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Scientometric Visualisation of the Documentary Array on Semipalatinsk Nuclear Test Site

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ABSTRACT

The article presents the analysis of a documentary array on Semipalatinsk nuclear test site using analytical services of the Web of Science database. It identifies the authors, organisations, countries, leading in the publications number at the research field. Shows the journals in which articles on the studied problem are published most frequently. Enumerates scientific meetings where the problems of Semipalatinsk test site were discussed and identifies the most cited publications. Using CiteSpace software, the paper reveals and visualises research fronts and its intellectual bases by means clustering and cluster automated labelling of Semipalatinsk test site papers co-citation network. Document co-citation network and research clusters are revealed using CiteSpace software. It shows, that studies are related to research of medical and biological (genetic changes, diseases as a result of ionizing radiation) effects of nuclear tests and its effects on the environmental situation (degree of contamination of the territory); the effectiveness of various dosimetry methods to determine the degree of radiation exposure on living organisms and objects of inanimate nature. The work represents scientometric visualisation of the documentary array showing research trends on Semipalatinsk nuclear test site.

Keywords: Scientometrics; Semipalatinsk nuclear test site; Web of science; CiteSpace knowledge domain visualisation; Research fronts.

1. INTRODUCTION

Semipalatinsk Nuclear Test Site (SNTS) construction started at the territory of East Kazakhstan in 1947. Creating a site for testing nuclear weapons was essential in the period of the USSR and USA confrontation. During the military and civil tests a huge amount of valuable information has been accumulated, most of which is secret up to nowadays. In 1991, after the USSR collapse, the test site was closed according to Decree no. 409 by the Kazakh Soviet Socialist Republic President N. Nazarbaev. Since that time, STS has become an object where scientists from different countries are studying the consequences of ionising radiation exposure, environment radioactive contamination. The investigation structure and directions are of great interest for the world scientific society, because similar nuclear test sites are situated in different point of the Earth, which face the same problems.

Bibliometric and scientometric information generated by analytical services of bibliographic and abstract databases (WoS, Scopus, eLibrary.ru) is increasingly demanded by specialists and scientists. The need for this type of information arises because scientometric indicators are actively involved as indicators to estimate scientific activity of research institutions and individual researchers. In addition, scientometrics is a necessary tool to study thematic areas. Many academic libraries and information centers staff has mastered the scientometric research methodology[1]. The authors try to analyse the documentary array on SNTS presented in the largest international database Web of Science (WoS) and to visualise patterns of scientific literature.

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2. SCOPE AND OBJECTIVES

The investigation relevance is due to necessity of studying consequences of nuclear tests for human health and environment, developing measures to eliminate these consequences. Main trends of researching STNS and their visualisation with WoS analytical tools and CiteSpace software are revealed. The study object is a documentary array on SNTS presented in WoS for 1983-2018 mainly in English. Russian-language corpus of documents from the Russian Index of Science Citation (DB eLibrary.ru) was not included in the study, as CiteSpace operates only with English language records

3 METHODOLOGY

The WoS analytical tools make it possible to characterise publications on the following aspects - number of publications, the dynamics of publications in time, the most productive authors, institutions, countries, sources of documents publishing; spreading documents on thematic categories.

Bibliometric data of the publications, retrieved from WoS and exported into CiteSpace, give possibilities to plot networks using the CiteSpace analytical and visualising tools. Networks nodes represent documents; links between the nodes mean co-citation of documents (a link is joint quoting of two publications in the third one). Its thickness shows the co-citation frequency of a definite publications pair; its color reflects the first co-citation year. The network and its nodes have other parameters: citation burst represents the year of citation beginning and termination and its duration; betweenness centrality (BC) is the importance of the network node. Papers with large BC values are regarded the most significant, their nodes are key ones (pivotal points)[2-4].

CiteSpace groups nodes into clusters and labels the clusters with keywords (Author Keywords or Keywords Plus (WoS), terms, phrases, derived from titles of the documents and abstracts of the citing documents. Thus, CiteSpace combines methods of bibliometric analysis, visualising information, and data mining algorithms to form a tool for visualising new data based on the data about citation

4 SCIENTOMETRIC ANALYSIS OF A DOCUMENTARY ARRAY ON SNTS WITH WOS SERVICES

Web of Science (WoS) includes 376 papers on May 2018 concerning SNTS. Since 1994, after STS closure as a nuclear test site, it is observed rising the number of publications caused by the increased interest of scholars to study the consequences of its activities: the peak number of publications (38 document) was noted in 2006 (Fig. 1). Further, the publication amount is reduced and varies 7-20 works a year. 2018 is not an indicative year, as not all documents published in 2018 have been represented in WoS till this study.

