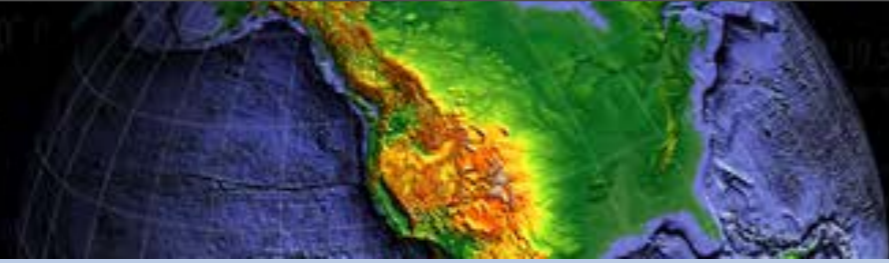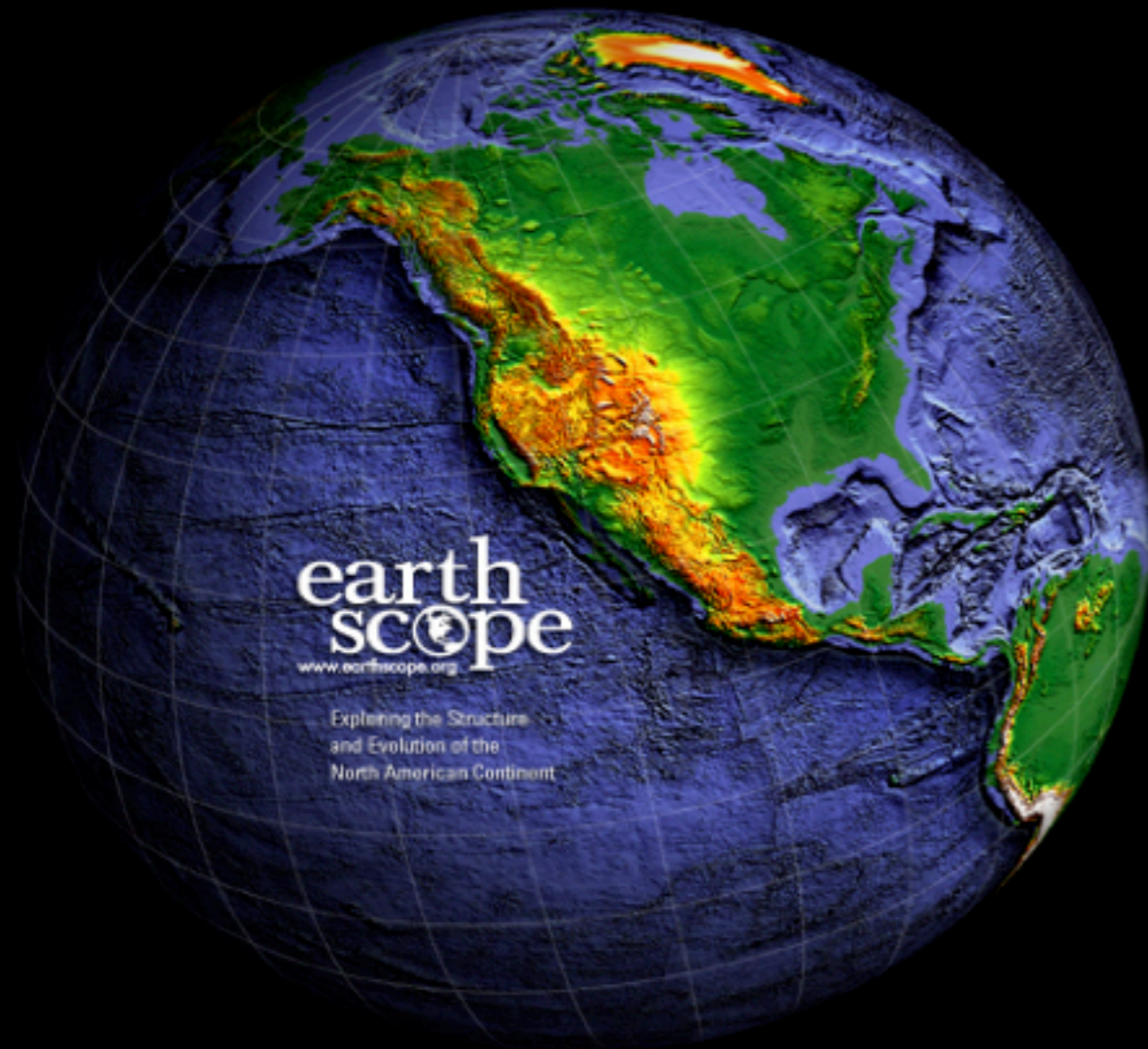# USArray

Frank Vernon for the ANF

IGPP

UCSD

Antelope User Group

Reno

23 October 2012

- Number of stations
  - TA operated
    - 1454 so far
    - 440 current
  - Contributed via ORB
    - AZ   3
    - BK   20
    - CI   50
    - NN   3
  - Contributed via Seedlink
   - IU   9
    - LD   1
    - PO   32
    - US   50
    - UU   1

