Acquiring Data from IRIS

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EarthScope Introductory
Data Processing Short Course

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IRIS

The Incorporated Research Institutions for Seismology

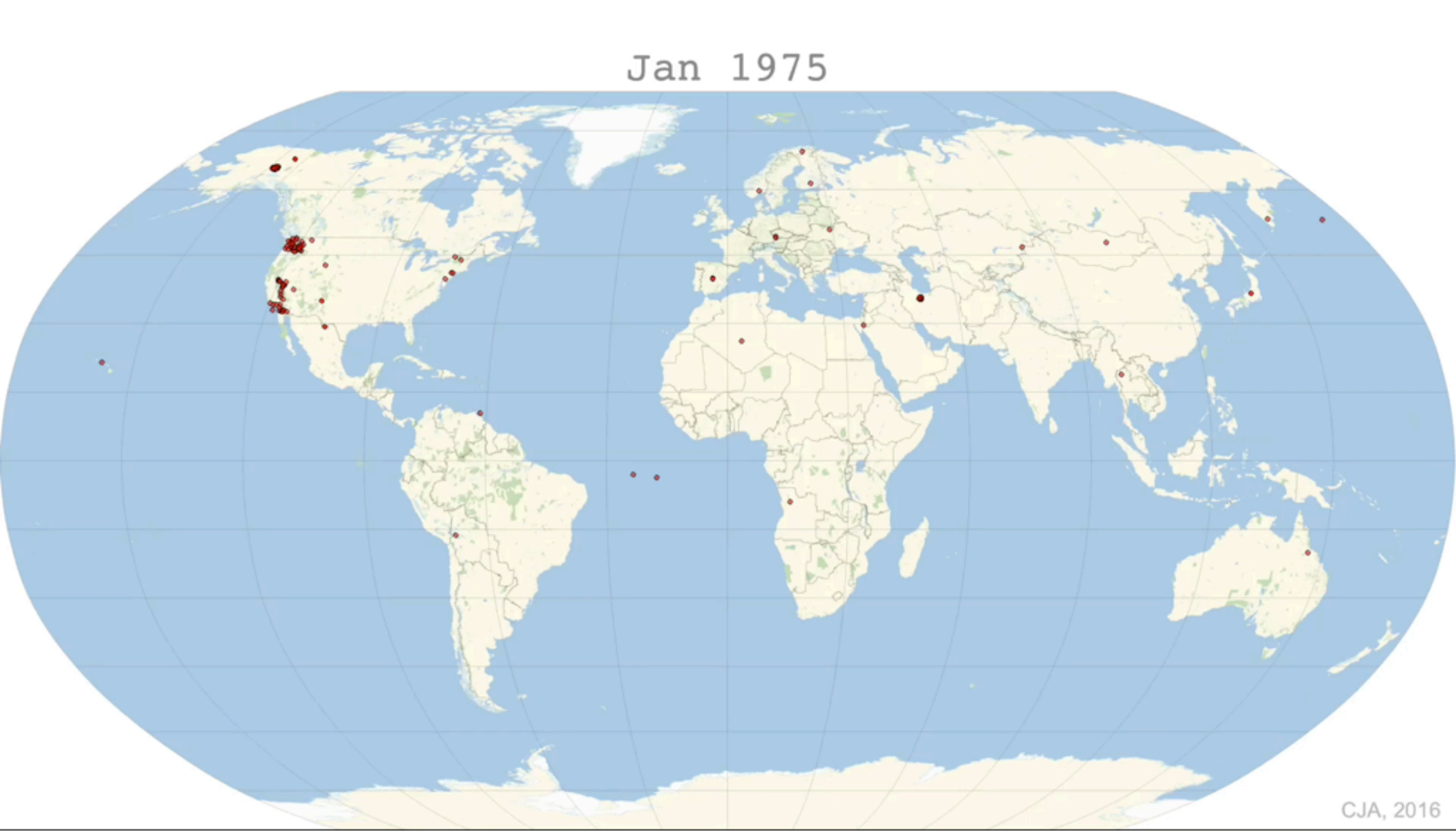
IRIS is a consortium of academic and other non-profit earth-science institutions funded by the U.S. National Science Foundation (NSF) to collect, to manage, and to provide open access to observed and derived data including ground motion, atmospheric, infrasonic, hydrological, and hydroacoustic data.

