

A Bibliometric Analysis: Remote Sensing Literature in Reputable International Journals Indexed in Dimensions.ai Database

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Informasi artikel	ABSTRAK
<i>Sejarah artikel</i> Diterima : 2022-08-01 Revisi : 2022-11-14 Dipublikasikan : 2022-12-08	Penelitian ini menggunakan analisis bibliometrik dengan tujuan untuk mengidentifikasi dan memvisualisasikan perkembangan penelitian di bidang studi penginderaan jauh. Jurnal-jurnal yang memenuhi kualitas standar akan di indeks oleh database ilmiah seperti database dimensions.ai. Dengan demikian penelitian dan diseminasi terhadap perkembangan ilmu pengetahuan menjadi kegiatan yang penting dilakukan. Data diperoleh dari tahun 2020-2022 melalui database dimensions.ai dengan kriteria artikel yang terbit dari jurnal internasional bereputasi yang dilengkapi digital object identifier (DOI). Data yang dihasilkan sebanyak 2645 artikel yang kemudian dianalisis menggunakan software VosViewer. Data yang dianalisis meliputi perkembangan kata kunci populer, afiliasi, negara dan penulis yang banyak melakukan penelitian di bidang penginderaan jauh. Hasil penelitian ditemukan 5 kluster dengan 73 item untuk kata kunci, 6 kluster dan 36 item untuk penulis, 15 kluster dan 323 item untuk afiliasi, 7 kluster dan 61 item untuk analisis negara yang sebagian besar melakukan penelitian penginderaan jauh. Fokus penelitian remote sensing dari tahun 2020-2022 lebih banyak berfokus terhadap fenomena covid-19 yang terintegrasi dengan beberapa bidang seperti ekonomi, industri, lingkungan, kesehatan, kehutanan, klimatologi, meteorologi, dan pertanian.
Kata kunci: Penginderaan Jauh Analisis Bibliometrik Dimensions.ai	

Keywords:	ABSTRACT
Remote Sensing Bibliometric Analysis Dimensions.ai	This study uses bibliometric analysis with the aim of identifying and visualizing research developments in the field of remote sensing studies. Journals that meet quality standards will be indexed by scientific databases such as the dimensions.ai database. Thus research and dissemination of the development of science is an important activity to do. Data obtained from 2020-2022 through a database of dimensions.ai with the criteria for articles published from reputable international journals equipped with digital object identifiers (DOI). The resulting data were 2645 articles which were then analyzed using the VosViewer software. The data analyzed includes the development of popular keywords, affiliations, countries and authors who have done a lot of research in the field of remote sensing. The results of the study found 5 clusters with 73 items for keywords, 6 clusters and 36 items for authors, 15 clusters and 323 items for affiliations, 7 clusters and 61 items for country analysis which mostly carried out remote sensing research. The focus of remote sensing research from 2020-2022 focuses more on the covid-19 phenomenon which is integrated with several fields such as economics, industry, environment, health, forestry, climatology, meteorology, and agriculture.

Introduction

Remote sensing is the art and science of obtaining information about an object through the analysis of data obtained by a special set of tools without direct contact with the object under study. According to Jensen (2000); Lillesand and

Keifer, (1987) remote sensing is a science to obtain and analyze information about an object or phenomenon from a distance.

Remote sensing refers to the identification of planet earth by analyzing various physical events such as detecting electromagnetic

radiation. The use of remote sensing is currently very widely used in various fields, including education (Botto et al., 2022; Li et al., 2020; Tiwari et al., 2021), industry (Hao et al., 2022), mining (Song et al., 2020), defense and security (Mehta et al., 2021), regional planning (Kumar et al., 2021), to the health sector (Ye, 2022).

The analysis of the earth's surface using remote sensing aims to improve natural resource management, land use analysis, natural disaster mitigation, weather and climate monitoring, mapping of human territory of the earth's surface and other purposes to assist in every human activity (Benz, 2004; Song et al., 2001; Tralli et al., 2005; Wang et al., 2020).

