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Decision support systems: An overview of global research trends

Sistemas de apoyo a la toma de decisiones: una visión general de las tendencias mundiales en materia de investigación

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ABSTRACT

This article examines trends in research on decision support systems from a bibliometric perspective. A quantitative approach was employed for data collection, utilizing the bibliometric perspective, which integrates mathematical methods and documentary analysis. The sample was selected through a thorough bibliographic review in Scopus. Co-word mapping and co-citation analysis of journals were conducted using Vosviewer software. Additionally, specific general data on scientific production were calculated using Bibliometrix. The final sample comprised 4118 documents from the period 2000 to 2024. In the health field, significant production levels have been achieved, focusing on applying computational technologies to develop systems. Despite the existence of bibliometric studies examining the scientific output and impact of the subject, these predominantly focus on specific application areas. The global analysis shows evidence of a subject that exhibits continuous development, particularly in the health field.

Keywords: intelligent decision support; bibliometrics; bibliometric maps; Scopus; research trends

RESUMEN

En este artículo se examinan las tendencias en las investigaciones sobre sistemas de apoyo a la toma de decisiones desde una perspectiva bibliométrica. Para la recolección de datos, se implementó un enfoque cuantitativo, mediante la perspectiva bibliométrica, que integra métodos matemáticos y el análisis documental. La muestra se seleccionó mediante la exhaustiva revisión bibliográfica en Scopus. El mapeo de co-palabras y la co-citación de revistas se efectuaron mediante el software Vosviewer. Asimismo, se procedió al cálculo de ciertos datos generales de la producción científica mediante el uso de Bibliometrix. La muestra final fue de 4118 documentos durante el periodo 2000-2024. En el ámbito de la salud, se han alcanzado niveles de producción significativos, orientados a la aplicación de tecnologías computacionales para el desarrollo de sistemas. A pesar de la existencia de antecedentes bibliométricos que examinan la producción científica y el impacto de la temática, estos se centran predominantemente en áreas específicas de aplicación. El análisis global evidencia la presencia de una temática que exhibe un desarrollo continuo, particularmente en el ámbito de la salud.

Palabras clave: apoyo decisiones inteligentes; bibliometría; mapas bibliométricos; Scopus; tendencias de investigación

1. INTRODUCTION

Bibliometrics is a quantitative discipline that examines the production, dissemination, and use of scientific information through the application of statistical and mathematical methods. The methodological approach focuses on the analysis of publication, citation, and collaboration patterns in the field of academic literature, providing tools for evaluating research impact and trends across various fields of knowledge (Glänzel & Moed, 2002). This discipline is applied in various areas, including research evaluation, measuring the impact of articles, authors, and institutions through indicators, scientific mapping for identifying collaborative networks and emerging fields using technological tools, and managing collections that contribute to optimizing library resources based on use and citation analysis (Gutiérrez & Espinosa, 2024).

One of the most relevant contributions of bibliometrics is its ability to identify and analyze thematic trends in scientific research (Salgado-García et al., 2024). In this sense, co-citation mapping and co-word analysis enable the determination of emerging fields, the evolution of disciplines, collaborative networks, and future lines of research (Tapia et al., 2024). In conclusion, the bibliometric perspective is significant and has been validated in the scientific literature, serving as a methodological tool for identifying trends in various thematic areas, disciplines, or fields of knowledge.

Decision Support Systems (DSS) is a field of knowledge that has undergone remarkable evolution since the 1970s due to technological and organizational advances. Initially, DSSs had limited capabilities in databases, models, and user interfaces. However, technological progress has facilitated the development of much more advanced functionalities. Today, it is a growing area, as evidenced by the integration of artificial intelligence, big data, and mobile computing, which promises greater automation and support for complex decision-making (Shim et al., 2002).

DSS, utilizing computational tools designed to assist decision-makers in complex processes, employs data analysis, predictive models, and interactive visualization (Shim et al., 2002). According to the analysis conducted by Arnott and Pervan (2005), it is possible to classify functions based on various criteria. In this regard, a taxonomy including three main categories is proposed: data-driven functions, model-driven functions, and collaborative functions. The integration of DDS with artificial intelligence occurs through the implementation of expert systems, machine learning, and natural language processing (Turban & Aronson, 2001). As demonstrated by Kawamoto et al. (2005), Quandt et al. (2023), Kayvanfar et al. (2024), Nakuloadi et al. (2024), and Vaduka et al. (2024), applications of these tools are widely present in fields such as healthcare, logistics, and finance.

