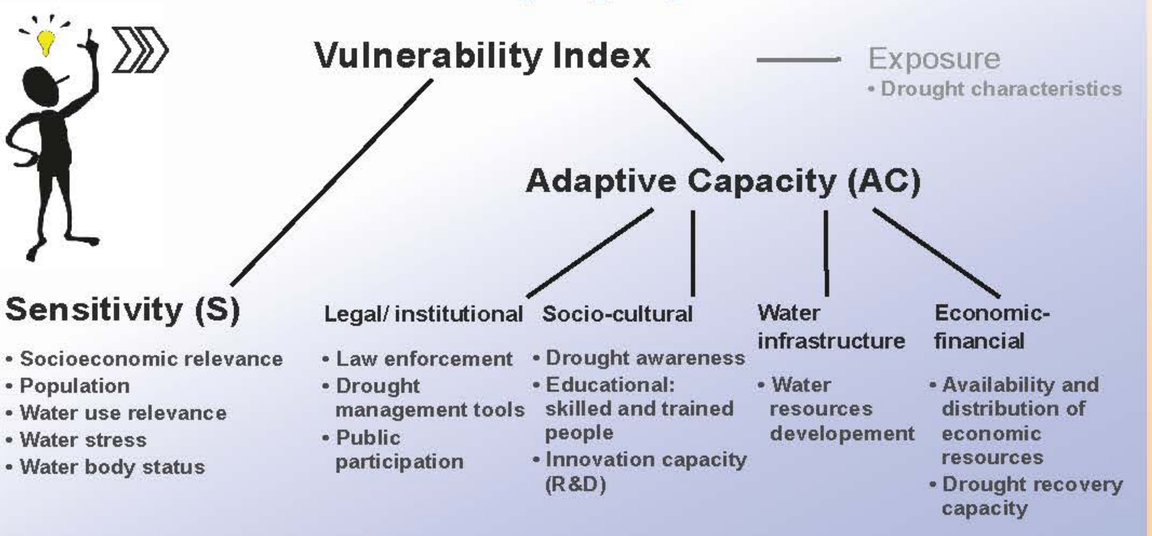
Towards pan–European drought risk maps: Factor - vs. Impact - based vulnerability assessment

Veit Blauhut[1], Julia Urquijo[2], Itziar González Tánago[2], Mario Ballesteros[2], Kerstin Stahl[1], Lucia De Stefano[2]

The risk of natural disasters in a very general sense is a combination of hazard and vulnerability (IPCC 2007). Commonly, the drought hazard is described by one or a set of drought indicators such as the standardized precipitation evaporation index (SPEI). Vulnerability to drought is typically estimated by a combination of relevant vulnerability factors (Jordaan 2012; Sreedhar et al. 2013). This approach requires explicit information on physical, ecological, institutional and socioeconomic parameters.

