IRIS CITATION PROJECT

January 2016 – December 2016

Summary

Between January 1, 2016 and the December 31, 2016 there were 885 references to IRIS related data or products in published scientific literature. This includes 464 references in top journals, 216 references in other journals and 205 references in conference proceedings or abstracts. This is 75 more total citations then were found during 2015 and 150 more then were found in 2014.

Introduction

The aim of this year's project was to continue the 17-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 2016

The eleven 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, Science*** and ***Geology.***

The journals were searched for the following key words: *IRIS, Incorporated Research Institution for Seismology, PASSCAL, DMC, DMS, Data Management Center, GSN, Global Seismographic Network, GDSN, USArray, EarthScope, PBO, Plate Boundary Observatory, Transportable Array (TA), Magnetotellurics and Flexible Array,*

OBSIP, *Ocean Bottom Seismograph Instrument Pool*, *GLISN, Greenland Ice Sheet Monitoring Network* and *www.iris.edu*.

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

- *Journal of Geophysical Research*, *Geophysical Research Letters*, and *Geophysical Journal International* were searched through Wiley search engine.

- For SSA publications (*Bulletin of Seismological Society of America, Seismological Research Letters*) the GSW engine was used.

- For Elsevier publications, *Earth and Planetary Science Letters*, *Physics of the Earth and Planetary Interiors*, and *Tectonophysics*, the ScienceDirect engine was used.

- The other journals, *Nature* and *Science* have their own search engines on their respective web pages and *Geology* has the search engine of Geological Society of America.

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. In order to cull unrelated references the initial search results are individually examined and the unrelated entries are deleted. For the remaining documents a manually "find" function is performed for the appropriate key word on the abstract, primary text, figures, funding sources and/or acknowledgements (but not references). If the document is relevant it is marked and exported into the database as a .ris file.

The distribution of findings are given in the following table:

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

No.	Journal / Magazine	Number of references Jan. 2016 – Dec. 2016

1	Bulletin of the Seismological Society of America	72
2	Journal of Geophysical Research	92
3	Geophysical Journal International	79
4	Geophysical Research Letters	79
5	Earth and Planetary Science Letters	37
6	Seismological Research Letters	48
7	Physics of the Earth and Planetary Interiors	14
8	Tectonophysics	25
9	Science	9
10	Nature	1
11	Geology	8
Total		**464**

There was an increase in the total number of citations found in these journals in 2016 compared to calendar year 2015; there were 395 citations in 2015 and 464 citations in 2016. Since the inception of the IRIS citations database in 2000 the number of IRIS related citations in these journals has steadily increased (Figure 1).