The typological composition of WoS documents shows dominating periodicals papers (272 journal article) and proceedings (147 conference proceeding and abstracts). Besides, there are 10 review, a book chapter, and other (notes, letters, editorials). The main language of publications is English (94.4 % - 355 documents). It's natural, as WoS is English language DB. Papers in Russian and German are few, respectively 4.5 per cent (17 documents) and 1.1 per cent (4 ones). Of 33 countries participating SNTS research Kazakhstan, Russia, Japan, USA, Germany are the most productive in terms of publication activity; the authors' works of the studied corpus are affiliated with them and are as shown in Table 1 (it includes countries with more then 10 publications).

Table 1. Countries/regions participating research at SNTS

Country	Documents number	Country	Documents number
Kazakhstan	182	UK	29
Russia	112	France	16
Japan	90	Austria	11
USA	86	Italy	11
Germany	41	Norway	11

363 organisations took part in studies presented in the considered documents corpus, where the leaders in publication amount are the University of Hiroshima, the Research Institute of Radiation Medicine and Ecology of the Ministry of Health of the Republic of Kazakhstan, the National Nuclear Center of the Republic of Kazakhstan, institutions of the Russian Academy of Sciences, etc. as shown in Table 2.

Among the authors with high publication activity on the topic should be noted employees of research institutions of Kazakhstan, Russia and universities of Japan and the United States. After nuclear tests shutdown, Kazakhstan began actively cooperating with the above-mentioned countries (Tables 1-3) to investigate the consequences of nuclear explosions on human health and environment. The author-leader in the publication number is Masaharu Hoshi (59 documents), a Professor Emeritus of the University of Hiroshima

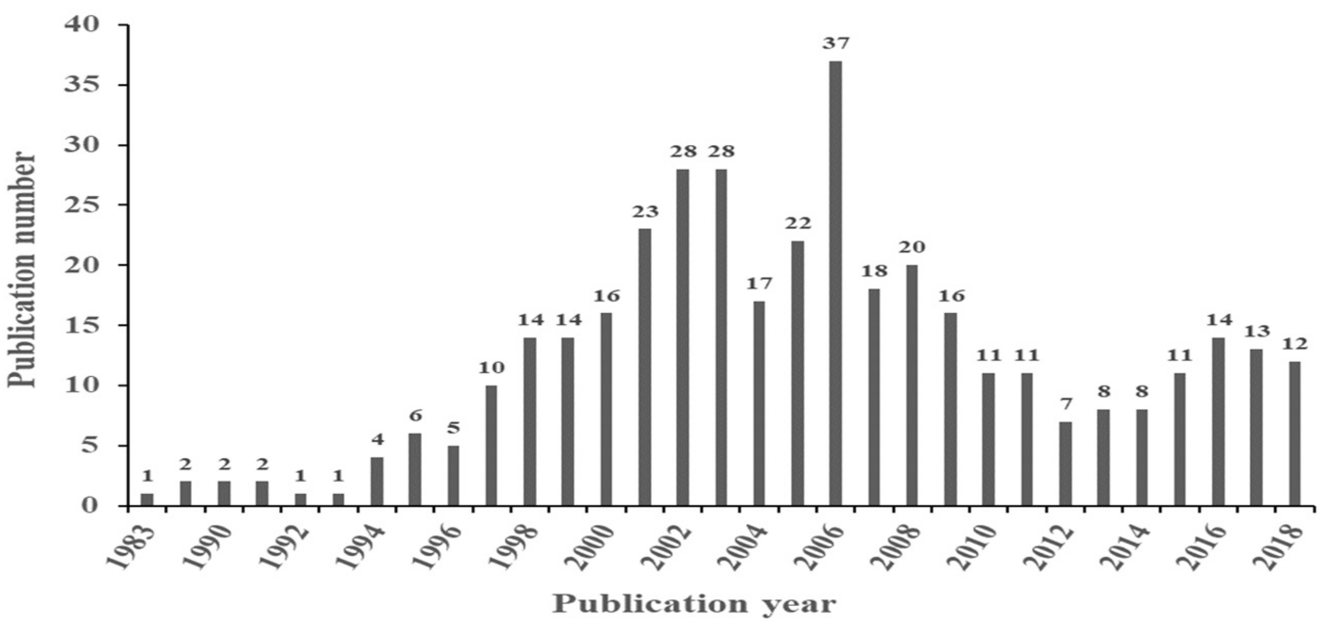

Figure 1. Dynamics of publications on SNTS.

