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Research Data Management

Simple Ways to Make your Research Life Easier

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BE/Bi 103

October 10, 2018

Current Research Data Practices

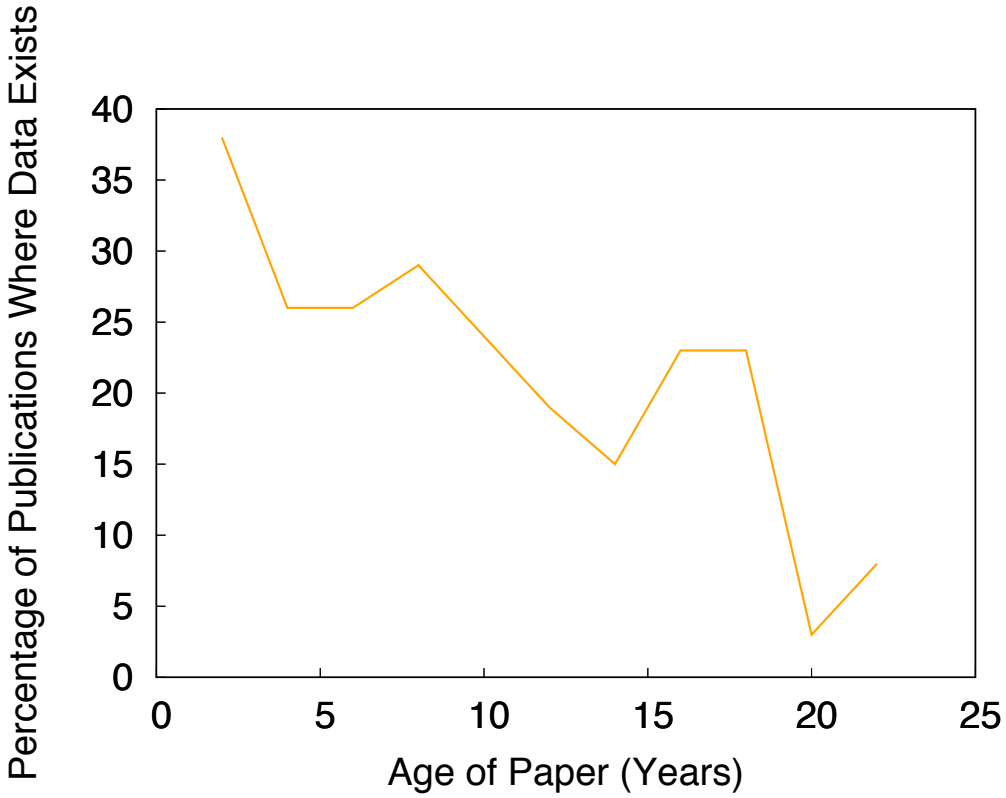
Most researchers store data on local computer hard drives

Researchers report that finding data is their biggest challenge

Akers, K. G. & Doty, J. Disciplinary differences in faculty research data management practices and perspectives. *Int. J. Digit. Curation* **8,** 5–26 (2013). (Emory)
Shen, Y. Strategic Planning for a Data-Driven, Shared-Access Research Enterprise: Virginia Tech Research Data Assessment and Landscape Study. *Coll. Res. Libr.* **77,** 500–519 (2016).

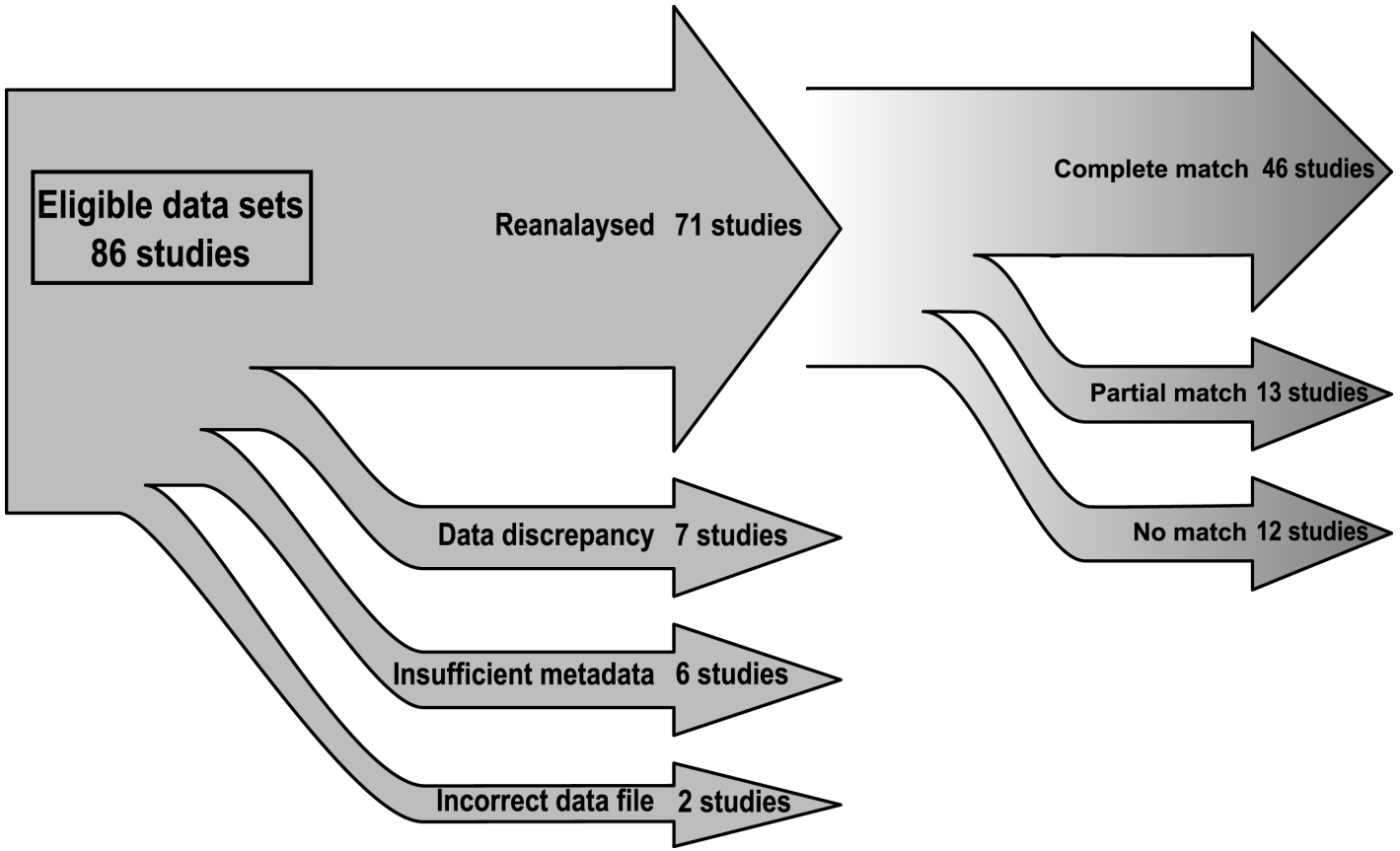
How Reusable is Research Data Today?

