New advances in atmospheric measurements using UAVs

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Braydon Revard
David Schvartzman
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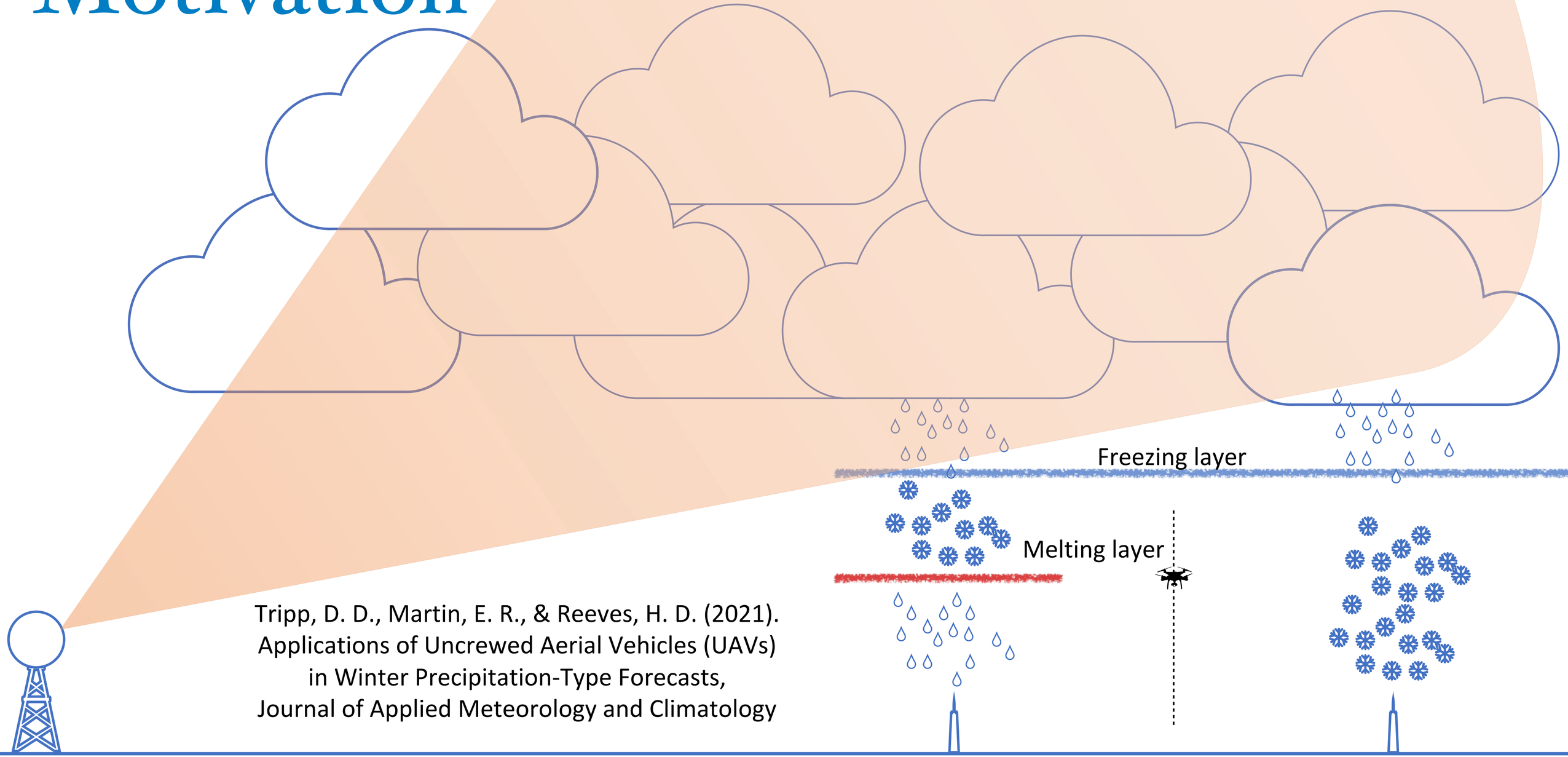
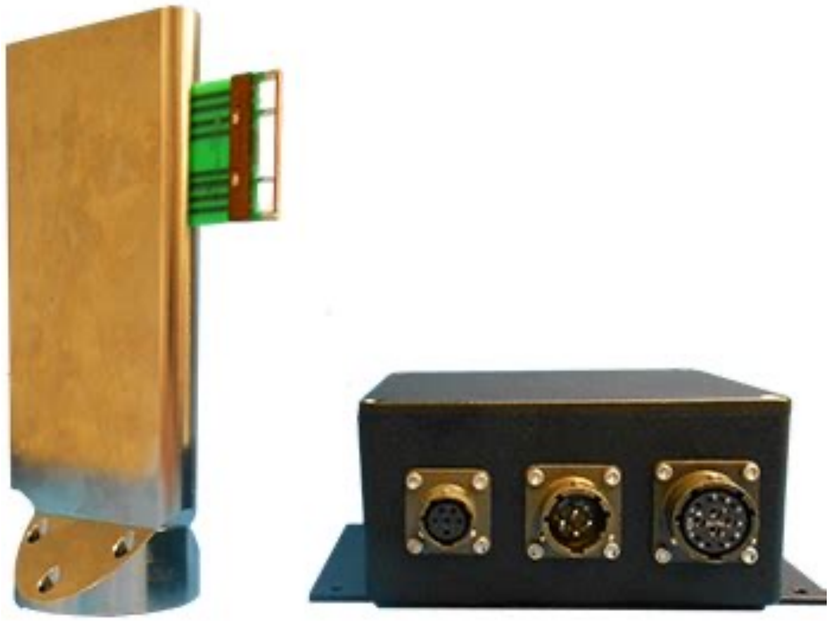
Motivation

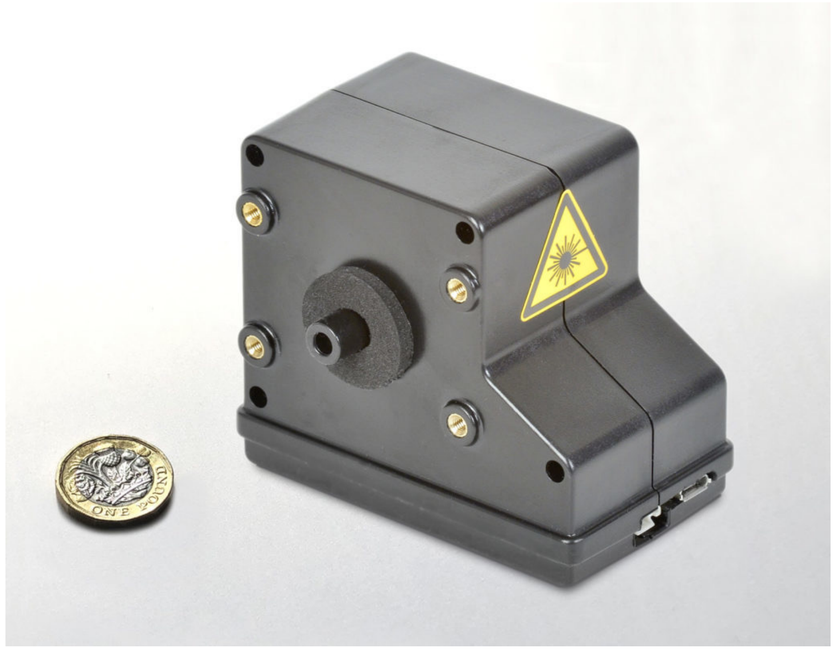


Tripp, D. D., Martin, E. R., & Reeves, H. D. (2021). Applications of Uncrewed Aerial Vehicles (UAVs) in Winter Precipitation-Type Forecasts, Journal of Applied Meteorology and Climatology

