HEATWAVES IN EUROPE 1950-2020 : METEOROLOGY, POPULATION AND IMPACTS

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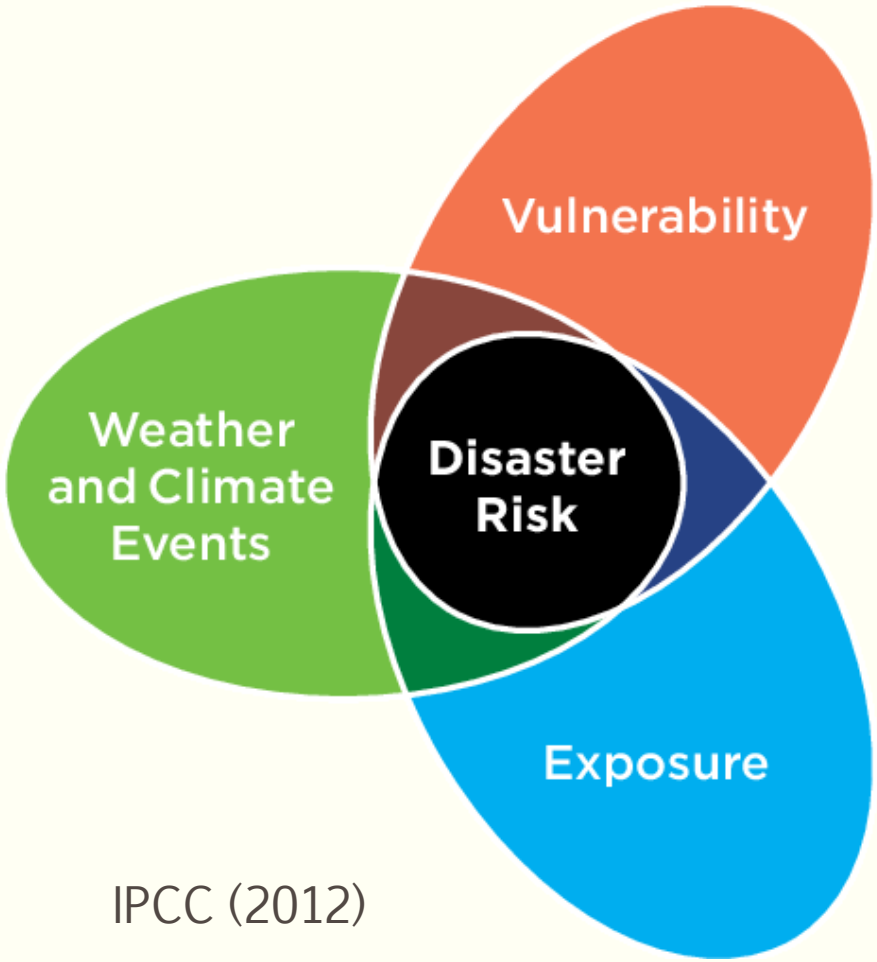
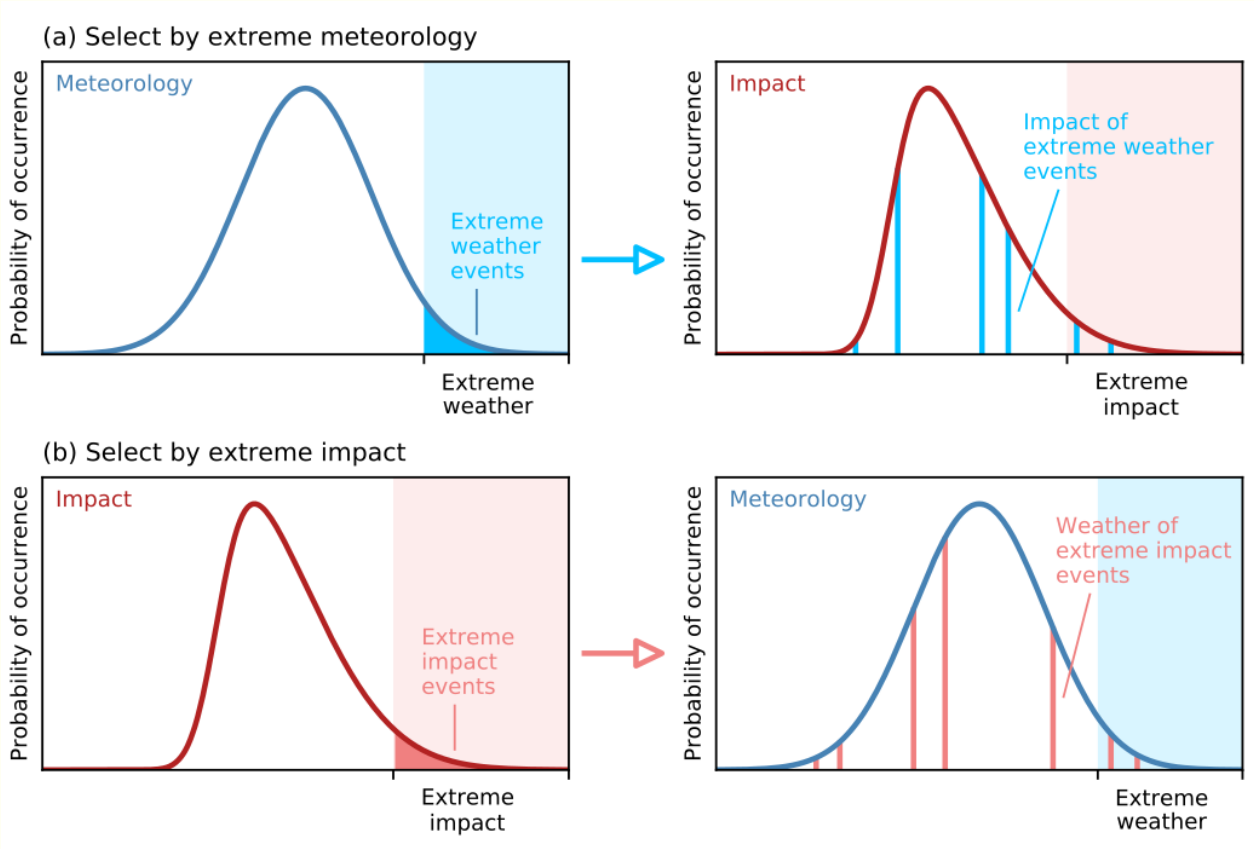
Context & objective