Complex research problems must be investigated by quantitative and qualitative analysis. The indicator of scientific progress is the development of research that produces scientific articles which include the distribution of publications, the contribution of each country, the existence of cooperation that connects national

Method

The method used in this research is bibliometric analysis (van Eck & Waltman, 2010; Van Eck & Waltman, 2012). Bibliometric analysis has the ability to build on previous studies from published articles in various countries Rahman et al., (2005) covering development, journals, authors, and research fields (Davis & Gonzalez, 2003; Rajendram et al., 2006; Rajendran et al. 2005). The research data was obtained from Dimensions.ai from 2020-2022 and resulted in 2645 articles.

VosViewer is a JAVA-based software developed by Van Eck and Waltman at Leiden University, The Netherlands in 2009. VosViewer has the ability to create maps of the development of scientific knowledge through analysis of literature / scientific articles. VosViewer software has an advantage over other bibliometric analysis software, namely in its graphical presentation capabilities, such as being able to analyze data on a large scale and having the ability to index various formats from various databases (Zhang et al., 2022).

and international researchers (Cascajares et al., 2021).

With the rapid development of research and publications on remote sensing, it is necessary to evaluate and map research aimed at improving the quality of future publications (Mohd Razali et al., 2022). Therefore, it is important to conduct a bibliometric analysis of remote sensing. This article presents a bibliometric analysis of keywords, affiliations, countries and authors.

Bibliometric research on remote sensing has been studied by several researchers, but not in large numbers and is still limited so that a wider analysis is needed. Among the bibliometric remote sensing research that has been carried out by Vijaylakshmi, (2013) with bibliometric research using the Scopus database, then research by Zhuang et al., (2013) analyzing topics that are widely studied in remote sensing, then research by Zhang et al., (2019) which examines remote sensing articles published from MDPI from 2009 to 2018 and Badaluddin et al., (2021) which examines soil moisture using remote sensing.

VosViewer also has the ability to build maps of scientific knowledge from keywords, authors, affiliations, co-occurrence, co-authorship, citations, bibliographic-coupling (Mehmood et al., 2022). Keywords are an important part of scientific work, they can provide an overview of the focus/theme in research. Keyword analysis using VosViewer software can provide information about the objects studied in scientific articles.

Co-occurrence analysis makes it possible to make an analysis of the common occurrences of lexical nouns / phrases in a scientific article in order to know the relationship between the themes of each scientific article. Sources of articles analyzed by bibliometrics come from reputable journals such as Plos One, Elsevier / Science direct, MDPI, IEEE, Springer and several other reputable international journals. The formulas for the bibliometric equations are as follows:

