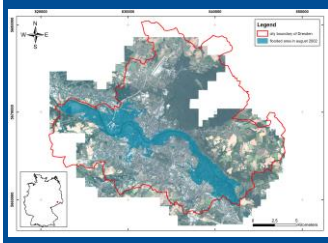
Flood damage modelling on basis of urban structure mapping using high-resolution remote sensing data

Heidi Kreibich, Tina Gerl, Mathias Bochow
GFZ-German Research Centre for Geosciences, Potsdam, Germany

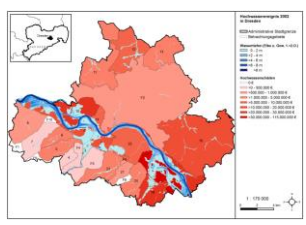


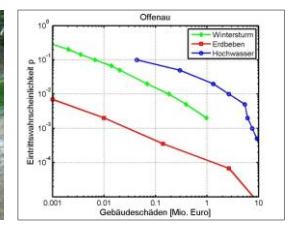
GFZ Helmholtz-Zentrum Potsdam

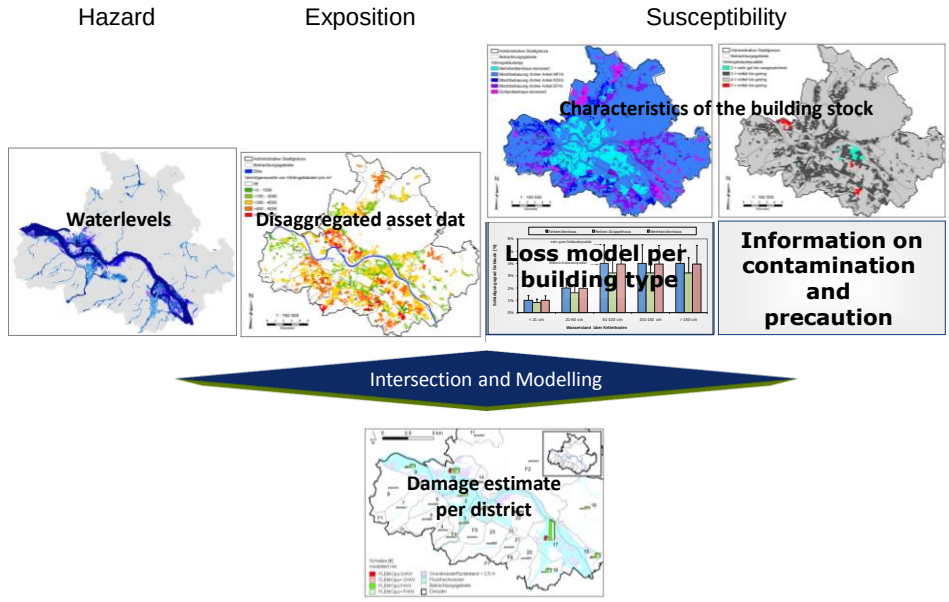
HELMHOLTZ GEMEINSCHAFT

Flood damage modelling is needed for …

- Vulnerability assessment
- Risk mapping
- Efficient decisions about protective and precautionary measures
- Assessment of climate adaptation strategies
- Comparison of multi natural hazards risks
- Cost assessment for the (re-)insurance sector
- Loss estimation during/after flood events for compensation and reconstruction

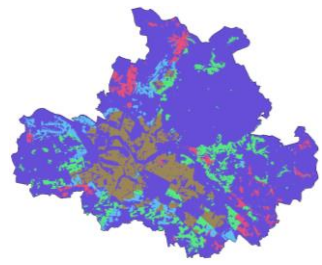
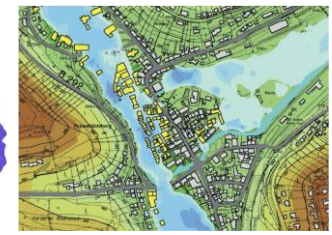