- Morphological characteristics of plants and animals
  - 516 publications using a specific analysis technique between 1991 and 2011
    - 25% of emails didn't work
    - 38% didn't respond to email
    - 13% didn't have data
    - 4% didn't want to share
    - Received 19% of data
    - Availability decreased with time



Vines, T. H. *et al.* The availability of research data declines rapidly with article age. *Curr. Biol.* **24,** 94–97 (2014).

Data Quality



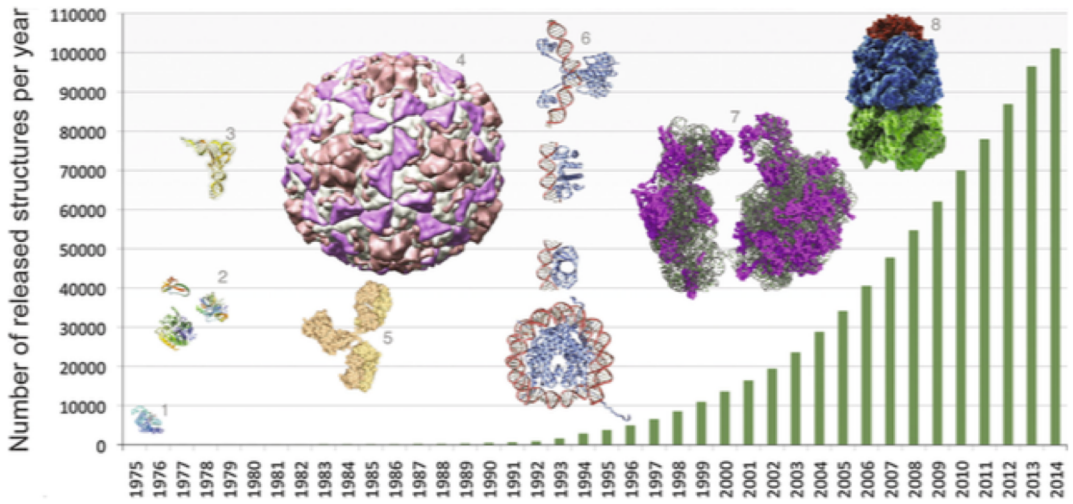
On Average, 13% of Papers Had Usable Data

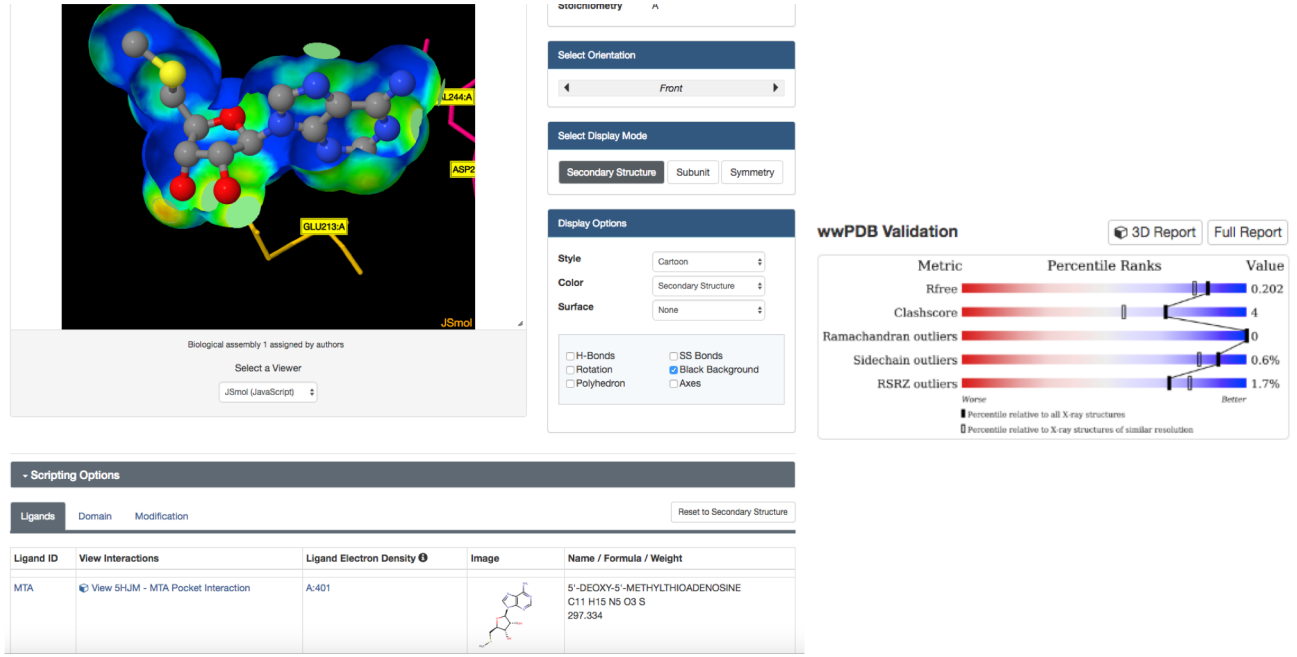
Andrew, R. L. *et al.* Assessing the reproducibility of discriminant function analyses. *PeerJ* (2015). doi:10.7717/peerj.1137

Why is it better to have data available?

