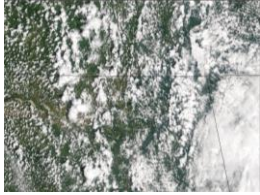
UPDATE



DEVELOPMENT OF A REMOTE-SENSING TESTBED FOR TROPOSPHERIC AIR QUALITY AND WINDS

University of Alabama in Huntsville

Mike Newchurch, Sundar Christopher, David Bowdle,
Kevin Knupp, John Mecikalski , Walt Petersen,
Mike Botts, Dick McNider, Rochelle Williams

NASA Marshall Space Flight Center

Tim Miller, Steve Johnson

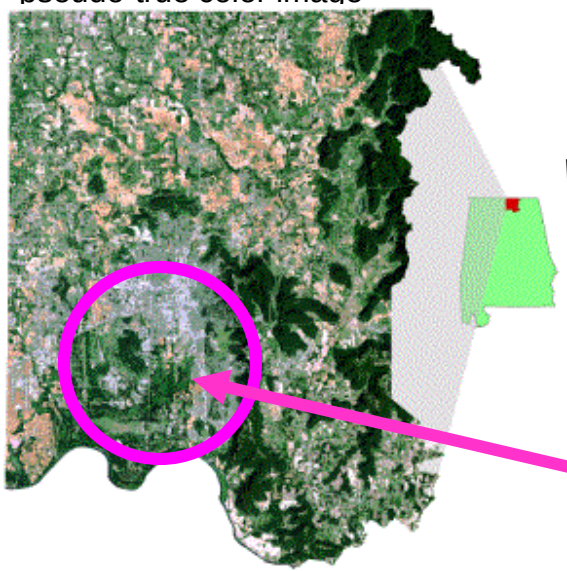
Simpson Weather Associates

Dave Emmitt

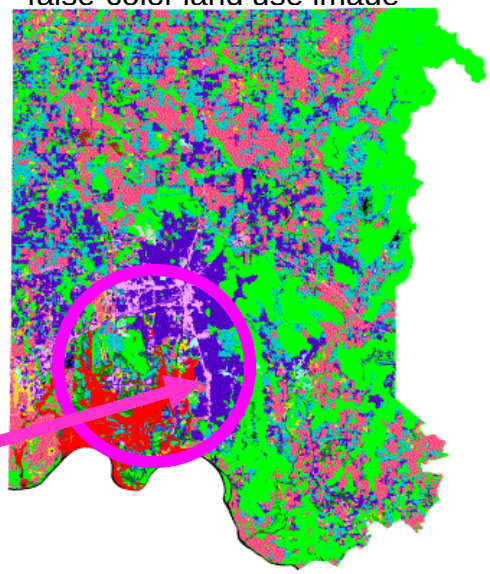
Working Group on Space-Based Lidar Winds

Welches, Oregon, June 27-30, 2006

pseudo-true color image



false-color land use image



Huntsville/Madison Urban Corridor and Redstone Arsenal In Northern Alabama

Presentation Outline

- **hosting Army Workshop**
- **installing Doppler lidar scanner**
- **integrating lidar winds with radar winds**
- **initiating NOAA Air Quality research**
- **integrating Huntsville assets**

Workshop on a Soldier-Scale Atmospheric Testbed (SSATB)

March 29-31, 2006, Huntsville, Alabama

Sponsored by the Army Research Office (ARO, Walter Bach)

Coordinated by the Aviation and Missile Research, Development, and Engineering Center (AMRDEC, Henry Everitt)

Hosted by the University of Alabama in Huntsville (UAH, Mike Newchurch)

ATTENDANCE

- 30 attendees, civilian (UAH, NASA/MSFC) and military (Army, Air Force)

ISSUES

- improved characterization of the atmospheric boundary layer
- comparison of model results to observations
- high spatial and temporal resolution
- data collection requirements