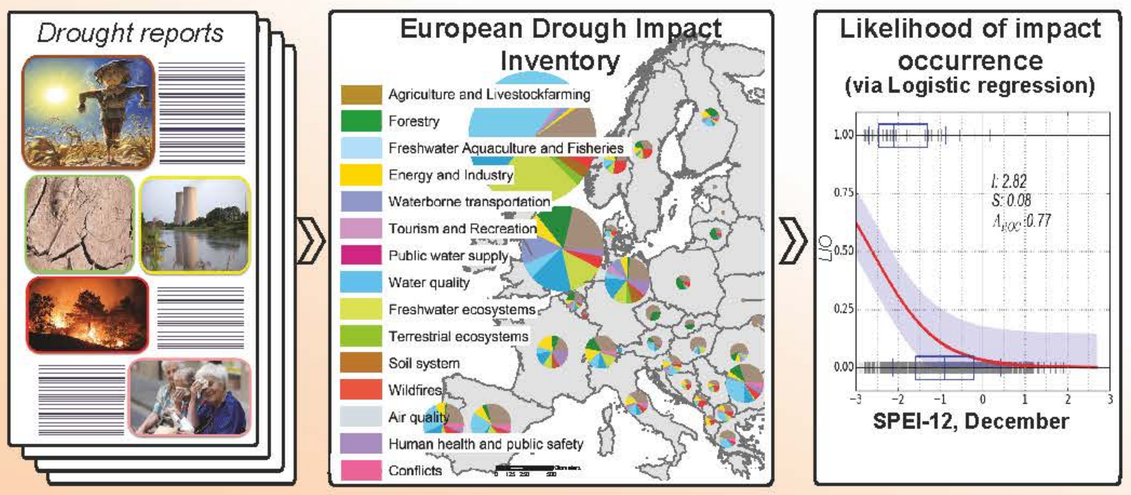
Although drought impacts are symptoms of vulnerability (Knutson et al. 1998), the majority of current approaches do not consider past drought impact reports to estimate vulnerability. A recent approach by Blauhut et al.(in review) uses data from the European Drought Impact report Inventory (EDII) as proxy for vulnerability to drought. Thus, sector- specific drought risk maps for selected hazard levels were developed for European macro regions. This poster compares maps based on: vulnerabiltiy factors and impacts, and explores the potential for combined approaches .

FACTORS



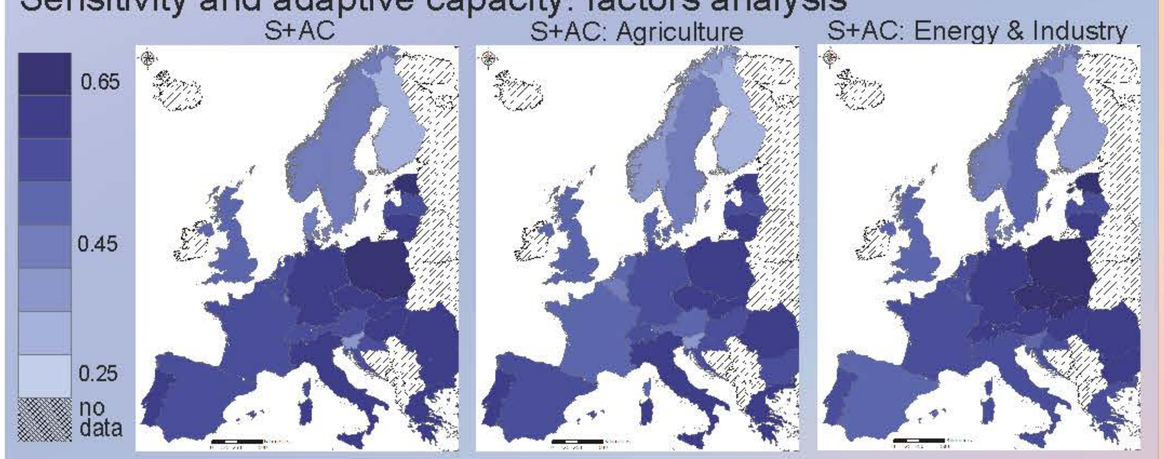
Data stems from Eurostat, European Environment Agency, Eurobarometer, World Bank and Aquastat. The majority of data could directly be used as S & AC factors (after normalization), only few were transformed from qualitative data or combined from different datasets. Finally the resulting factors of S or AC were evenly weighted. An adequate way to identify exposure is still pending. Hence, the presented maps are of preliminary character and present a relative estimate of S+AC from 0-1.