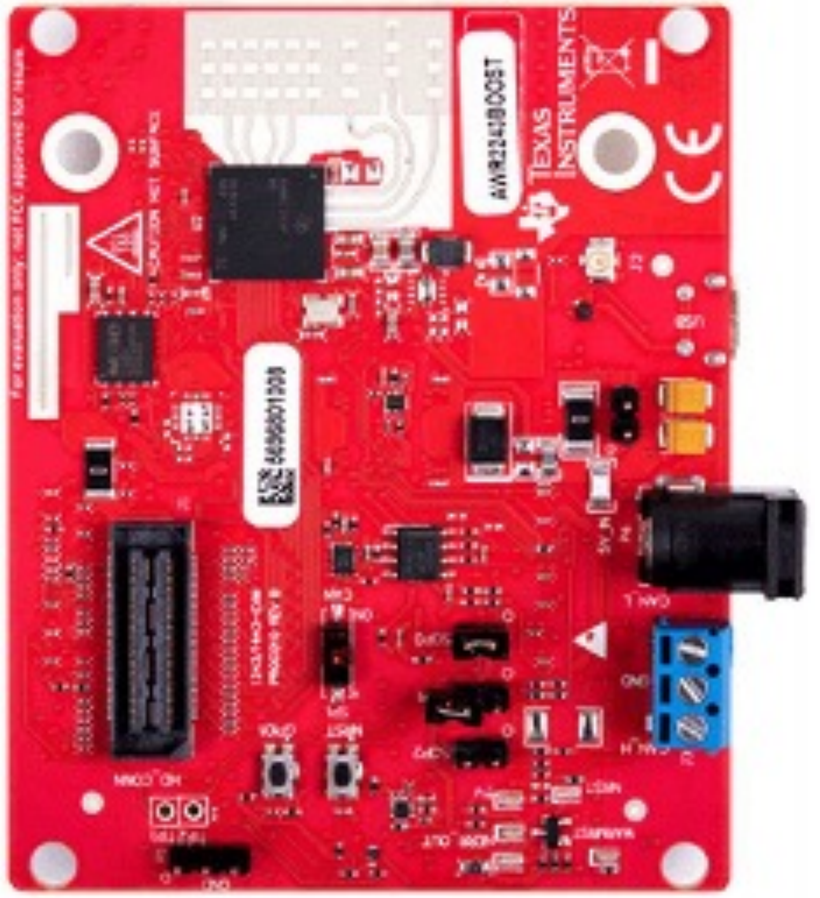
Sensors



Droplet Measurement Technology
LWC-300

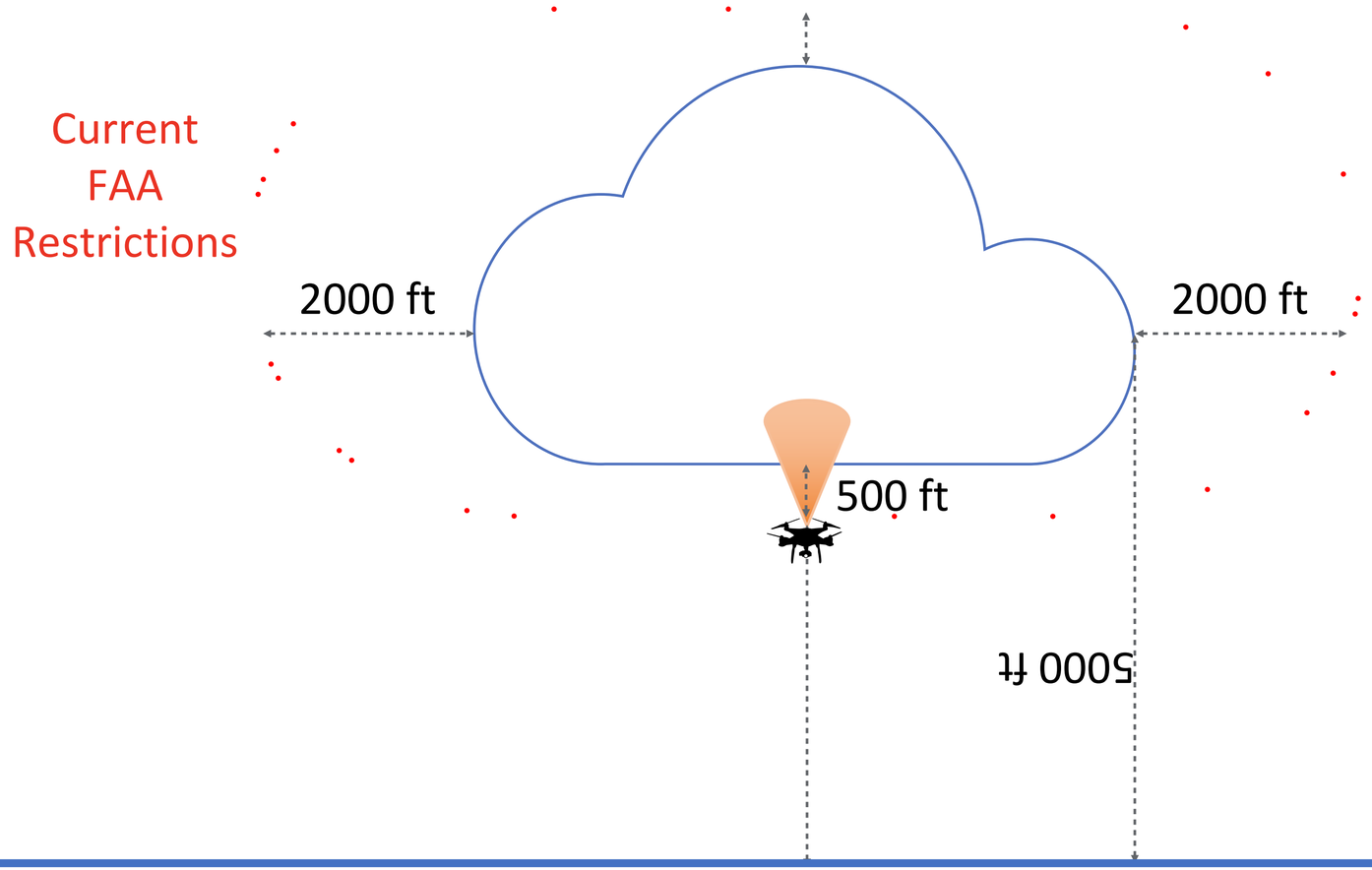


AlphaSense
OPC-N3

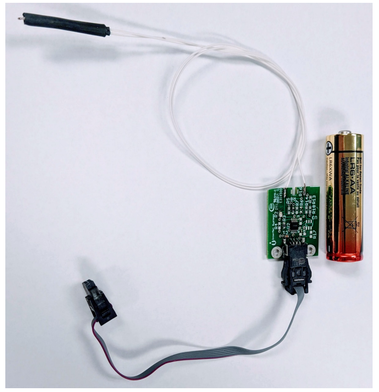


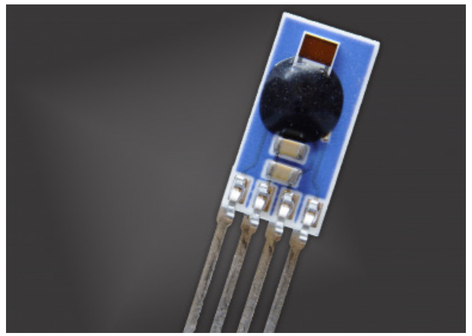
