Proposers Day

Gravity Anomaly for Tunnel Exposure (GATE)

Joseph Durek
Program Manager

24 April 2009

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Agenda

- 0730 Check-in
- 0830 Start Unclassified Proposer Day Session
  - Welcome — Joe Durek
  - Contracting — Patricia Matyskiela
  - Technical — Joe Durek
  - Program Description — Joe Durek
  - Concluding Remarks — Joe Durek
- 1030 End Unclassified Session / Break
- 1030 Prepare room for classified session
- 1045 - 1215 Classified session
- 1300 - 1800 Sidebars with PM

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DARPA-BAA-09-20
Gravity Anomaly for Tunnel Exposure (GATE)

Contracting
Patricia Matyskiela

DARPA-BAA-09-20

CMO

Solicitation is released utilizing Broad Agency Announcement procedures IAW FAR 35.016

- ELEMENTS OF THE BAA
  - Synopsis in FEDBIZOPPS
  - “Add to Watch List” to get any update notices
- TIME PERIOD(S) –
  - BAA is open through 25 Mar 2010
  - Initial proposals due **05 Jun 2009**
  - Proposals received after 06 Jun 2009 will be evaluated/selected based on availability of subsequent program funding

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BAA PROCESS

CMO

- ELIGIBILITY
  - All interested/qualified sources
  - Foreign participants/resources may participate to the extent authorized by applicable Security Regulations, Export Laws, etc.
  - Government agencies/labs, FFRDC's, are subject to direct competition limitations and cannot respond unless they demonstrate work is not otherwise available and cite the specific statutory authority
  - Teaming is encouraged and the expectation is one unified proposal per team is submitted

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BAA PROCESS

CMO

- PROPOSAL PREPARATION/SUBMISSION
  - Instructions are detailed in the BAA (**Follow closely**)
  - **ALL** questions to DARPA-BAA-09-20@darpa.mil
  - Funding instruments = primarily contract(s) and other transactions, no assistance instruments (grants, cooperative agreements)
- Assert rights to **all** technical data & computer software generated, developed, and/or delivered to which the Government will receive less than Unlimited Rights
  - Assertions that apply to Prime and Subs
  - Use defined "Basis of Assertion" and "Rights Category"
  - **Justify** "Basis of Assertion"
  - **This information is assessed during evaluations**

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BAA PROCESS

CMO

- Volume I Technical/Management Proposal
  - Mind Page Limitations (**don't use Cost Prop for overflow)**
  - SOW (by phase, WBS, milestones, deliverables, exit criteria)
  - Don't forget to address the addendum
- Volume II Cost Prop
  - Provide **all** Cover Page info
  - FAR Part 15.4/Table 15-2 (suggested format/content)
  - Provide BOE(s) to support proposed costs (labor & material)
  - **Include all** subcontract proposals

Following the proposal instructions assists the evaluation team to clearly understand what is being proposed.

Following the proposal instructions supports a timely negotiation.

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BAA PROCESS

CMO

- EVALUATION/AWARD
  - Government reserves the right to select for award all, some, or none of the proposals received.
  - Government anticipates making multiple awards
  - No common Statement of Work - Proposals evaluated on individual merit and relevance as it relates to the stated research goals/objectives rather than against each other
  - Once selections are made, proposals are provided to the Contracting Officer in preparation for negotiations
  - Only authorized Contracting Officer may obligate the Government

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BAA PROCESS

CMO

- COMMUNICATIONS
  - Prior to receipt of proposals – No restrictions, however Gov't (PM/PCO) shall not dictate solutions or transfer technology

    After Receipt of Proposals – Government (PM/PCO) may communicate with offerors in order to understand the meaning of some aspect of the proposal that is not clear or to obtain confirmation or substantiation of a proposed approach, solution, or cost estimate
  - Informal feedback may be provided once selection(s) are made

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DARPA-BAA-09-20
Gravity Anomaly for Tunnel Exposure (GATE)

Technical
Joe Durek

Problem Definition

- Our adversaries shown a willingness to operate underground in an effort to shield their activities from ISR assets
- Unimproved shallow tunnels and hardened, deeply buried facilities are difficult to detect and characterize
- Gravity is an inherent tunnel signature – “absence of mass”

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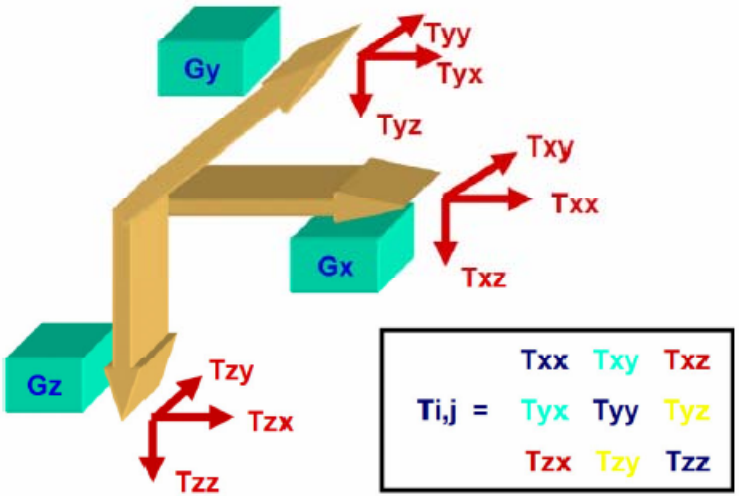
Gravity Gradients

- Gravitational potential
  - Scalar quantity that represents the energy associated with a unit mass in a gravity field
  - Gravity field => Vector field that describes the spatial variations in potential
    - Decomposed three components: x, y, and z- axis
- Gravity gradiometry
  - Measurement of spatial variations (gradients) of gravity field
  - Each components has a gradient paralled to each of the perpendicular coordinate axes
  - Full tensor consists of 9 components, only 5 are truly independent



Gravity vector elements

$$\Gamma(x,y,z) = \frac{GM}{r^3}\begin{bmatrix} 3\frac{x^2}{r^2}-1 & 3\frac{xy}{r^2} & 3\frac{xz}{r^2} \\ 3\frac{xy}{r^2} & 3\frac{y^2}{r^2}-1 & 3\frac{yz}{r^2} \\ 3\frac{xz}{r^2} & 3\frac{yz}{r^2} & 3\frac{z^2}{r^2}-1 \end{bmatrix}$$

Gravity gradient due to a point mass

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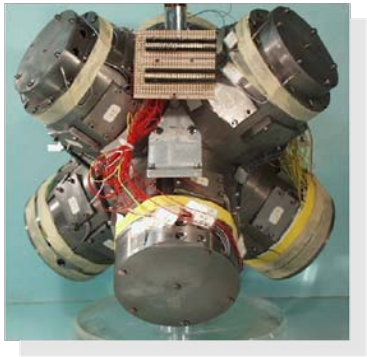
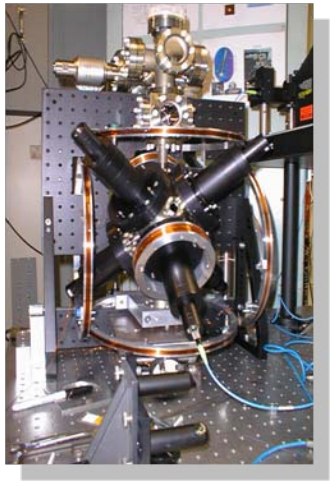
Gravity Gradiometers

- Eötvös Torsion Balance (circa 1920)
- Rotating discs
- Superconducting
- Atom Interferometer





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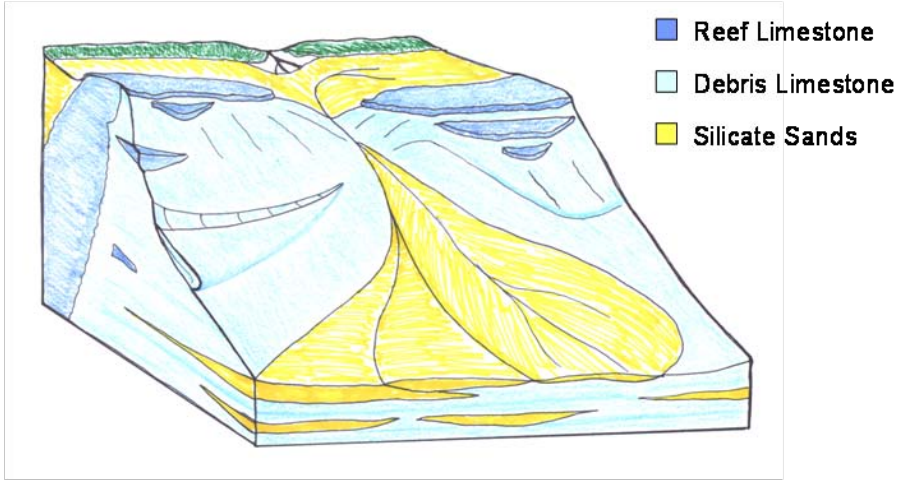
DARPA Activity in Gravity Detection

- R&D Collect and conclusion from NTS U12V
  - One of the biggest challenges in the processing of gravity gradiometer data was the modeling error (clutter)
  - As terrain measurement technology improved the terrain error became a less significant contributor to the clutter
  - Sub-Surface Density Variation (SSDV) was the dominant source of clutter
  - Statistical characterization of the SSDV permitted some level of clutter mitigation by incorporating the covariance into the objective function
  - Characterization of the SSDV remains a challenge

Nevada Test Site Devonian Slope Faces

Depositional System of Slope Faces



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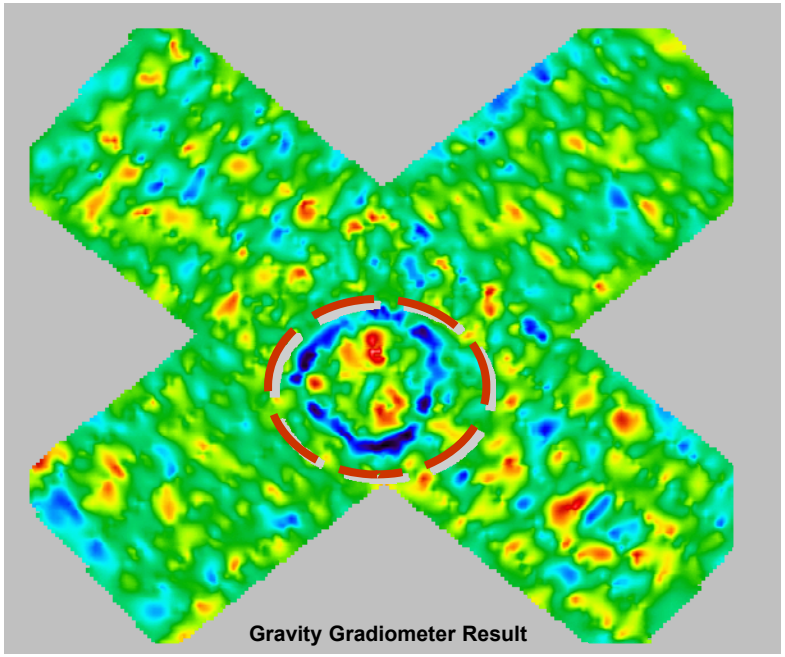
System Requirement Study

- Data collect using commercial sensors
  - Airborne 2-D Gravity Gradient measurements successfully completed March 06
  - 3 E/√Hz noise floor:
  - Provided data and requirements for clutter suppression, algorithm development, and sensor definitions:
    - Sub-surface density variation (SSDV)
    - Surface topography corrections
    - Target characterization



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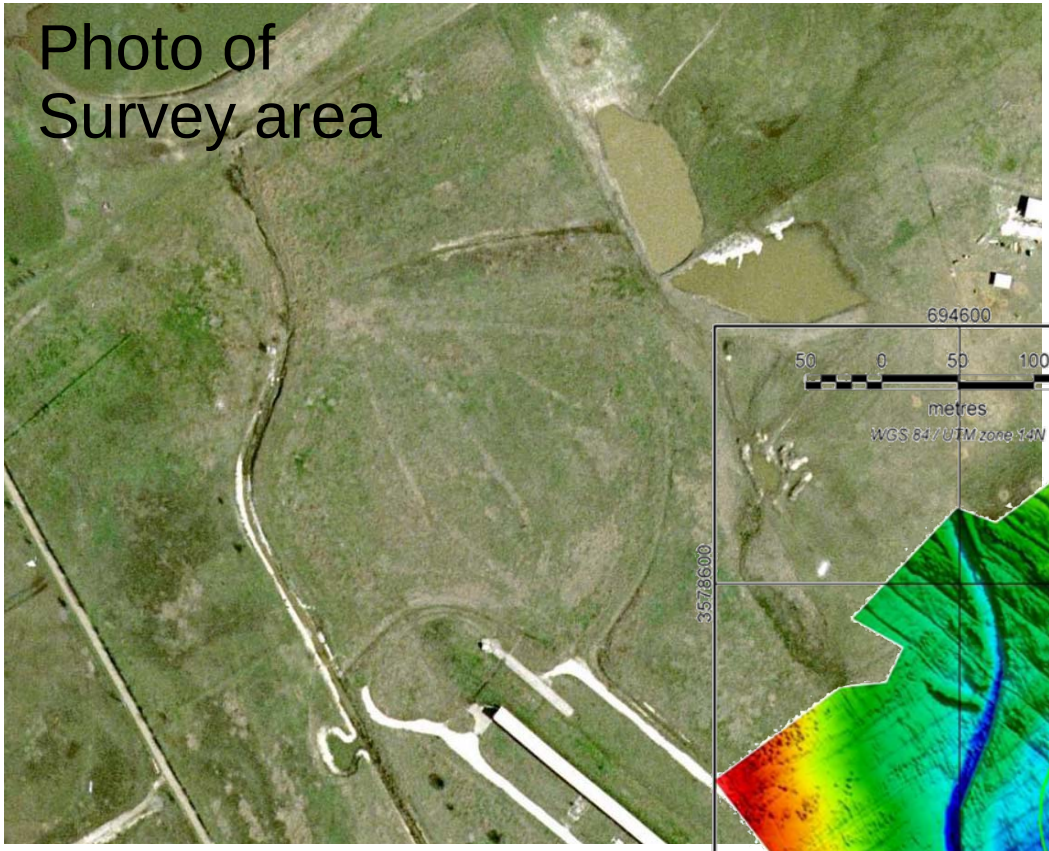
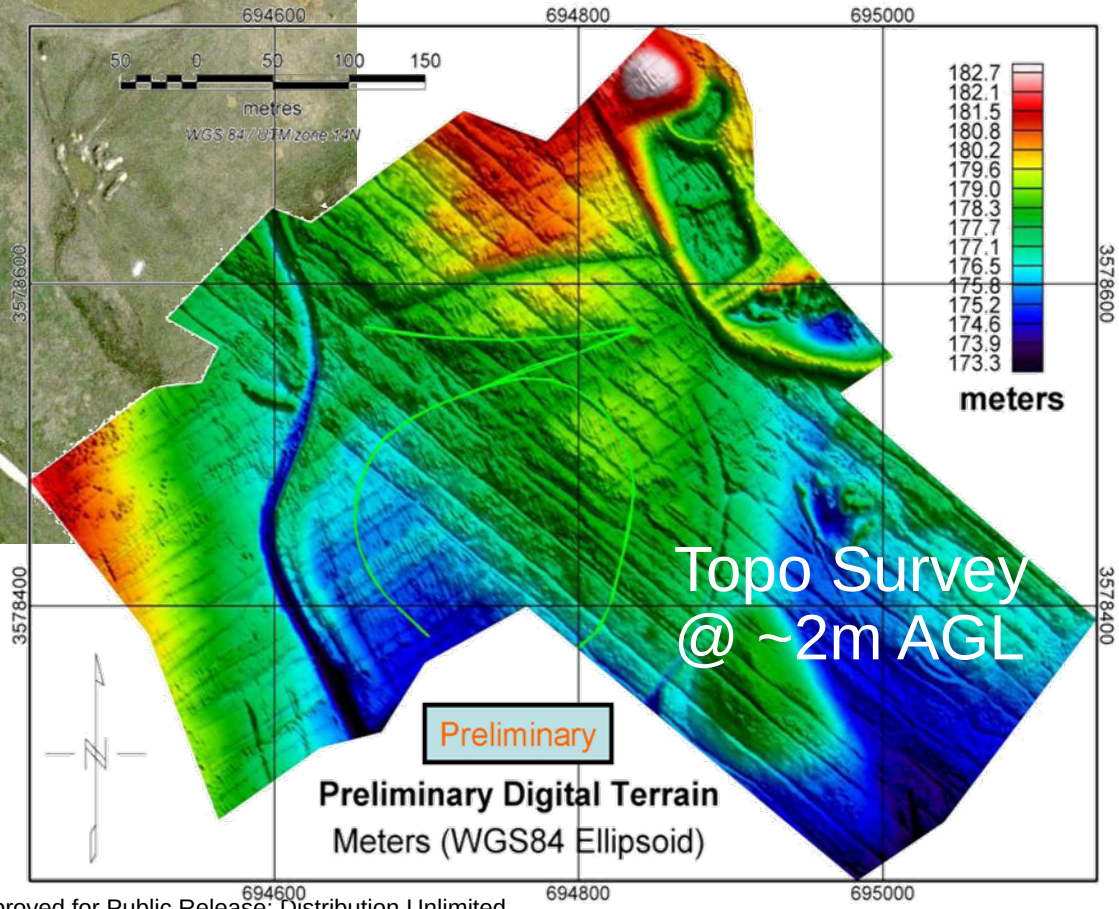
March 2006 Gravity Data Collection

DARPA Gravity data collection
- Clutter characterization + “easy” target





Same location as Phase 1 Land Gravity Gradient System (LGS) collection
- Low Energy Booster (LEB) of the Super-conducting Super Collider (SSB)

