Bibliometrics-based Research Landscape of Artificial Intelligence in Flood Prediction

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Abstract: Climate change has caused an increasing threat of flood disasters, and using artificial intelligence methods to predict floods is now a hot subject in the field of flood prediction. To find out the current situation of the flood prediction research based on artificial intelligence methods, it is essential to summarise the main research focus and direction at present. 612 references on flood forecasting based on AI methods were selected from the Web of Science Core Collection database. The collected articles were analysed visually using CiteSpace and VOSviewer. The results of the study indicate that the overall trend of publications in AI-based flood prediction studies is increasing. In particular, China, the United States and India are the main contributors to research in this research area. The analysis of collaborating institutions shows that Chinese institutions have high activity in this field. The keywords and term analysis show that the research direction of flood prediction based on AI methods mainly focuses on three aspects, which are flood risk assessment, hydrological information prediction and simulation, and integration and improvement of AI algorithms. In recent years, the integration and improvement of artificial intelligence (AI) algorithms have became as a new focal point of research. The incorporation of multiple machine learning or deep learning methods, as well as using additional algorithms to improve the quality of prediction models have received high attention in this flood prediction. In the future, it is important for research efforts to explore these research avenues further, in order to strengthen China's scientific and efficient response capabilities in the face of flood disasters. This study's results can be a reference for researchers to understand the current landscape and emerging frontiers of AI-driven flood prediction research. It will help guide future research directions and strategies and promote the continued development of this field.

Keywords: Flood Prediction; Artificial Intelligence; Bibliometric Analysis; Visualisation Mapping

1. Introduction

Against the backdrop of global climate change, there has been a remarkable increase in the frequency of extreme rainfall events, further leading to more frequent and intensified flood disasters. This phenomenon has exerted a profound impact on the economy and the safety of life and property worldwide. In 2022, there were a total of 163 significant floods globally, accounting for over 50% of the total frequency of significant disasters. Compared to the three-decade average, the occurrence of flood disasters in 2022 increased by 14%, resulting in a 20% rise in the number of fatalities and a 25% increase in direct economic losses. The regions and populations facing flood disasters are increasing annually on a global scale, with projections indicating that by 2030, over 700 million people worldwide will be affected by flood disasters. Influenced by geographical conditions, flood disasters in China are characterized by high frequency, extensive impact, and substantial losses [1]. Therefore, conducting research on flood prediction and establishing accurate and reliable flood prediction models are essential for disaster prevention and mitigation.

Flooding is a natural occurrence caused by a combination of factors. Predicting the location, time, intensity, and inundation area of a flood can aid emergency response. Traditional hydrological models are typically created by using physical mechanisms. However, the flood process is a complex nonlinear model,

single mathematical and physical models have some limitations in the simulation of complex hydrological processes, nonlinear problems and uncertainty handling[2].This limitation leads to a significant bias in flood prediction results, which is a major problem in the field of flood prediction. Therefore, it is vital to enhance the accuracy and reliability of flood forecasting. The search for a more accurate and stable flood prediction model has attracted the attention of hydrology experts both domestically and internationally. The advancement of artificial intelligence (AI) technology has introduced new possibilities for improving flood prediction techniques. By leveraging complex models and algorithms such as deep learning, AI exhibits robust nonlinear fitting capabilities, enabling better capture of the intricate relationships within flood processes and enhancing prediction accuracy. Wang et al. [3] proposed a fast urban flood prediction method with high reliability based on disaster breeding environment clustering and deep learning model. Studies have proved that the prediction accuracy of artificial neural network model is higher than that of physical model.