IPCC (2012)



Van der Wiel *et al* (2020)

Mandonnet Théo *et al*

Methodology : EM-DAT & E-OBS

Heatwaves identification

- 95th temperature percentile
- 4-days duration
- Spatial extension
- Spatio-temporal propagation

Overlap analysis

- Time overlap
- Spatial overlap

Index derivation

- Index derivation
- Index evaluation

$$A_d = \bigcup_{y=1950}^{2020} \bigcup_{i=d-7}^{d+7} TA_{y,i}$$

Stefanon *et al* (2012)

Mandonnet Théo *et al*

Impact predictor

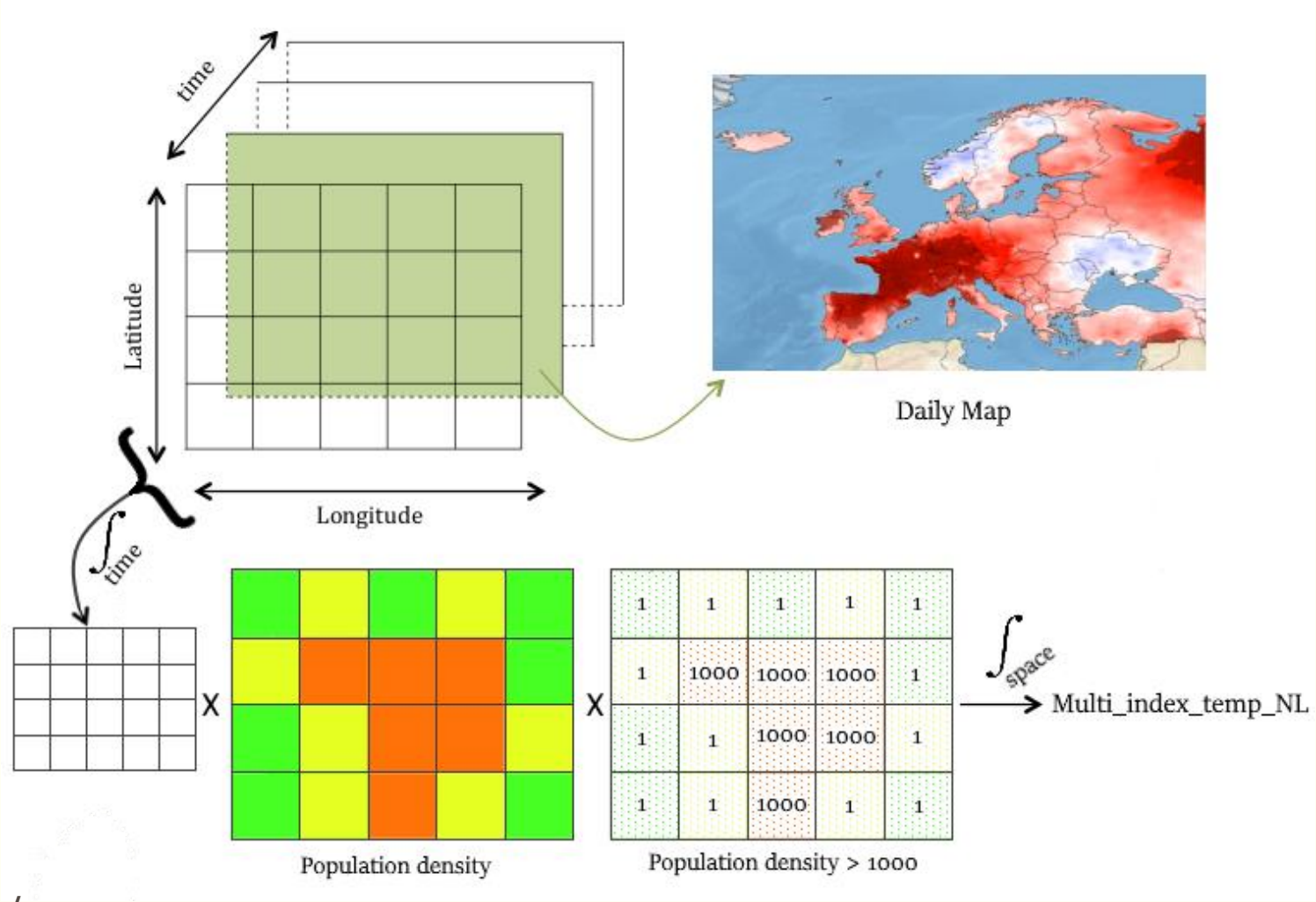


