USArray EFEC Site Review

May 17, 2006
Outline

• USArray Overview
  – Agenda/Logistics

• USArray Facility Construction Update
  – Transportable Array – Bob Busby
  – Flexible Array – Marcos Alvarez
  – Permanent Array – Kent Anderson
  – Magnetotellurics – Shane Ingate
  – Data Management – Tim Ahern

• Conclusion – David Simpson
USArray Summary Status

- **Array Operations Facility (AOF)**
  - Supporting the Transportable and Flexible Arrays

- **Array Network Facility (ANF)**
  - Servicing over 160 Transportable Array stations and Flexible Array experiments with real-time telemetry
  - See displays/posters

- **Siting Outreach**
  - 1st quarterly *onSite* newsletter distributed to landowners (joint with UNAVCO and EarthScope E&O)
  - 6 Backbone sites identified for Museum Lite display
  - Training workshop for sites in Utah, Idaho, and Montana begins May 22
  - See posters
USArray Performance

1.4 USArray

Cumulative Dollars (thousands)

- What we said we would do
- What we did (schedule and budget)
- How much it cost

PV
EV
AC

SV = (14) %
CV = 10 %
Key USArray MREFC Milestones

- 39 Permanent Array stations by Sept 2006
- 400 operating Transportable Array stations by Sept 2007
- 2400 Flexible Array Instruments by Sept 2008
- 7 permanent and 20 transportable MT stations by Mar 2007
- Seismic station data availability of 85%
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  – Magnetotellurics – Shane Ingate
  – Data Management – Tim Ahern

• Conclusion – David Simpson
USArray Transportable Array

Robert Busby
Transportable Array Manager

EFEC Site Review
May 17, 2006
Transportable Seismic Array

- Review of Year 3 and MRE Goals
- Progress of the Array
- Performance
- Special Topics:
  - Operational Concerns
    Construction and Installation
    Crew Strength
  - Permitting Plans
    Current Permit status
Transportable Array: Year 3 Goals

EarthScope Year 3  Oct 2005 - Sept 2006

• Permitting in eastern Nevada, Idaho, western Montana, Utah and Arizona

• Permit goal is
  – 16 per month
  – In-hand permits for about three month lead time on Construction, or 42 permits

• Routine deployment phase in Oregon, Washington and western Nevada
  – Installation
    10 stations per month
  – Construction
    14 stations per month
Transportable Array Status

- End of April 2006

  168 stations operating
  - 64 shared stations
  - 104 new stations

- End of Quarter goal 200

Near term Work Plan
- Completing SE NV (24)
- Construction / Installs in Oregon (33) to mid June
- Construction / Installs in WA June / July

N1
MRE Goal

MRE goal is 400 operating stations by Sept 2007

Rolling of the Array begins under O&M in Jan 2008 with removal from Northern California and Cascades
Measuring Progress

- EVM tracks budget and schedule in terms of dollar value
- Equivalent Station is an EarthScope measure of Schedule

**TA Equivalent Station Model**

- Equipment available 5%
- Recon Complete 20%
- Permit submitted 5%
- Permit accepted 20%
- Site constructed 20%
- Equipment installed 20%
- Data flow started 5%
- Station certified 5%

Total 100%
Transportable Array Production

Per Quarter Production

Last Quarter matched production rate needed for MRE and O&M

<table>
<thead>
<tr>
<th>MRE Quarter</th>
<th>Planned</th>
<th>Actual</th>
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<tbody>
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<td>0</td>
</tr>
<tr>
<td>Jan-Mar 2006</td>
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</tr>
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<td>Apr-Jun 2006</td>
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<td>Jan-Mar 2007</td>
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<tr>
<td>Jul-Sep 2009</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Oct-Dec 2009</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

Equivalent Stations

0 10 20 30 40 50 60 70
1.4.3 Transportable Array Stations

Cumulative Dollars (thousands)

- PV
- EV
- AC

SV = (13) %
CV = 8 %
Budget Projections to Completion

- April 2006 Cost Baseline used revised unit cost estimates for station construction and installation. Flexible crew scheduling is new basis rather than turn-key staff contracts.