RCSB PDB
PROTEIN DATA BANK

www.rcsb.org





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Berman, H. M., Kleywegt, G. J., Nakamura, H. & Markley, J. L. The Protein Data Bank archive as an open data resource. *J. Comput. Aided. Mol. Des.* 1009–1014 (2014). doi:10.1007/s10822-014-9770-y

Why is it better to have data available?

"Digitally formatted scientific data resulting from unclassified research supported wholly or in part by Federal funding should be stored and publicly accessible to search, retrieve, and analyze."

2013 OSTP Memo

Data Management Plans

- Expected Data
- Data Formats and Metadata
- Access to Data
- Data Archiving

https://www.science.gov/docs/ostp_public_access_memo_2013.pdf

Why is it better to have data available?

Journals require data availability:

PLOS

nature

Science
AAAS

PNAS

The Review of Economics and Statistics

Cell
PRESS

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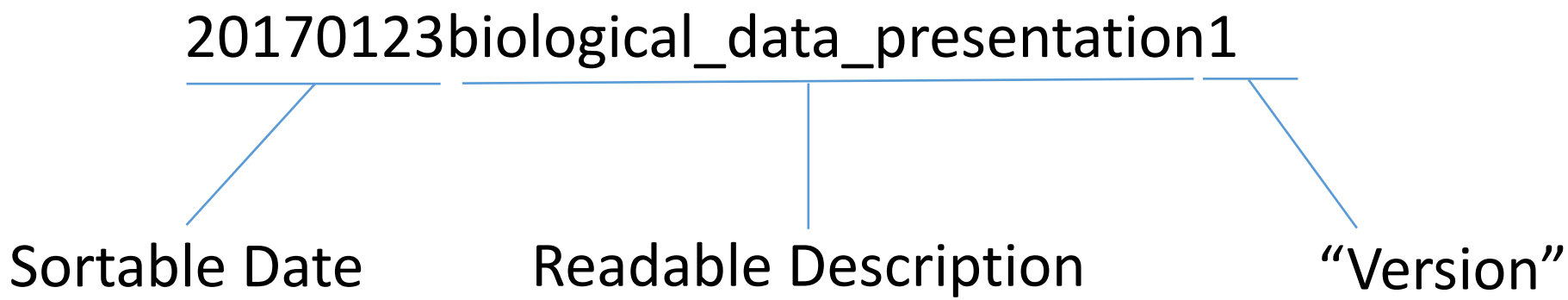
Simple Solutions

- Choose a file naming/organization scheme
- Save reasonable files
- Use reliable storage
- Plan for sharing

Naming

- Trying to recreate your work months/years later is hard
- Choosing a consistent naming system makes things easier



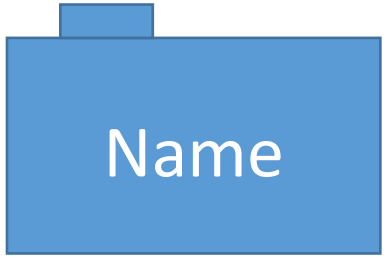
Data Architectures

Dataset

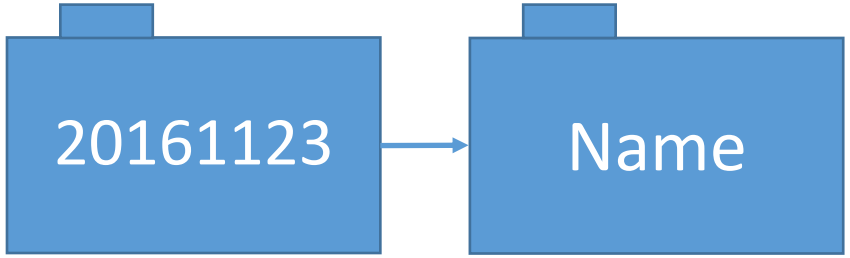
Automatically Manage Metadata/Documents

https://github.com/caltechlibrary/dataset

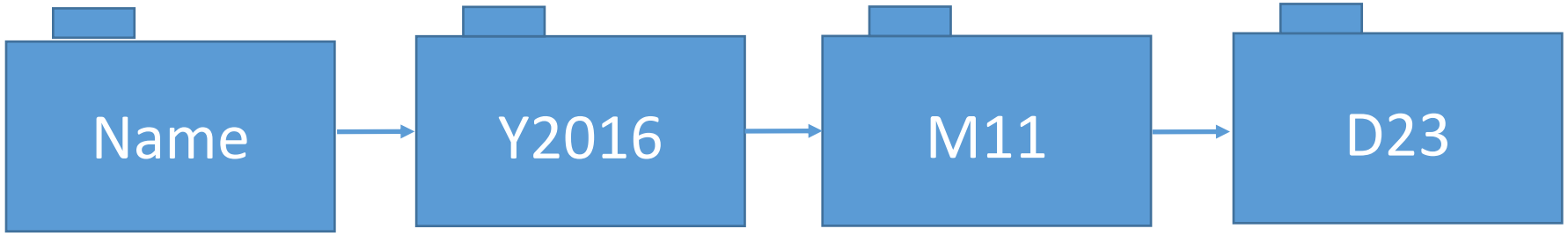
Simple



Date Based



Complex



Save Reasonable Files

- Human-readable text files are best (.txt, .csv)
- Non-proprietary files are better than proprietary
- Do analysis with scripts if possible
- Save both input and output files as space allows