2

Network Legend

△	AZ (UC San Diego) [2]
▲	BK (UC Berkeley) [17]
▲	CI (CalTech) [43]
◆	IU GSN [0]
▲	NN (UN Reno) [0]
▲	TA (USArray) [0]
◆	US ANSS [0]
▲	UUSS (Uni. Utah) [0]

2004 04

km
0   500

km
0   500

Thursday, October 25, 12

- ## Operating Budget
  - $1.5M/year

- ## Staffing
  - 2   FTE system/networking admin
  - 3.5 FTE seismic data analyst
  - 1   FTE seismic operations
  - 2   FTE programmer
  - 1   FTE program management

- ## NSF Funded

- Hardware
  - 3 Dell R710 Redhat Servers
  - Compellant Storage
    - (32) 2TB SATA 7K RPM Hard Drives
    - (4) total 1Gb iSCSI Front-end ports
    - (4) total 4Gb FC Front-end Ports
    - Total 61 TB usable space
    - 6600 IOPS
  - Future plans
    - Slow growth in processing and disk usage

5

- Sensor: 3 component Broadband seismometer & auxiliary sensors

- Datalogger & local data storage

- Power &   data telemetry

TA Station 345A, MS

6
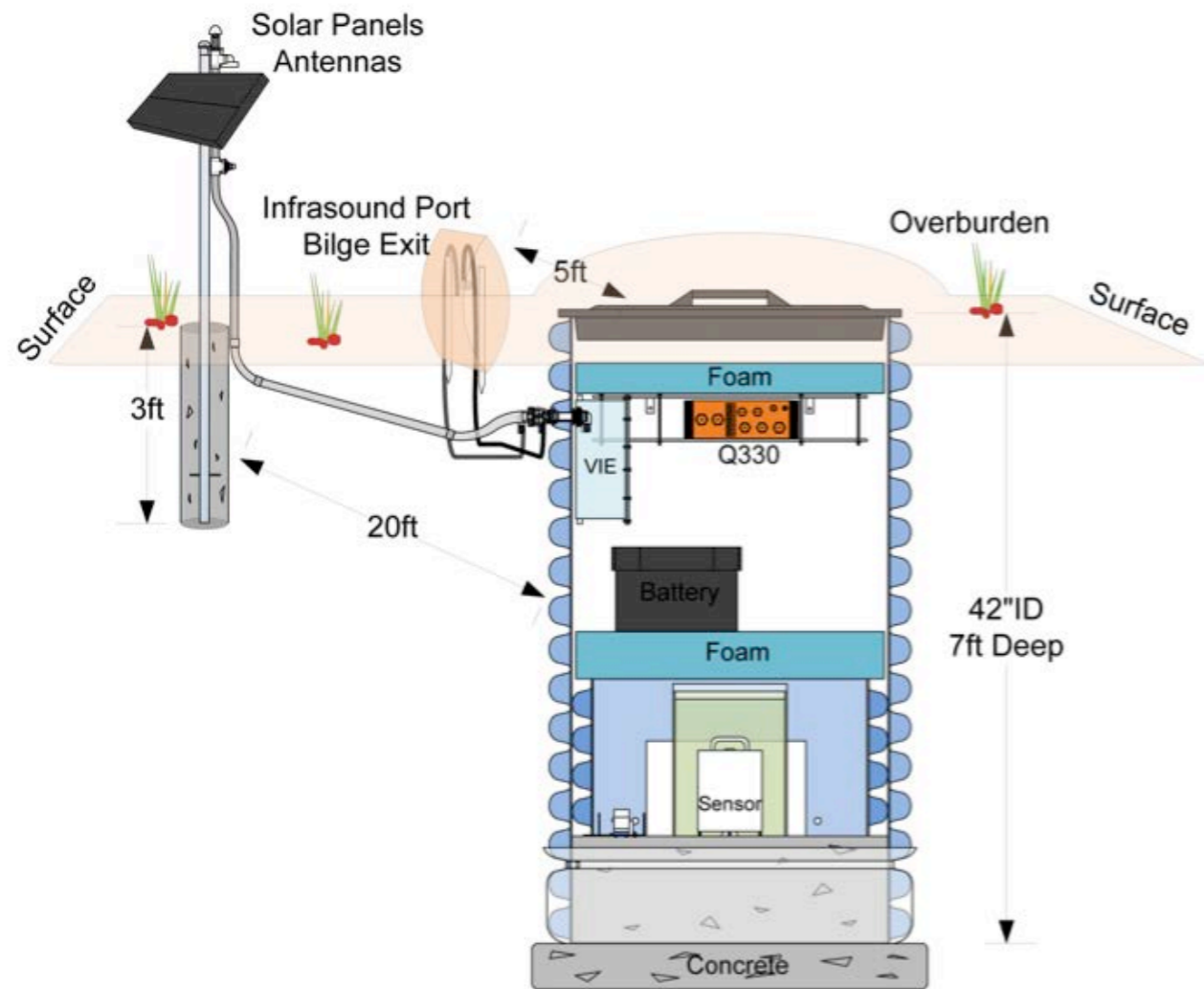
- Data Acquisition Systems
  - Q330
  - Q330HR
  - Baler 14
  - Baler 44
  - QEP
  - VIE
- Seismic Sensors
  - 220 Streckeisen STS-2
  - 111 Guralp CMG3T
  - 109 Nanometrics Trillium 240
- Mechanisms to bring in data
  - q3302orb
 - orb2orb
  - various baler mechanisms

