

Analysis of the CTBTO scientific communication using network visualizations

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The CTBTO Library performed a comprehensive analysis of the CTBTO scientific communication, by using bibliometric and scientometric techniques, through key network visualizations representing contribution to the global scientific community during the 25 years of its creation.

In the context of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification system, the analysis incorporated the content review of more than 3,000 scientific publications, including but not limited to papers, conference proceedings, books, book chapters, expert reports, and dissertations (from 1998-2021) where CTBTO Preparatory Commission and the Treaty were mentioned by experts from different backgrounds and institutions that interacted and contributed with innovative solutions to improve the verification regime.

In this framework, the visualizations offer an innovative approach to represent the complexity of this universe; characterizing all the connections between experts, subjects of interest in common, institutions, and countries.

The analysis was accomplished using the following software:

- a) Mendeley (free software);
- b) VoSviewer (open source)

The role of the metadata was crucial, especially for the standardization of author, keywords, institutions, and countries. These representations expressed the network between clusters as well as co-occurrence, and relatedness based on the frequency of publications.

The CTBTO Library main goal is to support novel strategy development by experts, ensuring sources of reliable information as well as keeping up to date the community with the latest research about the four main monitoring technologies of the verification regime by providing access to technical and scientific databases to the entire PTS.

The CTBTO Library as part of the Capacity Building Section, IDC Division (IDC/CBT), was tasked to develop a map of knowledge to understand accurately the specific information needed by the users, as well as to learn how CTBTO experts communicated with the scientific community.

To address this challenge one of best tools of the Bibliometrics in Library Science is the **social network analysis approach**. This framework allows to identify how the knowledge grows and learn when, how and who has established connections.

The network visualization represents with bubbles the number of publications with links, direct connection and interaction in co-authorship, on the same organization or with many others every time one author recognize its affiliation; countries in this particular analysis represent the collaboration between CTBTO State Signatories.

This study provides insights where CTBTO may develop capacities with other institutions in terms of seismic, hydroacoustic, infrasound and radionuclide monitoring technologies to achieve its goal.

Objective

Determine how CTBTO Preparatory Commission establish scientific communication through its scientific publications in a global scientific community.

The following steps were established:

Step 1: CTBTO database creation	Step 2: Data Collection
<p>Manual entry of data focused on the following metadata fields:</p> <ul style="list-style-type: none"> • Experts's name; • CTBTO affiliation; • Title of each document; • Abstract; • DOIs (when available); • Source of publication; • Year; • Keywords 	<p>Retrieve and collecting from different scientific databases documents that mention CTBT and CTBTO, filtering searches in a period of 1998- 2021 with the following criteria:</p> <ul style="list-style-type: none"> • Full and partial author(s) name; • Institutional affiliation; • Field of research; • CTBT or CTBTO keywords mentioned in abstracts or text.
Step 3: Data Curation	Step 4: Data Analysis
<p>Identifying and tracking metadata accuracy:</p> <ul style="list-style-type: none"> • Full and partial typo/spelling mistakes on researcher's name; • Mismatches of institutional affiliation; • Mismatches on research field; • Mismatches in countries. 	<p>Comparison of field, country and institutional affiliation, number and type of publications in local, regional and international levels.</p> <ul style="list-style-type: none"> • Reviewing with the current 95 authors working at CTBTO; • Retrieving from the authors not indexed in scientific databases.

The sources used for this analysis during the last 2 years were:

Databases	Institutional repositories
<ul style="list-style-type: none"> • Dimensions, • Scopus, • Science Direct, • Web of Science, • Springer, • Google Academic, • Microsoft Academic, • Frontiers, • Hindawi, • MIT Press Journals, • Academic Oxford University Press, • AGU publications, • ASA, • Wiley, • IEEE Explore; 	<ul style="list-style-type: none"> • AGU, EGU, • SnT editions (CTBTO), • Orbit, • eScholarship, • Calhon, • Discover, Boris, • Korea Science, • SSOR, • DOAJ, • NCBI PubMed, • CORE, • Osaka University Library, • Hindawi, • Mountain Scholar, • Astrophysics Data System (NASA), • Semantic Scholar.

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Documents identified

Figure 1. 823 scientific documents were collected (from 1998-2021)

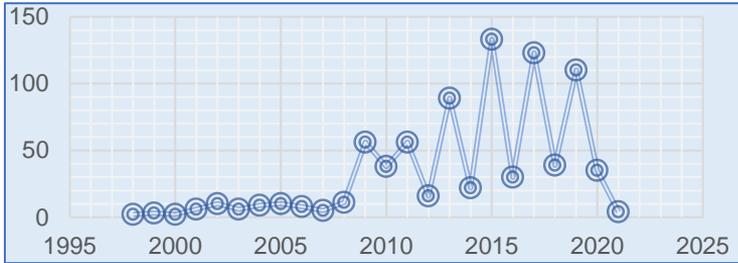
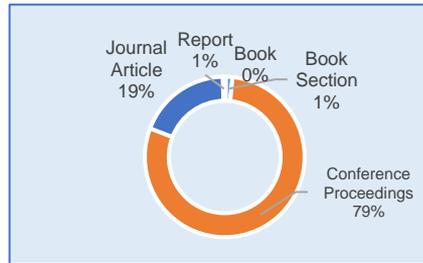