As research endeavors in the field of flood prediction progress, a systematic analysis of these research findings contributes to an enhanced understanding of the current status and focal points within the realm of flood prediction. Bibliometrics stands as a vital instrument for the assessment and analysis of academic research conducted by nations, research institutions, and scholarly journals. Through quantitative analysis of scientific literature, it facilitates an understanding of emerging trends and knowledge structures within research domains. The research conducted by Diez-Herrer [4] utilized a bibliometric approach within the Web of Science (WOS) repository to evaluate the developmental trajectory and potential future of flood risk assessment and analysis. Ahmed et al. [5] employed bibliographic analysis to investigate regional flood frequency analysis, providing an overview of the current state and future trends in research development within this field. However, there is a scarcity of literature that provides in-depth analysis from the bibliometric perspective on the current state and developmental lineage of research in the field of AI-based flood prediction. Therefore, this study utilizes bibliometric methods and two information visualization software packages (CiteSpace and VOSviewer) to analyze the core collection database of the Web of Science (WOS). It delves into aspects such as the distribution characteristics of literature, research frontiers, and focal points within this domain. The aim is to provide researchers in the field of flood prediction with an exposition of the current state and future trends of research.

The organization of the remaining sections in this document is detailed as follows: Section 2 introduces the sources of collected paper data and the research methodology employed. In Section 3, an analysis and discussion of the research findings are presented, encompassing aspects such as annual publication volume, disciplinary analysis, author collaboration, and analysis of collaboration between countries/institutions. Additionally, analyses of references, keywords, and terminologies are conducted. The final section provides the conclusion.

2. Data Sources and Analysis Methods

2.1 Data Sources

Web of Science (WOS) is widely regarded as a primary research platform for hard sciences, social sciences, arts and humanities information. Additionally, it is recognized as the most reliable independent global citation database worldwide. The information utilized in this investigation was gathered from the Core Collection within the Web of Science (WOS).The search period spanned from January 1, 2000, to December 31, 2023. The subject search strategy employed the keyword "flood prediction." Document types encompassed articles, review articles, early access articles, and conference papers. An initial search yielded 1331 documents, with 612 documents retained after excluding those unrelated to flood prediction and artificial intelligence.

2.2 Research Methods

This paper employs CiteSpace and VOSviewer for visualizing and analyzing the selected literature information. CiteSpace is an information visualisation software developed by Professor Chaomei Chen's team, based on the Java programming language. VOSviewer,

which is also Java-based, was designed and developed by Nees Jan van Eck and Ludo Waltman and is used for the construction of knowledge networks of authors, institutions, countries, references and other entities. These visualization software tools are widely employed in bibliometric research. By analyzing relationships such as co-citations and co-occurrence of keywords, they assist researchers in identifying research hotspots, recognizing core keywords and themes, and revealing the developmental trends within research domains. As a result, they enhance researchers' understanding of the dynamic changes within academic fields.

3. Results and Discussion

3.1 Annual Publication Trend

Statistical analysis of the yearly publication count of literature on flood prediction utilizing artificial intelligence methods aids in understanding the temporal evolution of this field. Figure 1 displays the annual count of published articles and the cumulative totals from 2000 to 2023. From 2000 to 2023, emerged a cumulative total of 612 articles emerged in the domain of flood prediction utilizing artificial intelligence. The annual output of papers on flood prediction utilizing artificial intelligence exhibits an overall increasing trend. The research trend can be divided into two phases.

In the first phase, spanning from 2000 to 2012, an average of 3.58 papers were published annually. The years 2011 and 2012 witnessed the highest number of publications (37 papers). This phase was likely influenced by limitations in computational power and relatively lower attention towards the field of artificial intelligence. Traditional hydrological methods continued to dominate during this period, indicating that research utilizing artificial intelligence methods for flood prediction was still in its nascent stage. In the second phase, spanning from 2013 to 2023, the number of papers utilizing artificial intelligence methods for flood prediction began to rapidly increase. The peak in publication occurred in 2022, with 134 papers published. In 2015, the year-on-year growth rate in publications reached 142.86%, marking the highest growth rate during this phase. Several factors have contributed to the significant increase in publishing over this period. Firstly, there has been a significant improvement in hardware capabilities and computational power, enabling more efficient processing of complex hydrological and meteorological data using artificial intelligence algorithms. Consequently, there has been an enhancement in prediction accuracy. Secondly, the growing attention towards climate change and natural disasters has prompted scholars to actively explore new technological approaches to improve flood prediction capabilities.