7
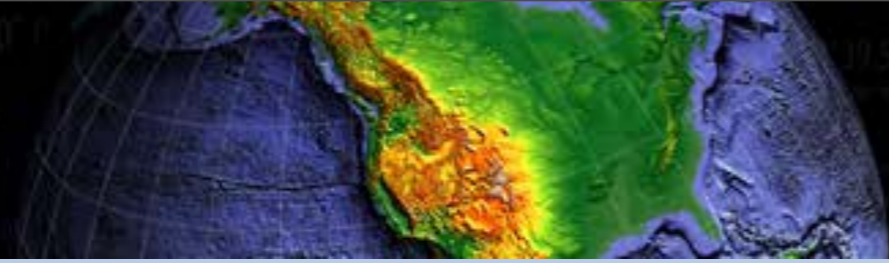
- ## Primary Data Center
  - ### San Diego Supercomputer Center
  - ### 18 hours realtime buffering at stations
- ## Backup Data Center
  - ### IGPP, UCSD
  - ### SDSC offline for more than 12 hours
- ## Secondary Backup Data Center
  - ### IRIS DMC
  - ### SDSC and IGPP both offline

- Sites are selected with the telemetry option as part of the plan.

- The available options in order of preference are:
  - Verizon digital service (EVDO)
  - AT&T (GPRS / GSM)
  - Radio to a VSAT located near AC Power
  - Radio to a location with AC power that has DSL or Cable Modem service available, not landowners.
  - Radio to a VSAT powered by solar panels.
  - Radio range is 20 km line of sight.
    - It is most often a few hundred meters.

- Funding through NSF

- Regular operations meetings
  - Monday mornings
  - 1 hour max
  - Review
    - computers
    - analysts
    - programming
    - seismic operations
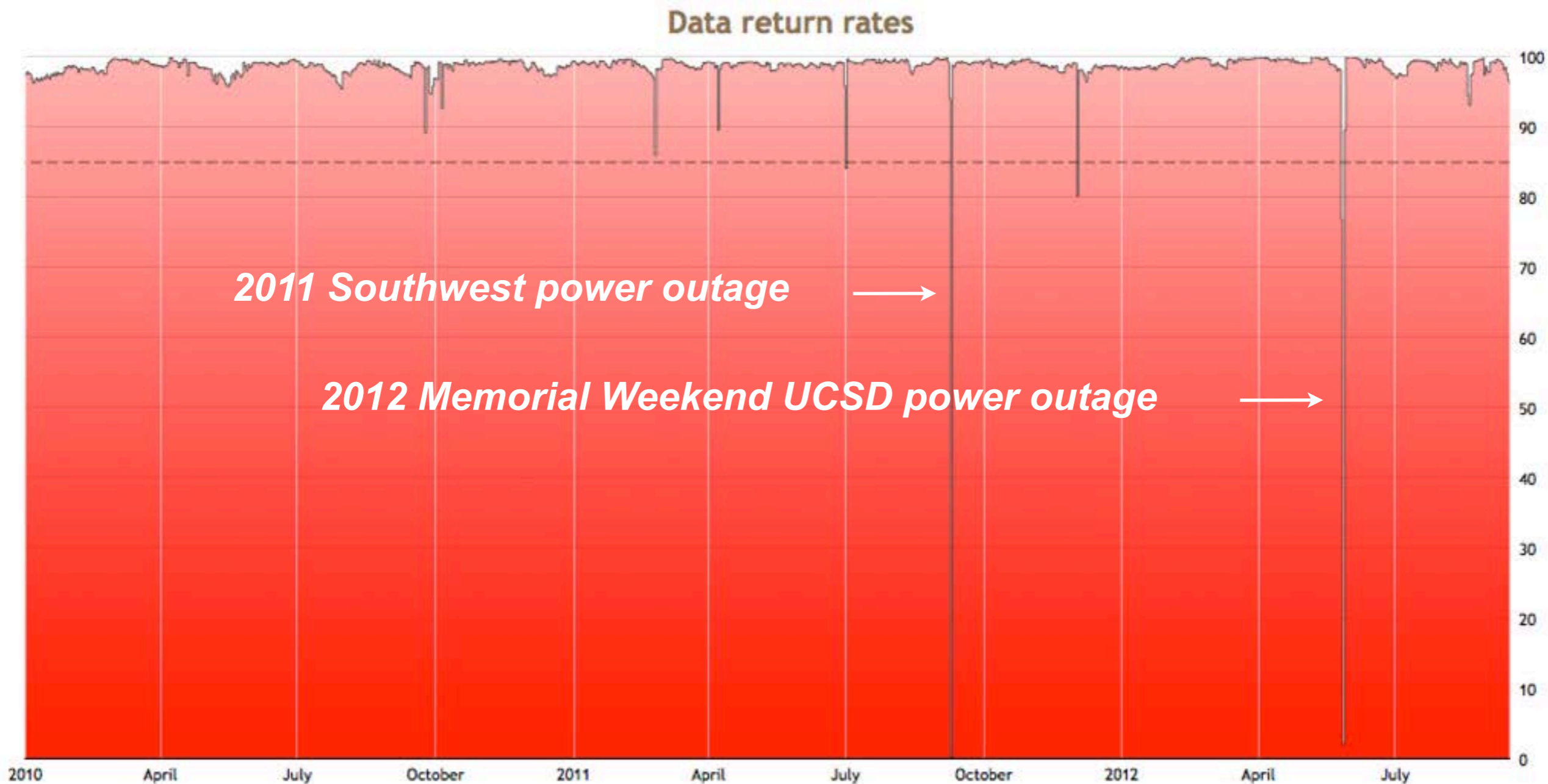   - other issues
    - treats!

