

TG 3.11

The role of heat early warning systems to reduce heat-related mortality in Europe

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PROCLIAS TGs 3.2 & 3.11 + MCC



MCC Collaborative Research Network
An international research program on the associations
between environmental stressors, climate, and health

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HEWS/HHAP catalogue

- https://docs.google.com/spreadsheets/d/1JLJjCjHEylp-gyqVeRjkjtIIBkGNITXkiGI7_ZeYTRM/edit#gid=2071005344
- Nuria Plaza Pilar (VM mobility grant intern with Veronika Huber)
– initiation of the catalogue, collecting data from PROCLIAS and MCC members
- Salomé Henry (intern with Aleš Urban) – update on the catalogue, review of heat action plans in individual countries => typology of HWSs



HEWS/HHAP catalogue

- Data on early heat warning systems (HEWS) and heat-health action plans (HHAP)

PROCLIAS Catalogue of Heat Early Warning Systems and Heat Health Action Plans

This table summarizes information about **Heat Early Warning Systems (HEWS)** in Europe and associated countries of PROCLIAS. Currently, it is based on [Casanueva et al. \(2019\)](#) (their Table 1, 2 and 4)

Please fill in missing information and update it if possible

COUNTRY/CITY	PROVIDER / INSTITUTION	IMPLEMENTATION YEAR OF CURRENT WARNING SYSTEM	INFORMATION ON CURRENT HEWS							NATURE OF THE WARNING THRESHOLDS	TARGET GROUPS	COMMUNICATION TOOLS	FIRST HEWS	MAJOR UPDATES	GENERAL COMMENTS
			MODEL SYSTEM	LEAD TIME	SPATIAL RESOLUTION	HEAT INDEX	WARNING THRESHOLDS/ALERT LEVELS	IMPLEMENTATION YEAR OF FIRST WARNING SYSTEM	YEARS OF UPDATES				SHORT DESCRIPTION OF UPDATES		
CZECH REPUBLIC	Czech Hydrometeorological Institute	2019	ALADIN (2.3 km) based on the global model ARPAGE, cross validated with ICON, GFS, ECMWF, GEM	warnings for 48h; 3-5 days for preliminary warnings	152 major municipalities	Tmax	three alert levels (yellow, orange, red) based on the intensity and probability of the event: Tmax > 31, 34, 37 °C;	climatology based thresholds	the national fire department, regional and local authorities, general public	public media, social media, website, phone application	2000	2006; 2012; 2019;	2000 (two levels: Tmax > 32 °C and 37 °C); 2006 (three level system: Tmax > 30 °C, 34 °C, 37 °C in at least 30% of the region area; warnings for districts (76)); 2012 (three level system: Tmax > 31 °C, 34 °C, 37 °C in at least 50% of the region area); 2019 (three level system: Tmax > 31 °C, 34 °C, 37 °C, warnings for major municipalities (152) instead of districts (76));	similar three level system for other severe weather event	
DENMARK	Beredskabsstyrelsen (Emergency Agency) www.brs.dk , on the basis of		DMI weather models (many), including for Greenland and Færø Islands and Bornholm	12-72 h	Kommunalt beredskab (district level); special services for shipping and sea transports	Tmax, Tmin	Tmax > 30-C; Tmin < (-10 -C)		Two groups: general population, and selected organizations (dependent on	Institutional command lines from Beredskabsstyrelsen to local districts, civil	For cold situations and Greenland, early 1950's; for heat situations from 2003; labour law aspects implemented in law and policy since 09/6/2016 political			On the issue of labour regulations under temperature stress condition	

HEWS | HHAP | HWA | List of experts

Creating a typology among HHAPs and HEWSs

- Defining criteria based on the study by Èrica Martínez-Solanas and Xavier Basagaña: *Temporal changes in temperature related mortality in Spain and effects of the implementation of a heat health prevention plan (2019)*
- Criteria corresponding to 7 leads defined by the WHO:

