Overview of the Capabilities of the DataHawk Small Unmanned Aerial System (sUAS)

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Overview of the DataHawk System

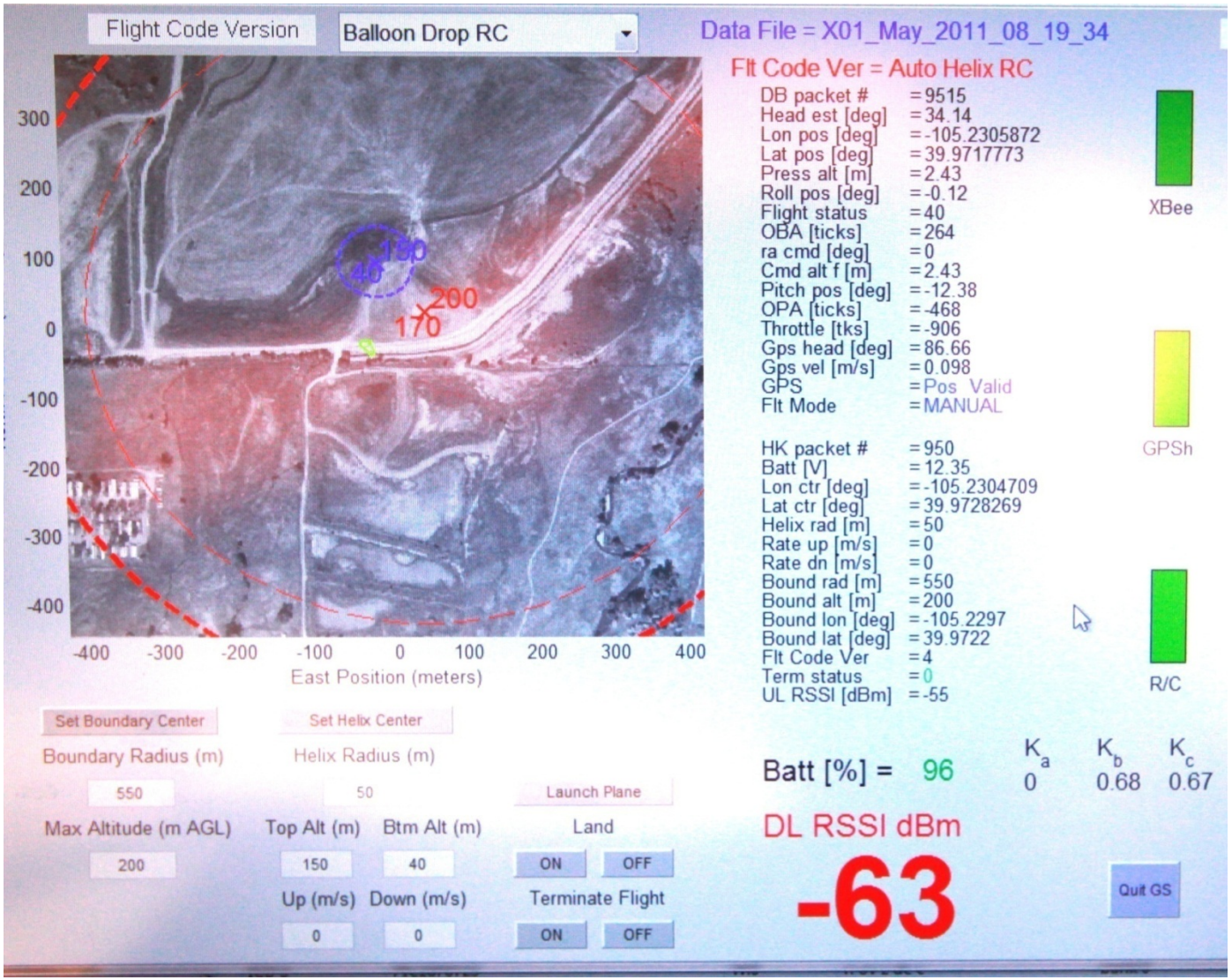
Unmanned Aircraft

- Wingspan: 1 m
- Weight: ~700 gm
- Payload: ~ 80 gm
- Electric propulsion
- Duration: about 40 min.
- Rear folding propeller
- 11-16 m/s airspeed
- Power: 40-min lifetime battery
- Cost: ~ $600
- Airframe: EPP foam
- Autopilot: custom (CUPIC)
- Autonomous flight control with user supervision, real time changes in flight profile
- Flight termination mode prevents fly-away and conflict with other air traffic