IMPACTS



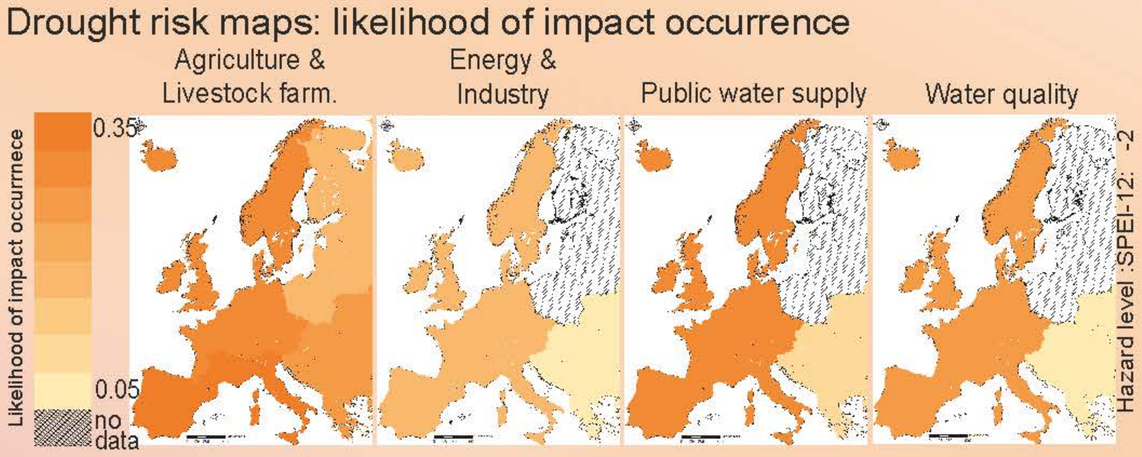
Data on drought impacts stems from the European Drought Impact Inventory (EDII) database (http://www.geo.uio.no/edc/droughtdb/). Therein, impacts are aligned to a certain impact category (sectors), impact type, spatial (NUTS- levels) and temporal references. Logistic regression models predict the likelihood of impact occurrence (LIO) for four selected impact categories for European macro regions using SPEI-12 as predictior.

Sensitivity and adaptive capacity: factors analysis



The vulnerability components Sensitivity and Adaptive Capacity, and its underlying factors, are weighted equally. The 'overall' analysis results in the highest values for central Europe, the Iberian Peninsula, Italy and Estonia. Scandinavia has a generally lower value compared to the rest of Europe. Sector specific analyses display higher values for the Energy & Industry sector in Central and Eastern Europe, while Agriculture presents higher values mainly for the Mediterranean region.

Drought risk maps: likelihood of impact occurrence



For severe droughts the resulting maps largely reflect the available impact data suggesting the highest risk for impacts on 'Agriculture & Livestock farming' and 'Public Water Supply' in Western Mediterranean Europe and Maritime Europe, followed by impacts on 'Water Quality' in Maritime Europe. Lower risks for Northeastern and Southeastern Europe, especially for less severe hazard levels, may be biased to the underlying data availability.

Key elements

- Descriptive character
- Literature-based factor selection
- Constraints in data availability and coverage

Synergy potentials

- Data availability of relevant factors
- Spatial coverage of available data
- partlial high resolution of factor data (NUTS2 - level)
- Ground truth via drought impacts
- Temporal coverage of EDII data, potential for event specific investigation
- empirical approach: no subjective weighting schemes

Key elements

- Predictive character
- Impact dataset based on available impact reports
- Constraints in data availability and coverage