Agreement on a lead body and clear definition of actor's responsibilities

Accurate and timely alert systems

Health information plan

Reduction in indoor heat exposure

Particular care for vulnerable groups

Preparedness of the health/social care system

Real-time surveillance and evaluation



Setting weights to the characteristics

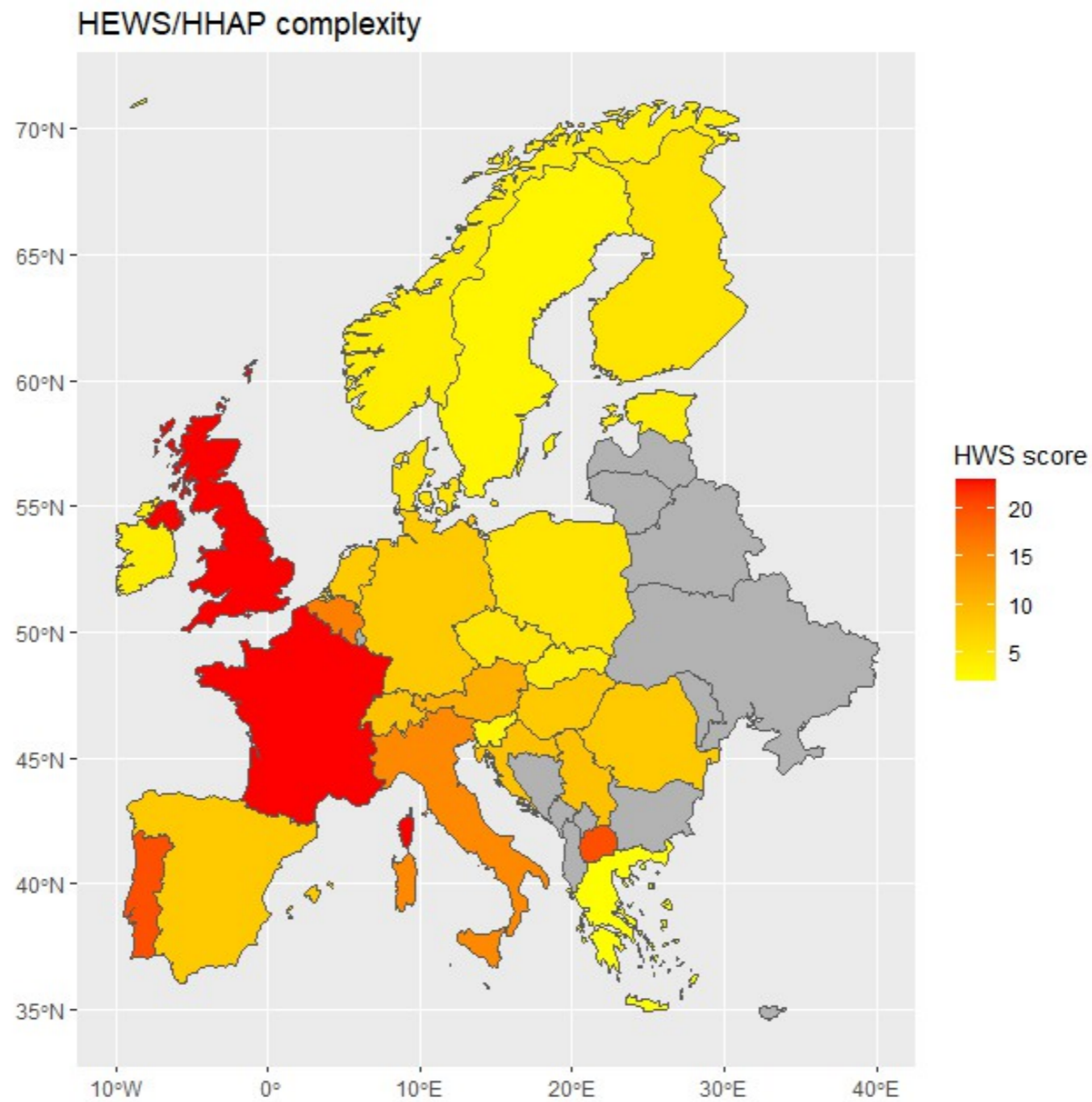
- Motivation: attributing a mark on each lead for each plan, and some characteristics should get more points than others.
- Total points that can be attributed for each lead:

Lead	Maximum points
Agreement on a lead body	2
Accurate and timely alert systems	7
Health information plan	7
Reduction in indoor heat exposure	4
Particular care for vulnerable groups	8
Preparedness of the health/social care system	9
Real-time surveillance and evaluation	2

