

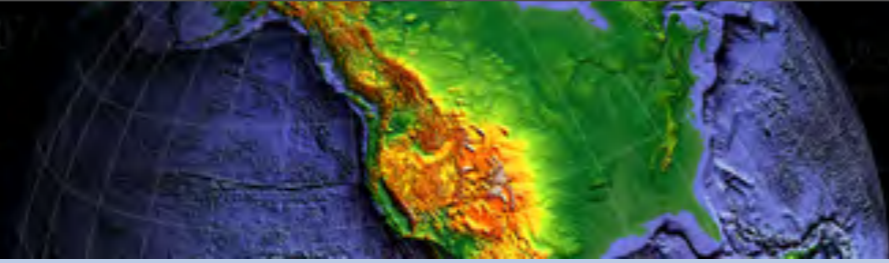
USArray



Frank Vernon for the ANF
IGPP
UCSD

Antelope User Group
Muscat, Oman
2-4 March 2013





- 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



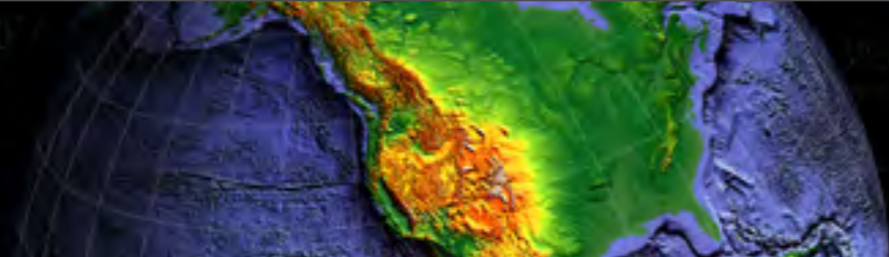
Network Legend	
▲	AZ (UC San Diego) [2]
▲	BK (UC Berkeley) [17]
▲	CI (CalTech) [43]
▲	IU GSN [0]
▲	NN (UN Reno) [0]
▲	TA (USArray) [0]
▲	US ANSS [0]
▲	UUSS (Uni. Utah) [0]

km
0 500

km
0 500

2004 04

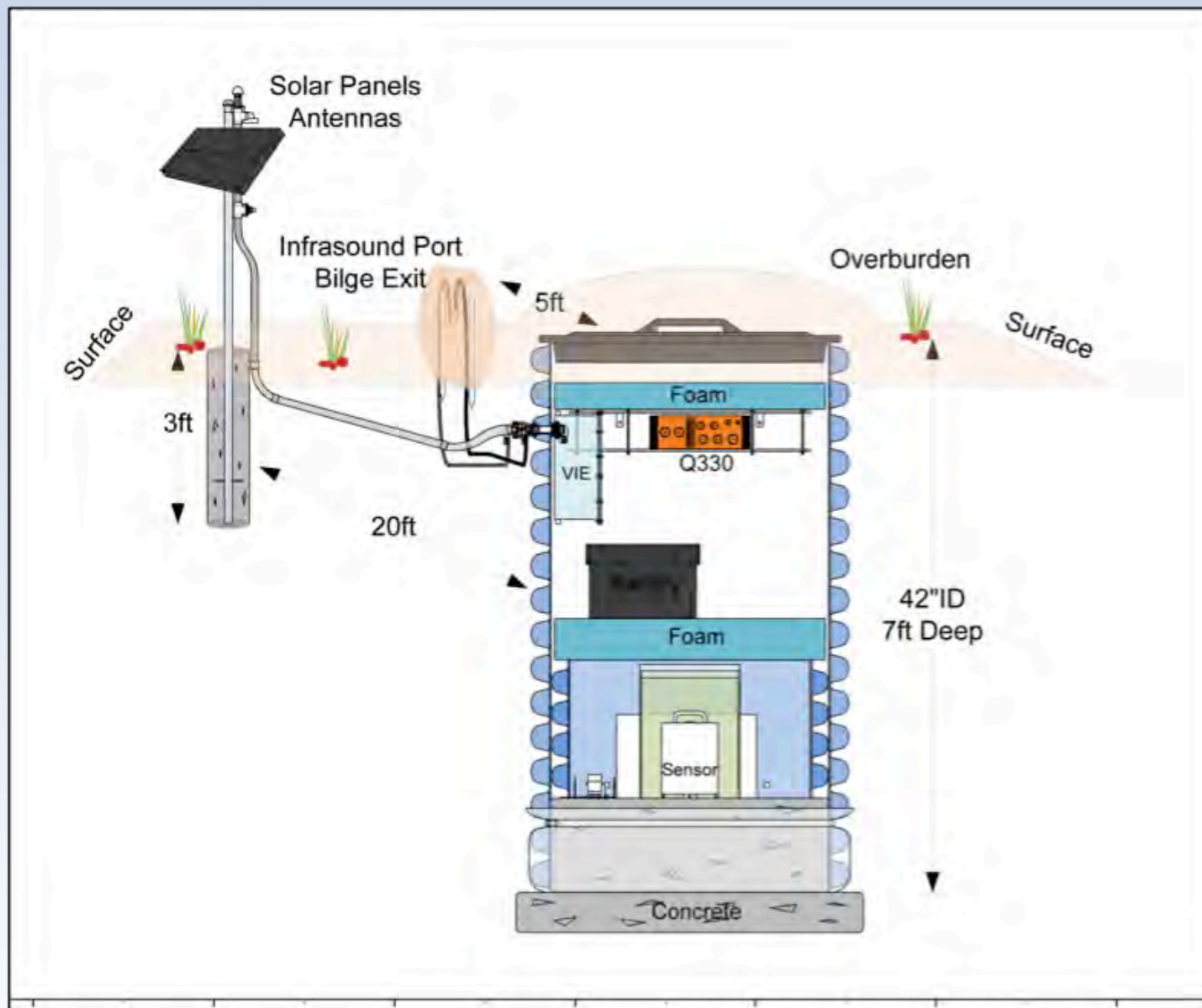
- Staffing
 - 2 FTE system/networking admin
 - 3.5 FTE seismic data analyst
 - 1 FTE seismic operations
 - 2 FTE programmer
 - 1 FTE program management
- NSF Funded