FOLLOWUP

- pending review

Installation of Doppler Lidar Scanner

2 µm Doppler lidar transceiver
provided by Earth Science Office (ESO)
NASA Marshall Space Flight Center (MSFC)

transceiver status
– operating

scanner mount design
– completed

scanner mount assembly
– completed

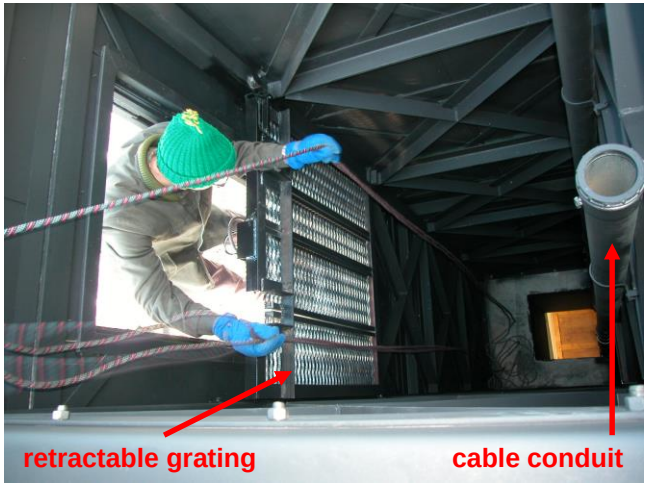
scanner mirror recoating
– in progress

scanner installation
– summer 2006

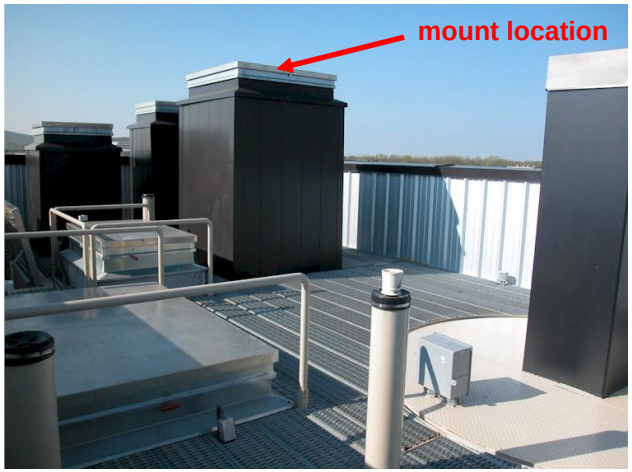
scanner georegistration
– summer 2006

lidar characterization
– fall 2006

DFM alt/azimuth scanner
provided by Simpson Weather Associates



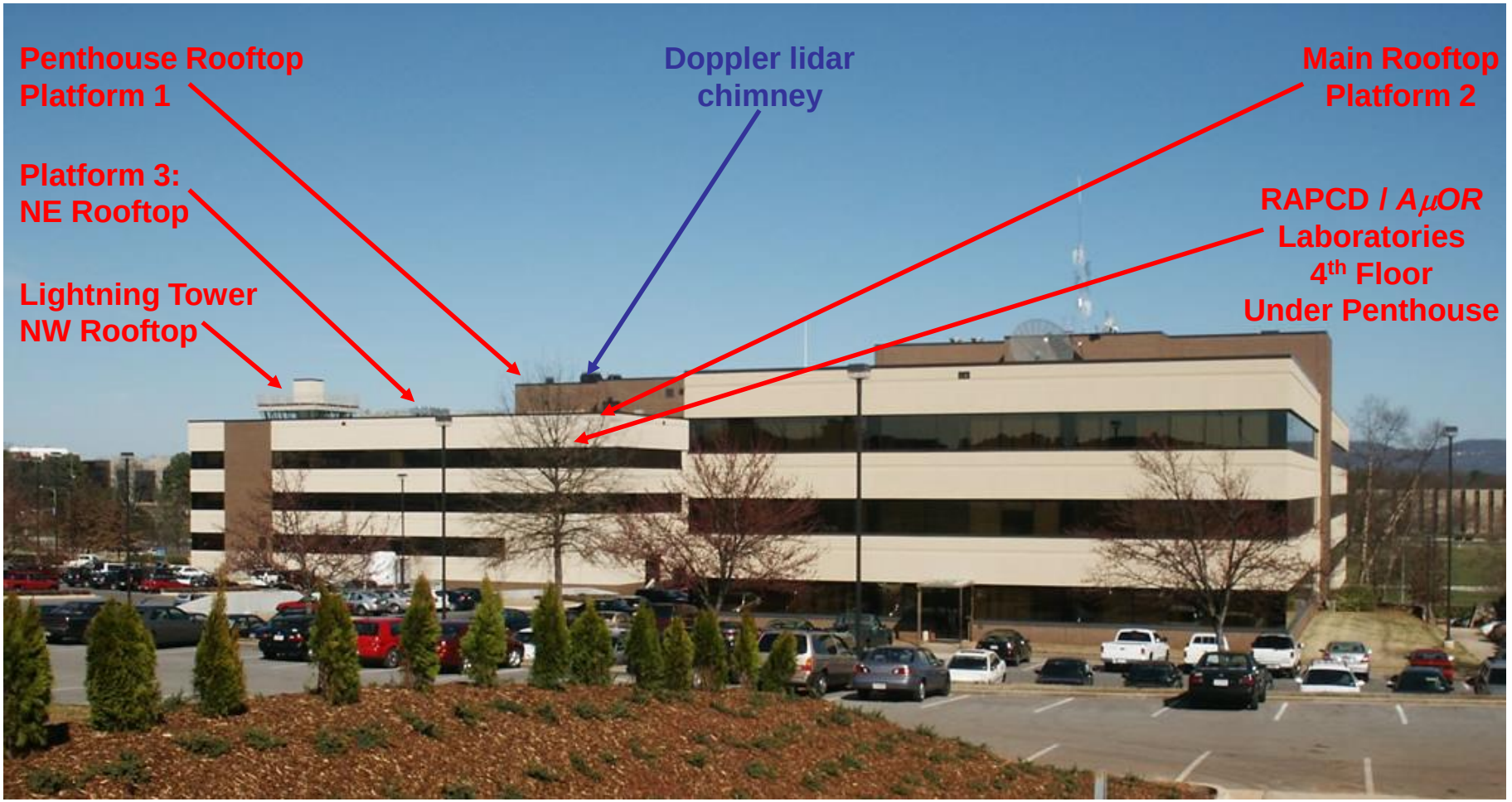
Doppler lidar chimney – interior view



Doppler lidar chimney – exterior view

Installation of Doppler Lidar Scanner