Active Data Storage

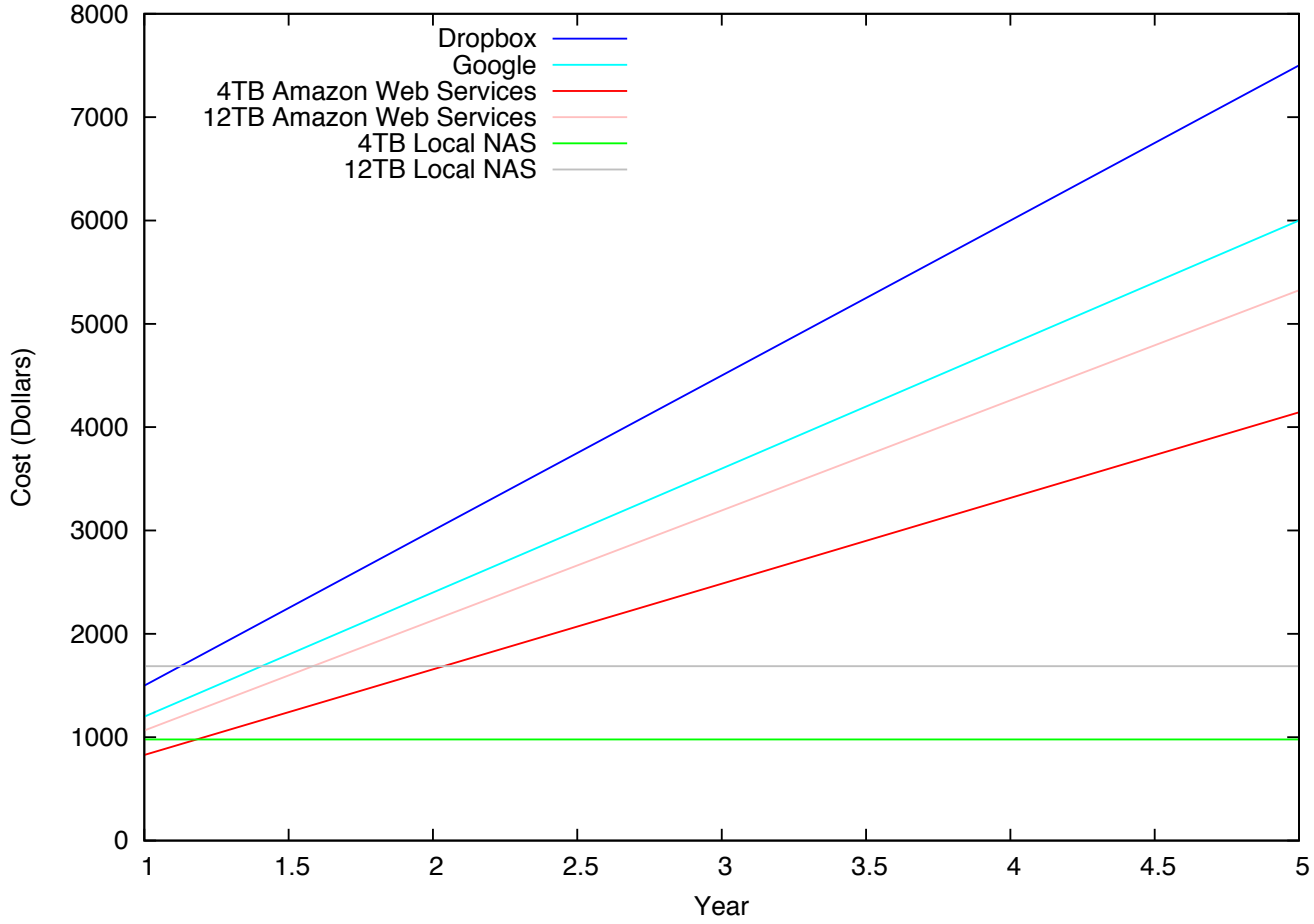
- Small amounts of data (GB) are easy
- TB-scale data require planning
  - Need a system that will be reliable
    - Network-Attached Storage (Local RAID array)
    - Cloud Storage

Network-Attached Storage

- Small computer with array of hard disks
- Consumer/Prosumer devices
- Low Cost (4 TB-$425; 42 TB-$3000)
- Need to plan space requirements
- Need to manage

Cloud Storage

- Defined or flexible storage
- Vendor Managed
- Continuous cost
- Limited by bandwidth
- Dependent on vendor



Disaster Recovery

- What Happens in a Disaster?
- Use 2 mirrored NAS units in 2 locations
- Mirror NAS to cloud storage (Box.com - imss.caltech.edu/box)

Data Sharing

- FAIR (Findability, Accessibility, Interoperability, Reusability)
  - Subject Repositories
  - General Repositories
  - Institutional Repositories

Wilkinson, M. D. *et al.* The FAIR Guiding Principles for scientific data management and stewardship. *Sci. Data* 3:160018 doi: 10.1038/sdata.2016.18 (2016)

Subject Repositories

- Protein Data Bank
- GenBank
- Wormbase
- Pangaea
- Long Term Ecological Research Data Portal
- Good listing: journals.plos.org/plosone/s/data-availability
- Thousands more: www.re3data.org

General Repositories

- Zenodo (CERN-Free)
- Dryad (Nonprofit-$120 per submission + Space)
- Figshare (20GB Max)
- Mendeley Data (Elsevier-Free)
- Dataverse (Harvard-Free)

