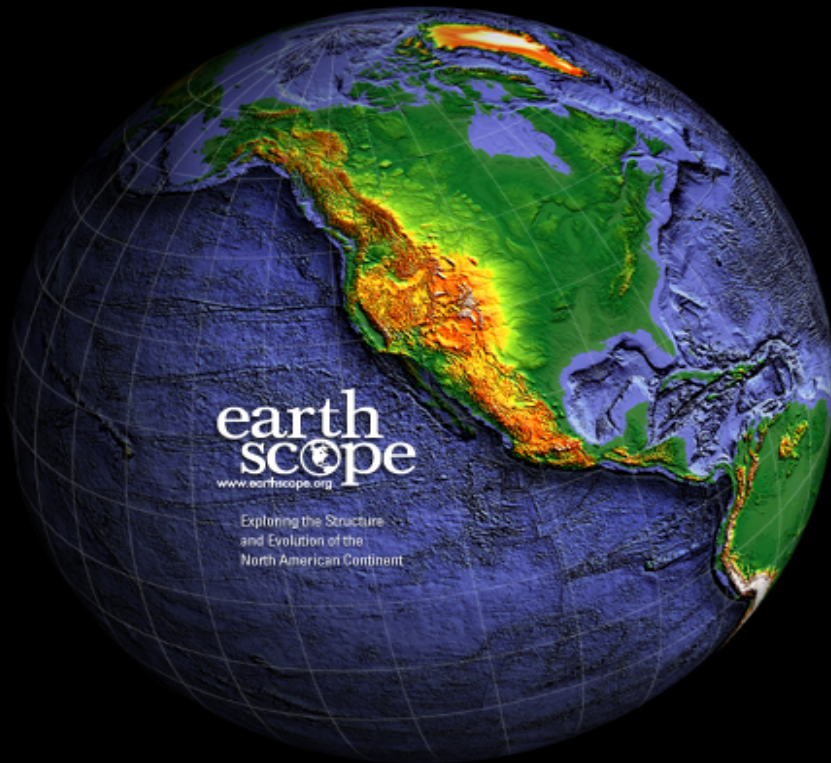


Accessing DATA at the DMC



Alex Hutko
USArray Data Short Course
August 2015
Indiana U

Precambrian seismology

Study a few
seismograms



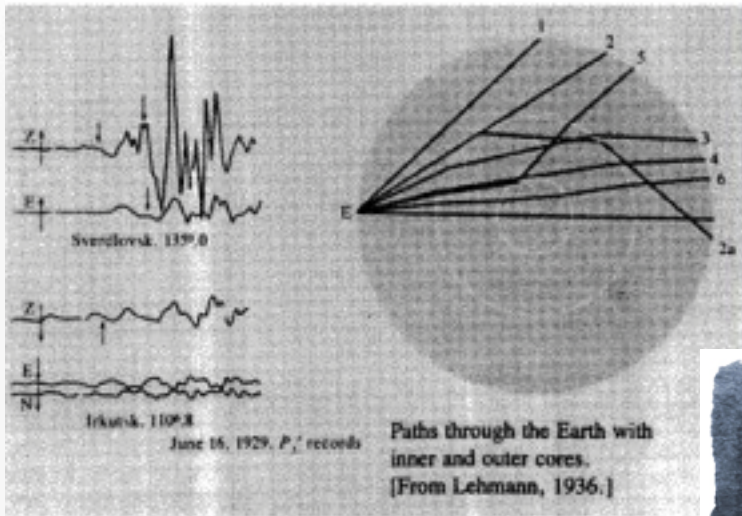
Find a new part
of the Earth



Get a different
part of the Earth
named after you



Get a Google
Doodle in your
honor



Jurassic seismology

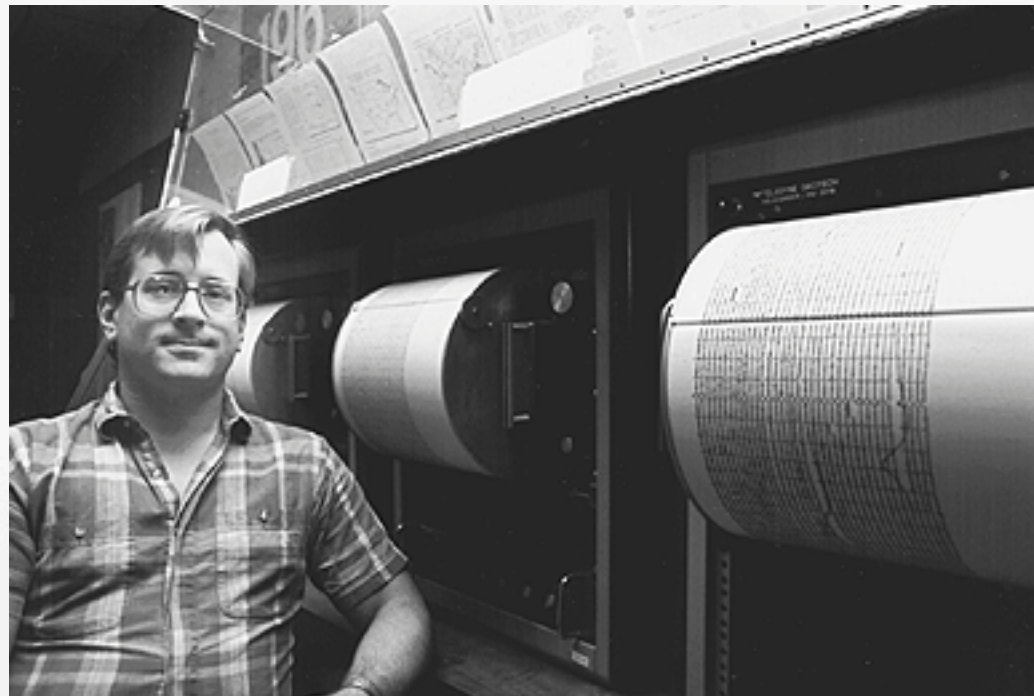
Hand digitize
seismograms
your lab has



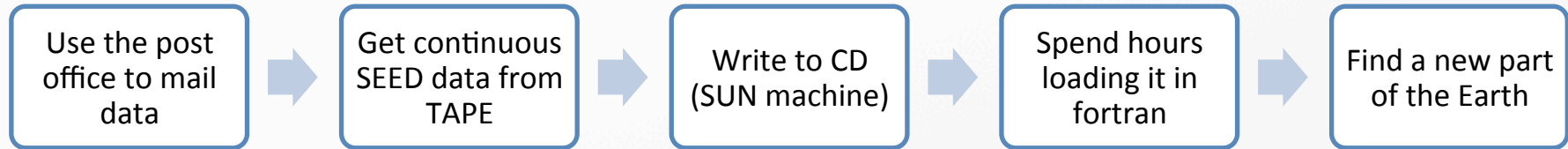
Find a new part
of the Earth
(e.g. using SdS)



Get a part of the
Earth named
after you



Cretaceous seismology (80s - 90s)



ARTICLES

Seismic imaging of upper-mantle structure with new evidence for a 520-km discontinuity

Peter M. Shearer

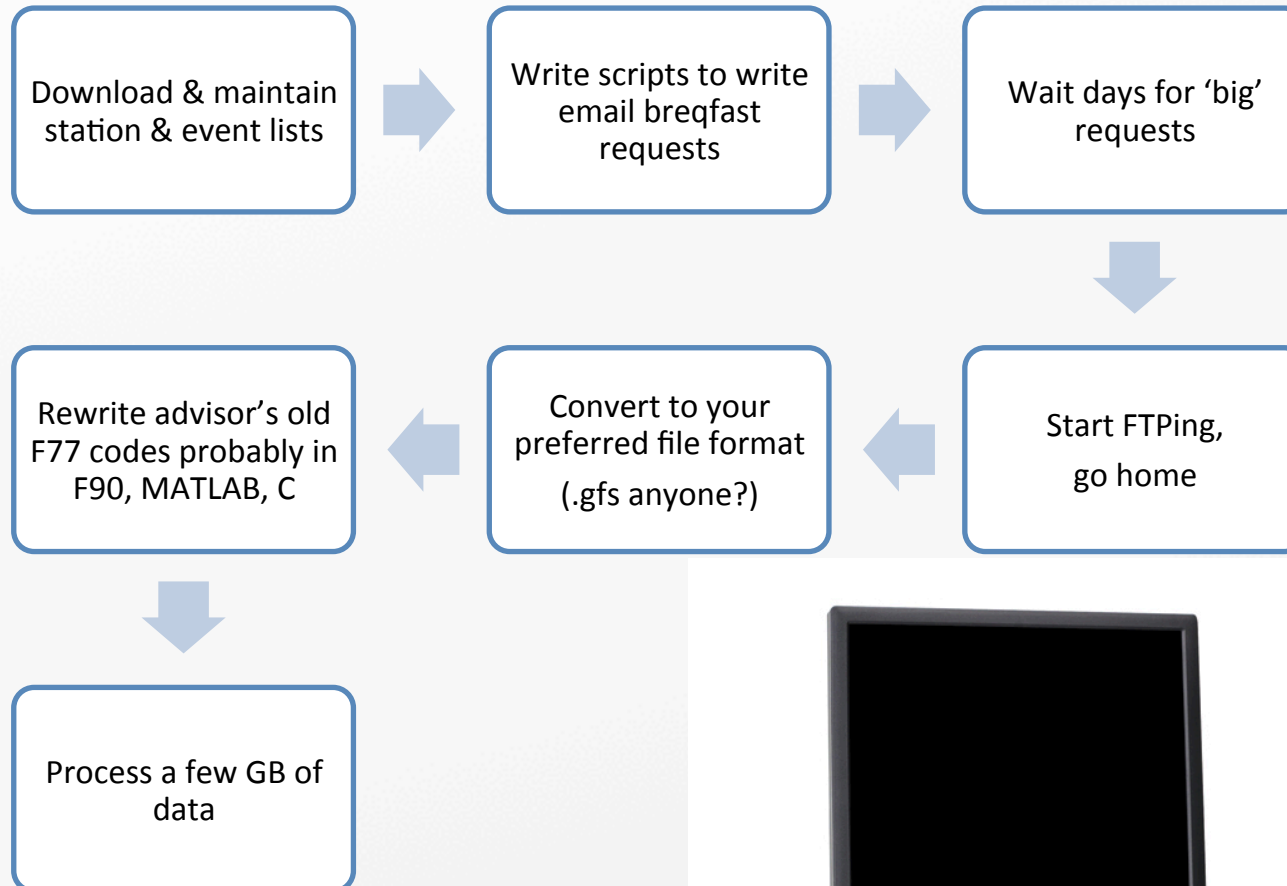
Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California 92093, USA

Stacking long-period seismograms

For more than ten years, seismograms from the Global Digital Seismograph Network (GDSN) have been available through the National Earthquake Information Center at the United States Geological Survey. This study uses data only from the five years (1980-1984) that are currently available on optical disk (CD-ROM), the most convenient form for automatic processing of large parts of the data set. These five years contain records for 1,827 earthquakes and nuclear explosions, with an average of about 21 stations per event, for a total of 38,578 event-station pairs.



Neogene seismology (my generation)



Seismology today

Use WebServices to get the data you want instantly directly into your programming environment. Includes non-traditional data types (GPS, ambient-noise, large N...)



Process TB scale data sets across many CPUs

Pre-process using existing packages (ObsPy, MATLAB, Parallel friendly...)



Tell data centers
how you want your
data



“Research Ready
Data Sets”
automatically
delivered

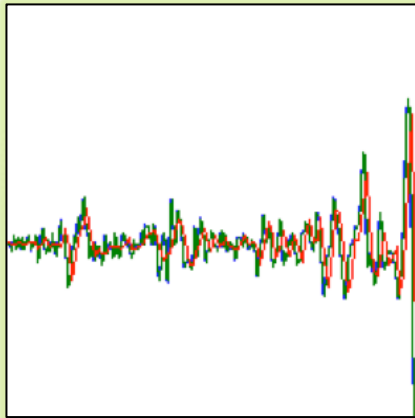


Boldly go where no
one has gone
before



The DMC has ...

Timeseries data



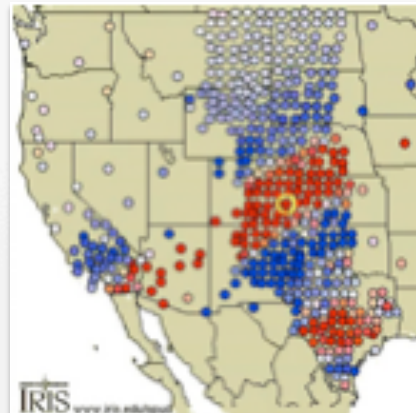
Channel metadata

```
-463.1000 -430.5000  
-176.6000 0.0000  
-15.1500 0.0000  
POLES 11  
-13300.0000 0.0000  
-10530.0000 10050.0000  
-10530.0000 -10050.0000  
-520.3000 0.0000  
-374.8000 0.0000  
-97.3400 400.7000  
-97.3400 -400.7000  
-15.6400 0.0000  
-0.0370 0.0370  
-0.0370 -0.0370
```

Event information

Event	
Date-Time (UTC):	2007-1
Location:	WINDV
Latitude, Longitude:	14.995
Magnitude:	7.4 MV
Depth:	147.3 k
Author:	ISC
Catalog, Contributor:	ISC, IS

Derived data products

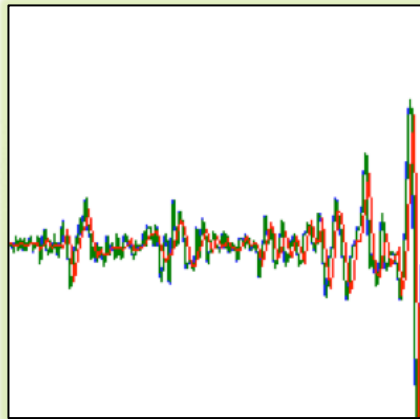


Tools and services

```
ceAzimuth>  
uth>229.278  
Azimuth>47.  
ance>29.499  
nceAzimuth>
```

TIMESERIES data...

Timeseries data



Channel metadata

SAC
ZRT

Event information

Filtered
Rotated

ASCII

Derived data products



Tools and service

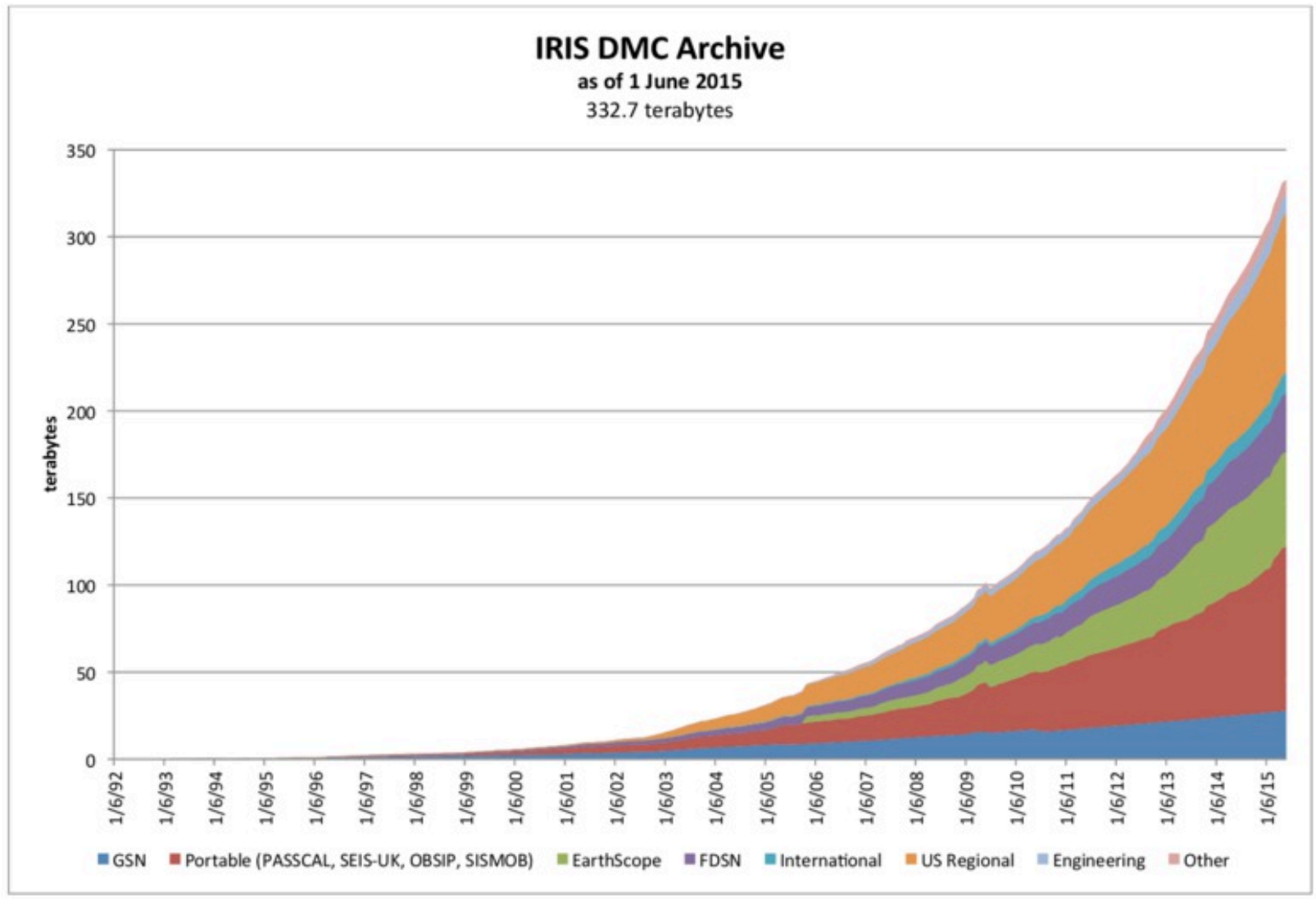
PLOTS
ceAzimuth>
Azimuth>47.
ance>29.499
nceAzimuth

gathered by EVENT

Inst. Corrected

SEED

What is in the DMC Archive?



Types of Sensor Data

Seismological

- Broadband Seismometers
- Strong Motion
 - Buildings
 - Structures
 - Free Field
- Geophones

Geophysical

- Magnetotelluric
 - Magnetometer
 - Electric Field
- Strainmeter
 - Dilatational
 - Tensor
- Tidal Pendulum
- Gravimeter
 - Conventional
 - Superconducting
- Creep Meters

Meteorological

- Wind Speed
- Wind Direction
- Temperature
- Humidity
- Rain Gauge
- Solar Radiation
 - Insolation/Pyranometer
- Microbarograph
 - Relative/Absolute
- Infrasound
 - Microphones

Water Column

- Water Current
- Depth
- Temperature
- Water Level

Time Series Data Channels

Most of the data collected and archived at the DMC is **time series data**. Each channel of timeseries data is identified by a 3-character **channel code** which indicates the type and placement of the sensor. The convention for time series channel codes is documented in greater detail in [Appendix A of the SEED Manual](#).

These are merely conventions! Not all data sources follow all aspects of these conventions, particularly regarding the orientation code.

Add and modify channels in the table below. You can then request data for these channels using the link below.

Channel Code ②	Band / Sample Rate ②	Instrument Type ②	Orientation ②	Remove
???	?: All bands	?: All instruments	?: All orientations	X

+ Add Channel

Request data for these channels from: SeismiQuery

Go

You can also click on any of these commonly used channel codes to add it to the list.