Table 2. Leading organisations by number of publications concerning SNTS

Organisation, country	Documents number
Hiroshima University, Japan	65
Kazakh Research Institute for Radiation Medicine Ecology, Kazakhstan	49
Russian Academy of Sciences, Russia	37
Kazakhstan National Nuclear Center, Kazakhstan	35
Research Center for Environmental Health, Helmholtz Association, Germany	35
Semey State Medical University, Kazakhstan	27
Kanazawa University, Japan	26
Nagasaki University, Japan	21
National Cancer Institute, USA	21
National Institute of Health, USA	21
Institute of Nuclear Physics, Kazakhstan	20

Table 3. Authors leading in the publications amount

Author	Affiliation	Country	Papers number
Hoshi M.	Hiroshima University	Japan	60
Gusev B.I.	Kazakh Research Institute for Radiation Medicine & Ecology	Kazakhstan	38
Apsalikov K.N.	Kazakh Research Institute for Radiation Medicine & Ecology	Kazakhstan	30
Yamamoto M.	Kanazawa University	Japan	26
Endo S.	Hiroshima University	Japan	20
Zhumadilov Z.	Nazarbayev University	Kazakhstan	20
Tanaka K.	Hiroshima University	Japan	19
Simon S.L.	National Cancer Institute of National Institutes of Health	USA	19
Toyoda S.	Okayama University	Japan	18
Zhumadilov K.	L.N. Gumilyov Eurasian National University	Kazakhstan	18

(according to ResearchGate https://www.researchgate.net/profile/Masaharu_Hoshi). His area of interest is defined as Radiation Detection, Radiation Protection, Radioactivity (by WoS thematic headings). The authors-leaders list includes specialists from other Japanese universities: Hiroshima - Satoru Endo, Kenichi Tanaka, Aya Sakaguchi, Jun Takada; Nagasaki – Shunichi Yamashita, Noboru Takamura; Okayama – Shin Toyoda; Kanazawa - Masayoshi Yamamoto. Studies of the radiation effects on biota, including humans, have been the focus of Japanese scientists since the tragedy in Hiroshima and Nagasaki. Kazakhstan scholars obtain a significant number of publications in the considered information array: B.I. Gusev and K.N. Apsalikov (Research Institute of Radiation Medicine and Ecology of the Ministry of health of the Republic of Kazakhstan); Zh. Zhumadilov (N. Nazarbayev University), K. Zhumadilov (L.N. Gumilev Eurasian National University), S.N. Lukashenko (National Nuclear Centre of the Republic of Kazakhstan). Russian specialists who take part in research are employees of A. F. Tsyba Medical Radiological Scientific Center (Obninsk, Russia), among them V.F. Stepanenko and V.I. Ivannikov lead in the number of publications in the studied documents corpus. The main American institution engaged in studying SNTS is the National Cancer Institute, National Institutes of Health, where most of the work on the subject belongs to S.L. Simon, A. Bouvill, N.K. Luckyanov. Table 3 includes Top-10 authors' names with the highest publication activity on the topic.

47 of 376 documents (according WoS data) describes research carried out with grant support (53 grant). Among the funding organisations Japan Society for the Promotion of Science, National Cancer Institute and National Institute of Allergy and Infectious Diseases of the USA, Ministry of Education and Science of the Republic of Kazakhstan, European Commission are called most often.

As mentioned above, the journal articles and conference proceedings in English combine the most documents body. Table 4 shows major journals, which published the documents on SNTS research. The lower ranking threshold is 10 documents and more.

