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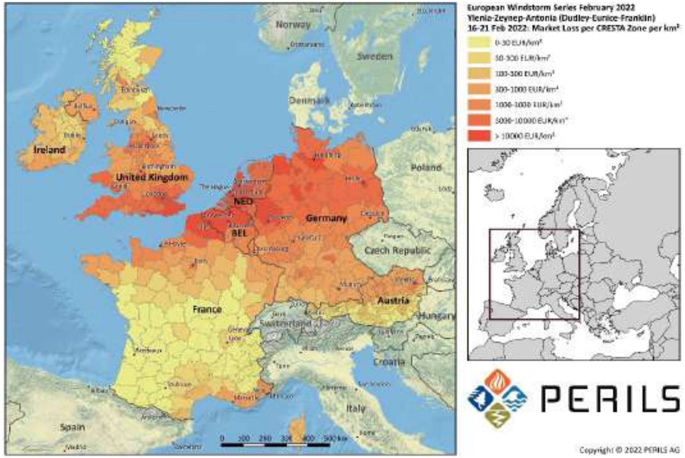
Windstorm losses in Europe – What to gain from damage data sets

Julia Mömken[1], Gabriele Messori[2], Joaquim Pinto[1]

[1] Institute of Meteorology and Climate Research (IMK-TRO), Karlsruhe Institute of Technology (KIT), Germany
[2] Department of Earth Sciences / Centre of Natural Hazards and Disaster Science (CNDS), Uppsala University, Sweden

Zeynep (Feb 2022)



Different types of data sets for windstorm impacts

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- Meteorological indices
  - Estimates of disaster impacts derived from meteorological variables
  - E.g. Storm Severity Index (*Pinto et al., 2012, Clim Res*)
- Natural hazard / disaster database
  - Collection/documentation of disaster impacts/losses
  - Publicly available
  - E.g. EM-DAT, DesInventar
- Insurance data
  - Information on insured losses

Different types of data sets for windstorm impacts

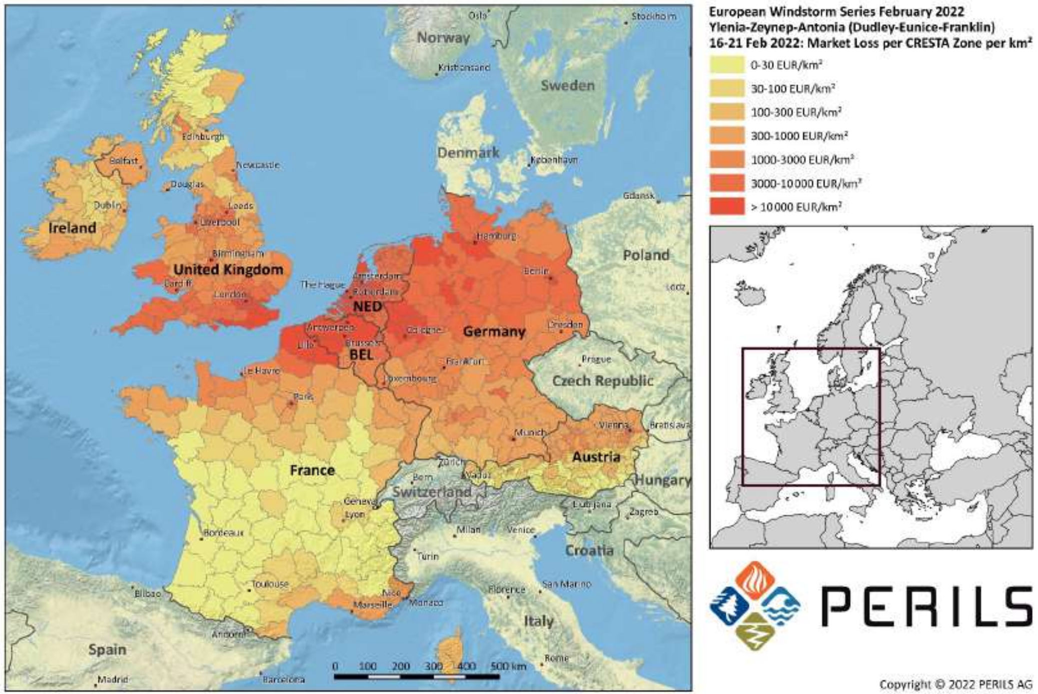
NAME	ABBREVIATION	TYPE	TIME
Extreme Wind Storms Catalogue	**XWS**	Meteorological index	1979 – 2014
Copernicus Climate Change Service (Winter windstorm indicators)	**C3S**	Meteorological index	1979 - 2021
Loss Index	**LI3D**	Meteorological index	1999 – 2022
EM-DAT		Disaster database	1900 – present
PERILS		Insurance data	1999 – present