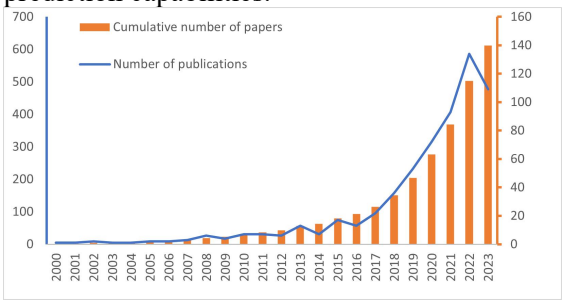

Figure 1. Annual Trend of Articles Published based on Artificial Intelligence in Predicting Floods from 2000 to 2023

3.2 Cooperation Network

3.2.1 National and institutional cooperation networks

Investigating the distribution of publications by country aids in understanding the research activity and contribution levels of different nations in this field. The literature collected for this study originates from 87 countries. Table 1 shows the data for the top 10 countries based on the amount of papers published.

Table 1 reveals that China has the highest number of relevant papers on flood prediction using artificial intelligence methods (261 papers, accounting for 42.647% of the total), followed by the United States (70 papers, accounting for 11.438% of the total) and India (65 papers, accounting for 10.621% of the total). The total citation count of a country is typically considered an indicator of its influence and contribution in the academic research field, reflecting its scientific impact within that domain. Table 1 demonstrates that China ranks first in total citations (3107), followed by the United States (1272) and India (914). Whether in terms of paper publication quantity or citation count, China emerges as a major contributor to research on flood prediction using artificial intelligence methods. This also indirectly reflects the significant

attention given by the Chinese government to disaster prevention and mitigation efforts related to floods in recent years.

Table 1. Top 10 Countries with the Highest Number of Published Papers

Rank	Country	Number of publications	Proportion /%	Total citations	Average year of publication
1	China	260	42.484	3107	2019.74
2	USA	70	11.438	1272	2018.80
3	India	65	10.621	914	2021.09
4	Iran	53	8.660	860	2019.98
5	South Korea	51	8.333	416	2019.76
6	Japan	35	5.719	248	2017.77
7	U.K.	29	4.739	404	2018.38
8	Vietnam	29	4.739	400	2020.48
9	Canada	26	4.248	323	2018.77
10	Malaysia	26	4.248	306	2020.12

Based on data exported from WoS CC, a visualization graph depicting the collaboration relationships between countries has been generated, as shown in Figure 2. In this graph, node size represents the number of papers published by each country, with larger nodes indicating a higher volume of publications. The connections between nodes reflect collaboration between countries, with the thickness of the connections indicating the level of collaboration. The United States and India lead in the number of international collaborations, each with 36 partner countries according to the WoS CC database. China and Iran follow closely, each having 34 collaborating countries, ranking jointly in second place. From the perspective of the average publication year, China's research in the field of flood prediction using artificial intelligence methods appears relatively mature, with a focus on improving and deepening existing knowledge (average publication year: 2019.74). In terms of both publication quantity and citation count, China surpasses other countries, with the United States and India ranking second and third, respectively. Overall, countries are dedicated to exploring more accurate and reliable flood prediction methods.