Texas Instruments
AWR2243

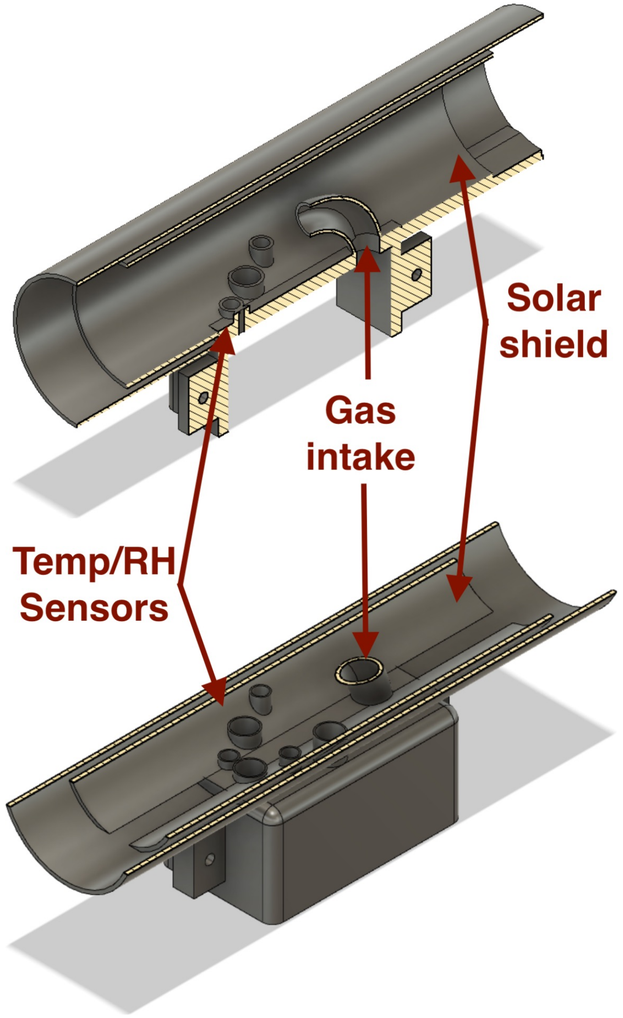
UAS-based mmWave PAR

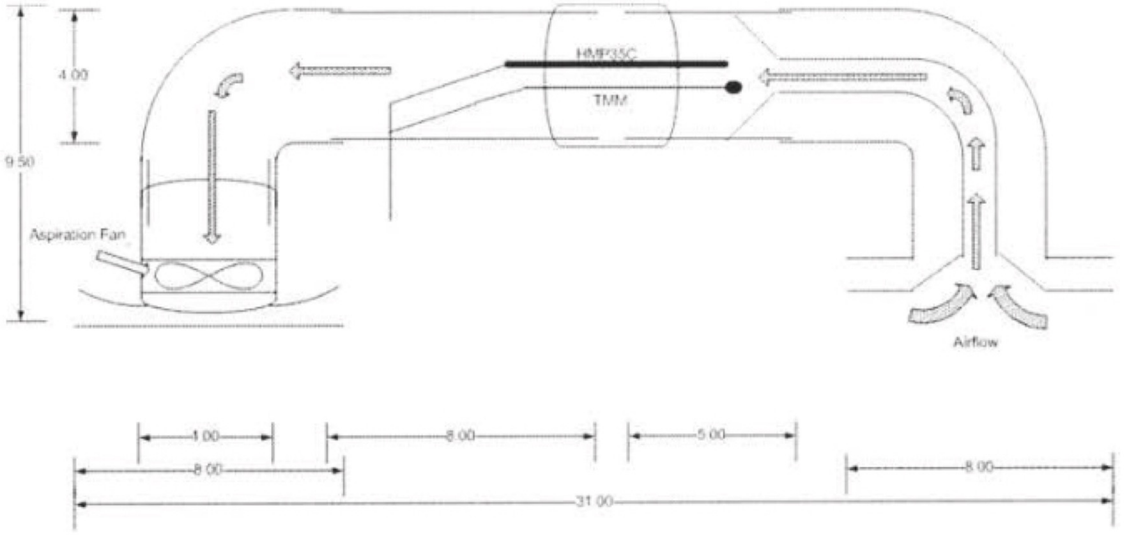


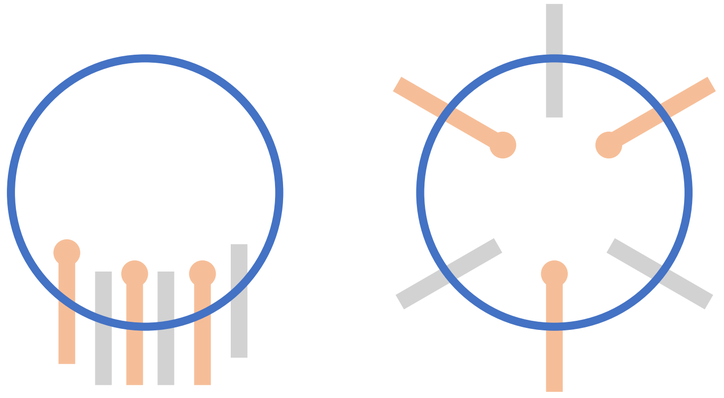
Temperature and Rel. Humidity



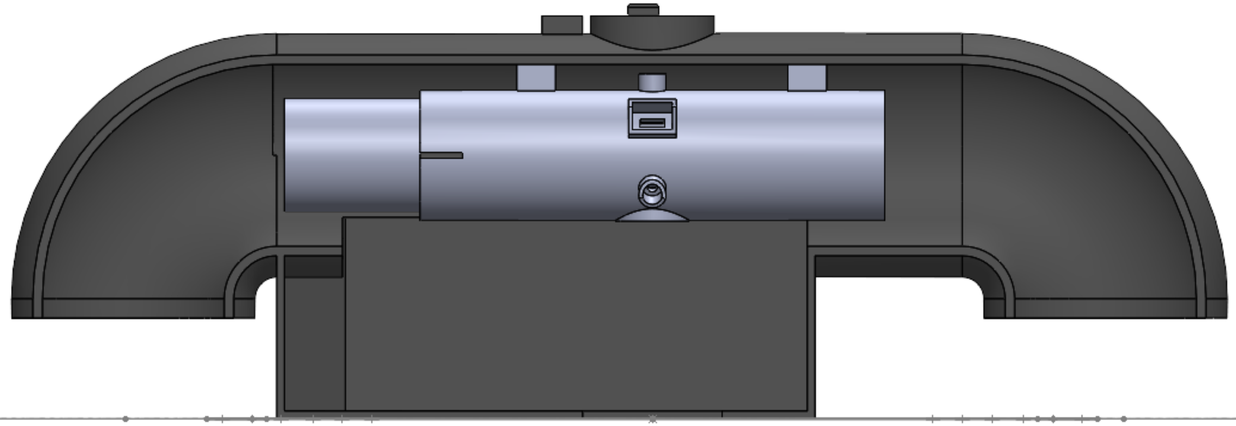


