Technology & Services

Capturing Moisture and Wind:
Water Vapor DIAL, Modular Radar Wind Profiler

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I. Description

Water vapor and its transitions from gas to liquid to solid phases help drive atmospheric dynamics—the way weather moves—in the lower atmosphere. Adding complexity, water vapor itself is advected—moved horizontally—by the wind. However, there are major observational gaps in the lower atmosphere, or troposphere, especially in the boundary layer (the atmosphere’s lowest layer, whose thickness varies from 300 to 9,000 feet). Filling these gaps with precise measurements is important for research as well as for forecasting and decision making in sectors such as water, energy, transportation, air quality, agriculture, and more.

To address these needs, NCAR is developing technologies for lower atmospheric profiling of both water vapor and wind. The prototype Water Vapor DIAL (Differential Absorption Lidar) leverages fiber-optic advances from the telecommunications industry, an innovative optical amplifier, and many commercial, off-the-shelf components. The result is an optimal blend of price and performance that meets the needs of research and of mesoscale observing networks used in forecasting thunderstorms, fronts, and other mid-scale phenomena.

NCAR scientists and technicians have also created the 449-MHz Modular Radar Wind Profiler. With its adaptable design and novel, inexpensive power amplifier, the wind profiler maximizes flexibility in system configuration. The system may be set up as a network of radars for the lower atmosphere or as a single large wind profiler able to take measurements as high as the stratosphere.

II. Stage of Research

A prototype Phase 1 Water Vapor DIAL has been built to understand design strengths and weaknesses. The Phase 2 prototype, to be built over the next year, will be suitable for replication and use in a network.
The Modular Radar Wind Profiler system has already been fielded as a highly capable boundary-layer wind profiler, and a mid-tropospheric configuration is near completion. Follow-on research and development will create a stratospheric version, as well as a mobile storm-chasing wind profiler.

### III. Applications

- Both instruments are suitable not only for regional or nationwide observing networks but for research networks as well. Co-location with other profiling instruments has synergistic benefits well beyond profiling a single phenomenon.
- Boundary-layer wind and water vapor are *fundamental* phenomena for research in areas such as boundary-layer meteorology, mountain meteorology, initiation of the convection that leads to thunderstorms, and model development and testing.
- Mesoscale profile observations capture mid-sized atmospheric phenomena such as thunderstorms, squall lines, fronts, and precipitation bands. They support both public and private sector services in, for example, weather and air quality forecasting, decision making for transportation, agriculture, water, and homeland security, and other applications.

### IV. Advantages

- The Water Vapor DIAL will provide profiles with research-quality accuracy, time resolution, and altitude resolution, with an order-of-magnitude cost reduction compared to current technologies.
- The Modular Radar Wind Profiler provides unique deployment flexibility, with excellent time resolution and altitude coverage for research applications.

### V. Funding and IP Status

Primary: NCAR incubator funds  
Secondary: NASA (for one investigator) and NWS (partial DIAL deployment funds)

### VI. Research Partners

- **Water Vapor DIAL**: Montana State University  
- **Modular Radar Wind Profiler**: NOAA

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**Contacts**

Scott Rayder, UCAR Senior Advisor for Development and Partnerships  
303-497-1673, rayder@ucar.edu