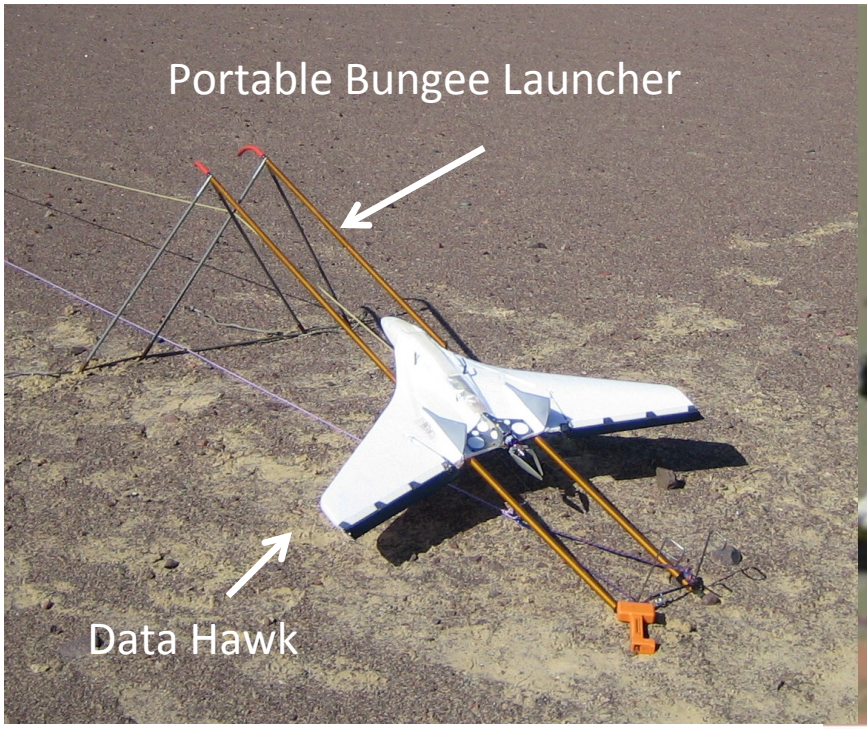
Overview of the DataHawk System

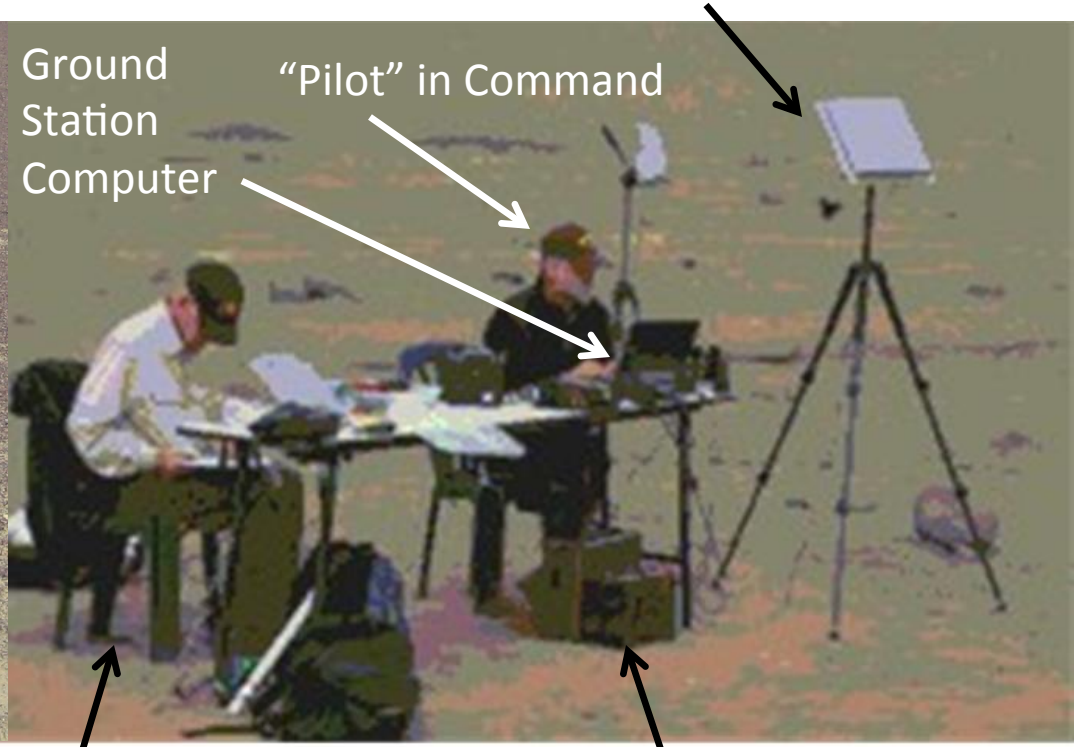
Ground Station

- Laptop computer running a Matlab user interface
- Data radio module and suitable antenna
- Real time aircraft location, status, and sensor data display
- Real time uplink of flight parameter changes and mode commands
- Tested radio range:
  - 3 km laterally
  - 10 km vertically