$\Sigma=37$

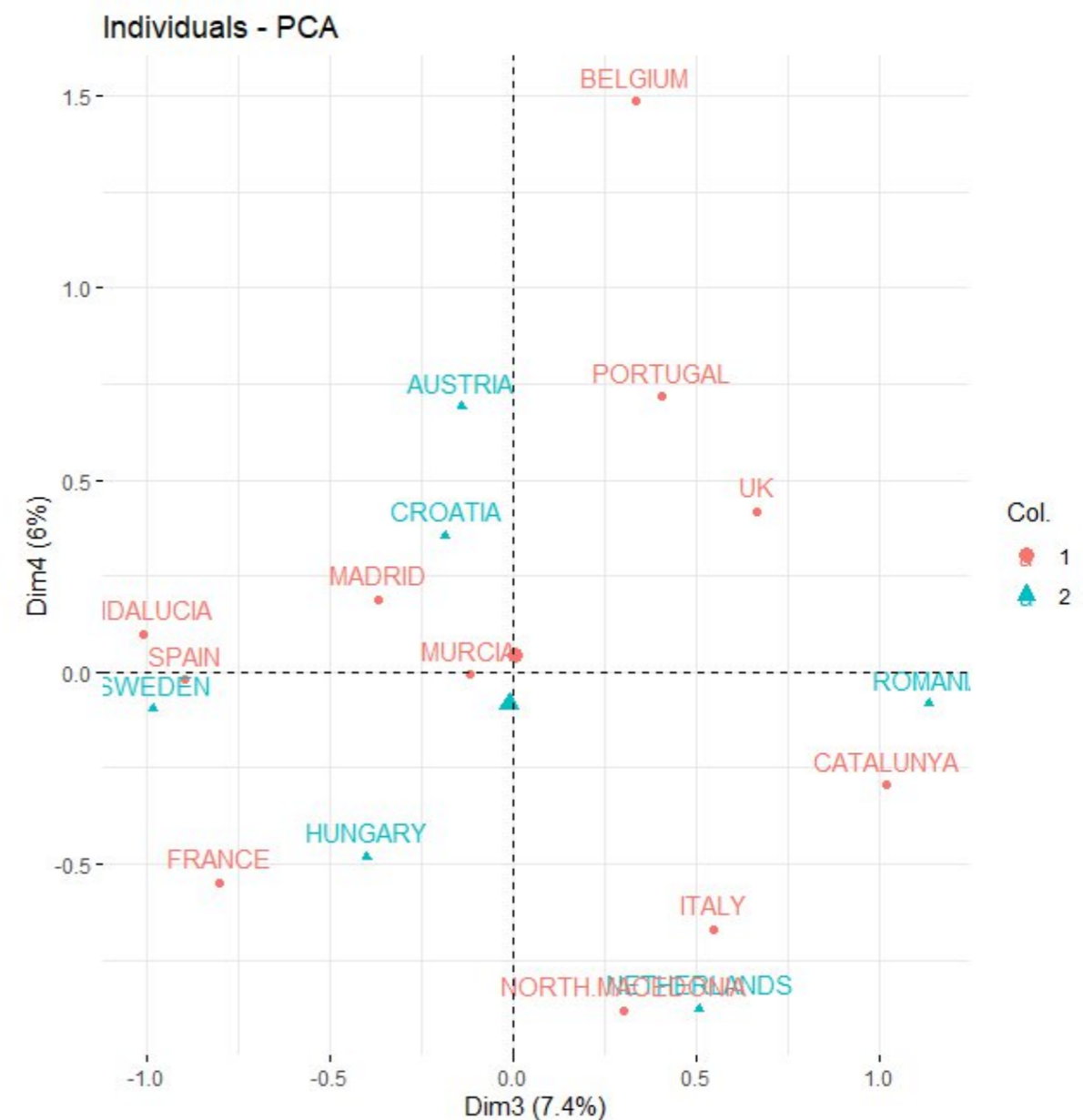
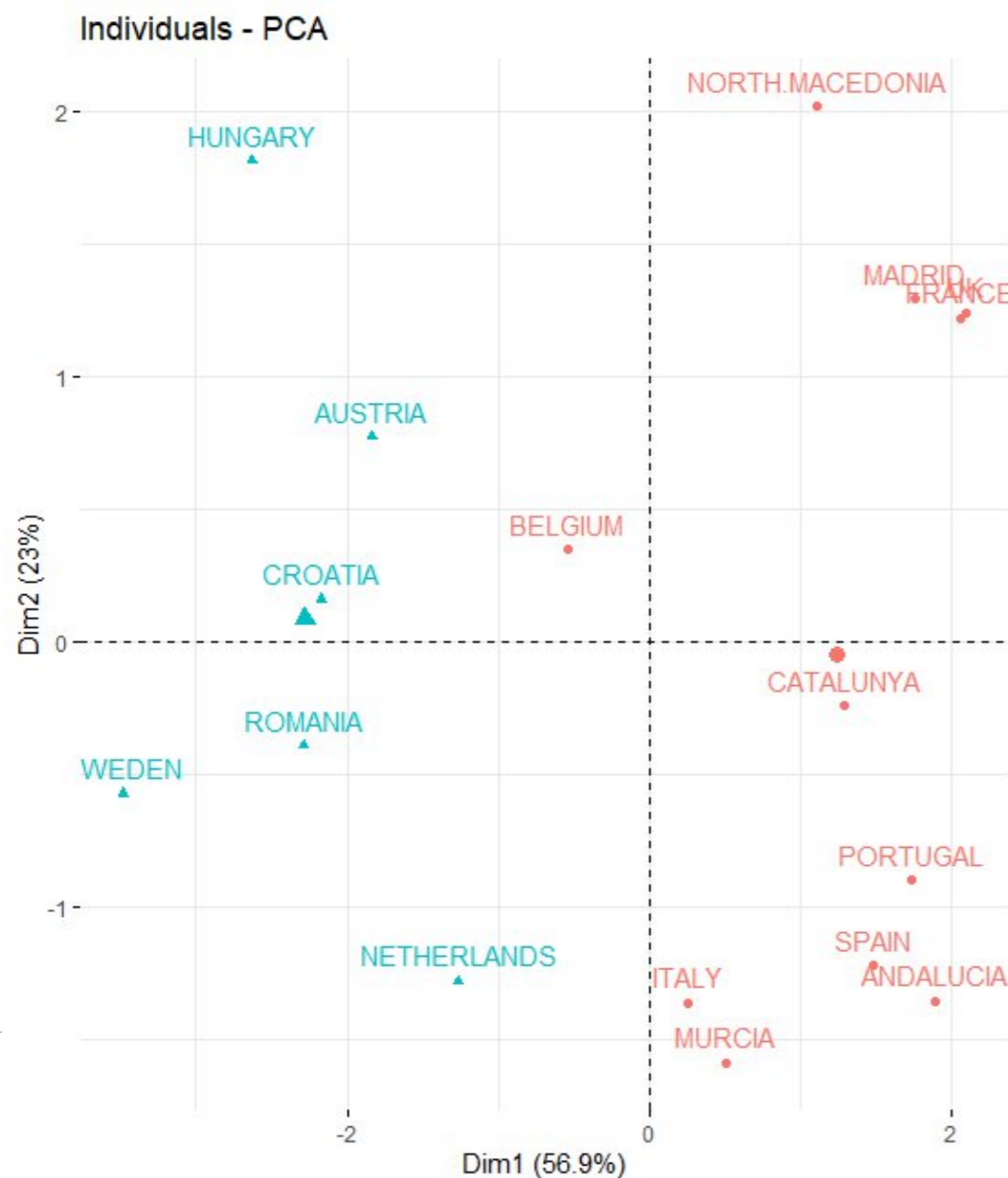


