A New Database of Extreme European Winter Windstorms

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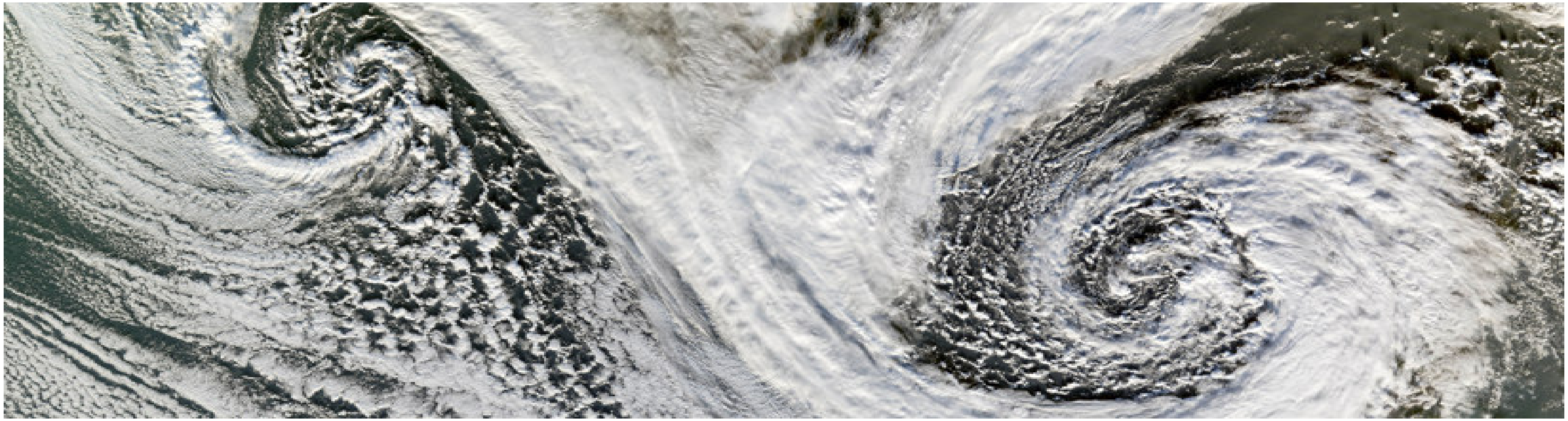
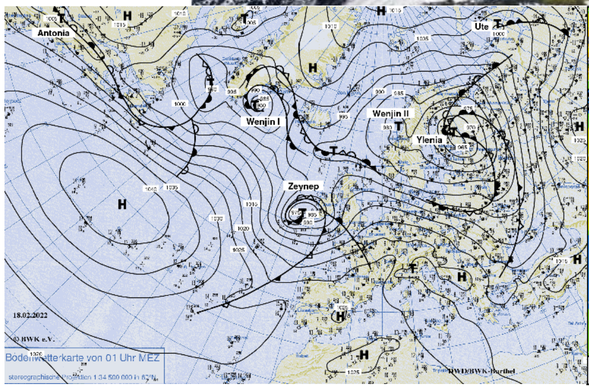
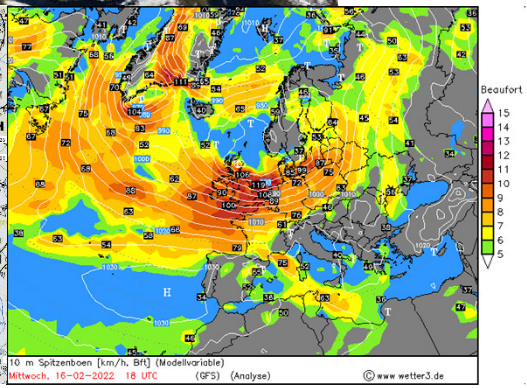
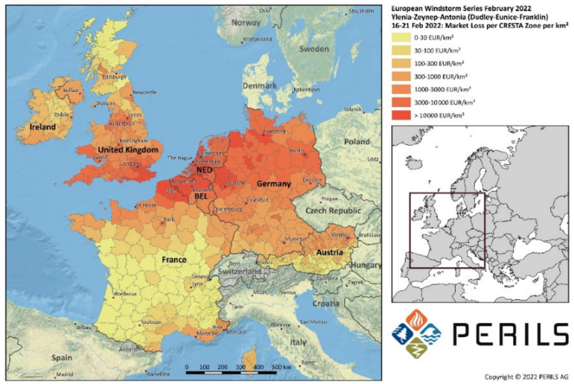


Ways to describe a windstorm

Zeynep / Eunice
(Feb 2022)







What to gain from damage data sets?

