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Army Research Lab's Meteorological Sensor Array, White Sands Missile Range

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20th Annual George Mason University Conference on Atmospheric Transport and Dispersion Modeling

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U.S. Army Research Laboratory

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Vision

The Nation's Premier Laboratory for Land Forces.

Mission

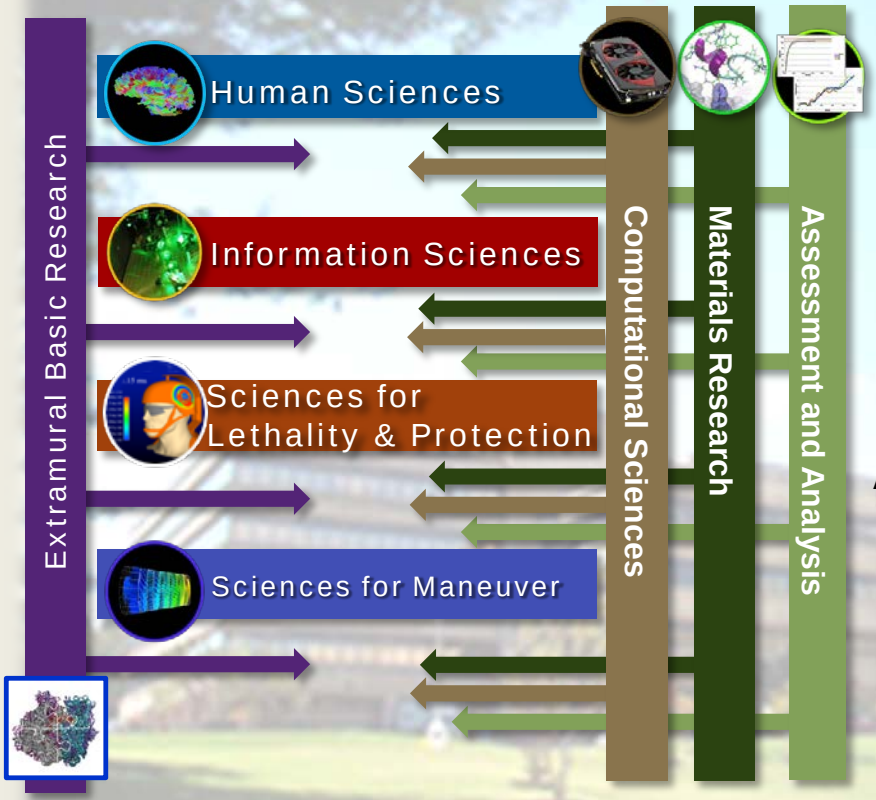
DISCOVER, INNOVATE, and TRANSITION Science and Technology to ensure dominant strategic land power

Making today's Army and the next Army obsolete

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Changing Defense Lab Paradigm ARL

S&T Campaign Plans



Open Campus Business Model





http://www.arl.army.mil/publications

The Nation's Premier Laboratory for Land Forces

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ARL's New Research Centers

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Aberdeen Proving Ground, MD



Adelphi, MD

- Army Cyber Research Center
- Intelligent Systems Research Center (APG/ALC)
- Battery Materials Research Center
- Network Science Research Center
- Specialty Electronics Center