Setting weights to the characteristics

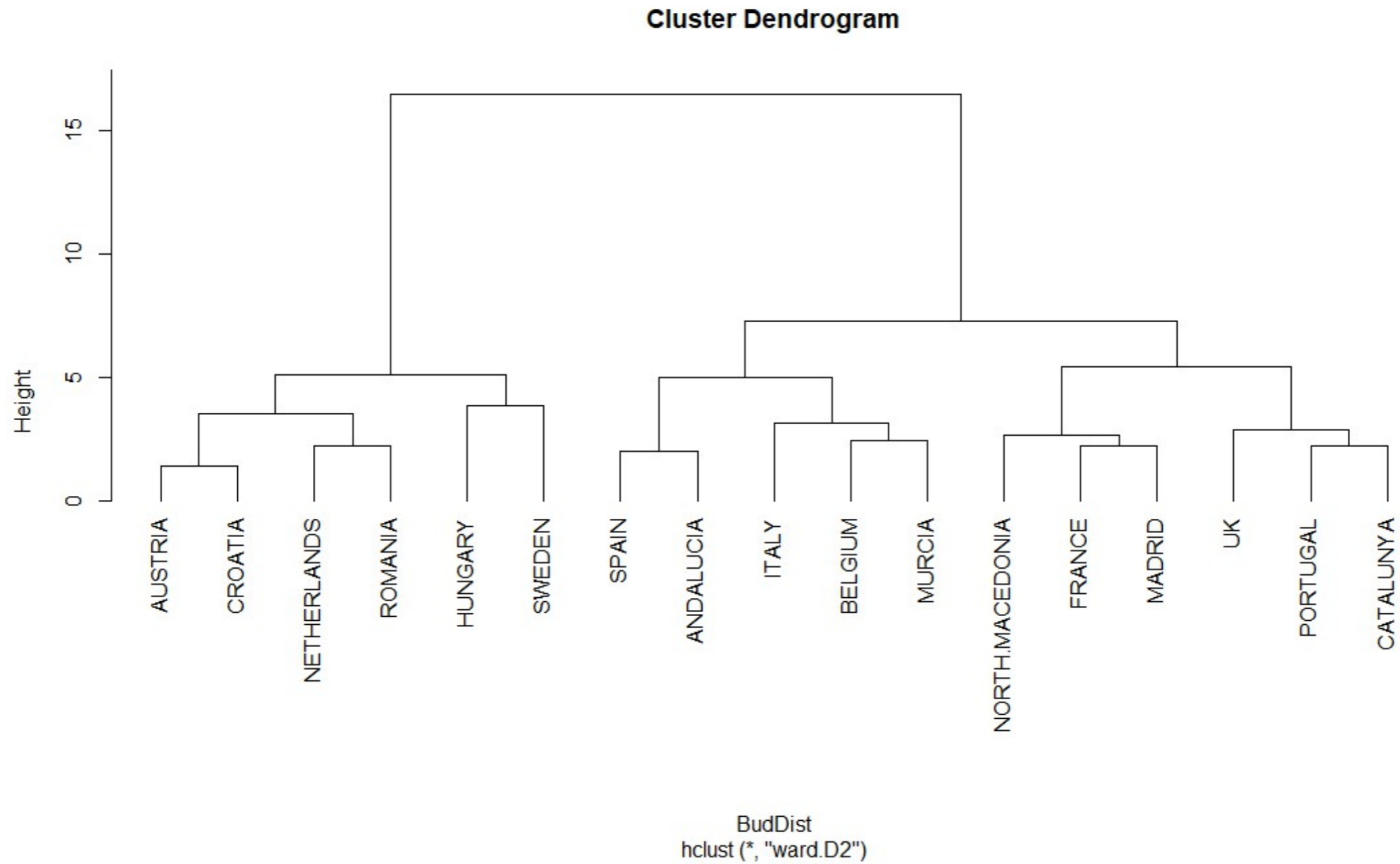


Defining the HWS levels

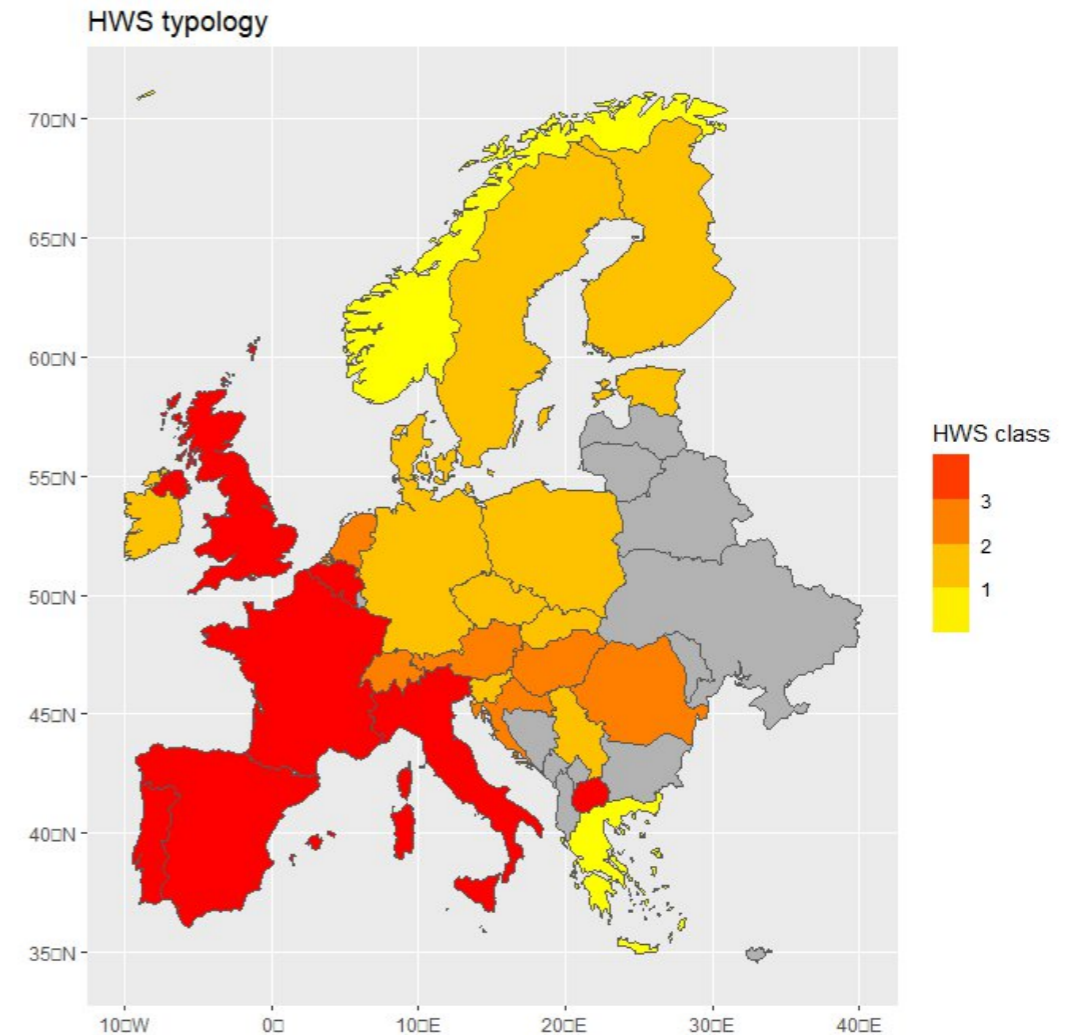
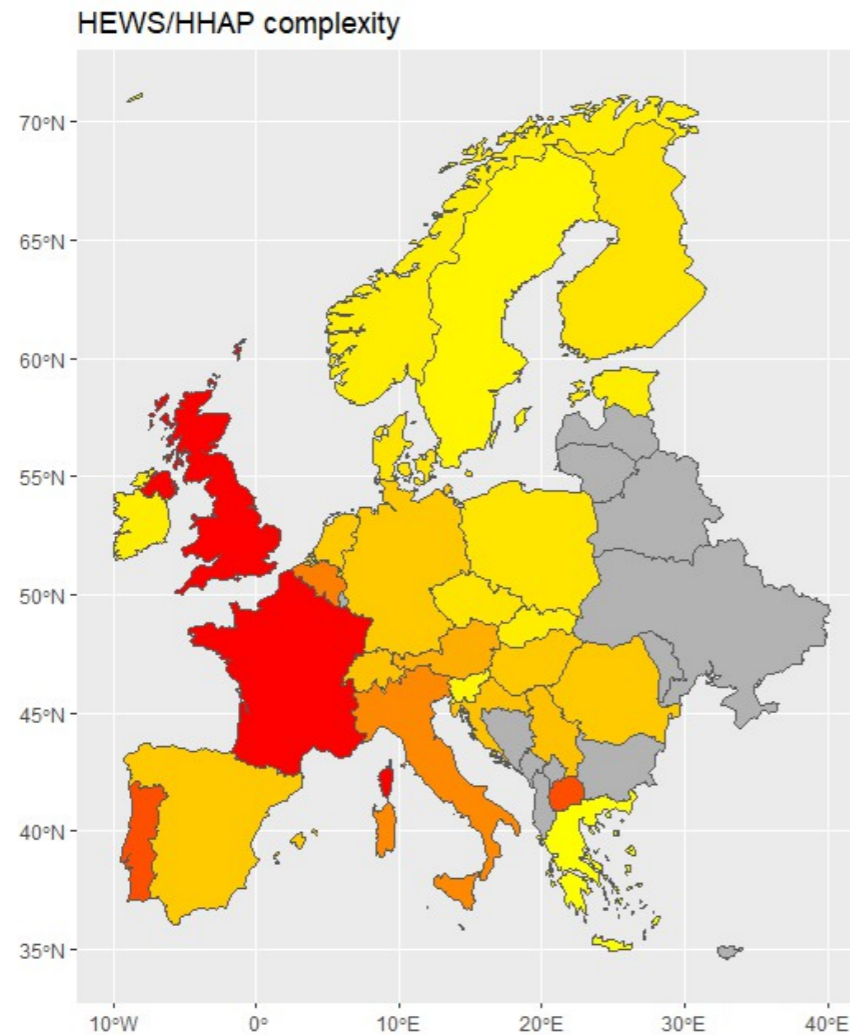
- 1st level: no coordination with the health care system, only meteorologic alerts and communication plan
- 2nd and 3rd levels: PCA with the marks on the different leads.