$$V(xi, \dots, xn) = \sum_{i < j} sij \|xi - xj\|^2 \quad (1)$$

$$\frac{2}{n(n-1)} \sum_{i < j} \|xi - xj\| = 1 \quad (2)$$

Result and Discussion

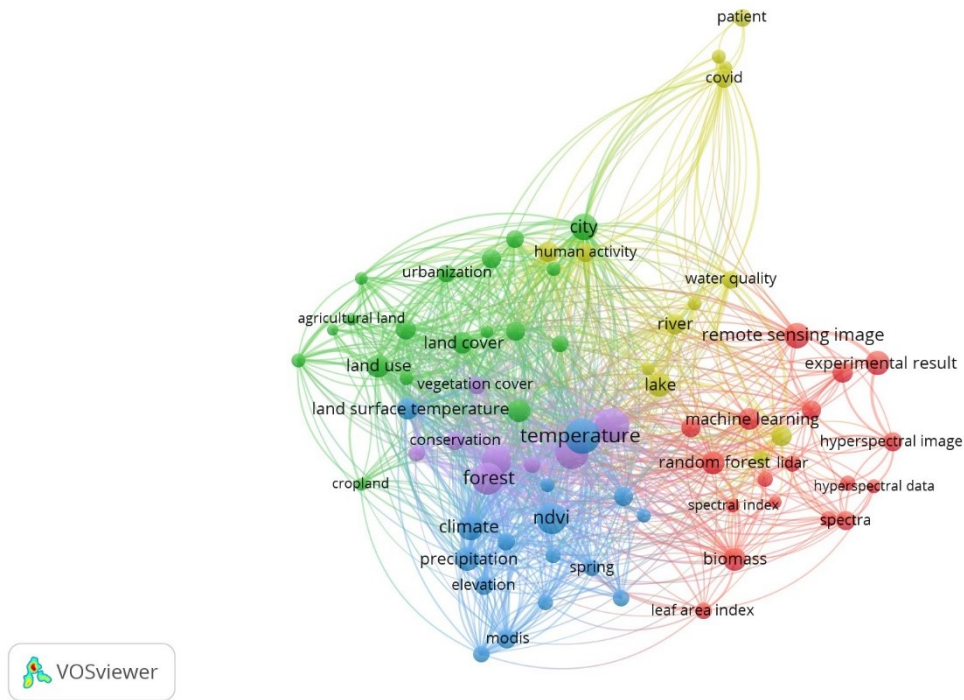


Figure 1. Bibliometric Keyword Analysis Graph

In making a grouping of popular keywords, a setting is made by making a minimum limit of keywords that appear / are often used as many as at least 30 keywords that can be indexed. There are a total of 436 keywords based on the minimum

settings that have been set. There are 5 clusters and 73 keyword items that show the intensity of research focus in remote sensing. Table 1 is the 10 main keywords that are the focus of integrated remote sensing research.

Table 1. 10 main keywords in remote sensing research

No.	Keywords	Links	Total link Strength	Occurences
1	Temperature	70	902	264
2	Ecosystem	70	840	250
3	Forest	70	752	218
4	NDVI	70	702	208
5	Vegetation	70	922	244
6	Land Use	62	523	117
7	City	66	575	161
8	Machine Learning	65	241	101
9	Biomass	62	294	109
10	Covid-19	49	248	83

Based on table 1, the keywords that often appear and are studied include sensing with Occurences 769 and other keywords such as change, accuracy, application, performance,

classification, variation, temperature, ecosystem, and NDVI.

The development of research in the field of remote sensing is very rapid and has been

integrated with other scientific fields. Several remote sensing studies related to the environment, for example, were carried out by (J. Wang, 2022) with a focus on research on the analysis of vegetation classification in landscapes. In addition, remote sensing functions have expanded to the mining sector (Song et al., 2020). Activities to monitor developments in environmental conditions by utilizing remote sensing are considered effective and have a high degree of accuracy.

The use of remote sensing with the NDVI method, one of the objects of which is to measure the density of vegetation in a landscape / landform (Gao et al., 2020). In other fields, the development of remote sensing is now more rapid, for example, regarding the detection of aircraft using super resolution (Y. Y. Wang et al., 2022).

Attention to land use change was also studied in depth using remote sensing analysis. Mapping of areas with significant changes in land use can be detected using satellites and processed using a remote sensing approach, such as research that aims to classify landscapes using the U-Net model to monitor the ecological environment (Song et al., 2020; J. Wang, 2022). In another study analyzed the classification of land use of open pit mines (Yu et al., 2022).

In addition, the use of remote sensing is used to assess how representative protected areas (PA) of ecosystems in protected forests are as one of the benchmarks in assessing progress in biodiversity conservation (Muisse et al., 2022), Analyzing Forest Health Levels (Hanavan et al., 2022). The use of remote sensing has also been used during the covid-19 pandemic sweeping the world, among her research in agricultural midwives on plant growth during the spread of covid-19 in China (Y. Wang et al., 2020).

Furthermore, remote sensing analysis has been used to analyze changes in land planning using multisourced SBERS and ASAR data (Jia et al., 2022). It is proven that the results of research using a remote sensing approach can produce reliable data. In addition, it is about classifying land resources using deep learning (Xia et al., 2022).

Among the recent studies is combining remote sensing with microbial omics-based approaches (Beatty et al., 2021). In this study remote sensing was used as a tool to analyze microbial interactions in crossing space and time. This phenomenal research investigates how microbes interact with the environment and how they impact the structure and function of ecosystems.

The study of the development of remote sensing has now also come to the study of gas emissions / pollution caused by motor vehicles, as an analytical tool, remote sensing carries out distance-based measurements to measure these emissions (Davison et al., 2020). In the field of disaster for example, remote sensing approaches are used for monitoring meteorological disasters (Ye, 2022) and geology (Z. Wang & Tian, 2021). Some specific studies on meteorological disasters are studies on floods (Tariq & Van de Giesen, 2012).