Scientific meetings of different form play a significant role in the information exchange and discussions between scientists and specialists, their proceedings allow us to judge the state of modern scientific and applied research. It is necessary to highlight forum titles with a great number of reports dedicated SNTS in WoS: NATO Advanced Research Workshop on Nuclear Physical Methods in Radioecological Investigations of Nuclear Test Sites (Almaty, Kazakhstan, 7-10 June 1999); NATO Advanced Research Workshop on Environmental Protection Against Radioactive Pollution (Almaty, Kazakhstan 16-19 September, 2002); 3rd Dosimetry Workshop on the Semipalatinsk nuclear Test Site area, (Hiroshima University, Hiroshima, 9-11 March, 2005); NATO Advanced Research Workshop on Nuclear Risks in Central Asia (2005). Almaty, Kazakhstan 20-22 June, 2006); Global Strategic Center for Radiation Health Risk Control: Meeting of Nagasaki University on Global COE Program (Fukushima, January 29 – 30, 2012) and others.

To get an idea of the research topics reflected in the analysed documents, it is necessary to refer to their distribution by WoS categories – publication thematic profiles. Several categories at the same time could be assigned for both journals and documents published in them. 109 documents of the

Table 4. Top-10 of journals published documents of the studied corps on SNTS

Edition title, (country)	Quartiles by topic sections in WoS	Publ. number
Journal of Radiation Research (Japan)	Radiation – Q2; Radiology, nuclear medicine & imaging – Q2	35
Radiation and Environmental Biophysics (Germany)	Biology Q2; Biophysics Q3; Environmental sciences Q2; Radiology, nuclear medicine & medical imaging Q2	21
Health Physics (USA)	Environmental sciences Q3; Nuclear science & technology Q2; Public, environmental & occupational health Q3; Radiology, nuclear medicine & medical imaging Q3	18
Radiation Measurements (UK)	Nuclear science & technology Q1	17
Journal of Environmental Radioactivity (the Netherlands)	Environmental sciences Q2	16
Journal of Radioanalytical and Nuclear Chemistry (Hungary)	Analytical chemistry Q3; Nuclear science & technology Q2	14
Pure and Applied Geophysics (Switzerland)	Geochemistry & geophysics Q3	14
Radiation Research (USA)	Biology Q2; Biophysics Q2; Radiology, nuclear medicine & medical imaging Q2	12
Bulletin of the Seismological Society of America (USA)	Geochemistry & geophysics Q2	10
International Congress Series	Published until 2008, ceased	10

Table 5. The distribution of documents by WoS subject categories

WoS subject category	Documents number
Radiology Nuclear Medicine Medical Imaging	111
Environmental Sciences, Ecology	110
Nuclear Science Technology	104
Life Sciences, Biomedicine Other Topics	72
Public, Environmental, Occupational Health	54
Oncology	51
Geochemistry Geophysics	42
Biophysics	41
Chemistry	35
Physics	22
Engineering	16
Science Technology Other Topics	15
Genetics Heredity	13
Geology	13
Pathology	11
Biochemistry Molecular Biology	10

selected array are relevant to Radiology, Nuclear Medicine & Medical Imaging (Radiology, Nuclear medicine and medical imaging); 106 - Environmental Sciences, Ecology (environmental Science, Ecology); 104 - Nuclear Science Technology (Nuclear technology). The documents of the studied corpus are classified into 67 categories presented in Table 5 (only categories assigned to ten or more documents from the studied array are as shown).

Topics and keywords analysis (Table 6) shows that the main areas of research are the following:

- medical aspects of radiation effects on human health and living organisms
- ways to determine and control the environment radioactive pollution
- nuclear weapon test explosions impact on seismic activity.

Sum citing of the whole information massif is 1821 (without self-citing), an average document citing is 7.26. Publications with the highest citation value are as shown in Table 6.

5. VISUALISING AND ANALYSING THE INFORMATION ARRAY ON SNTS USING CITESPACE SOFTWARE

For additional thematic analysis of SNTS research problems CiteSpace software is applied to the same array of documents retrieved from the WoS (see above). There are lots of visualising tools used to represent data in the form of graphs and images[15-16]. The CiteSpace software used in this paper provides wide opportunities for the analysis and visualisation of patterns and trends of scientific literature[2-4]. It combines the techniques of bibliometric analysis, information visualisation, and data mining algorithms forming a tool that clearly shows new characteristics of the information array

