A European perspective on drought impacts

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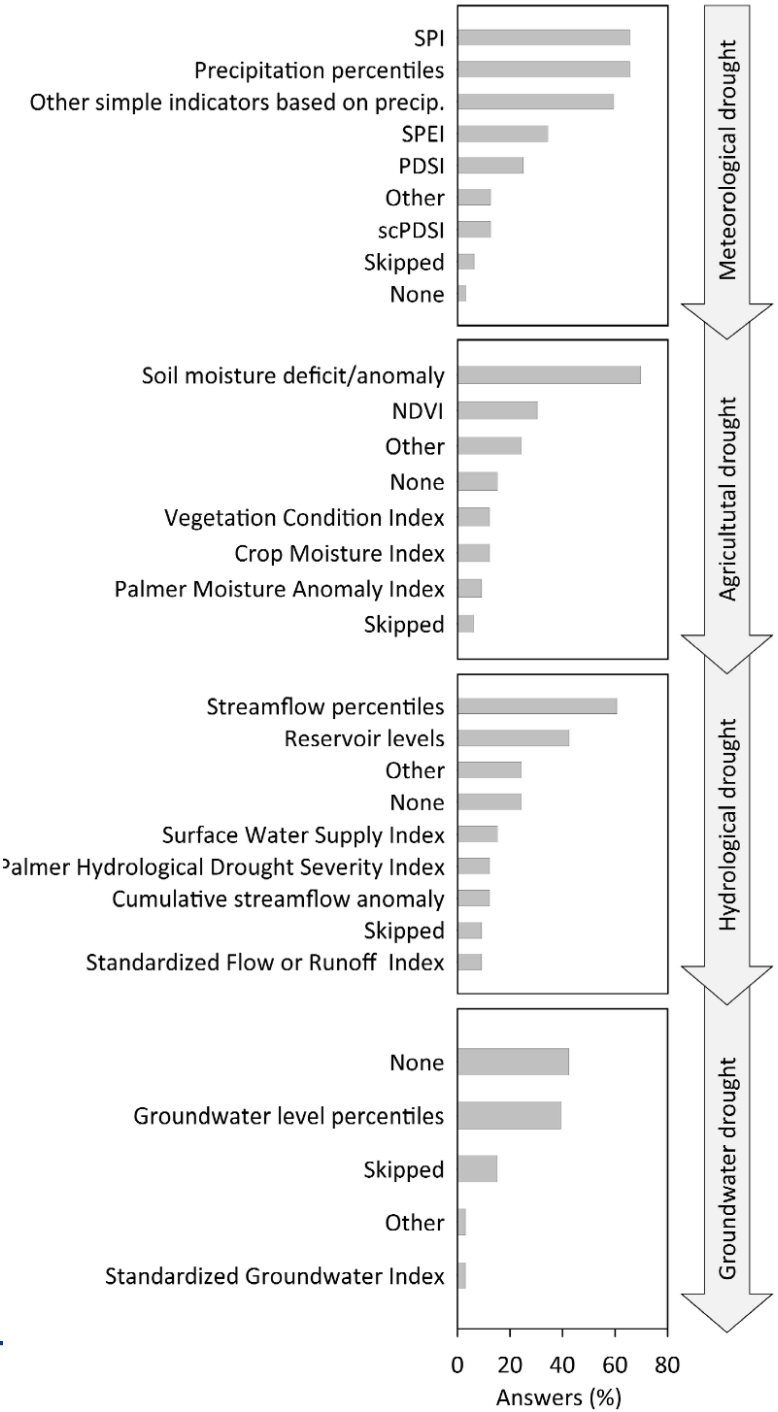
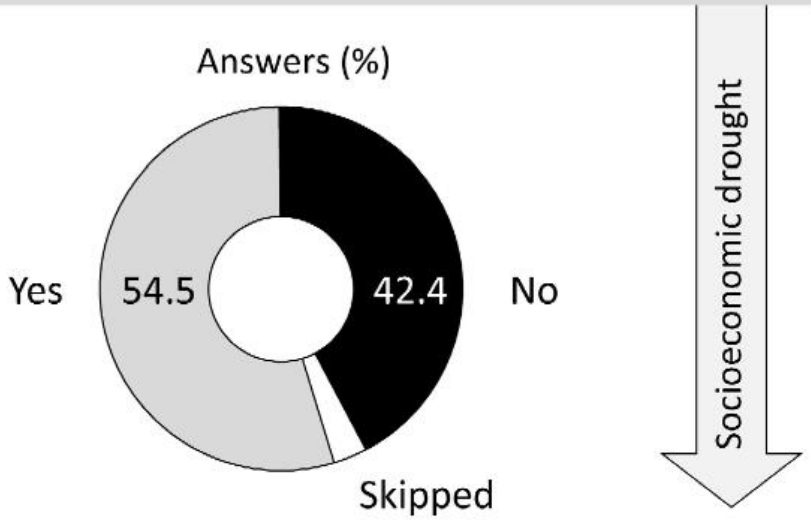


Which indicators does your system use?

Do you currently collect data on drought impacts, i.e. negative environmental, economic or social effects experienced under drought conditions?



