Ai4W Challenge

May 24, 2024 – on-line

Monitoring News to Detect Extreme Weather Events

by

Matjaž Mikoš

IRCAI Scientific Programme Committee „AI & WRM“

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OUTLINE OF THE TALK

1. A word on the University of Ljubljana
2. A word on the UNESCO CHAIR on WRDRR
3. Scientific literature and media news
4. How can media news be used in Disaster Risk Reduction
5. Case study: Media News and Extreme Weather Events
6. The way forward

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Publications & Media

ELSEVIER

Science of The Total Environment
Volume 780, 1 August 2021, 146494

Review

Soil erosion modelling: A global review and statistical analysis

Pasquale Borrelli [a b c], Christine Alewell [b], Pablo Alvarez [d e], Jamil Alexandre Ayach Anache [f g], Jantiene Baartman [h], Cristiano Ballabio [i], Nejc Bezak [j], Marcella Biddoccu [k], Artemi Cerdà [l], Devraj Chalise [m], Songchao Chen [n], Walter Chen [o], Anna Maria De Girolamo [p], Gizaw Desta Gessesse [q], Detlef Deumlich [r], Nazzareno Diodato [s], Nikolaos Efthimiou [t], Gunay Erpul [u], Peter Fiener [v], Michele Freppaz [w]...Panos Panagos [i]

ELSEVIER

Environmental Research
Volume 197, June 2021, 111087

Soil erosion modelling: A bibliometric analysis

Nejc Bezak [a], Matjaž Mikoš [a], Pasquale Borrelli [b c d], Christine Alewell [d], Pablo Alvarez [e f], Jamil Alexandre Ayach Anache [g h], Jantiene Baartman [i], Cristiano Ballabio [j], Marcella Biddoccu [k], Artemi Cerdà [l], Devraj Chalise [m], Songchao Chen [n], Walter Chen [o], Anna Maria De Girolamo [p], Gizaw Desta Gessesse [q], Detlef Deumlich [r], Nazzareno Diodato [s], Nikolaos Efthimiou [t], Gunay Erpul [u], Peter Fiener [v]...Panos Panagos [j]

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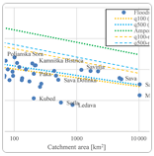
Brief communication: A first hydrological investigation of extreme August 2023 floods in Slovenia, Europe



Nejc Bezak, Panos Panagos, Leonidas Liakos, and Matjaž Mikoš

Abstract

Extreme floods occurred from 4 to 6 August 2023 in Slovenia causing three casualties and causing total direct and indirect damage, including post-disaster needs according to the Post-Disaster Needs Assessment (PDNA), close to EUR 10 billion. The atypical summer weather conditions combined with the high air and sea temperatures in the Mediterranean and the high soil moisture led to the most extreme flood event in Slovenia in recent decades. The return periods of both daily and sub-daily precipitation extremes and peak discharges reached 250–500 years, and the runoff coefficient of a typical torrential and mostly forested mesoscale catchment was around 0.5. In addition, flooding, soil erosion, mass movements and river sediment transport processes caused major damage to buildings (more than 12 000 houses) and diverse infrastructure.

Please read the corrigendum first before continuing.

How to cite. Bezak, N., Panagos, P., Liakos, L., and Mikoš, M.: Brief communication: A first hydrological investigation of extreme August 2023 floods in Slovenia, Europe, Nat. Hazards Earth Syst. Sci., 23, 3885–3893, https://doi.org/10.5194/nhess-23-3885-2023, 2023.

Received: 30 Aug 2023 – Discussion started: 05 Sep 2023 – Revised: 07 Nov 2023 – Accepted: 08 Nov 2023 – Published: 20 Dec 2023

REPORT

Changing climate shifts timing of European floods

GÜNTER BLÖSCHL, JULIA HALL, JURAJ PARAJKA, RUI A. P. PERDIGÃO, [...], AND NENAD ŽIVKOVIĆ +41 authors Authors Info & Affiliations

SCIENCE · 11 Aug 2017 · Vol 357, Issue 6351 · pp. 588-590 · DOI: 10.1126/science.aan2506

6.035 475

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SCIENCE • 11 Aug 2017 • Vol 357, Issue 6351 • pp. 588-590 • DOI: 10.1126/science.aan2506

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RESEARCH

FLOODING

Changing climate shifts timing of European floods

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A warming climate is expected to have an impact on the magnitude and timing of river floods; however, no consistent large-scale climate change signal in observed flood magnitudes has been identified so far. We analyzed the timing of river floods in Europe over the past five decades, using a pan-European database from 4262 observational hydrometric stations, and found clear patterns of change in flood timing. Warmer temperatures have led to earlier spring snowmelt floods throughout northeastern Europe; delayed winter storms associated with polar warming have led to later winter floods around the North Sea and some sectors of the Mediterranean coast; and earlier soil moisture maxima have led to earlier winter floods in western Europe. Our results highlight the existence of a clear climate signal in flood observations at the continental scale.

River flooding affects more people worldwide than any other natural hazard, with an estimated global annual average loss of US $104 billion (*1*). Such damages are expected to increase as a result of continued economic growth and climate change (*2*, *3*). The intensification of the water cycle due to a warming climate is projected to change the magnitude, frequency, and timing of river floods (*3*). However, existing studies have been unable to identify a consistent climate change signal in flood magnitudes (*4*). Identification of a large-scale climate change signal in flood observations has been hampered by the existence of many processes controlling floods, including precipitation, soil moisture, and snow; by nonclimatic drivers of flood change, such as land use change and river training; and by the inconsistency of data sets and their limited spatial extents (*4*, *5*). Use of the seasonal timing of floods as a fingerprint of climate effects on floods may be a way to avoid some of those complications (*6*, *7*). For example, in cold regions, earlier snowmelt due to warmer temperatures leads to earlier spring floods (*8*), and this climate-related signal may be less confounded by nonclimatic drivers than flood magnitudes themselves because of the strong seasonality of climate. The changing timing of floods has been studied at local scale in Nordic and Baltic countries (*8*–*10*), but no consistent analysis exists at the European scale.