CaltechDATA

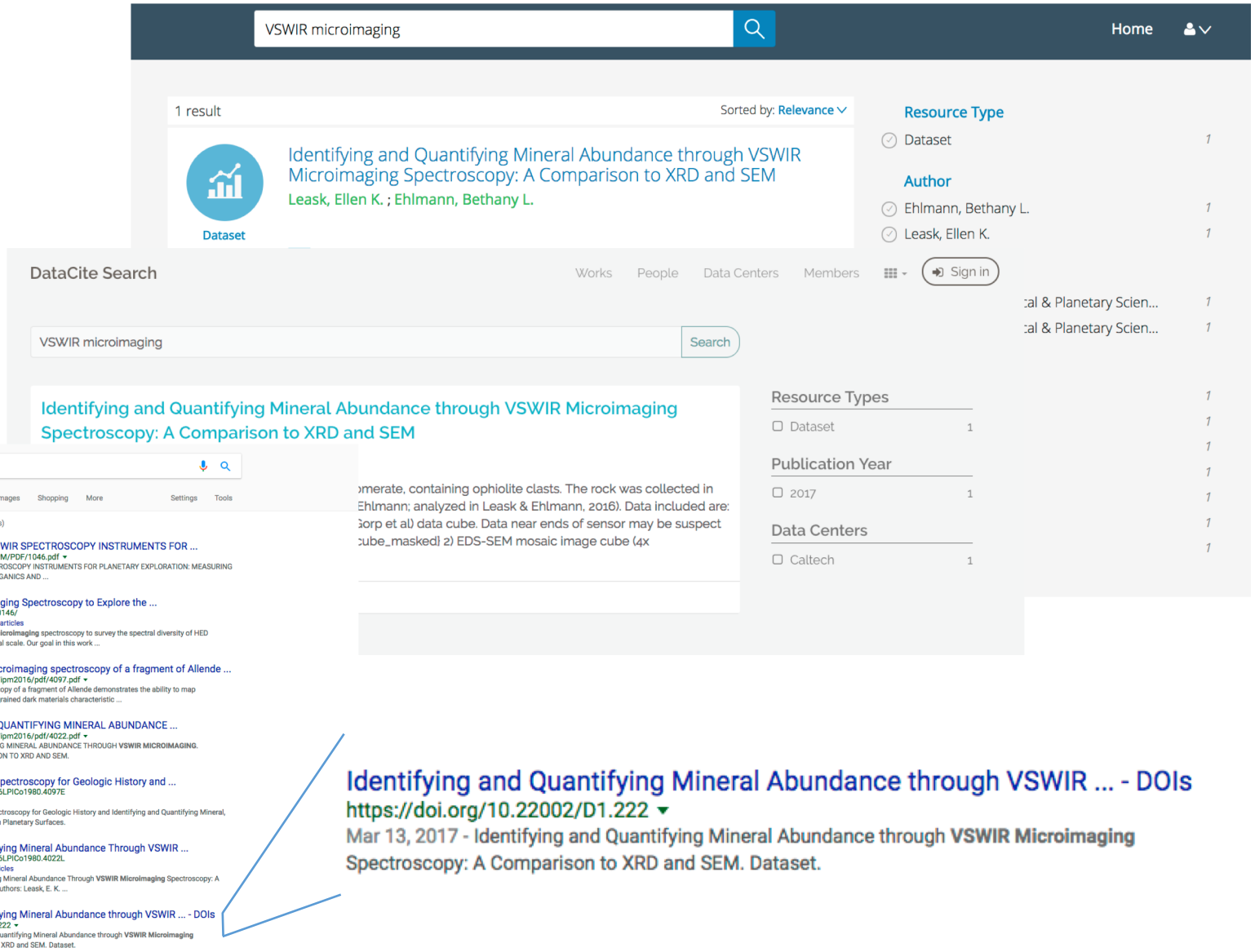
California Institute of Technology
Research Data Repository

- Available at data.caltech.edu
- Easy to describe and upload files
- All records get a DOI (permanent, registered link)
- Integration with Github
- API for accessing data
- Library takes care of preserving and maintaining access to files

Caltech Library

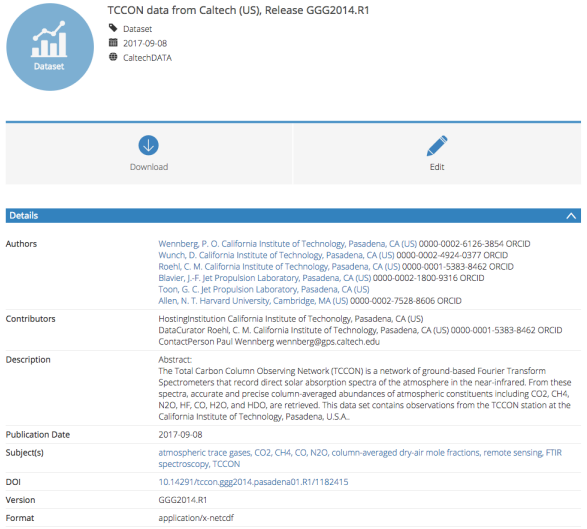
Discoverability

- CaltechDATA site search
- DOIs appear in DataCite search
- and Search Engines

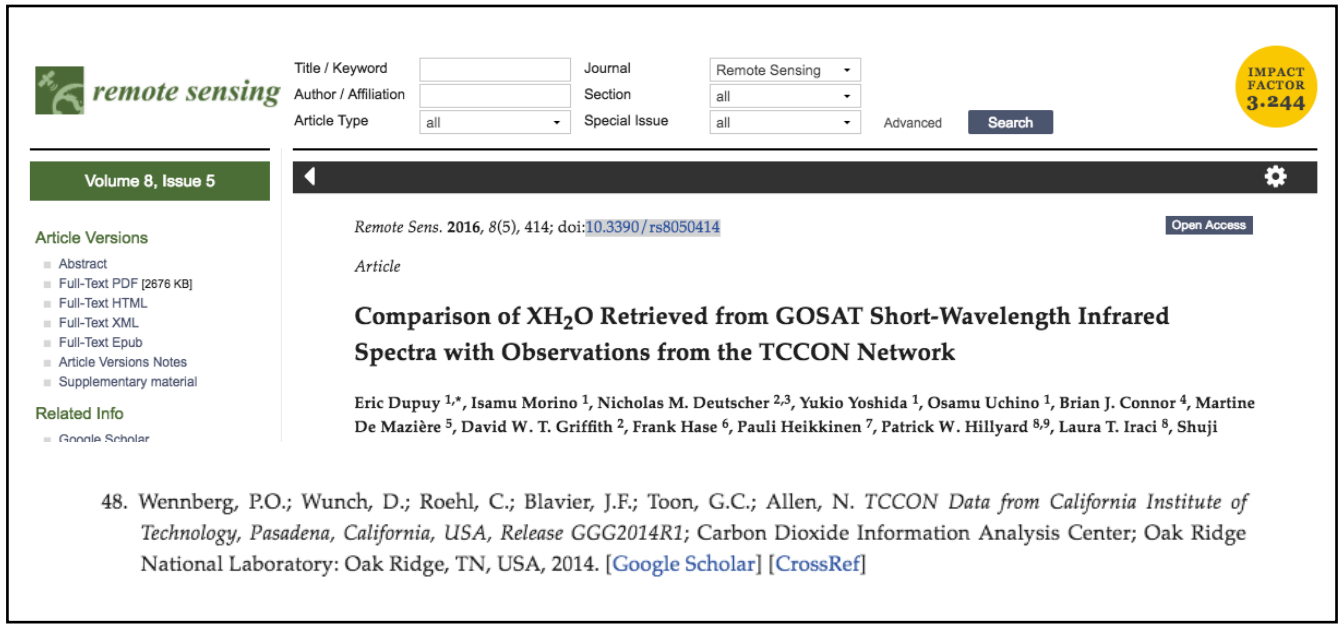


Caltech Library

Citations



California Institute of Technology
Research Data Repository



https://doi.org/10.3390/rs8050414

Citation

https://doi.org/10.14291/tccon.ggg2014.pasadena01.R1/1182415

Update Record

Email Alert

Related Identifier(s)