From a bibliometric perspective, precedents have been identified on the topic of DSSs driven by artificial intelligence, big data, and health applications (Aboelkhir et al., 2022; Yousaf et al., 2023). In the field of DSS, a recent precedent is evident where, through a bibliometric analysis, the current state of technology applied to DSS in the logistics and manufacturing sectors is examined (Dwivedi et al., 2023).

Bibliometric analyses have been conducted in various areas, including logistics (Qaiser et al., 2017) and agriculture (Yousaf et al., 2023). In the field of security, the implementation of strategies aimed at preventing maritime events is evident (Gil et al., 2020). Similarly, in construction, the application

of project management methodologies is observed (Minhas & Potdar, 2020; Kalibatas & Kalibatiene, 2024).

Another relevant research result outlines the historical evolution of clinical decision support systems, featuring contributions from influential institutions in the field, such as Harvard University and MIT. The findings of this study suggest a transition from rule-based systems to artificial intelligence models (Aktürk, 2021). In the study by Chien et al. (2022), the analysis of clinical alerts in these systems is addressed. This research identifies fatigue caused by receiving an excessive number of alerts as a significant challenge. Additionally, the importance of implementing measures to reduce medical errors is emphasized.

In general terms, the precedents reported have relied on conventional bibliometric databases, such as *Web of Science or Scopus*. Several authors have utilized analysis tools, such as *CiteSpace* (Yangöz et al., 2024), to identify "hotspots" and emerging trends. They have also employed *VOSviewer* (Aboelkhir et al., 2022; Yangöz et al., 2024) to map co-authorship and co-citation networks. Abdelaziz & Rosa (2024) conducted an analysis of DSS in electronic medical records, yielding results that indicate a greater impact on accurate diagnoses by integrating artificial intelligence. In this regard, the leading countries in this area are the United States, China, and the United Kingdom.

Some of the key findings indicate that DSS is an expanding multidisciplinary field with critical applications in health and sustainability. In this field, bibliometrics has helped map collaborations, trends, and gaps, but greater methodological uniformity is required (Fernandez, 2023). Previous research has shown a history of bibliometric analyses for monitoring and examining trends in SSD, although such analyses have focused on specific applications within particular areas of knowledge. The purpose of this study is to present a comprehensive analysis of the topic to identify the predominant trends in current research in this field.

2. MATERIALS AND METHODS

The study design was based on a bibliometric analysis utilizing a quantitative methodology that describes scientific production. The bibliometric procedures were conducted through stages and techniques associated with the measurement of scientific information recorded in databases.

For this study, the Scopus database was selected as the information source. Scopus is a multidisciplinary and international database with extensive coverage. The selection of the population and sample was based on using the entire available time frame to retrieve documents related to the research topic. The sample spans the period from 2000 to 2024. Thematic delimitation was performed by combining terms with the Boolean operator OR. Additionally, the sample was filtered according to documentary typology to analyze only citable documents, such as original articles, review articles, event papers, books, and book chapters. The final search equation used was: TITLE (decision AND support AND systems*) AND PUBYEAR > 1999 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "re") OR LIMIT-TO (DOCTYPE, "cr")).

Regarding data processing and the representation of information, cleaning and debugging of the recovered data were implemented. Subsequently, the files were exported and imported to execute the procedures required before calculating the indicators. In this stage, several tools were used,

including *Microsoft Excel* spreadsheets, the EndNote reference manager, the *R* analysis environment with the *Biblioshiny* package for generating frequency reports of the analyzed variables, and the *VOSviewer* tool for constructing co-occurrence networks.

Regarding the calculation of indicators and analysis of results, general data on scientific production were gathered, including the total number of papers published as well as the annual count during the study period, along with the total and yearly citation averages. A graphic representation of the co-occurrence network of keywords was created, which underwent a pruning process, considering connections generated from at least three co-authored papers. In the realm of academic research, a thorough analysis of the most influential journals was conducted, along with the examination of Bradford's concentration zones for sources publishing on DSS. Ultimately, a factor map was generated using the multidimensional scaling technique to illustrate the most significant correlations within the extensive body of research related to DSS.

