Title: 2023 Propagation, Evolution, and Rotation in Linear Storms (PERiLS) ULM Mobile Radiosonde Dataset

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1.0 Dataset Overview

ULM used one mobile radiosonde system to support upper-air observations at locations across the Southeastern United States during the 2023 PERiLS field campaign. The ULM radiosonde system was co-located with the ULM mobile LiDAR platform for each Intensive Observation Period (IOP). The choices for locations and times of the releases were made in collaboration with other PERiLS PIs. The launch location for each IOP remained fixed for the duration of the IOP. This dataset includes 41 high vertical resolution (5-second), quality-controlled soundings. Locations and launch times for each IOP are given in Table 1 below.

Table 1: Launch locations and times for the ULM PERiLS radiosonde dataset.

IOP #	Start Date	Site Name	Latitude	Longitude	Launch Times (UTC)
1	2/16/23	Kewanee, MS	32.4262	-88.4496	1201, 1337, 1459, 1629, 1758, 1850, 2026, 2209, 0027
2	3/3/23	Shelby, MS	33.9536	-90.7570	0101, 0231, 0400, 0502, 0558, 0658, 0757, 0923
3	3/24/23	Oak Grove, LA	32.8462	-91.3929	1701, 1825, 1954, 2107, 2158, 2258, 0000, 0059
4	3/31/23	Lawrenceburg, TN	35.2041	-87.3453	1959, 2129, 2300, 2356, 0058, 0159, 0259, 0359, 0458, 0601
5	4/5/23	Wynne, AR	35.1974	-90.7923	1101, 1231, 1356, 1458, 1600, 1653

2.0 Instrumentation Description

ULM utilized InterMet's iMet-4-AB 403 MHz radiosondes with pressure sensor and GPS wind finding during PERiLS. The iMet-4-AB radiosonde sample frequency is 1 Hz, however actual sample resolution is dependent upon signal quality between the radiosonde and receiving station. The manufacturer's specifications for the iMet-4 radiosondes are given in Table 2 below. Data were received using InterMet's iMet-3050-A 403 MHz portable sounding system and iMetOS-II software.

Table 2: Manufacturer stated uncertainty and resolution for each of the variables sampled by the iMet-4-AB radiosondes (available from https://www.intermetsystems.com/wp-content/uploads/2022/01/202084-12_iMet-4_Technical_Data_Sheet.pdf)

Variable	Resolution	Uncertainty
Temperature	0.01 °C	0.5°C
Humidity	0.1 %	5 %
Pressure	0.01 hPa	2.0 hPa
Wind Speed	0.1 m/s	0.5 m/s
Wind Direction	1°	1°
Altitude	0.1 m	30 m

3.0 Data Collection and Processing

Data collection occurred at the sites given in Table 1. Balloons were filled to target a median ascent rate between 3 and 5 m s^{-1}. Radiosondes were turned on at least 10 minutes preceding each flight to acquire a GPS signal and begin collection of surface data. The iMet-4's surface data were inserted as the flight's "surface measurements" via the iMetOS-II software. The surface data were compared to a Kestrel 3500 to ensure consistency; if the data varied more than the manufacturer listed uncertainties then the sonde was either replaced or the flight was marked for further examination during post processing.

The raw iMet-4 data were automatically processed and quality controlled by the iMetOS-II software. During processing the 1 Hz (1-s) resolution data were resampled to 0.2 Hz (5-s). The post-processed iMet data were run through computer code that further checked for inconsistent heights, temperature/dewpoint, and wind data. These checks were primarily added to reduce error when using the data in plotting software. Data collected while the balloon was descending was omitted from the SHARPpy file but remain present in the primary file format. The data were also rearranged into a consistent format.

Surface data were further checked during post-processing. Each flight was compared with nearby ASOS or sticknet datasets for consistency. In some instances, the iMet-4's dew point values were low compared to surrounding surface datasets (see Section 5 Data Remarks for more information). On flights where large discrepancies relative to surrounding datasets were present, the surface relative humidity was increased by no more than 5% (within the sensor's stated uncertainty) to better align with nearby (≤ 10 km) surface data. Relative humidity data above the surface were not changed and are provided as collected by the radiosonde.

4.0 Data Format

Three files are provided for each flight: two data files and a flight summary file. The data files are provided as CSV text files at 5-s temporal resolution. The data files include the primary data file for each launch and a SPC/SHARPpy formatted file. The summary file contains site information, surface measurements, median ascent rate, and maximum altitude measurements.

The filename format is as follows:

upperair.ULM_sonde.YYYYMMDDHHMMSS.City_State.filetype.txt

Where:

YYYYMMDDHHSS	→ release date as 4-digit year, 2-digit month, 2-digit day, 6-digit UTC time
City_State	→ nearest city/town name and State where flight occurred
Filetype	→ Summary or SHARPpy formatted file. If no filetype then assume it's the primary data file

No special missing data marker is given – filtered data at each time interval are simply not included.

4.1 Primary File Format

The primary data file contains a standard header (marked by #) that gives the following:
Line 1: Data set title
Line 2: Launch Date, Launch Time, Launch Location, Launch Elevation
Line 3: Included variables and units

An example header is given below:

```
# ULM PERiLS Radiosonde Data
# 20220322, 152922 UTC, Demopolis_AL, 25 m
# latitude (deg), longitude (deg), UTC (HH:MM:SS), height (m AGL), pressure(mb),
temp (deg C), RH (%), dewpoint (deg C), wind speed (m/s), wind direction (deg),
ascent rate (m/s)
```

Variables include the following:

Latitude	degree decimal format
Longitude	degree decimal format
Time	UTC (HH:MM:SS)
Height	m AGL
Pressure	mb
Temperature	°C
Relative humidity	%
Dew point	°C
Wind speed	m/s
Wind direction	degrees from north
Ascent rate	m/s

4.2 SPC/SHARPpy File Format

A SPC/SHARPpy formatted file is given to facilitate easy plotting using the SHARPpy program. The SPC/SHARPpy file contains a standard header that starts with %TITLE% and gives the following:
Line 1: Launch title & location, launch date/launch time
Line 2: blank
Line 3: Variables

An example header is given below:

```
%TITLE%
ULM-Demopolis_AL   220322/1656

   LEVEL       HGHT       TEMP       DWPT       WDIR       WSPD
-------------------------------------------------------------------
%RAW%
```

Data begins on the line after %RAW% and includes the following variables:

Pressure	mb
Height	m MSL
Temperature	°C
Dew Point	°C
Wind direction	degrees from north
Wind speed	m/s

5.0 Data Remarks

Surface Dew Point / Relative Humidity: It was noted during IOPs the iMet-4 surface dew points were often a few degrees lower that surrounding surface data. This was examined in more detail following PERiLS and while a *systematic* low bias was not present, the iMet-4s occasionally recorded dew point temperatures 2-4°C lower than known calibrated sensors. However, this low bias is within the uncertainty of the relative humidity sensor used on the iMet-4 radiosondes.

Flight issues: Various problems can cause flight issues and thus premature flight failures. The iMet-4's particularly exhibit frequency interference within the presence of significant lightning. The following sondes exhibited premature signal loss or negative ascent rates:

upperair.ULM_sonde.202302161850.Kewanee_MS	No data above 559 mb
upperair.ULM_sonde.202302162026.Kewanee_MS	No data above 504 mb
upperair.ULM_sonde.202302170027.Kewanee_MS	No data above 525 mb
upperair.ULM_sonde.202304010601.Lawrenceburg_TN	No data above 502 mb; negative ascent rates
upperair.ULM_sonde.202304051653.Wynne_AR	negative ascent rates