Development Focus from the side of remote sensing technology based on the results of the analysis of several articles is on machine learning (ML) and hyperspectral images for future research (Datta et al., 2022). In agriculture, the integration between remote sensing and artificial intelligence is used as a tool to increase the resilience of agricultural production systems (Jung et al., 2021), Among them to see the development of agricultural products before and after restrictions on population mobility before and after the Covid-19 pandemic (Saxena et al., 2021), and analysis of climate change issues in agricultural production (D. Xu, 2021).

During the Covid-19 period, remote sensing has many functions (Louw et al., 2022; Mir et al., 2021), such as analysis of the impact of COVID-19 on the environment and climate change and the environment using sentinel-5P imagery (Ghosh et al., 2022; Madkour, 2022), tracking the spread of covid-19 based on geographic information systems (GIS) (S. K. Das & Beborra, 2022; Ghasempour et al., 2020; Sarfo & Karuppanan, 2020), mapping traffic density in Wulan during lockdown implementation during covid-19 (Wu et al., 2021), Pre-Lockdown,

Lockdown and Post-Lockdown River Water Quality Measurements (N. Das et al., 2022).

Remote sensing Utilization Focus was also implemented during covid-19 to analyze surface temperature, Surface Urban Heat Islands Intensity (SUHI), and air pollution such as NO₂, CO₂ and O₃ during Large-Scale Social Restrictions (LSSR) (Cao & Han, 2022; Maithani et al., 2020; Parida et al., 2021; Purwanto et al., 2022), Analysis of air changes in various land cover related to COVID-19 (Matci et al., 2022), River Water Quality Analysis (Chen et al., 2022), transmission rate of covid-19 infection (Jadhav et al., 2021; Kanga et al., 2021).

Furthermore, temperature analysis of the level of spread of covid-19 (Meraj et al., 2021), changes in river and air water quality (Aman et al., 2020; Joshi & Agrawal, 2022; Kumari et al., 2022; Muduli et al., 2021; Naqvi et al., 2021; Xing et al., 2022; H. Xu et al., 2021), improved quality of snow and ice in the Indus river valley during lockdown (Bair et al., 2021), reduction of NO₂ levels during lockdown (Abdelsattar et al., 2021; Naqvi et al., 2021; Siddiqui et al., 2020), air pollution reduction rate using air pollution index (API), aerosol and GHG (NO₂) in Malaysia (Mazlan et al., 2022), in India (Mohite et al., 2022; Singh et al., 2022; Tan et al., 2022), and Egypt (Abou El-Magd & Zanaty, 2021), monitoring of chemical pollution from the boundary layers of the atmosphere during lockdown (Joshi et al., 2020; Liu et al., 2021; Rani & Kumar, 2022; Tourre et al., 2022; Varotsos et al., 2021), analyzing the agricultural harvest situation during lockdown through NDVI analysis (Saxena et al., 2021), analysis of the growth status of agricultural crops in China (Y. Wang et al., 2020).

Analysis of human mobility during lockdown (Lan et al., 2021; Shanableh et al., 2022;

Shao et al., 2022), improved quality of agricultural ecosystems during lockdown as measured through UV-aerosol indices obtained from the Sentinel-5 Precursor satellite (Pokhariyal et al., 2021), and the impact of the lockdown has had a positive impact on the biosphere as it restricts development and exploitation activities (Bhandari et al., 2021), Evaluation of mapping green spaces and ventilation in urban areas as areas that can accelerate physical and mental healing during COVID-19 (Lu et al., 2022; Pouya & Aghlmand, 2022), tracing of cooling and ecological status of urban surfaces using landsat 8 imagery during lockdown (Firozjaei et al., 2021; Mijani et al., 2022), Providing prevention against COVID-19 virus infection through mapping areas with high infection rates (Annamalai et al., 2022).