10

- **High Quality Data**
  - PDFs at DMC
  - Calibration
  - Data review
- **Data completeness**
  - 100% data return
- **Event association**
  - local, regional, teleseismic
  - locations and phase picks to DMC
  - phase picks to ISC
- **Realtime**
  - Ranks behind data completeness
  - No mandate for early warning
  - No seismic hazard assessment role
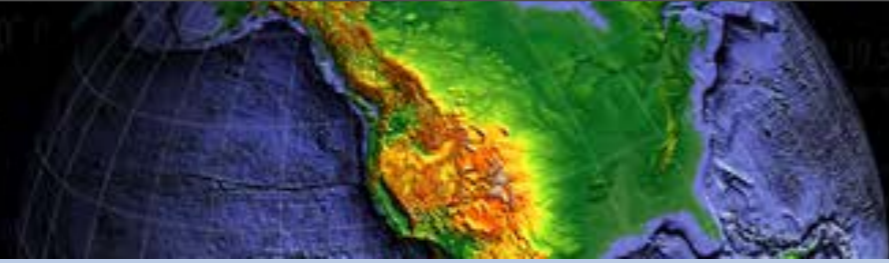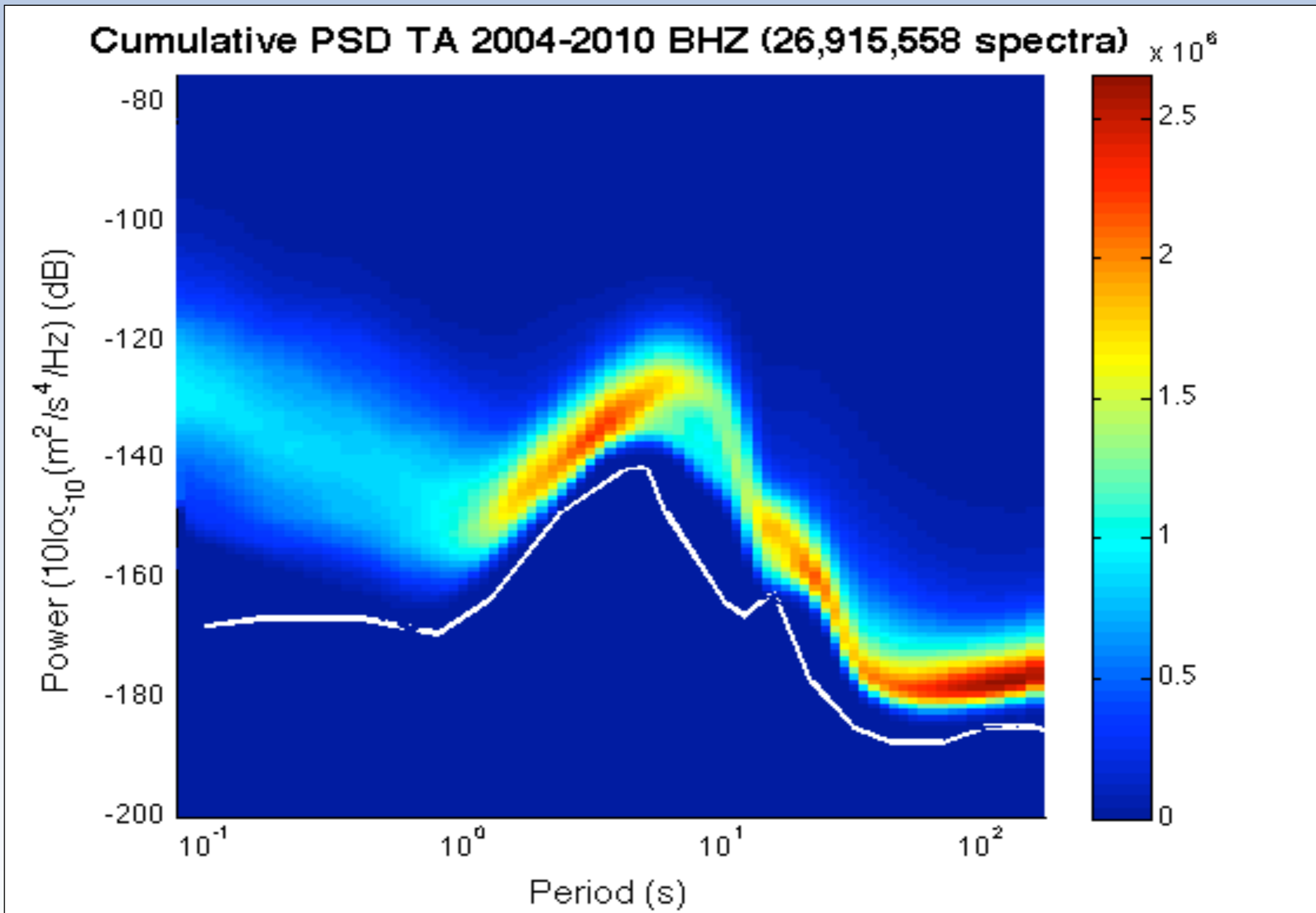- **Endusers**
  - Science users
  - Education and outreach

