ADVANCES IN FOREST FIRE RESEARCH

2022

Edited by
DOMINGOS XAVIER VIEGAS
LUÍS MÁRIO RIBEIRO

Uncovering the science-policy interface: applying bibliographic approaches to the wildfire risk management domain

Schlierkamp Juliane*; Berchtold Claudia; Neisser Florian; Linde-Frech Isabelle

[1]Fraunhofer INT. Appelsgarten 2, 53879 Euskirchen,
{juliane.schlierkamp, claudia.berchtold, florian.neisser, isabelle.linde-frech}@int.fraunhofer.de

**Corresponding author*

Keywords

Science-Policy Interfaces, Bibliometrie, Wildfire Risk Management, Altmetrics

Abstract

The impact of research is increasingly gaining importance as science is understood as a means to solve the challenges of humanity. Therefore, processes of interaction between science and policy makers are needed, these processes are named Science-Policy Interface (SPI). But who is actually participating in SPIs? This question is relevant since scientific findings can be subject to interpretation, might contradict each other or can be driven by normative frameworks. Additionally, complex challenges require the involvement of all relevant disciplines and if certain disciplines are not heard, policies might as well only address parts of the problem. To unpack respective processes, this paper explores the opportunities of bibliometrics to trace and track science-policy interactions applying it to the field of wildfire risk management (WFRM).

An analysis of bibliometric data provided by Dimensions (https://app.dimensions.ai) was carried out. Therefore, the development of the numbers of publications and policy documents over time as well as the numbers of publications and policy documents in different fields of research (FoR) are considered. Furthermore, the Altmetrics of publications which are cited in policy documents are compared to the total of publications with reference to WFRM.

It can be stated that the number of publications with reference to WFRM follows the general trend of an increasing publication rate. Individual deviations from the general trend can be attributed to extraordinary wildfire events. The number of policy documents with reference to WFRM seems to correlate more strongly with the number of scientific publications with reference to WFRM than to the general trend in the number of policy documents. In addition, indicators for delay of 6 to 7 years in knowledge uptake from science to policy were found. Regarding the FoRs, three clusters of were identified. While two of these clusters indicate a positive correlation between the number of publications in a FoR and the number of citations, one cluster of FoR has low numbers of citations in policy documents while the number of publications is high. That leads to the conclusion, that there are bias respective unknown impacting factors which affect whether or not a policy maker considers a particular FoR. One impacting factor seems to be the attention a publication receives in scientific but also non-scientific communities. The Altmetric Scores of publications with citations in policy documents are double as high as the Altmetric Scores of the total of publications with reference to WFRM. By analysing the composition of the Altmetric Scores of cited publications respective the Altmetric Donuts, it could be found that the vast majority of publications that are cited in policy documents did receive attention in social media, especially twitter.

Another result of the analysis is, that the data quality concerning the links between policy documents and publications is insufficient. However, the bias found in the SPI demonstrate the usefulness of this bibliometric approach. With increasing reliability of bibliometric databases, the methodology presented in this paper can be applied broadly as a tool to analyse SPIs and help to create transparency on the integration of scientific findings into policy processes.

1. Introduction: The Science-Policy Interface in WFRM

The impact of research is increasingly gaining importance as science is understood as a means to solve the challenges of humanity. Therefore, processes of interaction between science and policy makers are needed, these processes are named Science-Policy Interfaces (SPI). But who is actually participating in such SPIs? This question is relevant since scientific findings are often subject to interpretation, might contradict each other or can be based on normative frameworks. Additionally, complex challenges require the involvement and consideration of all relevant and related disciplines and if certain disciplines are not heard, policies only address parts of the problem.

However, SPI processes sometimes seem to be black-boxes that are hard to reconstruct or understand from an outside perspective. It is not necessarily clear who contributed to certain papers or who was involved in committees and fora. To unpack respective processes, the review of policy papers and their scientific input, this paper explores the opportunities of bibliometrics to trace and track science-policy interactions applying it to the field of wildfire risk management.

1.1. Research Questions

In many cases, it is not always comprehensible why scientific findings are considered in policies or why they have not been considered. This raises the question of potential biases that influence the transfer of knowledge. *In order to divide and specify this overarching question, the following subsequent research questions (RQs) have been devised:*

1. *Is there a time lag between the publication of scientific publications and the publication of the policy document? (RQ1)*
2. *Do more publications in a field of research lead to more citations in policy documents? (RQ2)*
3. *Are publications that are frequently mentioned online cited more often in policy documents? (RQ3)*
    a. Are there similarities or differences between the Altmetric Scores of the publications cited in policy documents and those of the publications as a whole?
    b. How are the Altmetric Scores of the publications cited in policy documents composed?