Table 6. Top-10 of publications with the highest citation value according to WoS

Citation number	Publication year	Keywords of authors, WoS	Paper
78	2002	antioxidant enzymes; ionising radiation; Poaceae	Zaka, et al. Journal of Experimental Botany,53[5]
64	1992	nuclear explosions; regional magnitude anomalies; satellite imagery; seismic magnitudes; yield estimation	Ringdal, et al. Geophysical Journal International,109, 75[6]
62	1996	Pu isotopic ratio; (240) Pu; (239) Pu ratio; high resolution ICP-MS; Semipalatinsk; nuclear test site; soil; former USSR	Yamamoto, et al. Radiochimica Acta, 72: 209[7]
57	1998	nuclear test site; Techa River; radioactive contamination; radionuclides	Beasley, et al. Journal of Environmental Radioactivity, 39: 215[8]
52	1997	Semipalatinsk; nuclear test site; dosimetry	Gusev, et al. Radiation and Environmental Biophysics, 36: 201[9]
50	1996	soil; radioactivity; plutonium; atomic bomb	Yamamoto, et al. Health Physics, 71:142[10]
45	2006	United States earthquakes; Central Asia; seismic events; Novaya Zemlya; Lop-Nor; amplitude corrections; NTS explosions; China; wave spectra; propagation	Fisk, Bulletin of Seismological Society of America, 96:2348[11]
43	2005	atomic-bomb survivors; test-site; thyroid-disease; Mayak workers; follow-up; participants; population; risk	Bauer, et al. Radiation Research,164, 11[12]
38	2002	accidents, nuclear; calibration; dose assessment; exposure, population	Ivannikov, et al.Health Physics, 83:183[13]
36	1999	Semipalatinsk; nuclear tests; TLD; brick; external dose	Takada, et al. Journal of Radiation Research, 40, 337[14]

Table 7. Publications ranked for co-citation frequency, and publications with BC value > 0.1 in DC network according to Figure 2

DCA number	BC value	Year of publication	Paper
32	0.27	2002	Gordeev, et al. Radiation and Environmental Biophysics, 41: 61[19]
25	0.03	1996	Yamamoto, et al. Health Physics, 71:142[10]
25	0.01	2005	Imanaka et al. Journal of Radiation Research, 46: 395[23]
21	0.29	1997	Gusev, et al. Radiation and Environmental Biophysics, 36: 201[9]
21	0.05	1999	Takada et al. Journal of Radiation Research, 40: 337[14]
16	0.01	2002	Grosche et al. Radiation and Environmental Biophysics, 41: 75[24]
15	0.02	2002	Ivannikov et al. Health Physics, 83:183[13]
12	0.14	2006	Zhumadilov, et al. Journal of Radiation Research, 47: A47[21]
12	0.09	2004	Bailiff et al. Health Physics, 87: 625[26]
12	0.08	2006	Ivannikov, et al. Journal of Radiation Research, 47: A39[26]
12	0.01	2004	Sakaguchi et al. Journal of Radioanalytical and Nuclear Chemistry, 260:543[27]
12	0.01	2006	Stepanenko et al. Journal of Radiation Research, 47: A149[28]
11	0.19	1998	Gusev et al. Radiation and Environnemtal Biophysics, 37: 209[18]
11	0.16	2003	Simon, et al. Health Physics, 84: 718[20]
11	0.04	2006	Gordeev et al. Journal of Radiation Research, 47: A129[29]
5	0.10	2009	Zhumadilov, et al. Radiation and Environmental Biophysics, 48: 419[30]
4	0.11	2000	Ivannikov, et al. Applied Radiation and Isotopes, 52: 1291[22]

based on references. This software presents the possibility to create several types of networks and to carry out several types of analyses: DCA – document (references) co-citation (DC) analysis, ACA – author co-citation analysis, co-occurence of word analysis (or co-word analysis), etc. Documents, authors, countries, organisations, scientific journals, co-occurred words and phrases extracted from paper titles, keywords (Author or Keywords Plus of WoS) and abstracts are nodes of these networks. Links between nodes are co-citation of documents, authors or co-occurrence of keywords, phrases, terms. The method is a way to determine the relationship between different publications in a research field: if two references (two authors) are cited together (co-cited) in the third one, then they are likely to belong to the same scientific research field. The co-citation method may indicate the research area formation.

The co-citation network in CiteSpace consists of nodes of different sizes. Each node in CiteSpace is a separate reference or author. The node size is determined by a frequency of the document (author) citations. A spectrum of colors indicates the temporal orders of co-occurrence links among references/authors: oldest in blue, and newest in orange. Nodes are characterised by the number of links (a link is a co-citation of this document with another document in the third article). Two other parameters characterising the network and nodes are citation burst (or citing beginning, end (years) and citation duration); betweenness centrality (BC) is the number of shortest paths between other nodes passing through a given node)[18], which characterises the node importance in the network. Articles (authors) with large BC values are considered to be the most significant, and their designating nodes are key nodes (pivotal points).