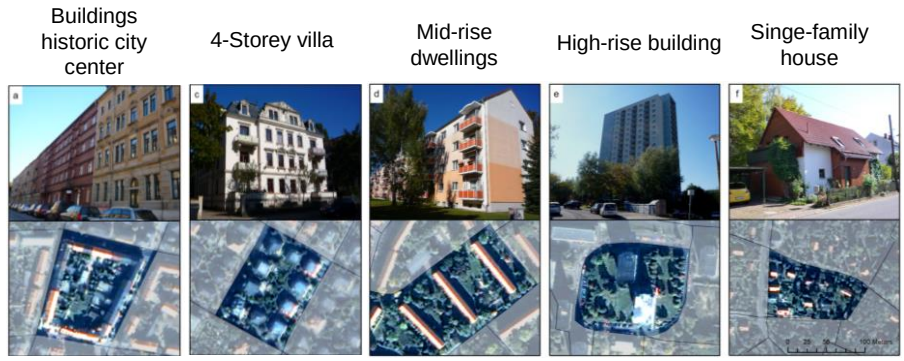


Damaging processes

- Damaging processes differ from building to building
- Damage determining factors are e.g. building use, type, size, material, precaution, basement
- More detailed information about exposed residential buildings are necessary

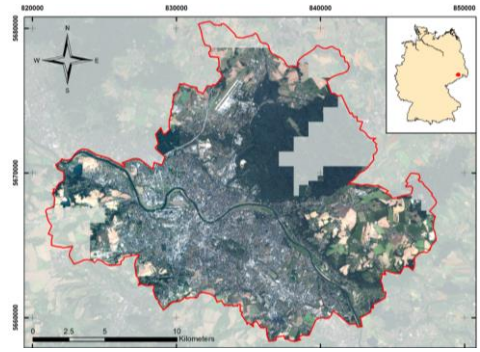
Residential areas



Morphological units differ in regard to:

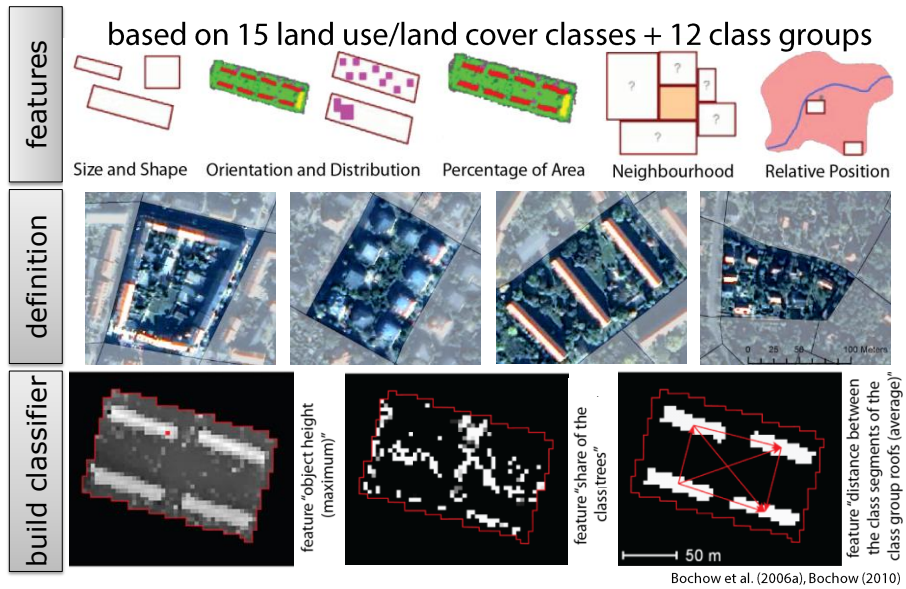
- composition of different objects (e.g., buildings, trees)
- surface materials (e.g., roof materials, vegetation type)
- distribution and arrangement within space