National Space Science and Technology Center: View from West



Integrating Lidar Winds with Radar Winds

SPECIFICATION	*DWL*	*ARMOR*	*MAX*
Wavelength	2.017 μm	C-band, 5.625 GHz (5.333 cm)	X-band, 9.4 GHz (3.2 cm)
Pulse Rate	6.6 Hz	250 Hz - 2 kHz	2 kHz max
Pulse Length	0.7 μs (FWHM)	0.5 - 2.0 μs	0.4, 0.8, 1.2, 2.0 μs
Pulse Strength	50 mJ	350 kW	200 kW
Exit Beam Diameter	0.08 m ($1/e^2$)	1.1° FWHM	0.9° FWHM
Gate Spacing	105 m	75 – 1000 m	30 – 300 m
Minimum Range	150 m	1 km	2 km
Maximum Range	10 km	50-200 km	50-200 km

DWL = Doppler Wind Lidar
ARMOR = Advanced Radar for Meteorological and Operational Research (*dual polarization*)
MAX = Mobile Alabama X-Band Radar (*dual polarization*)

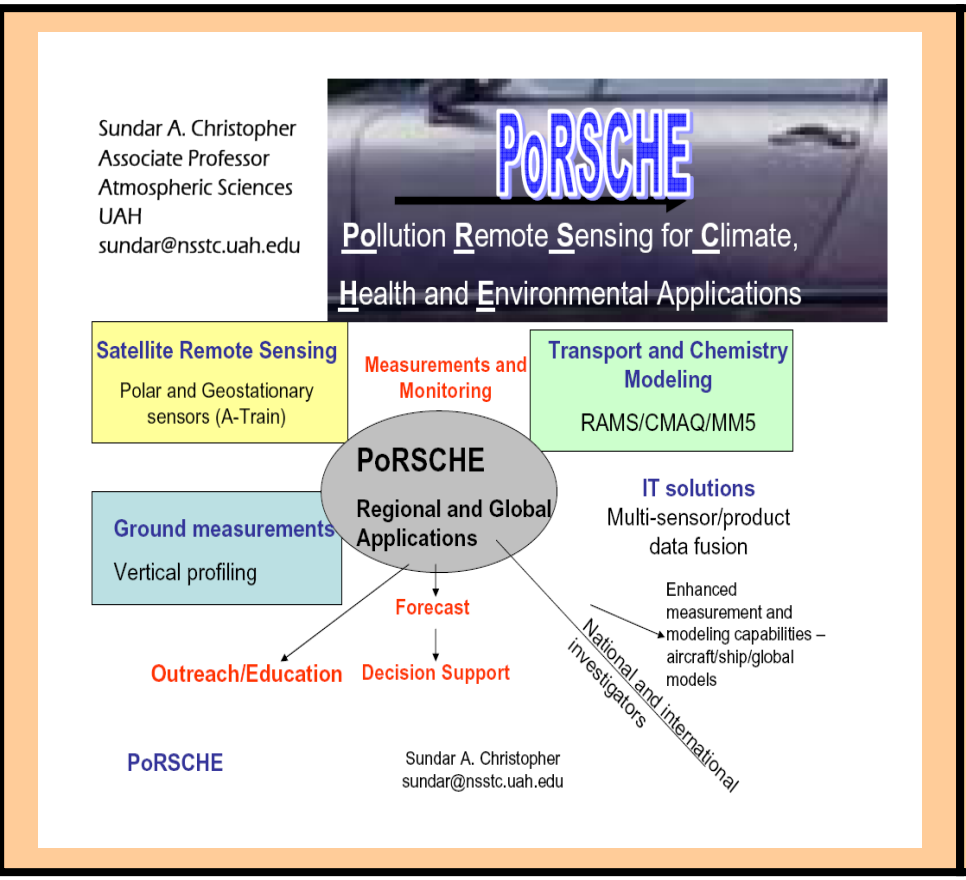
Integrating Lidar Winds with Radar Winds