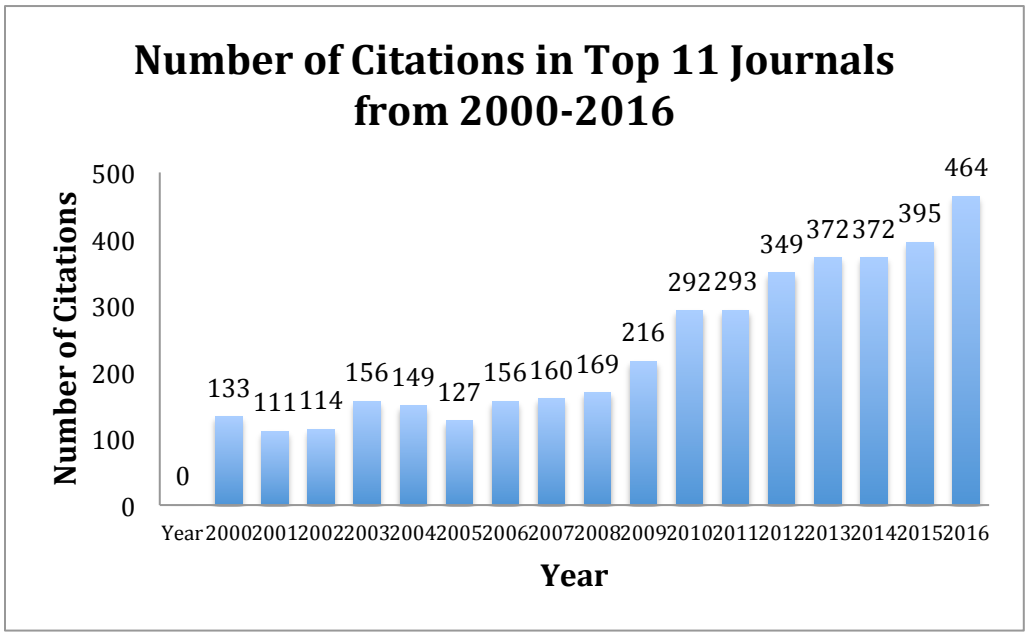

Figure 1. Total number of IRIS related citations in the eleven most prominent earth science journals since the inception of the database in 2000. The number above each bar is the total number of citations in the Top 11 journals for that year.

This year there were more IRIS related publications in BSSA, JGR, GRL, EPSL, SRL, PEPI, TP, Science and Geology (13, 12, 24, 5, 2, 10, 9, 6 and 4 more references, respectively), but there were less IRIS related publications in JGI (1 less) and Nature (11 less). Refer to Figure 2 to see a direct comparison of the number of citations in each journal for the last 2 calendar years.

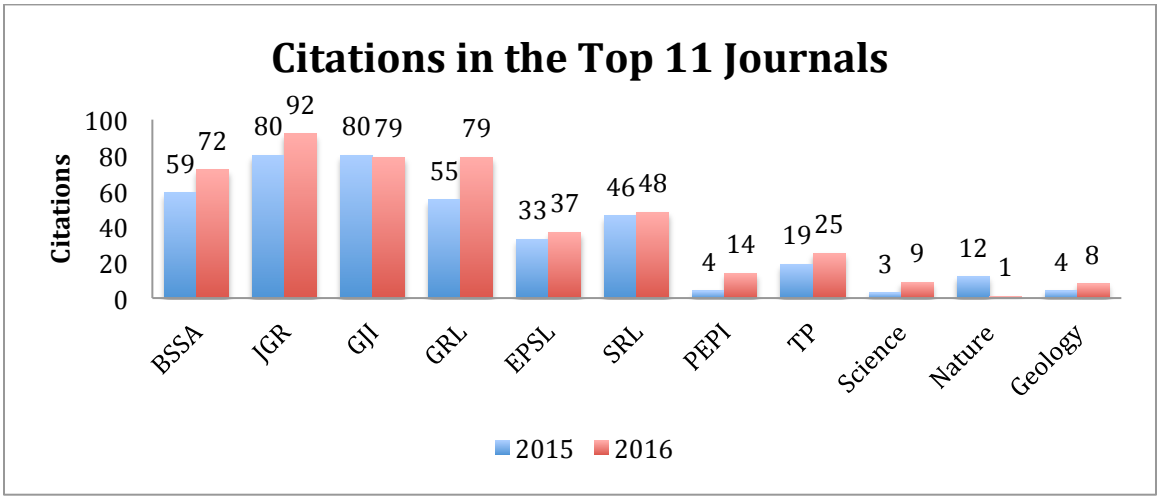

Figure 2. Number of publications in the top eleven journals during calendar years 2015 and 2016.

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, 29 other journals from

earth science publications were selected for expanding our searching for IRIS-related citations. These journals are: ***Canadian Journal of Earth Sciences, Geophysics, The Leading Edge, Reviews of Geophysics, Tectonics, Polar Science, Earth Surface, Journal of Glaciology, Marine Geophysical Research, Nature Geoscience, Lithosphere, Journal of Geodynamics, Geosphere, Earthquake Science, 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.***

The number of citations for each of these journals for the calendar years 2015 and 2016 are presented in Table 2 below.

