SAGE-I Final Report

Publications: (major publications resulting from the work under the award)

IRIS, a university research consortium dedicated to exploring the Earth's interior and earthquake processes through the collection and distribution of seismological data, plays an important supporting role in scientific research, reflected through citations in publications of research papers and abstracts. IRIS's existing database of publications based on the use of IRIS resources now has more than 11,400 entries.

IRIS has been tracking citations in 11 traditional journals since 2000. To maintain continuity while searching journals and procuring citations, the processes and procedures used in previous years were followed closely and improved upon where applicable. These procedures and data findings are outlined below.

This report has been prepared for the SAGE-I Final Report. While it uses the same approach as in previous years and includes nearly all of the IRIS-related citations for 2021, there will be a slightly expanded citations report included with the SAGE-II Annual Report.

Citations Summary – Calendar Year 2021

Between January 1, 2021 and December 31, 2021, there were 1,176 references to IRIS-related data or products in published scientific literature. This includes 717 references in top journals (Top 11 and 26 others), 227 references in additional journals and books, 166 references in conference proceedings or abstracts, and 66 references in theses.

Introduction

The aim of this year's project was to continue the 21-year compilation of IRIS-related citations into one database. In order to maintain continuity while searching journals and procuring citations, the processes and procedures used in previous years were followed as closely as possible and improved upon where applicable. These procedures and data findings are outlined below.

Searching for IRIS Citations from 2021

The 11 most prominent Earth science journals were given priority while searching. These journals are:

- Bulletin of Seismological Society of America (BSSA)
- Journal of Geophysical Research (JGR)
- Geophysical Journal International (GJI)
- Seismological Research Letters (SRL)
- Geophysical Research Letters (GRL)
- Earth and Planetary Science Letters (EPSL)
- Physics of the Earth and Planetary Interior (PEPI)
- Tectonophysics (TP)
- Nature and related journals
- Science and related journals
- Geology
The journals were searched for the following key words:

- IRIS
- Incorporated Research Institutions for Seismology
- PASSCAL
- DMC
- DMS
- Data Management Center
- Global Seismographic Network (and Global Seismic Network)
- GSN
- GDSN
- SCARDEC
- USAArray
- EarthScope
- Transportable Array (TA)
- Magnetotellurics
- Flexible Array
- Greenland Ice Sheet Monitoring Network (GLISN)
- www.iris.edu

All searches were carried out electronically with different search engines for journals as follows:

- *Journal of Geophysical Research* and *Geophysical Research Letters* were searched using the Wiley search engine.
- *Geophysical Journal International* was searched with the search engine for the journal.
- For Seismological Society of America publications (*Bulletin of Seismological Society of America* and *Seismological Research Letters*), the GeoScienceWorld search engine was used.
- *Nature* and *Science* have their own search engines on their respective web pages.
- For the Geological Society of America publication, *Geology*, the GeoScienceWorld engine was used.

Most of these search engines are capable of an all-text search, which often brings up unrelated documents as well as the intended IRIS research results. To cull unrelated references, the initial search results were individually examined, and the unrelated entries were deleted. For the remaining documents, a manual “find” function was performed for the appropriate keyword in the abstract, primary text, figures, funding sources and/or acknowledgements. If the document was relevant, it was marked and exported into the database as a .ris file.
The distribution of findings are as follows:

Table 1. Total number of citations in the Top 11 journals.

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<thead>
<tr>
<th>No.</th>
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<tr>
<td>1</td>
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</tr>
<tr>
<td>3</td>
<td>Geophysical Journal International</td>
<td>94</td>
</tr>
<tr>
<td>4</td>
<td>Geophysical Research Letters</td>
<td>54</td>
</tr>
<tr>
<td>5</td>
<td>Earth and Planetary Science Letters</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>Seismological Research Letters</td>
<td>120</td>
</tr>
<tr>
<td>7</td>
<td>Physics of the Earth and Planetary Interiors</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>Tectonophysics</td>
<td>22</td>
</tr>
<tr>
<td>9</td>
<td>Science</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>Nature</td>
<td>36</td>
</tr>
<tr>
<td>11</td>
<td>Geology</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>606</td>
</tr>
</tbody>
</table>

There was an increase in the total number of citations found in these journals in 2021 compared to calendar year 2020 – there were 569 citations in 2020 and 606 citations in 2021. Since the inception of the IRIS citations database in 2000, the number of IRIS-related citations in these journals has typically increased (Figure 1).