Mapping areas with the level of vulnerability to the spread of covid-19 (Meer & Mishra, 2021; Ramadan & Ramadan, 2022; Soni et al., 2022), and its relationship to the multidimensional poverty rate (MPI) (Henao-Céspedes et al., 2022), Air quality measurement during lockdown (Deng et al., 2022), The impact of lockdowns on climate change and the environment through restrictions on human activities on energy use (Madkour, 2022), in the marine sector shows that during the lockdown there was a growth of phytoplankton in the northwest of the Arabian gulf/Persia (Kuwait bay) (Polikarpov et al., 2021), In the health sector such as monitoring the status of Covid-19 infection (Yang et al., 2021), Comparison of Covid-19 infection status between medical personnel and patients (P. Wang et al., 2021), and analysis of industry-based economic sectors through spatiotemporal (Zhou et al., 2021).

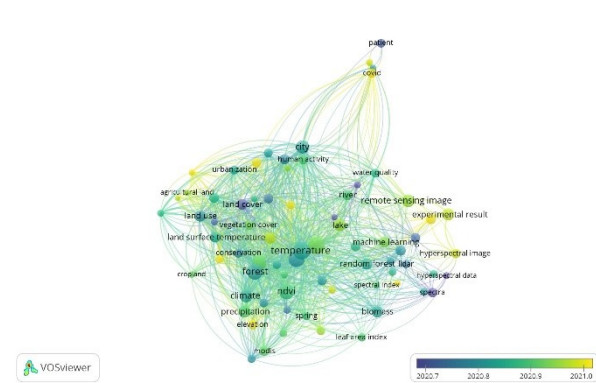
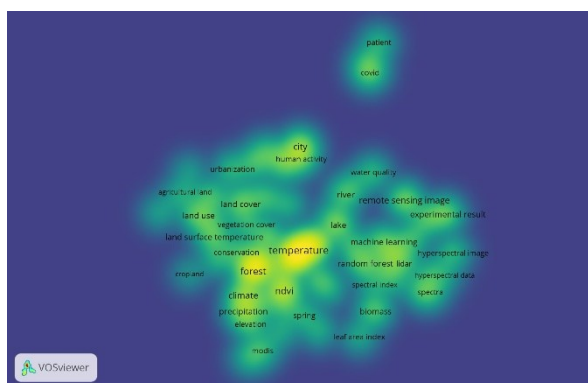


Figure 1. Keywords Density Visualization and Overlay Visualization

Density visualization (Fig.2) shows several keywords that are widely used in remote sensing research. The results of this analysis provide information on popular keywords displayed through the level of color density, the lighter the color of the keyword, the more classified it is in popular keywords or is the focus of research at this

time. By looking at density visualization, other authors can see the latest developments regarding the research focus to get a research gap in research. The popular keywords in this study were classified into 10 popular keywords found in table 1.

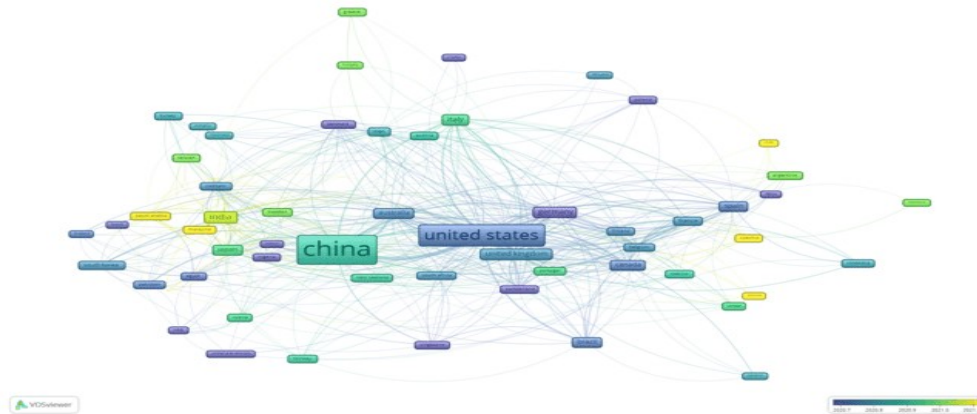


Figure 3. Country Analysis

In the analysis of countries that researched a lot on remote sensing, it was found that China was in the first position that carried out the most remote sensing research, followed by USA, India, UK, Germany, Italy, Australia, Japan, Spain, and France in 10th position.