Approach

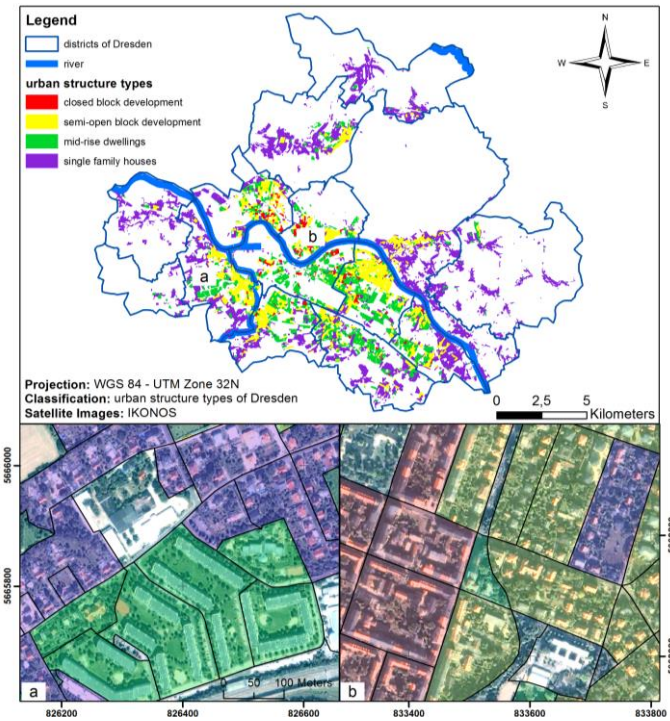


IKONOS imagery of the case study area

Urban structure type classification



Bochow et al. (2006a), Bochow (2010)



Urban structure type map

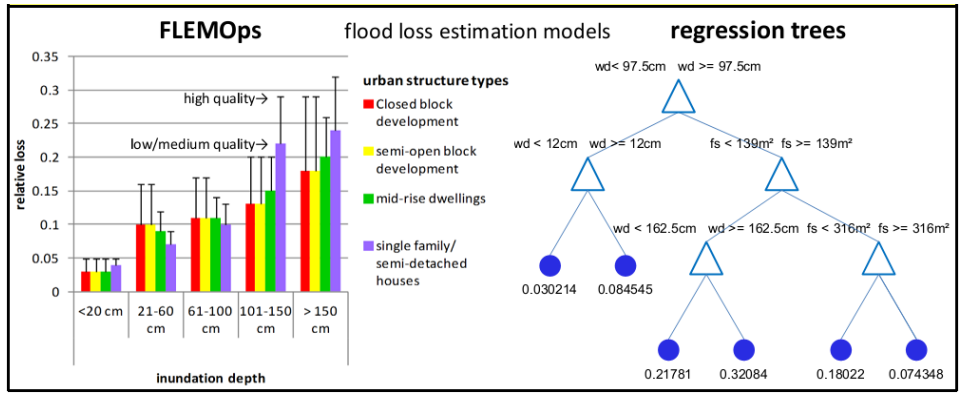
Error matrix of the urban structure type classification

	Number of training building blocks	Closed block development	Semi-open block development	Mid-rise dwellings	Single family houses	Omission error
Closed block development	36	**63.9**	16.7	19.4	0	36.11
Semi-open block development	493	1.2	**72.8**	11.6	14.4	27.18
Mid-rise dwellings	745	1.5	16.0	**64.1**	18.4	35.84
Single family houses	1157	0	11.5	8.1	**80.4**	19.62
Commission error		42.50	41.82	24.84	18.28	