Here, we analyzed a large data set of flood observations in Europe to assess whether a changing climate has shifted the timing of river floods during the past five decades. Our analysis is based on river discharge or water-level observations from 4262 hydrometric stations in 38 European countries for the period 1960–2010 (table S1). For each station, we use a series consisting of the dates of occurrence of the highest peak in any calendar year. We define the average timing of the floods by the average date on which floods have occurred during the observation period. We then use the Theil-Sen slope estimator (*11*) to estimate the trend in the timing of the floods for stations with at least 35 years of data, and apply a 10-year moving-average filter to estimate the long-term evolution. Finally, we analyze the change signal of three potential drivers of flood changes in a similar fashion: (i) the middle date of the maximum 7-day precipitation; (ii) the middle day of the month with the highest soil moisture; and (iii) the middle day of the first 7 days in a year with air temperature above 0°C as a proxy for spring snowmelt and snowfall-to-rain transition (see supplementary materials).

Our data show a clear shift in the timing of floods in Europe during the past 50 years (Fig. 1). The regionally interpolated trend patterns shown in Fig. 1 range from −13 days per decade toward earlier floods to +9 days toward later floods, which translates into total shifts of −65 and +45 days, respectively, of linear trends over the entire 50-year period. The local, station-specific, trends (fig. S2) are larger, but these trend sizes reflect smaller-scale rather than regional-scale processes. The changes are most consistent in northeastern Europe (Fig. 1, region 1), where 81% of the stations show a shift toward earlier floods (50% of the stations by more than −8 days per 50 years) (fig. S2). The changes are largest in western Europe along the North Atlantic coast from Portugal to England (region 3), where 50% of the stations show a shift toward earlier floods by at least −15 days per 50 years (25% of the stations by more than −36 days per 50 years). Around the North Sea (region 2; southwestern Norway, the Netherlands, Denmark, and Scotland), 50% of the stations show a shift toward later floods by more than +8 days per 50 years. In some parts of the Mediterranean coast (region 4; northeastern Adriatic coast, northeastern Spain), there is a shift toward later floods (50% of the stations by more than +5 days per 50 years). Apart from the large-scale change patterns described

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https://www.science.org/doi/pdf/10.1126/science.aan2506

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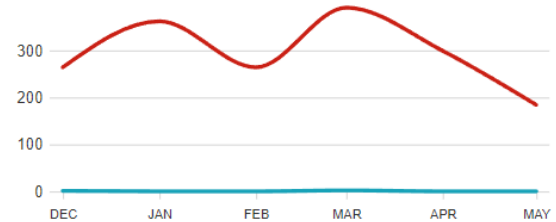

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Changing climate shifts timing of European floods

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Published in	Science, August 2017
DOI	10.1126/science.aan2506
Pubmed ID	28798129
Authors	Günter Blöschl, Julia Hall, Juraj Parajka, Rui A P Perdigão, Bruno Merz, Berit Arheimer, Giuseppe... [show]
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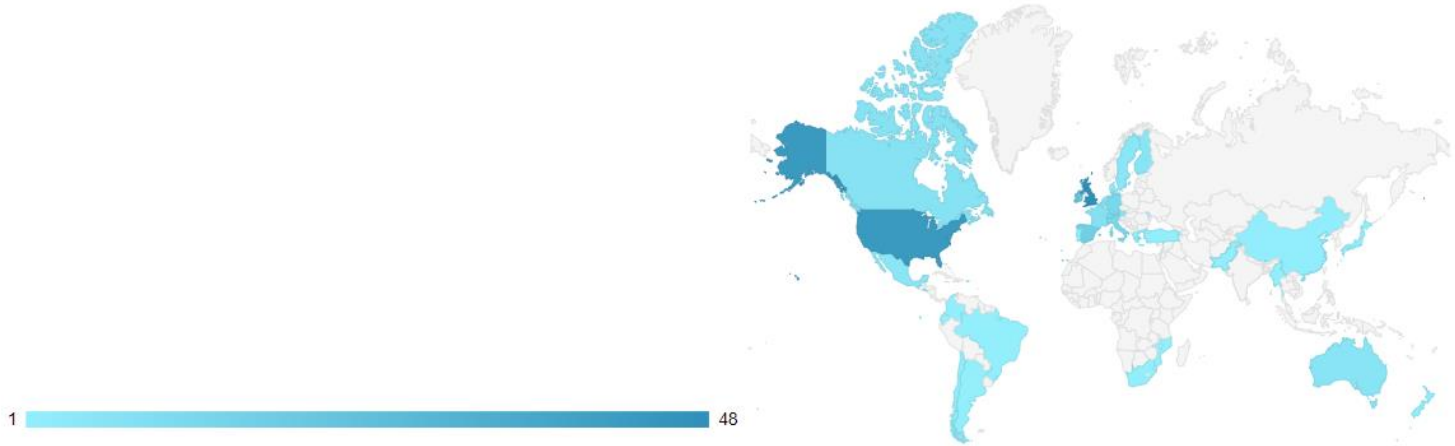

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United States	43	11%
Ireland	22	6%
Spain	17	4%
Germany	13	3%
Italy	12	3%
France	8	2%
Switzerland	8	2%
Austria	8	2%
Other	66	17%
Unknown	152	38%

Demographic breakdown

Type	Count	As %
Members of the public	271	68%
Scientists	108	27%
Science communicators (journalists, bloggers, editors)	14	4%
Practitioners (doctors, other healthcare professionals)	3	<1%
Unknown	1	<1%

Publication - Article

Changing climate shifts timing of European floods

Science, 357(6351), 588-590 - August 2017
https://doi.org/10.1126/science.aan2506

Authors

Günter Blöschl - TU Wien

Julia Hall - TU Wien

Juraj Parajka - TU Wien

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Summary

TL;DR Key highlights Top keywords

Climate change is causing shifts in the timing of river floods in Europe, with earlier spring snowmelt floods in northeastern Europe, delayed winter floods around the North Sea and Mediterranean coast, and earlier winter floods in western Europe. This indicates a clear climate signal in flood observations at a continental scale.