White Sands Missile Range, NM

Atmospheric Sciences Center

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Basic and Applied Research

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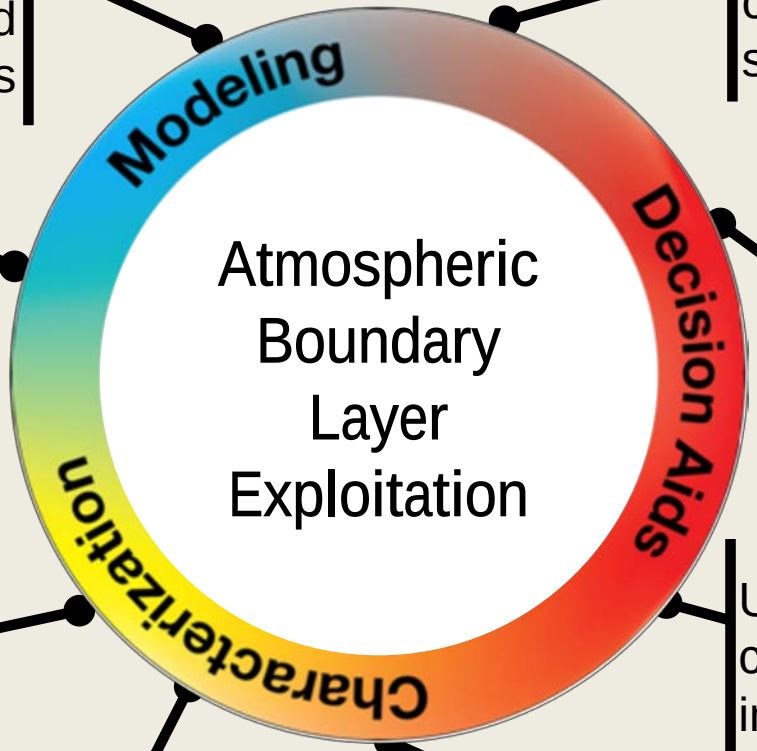
Environmental Understanding

Actionable Env. Intelligence

Develop new modeling algorithms and parameterizations

Enhance modeling capability in Army relevant settings

Simulate microscale and mesoscale flow and verify with observations



Use current and forecast information for mission planning

Quantify important boundary layer processes

Use current information to communicate tactical impacts to the soldier

Develop novel sensing techniques of important environmental variables

Research environmental impacts on Army operations

- **Bring together government, industry, and academia to advance atmospheric science and its application to critical defense technologies through a collaborative, innovative research ecosystem.**
- **Primary Focus**
  - **Boundary Layer Processes**
  - **Complex and Urban Terrain**
- **Shared Resources**
  - **Meteorological Sensor Array**
  - **Mobile Instrumentation**
  - **High-performance Computing Resources**

MSA Mobile Instrumentation

- Multiple Doppler Wind Sensing LiDARs
- Distributed Temperature System
- Portable radiosonde
- Resource Effective Bio-Identification System (REBS)
- Soil and Dust particle counters
- etc.