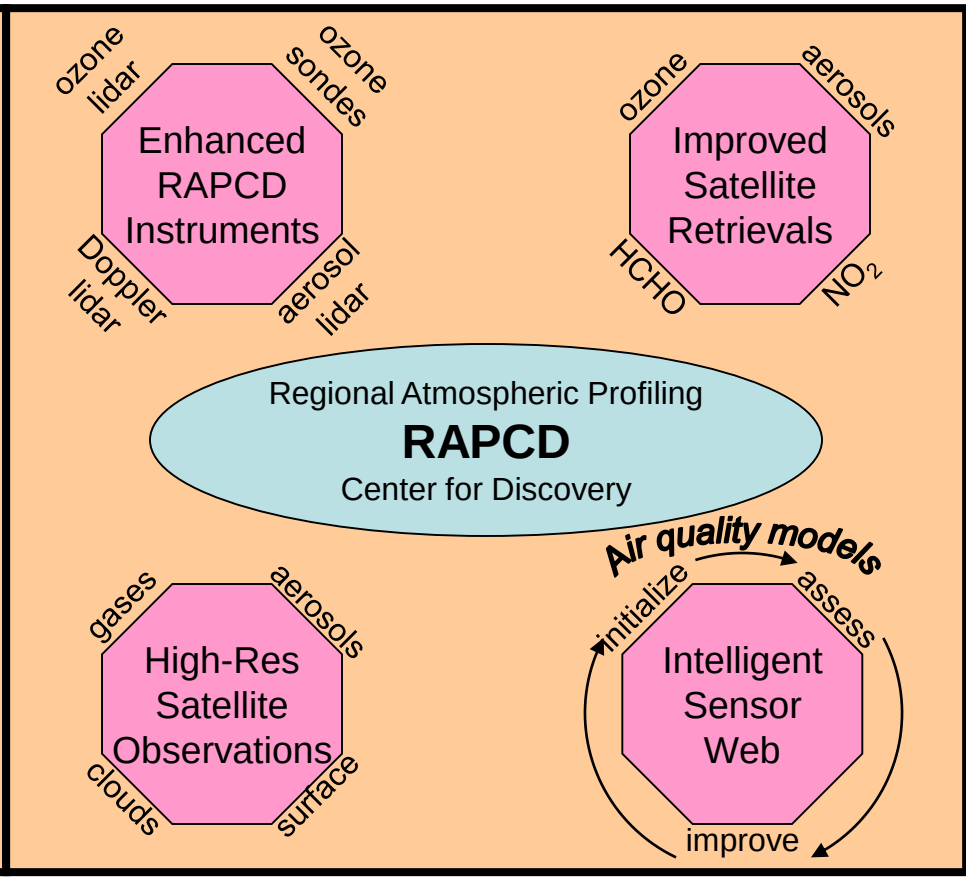
- emphasize clear-air wind analyses in the atmospheric boundary layer (ABL)
- dual polarization radars minimize contamination from birds and insects
- dual Doppler radar coverage centered over Doppler lidar domain
- in-house tests show Advanced Regional Prediction System (ARPS) Data Analysis System (ADAS) superior to Local Analysis and Prediction System LAPS)
- high-resolution nested mesoscale models generate gridded wind fields
- minimizes need for 4-D variational assimilation of Doppler lidar data
- routine wind fields for studying ABL structures and processes