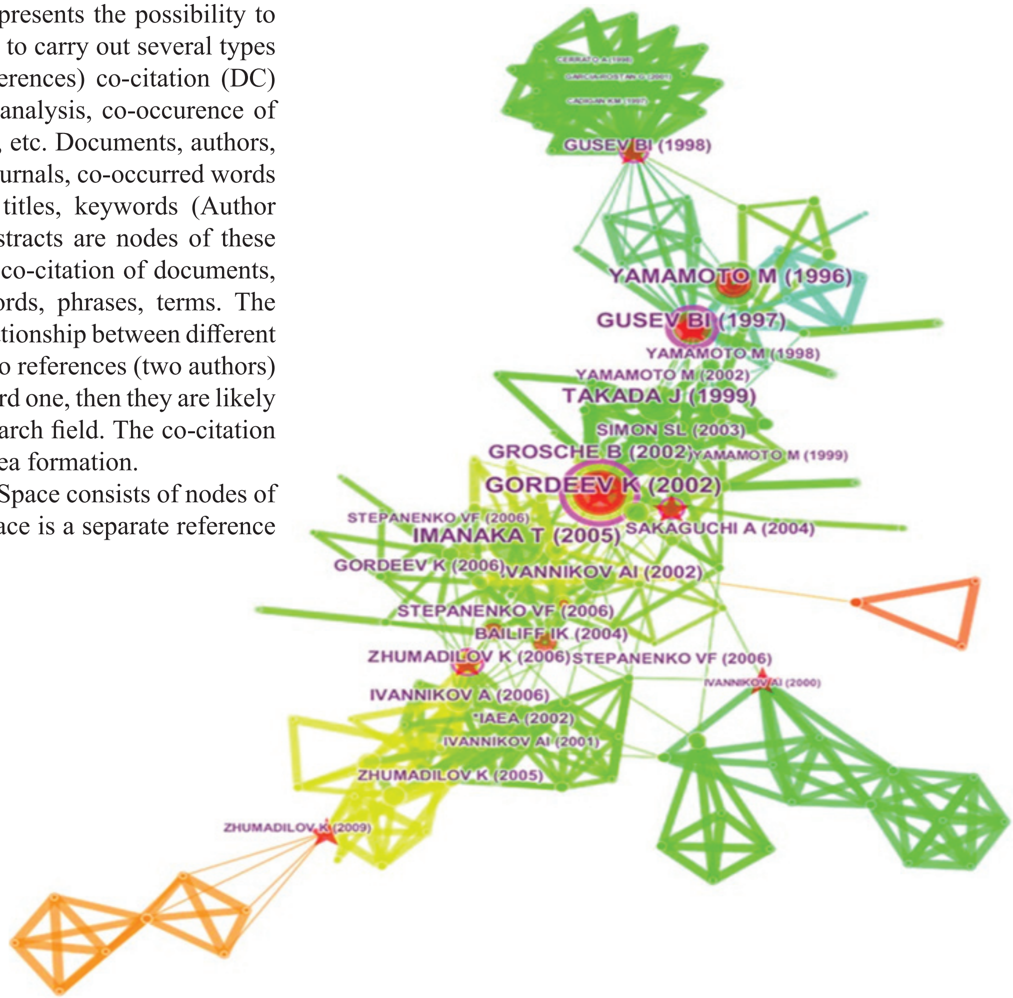

Figure 2, DC network on SNTS research. A network of 6229 co-cited references representing citation patterns of the 381 SNTS's articles between 1983 and 2018. Nodes in the network with BC value > 0.1 marked with asterisks (Table 7) and with red circus the with high level of burstness (Table 8). Most frequently co-cited papers marked with the name of the first author and year of the publication. Lines that connect nodes are co-citation links. The colors of these lines show when a connection was for the first time. (Note: For a colored illustration of this figure, the reader is referred to the web version of the article). The node color (from red to violet) is related to the year of citation (than colder is the color, the earlier the document citation dates are).