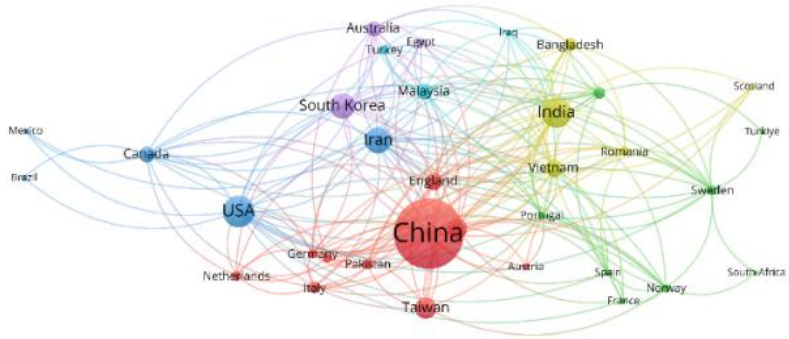

Figure 2. Visualisation of Cooperation Relations between Countries

Figure 3 shows a map of the collaborative network of institutions with five or more publications, which was generated using the VOSviewer. The network shows how many Chinese institutions have carried out extensive research on floods forecasting using artificial intelligence methods since 2000. The thickness of the connections in the graph represents the strength of collaboration between institutions. Table 2 shows the top 10 research institutions ranked by the number of published articles. The Chinese Academy of Sciences has the highest number of publications with 28, which is followed by the National Taiwan University with 20. Among the top 10 institutions, 7 are based in China, with the remainder coming from Japan and Vietnam. This observation highlights China's high level of activity in research on flood prediction using artificial intelligence methods.

3.2.2 Author collaboration network

An analysis of the authors' publications and collaborations may reflect their research capabilities. In total, 45 authors have published 4 or more papers each. Table 3 shows the top 10 authors by number of publications,

including 4 scholars from China. In terms of citation analysis, Biswajeet Pradhan, Haoyuan Hong and Hamid Reza Pourghasemi are in the top 3 with citation counts of 1184, 955 and 701 respectively.

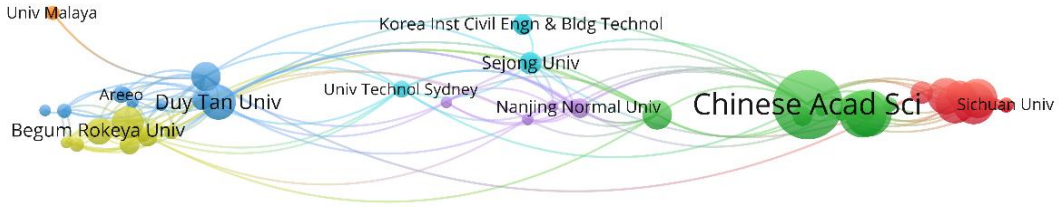

Figure 3. Visualization Graph Depicting Collaboration Relationships between Institutions

Table 2. Top Ten Organisations by Number of Articles Published

Rank	institution	The number of publications	The total citation	Country
1	Chinese Academy of Sciences	28	909	China
2	National Taiwan University	20	520	Taiwan, China
3	Nanjing University of Information Science and Technology	19	169	China
4	Hohai University	19	188	China
5	China Research Institute of Water Resources and Hydropower	17	253	China
6	Sun Yat-sen University	16	532	China
7	Zhengzhou University	16	209	China
8	Kyoto University	15	305	Japan
9	Duy Tan University	14	1370	Vietnam
10	Tarbiat Modares University	13	630	Iran

Table 3. Top 10 Authors by Publication Count

Author	The number of publications	The total citation	Country
Romulus Costache	10	300	Romania
Haoyuan Hong	8	955	China
Biswajeet Pradhan	8	1184	India
Gwo-Fong LIN	7	147	Taiwan, China
Subodh Chandra Pal	6	300	India
Junnan Xiong	6	67	China
Xiaohong Chen	6	418	China
Hamid Reza Pourghasemi	6	701	Iran
Zening Wu	6	88	Iran
Abu Reza Md Towfiqul Islam	5	268	Bangladesh

3.3 Co-citation Literature Analysis

Analysing co-citations of papers can help researchers understand research hotspots and trends within an academic field, as well as evaluating the influence and importance of papers [6]. A co-citation analysis was conducted on the citations of 612 articles selected for this study. Table 4 shows the list of the top 10 references in order of citation intensity. Table 4 shows that the top 10 papers in terms of citation intensity were all published around 2015, which may be due to the continuous improvement of hardware performance and artificial intelligence algorithms during this period, which promoted the application of artificial intelligence methods in the field of flood prediction. The reference with the highest citation intensity is Biswajeet Pradhan [7]'s "Flood susceptibility mapping using a novel ensemble weights-of-evidence and support. vector machine models in GIS "(citation Strength 11.7). The high citation strength of this paper can be attributed to several factors. Firstly, the paper provides a comprehensive review of previous natural disaster modeling, showcasing the current state of research on the application of machine