Figure 1. Total number of IRIS-related citations in the 11 most prominent Earth science journals since the inception of the database in 2000. The number above each bar is the total number of citations in the Top 11 journals for that year.
This year, there were more IRIS-related publications in every top journal except for *BSSA*, *GRL*, and *PEPI*. The number of publications in *Science* remained the same. Refer to Figure 2 to see a direct comparison of the number of citations in each journal for the last two calendar years.

![Top 11 Journals](image)

*Figure 2. Number of publications in the Top 11 journals during calendar years 2020 and 2021.*

**Searching for IRIS Citations in Other Important Earth Science Journals**

IRIS promotes continuous conducting of geophysical investigations of seismic sources and Earth properties through its facilities and allows free and unrestricted access to its seismic database, which is one of the largest in the world. Researchers around the world use the IRIS database to explore the lithosphere, cryosphere, atmosphere, hydrosphere, and deep Earth in unprecedented ways. The types of scientific findings aided by IRIS facilities are extremely varied, and this is reflected in the number and type of journals that cite IRIS data, instruments, and facilities. Given the importance of some of these journals, their impact factor and effectiveness citation index, 26 other Earth science publications were selected for expanding the search for IRIS-related citations.
These 26 journals are:

- Canadian Journal of Earth Sciences
- Geophysics
- The Leading Edge
- Reviews of Geophysics
- Tectonics
- Polar Science
- Journal of Glaciology
- Marine Geophysical Research
- Lithosphere
- Journal of Geodynamics
- Geosphere
- Journal of Volcanology and Seismology
- Seismic Instruments
- Natural Hazards and Earth System Sciences
- Journal of Structural Geology
- Natural Hazards
- Geochemistry, Geophysics, Geosystems
- Soil Dynamics and Earthquake Engineering
- Russian Journal of Pacific Geology
- Journal of Volcanology and Geothermal Research
- Marine Geology
- Geomorphology
- Pure and Applied Geophysics
- Chinese Journal of Geophysics
- Journal of Seismology
- EOS

Note: Due to changes in publishing since the 2019 report, three of the previously searched other journals have been removed from the list.
- *Earth Surface* is part of the Top 11 journal *Journal of Geophysical Research*.
- *Nature Geoscience/Nature Communication* was combined with the Top 11 journal *Nature*.
- *Journal of Earthquake Science* is no longer published and was removed.

The number of citations for each of these other important journals for the calendar years 2015 - 2021 are presented in Table 2.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
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<tr>
<td>Canadian Journal of Earth Sciences</td>
<td>1</td>
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<tr>
<td>Geophysics</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>The Leading Edge</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Reviews of Geophysics</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Tectonics</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Polar Science</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Journal of Glaciology</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Marine Geophysical Research</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lithosphere</td>
<td>2</td>
<td>0</td>
<td>8</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<td>Journal of Geodynamics</td>
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<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Geosphere</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
The total number of citations found in these journals in 2021 is lower than what was found the previous year (Figure 3). In particular, there were 15 more IRIS-related citations in the journal *Pure and Applied Geophysics* in 2020 compared to 2021.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Journal of Volcanology and Seismology</em></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
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<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><em>Natural Hazards and Earth System Sciences</em></td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><em>Journal of Structural Geology</em></td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural Hazards</td>
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<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><em>Geochemistry, Geophysics, Geosystems</em></td>
<td>28</td>
<td>22</td>
<td>12</td>
<td>21</td>
<td>33</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td><em>Soil Dynamics and Earthquake Engineering</em></td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><em>Russian Journal of Pacific Geology</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Journal of Volcanology and Geothermal Research</em></td>
<td>8</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Marine Geology</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Geomorphology</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pure and Applied Geophysics</em></td>
<td>12</td>
<td>9</td>
<td>4</td>
<td>13</td>
<td>16</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td><em>Chinese Journal of Geophysics</em></td>
<td>0</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><em>Journal of Seismology</em></td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>13</td>
<td>11</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Eos</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td><strong>All 26 Journals</strong></td>
<td><strong>88</strong></td>
<td><strong>85</strong></td>
<td><strong>68</strong></td>
<td><strong>119</strong></td>
<td><strong>105</strong></td>
<td><strong>117</strong></td>
<td><strong>111</strong></td>
</tr>
</tbody>
</table>
Figure 3. Graph showing the number of citations per year in the 26 other important journals. The number above each bar is the number of citations for that year.

**Searching for IRIS Citations in Other Journals**

As the application of IRIS facilities expands into new realms (e.g., rapid response, distributed acoustic sensing, and weather-related applications), citations in journals that were previously not relevant to IRIS-related research are expected. Additionally, unexpected and novel uses of the data and facilities are creating an exciting body of work outside of the traditional Earth science journals. Books where IRIS data were used are also included in this section and are marked as such.