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Windstorm losses in Europe – What to gain from damage datasets

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ACRONYM	TYPE / REF.	TIME
PERILS	Insurance data	1999 – present
EM-DAT	Disaster database	1900 – present
C3S	C3S Data Store, 2022	1979 – 2021
XWS	Roberts et al., 2014	1979 – 2014
LI3D	Pinto et al., 2012	1999 – 2022

- Datasets provide different views on windstorm impacts, with almost no redundant information
- Could be used to assign an uncertainty range to windstorm losses
- And to test which features are relevant for calibrating windstorm impacts
- Only a combination of different datasets can provide a representative picture of windstorm impacts

Source: Mömken et al., 2024, WACE, https://doi.org/https://doi.org/10.1016/j.wace.2024.100661

Developing a new database for windstorms

- The aim is to characterize the footprints of destructive windstorms to enable quantitative estimates of storm-related economic losses with uncertainty ranges.
- We provide a new, publicly available database of extreme European windstorm footprints for 1995–2015.
- With this aim, we have compiled information from different sources:

Data Set Name	Data Set Type	Domain	Horizontal Resolution	Number of Storms Identified
ERA5	Global Reanalysis	Global (European sub-domain selected)	0.25 °	50
CCLM_ERA5_EUR-11	Regional Climate Model	CORDEX EUR-11	0.11° (∼ 12 km)	50
COSMO-REA6	Regional Reanalysis	CORDEX EUR-11	0.055° (∼ 6 km)	50
CCLM_ERA5_CEU-3	Regional Climate Model	enlarged Germany domain	0.0275° (∼ 2.8 km)	50
XWS	Derived from ERA-Interim Reanalysis and insurance data	Europe	∼ 25 km	23
C3S	Derived from statistical downscaling of ERA5	Europe	1 km	30

- CCLM_ERA5_EUR-11 and CCLM_ERA5_CEU-3 are COSMO-CLM continuous simulations

Developing a new database for windstorms

- We derived and included the storm footprints associated with the 50 most extreme storms (Top50), identified within each of the four input data sets. Native resolution is kept.
- Consistent methodology: storm loss index (LI3D; Klawa and Ulbrich, 2003; Pinto et al., 2012), across input data sets for identifying storm footprints and assessing their severity.

$$LI_{3D} = \Sigma_{ij}[([max_{3D}\frac{v_{ij}}{v_{98_{ij}}})]^3 * POP_{ij} * I(v_{ij}, v_{98_{ij}})]$$

- Provided are i) Relative daily maximum wind gust associated with storm event ii) Absolute daily maximum wind gust. This enables a direct comparison and enables assessment of uncertainty in the footprints.
- Additionally considered (only absolute wind gusts):
  - XWS Dataset (Roberts et al., 2014) with 23 storms
  - C3S (C3S Climate Data Store, 2022; van den Brink, 2019) with 30 storms