Abstract

A warming climate is expected to have an impact on the magnitude and timing of river floods; however, no consistent large-scale climate change signal in observed flood magnitudes has been identified so far. We analyzed the timing of river floods in Europe over the past five decades, using a pan-European database from 4262 observational hydrometric stations, and found clear patterns of change in flood timing. Warmer temperatures have led to earlier spring snowmelt floods throughout northeastern Europe; delayed winter storms associated with polar warming have led to later winter floods around the North Sea and some sectors of the Mediterranean coast; and earlier soil moisture maxima have led to earlier winter floods in western Europe. Our results highlight the existence of a clear climate signal in flood observations at the continental scale.

Acknowledgements

Supported by ERC Advanced Grant "FloodChange," project no. 291152; the Austrian Science Funds (FWF) as part of the Doctoral Programme on Water Resource Systems (W1219-N22); the EU FP7 project SWITCH-ON (grant 603587); and Russian Science Foundation project no. 14-17-00155. We acknowledge the involvement in the data screening process of C. Álvaro Díaz, I. Borzì, E. Diamantini, K. Jeneiová, M. Kupfersberger, and S. Mallucci during their stays at the Vienna University of Technology. We thank L. Gaál and D. Rosbjerg for contacting Finish and Danish data holders, respectively; A. Christofides for pointing us to the Greek data source; B. Renard (France), T. Kiss (Hungary), W. Rigott (South Tyrol, Italy), G. Lindström (Sweden), and P. Burlando (Switzerland) for assistance in preparing and/or providing data or metadata from their respective regions; and B. Lüthi and Y. Hundecha for preparing cross-check the results. The flood date data

More

Changing climate shifts timing of European floods

Publication	Article in **Science**, published August 2017
Authors	Günter Blöschl, Julia Hall, Juraj Parajka, Rui A P Perdigão, Bruno Merz, Berit Arheimer, Giuseppe... [show more]
DOI	10.1126/science.aan2506
PubMed ID	28798129
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Review

Soil erosion modelling: A global review and statistical analysis

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https://doi.org/10.1016/j.scitotenv.2021.146494

Science of the Total Environment 780 (2021) 146494

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Review

Soil erosion modelling: A global review and statistical analysis

Pasquale Borrelli [a,b,c,*], Christine Alewell [b], Pablo Alvarez [d,e], Jamil Alexandre Ayach Anache [f,g], Jantiene Baartman [h], Cristiano Ballabio [i], Nejc Bezak [j], Marcella Biddoccu [k], Artemi Cerdà [l], Devraj Chalise [m], Songchao Chen [n], Walter Chen [o], Anna Maria De Girolamo [p], Gizaw Desta Gessesse [q], Detlef Deumlich [r], Nazzareno Diodato [s], Nikolaos Efthimiou [t], Gunay Erpul [u], Peter Fiener [v], Michele Freppaz [w], Francesco Gentile [x], Andreas Gericke [y], Nigussie Haregeweyn [z], Bifeng Hu [aa,ab], Amelie Jeanneau [ac], Konstantinos Kaffas [ad], Mahboobeh Kiani-Harchegani [ae], Ivan Lizaga Villuendas [af], Changjia Li [ag,ah], Luigi Lombardo [ai], Manuel López-Vicente [aj], Manuel Esteban Lucas-Borja [ak], Michael Märker [a], Francis Matthews [i], Chiyuan Miao [ag], Matjaž Mikoš [j], Sirio Modugno [al,am], Markus Möller [an], Victoria Naipal [ao], Mark Nearing [ap], Stephen Owusu [aq], Dinesh Panday [ar], Edouard Patault [as], Cristian Valeriu Patriche [at], Laura Poggio [au], Raquel Portes [av], Laura Quijano [aw], Mohammad Reza Rahdari [ax], Mohammed Renima [ay], Giovanni Francesco Ricci [x], Jesús Rodrigo-Comino [l,az], Sergio Saia [ba], Aliakbar Nazari Samani [bb], Calogero Schillaci [bc], Vasileios Syrris [i], Hyuck Soo Kim [c], Diogo Noses Spinola [bd], Paulo Tarso Oliveira [g], Hongfen Teng [be], Resham Thapa [bf], Konstantinos Vantas [bg], Diana Vieira [bh], Jae E. Yang [c], Shuiqing Yin [ag], Demetrio Antonio Zema [bi], Guangju Zhao [bj], Panos Panagos [i,**]

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https://doi.org/10.1016/j.scitotenv.2021.146494

Soil erosion modelling: A global review and statistical analysis

Citation Data: Science of The Total Environment, ISSN: 0048-9697, Vol: 780, Page: 146494
Publication Year: 2021

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Review Description

To gain a better understanding of the global application of soil erosion prediction models, we comprehensively reviewed relevant peer-reviewed research literature on soil-erosion modelling published between 1994 and 2017. We aimed to identify (i) the processes and models most frequently addressed in the literature, (ii) the regions within which models are primarily applied, (iii) the regions which remain unaddressed and why, and (iv) how frequently studies are conducted to validate/evaluate model outcomes relative to measured data. To perform this task, we combined the collective knowledge of 67 soil-erosion scientists from 25 countries. The resulting database, named 'Global Applications of Soil Erosion Modelling Tracker (GASEMT)', includes 3030 individual modelling records from 126 countries, encompassing all continents (except Antarctica).

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http://dx.doi.org/10.1016/j.scitotenv.2021.146494;
http://www.scopus.com/inward/record.url?partnerID=HzOxMe3b&scp=85102969281&origin=inward;
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Soil erosion modelling: A global review and statistical analysis

The Science of The Total Environment, 780, 146494 - March 2021
https://doi.org/10.1016/j.scitotenv.2021.146494

Authors

Pasquale Borrelli - University of Pavia; University of Basel; Kangwon National University
Corresponding Author

Christine Alewell - University of Basel

Pablo Alvarez - Karlsruhe Institute of Technology; Universidad Nacional de Loja

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Summary

TL;DR Key highlights Top keywords

This research paper provides a comprehensive review and statistical analysis of soil erosion prediction models used globally. The resulting database, GASEMT, includes 3030 individual modelling records from 126 countries and aims to support future soil erosion research and inform United Nations assessments.