3. RESULTS AND DISCUSSION

The primary bibliometric indicators of the literature registered in Scopus on DSS reveal a field of research that is constantly growing, with scientific production experiencing an annual increase of 6.27% over the last two decades. This dynamism is evident in the 4118 documents examined from more than 2000 academic sources, showcasing the diversity and breadth of research on the subject. The high average number of citations per paper (18.16) suggests that the existing literature in this field has a significant impact, while the average age of the papers (10.3 years) indicates that, although the field continues to evolve, seminal works remain relevant. The abundance of automated terms, with over 17,000 (Keyword Plus), in contrast to the 8,600 terms assigned by the authors (Author's Keywords), highlights the thematic breadth and multidisciplinary nature of DSS. These range from technical applications to sector-specific solutions, providing evidence of comprehensive coverage and integration across various areas of knowledge.

On the other hand, the collaboration patterns reveal a balance between individual (515 papers) and collaborative (3.77 co-authors per paper on average) works, although there is a relatively low proportion of international collaborations (19.38%). This finding suggests the existence of a consolidated research network, as well as opportunities to foster global cooperation, particularly in a field as interdisciplinary as DSS. The predominance of scientific articles (49.1%) and conference papers (41.1%) reflects a focus on the rapid dissemination of findings, characteristic of evolving technology areas. These findings highlight the maturity achieved in the field of study while also identifying areas for improvement, such as further integration of international perspectives and leveraging emerging approaches, such as explainable artificial intelligence and big data analytics, to drive innovation in DSS.

Table 1. General literature indicators registered in Scopus on DSS (2000-2024)

Indicators	Data	Interpretation
Documents analyzed	4118 (articles, papers, reviews).	Wide and active field.
Citations by document	18.16	High scientific influence
International collaboration	19.38%	Low proportion of international collaboration. Potential for greater cross-border cooperation.

Annual growth rate	6.27%	Sustained increase in DSS research
Document life	10.3 years	Classical studies are still relevant
Index of authors by article	3.77	High collaboration

Word co-occurrence networks on DSS

Figure 1 illustrates the co-occurrence network of words found in the research published and registered in Scopus. The arrangement of the three nodes clearly reflects the contents grouped in the documents according to three thematic axes, considering their centrality in the network: artificial intelligence applied to decision support systems (red color), clinical decision support systems (green color), and documents more associated with computational technologies (blue color). The semantics surrounding DSS form a dense network with a well-defined structure, featuring highly integrated terms.