But: few details, not systematically monitored and used

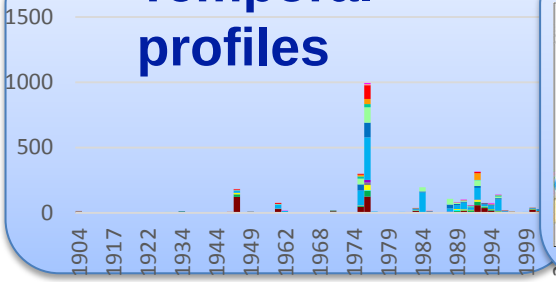
Bachmair et al. Drought indicators revisited, WIRES Water, 2016

Impacts - a European perspective

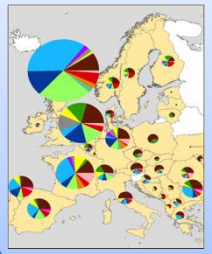
- Drought impact: **data** collection for Europe
- Drought impacts, **affected sectors** in time and space
- **Linking** impact occurrence to monitored drought indices: challenges

Data:
The European Drought impact report Inventory (EDII)
– a text-based archive -

Temporal profiles



Spatial profiles

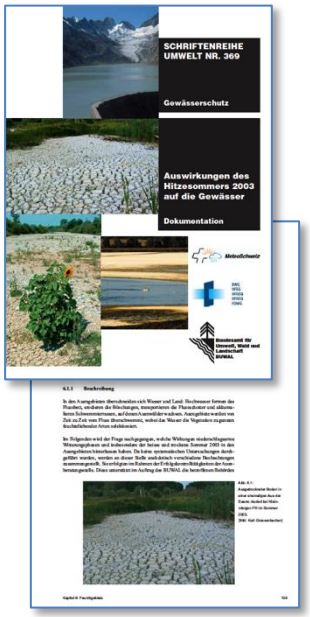


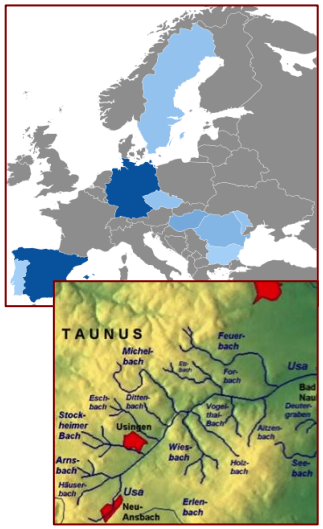
Correlation & Modelling

Collecting and archiving impact reports

The EDII (European Drought Impact report Inventory @ www.geo.uio.no/edc/droughtdb/

Source of information → **Location** → **Impact Occurrence** → **Impact Categorization** → **The Archive**





ID	Location		
	Country	NUTS 1	NUTS 2
bf_1	Switzerland	Switzerland	Espace Mittellan
ik_1	Switzerland	Switzerland	Nordwes

NUTS 3	Location
Bern	nuclear power plant Mühleberg in Mühleberg
Aargau	nuclear power plant Beznau in Döttingen (Zurzach)
Bern;Luzern;	several parts of

	Impact details		
YYYY	categ.	type	description
2003	4	4.2;	Due to a lack of cooli were needed to redu
2003	4	4.2;	Due to a lack of cooli were needed to redu and August 2003.
	7	7.3;7 .4	Limitations and bans the lawn, filling of po actions were necessa

→Textual evidence links cause (drought) and effect (impact)

→ Classification systems guarantee consistency!

EDII Contents: information sources

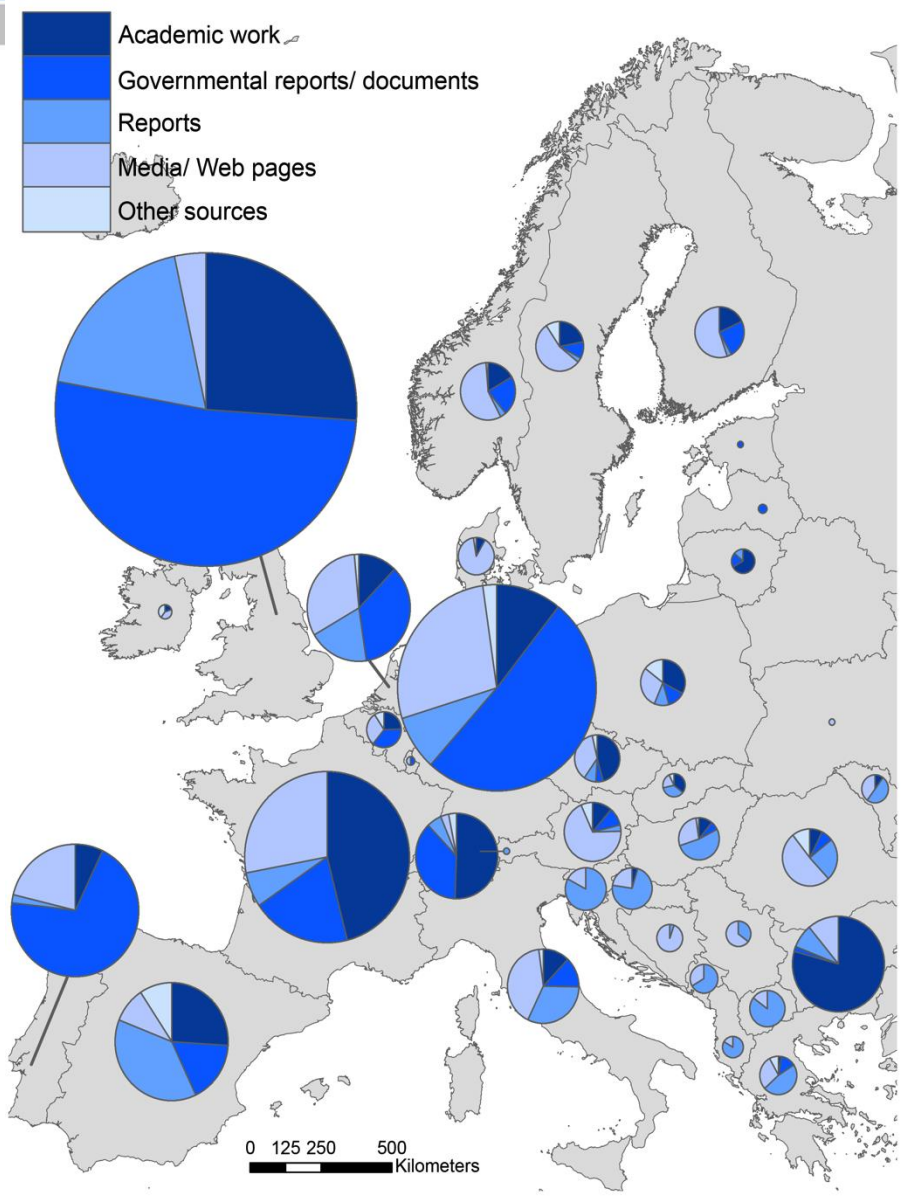
www.geo.uio.no/edc/droughtdb/

Contents:

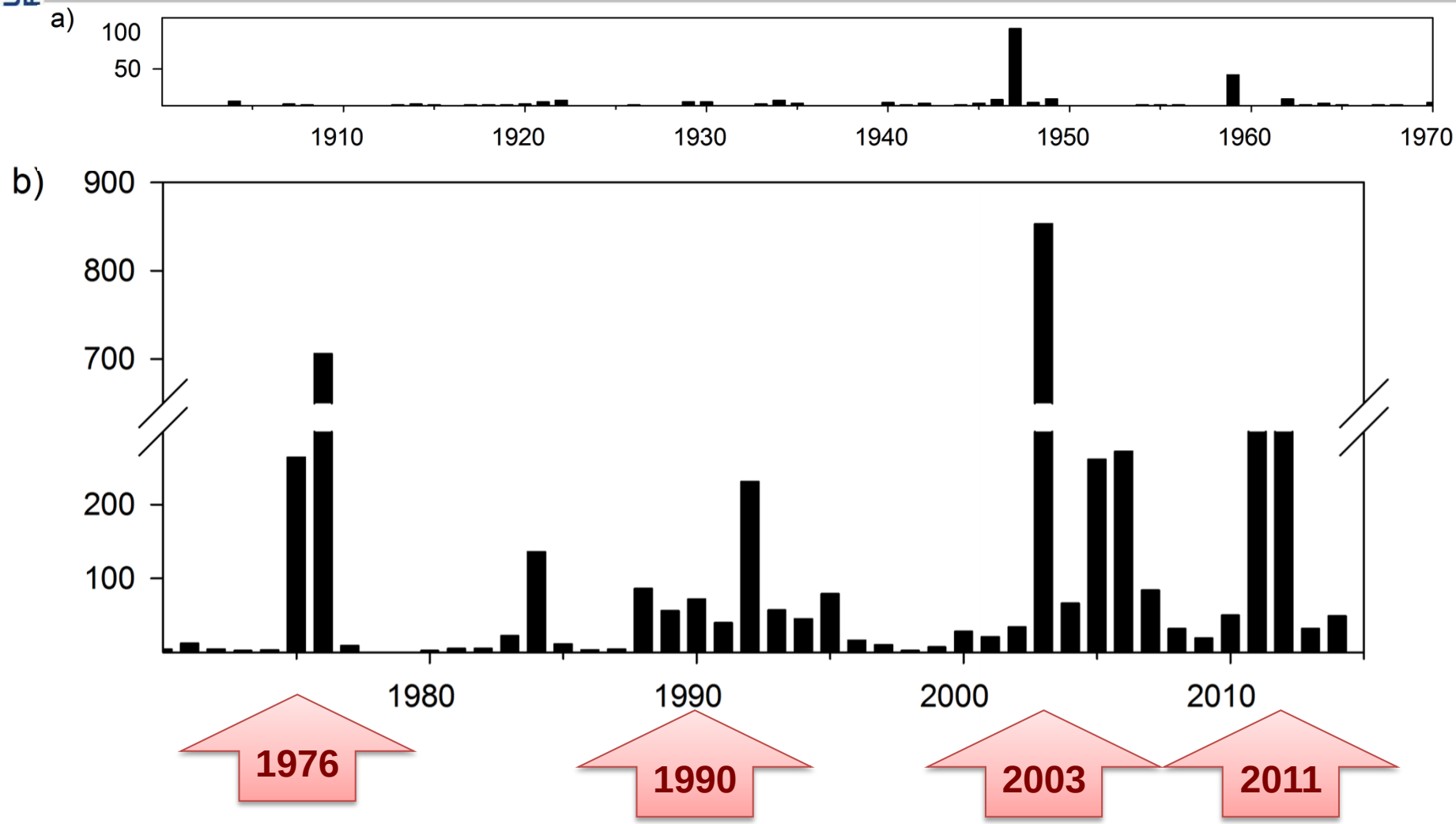
- **>5000 reported impacts**
- **from 1900-2014**
- **33 countries**

- Academic work[1]
- Governmental reports/documents
- Reports[2]
- Media / Webpages
- Other sources[3]

[1] including: Book, Scientific article, Thesis
[2] including: Report by NGO, River basin organization report, Report (private sector)
[3] including: Database, Map, Press release, Pamphlet, Other



Time: reported drought impacts



→ **20th Century major events**

Space/Time: impacts of historical events

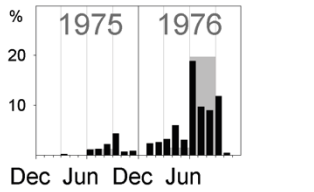
Pan-European events

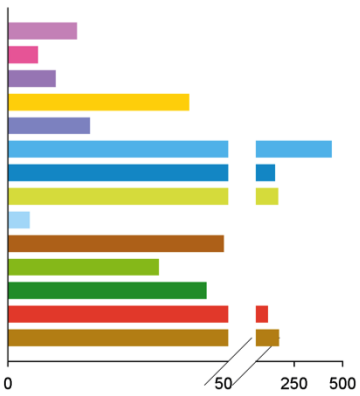
Impact **Start**
- month
- season

Regions
(with ≥ 1 DI)
- Country
- NUTS-1
- NUTS-2
- NUTS-3

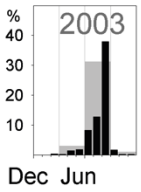
Reported impacts **per Category**
- Recreation and tourism
- Conflicts
- Human health and public safety
- Energy and industry
- Waterborne transportation
- Public water supply
- Water quality
- Freshwater ecosystems
- Aquaculture and fisheries
- Soil system
- Terrestrial ecosystems
- Forestry
- Forest fires
- Agriculture and livestock farming