11
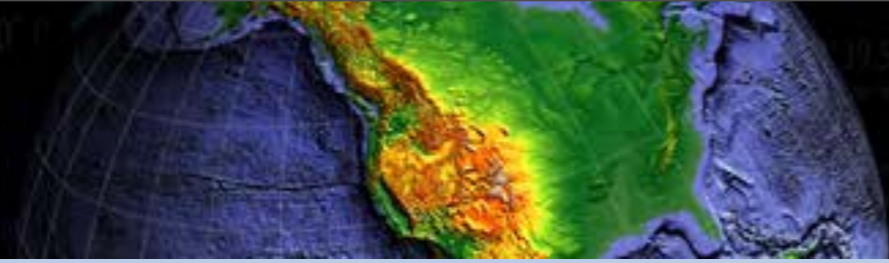
990 days of data
504 days with >= 99% data return

98.52% Average data return weighted by number of stations
**99.01% Median daily data return**

Data return rates

2011 Southwest power outage ⟶

2012 Memorial Weekend UCSD power outage ⟶

Thursday, October 25, 12

Cumulative PSD TA 2004-2010 BHZ (26,915,558 spectra)

- High Quality Data
  - Excellent timing
  - Accurate metadata
    - orientation to ~1°
  - Long continuous time series
  - Low noise stations
- Event processing
  - phase picks
  - locations (local, regional)
  - associations (local, regional, teleseismic)
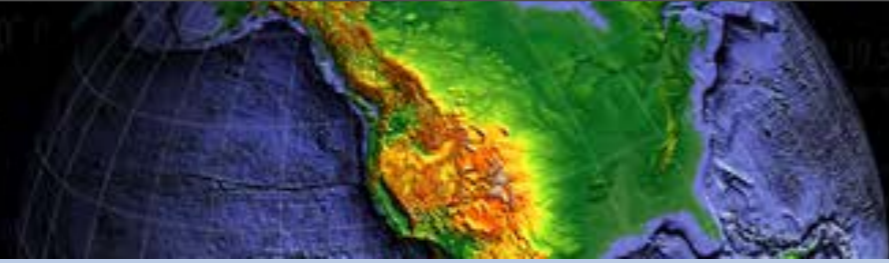 - magnitudes

14
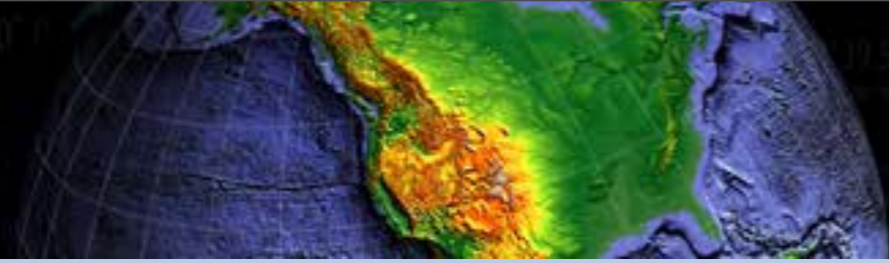
- Realtime
  - orbdetect
  - orbassoc
  - dborigin2db
  - orbevproc
- Post processing
  - dbloc2
    - locate with dblocsat
    - associate with external catalogs
  - dbevproc
  - associations
  - magnitudes
  - no flagging of blasts, sonic, atmospheric, etc.
- End users
  - Science community
  - IRIS DMC
  - Special studies for USGS, IRIS, ...

15

- ## UCSD
  - ### seismic waveforms
  - ### event parametric data
  - ### metadata
  - ### soh waveforms