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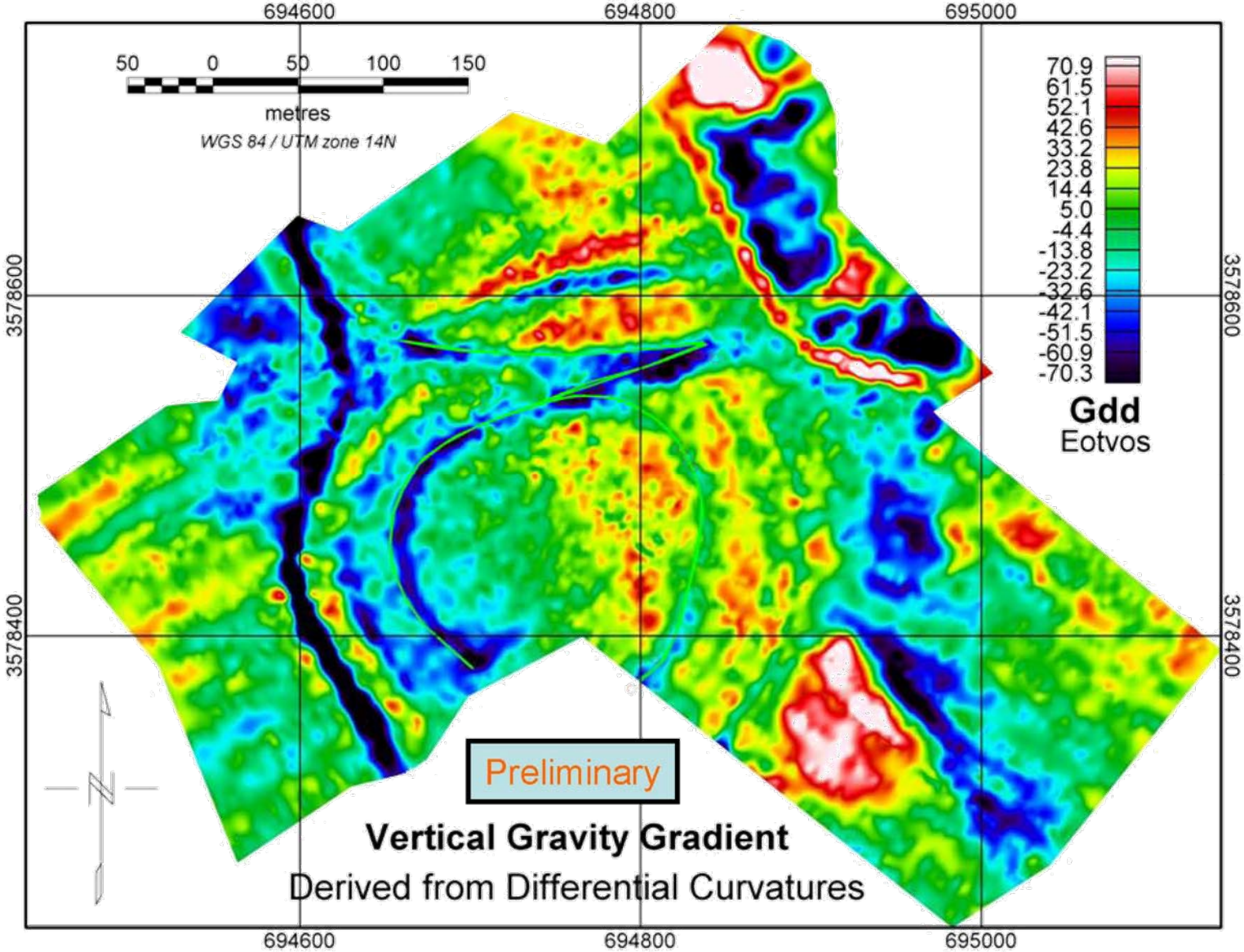
Uncorrected G_{dd} Approximately 2m AGL



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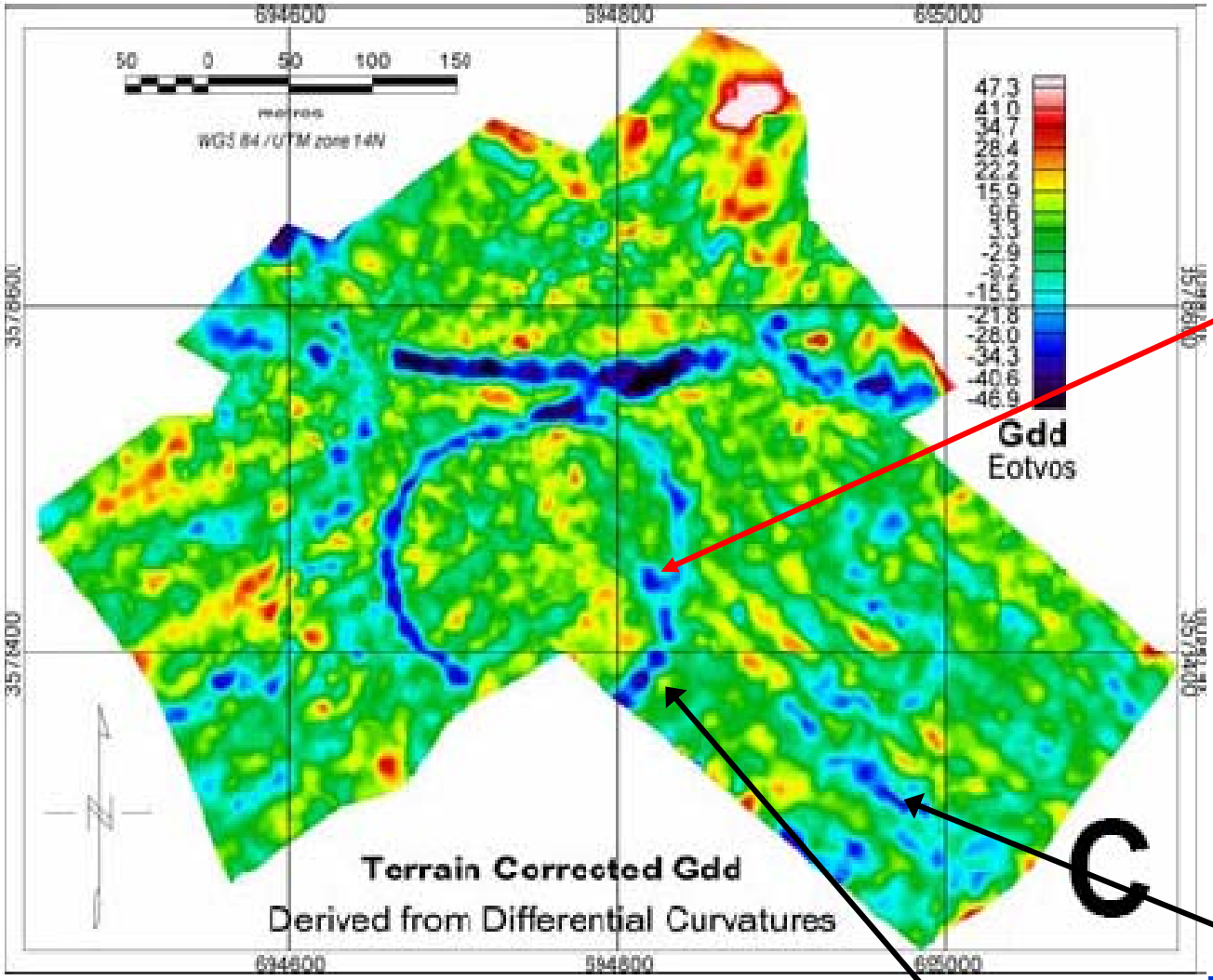
Terrain Corrected G_{dd} Approximately 2m AGL



Corrected using assumed terrain density of 2.2 gm/cc

- Results from initial Gravity data analysis using terrain correction show clear detection of LEB ring and actual tunnel offshoot
- System requirement effort further provided further analysis, inverse target modeling, Sub-surface Density Variation (SSDV) clutter characterization, and sensor requirements definition (number of tensor components, sensor noise floor, sample rate, …)

Residual uncorrected TOPO clutter and SSDV clutter

Target Fading due to signal strength, SNR, and topo corrections: not yet an inversion for subsurface void

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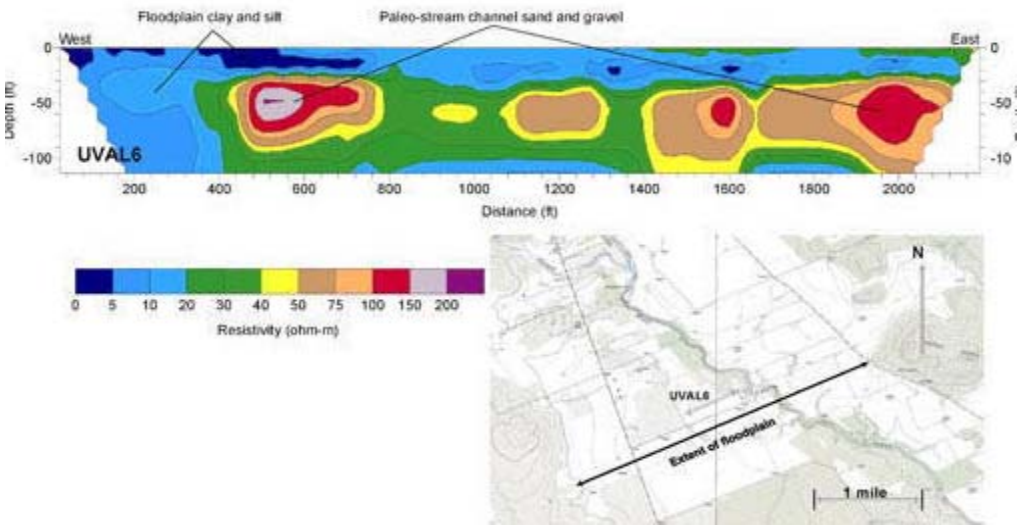
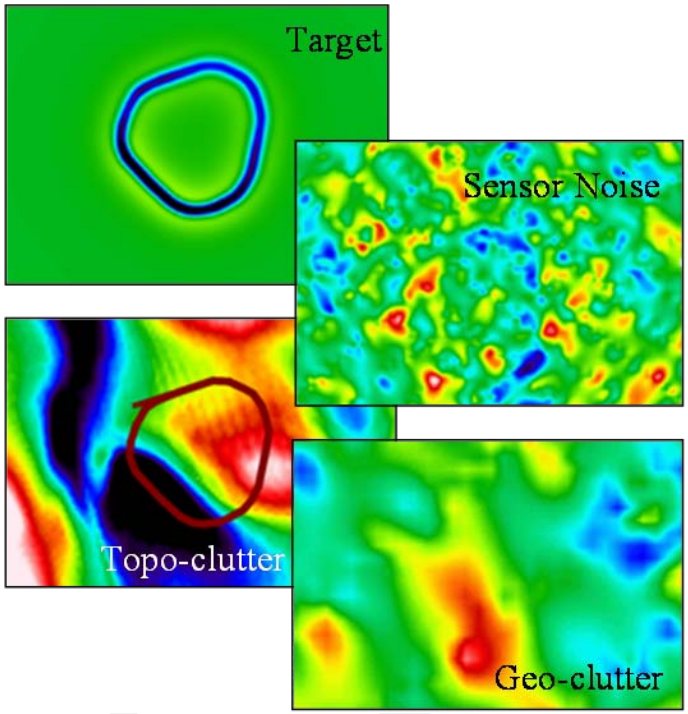
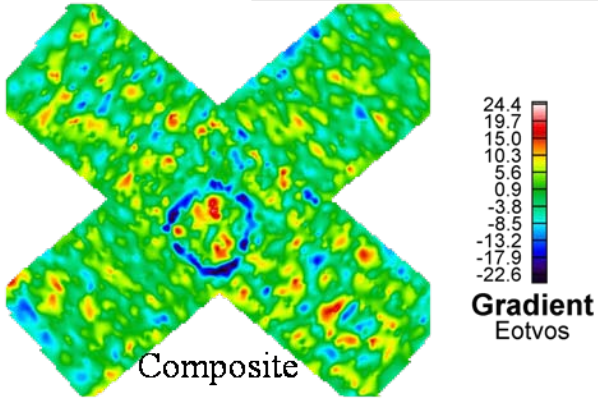
Clutter Sources that Challenges Gravity

- Topographic
  - Accuracy of topo (1st order)
  - Accuracy of geology (2nd order)
- Geology
  - Deterministic (alluvial flow)
    - Paleo channels
  - Random
    - Sub-surface Density Variation (SSDV)



Paleo Channels





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Proposers Day

REVIEW AND OF GROUND AND AIRBORNE LOW ENERGY BOOSTER SURVEY

Joseph Durek
Program Manager

24 April 2009

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Presentation Outline

I. Overview of Site with Location of Facility

II. Gravity Gradient Tensor: Brief gradient mathematics and theoretical prism models

III. Summary of ’97 and ‘05 surface gravity gradient surveys

IV. Summary of ’05 airborne survey and comparison to LEB models

V. Examination of LiDAR terrain data: Precision estimates and possible error source

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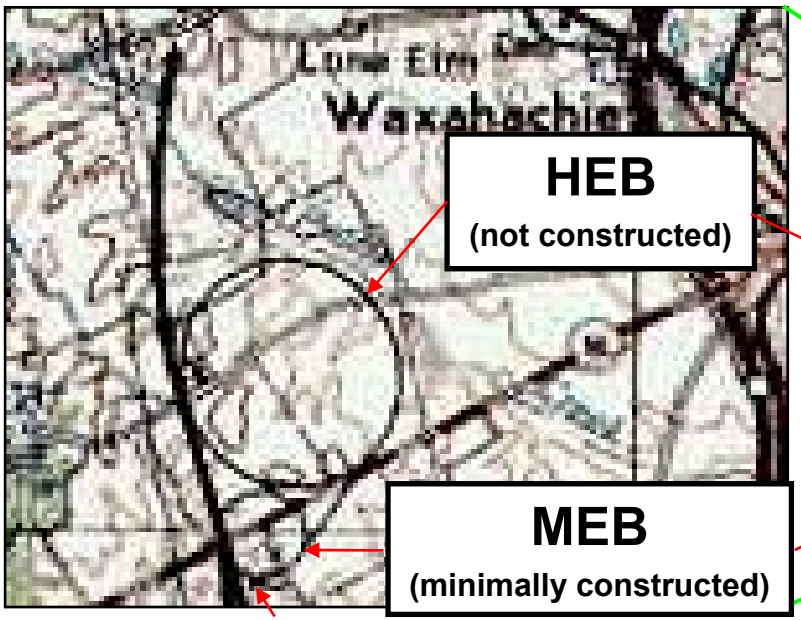
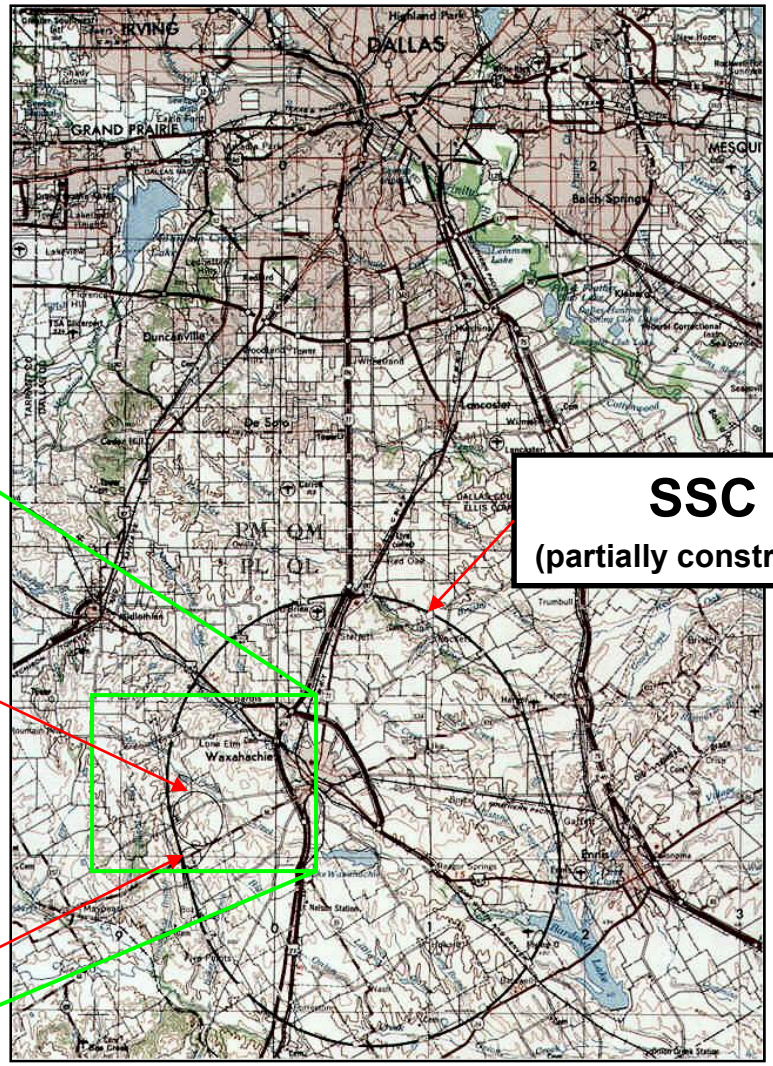
Components of Super Collider

- **Superconducting Super Collider**
- **High Energy Booster**
- **Medium Energy Booster**
- **Low Energy Booster**
- **Linear Accelerator**





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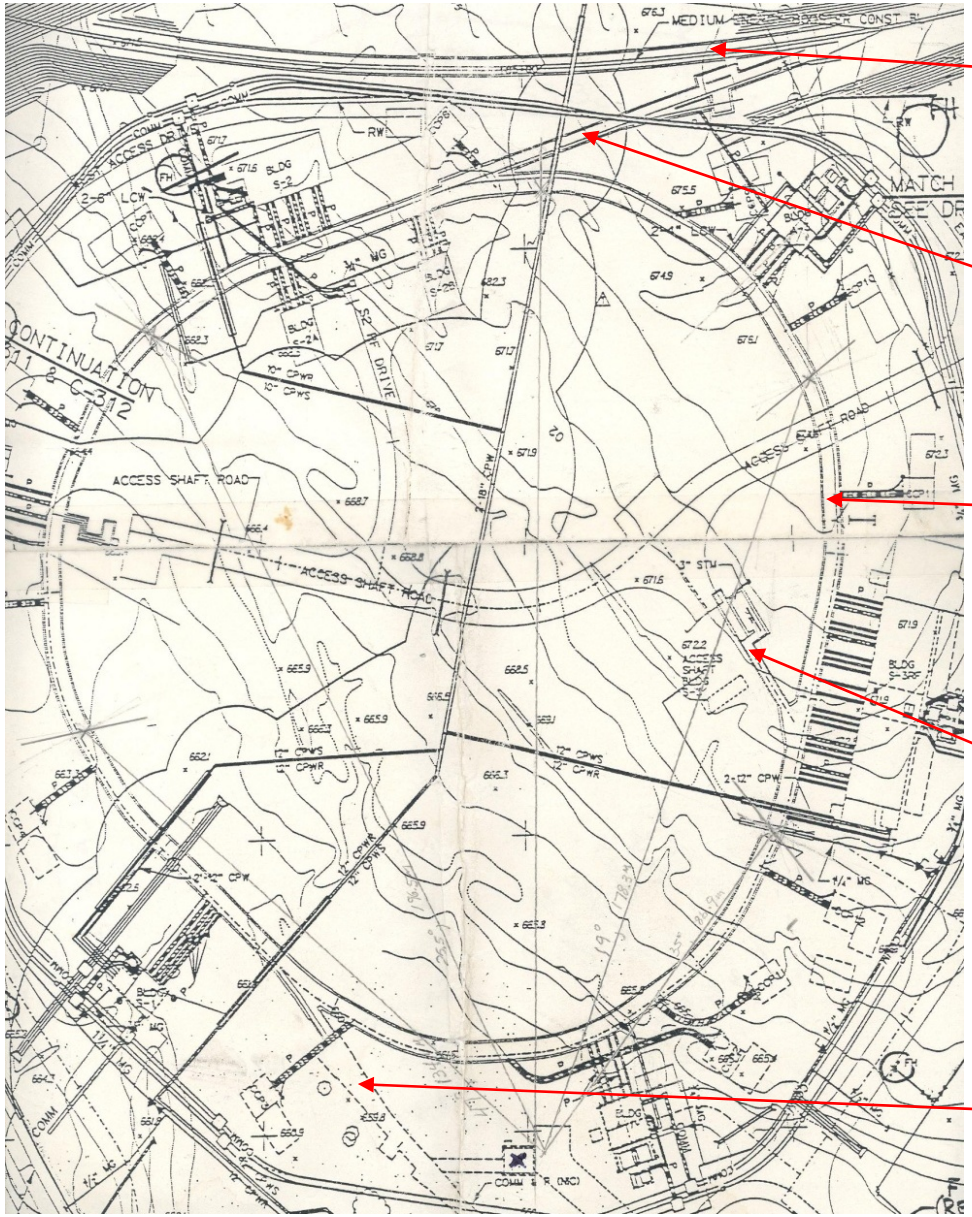
Components of Super Collider Cont.