Based on this analysis, it can be known the development of science, especially remote sensing from each country. In this classification is based on the highest number of article productions each period. The development of innovation and contribution to remote sensing science has made China occupy the first position as the most research study using a remote sensing approach.

Analyzing research institutions can help to understand the collaboration of each of these

institutions. There are 107 countries involved in research with the theme of remote sensing from 2020-2022. The results of the analysis show China as the country that occupies the first position in scientific publications with the theme of remote sensing from 2020-2022 with a total of 960 documents, 44 links, 390 link strength and 6.10 average citations, the second position is USA with a total of 571 documents, 52 links, 494 total link strength and 8.10 average citations, third India, fourth United Kingdom, fifth germany, sixth Italy, seventh Australia, eighth Japan, ninth Spain and tenth France. In table 2. can be seen in 10 countries with the most research studies with remote sensing approaches.

Table 2. The 10 largest countries with remote sensing research

Item	Links	Total Link Strength	Document	Avg.Citations
China	44	390	960	6.10
United States	52	494	571	8.10
India	35	80	157	8.83
United Kingdom	41	217	147	5.80
Germany	35	189	126	10.69
Italy	30	125	112	7.00
Australia	36	153	107	7.21

Japan	21	70	79	8.75
Spain	27	99	76	7.66
France	30	125	73	10.42

Table 2 shows that China occupies the first position in remote sensing research with a total of 960 documents, and the second largest position is the USA with 571 documents.

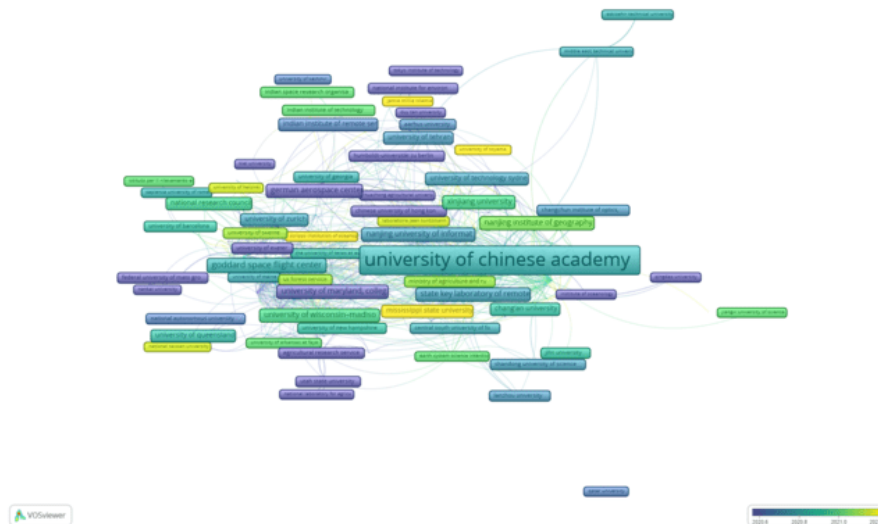


Figure 4. Affiliate Analytics Chart

Figure 4. shows that the affiliation with the most remote sensing research is the University of Chinese Academy of Science with 95 links, a total link strength of 259 and 121 documents. Databases by affiliate/university show that universities from China have more research studies compared to other countries, for example

countries in Europe. This means that the data from the country analysis is related to the data of the country's universities, where the country that has the publication of remote sensing research results is supported by various universities in the country.

Table 3. Top 10 affiliates with remote sensing research

No	Item	Links	Total Strength	Link Document	Citations	Avg.Citations	Avg.Pub (%)
1	University of Chinese Academy of Science	95	259	121	610	5.04	2020/82
2	Wuhan University	44	76	70	642	9.17	2020/90
3	Aerospace Information Research Institute	54	123	59	398	6.75	2020/92
4	China University of Geoscience	24	44	44	343	7.80	2020/73
5	University of Wisconsin-madison	56	93	26	213	8.19	2020/96
6	Goddard Space Flight Center	47	76	29	263	9.07	2020/83
7	Germany Aerospace Center	32	56	22	414	18.83	2020/55
8	University of Maryland, College Park	48	61	21	239	11.38	2020/62
9	Tsinghua University	47	60	24	160	6.67	2020/63
10	Mississippi state University	22	27	15	90	6.00	2021/20

In addition, based on the table, it was found that the highest average of publications per year 2020-2021 was the University of Wisconsin-Madison, the second was the Aerospace Information Research Institute, the third was

Wuhan University and the fourth was the University of the Chinese Academy of Science. While the affiliation with the most citations was first by Wuhan University and second by the University of Chinese Academy of Science.

