Please don't hesitate to call to discuss your possible use of the REAL:
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Raman-shifted Eye-safe Aerosol Lidar (REAL)

California State University Chico

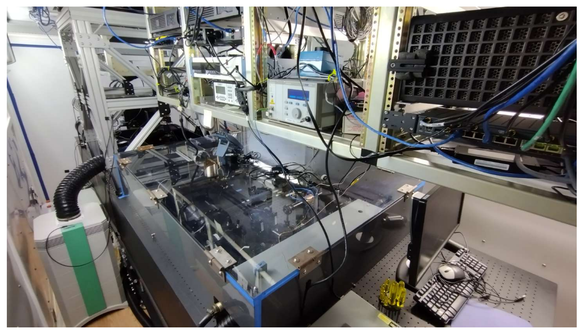
Unlike commercially available Doppler lidars and micropulse lidars, the REAL transmits very energetic laser pulses (130 mJ/pulse) at a low pulse rate (10 Hz) in order to produce images quickly. No temporal integration of the returns is required. It also transmits very short pulses (6 ns) and samples at a high rate (100M samples/s) in order to produce images with very fine range resolution (1.5 m).

Some features of the fieldable lidar research facility:

SCANNER: The rooftop scanner can aim the invisible and eye-safe infrared laser pulses in any direction. It can be programmed to scan at any speed and collect custom scan sequences.
NETWORK: REAL has a rooftop Starlink for network access in remote locations.

TRAILER: The REAL's air-ride trailer has leveling legs on each corner that allow precise leveling of the entire facility. High precision and accuracy tiltmeters monitor the pitch and roll of the trailer at all times. The system can run 24x7 and unattended in all weather conditions.

CONTAINERS: The REAL has two insulated shipping containers. The one on the front of the trailer is the lidar laboratory. The one on the back of the trailer is an operations center.



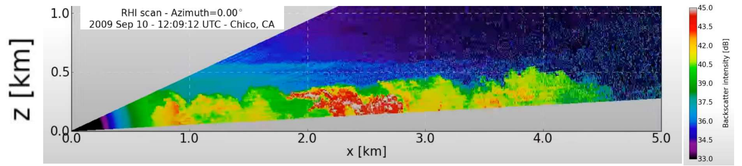
LABORATORY: The laboratory is a climate-controlled clean-room, with mini-split heat pump and HEPA air filtration. All system components are on uninterruptable power supplies.

SERVER: The laboratory also contains a new server with a 64 TB RAID and an Nvidia A-30 GPU for immediate data storage and processing.

What can the REAL do?

Because atmospheric aerosol is present everywhere and a great tracer of atmospheric structure and flow, a high performance lidar like the REAL can visualize many different aspects of the lower atmosphere. Here are just a few examples of past observations.

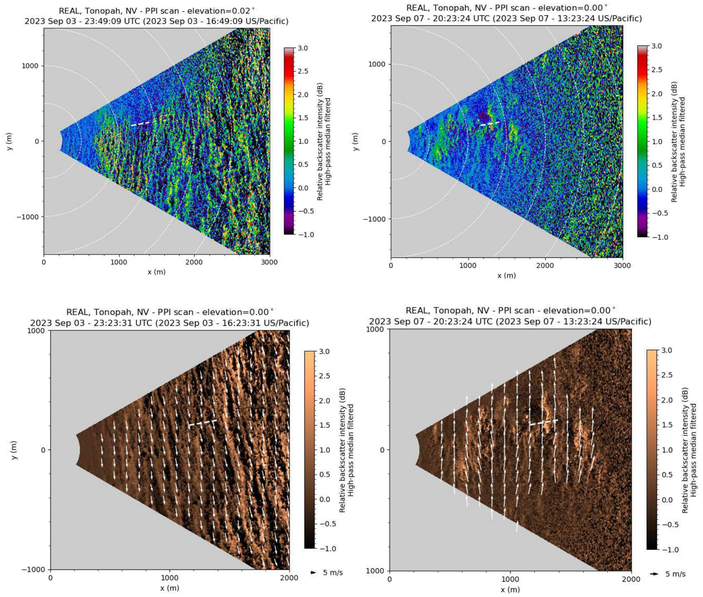
1. Boundary Layer Height and Entrainment Zone Structure



By performing rapid (15 s) RHI scans such as the one to the left, REAL excels at observing the structure and vertical evolution of convective boundary layers, especially polluted and shallow ones where the entrainment zone offers sharp contrast. A Haar wavelet-based analysis algorithm can be applied to the images to automatically and objectively delineate the top edge.

2. Turbulent coherent structures

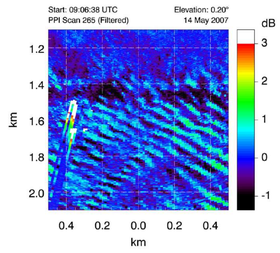
REAL can scan horizontally, or nearly horizontally, to reveal coherent structures in the atmospheric surface layer. During more stable conditions we often see waves and "linear streaks" and during unstable conditions we can gust structures. The examples to the right are recent examples collected during the M²HATS project in Tonopah, NV.



3. Vector wind fields

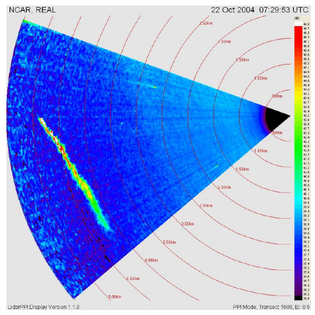
When the PPI images from REAL contain lots of coherent structures, a wavelet-based optical flow algorithm can be applied to derive 2-D and 2-component horizontal vector flow fields. This is a computer vision approach to wind field measurement. The name of the software is *Typhoon* and it was developed by Dr. Pierre Dérian. The solutions contain a vector at every pixel.

4. Waves and flows over complex terrain



REAL collected over 1600 frames of canopy waves during CHATS. These are shear-driven waves in stably-stratified conditions (Kelvin-Helmholtz Instability billows). Further inspection indicates that it can see very fine scale structure of primary and second instabilities.

5. Dispersion of aerosol plumes



REAL is capable of detecting very small changes in particle concentration and subvisual aerosol plumes. Extensive testing was conducted for the DOD and copies of the REAL were created for national security applications.

6. Polarization sensitivity

REAL transmits linearly polarized infrared laser pulses and detects backscatter polarization simultaneously in two channels: parallel and perpendicular. From this, it is capable of distinguishing spherical from non-spherical particles.