Moemken et al. (Wea Clim Extremes, under review)

Insurance data – PERILS

- *www.perils.org*
- Availability: 1999 – present
- Aggregated and anonymised data from insurance companies
  - Ultimate gross event loss per country and CRESTA zone
  - Property premium data per country
  - Exposure (sums insured) per country and CRESTA zone
  - Countries covered: Austria, Belgium, Denmark, France, Germany, Ireland, Luxembourg, Netherlands, Norway, Sweden, Switzerland, UK
- Windstorm event reported if total insured loss > 200 Mio €
  - New threshold since Sep 2022: 500 Mio € for pan-European events, 300 Mio € for individual countries

Insurance data – PERILS

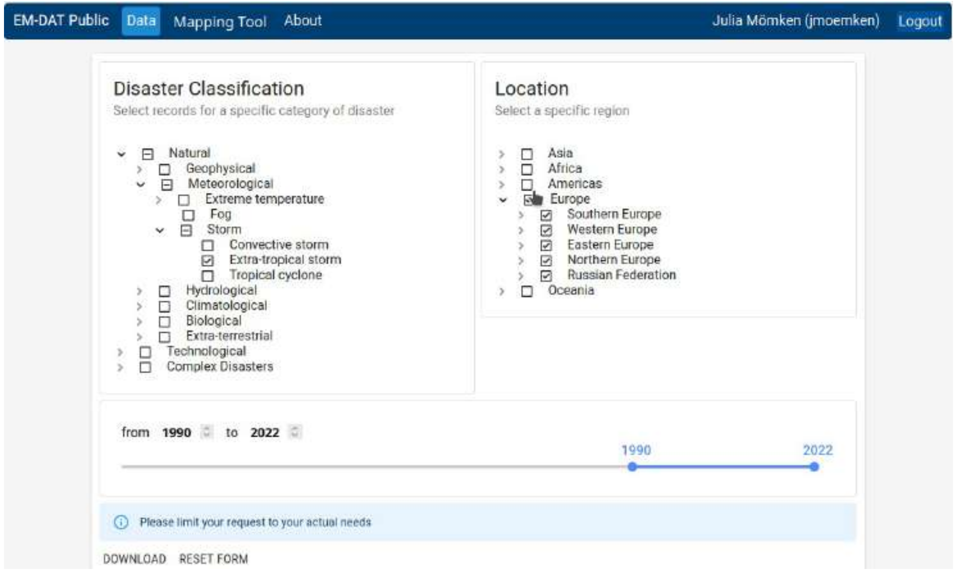


Industry Loss Footprint (3rd estimate) for windstorm series Ylenia-Zeynep-Antonia in Feb 2022

Disaster database – EM-DAT

- Availability: 1900 – present
- Information collected from UN agencies, NGOs, …
- Criteria for event reporting
  - 10+ people dead and/or
  - 100+ people affected and/or
  - Declaration of state of emergency and/or
  - Call for international assistance

www.emdat.be



Meteorological – Extreme Windstorm Catalogue

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- *www.europeanwindstorms.org*
- *Roberts et al. (2014, NHESS)*
- Availability: 1979 – 2014
- 50 most extreme storms
  - Storm tracks + footprints
  - Estimates of storm loss
- Derived from ERA-Interim

Organisations involved

Met Office

University of Exeter

University of Reading

National Centre for Atmospheric Science

Extreme Wind Storms Catalogue

Database

List of storms

The original database covering 1979-2012, shown in table below, consisted of 23 storms which caused high insurance losses (referred to as 'insurance storms'). The remaining 27 storms were selected because they are the top 'non-insurance' storms as ranked by the storm severity index $S_{ft} = U^3_{max}N$. (See the storm selection page for more details.)

Storms added since 2012 have been added to the same table and are indicated with a single asterix. The criteria for adding new storms is either that they rank in the top 50 according to Sft, or they have notable insurance losses.