IsDocumentedBy (URL): https://tccon-wiki.caltech.edu/Network_Policy/Data_Use_Policy/Data_Description
IsDocumentedBy (URL): https://tccon-wiki.caltech.edu/Sites
IsPartOf (URL): http://tccondata.org
IsDocumentedBy (DOI): 10.14291/tccon.ggg2014.documentation.R0/1221662
IsCitedBy (DOI): 10.5194/amt-9-683-2016
IsCitedBy (DOI): 10.5194/amt-9-227-2016
IsCitedBy (DOI): 10.5194/amt-9-3491-2016
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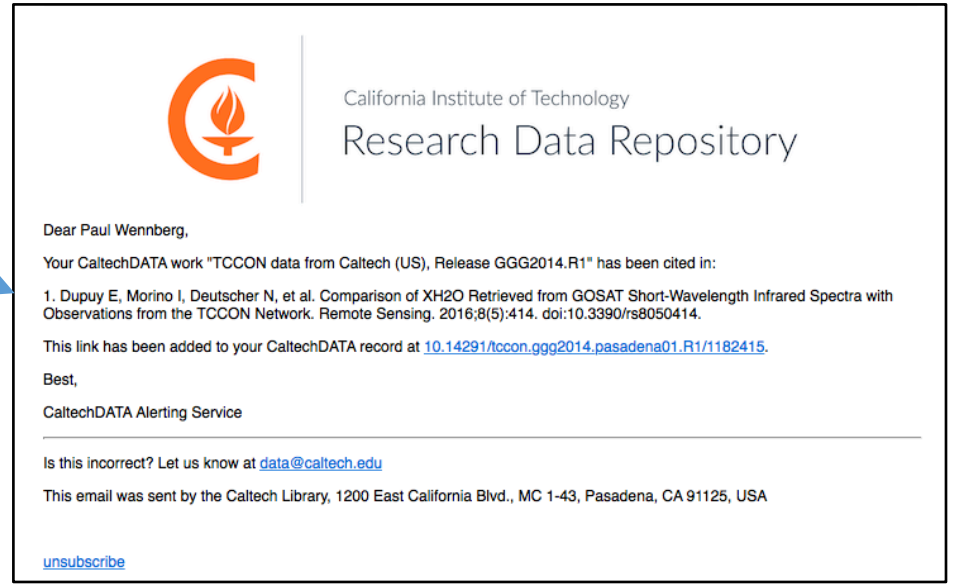

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Research Data Repository

Demo

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Use Cases - Theses

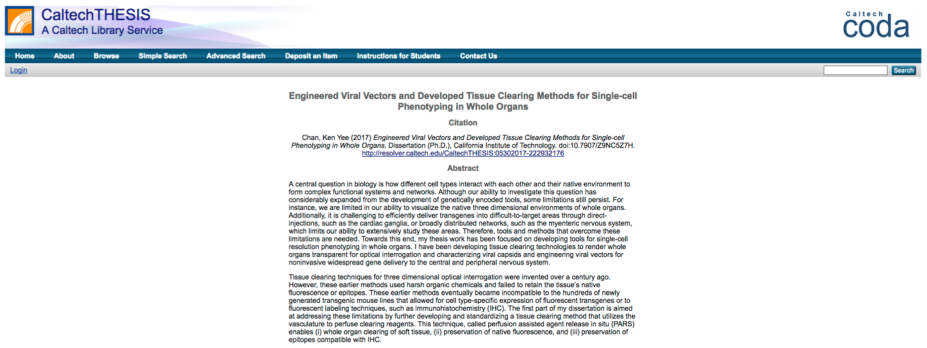
Upload files while writing

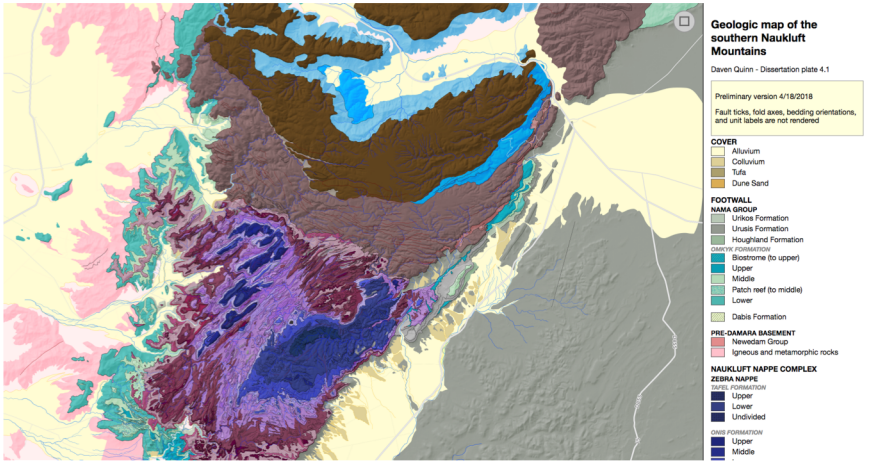
California Institute of Technology
Research Data Repository

https://doi.org/10.22002/D1.234
https://doi.org/10.22002/D1.235
https://doi.org/10.22002/D1.236
https://doi.org/10.22002/D1.237