http://www.iris.edu

The IRIS web site has many useful pages, here are two I use frequently.

http://services.iris.edu

http://ds.iris.edu/mda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Seismic Data

- Some General Types of Seismic Data
  - Earthquake Hypocenter Catalogs
  - Earthquake Faulting Geometry Catalogs
  - Earthquake Time & Amplitude Measurements
  - Time Series

Sensors @ IRIS

Seismometers

- Short Period, Long Period, Broadband
- Strong Motion
- Geophones

Meteorology Sensors

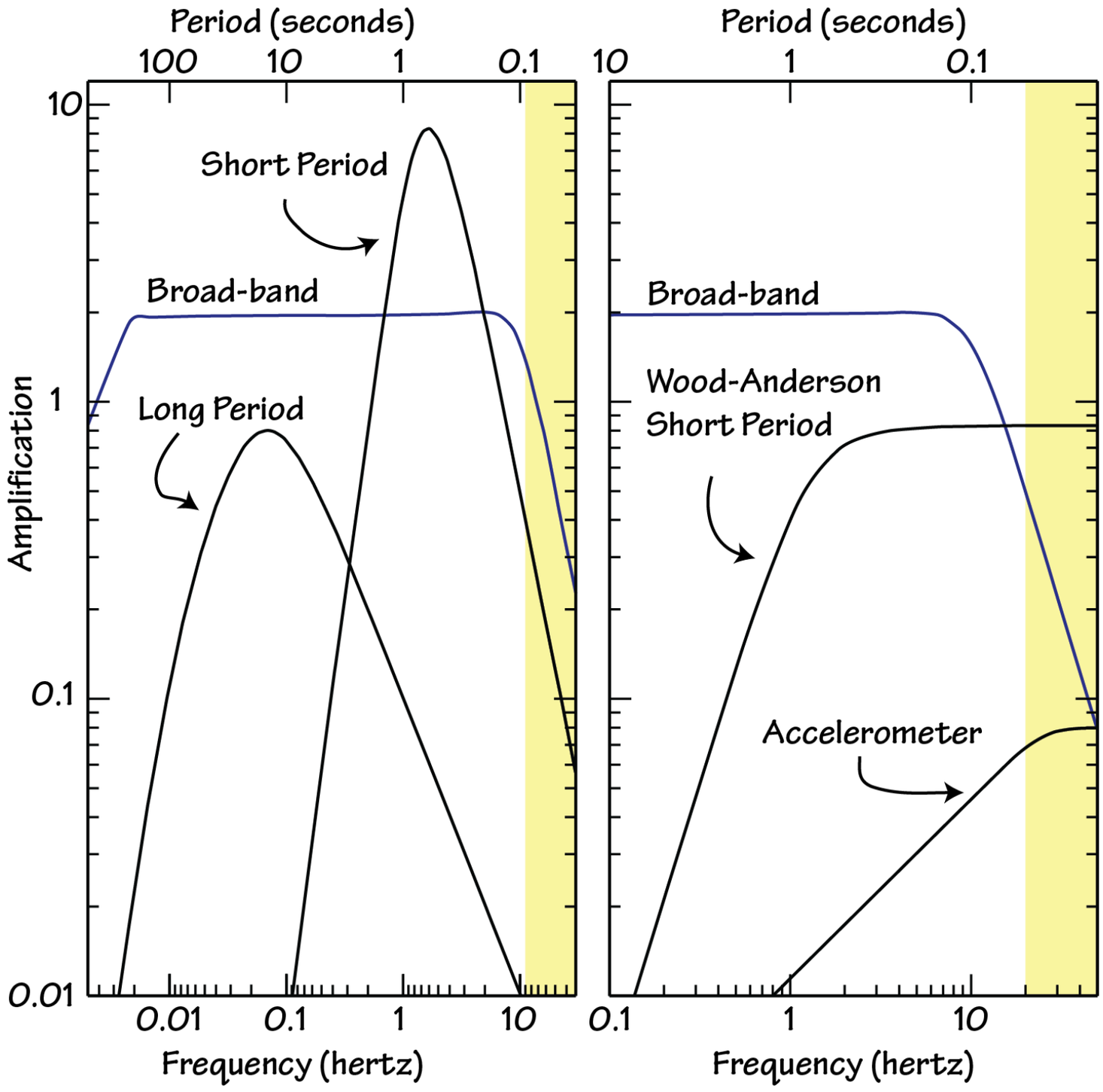
- Pressure
- Temperature
- Humidity
- Wind Speed & Direction