- 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

- Sensor: 3 component Broadband seismometer & auxiliary sensors
- Datalogger & local data storage
- Power & data telemetry

TA Station 345A, MS



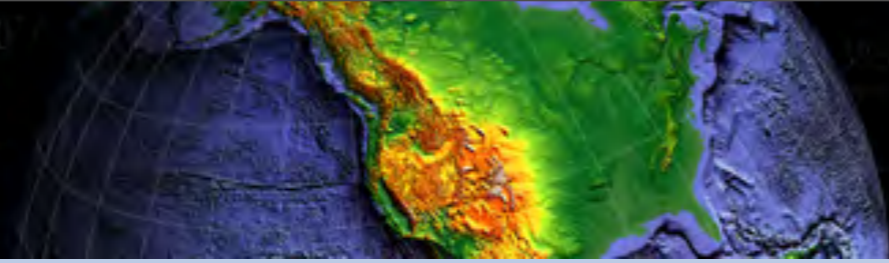
- Data Acquisition Systems
 - Q330
 - Q330HR
 - Baler 14
 - Baler 44
 - QEP
 - VIE
- Seismic Sensors
 - 220 Streckeisen STS-2
 - 111 Guralp CMG3T
 - 109 Nanometrics Trillium 240
- Mechanisms to bring in data
 - q3302orb
 - orb2orb
 - various baler mechanisms

- 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

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

- 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

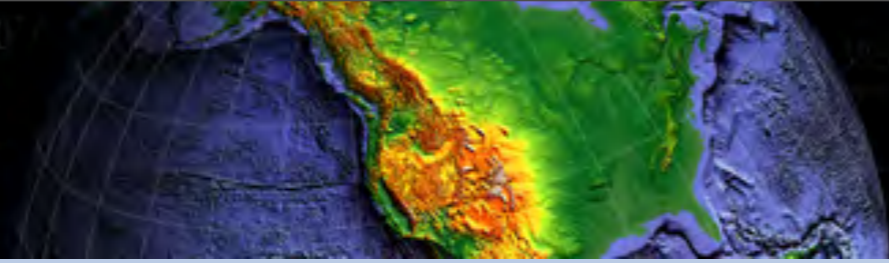


TA Total RT Data Return

3220 days of data
653 days with $\geq 99\%$ data return

96.75% Average data return weighted by number of stations
97.43% Median daily data return