learning to the study of floods. Secondly, by integrating WoE with SVM, the paper addresses the limitations of WoE in conducting multivariate statistical analysis while also enhancing the performance of the SVM model. This integration offers new insights for improving the accuracy of flood prediction models. In addition, Biswajeet Pradhan was also the author of three of the top 10 papers in citation intensity. These studies focus on the prediction of flood-prone areas and improve the performance and accuracy of the flood prediction model by introducing integrated artificial intelligence algorithm models or improving existing models. Other works have also enriched the field of research. For example, Lai et al. [8] established a flood risk assessment model based on random forest (RF) algorithm for the first time, demonstrating the great potential of artificial intelligence methods in the field of flood prediction. Many scholars have proved that artificial intelligence methods are efficient and reliable in the field of flood prediction. In order to enhance the predictive performance of individual flood prediction models, Biswajeet Pradhan proposed an integrated model combining Random Forest (RF) and Support Vector Machine (SVM), which has demonstrated efficient and reliable characteristics in flood prediction. Additionally, he utilized an ensemble weights-of-evidence (WoE) approach combined with the Support Vector Machine (SVM) model to generate flood susceptibility maps, addressing the limitation of WoE in performing multivariate statistical analysis and optimizing the performance of the SVM model. This approach resulted in improved accuracy in flood prediction [7,9].

Additionally, Diue [10] proposed a novel artificial intelligence method called MONF, which integrates a Neuro-Fuzzy Inference System with metaheuristic optimization algorithms, for predicting flood susceptibility. This research demonstrates that integrating multiple artificial intelligence methods into a single model can enhance predictive performance.

In order to explore the current knowledge base and research frontiers in this field, cluster analysis of the literature was conducted using Citespace. This paper utilized the log-likelihood ratio (LLR) algorithm for clustering analysis of the cited literature. The clustering effectiveness was evaluated based on the Silhouette coefficient. Table 5 summarizes the detailed clustering information, while the clustering results are depicted in Figure 4. Additionally, the timeline graph of clustered cited literature is presented in Figure 5. According to the data in Table 5, the average silhouette coefficient is calculated to be 0.945, which is greater than 0.7. This confirms that the generated clustering results exhibit a high level of reliability. The timeline graph in Figure 5 displays the top 9 ranked cluster themes. Smaller cluster numbers indicate larger quantities and scopes of research within that cluster .The largest cluster is #0 "Deep learning neural network," involving 54 papers. Following that are #1 "Alternating decision tree" and #2 "Random forest," with 45 and 41 papers, respectively. By observing the timeline graph, it is evident that the research hotspots in the past decade mainly focus on the top three clusters: #0 "Deep learning neural network," #1 "Alternating decision tree," and #2 "Random forest." These three clusters have a significantly larger number of papers compared to other clusters. From the cluster analysis, it can be preliminarily inferred that artificial intelligence methods have great potential in the field of flood prediction research, especially in deep learning and machine learning algorithms. With the improvement of hardware performance and further development of artificial intelligence algorithms, an increasing number of scholars are utilizing machine learning for flood prediction modeling. In the future, research hotspots in flood prediction may tend towards integrating various deep learning algorithms or utilizing data decomposition techniques to enhance data quality and improve prediction accuracy.

Table 4. References with the Top 10 Citation Strengths

Rank	Author	Title	Year	Strength	Country
1	Biswajeet Pradhan	Flood susceptibility mapping using a novel ensemble weights-of-evidence and support vector machine models in GIS	2014	11.7	India
2	Biswajeet	Flood susceptibility assessment using GIS-based support	2015	11.46	India