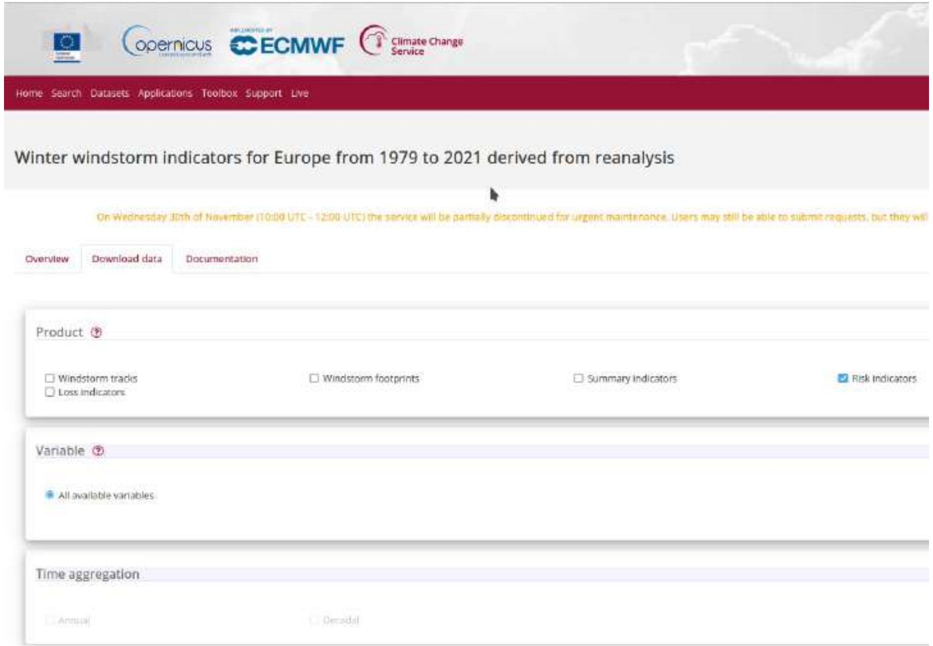
Navigate to storms using the left hand buttons or click on the storm name in the table below. It's also possible to alter how these storms are sorted with the form below

Sort: alphabetical (only for named storms)

Storm	Date*	Insured loss (USD, indexed to 2012)**	Affected countries	U_{max}++ (ms^{-1})	Lowest MSLP*** (hPa)	Maximum vorticity+++ (10^{-5-1})	S_{ft}****
Anatol	3/12/1999	2.6bn	Denmark, Germany and Sweden	39.86	956.05	10.98	47.01
Christian (St Jude)*	28/10/2013	1.3bn	Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Netherlands, Norway, Russia, Sweden and United Kingdom	35.09	967.33	6.68	8.51
Dagmar (Patrick)	26/12/2011	0.04bn	Finland and Norway	30.08	953.94	8.58	1.77
Daria (Burns' Day storm)	25/1/1990	8.2bn	Belgium, France, Germany, Netherlands and United Kingdom	37.92	948.62	11.89	48.05
Emma	29/2/2008	1.4bn	Austria, Belgium, Czech Republic, Germany, Netherlands, Poland and Switzerland	25.12	959.46	9.60	12.17
Erwin (Gudrun)	8/1/2005	2.2bn	Denmark, Ireland, Norway, Sweden and United Kingdom	39.22	959.89	9.82	36.08
Fanny	4/1/1998	NA	United Kingdom	34.60	966.23	8.30	12.30

Meteorological – Copernicus Climate Change Service (C3S)

- *https://cds.climate.copernicus.eu*
- Winter windstorm indicators
- Availability: 1979 – 2021
- Derived from ERA5
- Consider only Top50 events in period 1999 – 2021
- 21 countries covered: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK



Meteorological – Loss Index

- *Pinto et al. (2012, Clim Res); Karremann et al. (2014, NHESS)*

$$LI_{3D} = \sum_{ij} \left[max_{3D} \left({v_{ij}}/{v_{98_{ij}}} \right) \right]^3 * POP_{ij} * I(v_{ij}, v_{98_{ij}})$$

v_{ij}: daily maximum wind speed
v_{98ij}: 98th percentile of v_{ij}
POP: population density

- Derived from ERA5
- Period: 1999 – 2022
- Only Top50 events
- Same 21 countries as in C3S

$$I(a,b) = \begin{cases} 0 \; for \; a < b \\ 1 \; for \; a > b \end{cases}$$

Overview of reported storms

Reported storms

- All storms in period 1999 – 2022
  - Only winter half year (Oct – Mar)
  - Reported in at least one data set
  - Affected countries
  - 94 storms in total
- Storm names as given by Freie Universität Berlin and used by DWD
- Abbreviation of data sets

P: PERILS	E: EM-DAT	C: C3S
X: XWS	L: Loss Index (LI3D)	