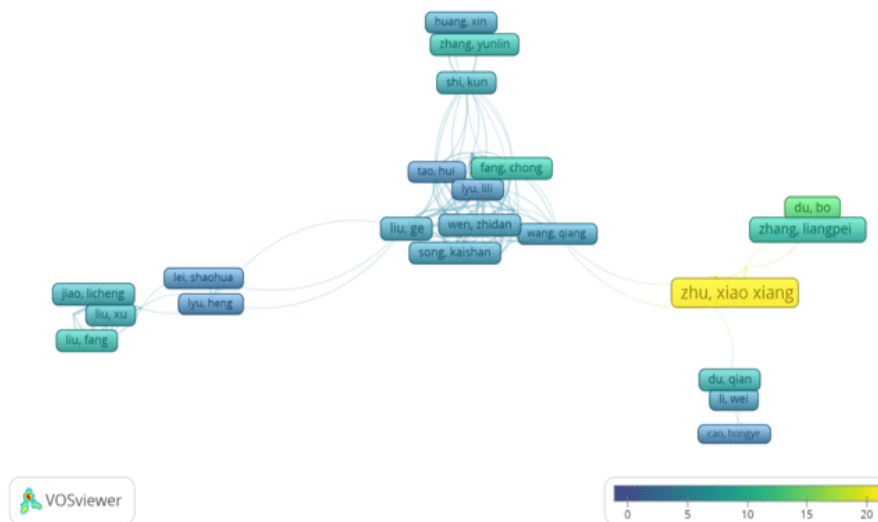


Figure 5. Graph of Author's Analysis

Figure 4 shows the 10 authors who have conducted the most research in the field of remote sensing are Liangpei Zhang, then Ge-Liu, Kaishan Song, Xiao Xiang Zhu, Yingxin Shang, Kun Shi, Chanussot Jocelyn, Qian du, Lili Lyu and Sijia Li.

Table 4. 10 Authors who do a lot of remote sensing research

No	Author	Links	Total link strength	Document	Citations	Avg. Citations (%)
1	Liangpei Zhang	4	11	15	142	9.47
2	Ge Liu	14	74	12	65	5.42
3	kaishan Song	11	71	11	58	5.27
4	Xiao Xiang Zhu	3	8	10	302	30.20
5	Yingxin Shang	11	70	10	52	5.20
6	Kun Shi	14	32	10	62	6.20
7	Chanussot Jocelyn	5	13	9	210	23.33
8	Qian du	2	5	8	60	7.50
					29	4.14
9	Lili Lyu	11	61	8		
10	Sijia Li	11	55	7	31	3.88

Based on table 4, it was found that the most cited writers were Xiao Xiang Zhu with an average of 30.20 and Chanussot Jocelyn 23.33.

Conclusion

Research on remote sensing indexed dimensions.ai is widely studied by China and America, so to find out the latest research

developments, other researchers can refer to these two countries or the 10 countries with the most publications and citations on remote sensing. Some universities and countries that can be used as references include the Germany Aerospace Center, the University of the Chinese Academy of Science, and Wuhan University.

The development of research in the scientific field of remote sensing in 2020-2022 has focused a lot on research on covid-19. Almost all areas relate to the remote sensing approach. Some of the areas of analysis results studied with remote sensing are fields such as economics, industry, environment, health, forestry, climatology, meteorology, and agriculture.

Bibliometric research with this theme of remote sensing can continue to develop every year. Therefore, other researchers may be able to recheck the results of this bibliometric analysis considering that the data analyzed is very dynamic.

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