Abstract

To gain a better understanding of the global application of soil erosion prediction models, we comprehensively reviewed relevant peer-reviewed research literature on soil-erosion modelling published between 1994 and 2017. We aimed to identify (i) the processes and models most frequently addressed in the literature, (ii) the regions within which models are primarily applied, (iii) the regions which remain unaddressed and why, and (iv) how frequently studies are conducted to validate/evaluate model outcomes relative to measured data. To perform this task, we combined the collective knowledge of 67 soil-erosion scientists from 25 countries. The resulting database, named 'Global Applications of Soil Erosion Modelling Tracker (GASEMT)', includes 3030 individual modelling records from 126 countries, encompassing all continents (except Antarctica). Out of the 8471 articles identified as potentially relevant, we reviewed 1697 appropriate articles and systematically evaluated and transferred

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Soil erosion modelling: A global review and statistical analysis

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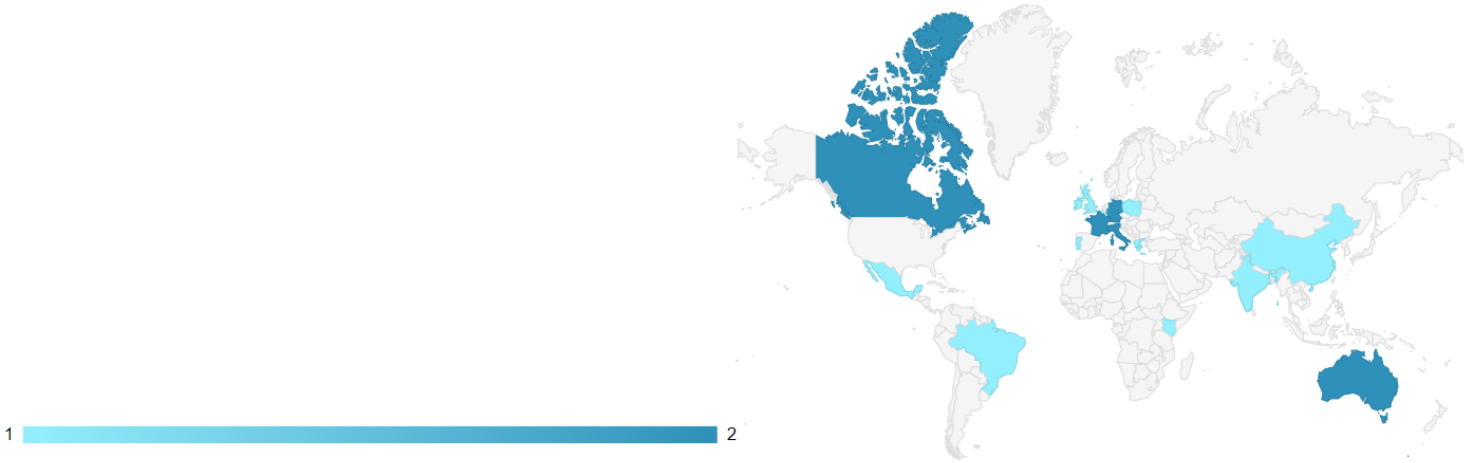

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Environmental Research
Volume 197, June 2021, 111087

Soil erosion modelling: A bibliometric analysis

Nejc Bezak [a], Matjaž Mikoš [a], Pasquale Borrelli [b c d], Christine Alewell [d], Pablo Alvarez [e f], Jamil Alexandre Ayach Anache [g h], Jantiene Baartman [i], Cristiano Ballabio [j], Marcella Biddoccu [k], Artemi Cerdà [l], Devraj Chalise [m], Songchao Chen [n], Walter Chen [o], Anna Maria De Girolamo [p], Gizaw Desta Gessesse [q], Detlef Deumlich [r], Nazzareno Diodato [s], Nikolaos Efthimiou [t], Gunay Erpul [u], Peter Fiener [v]...Panos Panagos [j]

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https://doi.org/10.1016/j.envres.2021.111087

Available online 31 March 2021

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United Nations Educational, Scientific and Cultural Organization

IRCAI International Research Centre on Artificial Intelligence under the auspices of UNESCO

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Soil erosion modelling: A bibliometric analysis

Citation Data: Environmental Research, ISSN: 0013-9351, Vol: 197, Page: 111087
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Estimating soil loss by laminar erosion using precision agriculture computational tools/Estimativa da perda de solo por erosao laminar usando ferramentas computacionais na agricultura de precisao.

September 13, 2022 | Free Library

INTRODUCTION For the most part, soil degradation in agricultural areas is associated with water erosion and, consequently, low productivity (Li et al., 2022). Soil loss

Article Description

Soil erosion can present a major threat to agriculture due to loss of soil, nutrients, and organic carbon. Therefore, soil erosion modelling is one of the steps used to plan suitable soil protection measures and detect erosion hotspots. A bibliometric analysis of this topic can reveal research patterns and soil erosion modelling characteristics that can help identify steps needed to enhance the research conducted in this field. Therefore, a detailed bibliometric analysis, including investigation of collaboration networks and citation patterns, should be conducted. The updated version of the Global Applications of Soil Erosion Modelling Tracker (GASEMT) database contains information about citation characteristics and publication type. Here, we investigated the impact of the number of authors, the publication type and the selected journa

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Soil erosion modelling: A bibliometric analysis

Environmental Research, 197, 111087 - March 2021
https://doi.org/10.1016/j.envres.2021.111087

Authors

Nejc Bezak - University of Ljubljana
Corresponding Author

Matjaž Mikoš - University of Ljubljana

Pasquale Borrelli - University of Pavia; Kangwon National University; University of Basel

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Summary

TL;DR Key highlights Top keywords

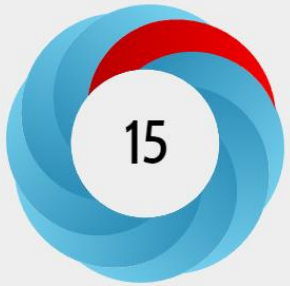
A bibliometric analysis of soil erosion modelling reveals that the selection of the model, scale, and publication type have the largest impact on the number of citations. Continental patterns are seen in bibliographic coupling and citation networks, but not in co-authorship networks. Modellers should focus on comprehensive reviews and field measurements, calibration, performance assessment, and uncertainty in modelling results. These attributes have a smaller impact on citations than expected, suggesting they should be given more attention in the soil erosion modelling community.