The DC network has been plotted based on 6229 references in 381 papers (retrieved from WoS Core Collection) for 1983-2018. It identifies 210 nodes connected by 540 co-citation links. Nodes highlighted with a purple rings of different thickness are those with the BC value > 0.1. Key publications in CC network are works with a high value of BC (Table 7). According to the graph theory, the greater is BC value, the more are the shortest paths connecting two other pairs of nodes pass through this node. By CiteSpace data the key publications of DC network are papers by Gusev at al. (1997, 1998)[9,18], Gordeev et al. (2002)[19], Simon et al. (2003)[20], Zhumadilov et al. (2006)[21], Ivannikov et al. (2000)[22] on SNTS study.

Figure 2 demonstrates documents co-citation network: papers with high co-citation value are marked by names of the first author and a year of a publication; articles with a high BC number are tagged with asterisk.

CiteSpace allows us to select work in the network (Table 8) on their citation burst. The publications with the strongest citation bursts are signed out by red circles of different diameters (Table 8). The citation burst is an integral indicator that takes into account not only citation frequency of the document, but as well how soon and how long it has been cited after publication. The works with highest citation burst are by Gordeev et al. (2002)[19] and Gusev et al. (1997)[9].

45 clusters, of them 10 visually represented, are identified in the DC network by CiteSpace. Authors' key words of the citing publications have been chosen for automatic labelling of clusters in Fig. 3 by the log-likelihood ratio (LLR) test (Fig. 2 and Fig. 3). This method allows identifying the cluster special aspects. Table 9 presents the cluster characteristics: DC network cluster identifier (ID); cluster size (number of references in the cluster); cluster silhouette, as well as the data

Table 8. Top-7 references with the strongest citation bursts

References	Year	Strength	Start	End	1983 - 2018
Yamamoto, Health Physics, 71: 142[10]	1996	8,6	1998	2004	
Gusev et al. Radiation and Environmental Biophysics, 36: 201[9]	1997	6,8	1998	2005	
Ivannikov et al. Radiation Measurements, 42: 1015[31]	2007	4,7	2008	2011	
Hoshi et al. Radiation Measurements, 42: 1005[32]	2007	4,7	2008	2011	
Gordeev et al. Radiation and Environmental Biophysics, 41: 61[19]	2002	4,6	2004	2010	
Stepanenko et al. Journal of Radiation Research, 47: A149[28]	2006	4,4	2006	2007	
Bailiff et al. Health Physics, 87: 625[25]	2004	4,4	2006	2007	

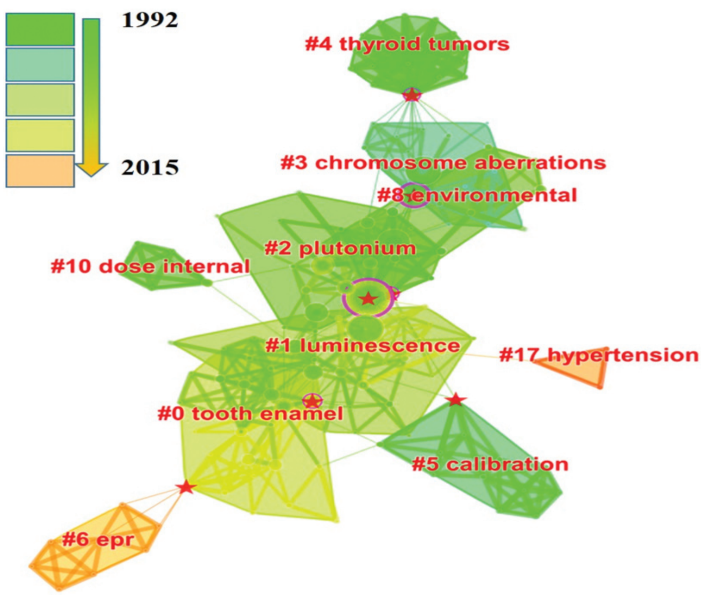

Figure 3. DC network clusters of the SNTS research field. Clusters are numbered and labeled in red color. Color of the cluster means the average year of publication of the references the cluster includes (Table 9). Clustering characteristics: modularity Q=0.7428; mean silhouette=0.5608.

of two other methods - latent semantic indexing technique and mutual information for automatic labelling of clusters, which are not represented in Fig. 3.