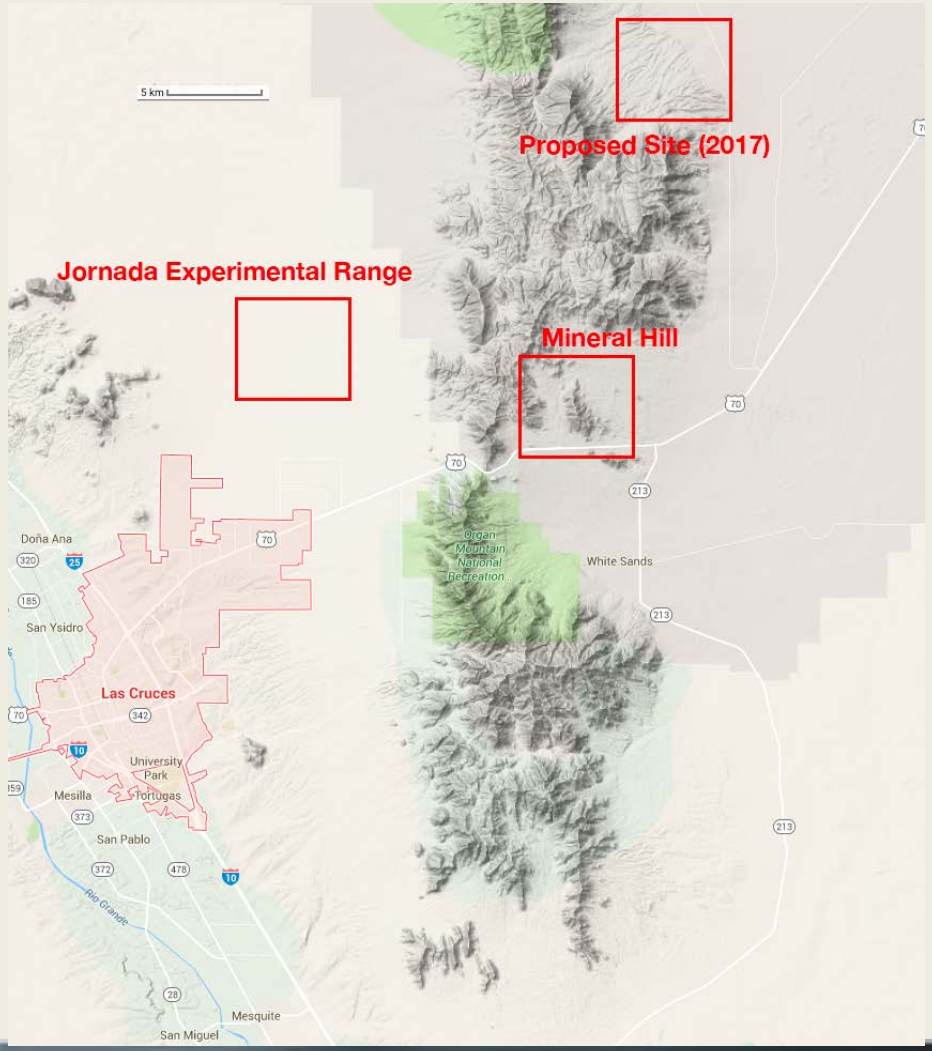


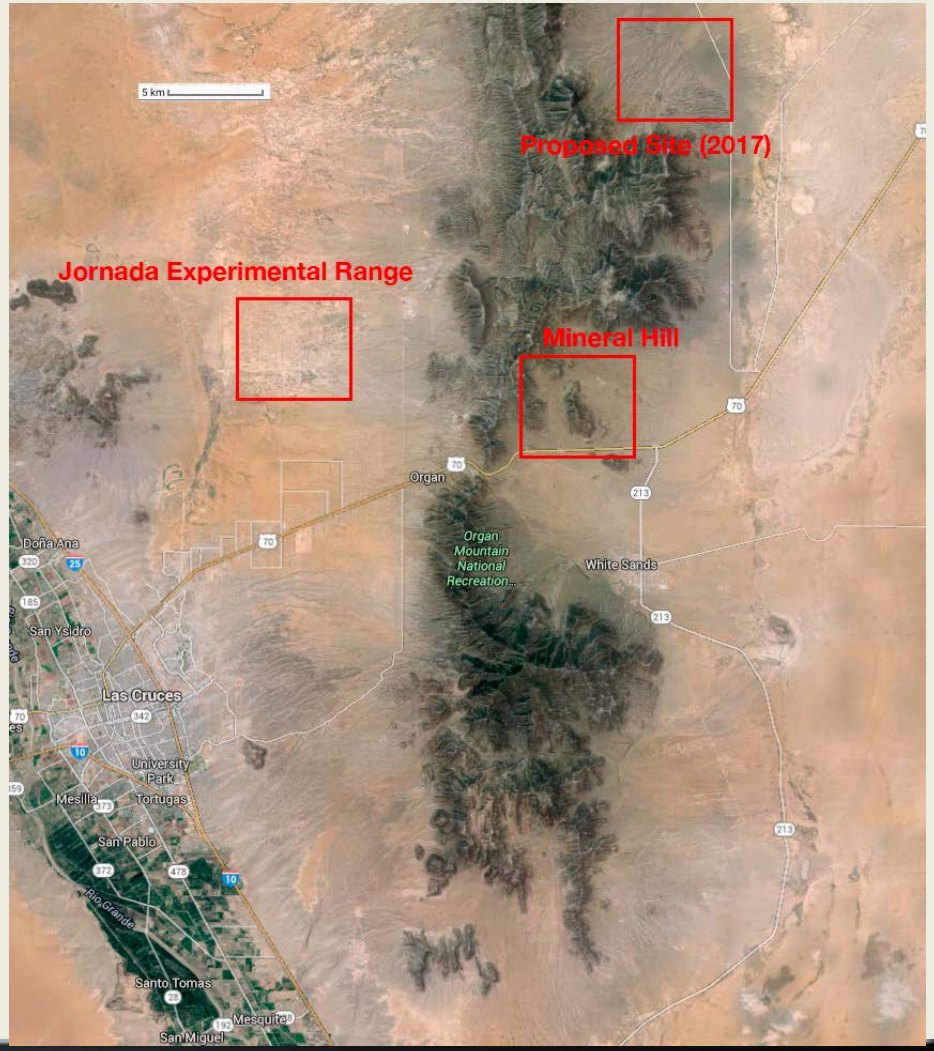
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Meteorological Sensor Array