Typical Ground Support Equipment





Data Hawk Operating Modes

Deployment

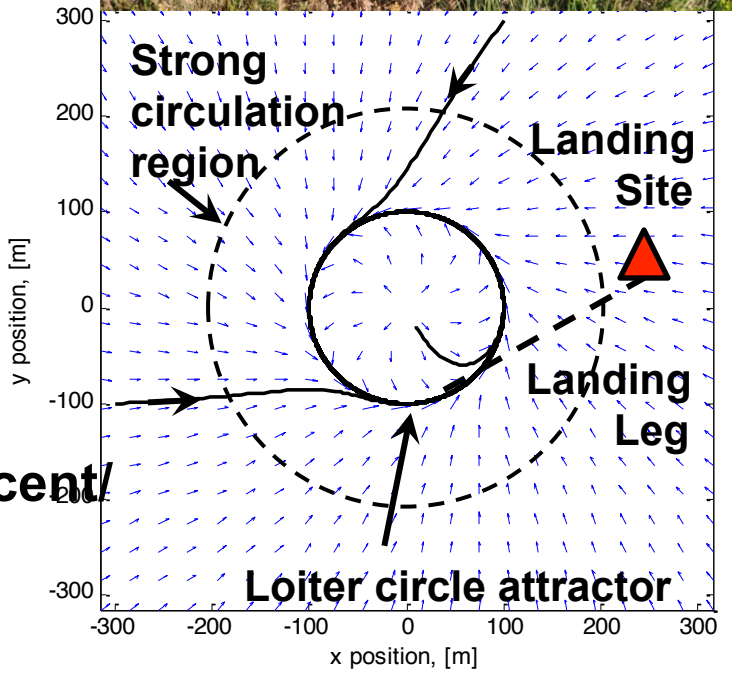
- **Auto-Launch: bungee launch for flights up to about 3 km AGL**
- **Auto-Drop: release from a weather balloon for flights up to about 10 km MSL**

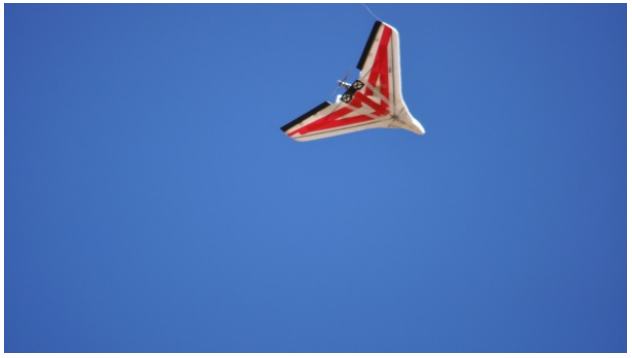
In-flight

- **Auto-Helix: vector field attraction to a loiter circle, with prescribed location and radius, and prescribed altitude ceiling/floor and ascent/descent rates**
- **All helix parameters can be changed in real time from the ground station**

Recovery

- **Auto-Land: Plane glides to designated landing coordinates upon ground station command**





DataHawk Auto-Launch Deployment

- Protable bungee launcher can be set up virtually anywhere
- Plane is released by ground station command
- Plane automatically transitions into the nominal Auto-Helix flight mode

DataHawk Auto-Drop Balloon Deployment :

- Uses a 200gm helium weather balloon to loft the DataHawk to release altitude (up to about 10km MSL)
- Release upon command from the ground station, and based on altitude and time limits if comm. link is lost.
- Plane automatically transitions to Auto-Helix flight mode