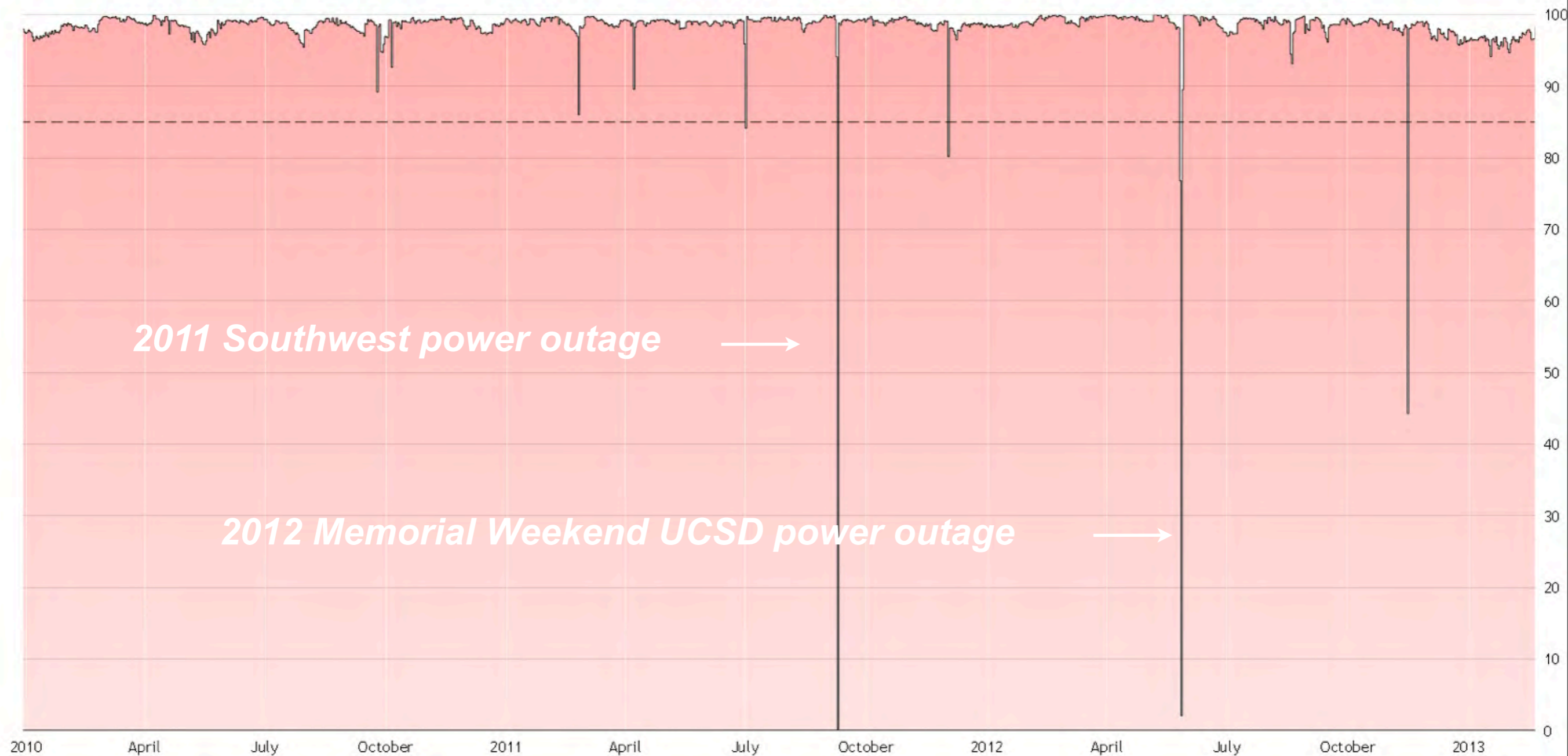


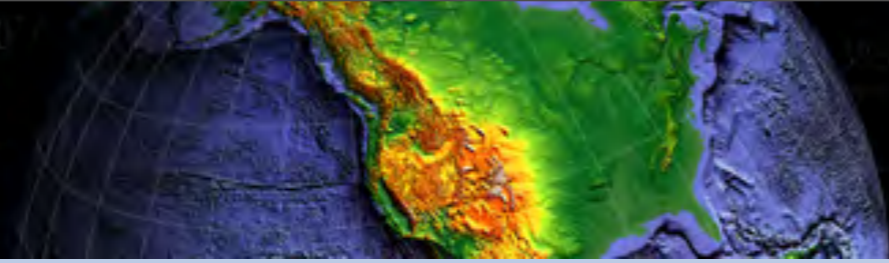
TA 1/2010-2/2013 RT Data Return

1152 days of data
527 days with $\geq 99\%$ data return

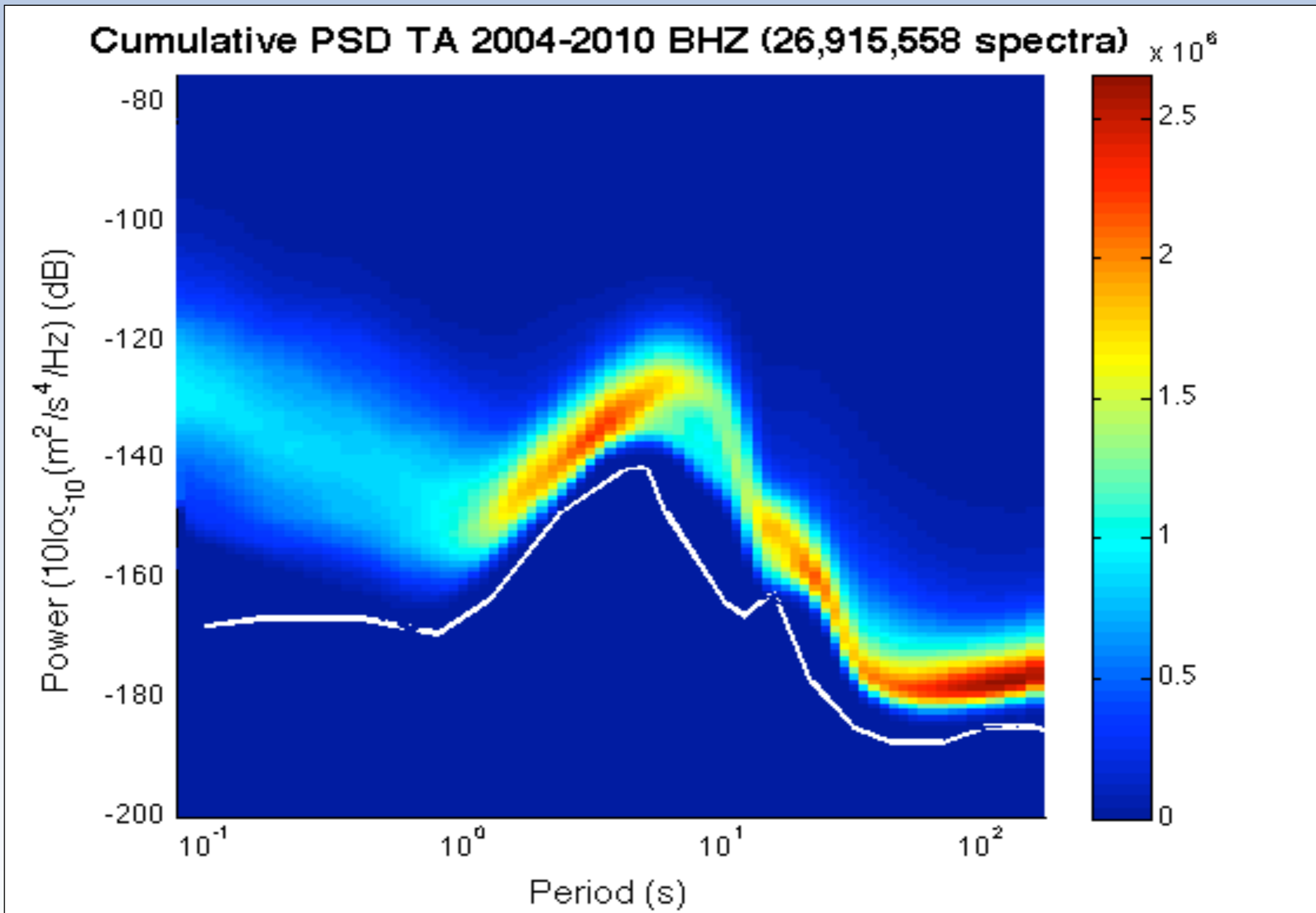
98.9% Median daily data return

Data return rates

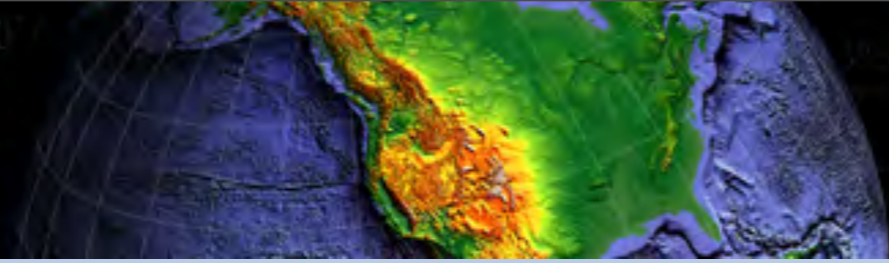




TA PSD Station Quality



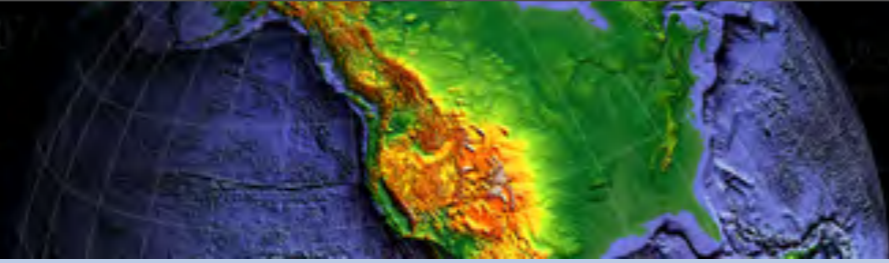
- High Quality Data
 - Excellent timing
 - Accurate metadata