Common Storm List

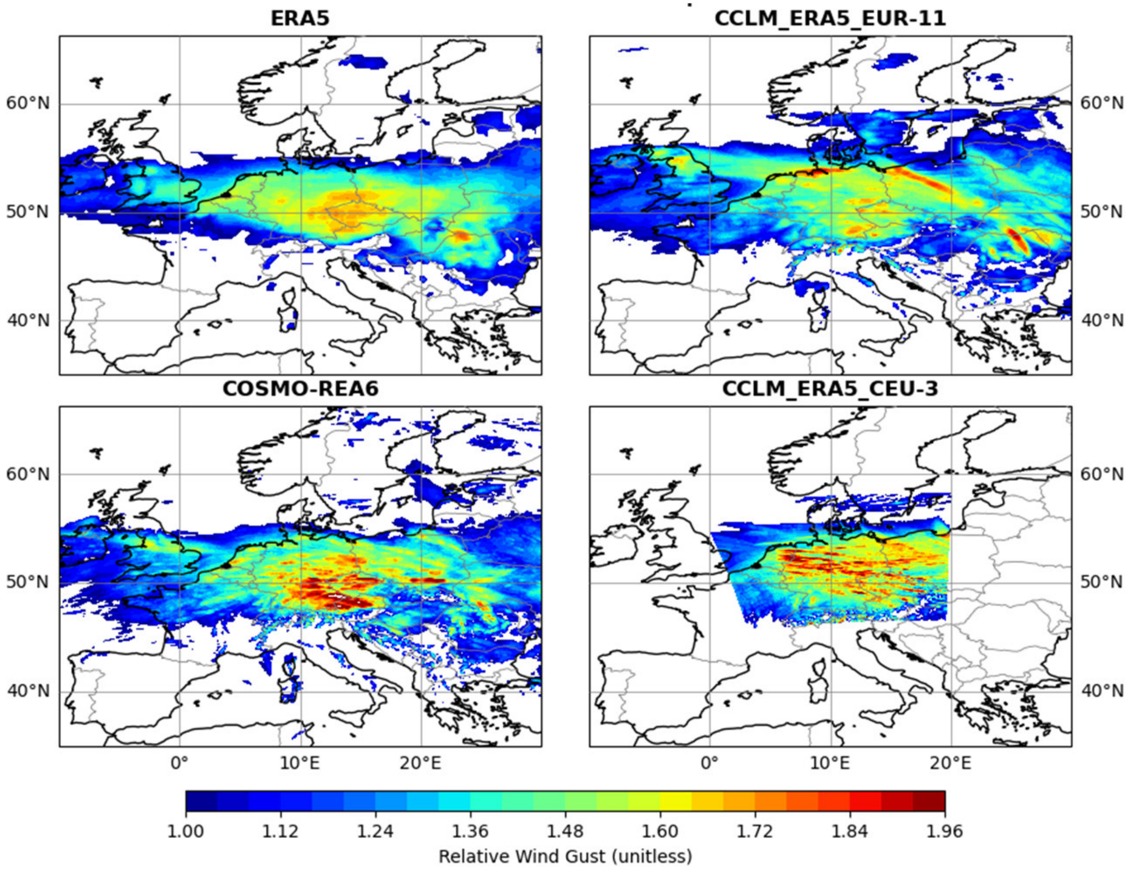
	ERA5		CCLM_ERA5_EUR-11		COSMO-REA6		CCLM_ERA5_CEU-3		XWS		C3S	
Storm Name	Date	Rank	Date	Rank	Date	Rank	Date	Rank	Date	Rank	Date	Rank
ANATOL	1999-12-03	18	1999-12-03	20	1999-12-03	14	1999-12-03	19	1999-12-03	3	1999-12-03	16
ANDREA (ULLI)	2012-01-05	4	2012-01-05	5	2012-01-05	5	2012-01-05	8	2012-01-03	12	2012-01-03	4
ANNA	2002-02-26	24	2002-02-26	17	2002-02-26	19	2002-02-26	25	X	X	2002-02-26	19
ARIANE	1997-02-13	32	1997-02-13	12	1997-02-13	10	1997-02-14	18	X	X	X	X
CARMEN	2010-11-12	33	2010-11-12	43	2010-11-12	48	2010-11-12	43	X	X	X	X
ELIVRA-FARAH	1998-03-04	20	1998-03-04	25	1998-03-04	22	1998-03-04	24	X	X	X	X
EMMA	2008-03-01	6	2008-03-01	19	2008-03-01	8	2008-03-01	4	2008-02-29	21	2008-03-02	6
FANNY	1998-01-04	12	1998-01-04	11	1998-01-04	11	1998-01-04	27	1998-01-04	20	1998-01-04	11
FRANZ	2007-01-11	7	2007-01-12	15	2007-01-11	13	2007-01-11	12	X	X	X	X
FRIDTJOF	2007-12-02	23	2007-12-02	23	2007-12-02	28	2007-12-02	37	X	X	X	X
GISELA-HEIDI	1997-02-25	9	1997-02-25	16	1997-02-25	9	1997-02-25	14	X	X	1997-02-23	8
GUNTER	2015-01-10	22	2015-01-10	21	2015-01-10	24	2015-01-10	16	X	X	2015-01-10	18
ILONA	2002-01-27	26	2002-01-27	28	2002-01-27	25	2002-01-27	17	X	X	2002-01-27	15
JEANETT	2002-10-27	5	2002-10-27	4	2002-10-27	3	2002-10-27	2	2002-10-27	1	2002-10-27	5
JOACHIM	2011-12-16	30	2011-12-16	31	2011-12-16	30	2011-12-16	31	2011-12-16	9	2011-12-16	23
KERSTIN-LIANE	2000-01-30	43	2000-01-30	44	2000-01-30	39	2000-01-30	33	X	X	X	X
KIRSTEN	2008-03-11	11	2008-03-11	7	2008-03-11	4	2008-03-11	13	X	X	2008-03-11	10
KYRILL	2007-01-18	1	2007-01-18	1	2007-01-18	1	2007-01-18	1	2007-01-18	2	2007-01-18	1
LARA	1999-02-05	40	1999-02-05	32	1999-02-05	33	1999-02-05	23	X	X	X	X
LOTHAR	1999-12-26	2	1999-12-26	3	1999-12-26	2	1999-12-26	3	1999-12-26	13	1999-12-26	2
MIKE-NIKLAS	2015-03-30	14	2015-04-01	10	2015-03-30	6	2015-30-30	6	X	X	X	X
NILS	2015-11-29	37	2015-11-29	50	2015-11-29	47	2015-11-30	38	X	X	X	X
NINA-ORALIE	2004-03-20	29	2004-03-20	36	2004-03-20	18	2004-03-20	26	X	X	X	X
ORATIA	2000-10-30	10	2000-10-30	22	2000-10-30	7	2000-10-30	42	2000-10-30	4	2000-10-30	9
u19950216	1995-02-16	47	1995-02-17	47	1995-02-17	37	1995-02-16	46	X	X	X	X
ULF	2005-02-13	48	2005-02-13	24	2005-02-13	35	2005-02-13	28	X	X	X	X
XAVER	2013-12-05	28	2013-12-05	26	2013-12-05	20	2013-12-05	20	2013-12-05	6	2013-12-05	22
XYLIA	1998-10-28	16	1998-10-28	9	1998-10-28	12	1998-10-28	10	1998-10-28	23	1998-10-28	14
XYNTHIA	2010-02-27	45	2010-02-27	29	2010-02-28	15	2010-02-28	11	2010-02-27	7	X	X

- 76 single storms, 47 in at least two, **29** in all four datasets.
- Dates of occurrence and ordinal ranks shown left

- (rank 1=most extr., rank 50 = least extr.).
- () two different names
- \- two storms which could not be effectively separated

Storm Footprint – Kyrill

- Included are:
- The footprints, expressed as the relative daily maximum wind gusts associated with a storm event (> 98. Percentile)
- the daily maximum wind gusts in absolute magnitude associated with the footprints.



