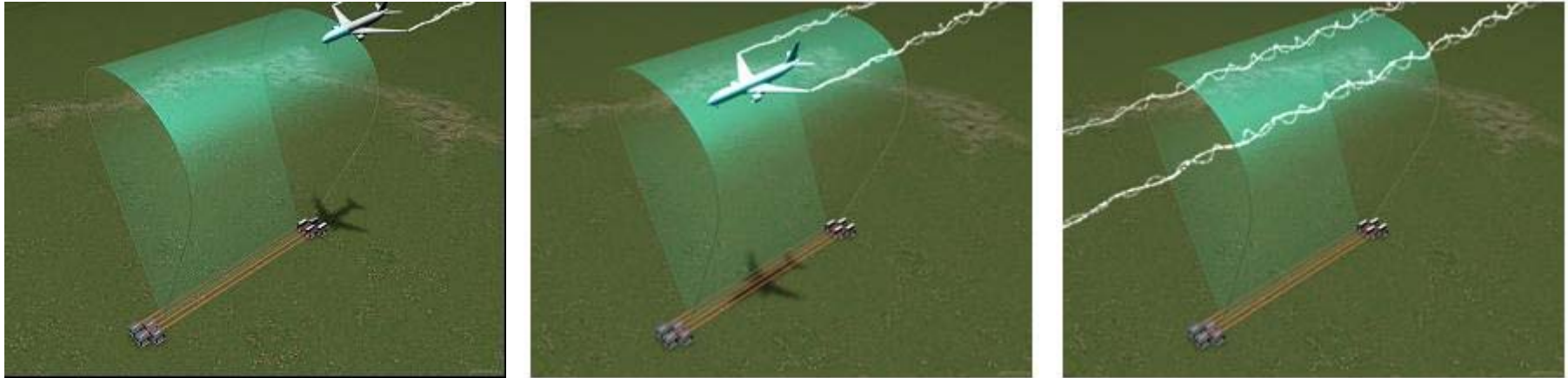


Acoustic Vortex Sensing  
**SOCRATES™**  
Status and Program Plans  
WakeNet USA  
March 17, 2005

# Outline

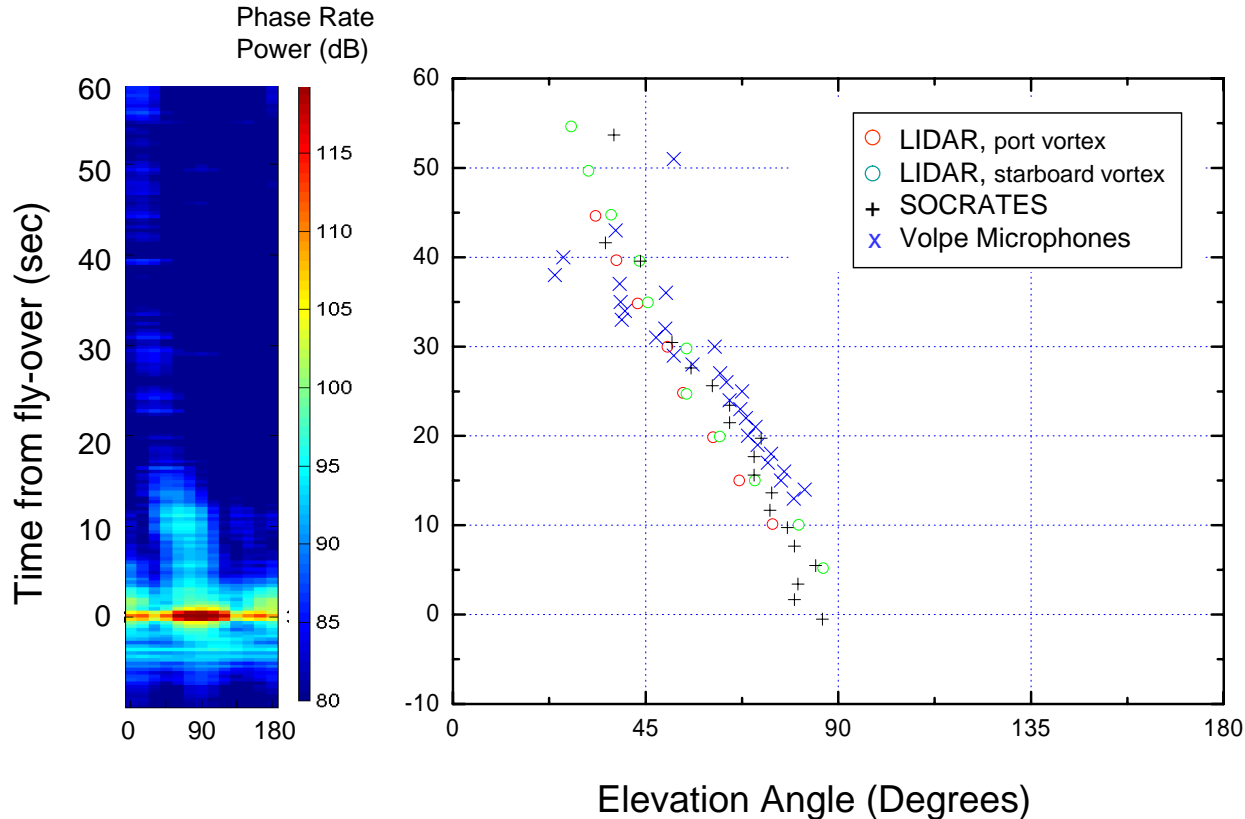
- 2003 DIA Test Results
- 2005 DIA Test Plan
- 2006 Proposed WakeVAS Emulation