Seismological

Broadband Seismometers

?H? High Gain

BH? Broadband

LH? Long Period

?L? Low Gain

?N? Strong Motion Accelerometer

?L? Legacy (1999 and earlier)

?M? Mass Position Seismometer

?P? Geophone

?DH? Hydrophone

Other Geophysical

Magnetotelluric

?F? Magnetometer

?Q? Electric Field

Strainmeter

?V? Volumetric

LS? RS? Laser

?S? Linear

BS? Tensor

?AE? Tidal Pendulum

?A? Tiltmeter

?G? Gravimeter

?B? Creep Meter

Meteorological

?W? Wind

?WS Speed

?WD Direction

?K? Temperature

?KI Internal

?KO External

?I? Humidity

?R? Rain

?U? Solar

?UO Pyranometer

LUX Solar Radiation

?D? Atmospheric Pressure

?DF Infrasound

Time Series Data Channels

Most of the data collected and archived at the DMC is **time series data**. Each channel of timeseries data is identified by a 3-character **channel code** which indicates the type and placement of the sensor. The convention for time series channel codes is documented in greater detail in [Appendix A of the SEED Manual](#).

These are merely conventions! Not all data sources follow all aspects of these conventions, particularly regarding the orientation code.

Add and modify channels in the table below. You can then request data for these channels using the link below.

Channel Code ?	Band / Sample Rate ?	Instrument Type ?	Orientation ?	move
??? + Add Channel You can also click on Seismological Broadband Seismology ?H? High Gain BH? Broadband LH? Long Period ?L? Low Gain ?N? Strong Motion ?L? Legacy (1990s) ?M? Mass Positioning ?P? Geophone ?DH? Hydrophone	✓ ? : All bands Broadband F: 1000Hz - 5000Hz C: 250Hz - 1000Hz H: 80Hz - 250Hz B: 10Hz - 80Hz Short Period G: 1000Hz - 5000Hz D: 250Hz - 1000Hz E: 80Hz - 250Hz S: 10Hz - 80Hz Long Period M: 1Hz - 10Hz L: ~1Hz V: ~0.1Hz U: ~0.01Hz R: 0.0001Hz - 0.001Hz P: 0.00001Hz - 0.0001Hz T: 0.000001Hz - 0.00001Hz Q: <0.000001Hz	✓ ? : All instruments H: High Gain Seismometer L: Low Gain Seismometer G: Gravimeter M: Mass Position Seismometer N: Accelerometer A: Tilt Meter B: Creep Meter C: Calibration Input D: Pressure E: Electronic Test Point F: Magnetometer I: Humidity J: Rotational Sensor K: Temperature O: Water Current P: Geophone Q: Electric Potential R: Rainfall S: Linear Strain T: Tide U: Bolometer V: Volumetric Strain W: Wind X: Derived or Generated Data Z: Synthesized Beams	✓ ? : All orientations Generic Orientations Z: Vertical N: North-South E: East-West Meteorological ?W? Wind ?WS Speed ?WD Direction ?K? Temperature ?KI Internal ?KO External ?I? Humidity ?R? Rain ?U? Solar ?UO Pyranometer LUX Solar Radiation ?D? Atmospheric Pressure ?DF Infrasound	Go

Time Series Data Channels

Most of the data collected and archived at the DMC is **time series data**. Each channel of timeseries data is identified by a 3-character **channel code** which indicates the type and placement of the sensor. The convention for time series channel codes is documented in greater detail in [Appendix A of the SEED Manual](#).

These are merely conventions! Not all data sources follow all aspects of these conventions, particularly regarding the orientation code.

Add and modify channels in the table below. You can then request data for these channels using the link below.

Channel Code ?	Band / Sample Rate ?	Instrument Type ?	Orientation ?	Remove
DPZ	D: 250Hz - 1000Hz	P: Geophone	Z: Vertical	×

+ Add Channel

Request data for these channels from: SeismiQuery

Go

You can also click on any of these commonly used channel codes to add it to the list.

Seismological

Broadband Seismometers

?H? High Gain

BH? Broadband

LH? Long Period

?L? Low Gain

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Other Geophysical

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?B? Creep Meter

Meteorological

?W? Wind

?WS Speed

?WD Direction

?K? Temperature

?KI Internal

?KO External

?I? Humidity

?R? Rain

?U? Solar

?UO Pyranometer

LUX Solar Radiation

?D? Atmospheric Pressure

?DF Infrasound

METADATA...

Timeseries data

RESP

Lat/Lon

start date

Channel metadata

```
-463.1000 -430.5000
-176.6000 0.0000
-15.1500 0.0000
POLES 11
-13300.0000 0.0000
-10530.0000 10050.0000
-10530.0000 -10050.0000
-520.3000 0.0000
-374.8000 0.0000
-97.3400 400.7000
-97.3400 -400.7000
-15.6400 0.0000
-0.0370 0.0370
-0.0370 -0.0370
```

Event information

```
Event
Date-Time (UTC): 2007-11-15T00:00:00
Location: WINDV
Magnitude: 7.4 MV
Depth:
Author:
Catalog, Contributor: ISC, IS
```

XML

samples per second

NSLC

Derived data products

Tools and services

m/s

SAC Poles & Zeros

orientation

dataless SEED

Virtual Network

Stages

EVENT information...

Timeseries data

NEIC+PDE



Lat/Lon

ISC Depth

Channel metadata

```
-463.1000 -430.5000
-176.6000 0.0000
-15.1500 0.0000
POLES 11
-13300.0000 0.0000
10530.0000 10050.0000
-10000.0000 -10050.0000
-5000.0000 0.0000
-3000.0000 0.0000
-97.3400 -400.7000
-97.3400 -400.7000
-15.6400 0.0000
-0.0370 0.0370
-0.0370 -0.0370
```

Event information

Event	
Date-Time (UTC):	2007-1
Location:	WINDV
Latitude, Longitude:	14.995
Magnitude:	7.4 MV
Depth:	147.3
Author:	ISC
Catalog, Contributor:	ISC, IS

Derived data products

Tools and services

Mw

Picks

Flinn-Engdahl Region

Arrival

XML



```
ceAzimuth>
Azimuth>47.
ance>29.49
nceAzimuth>
```

catalog

Miscellaneous TOOLS and SERVICES...

Timeseries data

spectra

**Quality
Control**



Channel metadata

```
-463.1000 -430.5000  
-176.6000 0.0000  
-15.1500 0.0000  
POLES 1  
-13300.0000 0.0000  
-10530.0000 10050.0000  
-10530.0000 -10050.0000  
-520.3000 0.0000  
-374.8000 0.0000  
-97.3400 400.7000  
-97.3400 -400.7000  
-15.6400 0.0000  
-0.0370 0.0370  
-0.0370 -0.0370
```

Event information

```
Event  
Location: 2007-1  
Latitude, Longitude: 14.995  
Magnitude: 7.4 M  
Author: ISC  
Catalog, Contributor: ISC, IS
```

Traveltime

Flinn-Engdahl

azimuth

Derived data products

Bode

Distance



Tools and services

```
ceAzimuth>  
uth>229.278  
Azimuth>47.  
ance>29.499  
nceAzimuth>
```

backaz

Derived DATA PRODUCTS...

Timeseries data

Channel metadata

Event information

Record sections

aftershocks

Global stacks

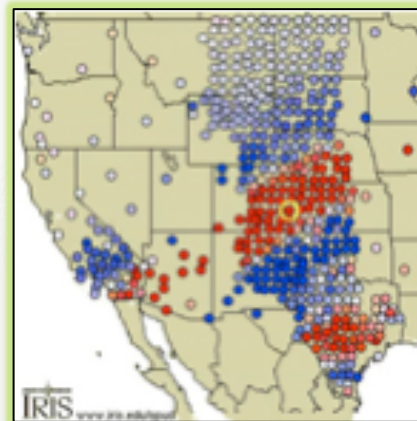
back projections

moment tensors

Derived data products

Tools and services

Earth models



receiver fncts

Ground Motion

Visualizations

Waveform access, by need

I need...	(qualifier)	Retrieve it with...
raw SEED files	Real Time	SeedLink
	process later	BREQ_FAST (SeismiQuery)
	within process	dataselect , FetchData
	LOTS!	BREQ_FAST, FetchData
3C rotated data	SAC or ASCII	rotation
Preprocessed data	1- channel	timeseries
SAC data	unprocessed	dataselect + mseed2sac
Data for Earthquake(s)	Interactive	WILBER, JWEED
	Automated	SOD
data in MATLAB		irisFetch
data in JAVA		IRIS-WS java library
data in Python		ObsPy

There is overlap. **BOLD** items are web services...

METADATA access, by need

I need...	(format)	Retrieve it with...
Dataless SEED		DATALESS@ (SeismiQuery)
Quick details		MDA, FetchData, FetchMetadata
to browse available ...		MDA, GMap
Virtual Network details	text, xml	virtualnetwork , station , MDA
Basic Channel info	text, xml	station , MDA
Instrument Response	xml (unconverted)	station
Instrument Response	RESP	resp
	Sac Poles and Zeroes	sacpz
	Plots, text [f-A- ϕ ,cplx spectra]	evalresp
metadata in ...	MATLAB	irisFetch
	JAVA	IRIS-WS java library
	PYTHON	ObsPy

There is overlap. **BOLD** items are web services...

EVENT parameter access, by need

I need...	(format)	Retrieve it with...
to retrieve waveforms for an event		JWEED, WILBER
Origins & Magnitudes	text, xml	event , FetchEvent
Distances between event and stations		distaz
Seismic travel times		traveltime
programmatic access	Text	FetchEvent
	MATLAB	irisFetch
	JAVA	IRIS-WS java library
	PYTHON	ObsPy
Derived data:	GMV, Moment Tensor, back projections, etc...	SPUD

There is overlap. **BOLD** items are web services.

Giving credit for data

www.fdsn.org/citation.htm

GSN / *IRIS Global Seismographic Network (including H2, IC, II, IU, MS)*

Global Seismographic Network is a cooperative scientific facility operated jointly by the Incorporated Research Institutions for Seismology (IRIS), the United States Geological Survey (USGS), and the National Science Foundation (NSF).

<http://www.iris.edu/hq/programs/gsn>

H2 / *Hawaii-2 Observatory Seismic System (H2O)*
University of Hawaii

Duennebier, F.K., David W. Harris, James Jolly, James Babinec, David Copson, Kurt Stiffel, The Hawaii-2 Observatory Seismic System, IEEE Jnl. Ocean Engineering, V 27, # 2, pp 212-217, Apr 2002

UH / *University of Hawaii*

Digital Object Identifiers (DOIs): future data citation



Overview

What the DMC Has

General ways to access



Programs & Tools

WILBER3

JWEED



Web Services I

What is a web service?

Exploring via Browser

Available Web Services



Web Services II

Fetch clients (perl)

IRISWS (java)

irisFetch (matlab)



Potpourri

Data Products

FDSN

Real Time Data access



Overview

What the DMC Has

General ways to access



Programs & Tools

WILBER3

JWEED



Web Services I

What is a web service?

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Available Web Services



Web Services II

Fetch clients (perl)

IRISWS (java)

irisFetch (matlab)



Potpourri

Data Products

FDSN

Real Time Data access

WILBER3, for Event-related waveforms

- Purpose: Request event-related waveform data
- Scenario: Need waveforms relating to a specific event.
 - Stations with spread
 - Choose distances & Azimuths
 - Preview ability
- Web based, all you need is browser

WILBER3 www.iris.edu/wilber3

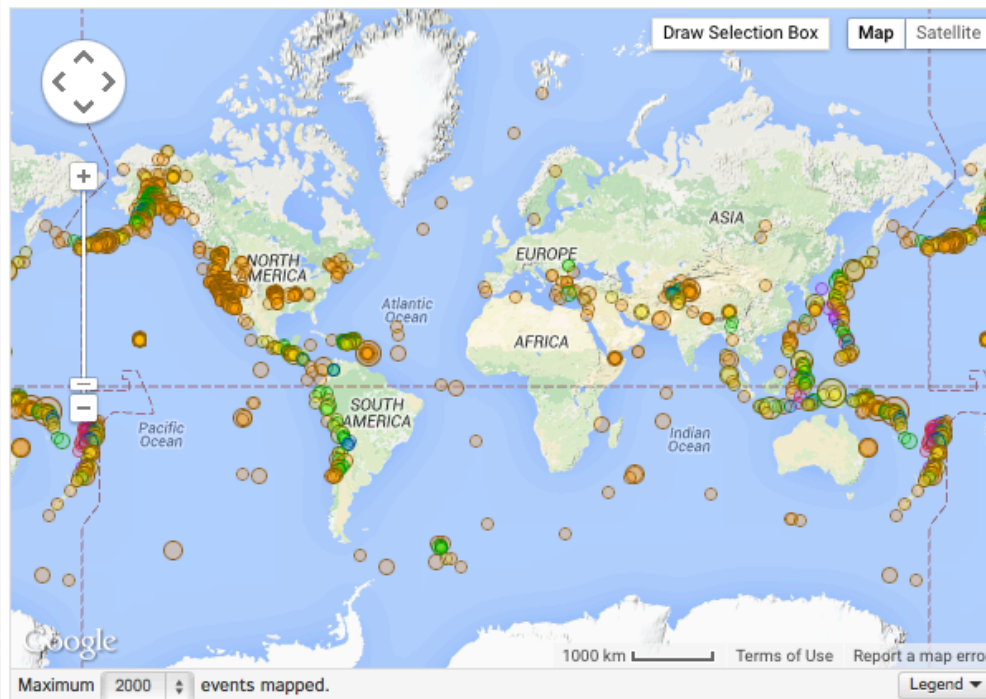
Wilber 3: Select Event

✉ Wilber Feedback/Questions

Looking for previously requested data? [View recent requests.](#)

Load Event Data:

Using the map and controls below, select a geographic area and date/magnitude range, then click the **Get Events** button to load events matching those criteria. The full database contains several million events, so some queries (particularly across large spans of time) may be very slow.



Show Only

Clear

Location

W N E
S

Date

2015-07-03



2015-08-02



Magnitude

0

- 10

Get Events

EarthScope Virtual Networks

Virtual Network	Description
_US-TA	USArray Transportable Array
_US-REF	USArray Reference Network
_US-FA	USArray Flexible Array
_US-MT	USArray Magnetotelluric
_US-ALL	All USArray Components
_PBO	Plate Boundary Observatory
_SAFOD	SAFOD

Many more virtual networks have been defined, see <http://ds.iris.edu/mda/>

Access online with WILBER III

Select event by:

Map location

Date

Magnitude

Filter options:

Station Distance

Station Azimuth

Network or Virtual Network

Channels

Windowed by:

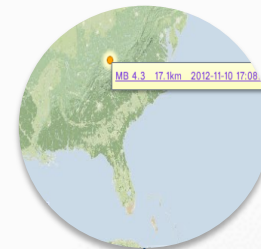
Event time

relative to P or S arrivals

Retrieved as:

SAC, SEED, ASCII

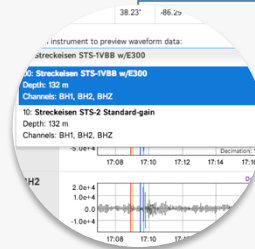
Individual files, gzip, or tar



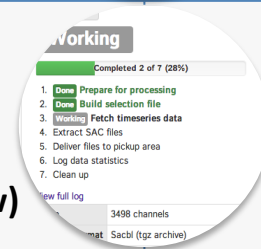
Pick Event



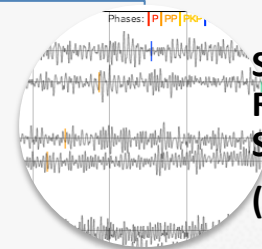
Choose Station(s)



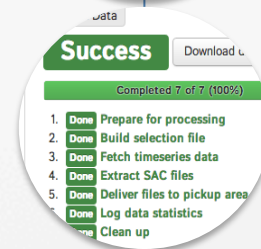
View station details (preview)



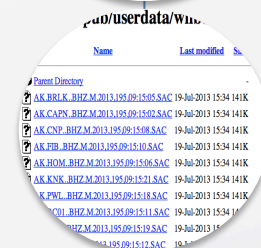
Request Data



Show Record Section (preview)



Request processed



Retrieve Data

WILBER Exercise

www.iris.edu/wilber3

1. Choose the Event
 - Custom query
 - Draw selection box around Mexico
 - Choose dates from 2014-2015
 - Sort by magnitude, choose largest event (Guererro April 18)
2. Select Stations
 - Distance 0 - 30
 - Zoom in and find array in Texas
 - Click on station
3. Explore Record Section
4. Request SAC data as gzipped tar archive
 - Label **WILBER3TEST**, your name & email

WEB SERVICES USE HTTP TO GET INFORMATION FROM IRIS TO YOUR COMPUTER.

Independently of where the request originated, or where the results will end up.

Available via services...

