Closing the loop: Linking Datasets to Publications and Back

Alberto Accomazzi, Günther Eichhorn, Arnold Rots
Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA, 02138, USA

Abstract. With the mainstream adoption of references to datasets in astronomical manuscripts, researchers today are able to provide direct links from their papers to the original data that were used in their study. Following a process similar to the verification of references in manuscripts, publishers have been working with the NASA Astrophysics Data System (ADS) to validate and maintain links to these datasets.

Similarly, many astronomical data centers have been tracking publications based on the observations that they archive, and have been working with the ADS to maintain links between their datasets and the bibliographic records in question. In addition to providing a valuable service to ADS users, maintaining these correlations allows the data centers to evaluate the scientific impact of their missions.

Until recently, these two activities have evolved in parallel on independent tracks, with ADS playing a central role in bridging the connection between publishers and data centers. However, the ADS is now implementing the capability for all parties involved to find out which data links have been published with which manuscripts, and vice versa. This will allow data centers to periodically harvest the ADS to find out if there are new papers which reference datasets available in their archives. In this paper we summarize the state of the dataset linking project and describe the new harvesting interface.

1. Introduction

Scientists responsible for a mission or a data archive know very well how important it is to keep track of who is using their data and how it is being used. Especially in this day and age of intense competition for research funds, it has become essential for large projects to maintain a list of scientific works that have been published based on the project’s data, and to evaluate the project impact in terms of bibliometric measures. Partly due to this motivation, many data centers have begun maintaining publication lists in electronic form since the first days of the web. This data has been shared with the ADS so that proper linking can occur between the ADS and the data centers.

In 2004 the AAS journals have introduced the option for authors to reference the datasets used in their studies in the body of their papers, with the purpose of strengthening the linking between publications and the supporting data. The
ADS has once again been involved in facilitating this effort, by implementing a scheme that allows the automated verification of dataset identifiers during the copy-editing process, and the automated linking of the identifiers from the electronic manuscripts.

More recently, the ADS and the Chandra Data Archive have been prototyping a service that allows a data center to harvest the list of links published in the literature which correspond to the datasets it archives. This allows a data center to supplement and verify the list of links it maintains between its data product and the published literature and provides a new paradigm for sharing linking information among collaborating institutions.

2. Links between the Literature and Datasets

Links between datasets maintained by the data centers and the ADS bibliographic records to which they are related have existed since 1995. These links have been maintained by librarians or data archivists as lists of bibcodes and URLs, and they have been shared with the ADS to allow the generation of cross-links. The creation and maintenance of such links has become an increasingly important aspect of the data archives operations (see, e.g. Rots et al. 2004).

In addition to providing access to publications related to a certain dataset, having a list of bibliographic records for a mission or project has also allowed the ADS to define bibliographic groups for some of the major missions. For instance, one can query the ADS for all papers published on Chandra data, and then get the total number of citations for them. As the data centers have become the authoritative repositories of the links between their datasets and the corresponding bibliographic records, the ADS has acted as an intermediary between the journal articles and the data.

In an attempt to improve the quality and usefulness of astronomical manuscripts, the Astrophysics Data Center Executive Committee (ADEC) in 2004 endorsed the proposal of creating links in the AAS journals to datasets maintained by the main astrophysics data archives (Eichhorn et al. 2004). The proposal calls for the definition of Dataset Identifiers according to the following syntax: ivo://ADS/FacilityId#PrivateId. These identifiers are designed to address a broad range of data granularity, from individual observations to collections of datasets, and may correspond to either static collection of data products or to data generated on the fly by a service (see, e.g., Alexov & Good, 2006). They are defined as a type of IVO Identifiers (Plante et al. 2006), and as such they are permanent, unique, and resolvable.

The implementation of the linkage from published papers to datasets requires the collaboration of both the data centers and the publishers, and is mediated by the ADS (Accomazzi & Eichhorn 2004). Data centers assign identifiers to the datasets they serve, uniquely identifying them. These identifiers need to be prominently displayed in the metadata related to the dataset, so that the scientists analyzing it will know how to reference it during publication. Publishers who participate in this effort provide suitable means for authors to include a reference to the data during the creation of the manuscript (typically via the use of LaTeX macros), and to verify the validity of the datasets through a central verification service provided by the ADS. The central verifier forwards
the query to the appropriate data center(s) in order to determine if a certain dataset is valid and what its final linking URL should be. The results of this query are cached in a local database and are used later to resolve the dataset identifier when a user requests it.