## Summary of DIA results by aircraft type

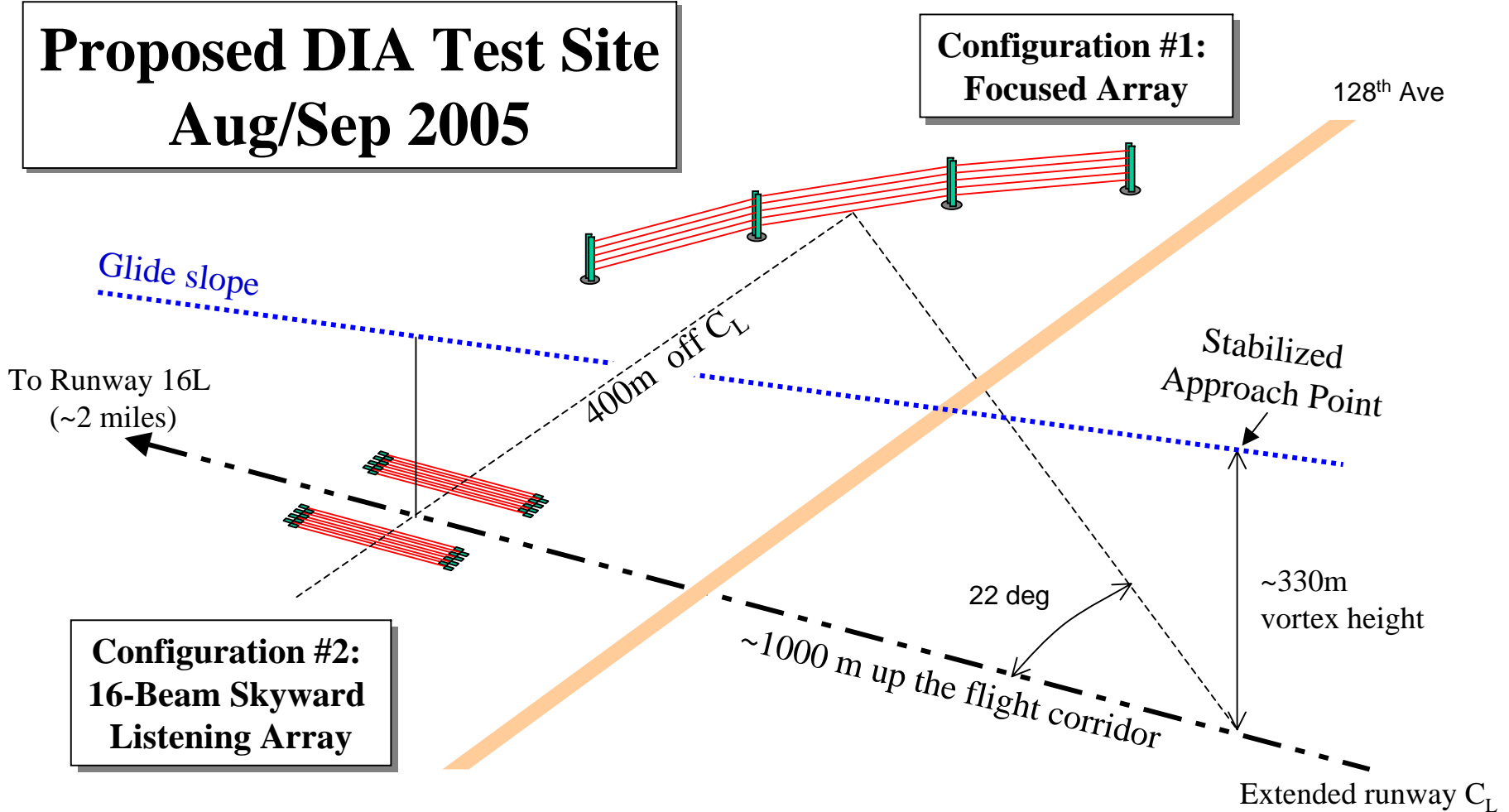
A-320	B-737	B-757	B-767	B-777	MD80	RJ	Total
191 of 245	217 of 283	73 of 92	13 of 15	17 of 17	46 of 54	156 of 176	713 of 882
78%	77%	79%	87%	100%	85%	89%	81%