- Using current unit cost estimates and the planned production rate, we can complete the project for less.
  - Original Years 1-5 $34,366,195 - Current Est. $34,040,294
Facility Performance Metric

Overall Transportable Array Performance

- TA
- TA-3
Broadband Performance Analysis

- Power Spectral Density (PSD) plots
- Overview of station response - 1 month at a time
  - Quickly shows any station problems
  - Can select and check any outliers
Construction and Installation Crew Strength

- Construction contractor paid per site. Can add crews or stand down in bad weather
- Installation crew is Lead plus assist from shared pool. Can collapse to one team, expand to three.
Construction

Current method; custom trailer with water tank, room for cement bags, and onboard mixer

42” dia. pipe set into 7’ deep pit with concrete on either side of rubber membrane

Flex conduit was replaced with straight sticks reducing field time significantly. Wires are pulled during construction phase

13 months of crew time annually at 16 sites per month
Installation

Lava Cap Winery. Site layout

2 two-person crews

Sensor alignment. Leveling and insulation takes over an hour

View into vault. Sensor encased in sand, Q330 and baler on shelf, foam insulation

Power distribution panel. CDMA cell radio, Trace C12 charge controller, Phoenix terminal strip

VSAT located in barn with AC power
Modularity in Communications

- Cellular Modem
- AC VSAT or BB provider
- Solar VSAT
Communications Variety

• 44% Cell modems
  – 40 Verizon, 4 Cingular

• 44% VSAT systems
  – 33 Wild Blue, 7 Hughes DirectWay, 4 SpaceNet

• 7% Broadband providers
  – 4 DSL, 1 Cable, 2 WiFi

• 5% Internet via Host
  – usually research campus
External Factors

- C05A Tolt Reservoir

11/17/2005 Construction
12/1/2005 Installation

S08C White Mtn Research Sta  C04A Brinnon, WA (below)  N02C Big Bar, CA
Siting / Permitting Process:
- Office Reconnaissance
- Field scouting
- Recon Report
- Technical Review
- Verification visit
- Permit Submitted
- [Permit Conditions]
- Permit Accepted

54 permits in-hand

E7
**TA: Permitting Plans**

**Idaho**
- Univ. of Idaho Moscow 16 sites, 2 students
- Boise State University 25 sites
- BYU Idaho 10 sites, 2 students

**Montana**
- Montana Tech, Butte 30 sites, 4 students

**Utah**
- Univ. of Utah 45 sites, 6 students

- Siting Workshop in Salt Lake City at Utah Seismological Station on May 22
- Siting through July with main focus on northern mountainous sites
Interactions with Regional Networks

• Integration of USArray stations into networks
  – Advance planning on siting and permit
  – Pick and choose from operating stations lowers risk
  – Provide advice on costs and procedures to adequately form budgets for obtaining resources
  – Work out a transition plan for hardware

• Assisting in delivery of USArray data into regional network operations
  – More eyes on more data
  – More advanced analyses that are automated
Conclusion: A Team with a Mission
Outline

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Flexible Array

Topics

• Quantitative measure of progress  
  (EVM as project management tool)
• Inventory and equipment
• Instrument use
• Experiments conducted and planned
• Array Operations Facility status
Flexible Array EVM

1.4.4 Flexible Array Stations

Cumulative Dollars (thousands)

PV
EV
AC

SV = (21) %
CV = 9 %
Flexible Array

Instruments Available (as of March 2006)

- **Active Source**
- **Broadband + Short Period**
- **Milestones**
- **Actual**

![Graph showing instruments available from D-03 to S-08 with various categories and milestones indicated.](image-url)
### Flexible Array Inventory

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
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<tr>
<td>Broadband</td>
<td>40</td>
<td>80</td>
<td>120</td>
<td>160</td>
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<tr>
<td>Short Period</td>
<td>40</td>
<td>80</td>
<td>120</td>
<td>160</td>
<td>200</td>
</tr>
<tr>
<td>Active Source</td>
<td>0</td>
<td>700</td>
<td>1200</td>
<td>1600</td>
<td>2000</td>
</tr>
</tbody>
</table>

**Current Inventory (5.2.06)**
- Broadband station = 80
- Short Period station = 120
- Active Source station = 1045
FA Example of EVM as the Project Management Tool

- Start with a complete Work Breakdown Structure (WBS) definition, assumptions and basis of estimate

“reflects our plan .. helps us keep the eye on the prize”

**WBS Task 1.4.4.2: Flexible Array Procurement**
*Definition:* Includes the purchase of components needed for the 2400 Flexible Array stations including sensors, data acquisition systems, and power systems.

**WBS Task 1.4.4.2.1: Sensors**
*Definition:* Includes 200 broadband sensors, 200 short-period sensors and 4000 active source sensors and their cables.