Waveforms

- [dataselect](#)
- rotation
- timeseries

Metadata

- [station](#)
- sacpz
- resp

Event Information

- [event](#)

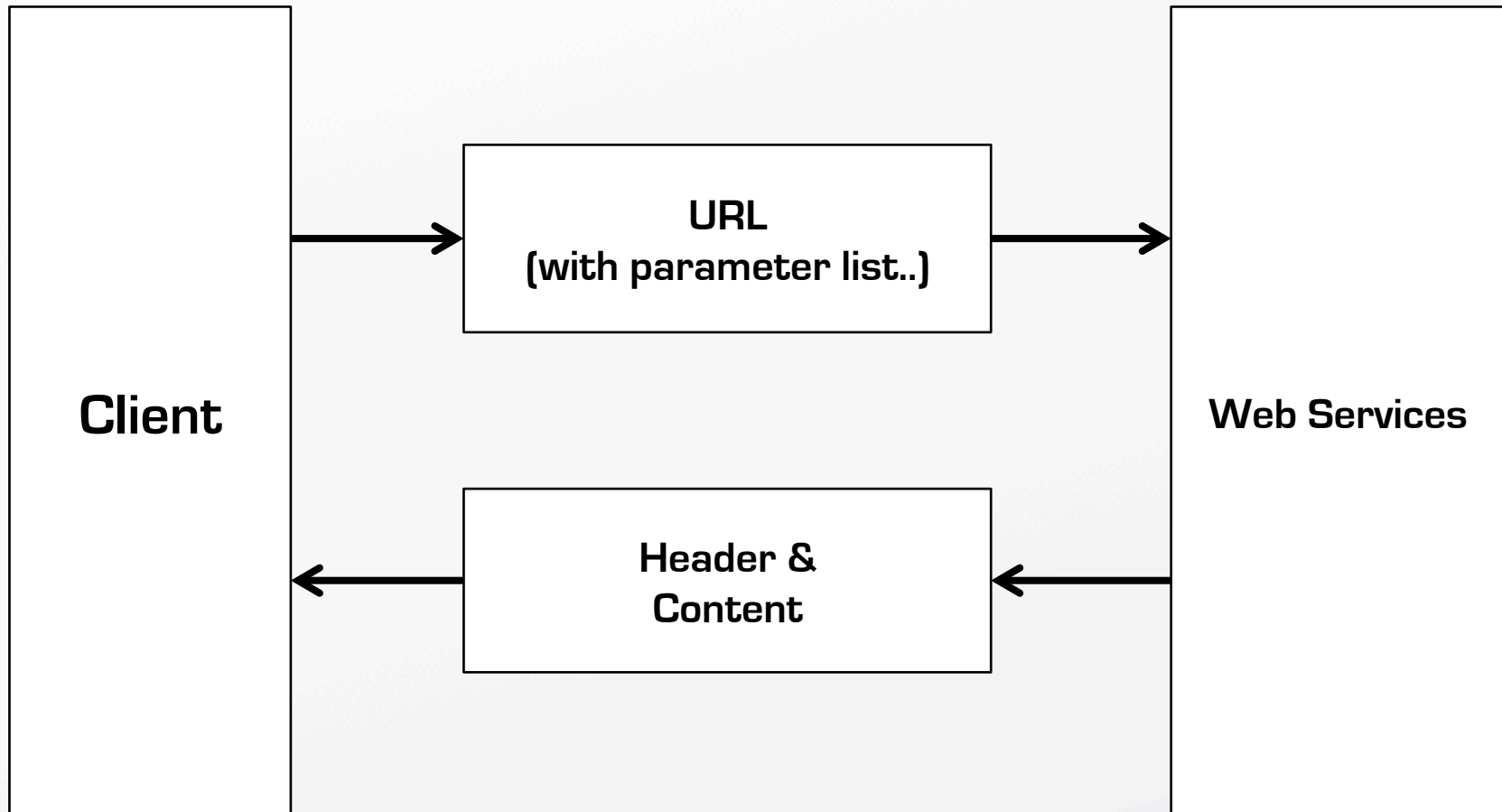
Processing & Calculation

- travelttime
- distaz
- flinnengdahl
- evalresp

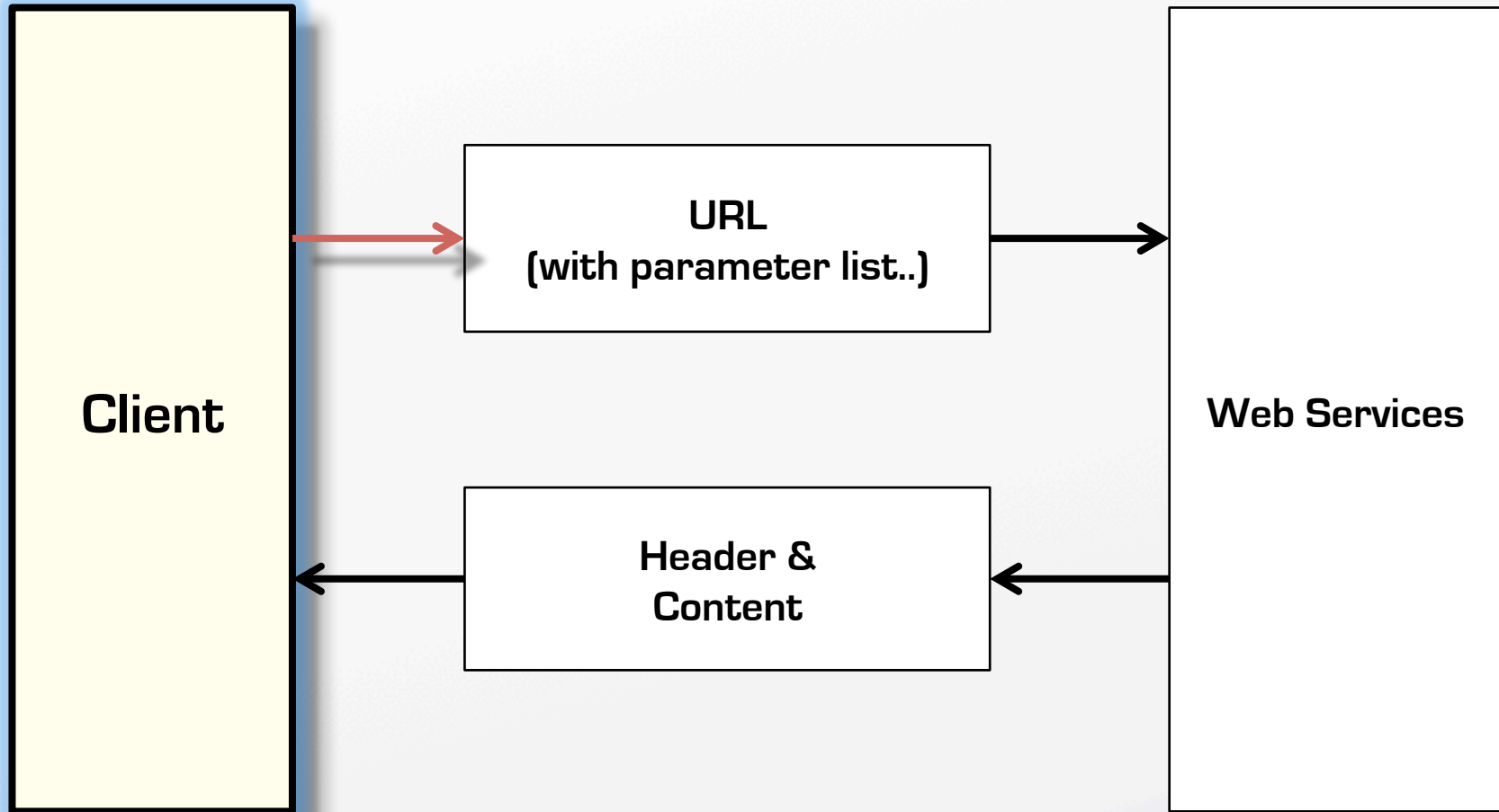
Data Quality metrics (new)

- mustang/noise-psd
- mustang/metrics (44 of them!)