	Pradhan	vector machine model with different kernel types			
3	Omid Rahmati	Flood susceptibility mapping using frequency ratio and weights-of-evidence models in the Golastan Province, Iran	2016	8.73	Iran
4	Biswajeet Pradhan	Spatial prediction of flood susceptible areas using rule based decision tree (DT) and a novel ensemble bivariate and multivariate statistical models in GIS	2013	8.68	India
5	Biswajeet Pradhan	Flood susceptibility analysis and its verification using a novel ensemble support vector machine and frequency ratio method	2015	8.09	India
6	Ioannis Kougias	Assessment of flood hazard areas at a regional scale using an index-based approach and Analytical Hierarchy Process: Application in Rhodope–Evros region, Greece	2015	7.61	Italy
7	Chengguang Lai	Flood hazard risk assessment model based on random forest	2015	6.18	China
8	Khabat Khosravi	A GIS-based flood susceptibility assessment and its mapping in Iran: a comparison between frequency ratio and weights-of-evidence bivariate statistical models with multi-criteria decision-making technique	2016	6.02	USA
9	Khabat Khosravi	Flash flood susceptibility analysis and its mapping using different bivariate models in Iran: a comparison between Shannon's entropy, statistical index, and weighting factor models	2016	4.68	USA
10	Dieu Tien Bui	Hybrid artificial intelligence approach based on neural fuzzy inference model and metaheuristic optimization for flood susceptibilitgy modeling in a high-frequency tropical cyclone area using GIS	2016	4.68	Norway

Table 5. 8 Clusters Ranked by Size

ID	Size	silhouette coefficient	Average year	Cluster label
#0	54	0.839	2019	Deep learning neural network
#1	45	0.911	2017	Alternating decision tree
#2	41	0.815	2019	Random forest
#3	25	0.993	2012	Weights-of-evidence
#4	13	1	2001	Natural disasters
#5	12	1	2006	Flood forecast
#6	7	1	2013	Analogue prediction
#7	7	1	2019	Runoff prediction

3.4 Keyword and Term Analysis

Keywords serve as succinct summaries of the content of a paper, enabling researchers to explore the hotspots of a field by analyzing high-frequency keywords and thereby gaining a better understanding of the academic fore front . Extracting key terms from the titles and abstracts of literature aids in revealing important themes and research trends within the field.

A keyword analysis of AI-based flood prediction research using Citespace shows that prediction, model, machine learning, spatial prediction and climate change are the top five most frequently occurring keywords in the field. The generated keyword clustering network, based on the existing keyword network, which is shown in Figure 6, consists of 17 primary clusters. Among them, the top 10 clusters are ranked as follows: #0 flood susceptibility, #1 flood forecasting, #2 resilience, #3 deep learning, #4 frequency ratio, #5 early warning, #6 climate change, #7 particle swarm optimization, #8 numerical simulation, and #9 skill. To further explore the research hotspots in this field, the paper analyzes the relevant terms appearing in the titles and abstracts of the literature. Terms were extracted using the VOSviewer automatic term identification method. A total of 534 terms with a frequency equal to or greater than 10 were identified, and the temporal distribution of each term is shown in Figure 7. The closer the colour to red, the closer the

occurrence to 2022. By summarising and organising the relevant literature information and terms contained in the top 10 clusters, three main research hotspots emerge in AI-based flood prediction studies.