Figure 2. Scientific publications collected included papers, conference proceedings, books, book chapters and expert reports



Availability

Figure 3. 79% of this content is open access, whereas 21% are **paywall scientific papers**

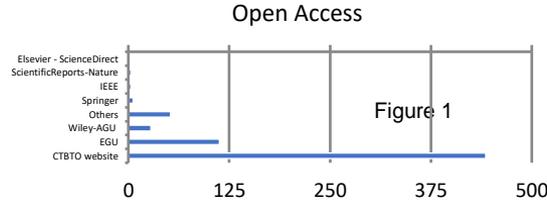
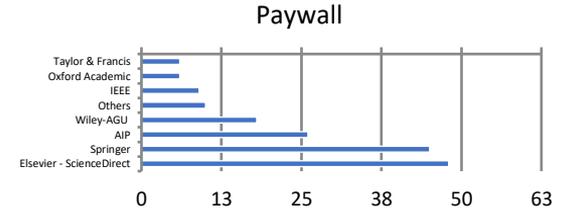


Figure 4. Public sources are available through CTBTO website, AGU, EGU, Scientific Reports (Nature) and others.

Others such as ACM digital library, ARPA site, Arxiv.org, Astrophysics Data System, BMU, Columbia University Repository, First Pan-American/Iberian Meeting on Acoustics, Frontiers, GFZ repository, INESAP, IRIS Repository, JSTAGE, Nature, NZIIA, SaPub, Scien

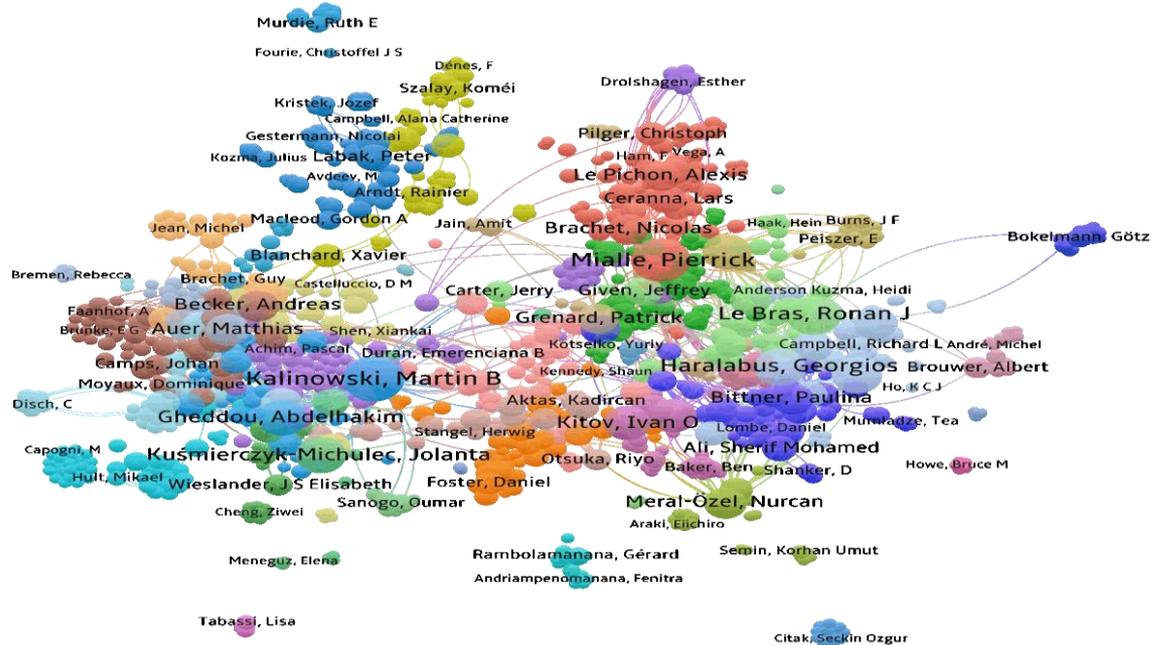
Figure 5. Paywall scientific papers are in prestigious scientific journals such as Science, Applied Radiation and Isotopes, Atmospheric Environment, and many others.