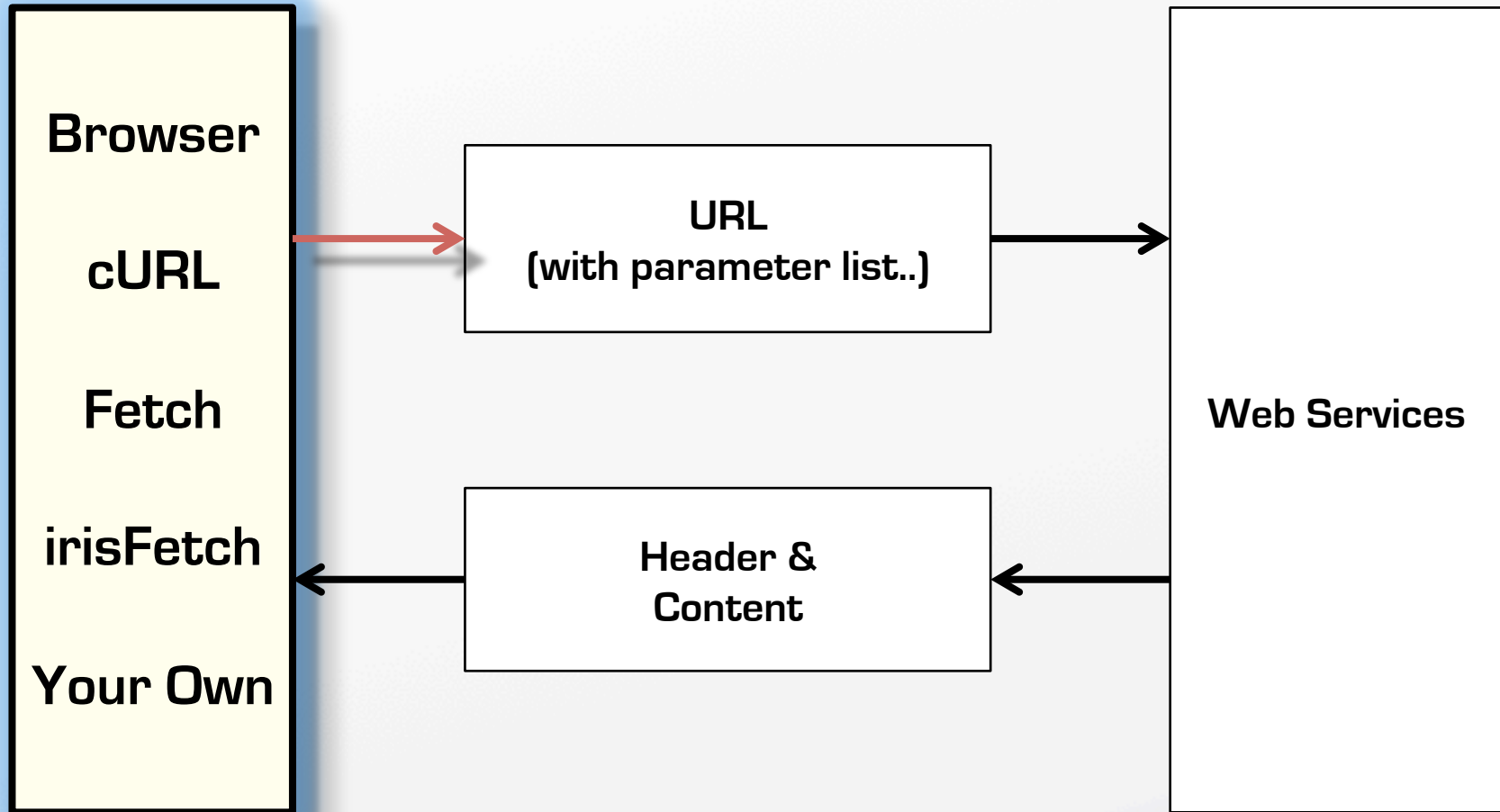
Web Service Requests



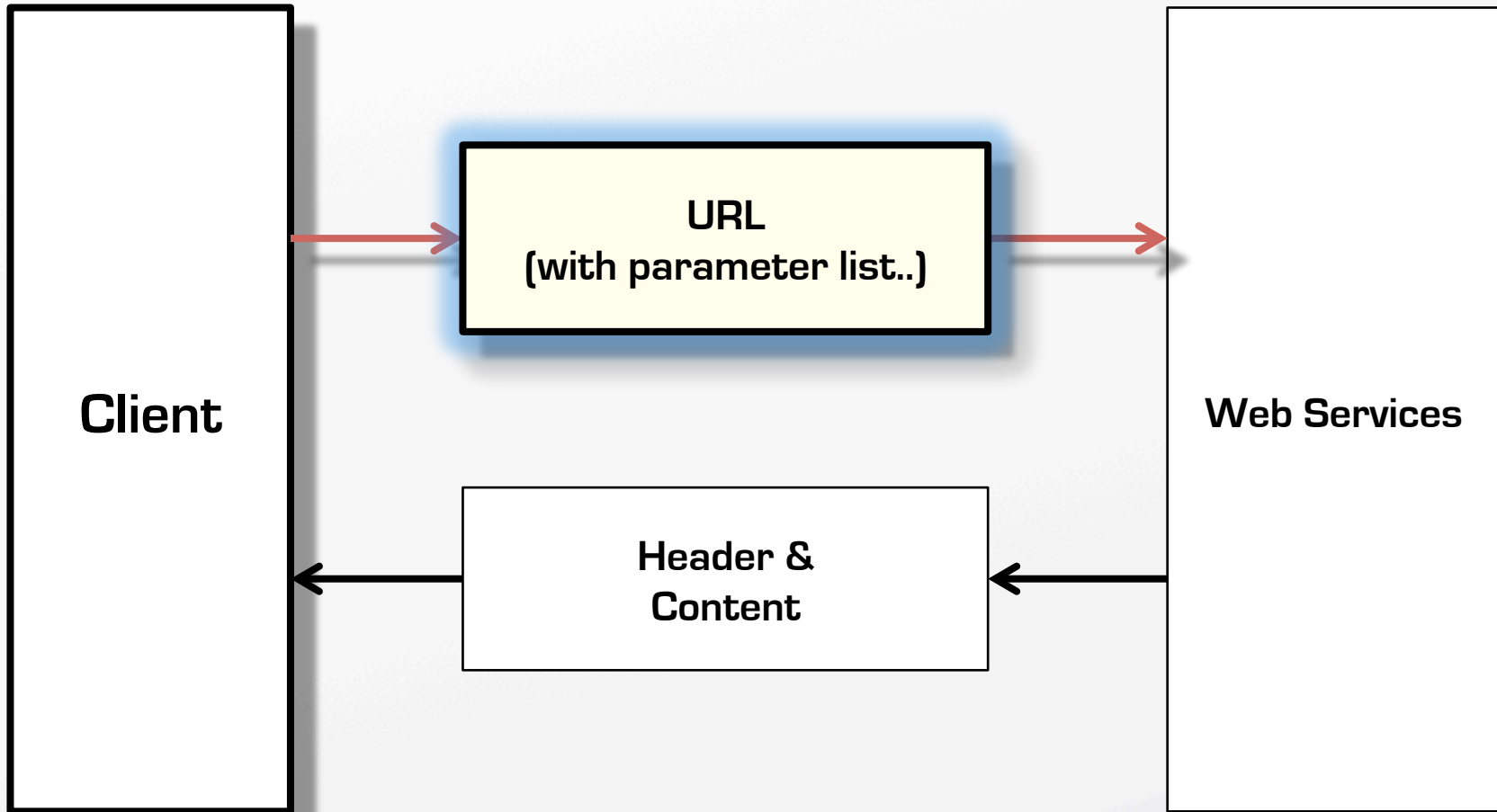
Communicate using client



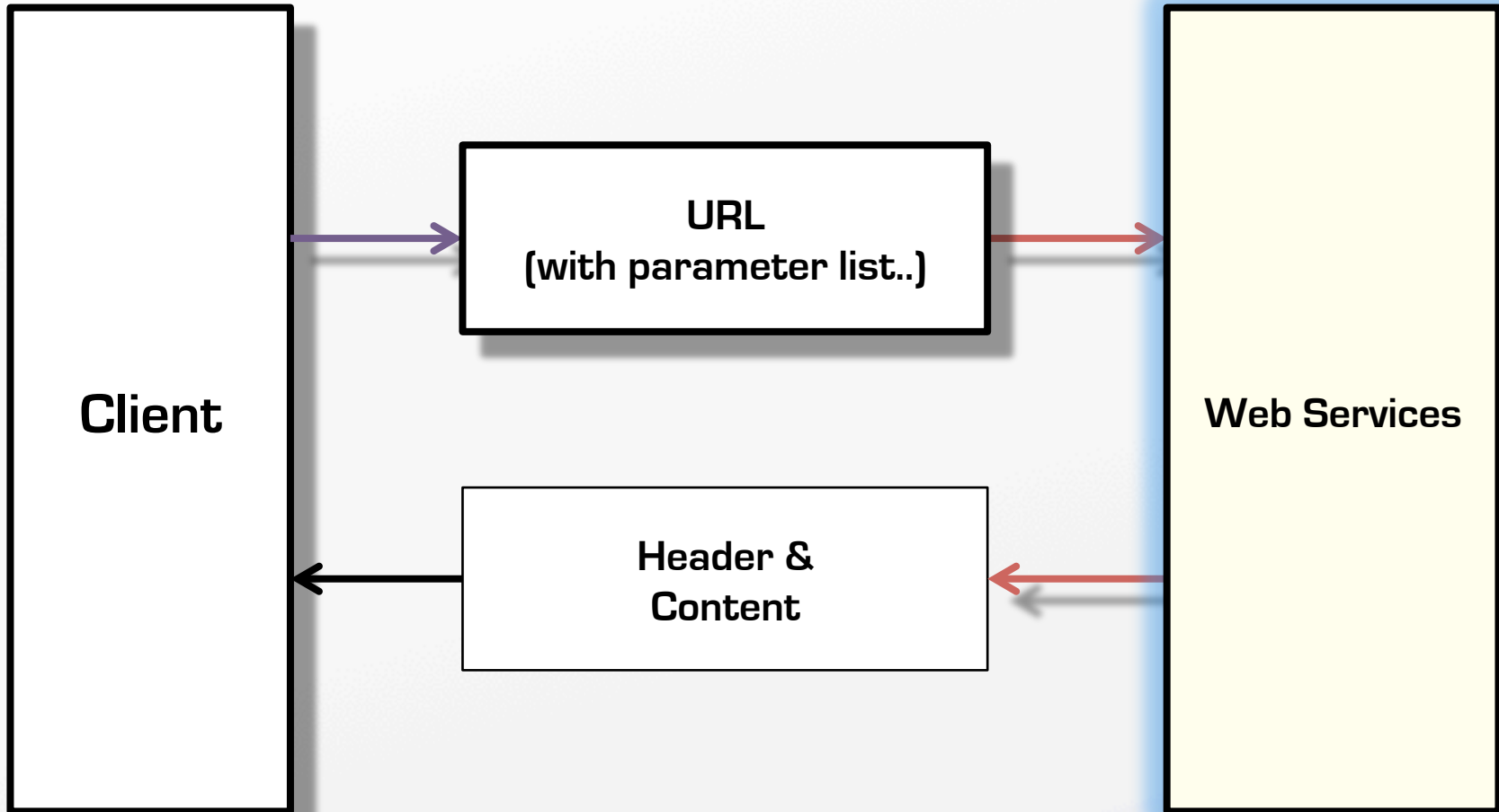
Communicate using client



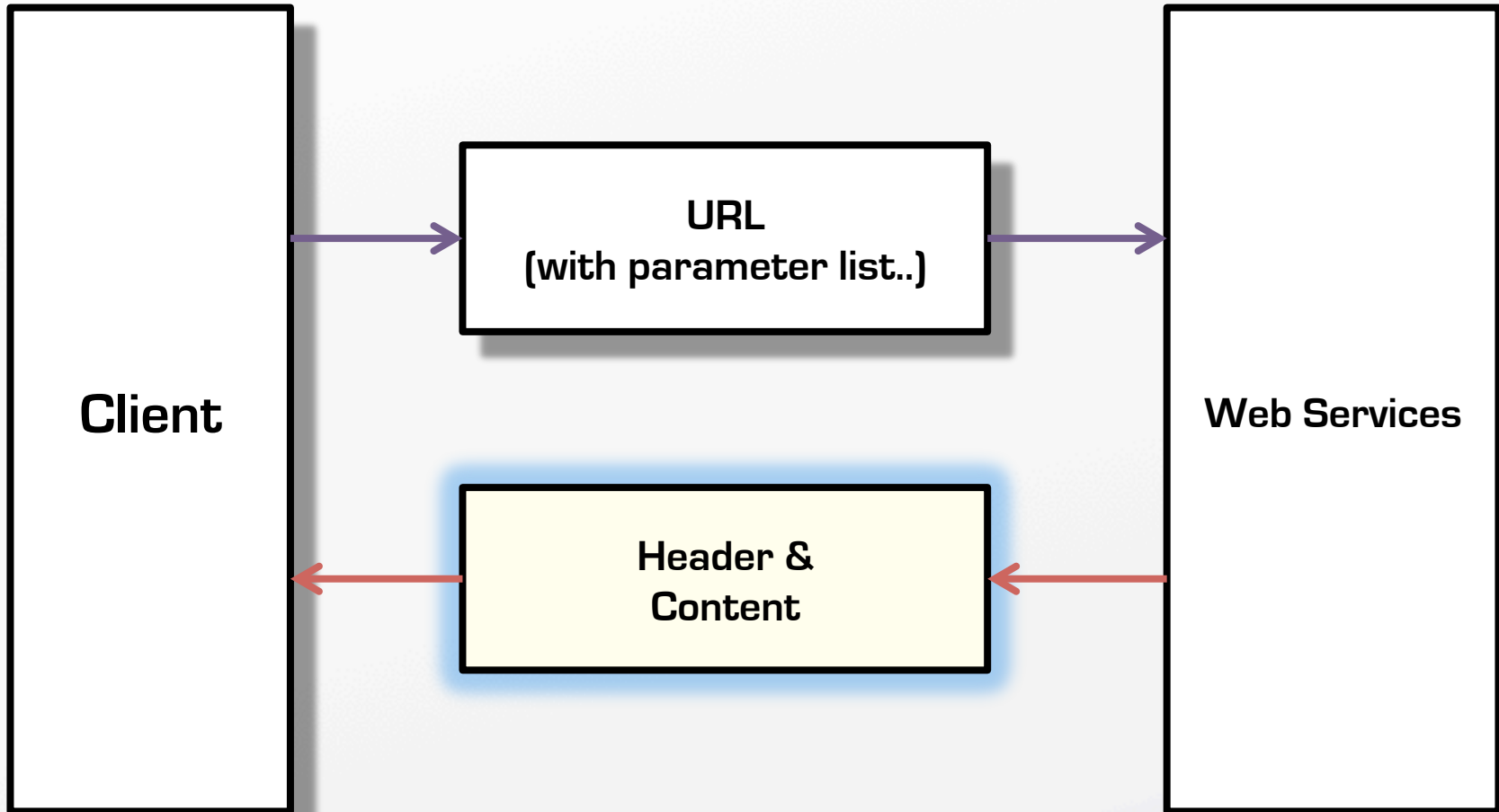
Request is passed as URL



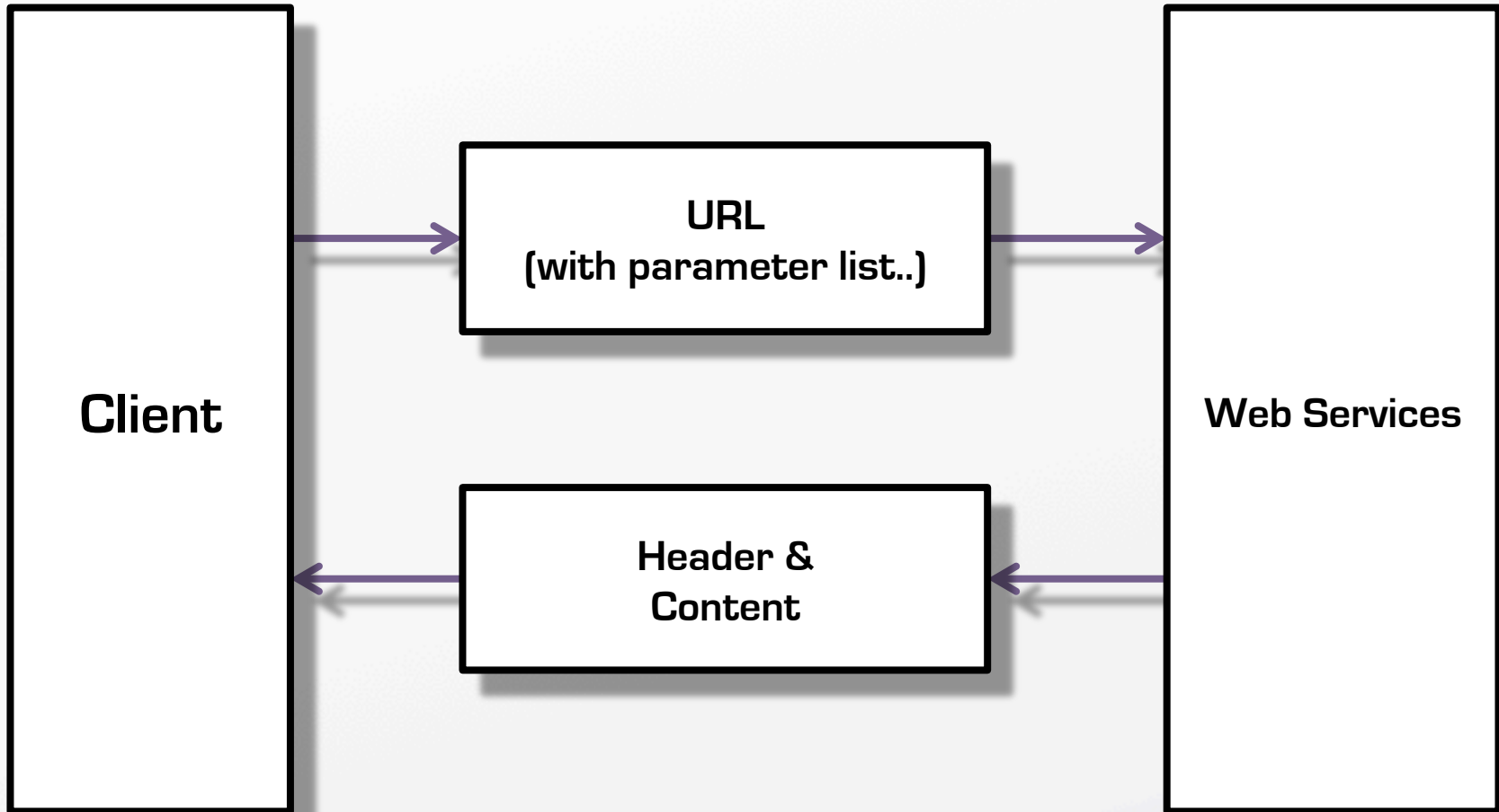
Web Service executes request



Content is returned



A Generic Web Service using HTTP





<http://service.iris.edu/.../query?what=TPSreport&when=2013-08-10&gotmemo=true>

Web Service

PARAMETERS

what = TPSreport
when = 2013-08-10
gotmemo = true

Valid
Request?



Data
Exists?



Get Data

A web service in action

400 - Invalid parameter
PCLOADLETTER

404 [204] - Not Found

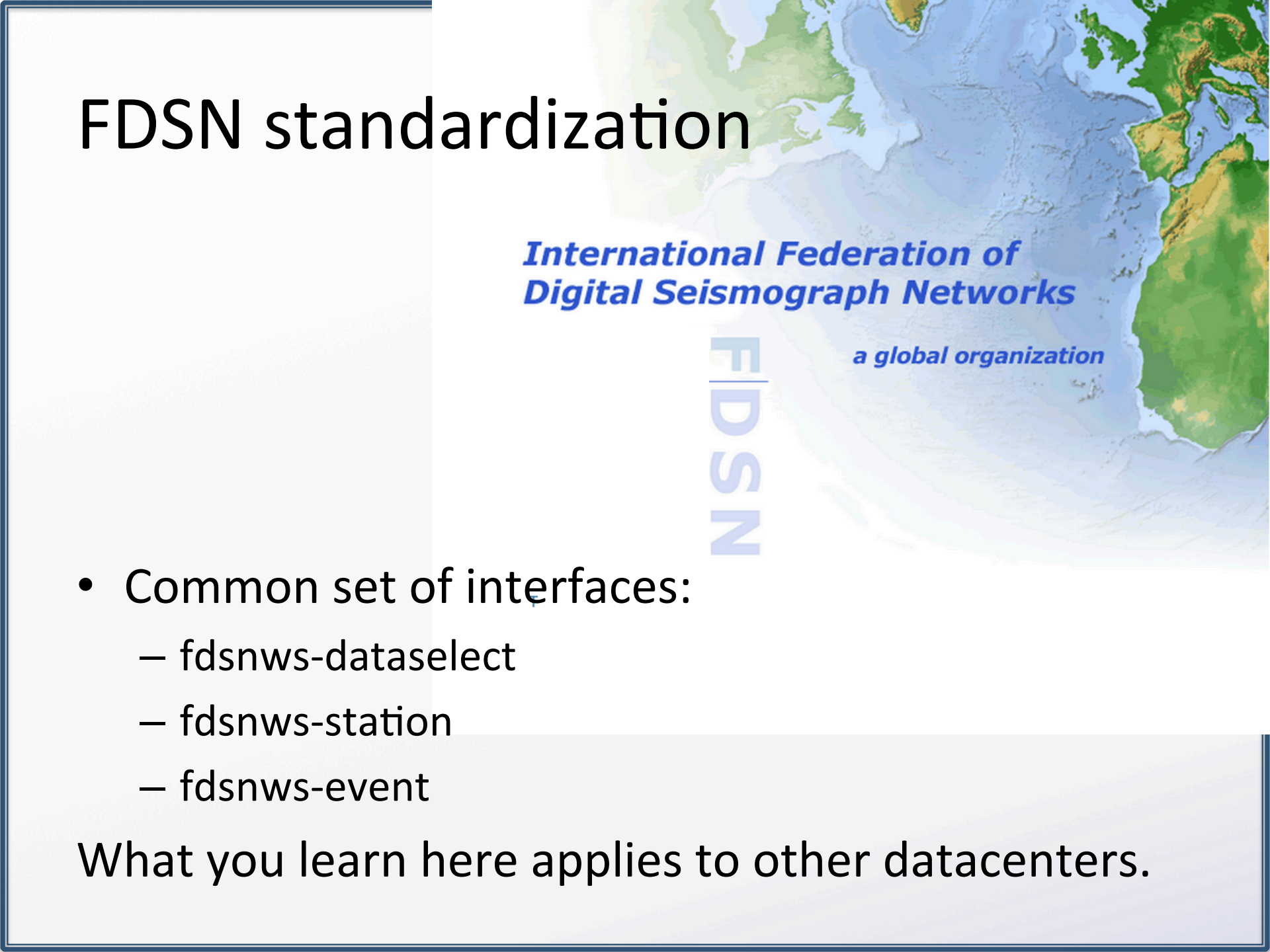
200 - Data Data Data
Data Data

service.iris.edu

FDSNWS

Service	Summary	Return formats
station	metadata for time series	FDSN StationXML, Text
dataselect	time series data	miniSEED
event	contributed EQ origin and magnitude est.	QuakeML, Text

FDSN standardization



*International Federation of
Digital Seismograph Networks*

a global organization

FDSN

- Common set of interfaces:
 - fdsnws-dataselect
 - fdsnws-station
 - fdsnws-event

What you learn here applies to other datacenters.



service.iris.edu

IRISWS

Service Interface	Version	Summary	Return options
fedcatalog	v.1	A service for federating requests for channel metadata across multiple data centers	text, request
timeseries	v.1	similar to ws-datasetselect with additional options for processing and reformatting	ASCII, WAV, miniSEED , SAC , PNG
rotation	v.1	rotate waveform data into alternate coordinate system	• zipped (various) • png
sacpz	v.1	instrument response information (per channel)	Poles and Zeroes in ASCII
resp	v.1	channel response information	SEED RESP
evalresp	v.1	instrument response information evaluated from IRIS metadata	• ASCII : frequency-amplitude-phase • ASCII : complex-spectra • Bode style plots
virtualnetwork	v.1	list of stations in a virtual network	• XML • CVS
traveltime	v.1	travel times and ray parameters for seismic phases using a 1-D spherical earth model	ASCII
flinnengdahl	v.2	a Flinn-Engdahl region code or name for a latitude, longitude pair	• ASCII : region code • ASCII : name
distaz	v.1	distance, azimuth and back-azimuth between two locations	XML
metadatachange	v.1	changes made to SEED metadata	XML

Each service is fully documented

IRIS DMC FDSNWS station Web Service Documentation

Service interface URL builder Help Revisions

Description

The **fdsnws-station** web service returns station metadata in **FDSN StationXML** format ([schema here](#)) or as delimited text. Results are available at multiple levels of granularity: **network**, **station**, **channel** and **response**.

Metadata may be selected based on channel descriptors, time ranges, geographic regions, and more.

This service is an implementation of the [FDSN web service specification](#) version 1.



Relevant Links

URL Builder

Description

Below is a full list of service parameters and their usage.

Query Usage

```
/query? [channel-options] [geographic-constraints] [time-constraints] [misc-parameters][nodata=404]
```

where

```
channel-options      :: [network=<network>] [station=<station>] [location=<location>] [channel=<channel>]
geographic-constraints :: [boundaries-rect] OR [boundaries-circular]
boundaries-rect      :: [minlatitude=<degrees>] [maxlatitude=<degrees>] [minlongitude=<degrees>] [maxlongitude=<degrees>]
boundaries-circular  :: [latitude=<latitude>&longitude=<longitude>&maxradius=<degrees>] [minradius=<degrees>]
time-constraints     :: [starttime=<date>] [endtime=<date>] [startbefore=<date>] [startafter=<date>]
                        [endbefore=<date>] [endafter=<date>]
misc-parameters      :: [level=<station|network|channel|response>] [format=<xml|text>] [includeavailability=<false|true>]
                        [updatedafter=<date>] [matchtimeseries=<false|true>] [includerestricted=<true|false>]
```

Query Parameters

Examples

Each parameter-value pair should be separated by an ampersand **&**, and with no space

Sample Queries

- <http://service.iris.edu/fdsnws/station/1/query?latitude=-56.1&longitude=-26.7&maxradius=15&nodata=404>
- [.../query?startafter=2003-01-07&endbefore=2011-02-07&minlatitude=15&maxlatitude=55&minlongitude=170&maxlongitude=-170](http://service.iris.edu/fdsnws/station/1/query?startafter=2003-01-07&endbefore=2011-02-07&minlatitude=15&maxlatitude=55&minlongitude=170&maxlongitude=-170)
- [.../query?starttime=2013-01-01&network=IU&sta=ANMO&level=channel&nodata=404](http://service.iris.edu/fdsnws/station/1/query?starttime=2013-01-01&network=IU&sta=ANMO&level=channel&nodata=404)
- [.../query?starttime=2013-01-01&network=IU&sta=A*&location=00&level=channel&format=text](http://service.iris.edu/fdsnws/station/1/query?starttime=2013-01-01&network=IU&sta=A*&location=00&level=channel&format=text)

Detailed Parameter Descriptions

Detailed Descriptions of each Query Parameter

parameter	examples	discussion	default	type
FDSN options				
start[time]	2001-12-19	Limit to metadata describing channels operating on or after the specified start time.	<i>any</i>	day/time
end[time]	2012-12-31	Limit to metadata describing channels operating on or before the specified end time.	<i>any</i>	day/time
startbefore	2001-12-31	Limit to metadata epochs starting before specified time. Applied to channel epochs.	<i>any</i>	day/time

Quickly access and explore web service data using the URL Builders

Use this form to build a URL to the **timeseries** web service. Notice that as you edit the form, the link is automatically updated.

 Usage

Network:	IU	Remove mean:	☐
Station:	ANMO	Low-Pass Filter:	☐ 1.0
Location:	00	High-Pass Filter:	☐ 1.0
Channel:	BHZ	Band-Pass Filter:	☐ 0.01-1.0
Start Time:	2010-02-27T06:30:00 	Differentiate:	☐
End Time:	2010-02-27T10:30:00 	Integrate:	☐
Correction:	None 	Envelope:	☐
Frequency Limits:	☐ 0.0033-0.004-0.05-0.06	Taper:	☐ 0.5
Auto Limits:	☐ 3.0-3.0	Taper Window Type:	☐ HANNING 
Units:	☐ DEF 	Decimate (samples per sec):	☐ 2.0
Scale:	☐ 2.0	Output:	☐ plot 
Div-Scale:	☐ 2.0	Dimensions (px):	☐ W 1000 H 700
		Anti Alias Plot:	☐
		Audio Dynamic Range Compression:	☐
		Audio Sample Rate (samples per sec):	☐ 16000

Click the link:

<http://service.iris.edu/irisws/timeseries/1/query?net=IU&sta=ANMO&cha=BHZ&start=2010-02-27T06:30:00&end=2010-02-27T10:30:00&output=plot&loc=00>

Web Services exercise

<http://service.iris.edu>

- Plot 35 minutes of 3-Component data with event
 - From network **IU** and station(s) **C?T?**
 - For the **LH?** channels
 - Starting 5 min before P wave arrival
 - For the largest shallow ($\leq 10\text{km}$) event occurring within the last month.
 - Rotated into RADIAL and TRANSVERSE components
- Use web services to do it.

Web Services exercise

<http://service.iris.edu>

1. **Event** – get event time, lat, lon, depth for largest shallow (<10km depth) event in last 30 days.
2. **Station** – get station name, lat & lon for net: **IU**, station: **C?T?**
3. **Distaz** – get distance & azimuth
4. **Traveltime** – Find first P arrival
5. **Rotation** – plot a response corrected, ZRT rotated seismogram for 5 min before P arrival to 30 minutes after P arrival. for **LH?** channels.

Web Services exercise

<http://service.iris.edu>

Exercise

1. **Event** – get event time, lat, lon, depth for largest shallow (<20km depth) event in last 30 days.
2. **Station** – get station name, lat & lon for net: IU, station: C?T?
3. **Distaz** – get distance & back-azimuth
4. **Traveltime** – Find first P arrival
5. **Rotation** – plot a response corrected, ZRT rotated seismogram for 5 min before P arrival to 30 minutes after P arrival. for LH channels.

Hints.

- Builders help...
- EVENT
 - Text output
 - order by magnitude
 - change dates & times
 - max depth
 - don't need ALL events
- STATION
 - text output, station level
- TRAVELTIME
 - Only need min P phase traveltime
- ROTATION
 - Rotate into ZRT

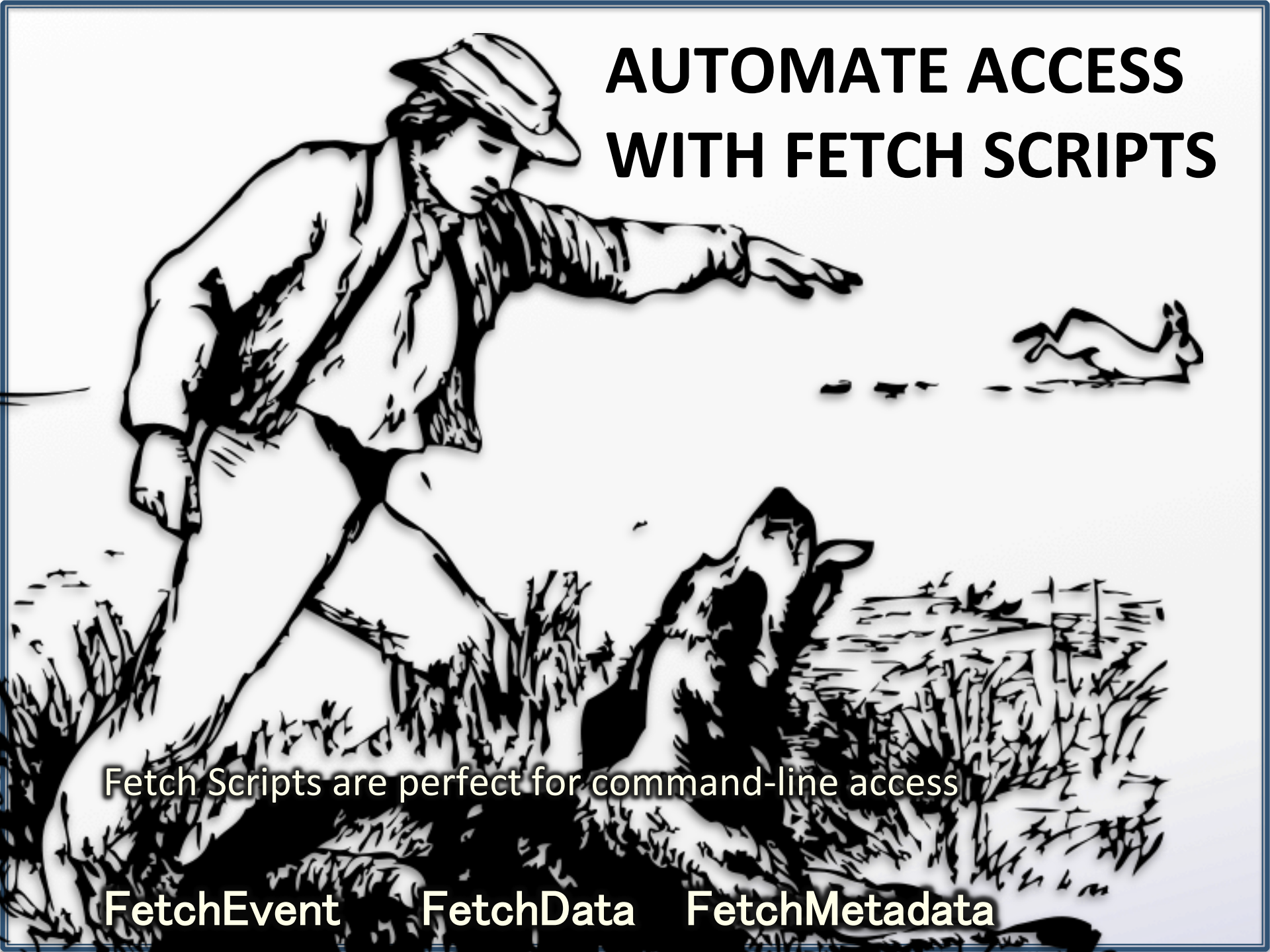
About using the Browser...

