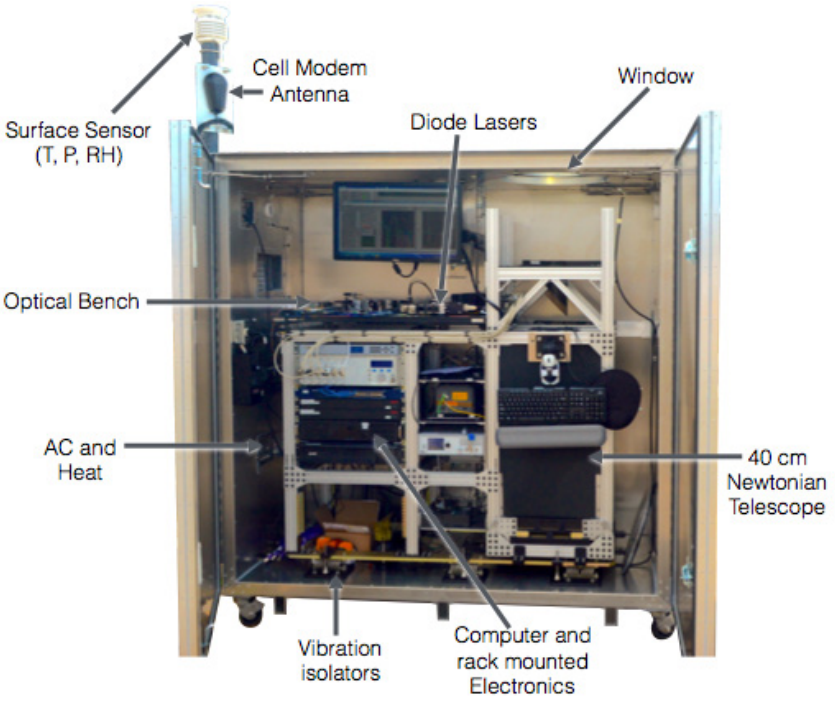
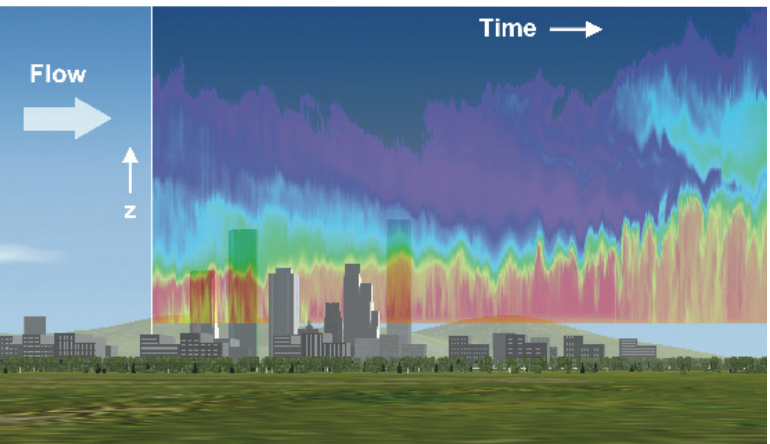
NCAR | EARTH OBSERVING LABORATORY

development • deployment • *data* • discovery

MicroPulse DIAL (MPD)

Since 2011, NCAR and Montana State University (MSU) have collaborated to develop a compact, field-deployable, micro-pulse differential absorption lidar (MicroPulse DIAL). The MPD provides continuous monitoring of water vapor in the lower troposphere at 150 m range resolution and 1-5 min temporal resolution from 300 m to 4 km above ground level in daytime operation with greater range (up to 6 km) at night. The instrument design and validation are discussed in detail in the scientific literature referenced on the website listed below. A network of five water vapor MPD units are now available. A high spectral resolution channel, capable of providing quantitative aerosol and cloud properties, is available in one of the units. These instruments can be used to advance knowledge in the areas of measuring water vapor concentration and distribution, convection initiation, and land-atmosphere exchange.