2. Methodology: bibliometric analysis

In this chapter Altmetrics are introduced, the development of the hypothesis and the used statistical tools are described.

2.1. Hypotheses and statistical tools

In order to answer the research questions by the use of statistical tool, hypothesis derived from the research questions are necessary.

To answer the RQ1 the hypothesis

"There is no time lag between the publication of scientific publications and the publication of the policy document."

is examined by comparing the timelines of publications with reference to WFRM and the timeline of all scientific publications. In addition to this descriptive approach, the hypothesis is also examined with multiple regression of the publication numbers.

The RQ2 is examined by testing the hypothesis

"The number of publications per field of research does not corelate with the number of citations in policy documents"

Therefore, histograms and scatter plots of the numbers of publications within the fields of research (FoR) are analysed and rank correlation test according to Spearman is applied (Handl und Kuhlenkasper 2018, pp. 169-173)

The hypothesis to answer the RQ3 is:

"The number of online citations does not correlate to the number of citations in policy documents."

This hypothesis is examined by analysing the key figures of the Altmetric Scores of the publications cited in policy documents compared to the total number of publications with reference to WFRM.

2.2. Altmetrics

Altmetrics were developed in response to the expansion of opportunities to publish and disseminate scientific results. They offer an insight into how often publications are used or discussed by others already after a short amount of time and are applicable on big numbers of publications. Furthermore, by including attention outside

of the scientific community can decrease the influence of bias which exist within the scientific community and affect scientific processes. (Priem et al. 2010; Howard 2012; Galligan und Dyas-Correia 2013, p. 56).

2.3. Data Collection

The Dimensions database is used to collect the bibliometric data. The database is characterised by the fact that different types of data are made available and shows linkages between different publications. (Dimensions n. a; Hook et al. 2018; Singh et al. 2021, p. 5).

3. Findings of the bibliometric analysis

The following chapter presents the results of the analysis of the bibliometric data of publications and policy documents with reference to WFRM. In addition, first findings with regard to data quality are presented.

3.1. Publications over time

The number of publications with refence to WFRM as well as the total of scientific publications has increased significantly over the 50 years (Figure 1, bottom graph). This trend, however, is not exclusive to WFRM publications, but number of publications in general (Figure 1, top graph).

