The University of Utah’s Environmental Fluid Dynamics Lab (EFD) utilizes a tethered meteorological device called a tethersonde to collect data for mapping and characterizing atmospheric boundary layers. Typically, multiple tethersondes are deployed on a moored helium-filled balloon that reaches heights of 1-3km. The device’s fletching rotates the device into the wind and collects measurements such as wind velocity, direction, temperature, barometric pressure, and humidity. These measurements can then be used to protect the temperature sensor from solar radiation. Fins were added to the bottom to ensure unimpeded flows. The design of the tethersonde includes placing the temperature/humidity sensor, thermocouple, and thermal anemometer away from the body to ensure unimpeded flows. The tethersonde includes placing the temperature/humidity sensor, thermocouple, and thermal anemometer away from the body to ensure unimpeded flows. Fins were added to the bottom to protect the temperature sensor from solar radiation.

To validate the RevP, a study was conducted in a wind tunnel with flows ranging from 1-10 m/s. In addition, a CSAT3 3D sonic anemometer was used for sub-one m/s flow in a transient outdoor environment. A regression model of King’s law was plotted to determine the relationship between the RevP’s voltage output, ambient temperature, and true wind speed.

Validation for the IMU consisted of a simulated deployment of the full prototype. Data was then collected for two hours, during which the 3D sonic anemometer collected wind direction data. Wind roses are shown below for each device.

Adafruit’s BN0085 IMU was advertised to have accuracies of ±5°, and its magnetometer was within ±5° of true north. With the addition of a magnetometer calibration script, incorporating declination, the sensor was able to gather azimuth data with an average error of 0.433°.

The Modern Devices RevP thermal anemometer was advertised for use in winds ranging from 1-67 m/s; however, the manufacturer neglected to state the device’s accuracy. Through testing, it was found that the RevP has an average wind velocity error of 0.2 m/s in a transient environment, compared to the industry standard CSAT 3D sonic anemometer and static tube.

The introduction of the enhanced tethersonde marks a significant advancement in atmospheric measurement technology. By incorporating wind speed, wind direction, and a communication protocol, the device has undergone substantial improvement, facilitating deeper insights into atmospheric layers. To further enhance its capabilities, future efforts should prioritize optimizing the wireless communication protocol to enable the deployment of a greater number of tethersondes simultaneously.