Table 2: Number of citations found in additional 29 journals

	2015	2016
Canadian Journal of Earth Sciences	0	3
Geophysics	5	10
The Leading Edge	4	1
Reviews of Geophysics	3	2
Tectonics	8	3
Polar Science	7	0
Earth Surface	0	0
Journal of Glaciology	2	0
Marine Geophysical Research	0	0
Nature Geoscience	0	5
Lithosphere	1	0
Journal of Geodynamics	0	3
Geosphere	5	7
Earthquake Science	2	3
Journal of Volcanology and Seismology	2	0
Seismic Instruments	1	0
Natural Hazards and Earth System Sciences	2	1

Journal of Structural Geology	0	2
Natural Hazards	3	1
Geochemistry, Geophysics, Geosystems	32	22
Soil Dynamics and Earthquake Engineering	0	2
Russian Journal of Pacific Geology	1	0
Journal of Volcanology and Geothermal Research	0	3
Marine Geology	2	0
Geomorphology	3	0
Pure and Applied Geophysics	16	9
Chinese Journal of Geophysics	3	6
Journal of Seismology	4	2
EOS	0	0
All 29 Journals	**106**	**85**

The total number of citations found in these journals in 2016 is less than what was found the previous year (Figure 2). In particular, there were less IRIS related citations in journals ***Pure and Applied Geophysics, Geochemistry, Geophysics and Geosystems***, and ***Tectonics.*** However, the number of citations in these journals during 2016 is similar to the number found in calendar years 2008-2011 and in 2014.

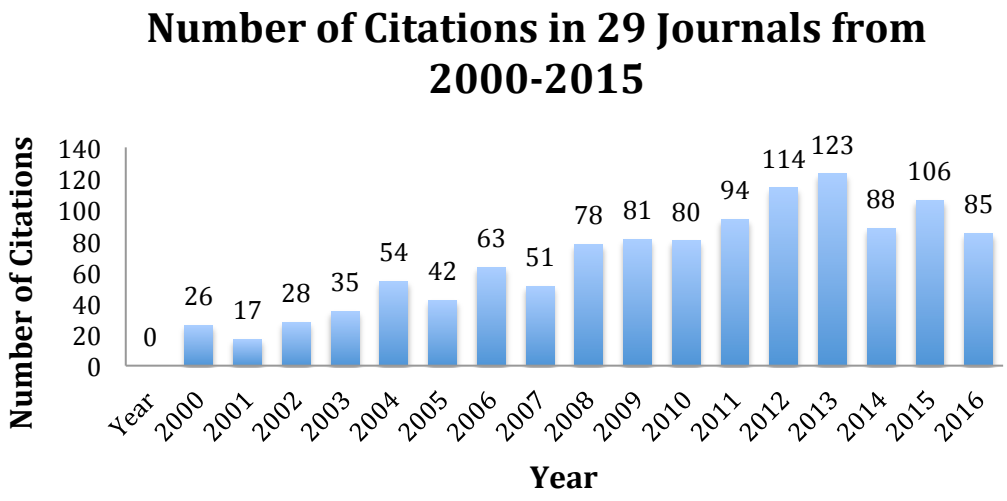

Figure 3. Graph showing the number of citations per year in the 29 additional journals. The number above each bar is the number of citations for that year.

Searching for IRIS citations in other journals

As the application of IRIS facilities expands into new realms (e.g. OBSIP, GLISN and USArray Alaska) we can expect an increase in the number of citations in journals that were previously not relevant to IRIS related research. Additionally, unexpected and creative uses of the data and facilities are creating an exciting body of work outside of the traditional earth science journals.

In order to explore the use of IRIS data and products in journals 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 and so the data for "Other Journals" only goes back 3 years. Each year this search uncovers more journals that didn't previously feature IRIS related research, demonstrating the diverse applications of the data collected and provided by IRIS institutions. In 2014 IRIS related citations were discovered in an additional 37 journals. In 2015 IRIS related citations were found in 34 more unique journals, and in 2016 citations were found in another 55 journals for a total of 126 unique journals citing IRIS data beyond the Top 11 journals and the 29 additional "important" journals. This means IRIS data and facilities were cited in a total of 166 different journals over the past 3 years alone.