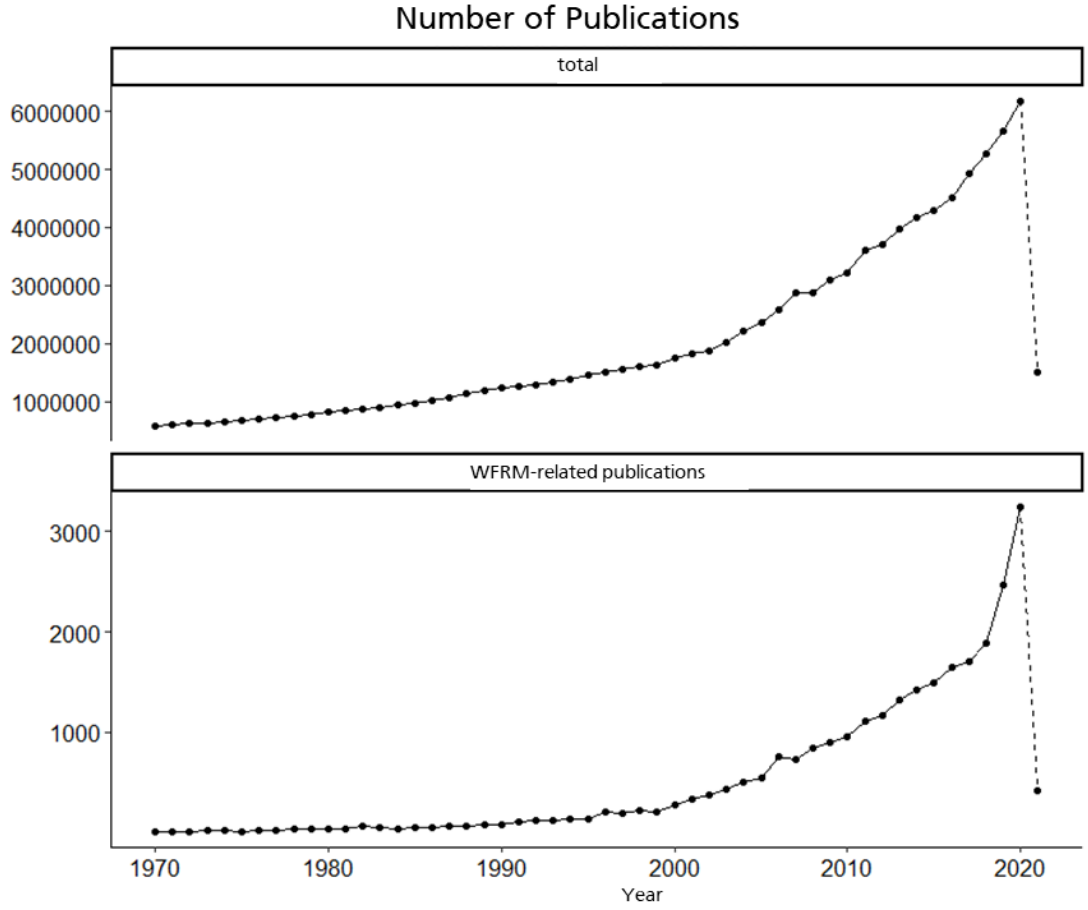

Figure 1 – Annual numbers of publication, total and with reference to WFRM

The numbers of publications with reference to wildfire follows the trend of exponentially increasing numbers of publications (Parthey und Biedermann 2002, p. 113) Exceptional effects can be attributed to outstanding wildfire events, e.g. wildfires as a consequence of a heatwave in Europe in 2003 can be associated with the exceptionally high number of publications in 2006 Spain (Lyamani et al. 2006, pp. 6456-6460). The average delay between these events and effects in the publication numbers is three years.

During the time period in question from 1970 to 2021, 476.548 policy documents were published. Out of those, 69 make reference to WFRM. Regarding the annual numbers of policy documents, a strong growth from 2010

to 2015 can be identified. From 2015 on, the numbers of policy documents declined (Figure 2). The numbers of publications with reference to WFRM fluctuate strongly during this time, still displaying a tendency of growing numbers of policy documents with reference to WFRM. That leads to the assumption that the number of policy documents with reference to WFRM possesses a stronger correlation to the number of publications with reference to WFRM than to the number of policy documents in general.