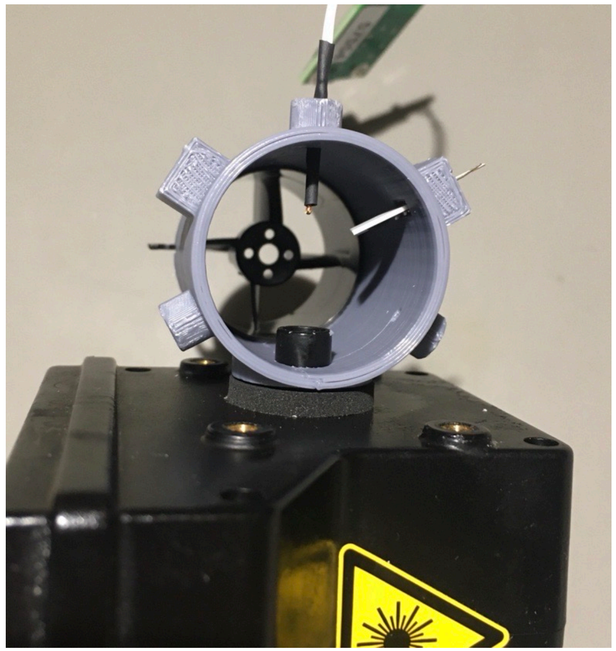


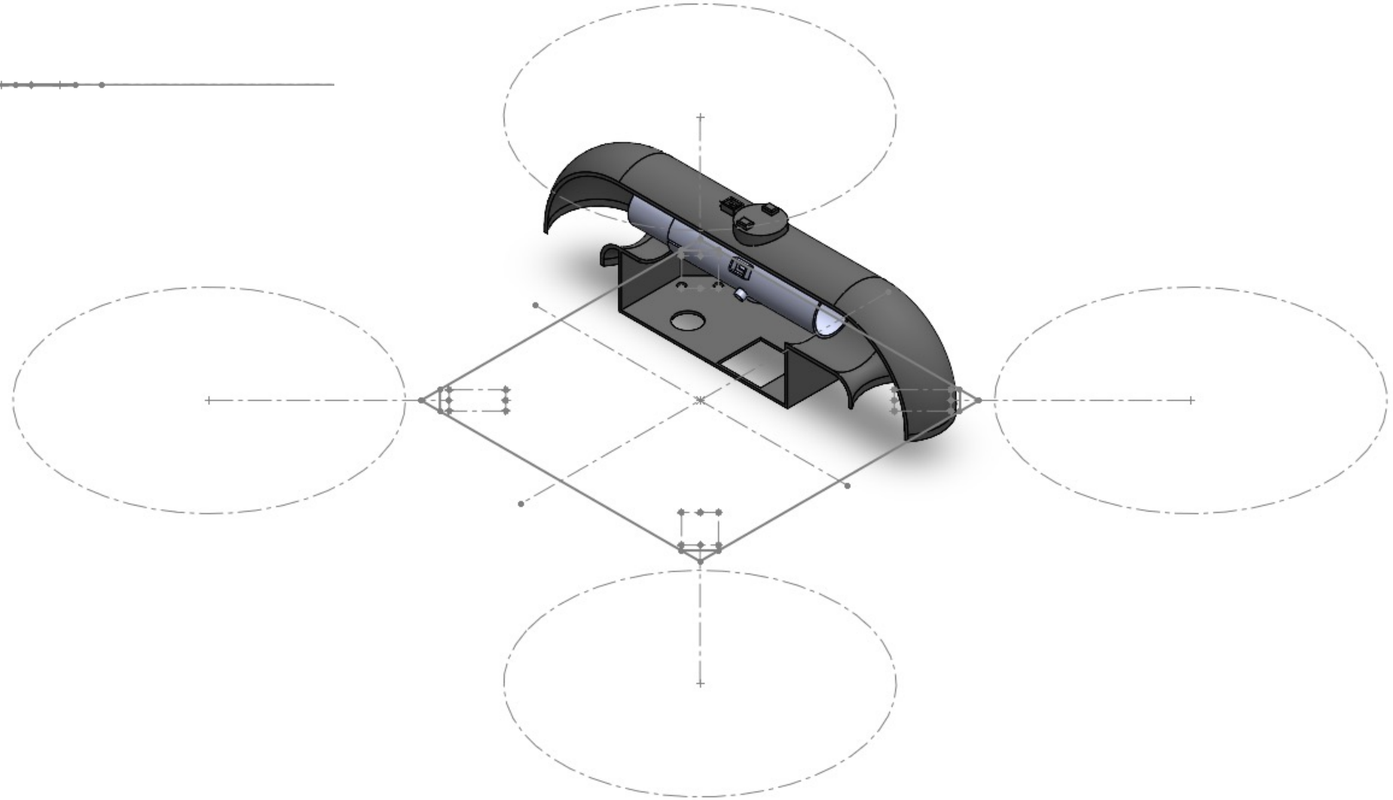




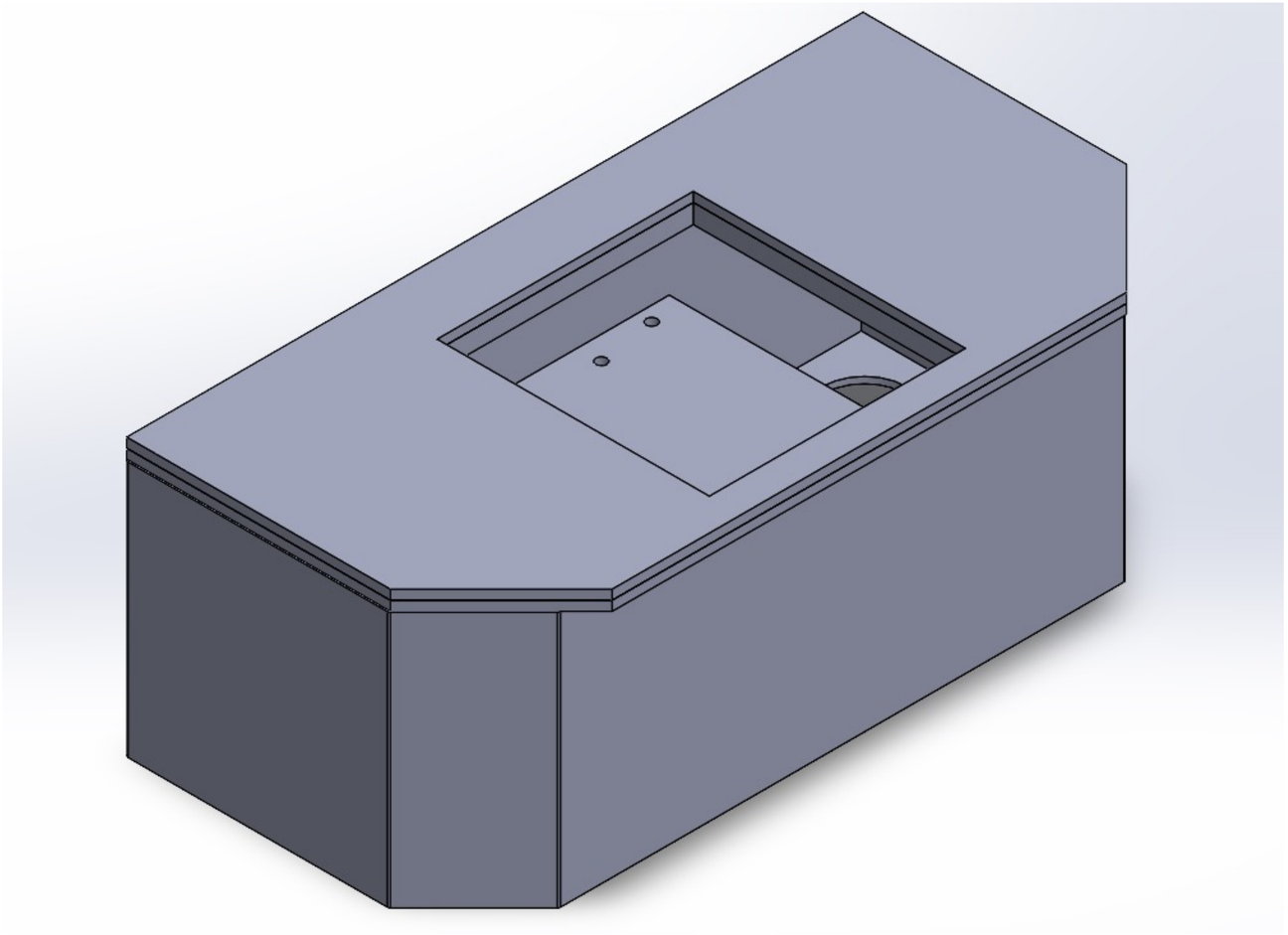
Temperature and Rel. Humidity

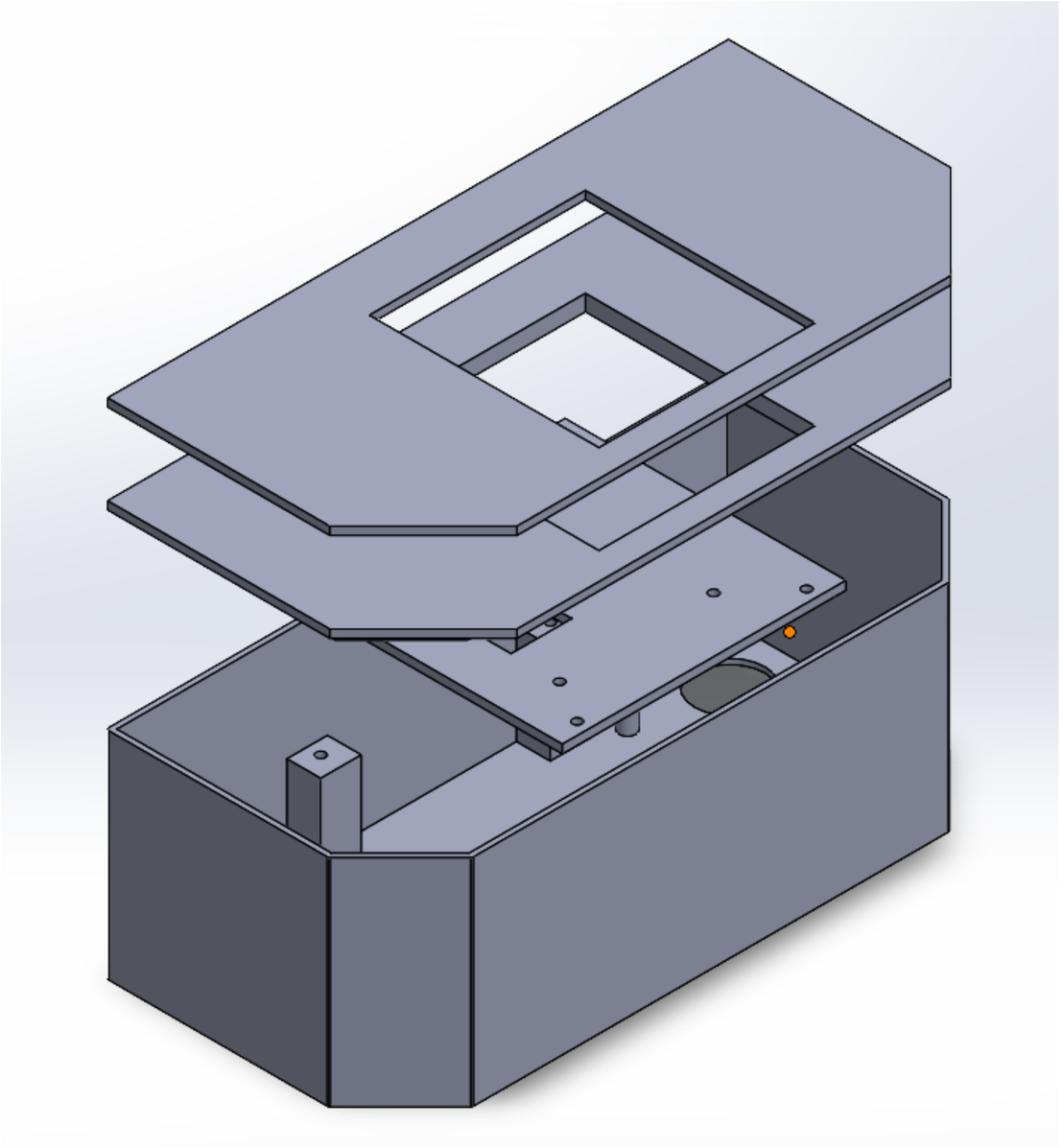




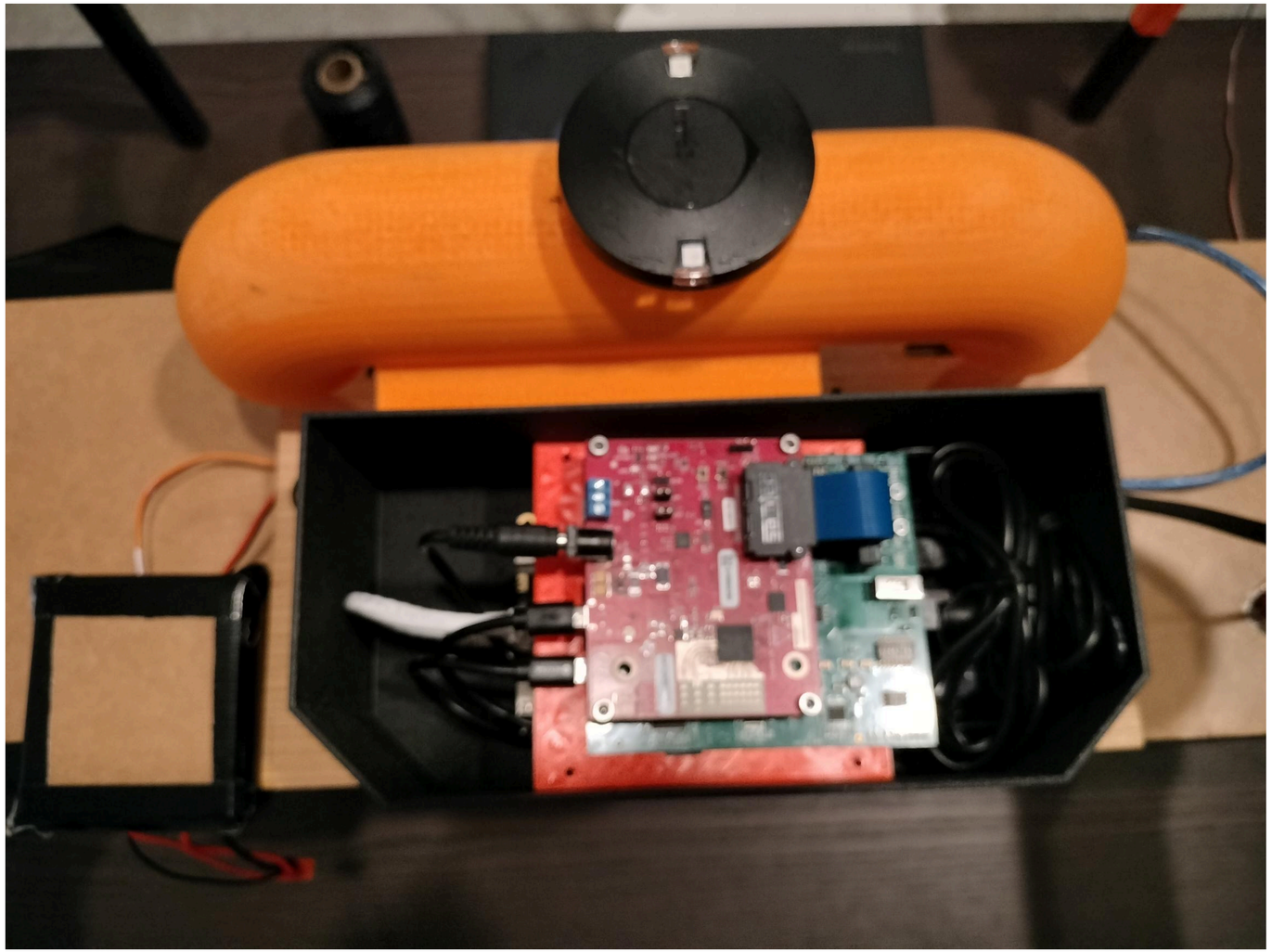