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. These journals and the number of citations from each journal in 2014-2016 are listed in Table 3.

In 2016 there were 131 articles in these journals that cited IRIS data, facilities or research. This is an increase from 2014 (n=60) and 2015 (n=81).

Table 3. Additional journals and total number of IRIS related citations in each

Other Journals	2014	2015	2016
Solid Earth Discussions	2	3	0
Journal of South American Earth Sciences	4	12	6
Computers & Geosciences	1	1	3
Encyclopedia of Earthquake Engineering	2	0	0
Surveys in Geophysics	2	2	0
Geotectonics	1	0	0
EURASIP Journal on Applied Signal Processing	1	0	0

The Journal of the Acoustical Society of America	1	1	1
Physical Review Letters	1	0	0
Geomagnetism and Aeronomy	1	1	0
Journal of Applied Physics	1	0	0
Journal of African Earth Sciences	1	0	1
Physics Today	1	0	0
Meteoritics and Planetary Science	1	0	0
Progress in Earth and Planetary Science C7 - 10	1	1	0
Scientific Reports	3	0	3
Journal of Asian Earth Sciences	5	3	6
Journal of Geodesy	1	1	0
International Journal of Biometeorology	1	0	0
Izvestiya, Physics of the Solid Earth	5	5	2
Ieee Journal of Selected Topics in Applied Earth Observations and Remote Sensing	1	0	0
Water Resources Research	1	0	0
Geological Society of America Special Papers	1	2	2
Geofísica Internacional	1	1	0
Earth, Planets, and Space	4	2	5
Journal of Applied Meteorology and Climatology	1	0	0
Advances in Geophysics	1	0	0
Annual Review of Earth and Planetary Sciences	1	0	0
Doklady Earth Sciences	2	0	0
Journal of Hydrology	1	0	0
Oceanography	1	1	7
The Cryosphere Discussions	1	0	0
Global and Planetary Change	1	0	0
Annual Review of Marine Science	1	0	0
Advances in Space Research	1	1	1
Geodesy and Geodynamics	1	1	1
Science China Earth Sciences	2	2	0
Radio Science	2	0	0
Acta Geologica Sinica	0	1	1
Modeling Earth Systems and Environment	0	0	1
Physics and Chemistry of the Earth	0	1	3
Arabian Journal of Geosciences	0	1	1
Physica A: Statistical Mechanics and its Applications	0	0	1
Precambrian Research	0	2	3
Earth and Space Science	0	0	1
Space Weather	0	0	2
The Science Teacher	0	0	1

Geoscience Letters	0	0	1
Ore Geology Reviews	0	0	1
Science Advances	0	0	4
Acta Geophysica	0	1	2
Gondwana Research	0	3	2
Rock Mechanics and Rock Engineering	0	0	1
Remote Sensing of Environment	0	0	2
Exploration Geophysics	0	0	1
International Journal of Disaster Risk Reduction	0	2	1
Field Guides	0	0	1
Journal of Natural Gas Science and Engineering	0	0	1
Science China Technological Sciences	0	0	1
Ain Shams Engineering Journal	0	0	1
International Journal of New Technology and Research (IJNTR)	0	0	1
Earthquake Spectra	0	0	3
Structural Control and Health Monitoring	0	0	1
Neural Computing and Applications	0	0	1
Geoscientific Instrumentation, Methods and Data Systems	0	0	1
South African Journal of Geology	0	0	1
Wiley Interdisciplinary Reviews: Water	0	0	1
Photogrammetric Engineering & Remote Sensing	0	0	1
Elements	0	0	2
Acta Geodaetica et Geophysica	0	0	2
International Journal of Geohazards and Environment	0	0	1
Journal of the Association for Information Science and Technology	0	0	1
Spatial and Spatio-temporal Epidemiology	0	0	1
Advances in Geosciences	0	2	1
Physics Letters A	0	0	1
Interpretation	0	1	3
Flow Measurement and Instrumentation	0	0	1
Earth Surface Processes and Landforms	0	0	1
International Journal of Earth Sciences	0	0	2
Engineering Geology	0	1	1
International Journal of Human-Computer Studies	0	0	1
Geological Journal	0	0	2
Italian Journal of Geosciences	0	1	1
Geological Society, London, Special Publications	0	0	1
Physics of Wave Phenomena	0	0	1
The Nonproliferation Review	0	0	1
Physics Reports	0	0	1

