FLEMOcs – a novel, multi-factorial model for the estimation of flood losses in the commercial sector

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Background

The estimation of flood damage is an important component for risk-oriented flood design, risk mapping, financial appraisals and comparative risk analyses. However, research on flood-loss modelling, especially in the commercial sector, has not gained much attention so far. The estimation of flood loss is a challenge, especially in the commercial sector, because of its great inhomogeneity. However, the reliability of loss modelling is fairly unknown, since flood-loss models are scarcely validated.

Objective

The objective of this poster is the presentation of the new flood loss estimation model **FLEMO**cs which stands for **F**lood **L**oss **E**stimation **MO**del for the **c**ommercial **s**ector and which is designed to estimate losses to buildings, equipment and goods, products, and stock of companies. The model is based on object-specific empirical data from floods in 2002, 2005 and 2006 in Germany. Additionally, a database of disaggregated asset values has been developed on basis of CORINE Land Cover data for model application on the meso-scale.
FLEMOcs is validated on the micro-scale using a leave-one-out cross validation procedure. Meso-scale model application is undertaken in 19 municipalities which were affected during the 2002 flood in Germany. Model results are compared with the results of other loss models, and official loss records.

Loss influencing factors

Table 1: Component loadings for variables that probably influence damage of companies (principal component analysis with varimax rotation; total variance explained is 56.7%; number of valid cases is 41).

Items	Components *				
	1	2	3	4	5
Loss ratios of buildings	**0.78**	0.09	-0.03	0.08	0.01
Loss ratios of equipment	**0.70**	-0.09	-0.37	-0.06	-0.08
Loss ratios of goods, products, stock	**0.68**	-0.13	-0.16	0.03	-0.03
Water depth [cm]	**0.50**	-0.11	0.31	0.18	0.20
Business volume before flood [€]	-0.05	**0.89**	0.08	0.04	0.08
Number of employees	-0.09	**0.88**	0.05	-0.03	0.03
Ownership structure: rented or owned buildings	-0.04	-0.18	**-0.69**	0.28	-0.05
Number of prior experienced floods	-0.16	-0.20	**0.65**	0.22	-0.15
Indicator for precaution	-0.17	0.14	**0.59**	0.03	-0.01
Flood duration [h]	0.01	0.08	-0.05	**0.72**	0.42
Warning lead time [h]	0.22	0.04	0.17	**0.64**	-0.19
Sector	-0.08	-0.18	-0.23	**0.49**	-0.37
Indicator for contamination	0.21	-0.10	-0.16	-0.08	**0.66**
Size of premises [m²]	-0.18	0.16	0.06	0.03	**0.53**

FLEMOcs damage model

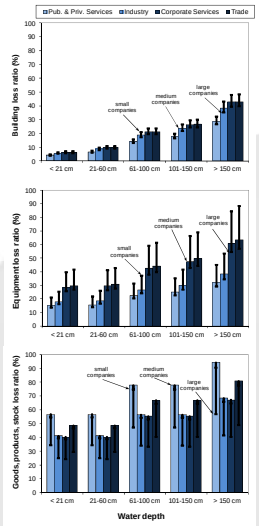

Figure 1: First stage of the micro-scale FLEMOcs model: mean loss ratios of flood losses to buildings, equipment as well as goods, products and stock of companies depending on water depth, sector and size of the company

Table 2: Scaling factors for the second stage of the micro-scale FLEMOcs model (FLEMOcs+): Scaling factors for company losses of buildings, equipment as well as goods, products and stock depending on contamination and precaution.

	scaling factors for loss ratios of		
	buildings	equipment	goods etc.
No contamination, no precaution	1.02	1.02	0.93
No contamination, medium precaution	0.82	0.86	0.79
No contamination, very good precaution	0.67	0.72	0.75
Medium contamination, no precaution	1.28	1.03	1.08
Medium contamination, medium precaution	1.03	0.87	0.92
Medium contamination, very good precaution	0.84	0.73	0.87
High contamination, no precaution	1.28	1.33	1.22
High contamination, medium precaution	1.03	1.12	1.04
High contamination, very good precaution	0.84	0.94	0.98