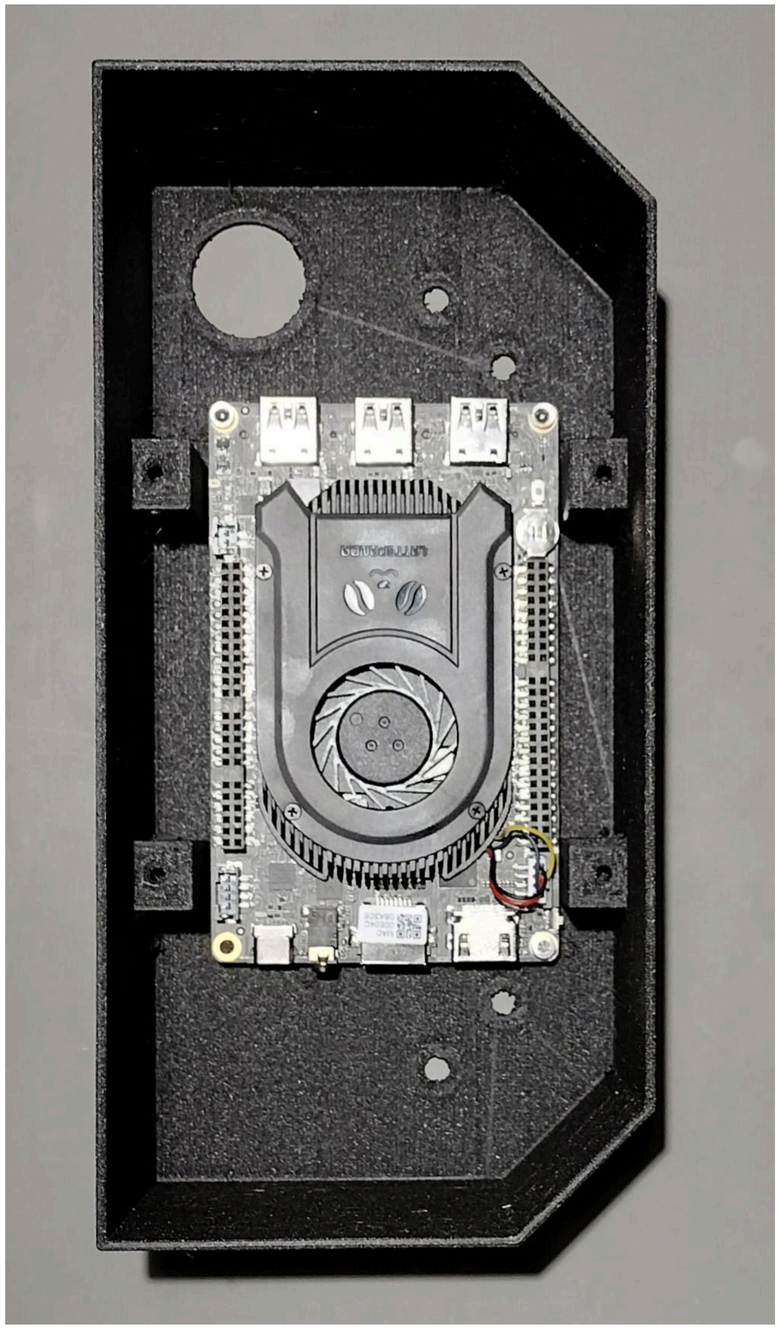
Radar



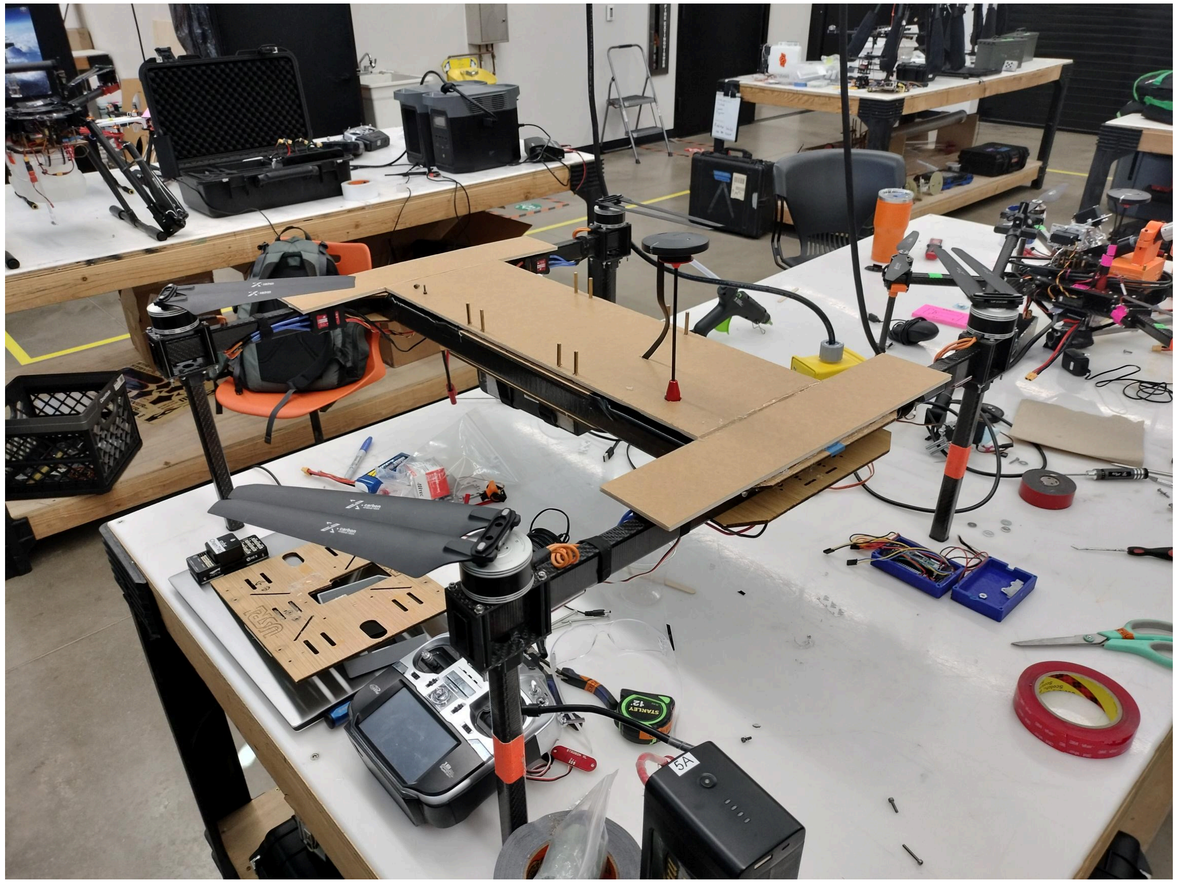


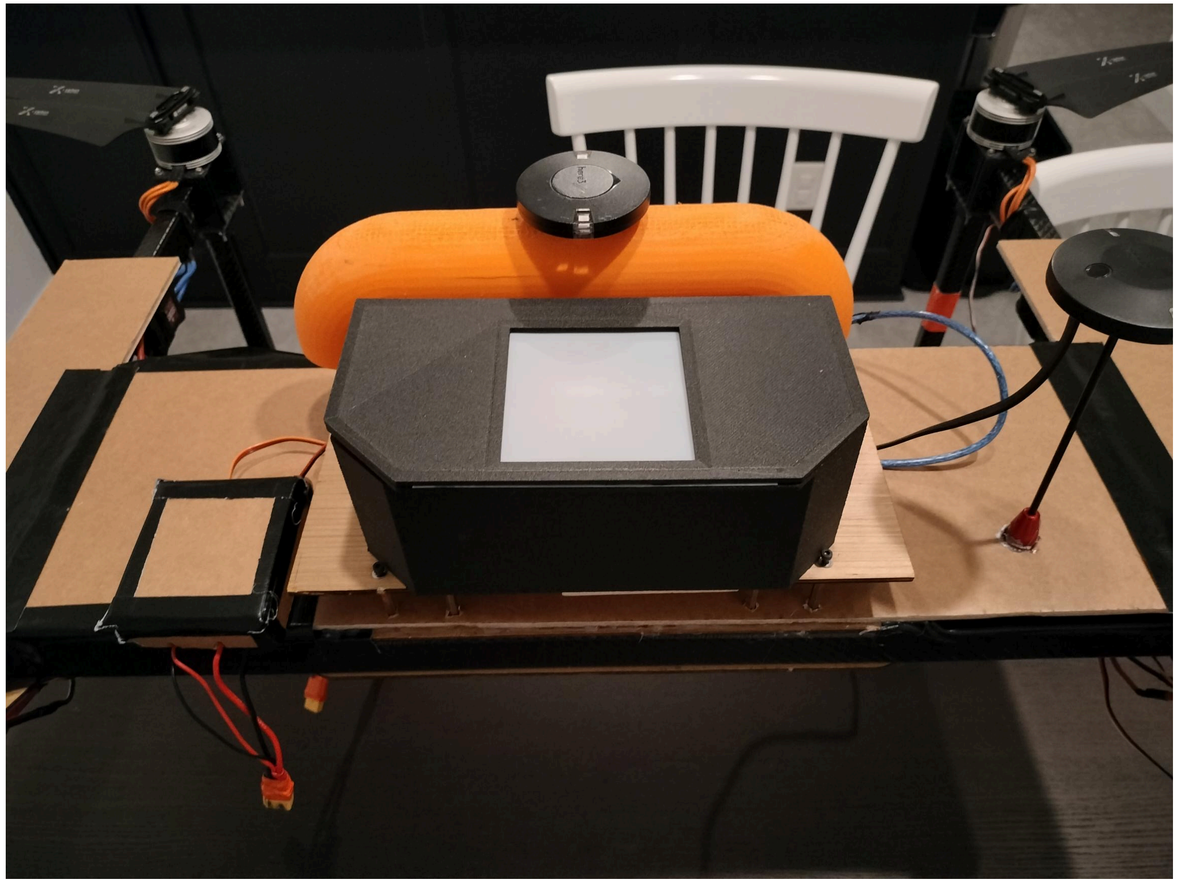
Final Payload



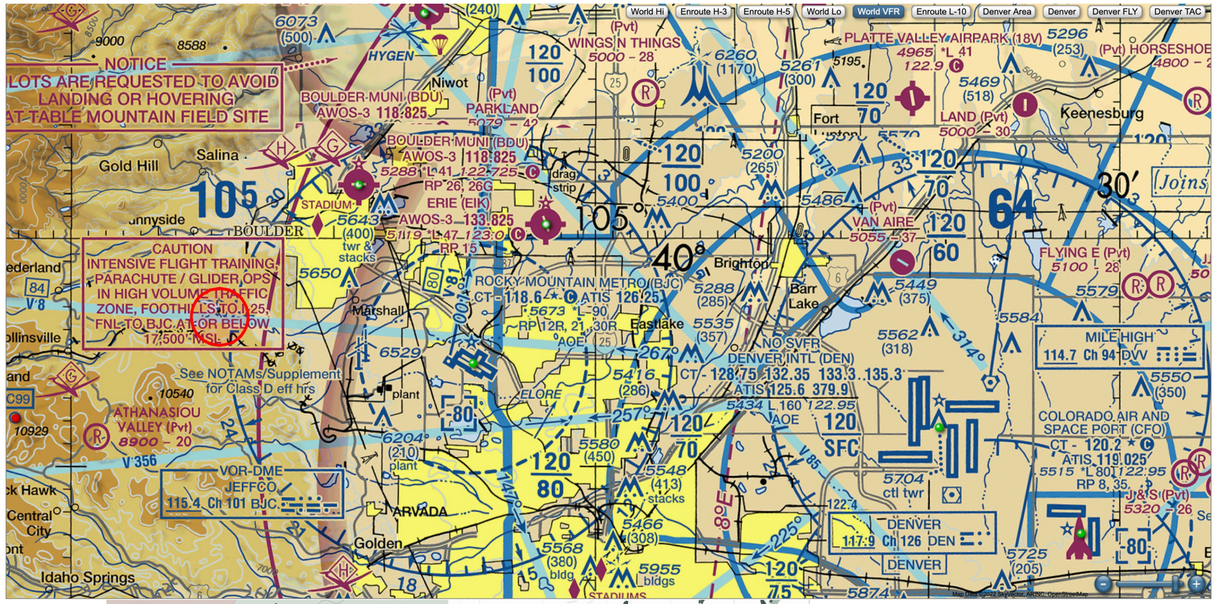


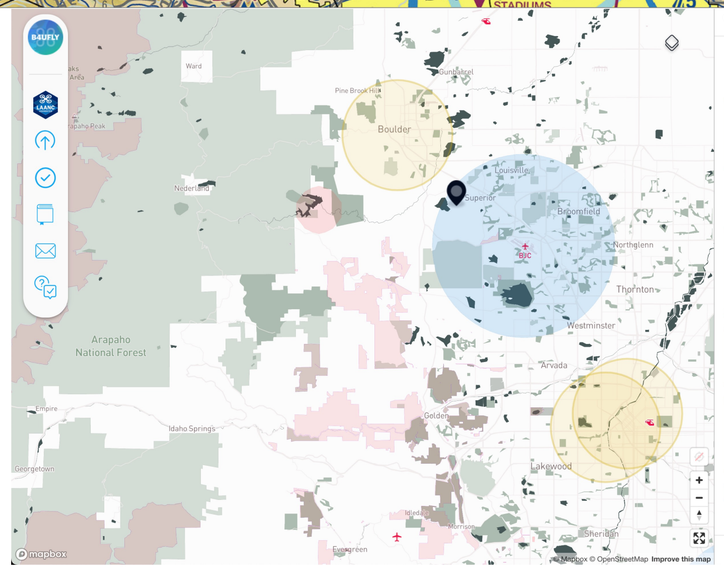
Platform Integration