MEB

LEB – MEB Transfer Tunnel

LEB

LEB Access Tunnel

LINAC

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SSC, MEB, and LEB Under Construction

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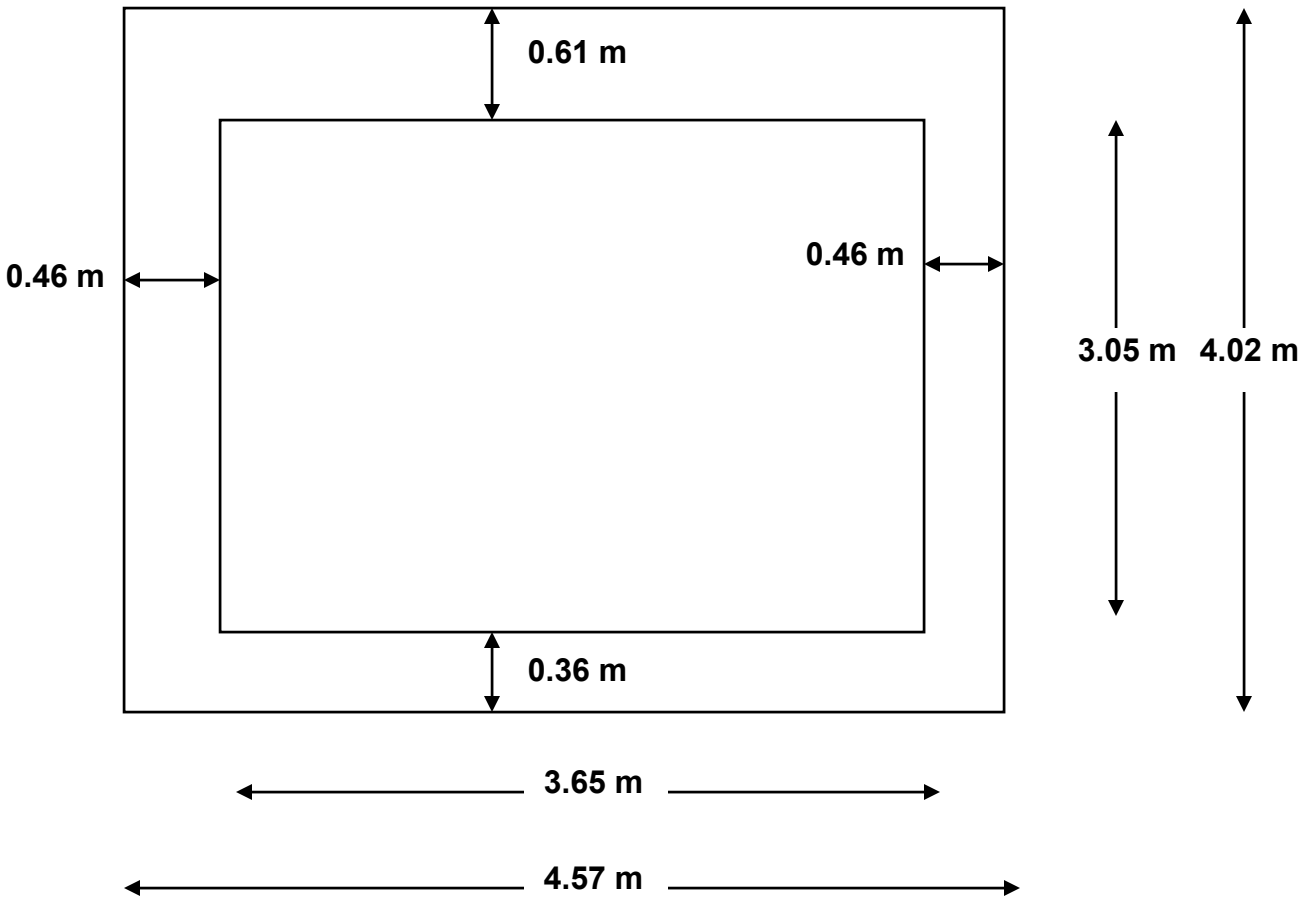
LEB Cross Section

MEB has the same lining dimensions as the LEB but the height is 4.07 m and the with is 4.12 m



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Gravity Gradient Tensor and Partial Tensor Gradient Values

Total Potential (scalar): Gravitational plus Centrifugal Potentials, i.e.

$$W = U + \Phi$$

$$\Gamma = \begin{pmatrix} \Gamma_{xx} & \Gamma_{xy} & \Gamma_{xz} \\ \Gamma_{yx} & \Gamma_{yy} & \Gamma_{yz} \\ \Gamma_{zx} & \Gamma_{zy} & \Gamma_{zz} \end{pmatrix} = \begin{pmatrix} \frac{\partial^2 U}{\partial x^2} & \frac{\partial^2 U}{\partial x \partial y} & \frac{\partial^2 U}{\partial x \partial z} \\ \frac{\partial^2 U}{\partial y \partial x} & \frac{\partial^2 U}{\partial y^2} & \frac{\partial^2 U}{\partial y \partial z} \\ \frac{\partial^2 U}{\partial z \partial x} & \frac{\partial^2 U}{\partial z \partial y} & \frac{\partial^2 U}{\partial z^2} \end{pmatrix}$$

Γ is symmetric 3 by 3 tensor obtained from the potential U

Units are Eötvös where 1 E = $10^{-9}/s^2$

Inline Gravity Gradient

$$\Gamma_{IN} = \left(\Gamma_{xx} - \Gamma_{yy}\right) = \left(\Gamma_{ee} - \Gamma_{nn}\right)$$

Cross Gravity Gradient

$$\Gamma_{CR} = 2\Gamma_{xy} = 2\Gamma_{ne}$$

Differential Curvature Magnitude

$$\left|\Gamma_C\right| = \sqrt{4\Gamma_{xy}^{\ 2} + \left(\Gamma_{yy} - \Gamma_{xx}\right)^2}$$

Minimum Curvature Azimuth

$$\alpha_c = \frac{1}{2}\tan^{-1}\left(\frac{2\Gamma_{xy}}{\Gamma_{yy} - \Gamma_{xx}}\right)$$

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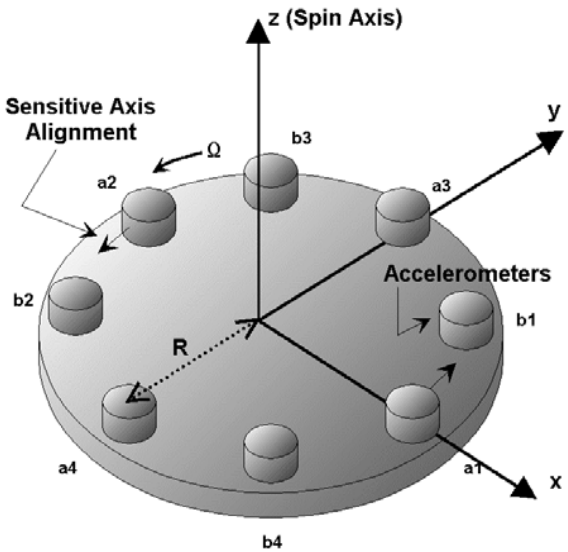
Vertical Spin Axis Gradient Terms Related to Accelerometer Output

Rotor rate, Ω, is 0.25 Hz in present configuration



Each set of accelerometers, a and b, simultaneously measures inline and cross gradient

$$\Gamma_{xx} - \Gamma_{yy} \propto \left\{ \frac{[(a_1 + a_2) - (a_3 + a_4)]\sin(2\Omega t) + [(b_1 + b_2) - (b_3 + b_4)]\cos(2\Omega t)}{2R} \right\}$$

$$2\Gamma_{xy} \propto \left\{ \frac{[(a_1 + a_2) - (a_3 + a_4)]\cos(2\Omega t) - [(b_1 + b_2) - (b_3 + b_4)]\sin(2\Omega t)}{2R} \right\}$$

If survey crosses tunnel at 90° inline = max and cross = 0; if survey crosses tunnel at 45° cross = max and inline = 0

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LEB Model Principles

- Prism-induced models based on R. Forsberg equations (shown on next slide)
- LEB modeled with 25 contiguous inner/outer prism pairs (50 total prisms)
  - Each pair: Inner void and outer concrete shell
  - All prisms require rotations and translations
- Prism-to-prism depths vary but depth held constant within each prism
- Models assume draped terrain data surface (constant height maintained above ground level)

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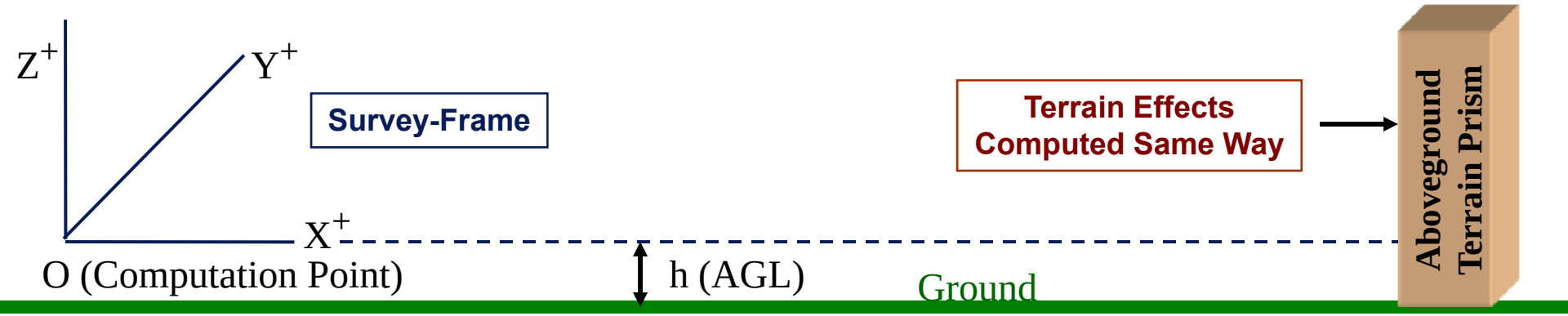
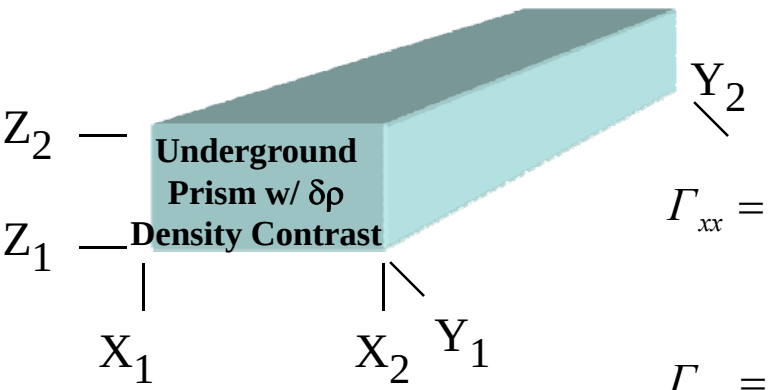
Level Prism-Induced Gradient Formulas at Survey Frame Origin





$$\Gamma_{zz} = -G(\delta\rho)\tan^{-1}\left(\frac{xy}{zr}\right)\Bigg|_{x_1}^{x_2}\Bigg|_{y_1}^{y_2}\Bigg|_{z_1}^{z_2}$$

$$\Gamma_{xx} = -G(\delta\rho)\tan^{-1}\left(\frac{yz}{xr}\right)\Bigg|_{x_1}^{x_2}\Bigg|_{y_1}^{y_2}\Bigg|_{z_1}^{z_2}$$

$$\Gamma_{xy} = G(\delta\rho)\ln(z+r)\Bigg|_{x_1}^{x_2}\Bigg|_{y_1}^{y_2}\Bigg|_{z_1}^{z_2}$$

$$\Gamma_{yy} = -G(\delta\rho)\tan^{-1}\left(\frac{xz}{yr}\right)\Bigg|_{x_1}^{x_2}\Bigg|_{y_1}^{y_2}\Bigg|_{z_1}^{z_2}$$

$$\Gamma_{xz} = G(\delta\rho)\ln(y+r)\Bigg|_{x_1}^{x_2}\Bigg|_{y_1}^{y_2}\Bigg|_{z_1}^{z_2}$$

$$\Gamma_{yz} = G(\delta\rho)\ln(x+r)\Bigg|_{x_1}^{x_2}\Bigg|_{y_1}^{y_2}\Bigg|_{z_1}^{z_2}$$

$$r = \sqrt{x^2 + y^2 + z^2}$$

Translations used for non-origin computation points
Prism edges <u>MUST</u> be parallel to XYZ axes

- **If prism edges <u>NOT</u> parallel to XYZ axes, we compute gradients in prism-frame & back-rotate to survey-frame**

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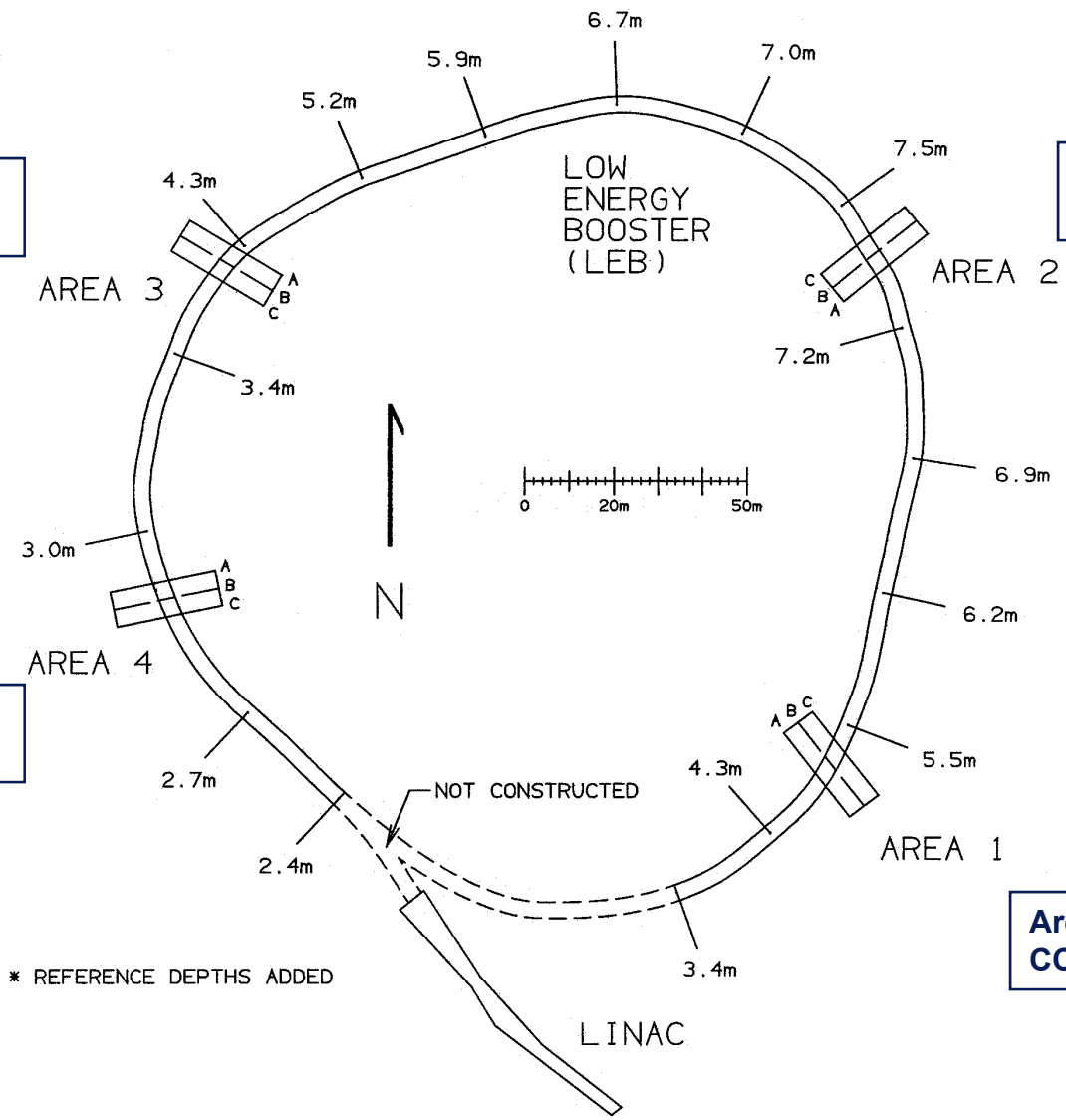
The LEB With Locations of the Four Surface Survey Areas