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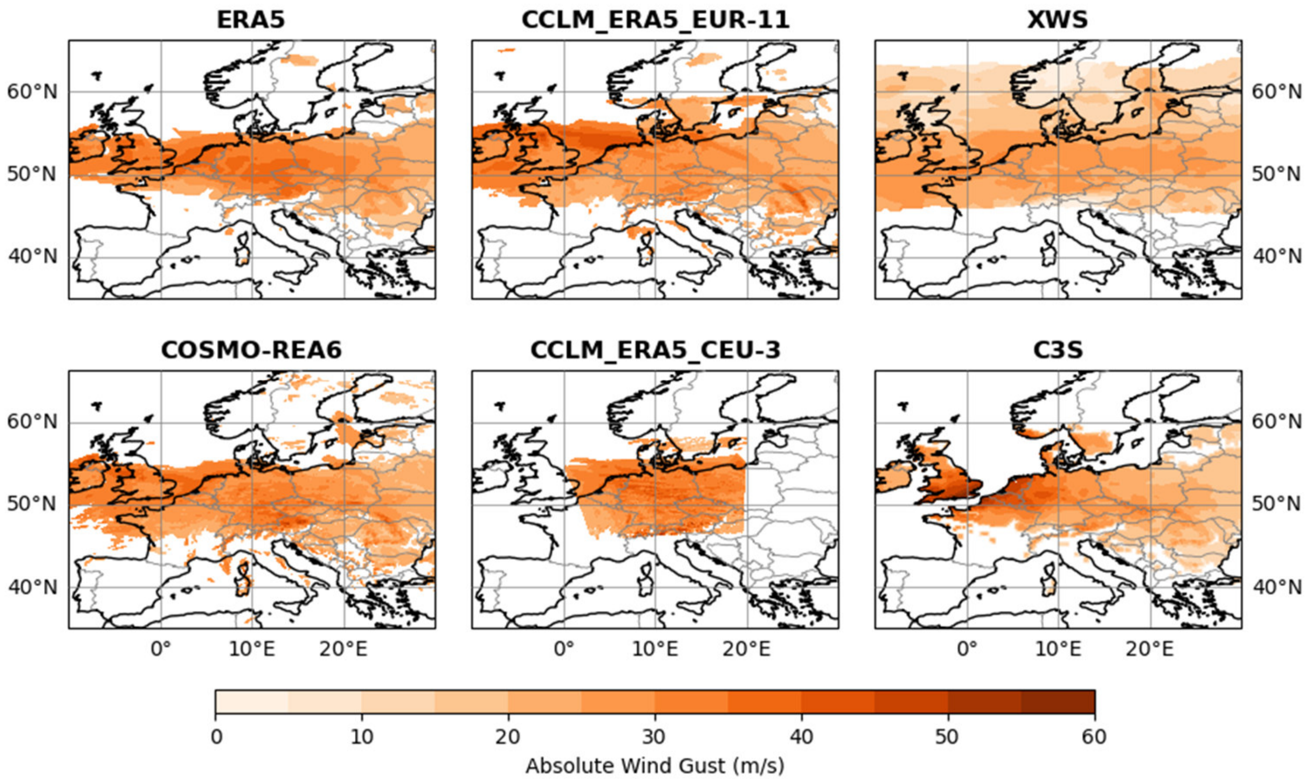
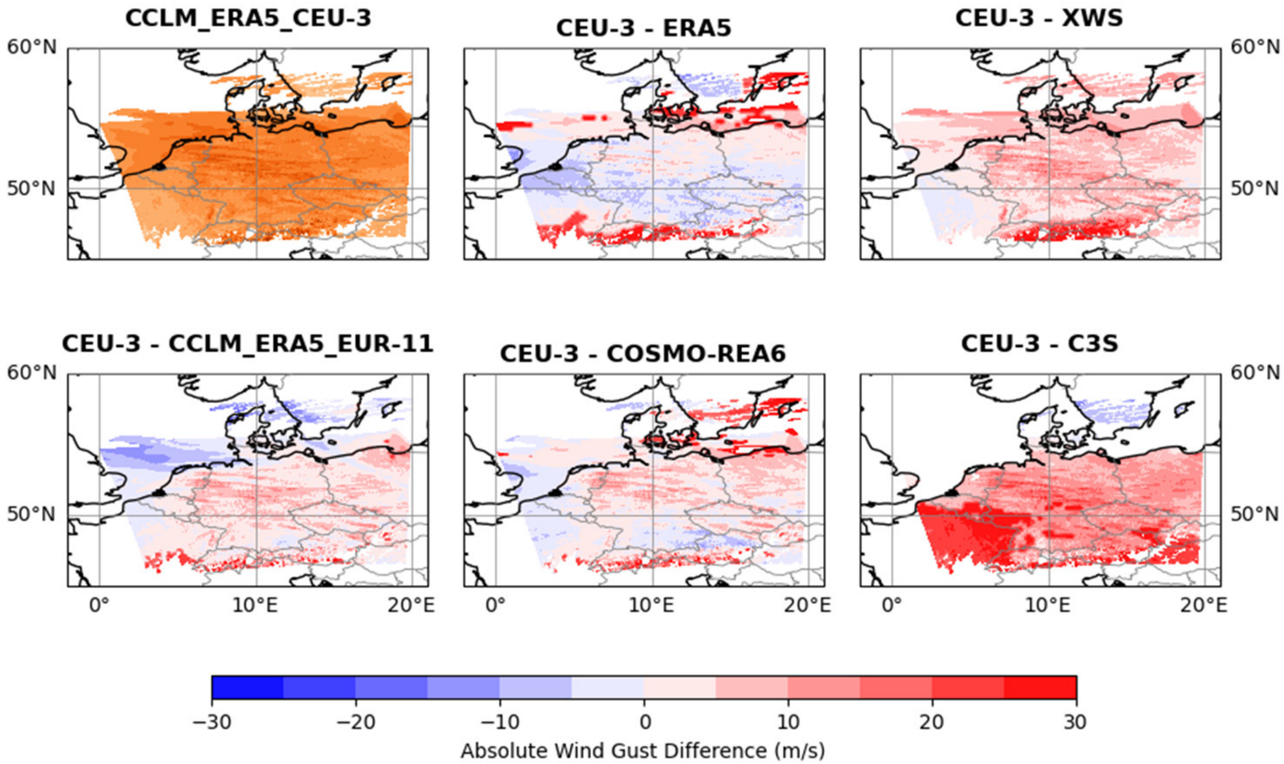