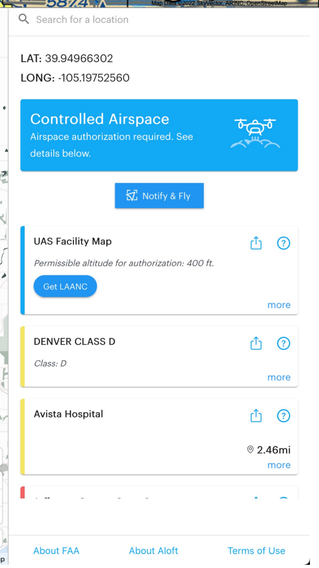




Marshall Field Tests





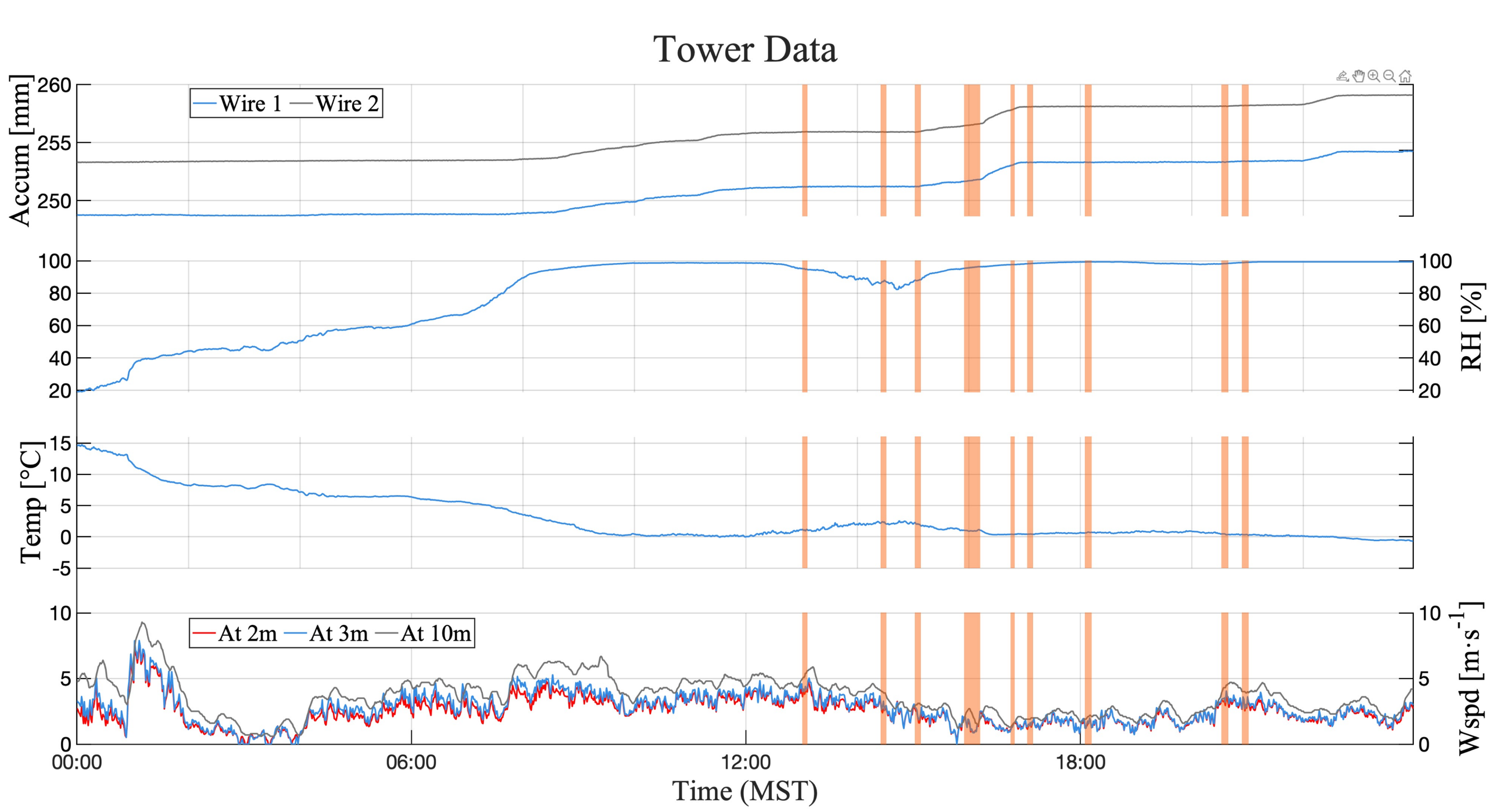


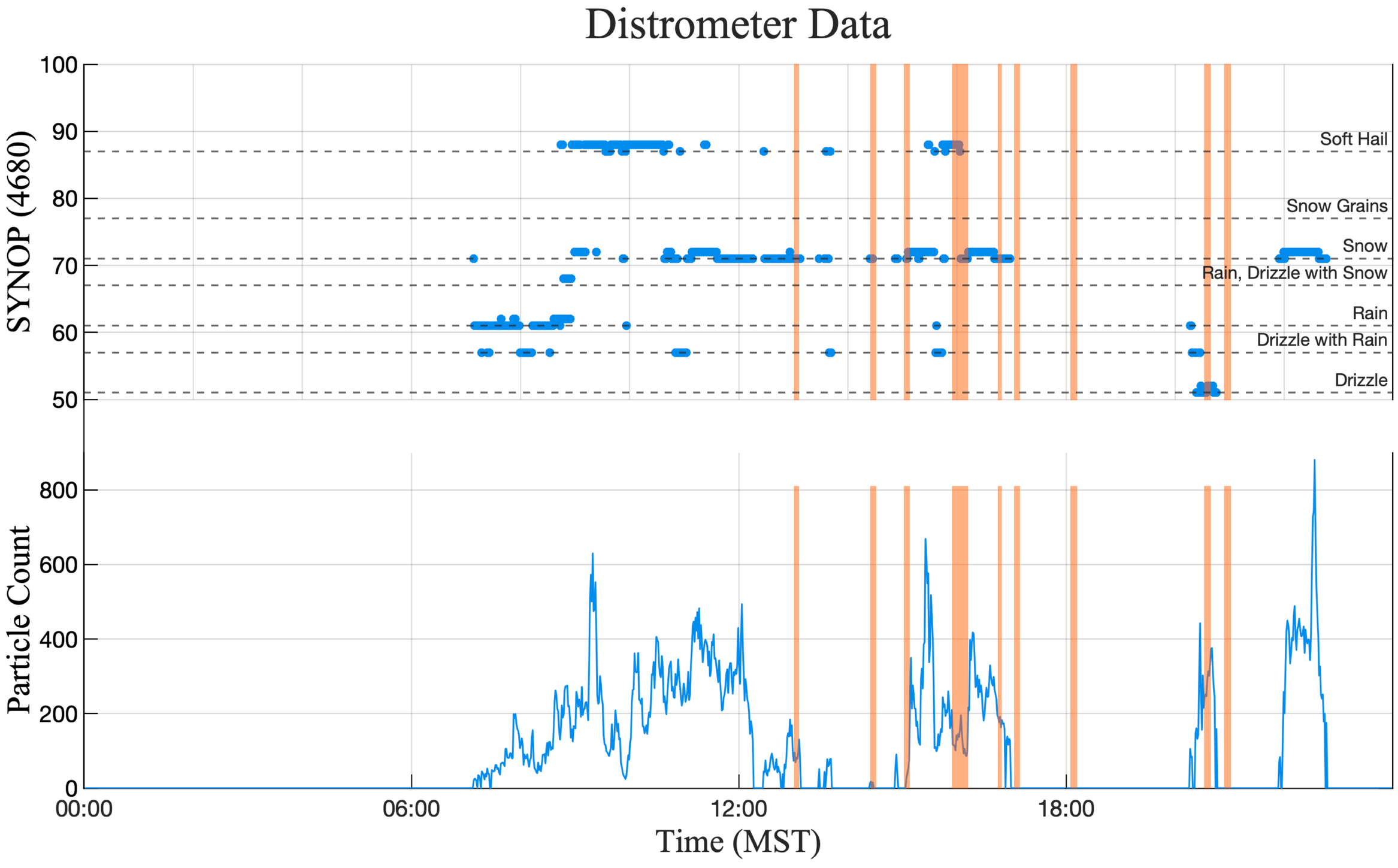
Weather Conditions

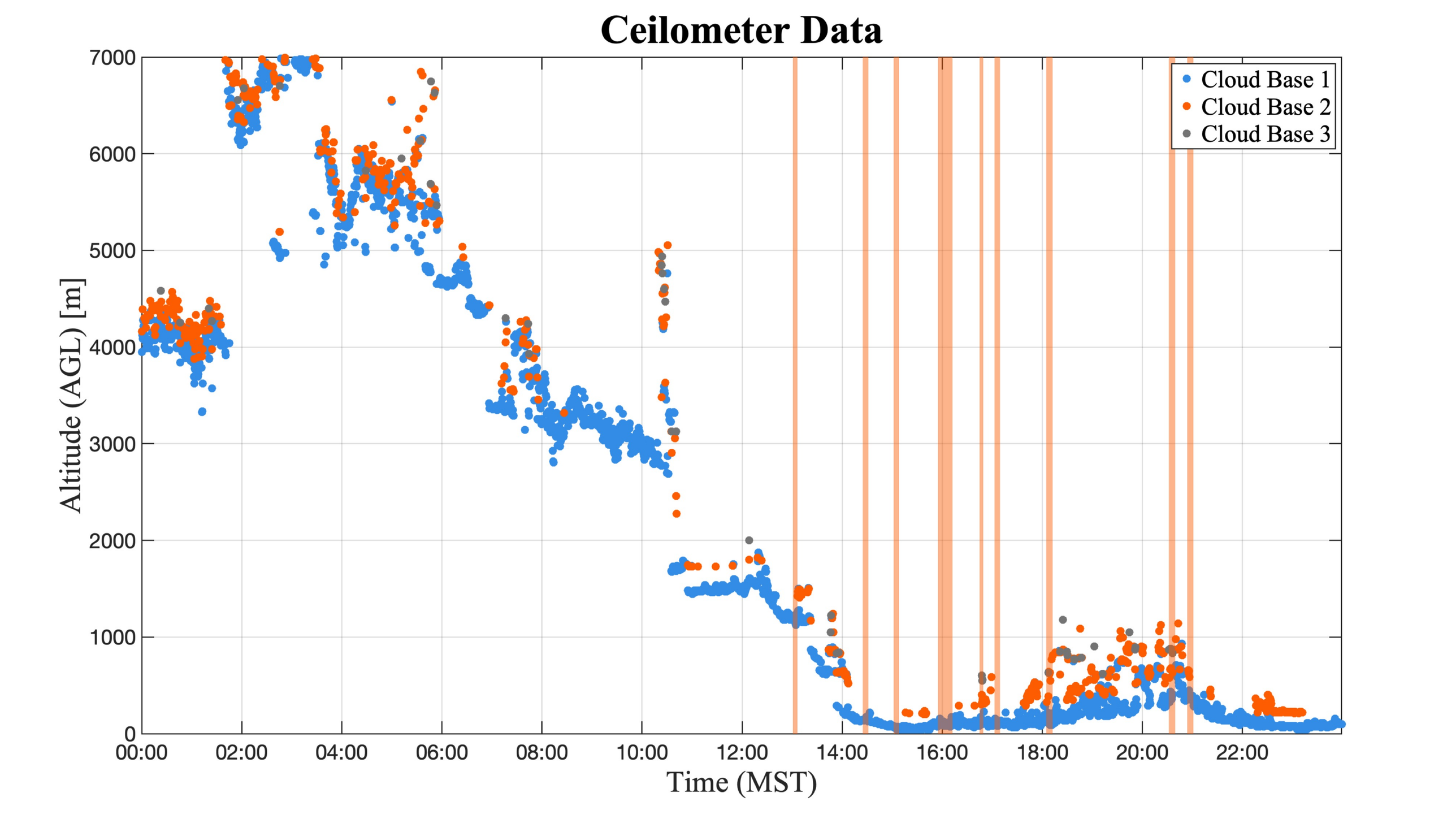
14:03

18:09