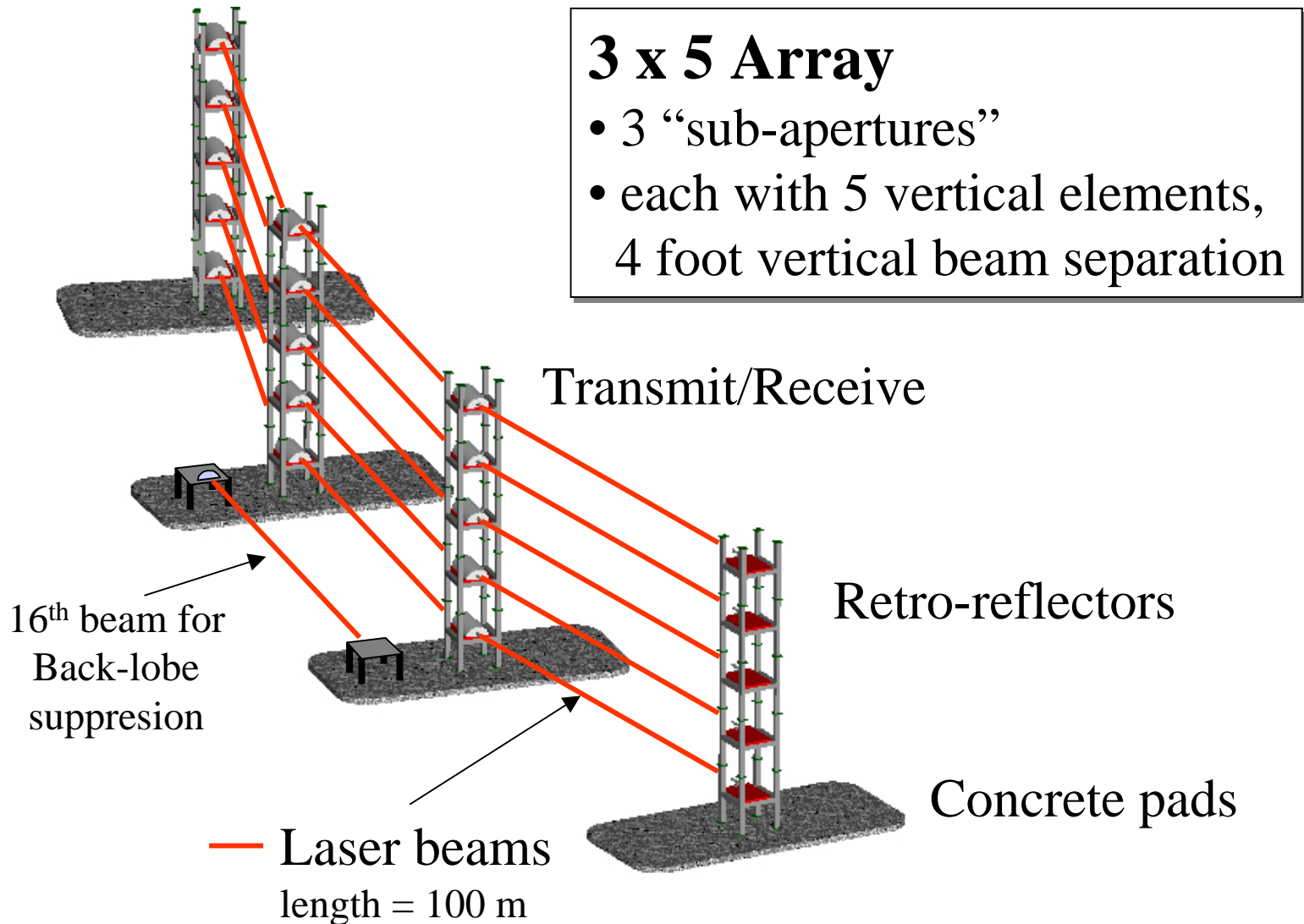
SOCRATES Tracking results compare well to LIDAR, Gov't microphones