Non-Seismic Geophysical Sensors

- Strain meters
- Creep meters
- Tidal Pendulums

- Gravimeters
- Magnetometers
- Electric-Field sensors

Seismometer Types



Exercises

Find reliable documentation of the instruments online (Wikipedia, government and/or academic institutions, etc.) to help answer these questions.

What is the difference between a strong-motion accelerometer and a seismometer?

What is the difference between a seismometer and a gravimeter?

An instrument important to seismology that is not listed above is a GPS sensor. Compare and contrast a seismometer with an GPS station.

Why might seismologists be interested in the meteorological measurements of pressure, temperature, humidity, etc in the vicinity of a seismic station?

Data Identification Codes Common in Earthquake Seismology

The "atom" of IRIS time series data is the signal recorded by a channel over a specified time range. We use a well-defined set of codes to identify our data.

- Each has a seismic **network code**.
- Each network is a collection of seismic "stations" that also have a three or four character **station code**.
- Each station may include a number of sensors that have several components (as in components of motion). Sensors are identified by a **location code** and channels by the **channel code**.

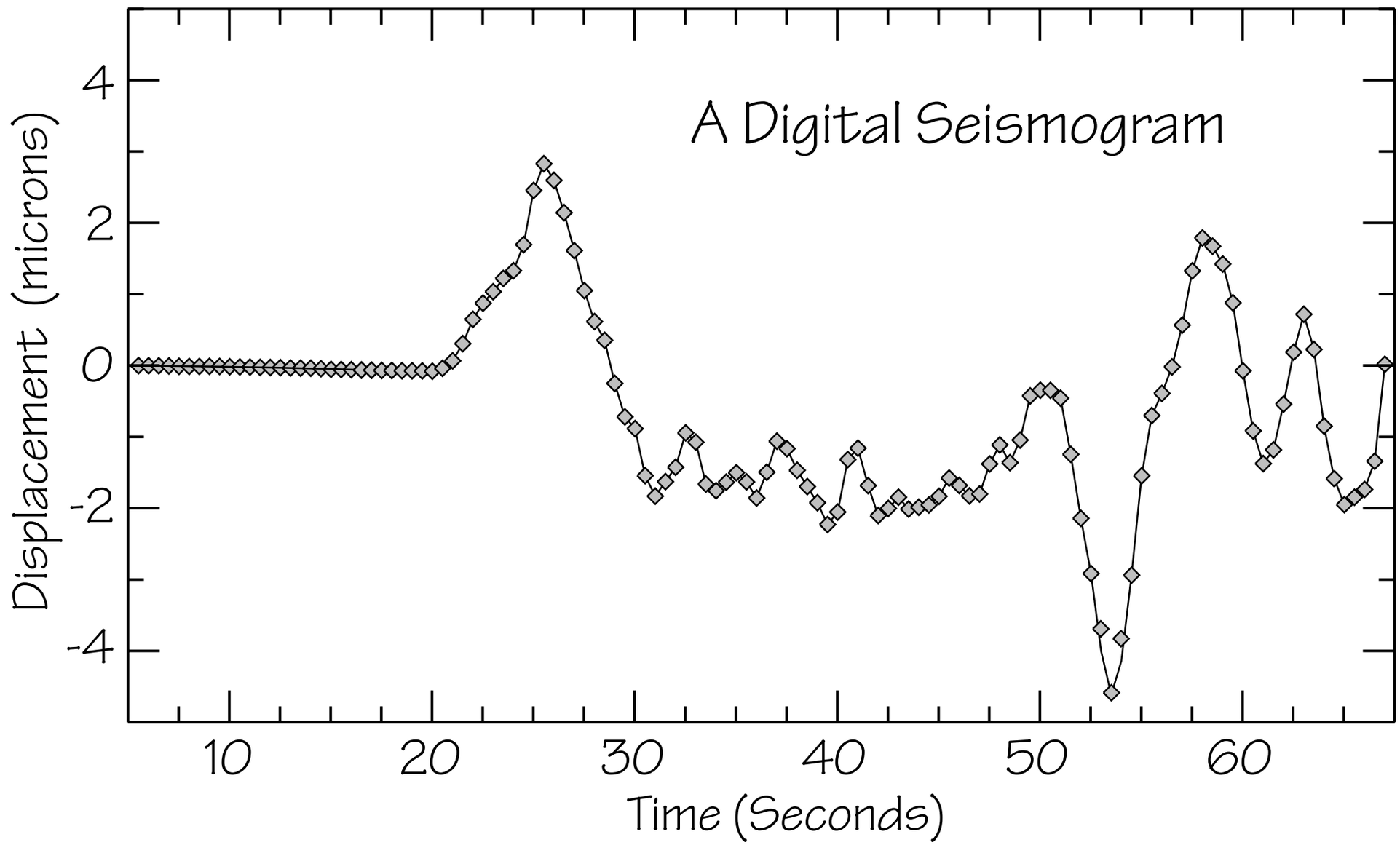
IRIS Channel Code Builder

http://ds.iris.edu/ds/nodes/dmc/tools/data_channels/

Exercises

- What is the channel code for a very long period vertical component sensor that is sampled at a rate of once every 10 seconds (the frequency of sampling is 0.1 Hz)?
- What is the channel code for an atmospheric pressure sensor sampled once each second?
- What is the channel code for a broadband high-gain strong-motion accelerometer sampled 100 times per second?
- What is the channel code for a broadband low-gain strong-motion accelerometer sampled 100 times per second?

Digital Seismograms



Metadata

Metadata - n. data that describes and gives information about other data.

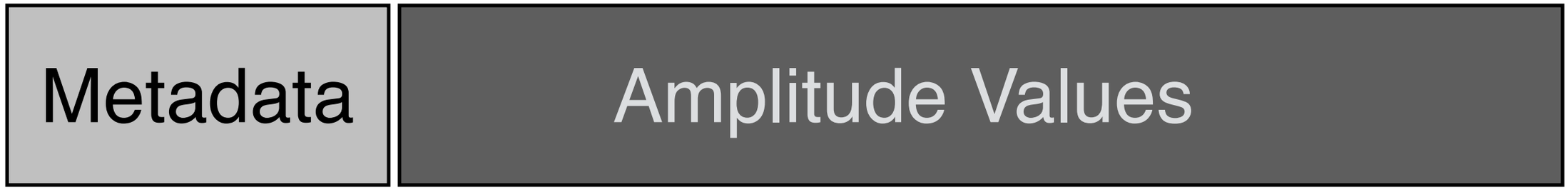
Metadata is a generic term for the information that you need to use data quantitatively.

You must know where the data were recorded (latitude, longitude, and depth/elevation), the instrument orientation, the data sample rate, the response of the instrument, whether they data were filtered, etc.