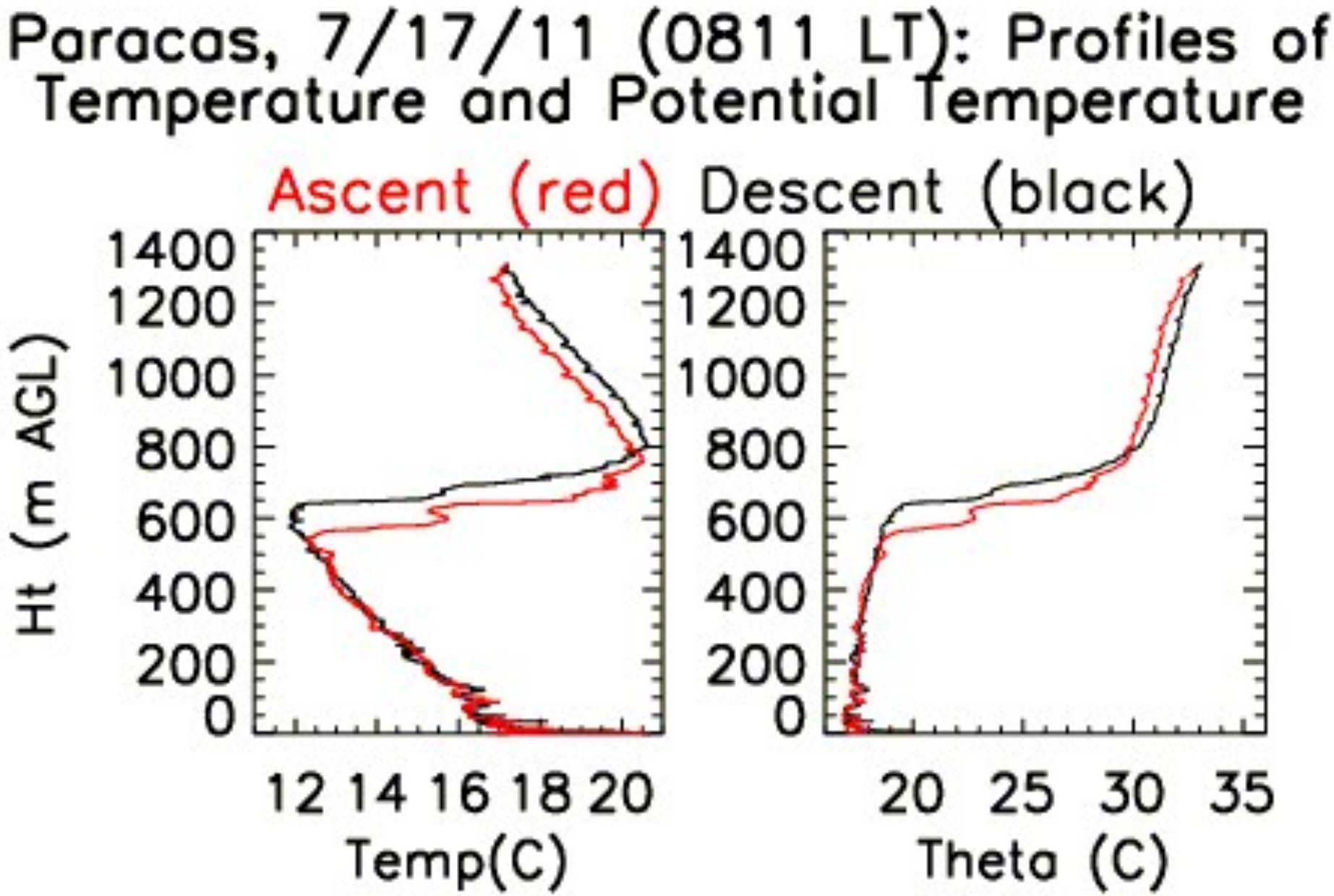
Double-click on picture for video of release