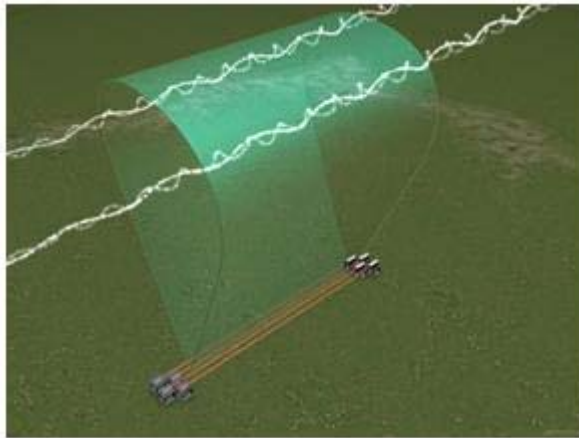
SOCRATES Technical Status Report available upon request

## Proposed DIA Test Site Aug/Sep 2005

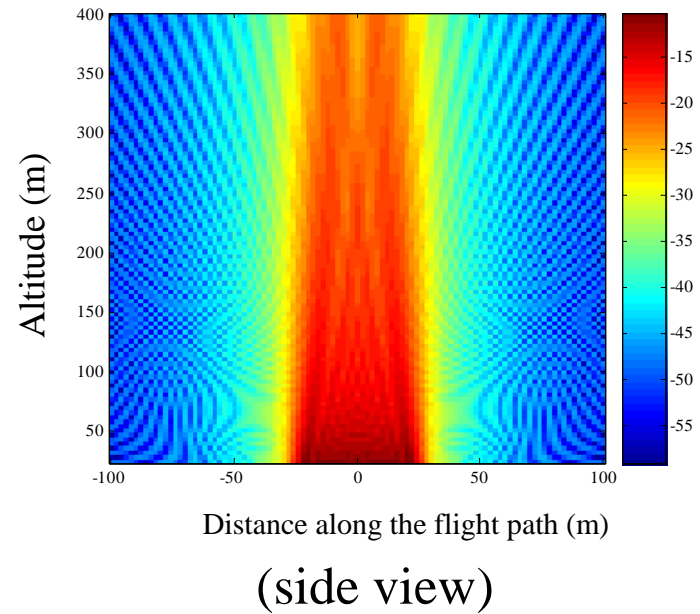




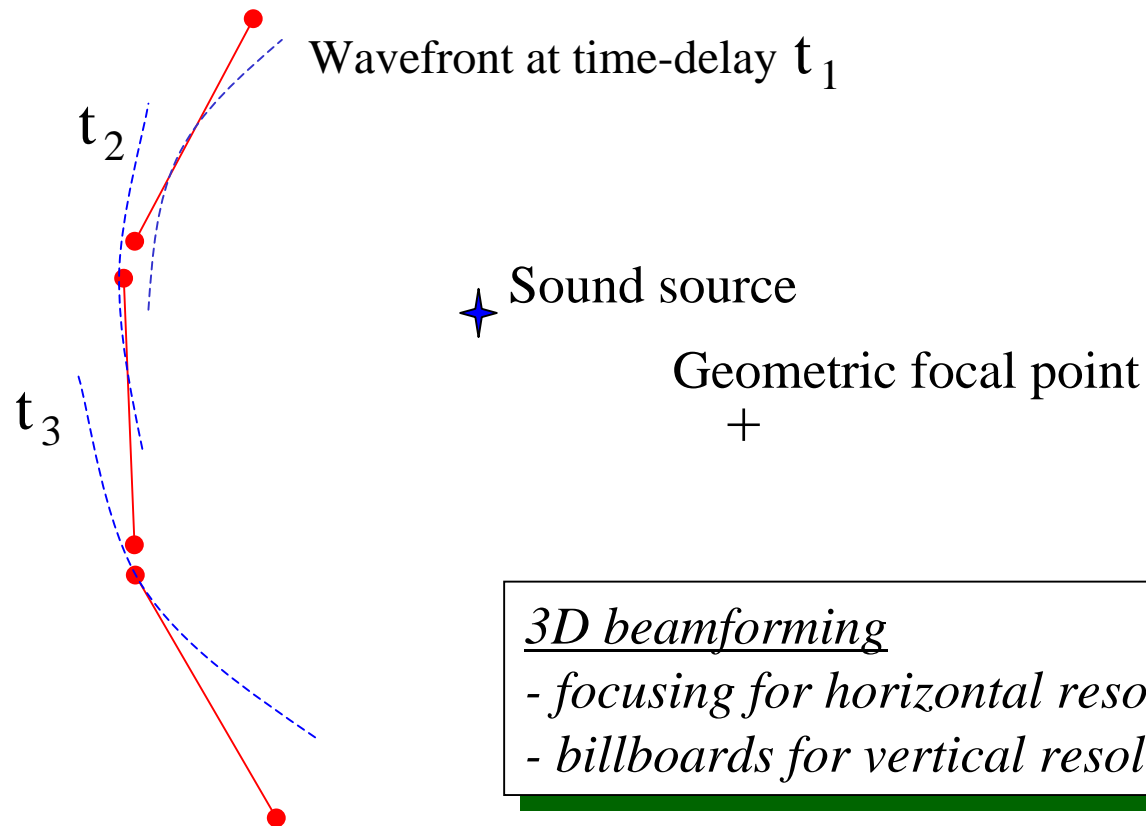
## Beampattern for skyward listening array