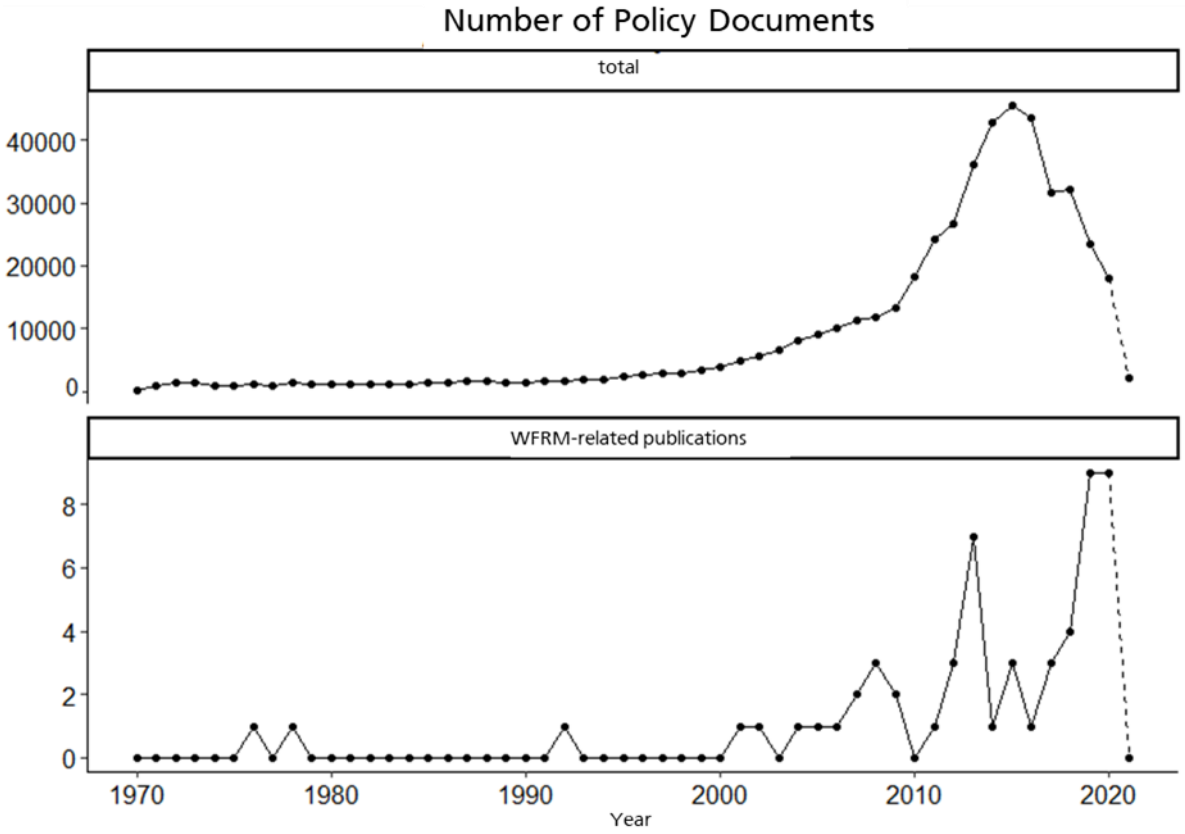

Figure 2- Annual numbers of policy documents, total and with reference to WFRM

To examine this assumption multiple regression analysis is carried out. The regression model considers the number of annual publications with reference to WFRM for the past 14 years as an impact number for the annual number of policy documents. Thus, a regression model was developed which contains the numbers of publication for the past 14 years as variables, 14 coefficients and one constant:

$$n_{PD}(t) = b_{t-1} * n_{pub}(t-1) + b_{t-2} * n_{pub}(t-2) + b_{t-3} * n_{pub}(t-3) + b_{t-4} * n_{pub}(t-4) + b_{t-5} * n_{pub}(t-5) + b_{t-6} * n_{pub}(t-6) + b_{t-7} * n_{pub}(t-7) + b_{t-8} * n_{pub}(t-8) + b_{t-9} * n_{pub}(t-9) + b_{t-10} * n_{pub}(t-10) + b_{t-11} * n_{pub}(t-11) + b_{t-12} * n_{pub}(t-12) + b_{t-13} * n_{pub}(t-13) + b_{t-14} * n_{pub}(t-14) + \epsilon$$

The result of the regression analysis is significant with values of $p=2{,}919*10^{-10}$ and $R^2=0{,}77$.

Table 1 – results of the multiple regression analysis

Ranking	*Coefficient*	*Value*	*Ranking*	*Coefficient*	*Value*
1.	b_{t-7}	0.0285282	8.	b_{t-12}	-0.0014705
2.	b_{t-13}	0.0197481	9.	b_{t-5}	-0.0036211
3.	b_{t-6}	0.0178220	10.	b_{t-1}	-0.0039888
4.	b_{t-14}	0.0068295	11.	b_{t-2}	-0.0057053
5.	b_{t-3}	0.0037625	12.	b_{t-10}	-0.0127954
6.	b_{t-11}	0.0026201	13.	b_{t-9}	-0.0142249
7.	b_{t-4}	0.0005291	14.	b_{t-8}	-0.0250294

Half of the coefficients is positive; the others are negative. While there is no factual explanation for the negative values of the coefficients, positive values might be an indicator for a certain delay of time. The coefficients b_{t-7}, b_{t-13} and b_{t-6} have the highest values, b_{t-10}, b_{t-9} and b_{t-8} have the lowest values (Table 1).

In the analysis of the publications over time it can be shown, that wildfire incidents lead to more publications with a delay of 3 years. Furthermore, a delay of 6 to 7 years from science to policies is indicated by the results of the multiple regression analysis.

3.2. Fields of Research

The scatter plot in Figure 3 shows a correlation between all publications with reference to WFRM and those which are cited in policy documents. Each dot represents a FoR. For the cited publications all values are increased by one (TC+1). Three cluster can be identified in the scatter plot.