- Interactive
- Builders only create URLs.
 - Faster to modify/create the URL by hand
- Browser can only handle a certain amount of data.
 - Lots of XML may crash your browser
- Requires your direct interaction

Web services: Beyond the Browser

- via **HTTP clients**, such as wget, curl, etc
These often are already on many systems
- via **DMC-provided interfaces**:
 - command line: Fetch family of Perl scripts
 - Java: IRIS Java Web Service Library (IRIS-WS library)
 - MATLAB: irisFetch.m
- via **Community developed solutions**:
 - ObsPy, SOD, Waveform Suite, EMERALD, SeisFile, etc.
- via **WILBER3** the **JWEED** and future desktop applications

AUTOMATE ACCESS WITH FETCH SCRIPTS



Fetch Scripts are perfect for command-line access

FetchEvent **FetchData** **FetchMetadata**

Fetch clients . . .

- Allow command-line access to IRIS-held data
- Have options that map to the service's parameters
- Fetch clients and mseed2sac are available from:
<http://seiscode.iris.washington.edu/>
- More usage details are available from:
<http://service.iris.edu/clients>

The DMC's Fetch web service clients

FetchData:

Fetch Mini-SEED data, simple metadata, and instrument responses (SEED RESP & SAC PZs)

FetchEvent:

Fetch Event (earthquake) information as text or XML

FetchMetadata:

Fetch primary channel metadata (coordinates, etc.) as text or XML

Usage: FetchEvent [options]

-v	More verbosity, may be specified multiple times (-vv, -vvv)
-s starttime	Limit to origins after time (YYYY-MM-DD,HH:MM:SS.sss)
-e endtime	Limit to origins before time (YYYY-MM-DD,HH:MM:SS.sss)
--lat min:max	Specify a minimum and/or maximum latitude range
--lon min:max	Specify a minimum and/or maximum longitude range
--radius lat:lon:maxradius[:minradius]	Specify circular region with opt. minimum radius
--depth min:max	Specify a minimum and/or maximum depth in kilometers
--mag min:max	Specify a minimum and/or maximum magnitude
--magtype type	Specify a magnitude type for magnitude range limits
--cat name	Limit to origins from specific catalog (e.g. ISC, PDE, SCMT)
--con name	Limit to origins from specific contributor (e.g. NEIC, IRIS)
--ua date	Limit to origins updated after date (YYYY-MM-DD,HH:MM:SS)
--allorigins	Return all origins, default is only primary origin per event
--allmags	Return all magnitudes, default is maximum magnitude per event
--orderbymag	Order results by magnitude instead of time
--evid id	Select a specific event by DMC event ID
--orid id	Select a specific event by DMC origin ID
-X xmlfile	Write raw returned XML to xmlfile
-A appname	Application/version string for identification
-o outfile	Write event information to specified file, default: console

--help

Exercise: Quick access to metadata

Working in a Terminal window:

Use `FetchMetadata` to get channel information for **TA**
network station **ELFS**

Hint 1: type `$ FetchMetadata -h` for usage

Hint 2: “`-N TA -S ELFS`”

Exercise: Quick access to metadata

```
$ FetchMetadata -N TA -S ELFS
```

Received 112.5 KB of metadata in 0.1 seconds (796.2 KB/s)

Processed metadata for 114 channel epochs in 0.4 seconds (316.7 KB/s)

```
#net|sta|loc|chan|lat|lon|elev|depth|azimuth|dip|instrument|scale|scalefreq|scaleunits|samplerate|start|end
TA|ELFS|--|ACE|40.6183|-120.7279|1553.0|0.0|0.0|0.0|Quanterra 330 Linear Phase Composite||0||0|2007-08-16T21:01:00|2007-10-09T18:
TA|ELFS|--|BHE|40.6183|-120.7279|1553.0|0.0|84.9|0.0|Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co|6.27192E8|0.2|M/S|40|2007
TA|ELFS|--|BHN|40.6183|-120.7279|1553.0|0.0|354.9|0.0|Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co|6.27192E8|0.2|M/S|40|200
TA|ELFS|--|BHZ|40.6183|-120.7279|1553.0|0.0|0.0|-90.0|Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co|6.27192E8|0.2|M/S|40|200
TA|ELFS|--|LCE|40.6183|-120.7279|1553.0|0.0|0.0|0.0|Quanterra 330 Linear Phase Composite|1000000.0|0|S|1|2007-08-16T21:01:00|2007
TA|ELFS|--|LCQ|40.6183|-120.7279|1553.0|0.0|0.0|0.0|Quanterra 330 Linear Phase Composite|1.0|0|PERCENT|1|2007-08-16T21:01:00|2007
TA|ELFS|--|LHE|40.6183|-120.7279|1553.0|0.0|84.9|0.0|Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co|6.25202E8|0.03|M/S|1|2007
TA|ELFS|--|LHN|40.6183|-120.7279|1553.0|0.0|354.9|0.0|Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co|6.25202E8|0.03|M/S|1|200
TA|ELFS|--|LHZ|40.6183|-120.7279|1553.0|0.0|0.0|-90.0|Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co|6.25202E8|0.03|M/S|1|200
TA|ELFS|--|LOG|40.6183|-120.7279|1553.0|0.0|0.0|0.0|Quanterra 330 Linear Phase Composite||0||0|2007-08-16T21:01:00|2007-10-09T18:
TA|ELFS|--|OCF|40.6183|-120.7279|1553.0|0.0|0.0|0.0|Quanterra 330 Linear Phase Composite||0||0|2007-08-16T21:01:00|2007-10-09T18:
TA|ELFS|--|UHE|40.6183|-120.7279|1553.0|0.0|84.9|0.0|Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co|3.61051E7|0.002|M/S|0.01|
```

✧ The existence of metadata does not
guarantee that time series data exists

FetchMetadata

Usage: FetchMetadata [options]

Options:

-v	Increase verbosity, may be specified multiple times
-N,--net	Network code, list and wildcards (* and ?) accepted
-S,--sta	Station code, list and wildcards (* and ?) accepted
-L,--loc	Location ID, list and wildcards (* and ?) accepted
-C,--chan	Channel codes, list and wildcards (* and ?) accepted
-s starttime	Specify start time (YYYY-MM-DD,HH:MM:SS)
-e endtime	Specify end time (YYYY-MM-DD,HH:MM:SS)
-ua date	Limit to metadata updated after date (YYYY-MM-DD,HH:MM:SS)
-mts	Limit to metadata where criteria match time series data
-X xmlfile	Write raw returned FDSN StationXML to xmlfile
-l listfile	Read list of selections from file
-b bfastfile	Read list of selections from BREQ_FAST file
-sta	Print station level information, default is channel
-resp	Request response level information, no details printed
-A appname	Application/version string for identification
-o outfile	Write basic metadata to specified file instead of printing

FetchData example

Request 1 hour of GSN long-period vertical (LHZ) data and simple metadata for 2010-2-27 M8.8 Chilean earthquake:

\$ FetchData

- -N _GSN -L 00 -C 'LHZ'
- -s 2010-02-27T06:34:00 -e 2010,02,27,07,34,00
- -o /data/Chile-GSN-LHZ.mseed
- -m /data/Chile-GSN-LHZ.metadata

Convert the miniSEED to SAC with metadata

\$ mseed2sac Chile-GSN-LHZ.mseed -m Chile-GSN-LHZ.metadata

- -E '2010,058,06:34:11/-36.122/-72.898/22.9'

FetchData

Usage: FetchData [options]

Options:

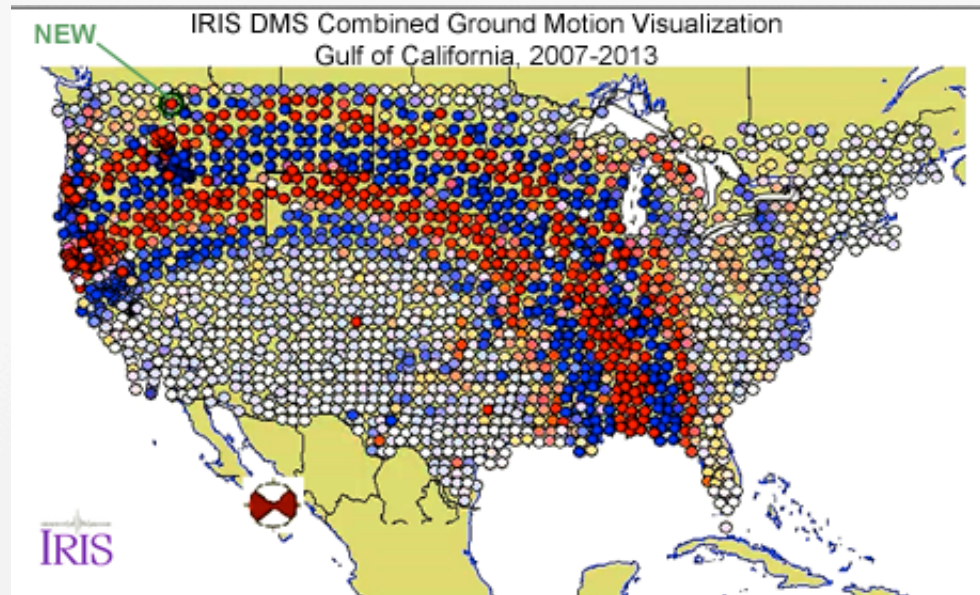
-v	Increase verbosity, may be specified multiple times
-q	Be quiet, do not print anything but errors
-N,--net	Network code, list and wildcards (* and ?) accepted
-S,--sta	Station code, list and wildcards (* and ?) accepted
-L,--loc	Location ID, list and wildcards (* and ?) accepted
-C,--chan	Channel codes, list and wildcards (* and ?) accepted
-Q,--qual	Quality indicator, by default no quality is specified
-s starttime	Specify start time (YYYY-MM-DD,HH:MM:SS.ssssss)
-e endtime	Specify end time (YYYY-MM-DD,HH:MM:SS.ssssss)
--lat min:max	Specify a minimum and/or maximum latitude range
--lon min:max	Specify a minimum and/or maximum longitude range
--radius lat:lon:maxradius[:minradius]	Specify circular region with optional minimum radius
-l listfile	Read list of selections from file
-b bfastfile	Read list of selections from BREQ_FAST file
-msl length	Limit returned data to a minimum segment length
-lso	Limit returned data to the longest segment only
-nm	Do not request metadata unless output file requested
-nr	No retry, exit immediately on time series request errors
-A appname	Application/version string for identification
-a user:pass	User and password for access to restricted data
-F	Federate the request to multiple data centers if needed Output files are prefixed by data center identifiers
-o outfile	Fetch time series data and write to output file
-O outfile	Write all timeseries to a single file, useful with -F
-sd sacpzdir	Fetch SAC P&Zs and write files to sacpzdir
-rd respdir	Fetch RESP and write files to respdir
-m metafile	Write basic metadata to specified file
-M metafile	Write all metadata to a single file, useful with -F

FetchData homework

2014/04/18 14:27:24.9200 Guerrero M7.2

30 minutes of BH? data and metadata

30 minutes of DPZ data and metadata



FetchData homework

2014/04/18 14:27:24.9200 Guerrero M7.2

30 minutes of BH? data and metadata

30 minutes of DPZ data and metadata

```
FetchData -s 2014,04,18,14,27,26 -e 2014,04,18,14,57,26 -N XB -  
C "BH?" -o sweetwaterBH.mseed -m sweetwaterBH.metadata
```

```
FetchData -s 2014,04,18,14,27,26 -e 2014,04,18,14,57,26 -N XB -  
C DPZ -o sweetwaterDPZ.mseed -m sweetwaterDPZ.metadata
```


Exercise: accessing other data centers

Find out what web services exist...

Hint: Internet search, including the term FDSNWS

Find 2 (non-IRIS) data centers with fdsnws-event services

Find 2 (non-IRIS) data centers with fdsnws-station services

Use **FetchEvent** to find out what the largest event is that each organization has.

Use **FetchMetadata** to find out how many stations each center has that start with A. (Hint: 1 station per line, so count the lines)

Hint: read about using the scripts with non-IRIS centers:

[https://seiscode.iris.washington.edu/projects/ws-fetch-scripts/wiki/Use with other data centers](https://seiscode.iris.washington.edu/projects/ws-fetch-scripts/wiki/Use_with_other_data_centers)

Broad support for FDSN services



<http://www.fdsn.org/webservices/datacenters/>

Embedded use: a Fetching script

```
#!/usr/bin/bash
# usage: ./fetchingscript minmag:maxmag startday endday
a=$(./FetchEvent --mag ${1} --s ${2} --s ${3} --orderbymag --limit 1)
# parse output
a=${a%*|*|*|*|*}          # strip off the end
a=${a//[[:space:]]}        # remove all spaces
IFS=' ' read -r evid evdt evlat evlon evdep <<< ${b//|/ } # split fields
# wrestle dates
evdate=${evdt:0:10}
evtime=${evdt:10}
eventtime=$(date -j -f "%T" -v+10M ${evtime} "+%H:%M:%S") #add 10 minutes
evstart="${evdate}T${evtime}"
evend="${evdate}T${eventtime}"

./FetchData -N _GSN -C BHZ -s ${evstart} -e ${evend} -o data.mseed
-m data.meta -A test --radius ${evlat}:${evlon}:85:95

./mseed2sac data -m data.meta data.mseed
```

IRIS Web Service Java Library

- Zero knowledge of networking required
- Zero knowledge of data formats (XML, mini-SEED) required
- Currently accesses:
 - Station metadata service (station)
 - Waveform data service (dataselect)
 - Event service (event)
 - SAC Poles and Zeros service (sacpz)
- Tutorials, Examples, Manual and Java Doc available online
 - <http://ds.iris.edu/ds/nodes/dmc/manuals/iris-ws>

Direct access with MATLAB®

irisFetch allows you to access DMC held data from MATLAB

- Uses the Java IRIS-WS library
- Supports access to these data
 - Traces (waveforms + common metadata)
 - Station metadata
 - Event parameters
- Works with MATLAB R2009 and later releases
- Available for download at:
<http://ds.iris.edu/ds/nodes/dmc/software/downloads/irisFetch.m>

Example MATLAB access

- Simple example:

```
tr =  
    irisFetch.Traces('IU','ANMO','10','BHZ','2010-02-27  
06:30:00','2010-02-27 10:30:00')
```

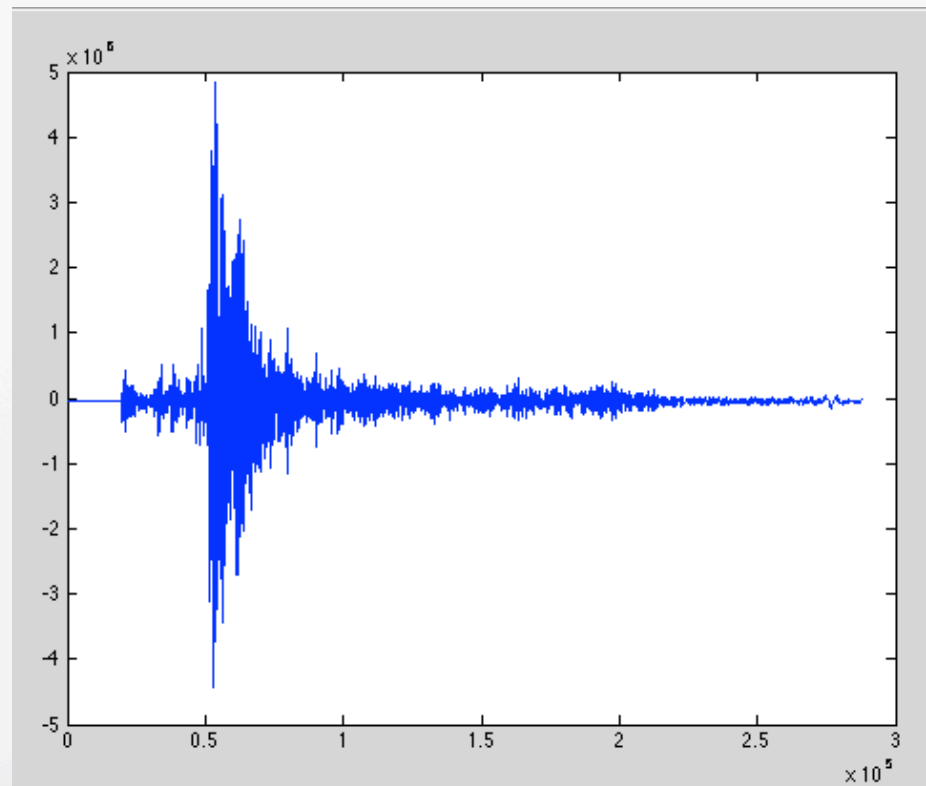
- Results are MATLAB structures

Example MATLAB access and plot

- Simple example:

```
>> tr = irisFetch.Traces('IU','ANMO','00','BHZ','2010-02-27  
06:30:00','2010-02-27 10:30:00')  
>> plot(tr(1).data);
```

- Makes this plot:

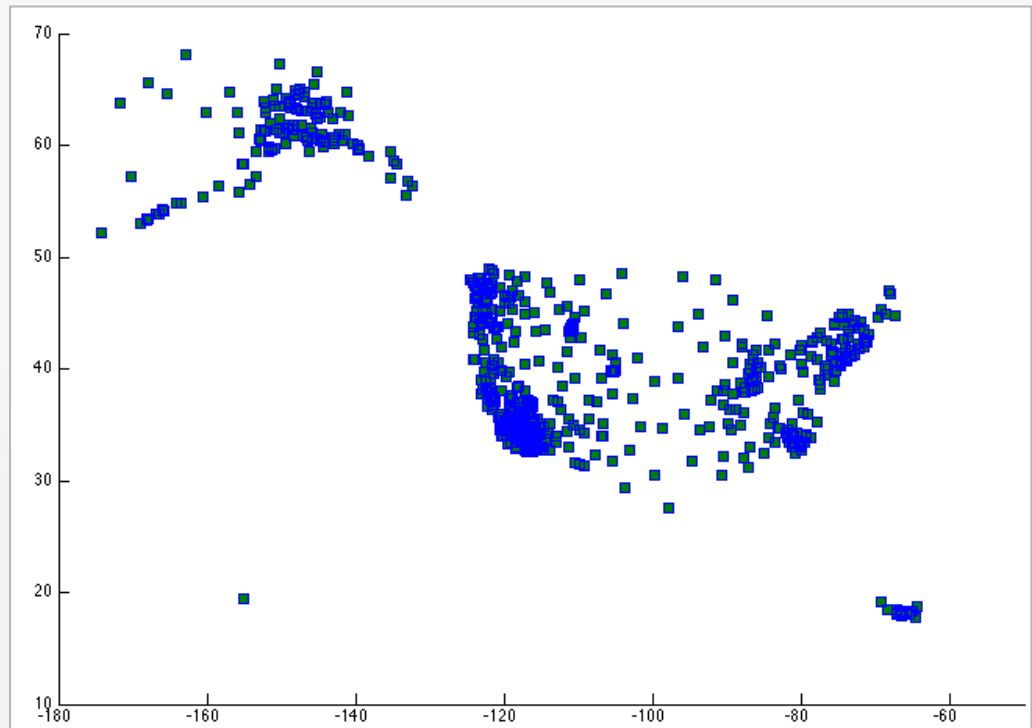


Example MATLAB access and plot

- Station example:

```
sf= irisFetch.Channels('channel','_US-REGIONAL','*','*','BHZ');  
scatter([sf.Longitude],[sf.Latitude],'s','markerfacecolor',[0 .5 0]);  
axis([-180,-50,10,70])
```

