AUTOMATED RADIOSONDE LAUNCHER MODEL ARL-9000

General Description

The Automated Radiosonde Launcher (ARL) is a low cost system that permits unattended upper air observations. It is a robust and fault-tolerant system that automates radiosonde observations. It is compatible with a variety of commercial radiosondes. The ARL is ideal for remote locations, manpower limited operations, and mobile requirements.

The ARL takes a manually intensive task and reduces it to a periodic maintenance routine. Because the it automates every step in the launch process personnel are free to perform more important value-added tasks, and human errors are eliminated.

- **Model ARL-9000:** The fixed-base system processes up to 8 upper air observations automatically. The ARL reduces manpower costs, while increasing data availability.
- **Model ARL-9001:** The trailer-mounted mobile system processes up to 8 upper air observations automatically.

Once loaded, the ARL system automatically:
- powers up a radiosonde
- checks the RF link
- starts data acquisition
- performs a verification of the radiosonde temperature and humidity signals
- acquires real time wind, temperature and dew point data from a Model PTU-2000 thermohygrometer
- inflates a balloon and verifies inflation
- releases the balloon
- verifies the payload is successfully away
- continuously captures data for flight duration
- transfers data to a central data archive
- returns to idle state and prepares for next launch

ARL-9001 Mobile version of the Automated Radiosonde Launcher

Features

- LORAN-C and GPS wind-finding options
- Operator safety: operators only need visit the system occasionally to load expendables, avoiding hazardous weather
- Can be automated for preset release times or conveniently remote-controlled via the Internet to capture rapidly changing weather events
- Supports XDR-928 GPS digital radiosondes

Applications

- Numerical Weather Prediction: Input for weather forecast models
- Operational Weather: Permanent upper air observing system for commercial and military applications. Mobile and tactical options available.
- Remote Sensing: Ground truth validation for calibration of satellite platforms
- Scientific Research: Global warming and climate change studies
- Field Experiments: ARL-9001 mobile version is ideal for storm-chasing/research
- Space/physical footprint-limited locations
- Labor Reduction: Replacement of human operators at remote or hostile locations

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Software Architecture

The system software runs on a core CPU running YESDAQ, a mySQL-based database with ODBC connectivity. The software manages ground support equipment and handles paper tapes. Because it provides web access to upper air data and system status, it can be remotely controlled. For example, with the click of a mouse, remote users can optionally control the release of a balloon for compliance with ATC/controlled airspace regulations. The software architecture permits hundreds of remote ARL stations to be centrally controlled.

- Schedule-driven Launch Control Engine

- Flight Database stores contiguous data sets

- Web server component for display interface

- Maintenance logs coordinate loading and system maintenance

Hardware Features/Installation

Radiosondes and expendables including helium gas, batteries and up to 600g balloons are loaded into the system. Each "channel" holds a single radiosonde in a launch carrier that manages the balloon inflation process and battery wetting. Expendables can be stored on or off site.

Flight Data Facility

At the center of the system is the Auto Launcher Executive (ALEX) a TCP/IP based remote control MS-Windows application that buffers you from the control language the core embedded controller uses to talk to the METHUB Met Data Receiver. Once released, the METHUB receives and stores in-flight data. Once stored, radiosonde data is displayed in web browser locally on a PC or workstation in a variety of meteorological formats. Skew-T charts, linear Pressure, Temperature, Humidity (PTU) or text displays are supported.
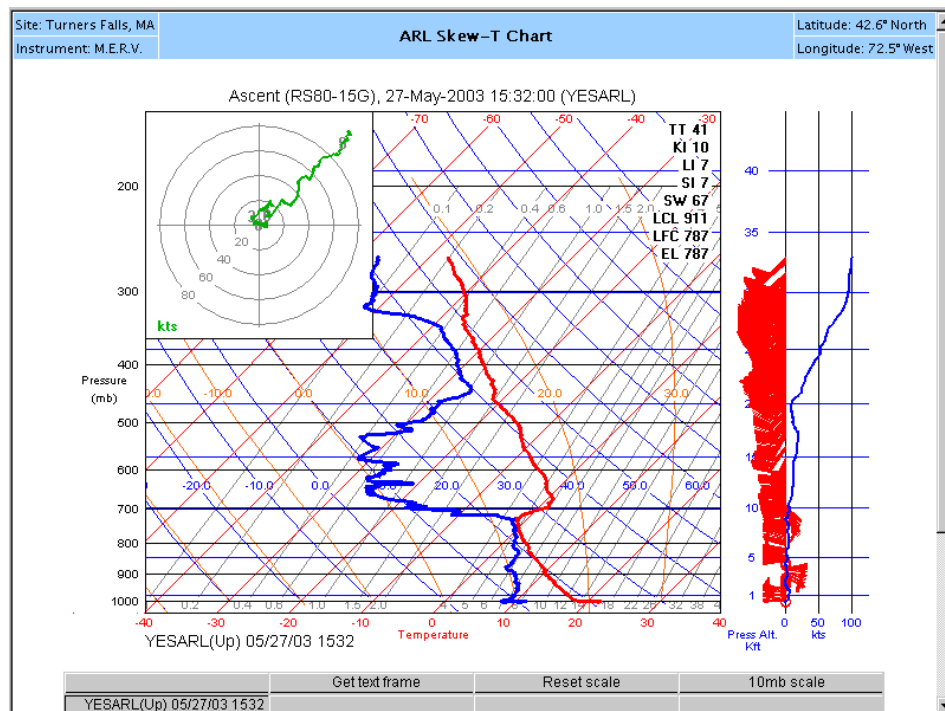
Example of Skew-T chart from a GPS wind finding radiosonde

