Integrating chains of DRR measures in coastal impact assessment: An application in Varna, Bulgaria

Authors: **Lydia Cumiskey[1] , S**ally Priest[2], Nikolay Valchev [3] , Nataliya Andreeva [3], Petya Eftimova [3]

[1] **Deltares (lydia.cumiskey@deltares.nl)**
[2] Flood Hazard Research Center, Middlesex University
[3] Institute of Oceanology – Bulgarian Academy of Sciences, Bulgaria
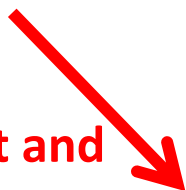
Bremen, 06 Sept 2016

Overview

- **Background – problem identification**

- **Review of the approach and results for the application in Varna (parallel)**

  - Step 1: Chain of Disaster Risk Reduction Measures

  - Step 2: Quantifying the intermediate pathway

  - Step 3: Inclusion in the impact assessment (Bayesian Network)

- **Conclusions**

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Background

SCIENTIFIC KNOWLEDGE

MODELS

DATA

Disaster Risk Reduction measures

Need to select and prioritize measures

Provide information to evaluate the impact of measures

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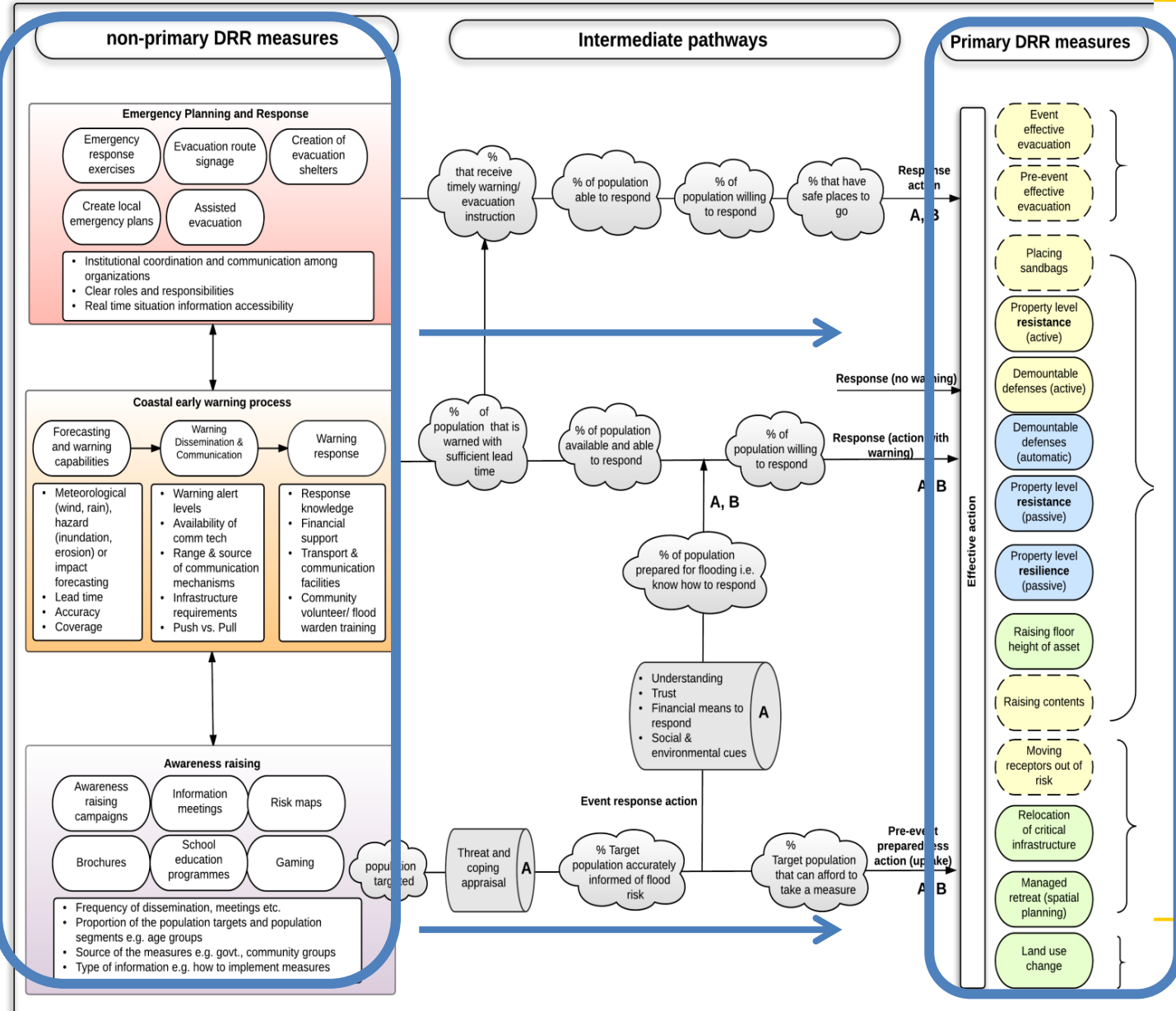**Complex... some measures risk reduction is more difficult to quantify than others**