*Assumptions:* The broadband sensors purchased for the Flexible Array are Guralp CMG 3T, three component, 120-second period to 50-Hz flat velocity response or equivalent sensors. Each broadband sensor is purchased with an accompanying breakout box and cable. A handheld control unit is purchased for every 5 broadband sensors. Custom cables are required to connect the broadband sensor to the Reftek R130 (or equivalent). The short-period sensors purchased for the Flexible Array are Guralp CMG 40T-1, three component, 1-second period to 100-Hz flat velocity response or equivalent sensor. Custom cables are required to connect the short-period sensor to Reftek R130 (or equivalent). For each of the planned 2000 single-channel miniature recorders, two vertical geophones will be purchased. One of these geophones is the Geospace GS11D 4.5 Hz, amphibious land case and 3-inch spike or equivalent sensor. The other active source sensor is the Sercel L40A, 40 Hz, amphibious land case and 3-inch spike or equivalent sensor.

*Basis of Estimate:* IRIS purchase order number 06-00141 for the purchase of 40 CMG 3Ts was referenced as a basis for this estimate. IRIS purchase order number 06-00132 for the purchase of 40 CMG 40T-1s was referenced as a basis for this estimate. IRIS purchase order number 05-00254 for the purchase of 40 CMG 40T-1s was referenced as a basis for this estimate. IRIS purchase order number 05-00053 for the purchase of 175 Geospace GSC1267 15-foot Guralp to Reftek 130 cables was referenced as a basis for this estimate. IRIS purchase order number 06-00132 for the purchase of 400 Sercel L40A was referenced as a basis for this estimate.
FA Example of EVM as the Project Management Tool

- Use detailed budget and schedule to plan purchases and achieve milestones
FA Example of EVM as the Project Management Tool

- Monthly inventory reports from the AOF are merged with invoices and expenses to calculate Cost Schedule Status Reports (CSSR)

<table>
<thead>
<tr>
<th>Flexible Array - Procurement Report</th>
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<tr>
<td>Please enter quantities in inventory as of: 3/31/06</td>
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</table>

<table>
<thead>
<tr>
<th>cumulative-to-date</th>
<th>Quantities Available</th>
<th>Yr 3 unit cost</th>
<th>Planned Quantities</th>
<th>MRE-YR3</th>
<th>Open Qty</th>
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<tbody>
<tr>
<td>Sensors 2001-315</td>
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<tr>
<td>BB (CMG-3T)</td>
<td>80</td>
<td>$14,500</td>
<td>120</td>
<td>40</td>
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<tr>
<td>Short-period</td>
<td>100</td>
<td>$3,500</td>
<td>120</td>
<td>20</td>
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<tr>
<td>Active source</td>
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<td>2400</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td>DAS 2001-316</td>
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<td></td>
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<tr>
<td>Hi-resolution</td>
<td>180</td>
<td>$7,500</td>
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<td>60</td>
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<td>Texan</td>
<td>800</td>
<td>$3,200</td>
<td>1200</td>
<td>400</td>
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</table>

| Power 2001-317     |                      |                |                    |         |          |
| 65 Watt Solar Panels | 180                 | $390           | 360                | 180     |
| Mount brackets     | 120                  | $440           | 240                | 120     |
| Power boxes and cables | 160                | $230           | 240                | 80      |
| Endosures (field)  | 120                  | $350           | 240                | 120     |

<table>
<thead>
<tr>
<th>Communications 2001-318</th>
<th></th>
<th></th>
<th>(120 FA communications stations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless radios, antennas and cables</td>
<td>40</td>
<td>$1,600</td>
<td>144</td>
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<tr>
<td>VSAT hardware system</td>
<td>1</td>
<td>$1,900</td>
<td>6</td>
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</table>
• Cost and schedule variances are reviewed with USArray Project Manager; actions taken when appropriate
Flexible Array Standard Station Equipment

- Spread-spectrum internet protocol radio system for 200 stations
- 65 W x 1.5 solar modules and mounting systems for 400 stations
- Instrument enclosure system
Flexible Array Standard Station Equipment

Sensor vault systems for 400 stations

Charge and power control systems for 400 stations

Insulated equipment enclosures for 400 stations
Has USArray had any trouble with the sensors?