DataHawk Auto-Land Recovery

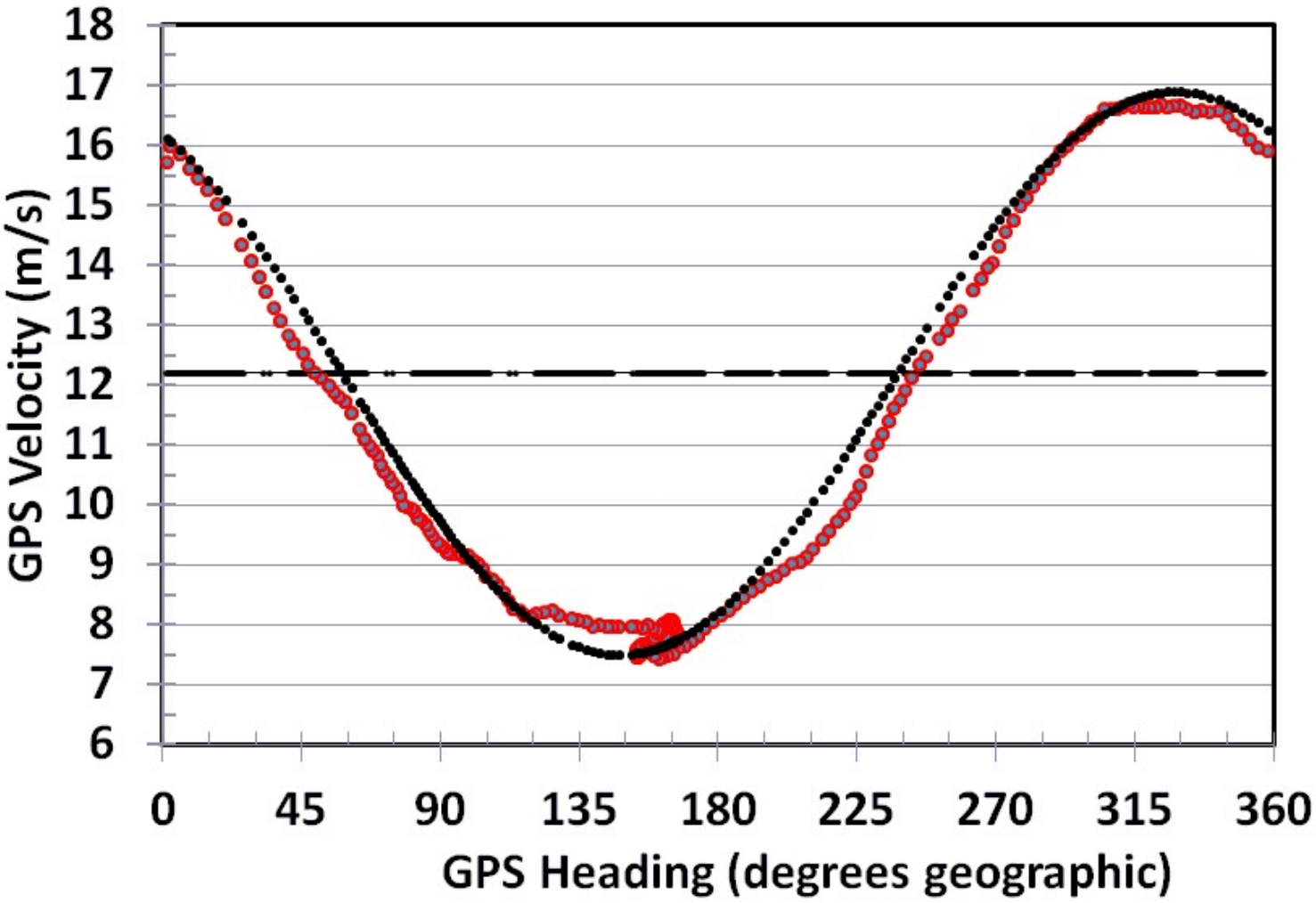
Current Measurement Capabilities

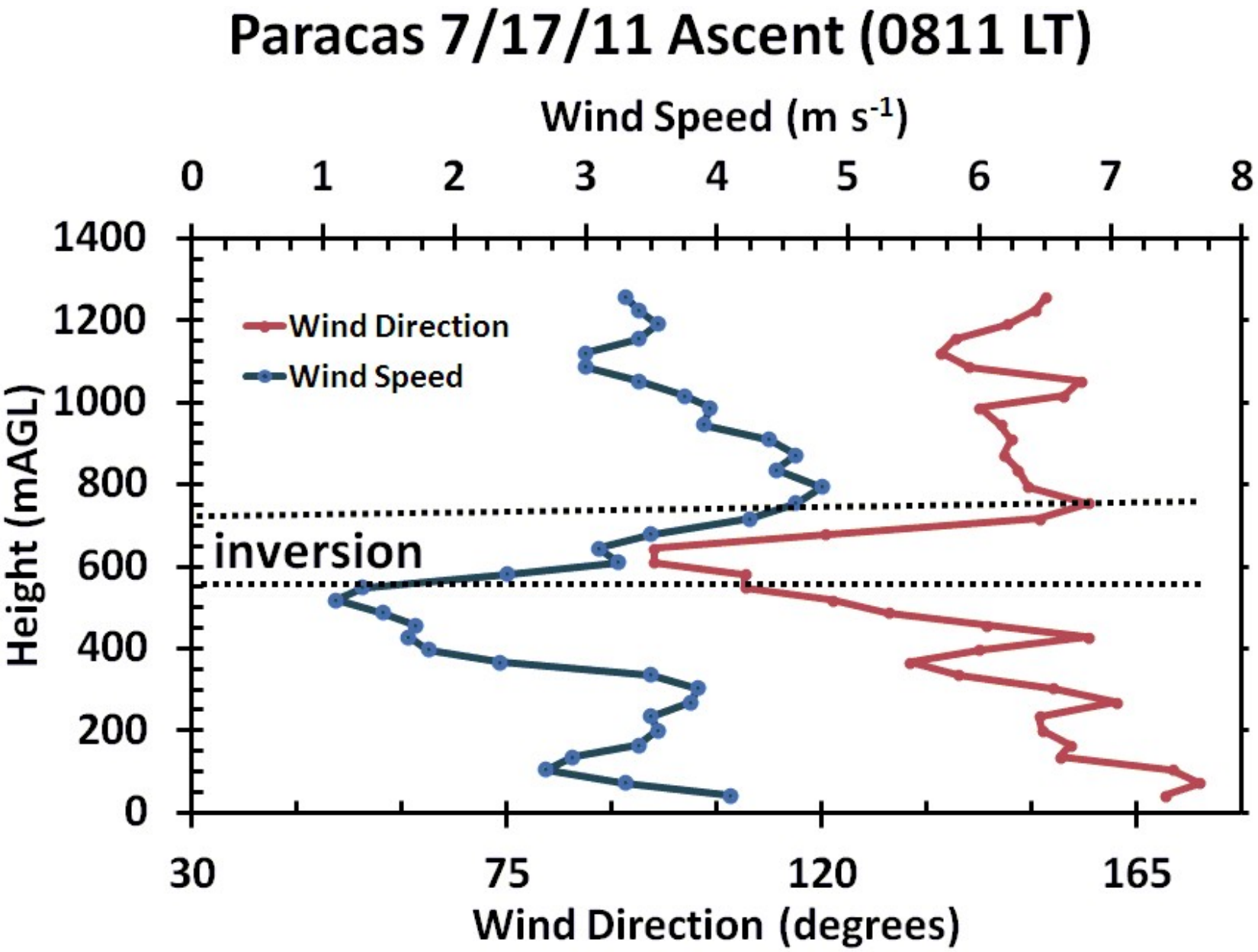
(resolution, cadence)