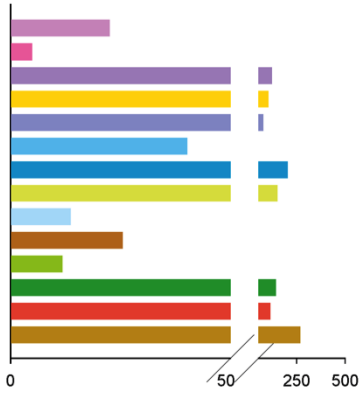
1975/76



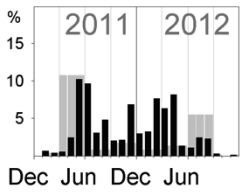


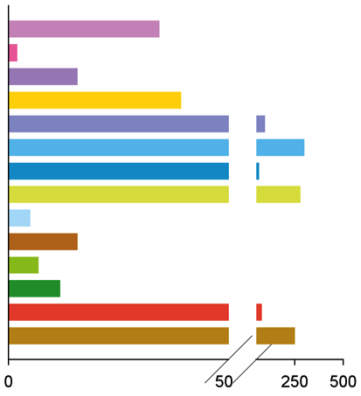
2003





2011/12





Space: relative importance of impacts

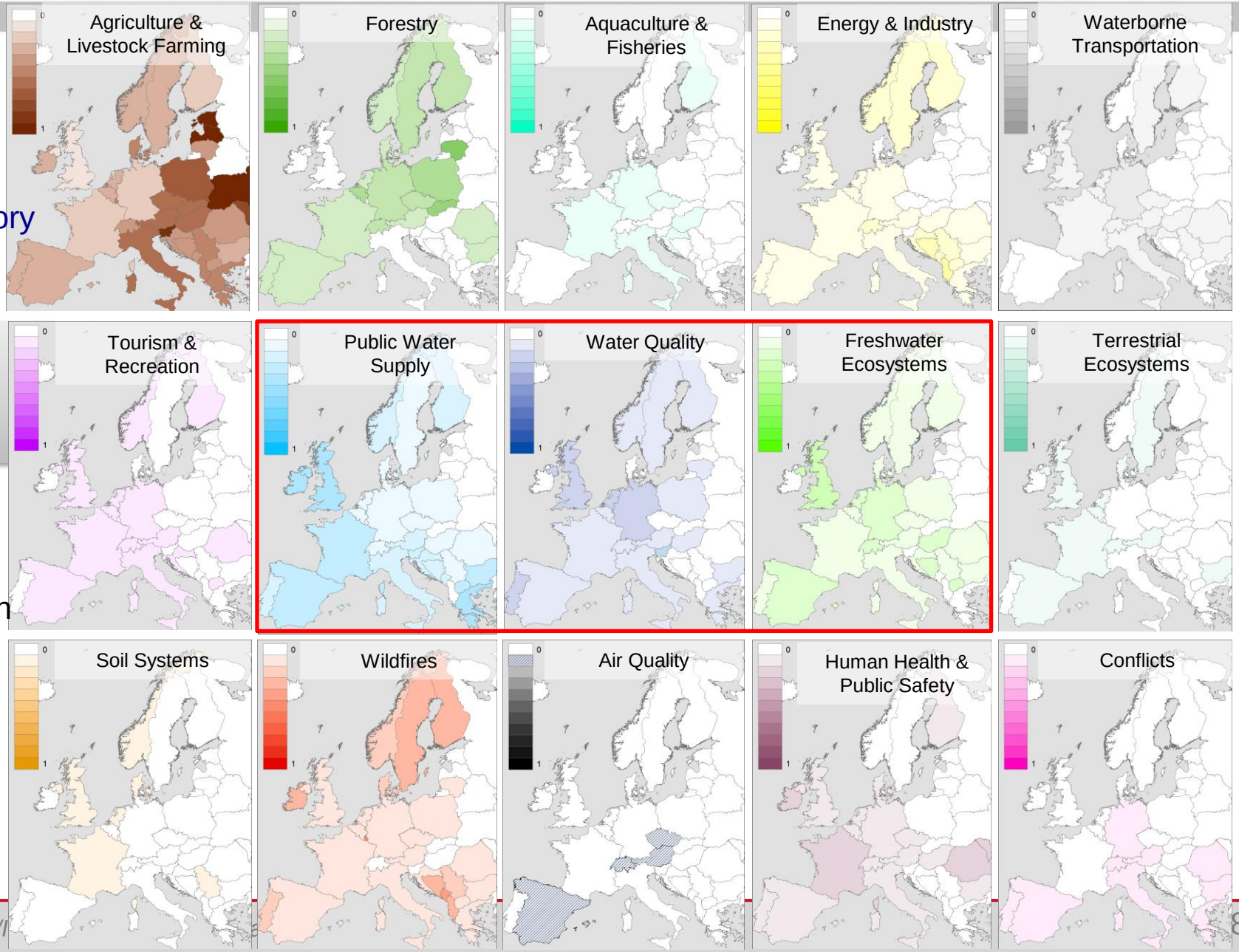
$\frac{n_{c,s}}{n_s}$

c= category
s=state (country)