**Guralp CMG 3T:**
- 190 units received (TA & FA), 34 returned for RMA; **18% rejection**
- New sensors are now being tested at the factory using AOF procedures before shipment
- Manufacturer delivered **on schedule** for Year 1 and Year 2
- Delivery **delays** for Yr3 have not affected campaign schedules

**Guralp CMG 40T 1 Hz:**
- 100 units received (FA), 2 returned for RMA; **2% rejection**
- Deliveries have either been **on schedule** or ahead of schedule

**Streckeisen STS2:**
- 100 units received (TA), 3 awaiting returned for RMA; **3% rejection**
- Manufacturer delivered **on schedule** for Year 1 and Year 2
- Delivery **delays** for Yr3 have not affected installation schedules
Is the USArray campaign pool over or under subscribed?

![Broadband Use and Inventory](image)
Is the USArray campaign pool over or under subscribed?
Is the USArray campaign pool over or under subscribed?
<table>
<thead>
<tr>
<th>Name</th>
<th>PIs</th>
<th>Type</th>
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<td>Trapped Waves</td>
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<tr>
<td></td>
<td></td>
<td>Stand alone</td>
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<tr>
<td>Paso Tres</td>
<td>Roecker/ Thurber</td>
<td>Short Period</td>
<td>12</td>
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<td>Telemetered</td>
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<td>NW - Nevada</td>
<td>Klemperer</td>
<td>Active Source</td>
<td>700</td>
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<tr>
<td></td>
<td></td>
<td>Short Period</td>
<td>100</td>
</tr>
</tbody>
</table>

![Map of experiments conducted in 2004](image)

- **Planned station**
- **Planned array**
- **Active station**
- **Completed station**
- **Completed line**
- **TA station**
### Experiments Conducted 2005

<table>
<thead>
<tr>
<th>Name</th>
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<tr>
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<td>Creager</td>
<td>Broadband Short Period</td>
<td>5</td>
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<tr>
<td>NUTT</td>
<td>Louie</td>
<td>Active Source</td>
<td>700</td>
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**Map:**
- Planned station
- Planned array
- Active station
- Completed station
- TA station
- Completed line
<table>
<thead>
<tr>
<th>Name</th>
<th>Pls</th>
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<tbody>
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<td>Creager/ Rondenay/ Abers</td>
<td>Broadband Short Period Stand alone Telemetered</td>
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<td>Humphreys</td>
<td>Broadband</td>
<td>20</td>
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<td>Urban Yield</td>
<td>Snelson</td>
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<td>40 0</td>
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<td>Utah 06</td>
<td>Stump</td>
<td>Active Source Short Period</td>
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<td>Y.G.Li</td>
<td>SP</td>
<td>30</td>
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USArray Functions at the Array Operations Facility

Transportable Array

TA Coordinating Office
- Coordinate field logistics
- Produce GIS products
- Coordinate permits
- Maintain data base

Testing
- Sensors
- DAS’s
- Communications
- Power systems

Station Kitting
- Assemble construction, power and comms

Flexible Array

Instruments & Equipment
- Procure
- Receive
- Inventory

Experiment Support
- Provide training to PIs
- Coordinate field logistics with PIs
- Provide limited field support

Data Archiving Support
- Receive raw and meta data from field
- Archive data at DMC
- Monitor real-time data

Shipping
- Pack and ship to field locations and depots
Inventory System for Flexible Array Equipment

Receive, barcode and input into data base all new equipment at AOF

Maintenance records added to data base

Experiment code assigned, shipping list provided with experiment

Equipment summaries used to track and schedule

Equipment reconciled at end of experiment

Full listing of all FA equipment and location:
>6500 FA items

Summaries and shipping documents provided

Custom barcodes attached to equipment

Experiment equipment listing (SNEP)
Inventory Information Cycle

**Array Operations Center**
- barcode new equipment
- input all info into db (in-house)
- track maintenance
- produce shipping & status docs
- reconcile & update database from field and ANF info
- reports to IRIS HQ

**Bulk Ship**

**TA - Field Depots**
- receive shipment, confirm pallets

**TA - Field Deployment Teams**
- pick-up equipment from depots
- install equipment
- document serial numbers & station locations in installation reports

**FA - Field Campaigns**
- AOF personnel and PI on-site to receive shipment, confirm pieces

**ANF**
- input metadata from TA field installation reports into real-time data monitoring system

---

**email report**

**orb2orb, metadata**

**email, phone communication**

N4
Personnel
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• Conclusion – David Simpson
Topics