- Makes this plot:



irisFetch.m MATLAB exercise

Exercise: use irisFetch.m to access 30 minutes of **LH?** channels from network **IU** and station **COLA** for this time window:

Start time: 2010-02-27 06:50:00

End time: 2010-02-27 07:20:00

- a) Print channel metadata
- b) Plot seismograms

Download irisFetch.m if needed

```
>> javaaddpath('./IRIS-WS-2.0.14.jar')
```

Data access with Python/ObsPy

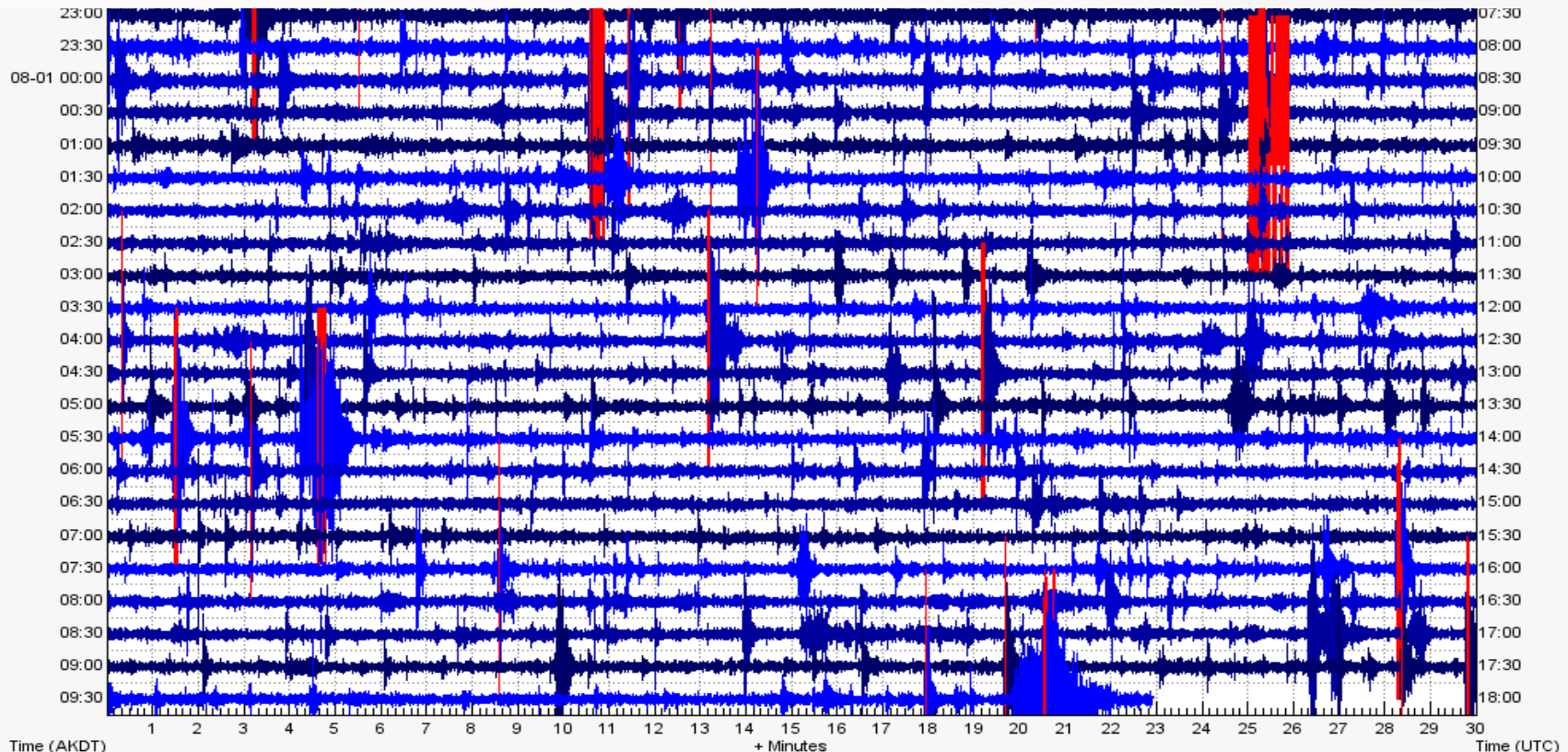
<http://www.obspy.org>

The same advantages as IRIS-WS Java and MATLAB: no knowledge of networking or formats, data available in native environment.

working environment

	Python	MATLAB	SAC/C/Fortran	R
entry point	higher	low	low	high
memory overhead	low	not low	low	low
graphics flexibility	very	very	limited	low
functions flexibility	very	yes	low	yes
quick and dirty?	need experience	yes	excellent	need experience
all-in-one programming	excellent	limited	limited	excellent
cost	free	\$\$\$	free	free
existing seismo code online	growing	lots	decades worth	growing
Ease of code sharing/ maintenance	can vary	easy	very easy	Painful

Please don't use these tools to create a Real-Time System



i.e. please do not poll for data quickly & often

SeedLink: Streaming Data Feeds

All open data streams received by the DMC's real-time collection system (BUD) are available as streaming SeedLink feeds. The SeedLink protocol transports 512-byte Mini-SEED records.

Latency is dependent on the arriving data stream latency and the sample rate.

Primary client software:

- [slink2orb](#): Antelope ORB client
- [slink2ew](#): Earthworm ring buffer client
- [slarchive](#): SeedLink client writes Mini-SEED to disk

Please don't make many connections
at once to web services

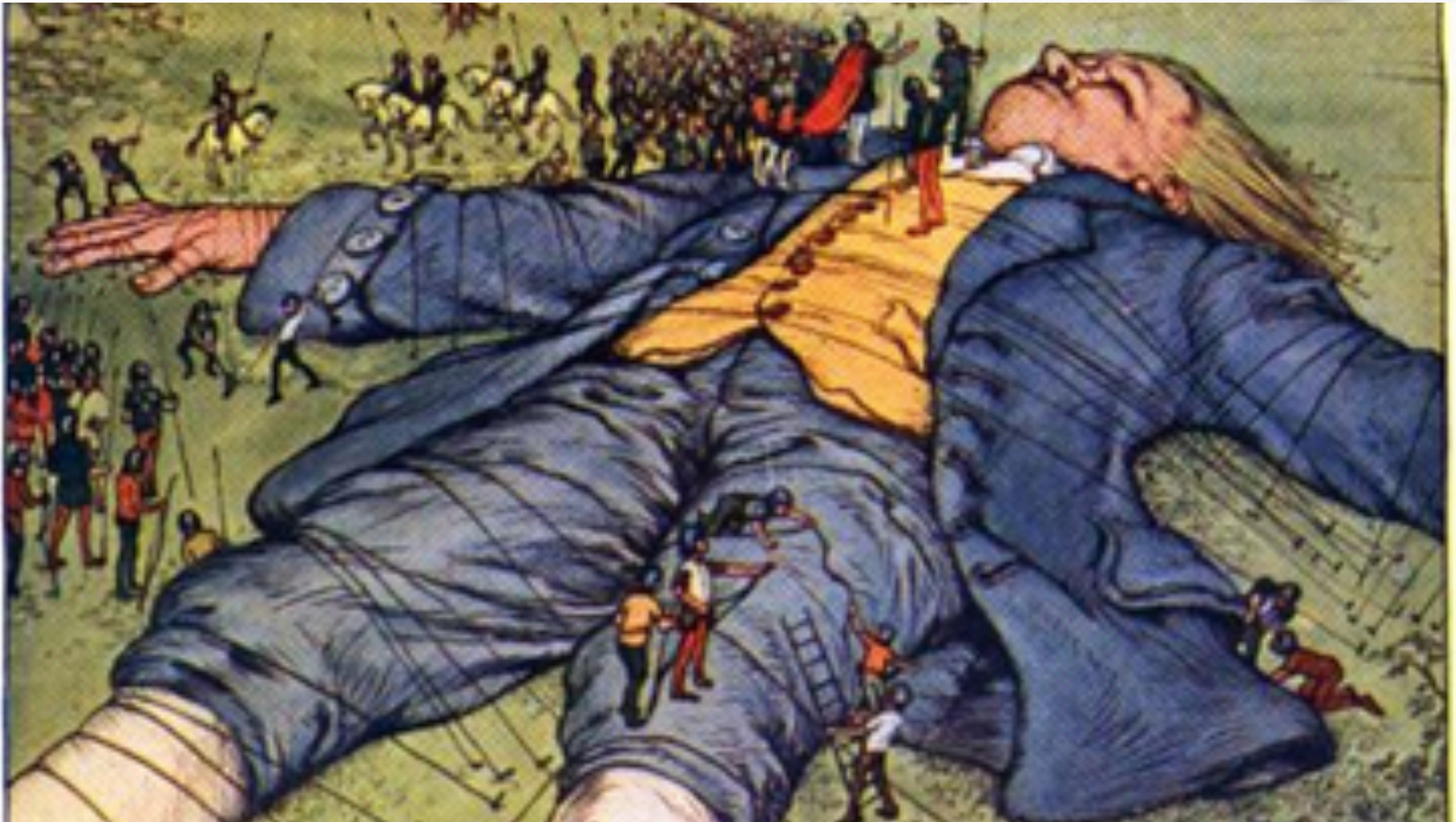


Illustration by Milo Winter (1912).

Please don't overwhelm web services
with many small requests $> \cancel{10}/\text{sec}$



Smithsonian Institute

OK, but what if I need to download TBs of data from IRIS?

Our archive structure: `/net/year/jday/station/channel`

Not efficient:

```
foreach channel ( BHZ BHE BHN )  
for year = 2000:2010  
  foreach net ( IU II AK ....)  
    FetchData -n $net -s $year,01,01,00,00,00 -e $year,12,31,23,59,59 -C $channel -o nobueno.mseed
```

Better:

```
foreach net ( IU II AK ...)  
  for year = 2000:2010  
    for i=1:365  
      mo = ...  
      day = ...  
      Fetchdata -s $year,$mo,$day,00,00,00 -e $year,$mo,$day,00,00,00 -C BH? -o $month.$day.mseed
```

```
$ cat mseed1 mseed2 mseed3 > mseedall
```

OR better yet: BREQ_FAST

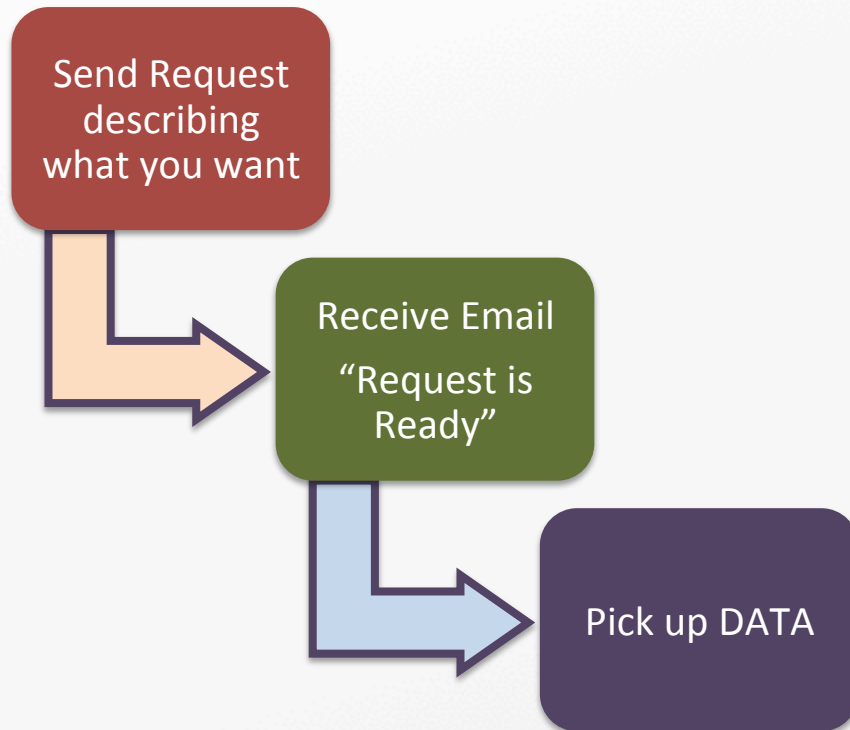
Final web service comments

- Many retrieval mechanisms exist
- Please contribute your creations to SeisCode
- Join the webservicess mailing list:
 - www.iris.washington.edu/mailman/listinfo/webservicess
- Feedback is appreciated
 - How are the services working or not-working?
 - What services should we consider adding?
- Ask for help!

Batch REQuest FAST (BREQ_FAST)

- **Purpose:** Request large volume of SEED information asynchronously
- **Scenario:** You're away, and need to get data.
 - Not at your computer
 - Slow internet connection
 - Need large volume of data
 - Don't/can't need to work on it right away

Order SEED now, process later with BREQ_FAST



- Request data
 - using **SeismiQuery**
 - using **Email**
- Retrieve via
 - HTTP
 - FTP
- Advantages
 - Asynchronous
 - Large Requests

Batch REQUEST FAST

BREQ_FAST via SeismiQuery



www.iris.edu/SeismiQuery/breq_fast.phtml

BREQ_FAST Request Form

virtual network

network

station

location

channel

data start time* 2013 Jun 24 000000

data end time* 2013 Jun 24 010000

latitude and longitude

NORTH

WEST EAST

SOUTH

Clear

channel parameters

sample rate $\geq$ and $\leq$

flags like

comments like

sensor type like

site like

data quality Best

elevation $\geq$ $\leq$

depth $\geq$ $\leq$

azimuth $\geq$ $\leq$

dip $\geq$ $\leq$

name*: Celso

institution*: IRIS

street address*: HERE

email*: celso@iris.washington.edu

phone*: 206-547-0393

label*: Test

media: Electronic (FTP)

alternate media: DAT 4mm

alternate media: DLT

query over ☐ DMC archived waveforms or ☒ metadata/dataless/RESP**

Start Query

*These fields are required.

**A query on metadata may result in a request file for unavailable data, but returns much faster.

BREQ_FAST via SeismiQuery

BREQ_FAST Request Form

virtual network

network

station

location

latitude and longitude

NORTH

WEST EAST

SOUTH

Clear

data start time* 2013 Jul 1 000000

data end time* 2013 Jul 1 010000

sample rate $\geq$ and $\leq$

flags like

comments like

sensor type like

site like

data quality Best

channel parameters

elevation $\geq$ $\leq$

azimuth $\geq$ $\leq$

depth $\geq$ $\leq$

dip $\geq$ $\leq$

*These fields are required.

**A query on metadata may result in a request file for unavailable data, but returns much faster.

BREQ_FAST via SeismiQuery

SeismiQuery BREQ_FAST Request Form

virtual network

network

station

location

channel

latitude and longitude

NORTH

WEST EAST

SOUTH

Clear

elevation depth

azimuth dip

name*:

institution*:

street address*:

email*:

phone*:

label*:

media:

alternate media:

alternate media:

query over ☐ DMC archived waveforms or ☒ metadata/dataless/RESP**

Start Query

*These fields are required.

**A query on metadata may result in a request file for unavailable data, but returns much faster.

BREQ_FAST via SeismiQuery

SeismiQuery BREQ_FAST R IRIS DMC: SQL Query

www.iris.edu/SeismiQuery/bin/breq_fast.pl

Notice

If this query takes more than 5 minutes, you may wish to hit the STOP button on this browser window, further restrict your query, and resubmit the query.

Found metadata for 2 stations and 86 channels.

Make Map of Stations

☐ full SEED
☒ dataless SEED
☐ mini SEED
☐ sync file
☐ RESP file
☐ email request to myself

Submit request below to receive

```
.NAME Celso
.INST IRIS
.ADDRESS HERE
.EMAIL celso@iris.washington.edu
.PHONE 206-547-0393
.FAX YOUR_FAX
.MEDIA: FTP
.ALTERNATE MEDIA: DAT
.ALTERNATE MEDIA: DLT3
.LABEL Test
.FROM SQ
.QUALITY B
.END
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 ACE (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 BDF EP (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 BDO EP (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 BHE (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 BHN (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 BHZ (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 HNE (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 HNN (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 HNZ (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 LCE (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 LCE EP (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 LCO EP (View in MDA)
A04D TA 2013 07 01 00 00 00.0000 2013 07 01 01 00 00.9999 1 LCO (View in MDA)
```

Request from BREQ_FAST Via Email

Request SEED : breq_fast@iris.washington.edu

Request SEED metadata : dataless@iris.washington.edu

Request miniSEED : miniseed@iris.washington.edu

Manual: http://ds.iris.edu/dms/nodes/dmc/manuals/breq_fast/

.NAME Joe Seismologist

.EMAIL joe@podunk.edu

.MEDIA FTP

.LABEL Earthquake1

.QUALITY B

.END

GRFO IU 1999 01 02 00 18 10.4 1999 01 02 00 20 10.4 1 SHZ

ANTO IU 1999 01 02 02 10 36.6 1999 01 02 02 12 36.6 1 SH?

AFI IU 1999 01 02 02 10 37.1 1999 01 02 02 12 37.1 1 BH? 00

SEE CD 1999 01 02 14 45 08.9 1999 01 02 14 47 08.9 1 SHZ

CASY IU 1999 01 04 02 42 13.4 1999 01 04 02 44 13.4 1 BHZ 10

KMI CD 1999 01 04 02 41 57.5 1999 01 04 02 43 57.5 1 BHZ

SSE CD 1999 01 04 02 18 25.4 1999 01 04 02 20 25.4 2 B?? SHZ

PAS TS 1999 1 4 2 10 49 1999 1 4 2 12 49 3 BH? SHZ L??