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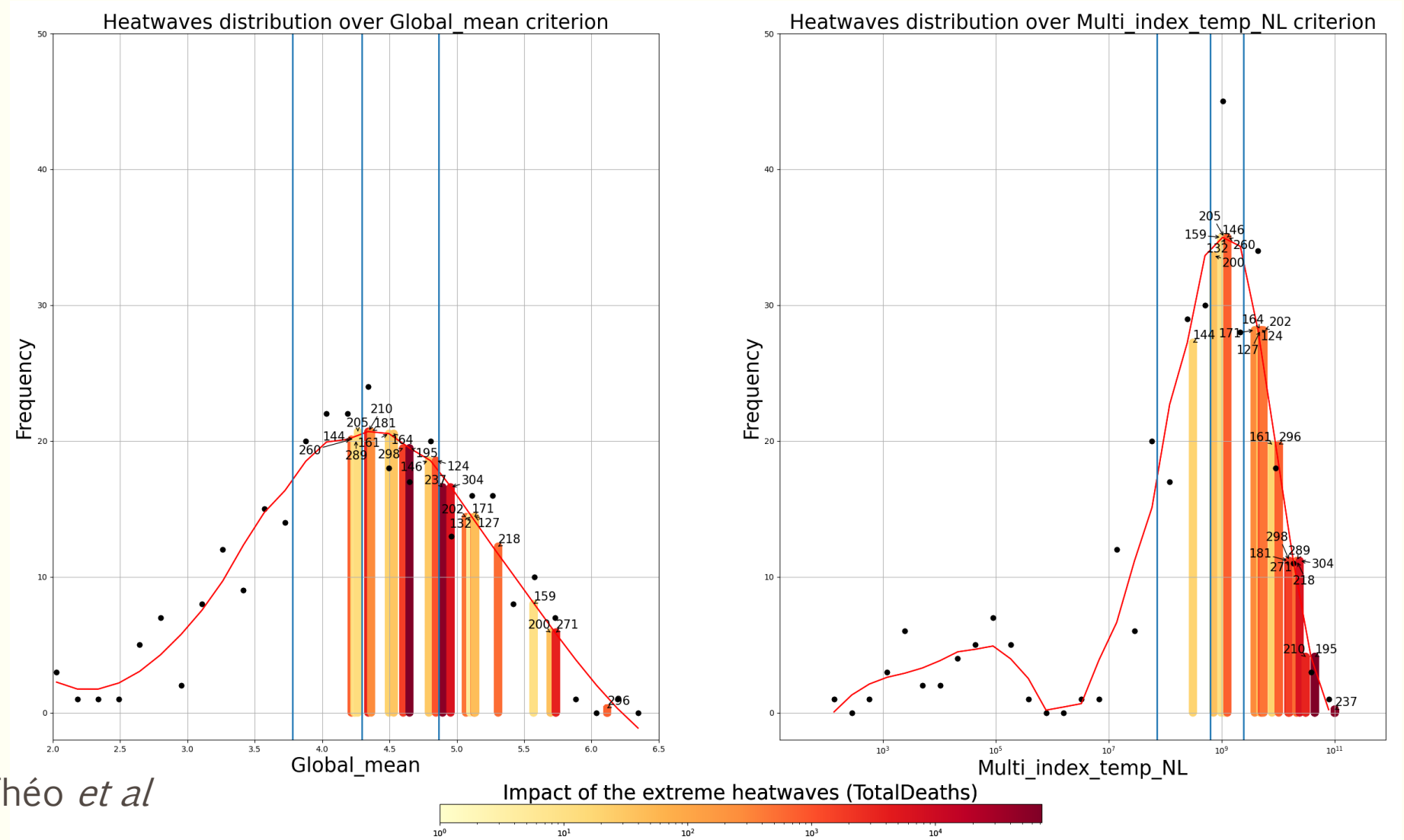
Illustration of worst and best indices



Conclusion and prospects

- Relatively low consistency between temperature characteristics and impact
- Including demographic parameters → improve the derived indices

- Include other socio-economic parameters ? (vulnerability)
- Heatwaves detection process based on :
  - bioclimatic indices ? (wet-bulb index)
  - meteo and socio-economic data ? (finer resolution)

Thank you for your attention !

Abstract and display materials are available here:

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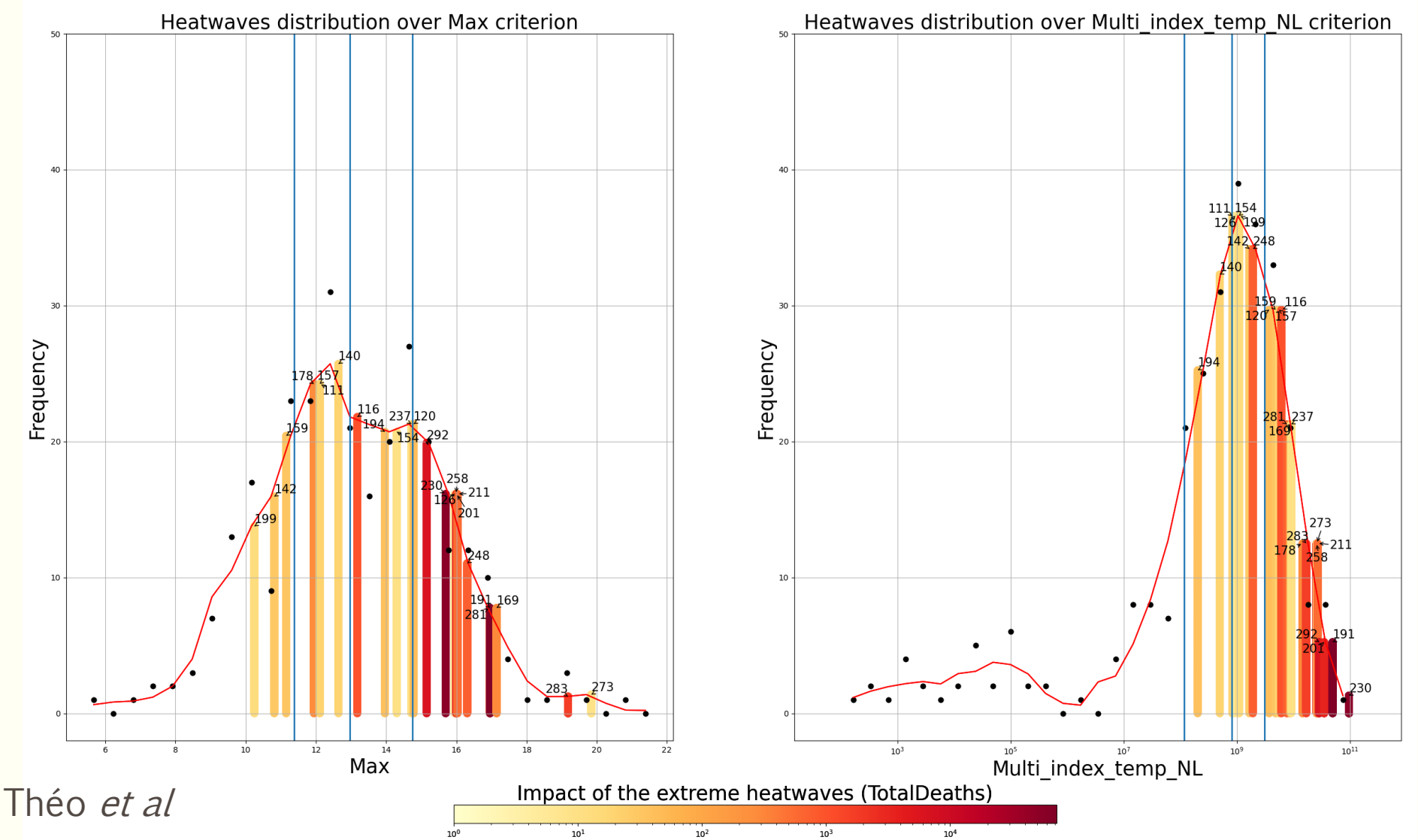
APPENDICES

Illustration of 2nd worst