• Status
  – Work accomplished
  – Data quality
  – Synergy

• Plan for completion
  – Current position on baseline
  – Remaining tasks
Permanent Array

Equivalent Stations (through March 2006)

- Personnel added and field teams doubled
- Personnel added

Legend:
- Certification
- Communications
- Installation
- Civil Works
- Equipment
- Siting
- Procurement
- Milestones
- Actual
- TA Rolls
Permanent Array EVM

1.4.2 Backbone Stations

Cumulative Dollars (thousands)

PV
EV
AC

SV = (14) %
CV = 19 %
Permanent Array Component of the Backbone
Backbone Improvements

WVOR PSD Mode

Power Spectral Density
Day of Year (2005)

Vault
Sensor
Power Spectral Density

US WVOR – BHZ
17124 PSDs : 2004:365 - 2006:094

Differential PDF plots
WVOR-BHZ Jan 2006 - Jan 2005

Z
E
Co-located GPS
78% of all work is complete
Remaining Schedule

• **May**
  – ECSD - Install from 8-19 May
  – KSU1 - Install from 22-31 May
  – SCIA - Install from 20-31 May

• **June**
  – BRAL - Installation 5-15 June
  – CNNC - Installation 19-31 June
  – NLWA - Installation 5-14 June
  – KVTX - Installation 16-26 June

• **July**
  – EYMN - Installation 5-17 July
  – JFWS - Installation 7-19 July
  – PKME - Installation 17-28 July

• **August**
  – EGAK - Installation 1-15 Aug
  – WRAK- Installation 17-31 Aug
  – COWI - Installation 1 - 15 Aug
  – GRMI - Installation 1 -15 Aug
  – HDIL - Installation 16 - 29 Aug

• **September**
  – AGMN - Installation 5-20 Sept
Permanent Array Personnel

- **IRIS**
  - Rob Woolley
  - Rhett Butler
  - Kent Anderson

- **USGS**
  - Lind Gee
  - John Derr
  - Bob Hutt

- **Honeywell**
  - Doug Ford
  - Kyle Persefield
  - Jared Anderson
  - Steve Roberts
  - Leo Sandoval

- **Not Pictured**
  - USGS
    - Alena Leeds, Mark Meremonte, Jim Allen, John McMillan
  - Temporary hires
    - Mike Bolz, Mike Busby, Ryan Davis, Jeff Fox
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MT Status Report - By Task

• Management Activities
  – EMWoG
  – Change Order #15

• MREFC Status
  – Procurement
  – Backbone construction
  – Co-location test

• O&M Status
  – Mobile (Transportable)

• Other Activities, Planning and Opportunities
MT Re-structure

• A USArray Magnetotelluric Manager will be responsible for coordination of MT activities and oversight of the portable MT program. The MT Manager will report to the IRIS President as PI for USArray.

• A Magnetotelluric Working Group will be established to provide advice to the MT Manager. This working group will be constituted under and report to the IRIS Coordinating Committee. EMWoG has been established as a joint working group of IRIS and EMSOC, the electromagnetic consortium.

After USArray Site Review, May 2005
ElectroMagnetic Working Group (EMWoG)

Members
• Gary Egbert (OSU)
• Rob Evans (WHOI)
• Shane Ingate (IRIS) - Liaison
• Dean Livelybrooks (UO)
• Kevin Mickus (Miss State)
• Stephen Park (UCR)
• Adam Schultz (OSU)
• Martyn Unsworth (U. Alberta)
• Phil Wannamaker (UU) - Chair

Observers
• Tim Ahern (IRIS)
• Kent Anderson (IRIS)
• Bob Busby (IRIS)
• Jim Fowler (IRIS)

Meetings
• Nov 22, 2005
• Dec 20, 2005
• Jan 17, 2006
• Feb 2, 2006
• Feb 21, 2006
• Mar 9, 2006
• Mar 23, 2006
• Apr 11, 2006
• Apr 25, 2006

• All Minutes at http://www.emscope.org
USArray Change Order #15

- Affected MREFC budget allocation only
- Submitted 1/25/06, approved by ESO 2/8/06, approved by NSF 2/24/06
- Solved the oversight in funds for MT equipment procurement absent from the 2003 Baseline by using $144K from USArray-held contingency.
- Descoped from 10 Backbone purchase/installation to 7
- Descoped purchase of 30 systems for transportable use to 20
- Reiterated 2003 request (no change) for O&M funds, including out-years
Procurement