Area 3 Bearing 58.965° CCW from North

Area 2 Bearing 129.693° CCW from North

Area 4 Bearing 101.576° CCW from North

Area 1 Bearing 37.643° CCW from North



Arms Control and Verification Gravity Gradiometer (ACVGG)

The ACVGG Survey at the LEB in 1997

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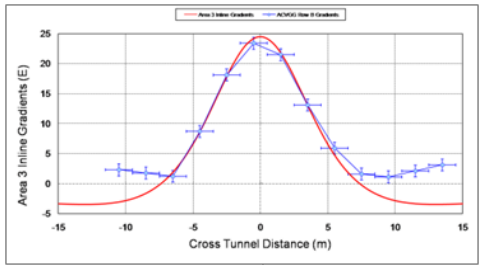
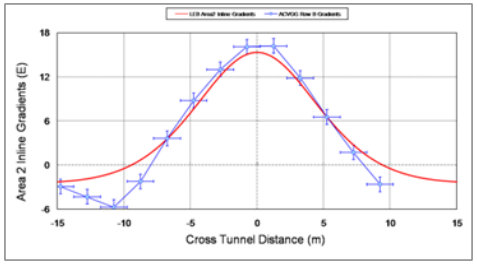
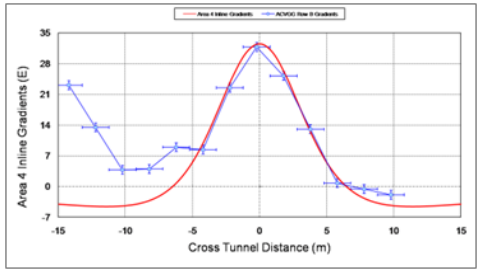
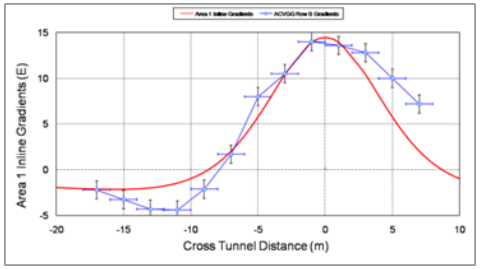
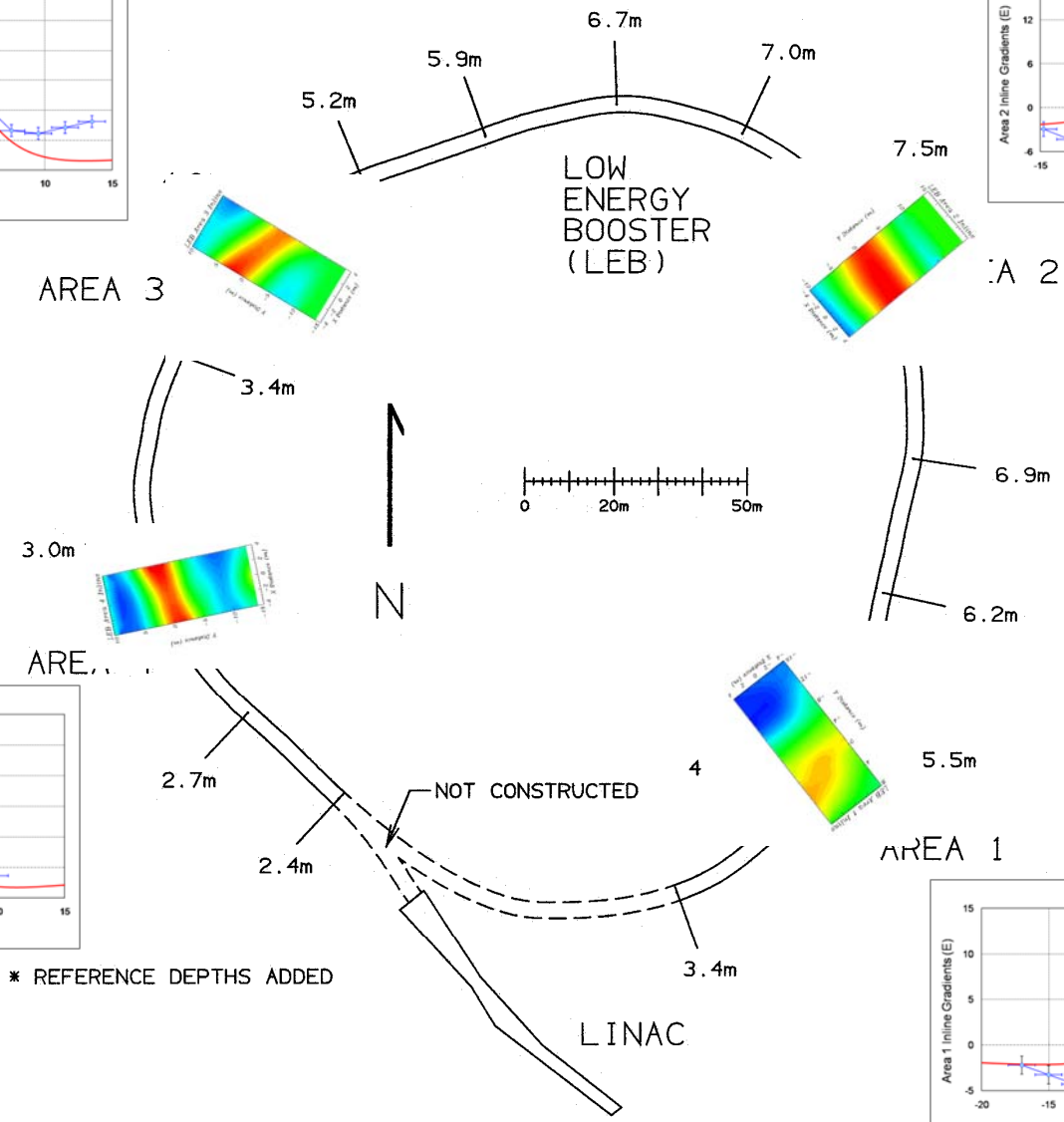
LEB Outline With Measured and Modeled Inline Gradients





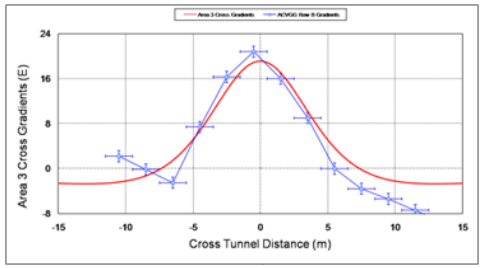


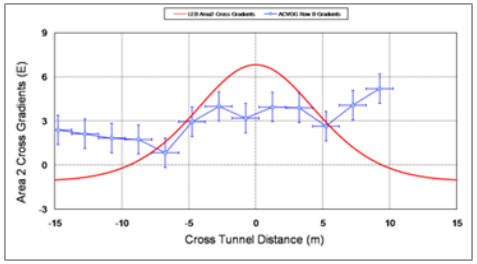


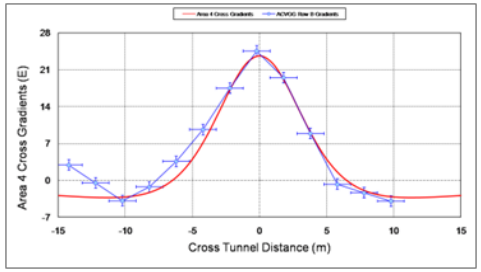


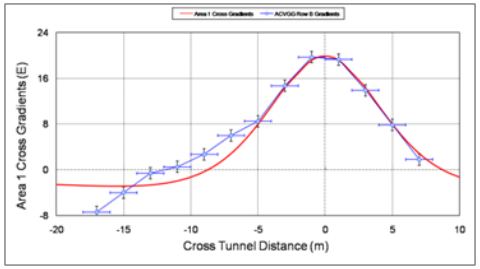
* REFERENCE DEPTHS ADDED

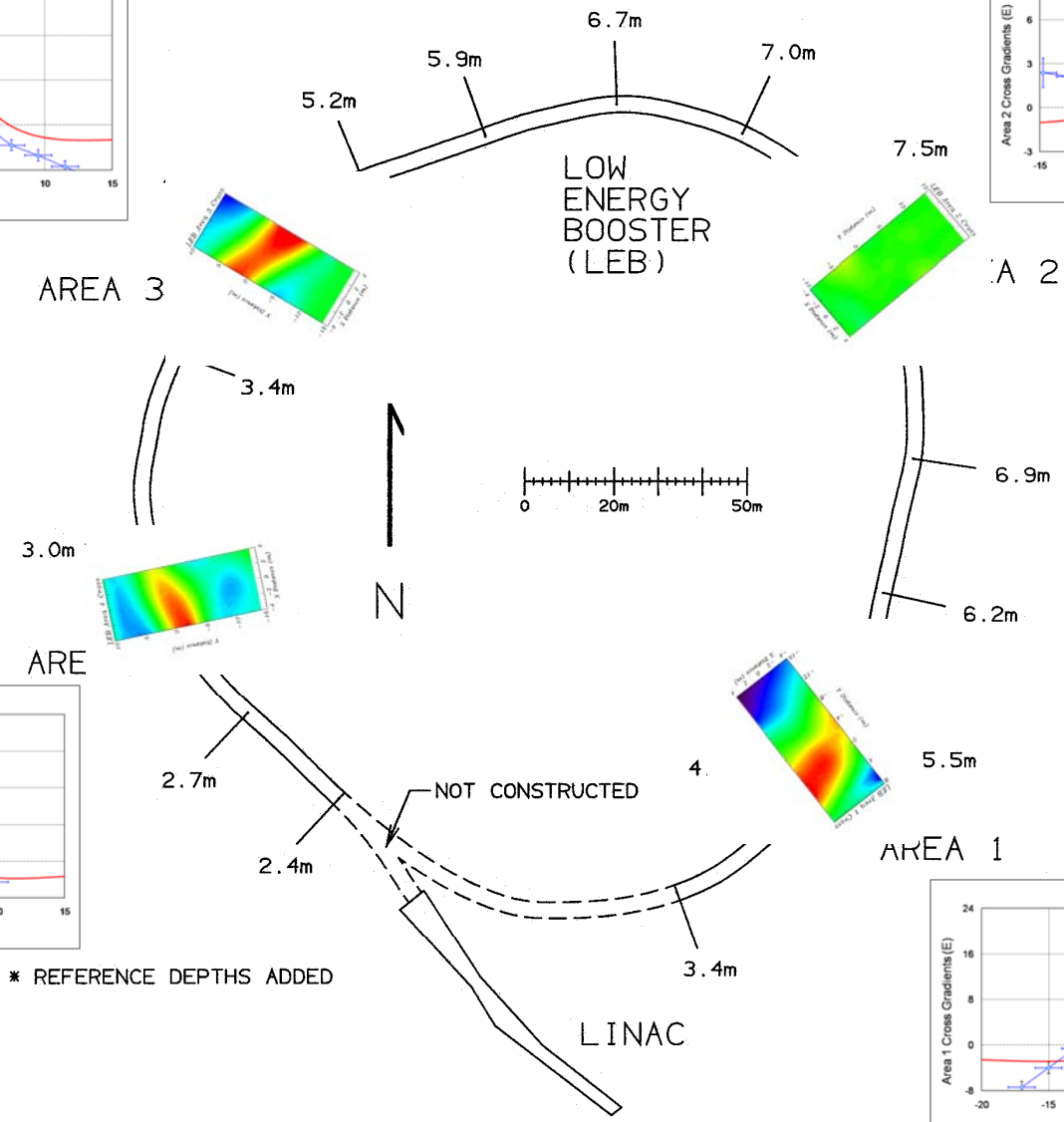
LEB Outline With Measured and Modeled Cross Gradients





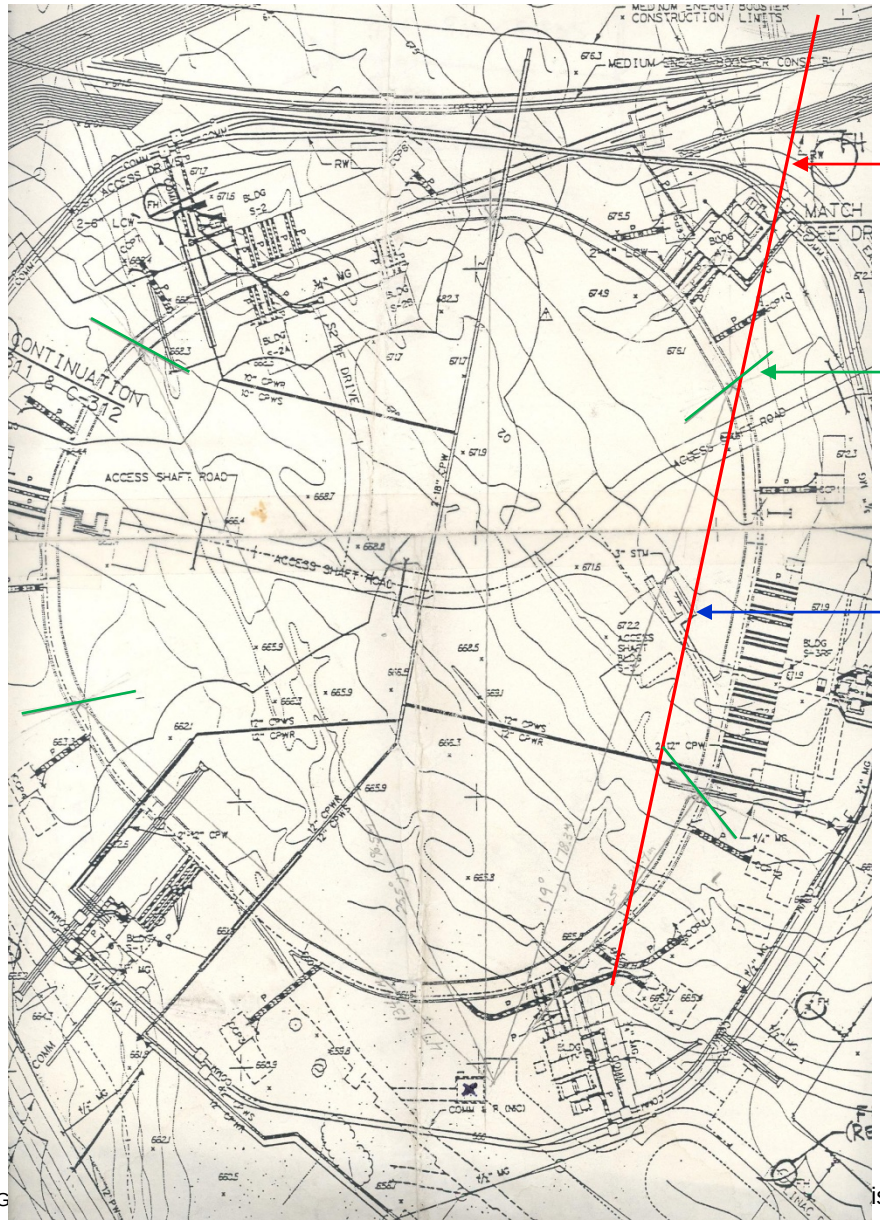






* REFERENCE DEPTHS ADDED

LEB Drawing With 1997 and 2005 Surveys



2005 LGS Profile

1997 Area 2

Access Tunnel?

If the access tunnel was in fact constructed the LGS should have detected it and appears to have done so

istribution Unlimited.