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White Sands Missile Range, NM





Meteorological Sensor Array: Motivation

- Address Army and larger community need for reliable and persistent fine-scale observational datasets especially in areas of complex terrain.
- Verify Army meso-*γ* and microscale models.
- Validate systems based on environmental state information
- Develop and verify new sensing technology and strategies.
- Characterize boundary layer processes through detailed observation.
- Provide an augmentable community resource for collaborative advancement of boundary-layer meteorology.

Mineral Hill



Located on WSMR

Peak is 6200 ft MSL.

Surrounding valley ~5000 ft MSL.

Organ Mountain range to the West is 6600-7000 ft MSL.

Tularosa Basin to the east ~4000 ft MSL.

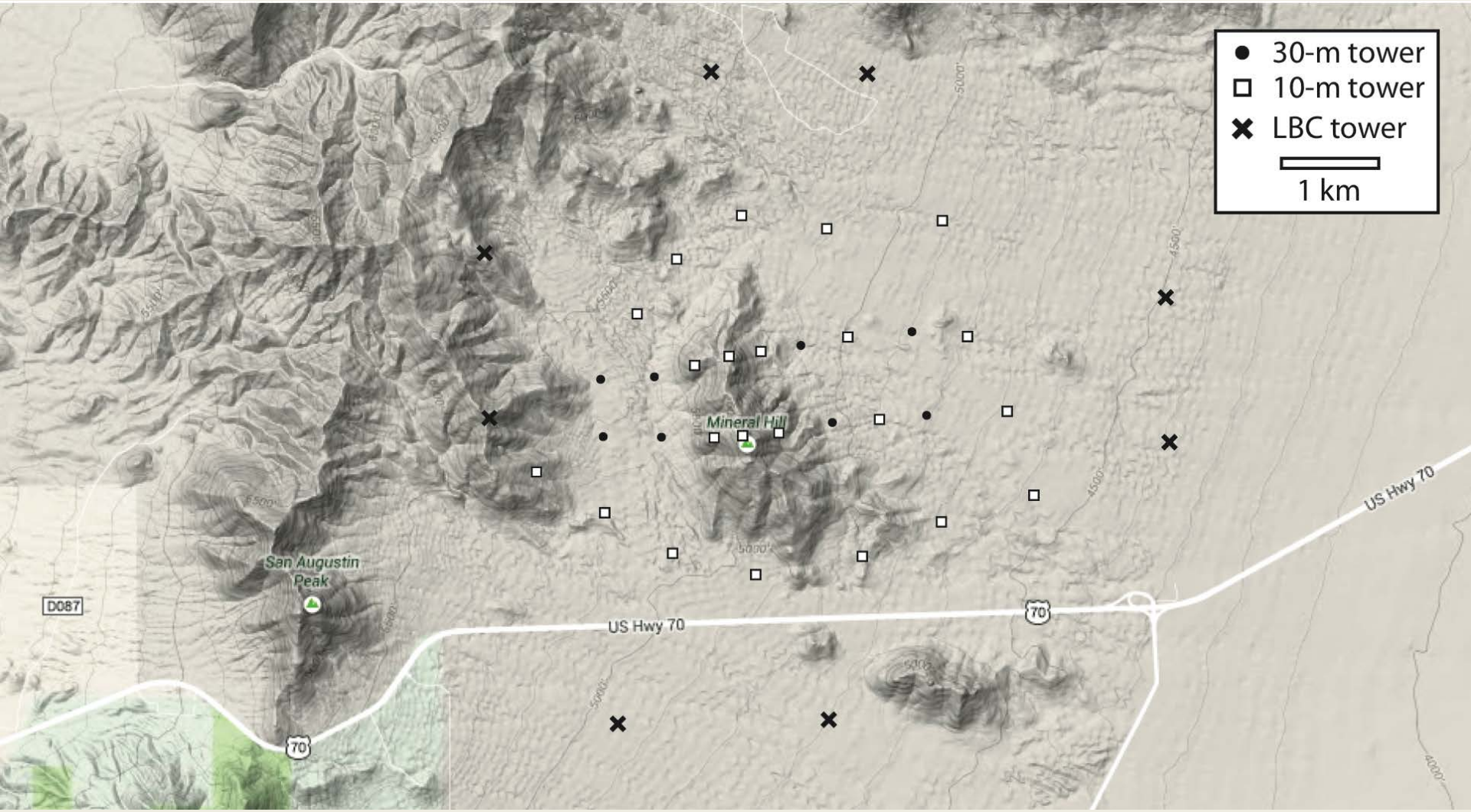
36 Towers

- **8 30-m towers**
- **20 10-m towers**
- **8 simplified towers for lateral boundary conditions**

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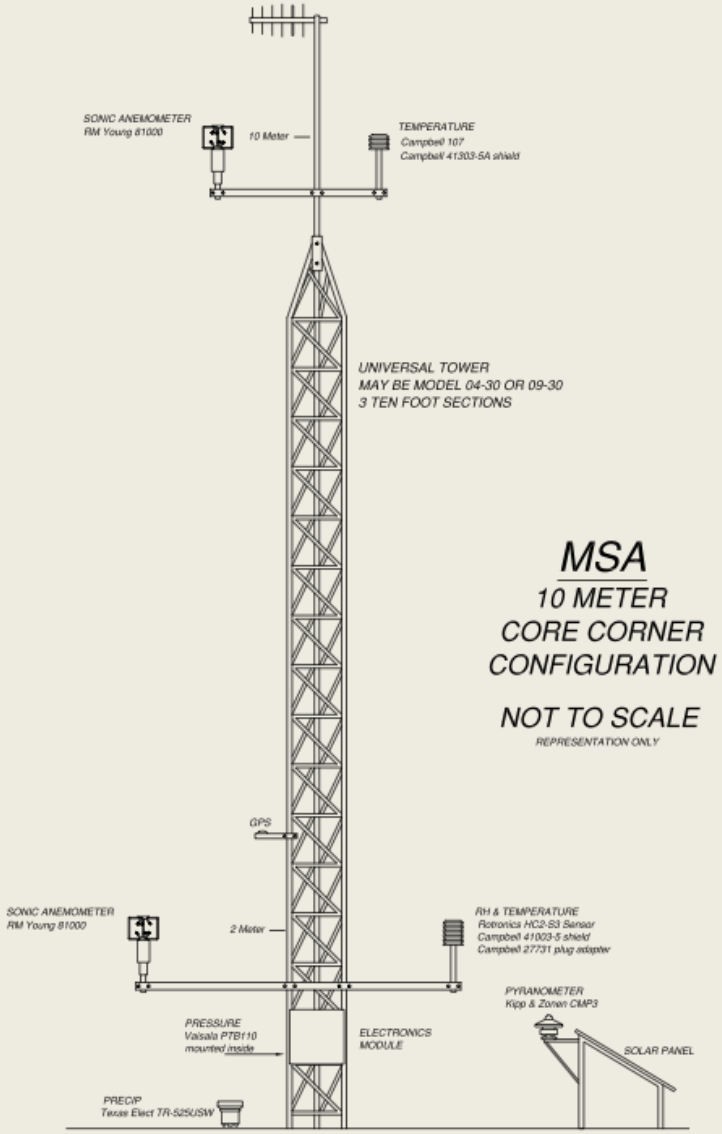
Mineral Hill

