Aggregation and Linking of Observational Metadata in the ADS

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Abstract. We discuss current efforts behind the curation of observing proposals, archive bibliographies, and data links in the NASA Astrophysics Data System (ADS). The primary data in the ADS is the bibliographic content from scholarly articles in Astronomy and Physics, which ADS aggregates from publishers, arXiv and conference proceeding sites. This core bibliographic information is then further enriched by ADS via the generation of citations and usage data, and through the aggregation of external resources from astronomy data archives and libraries. Important sources of such additional information are the metadata describing observing proposals and high level data products, which, once ingested in ADS, become easily discoverable and citeable by the science community. Bibliographic studies have shown that the integration of links between data archives and the ADS provides greater visibility to data products and increased citations to the literature associated with them.

1. Introduction

This paper discusses the current curation of archive bibliographies and their indexing in ADS. Integration of these bibliographies provides convenient cross-linking of resources between ADS and the data archives, affording greater visibility to both data products and the literature associated with them.

The primary data curated by ADS is bibliographic information provided by publishers or harvested by ADS from conference proceeding sites and repositories. This core bibliographic information is then further enriched by ADS via the generation of citations and usage data, and through the aggregation of external bibliographic information. Important sources of such additional information are the metadata describing high level data products associated with publications, observing proposals from major missions, the curated bibliographies for archives and organizations, and the sets of links between archival observations and published papers.

While ADS solicits and welcomes the inclusion of this data from US and foreign data centers alike, the curation of these metadata is left to the archives which host the data and which have the expertise and resources to properly maintain them. In this regard, the role of ADS is one of resource aggregation and indexing, providing a lightweight discovery mechanism through its search capabilities. While limited in scope, this level of aggregation can still be quite useful in supporting the discovery and selection of data products associated with publications. For instance, a user can use ADS to find papers which have been classified in the bibliography for HST, Chandra, and Spitzer, which typically yields multi-spectral studies making use of data from
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NASA’s Great Observatories. Following data links associated with this collection of papers allows the user to directly download the data products themselves.

2. Data Products Indexed in ADS

In the section below we describe how archives can provide to ADS the observational metadata which is then integrated in ADS’s discovery platform. Collecting and sharing this information provides the basis for the creation of bi-directional links between the ADS and data centers, thus enhancing the discoverability of data and literature across Astrophysics archives.

2.1. High-level Data Products

Important datasets are often described in “data” papers, but are also typically available in machine-readable format as digital surveys or electronic catalogs hosted by one or more archives (think of the data products generated by projects such as 2MASS or SDSS). Additionally, the high-level data products associated with refereed papers currently being published in the major astronomy journals are captured and ingested in repositories such as Vizier, SIMBAD, or NED. Depending on the nature of the paper, these datasets might then become available as data collections which include electronic data catalogs (corresponding to tables or plots in the paper), or other products such as images and spectra (corresponding to figures).

In order to facilitate the discovery of these data products, the ADS has been indexing these records in its database since 1995, with an automated feed from Vizier since 2001. Today, ADS has records for over 10,000 Vizier catalogs, making this the biggest collection of high-level data products in our system. Once they become indexed in ADS, these records gain greater visibility as well as the ability to be easily cited in the literature. It is thanks to this arrangement that astronomers have been able to cite data catalogs for over two decades, thus providing a simple (although incomplete) solution to the problem of data citation.

2.2. Observing Proposals

Abstracts for awarded observing proposals are useful additions to the content indexed in ADS for a variety of reasons. First and foremost, they provide early descriptions of current and ongoing science investigations being carried out by the observing facilities, making them more discoverable by the research communities. Observing proposals also provide a direct link to either existing or planned observations. Since there can be a significant lag between the taking of the data and the publication of science results from its analysis, the observing proposals are often the only descriptive science metadata associated with the observations themselves.