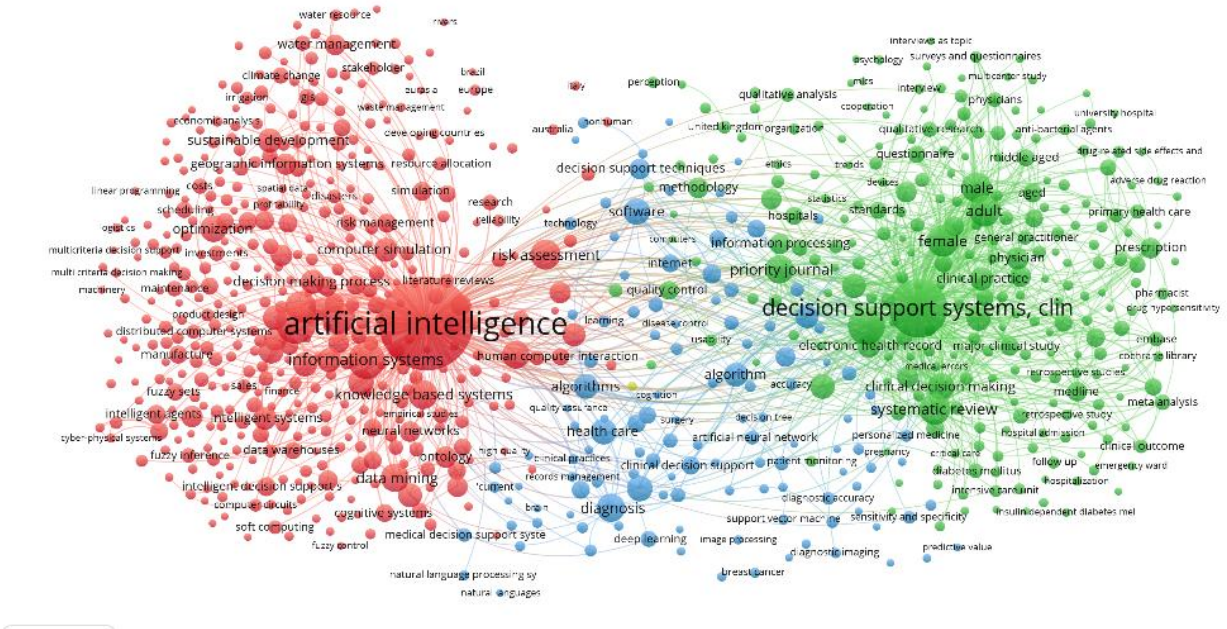

Figure 1. Keyword co-occurrence network (n≥10)

The magnitude of the discrepancies in the dimensions of the nodes is remarkable. The red node, on the other hand, groups a total of 431 terms. While the main node refers to artificial intelligence, the cluster presents a wide range of approaches or aspects of artificial intelligence in DSS. Therefore, the clustering of terms covering computational techniques applied to DSS has been identified as a significant aspect. Cluster 2 encompasses all semantics contained in the works associated with DSS. This study addresses the relevance of DSS in clinical aspects, a topic widely explored in the scientific literature. It has been observed that the papers dedicated to this topic usually consist of a substantial number of words, with an average of 256 words in total.

Ultimately, the blue cluster serves as a connecting area and shows a smaller magnitude, as it does not represent the robust core of activities related to the subject matter in question. Instead, this cluster forms the links between artificial intelligence and computational science, on one hand, and clinical studies supported by DSS. The present study highlights the relevance of algorithms, machine learning, software, and techniques for decision-making in the broad network, consisting of 122 words.

To identify the most relevant journals that focus on the highest number of articles related to SSD research, the Bradford bibliometric principle was utilized. This principle determines the concentration areas of articles and journals and enables the identification of productivity levels (Table 2). Combined with Figure 2, this analysis highlights the ten most productive publications or resources regarding the subject matter.

Table 2. Bradford Zone

Zones	Number of Cumulative Articles	Number of Journals
Zone 1	1359	77
Zone 2	2761	659
Zone 3	4118	1358

The analysis of Bradford's areas shows that zone 1 comprises approximately 33% of the total published articles, suggesting that access to this area of information sources or resources is fundamental for literature and the development of research in this field. The results of the analysis confirm the fundamental principle of Bradford's Law, demonstrating that relevant scientific literature is unevenly concentrated in a small core of journals. In this case, only 77 journals (zone 1) contribute 33% of the essential articles, while the subsequent zones require an exponentially larger number of sources (659 and 1358 journals, respectively) to provide a similar proportion of knowledge. This phenomenon reflects a high degree of specialization and a wide thematic dispersion in scholarly output.

However, discrepancies in the Bradford factor (n) indicate that the field under study exhibits specific dynamics, such as the presence of several subdisciplines or an atypical distribution of productivity. This analysis highlights the usefulness of law as a tool for mapping the structure of scientific communication and making evidence-based decisions. As shown in Table 3, which displays the ranking of the ten most relevant journals, the classificatory thematic areas were identified in the Scopus database.

The analysis in Table 3 shows the existence of a primary thematic domain, corresponding to Computer Science and Medical Informatics. Among the ten journals, six demonstrate a strong connection to computer science, particularly in artificial intelligence (Lecture Notes in AI, Expert Systems with Applications), information systems and decision making (Decision Support Systems, BMC Medical Informatics), and health applications (Studies in Health Technology and Informatics, Journal of the American Medical Informatics Association).