Land Gradiometer System (LGS)

LGS Survey at the LEB in 2005

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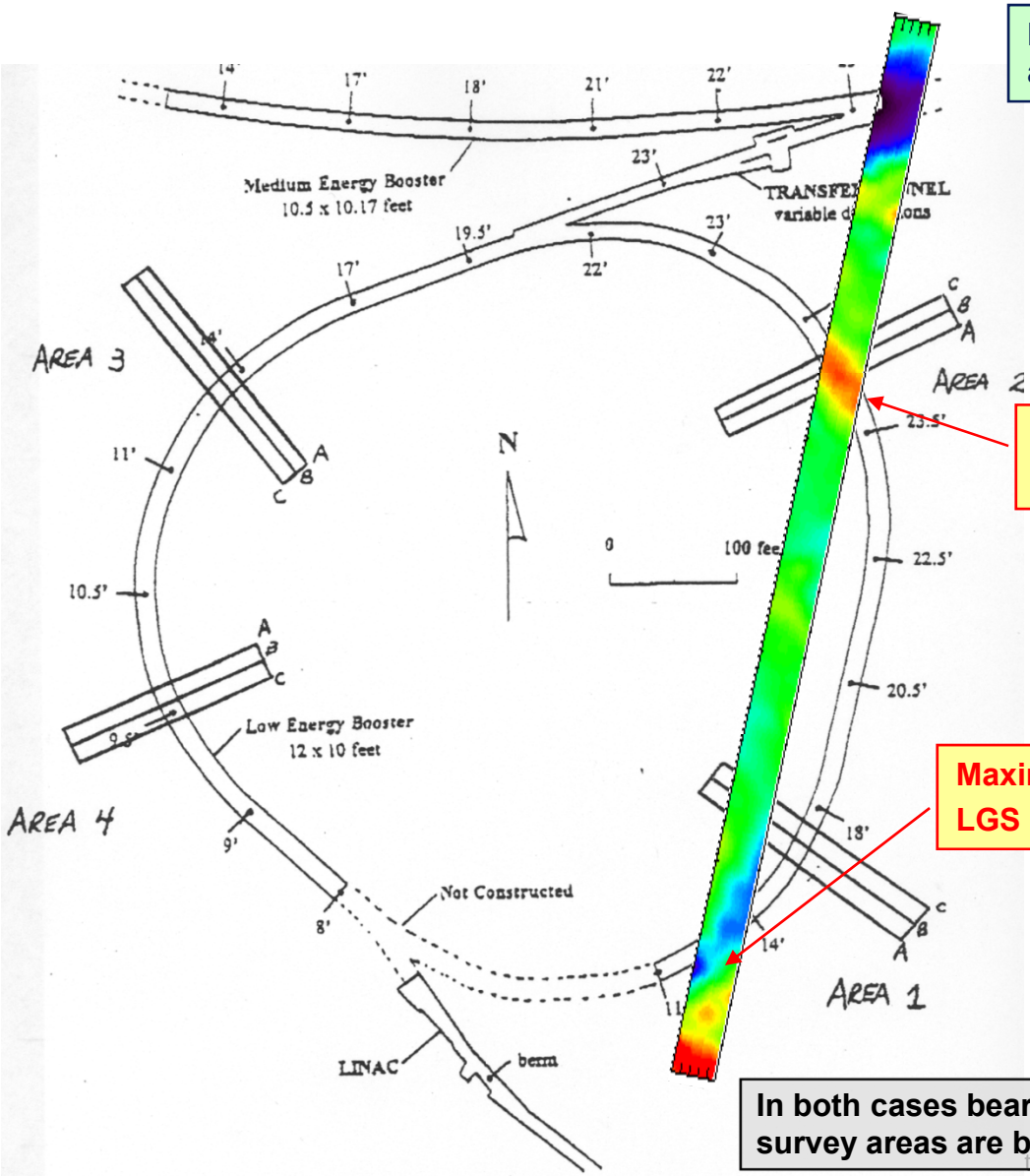
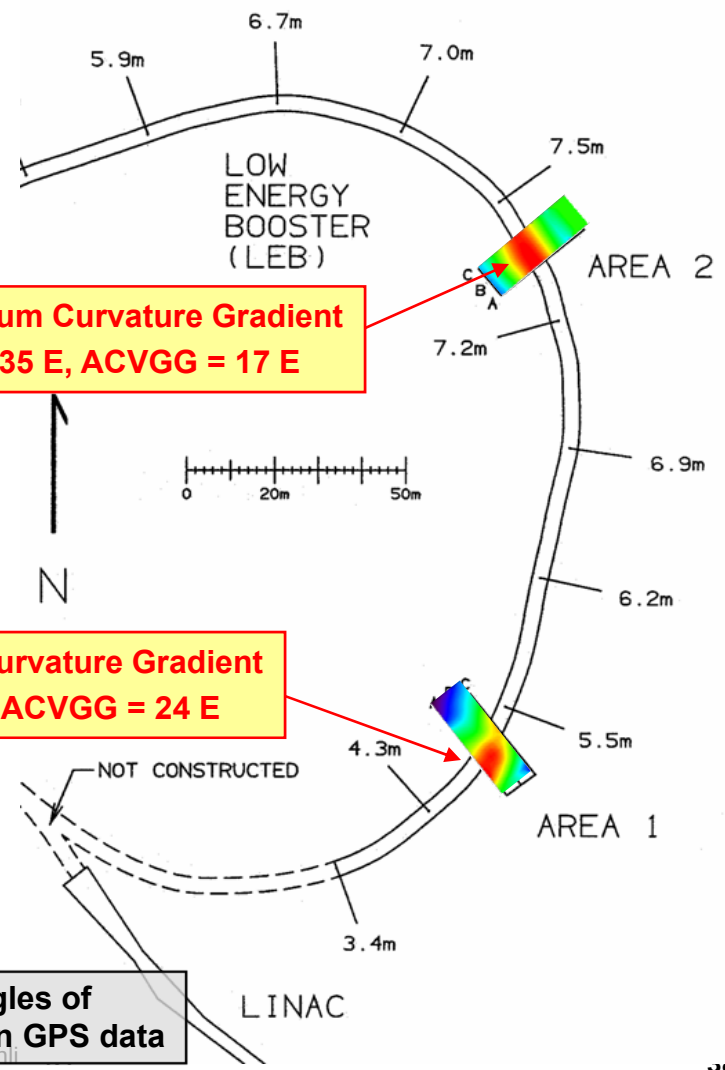
LEB with 2005 LGS (Left) and 1997 ACVGG (Right) Surveys

Note: LGS gradient magnitudes twice the ACVGG and current AGG magnitudes of $(\Gamma_{xx} - \Gamma_{yy})/2$ and Γ_{xy}



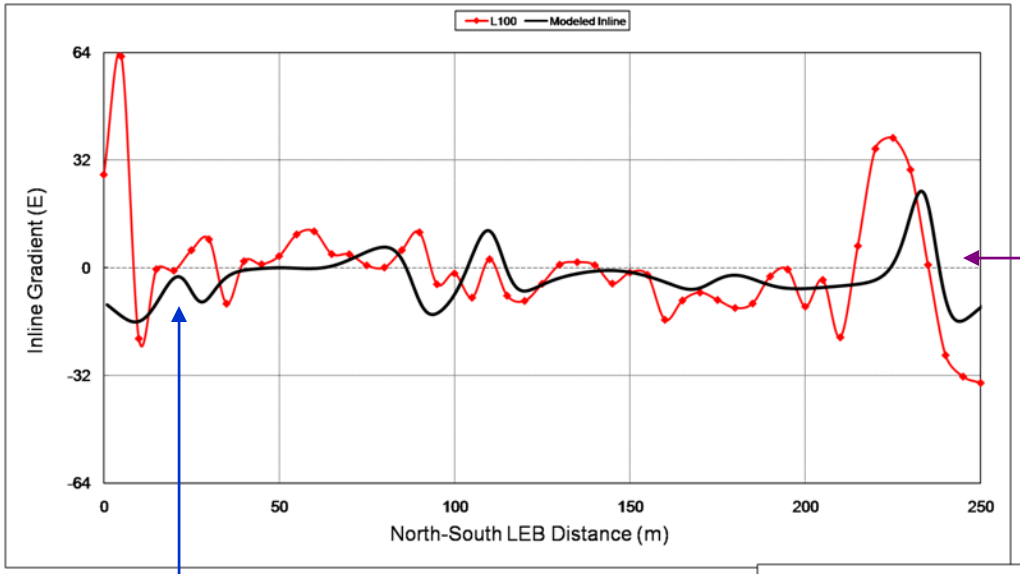


Maximum Curvature Gradient
LGS = 35 E, ACVGG = 17 E

Maximum Curvature Gradient
LGS = 51 E, ACVGG = 24 E

In both cases bearing angles of survey areas are based on GPS data

Modeled Profiles Compared with LGS-Measured L100 Profile

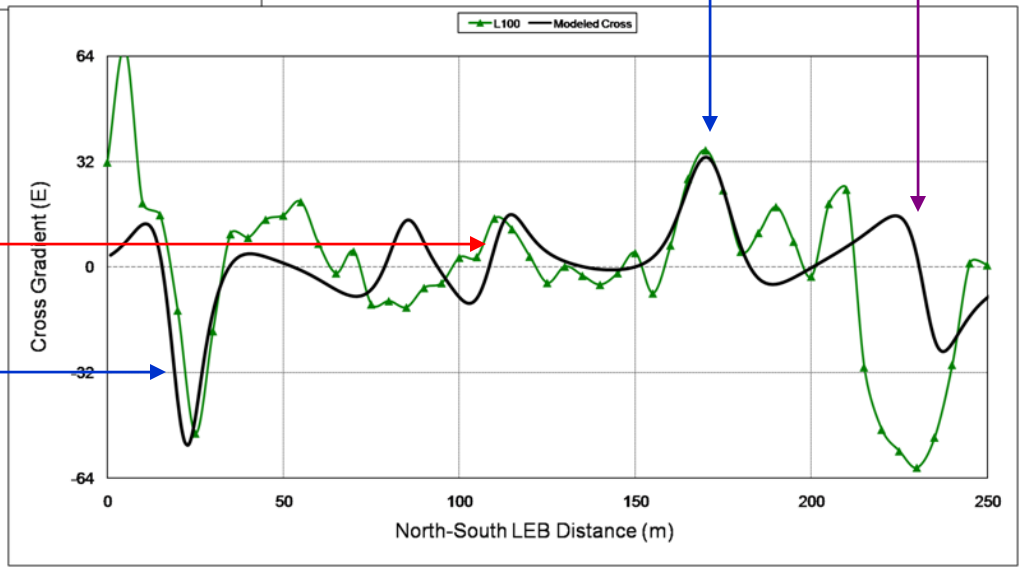


MEB Crossings

LEB Second Crossing

Access Tunnel Crossing?

LEB First Crossing



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Remarks on ’97 and ‘05 Ground Data

- LGS-measured magnitudes at LEB crossings in good agreement with model and 1997 ACVGG data
- In addition to the main tunnels the ‘05 data appear to reveal access tunnel
  - The construction of this feature was previously unknown
- LGS-measured magnitudes at MEB crossing much larger than predicted
  - Re-examination of drawings revealed no clear reason
  - Possibility: Additional excavation not marked on drawings?
- The very good agreement between measurements and models leads to conclusion that the main tunnels are not filled with water

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Presentation Outline

I. Overview of Site with Location of Facility

II. Gravity Gradient Tensor: Brief gradient mathematics and theoretical prism models

III. Summary of ’97 and ‘05 surface gravity gradient surveys

IV. Summary of ’05 airborne survey and comparison to LEB models

V. Examination of LiDAR terrain data: Precision estimates and possible error source

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LAASS Airborne Survey of LEB: Purpose

- Acquire an airborne database for *determining the potential utility of gravity gradient sensing to future Low-Altitude Airborne Sensor System (LAASS) concepts and missions* by:
  - Conducting an airborne gravity gradiometric survey over the LEB
  - Assessing the strength of such signals relative to clutter from underground sources or deviations in the terrain corrections on gravity gradiometric signals
  - Establishing, as part of a larger LAASS database, characterization of state-of-the-art gravity gradient sensing capability
  - Providing a basis for modeling current and developmental gravity gradient capabilities against a wide variety of relevant target types

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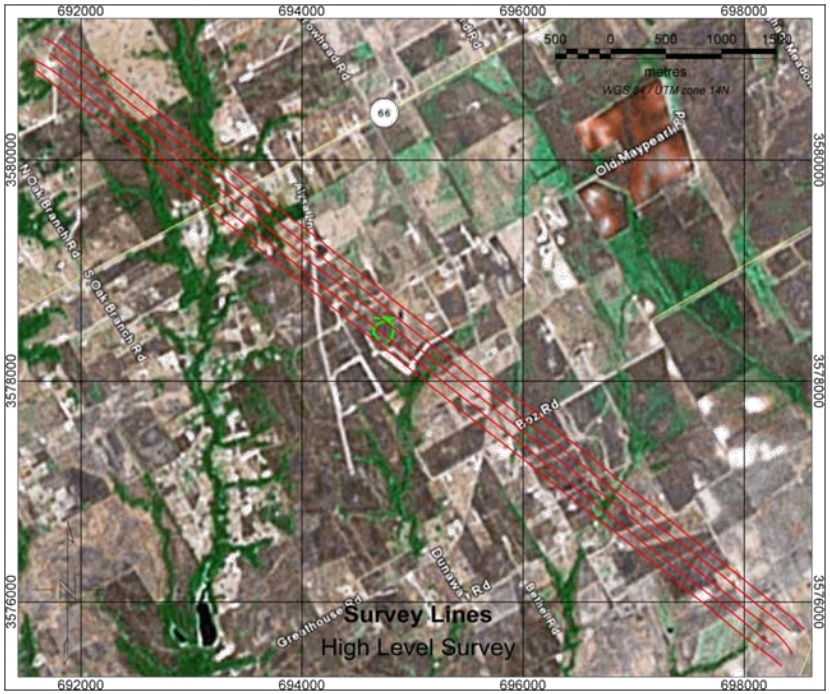
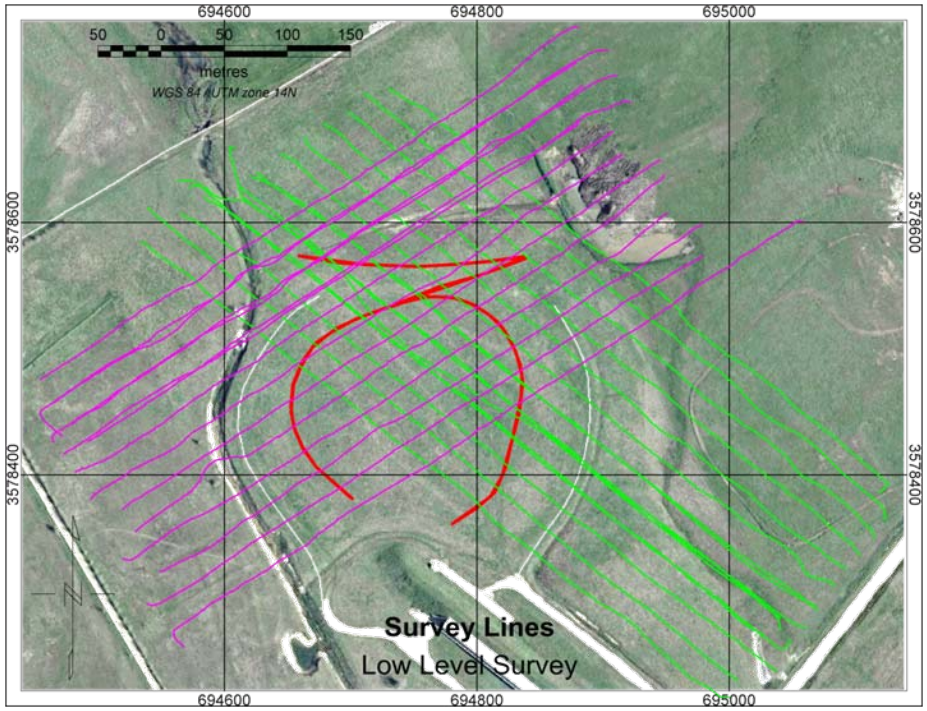
Location of High-Level and Low Level Lines over LEB





Five high-level lines; southeast to northwest

24 low-level lines; 12 southeast to northwest, 12 southwest to northeast

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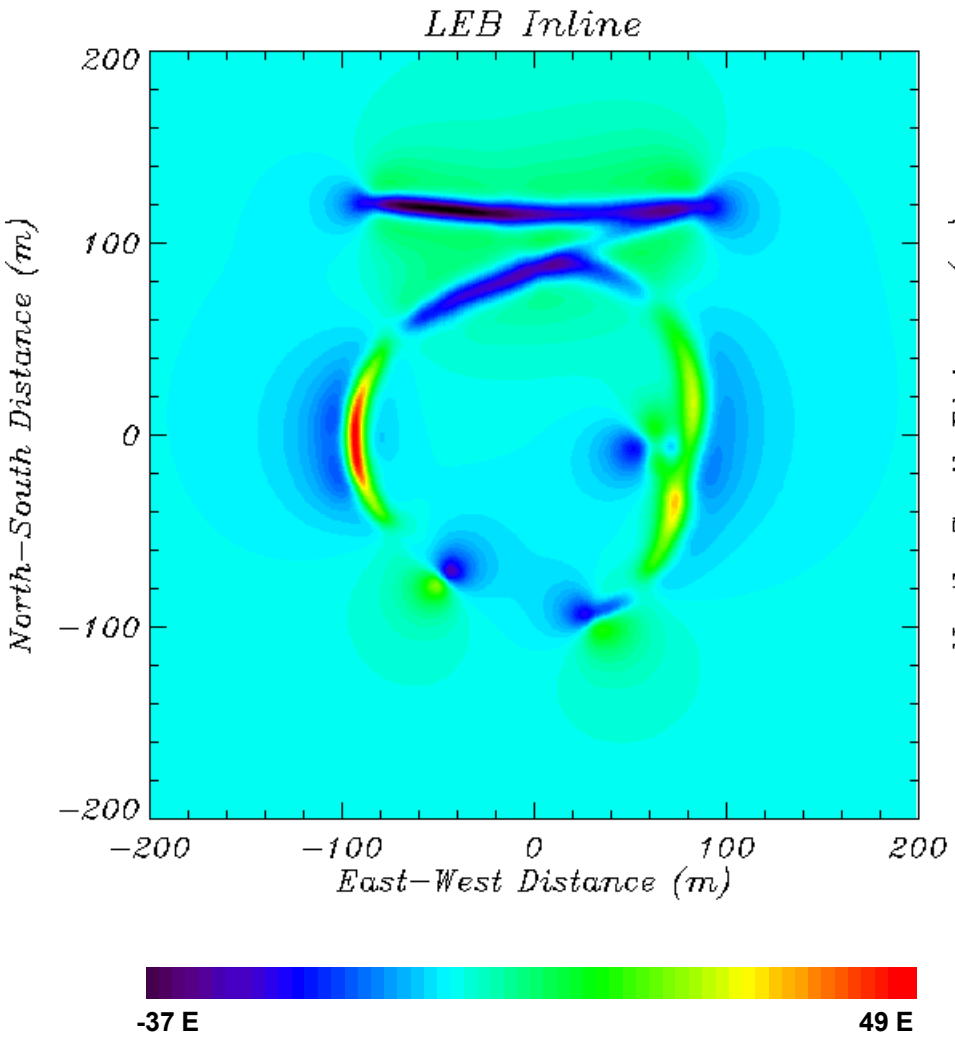
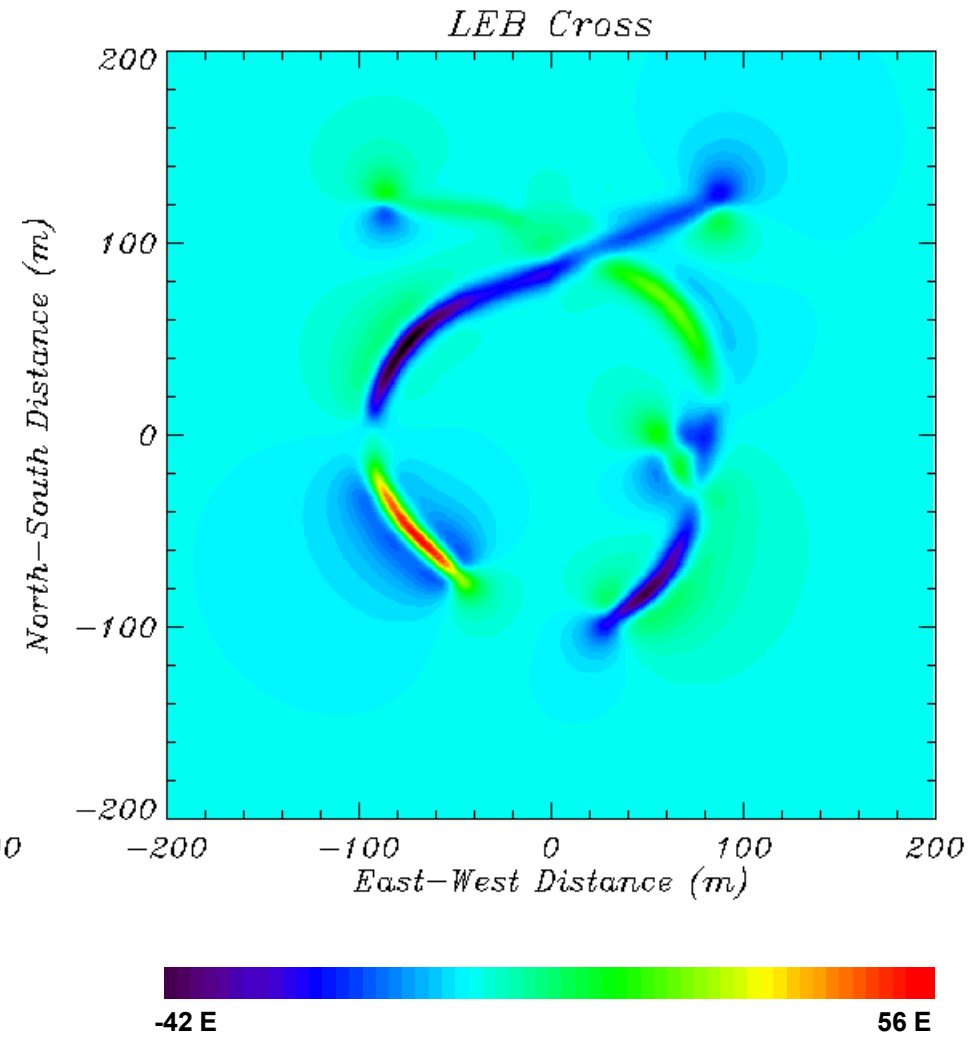
Modeled LEB Inline and Cross Gradients (h = 2.5 m AGL)