Defining the HWS levels



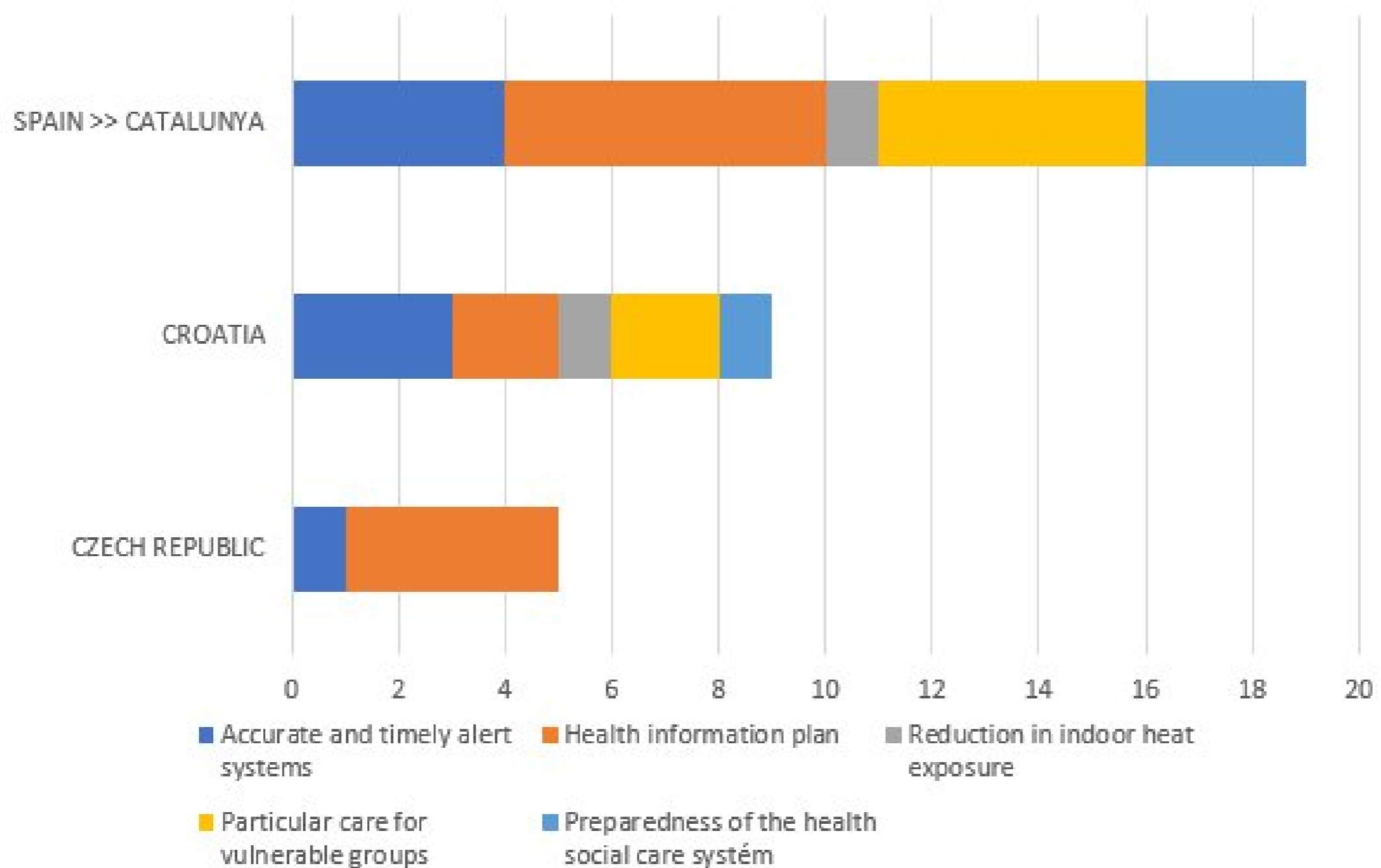
HEWS/HHAP catalogue



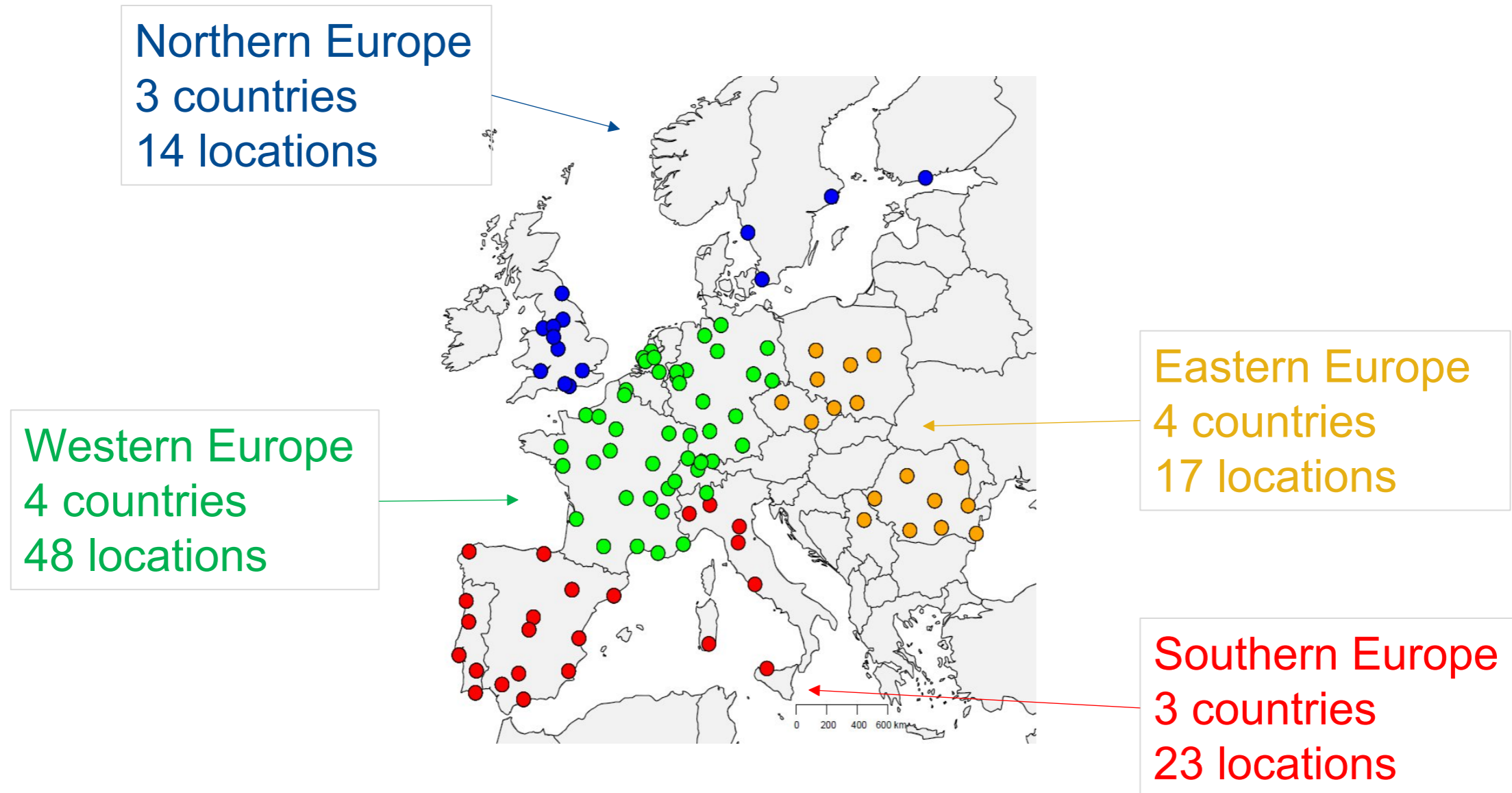
HWS = ?	No information
HWS = 0	no/basic weather forecast
HWS = 1	hws - climatology-based thresholds, no coordination with the health sector
HWS = 2	weather-based heat warnings, but epidemiological thresholds, some actions taken
HWS = 3	Heat-health prevention plan/action plan/national heat plan, many actions taken