Abstract

Soil erosion can present a major threat to agriculture due to loss of soil, nutrients, and organic carbon. Therefore, soil erosion modelling is one of the steps used to plan suitable soil protection measures and detect erosion hotspots. A bibliometric analysis of this topic can reveal research patterns and soil erosion modelling characteristics that can help identify steps needed to enhance the research conducted in this field. Therefore, a detailed bibliometric analysis, including investigation of collaboration networks and citation patterns, should be conducted. The updated version of the Global Applications of Soil Erosion Modelling Tracker (GASEMT) database contains information about citation characteristics and publication type. Here, we investigated the impact of the number of authors, the publication type and the selected journal on the number of citations. Generalized boosted regression tree (BRT) modelling was used to evaluate the most relevant variables related to soil erosion

Soil erosion modelling: A bibliometric analysis

Overview of attention for article published in Environmental Research, March 2021



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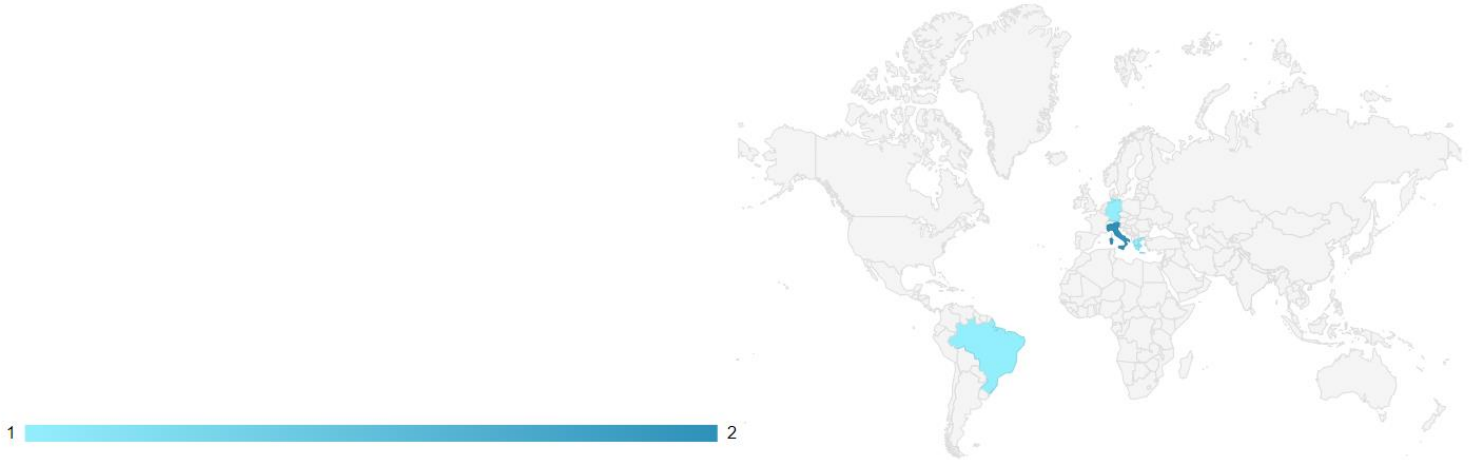

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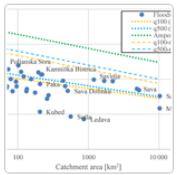

Nejc Bezak, Panos Panagos, Leonidas Liakos, and Matjaž Mikoš

Abstract

Extreme floods occurred from 4 to 6 August 2023 in Slovenia causing three casualties and causing total direct and indirect damage, including post-disaster needs according to the Post-Disaster Needs Assessment (PDNA), close to EUR 10 billion. The atypical summer weather conditions combined with the high air and sea temperatures in the Mediterranean and the high soil moisture led to the most extreme flood event in Slovenia in recent decades. The return periods of both daily and sub-daily precipitation extremes and peak discharges reached 250–500 years, and the runoff coefficient of a typical torrential and mostly forested mesoscale catchment was around 0.5. In addition, flooding, soil erosion, mass movements and river sediment transport processes caused major damage to buildings (more than 12 000 houses) and diverse infrastructure.

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Received: 30 Aug 2023 – Discussion started: 05 Sep 2023 – Revised: 07 Nov 2023 – Accepted: 08 Nov 2023 – Published: 20 Dec 2023

https://doi.org/10.5194/nhess-23-3885-2023

Nat. Hazards Earth Syst. Sci., 23, 3885–3893, 2023
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Brief communication: A first hydrological investigation of extreme August 2023 floods in Slovenia, Europe

Nejc Bezak[1], **Panos Panagos**[2], **Leonidas Liakos**[2], **and Matjaž Mikoš**[1]

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Received: 30 August 2023 – Discussion started: 5 September 2023
Revised: 7 November 2023 – Accepted: 8 November 2023 – Published: 20 December 2023

Abstract. Extreme floods occurred from 4 to 6 August 2023 in Slovenia causing three casualties and causing total direct and indirect damage, including post-disaster needs according to the Post-Disaster Needs Assessment (PDNA), close to EUR 10 billion. The atypical summer weather conditions combined with the high air and sea temperatures in the Mediterranean and the high soil moisture led to the most extreme flood event in Slovenia in recent decades. The return periods of both daily and sub-daily precipitation extremes and peak discharges reached 250–500 years, and the runoff coefficient of a typical torrential and mostly forested mesoscale catchment was around 0.5. In addition, flooding, soil erosion, mass movements and river sediment transport processes caused major damage to buildings (more than 12 000 houses) and diverse infrastructure.