Having ADS records for these proposals means that they are not only easily discoverable but they become part of the scholarly record, and thus can be formally cited in the literature. While this practice is not (yet) mainstream, we note that there are over 350 citations to observing proposals in ADS as of November, 2015. The ADS currently holds more than 32,000 records for observing proposals, including more than 9,000 from HST. The ingest rate has been above 1,000 per year for more than 15 years.
2.3. Bibliographies

The ADS provides a way for users to view curated collections of records related to a number of well-known astronomy institutions, projects and repositories. These collections (commonly referred to in ADS as “bibliographic groups”) can be used as search filters (“show me all papers on AGNs which have data from the Hubble Space Telescope”) or as browsable lists of papers (“show me all papers in the ESO telescope bibliography”).

The primary goal of such bibliographies has always been to facilitate the filtering of search results in the ADS, however the availability of paper-based metrics makes it possible for archivists and program managers use them in order to assess the impact of an instrument, facility, funding or observing program. While this is an inevitable outcome of the bibliography curation process, we urge caution whenever impact analysis is performed using bibliographic data, and encourage users to read the “fine print” whenever using and comparing paper-based metrics.

It is worth pointing out that while there is now an emerging consensus within the astronomical library community about the principles behind these bibliographies (Lagerstrom 2015), there is no single (or simple) set of criteria which is applied across all such collections. To promote transparency about the process behind their creation, the ADS help pages provide a short description of the bibliographic groups.¹

2.4. Data Links

Links between bibliographic records and data products are a bi-product of so-called “telescope bibliographies” (Accomazzi et al. 2012). In creating such a bibliography, the curator goes beyond the step described above of simply tagging articles associated with a particular mission or project, and instead identifies the particular data products analyzed in the paper. It is often the case that a paper will use a set of observations from one or more archives, and therefore an archive’s telescope bibliography needs to record the multiple mappings between a paper and a set of data products hosted by the archive. Similarly, an observation or derived data products may be featured in multiple papers, so the telescope bibliography needs to support a many-to-many mapping between articles in ADS and its own datasets.

Given the fact that the list of data products discussed in a paper can be quite long, the recommended approach for generating these mappings is having an archive expose all data products associated with a paper in a single landing page, so that a unique link exists between a paper and its data products within a given archive.

Exposing the set of curated linkages to ADS is as simple as publishing a table which correlates a bibliographic identifier (bibcode) with one or more corresponding resources hosted by the archive, with an optional label for the anchor text associated with each individual link. ADS periodically retrieves and ingests these mappings into its index, updating the links in an automated fashion, and generating the corresponding bibliographic groups.

¹http://doc.adsabs.harvard.edu/abs_doc/help_pages/search.html#Select_References_From_Group
3. Conclusions

Being able to read the literature and have access to the data discussed in the paper be just one click away is obviously of great convenience for the end-user, in addition to providing evidence in support of the scientific arguments in the paper and the reproducibility of its results. However, the integration and indexing of this information in ADS allows its use to enhance the discovery process. In the introduction we provided an example query based on bibliographic group indexing which finds multi-wavelength papers appearing in NASA’s Great Observatories bibliographies. A few additional examples which use ADS’s new search engine:\(^2\) illustrate the kind of inquiries which become possible once this information is indexed: literature-based topic searches constrained to a particular collection (exoplanets and bibgroup:Spitzer); papers on a topic having associated data catalogs with particular spectral properties (exoplanets and vizier:infrared); or any combination of the two (exoplanets and (bibgroup:Spitzer or vizier:infrared)).

Of course there are also direct benefits of this integration to the archives and projects providing their data to ADS. First of all, by having a bibliography integrated in the ADS database, it becomes trivial to retrieve metrics associated with it and thus evaluate the scientific impact of its datasets as well as using bibliographic-based analytics to gain insights on how the data is used in current research. However, the primary reason for this activity is the scientific impact gained by having publications linked to data products. Studies by Henneken & Accomazzi (2012) and Dorch et al. (2015) have shown a “data sharing advantage” for papers which have links to data products, resulting in higher citation counts. Similarly, data re-use increases upon the publication of papers studying them (Winkelman et al. 2006), leading to an increase in archival research (White et al. 2009). In other words, well linked-data is more heavily used, and well-linked publications are more heavily cited, a win-win scenario, and the primary reason to have well-described, well-curated data products indexed in ADS.

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\(^2\)https://ui.adsabs.harvard.edu