For seismometers, we usually describe the information needed to convert the raw data to something more useful like ground displacement, velocity, or acceleration using a transfer function applied to the original ground motion to produce the measurements which after digitization are often in "units" of digital counts.

Digital Seismogram Files

A digital seismogram file is a sequence of information that includes both metadata and the seismogram amplitudes.



We often call the metadata a “header” because it is often at the top of the file.

IRIS metadata aggregator

http://ds.iris.edu/mda

Here's a link to a list of near-real time stations

http://ds.iris.edu/mda/_REALTIME

You can see an interactive map if you click on the link in the upper right (both the table and the map take some time to load because so many stations are available in near real time).

If you know the network and station code and are curious about the channels available, you can just enter the we address directly

http://ds.iris.edu/mda/IU/SSPA

The mda site can save time as you examine data - it's often faster than looking in the files on your disk.

Exercises

- Roughly how many stations are affiliated with the USGS/ IRIS Global Seismographic Network, GSN (hint: the GSN is composed of two sub networks, the IU and II)?

- Roughly how many stations are part of the GEOFON (GE) and GEOSCOPE (G) networks?

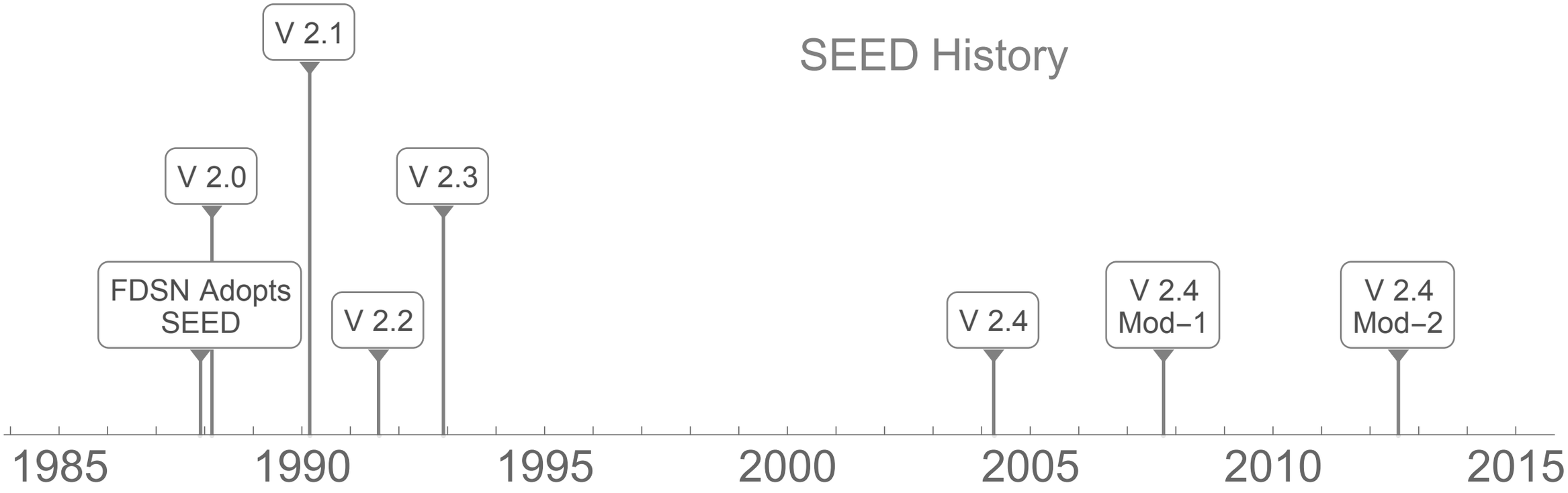
- What sensors are common to stations in the Transportable Array in Alaska (hint, use mda to get a list and then a map of the TA and then browse the channels of a few stations?