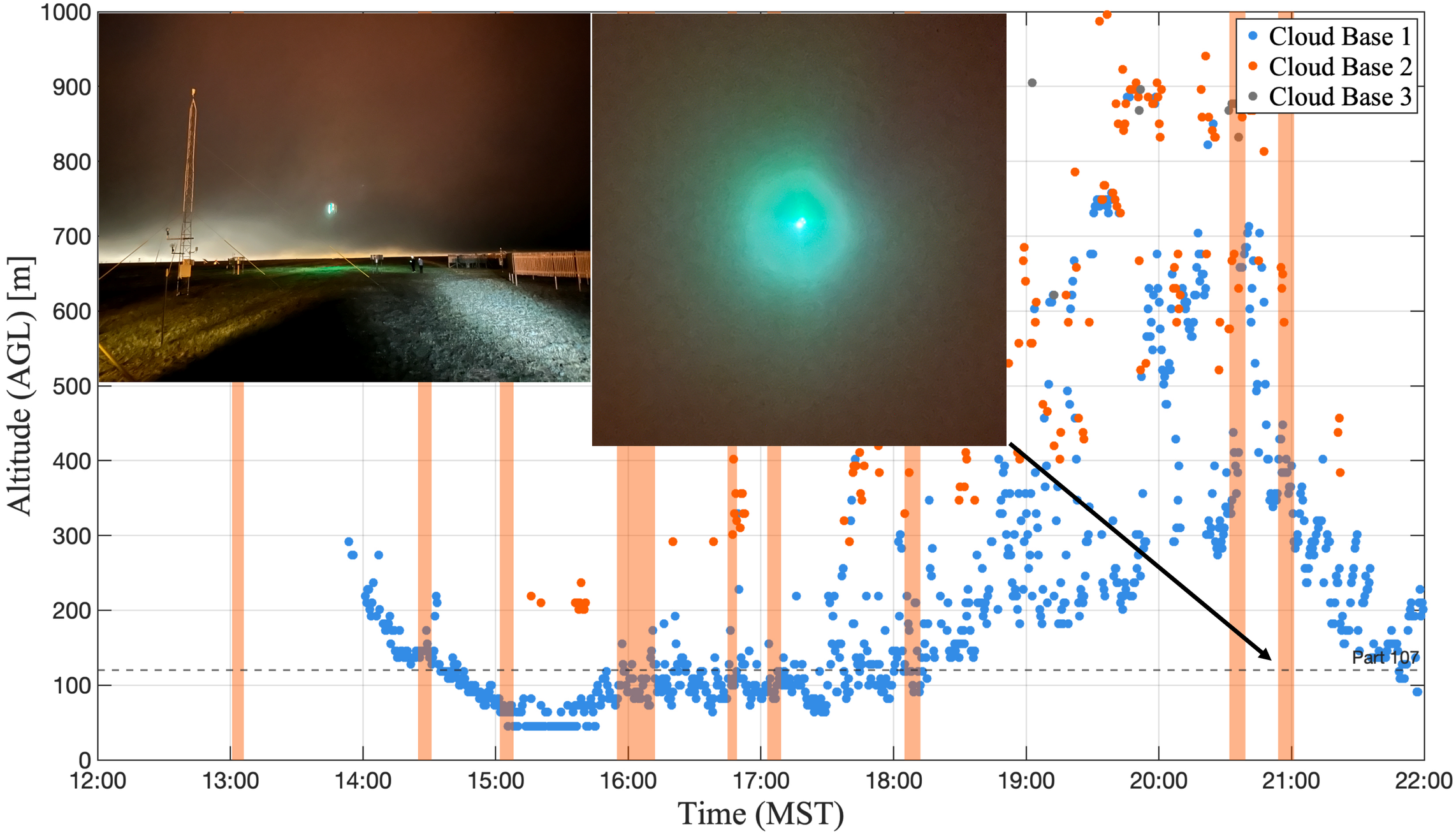
19:30

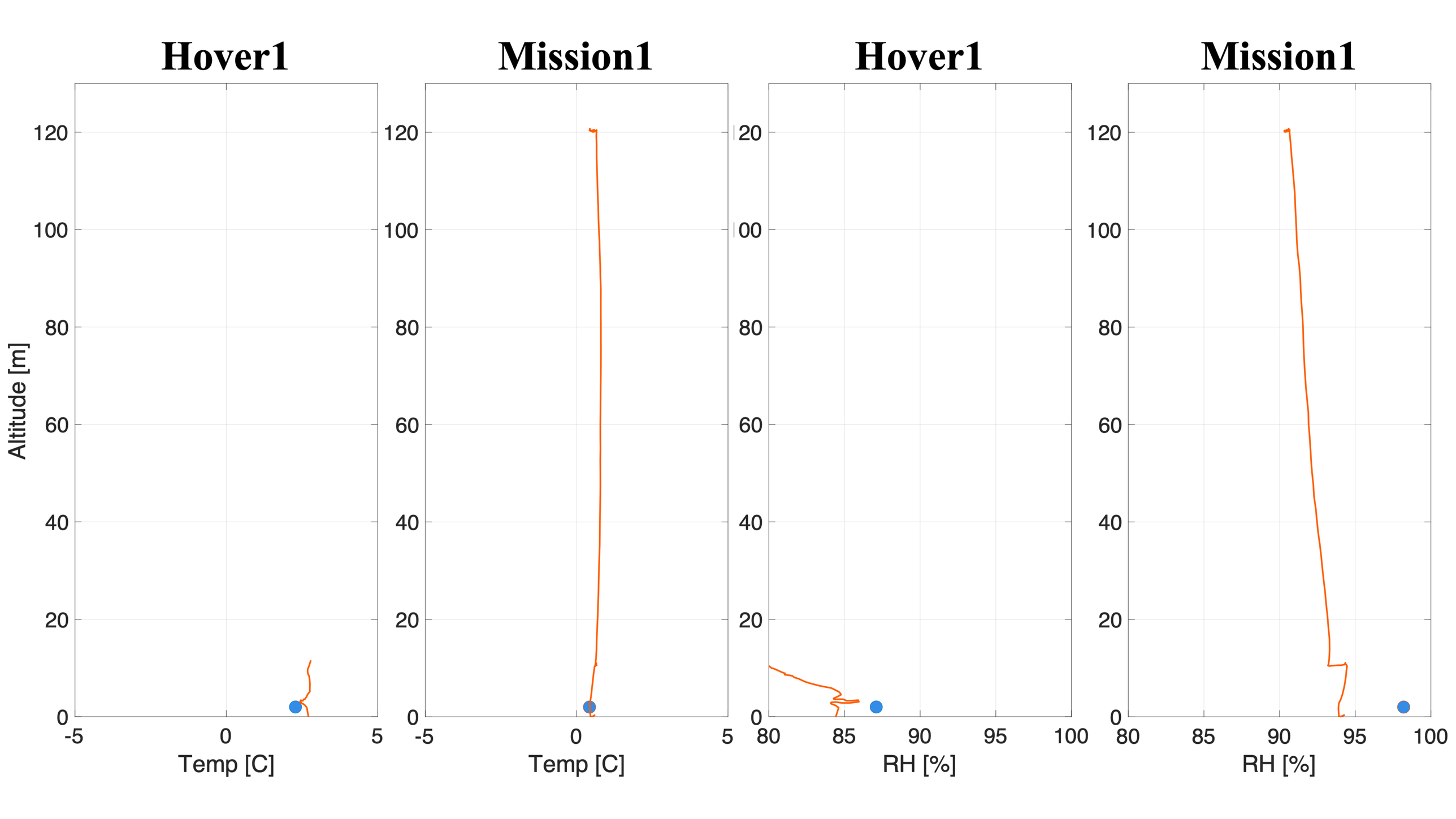

Tower Data
Accum [mm]
260
255
250
Wire 1
Wire 2
100
80
60
40
20
RH [%]
Temp [°C]
15
10
5
0
-5
10
5
0
At 2m
At 3m
At 10m
Wspd [m·s-1]
00:00
06:00
12:00
18:00
Time (MST)