3. Harvesting of Dataset links

The current linking schemes, described above, provide the basic functionality desirable from a user’s perspective: they allow access to the publications relevant to a particular dataset (when accessing the dataset); and they allow access to the datasets described in a scientific paper (when accessing an online article). However, this level of linking relies on two independent tracks, each headed by a different group of people: the data centers and the publishers. While these procedures accomplish their original goals, the current exchange of metadata among the parties involved has so far not facilitated the curation of links from the data centers’ point of view, since they have not received information about what new data links are being published in the current literature.

When a new article containing references to datasets is published, the relevant metadata is made available by the publisher to the ADS in the form of a list of dataset identifiers which have been successfully verified and resolved to a particular online data product. The ADS has now created a harvesting interface that data centers can use in order to discover which of the datasets in their archive are being referenced by new journal articles. The current interface supports simple HTTP REST-based queries returning straight XML, but we expect to extend it to support additional access methods as requested by the VO community. The interface supports both the complete and incremental retrieval of records related to a particular observing facility or maintained by a particular data center.

The harvesting procedure described above allows data centers to maintain an updated list of the datasets referenced by the current literature. We don’t expect this to be an exhaustive list for a variety of reasons: some publications don’t (yet) participate in this effort, so no linking metadata will be available from them; authors can’t always be trusted to properly cite all of the datasets they have analyzed in their study; and the verification procedures used to determine the validity of a link may have failed due to transient problems. For these and other reasons, we consider the data centers to be the authoritative source of links between publications and data products. Therefore the ADS will continue to rely on the correlation tables provided by the data centers to create links between bibliographic records and datasets. To this end, all data centers maintaining these correlations should provide a harvesting interface that will be used by ADS to populate the corresponding links from its bibliographic records back to the data centers.

As an added benefit, this harvesting interface can serve as a prototype for a more general service allowing the exchange of relational tables between any two sets of identifiers (in this case bibcodes and dataset identifiers). A similar service could be used by two data centers to share related links between them, e.g. to maintain lists of coordinated observations.
4. Conclusions

We have reviewed the existing procedures that allow the exchange of metadata used in creating links between the different entities involved in maintaining bibliographies and astronomical data products. We have proposed an improvement of the current linking procedures based on the use of harvesting services that can facilitate the curation and exchange of links between bibliographies and datasets. Even with the adoption of our recommendations, much work still needs to be done by all parties involved in order to further the creation and maintenance of these links. In particular, these are the areas where we think most our effort should be concentrated on:

- Data centers should make users aware of the identifiers that have been assigned to the datasets they download and analyze, so they can be referenced in the literature. Most of the NASA data centers have already provided this information to their users, but we hope for greater participation from the international community at large.
- Publishers should encourage the scientists to declare in their papers which datasets have been used in their study and reference them using the appropriate editing tools. The AAS journals have led the way in this effort, and we hope that the remaining astronomical journal publishers will join in the coming years.
- Data centers should harvest the ADS to find out what papers have published links to datasets under their curation. The data centers should also provide ADS with a complete list of links between their data products and the published literature.

We hope that broader participation in this important project can be accomplished by raising the awareness of these efforts within the astronomical community. More information about this project is available online at http://vo.ads.harvard.edu

Acknowledgments. The ADS is funded by NASA Grant NNG06GG68G. The Chandra X-Ray Center is funded by NASA Grant NAS 8-03060.

References

Accomazzi, A. & Eichhorn, G. 2004, in ASP Conf. Ser., Vol. 314, ADASS XIII, ed. F. Ochsenbein, M. Allen, & D. Egret (San Francisco: ASP), 181

Alexov, A. & Good, J. 2006, this volume, [P3.01]

Plante, R., Linde, T., Williams, R., & Noddle, K. 2006, http://www.ivoa.net/Documents/latest/IDs.html

Rots, A. H., Winkelman, S. L., Paltani, S., Blecksmith, S. E., & Bright, J. D. 2004, in ASP Conf. Ser., Vol. 314, ADASS XIII, ed. F. Ochsenbein, M. Allen, & D. Egret (San Francisco: ASP), 605

Eichhorn, G., & Astrophysics Datacenter Executive Committee (ADEC) 2004, Bulletin of the American Astronomical Society, 36, 805