In years past, to explore the use of IRIS data and products in journals and books outside of the traditional Earth science sphere and to show the breadth of the data usage, a generalized search was done on the aforementioned search terms using Google Scholar and Web of Science. This functionality became possible for IRIS in 2014. Each year, this search uncovers more journals that did not previously feature IRIS-related research, demonstrating the diverse applications of the data collected and provided by IRIS facilities. These journals cover a diverse range of subjects including acoustics and radio, engineering, computer science, law, planetary science, meteorology, marine science, petroleum geology, and education.

However, as the list of journals grows, this style of search has become inefficient. Instead, we chose to use publisher search engines for each search term. We used Google Scholar when publisher search engines failed to unearth citations.

A complete list of citations in these journals will be provided in the SAGE-II Annual Report. At this time, 227 citations have been found in 95 individual journals outside of the 37 journals that are rigorously searched (11 Top Journals and 26 Other Journals) as well as in five (5) books.
Searching for Conference Abstracts

The AGU Meeting search was used to search for AGU proceedings. There were 117 AGU abstracts with citations of IRIS or IRIS facilities (Figure 4) that were mentioned in 2021. This is less than the number of citations from 2019 (n=149) and more than in 2020 (n=107).

![AGU abstracts with IRIS related citations](image)

Figure 4. Number of AGU abstracts with IRIS-related citations from 2000-2021.

Because data from the Global Seismographic Network (GSN), the Data Management Center (DMC) and PASSCAL are widely used in studies throughout the world, abstracts of research presented at the Geological Society of America (GSA) Annual Meeting (and associated section meetings), the Seismological Society of America (SSA) Annual Meeting and the European Geosciences Union (EGU) General Assembly were also searched. Google Scholar and the society websites were used to search for GSA, SSA and EGU abstracts that cited IRIS or IRIS facilities. Ten (10) GSA abstracts, 36 SSA abstracts, three (3) EGU abstracts and eight (8) additional abstracts from smaller conferences cite one or more relevant search terms. Thus, there were 166 abstracts that used IRIS-related data or information.

**Theses**

In 2018, IRIS started tracking the number of dissertations that use IRIS resources and facilities. In 2021, there were 66 theses that verifiably used IRIS data, resources, or facilities. In 2018, there were 62 theses, 54 theses in 2019, and 44 theses in 2020 that used IRIS data or facilities.

**Books**

In 2018, IRIS started tracking the number of books and book chapters that cite IRIS data, resources, or facilities. This year, IRIS was cited in 27 articles in five (5) books. IRIS was cited in six (6) books in 2020, 17 books in 2019 and five (5) books in 2018.

**Findings from 2021**

Between January 1, 2021 and December 31, 2021, there were 1,176 references to IRIS-related data or products in published scientific literature. This includes 717 references in top journals (Top 11 and 26 others), 227 references in additional journals and books, 166 references in conference proceedings or abstracts, and 66 references in theses.

The 2021 List of Citations for the SAGE-I Final Report is provided in Appendix A.
IRIS, a university research consortium dedicated to exploring the Earth's interior and earthquake processes through the collection and distribution of seismological data, plays an important supporting role in scientific research, reflected through citations in publications of research papers and abstracts. IRIS’s existing database of publications based on the use of IRIS resources now has more than 11,400 entries.

IRIS has been tracking citations in 11 traditional journals since 2000. To maintain continuity while searching journals and procuring citations, the processes and procedures used in previous years were followed closely and improved upon where applicable. These procedures and data findings are outlined below.

Citations Summary – Calendar Year 2021

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Introduction

The aim of this year’s project was to continue the 21-year compilation of IRIS-related citations into one database. In order to maintain continuity while searching journals and procuring citations, the processes and procedures used in previous years were followed as closely as possible and improved upon where applicable. These procedures and data findings are outlined below.

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<td>Geophysical Journal International</td>
<td>94</td>
</tr>
<tr>
<td>4</td>
<td>Geophysical Research Letters</td>
<td>54</td>
</tr>
<tr>
<td>5</td>
<td>Earth and Planetary Science Letters</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>Seismological Research Letters</td>
<td>120</td>
</tr>
<tr>
<td>7</td>
<td>Physics of the Earth and Planetary Interiors</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>Tectonophysics</td>
<td>22</td>
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<tr>
<td>9</td>
<td>Science</td>
<td>11</td>
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<tr>
<td>10</td>
<td>Nature</td>
<td>36</td>
</tr>
<tr>
<td>11</td>
<td>Geology</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>606</td>
</tr>
</tbody>
</table>

There was an increase in the total number of citations found in these journals in 2021 compared to calendar year 2020 – there were 569 citations in 2020 and 606 citations in 2021. Since the inception of the IRIS citations database in 2000, the number of IRIS-related citations in these journals has typically increased (Figure 1).

