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Remote Sensing Capabilities and Needs at LANL:Synergy with Montana

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Remote Sensing Capabilities and Needs at LANL: Synergy with Montana

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DOE Lab Day, Butte, Montana
October 8, 2019 dubey@lanl.gov

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UNCLASSIFIED

Our capabilities define science, technology and engineering areas in which we must lead to meet our enduring & evolving nuclear stockpile, global and energy security missions

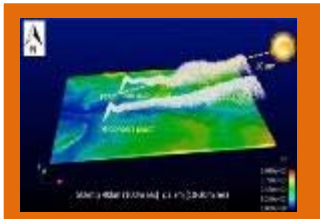
MATERIALS FOR THE FUTURE

Defects and Interfaces

Extreme Environments

Emergent Phenomena

RS Hardware



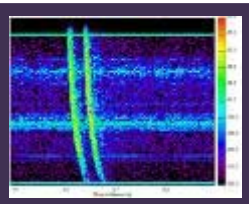
SCIENCE OF SIGNATURES

Discover Signatures

Revolutionize Measurements

Forward Deployment

RS Data Mining

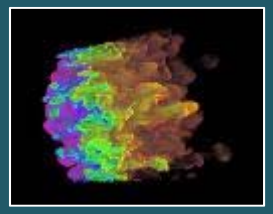


INTEGRATING INFORMATION, SCIENCE, AND TECHNOLOGY FOR PREDICTION

Complex Networks

Computational Co-Design

Data Science at Scale



NUCLEAR AND PARTICLE FUTURES

High Energy Density Physics & Fluid Dynamics

Nuclear & Particle Physics, Astrophysics & Cosmology

Applied Nuclear Science & Eng.

Accelerator S&T

RS Knowledge

COMPLEX NATURAL & ENGINEERED SYSTEMS

Understand and Control Systems

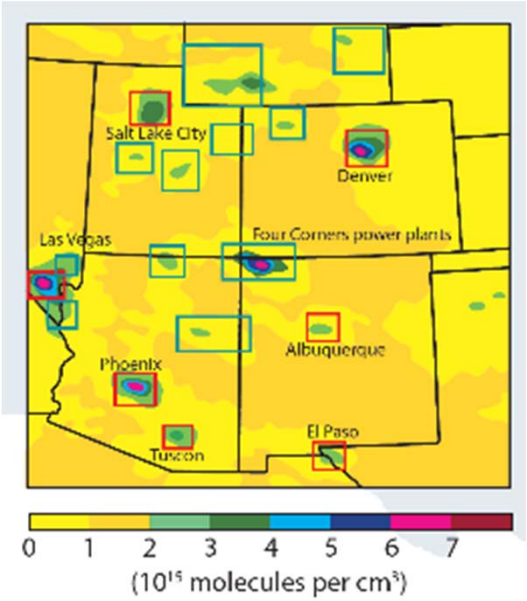
- **Weapon Effects**
- **Treaty Verification**
- **Energy Security**

Programs & Needs: Students & Postdocs are our pipeline

- Climate Observations for Predictions (BER, ARM/NGEE-Arctic)
- Energy Security: Resiliency in Complex Systems (FE)
- Treaty Verification and Surveillance (NNSA, DoD)
- Satellite, Ground and Airborne Observations (NASA, NNSA, DOE)
- Big Data & ML: Predict Earthquakes & Detect Leaks (BES/ARPA-E)
- End to End: RS Design, Development, Deployment to Discovery
- *450 postdoc, 1880 students in FY19: Pipeline for the future (61%)*
- *National Security Education Center*
  - *https://www.lanl.gov/projects/national-security-education-center/centers-institutes.php*

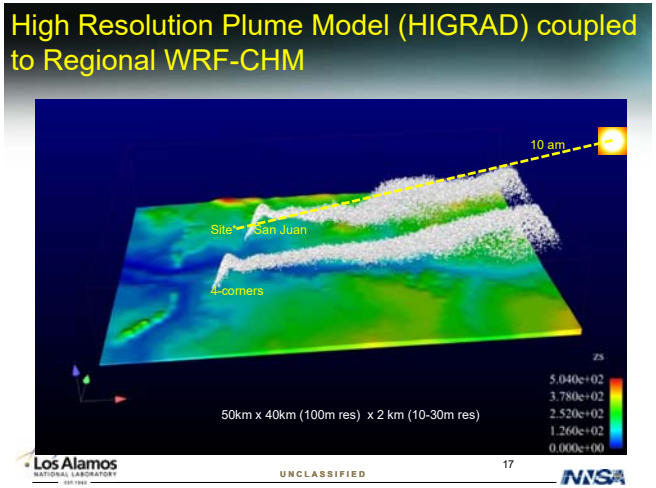
Energy NOx-CO_2 Emissions Verification: Four Corners

NO_2 OMI (NASA)



