Panta Rhei Benchmark Dataset

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Unsolved problem in hydrology

"How can we extract information from available data on human and water systems in order to inform the building process of socio-hydrological models and conceptualisations?"

2 Steps towards benchmark dataset

1) Collection of drought and flood paired event case studies

Undertaken by the Panta Rhei working groups "Changes in flood risk" and "Droughts in the Anthropocene" namely by Heidi Kreibich, Giuliano di Baldassarre, Anne van Loon, Kai Schröter and Philip Ward

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2) Panta Rhei benchmark dataset – extending the paired event data to longer time series

Undertaken by the Panta Rhei initiative, coordinated by the following core group: Heidi Kreibich, Giuliano di Baldassarre, Anne van Loon, Kai Schröter, Philip Ward, Fuqiang Tian, Alberto Viglione, Margaret Garcia, David J. Yu, Murugesu Sivapalan, Günter Blöschl

1st Step: Collection of paired events

- **43 Paired event cases**, i.e. droughts or floods that occurred in the same catchment or region (analog to 'Paired catchment studies')

Floods		Droughts	
Pluvial	6	Meteorological	7
Riverine & mixed	14	Hydrological	5
Coastal	4	Mixed	7
total	*24*	*total*	*19*

Previous work is basis for the study (both open access):

- *How to improve attribution of changes in drought and flood impacts - HSJ 64, 1, 1-18, DOI: http://doi.org/10.1080/02626667.2018.1558367*
- *Adaptation to flood risk - results of international paired flood event studies - Earth's Future, 5, 10, 953-965, DOI: http://doi.org/10.1002/2017EF000606*

Information collected for paired event

Template for comprehensive paired event description

Heading: Paired events: *0000 (event-year1) and 0000 (event-year2) hazard type in the xx catchment (or xx region) in country/continent*
Authors and Affiliations

Short description of both events: *limited to hazard type, catchment/region affected and consequences/damage (all other description will be in the event comparison below)*

Descriptions of processes between events: *e.g. land use change, increase in population density or wealth, improvements in risk management, changes in early warning systems, infrastructure projects, risk communication campaigns, Legal developments, etc.*

Event comparison in respect to hazard: *potentially with figure providing hazard overview of both events*

Event comparison in respect to exposure: *e.g. people affected, area/assets affected, exposure hotspots (e.g. cities), in cases where*

Event comparison in respect to vulnerability*: e.g. Preparedness (early warning, lead times, risk communication, private emergency measures), Awareness and precaution (experience, information campaigns, precautionary measures), Organisational emergency management (governmental crisis management), Perceived consequences (e.g. duration to recover, stress-related)*

Summary *including evaluation of important drivers of change, what drives the development, e.g. learning effect or levee effect or combination?*