1 Introduction

Slovenia is a relatively small country in Central Europe (approx. 20 000 km^2) that is located in temperate–continental, Mediterranean and alpine climates, and where mean annual precipitation (1981–2010) ranges from below 900 mm in the eastern part of the country to more than 3000 mm in the western part (Dolšak et al., 2016). In combination with complex topography and lithological characteristics, extreme rainfall events can generate significant soil erosion and mass movement processes that endanger around 45 % of the country (Mikoš et al., 2004). Flood risk is a potential threat for more than 5 % of the total surface. Hence, extreme floods and mass movements occur relatively frequently, causing significant economic damage and human fatalities (Bezak et al., 2016; Mikoš, 2021; Mikoš et al., 2004; Špitalar et al., 2020). Due to climate change (Kaitna et al., 2023; Tarasova et al., 2023), extreme rainfall events will become more frequent and more extreme, leading to more severe floods and mass movements. The main objective of this brief communication is to investigate the main drivers, mechanisms and impacts of an extreme flood event that occurred in August 2023 in Slovenia, Europe. We conduct a preliminary hydrological investigation of the main characteristics of this event in order to (i) provide basics for effective remediation measures that will follow the concept of "building back better" and (ii) provide useful examples of lessons learned that could benefit other countries and will increase flood resilience in Slovenia.

2 August 2023 floods in Slovenia

2.1 Drivers and triggering mechanisms

The first half of 2023 was relatively wet in Slovenia compared to previous years, as almost all parts of the country recorded more than 50 % of the total annual rainfall by the end of June. In Slovenia, the autumn period is usually the wettest period of the year and main flood events and big mass movements occur in the period from September to December (Bezak et al., 2016; Mikoš et al., 2004; Špitalar et al., 2020). Summer (June to August) is usually the period with smaller amounts of rainfall but with thunderstorms that can yield high rainfall erosivity (Panagos et al., 2016). By the end of July 2023, the western part of the country recorded around 50 % of mean annual precipitation; this number was close to 80 % for some locations in the eastern part of the country and close to 70 % in the central part of Slovenia. In July 2023, the

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https://doi.org/10.5194/nhess-23-3885-2023

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Natural Hazards and Earth System Science, 23(12), 3885-3893 - December 2023
https://doi.org/10.5194/nhess-23-3885-2023

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Leonidas Liakos - Joint Research Centre

Matjaž Mikoš - University of Ljubljana

Summary

TL;DR Key highlights Top keywords

In August 2023, Slovenia experienced extreme floods that caused significant damage and casualties. The floods were caused by atypical weather conditions and high temperatures, with return periods of 250-500 years. The runoff coefficient was around 0.5 and resulted in damage to buildings and infrastructure.

Abstract

Abstract. Extreme floods occurred from 4 to 6 August 2023 in Slovenia causing three casualties and causing total direct and indirect damage, including post-disaster needs according to the Post-Disaster Needs Assessment (PDNA), close to EUR 10 billion. The atypical summer weather conditions combined with the high air and sea temperatures in the Mediterranean and the high soil moisture led to the most extreme flood event in Slovenia in recent decades. The return periods of both daily and sub-daily precipitation extremes and peak discharges reached 250–500 years, and the runoff coefficient of a typical torrential and mostly forested mesoscale catchment was around 0.5. In addition, flooding, soil erosion, mass movements and river sediment transport processes caused major damage to buildings (more than 12 000 houses) and diverse infrastructure.

Acknowledgements

The Slovenian Environment Agency (ARSO) is greatly acknowledged for making hydro-meteorological data publicly available. Useful and critical comments by Lorenzo Marchi, Ognjen Bonacci, two anonymous referees, and NHESS editor Olga Petrucci greatly improved this work.

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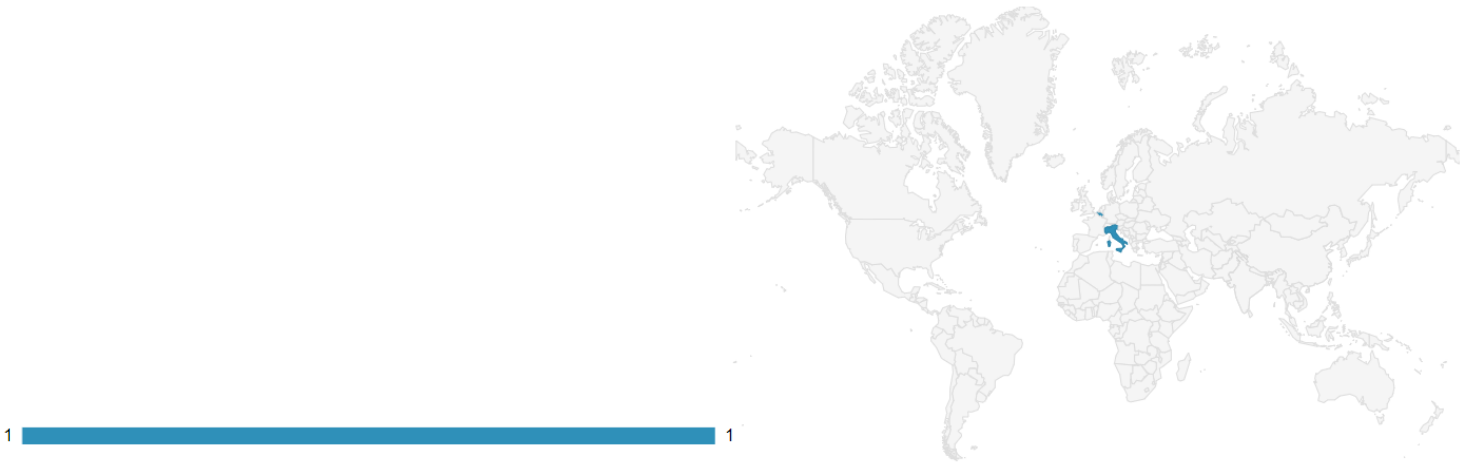
X Demographics | Mendeley readers | Attention Score in Context

The data shown below were collected from the profiles of **5** X users who shared this research output. Click here to find out more about how the information was compiled.



Geographical breakdown

Country	Count	As %
Belgium	1	20%
Italy	1	20%
Unknown	3	60%

Demographic breakdown

Type	Count	As %
Members of the public	3	60%
Science communicators (journalists, bloggers, editors)	2	40%

SOCIAL NETWORKS & MEDIA POSTS vs. EXTREME WEATHER EVENTS - I

www.consensus.app

The question read as follows:

How can we use information from social networks and media posts to identify extreme weather events?