- Order for 20 NIMS systems placed Nov 2005
  - Order revised Apr 2006
  - ETA Autumn, 2006
- Order for 7 NIMS systems placed Apr 2006
  - ETA Spring, 2007
- Order total CAD$412,793 (~$363K)
- Concern: Availability of suitable ring core material (5/12/06 run failed)
Backbone MT (BBMT)
Backbone Schedule

- 4/30-5/5 ANMO, NM (now Hilton Ranch)
- 5/19-5/23 Parkfield, CA
- 6/5-6/9 Bull Shoals, MO
- 6/22 -6/25 Wild Horse Valley, OR (now Soap Creek Ranch)
- 7/9-7/14 Conover (COWI), WI
- 8/27-9/1 Alum Ck State Park (ACSO), OH
- 9/17-9/22 Dagmar (DGMT), MT
- 10/15-10/27 Visit any alternative Backbone sites required
- 11/12-11/25 Acceptance testing newly delivered Backbone NIMS

(Note: 2 systems for Backbone testing on loan from EMSOC)
Tests conducted at TA.H03A (May 8-12) to determine influence of passive MT recording systems on TA equipment, and impact of TA telemetry and large mass/coil movements on MT.
SPC02/H03A - Interactions

- Effect of large-scale seismic sensor calibration
Site SPC02 uses Pb-PbCl2 electrodes with kaolin/KCl buffer in a Russian bucket filled with kaolin/NaCl
- SPC03, separated by 2 m, uses same electrodes with kaolin/NaCl buffer
- Will run for 1 more week
• Pilot Project provides temporary support and cost experience
• Select, permit, install, operate up to 50 MT sites in OR
• ~70 km station spacing
• Two RFPs released April, bidding closed 5/5/06
  – Site selection & permitting (PSP)
  – Installation, operations and maintenance (POM)
• 6 proposals received from for-profit organizations
• 5 months of field work, June-November, 2006
• 10 NIMS on loan from EMSOC
• Oversight conducted via subaward
• Evaluation at end of contract will be conducted
• Why Oregon? Fluids in the Cascade subduction system and tectonic accretion
GeoFrame community listed priority areas for Flex Array studies

- Cascadia/Idaho bath/Yellowstone/maybe Black Hills
- Salton Sea/Walker Lane
- Mid Continent Rift/Superior area
- S. Appalachians/New Madrid/Reelfoot Rift

These areas will have to get broader community support through the proposal process but they may be tentative choices for us to put our groups of 70 km sites.
Other Activities & Opportunities

ESMT pre-IRIS Workshop short course
6/7/06

Siting Outreach

Participating in EarthScope:
Hosting a Transportable Magnetotelluric Station
www.earthscope.org

EOS paper (EMWoG)

Magnetoseismology (McMAC, funded by NSF/ATM)
Outline

• USArray Overview
  – Agenda/Logistics
• USArray Facility Construction Update
  – Transportable Array – Bob Busby
  – Flexible Array – Marcos Alvarez
  – Permanent Array – Kent Anderson
  – Magnetotellurics – Shane Ingate
  – Data Management – Tim Ahern
• Conclusion – David Simpson
Data Management Center

Tim Ahern
Data Management System Program Manager

EFEC Site Review
May 17, 2006
DMS Topics

- Earned Value Management
- EarthScope Data Volumes
- USArray Data Quality Issues
- Product Management System (SPADE)
- PBO and SAFOD Seismic Data
- EarthScope Data Usage
1.4.5 Data Management

Cumulative Dollars (thousands)

- PV
- EV
- AC

SV = 0%
CV = (1)%
EarthScope Data Volumes

EarthScope Data Holdings

- Gigabytes
- Date (Sep-03 to Mar-06)

Legend:
- SAFOD
- PEIO
- US-RA
- US-FA
- US-B3
Data Quality

• Current emphasis
  – Data completeness
  – Correct Metadata
    • defined in the SEED format for scientific use of EarthScope data
      – Coordinated between DMC and ANF, USGS, AOF

• Near term
  – Features on Power Density Function Plots
  – Closer review of problems identified by the automated QA system

N2, N6
Transportable Array Performance

Overall Transportable Array Performance

Data Availability %

April 2005 to March 2006
Backbone Performance

Overall Backbone Performance

Data Availability %

April 2005  March 2006
Overall USArray Performance

Data Availability %

March 2006

April 2005
**Product Management System**

**USArray Data Management Plan**

**Uniform Product Distribution System**

As part of the developments within the IRIS DMS we will develop the Uniform Product Distribution System (UPDS). This system will be a fairly complete web service implementation including leveraging technologies such as XML, SOAP, WSDL, and we hope an instantiation of UDDI. The UDDI will act as a yellow page directory from which individuals or organizations can discover resources such as USArray products on the Web, determine how to use them, and even manipulate them through other Web Services.