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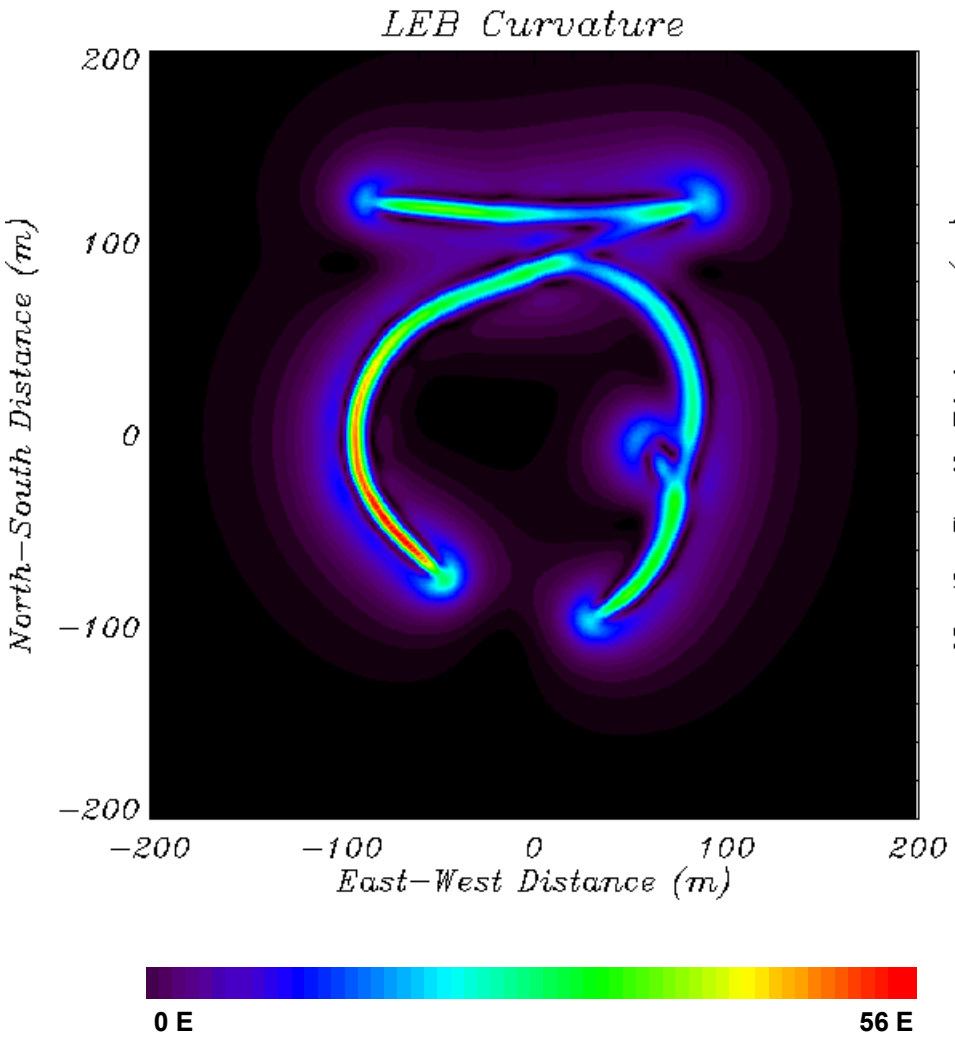
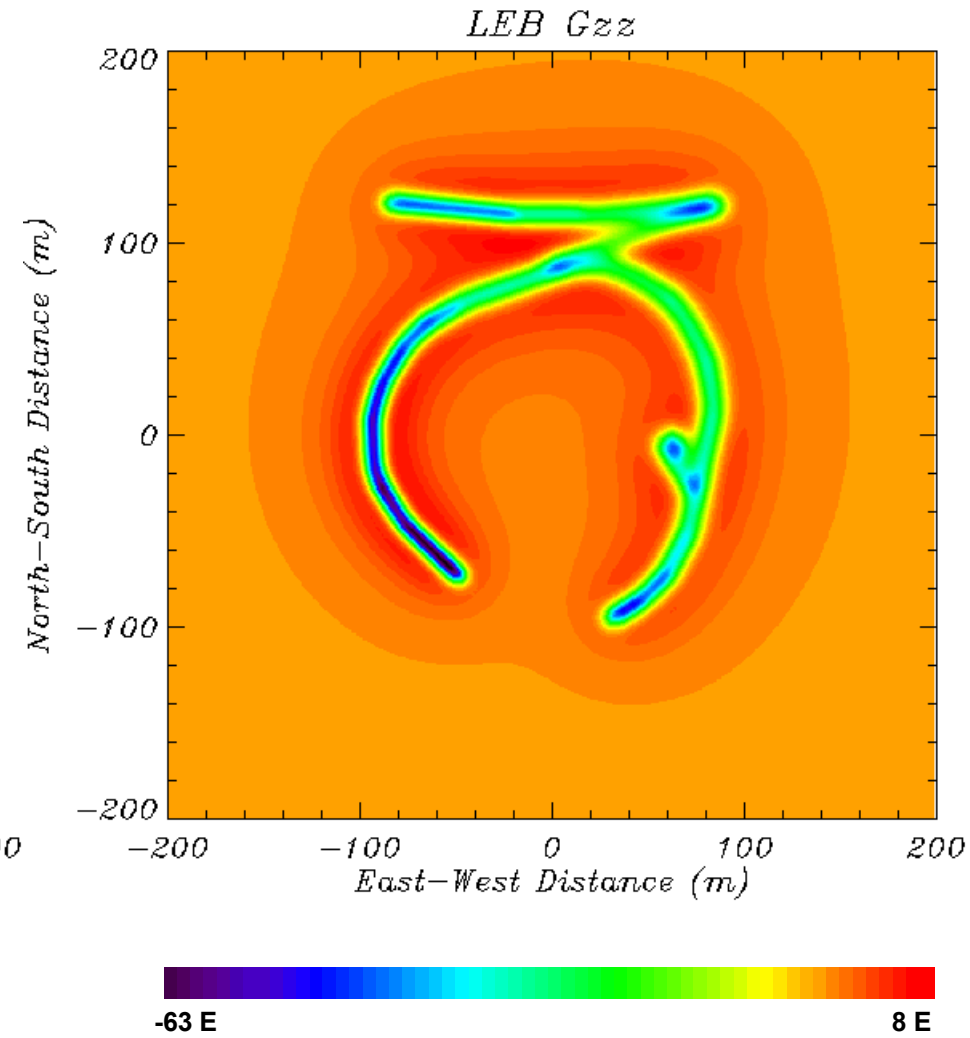
Modeled LEB Curvature and Γ_{zz} Gradients (h = 2.5 m AGL)





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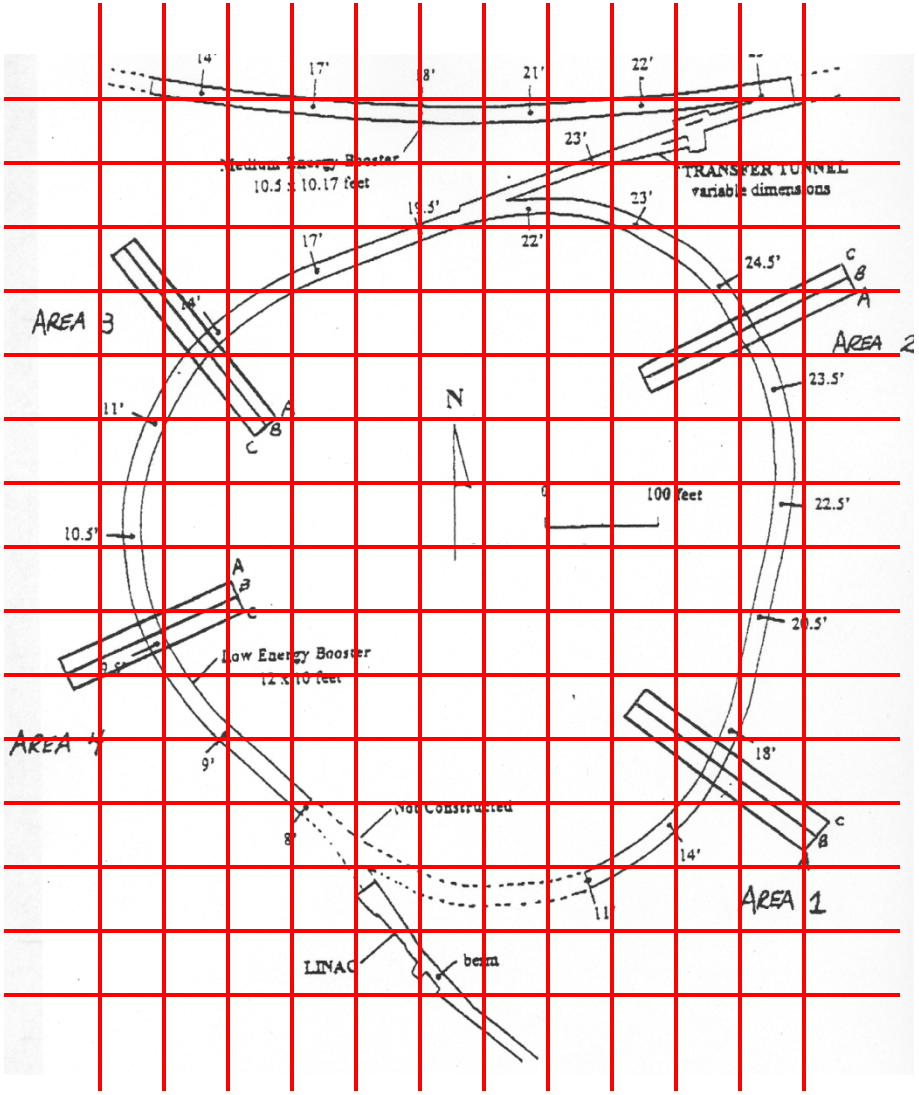
Airborne Survey Tracks



Along track spacing = 2.5 m and spacing between tracks = 15 m; sensor elevation at 2.5 m AGL

Sensor noise level = 3 E for inline and cross gradients and 6 E for vertical gradient

Survey inline gradients are of opposite sign to the model likely due to different coordinate systems

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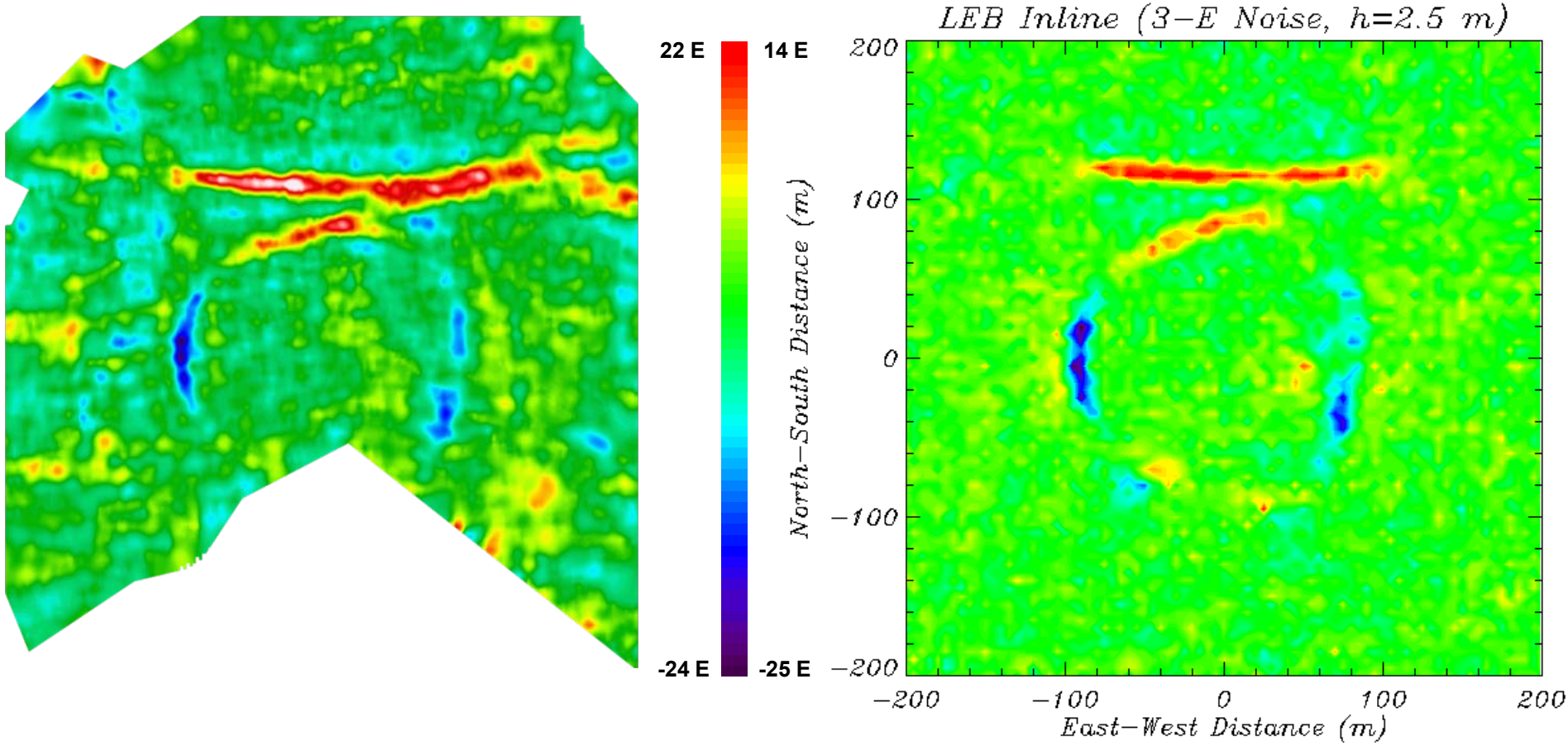
Measured and Modeled Inline Gradients



Note: the larger and wider MEB signal in the surveyed data

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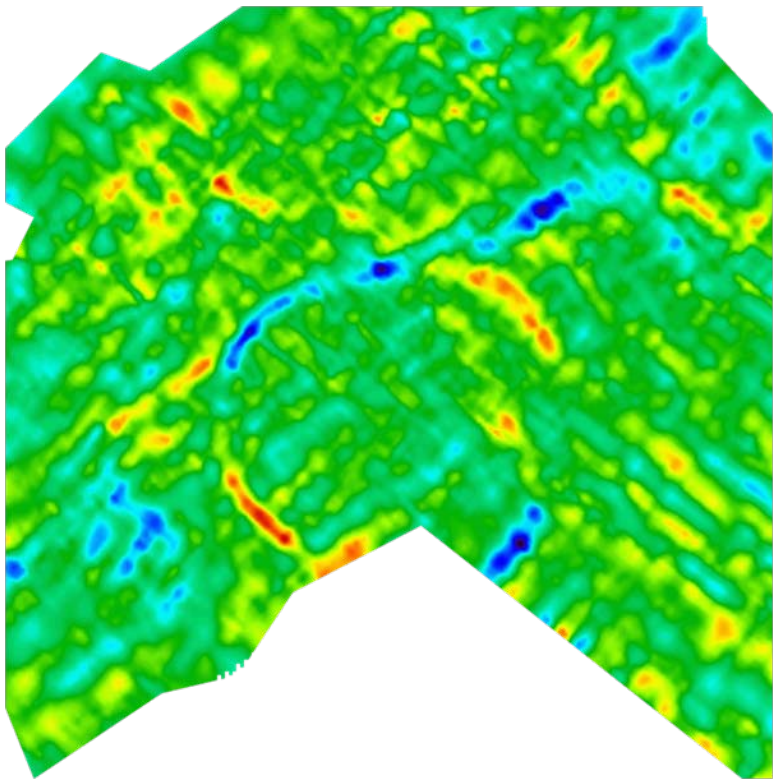
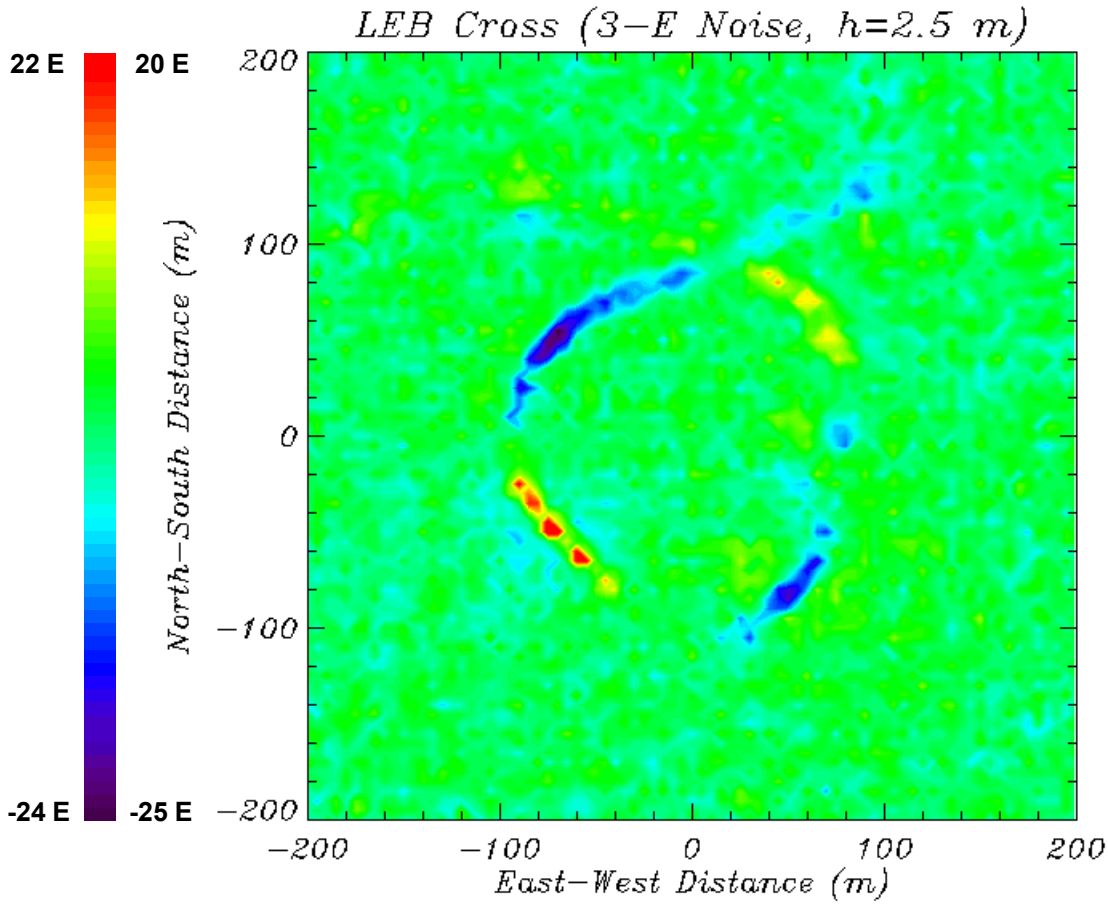
Measured and Modeled Cross Gradients