 - orientation to $\sim 1^\circ$
 - Long continuous time series
 - Low noise stations
- Event processing
 - phase picks
 - locations (local, regional)
 - associations (local, regional, teleseismic)
 - magnitudes



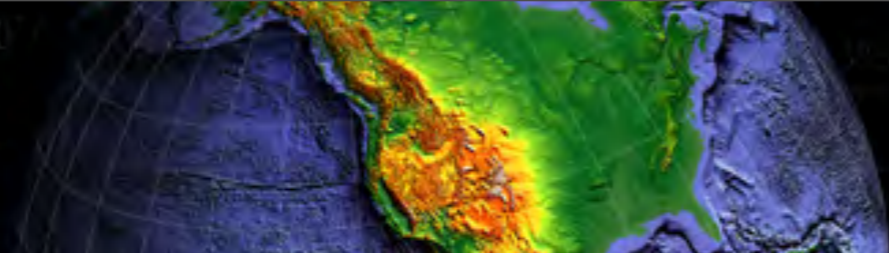
- Realtime
 - orbdetect
 - orbassoc
 - dborigin2db
 - orbevproc
- Post processing
 - dbloc2
 - locate with dblocsat
 - associate with external catalogs
 - dbbevproc
 - associations
 - magnitudes
 - no flagging of blasts, sonic, atmospheric, etc.
- End users
 - Science community
 - IRIS DMC
 - Special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

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

- Other products
 - infrasound waveforms
 - pressure waveforms
- Development
 - Infrasound event detector
 - Convert show_stalta into python
- Needs
 - automatic blast detector
- Challenges
 - 450 station moving array
 - regional detection and association