Combination

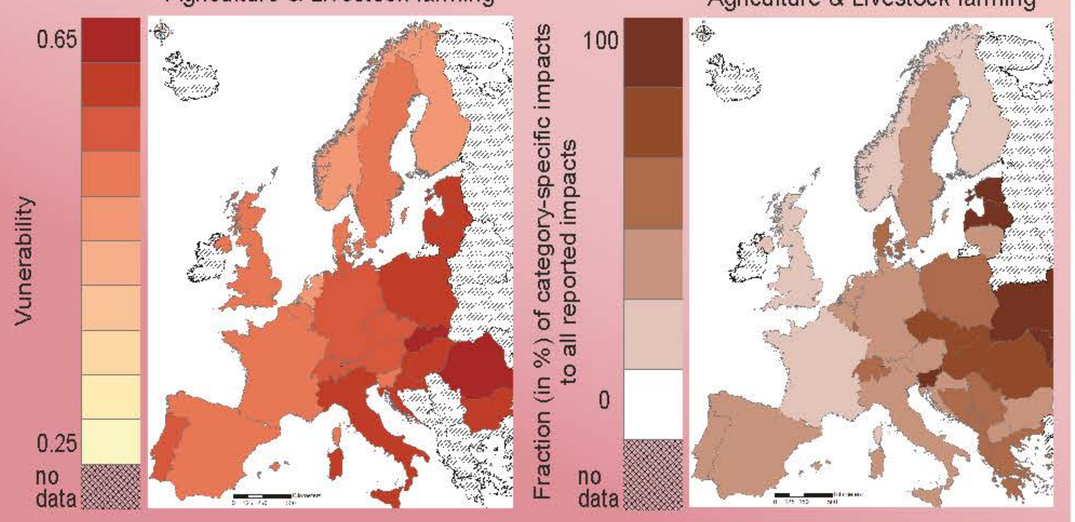
Multivariable logistic regression

Data about the underlying causes of vulnerability and drought indices were combined with data about past drought impacts through a multivariable logistic regression. This preliminary analysis explores the relationships between descriptive variables of sensitivity and adaptive capacity factors and data of impact occurrence. This analysis explores the significance of all variables as predictors in the statistics model. For this preliminary test, input data were aggregated at a country scale and a model was fitted for the entire Europe. The table shows the significant factors. The resulting maps provide an example of the potential of this combination, as there is a good degree of correspondence between both maps. The map on the left shows the aggregation of single vulnerability factors that appeared to be significant in the logistic regression for the agricultural sector. The map on the right presents the share of agricultural impacts recorded in the EDII.

		Agriculture & Livestock f.	Forestry	Public water supply	Water quality	Freshwater ecosystems	Wildfires	All sectors
Drought indices	SPEI-01							
	SPEI-03	x					x	x
	SPEI-06	x				x		x
	SPEI-09	x	x		x	x	x	x
	SPEI-12			x				
	SPEI-24		x	x		x	x	x
	SPEI-36						x	
Sensitivity	Total water abstraction							x
	Population density	x	x					x
	Water stress		x					
	Status of waterbody		x					
	Social relevance - Agricult.	x		x			x	x
	Social relevance - Ind.	x		x				x
	Social relevance - Serv.	x						x
Adaptive Capacity	Law enforcement							x
	Drought Management Tools	x	x		x			x
	Public participation	x		x				x
	Drought awareness		x					
	Education		x					
	Innovation c.	x	x	x		x		x
	Freshwater storage c.	x	x			x		x
	Economic c.	x		x	x	x	x	x
	Drought recovery c.		x		x	x		

Significant S+AC factors:: Agriculture & Livestock farming

Impacts by EDII: Agriculture & Livestock farming



This poster presents a combination of approaches to assess vulnerability and risk to drought: a knowledge based factor approach and an empirical method. Whereas both have limitations due to the nature of the particular approach, a combination of factors, impacts and hazard variables via multivariable logistic regression may result in mutual improvement. For example, factor analysis could be adjusted to factors that are significant or weighting schemes might be adapted from model fit parameters. The empirical approach may profit from the information on drivers of vulnerability and include them as descriptive variables to improve predictions. This is still work in progress, as to obtain final results it will be necessary to test different options of combination and aggregation schemes.

(1) Faculty of Environment and Natural Resources, University of Freiburg
veit.blauhut@hydrology.uni-freiburg.de
(2) Departamento de Geodinámica, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid

DROUGHT-R&SPI (Fostering European Drought Research and Science-Policy Interfacing) is a Collaborative Project funded by the European Commission under the FP7 Cooperation Work Programme 2011, Theme 6: Environment (including Climate Change, ENV.2011.1.3.2-2: Vulnerability and increased drought risk in Europe (Grant agreement no: 282769). The DROUGHT-R&SPI project started 01/10/2011 and will continue for 3.5 years.