index and best index



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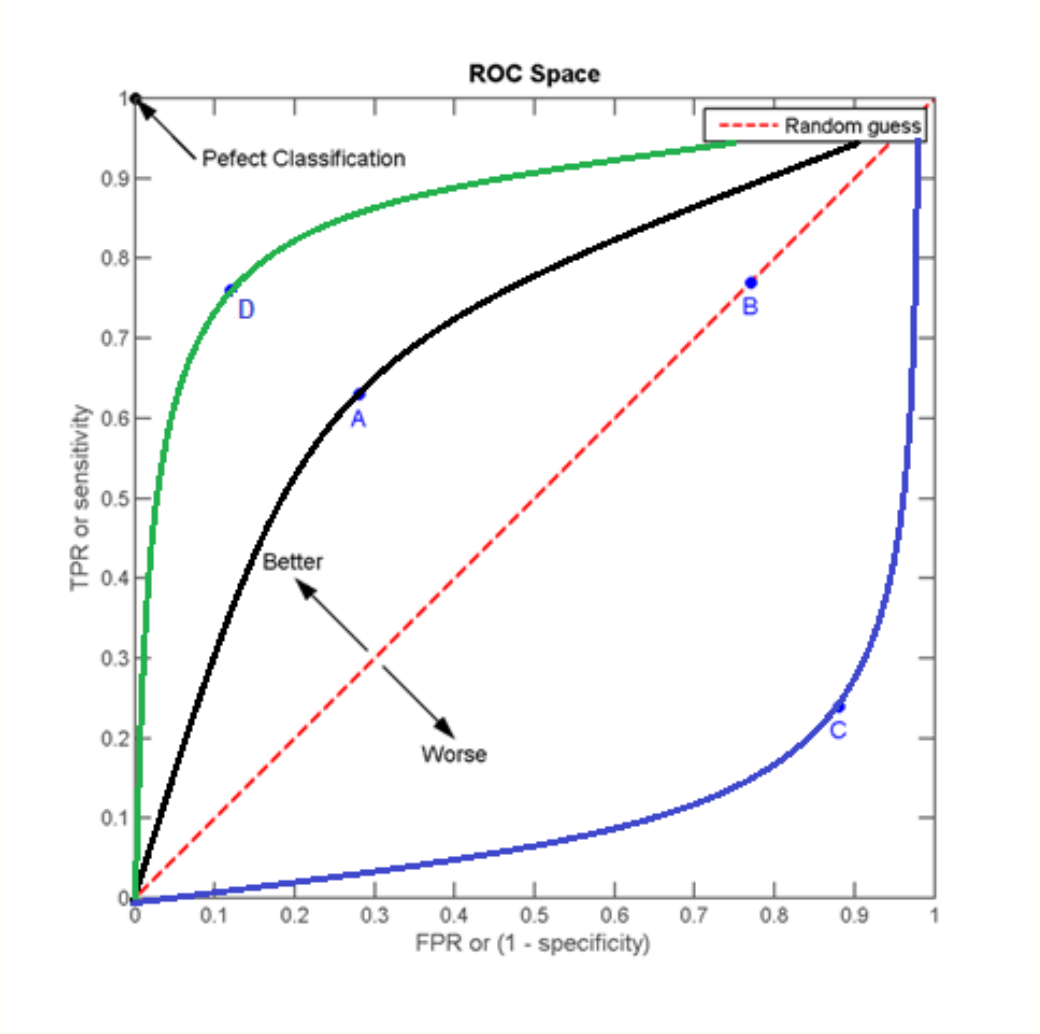
EM-DAT heatwaves