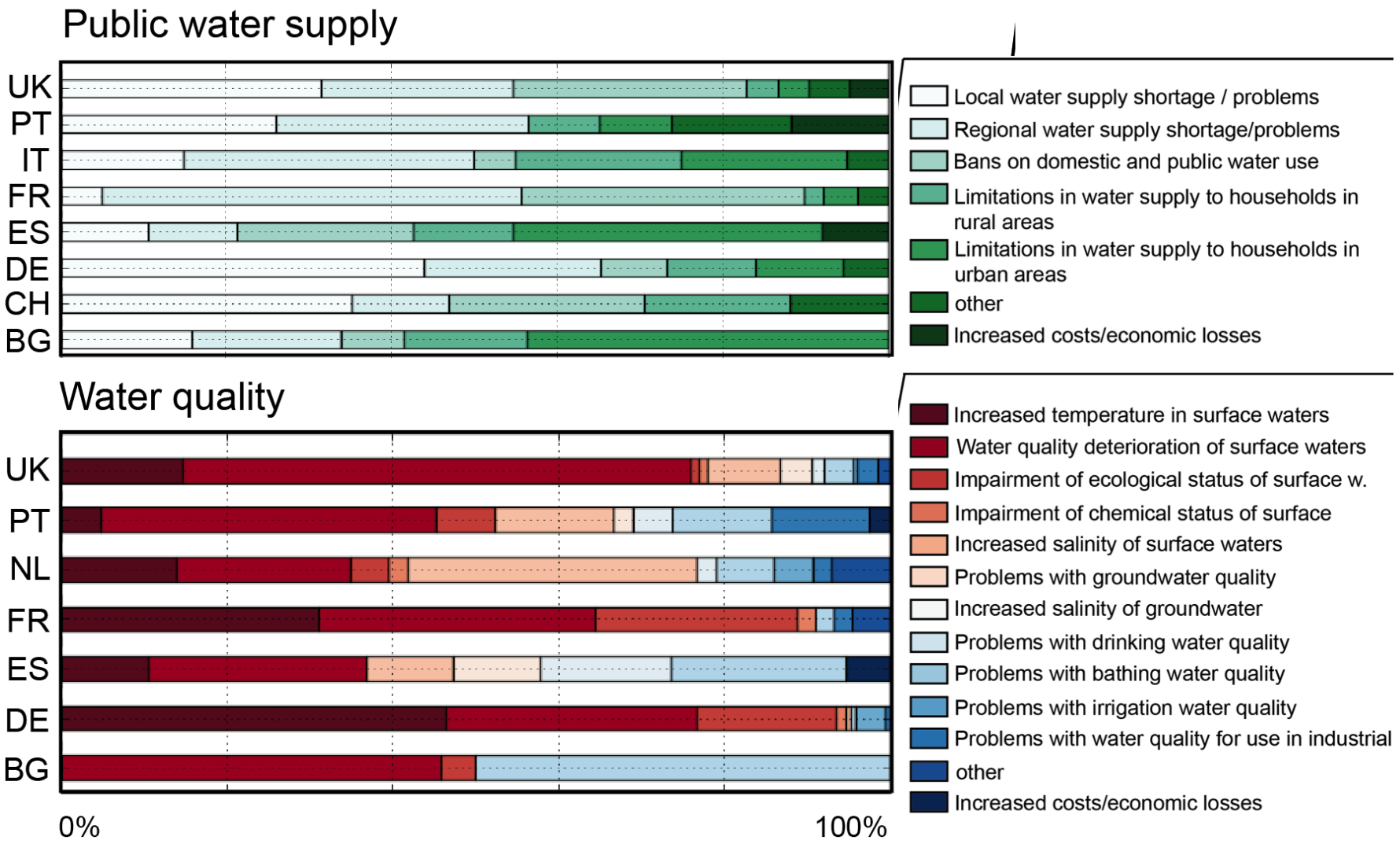
0%

100%

Relative frequ. of reported category in each country

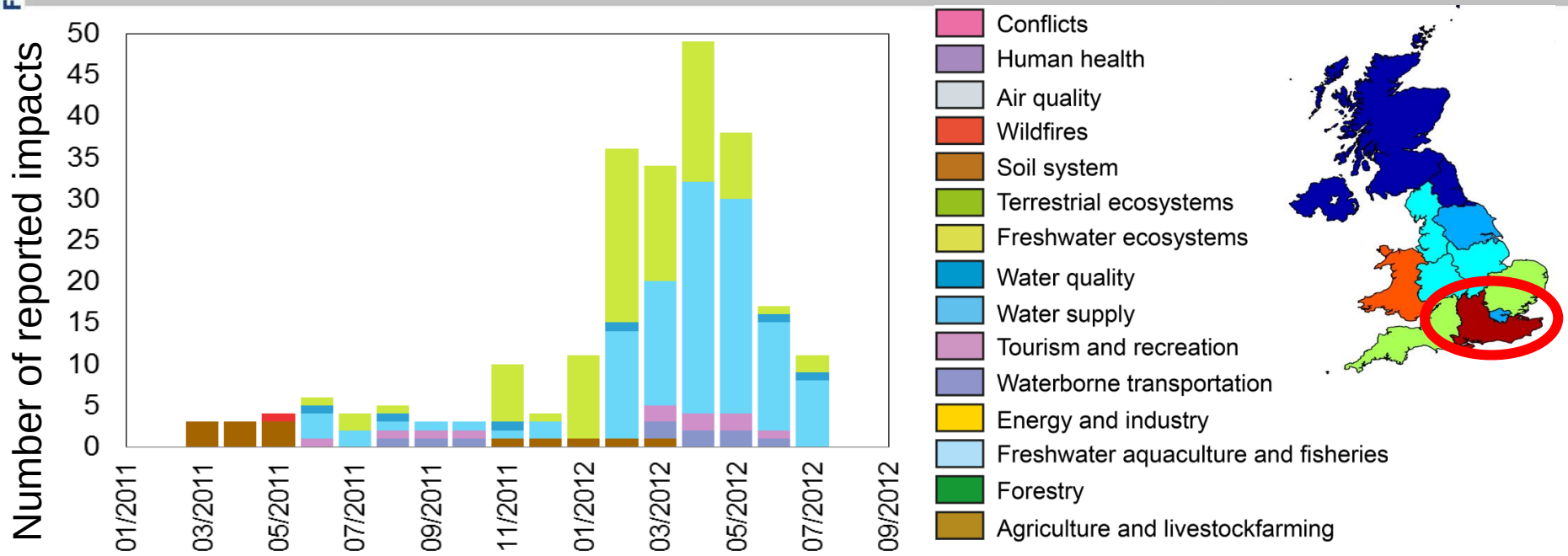


Zoom: details of impacts by sector and country



Stahl et al. 2016 NHESS

Zoom: impacts in SEE in 2011-12



Freshwater ecosystems

1-2/2012: **Fish deaths** and **distress** in River Meon and a lake in Hampshire. 30 mature sea trout and 6 salmon reported dead.

Water supply

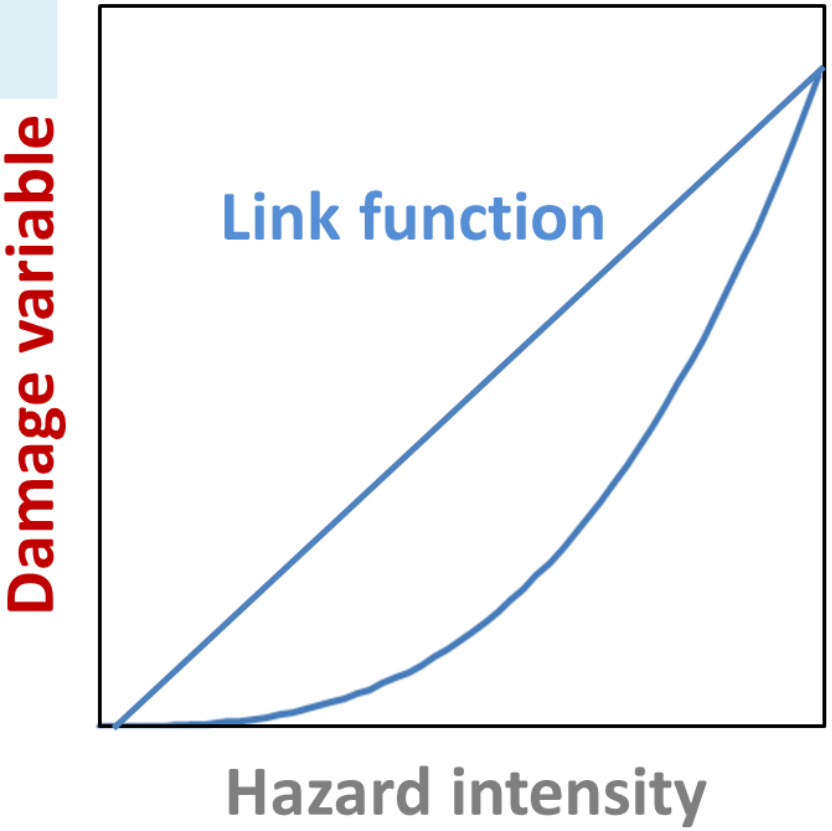