Table 3. Top 10 resources or sources of information on DS

#	Journal	Number of documents	Subject area
1	Lecture Notes In Computer Science (Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics)	90	1. Computer Science: General Computer 2. Science Mathematics: Theoretical Computer Science

2	Studies In Health Technology And Informatics	82	1. Health Professions: Health Information 2. Management Medicine: Health 3. Informatics Engineering: Biomedical Engineering
3	Decision Support Systems	67	1. Arts and Humanities: Arts and Humanities (miscellaneous) 2. Psychology: Developmental and Educational 3. Computer Science: Information 4. Decision Sciences: Information Systems and Management 5. Business, Management and Accounting: Management Information Systems
4	Ceur Workshop Proceedings	55	1. Computer Science: General Computer Science
5	Bmc Medical Informatics And Decision Making	53	1. Medicine: Health Policy 2. Medicine: Health Informatics 3. Computer Science: Computer Science Applications
6	Advances In Intelligent Systems And Computing	40	1. Computer Science: General Computer 2. Engineering: Control and Systems Engineering
7	Expert Systems With Applications	38	1. Engineering: General 2. Computer Science: Computer Science Applications 3. Computer Science: Artificial Intelligence
8	Journal Of Decision Systems	34	1. Social Sciences: Library and Information Sciences 2. Business, Management and Accounting: Management Information Systems
9	Communications In Computer And Information Science	30	1. Mathematics: General Mathematics Computer 2. Science: General Computer Science
10	Journal Of The American Medical Informatics Association	28	1. Medicine: Health Informatics

In the field of periodicals, three journals have become benchmarks in the study of Medical Informatics and Digital Health. This phenomenon reflects the increasing relevance that technology is gaining in medicine, underscoring the need for critical analysis and effective integration of these tools in the clinical context. There are multidisciplinary and specialized areas, such as Lecture Notes in Computer Science and *CEUR Workshop Proceedings*, which cover general topics in computing, and *Advances in Intelligent Systems and Computing*, which focuses on artificial intelligence and engineering. *BMC Medical Informatics and Decision Making and the Journal of the American Medical Informatics Association concentrate* exclusively on digital health. At the same time, Decision Support Systems and *Expert Systems with Applications* address intelligent systems applied to business and engineering.

Additionally, a bias toward conference proceedings as a form of publication has been observed. Previous research has shown that the *Lecture Notes in Computer Science*, *CEUR Workshop Proceedings*, and *Communications in Computer and Information Science* conference series serve as paradigmatic examples of disseminating research results in the computing field. This indicates that a significant proportion of studies conducted in this area is disseminated through academic events rather than traditional journals. Another important aspect to highlight is that, although the field of DSS includes management, the predominant focus is technical in nature. This implies a

limited presence of the social and humanistic sciences in the thematic areas of the periodicals where such content is published.