SEED

The SEED Manual is available at:

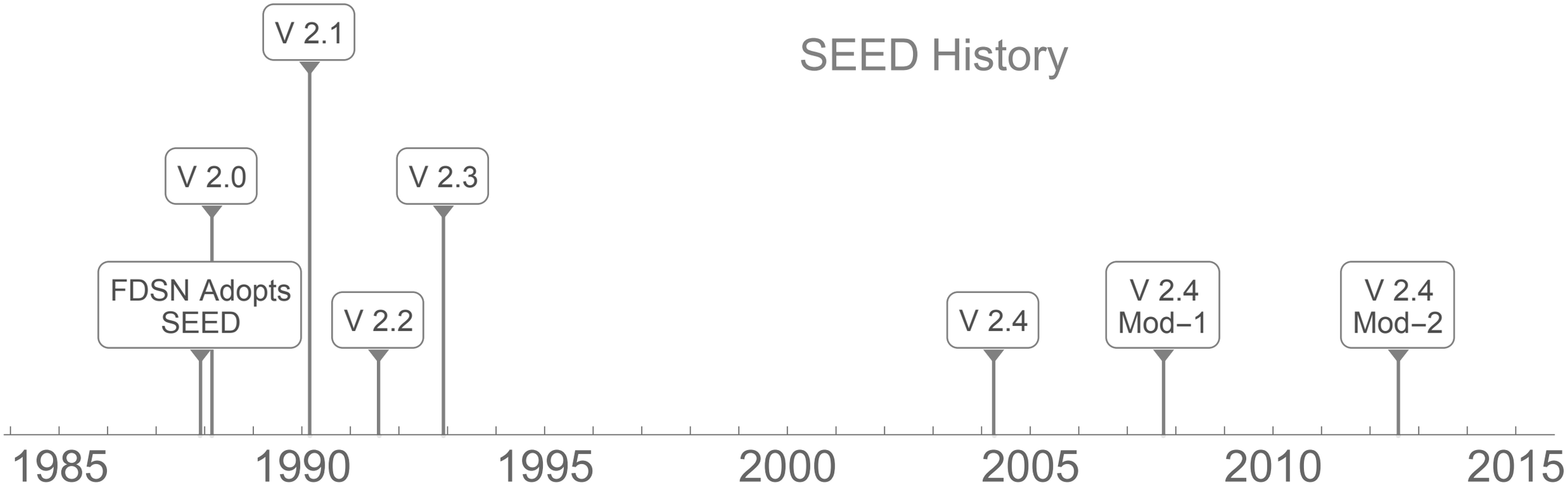
http://www.fdsn.org/seed_manual/SEEDManual_V2.4.pdf

You should look at it, and read Appendix A: Channel Naming, and Appendix C: Specifying and Using Channel Response Information.



SEED

The SEED format is community-defined, standardized format designed to store digital time-series data and metadata in a compact format. SEED has a relatively long history and well established, but at least parts of it will be replaced during your careers (station.xml).



Full SEED, miniSEED, DatalessSEED

A full **SEED** file includes stations, instrument, and perhaps even event information in addition to the actual data. You may commonly hear people discuss two flavors of SEED files.