Marine Technology Society Journal	0	0	2
Monthly Weather Review	0	1	1
Journal of Petroleum Science and Engineering	0	0	1
Bulletin of the American Meteorological Society	0	1	1
International Journal of Greenhouse Gas Control	0	1	2
Geological Society of America Bulletin	0	0	2
Journal of Navigation	0	0	1
Geothermal Play Fairway Analysis	0	0	1
American Meteorological Society	0	0	1
Elementa: Science of the Anthropocene	0	0	1
Journal of Environmental and Engineering Geophysics	0	1	1
Journal of Applied Geophysics	0	1	2
Journal of the Geological Society	0	0	1
Materials Science and Engineering: A	0	0	1
The International Journal of Ocean and Climate Systems	0	0	1
Journal of the Royal Statistical Society: Series C (Applied Statistics)	0	0	1
Chinese Journal of Geophysics	0	0	1
Annales Geophysicae	0	0	1
Geoscience Data Journal	0	0	1
Geofluids	0	0	1
Journal of Micromechanics and Microengineering	0	0	1
Sensors and smart technologies for civil, mechanical and aerospace engineering	0	1	0
GeoResJ	0	1	0
Journal of Atmospheric and Solar-Terrestrial Physics	0	1	0
Marine and Petroleum Geology	0	1	0
Cuadernos de Geografia	0	1	0
Earth Science Informatics	0	1	0
Bulltein of Earthquake Engineering	0	1	0
Earth Science Reviews	0	1	0
International Journal of Law, Crimes and Justice	0	1	0
AAPG Bulletin	0	1	0
Knowledge Based Systems	0	1	0
Geoscience Frontiers	0	2	0
Engineering Structures	0	1	0
Science of Tsunami Hazards	0	1	0
Icarus	0	1	0
Geosciences Journal	0	2	0
Contributions to Geophysics and Geodesy	0	1	0
Polish Polar Research	0	1	0

NRIAG Journal of Astronomy and Geophysics	0	1	0
TOTAL	60	81	131

Searching for IRIS citations in AGU, GSA and EGU abstracts

The NASA ADS Service Abstracts search engine and Google Scholar were used to search for AGU proceedings. There were 168 AGU abstracts with citations of IRIS or IRIS facilities (Figure 4) that were mentioned increased in 2016. This is slightly less than the number of citations from 2015 (n=172) and significantly less then the number of abstracts from 2013 and 2014.