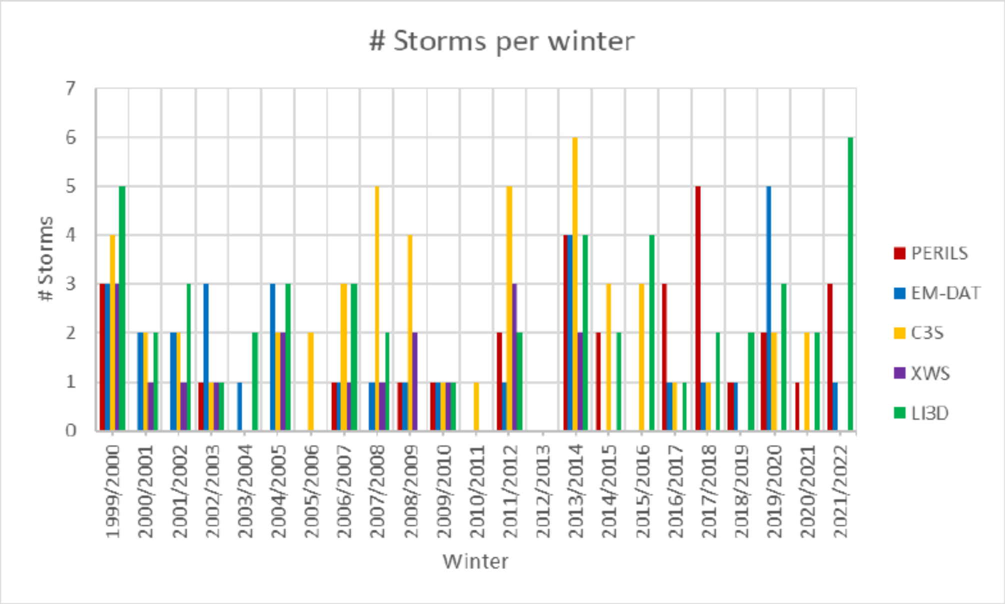
Reported storms – extract

		AUT*	BEL*	CHE*	CZE	DEU*	DNK*	ESP	EST	FIN	FRA*	GBR*	IRL*	ITA	LTU	LUX*	LVA	NLD*	NOR*	POL	PRT	SWE*	
1	Zubin (Dec 1999)		L		L	L	L		L	L		L			L		L		L	L		L	Zubin (Dec 1999)
2	Anatol (Dec 1999)		L		L	PECXL	PECXL			L	C	ECL	CL	L	ECL	L	ECL	CL		ECL		ECXL	Anatol (Dec 1999)
3	Lothar (Dec 1999)	CL	PEL	PECXL	CL	PECXL		CL		C	PECXL	ECL	EC	CL		PCL		CL	CL				Lothar (Dec 1999)
4	Martin (Dec 1999)	C	L	PCXL	CL	CL		ECL			PECXL	C		CXL		CL		L			L		Martin (Dec 1999)
5	Afra (Jan 2000)											C	C						C				Afra (Jan 2000)
6	Kerstin (Jan 2000)	L	L	L	L	L	L		L	L		L					L	L	L	L		L	Kerstin (Jan 2000)
7	Nicole (Oct 2000)		L			L	L				L	L				L		L	L				Nicole (Oct 2000)
8	Oratia (Oct 2000)		L			CXL	CL	C		L	CXL	CXL	C			C		CXL	CL			L	Oratia (Oct 2000)
9	Yamura (Nov 2000)											C	C										Yamura (Nov 2000)
10	Elke (Dec 2000)							E													E		Elke (Dec 2000)
11	Quendula-Romy (Dec 2000)							E				E											Quendula-Romy (Dec 2000)
12	Torsten (Nov 2001)							E															Torsten (Nov 2001)
13	Ginger-Heike (Jan 2002)		L	L	L	L	L		L	L	L	L	L		L	L	L	L		L		L	Ginger-Heike (Jan 2002)
14	Jennifer (Jan 2002)		L	L	CL	ECL	CXL		CL		CL	ECXL	CL		CL	L	CL	L	CL	ECL		CL	Jennifer (Jan 2002)
15	Anna (Feb 2002)		L	L	L	CL	CL		L	L	CL	CL	CL		L	L	L	CL		C		C	Anna (Feb 2002)
16	Jeanett (Oct 2002)	ECXL	PECL	PEL	ECXL	PECXL	XL				PECXL	PECXL	CXL			CL		PECXL		ECXL		X	Jeanett (Oct 2002)
17	Tamara-Uschi (Nov 2002)	E									E												Tamara-Uschi (Nov 2002)
18	Calvann (Jan 2003)			E		E					E												Calvann (Jan 2003)
19	Gerda (Jan 2004)					E																	Gerda (Jan 2004)
20	Pia-Queenie (Jan 2004)		L			L			L		L	L				L		L					Pia-Queenie (Jan 2004)
21	Nina-Oralie (Mar 2004)		L		L	L	L				L	L	L		L	L		L		L			Nina-Oralie (Mar 2004)
22	Carolin (Oct 2004)												E										Carolin (Oct 2004)
23	Pia-Quimburga (Nov 2004)	L	L	L	L	L	L				L			L	L	L				L		L	Pia-Quimburga (Nov 2004)
24	Christian-Dimitri (Jan 2005)					L	L		L		L	L	L		L		L		L			L	Christian-Dimitri (Jan 2005)
25	Erwin (Jan 2005)		L			ECL	ECXL		ECL		CL	ECXL	ECXL		ECL		ECL	ECL	ECXL	ECL		ECXL	Erwin (Jan 2005)
26	Gero (Jan 2005)											ECX	CX						C				Gero (Jan 2005)
27	Lutz (Nov 2005)											C	C										Lutz (Nov 2005)
28	Nino (Nov 2005)											C	C						C				Nino (Nov 2005)
29	Lotte (Dec 2006)		L	L		CL	CL				CL	CL	CL	L	L	L	L	CL		CL		L	Lotte (Dec 2006)
30	Franz (Jan 2007)	L	L	L	L	L	L		L	L		L	L		L	L	L	L	L	L		L	Franz (Jan 2007)
31	Kyrill (Jan 2007)	ECXL	PECXL	PEL	ECL	PECXL	EL		L	L	PECXL	PECXL	PCXL		L	PCL	L	PECXL		ECL		L	Kyrill (Jan 2007)