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



5 Year Vision

294 sites

85 km grid



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

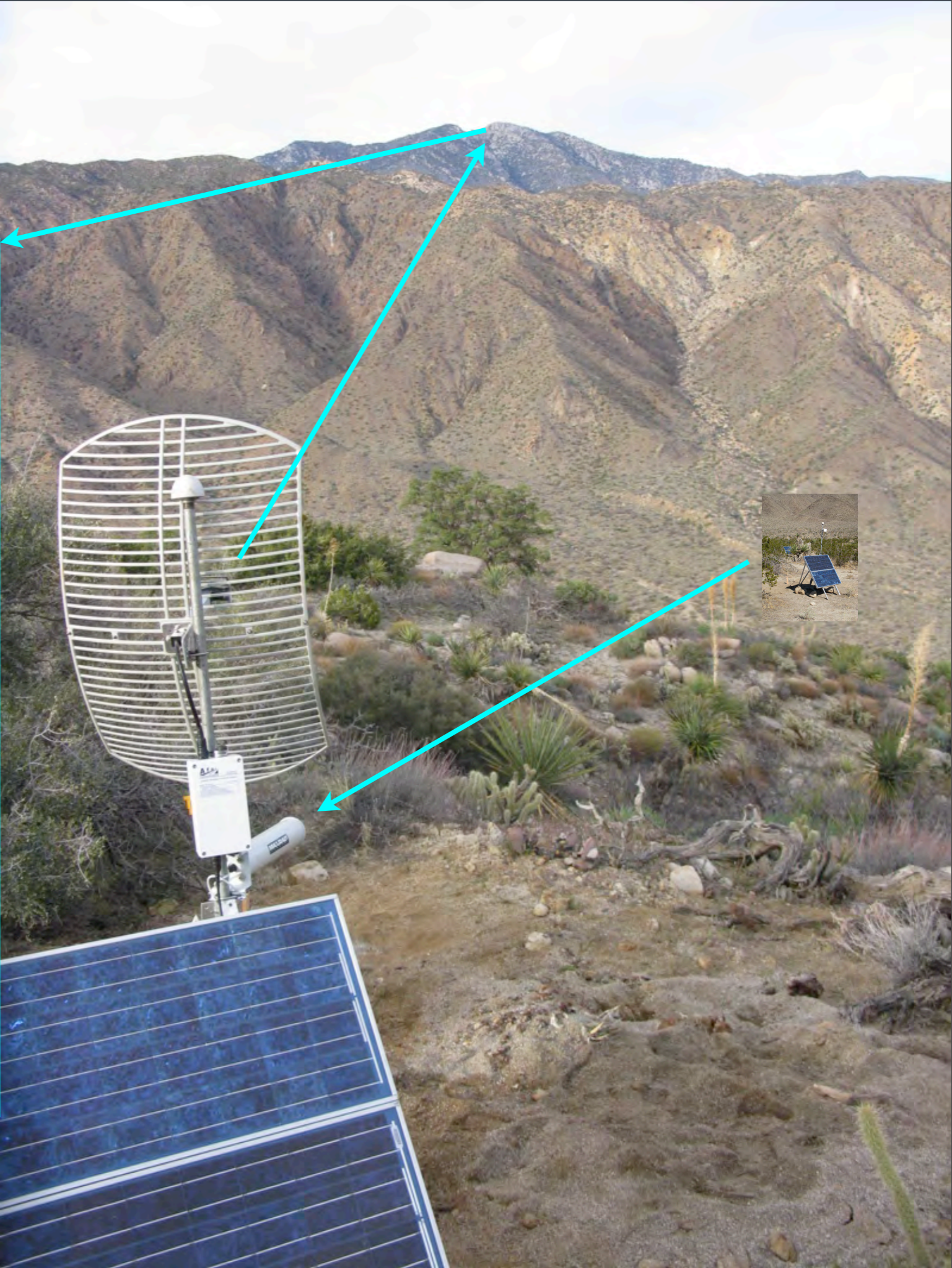


PASSCAL Ad Hoc Telemetry



SCRIPPS INSTITUTION OF
OCEANOGRAPHY
UC San Diego

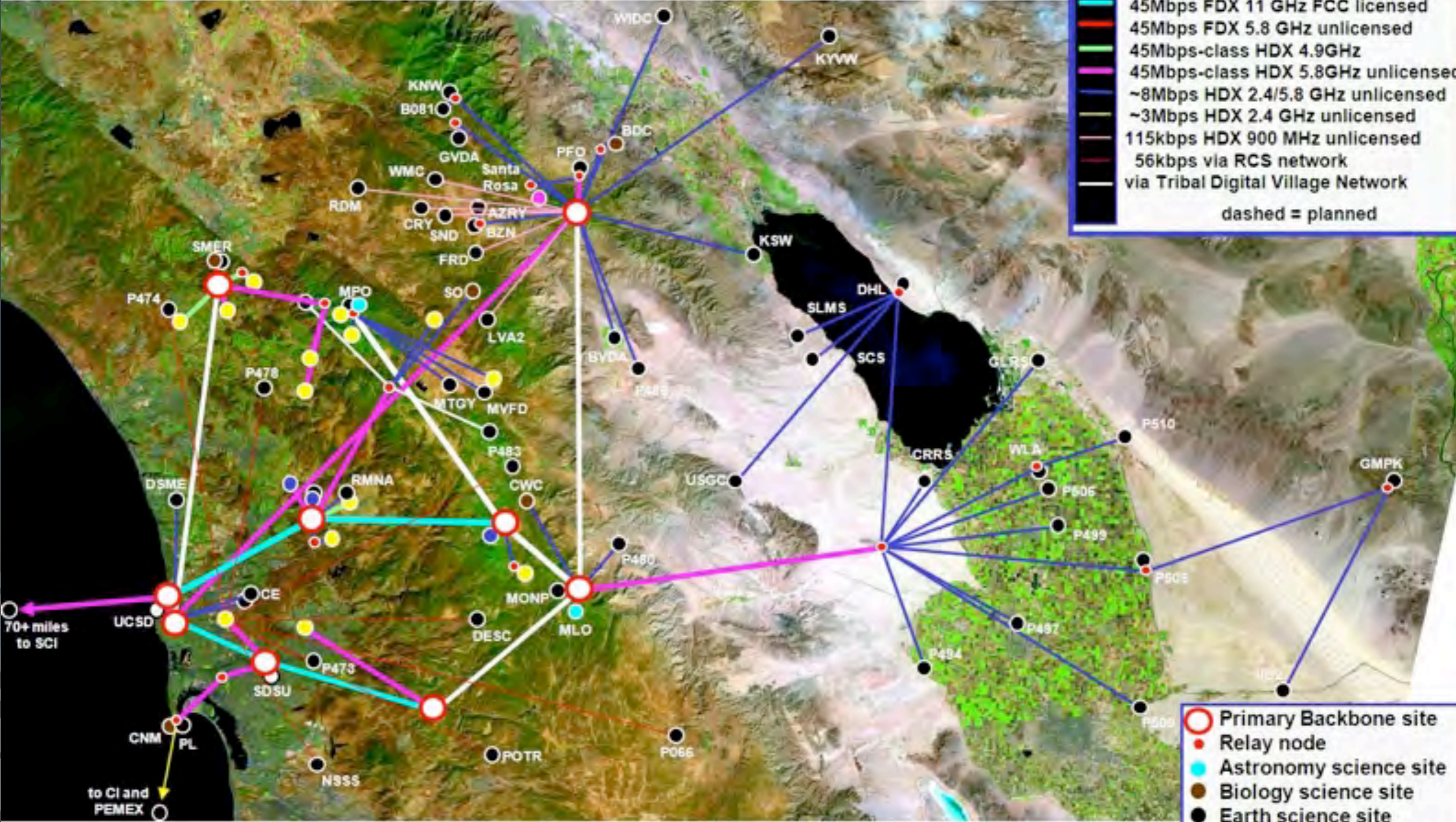
PASSCAL Ad Hoc Telemetry



SCRIPPS INSTITUTION OF
OCEANOGRAPHY
UC San Diego

HPWREN topology – January 2012

- 155Mbps FDX 6 GHz FCC licensed
- 155Mbps FDX 11 GHz FCC licensed
- 45Mbps FDX 6 GHz FCC licensed
- 45Mbps FDX 11 GHz FCC licensed
- 45Mbps FDX 5.8 GHz unlicensed
- 45Mbps-class HDX 4.9GHz
- 45Mbps-class HDX 5.8GHz unlicensed
- ~8Mbps HDX 2.4/5.8 GHz unlicensed
- ~3Mbps HDX 2.4 GHz unlicensed
- 115kbps HDX 900 MHz unlicensed
- 56kbps via RCS network
- via Tribal Digital Village Network
- dashed = planned



approximately 50 miles:

Note: locations are approximate

- Primary Backbone site
- Relay node
- Astronomy science site
- Biology science site
- Earth science site
- University site
- Researcher location
- Native American site
- Public Safety site

ANZA Budget and Staffing

- Staffing
 - .1 FTE system/networking admin
 - 0 FTE seismic data analyst
 - .1 FTE seismic operations
 - .3 FTE field engineer
- USGS Funded



ANZA Hardware

- Hardware
 - Dell R710 Redhat Server
 - Compellant Storage



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
 - Focal Mechanism implementation
 - Convert show_stalta into python
- Research tools
 - Same as ANF
- 5 Year Vision
 - Stay alive