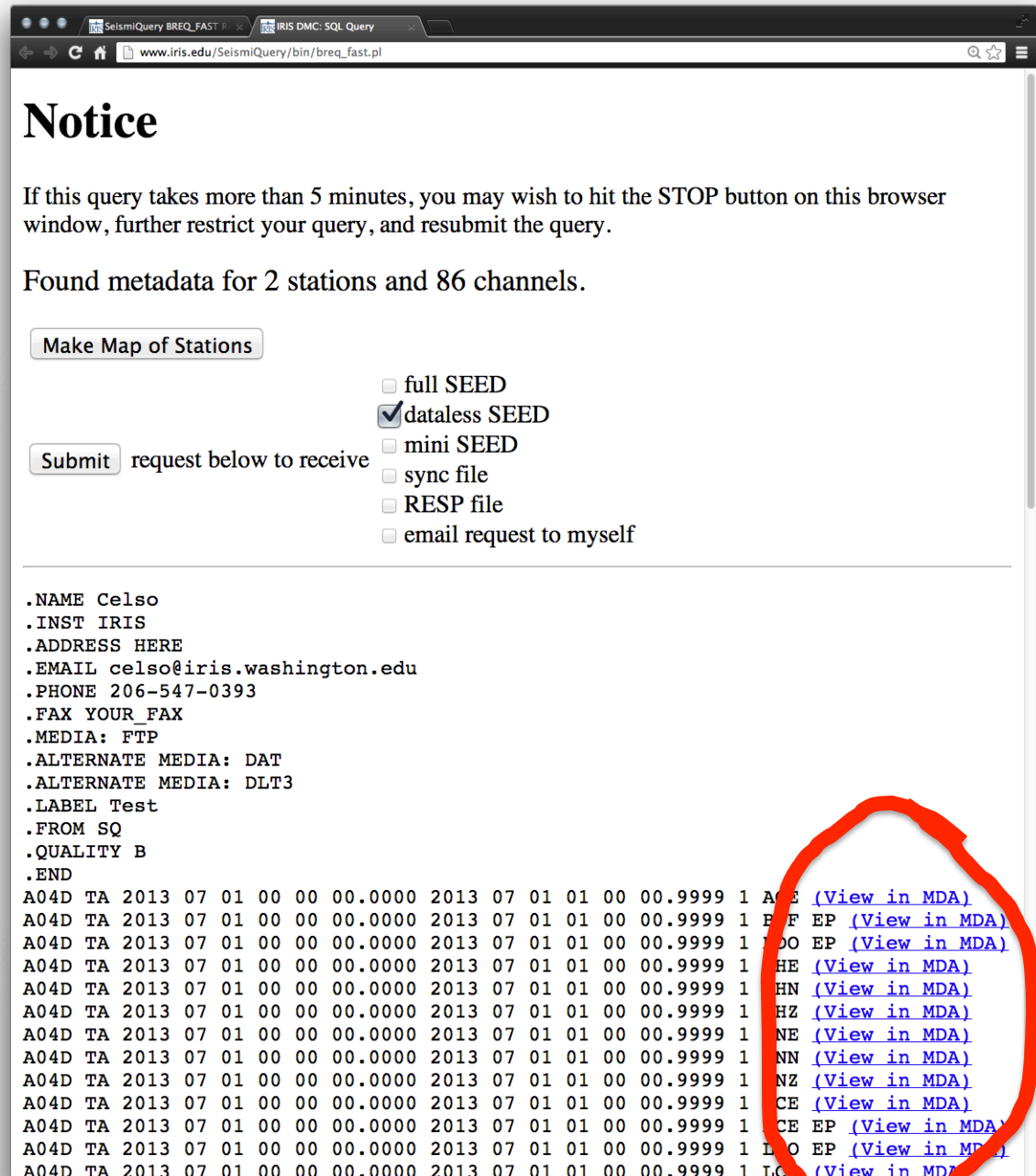
BREQercise

- Request 2 hours of data from two of your favorite stations.
 - If you don't have favorite stations:

Network:	IU	IU
Station:	ANMO	COLA
Channel:	?HZ	B*
Location:	00	
- Retrieve by following instructions in email.

BREQ_FAST via SeismiQuery

(Revisited)



SeismiQuery BREQ_FAST | IRIS DMC: SQL Query

www.iris.edu/SeismiQuery/bin/breq_fast.pl

Notice

If this query takes more than 5 minutes, you may wish to hit the STOP button on this browser window, further restrict your query, and resubmit the query.

Found metadata for 2 stations and 86 channels.

[Make Map of Stations](#)

☐ full SEED
☒ dataless SEED
☐ mini SEED
☐ sync file
☐ RESP file
☐ email request to myself

[Submit](#) request below to receive

.NAME Celso
.INST IRIS
.ADDRESS HERE
.EMAIL celso@iris.washington.edu
.PHONE 206-547-0393
.FAX YOUR_FAX
.MEDIA: FTP
.ALTERNATE MEDIA: DAT
.ALTERNATE MEDIA: DLT3
.LABEL Test
.FROM SQ
.QUALITY B
.END

A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	AE	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	BF	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	DO	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	HE	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	HN	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	HZ	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	NE	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	NN	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	NZ	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	CE	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	CE	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	DO	(View in MDA)
A04D	TA	2013	07	01	00	00	00.0000	2013	07	01	01	00	00.9999	1	LO	(View in MDA)

http://ds.iris.edu/SeismiQuery/breq_fast.phtml

MDA: MetaData Aggregator

<http://ds.iris.edu/mda/>

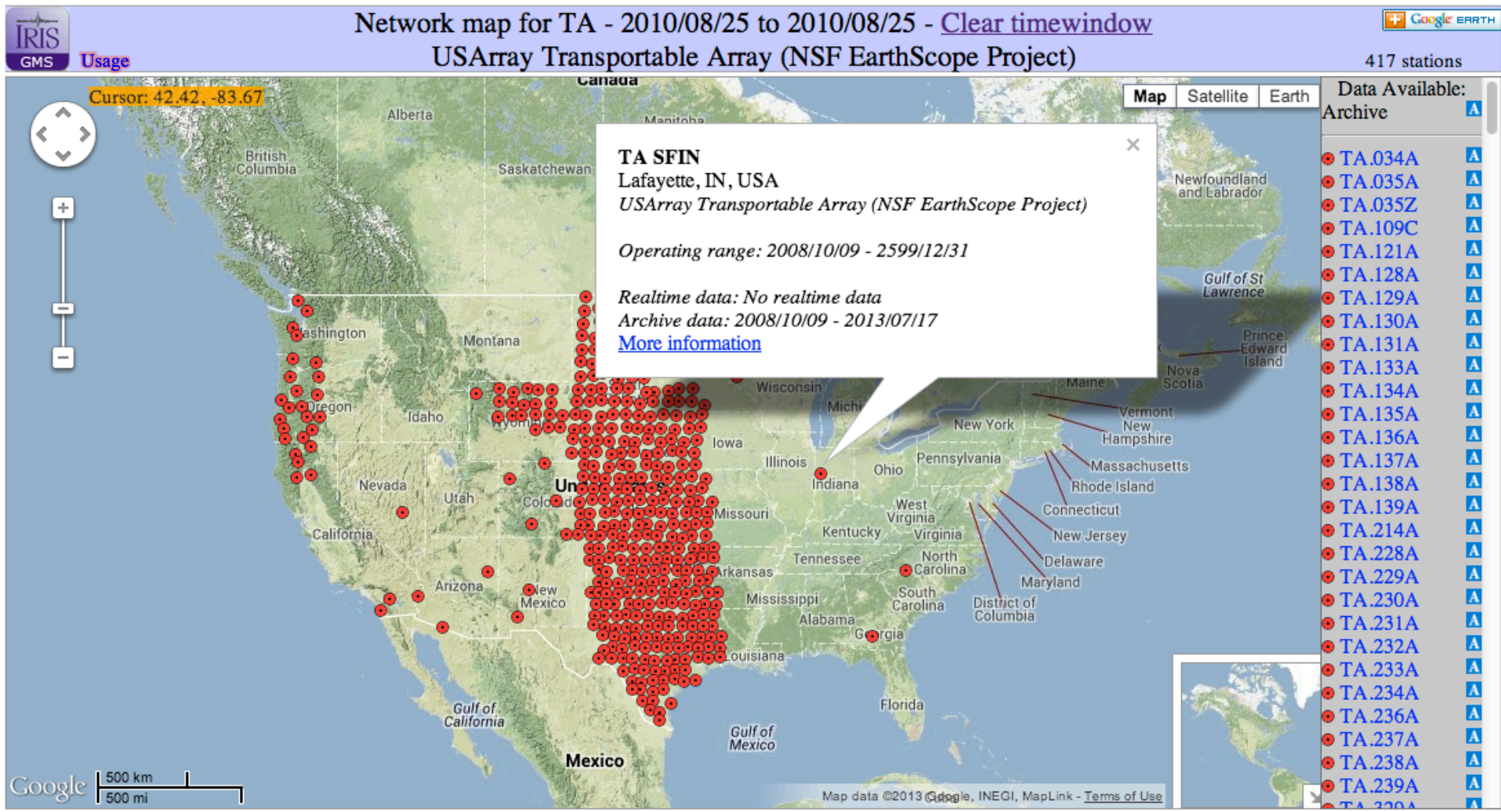
Legend: **R** **A** **R** **P**

Station summary (1 time span)

Network	TA :: USArray Transportable Array (NSF EarthScope Project) :: TA Network Map
Station	SFIN :: Lafayette, IN, USA :: USArray Transportable Array :: SFIN Station Map :: View RESP
Latitude	40.38
Longitude	-87.10
Elevation	165
Start	2008/10/09 (283) 00:00:00
End	2599/12/31 (365) 23:59:59
Epoch	2011/10/10 (283) 16:05:00 - 2599/12/31 (365) 23:59:59 :: View 1 Data Problem Report
Instrument	Setra 278 microbarometer/Q330 w/Environmental Proc
Channels (Hz)	Location EP : BDO (40) R A , LDO (1) R A
Instrument	Q330 w/Environmental Processor, fixed State of Hea
Channels (Hz)	Location EP : LCE (1) R A , LCO (1) R A , LDM (1) R A , LEP (1) R A , LIM (1) R A , LKM (1) R A
Instrument	Hyperion microbarometer/Q330 w/Environmental Proce
Channels (Hz)	Location EP : BDF (40) R A , LDF (1) R A
Epoch	2008/10/09 (283) 00:00:00 - 2599/12/31 (365) 23:59:59 :: View 1 Data Problem Report
Instrument	Streckeisen STS-2 G3/Quanterra 330HR Linear Phase
Channels (Hz)	Location --: BHE (40) R A , BHN (40) R A , BHZ (40) R A , LHE (1) R A , LHN (1) R A , LHZ (1) R A , UHE (.01) A , UHN (.01) A , UHZ (.01) A , VHE (.1) A , VHN (.1) A , VHZ (.1) A
Instrument	Quanterra 330HR Linear Phase Composite
Channels (Hz)	Location --: ACE (0) A , LCE (1) R A , LCQ (1) R A , LOG (0) A , OCF (0) A , VCO (.1) A , VEA (.1) A , VEC (.1) A , VEP (.1) R A , VKI (.1) R A , VM0 (.1) R A , VM1 (.1) R A , VM2 (.1) R A , VM3 (.1) R A , VM4 (.1) R A , VM5 (.1) R A , VM6 (.1) R A , VPB (.1) A
MetaData Load	2013/06/17 (168) 17:28:46

GMap: Google Map Service

<http://ds.iris.edu/gmap/>



MDA: MetaData Aggregator

<http://ds.iris.edu/mda/>

Legend: **R** **A** **R** **P**

Station summary (1 time span)

Network	TA :: USArray Transporta	R = Real-time data available from DMC (access)
Station	SFIN :: Lafayette, IN, US	A = Archive data available from DMC (access)
Latitude	40.38	R = Restricted data access
Longitude	-87.10	P = Partially restricted data access
Elevation	165	
Start	2008/10/09 (283) 00:00:00	
End	2599/12/31 (365) 23:59:59	
Epoch	2011/10/10 (283) 16:05:00 - 2599/12/31 (365) 23:59:59 :: View 1 Data Problem Report	
Instrument	Setra 278 microbarometer/Q330 w/Environmental Proc	
Channels (Hz)	Location EP: BDO (40) R A , LDO (1) R A	
Instrument	Q330 w/Environmental Processor, fixed State of Hea	
Channels (Hz)	Location EP: LCE (1) R A , LCO (1) R A , LDM (1) R A , LEP (1) R A , LIM (1) R A , LKM (1) R A	
Instrument	Hyperion microbarometer/Q330 w/Environmental Proce	
Channels (Hz)	Location EP: BDF (40) R A , LDF (1) R A	
Epoch	2008/10/09 (283) 00:00:00 - 2599/12/31 (365) 23:59:59 :: View 1 Data Problem Report	
Instrument	Streckeisen STS-2 G3/Quanterra 330HR Linear Phase	
Channels (Hz)	Location :: BHE (40) R A , BHN (40) R A , BHZ (40) R A , LHE (1) R A , LHN (1) R A , LHZ (1) R A , UHE (.01) A , UHN (.01) A , UHZ (.01) A , VHE (.1) A , VHN (.1) A , VHZ (.1) A	
Instrument	Quanterra 330HR Linear Phase Composite	
Channels (Hz)	Location :: ACE (0) A , LCE (1) R A , LCQ (1) R A , LOG (0) A , OCF (0) A , VCO (.1) A , VEA (.1) A , VEC (.1) A , VEP (.1) R A , VKI (.1) R A , VM0 (.1) R A , VM1 (.1) R A , VM2 (.1) R A , VM3 (.1) R A , VM4 (.1) R A , VM5 (.1) R A , VM6 (.1) R A , VPB (.1) A	
MetaData Load	2013/06/17 (168) 17:28:46	



Accessing Restricted Data

- There are four generalized policies for what data are restricted:

PARTNER	Data should become open ...
IRIS/PASSCAL	2 years after last instrument is pulled from field
OBSIP	2 years after last instrument is pulled from field
SEIS-UK	3 years after last instrument is pulled from field
SISMOB-FR	3 years after last instrument is pulled from field

Access from desktop with JWEED

- <http://ds.iris.edu/dms/nodes/dmc/software/downloads/JWEED/>
- Interactive download of time series:
 1. Select stations
 2. (optional) select events
 3. Specify time window or arrival time
 4. Download & view data
 5. Save as SEED or SAC

Standing Order for Data (SOD)

- <http://www.seis.sc.edu/SOD/>
- Automated download of time series:
 - Runs locally
 - Data access and processing based on a “recipe”
 - Can select data based on events, future events!
 - Includes pre-processing and formatting options

Tutorials:

<http://www.seis.sc.edu/SOD/documentation/tutorials/>

Beyond raw data

The DMC has two significant activities taking us beyond providing management of and access to raw data:

- Quality control metrics
- Derivative, higher level data products

Quality Assurance Using MUSTANG

Modular Utility for Statistical Knowledge Gathering



- What is MUSTANG
 - A system providing 45 QA metrics
 - Web services design
 - Measures historical and new data
 - Changes in data and metadata trigger recalculation
 - Integration with IRIS Web Services suite
 - Metrics available as web services
 - Can be part of a larger network of QA systems
 - Metrics derived externally can be incorporated into MUSTANG

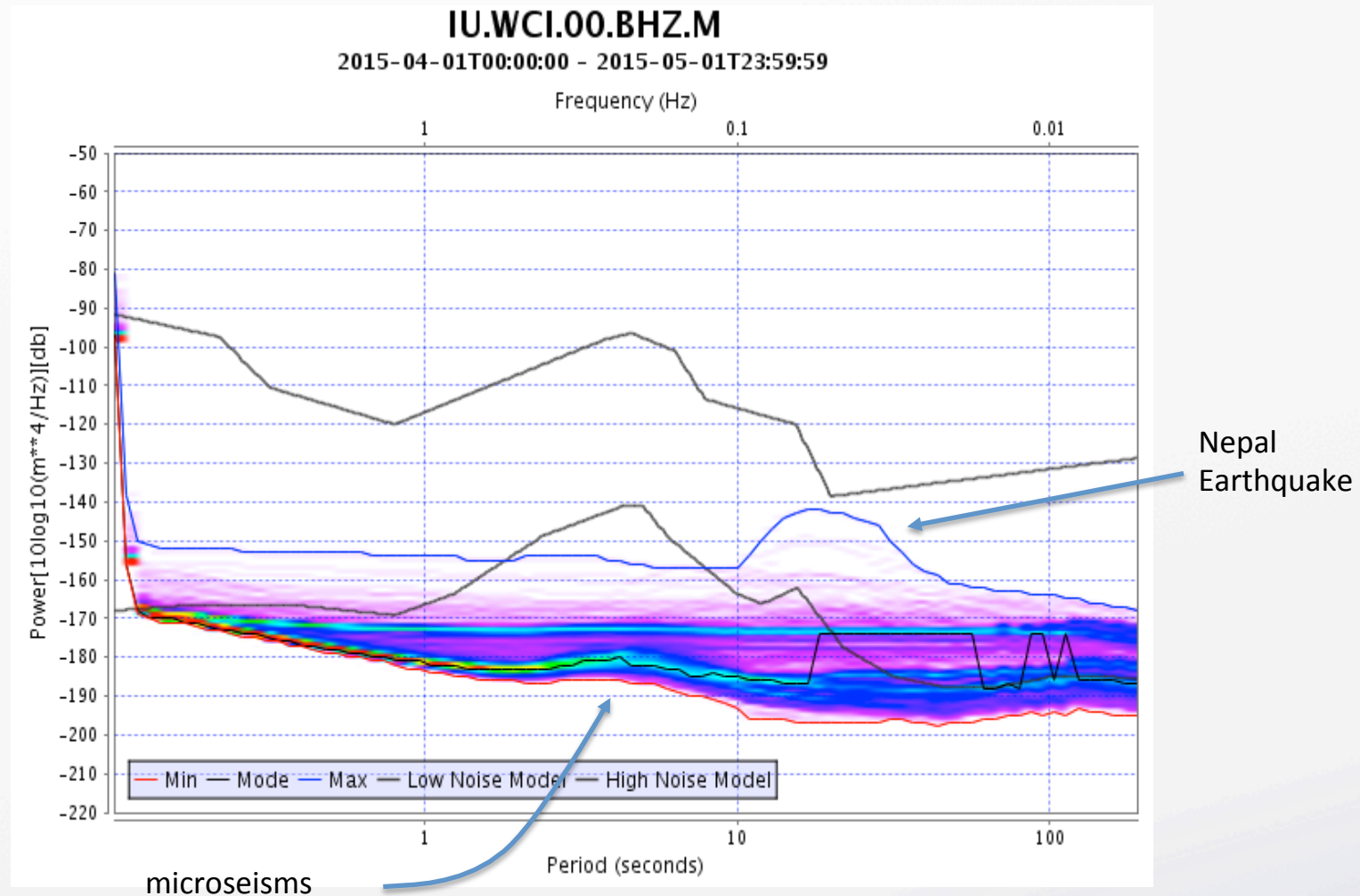
<http://service.iris.edu/mustang/>

Quality Assurance Using MUSTANG

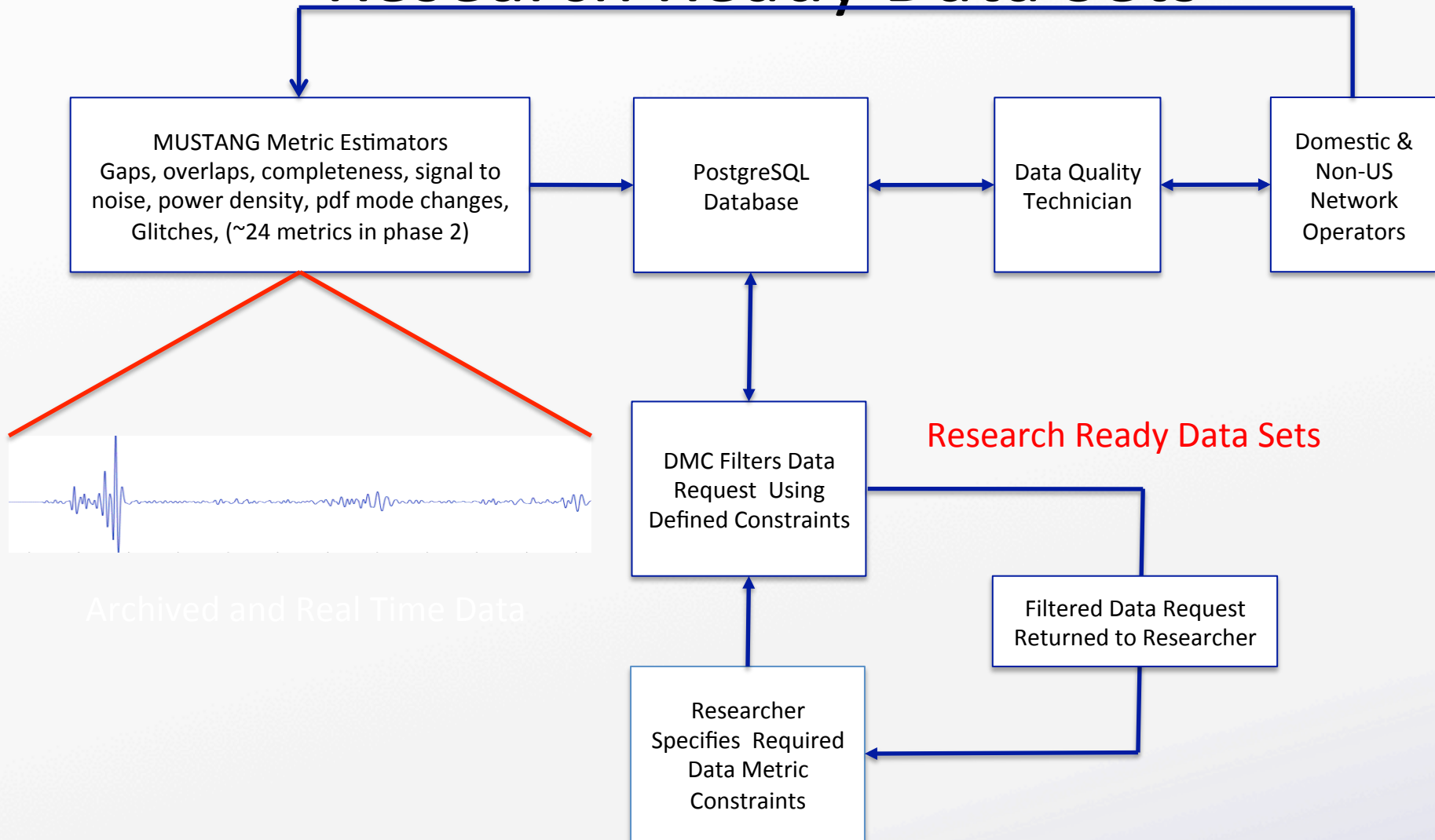
Modular Utility for Statistical Knowledge Gathering