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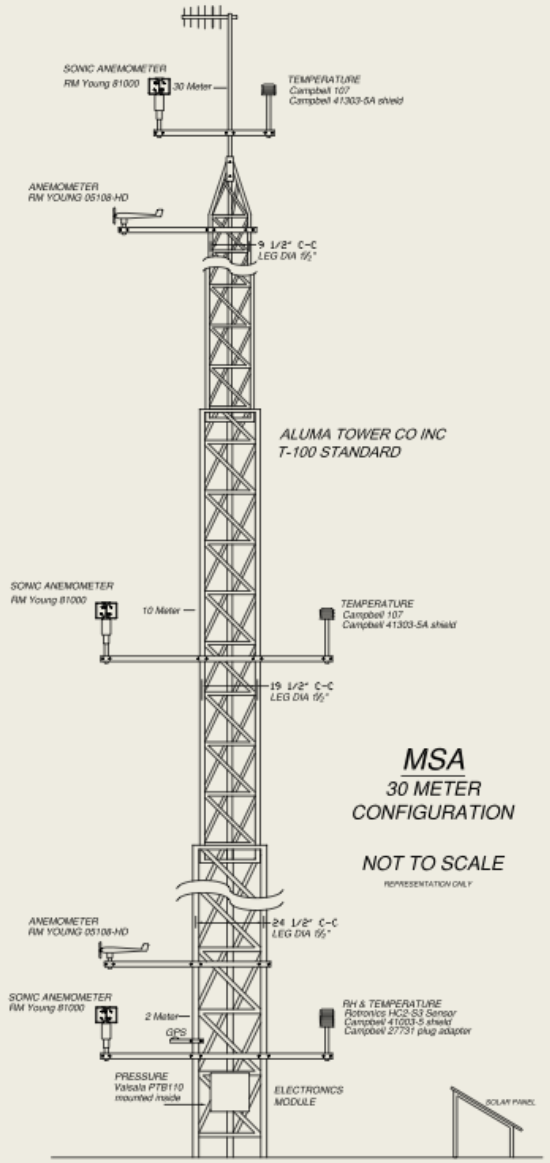
Mineral Hill: 10 m Tower Configuration

- 10-m tower configuration
- 2m & 10m: 3D Sonic Anemometer; Temperature
- 2m RH; pressure
- Pyranometer
- Precipitation
- Wireless connection
- For LBC tower, only sonic and temp at 10 m.



Mineral Hill: 30 m Tower Configuration

- 2m, 10m & 30m: 3D Sonic Anemometer; Temperature
- ~4m, ~29m: propeller anemometer
- 2m RH; pressure
- Wireless connection



Mineral Hill: Additional Instrumentation

- 10 Paroscientific nanobarometer with quad-disk pressure probe.
- 3 Halo Doppler Wind-sensing LiDAR.
- Ozone monitor
- 20 Stevens Hydra Probe for soil mosture.
- Tethered Lifting System (TLS)
- Intermet Systems portable Radiosonde system.
- DTS 2km and 4km fiberoptic temperature sensor.
- 2 Infrared cameras for surface temperature.

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Jornada Experimental Range (JER)