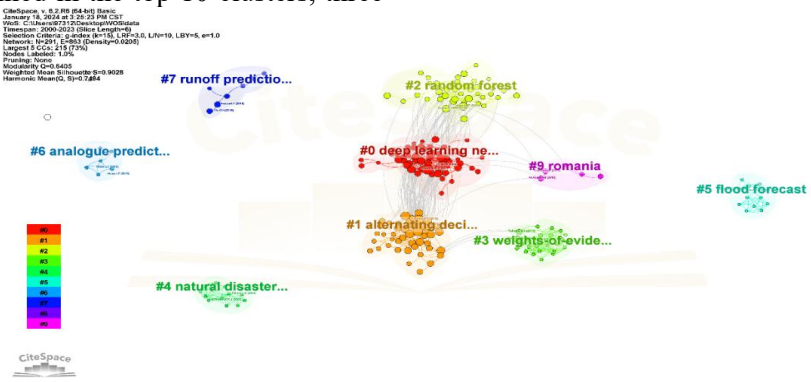

Figure 4. Cluster Analysis Diagram of Co-cited Documents

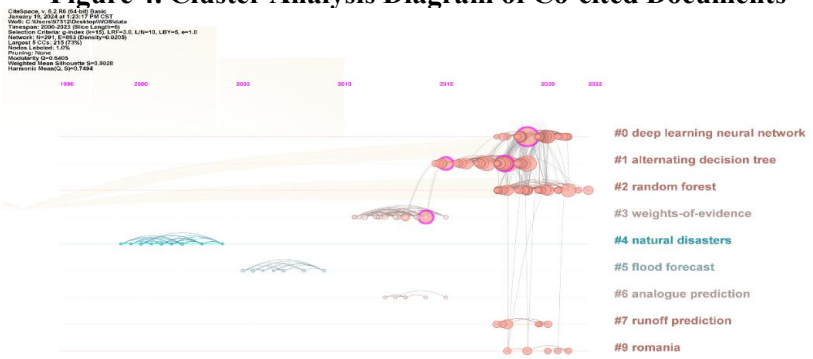

Figure 5. Timeline Chart of Document Co-citations

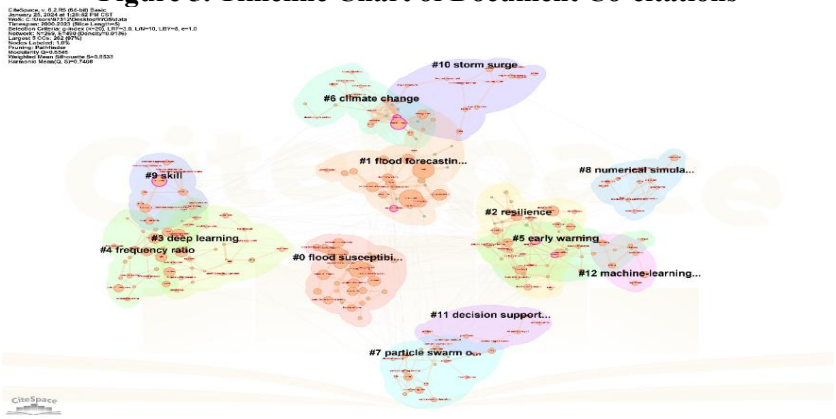

Figure 6. Keyword Co-occurrence Settlement Analysis Diagram

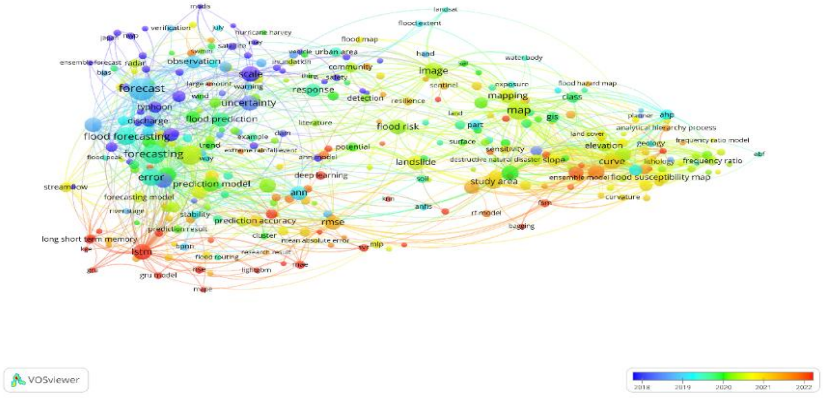

Figure 7. Flood Prediction Terminology Diagram based on Artificial Intelligence

The first research direction mainly focuses on flood risk assessment. Because of the devastating impact of floods on the environment and human society, flood risk assessment is crucial for flood control and mitigation. As remote sensing technology and artificial intelligence advance swiftly, more and more scholars use machine learning methods to simulate and predict flood disaster risk. Kia et al. [11] used the artificial neural network to simulate the flood disaster risk in the Johor River Basin in Malaysia by taking the average annual rainfall, the maximum annual rainfall and the minimum annual rainfall as trigger factors. Liu et al [12] considered the importance of land use change in flood risk modelling by proposing a comprehensive model chain for regional flood risk prediction. Assessing flood risk and predicting flood vulnerability in the area can predict the likelihood of flood disasters and assist in flood prevention and mitigation efforts.