4/2012: 7 water companies in the south and east of England imposed **temporary water use bans** on 20 million customers.

3/2012: In some regions in the east and south east of England several domestic **wells dried up**.

Linking impacts to indices

Impact functions (data driven empirical models)

- as a step towards damage or vulnerability functions for risk quantification
- to predict impact likelihood



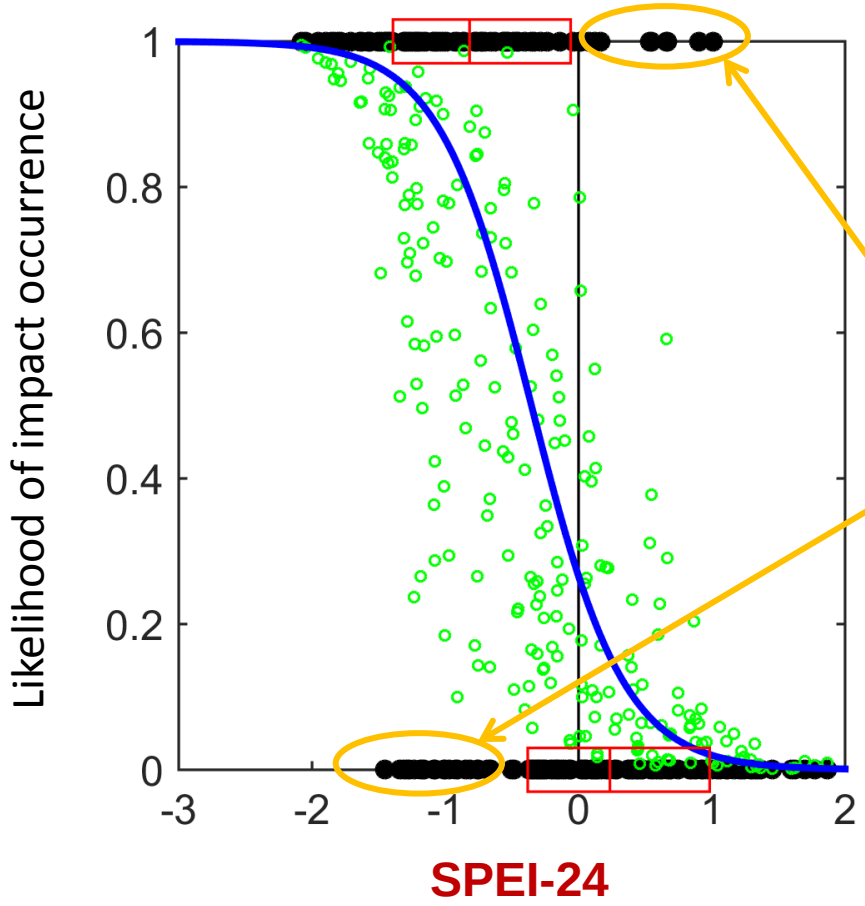
European experience:

- Drought impacts are diverse and different in different regions
- Drought impacts are often non-structural, hard to quantify or monetize
- Apart from crop yield statistics data on drought impacts is sparse

Bachmair et al., in prep for NHESS

Example for SEE: drought impact function

Logistic Regression



Multiple predictor model based on:
SPI-6 | **SPEI-24** | month

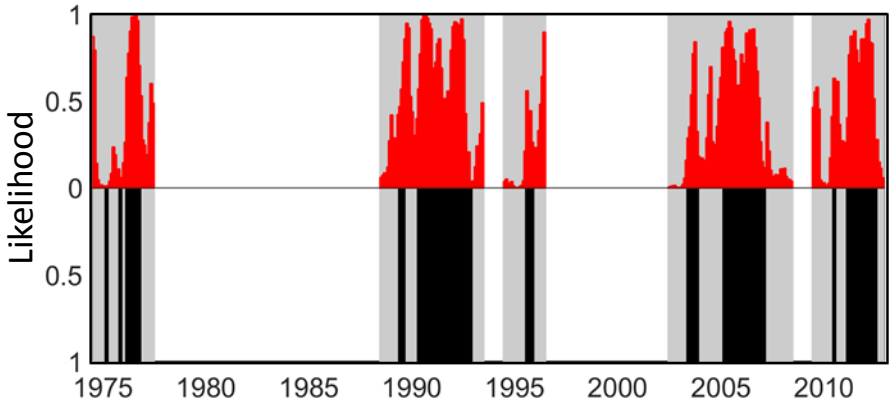
- Observed impacts
- Boxplot: 25-50-75 percentile
- Fitted data
- Model (SPI and SPEI constantly decreasing | constant month)

- Impacts persistent during wet conditions (e.g. water use restrictions due to low groundwater levels)
- No impacts during dry conditions (possible reasons: no reports on impacts or information missing in the database)

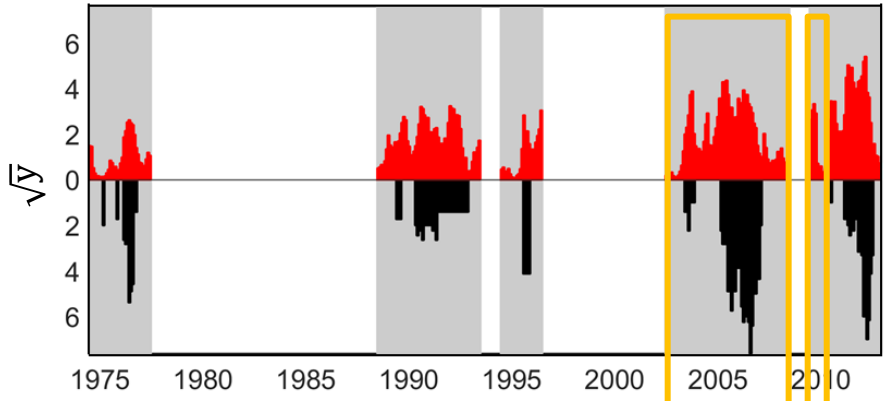
Bachmair et al., in prep for NHESS

SEE: predictive performance of different models

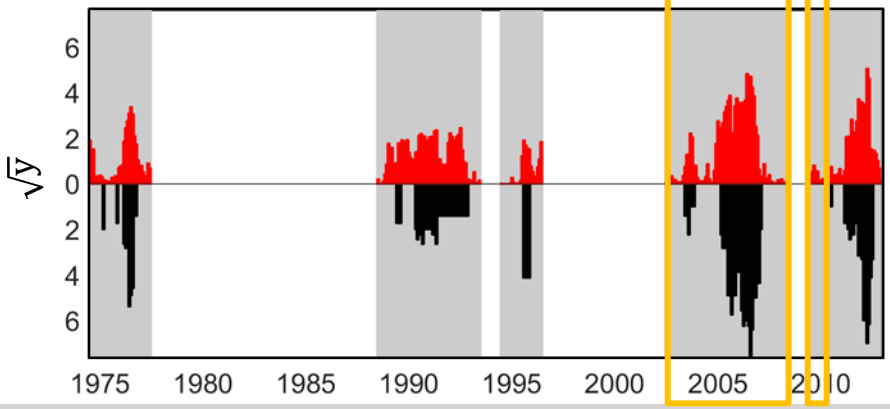
Logistic reg.