Acoustic Power Level  
 $20\log_{10}(? f / \mu\text{rad})$   
for a  $20 \mu\text{Pa}$  340 Hz source



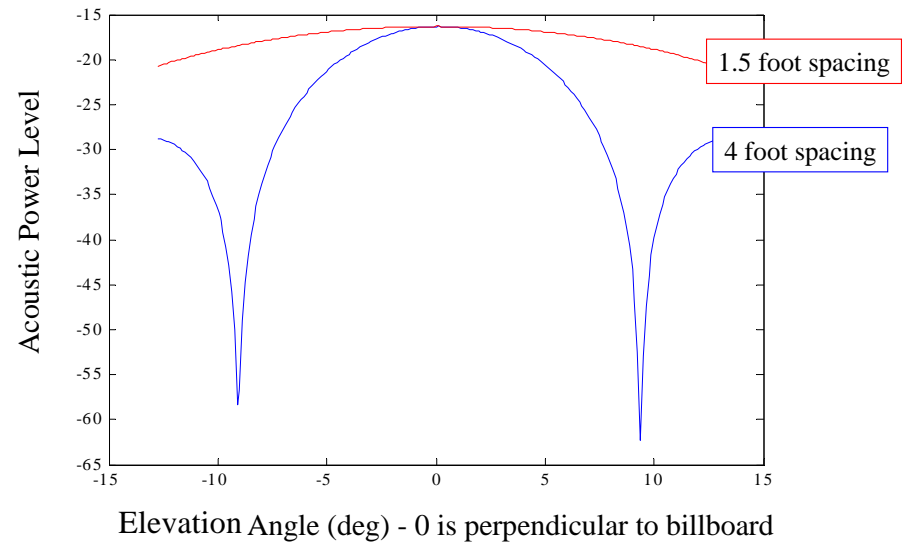
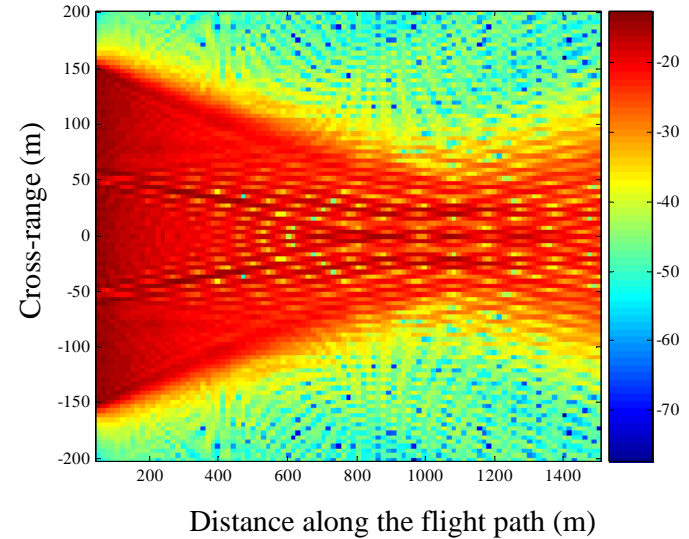
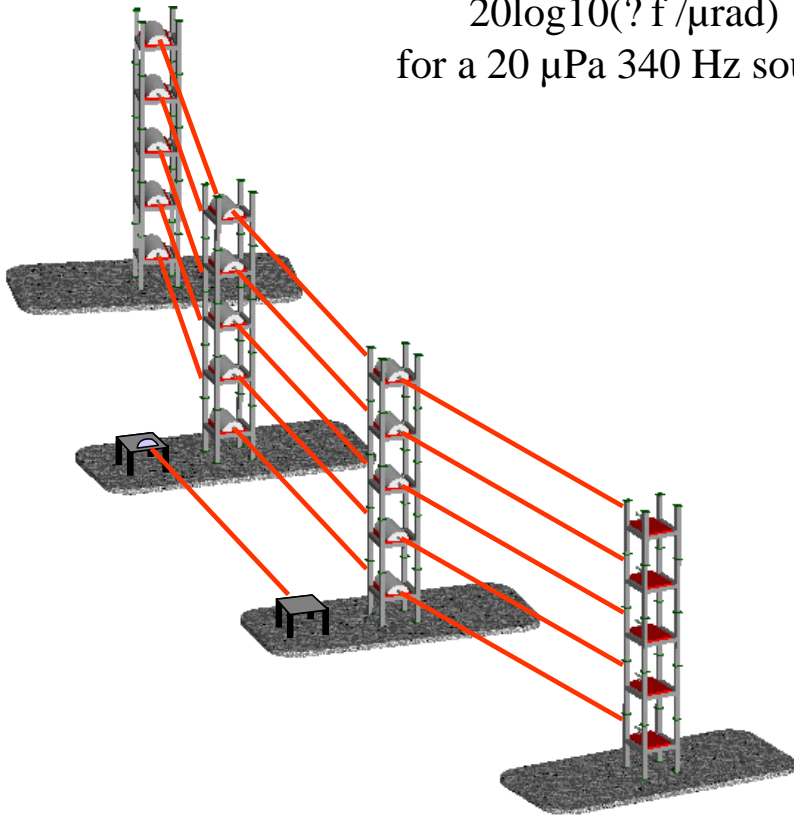
## Focused Array Concept – *increases stand-off gain and tracking resolution*