An analysis of 10 relevant scientific papers (studies) suggests that social networks and media posts can be used to identify extreme weather events through techniques like machine learning classifiers, event detection, social sensing, and visual analytics.

Introduction

The use of social networks and media posts to identify extreme weather events has become increasingly important due to the real-time and widespread nature of social media platforms. Researchers have explored various methodologies to leverage this data for early detection, situational awareness, and response to extreme weather scenarios.

Key Insights

- ❑ **Event Detection and Information Extraction**:
  - Automated services can detect weather events and extract relevant information from social media to complement meteorological models and enhance situational awareness.
  - Machine learning classifiers and neural networks can classify and analyze social media posts to identify weather-related events and their impacts.
- ❑ **Location and Sentiment Analysis**:
  - Social media posts can be analyzed to detect and locate extreme weather events, with a significant portion of relevant tweets providing location data.
  - Sentiment analysis of social media posts reveals changes in public sentiment before, during, and after weather events, providing insights into the social impact of these events.

- **Visualization and Exploration:**
  - Visual analytics pipelines can be used to classify, locate, and visualize extreme weather events from social media data, aiding in real-time monitoring and exploration of these events.
  - Tools like the DISIT-Twitter Vigilance Platform help manage and visualize Twitter data to monitor severe weather events.
- **Predictive Models and Reinforcement Learning**:
  - Predictive models using convolutional neural networks and reinforcement learning techniques can forecast critical weather events with high precision by analyzing social media data.
  - Spatio-temporal multiplex networks integrating social media data with weather and geographic information improve the accuracy of predicting weather-related power outages.
- **Challenges and Limitations**:
  - While social media is useful for disseminating information, it may not fully capture the economic and political impacts of extreme weather events.
  - The unstructured nature of social media data poses challenges for traditional topic discovery techniques, necessitating the use of metadata and feature-based clustering for better event detection.

Conclusion

- Social media platforms, particularly Twitter, provide valuable real-time data that can be used to detect, locate, and analyze extreme weather events.
- By employing machine learning, sentiment analysis, and visualization tools, researchers can enhance situational awareness and improve predictive models for weather-related emergencies.
- However, challenges remain in fully capturing the broader impacts of these events and managing the unstructured nature of social media data.

SOCIAL NETWORKS & MEDIA POSTS vs. EXTREME WEATHER EVENTS - II

www.consensus.app

The question read as follows:

Can social media data predict extreme weather events?

An analysis of ~10 relevant scientific papers (studies) suggests that social media data, particularly from Twitter (now X), can **predict** extreme weather events with high precision, support early detection, and enhance situational awareness and real-time monitoring.

Introduction

The potential of social networks and media news to predict extreme weather events has garnered significant interest in recent years. Researchers have explored various methodologies to leverage the vast amount of data generated on social media platforms to enhance the prediction and response to such events.

Key Insights

- ❑ **Predictability of Extreme Events in Social Media:**
  - Social media platforms can predict extreme events with high precision by analyzing the early stages of user engagement and collective behavior patterns.
- ❑ **Information Dissemination and Anomaly Detection:**
  - Social networks, particularly Twitter, can be used to identify and predict extreme weather scenarios by aggregating and analyzing user-generated content and applying machine learning techniques.
- ❑ **Early Detection and Situational Awareness:**
  - Automated services that combine weather forecasts with social media data can detect emergency events early and provide valuable qualitative feedback for meteorological models and situational awareness

- ❑ Real-Time Data Mining for Disaster Prediction:
  - Real-time data mining from social networks like Twitter can predict the path of disasters such as tornadoes, providing timely warnings and enhancing disaster response.
- ❑ Power Outage Prediction:
  - Integrating social media data with weather, geographic, and grid topology information improves the accuracy of predicting weather-related power outages, demonstrating the utility of social media in enhancing predictive models.
- ❑ Behavioral Analysis in Disaster Response:
  - Analyzing social media behavior during disasters, such as floods and heat waves, using machine learning classifiers can provide valuable insights into public response and improve disaster management strategies.

Conclusion

Social networks and media news have shown significant potential in predicting extreme weather events. By leveraging user-generated content and applying advanced analytical techniques, researchers can enhance early detection, situational awareness, and response to such events. Integrating social media data with traditional meteorological and geographic information further improves the accuracy and reliability of these predictions, making social media a valuable tool in disaster management and emergency response.

International Journal of Disaster Risk Reduction 100 (2024) 104172

Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: www.elsevier.com/locate/ijdrr

Towards improved knowledge about water-related extremes based on news media information captured using artificial intelligence

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ARTICLE INFO

Keywords:
Climate change resilience
Web-based observatory
Hydrometeorological extremes
Artificial intelligence
Machine learning
Multilingual news
Twitter (X) nowcasting
Text mining

ABSTRACT

Recent advances in machine learning have enabled near real-time retrieval of information from textual documents impacting a wide range of knowledge domains. This advantage makes of the insight extracted from text-based documents (e.g., reports and news) on water-related events an invaluable source of information that complements traditional approaches. By leveraging machine learning, we can not only characterize the event and determine its magnitude or phases of extreme weather event, but also identify its core elements. This is especially crucial in the current era of climate change, where extreme weather events such as floods or thunderstorms are becoming more frequent and unpredictable. By improving our ability to detect and analyse such events, we can enhance our alert systems and take more effective action to mitigate their impact. In this paper we discuss the role of worldwide media observation in extracting and estimating hydrological characteristics of floods, droughts, and heat waves, through the analysis of three case studies, complementing the information provided by traditional monitoring and measurement methods as an earlier but weaker signal. The results presented in this study indicate that the news media signal can be regarded as relatively good proxy of flood dynamics. It can capture the temporal dynamics of the event, and, in some cases, there could be a clear up to 1-day lag between the peak discharge values (i.e., the most extreme flood situation) and the peak in the number of published news. This lag can be attributed to the time needed by journalists to respond to the situation in publishing related news articles covering the event. Our result show that national and regional news can cover well local events. When compared to floods, drought conditions are less explicitly detected from the media. Our result show that European April 2022 drought did not produce much activity in the media while the combination of drought and extreme heat in July 2022 yielded a significant media coverage throughout the Europe. Hence, this can be attributed to the fact that hydrological drought such as low river flows do not attract much attention by the media unless there is a significant impact on the society. Therefore, media signal can be regarded as a relatively good proxy of the hydro-meteorological conditions in case there is a significant impact on the society such as extreme floods causing many casualties and large economic damage.