![Number of Citations in Top 11 Journals: 2000-2021](image)

*Figure 1. Total number of IRIS-related citations in the 11 most prominent Earth science journals since the inception of the database in 2000. The number above each bar is the total number of citations in the Top 11 journals for that year.*
This year, there were more IRIS-related publications in every top journal except for *BSSA*, *GRL*, and *PEPI*. The number of publications in *Science* remained the same. Refer to Figure 2 to see a direct comparison of the number of citations in each journal for the last two calendar years.

![Top 11 Journals](image)

*Figure 2. Number of publications in the Top 11 journals during calendar years 2020 and 2021.*

The number of search terms found in each of the Top 11 journals is presented in Table 2. It is broken down by search term and individual journal. Some terms, such as “Global Seismographic Network” and “Global Seismic Network,” were searched by the proper term as well as by a commonly used, but incorrect, variation.
Table 2. Number of search terms in the Top 11 journals.

<table>
<thead>
<tr>
<th>Search Term</th>
<th>JGI</th>
<th>JGR</th>
<th>Geology</th>
<th>GRL</th>
<th>SRL</th>
<th>BSSA</th>
<th>PEPI</th>
<th>TP</th>
<th>EPSL</th>
<th>Science</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRIS</td>
<td>83</td>
<td>231</td>
<td>8</td>
<td>51</td>
<td>102</td>
<td>46</td>
<td>10</td>
<td>20</td>
<td>23</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>Incorporated Research Institutions for Seismology</td>
<td>29</td>
<td>100</td>
<td>7</td>
<td>21</td>
<td>103</td>
<td>49</td>
<td>5</td>
<td>9</td>
<td>13</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>PASSCAL</td>
<td>4</td>
<td>22</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DMC</td>
<td>31</td>
<td>112</td>
<td>2</td>
<td>24</td>
<td>36</td>
<td>29</td>
<td>4</td>
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<td>7</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>DMS</td>
<td>2</td>
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We also provide new metrics that better highlight how IRIS-curated data or facilities were cited in papers across the Top 11 journals. For each paper, we determined which IRIS data product or facility was used, with many papers citing the use of multiple data products or facilities. Of the 606 citations, 375, or about 62%, cited the use of the IRIS Data Management Center, whereas 119 papers, or nearly 20%, did not specify which IRIS data product or facility was used but instead opted to thank IRIS. It is likely that of those 119 papers, the vast majority used the IRIS Data Management Center to obtain seismic data. This highlights a recurring problem—that many publications do not appropriately cite IRIS data. Thus, 62% is likely an underestimate for how many papers used the IRIS Data Management Center. The same is likely true for the other facilities listed in Table 3.
Table 3. IRIS facility or data product cited in papers from Top 11 journals.

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<th>Times Cited</th>
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<td>GLISN</td>
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Searching for IRIS Citations in Other Important Earth Science Journals

IRIS promotes continuous conducting of geophysical investigations of seismic sources and Earth properties through its facilities and allows free and unrestricted access to its seismic database, which is one of the largest in the world. Researchers around the world use the IRIS database to explore the lithosphere, cryosphere, atmosphere, hydrosphere and deep Earth in unprecedented ways. The types of scientific findings aided by IRIS facilities are extremely varied, and this is reflected in the number and type of journals that cite IRIS data, instruments, and facilities. Given the importance of some of these journals, their impact factor and effectiveness citation index, 26 other Earth science publications were selected for expanding the search for IRIS-related citations. These journals are:

- Canadian Journal of Earth Sciences
- Geophysics
- The Leading Edge
- Reviews of Geophysics
- Tectonics
- Polar Science
- Journal of Glaciology
- Marine Geophysical Research
- Lithosphere
- Journal of Geodynamics
- Geosphere
- Journal of Volcanology and Seismology
- Seismic Instruments
- Natural Hazards and Earth System Sciences
- Journal of Structural Geology
- Natural Hazards
- Geochemistry, Geophysics, Geosystems
- Soil Dynamics and Earthquake Engineering
- Russian Journal of Pacific Geology
- Journal of Volcanology and Geothermal Research
- Marine Geology
- Geomorphology
- Pure and Applied Geophysics
- Chinese Journal of Geophysics
- Journal of Seismology
- EOS

Note: Due to changes in publishing since the 2019 report, three of the previously searched other journals have been removed from the list.