- ## DMC
  - ### seismic waveforms
  - ### event parametric data
  - ### metadata
  - ### soh waveforms
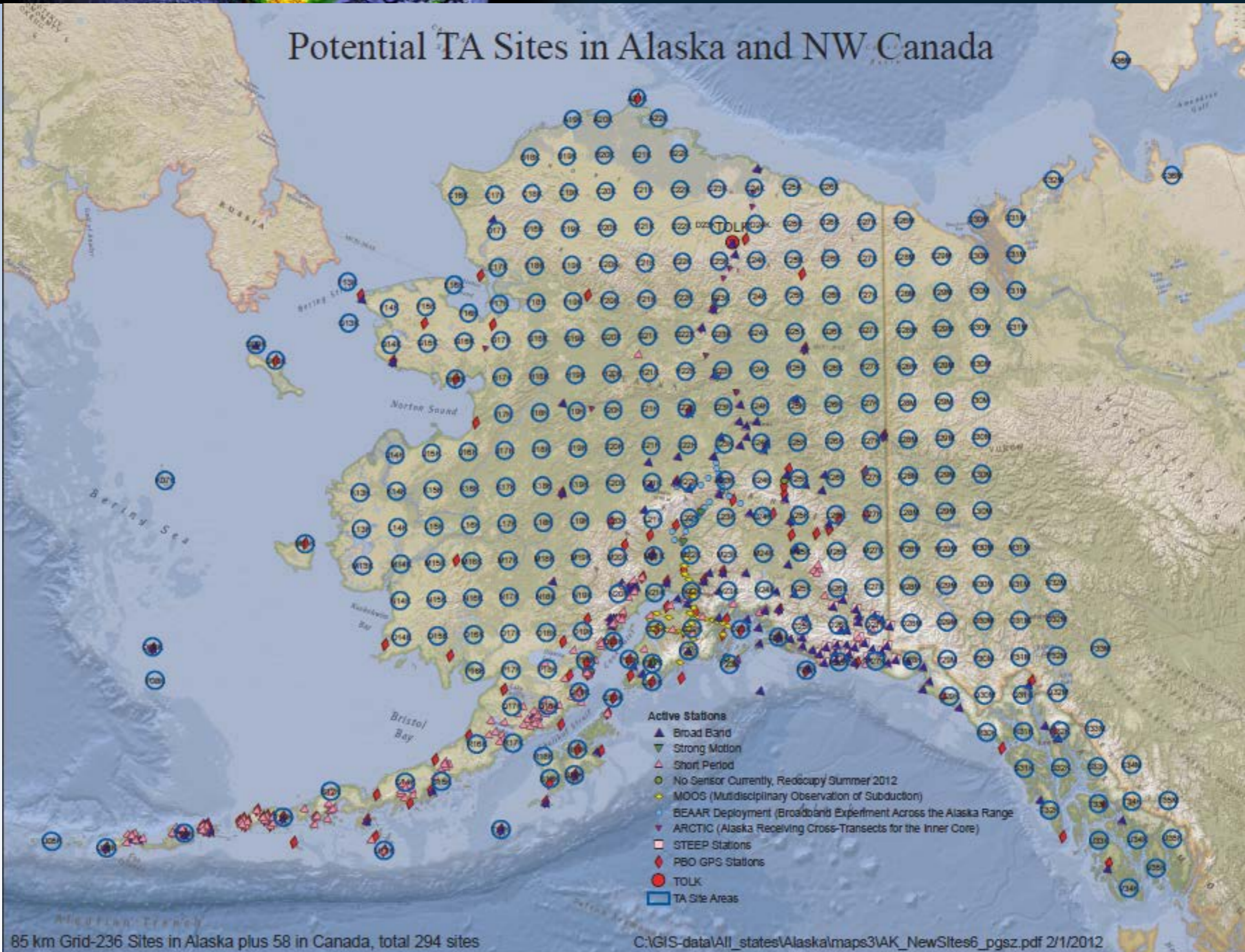
- ## ISC
  - ### phase picks

16
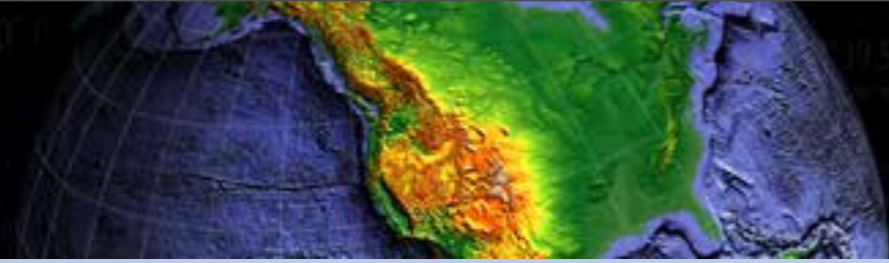
- Other products
  - infrasound waveforms
  - pressure waveforms
- Development
  - Infrasound event detector
  - Implementation of Andreas Rosenberger's S-wave detector
  - Moment tensor implementation
  - Convert show_stalta into python
- Needs
  - automatic blast detector
- Challenges
  - 450 station moving array
  - regional detection and association

17

- Antelope platform for data analysis
  - Antelope APIs
  - contrib
- Matlab interface
  - exploratory prototyping
  - testing

Thursday, October 25, 12

Potential TA Sites in Alaska and NW Canada

294 sites

85 km grid

Active Stations
- ▲ Broad Band
- ▽ Strong Motion
- △ Short Period
- ○ No Sensor Currently, Redeploy Summer 2012
- ◇ MOOS (Mutidisciplinary Observation of Subduction)
- ○ BEAAR Deployment (Broadband Experiment Across the Alaska Range
- ▼ ARCTIC (Alaska Receiving Cross-Transects for the Inner Core)
- □ STEEP Stations
- ◆ PBO GPS Stations
- ● TOLK
- □ TA Site Areas

85 km Grid-236 Sites in Alaska plus 58 in Canada, total 294 sites   C:\GIS-data\All_states\Alaska\maps3\AK_NewSites6_pgsz.pdf 2/1/2012