Moemken et al. (Wea Clim Extremes, under review)

Number of storms per winter 1999 – 2022

WINTER	PERILS	EM-DAT	C3S	XWS	LI3D
1999/2000	3	3	4	3	5
2000/2001	0	2	2	1	2
2001/2002	0	2	2	1	3
2002/2003	1	3	1	1	1
2003/2004	0	1	0	0	2
2004/2005	0	3	2	2	3
2005/2006	0	0	2	0	0
2006/2007	1	1	3	1	3
2007/2008	0	1	5	1	2
2008/2009	1	1	4	2	0
2009/2010	1	1	1	1	1
2010/2011	0	0	1	0	0
2011/2012	2	1	5	3	2
2012/2013	0	0	0	0	0
2013/2014	4	4	6	2	4
2014/2015	2	0	3	0	2
2015/2016	0	0	3	0	4
2016/2017	3	1	1	0	1
2017/2018	5	1	1	0	2
2018/2019	1	1	0	0	2
2019/2020	2	5	2	0	3
2020/2021	1	0	2	0	2
2021/2022	3	1	0	0	6
TOTAL	30	32	50	18	50



Moemken et al. (Wea Clim Extremes, under review)

Comparison of data sets:

Storm ranking at European level

Ordinal ranking – all storms

- Storm ranking based on reported/estimated losses at European level
- Storms that are reported in at least two data sets
  - 37 storms in total
- EM-DAT not included (too many missing data)

	PERILS	C3S	XWS	LI3D
Anatol (Dec 1999)	4	5	3	15
Lothar (Dec 1999)	1	1	13	3
Martin (Dec 1999)	3	2	11	6
Oratia (Oct 2000)	X	6	4	21
Jennifer (Jan 2002)	X	8	9	11
Anna (Feb 2002)	X	17	X	34
Jeanett (Oct 2002)	6	9	1	2
Erwin (Jan 2005)	X	3	5	28
Gero (Jan 2005)	X	24	14	X
Lotte (Dec 2006)	X	27	X	37
Kyrill (Jan 2007)	2	4	2	1
Emma (Feb 2008)	X	28	16	8
Kirsten (Mar 2008)	X	23	X	24
Klaus (Jan 2009)	7	7	7	X
Quinten (Feb 2009)	X	36	15	X
Xynthia (Feb 2010)	8	19	8	22
Joachim (Dec 2011)	22	14	10	42
Patrick (Dec 2011)	X	26	18	X
Andrea (Jan 2012)	17	18	12	9
Christian (Oct 2013)	11	15	17	47
Xaver (Dec 2013)	12	11	6	18
Dirk (Dec 2013)	16	22	X	27
Tini (Feb 2014)	20	10	X	X
Elon-Felix (Jan 2015)	18	20	X	23
Mike-Niklas (Mar 2015)	13	X	X	14
Ruzica (Feb 2016)	X	39	X	33
Thomas (Feb 2017)	27	X	X	30
ex-Ophelia (Oct 2017)	30	12	X	X
Burglind (Jan 2018)	14	X	X	36
Friederike (Jan 2018)	9	X	X	10
Dragi-Eberhard (Mar 2019)	15	X	X	13
Sabine (Feb 2020)	10	13	X	5
Victoria (Feb 2020)	21	30	X	29
Klaus-Luis (Mar 2021)	29	X	X	41
Hendrik-Ignatz (Oct 2021)	23	X	X	25
Nadia (Jan 2022)	28	X	X	46
Ylenia-Zeynep-Antonia (Feb 2022)	5	X	X	4
	PERILS	C3S	XWS	LI3D

