Title: ARL Tether Lifting System (TLS)

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1.0 Data Set Overview:

The ARL Tether Lifting System was deployed east of the valley at the "George" site during the IOP period (1 May – 15 June 2017).

It was located at:

Site	PT-TM06/ETRS89 x (more accurate)	PT-TM06/ETRS89 y (more accurate)	Latitude (less accurate)	Longitude (less accurate)	Elevation (msl)
George	34462.56	6069.35	39.722228°	- 7.731161°	260.3

Note that the more accurate PT-TM06 and elevation readings listed in the table above should be considered authoritative.

2.0 Instrument Description:

The US Army Research Laboratory's tethered lifting system (TLS) is a specialty-designed state-of-the art tethersonde that offers unique high resolution and highly sensitive in situ measurements of wind speed and direction, temperature, and TKE dissipation rate (Frehlich et al., 2003). When used in profiling mode, the TLS can collect continuous high-resolution profiles from the surface up to heights of several hundred meters. The TLS capabilities for observing detailed mean wind speed and temperature profiles, as well as turbulence dissipation rates, is proven in numerous field experiments (Balsley et al., 2003; Frehlich et al., 2003).

The setup for PERDIGAO will described in an upcoming paper (Bariteau et al., 2018) but the current payload is similar to that used in the Turbine Outflow and Dissipation Study (TODS) field campaign in Fall 2012 (Lundquist and Bariteau, 2015), including 1.25 mm length and 5 μm diameter Tungsten wires for 1 kHz hotwire anemometer velocity measurements and 1 KHz coldwire temperature measurements (Auspex Scientific, custom-made), 100 Hz thermistors (Honeywell 111-103EAJ-H01) and solid-state measurements for temperature (Analog Devices Inc TMP36) and relative humidity (Honeywell HIH-4000), a 100 Hz pitot tube (Dwyer instruments model 166-6) and pressure sensor (Honeywell DC001NDC4) for velocity and pressure measurements, as well as GPS and compass measurements. The GPS measurements of latitude, longitude, and altitude are sampled every 5 seconds and are estimated to have a positional error of less than 5 m by the manufacturer.

3.0 Data Collection and Processing:

The turbulent payloads were suspended below a Helikite (Allsopp inc., UK) lifting platform tethered to a winch located at the George site (Figure 1 and 2)

Figure 1: ARL TLS with winch, helikite and base setup at 'George' site.

Figure 2: ARL TLS with suspended turbulent payload in profiling mode.

The hotwire anemometer is calibrated with respect to the pitot tube previously calibrated at NCAR wind tunnel. The coldwire anemometer data are calibrated with respect to a small bead thermistor sensor calibrated against a solid-state sensor. We follow techniques similar to Frehlich et al., 2008.
Basic outliers removal and quality control has been applied to these data set, but they will be subject to revisions.

4.0 Data Format:

100Hz Data have been saved in tab delimited ASCII text files. Missing data are denoted as NaN. This is the first version of the data, March 21, 2018. Filenames are as follow MMDDYYYY_HHMMUTC.txt with MM the month, DD the day, YYYY the year, and HHMM the starting time of data collection. Each file contains one header line and eight columns as follow:

1) Day-Of-Year
2) Altitude (m).
3) Latitude (decimal degrees)

4) Longitude (decimal degrees)
5) Barometric pressure (mbar)
6) Air temperature from the coldwire (C)
7) Relative Humidity (%)
8) Wind speed from the hotwire anemometer (m/s)

5.0 Data Remarks:

Sometimes the GPS had issues so the altitude was replaced by the geopotential height for a few instances.

RH data is often not included because of sensor issues that resulted in poor data quality not suitable for analysis.

The following files have missing CW and HW data for all or portions of the flight and so they are replaced with thermistor temperature and pitot tube wind speed respectively - 07062017_0553UTC.txt, 07062017_0757UTC.txt.

The following files have no HW but do have CW data 22052017_1902UTC.txt, 22052017_2041UTC.txt, 22052017_2310UTC.txt, 27052017_1810UTC.txt.

6.0 References:

Balsley, B. B., R. G. Frehlich, M. L. Jensen, Y. Meillier, and A. Muschinski, 2003: Extreme gradients in the nocturnal boundary layer: Structure, evolution, and potential causes. *J. Atmos. Sci.*, **60**, 2496–2508, https://doi.org/10.1175/1520-0469(2003)060<2496:EGITNB>2.0.CO;2.

Bariteau et al. 2018: Turbulence measurements from the TLS during PERDIGAO: Overview, results, and future capabilities, Atmos. Meas. Tech., in preparation.

Frehlich, R., Y. Meillier, M. L. Jensen, and B. Balsley, 2003: Turbulence measurements with the CIRES tethered lifting system during CASES-99: Calibration and spectral analysis of temperature and velocity. *J. Atmos. Sci.*, **60**, 2487- 2495, https://doi.org/10.1175/1520-0469(2003)060<2487:TMWTCT>2.0.CO;2.

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