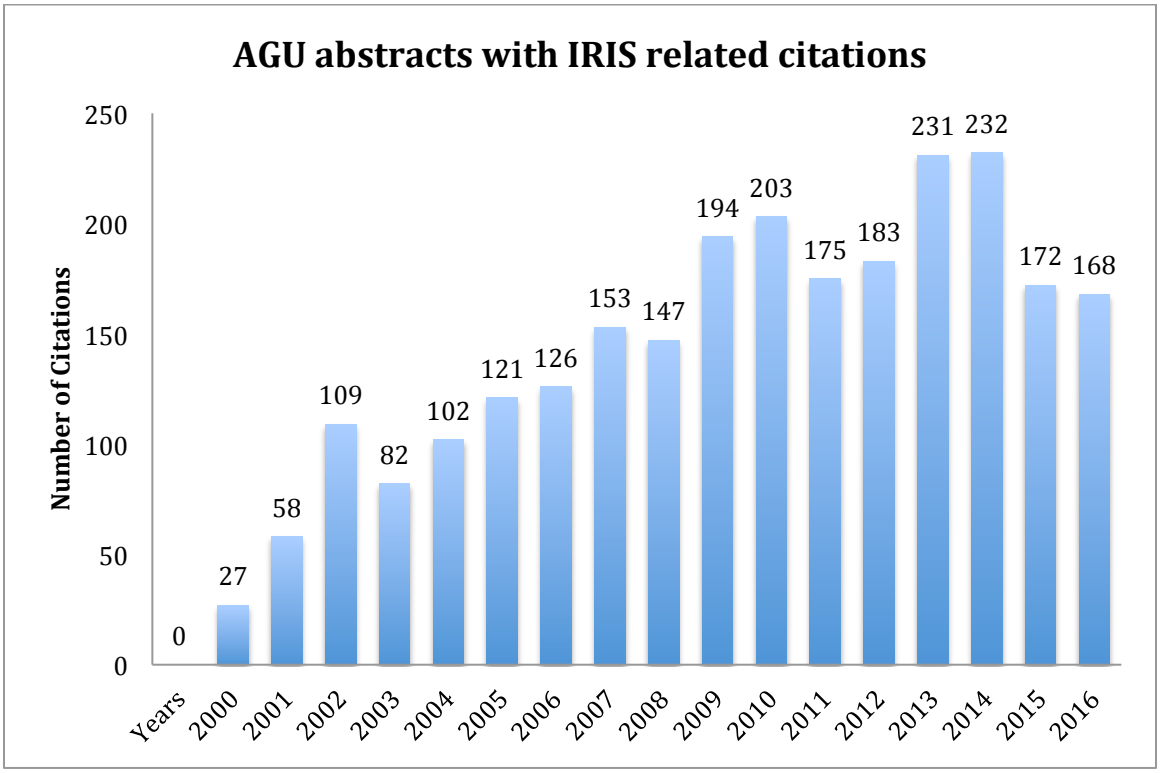

Figure 4. Number of AGU abstracts with IRIS related citations from 2000-2016.

Because the IRIS Global Seismic Network (GSN), Data Management Center (DMC) and PASSCAL data are widely used in studies throughout the world, abstracts of

research presented at the Geological Society of America (GSA) meeting and the European Geophysical Union (EGU) meeting were also searched. Google Scholar was used to search for GSA and EGU abstracts that cited IRIS or IRIS facilities. 19 GSA abstracts and 18 EGU abstracts cite one or more relevant search terms. Thus, there were 205 abstracts that used IRIS related data or information. 27 of these abstracts were authored or co-authored by IRIS staff.

Findings from 2016

There were 680 IRIS related citations found in all journals in 2016, an increase of 93 references over the previous year and 178 more than were published in 2014. The total number of citations found in abstracts was 205, which is a decrease from the previous year (n=223). Thus, the total number of IRIS related references in 2016 is 885; 75 more than in 2015.

This increase is partially the result of more IRIS-citation references in the traditional journals. The number of citation in these journals increased significantly; ***Bulletin of the Seismological Society of America*** (22%), ***Geophysical Research Letters*** (44%), ***Physics of Earth and Planetary Interiors*** (250%), and ***Science*** (200%). Additionally, there was a 62% increase in the number of citations found in "other" journals.

It may be that the large number of abstracts (particularly AGU abstracts) during 2013-2014 is related to the significant increase in the number of citations in 2016, as there is lag between presenting initial results and the formal publication of those results. If that is the case there may be a decrease in citations over the next few years that reflects the decline in abstracts. However, as the TA moves across Alaska there may another influx of TA related data and research.

The current file of the project for this year contains:

- a list of all papers and abstracts with IRIS related citations for 2016
-libraries with all the entries in EndNote for 2016 citations **(**All citations, 11 top journals, Abstracts, all other journals)

- a report documenting the processes, procedures and findings for 2016 citation findings

Dr. Wendy Bohon, Aug 2017.