Comprehensive description of both events and processes in between

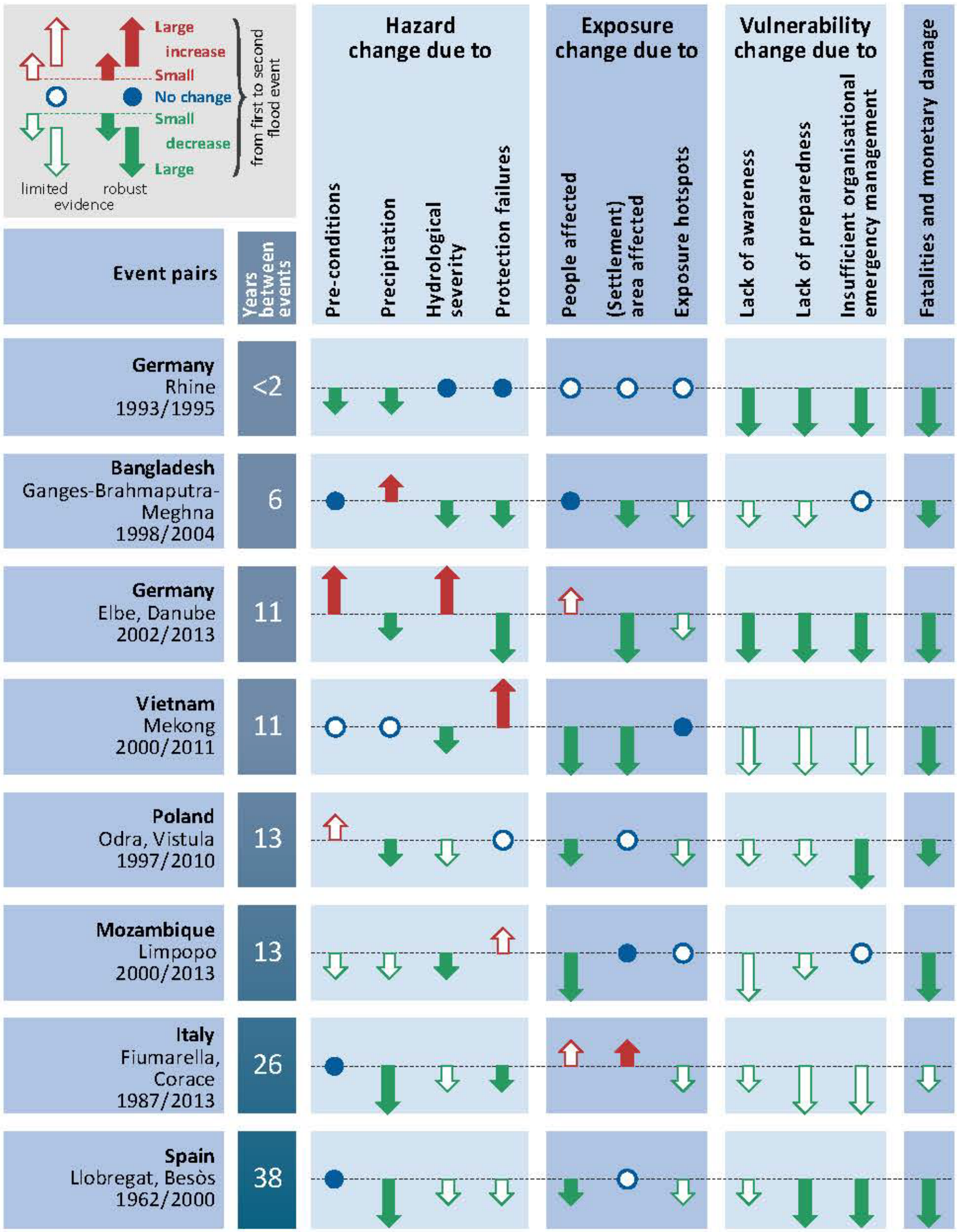
Information collected for paired event

Table 1. Information on Risk Drivers and Resulting Damage of the Individual Success Stories of Risk Reduction, that is, Paired Flood Events (for Detailed Information see Supporting Information S1, Texts S1–S8)