rank 1-5	rank 6-10	rank 11-15	rank 16-20	rank > 20	not in data

Moemken et al. (Wea Clim Extremes, under review)

Ordinal ranking – common storms

- "PCXL-storms": common storms in all 4 data sets
  - 10 storms in total

- "PCL-storms": common storms in PERILS, C3S and LI3D
  - 14 storms in total

a)	PERILS	C3S	XWS	LI3D
Anatol (Dec 1999)	4	4	3	6
Lothar (Dec 1999)	1	1	9	3
Martin (Dec 1999)	3	2	7	4
Jeanett (Oct 2002)	5	5	1	2
Kyrill (Jan 2007)	2	3	2	1
Xynthia (Feb 2010)	6	10	5	8
Joachim (Dec 2011)	10	7	6	9
Andrea (Jan 2012)	9	9	8	5
Christian (Oct 2013)	7	8	10	10
Xaver (Dec 2013)	8	6	4	7
	PERILS	C3S	XWS	LI3D

b)	PERILS	C3S	LI3D
Anatol (Dec 1999)	4	4	7
Lothar (Dec 1999)	1	1	3
Martin (Dec 1999)	3	2	5
Jeanett (Oct 2002)	5	5	2
Kyrill (Jan 2007)	2	3	1
Xynthia (Feb 2010)	6	11	9
Joachim (Dec 2011)	14	8	13
Andrea (Jan 2012)	11	10	6
Christian (Oct 2013)	8	9	14
Xaver (Dec 2013)	9	6	8
Dirk (Dec 2013)	10	13	11
Elon-Felix (Jan 2015)	12	12	10
Sabine (Feb 2020)	7	7	4
Victoria (Feb 2020)	13	14	12
	PERILS	C3S	LI3D