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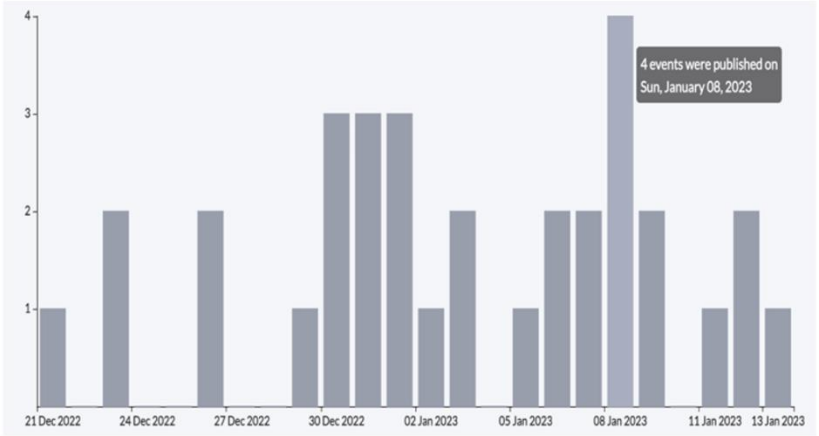
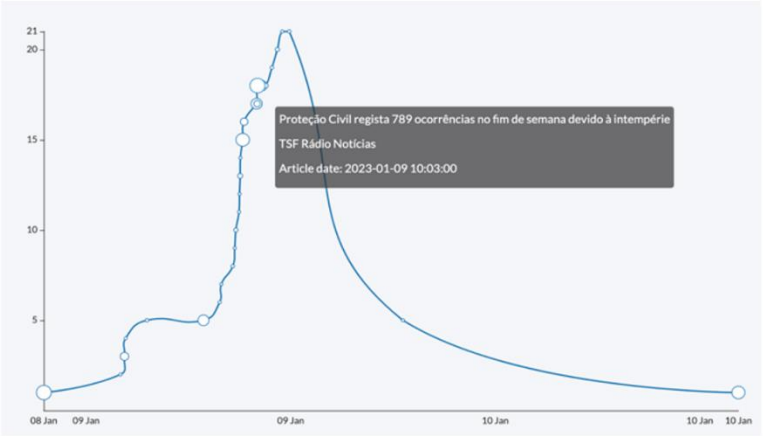
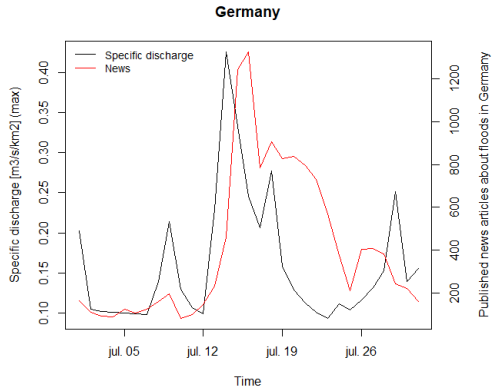
https://doi.org/10.1016/j.ijdrr.2023.104172
Received 11 April 2023; Received in revised form 16 October 2023; Accepted 1 December 2023
Available online 7 December 2023

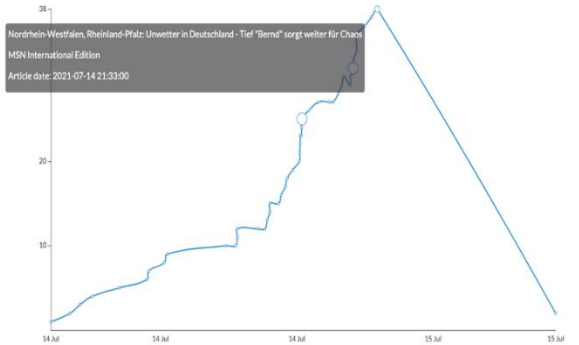
Flood incidents of early 2023 in Portugal from historical news data to retrieve specific news articles (left); and exploring the different phases of a related event from the published news about it (right)





The evolution of flood events in Hagen, Germany (on the right), the mentioned name entities extracted from the news on the impact of the event (in the centre), and the comparison between the maximum specific discharge and the published news articles during the same time period.





Research Question

The research explores the potential of NLP-based methodologies and algorithms to address the following:

I. Can we capture in the information extracted from the news media, new previously unidentified aspects of an extreme water event that can complement classical hydro-meteorological methods?
II. Are we able to measure aspects of an extreme weather event that are harder to measure through classical methods, and learn from the past events?
III. Can we estimate the magnitude of an event (i.e., return period) from the news and provide information on the spatial extension of the event, extracted location and/or magnitude?

Key Insights:

- ❑ News can capture the dynamics of the extreme hazards such as floods relatively well, even in the case of an event with smaller spatial extent
- ❑ Capturing the drought dynamics is more complex and news articles are generally not able to capture the drought dynamic

Conclusions:

From news articles we can: (i) extract information directly from the text, using a machine learning-based methodology that allows for name entity recognition, and can also deal with disambiguation; and
(ii) estimate parameters (e.g., extension of the damage caused by an extreme event) having enough data in the collected articles about the same event to ensure a certain hypothesis.

THE WAY FORWARD (Message to be taken)

1. More studies are needed on the interactions between media/social news and extreme weather events (for a variety of events) for identification & prediction. Such studies can be complemented by post-event surveys.

2. Real-time applications are welcome in the field of DRR on using media (web) news for preparedness (early detection & warning) & for emergency response (rescue & evacuation & relief).

3. Challenge 1: How to improve the quality of harvesting social networks and media news data with regard to the extreme weather events‘ temporal & space resolution & attribute characteristics using AI tools.

4. Challenge 2: How to use such data as feedbacks to meteorological & hydrological models and as a support to emergency and rescue units?

5. Challenge 3: How to use such media (web) data for development of drill scenarios for Civil Protection and Disaster Relief units?