Link in thesis

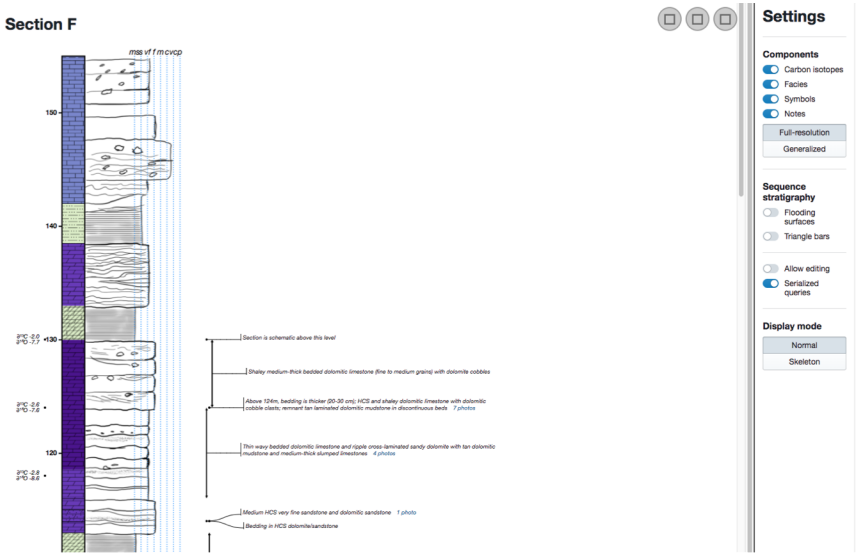
https://doi.org/10.7907/Z9NC5Z7H





https://doi.org/10.7907/5exk-mr58

https://doi.org/10.22002/D1.946



https://doi.org/10.7907/9kva-eq78

https://doi.org/10.22002/D1.947

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Use Cases

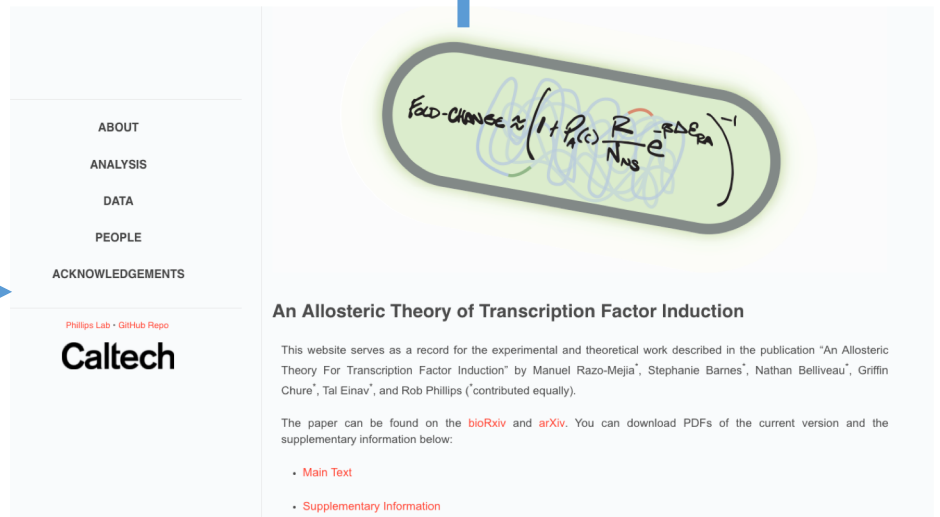
https://doi.org/10.1101/111013

Paper Website on GitHub

California Institute of Technology
Research Data Repository

https://doi.org/10.22002/D1.224
https://doi.org/10.22002/D1.227
https://doi.org/10.22002/D1.228
https://doi.org/10.22002/D1.229

Data Files



https://rpgroup-pboc.github.io/mwc_induction
https://doi.org/10.22002/D1.299

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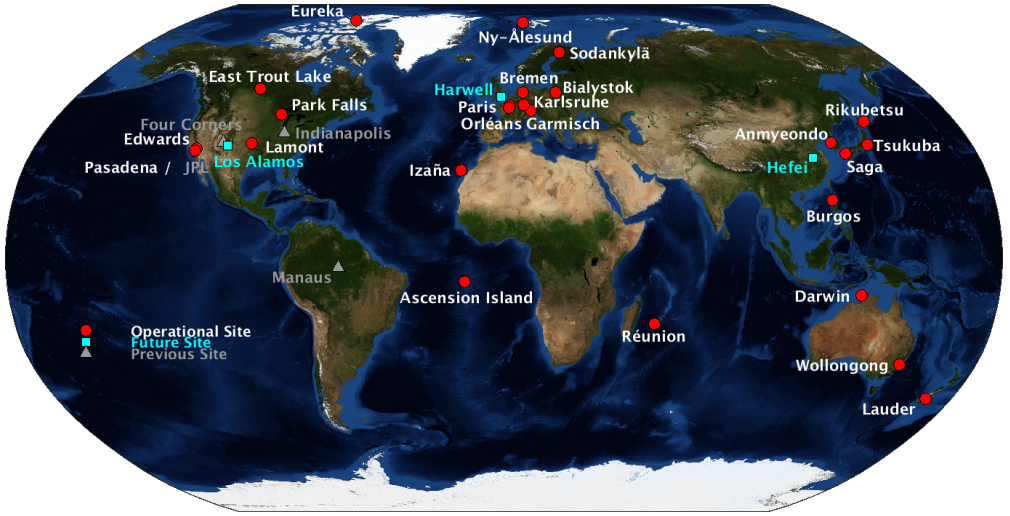
Use Case - TCCON



Total Carbon Column Observing Network (TCCON)
29 Data Collection Sites Around the World