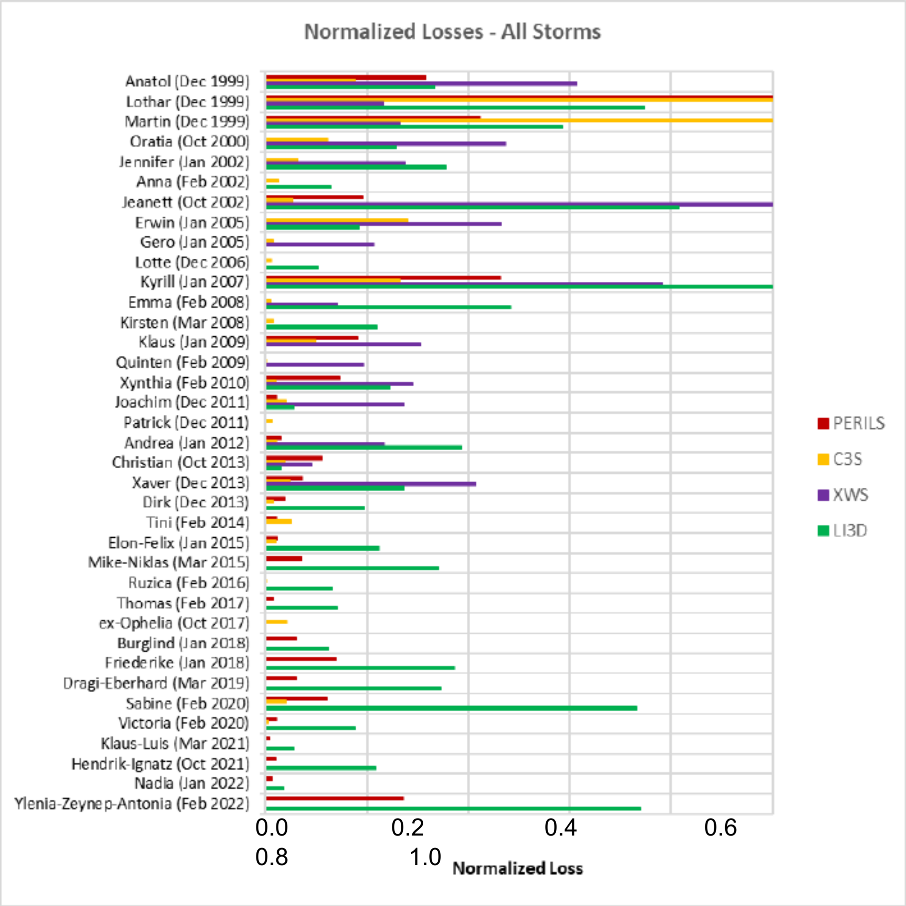
rank 1-3	rank 4-6	rank 7-10	rank > 10

Moemken et al. (Wea Clim Extremes, under review)

Relative ranking – all storms

- Normalized losses
  - Via min-max scaling
- Storms that are reported in at least two data sets
  - 37 storms in total
- EM-DAT not included (too many missing data)

Moemken et al. (Wea Clim Extremes, under review)



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Comparison of data sets:

Case studies at country level

Case study – Kyrill (Jan 2007)

- All storms vs common PCL storms

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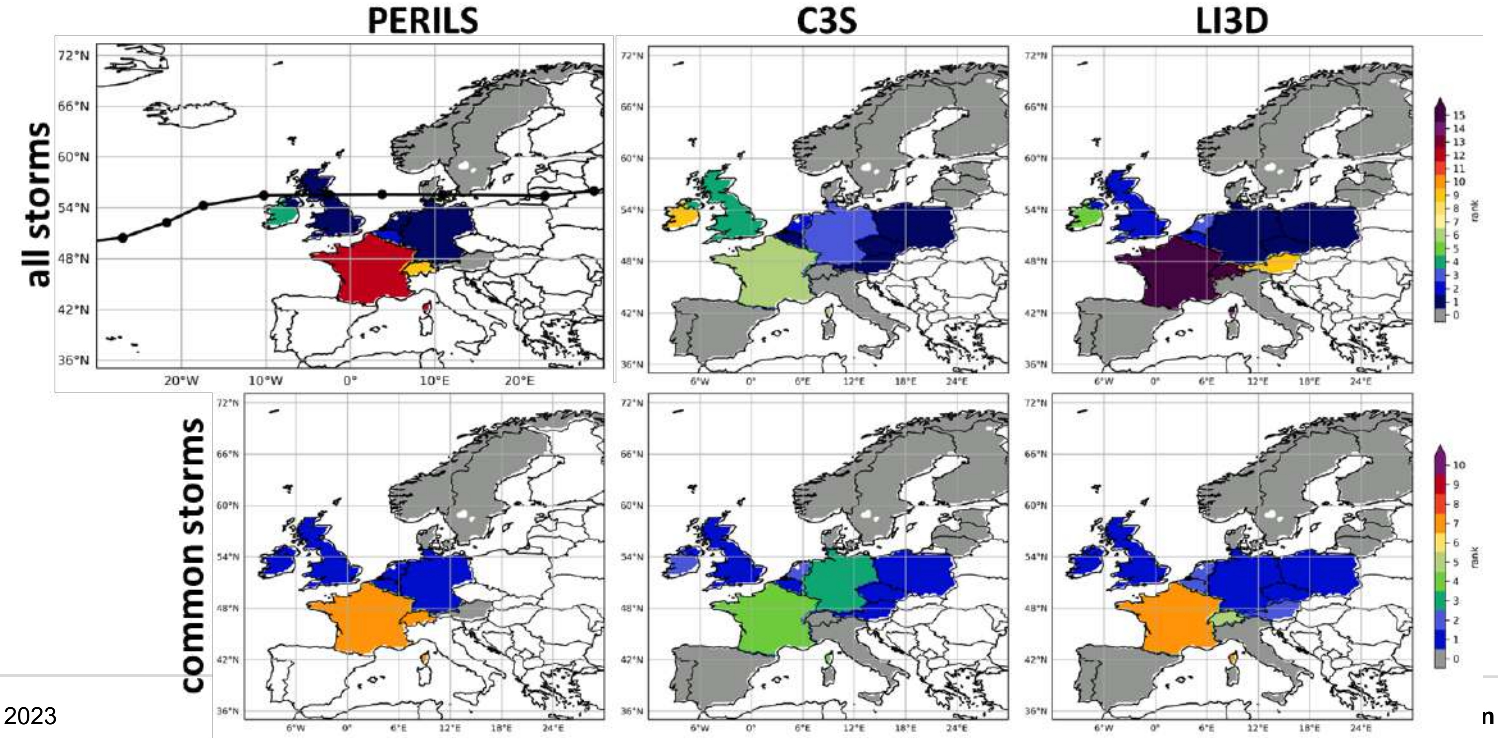