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Science Need

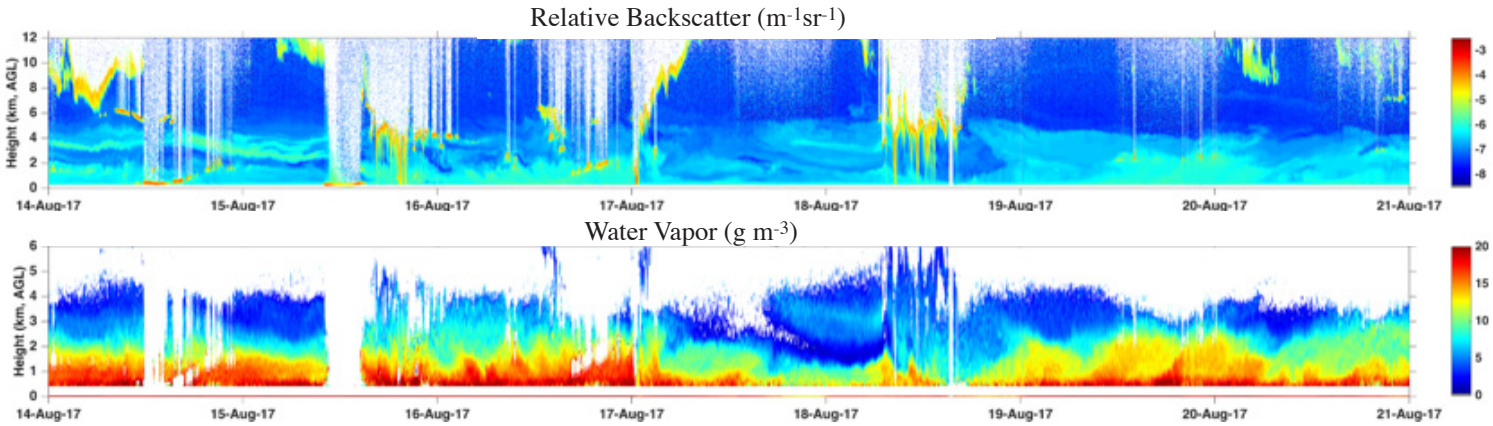
Water vapor is one of the fundamental thermodynamic variables that define the state of the atmosphere. It is highly variable in space and time and influences many important processes related to weather and climate. The ability to continuously measure water vapor in the lower troposphere with high vertical resolution has been identified as a priority observation needed by the weather forecasting, atmospheric science, and climate science communities. Several National Research Council reports list high-resolution vertical profiles of water vapor as one of the highest priority observations that need to be addressed for the next generation mesoscale weather observation network. Additionally, these observations are of high importance to the National Weather Service and other Federal agencies for the improvement of both severe weather forecasts and quantitative precipitation forecasts.

MicroPulse DIAL Technique

The instrument uses a micro-pulse diode-laser-based transmitter which is considerably more compact, reliable and less expensive than typical lasers used for lidar. The DIAL technique uses two separate laser wavelengths: an absorbing wavelength (online) and a non-absorbing wavelength (offline). The ratio of the range-resolved backscattered signals between the online and offline wavelengths is proportional to the amount of water vapor in the atmosphere. The technique requires knowledge of the absorption feature (obtained from a molecular absorption database) and estimates of the atmospheric temperature and pressure (obtained from surface measurements and standard atmosphere models). The technique also requires the laser wavelength to be stable and confined to a narrow band or "single frequency" so a type of diffraction grating is used for feedback to the seed laser.

MPD Applications

- Forecasting high-impact weather through detailed moisture observations
- Providing high-resolution continuous water vapor profiles for data assimilation into numerical models
- Assessing atmospheric moisture response to climate change through long-term observations
- Increasing understanding of the hydrological cycle
- Studying water vapor variability and transport
- Contributing to model validation



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