Data files

~~CDIAC Carbon Dioxide Information Analysis Center~~

~~OAK RIDGE National Laboratory~~

Processed Data

Data Curation and Processing

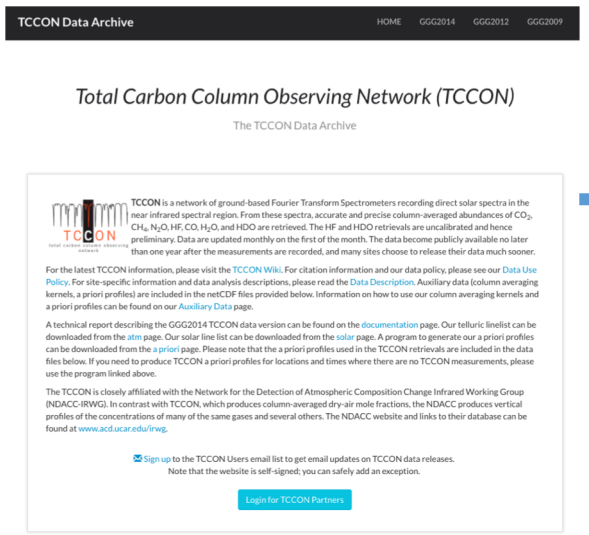
Caltech Library

https://tccon-wiki.caltech.edu/Sites/Park_Falls
http://tccondata.org/

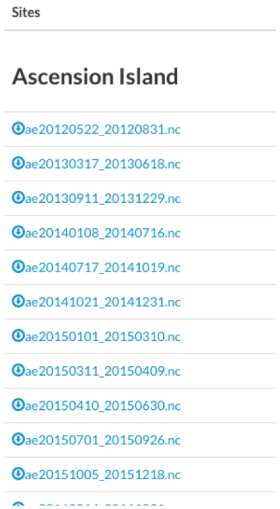
Use Case - TCCON

OAK RIDGE National Laboratory

tccon.ornl.gov



Private data files

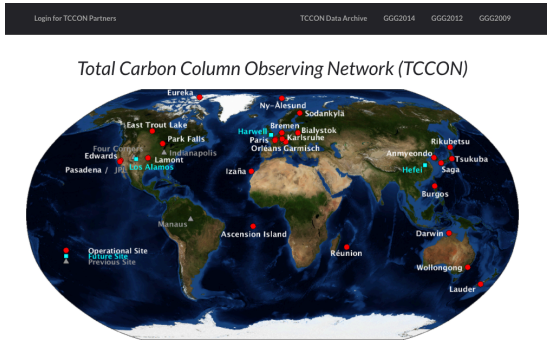


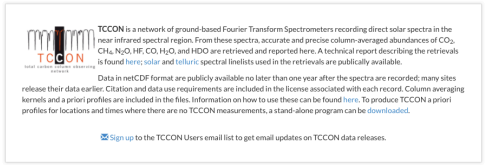
Public data files

Automatically released 1x/month

Migration

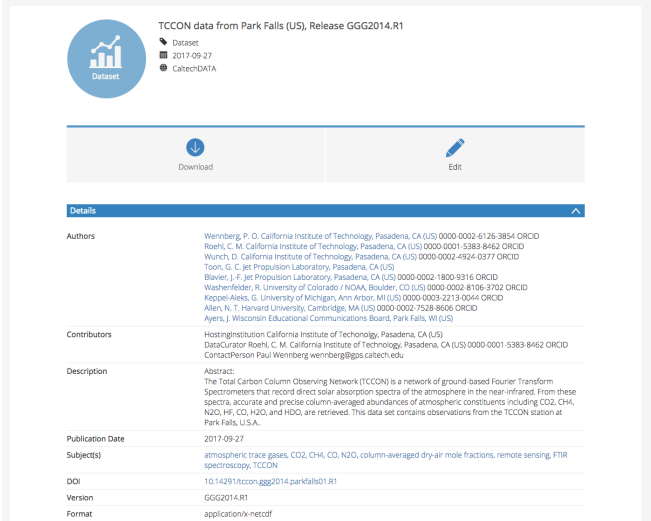
Departmental Server at Caltech





tccondata.org

CaltechDATA



https://doi.org/10.14291/tccon.ggg2014.parkfalls01.R1

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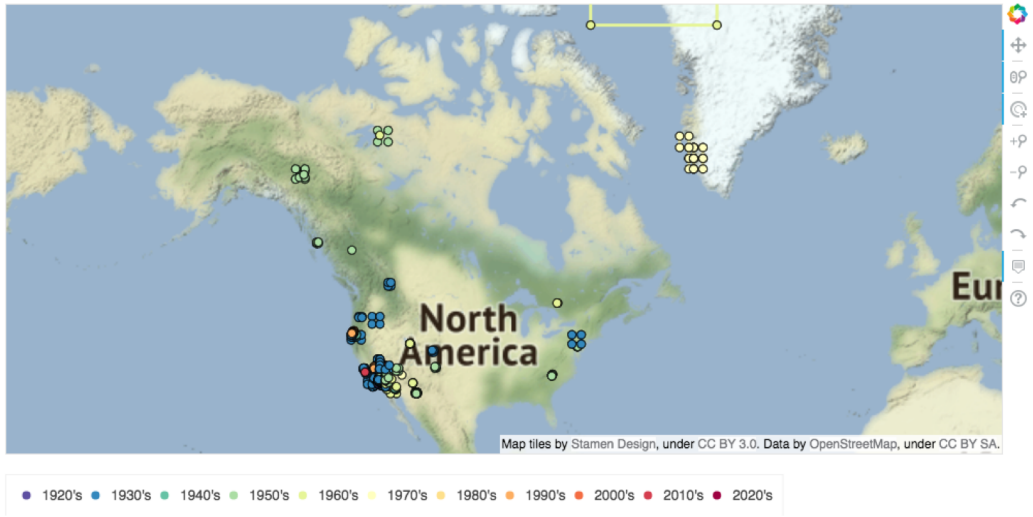
Research Data Repository

Caltech Division of Geological and Planetary Sciences Theses

This map shows the coordinates of content in CaltechDATA associated with theses from the Geological and Planetary Science Division at Caltech. Data included from historic theses are supplemental pocket contents such as maps and drawings.

Scrolling inside the map will zoom and dragging will move the map. Click on any point or bounding box to see the original item in CaltechDATA.



Want your thesis to show up on the map?

Upload files associated with your thesis to CaltechDATA and include a geolocation point or area. You'll also have to include the keywords 'gps' and 'thesis' in the record. If you run into any problems just send us an email.

Did you complete your thesis in the Caltech GPS Division?

We haven't been able to assign locations for every thesis. Send us an email and we can get your thesis on the map.

Want to improve this map?

The code to generate the map is available on GitHub and we accept pull requests for improvements.

http://maps.library.caltech.edu/

https://doi.org/10.22002/D1.856

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Caltech Library Data Management Services

- Want to chat about data issues?
- Data management plan development
- Consultations on storage technologies or file organization

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