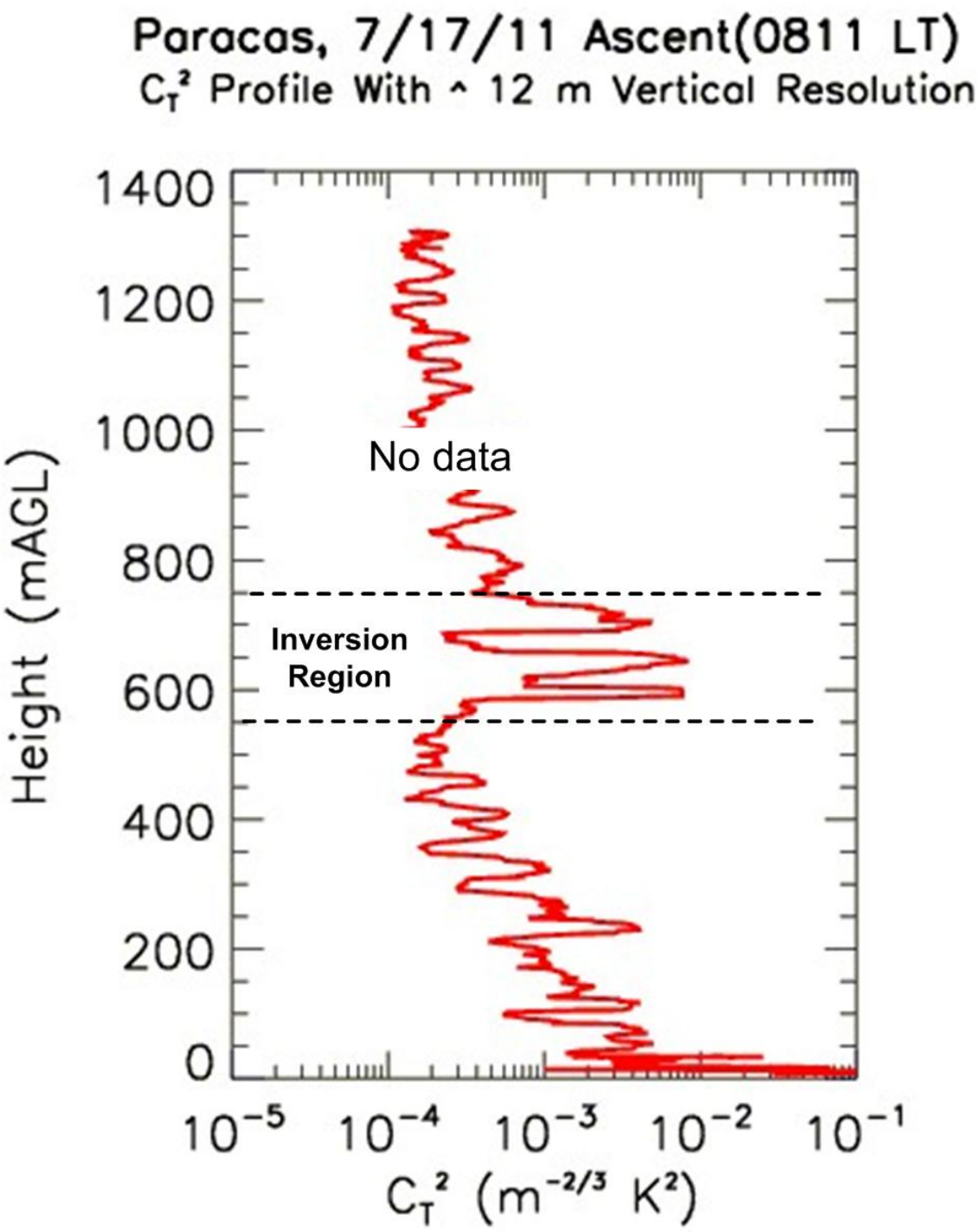
- Temperature (.003C, 100Hz)
- 3D Wind Vector (.01m/s, 10Hz)
- CT^2 Turbulence (1.0e-6 $m^{-2/3}K^2$,1 Hz)
- epsilon Turbulence (1.0e-6 m^2s^{-3}, 1 Hz)
- Humidity (.01%, 10 Hz)
- Pressure (1.0 Pa, 100 Hz)
- GPS location (0.01m, 5 Hz)
- Pressure altitude (0.1m, 100 Hz)