Hurdle Model



Random Forest



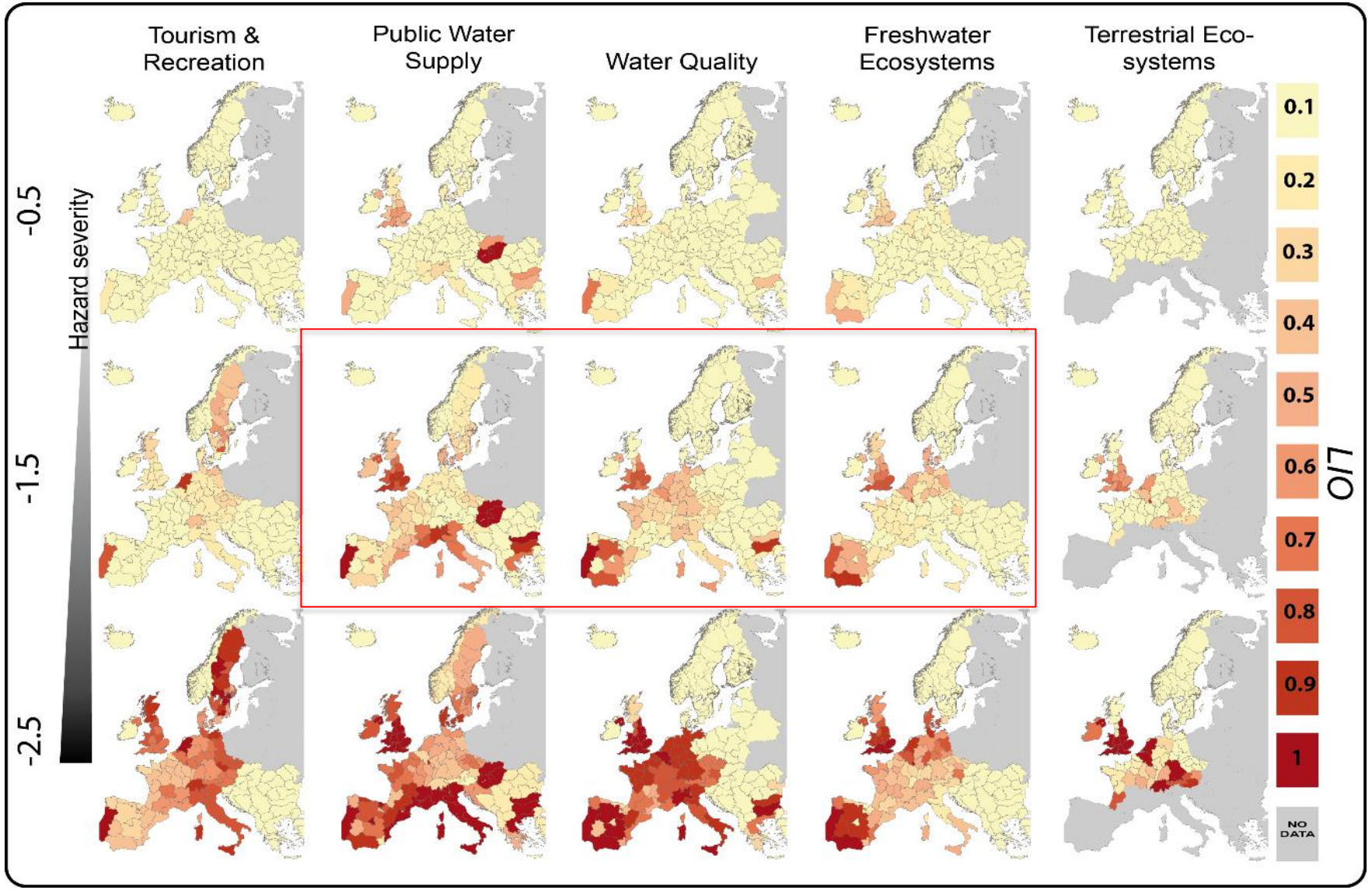
Modeled
Observed

Selected time for analysis

- The dynamics of impact occurrence are reasonably reproduced
- Peaks are underpredicted
- The Hurdle Model more often over-predicts small values than Random Forest

Bachmair et al., in prep for NHESS

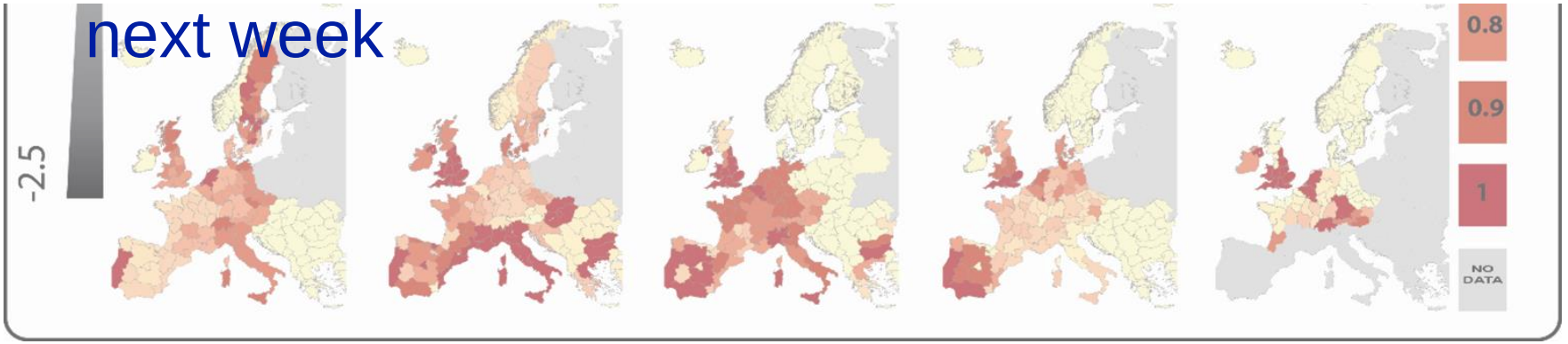
European perspective: LOI maps based on one model



Blauhut et al. 2016 HESS

Plans for Europe?

- Diversity and details of impacts
  - search scale for impact modelling and prediction
- EU (European Drought Observatory @ JRC)
  - So far, only impact on vegetation (via remote sensing)
  - Integrated into a combined drought index
  - No wider continuous impact data collection
- EU/NOAA workshop in Pillnitz to “Sort-out drought” next week



Acknowledgements & Further Information

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  http://europeandroughtcentre.com
- DrIVER Project Team

  www.drought.uni-freiburg.de