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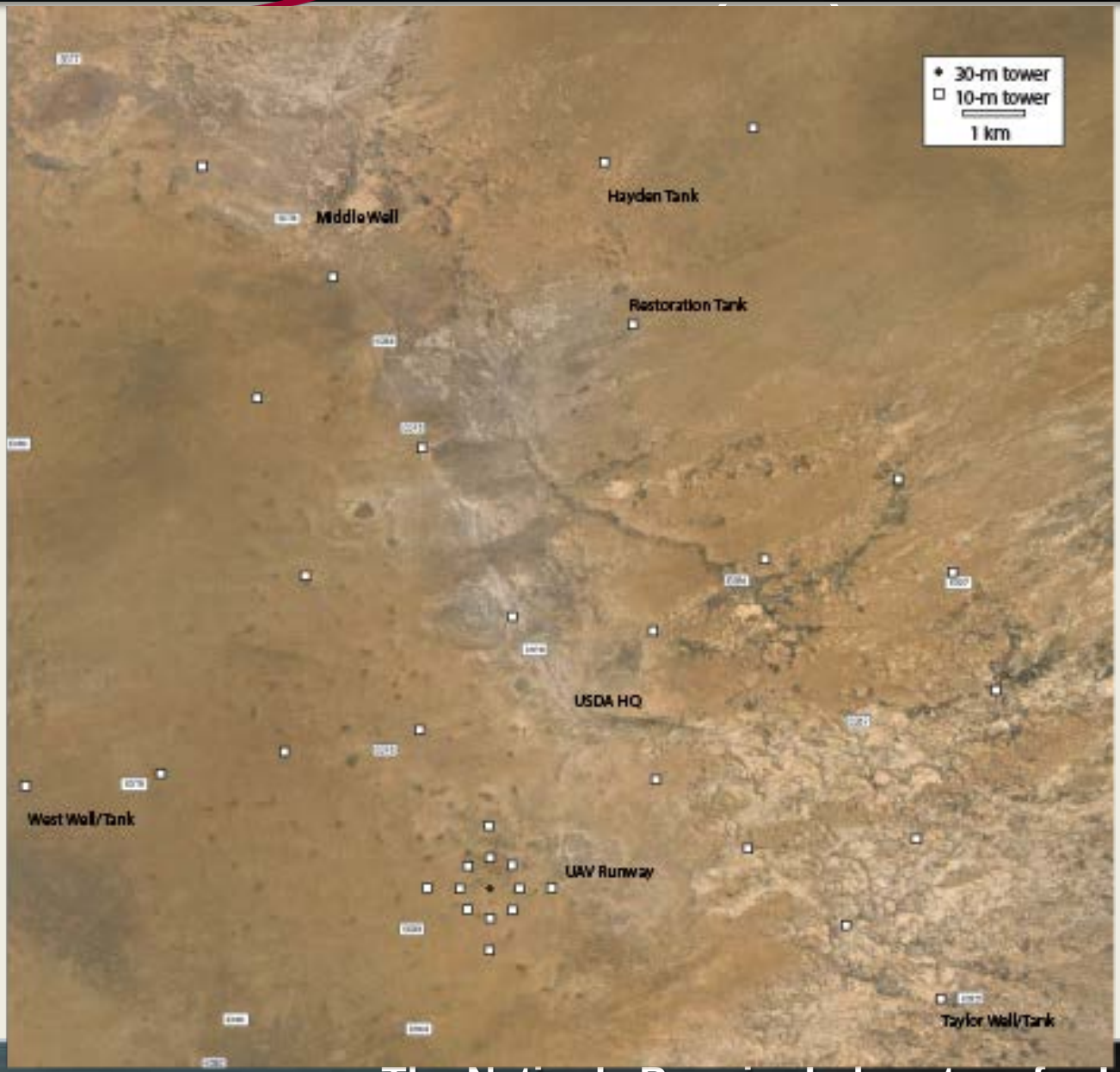


- Owned by USDA with NMSU collaborators.
- Relatively flat at 4400 ft MSL
- Organ Mountain range to the East is 6600-7000 ft MSL.
- 36 Towers
  - 8 30-m towers
  - 28 10-m towers