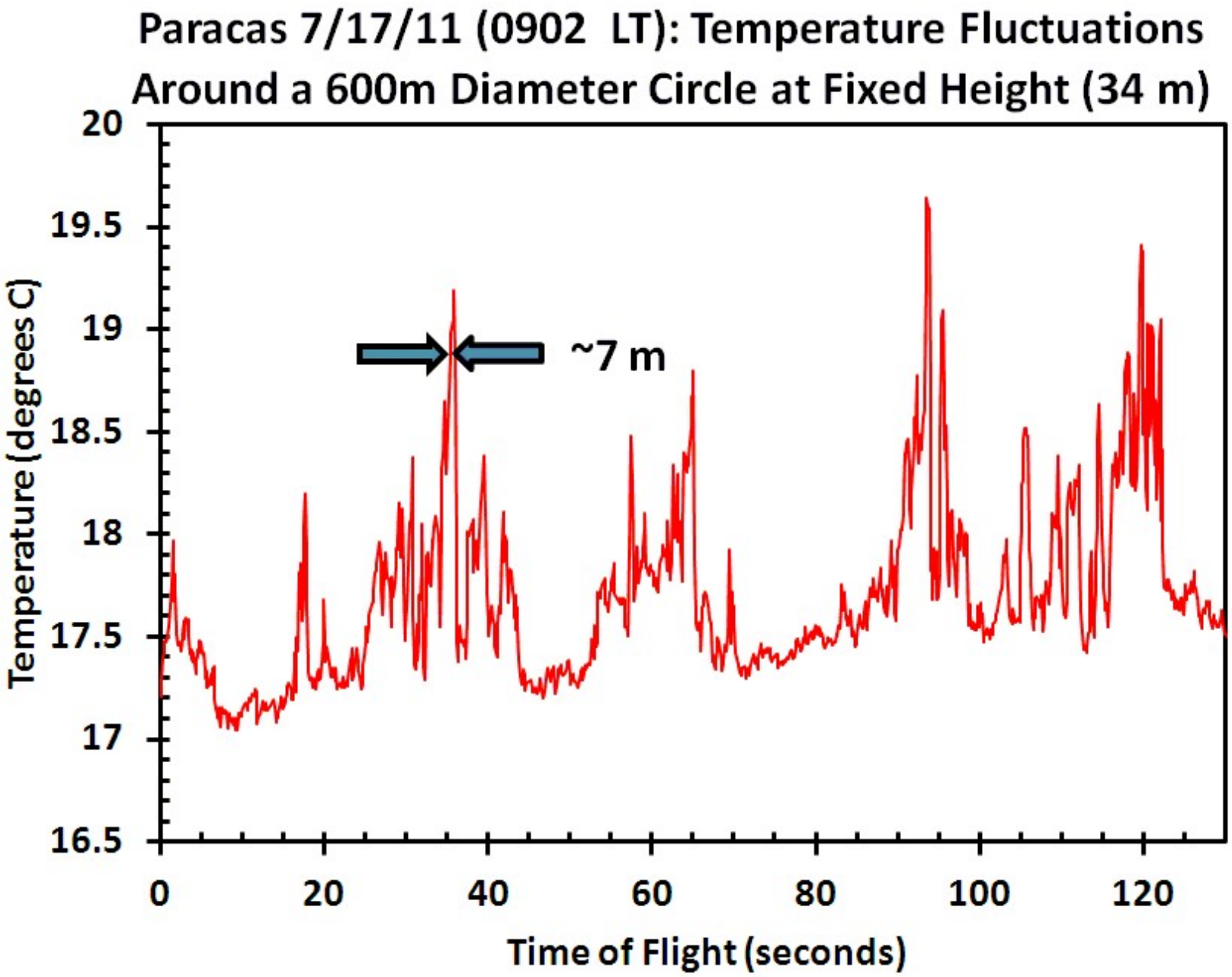

Paracas, 7/17/11 (0811 LT): Profiles of Temperature and Potential Temperature
Ascent (red)
Descent (black)
Ht (m AGL)
1400
1200
1000
800
600
400
200
0
12 14 16 18 20
Temp(C)
20 25 30 35
Theta (C)