NOAA Air Quality Research Initiative

Objective : To study and predict the impact of air pollution on climate, health and other environmental applications

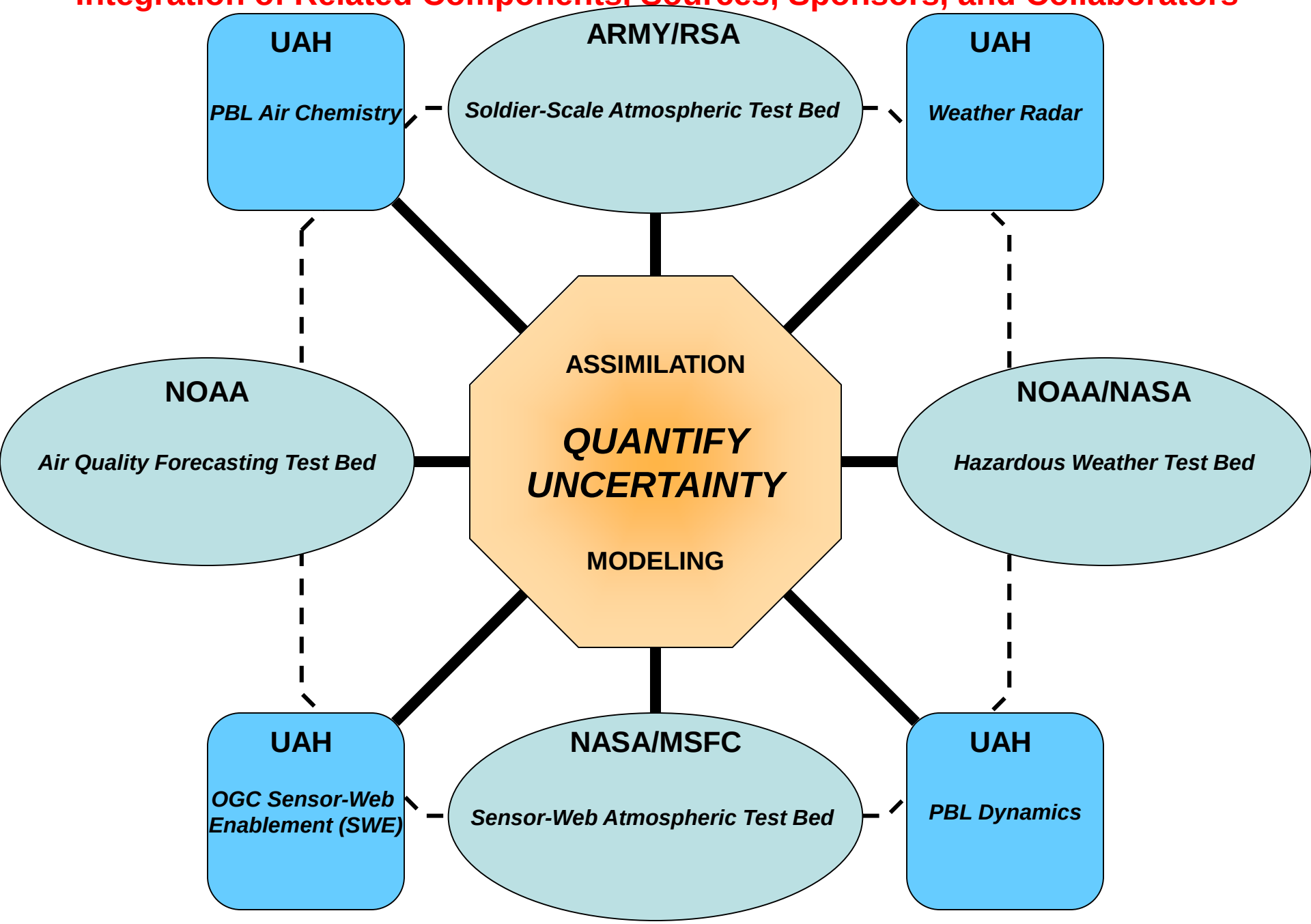
Objective : Develop improved transferable air quality models for the Huntsville-Madison-Decatur transportation corridor.