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**Year 3 Quarter 2**

**Beta Test**

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**Year 2 Quarter 4**

- Added support to the Uniform Product Distribution System for optional metadata fields, optional client-side product validation, database extension, and name space-aware product processing.

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**Year 2 Quarter 3**

- Continued development of Uniform Product Distribution System at the IRIS Data Management Center. Focused on the consideration of various design and implementation questions, particularly the structure of the document archive, general product XML schema questions, and issues relating to system and product definition and extension.

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**Year 2 Quarter 2**

- Completed Uniform Product Distribution System requirements gathering. Submitted a preliminary WBS and schedule. Began detailed design and development on the web service-based submission component with an emphasis on handling generic data products.

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**Year 2 Quarter 1**

- Began design and development of the Uniform Product Delivery System at the IRIS Data Management Center. Feedback will be sought to insure compatibility with community needs.

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**Year 1 Quarter 4**

- Design has begun on the Uniform Product Distribution System for the distribution of EarthScope products.
Product Archiving for USArray … and more

Architecture

DATA PRODUCT PRODUCER

<XML>
<Product>
</XML>

SUBMISSION WEB SERVICE

ARCHIVE

XML PRODUCT INSTANCES

METADATA DB

QUERY / ACCESS WEB SERVICES

CLIENT PROGRAM

Web Access
Searchable Product Archive and Distribution Engine -beta

NOTE: This system is under development. Results should be considered incomplete and subject to change.

### Enter Query Filters

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProductBase.CreateTime</td>
<td></td>
<td>Time stamp of all</td>
</tr>
<tr>
<td>ProductBase.Description</td>
<td></td>
<td>Description of th</td>
</tr>
<tr>
<td>ProductID</td>
<td></td>
<td>Unique (within d</td>
</tr>
<tr>
<td>ProductSourceID</td>
<td></td>
<td>Unique PEID for</td>
</tr>
<tr>
<td>EventLatitude</td>
<td></td>
<td>Origin latitude</td>
</tr>
<tr>
<td>EventLongitude</td>
<td></td>
<td>Origin longitude</td>
</tr>
<tr>
<td>EventTime</td>
<td></td>
<td>Origin in time</td>
</tr>
<tr>
<td>EventDepth</td>
<td></td>
<td>Origin depth</td>
</tr>
<tr>
<td>SourceStation</td>
<td></td>
<td>Source station</td>
</tr>
<tr>
<td>CollectionOfProducts</td>
<td></td>
<td>Collection of th</td>
</tr>
<tr>
<td>ChannelData.AZDistance</td>
<td></td>
<td>Azimuthal distanc</td>
</tr>
<tr>
<td>ChannelData.Channel</td>
<td></td>
<td>Channel code</td>
</tr>
<tr>
<td>ChannelData.Location</td>
<td></td>
<td>Location code</td>
</tr>
<tr>
<td>ChannelData.Network</td>
<td></td>
<td>Network code</td>
</tr>
<tr>
<td>ChannelData.NK</td>
<td></td>
<td>Channel NK</td>
</tr>
<tr>
<td>ChannelData.SignalPhase</td>
<td></td>
<td>Signal phase</td>
</tr>
<tr>
<td>ChannelData.Station</td>
<td></td>
<td>Station code</td>
</tr>
<tr>
<td>Product/ChannelData</td>
<td></td>
<td>Product channel</td>
</tr>
<tr>
<td>Product/Magnitude*</td>
<td></td>
<td>Magnitude contrib</td>
</tr>
<tr>
<td>MagnitudeType</td>
<td></td>
<td>Magnitude type</td>
</tr>
<tr>
<td>MagnitudeValue</td>
<td></td>
<td>The magnitude val</td>
</tr>
</tbody>
</table>

### Available Products

- ChannelData.AZDistance => 40
- ChannelData.AZDistance <= 40
- ChannelData.Station = 109C

Returned 11 products.