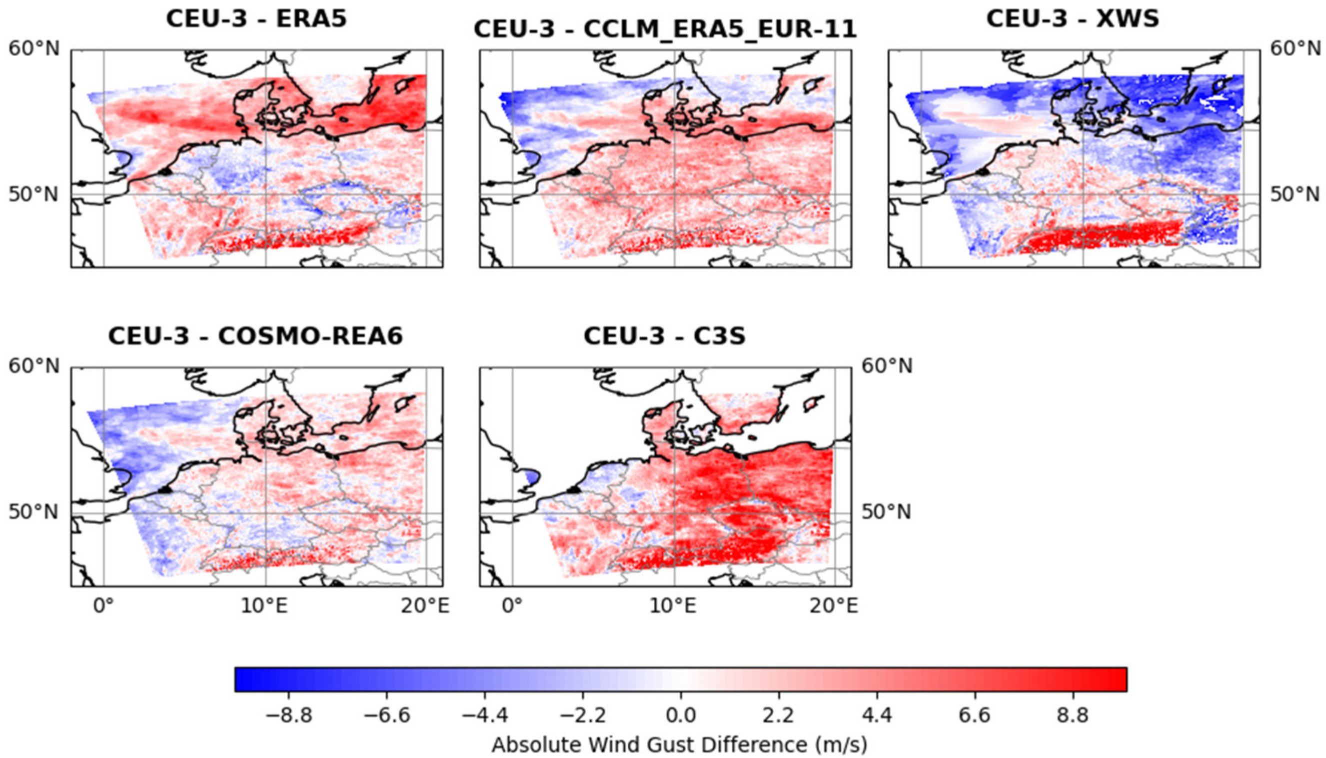
Storm Footprint – Difference between data sets