Anticipated Start: Summer 2006

Integration of Related Components, Sources, Sponsors, and Collaborators

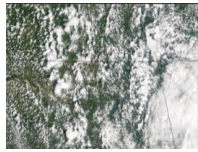


coordinated multi-agency research and development, with rapid-prototyping user-responsive transition to transferable operations

Integration of Research Activities and Huntsville Distinctives

diverse weather

other agencies



diverse airmasses

multiple applications

UAH

PBL Air Chemistry

ARMY/RSA

Soldier-Scale Atmospheric Test Bed

UAH

Weather Radar

multiple parameters

routine operation

stationary sensors

complementary sensors

ASSIMILATION

QUANTIFY UNCERTAINTY

MODELING

NOAA

Air Quality Forecasting Test Bed

NOAA/NASA

Hazardous Weather Test Bed

nested observations

nested models

satellite data analysis

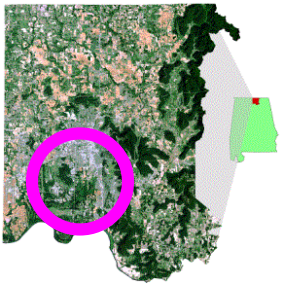
surface energetics

guest investigators

intensive ops periods

complex terrain

diverse land usage



UAH

OGC Sensor-Web Enablement (SWE)

NASA/MSFC

Sensor-Web Atmospheric Test Bed

UAH

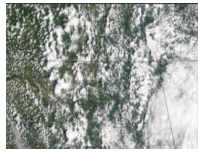
PBL Dynamics

coordinated multi-agency research and development, with rapid-prototyping user-responsive transition to transferable operations

Integration of Multi-Institutional Multi-Disciplinary Research Staff

diverse weather

other agencies



diverse airmasses

multiple applications

UAH

PBL Air Chemistry
Mike Newchurch
David Bowdle
Kirk Fuller
Steve Johnson (MSFC)

ARMY/RSA

Soldier-Scale Atmospheric Test Bed
Henry Everitt (AMRDEC)
Dan Schmitt (RTTC)
Walter Bach (ARO)

UAH

Weather Radar
Walter Petersen
Kevin Knupp

multiple parameters

routine operation

stationary sensors

complementary sensors

John Case (ENSCO)

ASSIMILATION

John Mecikalski

QUANTIFY UNCERTAINTY

Udaysankar Nair

MODELING

Bill Lapenta

Dick McNider

Kevin Doty

NOAA

Air Quality Forecasting Test Bed
Mike Newchurch (UAH)
Sundar Christopher (UAH)
Chris Darden (NWS), Dale Quattrochi (MSFC)
Arastoo Biazar, Noor Gillani (UAH)
Quingyuan Han (UAH)

NOAA/NASA

Hazardous Weather Test Bed
Bill Lapenta, Gary Jedlovec (MSFC)
Rich Blakeslee, Dan Cecil (MSFC)
Kevin Knupp, Walter Petersen (UAH)
Chris Darden (NWS)

nested observations

nested models

satellite data analysis

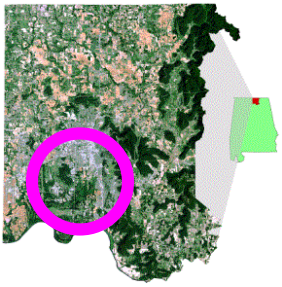
surface energetics

complex terrain

guest investigators

intensive ops periods

diverse land usage



UAH

OGC Sensor-Web Enablement (SWE)
Mike Botts

NASA/MSFC

Sensor-Web Atmospheric Test Bed
Bill Lapenta, Gary Jedlovec (MSFC)
Robbie Hood, Rich Blakeslee (MSFC)
Tom Sever, Dan Irwin (MSFC)
Mike Botts (UAH)

UAH

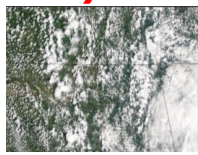
PBL Dynamics
Dick McNider
Kevin Knupp

coordinated multi-agency research and development, with rapid-prototyping user-responsive transition to transferable operations

Integration of Existing/*Planned* Assets (Most Installed in or Near Huntsville)

diverse weather

other agencies



diverse airmasses

multiple applications

UAH
PBL Air Chemistry
ozone sondes
ozone lidar
aerosol lidar
Doppler wind lidar
spectroscopy lab
chemistry trailer

ARMY/RSA
Soldier-Scale Atmospheric Test Bed
100-meter mega-tower, surface network,
Doppler lidar, Doppler radar, radiosondes,
instrumented UAV's, tracer releases,
AutoNowcaster, incident simulations,
laser test facility, scintillometers,
ceilometer, *microsats*