ANZA network
and the
San Jacinto Fault Zone Experiment

Frank Vernon for the ANF

SIO

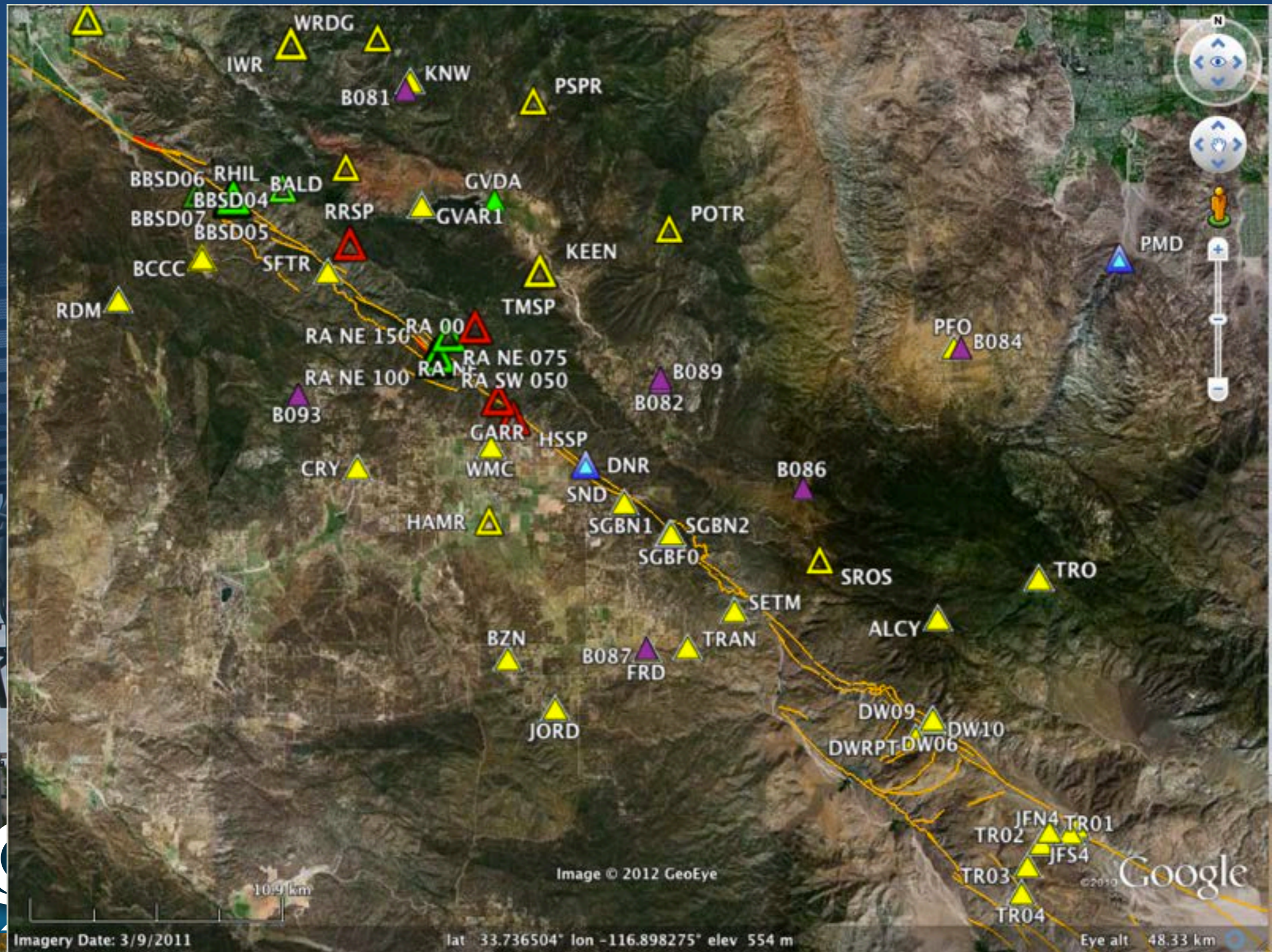UCSD

23 October 2012

Stations

- Number of stations
  - UCSD operated
    - 24 ANZA
    - 55 SJFZ
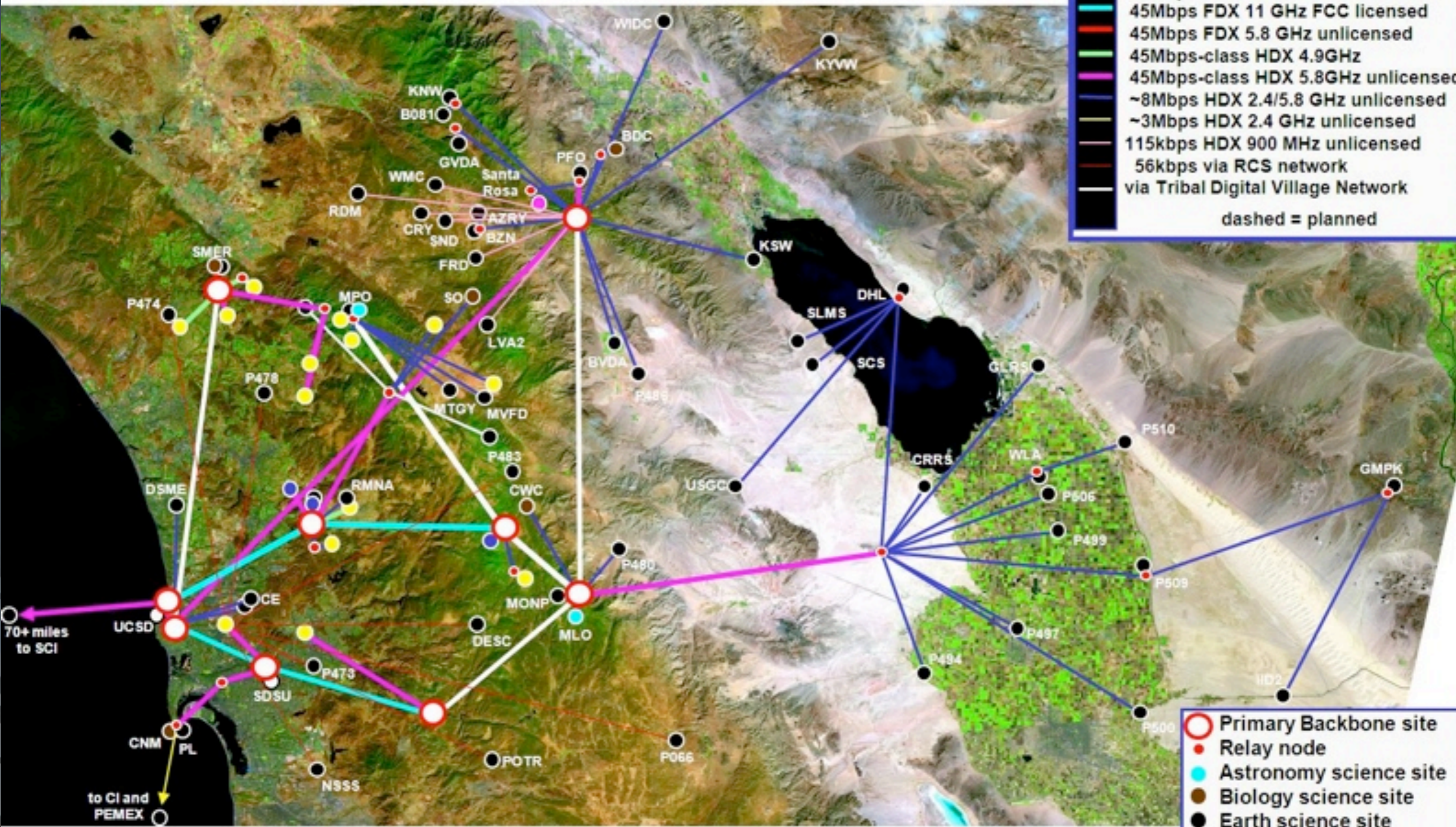 - Contributed via ORB
    - CI   ~50
    - PB   8
    - SB   4

ANZA/San Jacinto Telemetry

HPWREN topology – January 2012

Applied Network Research

http://anr.ucsd.edu

ANZA Budget and Staffing

- ## Operating Budget
  - $110k/year
- ## Staffing
  - .1 FTE system/networking admin
  - 0 FTE seismic data analyst
  - .1 FTE seismic operations
  - .3 FTE field engineer
- ## USGS Funded

ANZA Hardware

- Hardware
  - 1 Sun T5220
  - ANF Storage

  - Future plans
    - Stay alive

ANZA Station Equipment

- Data Acquisition Systems
  - Q330
    - Baler 14
    - Baler 44
    - Marmot
  - Reftek RT72A
  - Basalt

- Seismic Sensors
  - Streckeisen STS-2
  - KMI Episensors
  - KMI SBEPI

- Mechanisms to bring in data
  - q3302orb
  - dcbba2orb
  - various baler mechanisms

ANZA Failover

- Primary Data Center
  - San Diego Supercomputer Center
- Backup Data Center