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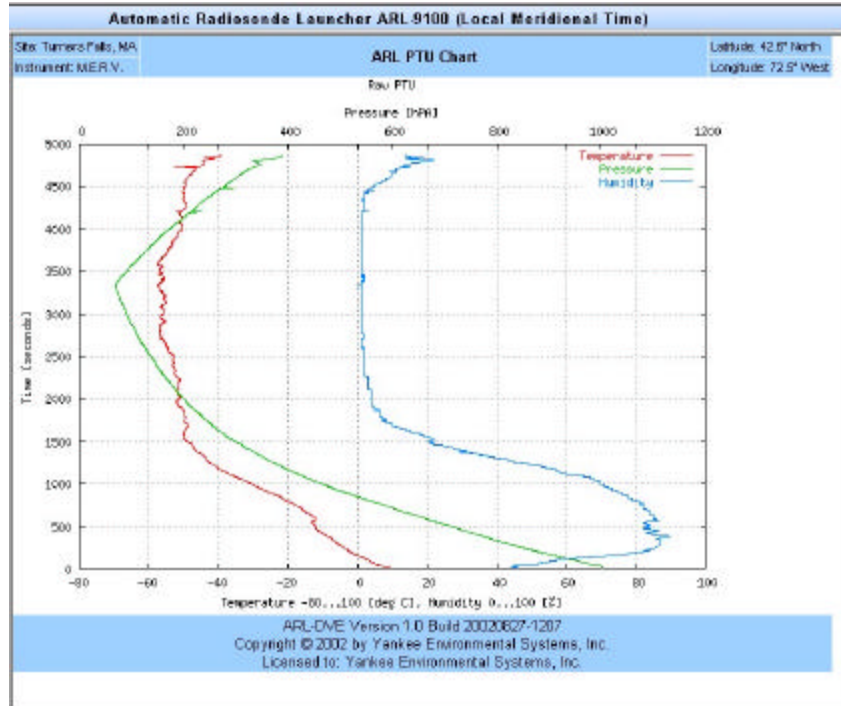
Example of web-based Linear PTU radiosonde data
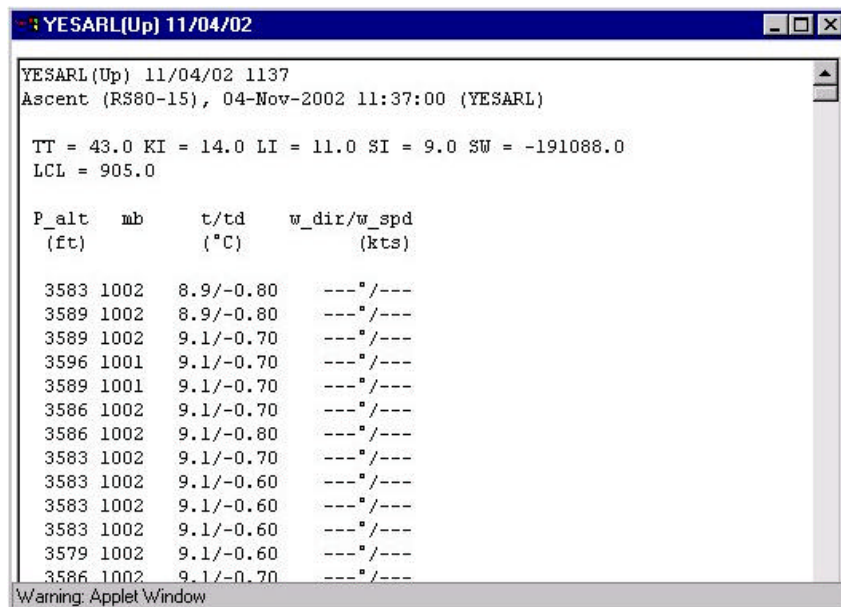
Example of text data window from a radiosonde