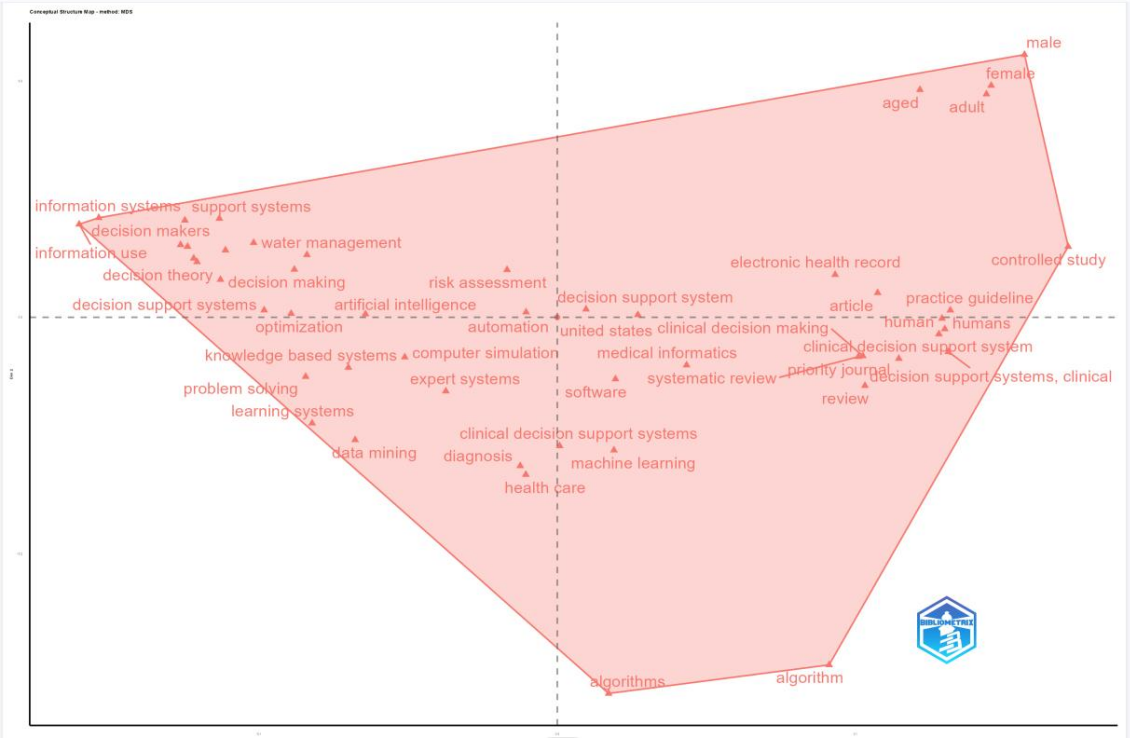

Figure 2. Factor map of words using the multidimensional scaling technique (MDS)

The factor analysis, in this case of keywords, reaffirms the high correlation between technological topics and the development of DSS. The terminology located in the center of the map exhibits these strong correlations. In the conducted study, a significant recurrence is evident in the mention of the United States as a country of interest in the examined scientific literature, particularly in the context of automation and simulation in clinical decision-making. These aspects emerge as fundamental axes of contemporary research in the field. In the realm of information systems management in the healthcare sector, there is a growing trend towards the development of specialized software solutions. In this context, the relevance of expert systems and medical informatics as key components in the creation of these systems is evident.

CONCLUSIONS

Recent bibliometric studies have revealed a remarkable evolution in the field of DSS. These systems have undergone a progressive transformation, evolving from mere modeling tools to sophisticated intelligent systems driven by artificial intelligence, big data, and emerging technologies. The field has diversified into critical applications such as healthcare (precise diagnostics, clinical alerts), sustainable logistics, and precision agriculture, demonstrating its cross-cutting impact across various sectors. However, challenges remain, including methodological standardization in bibliometrics, the need for more interpretable DSS, and the reduction of geographical bias in research. Progressive integration with the Internet of Things (IoT), blockchain technology, and generative artificial intelligence outlines a trajectory toward more adaptive and ethical systems, capable of responding to complex problems in real time.

In the future, DSS will need to balance technological innovation with usability and transparency, especially in sensitive areas such as health and safety. Bibliometric findings have highlighted the

relevance of fostering interdisciplinary collaborations and policies that drive the development of accessible and equitable solutions. This analysis not only maps the current state of the field but also identifies opportunities for future research, such as the study of DSS in underserved contexts (e.g., developing countries) and its alignment with the Sustainable Development Goals (SDGs). In this sense, bibliometrics emerges as an essential component to guide the responsible evolution of such systems in the coming decade.

Analysis of the top 10 journals revealed the preeminence of Computer Science and Medical Informatics in the academic production examined, with a clear core of leading journals (Lecture Notes in Computer Science, Studies in Health Technology and Informatics) exhibiting the highest productivity. The proceedings suggest that research in these areas is widely communicated at conferences, indicating a trend towards collaboration and knowledge sharing in this field. This list serves as a reference tool for researchers to identify key sources according to their specialization, prioritizing the most productive and recognized journals in their respective fields.

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CONFLICT OF INTEREST

There is no conflict of interest related to the work's subject matter.

AUTHORSHIP CONTRIBUTION

Conceptualization: Muñoz-Vilela, A. J. Data Curation: Vellón-Flores, V. I. Formal Analysis: Vellón-Flores, V. I. and Solano-Armas, T. Research: Solano-Armas, T. and Ramos la Rosa, P. E. Methodology: Muñoz-Vilela, A. J. and Solano-Armas, T. Software: Vellón-Flores, V. I. Supervision: Solano-Armas, T. Validation: Muñoz-Vilela, A. J. Display: Vellón-Flores, V. I. Editorial staff - original draft: Muñoz-Vilela, A. J. Writing - proofreading and editing: Muñoz-Vilela, A. J. and Ramos la Rosa, P. E.

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