Each of these three legs (in red) represents a vertical billboard stack of 5 sensors

## Beampattern for focused array

Acoustic Power Level  
 $20\log_{10}(f/\mu\text{rad})$   
for a 20  $\mu\text{Pa}$  340 Hz source



## Relative Signal Array Gain

*Acoustic Power Level*

4-beam array: 4 50m sensors at 200m ... -19.4 dB

Focused Array: 3x5 100m sensors at 1100m ... -15.0 dB

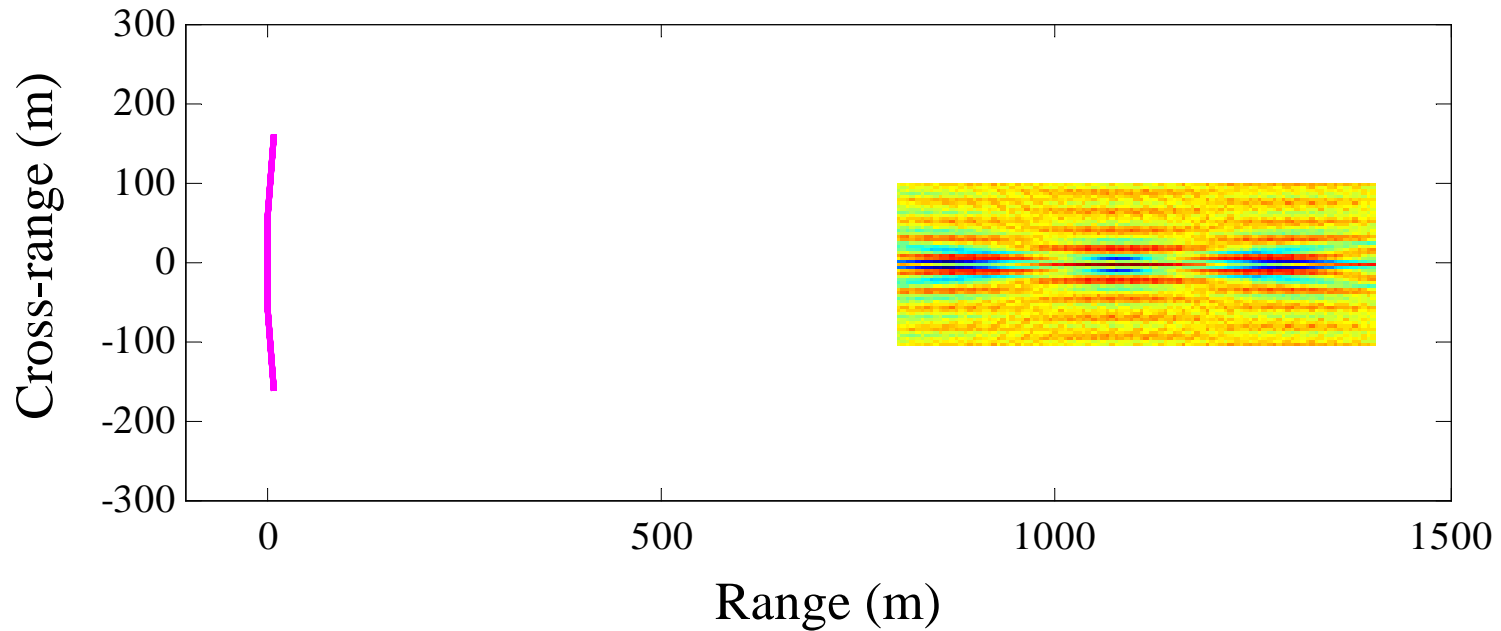
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4.4 dB gain