  - IGPP, UCSD
- Toro Peak buffering
- Marmots and Balers

ANZA Telemetry

- Q330
  - Afar
  - Wilan
- Reftek
  - Freewave
- HPWREN
- Basalt
  - Internet

ANZA Network Operations

- Regular operations meetings
  - Monday mornings
  - 1 hour max
  - Review
    - computers
    - analysts
    - programming
    - seismic operations
    - other issues
    - treats!

ANZA ANSS Tier 2 Network

- High Quality Data
  - ANSS performance standards
  - PDFs at DMC
  - Calibration
  - Data review
- Data completeness
  - 100% data return
- Event association
  - local, regional, teleseismic
  - locations and phase picks to DMC
- Realtime
  - Ranks behind data completeness
  - Mandate for early warning
  - No seismic hazard assessment role
- Endusers
  - SCSN, CISN, ANSS
  - Science users
  - Education and outreach

ANZA ANSS Tier 2 Network

- Data products
  - Same as ANF
- Catalog processes
  - Same as ANF
- Archives
  - Same as ANF
- Needs and challenges
  - Implementation of Andreas Rosenberger's S-wave detector
  - Moment tensor implementation
  - Convert show_stalta into python
- Research tools
  - Same as ANF
- 5 Year Vision
  - Stay alive