Authorship

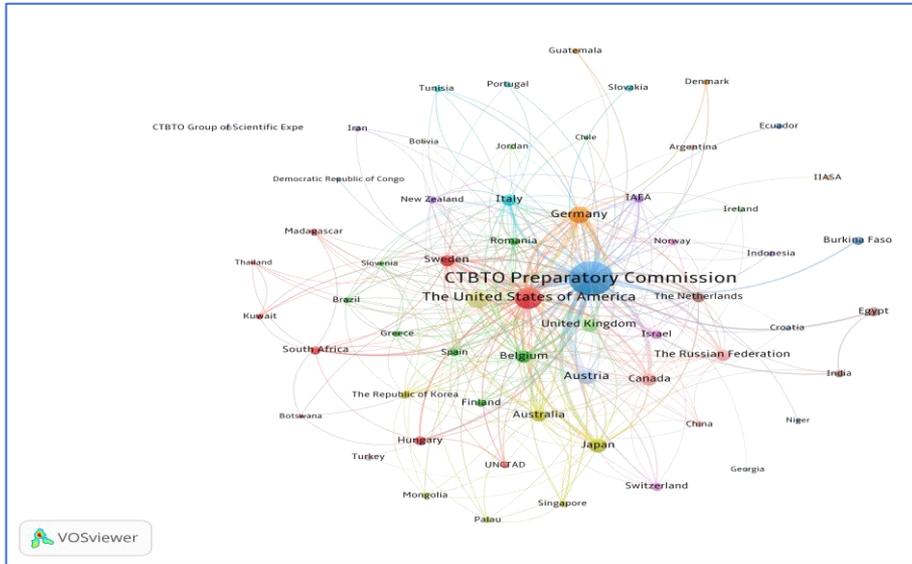
Figure 6. 279 authors (affiliated to CTBTO) leader the scientific production, from which 34,05% are currently working at the organization.

During the period from 1998-2021, 39 clusters were developed (each bubble represents one author, colors represents clusters).

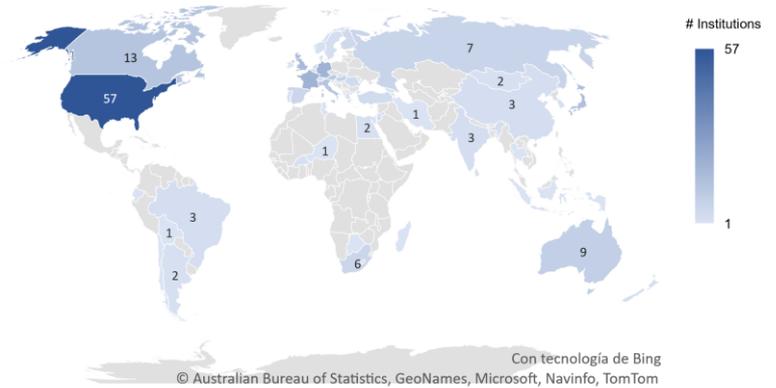


Countries

Figure 9. From the co-authorship of this collection analysis. We found the close collaboration of **296 institutions**. Organizations such as **CTBTO Preparatory Commission, IAEA, IIASA, UNCTAD** and **WMO** were treated as countries to see the impact in this scientific community. (each bubble represents a country on the collection)



Institutional Collaboration



Top 10 Co-Authorship

Country	Collaborative institutions
USA	57
Germany	20
France	20
UK	17
Japan	15
Canada	13
Italy	13
Austria	11
Australia	9
Hungary	8

Top 10 Scientific Production

Country	Number of documents:
USA	229
Germany	99
France	98
Austria	59
Japan	50
UK	37
Canada	36
Italy	34
Australia	31
Belgium	27

RESULTS

- CTBTO experts scientific communications are mostly through conference proceedings that could often end in scientific papers (i.e., EGU, AGU international conferences, SnT editions).
- The kernel of the CTBTO scientific communication is located at:
 - I. **Scientific Methods Unit, Software Applications Section of the IDC Division (IDC/SA/SM);**
 - II. **Engineering and Development Section, of the IMS Division (IMS/ED);**
 - III. **Equipment and Implementation Section of the OSI Division (OSI/EP)**
- CTBTO experts focus over the past two decades has been established in four areas; seismic, hydro-acoustics, infrasound and radionuclide monitoring technologies; with different kind of information flow and knowledge, in a very diverse and dynamic scientific community with a rich collaborative network from of all over the world.

- This compilation is now available as a reference at the [CTBTO Library Catalogue](#).
- IDC/CBT Section is currently building capacities with short- and long-term projects in terms of sharing CTBTO knowledge such as
 - a) Promoting an **Open Access Policy** in terms of scientific communication;
 - b) Managing a **DOI** for each document compiled for easy retrieve;
 - c) Creating an **International Network/Repository** where institutions can share not only peer reviewed literature (**Gold OA**) but also grey literature (**Green OA**).

In the matter of Information Management, the CTBTO Library main goal (SDG4) with these strategies is to ensure inclusive and equitable quality of information to the scientific community of the State Signatories and promoting lifelong learning opportunities for all about the Treaty and its verification regime.

References

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