- Kyrill
- Mean difference in daily maximum wind gusts for common area
- Note differences over high orography, small shifts in footprint

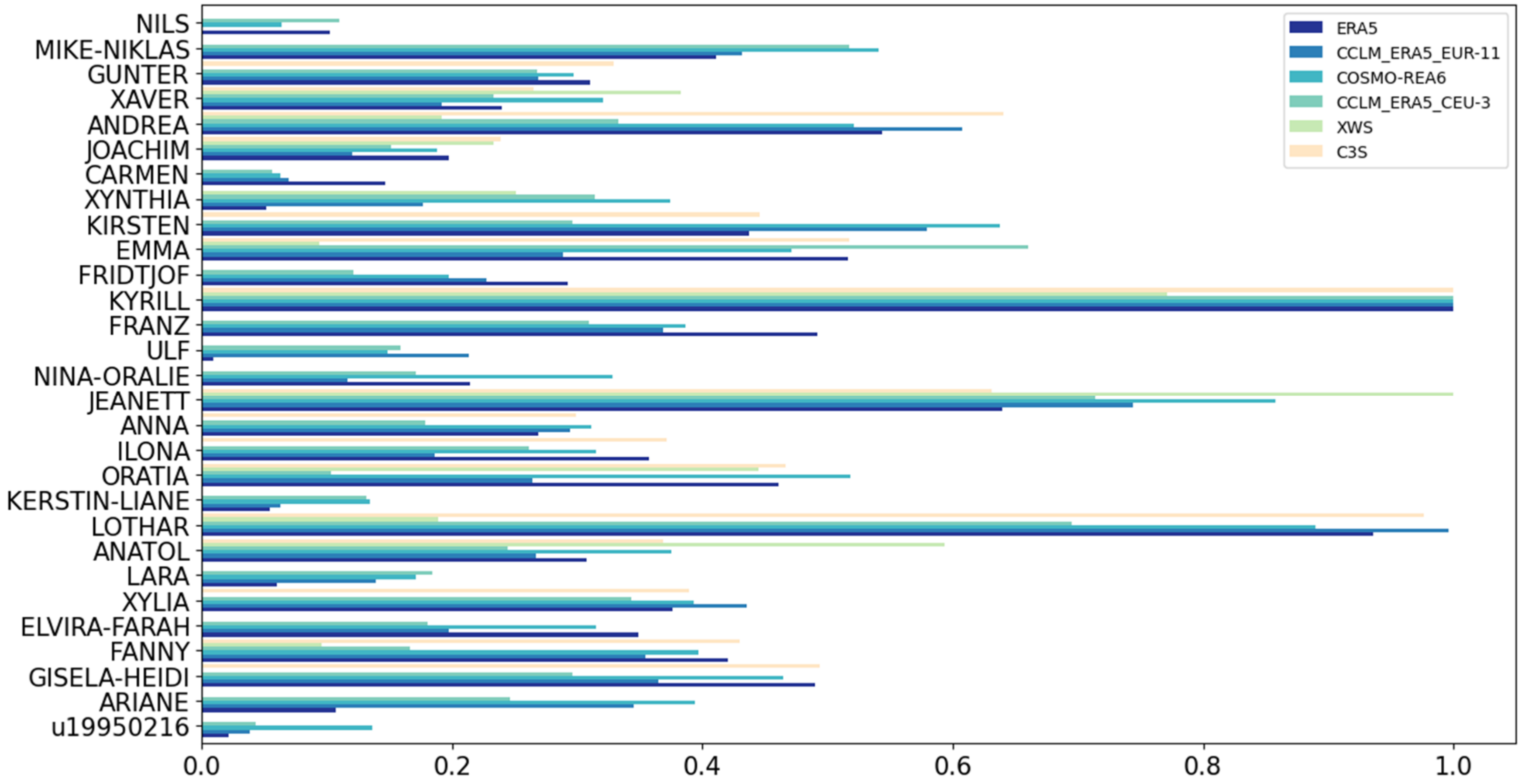


Storm Footprint – Difference between data sets

- Common storms
- Mean difference in daily maximum wind gusts for common area
- Some systematic differences, not only over high orography