	Country	ISO	Location	EndDate	TotalDeaths	NoInjured	NoAffected	NoHomeless	TotalAffected	Reconstruction_Cos	Insured_Damages	Total_Damages
2	Greece	GRC	Countrywide	1985-8-5	20	0	0	0	0	0	0	0
3	Greece	GRC		1987-7-31	1000	0	0	0	0	0	0	0
4	Greece	GRC		1988-7-3	56	0	0	0	0	0	0	0
5	Yugoslavia	YUG	Belgrade (Serbia)	1988-7-11	38	0	0	0	0	0	0	0
6	France	FRA	Southwestern	1990-7-24	5	0	0	0	0	0	0	0
7	Romania	ROU		1994-5-	0	0	0	0	0	0	0	0
8	Spain	ESP	Andalusia	1995-7-25	30	70	0	0	70	0	0	0
9	Russian Federation (the)	RUS	Moscou	1995-6-14	20	0	0	0	0	0	0	0
10	Romania	ROU		1996-7-4	16	200	0	0	200	0	0	0
11	Italy	ITA	Calabria	1998-7-4	10	0	0	0	0	0	0	0
12	Romania	ROU		1998-8-3	20	0	0	0	0	0	0	0
13	Lithuania	LTU		1999-6-14	32	0	0	0	0	0	0	0
14	Croatia	HRV	Zagreb city (Zagreb provin	2000-6-	40	200	0	0	200	0	0	240000
15	Greece	GRC	Anatoliki Makedonia Kai T	2000-7-	27	176	0	0	176	0	0	3000
16	Romania	ROU	Bucuresti, Dolj provinces	2000-7-	6	100	0	0	100	0	0	0
17	Bulgaria	BGR	Sofia, Sofia-city, Stata Zag	2000-7-	7	0	0	0	0	0	0	50
18	Serbia Montenegro	SCG	Subotica city (Severno-bac	2000-7-	3	70	0	0	70	0	0	0
19	Russian Federation (the)	RUS	Moskva, Moskovskaya Ob	2001-7-	276	0	0	0	0	0	0	0
20	Austria ; Belgium ; Switzerl	AUT ; BEL ; CHE ; C	Burgenland, Karnten, Nied	2003-8- ; 20	72210	0	0	0	0	0	10000	12120000
21	Albania ; Macedonia (the fo	ALB ; MKD ; ROU	Durres city (Durres district	2004-7- ; 20	45	0	0	0	0	0	0	0
22	Spain ; Canary Is	ESP ; SPI	AndalucÃ-a, Castilla-La Ma	2004-7-30 ;	39	113	0	0	113	0	0	0
23	Romania	ROU	Bucuresti province	2005-8-1	13	500	0	0	500	0	0	0
24	Portugal	PRT	Aveiro, Beja, Braga, Bragar	2005-8-	462	0	0	0	0	0	0	0
25	Romania	ROU	Bucarest, Galati, Mehedint	2006-7-	26	200	0	0	200	0	0	0
26	Belgium ; Germany ; Spain	BEL ; DEU ; ESP ; FF	Vlaams Geweest, Region d	2006-7- ; 20	3392	0	0	0	0	0	0	0
27	Albania ; Austria ; Bulgaria	ALB ; AUT ; BGR ; B	Berat, Bulqize, Delvine, De	2007-7-22 ;	560	139	352	0	491	0	0	0
28	Russian Federation (the)	RUS	Moska, Moskovskaya Obla	2010-8-	55736	0	0	0	0	0	0	400000
29	Italy	ITA	Milano district (Lombardia	2011-8-24	10	0	0	0	0	0	0	0
30	United Kingdom of Great B	GBR	England, Wales provinces	2013-7-	760	0	0	0	0	0	0	0
31	Belgium ; France	BEL ; FRA	Vlaams Gewest, Region de	2015-7-5 ; 2	3685	0	0	0	0	0	0	0
32	Belgium ; Germany ; Spain	BEL ; DEU ; ESP ; FF	; ; ; ; ; ; ;	2018-7- ; 20	9	0	0	0	0	0	0	0
33	Belgium ; Germany ; Spain	BEL ; DEU ; ESP ; FF	; ; Cordoba, Valladolid ; V	2020-7-1 ; 2	709	0	0	0	0	0	0	0
34	Austria ; Belgium ; German	AUT ; BEL ; DEU ; F	; ; ; Toute la France mÃ©	2019-7-26 ;	1669	0	0	0	0	0	0	0
35	Belgium ; United Kingdom	BEL ; GBR	;	2019-8-29 ;	188	0	0	0	0	0	0	0
36	Belgium ; France ; United K	BEL ; FRA ; GBR ; N	; ; ;	2020-8-8 ; 2	6340	0	0	0	0	0	0	0