State of health flags	Data continuity	Time series amplitude statistics	Noise analysis
amplifier_saturation	max_gap	sample_max	noise-psd
calibration_signal	max_overlap	sample_mean	noise-pdf
clock_locked	num_gaps	sample_median	noise-mode-timeseries
digital_filter_charging	num_overlaps	sample_min	pct_above_nhnm
event_begin		sample_rms	pct_below_nlnm
event_end		sample_snr	
event_in_progress			
glitches	Data transmission and archiving	Signal anomalies	Metadata accuracy
missing_padded_data	percent_availability	cross_talk	m2_tides*
spikes	channel_uptime	dc_offset	orientation_check
suspect_time_tag	station_completeness	dead_channel_exp	polarity_check
telemetry_sync_error	data_latency	max_stalta	timing_drift
timing_correction	feed_latency	num_spikes	transfer_function
timing_quality	total_latency	asl_coherence	
* in development			

- Dead channel example using MUSTANG pdf-noise service
 - IU.WCI.00.BHZ isn't completely dead – it still records some energy

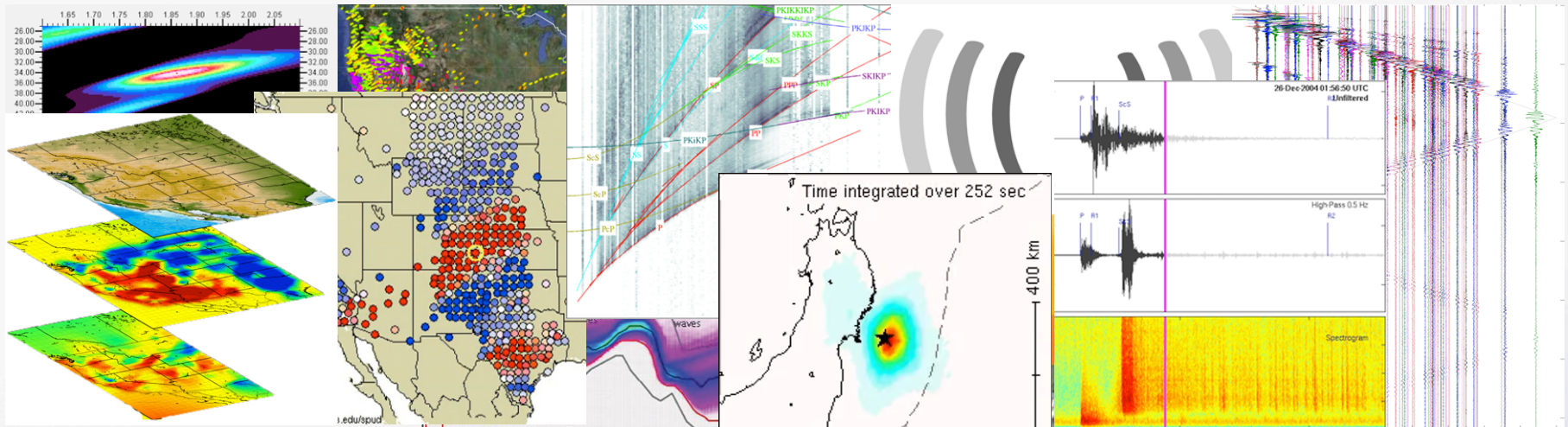


IRIS DMC: Research Ready Data Sets



Data products at IRIS DMS

The DMC data products are intended to serve many purposes: stepping-stones for future research projects, data visualizations, data characterization, research result comparisons as well as outreach material.



<http://www.iris.edu/ds/products/>

- USArray Ground Motion Visualizations (GMVs) + Customized
- EarthScope Automated Receiver Survey (EARS)
- Aftershocks
- Event plot suite
- Global Centroid Moment Tensors
- Earth Model Collaboration (share and access models)
- Infrasound detections and reference event database
- Shear wave splitting databases (2)
- Source time functions
- Global stacks
- Back projection rupture imaging visualizations
- Earthquake energy and duration estimates
- Ambient noise cross correlations for TA stations
- Automated Surface Wave Phase Velocity Measuring System
- Envelope functions (Chile, PNW, Alaska)
- 3D synthetics generate by the ShakeMovie project (SPECFEM3D_GLOBE)
- Event Bulletins (USArray ANF)
- USArray MagnetoTelluric (MT) Transfer Functions
- ...

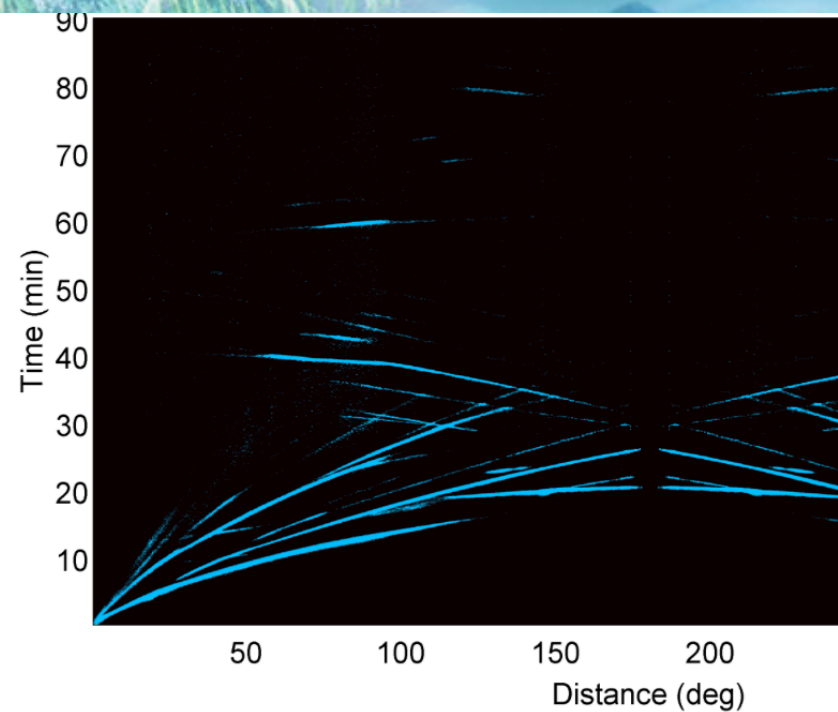
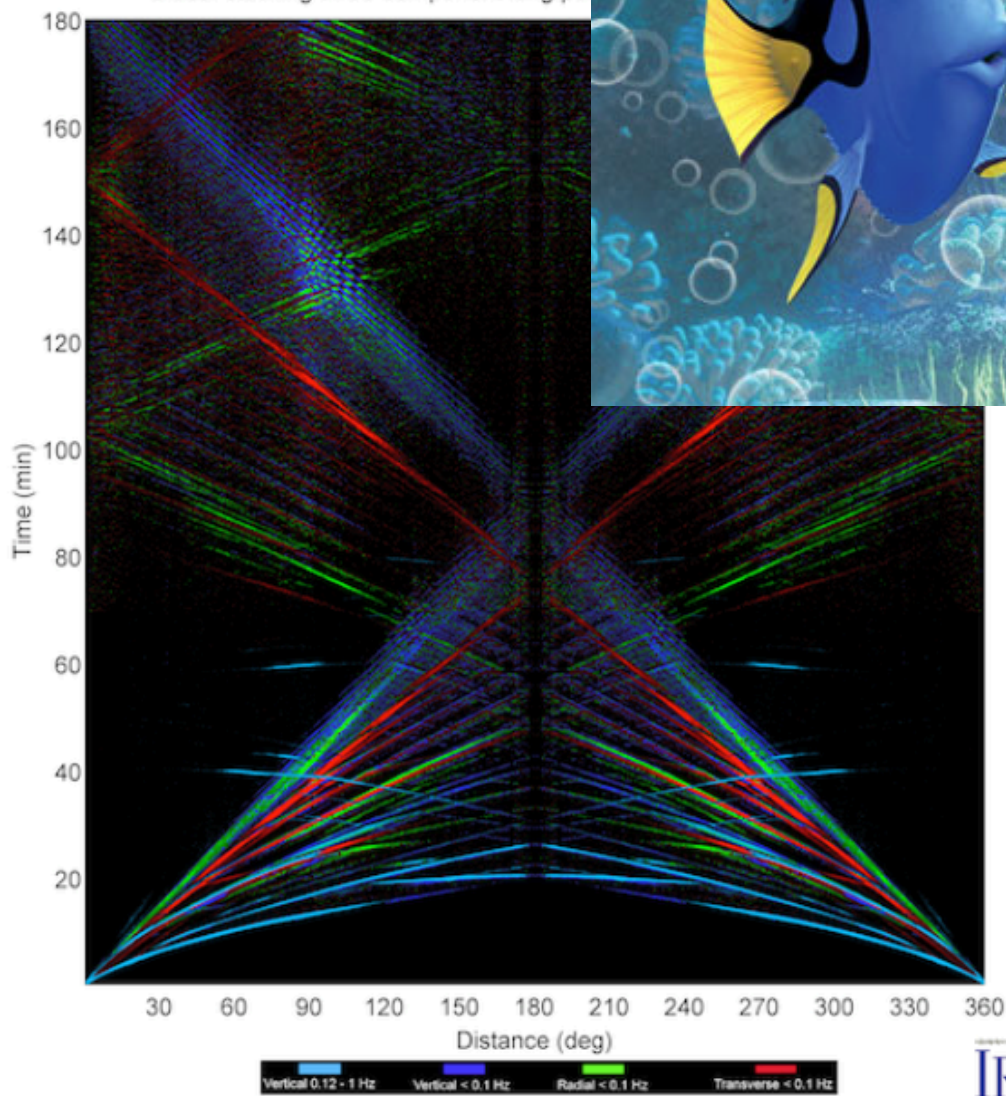
Products: the take home messages

- Contribute! Researchers create data products all the time. We are willing to collaborate on development (e.g. automating, polishing).
- Look for existing products when starting research or exploring an idea.
- Provide feedback: got a product idea but no time to develop it? Please tell us:
product@iris.washington.edu

Finding PKPPKPPKPPKPP



Global stacking three-component long per



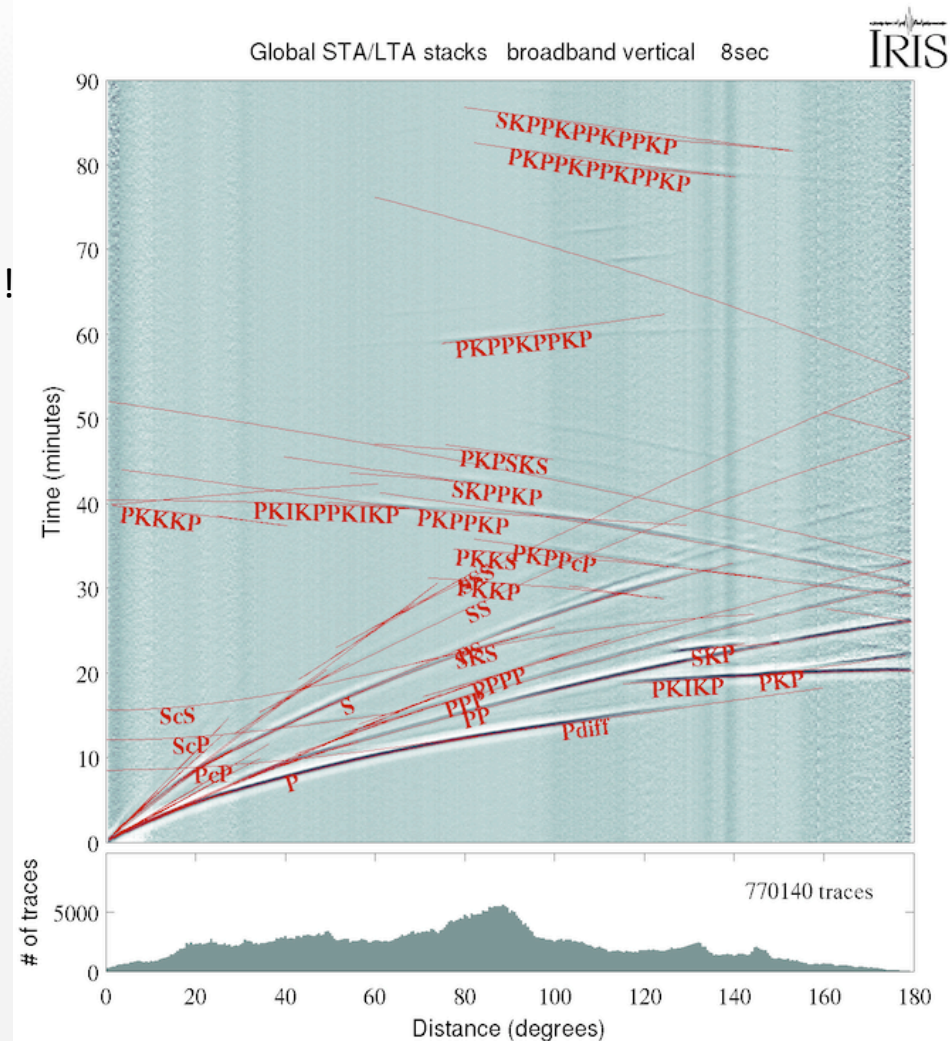
http://ds.iris.edu/ds/products/globalstacks_supplement

→ DIY stacks

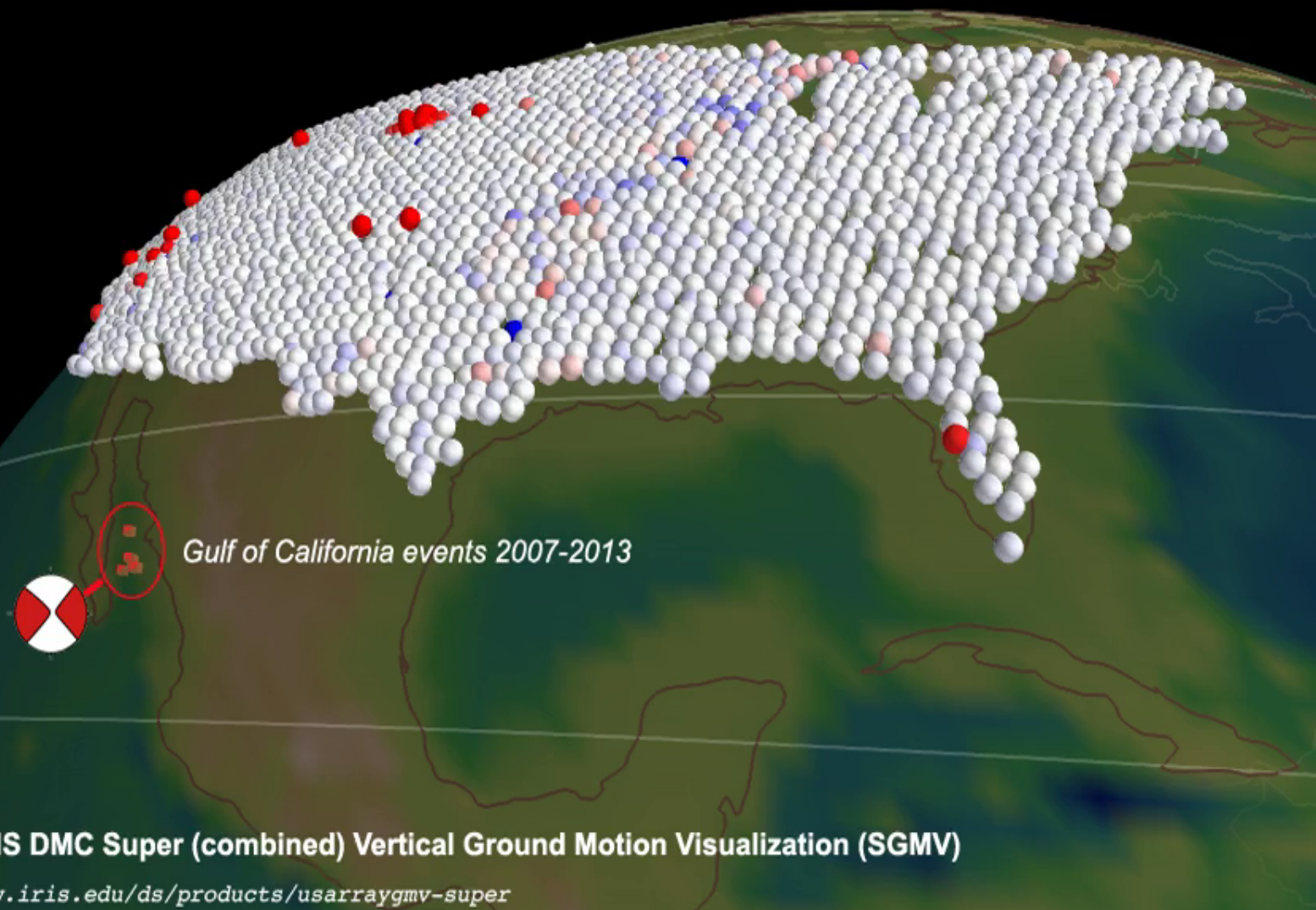
quick_n_dirty_globalstacks.zip

Exercise

- Go ahead, pick a phase, any phase and hunt for it. (use traveltime WS)
- Think about what parameters should be
“at some point you have to pick a number”
- Tune parameters with a small (fast) data set first!!
- Unleash it on a large data set and go to lunch.



3D USArray GMVs TNG



3D USArray GMVs TNG – full motion