Building characteristics of the four urban structure types

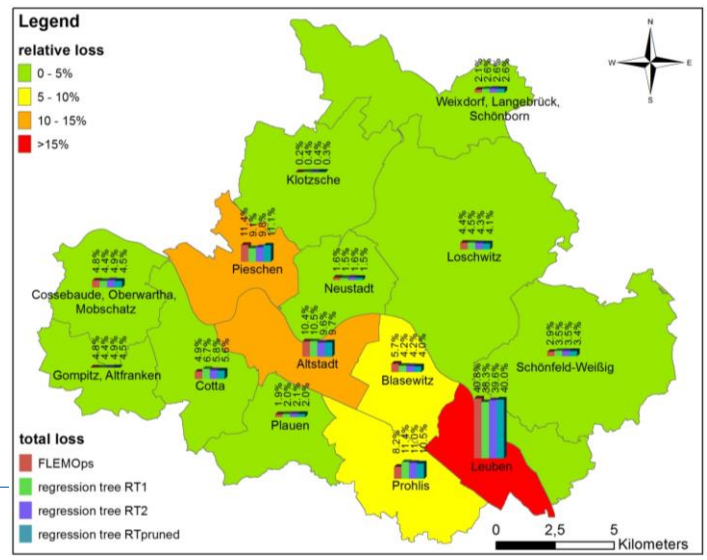
		Closed block development	Semi-open block development	Mid-rise dwellings	Single family houses
Share of area [%]		2.9	22.6	24.7	49.8
Age of building [%]	before 1924	28.0	35.1	12.2	25.6
	1924-1948	16.1	23.1	25.1	33.7
	1949-1990	40.9	22.5	47.6	17.6
	after 1990	15.1	19.2	15.0	23.0
heating system [%]	coal	2.3	0.6	0.7	2.3
	gas	30.7	67.5	38.5	75.1
	fuel oil	6.8	8.6	6.8	15.5
	electricity (night storage)	5.7	1.3	4.3	2.3
	district heating	54.5	21.2	49.0	2.8
	wood, pellets, tile stoves	0	0.6	0.4	1.9
	others	0	0	0.4	0
mean floor space [m²]		4336	1078	2549	388

Flood loss models



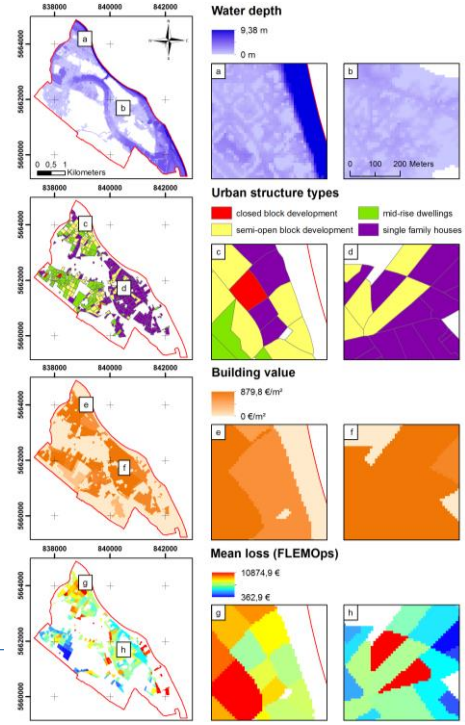
Flood loss estimations

	Modelled flood losses				Official estimates	
	FLEMOps	RT1	RT2	RTpruned	SAB (2005)	Korndörfer (2006)
Total loss [€ in million]	288.9	189.2	214.4	241.9	239.8	304.0



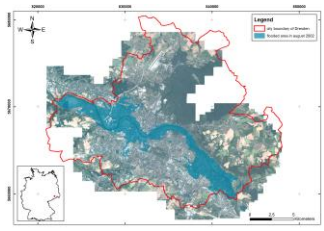
Example of spatial characteristics:

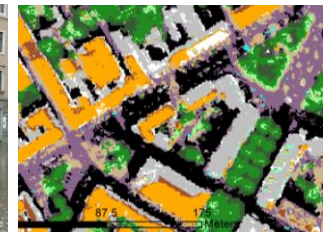
- Water depth
- urban structure type
- building values
- losses



Conclusions

- The urban structure map achieved a good accuracy of 74%
- On this basis modelled flood losses are in the same order of magnitude as official damage data
- Single family houses show significantly higher losses than the other three urban structure types, so that information on their specific location is very valuable





Gerl, T. M., Bochow, M., Kreibich, H. (2014): Flood Damage Modeling on the Basis of Urban Structure Mapping Using High-Resolution Remote Sensing Data. - Water, 6, 8, p. 2367-2393.