Description of the levels – examples



MCC Collaborative Research Network



- 101 cities in 14 European countries – daily mortality and air temperature data.

MCC data + HEWS/HHAP catalogue

COUNTRY	N LOCATIONS	1969	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
<i>Finland</i>	1 metropolitan area						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	North
<i>Norway</i>	1 city	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Sweden</i>	3 cities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	
<i>UK</i>	10 cities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
<i>Czech Republic</i>	3 cities						0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	East
<i>Romania</i>	8 cities						0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
<i>Poland</i>	5 cities		0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
<i>Serbia</i>	1 city						0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
<i>France</i>	20 cities											0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	West	
<i>Germany</i>	14 cities					0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
<i>The Netherlands</i>	5 regions							0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
<i>Switzerland</i>	8 cities						0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
<i>Italy*</i>	7 cities												0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	South	
<i>Portugal</i>	5 districts		0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
<i>Spain</i>	11 cities		0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	

- HWS = ? No information
- HWS = 0 no/basic weather forecast
- HWS = 1 hws - climatology-based thresholds, no coordination with the health sector
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- HWS = 3 Heat-health prevention plan/action plan/national heat plan, many actions taken



Methods – Meta-regression models

Two-stage design:

- 1st stage: time series on city level. Divided to 3-year periods
- DLNM: ERF for each 3-year period, May-September
- **2nd stage – mixmeta model:**
- `model <- mixmeta (coef ~ as.factor(HWS), vcov, data=cityinfo, method="ml", random=~1|countryname/cityname, bscov="diag")`

i. `coef` and `vcov` = first stage estimated coefficients for each city in each 3-year period

ii. `HWS` = HWS typology (0-3) from each city in each 3-year period

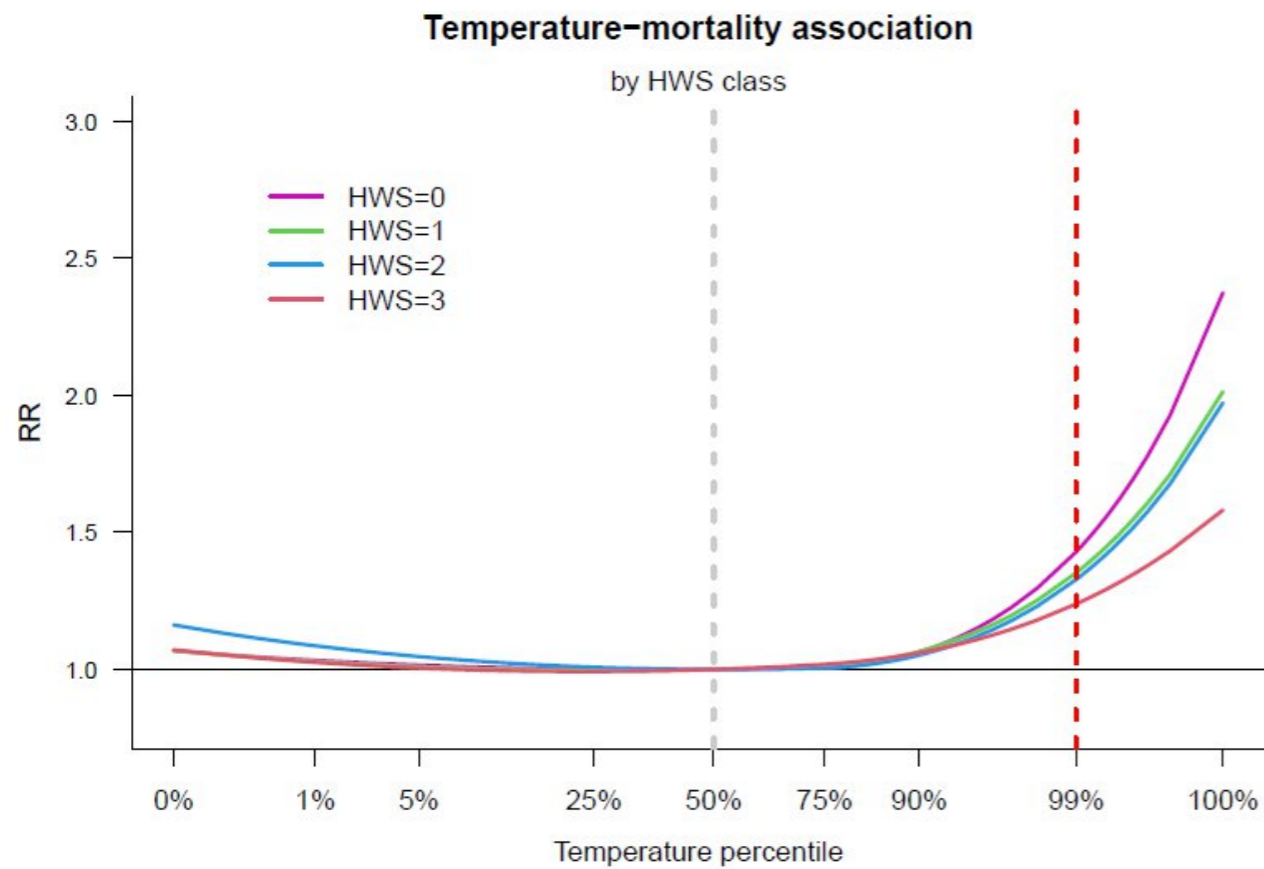
iii. `random` = nested country/city random effect