Wind Sinusoid




Paracas 7/17/11 Ascent (0811 LT)
Wind Speed (m s-1)
0
1
2
3
4
5
6
7
8
1400
1200
1000
800
600
400
200
0
Height (mAGL)
Wind Direction
Wind Speed
inversion
30
75
120
165
Wind Direction (degrees)


Paracas, 7/17/11 Ascent(0811 LT)
C_T^2 Profile With ~ 12 m Vertical Resolution
1400
1200
1000
800
600
400
200
0
Height (mAGL)
No data
Inversion
Region
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
C_T^2 ($m^{-2/3}$ K^2)


Paracas 7/17/11 (0902 LT): Temperature Fluctuations
Around a 600m Diameter Circle at Fixed Height (34 m)
Temperature (degrees C)
20
19.5
19
18.5
18
17.5
17
16.5
~7 m
0
20
40
60
80
100
120
Time of Flight (seconds)

Matterhorn (Granite Mountain) Flight Profile Concepts

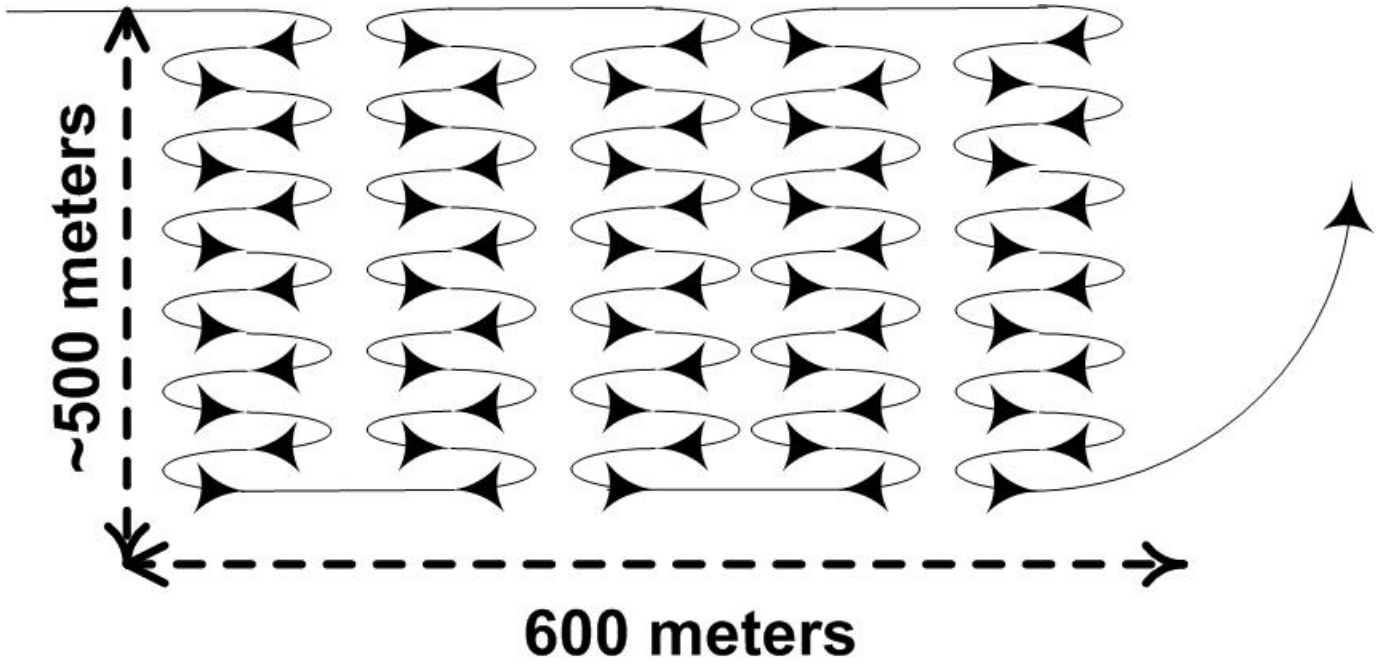
One possibility would be to examine the mouth of a specific canyon, as shown below

Matterhorn Flight Profile Concepts

Mouth of Canyon Coverage:

"profile curtain"

Method for Documenting Winds, Temperatures, Humidity, and Turbulence at the Mouth of a Canyon



Note: This pattern would take ~ 15-20 minutes

Other Possibilities :

- Large circles
- Transects between circles
- Higher altitude profiles (to about 3km AGL)