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Jornada Experimental Range

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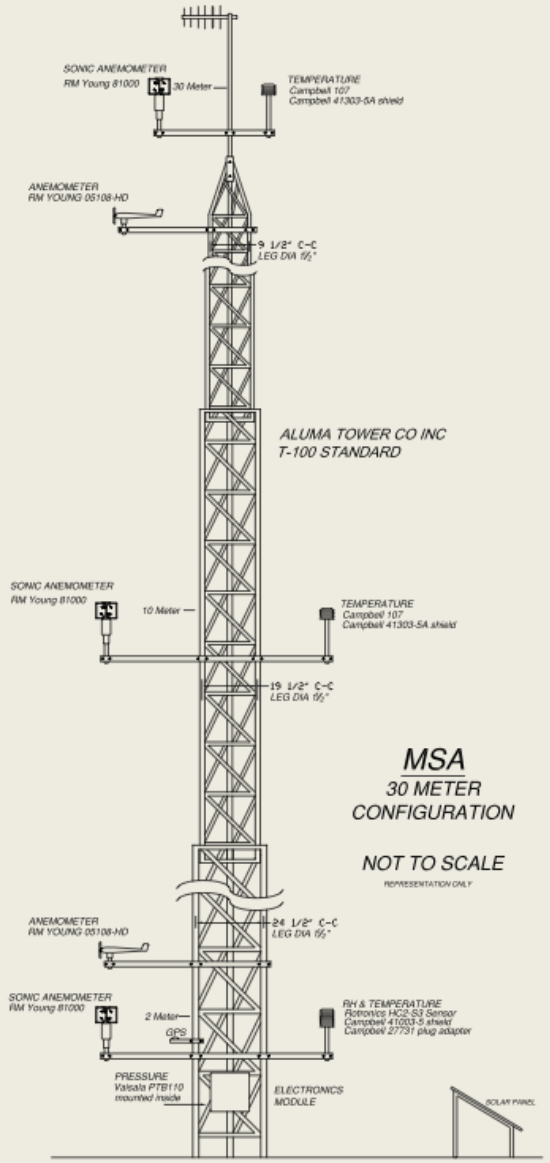
JER: 10 m Tower Configuration

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- Pyranometer
- Precipitation
- Wireless connection



JER: 30 m Tower Configuration

- 2m, 10m & 30m: 3D Sonic Anemometer; Temperature
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JER: Additional Instrumentation

- 3 Halo Doppler Wind-sensing LiDAR.
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- Tethered Lifting System (TLS)
- DTS 2km and 4km fiberoptic temperature sensor.
- 2 Infrared cameras for surface temperature.

JER: Additional Instrumentation

- Outdoor Dome camera
- 4 Battelle REBS
- 5 Grimm Aerosol Size spectrum
- 2 TSI DustTrak aerosol analyzer.
- 2 TSI NanoScan/Optical particle sizer
- Unmanned Aerial Systems (runway on site)
- Scintillometer
- Nephelometer

MSA Operations

- Set of persistent sensors that will be maintained year round
- Other instruments are available for planned campaigns
- All towers powered by solar panels
- Additional equipment, such as LiDARs will use generators or tie in to power lines if available.
- Wireless connections back to the data center at WSMR
- Excess capacity in both power and wireless bandwidth
- Possible to install additional data logging ports
- Working to get data hosted by NCAR

A Few Currently Planned

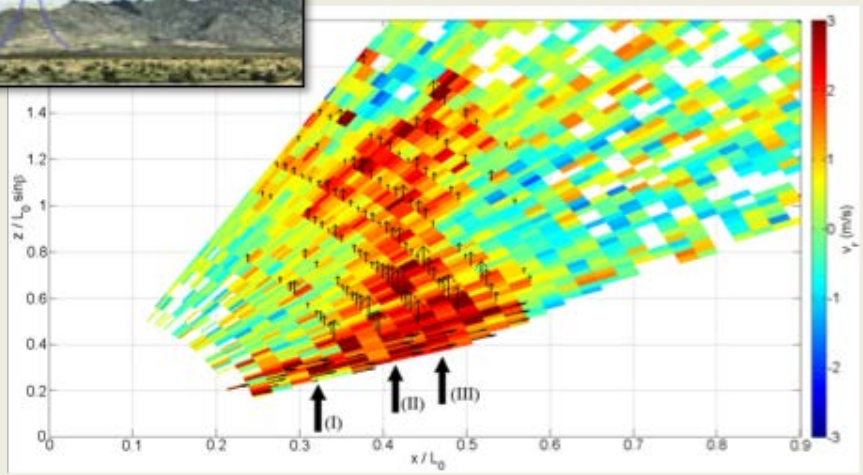
Mineral Hill

- Mountainous Slope Transport and Diffusion– MASTODON (with Teachnion-Israel Inst. Tech. and Notre Dame)
- Slope flow transitions (with Univ. Utah)

JER

- Turbulence measurements using coordinated doppler LiDARs (with Notre Dame)
- Acoustic tomography (internal)





LiDAR Comparison with Sonic Anemometer