Data Interfaces

Managing a network of upper air sites for an extended period of time produces a sizable data repository. Upper air data are collected and stored for later display or further analysis in YESDAQ, a mySQL-based open source relational database supporting ODBC, JDBC, Perl and native mySQL driver connectivity. System profiles are stored permitting site quality control.

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ARL Launch Sequence Diagram

```
Start launch
Sequence initiated

      │
      ▼
 Wind speed          No
 < 40 mph? ──────────────►  Go to next sonde
      │
     Yes
      │
      ▼
 System ON? ──── No ────► Critical Stop
      │                   He gas is out ◄── No ── Buoyancy ok?
     Yes                                              ▲
      │                                               │
      ▼                                      Begin balloon
 Start sounding                              Inflation seq.
 session                                              │
      │                                              Yes
      ▼                                               │
 Activate battery                                     ▼
      │                                        End balloon
      ▼                                        Inflation seq.
 Battery ON? ──── No ──►                              │
      │                                               ▼
     Yes                         No          PTU Data
      │              ◄───────────────────── still ok?
      ▼                                          │
 Telemetry                                      Yes
 Received? ──── No ──►                           │
      │                                          ▼
     Yes                                  Start data log to
      │                                   YESDAQ
      ▼                                          │
 Frequency                                       ▼
 check ok? ──── No ──►  Critical Stop       Open roof
      │                 Motor failure ◄─ No       │
     Yes                                          ▼
      │                                     Roof open? ──── No
      ▼                                          │
 Data                                           Yes
 communication ──── No ──►                       │
 ok?                                             ▼