		Germany Rhine (Supporting Information S1, Text S1)		Bangladesh (Supporting Information S1, Text S2)		Germany Elbe, Danube (Supporting Information S1, Text S3)		Vietnam (Supporting Information S1, Text S4)	
		1993	1995	1998	2004	2002	2013	2000	2011
Hazard	Preconditions	Wetness-index: 49.2 [*Schröter et al.*, 2015]	Wetness-index: 30.8 [*Schröter et al.*, 2015]	Saturated soils due to regular monsoon rainfall	Saturated soils due to regular monsoon rainfall	Wetness-index: 47 [*Schröter et al.*, 2015]	Wetness index: 114 [*Schröter et al.*, 2015]	ND[a]	Saturated soils
	Precipitation	Precipitation index: 21.97 [*Schröter et al.*, 2015]	Precipitation index: 8.6 [*Schröter et al.*, 2015]	1870 mm	2000 mm	Precipitation index: 30 [*Schröter et al.*, 2015]	Precipitation index: 17 [*Schröter et al.*, 2015]	ND[a]	High continuous rainfall combined with high number of typhoons
	Hydrological severity	Severity index: 44.4 [*Schröter et al.*, 2015], lower Rhine mainly affected	Severity index: 51.2 [*Schröter et al.*, 2015] lower Rhine mainly affected	68% of Bangladesh inundated	40% of Bangladesh inundated	Severity index: 35 [*Schröter et al.*, 2015]	Severity index: 75 [*Schröter et al.*, 2015]	Bivariate probability of peak discharge and volume: 0.05 [*MRC*, 2015]; 0.01 [*Dung et al.*, 2015]	Bivariate probability of peak discharge and volume: 0.1 [*MRC*, 2015]; 0.02 [*Dung et al.*, 2015]
	Protection failures	0	0	4500 km dikes partially/totally damaged	3100 km dikes partially/totally damaged	131 dike failures	30 dike failures including 3 major breaches [*DKKV*, 2015]	1270 km dikes failed/were over-topped [*DMC-CCFSC*, 2016]	3370 km dikes failed [*DMC-CCFSC*, 2016]
Exposure	People affected	100,000 [*EM-Dat*, 2015]	ND[a]	30,000,000	36,000,000	330,000 [*EM-Dat*, 2015]	600,000 [*EM-Dat*, 2015]	~5 million people, 895,499 houses affected [*DMC-CCFSC*, 2016]	590,000 people, 176,588 houses affected [*DMC-CCFSC*, 2016]
	(Settlement) area affected	ND[a]	ND[a]	100,250 km^2	54,720 km^2	52.6 km^2 (own calculation, see S3)	13.7 km^2 (own calculation, see S3)	615,704 ha [*DMC-CCFSC*, 2016]	137,599 ha [*DMC-CCFSC*, 2016]
	Exposure hotspots	Cologne, Koblenz, Bonn	Cologne, Koblenz, Bonn	Eastern part of Dhaka City.	Sylhet city, eastern part of Dhaka City	Dresden (Cultural heritage)	Passau, Deggen-dorf, Halle (Saale)	No particular hotspots	No particular hotspots
Vulnerability	Lack of awareness	Last severe floods in 1926 and 1970	Experience with flood event just 13 months before [*Bubeck et al.*, 2012]	High awareness due to annual flooding, last severe floods in 1987 and 1988	Increased coping capacity due to decreasing poverty, increasing access to education	Last severe floods in 1974 and 1954 [*Kreibich et al.*, 2011; *Kreibich and Thieken*, 2009]	Several recent floods in 2002, 2005, 2006, 2010, 2011 [*Kienzler et al.*, 2015]	Last severe flood 22 years ago	Experience with 2000 flood
	Lack of preparedness	Low preparedness [*Bubeck et al.*, 2012; *Engel et al.*, 1999]	Improved early warning and sign. Increased preparedness [*Bubeck et al.*, 2012; *Engel et al.*, 1999]	Good preparedness and early warning (forecasts for 24 and 48 h lead times) [*Gain et al.*, 2015]	After 1998, further improved forecast-ing/warning (forecasts for 72 h lead time)	Warnings relatively late and imprecise, low preparedness [*Kreibich and Merz*, 2007]	Sign. Improved warning and preparedness [*Thieken* et al., 2016b]	Low preparedness	Medium to high preparedness, good early warning
	Insufficient organizational emergency management	Public flood management badly prepared	Public management sign. Improved due to learning in 1993 [*Engel et al.*, 1999]	Weak disaster preparedness and response planning	Weak disaster preparedness and response planning	Exercises within individual relief organizations	Every 2 years trans-organizational national crisis management exercise (LÜKEX) [*Thieken et al.*, 2016b]	Unprepared and not well organized	Much better organized, frogm communal to governmental level
Damage	fatalities	5	5	1050	730	21 [*DKKV*, 2015; *Thieken et al.*, 2016a]	14 [*DKKV*, 2015; *Thieken et al.*, 2016a]	481 [*DMC-CCFSC*, 2016]	89 [*DMC-CCFSC*, 2016]
	Monetary damage[b]	EUR 767 million	EUR 256 million	US$ 5000 million	US$ 2200 million	EUR 14.6 billion [*DKKV*, 2015; *Thieken et al.*, 2016a]	EUR 6 to 8 billion [*DKKV*, 2015; *Thieken et al.*, 2016a]	US$ 500 million [*Chinh et al.*, 2016]	US$ 208.9 million [*Chinh et al.*, 2016]

Quantitative and qualitative data about both events and processes in between *(see example of preliminary study: Table 1 in Kreibich et al. 2017 (http://doi.org/10.1002/2017EF000606)*

Information collected for paired event



Semi-quantitative data about changes between events *(see example of preliminary study: Figure 2 in Kreibich et al. 2017 (http://doi.org/10.1002/2017EF000606)*

2^{nd} Step: Extending the paired event data to longer time series

Approach:

1) Identify the variables for which time series of data shall be collected and setup a framework for the benchmark dataset: Since the benchmark dataset shall be used to develop, apply and maybe calibrate socio-hydrological models (for an example see Barendrecht et al. 2019, DOI: http://doi.org/10.1029/2018WR024128), a few of these models related to floods and droughts will be selected.

2) The data collection will use the paired event case study data (and community) as a basis. Where possible, the paired event data shall be extended and complimented with time series of the variables identified above under 1).

3) The socio-hydrological models selected under point 1) will be calibrated and applied on basis of the collected data, which will be analysed and the results published in a community paper.

Discussion

This presentation shall be used to discuss and finalise the concept for the 2nd step of data compilation and analyses, to promote this initiative and to motivate as many colleague as possible to contribute to the data collection and comparative analyses.