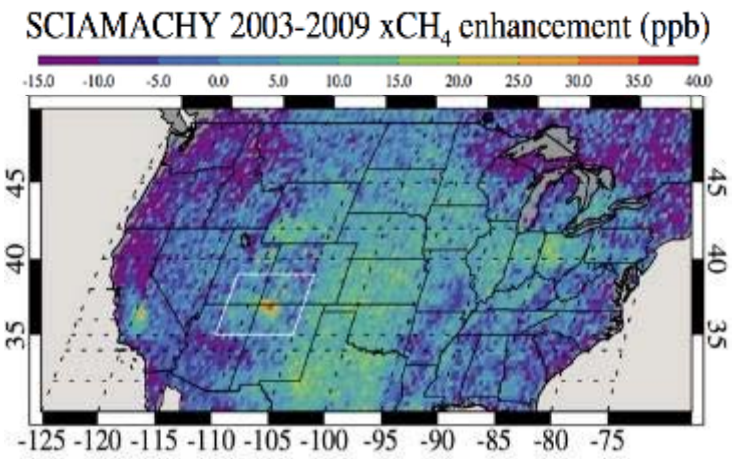
LANL Solar FTS

LANL Plume Model

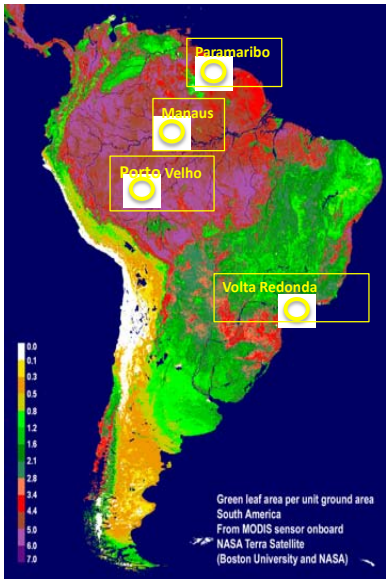


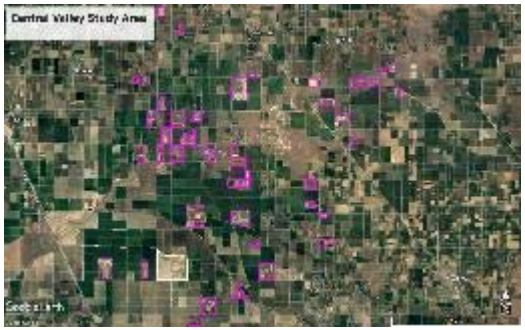
NASA A-Train

CH_4 hot spot in 4Corners, CO_2 uptake by Amazon & CH_4 from CA Dairies



Top-down emissions x3 EPA inventory



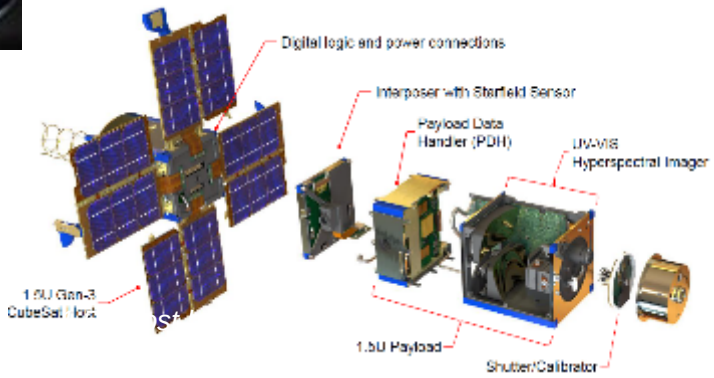


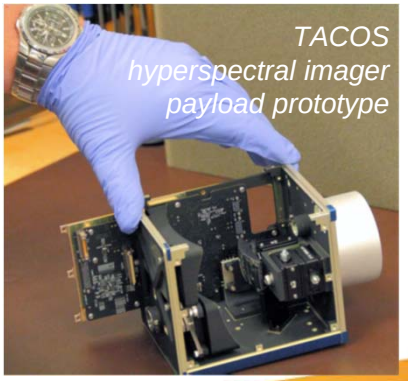
- Emissions from Four Corners of **~0.59 Tg CH_4/yr** have persisted 2003-2009, 2012 and verified by ground based observations.
- The study pioneers the use of space-based observations to identify and quantify localized regions of anomalous CH_4 emissions.
- **LANL's portable solar FTS, UAV, Cubesat & Machine Learning expertise extends verification applications**

Agile Space: SmallSat Program at LANL

- ***19 launches since 2010 – 7 launches planned for 2020***
- CubeSats based on a 1.5U host bus developed at LANL: includes a Command & Data Handler, 2 software defined radios, Attitude Determination & Control System & a power system
- Designs embrace modularity, on-orbit reconfigurability, and on-orbit processing
- Capability to host a 1.5U payload via an interface board → 3U CubeSat
- Various missions underway to measure RF and hyperspectral signatures
- Upcoming missions are trending to larger 6U and 12U sizes
- Multi-disciplinary team of scientists, hardware/software engineers, and technicians

TACOS / NACHOS Project: 3U hyperspectral imager for mapping of volcanic trace gases (SO_2, NO_2) in the 300-500 nm spectral range





Landscape change detection and characterization using Unmanned Aerial Systems (UAS)

Arctic Application: Hyper-resolution (500 points per square meter) Lidar altimetry is used to understand the interactions between multi-scale topography, ecosystem structure, hydrology and permafrost degradation in the hilly shrub-tundra watersheds of the Seward Peninsula, Alaska.