The analysis of resulted graphics allows us to reveal the following research fronts:

- Analysis of radioactive elements distribution are the territory of SNTS and other territories, where nuclear tests or radiation accidents occurred, its impact on ecosystems and humans (clusters 2 and 8)
- Studies using retrospective methods (reconstruction of radiation doses obtained during irradiation (nuclear tests, accidents) dosimetry: electron paramagnetic resonance (EPR) dosimetry with tooth enamel, thermoluminescent dosimetry (clusters 0, 1, 5, 6, 10)
- Investigations of the frequency of stable chromosomal aberrations (translocations), gene mutations in animals (in human, particularly) and plants at the territory of STS (cluster 3)
- Oncological diseases, in particular diseases of the thyroid gland, at STS territory (cluster 4)
- Cardiovascular diseases in the Semipalatinsk Historical Cohort (cluster 17).

Arranging clusters on an average publication year (Fig. 3) of its document shows, that the oldest clusters are 3, 4, 5, 10. That is, the earliest studies on SNTS covered biota genetic changes caused by mutations and the cancer prevalence. Simultaneously, investigations were directed towards tools of radiation dosimetric measurements (cluster 10). Later, scholars researched the radiation contamination map of SNTS territory (cluster 2, 8), continued development of dosimetry techniques (clusters 0, 1, 6) tr reconstruct radiation doses received by SNTS population in different periods of its existence.

The youngest clusters are 6 and 17. Cluster 6 is closely related to clusters 0 and 5 (tooth enamel calibration), applying a method of electron paramagnetic resonance dosimetry with tooth enamel. These studies allow evaluating the contamination level and character, risks for human health at territories adjacent SNTS. Zhumadilov (2009)[31] and Ivannikov (2006)[27] are the first authors of key publications in cluster 6. Cluster 17 includes only 3 papers and aims at studying the cardiovascular diseases of the Semipalatinsk Historical Cohort due to radiation exposure.

Numerous studies in SNTS have been carried out within the international and national program frameworks. They was necessary to assess the level and nature of contamination nowadays, to evaluate risks for the population, to elaborate measures to clean SNTS territory.

Table 9. Clusters of DC network

Cluster ID	Size	Silhouette	Average year	Lable by LSI*	Lable by LLR**
0	26	0.868	2005	tooth enamel	tooth enamel
1	25	0.791	2004	Semipalatinsk nuclear test site	luminescence
2	21	0.854	2000	Semipalatinsk	plutonium
3	18	0.845	1996	Semipalatinsk	chromosome aberrations
4	17	0.994	1998	radionuclides	thyroid tumors
5	12	0.973	1998	accidents nuclear	calibration
6	8	0.973	2011	radiotherapy	EPR
8	6	0.944	2001	Semipalatinsk	environmental
10	5	0.994	1998	dose internal	dose internal
17	3	1	2013	hypertension	hypertension

*LSI - Latent Semantic Indexing, **LLR - Log-likelihood ratio.

6. CONCLUSIONS

Thus, a multi-faceted scientometric study of the scientific direction was carried out using WoS analytical tools and CiteSpace software, which combines the methods of bibliometric analysis, information visualisation and data mining. The information array on SNTS presented in DB WoS is highlighted. It is shown that active studies of the consequences of nuclear weapons tests at SNTS territory began after it was closed by order of President N. Nazarbayev. The scientometric analysis of the information array identified the authors, organisations, countries leading in the number of publications on the research problem; named the journals with the highest publishing activity on the topic are shown; the scientific events discussed SNTS problems; revealed the most important publications are identified. Document co-citation network and research clusters using CiteSpace software. Investigations carried out on SNTS territory are related to studying medical and biological (genetic changes, diseases as a result of ionising radiation) effects of nuclear tests and its effects on the environmental situation (degree of contamination of the territory); the effectiveness of various dosimetry methods to determine the degree of radiation exposure on living organisms and objects of inanimate nature.

Kazakhstan and Russia are active participants in studying the problems of SNTS. Probably, additional aspects of STS investigation (epidemiology of diseases related to radioactive pollution, the role of local medical authorities to reveal population morbidity, evaluation of future risks for human health, etc.) can be obtained by scientometric analysis of the document arrays from the Russian Index of Science Citation (DB eLibrary.ru), because it contains the Russian language part of the document flow unrepresented in WoS. Unfortunately, this document array can't be analysed using CiteSpase, as this software supports only English-language content. Similar software to analyse Russian-language information we do not know. Our further research is aimed at the analysis of the Russian-language corpus of documents on SNTS of much larger volume.

Such a way, the work shows research trends on SNTS by means of scientometric visualisation of the documentary array.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest Information about authors

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