Micro-scale validation

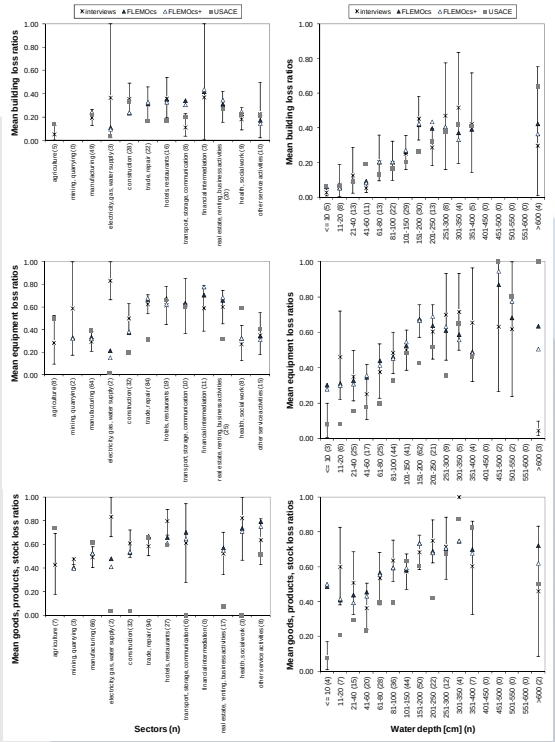

Figure 2: Surveyed and estimated mean ratios of losses to buildings (top), equipment (middle) and goods, products and stock (bottom). For the surveyed data the mean and the 2.5% to 97.5% confidence intervals, calculated by bootstrap, are shown.

Meso-scale application and validation

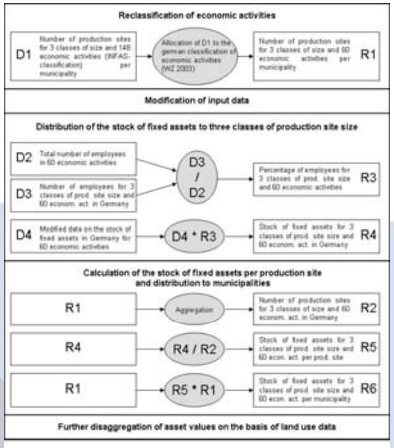

Figure 3: Procedure for the calculation of an asset values database for commercial and industrial assets.

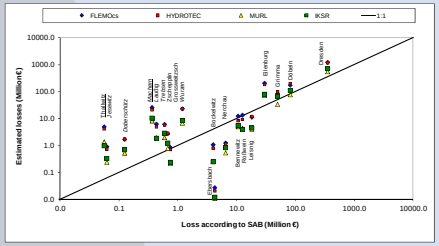

Figure 4: Comparison of the results of model application with SAB loss records. The four models mentioned in the legend were applied to the 19 municipalities, whose names are given in the diagram..

Conclusions

The new FLEMOcs model for the estimation of flood losses in the commercial sector considers the water depth divided into five classes, three sizes of companies in terms of the number of employees and four different sectors in the first model stage. In the second model stage, the effects of precaution and contamination can also be evaluated. The model can be applied to the micro-scale, i.e. to single production sites as well as to the meso-scale, i.e. land use units, which enables its countrywide application.
The micro-scale leave-one-out cross validation of the newly developed FLEMOcs model shows very good results with no bias and mean absolute errors between 23% and 31%. The model application on the meso-scale and comparison with official loss records as well as with other models shows that in municipalities with minor losses all models overestimate the losses. FLEMOcs provides good results in large areas with many affected companies and high expected losses, which is its purpose.

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