Step 1: DRR measures

Hazard influencing	Exposure/ vulnerability influencing	
	Primary measure	*Non-primary*
• Beach nourishment • Coastal structure adaptation • Flood storage area • Port wall reconstruction	• Managed retreat	
	Passive preparedness: • Elevated houses (raising floor level) • Property level resilience measures	• Awareness raising activities/ channels of communication
	Active preparedness: • Effective evacuation • Moving contents/assets • Moving receptors (boats, cars) • Placing sandbags • Flood shutters, gates	• Emergency planning and response activities • Early warning system improvements ****Not generally quantified in impact assessments**

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Step 1: Chain of DRR measures

Background on Varna, Bulgaria

Beach nourishment

Port wall enforcement

Restaurants/bars

Sports facilities/clubs
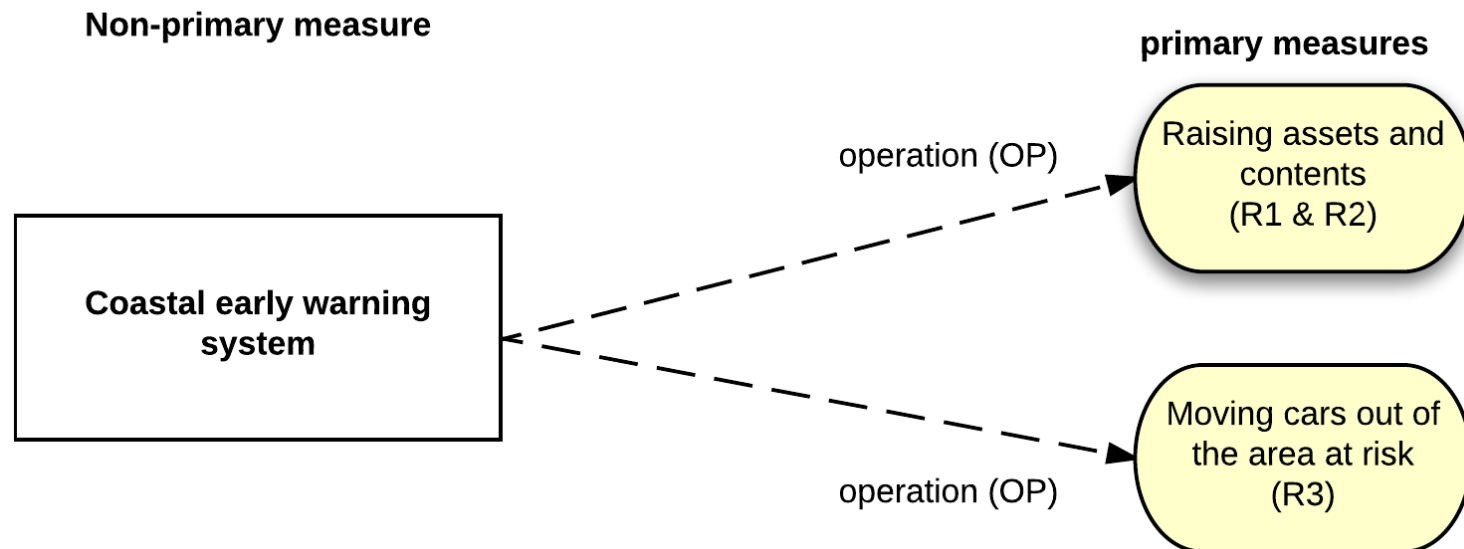
Car parks

VARNA

VARNA CENTRAL BEACH

PORT WALL
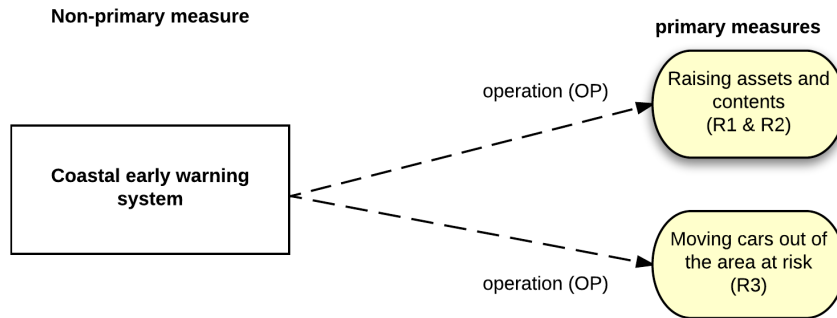
R1
R2
R3

Varna non-primary measure

Coastal (storm) Early Warning System

- Extend the current weather forecasting system to include storms for 3 days

- Disseminate via SMS and mobile application

Non-primary measure

primary measures

Coastal early warning system

operation (OP) → Raising assets and contents (R1 & R2)

operation (OP) → Moving cars out of the area at risk (R3)