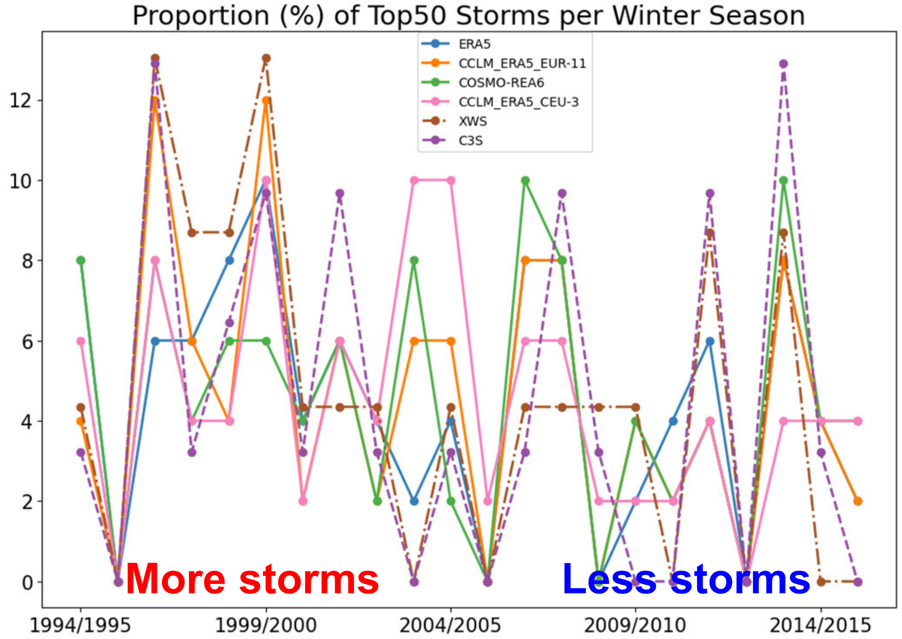


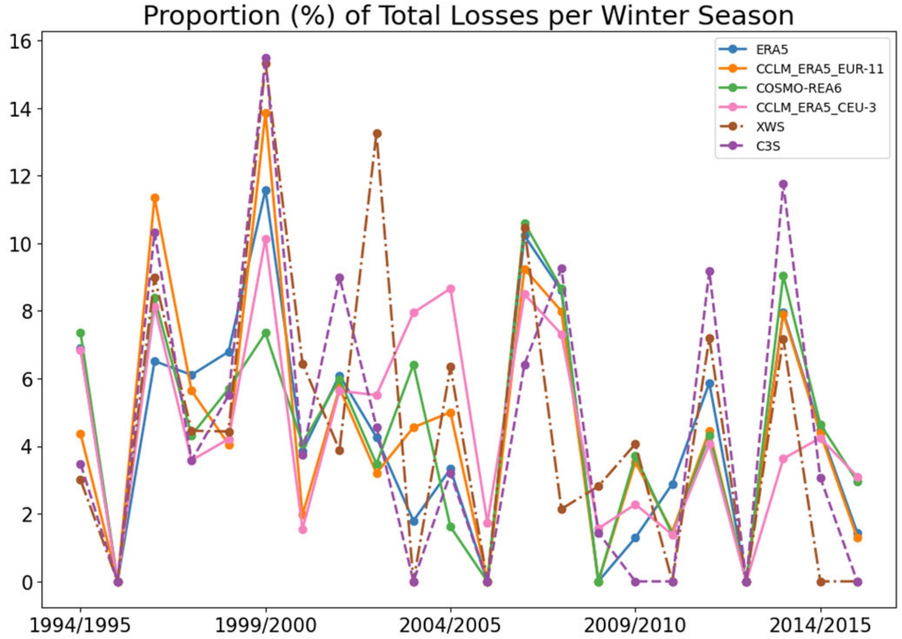
Normalised losses for common storms



- Very good agreement for some storms, e.g. Kyrill
- Strong deviations for others, e.g. Emma, Oratia

Year-to-year Variability for 1994-2015





- XWS, C3S partially quite different distribution than others, but with better agreement for high activity winters.

Preliminary evaluation by AXA Colleagues

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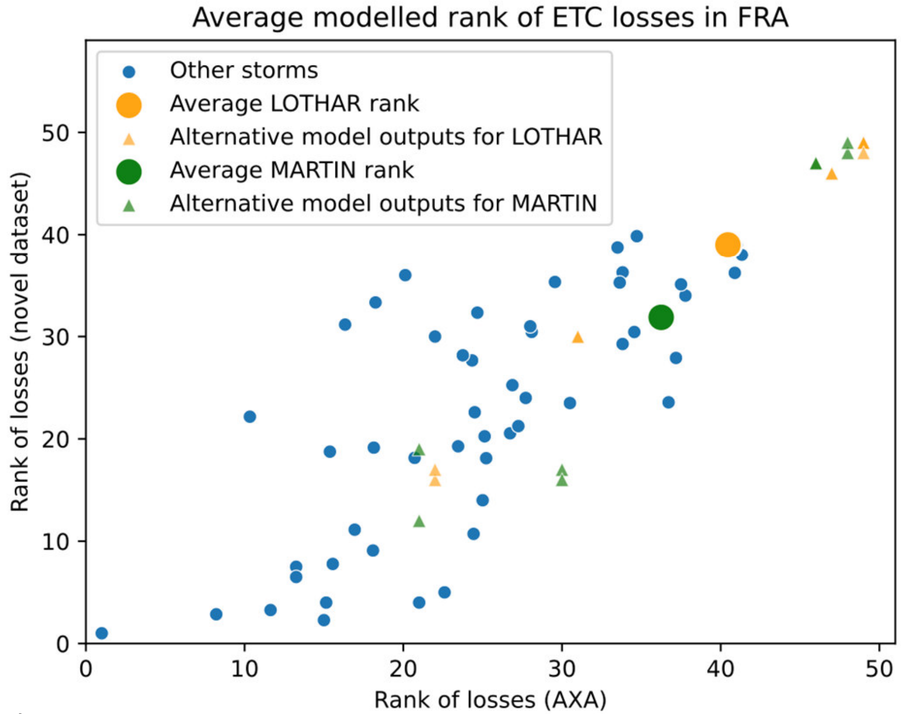
- The AXA EUWS model footprints have been cropped to the spatial extent of each dataset.
- The vulnerability stays the same.
- The model is run on several portfolios across Europe.
- The rank of losses is compared.
- Highlighted are **Lothar** and **Martin**, for which large deviations are found (resolution)