Index evaluation method

- Correlation coefficient between index and impact for extreme heatwaves
- Area Under the Receiver Operating Characteristic Curve (AUROCC)



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Predictor scores

Index	Correlation coefficient	p-value	AUROCC	Global score
Global_mean	0.029182	0.894847	0.72177	0.021062
Spatial_extent	0.526818	0.009801	0.785267	0.413693
Duration	0.527938	0.009618	0.771348	0.407224
Max	0.201875	0.355627	0.674851	0.136236
Max_spatial	0.499399	0.01526	0.784329	0.391693
Temp_sum	0.56172	0.005283	0.786831	0.441979
Pseudo_Russo	0.581288	0.003626	0.794495	0.46183
Pop_unique	0.601997	0.002372	0.837348	0.504081
Global_mean_pop	0.467748	0.024404	0.793869	0.371331
Duration_pop	0.490455	0.017500	0.847513	0.415667
Max_pop	0.56373	0.005088	0.835784	0.471156
Max_spatial_pop	0.556027	0.005869	0.819987	0.455935
Spatial_extent_pop	0.573395	0.004232	0.822959	0.471881
Temp_sum_pop	0.591867	0.002929	0.823272	0.487267
Pseudo_Russo_pop	0.602201	0.002361	0.827338	0.498224
Temp_sum_pop_NL	0.646314	0.000862	0.837504	0.54129
Pseudo_Russo_pop_NL	0.636301	0.001099	0.841883	0.535691
Multi_index_temp	0.628619	0.001315	0.846419	0.532075
Multi_index_Russo	0.605356	0.002208	0.850172	0.514657
Multi_index_temp_NL	0.641905	0.000960	0.853144	0.547637
Multi_index_Russo_NL	0.615370	0.001775	0.856741	0.527213