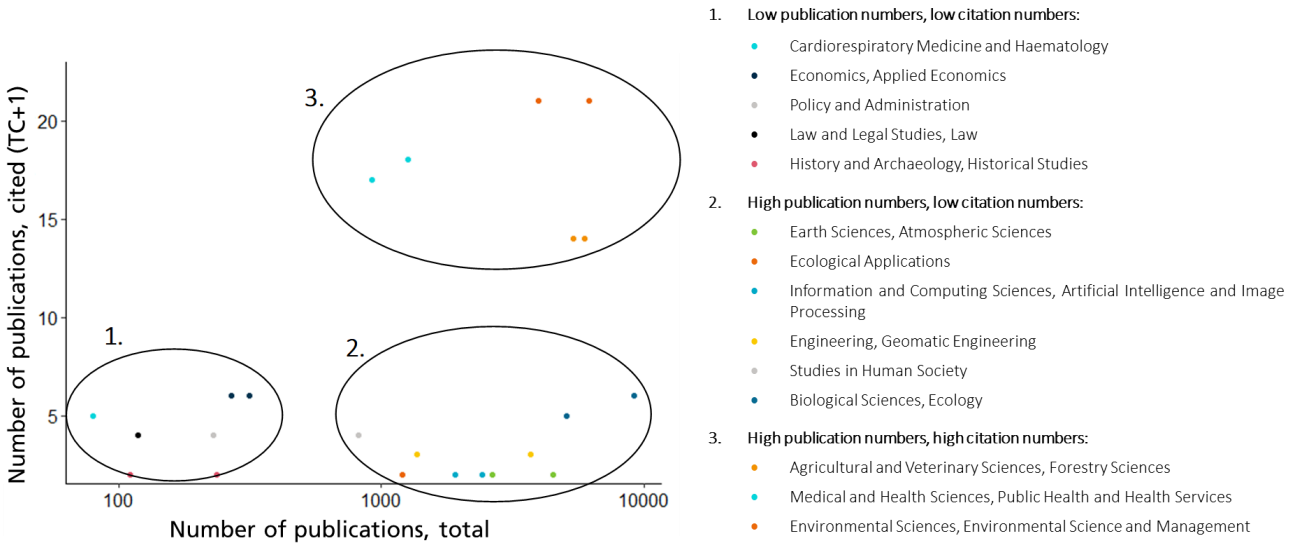

Figure 3-Number of publications per FoR, total and cited in policy documents

The rank correlation test by Spearman shows that the number of publications in the superordinate FoR corelates significantly (p=0,0022) with the number of publications cited in policy documents. With correlation coefficient ϱ= 0,62, which is a strong effect according to Cohen (1988). For the super- and subordinate FoR cumulated the correlation is also significant ($p=6{,}784*10^{-13}$) and with a strong effect (ϱ=0,52).

These results correspond with first and the third cluster which indicate that the numbers of publications in a FoR correlate to the number of citations in policy documents. The second cluster, where the number of publications is high and the number of citations is low contradicts this correlation which leads to the conclusion, that there are further impacting factors involved.

3.3. Altmetrics of the publications

For those publications which are cited in policy documents with reference to WFRM the Altmetric Scores and Donuts are analysed.

The arithmetic mean of Altmetric Scores of the cited publications is 50 and double the Altmetric Score of all publications, which is 25. The median is also double with a value of 6 for the cited publications and 3 for all publications. With a standard deviation of 124 the distribution of the Altmetric Scores of all publications is more homogeneous than the distribution of the Altmetric Scores of the cited publications with 213.

Table 2 – Comparison, key figures of the Altmetric Scores

Value	*Total of publication with reference to WFRM*	*Cited publication with reference to WFRM*
Arithmetic mean	25	50
Median	3	6
Standard deviation	124	213
Range	5289 (x_{min}=1; x_{max}=5290)	3089 (x_{min}= 3; x_{max}= 3092)

As the Altmetric Score is only an indicator for the amount of attention a publication receives, the Altmetric Donuts are analysed to get an insight of the platforms on which the publications are mentioned. All cited publications with a minimum score of 8 for the Altmetric Score are considered. These are 84 publications of which:

- 78 are cited on Twitter
- 41 are cited in Blogs
- 42 are cited on Facebook
- 15 are cited on Google+
- 5 are cited on Reddit
- 3 are cited on YouTube
- 1 is cited in the Stack Overflow Q&A

The Altmetric Scores of the cited publications have a higher arithmetic mean than the total of publications with reference to WFRM. Furthermore, it can be shown, that publications which were cited in policy documents were also often cited on Social Media as well.

3.4. Limitations of the results

The findings of this study of bibliometric data are limited by several factors. The results are only valid for the sector of WFRM. As the number of policy documents is generally low and most policy documents were published after the year 2000, which is a short observation timeframe when considering the observation that knowledge transfer from science to policies takes 6 to 7 years, this delay needs to be confirmed by further research.