### Results and Selection

Package format:
- TAR.GZ
- ZIP

Or you can browse the product archive.
Common Queries

This Example Returns
- Hypocenters
- TA FARM Products
- Harvard CMT's

All Products
- within a lat-lon box
- on December 26, 2004
SPADE and EarthScope Components

• SPADE already has
  – Ingested PBO XML Products
  – Wrapped SAFOD Products and ingested them

• Designed as a distributed system
  – Instances of SPADE could be running at
    • EarthScope HQ
    • NSF
    • PBO
    • SAFOD
    • USArray
Current Status - PBO Strain

13 Borehole Strain Stations
From ANF and PBO

99.9% Data Return

We also receive borehole strain data in native Bottle format via Unidata LDM
Current Status - PBO Strain

96.4% Data Return

2 Laser Strain Stations

We also receive laser strain data in native ICE-9 format via Unidata LDM
Current Status - PBO Seismic

99.4% Data Return

13 Borehole Seismic Stations

Borehole Seismic Stations

Time Span and Percent Data Available
Percent by Channel Time Range (Average is 99.6%)

N10
SAFOD Data

- All Data from NCEDC Electronically
  - All metadata will come from SAFOD
    - Data Manager & NCEDC
  - Real Time Telemetry
    - 90 gigabytes/year
    - Ingest into BUD and apply QUACK QA
  - Triggered Data
    - 85 gigabytes/year
    - Ingest into BUD and do not apply QUACK
    - Managed as Products?
  - Continuous High Sample Rate
    - 12 terabytes/year
    - Ingest electronically using method TBD
      - Data will be episodic
    - Develop appropriate QA (gaps, overlaps, SNR?)
    - Store as Tier-2 data
EarthScope Data Usage:
Shipments - 2.5 times higher rate than last year
EarthScope Data Usage:
Data Volume Shipped

SAFOD and USArray Shipment Volume through March exceeds entire year of 2005

EarthScope Shipments through March 31, 2006

- Blue: US-TR
- Green: US-BB
- Yellow: SAFOD
- Red: PBO
Outline

• USArray Overview
  – Agenda/Logistics

• USArray Facility Construction Update
  – Transportable Array – Bob Busby
  – Flexible Array – Marcos Alvarez
  – Permanent Array – Kent Anderson
  – Magnetotellurics – Shane Ingate
  – Data Management – Tim Ahern

• Conclusion – David Simpson
USArray Team is in place and performing well
- USArray Manager appointed
- TA, MT Managers appointed
- TA, FA, MT, DMS, TACO staffing filled
- TA Operational Plan established
  - Permanent positions filled
  - Scalable contractor support (construct and install) established
  - Siting plan established
- FA operations and field support active at NMT
- PA activities strengthened at ASL
- Reporting and EVM practices improved

- April baseline revisions adopted
  - Transportable deployment efficiency
  - Revised costing, especially for Management, FA and PA
USArray Developments 2005-2006

• **Community Involvement**
  – USArray Advisory Committee
    • Meeting 12/05, 03/06, 05/06
  – TA Working Group
    • Meeting 12/05, 04/06, monthly conference calls
  – PA Working Group
    • Teleconferences as required
  – MT Working Group
    • Meeting 12/05, bi-weekly conference calls
  – Siting Workshops
    • Oregon (6/05), Arizona (11/05), Utah (5/06)
  – GeoFrame
    • St Louis 02/06
  – IRIS Workshop
    • June 7-10, 2006
    • “USArray Today,” June 8
    • MT and Data Access pre-Workshop short courses, June 7
• **Data Utilization and PI Interactions**
  
  – Flexible Array
    • PI training and field support
  
  – Transportable Array
    • TA Working Group
    • Noise assessment and data quality
  
  – Permanent Array Network
    • Siting guidance and interactions with TA, MT and PBO
  
  – Magnetotelluric
    • EMWoG, EMSOC and Oregon Pilot Project
  
  – Regional Networks and NEIC
    • Access to current TA data
    • Future adoption of TA stations – especially with non-NSF funding
  
  – Data Management
    • Providing data to users and feedback on access tools and products
TRACKING THE PROGRESS OF THE USARRAY TRANSPORTABLE ARRAY:
SURFACE WAVE TOMOGRAPHY FROM AMBIENT SEISMIC NOISE

Morgan P. Moschetti, Michael H. Ritzwoller, Nikolai M. Shapiro
Center for Imaging of the Earth's Interior
Department of Physics, University of Colorado at Boulder

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.