Step 2: Intermediate pathway factors

Data collection challenge!!

Non-primary measure

primary measures

```
                                    operation (OP)      Raising assets and
                                    - - - - - - - - ->     contents
  +----------------------+        /                        (R1 & R2)
  |                      |       /
  | Coastal early warning|  <---
  |      system          |       \
  |                      |        \
  +----------------------+         - - - - - - - - ->   Moving cars out of
                                    operation (OP)      the area at risk
                                                              (R3)
```

Estimates were found from UK based literature and validated in interviews (x8) with local businesses and to collect contextual information

Estimates are needed for the % of the population that is

1. warned with <u>sufficient lead time</u>
2. <u>available and able</u> to respond
3. <u>prepared for and know how</u> to respond
4. <u>willing</u> to respond

Factors combine to form the **Operator Factor (OP)** – influence the effectiveness

Step 2: Limiting variables

- Age
- Financial deprivation
- Rental vs. owner occupied
- Flood experience
- Proportion of transient population
- Attitudes/trust in authorities
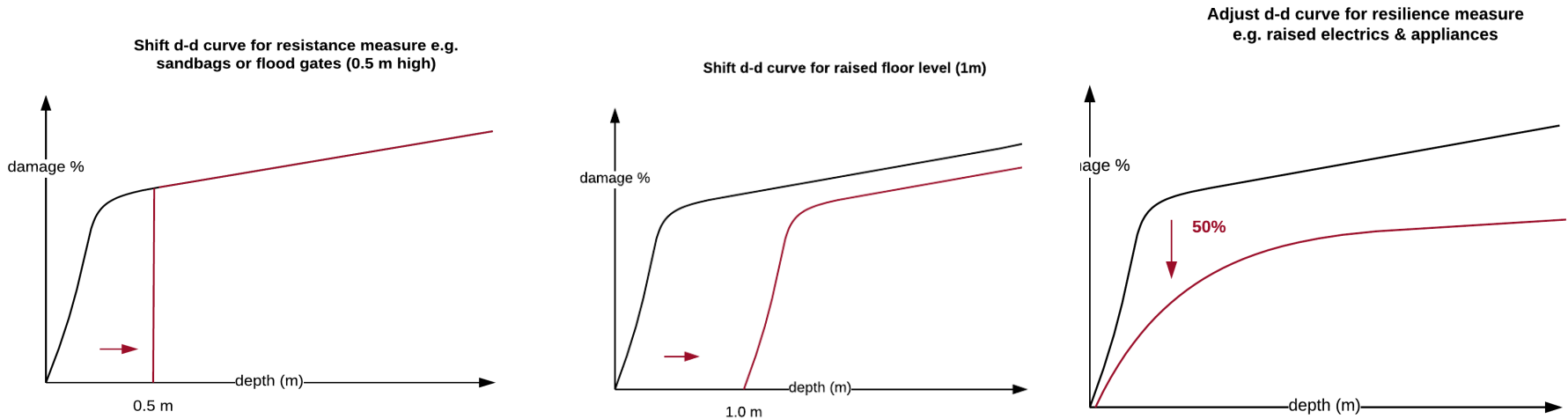- Community networks
- House type
- Financial incentives