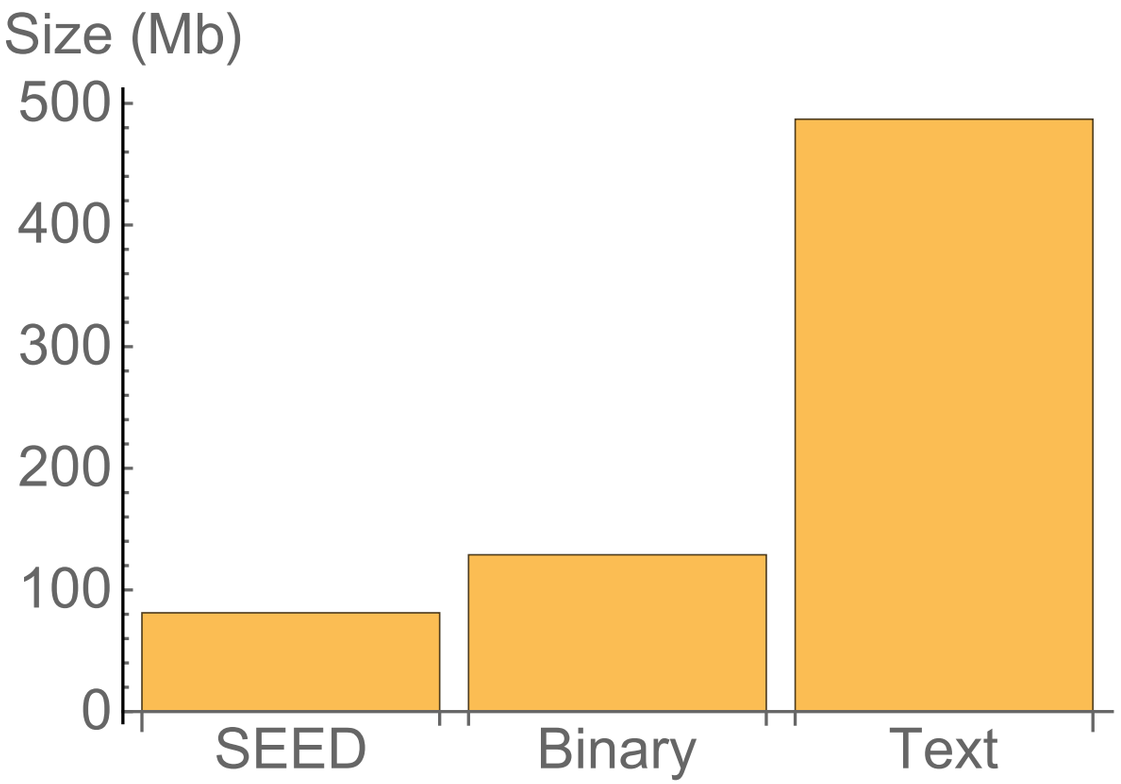
A **miniSEED** file has nothing but the data (mostly, some metadata are embedded in comments.

A **datalessSEED** file has only the metadata, no data. The reason for splitting the files is that station metadata do not change frequently, so if you are making many requests, you might as well not download the same meta-data over and over.

Why use SEED?

SEED is efficient.

Binary files are faster to read and write and the compression of SEED reduces data storage and transfer requirements.



Using SEED

The original application for dealing with SEED files is **rdseed**, which is still the choice tool for unpacking a full SEED file. rdseed imports the SEED and outputs seismograms files (in a choice of file formats) and instrument meta-data including response files of SAC polezeros files.

A valuable utility when working with miniseed files is **mseed2sac**. The program is available from IRIS and allows you to convert data from miniSEED to SAC formats. SAC format is fairly common and numerous tools are compatible with it, including SAC, Bob Herrmann's GSAC, etc.

IRIS Data Request Tools

- Web Services
- Wilber (3)
- FetchMetadata
- FetchData
- FetchSyn
- MatlabFetch
- JWEED
- BREQFAST
- SOD (Standing Order For Data)
- obsPy

Other Data Sources

Not all seismic data or all the data you may need are available through IRIS. You may need to visit other sites that use similar technologies to distribute the data.

For example, European Data are often available through ArcLink, Japanese data is available from individual web sites, and UNAVCO GPS data are available from web services.

Credit Your Data Sources

The groups that deploy and maintain seismic stations rely on their funding agencies and they must insure that the funding agencies are aware of the usefulness of the data. When you use data you should always acknowledge the data source as best you can. IRIS and the FDSN provide information only to help you craft your acknowledgement. To cite IRIS, use the information at

http://www.iris.edu/hq/iris_citations

For other networks, you can find information on citing the source at the FDSN citation page

http://www.fdsn.org/citations/

End