- **Pooled effect for all locations based on the HWS level**

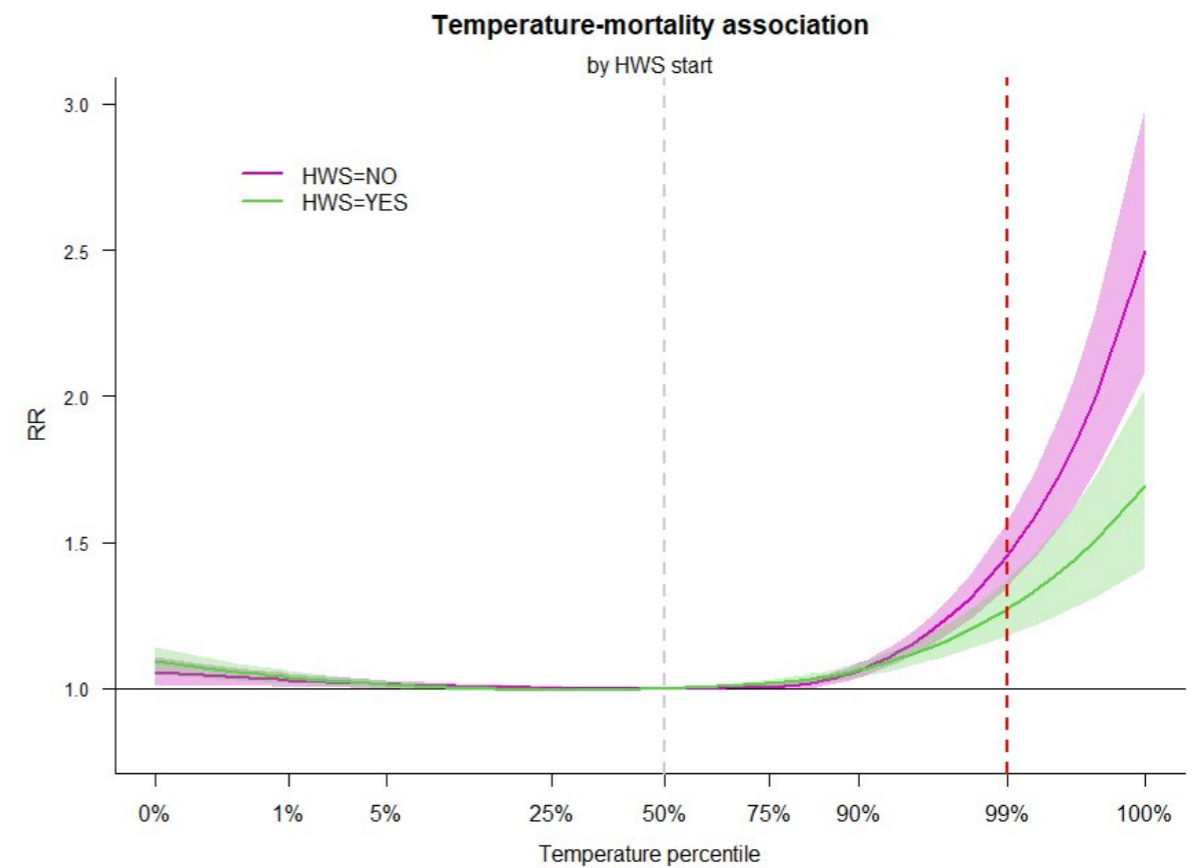


Results

By HWS level



By HWS implementation



Limitations => expert elicitation event

- Significant reduction of the risk with more complex HWSs
- Effect of heat-wave intensity / 2003 heat wave
- Better classification/typology of the national systems
- Expert-based weights to individual components
- **=> expert elicitation event: Tuesday after lunch in room DP411A**
– everyone interested in heat-health prevention is welcome to join the discussion!