Influence the intermediate pathway factors

Build arguments to justify the assumptions/ estimations of factors (before & after)

Step 2: Varna Results (moving assets)

Factor	Base	EWS	Literature	Contextual reasoning
% warned with sufficient lead time	40	60	Parker et al. (2007) assumes 40% and interviews suggest increases of 20%	Good social networks for spreading info. User friendly communication.
% available and able to respond	70	85	Dennis J Parker et al. 2007 - 73 to 85% (able) 55 to 64% (available) and matches with interviews	Restaurant staff can easily respond Season is a constraint for availability
% prepared for and know how to respond	95	95	Carsell et al. (2004) 75% Assumed to be higher	Contingency plans in place High flood experience Familiar activities
% willing to respond	70	80	Carsell et al. (2004) estimates 80%	Low trust in authorities but high trust in existing forecasts. Protect assets
Operator Factor	**20**	**45 *65**	In line with literature Parker et al. 2007	*Account for those that do not directly get the warning

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Step 3: Include in the impact assessment

Shift d-d curve for resistance measure e.g. sandbags or flood gates (0.5 m high)

damage %

depth (m)

0.5 m

Shift d-d curve for raised floor level (1m)

damage %

depth (m)

1.0 m

Adjust d-d curve for resilience measure e.g. raised electrics & appliances

age %

50%

depth (m)
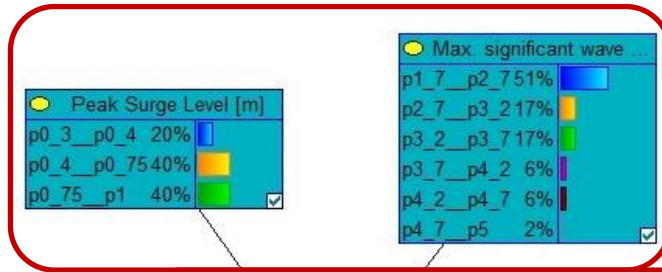
Shift d-d curve –
property level
resistance: sandbags

Adjusting D-D curve:
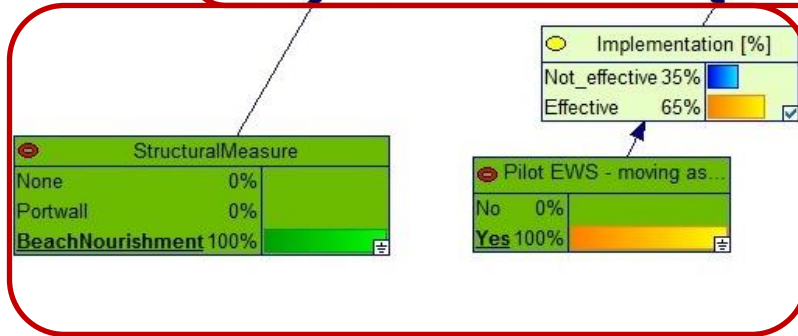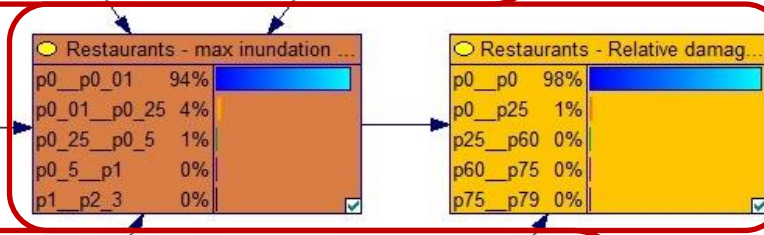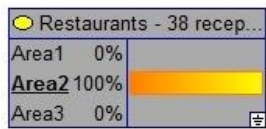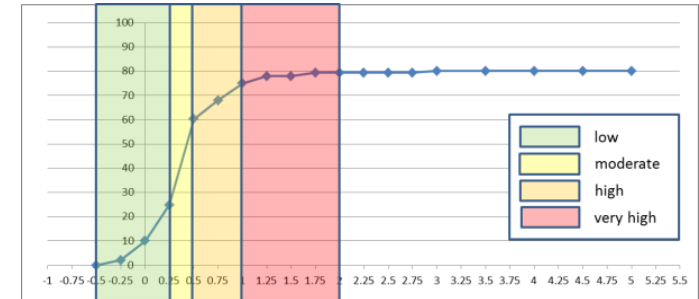Raised floor height