- Earth Surface is part of the Top 11 journal Journal of Geophysical Research.
- Nature Geoscience/Nature Communication was combined with the Top 11 journal Nature.
Journal of Earthquake Science is no longer published and was removed.

The number of citations for each of these other important journals for the calendar years 2015 - 2021 are presented in Table 4.

### Table 4. Number of citations found in 26 (formerly 29) other important journals.

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</table>
The total number of citations found in these journals in 2021 is lower than what was found the previous year (Figure 3). In particular, there were 15 more IRIS-related citations in the journal *Pure and Applied Geophysics* in 2020, compared to 2021.

![Citations in 26 Journals: 2000-2021](image)

*Figure 3. Graph showing the number of citations per year in the 26 other important journals. The number above each bar is the number of citations for that year.*

**Searching for IRIS Citations in Other Journals**

As the application of IRIS facilities expands into new realms (e.g., rapid response, distributed acoustic sensing, and weather-related applications), citations in journals that were previously not relevant to IRIS-related research are expected. Additionally, unexpected and novel uses of the data and facilities are creating an exciting body of work outside of the traditional Earth science journals. Books where IRIS data were used are also included in this section and are marked as such.

In years past, to explore the use of IRIS data and products in journals and books outside of the traditional Earth science sphere and to show the breadth of the data usage, a generalized search was done on the aforementioned search terms using Google Scholar and Web of Science. This functionality became possible for IRIS in 2014. Each year, this search uncovers...
more journals that did not previously feature IRIS-related research, demonstrating the diverse applications of the data collected and provided by IRIS facilities. These journals cover a diverse range of subjects, including acoustics and radio, engineering, computer science, law, planetary science, meteorology, marine science, petroleum geology, and education.

However, as the list of journals grows, this style of search has become inefficient. Instead, we chose to use publisher search engines for each search term. We used Google Scholar when publisher search engines failed to unearth citations. Using this method, we found 230 citations in these miscellaneous journals, which is a significant jump compared to the 189 citations found in 2020 (Table 5). Because citations are not found in every journal every year, we only show the data from 2021.

Table 5. Additional journals and total number of IRIS-related citations in each.

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<tr>
<td>Journal of the Royal Society Interface</td>
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<td>Malawi Journal of Science &amp; Technology</td>
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<td>Mantle Convection and Surface Expressions</td>
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<td>Masonry Construction in Active Seismic Regions</td>
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<td>Measurement: Sensors</td>
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<td>Multidimensional Systems and Signal Processing</td>
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<tr>
<td>Pollution Assessment for Sustainable Practices in Applied Sciences and Engineering (Book)</td>
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Searching for Conference Abstracts

The AGU Meeting search was used to search for AGU proceedings. There were 117 AGU abstracts with citations of IRIS or IRIS facilities (Figure 4) that were mentioned in 2021. This is less than the number of citations from 2019 (n=149) and more than in 2020 (n=107).

![AGU abstracts with IRIS related citations](image)

*Figure 4. Number of AGU abstracts with IRIS-related citations from 2000-2020.*
Because data from the Global Seismographic Network (GSN), the Data Management Center (DMC) and PASSCAL are widely used in studies throughout the world, abstracts of research presented at the Geological Society of America (GSA) Annual Meeting (and associated section meetings), the Seismological Society of America (SSA) Annual Meeting and the European Geosciences Union (EGU) General Assembly were also searched. Google Scholar and the society websites were used to search for GSA, SSA and EGU abstracts that cited IRIS or IRIS facilities. Ten (10) GSA abstracts, 36 SSA abstracts, three (3) EGU abstracts and eight (8) additional abstracts from smaller conferences cite one or more relevant search terms. Thus, there were 166 abstracts that used IRIS-related data or information.

**Theses**

In 2018, IRIS started tracking the number of dissertations that use IRIS resources and facilities. In 2021, there were 66 theses that verifiably used IRIS data, resources, or facilities. In 2018, there were 62 these, 54 these in 2019, and 44 theses in 2020 that used IRIS data or facilities.

**Books**

In 2018, IRIS started tracking the number of books and book chapters that cite IRIS data, resources, or facilities. This year, IRIS was cited in 27 articles in five (5) books. IRIS was cited in six (6) books in 2020, 17 books in 2019 and five (5) books in 2018.

**Findings from 2021**

Between January 1, 2021 and December 31, 2021, there were 1,176 references to IRIS-related data or products in published scientific literature. This includes 717 references in top journals (Top 11 and 26 others), 230 references in additional journals and books, 166 references in conference proceedings or abstracts, and 66 references in theses.

The 2021 List of Citations for the SAGE-II Annual Report is provided in Appendix A.


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