UAH
Weather Radar
dual polarization
Doppler radars
C-band, X-band
W-band

multiple parameters

routine operation

stationary sensors

complementary sensors

ASSIMILATION

QUANTIFY UNCERTAINTY

MODELING

NOAA
Air Quality Forecasting Test Bed
HSV NWS Forecast Office
operational satellite sensors
geostationary satellite risk reduction
AERONET multispectral sunphotometer
MPL-NET Micropulse Lidar

NOAA/NSAA
Hazardous Weather Test Bed
HSV NWS Forecast Office
Short-Term Prediction Research/Transition Center
NEXRAD Doppler radar network
satellite-based sensors
significant weather events

nested observations

nested models

satellite data analysis

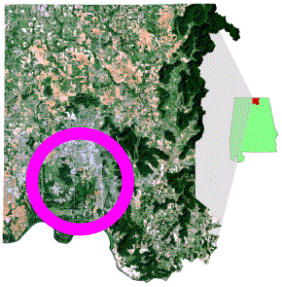
surface energetics

guest investigators

intensive ops periods

complex terrain

diverse land usage



UAH
OGC Sensor-Web Enablement (SWE)
SensorML development
SWE architecture

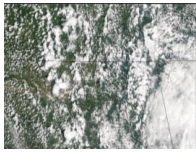
NASA/MSFC
Sensor-Web Atmospheric Test Bed
Short-Term Prediction Research/Transition Center
Regional Visualization & Monitoring System
research satellite sensors, microsats,
Lightning Mapping Array
instrumented UAV's

UAH
PBL Dynamics
ceilometer, *tethersonde*
Doppler sodars
915 MHz profiler
μ-wave radiometer
surface energy flux
mobile platforms

coordinated multi-agency research and development, with rapid-prototyping user-responsive transition to transferable operations

Focus of Integrated Research Activities

diverse weather



diverse airmasses

UAH

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ozone sondes
ozone lidar
aerosol lidar
Doppler wind lidar
spectroscopy lab

ARMY/RSA

Soldier-Scale Atmospheric Test Bed

100-meter mega-tower, surface network, Doppler lidar, Doppler radar, radiosondes, instrumented UAV's, tracer releases, AutoNowcaster, incident simulations, laser test facility, scintillometers, microsats

UAH

Weather Radar

dual polarization
Doppler radar
C-band, X-band
W-band

other agencies

multiple parameters

routine operation

multiple applications

ASSIMILATION

improved PBL diagnostics

theory, knowledge base

GSI, ADAS (VDRAS? VLAS?)

QUANTIFY UNCERTAINTY

with user acceptance

MM5→WRF←RAMS, CMAQ; LES

decision support tools

improved PBL forecasts

MODELING

stationary sensors

complementary sensors

NOAA

Air Quality Forecasting Test Bed

HSV NWS Forecast Office
operational satellite sensors
geostationary satellite risk reduction
AERONET multispectral sunphotometer
MPL-NET Micropulse Lidar

NOAA/NSAA

Hazardous Weather Test Bed

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NEXRAD Doppler radar network
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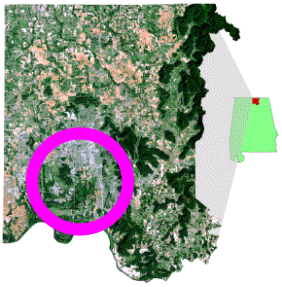

UAH

OGC Sensor-Web Enablement (SWE)

SensorML development
SWE architecture

NASA/MSFC

Sensor-Web Atmospheric Test Bed

Short-Term Prediction Research/Transition Center
Regional Visualization & Monitoring System
research satellite sensors, microsats,
Lightning Mapping Array
instrumented UAV's

UAH

PBL Dynamics

ceilometer, tethersondes
Doppler sodars
915 MHz profiler
μ-wave radiometer
surface energy flux
mobile platforms

coordinated multi-agency research and development, with rapid-prototyping user-responsive transition to transferable operations

Conclusions

- developing university-coordinated multi-agency partnership
- exploit existing, pending, proposed, and planned assets
- attract other agencies and local Army/NASA support contractors
- create national asset for boundary layer research and operations
- meet emerging weather needs for testing, training, and operations
- transfer knowledge and user-validated decision-making tools to other areas