      │                                     Release
     Yes                                    balloon ──────► Close roof
      │
      ▼
 Check PTU vs.
 PTU-2000
      │
      ▼
 Data ground                                                Roof closed? ── No ──► Continue flight,
 truth ok? ──── No ──►                                           │                 motor failure
      │                                                         Yes
     Yes                                                         │
                                                                 ▼
                                                            Store data
                                                                 ▲
                                                                Yes
                                                                 │
                                                            End of flight
                                                            Detected? ── No
                                                                 │
                                                                Yes
                                                                 │
                                                                 ▼
                                                            Terminate data
                                                            storage
                                                                 │
                                                                 ▼
                                                            Ready system for
                                                            next release
```
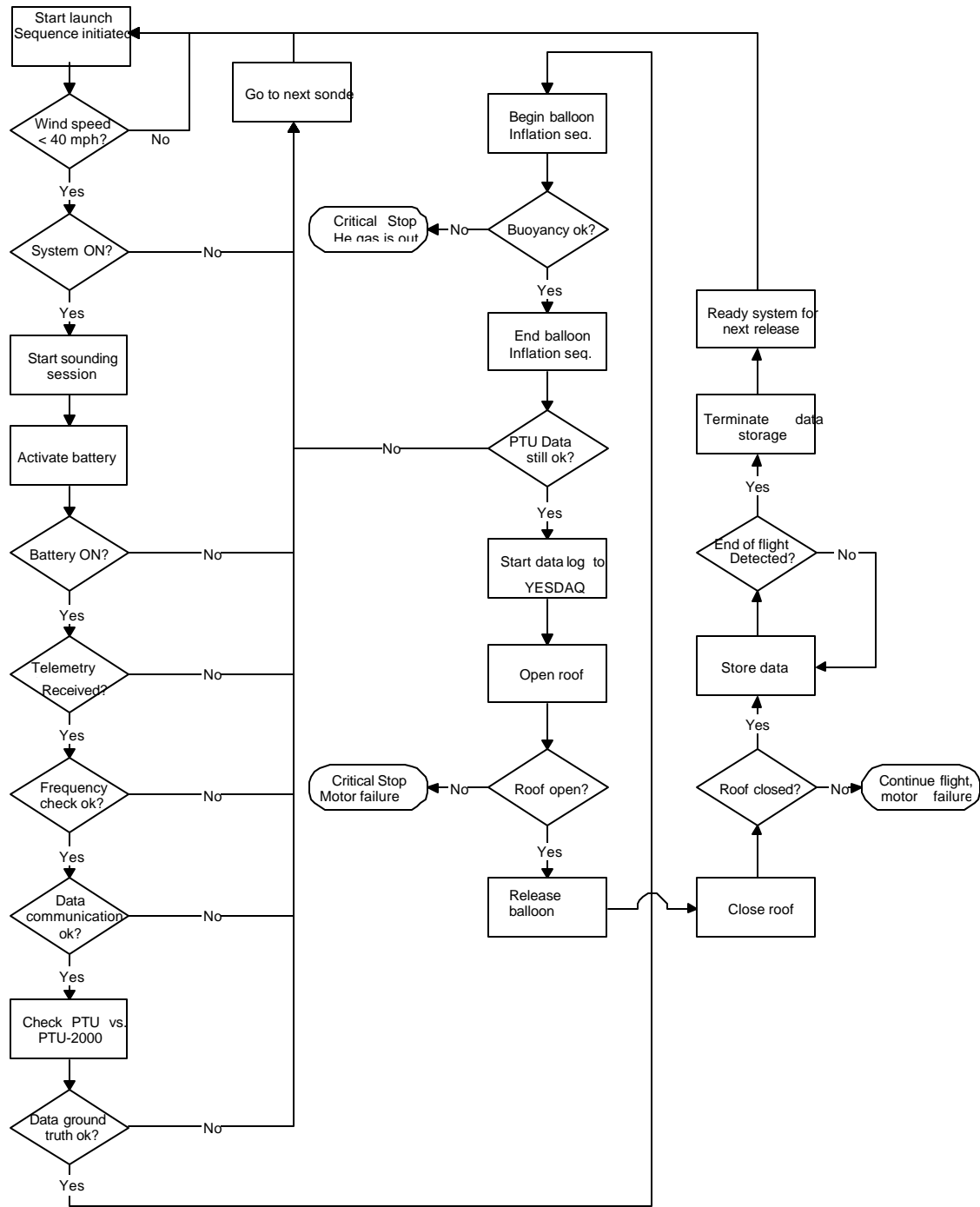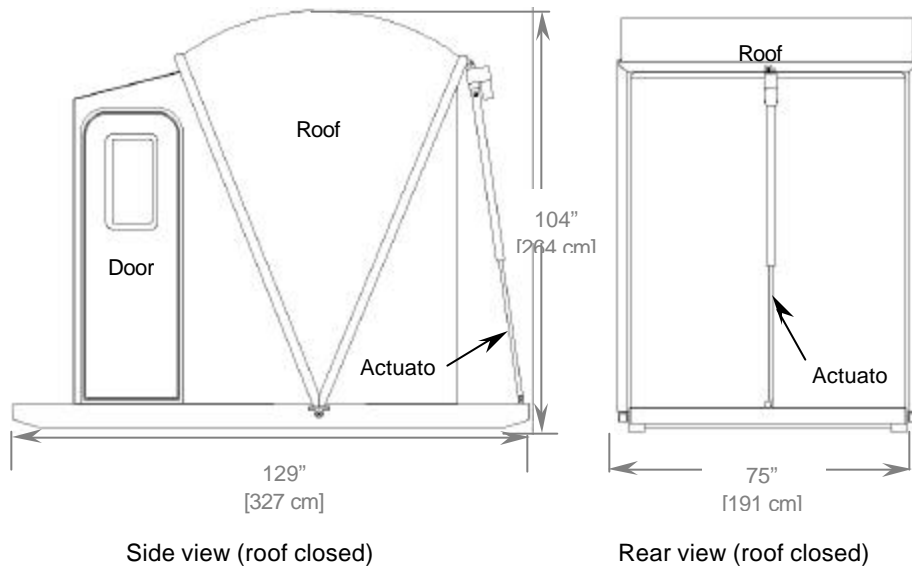
Mechanical Interface

Side view (roof closed)

Rear view (roof closed)

104"
[264 cm]

129"
[327 cm]

75"
[191 cm]

Roof

Door

Actuato

Roof

Actuato

Side view (roof open)

Roof

Door

Actuato

164"
[417 cm]

Launch Wind Speed Limits

≤ 45 mph (<100 MPH storage with tiedowns)

Development History

The ARL was developed in partnership with the US Dept of Energy and NOAA.

Specifications

Operating Temperature

-40°C to +44°C

Weight (ARL-9000)

2200 lbs. (not including helium tanks)

Power Requirements

110/220 Vac, 50/60 Hz, 15A heater on, 1A heater off