Slide by: Hugo Rakotoarimanga, Remi Meynadier (AXA)

Preliminary evaluation by AXA Colleagues

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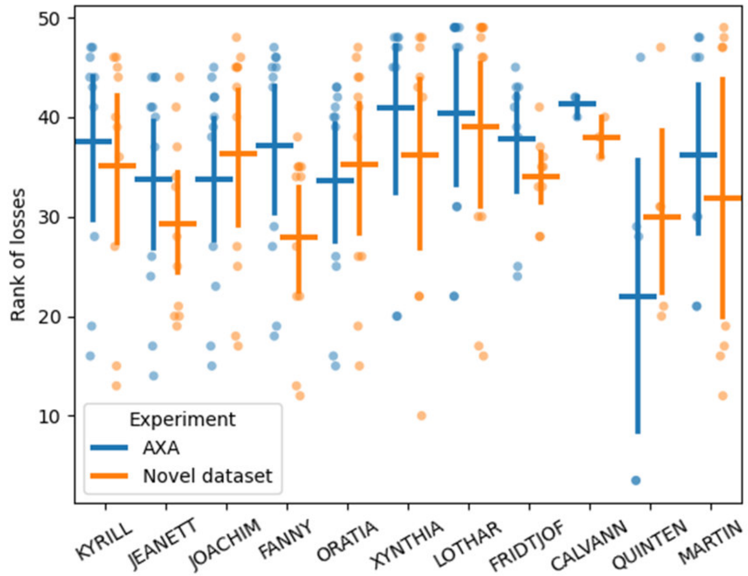
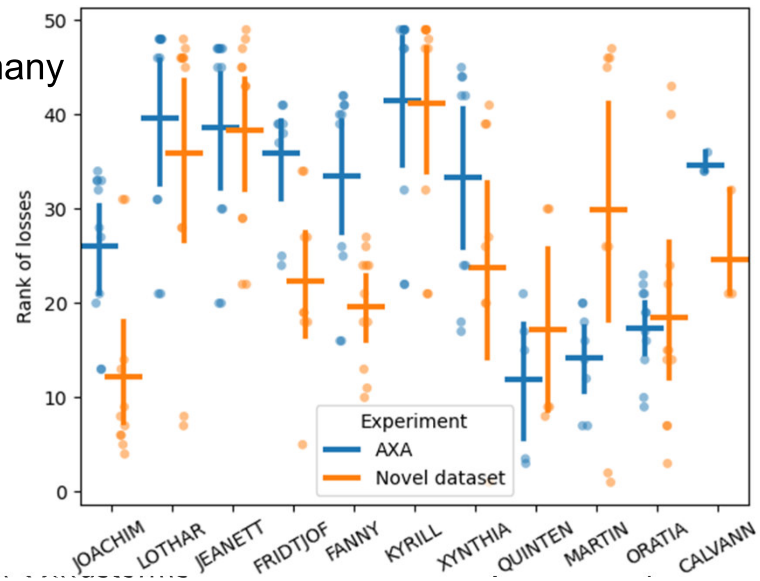
France



- AXA EUWS model footprints cropped to the spatial extent of each dataset and given portfolio (France, Belgium, UK, Switzerland, Germany, Ireland). AXA Portfolio

Germany



Slide by: Hugo Rakotoarimanga, Remi Meynadier (AXA)

Summary

- Database of extreme European windstorm footprints 1995 – 2015
  - Derived from four different datasets (ERA5, COSMO-REA6, -EUR-11, -CEU-3)
  - 50 most extreme storms per dataset, providing complementary perspectives
- Database includes
  - Relative daily maximum wind gust associated with storm event
  - Absolute daily maximum wind gust
- Database is extendable, both in time (2015-) or inclusion from further datasets

https://doi.org/10.5194/essd-2024-298

Preprint and Data Sets available online

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Abstract | Assets | Discussion | Metrics

08 Oct 2024

Status: this preprint is currently under review for the journal ESSD.

A New Database of Extreme European Winter Windstorms

Clare Marie Flynn, Julia Moemken, Joaquim G. Pinto, and Gabriele Messori

Abstract. European windstorms pose a significant threat to people, infrastructure and the natural environment. Several windstorms in the recent past have caused substantial damages, and los
with climate change. Characterizing the footprints of destructive windst
storm-related economic losses. To that end, we have developed a new, p
windstorm footprints for the extended winter season during 1995–2015

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Short summary
We created a new, publicly available database of the Top 50 most extreme European winter

Data sets

Storm Database Files for A New Database of Extreme European Winter Windstorms
Clare Marie Flynn, Julia Moemken, Joaquim G. Pinto, and Gabriele Messori
https://zenodo.org/records/10594399

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