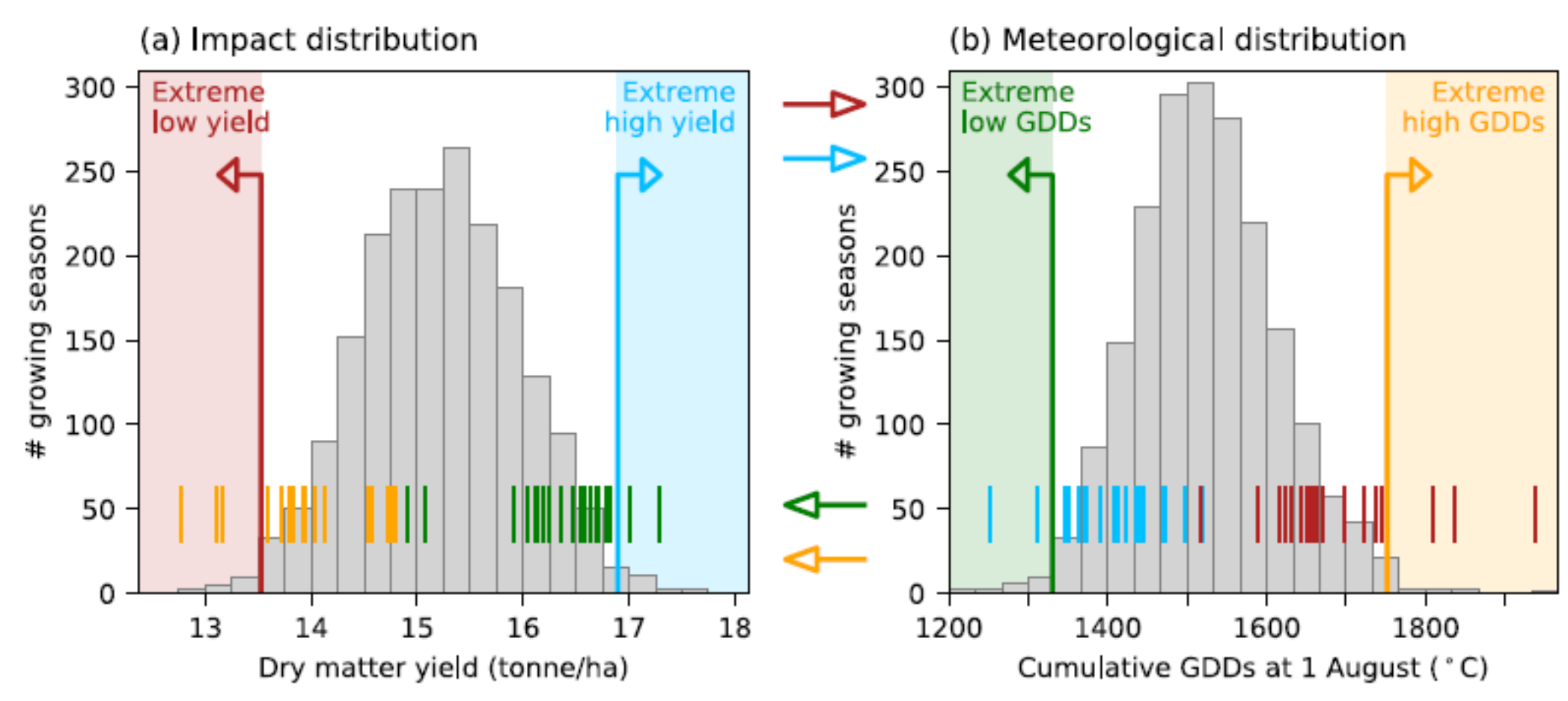
Russo *et al* (2015) : HWMId

$$M_d(T_d) = \begin{cases} \dfrac{T_d - T_{30y25p}}{T_{30y75p} - T_{30y25p}} & \text{if } T_d > T_{30y25p} \\ 0 \quad \text{if } T_d \leqslant T_{30y25p} \end{cases}$$

$$A_d = \bigcup_{y=1950}^{2020} \bigcup_{i=d-7}^{d+7} T_{y,i}$$

$$M_d = \begin{cases} \frac{T_d - T_{25}}{T_{75} - T_{25}} & \text{if } T_d \geq T_{95} \\ 0 & \text{if } T_d < T_{95} \end{cases}$$

Illustration : crop yield in Netherlands Van der Wiel *et al* (2020)



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