Adjusting D-D curve:
Resilience measures

- Shift or adjust depth-damage curves for OP %
- Use original d-d curve for the remaining
- Other options – use empirical damage reduction factors

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Step 3: Include in the impact assessment

Hazard

Impact

DRR measures
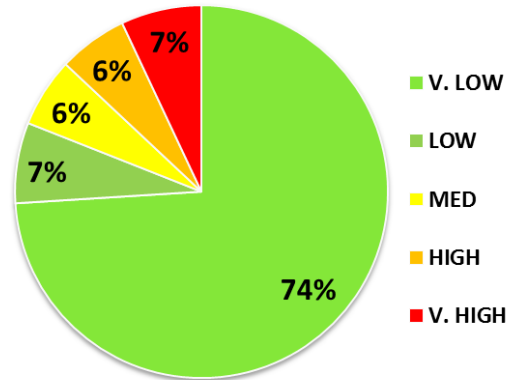
Bayesian Network Analysis tool used
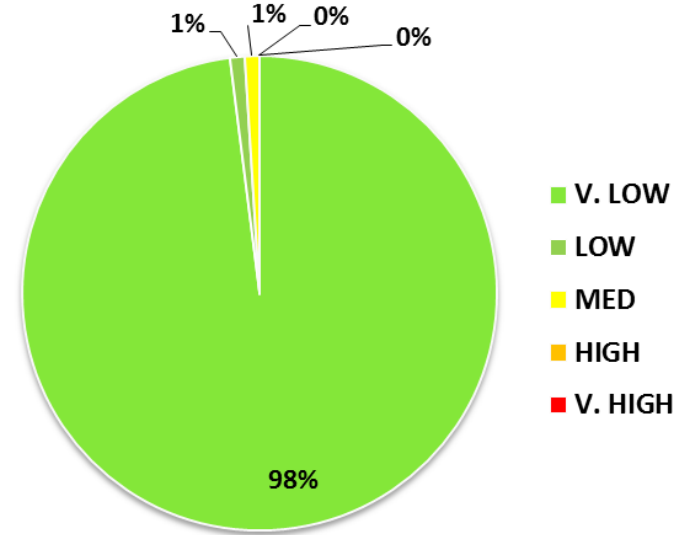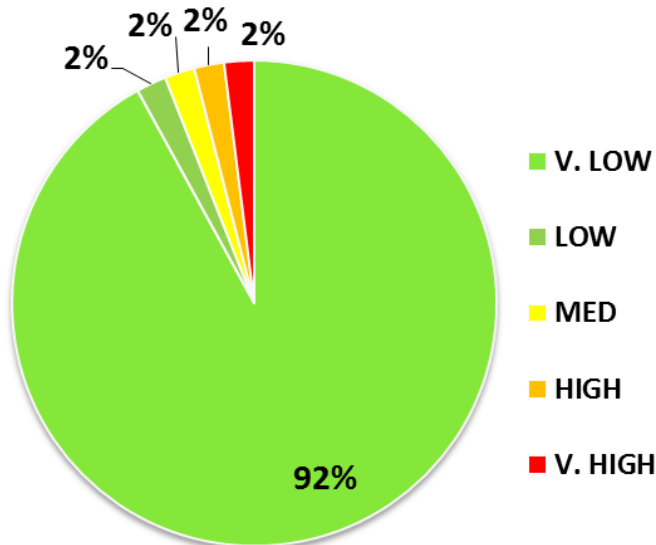
% relative damage per receptor

Step 3: Impact assessment results (restaurants)

Baseline situation for restaurants/shops

Coastal Early warning system + moving assets

Coastal Early warning system + moving assets + Beach Nourishment

Conclusions

- Approach is useful to **compare different DRR measures** and consider the chains

- **Process generates dialogue** on the human factors that will influence the DRR measures effectiveness

- Useful input for Multi-Criteria Analysis to prioritize the measures together with stakeholders

- **Data collection** is difficult but some literature is available and local data is helpful to validate and contextualize this.

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References

Parker, D.J., Tunstall, S.M., McCarthy, S., 2007. New insights into the benefits of flood warnings: Results from a household survey in England and Wales. Environmental Hazards 7, 193–210. doi:10.1016/j.envhaz.2007.08.005

Carsell, K.M., Pingel, N.D. & Ford, D.T., 2004. Quantifying the Benefit of a Flood Warning System. Natural Hazards Review, 5(3), pp.131–140.

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