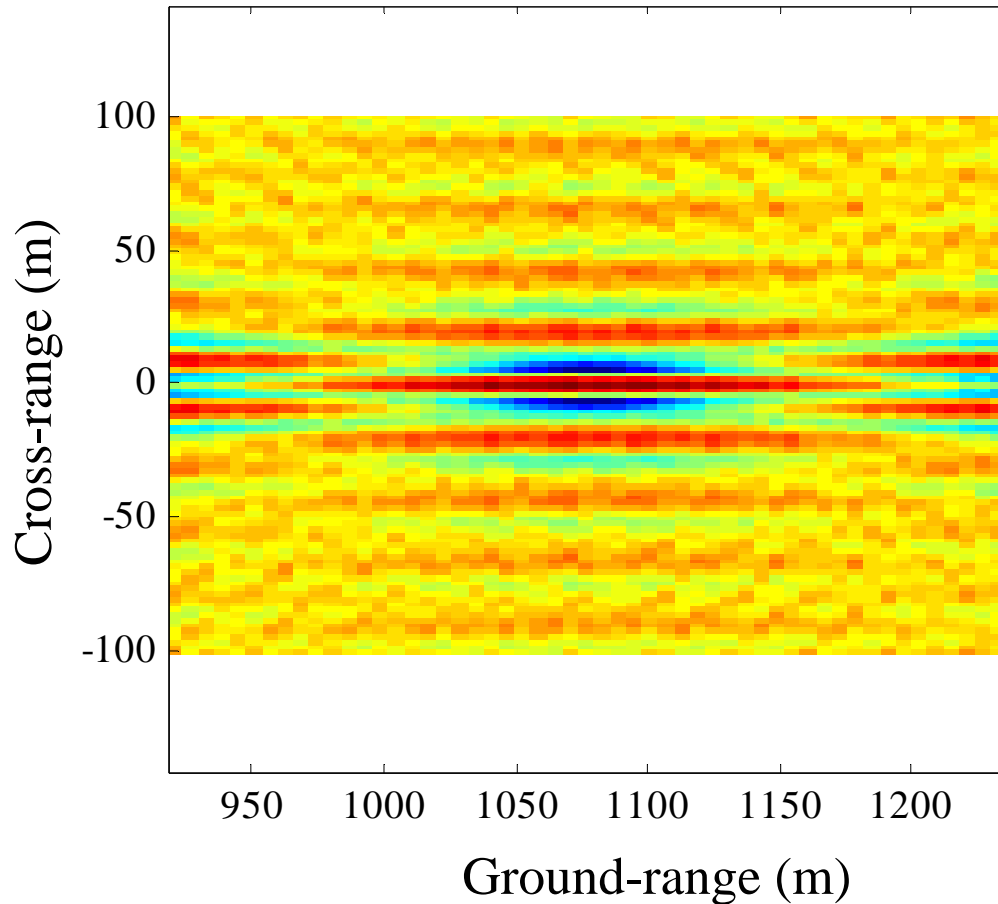
*Even with a possible 3dB increase (doubling) in RIV noise,  
an improved Detection Threshold should be achieved*

Focused Tracking: 3x5 billboard arrays

*3D resolution: range, cross-range, and elevation*



Tracking a broadband source  
*at 1077m ground-range, 250m elevation (1106m direct range)*



## Summary of Focused Array Performance Predictions

### Resolution

Cross-range: ~ 6 m

Down-range: ~ 170 m

Vertical: ~ 75 m (assuming gain from ground bounce)

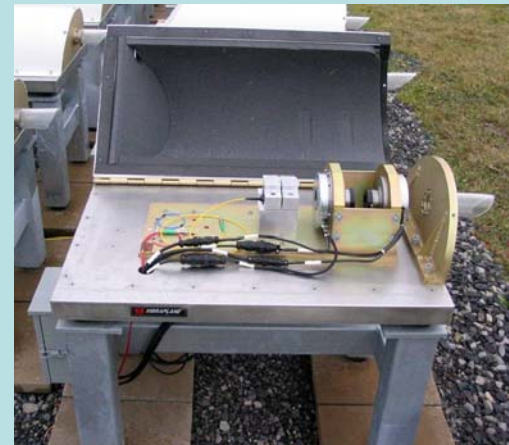
### Performance

Additional sensors yield ~ 1.4 - 4.4 dB increase in detection threshold over 2003 test

- Increase due to focusing and array gain
- Accounts for additional distance to source

## Current Status:

- Hardware for 16-beam system undergoing testing in Syracuse
- Software development is underway
- Billboard structure is in detailed design stage
- DIA officials have been briefed
- Previous test site is intact