Note: the linear intersecting artifacts in the surveyed data

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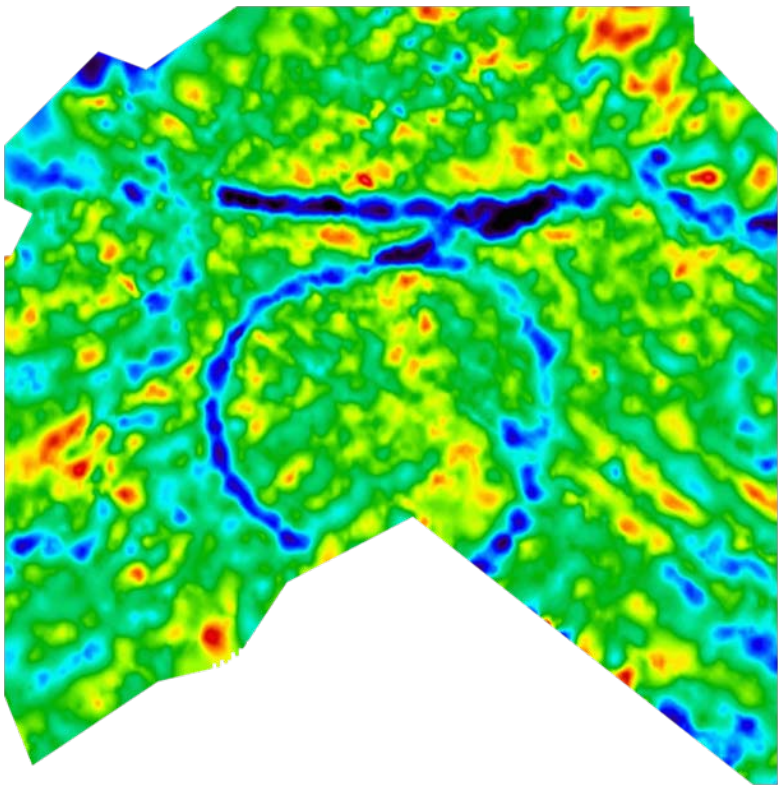
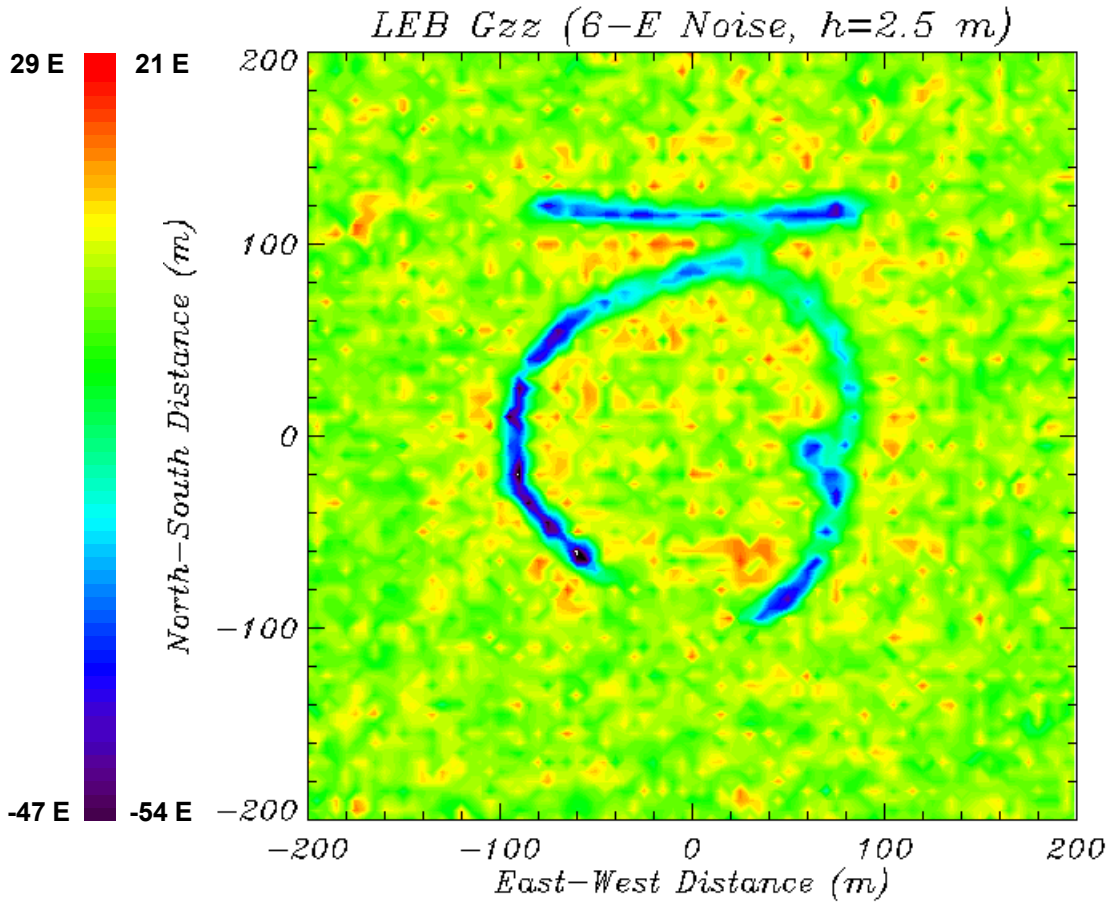
Algorithmically Derived and Modeled Γ_{zz} Gradient





Note: the larger and wider MEB and LEB-MEB transfer tunnel signal in the surveyed data

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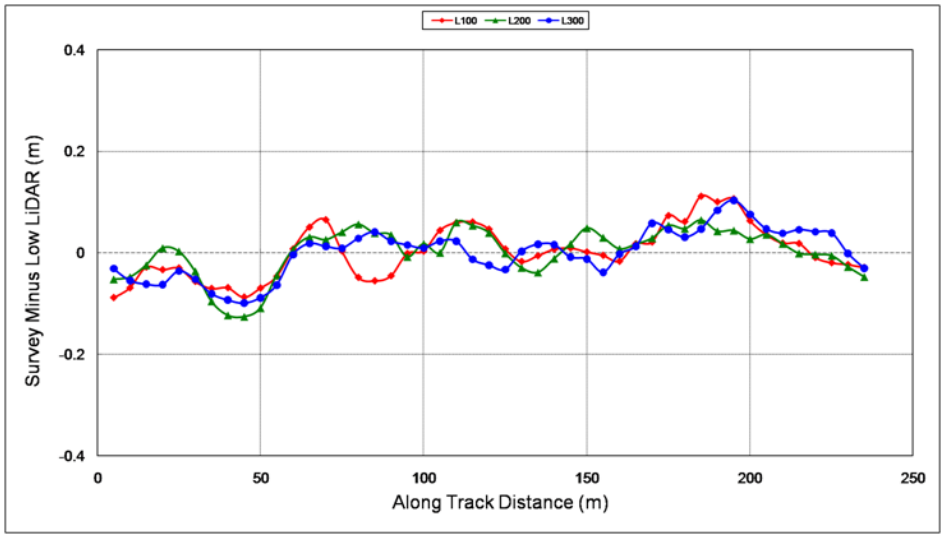
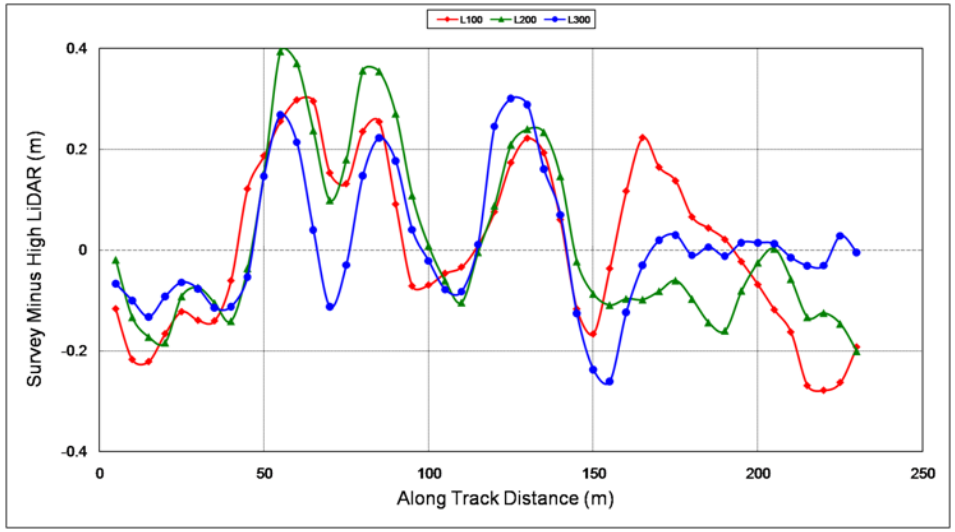
Elevation Differences Along LGS Profiles: LiDAR Minus GPS

LEB Low LiDAR vs. GPS
Mean = -1.274 m
Std. Dev. = 0.062 m

LEB High LiDAR vs. GPS
Mean = -0.462 m
Std. Dev. = 0.194 m





Means or vertical offsets were removed from profiles in above plots

High LiDAR elevations have ~3 times higher standard deviation
Lower and higher LiDAR vertical offsets differ by 0.812 m
No major topographic mismatch errors appear to be present

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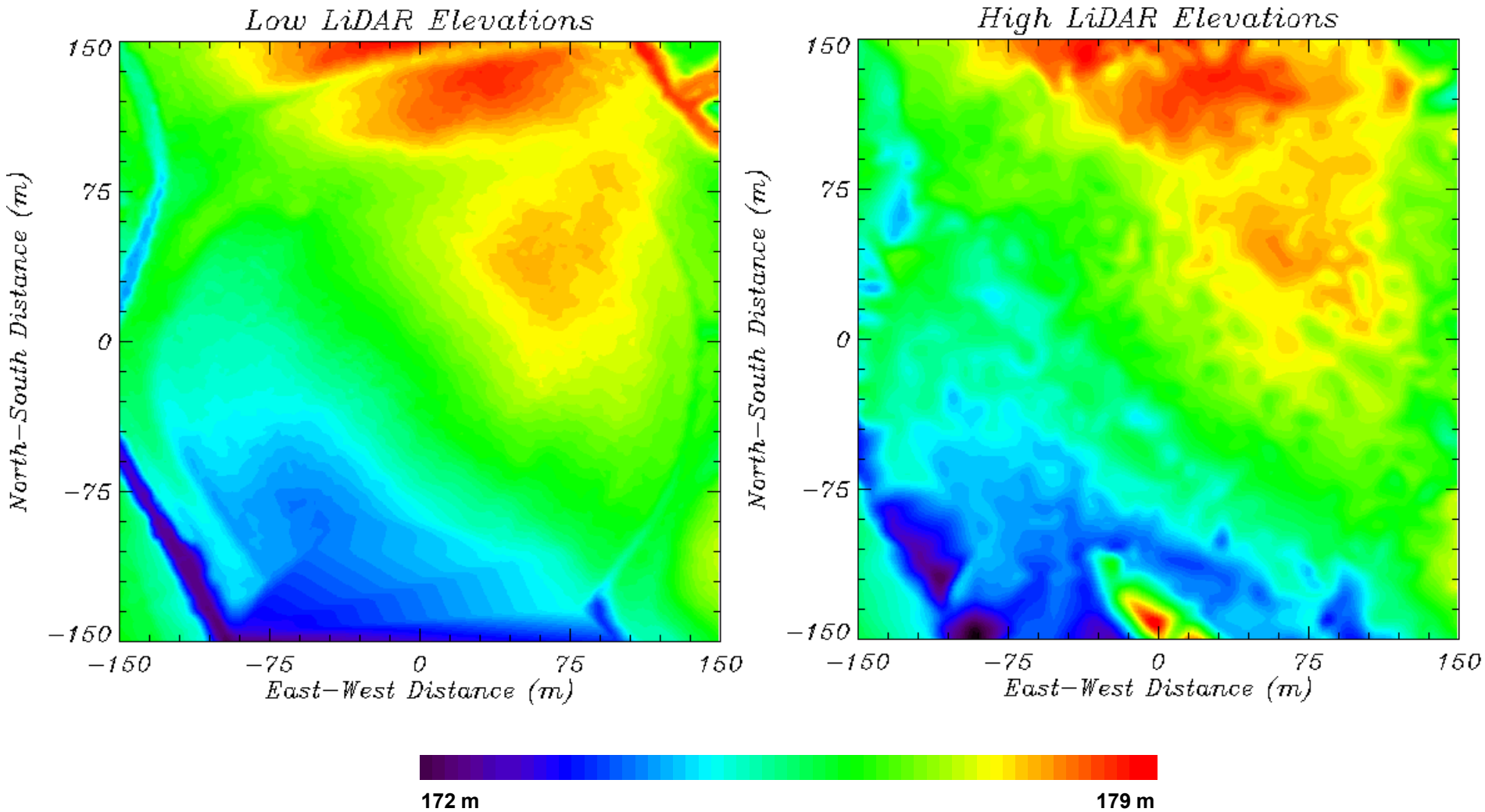
High & Low Gridded LiDAR Elevations After Applicable Offset Correction



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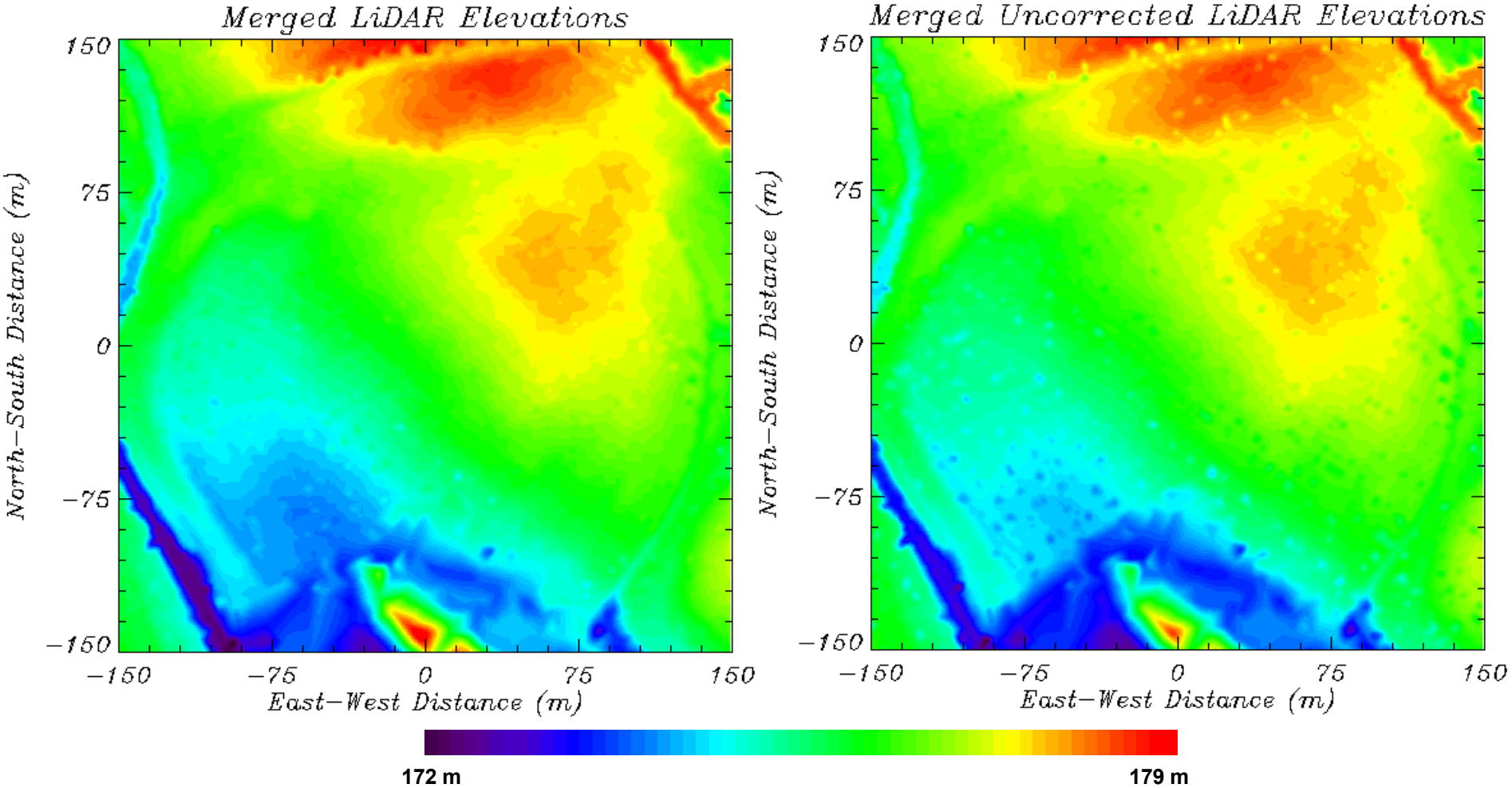
Merged High & Low Gridded LiDAR With and Without Two Offset Corrections



