - Integrated Management
- ▶ Accessibility Maps
- ▶ Location Theory
- ▶ Routing Problems
- ▶ Uncertainty
 - ▶ Spatial and time variability
 - ▶ Lack of knowledge
- ▶ Final Remarks





City developments – “We will be affected by major flooding events in the future.”

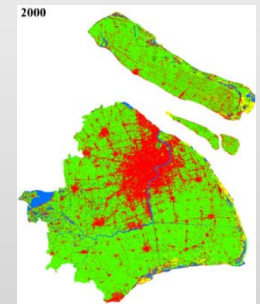
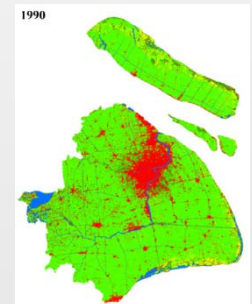
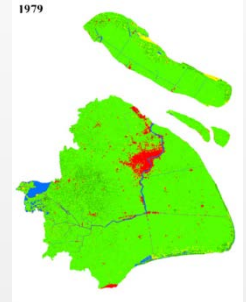
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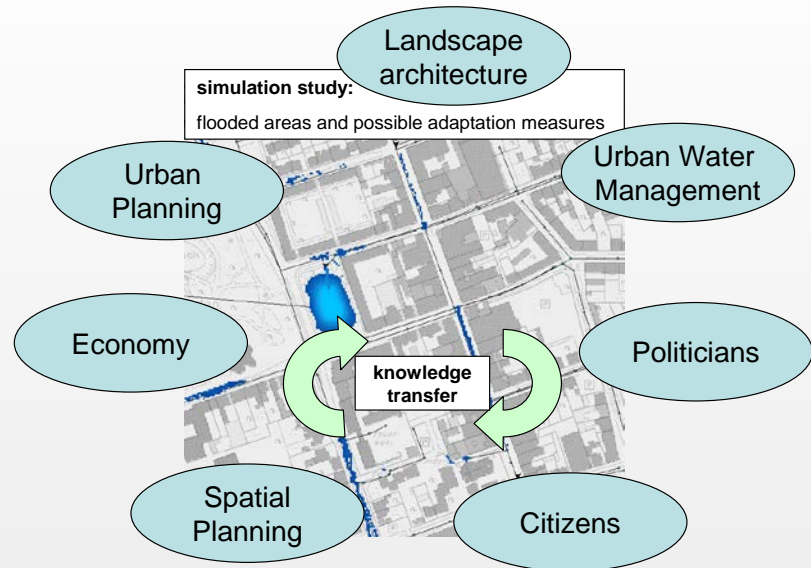
Christian Urich

City Developments



- ▶ **Motivation**
 - ▶ Multiple story line scenarios, to answer what if?
- ▶ **Flooding is highlighting weaknesses**
 - ▶ Sewer systems
 - ▶ Current strategies
- ▶ **Strategic planning tools**
 - ▶ Stormwater facilities
 - ▶ Societal transitional changes
 - ▶ Urban environmental changes
 - ▶ Access best options
- ▶ **Uncertainty**





Geographic Information Systems - “We must be willing to work together and share information.”

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Joao P Leitao

Geographic Information Systems



▶ Motivation

- ▶ View, Analyse and Share information

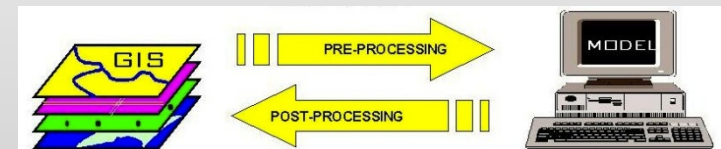
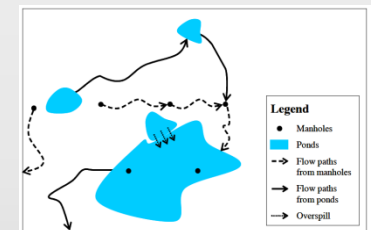
▶ Prepare information

- ▶ Geographic data for 1D sewer “flooding” models
- ▶ Geographic data for 1D and 2D surface flow (runoff) models
- ▶ Risk assessment, ...

▶ Communicate information

▶ Integration tool

- ▶ Flood Models
- ▶ Emergency Models
- ▶ Strategic planning tools





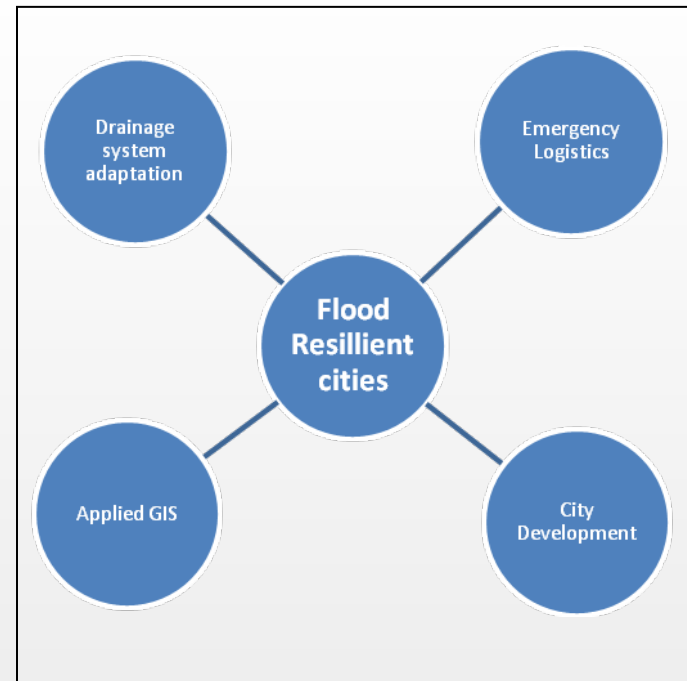
The PPRR (prevention, preparedness, response and recovery) concept

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PPRR concept

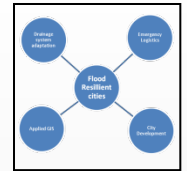


- ▶ **Motivation**
 - ▶ Make Cities more resilient
- ▶ **PPRR (20 years old concept)**
 - ▶ Prevention: long-term planning
 - ▶ Preparedness: before the disaster
 - ▶ Response: during the disaster
 - ▶ Recovery: after the disaster
- ▶ **How to improve PPRR?**
 - ▶ Integrating PPRR with modelling tools:
 - ▶ Water infrastructures, urban environment and societal systems
 - ▶ And than Ask and answer: What if...?



Final conclusions

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Conclusions

- ▶ Frequency of extreme events
- ▶ Need to move towards more resilient cities
- ▶ How? Flexible tools to tackle resilience

- ▶ PPRR concept is useful **however it must** be improved.
By considering:
 - ▶ Drainage systems design and modelling;
 - ▶ Emergency logistics;
 - ▶ City development
 - ▶ Geographic Information Systems.

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Thank you for your attention.

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Christian Urich, Thomas Siekmann