Another limitation is given by the quality of data. To evaluate the quality of the data provided by Dimensions an exemplary manual analysis of citations in a policy document was carried out. The policy document "Advances in remote sensing and GIS applications in forest fire management - EU Law and Publications" includes 203 citations according to Dimensions. In a manual analysis, 445 citations were found. One reason for these 242 citations which are not regarded in Dimensions is that not all kinds of publications are considered by Dimensions, but 112 of the 242 missing citations are articles which should be included in Dimensions. Of these 112 articles only 18 are not listed in Dimensions. One reason might be inconsistencies in the references in the policy paper. At least in the exemplary policy paper, different styles of citation were used and several citations were incomplete. On the other hand it might be the case, that the AI which identifies the citations in Dimensions is not sufficientlytrained in analysing policy documents, because these are not the main focus of Dimensions. Another problem which was identified in the evaluation of the data is that Dimensions does not include all crucial policy documents, e.g. the policy document "Forest Fires: Sparking firesmart policies in the EU" which is a key publication of the EU is not listed in Dimensions.

4. Conclusion

The use of bibliometric data and analyses has great potential to understand and reconstruct SPIs on a larger scale. As a direct effect, this would allow to compare and complement the consideration of certain disciplines in policy processes. Particularly for complex settings such as WFRM, this could lead to an enhancement of a holistic perspective by integrating (potentially so far disregarded yet important inputs. From an indirect perspective, it would contribute to enhancing transparency and thus democratic principles. Specifically, in times of "fake news" and science scepticism, the suggested approach could provide important contributions to not only reconstructing science-policy relations but to enhance the overall credibility in science and policy making through transparency.

Nevertheless, the generated insights for the WFRM domain have to be assessed against the fact that the list of policy papers is incomplete, as do the listed citations. Assuming however that these systematic errors affect all fields of research evenly, we can for example assume that policy makers do not regard all FoR evenly. There are fields like Earth Sciences, Engineering or Ecology that publish articles with reference to WFRM and are not properly regarded by policy makers. This clustering can be used by policy makers to identify blind spots. At the same time, it might be the case, that scientists in these fields do not communicate and spread their findings as

efficient as scientists in other fields. For further research, it might be useful to analyse the communication and dissemination in Cluster 1 of the FoRs (Figure 3) to identify best practises.

Finally, this paper results in additional research questions and aspects that require for further analysis. First of all, the mentioned data base shortfalls have not yet been understood in their entirety and they seem to be related to systematic errors, most likely caused by artificial intelligence and the applied machine learning approaches. More detailed insights can only be provided by the operators and experts. Since the access to the policy paper database is a service that needs to be paid, it can be assumed that this challenge will be addressed in the near future.

In a second stage, the use of national (or even local) level language policy papers should be considered since the presented approach seems also useful for analysing SPIs at the national level. However, respective papers are currently not covered by any database and can hence not be subject to analysis.

5. References

Cohen, Jacob Willem (1988): Statistical power analysis for the behavioral sciences. 2. ed. Hillsdale, NJ: Erlbaum.

Dimensions (n. a.): Why did we build Dimensions? Online: https://www.dimensions.ai/why-dimensions/

Handl, Andreas; Kuhlenkasper, Torben (2018): Einführung in die Statistik. Theorie und Praxis mit R. Berlin, Germany: Springer Spektrum.

Hook, Daniel W.; Porter, Simon J.; Herzog, Christian (2018): Dimensions: Building Context for Search and Evaluation. In: Front. Res. Metr. Anal. 3. DOI: 10.3389/frma.2018.00023.

Lyamani, H.; Olmo, F. J.; Alcántara, A.; Alados-Arboledas, L. (2006): Atmospheric aerosols during the 2003 heat wave in southeastern Spain I: Spectral optical depth. In: Atmospheric Environment 40 (33), S. 6453–6464. DOI: 10.1016/j.atmosenv.2006.04.048.

Parthey, Heinrich; Biedermann, Wolfgang (Hg.) (2002): Wissenschaft und Innovation. Gesellschaft für Wissenschaftsforschung. 1. Ed. Berlin: GEWIF (Wissenschaftsforschung, 2001).

Singh, Vivek Kumar; Singh, Prashasti; Karmakar, Mousumi; Leta, Jacqueline; Mayr, Philipp (2021): The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. In: Scientometrics. DOI: 10.1007/s11192-021-03948-5.

Turco, Marco; Jerez, Sonia; Augusto, Sofia; Tarín-Carrasco, Patricia; Ratola, Nuno; Jiménez-Guerrero, Pedro; Trigo, Ricardo M. (2019): Climate drivers of the 2017 devastating fires in Portugal. In: Scientific Reports 9 (1), S. 13886. DOI: 10.1038/s41598-019-50281-2.