**16-beam system assembled and tested in Syracuse**

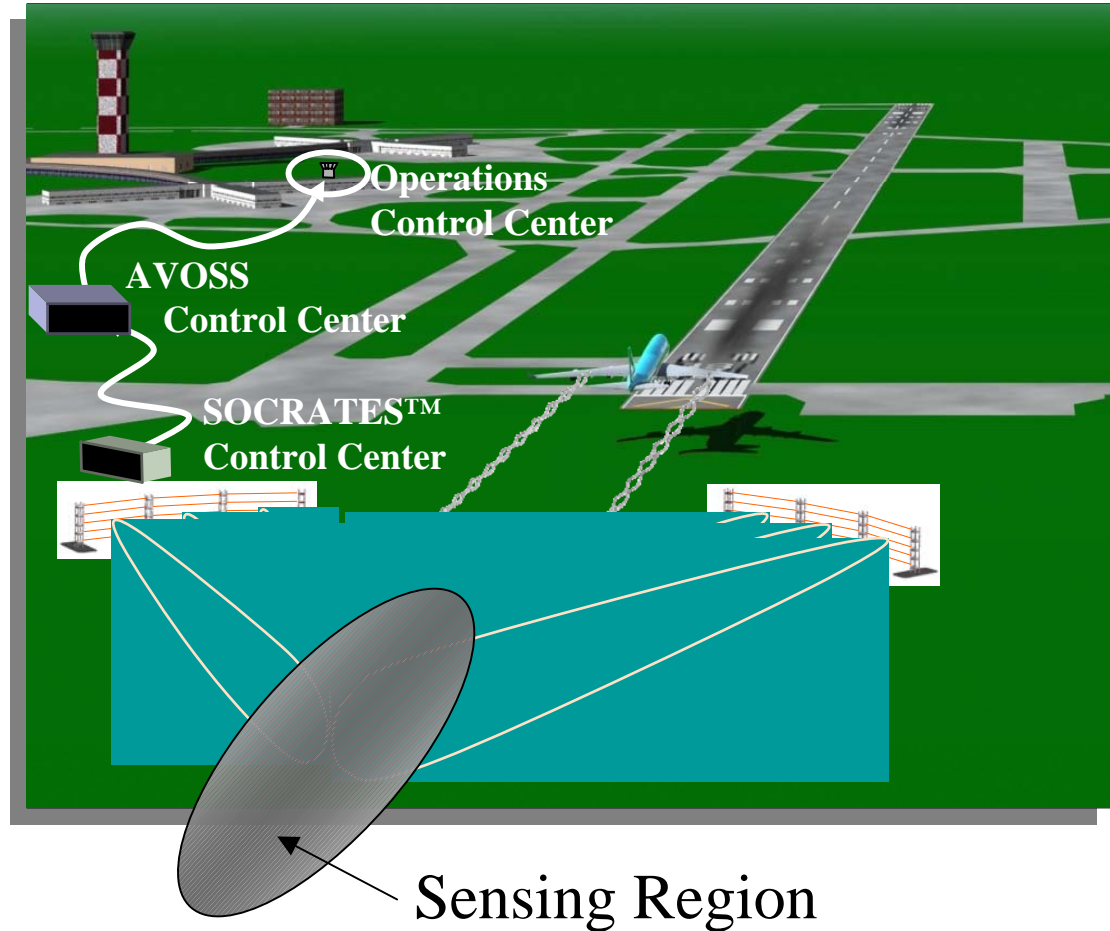
# **2006 Proposed WakeVAS Emulation**

## Wake Vortex Advisory System Emulation

- Develop, test and evaluate a 32-beam system
  - Remote, stand-off focused array
  - Integrated with AVOSS wake vortex predictions
  - System emulation, real-time display of predicted & measured vortex behavior
  - Assess potential capacity enhancement
- Compliance with WakeVAS Phase 3 CONOPS

## Wake Vortex Advisory System Emulation

- ① Wake behavior forecast using meteorological data and AVOSS algorithms.
- ② The SOCRATES sensor provides validation of the AVOSS algorithm's predicted vortex behavior.
- ③ Results are communicated to an operational control center (OCC)
- ④ OCC houses a real time display of aircraft surveillance and both predicted and measured vortex behavior.
- ⑤ The potential for increased capacity will be assessed.



## Wake Vortex Advisory System Emulation Demonstration Team

### **FST/LMC<sub>o</sub>**

- Complete 32-beam system
- Integrate sensor output with AVOSS predictions
- Facilitate communication of predicted and measured wake tracks to the Operations Control Center

### **UNITED AIRLINES**

- Provide aircraft surveillance data using PASSUR data
- Provide wind and turbulence measurements through MDCRS
- Provide workstation and operator in OCC

### **VOLPE**

- Facilitate test planning, test-site preparation, test monitoring

## Wake Vortex Advisory System Emulation

Other Desired Participants:

### **NASA LANGLEY**

- Provide AVOSS prediction tools
- Provide on-site test support

### **FAA**

- Provide guidance and oversight
- Emulate capacity enhancement
- Participate in benefit analysis