It is unknown if this offset was corrected prior to terrain correction

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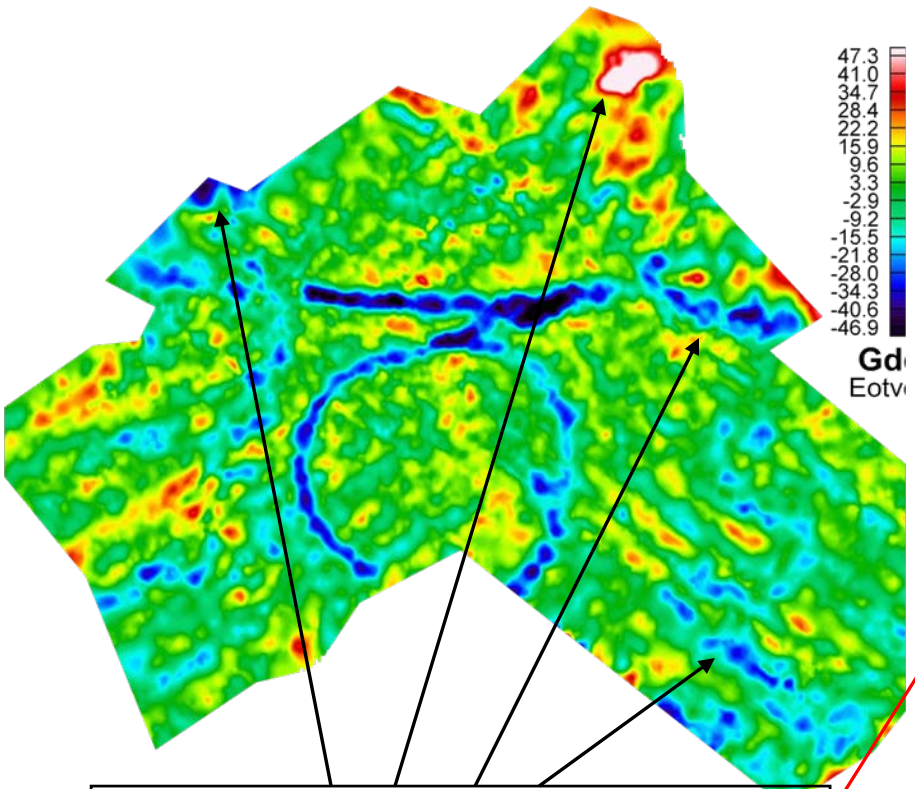
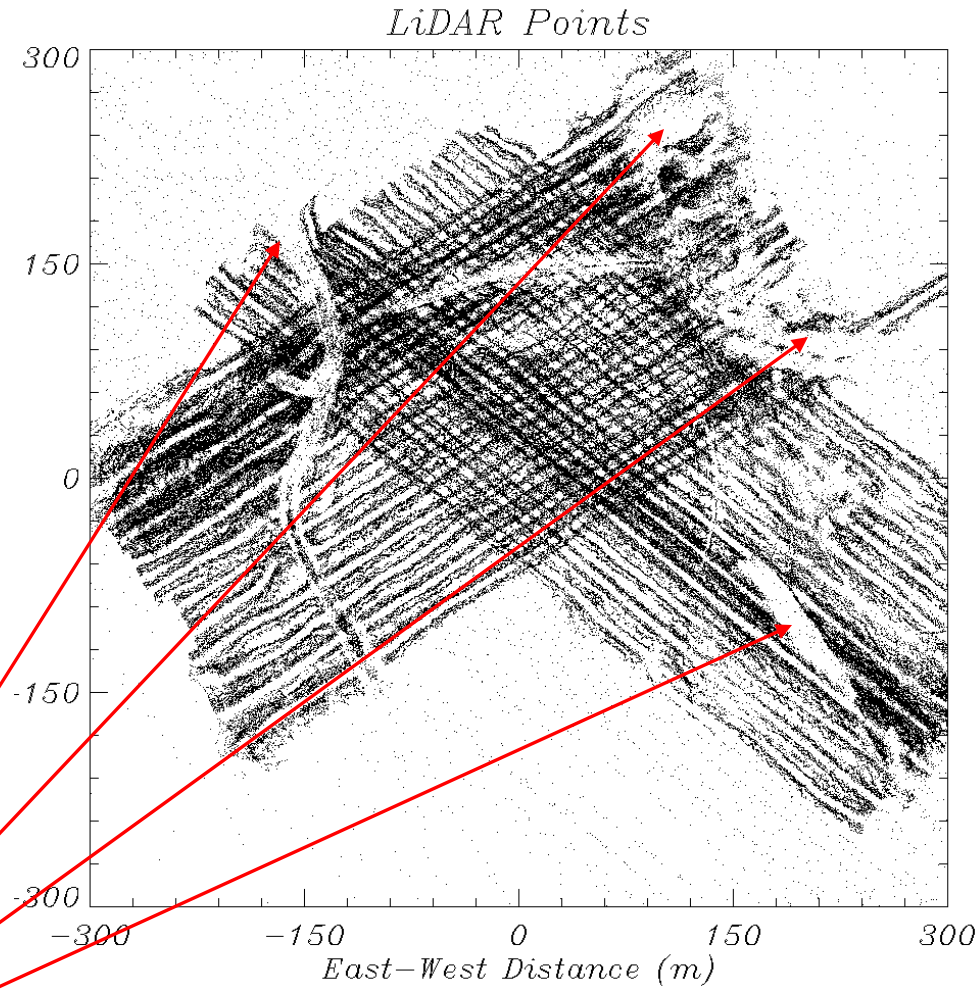
Airborne Terrain-Corrected Γ_{zz} and Merged LiDAR Point Plot





Features due to uncompensated terrain

Note LiDAR data gaps

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Conclusions

- Agreement between the surveyed data and forward models is very good at LEB crossings
- MEB and LEB-MEB transfer tunnel signal is much larger than the model
- No serious terrain mismatch errors evident in data
- Terrain-corrected surveyed data contain linear artifacts possibly due to LiDAR data gaps or offsets
- Some clutter component appears present but much smaller in amplitude than LEB and MEB signals
- LEB remains an excellent test bed for gradiometric technology tests

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DARPA-BAA-09-20
Gravity Anomaly for Tunnel Exposure (GATE)

Program Description

Joseph Durek
Program Manager

24 April 2009

Funding Opportunity Description

- DARPA is soliciting proposals under this BAA for prototype development of a gravity-based tunnel detection capability
- Program objective is to develop and demonstrate a prototype airborne gravity sensor system to detect and characterize tunnel networks
- System and performance metrics during classified session

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DARPA's Goal

- Develop, integrate, and demonstrate a prototype airborne gravity gradiometer system which is capable of detecting the mass deficit of a void in the presence of geological and topological variability
- Will provide a tunnel detection capability by integrating a gravity gradiometer, signal processing payloads, and mounting system on a low-altitude manned aircraft (MAC)/Unmanned Aerial System (UAS) and verifying performance in relevant geologic environments
  - Self contained within an airborne MAC/UAS
- Leverage emerging and existing research and development in gravity gradiometer technologies and develop these sensor technologies into a prototype airborne gradiometer system

Provide an additional intelligence and surveillance capabilities to the warfighter

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Acceptable Range of Technologies

- Interested in leveraging "emerging .. research and development" and the minimal qualification placed in the BAA is that proposed technologies have at least been shown to be viable in the laboratory
- Technologies that have been demonstrated in the laboratory and requires further sensor development to "mature and adapt the underlying transducer technology" for integration into a GATE platform

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3 Phase Program

- Phase 1 System Concept Feasibility
- Phase 2 Subsystem Validation
- Phase 3 Prototype System Demonstration
- Full scope of technical development across the three phases
  - Full cost proposals submitted for all three phases
  - Phase 2 and 3 cost proposals provided as costed options
  - Based on results of each phase, DARPA will decide whether to fund additional phases

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System Concept Feasibility

- Develop and validate the proposed end-to-end system concept prior to DARPA investment in full subsystem and system development
- Task 1: Demonstrate the ability of the end-to-end system concept and individual subsystems to meet prototype system performance metrics in classified Addendum 1
- Task 2: Develop advanced signal processing algorithms concepts to process gradiometer data for enhanced signature signal-to-noise ratio (SNR), clutter rejection in complex geologies, and tunnel detection and characterization
  - Government team will release simulated gradiometer and limited amount of survey data
- Task 3: Provide an end-to-end concept design outlining the GATE system deployment and operations and will develop a concept design for the prototype system which the performer proposes to develop in Phase 2 and Phase 3
- Task 4: Provide a concept of operation (CONOPS) detailing the GATE system deployment, operational platform, and flight profiles that will allow the GATE system to meet performance metrics

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Program Phasing: Phase 1 (Continued)

- The minimum expected deliverables are:
  - Monthly performance and financial reports.
  - Quarterly reviews including kick-off review and a final review.
  - System Concept document describing the subsystem- and system-level architecture of the proposed concept
  - CONOPS document describing the proposed operational profile for the GATE system, including proposed platforms and flight profiles required to meet performance objectives
  - Final Report detailing the algorithm concepts and prototype system specifications required to meet the GATE performance metrics
  - Updated Phase 2 technical and cost proposal
- Promising Sensing Technologies to be eligible for transition into Phase 2

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Subsystem Validation

- Develop critical GATE subsystems, demonstrating specifications sufficient to support system level performance metrics in the classified Addendum 1, to collect data from a relevant geologic environment to validate the sub-system performance
- Task 1: Integrate GATE sensor package hardware and demonstrate it on a surrogate airborne platform that is prototypical of the expected Phase 3 demonstration platform
- Task 2: Build a prototype isolation mount and demonstrate that it meets the subsystem performance determined in Phase 1 to provide sufficient sensor sensitivity
- Task 3: Develop advanced signal processing algorithms to process gradiometer data to demonstrate sensor SNR enhancement and detection and characterization performance meeting the classified Addendum 1 metrics
- Task 4: Provide details of a transition plan to operational user(s) which will be developed in cooperation with the Government

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Program Phasing: Phase 2 (continued)

- The minimum expected deliverables are:
  - System Architecture Document
  - Field Test Demonstration Plan Document
  - Validated functional prototype
  - Monthly performance and financial reports
  - Quarterly reviews (including kick-off and final review)
  - Updated Phase 3 technical and cost proposal
  - Final Report

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Prototype System Demonstration

- Develop, integrate, and demonstrate a prototype system at a relevant environment which has similar geographical noise and features as the areas of concern
- Task 1: Leverage results of the Phase 2, conduct GATE design review of GATE subsystems to assure that the design solution will satisfy the performance requirements as stated in the classified Addendum 1
- Task 2: Provide final design for all elements of the prototype system required to proceed to system development and integration
- Task 3: Integrate GATE sensor, sensor mounting, processing, and platform at the system level
- Task 4: Plan and coordinate the execution of the prototype system demonstration
- Task 5: Execute the prototype system demonstration and perform on-site data analysis and processing to extract target signatures from the background, interpret the signatures, and validate the GATE system prototype

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Program Phasing: Phase 3 (continued)

- The minimum expected deliverables are:
  - Preliminary Design and Critical Design Document detailing the prototype system design.
  - Demonstration on an operational airborne platform
  - Monthly performance and financial reports.
  - Quarterly reviews including kick-off review and a final review.
  - Demonstration test plan describing including description of flight profiles sufficient for Government safety review.
  - Final Report documenting the as-built demonstration system specifications and the system performance against the GATE program metrics.
  - The GATE demonstration system, suitable for independent operational evaluation by the user community

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Request Application Package

- Full packet
  - DARPA-BAA-09-20 (Unclassified)
  - DARPA-BAA-09-20 Appendix 1 (SECRET)
  - DD254 (Unclassified)
  - DARPA-CG-513 (FOUO)

- Instructions for requesting are in the BAA and classified package
  - Send an email to DARPA-BAA-09-20@darpa.mil

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Security and Proprietary Issues

- Proposals expected to be classified SECRET
  - To meet the system requirements and understand the Geographical areas of interest (GAOIs)
- Cost volume must be unclassified
- Mark all material appropriately
- Proprietary data
  - Mark cover and each page.
  - Clearly show what is proprietary

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Content and Form of Submission

- Proposal Information
  - BAA is open for 1 year (thru 27 Mar 10)
  - Due date for initial round of selection is: 05 Jun 09
  - Administrative correspondence to
    - DARPA-BAA-09-20@darpa.mil
    - Unclassified fax: 703-807-4992
    - DARPA/STO
      ATTN: DARPA-BAA-09-20
      3701 North Fairfax Drive
      Arlington, VA 22203-1714

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Submission Dates and Times

- For initial round of selections:
  - Proposal (1 hardcopy and 2 electronic (pdf and MS Word (MS Office 2003 Format) on CDROM)
  - Submitted to
    - DARPA/STO
    - Attn.: DARPA-BAA-09-20
    - 3701 North Fairfax Drive, Arlington VA 22203-1714
  - Received by 4:00 PM, local Arlington time, on 05 Jun 09
- For other submissions
  - Received after the above
  - Will be evaluated and may be selected
- DARPA will acknowledge by email and assign a control number

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Evaluation Criteria

- Evaluation will be through a review of each proposal using the following criteria, in order of descending importance:
  - Ability to Meet Program Go/No-Go Metrics
  - Overall Scientific and Technical Merit
  - Potential Contribution and Relevance to the DARPA Mission
  - Realism of Proposed Schedule
  - Proposer's Capabilities and/or Related Experience
  - Plans and Capability to Accomplish Technology Transition
  - Cost Realism

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Evaluation Criteria
Ability to Meet Program Go/No-Go Metrics

★The proposal clearly explains the technical approach(es) that will be employed to meet or exceed the applicable *program metrics* listed in the classified appendix

★The *feasibility and likelihood* of the proposed approach for satisfying the program go/no-go metrics are explicitly described and clearly substantiated

- The proposal reflects a mature and quantitative *understanding* of the performance go/no-go metrics, the statistical confidence with which they may be measured, and their relationship to the concept of operations that will result from successful performance in the program

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Evaluation Criteria
Overall Scientific and Technical Merit

- The proposed approach is feasible, achievable, and complete
- Task descriptions and associated technical elements provided are complete and in a logical sequence with all proposed deliverables clearly defined such that a final product that achieves the goal can be expected as a result of award
- The proposal clearly identifies major technical risks and planned mitigation efforts and provides ample justification as to why the approach(es) is / are feasible

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Evaluation Criteria

Potential Contribution and Relevance to the DARPA Mission

- The potential contributions of the proposed effort with relevance to the national technology base will be evaluated
- Specifically, DARPA's mission is to *maintain the technological superiority* of the U.S. military and *prevent technological surprise* from harming our national security by *sponsoring revolutionary, high-payoff research* that *bridges the gap* between fundamental discoveries and their military use

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Evaluation Criteria
Realism of Proposed Schedule

- The proposer's abilities to aggressively pursue performance metrics in the shortest timeframe and to accurately account for that timeframe will be evaluated, as well as proposer's ability to *understand, identify, and mitigate any potential risk* in schedule

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Evaluation Criteria
Proposer's Capabilities and/or Related Experience

- The proposer's assembled *technical team* that has the expertise and experience to accomplish the proposed tasks as referenced in Section 4.3.1, Section III, Detailed Proposal Information, on page 17
- The proposer's *prior experience* in similar efforts clearly demonstrates an ability to deliver products that meet the proposed technical performance within the proposed budget and schedule
- The proposed team's expertise to *manage the cost and schedule* will be evaluated
- Similar efforts completed/ongoing by the proposer in this area are fully described including identification of other Government sponsors

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Evaluation Criteria

Plans and Capability to Accomplish Technology Transition

- The capability to transition the technology to the research, industrial, and operational military communities in such a way as:
  - to enhance U.S. defense, and
  - the *extent to which intellectual property rights limitations creates a barrier* to technology transition.

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Evaluation Criteria
Cost Realism

- ... the proposed costs are realistic for the technical and management approach offered, as well as to determine the proposer's practical understanding of the effort.
- ... principally measured by cost per labor-hour and number of labor-hours proposed, but will also include evaluation of the labor resources assigned to complete major technical tasks.
- ...recognize that undue emphasis on cost may motivate proposers to offer low-risk ideas with minimum uncertainty and to staff the effort with junior personnel in order to be in a more competitive posture. *DARPA discourages such cost strategies and a low-cost proposal which does not assign sufficient resources and technical resources* to achieve the proposed objectives may be evaluated poorly for unnecessary risk.
- ... innovative management concepts that maximize direct funding for technology and limit diversion of funds into overhead.
- After selection and before award the contracting officer will negotiate cost/price reasonableness.

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Review and Recommendation Process

- DARPA will select source whose offeror meets the Government technical, policy and programmatic goals
- Primary basis for selecting proposals will be
  - technical,
  - importance to DARPA programs, and
  - fund availability.
- Government personnel will conduct review
- Proposals may be handled for administrative purposes by support contractors.
- Input on technical aspects may be solicited by DARPA from non-Government consultants/experts (under non-disclosure agreements).
- Proposals will not be returned.

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Agency Contacts

- Administrative, technical, or contractual questions
  - Email to DARPA-BAA-09-20@darpa.mil
  - Fax to 703-812-4992

- Technical POC
  - Dr. Joseph Durek

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DARPA-BAA-09-20
Gravity Anomaly for Tunnel Exposure (GATE)

Questions?