Case study – Sabine (Feb 2020)

- All storms vs common PCL storms

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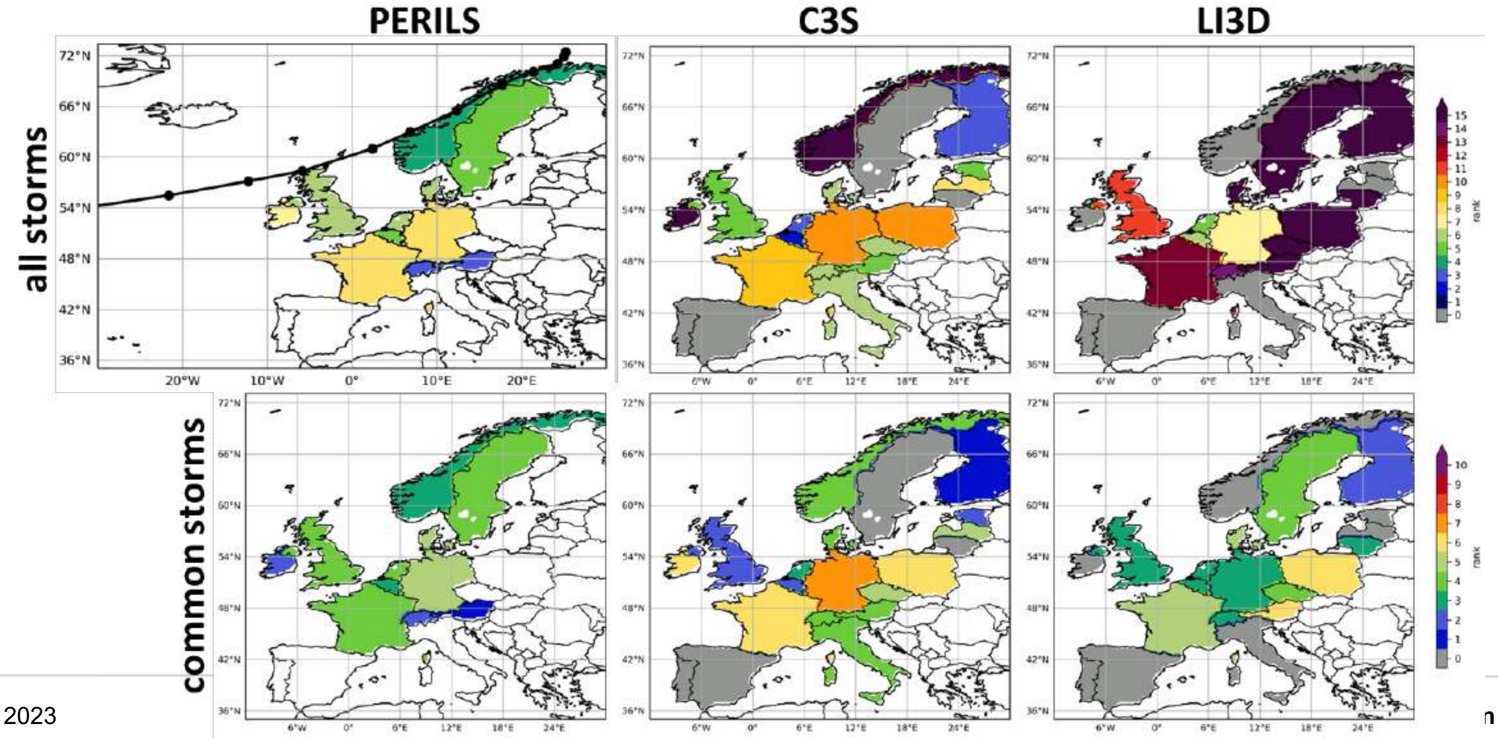

Summary

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- Data sets provide different views on windstorm impacts
- Data sets seem to better comparable in some countries than others
  - Dependent on insurance policy?
- Insurance data not solution for everything
  - Heterogeneous in space and time
- To study specific events, one needs both insurance data and meteorological perspective
- Still needed: Detailed comparison of the added value of the different datasets for impact research

julia.moemken@kit.edu

Julia Mömken | IMK-TRO