



Abstract

An atmospheric profiling system (APS) was funded by the Kilgore Faculty Research program at West Texas A&M University. Also known as a type of “weather balloon” system, the APS is a cornerstone of atmospheric science research that will support many studies going into the future at WTAMU, including extreme heat, severe weather, fire weather, and air pollution. Applications and results from preliminary system testing are presented.

Theoretical Background

The West Texas A&M University atmospheric profiling system (APS) utilizes the Windsond low-cost boundary-layer profiling suite. A key feature of the Windsond is that the system is re-usable and the payload can be “cut down” by the user and retrieved for re-use. The following variables are collected vertically in the atmosphere by the APS:

- **Temperature**
- **Humidity and dew point**
- **Wind speed and direction**
- **Barometric pressure**

The specification of the Windsond weather instrumentation:

Weight: 13 g
 Battery type: Rechargeable lithium ion
 Battery lifetime > 60 m, 2 days in recovery mode
 Telemetry range 60 km; Data collection frequency 1 s
 Rate of ascent: Variable 0.5 – 3 m s⁻¹

Method

Instrument Specifications

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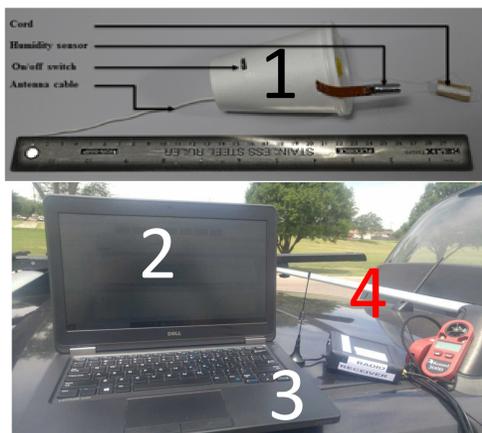


Figure 1. Components of APS: Top: (1) Windsond “cupsonde” (source Bessardon et al. 2019). Bottom: Ground station (laptop, 2), antenna (3), and receiver (4).

Results

APS System Tested in Tethersonde and Free-flying Mode

The APS system was successfully tested in two configurations:

- **Free-flying mode** (which also is recoverable and with a tracking system that utilizes GPS to recover).
- A novel **tethersonde system**, never used with this APS was also developed and tested.

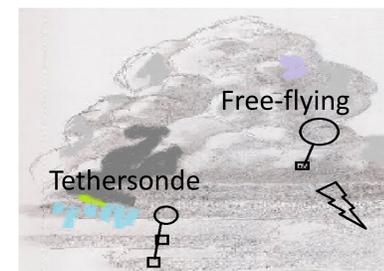
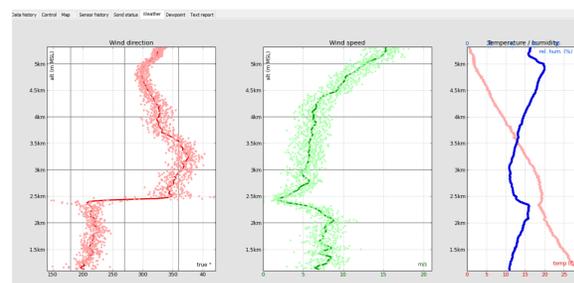


Figure 2. Vertical profiles of wind direction, wind speed, temperature and dew point (moisture) from the WTAMU APS on WTAMU Campus 11 am 21 August 2020 during Buff Nation outreach.



Air Pollution Applications Example

- Stable boundary layers where temperatures increase rapidly with height near the surface are ideal for utilizing the APS in tethersonde mode so that many vertical profiles can be obtained over a short period of time with low cost.

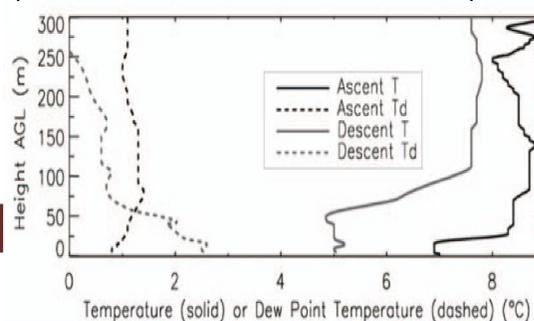


Figure 3. Left: Vertical profiles of temperature and dew point (moisture) from an APS during stable atmospheric conditions. Right: photo of stable layer in Utah. The WTAMU APS will be used to study stable boundary layers in the western US.

Severe Weather Applications Example

- Hailstorms, dry lines, supercells. WTAMU students will launch a sonde in the Near-storm environment to improve understanding of physical processes.



Figure 4. Left: A supercell thunderstorm (photo: B. Lee). Right: An unstable weather APS profile. Future research with the National Weather Service looking at dry lines in West Texas will utilize the APS.

Discussion and Future Work

The West Texas A&M University atmospheric profiling system (APS) has been successfully set up and tested in both free-flying and recover and “tethersonde” mode. In addition, the free-flying sondes can be recovered and re-used, further enabling previously prohibitively expensive research to be conducted.

- The APS was leveraged to obtain a successful grant to the University Corporation for Atmospheric Research COMET National Weather Service Partners Proposal Entitled: **Improving Understanding of Spatiotemporal Variations in Extreme Summertime Heat at Palo Duro Canyon State Park.**



- The APS will also be utilized in an upcoming research study on air quality (determining atmospheric stability and wind flow) in the western US (<https://atmos.utah.edu/aquarius/>) as well as severe weather research.
- The APS will be used for **student training** and real-world experience in ENVR 4404 (Environmental Sampling) and for other class demonstrations and for **outreach** at area schools

References

- [Windsond sounding webpage: http://windsond.com/](http://windsond.com/)
- Bessardon, G.E.Q., Fosu-Amankwah, K., Petersson, A., Brooks, B.J., 2019. Evaluation of Windsond S1H2 performance in Kumasi during the 2016 DACCWA field campaign. *Atmos. Meas. Tech.*, 12, 1311–1324. <https://doi.org/10.5194/amt-12-1311-2019>

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