The second research direction is hydrologic information prediction and simulation. At present, the flood prediction model mainly forecasts specific data, such as rainfall data, river level data and runoff data. Wang et al. [13] proposed a two-stage error compensation model based on Gated Recurrent Unit (GRU), Variational Mode Decomposition (VMD), and Error Compensation Mechanism (ECM) (GRU-VMD-ECM), significantly improving the accuracy of monthly rainfall prediction. Tiu et al [14] combined high quality data with Artificial Neural Network (ANN) and Support Vector Regression (SVR) models to predict river water levels. In the study by Xiang [15] a model for predicting hourly runoff from rainfall was introduced, utilizing the Long Short-Term Memory (LSTM) framework within a Sequence-to-Sequence (seq2seq) learning approach, tailored for application in watersheds locat. Prediction and simulation of hydrological information is a crucial aspect of flood prediction research. These predictions provide data for flood forecasting and serve as an important basis for the formulation of flood prevention strategies.

The third research direction is the integration and improvement of artificial intelligence algorithms. In AI-based flood prediction, the predictive performance of individual models or single algorithms is often limited. To enhance prediction accuracy, some scholars have begun integrating algorithms and employing hybrid models for flood prediction. A new methodology for forecasting floods has been put forward by Habibi [16], which employs a blended machine learning model and feature selection algorithm. Luu et al. [17] combined the Partial Decision Tree (PART) classifier with AdaBoost, Bagging, Dagging, and Random Subspace Ensemble Learning techniques to develop a novel GIS-based integrated computational model for flood susceptibility prediction. Ehteram [18] proposed a deep learning model called Convolutional Neural Network (CONN) - Support Vector Machine (SVM) - Gaussian Process Regression (GPR) to predict daily and monthly rainfall data in the Terengganu River Basin in Malaysia. Some researchers also use data decomposition techniques to improve the quality of datasets, thereby improving prediction accuracy [19]. By integrating and improving artificial intelligence algorithms, the prediction accuracy and reliability of flood prediction models can be significantly improved. This has become an increasingly important area of research in the academic community.

4. Conclusions

In this paper, 612 papers published between 2000 and 2023 were analysed using the WoS CC database and bibliometric methods. The following conclusions were obtained:

From 2000 to 2012, the number of AI-based flood prediction research papers increased slowly, and after 2013, the number of papers began to increase rapidly. Research on AI-based flood prediction spans several disciplines, with water resources, environmental sciences and multidisciplinary earth sciences ranking in the top three in terms of publication volume. China, the United States, and India are the top three countries in terms of paper production in this field. The United States and India have the most collaborations with other countries. Analysis of collaborative institutions indicates that Chinese institutions are highly active in this field. Future research should focus on strengthening collaboration among countries/regions or institutions. Biswajeet Pradhan, Haoyuan Hong and Hamid Reza Pourghasemi have published the most papers

in AI-based flood prediction research. The analysis of co-cited literature shows that the articles with the highest citation intensity integrate WoE and SVM models to map flood vulnerability, which avoids the shortcomings of WoE's inability to perform multivariate statistical analyses, and also improves the performance of the SVM model to increase the accuracy of flood prediction. Within the bracket of the most highly cited works, a preponderance of entries is attributed to scholars from India. The analysis of keywords and terms reveals that research in AI-based flood prediction primarily concentrates on three main areas: flood risk assessment, hydrologic information prediction and simulation and the integration and improvement of artificial intelligence algorithms. In the area of flood risk assessment, researchers have extensively simulated and evaluated flood disaster risks in different regions using artificial intelligence methods. The research of hydrological information prediction and simulation focuses on the use of advanced models and algorithms to improve the accurate prediction of flood-related data. The integration and improvement of artificial intelligence algorithms has emerged as a new research hotspot in recent years, garnering significant attention in flood prediction. Researchers are focusing on integrating different machine learning or deep learning methods and applying additional algorithms to upgrade the quality models for flood prediction. Future research directions will further strengthen the interdisciplinary integration of these fields to improve the accuracy and reliability of flood prediction models.

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