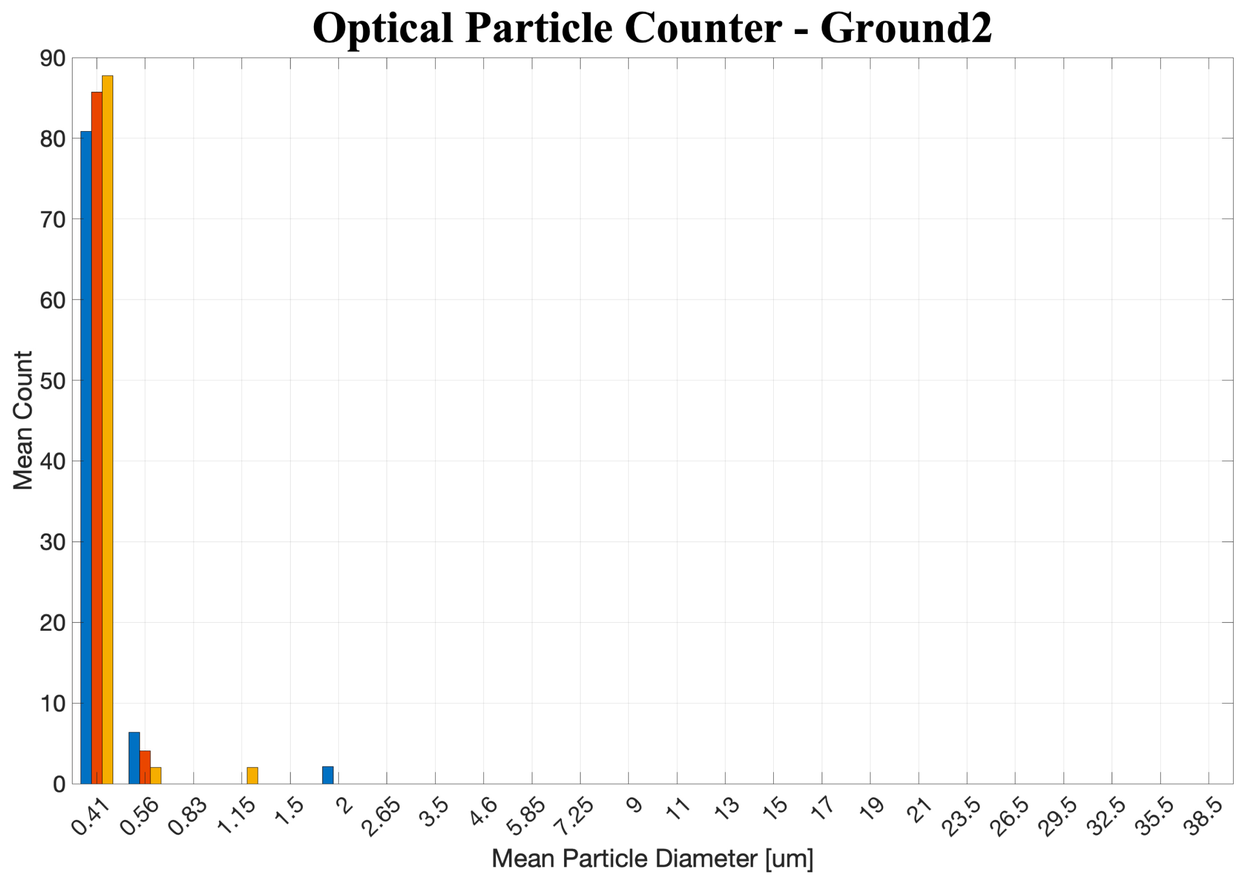

Distrometer Data
SYNOP (4680)
100
90
80
70
60
50
Soft Hail
Snow Grains
Snow
Rain, Drizzle with Snow
Rain
Drizzle with Rain
Drizzle
Particle Count
800
600
400
200
0
00:00
06:00
12:00
18:00
Time (MST)

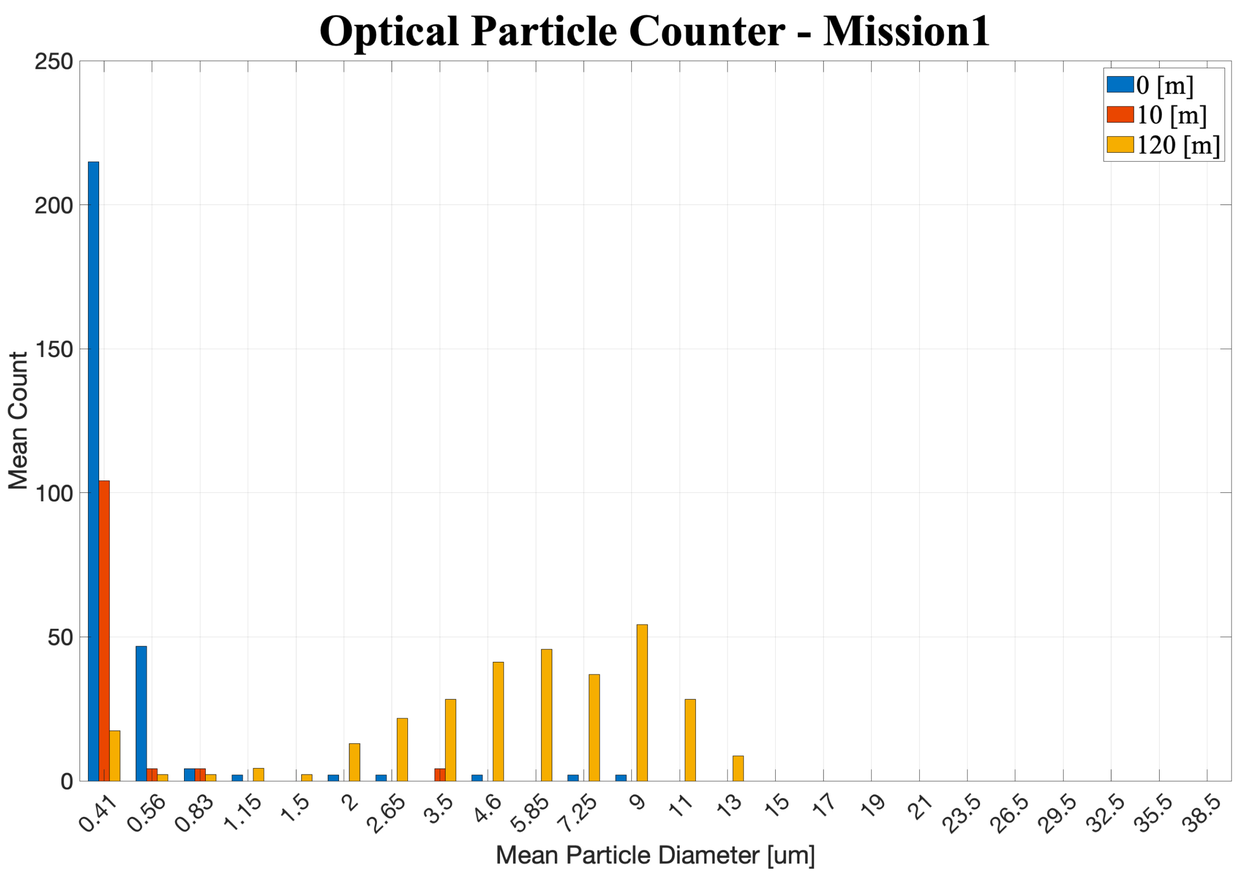

Ceilometer Data
Cloud Base 1
Cloud Base 2
Cloud Base 3
Altitude (AGL) [m]
Time (MST)
7000
6000
5000
4000
3000
2000
1000
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00

Ceilometer Data

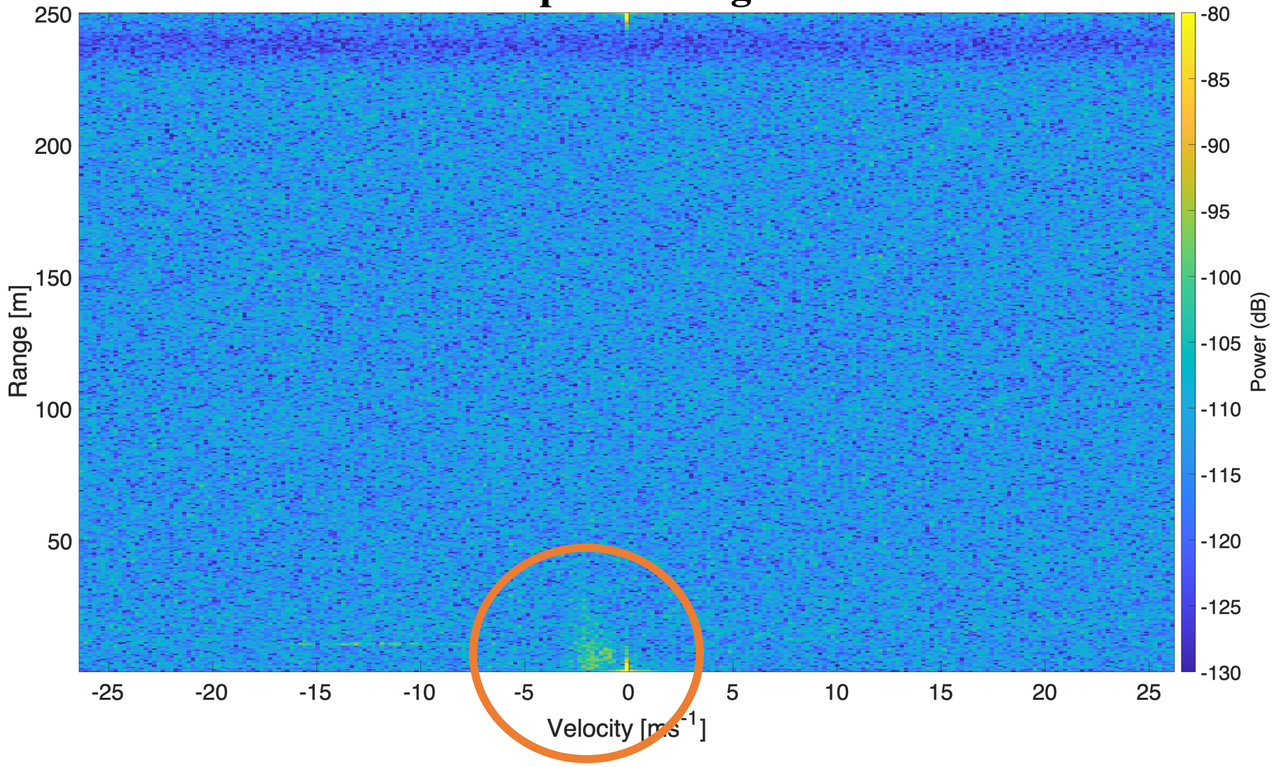



Hover1
Mission1
Hover1
Mission1
Altitude [m]
0
20
40
60
80
100
120
-5
0
5
Temp [C]
Temp [C]
80
85
90
95
100
RH [%]
RH [%]

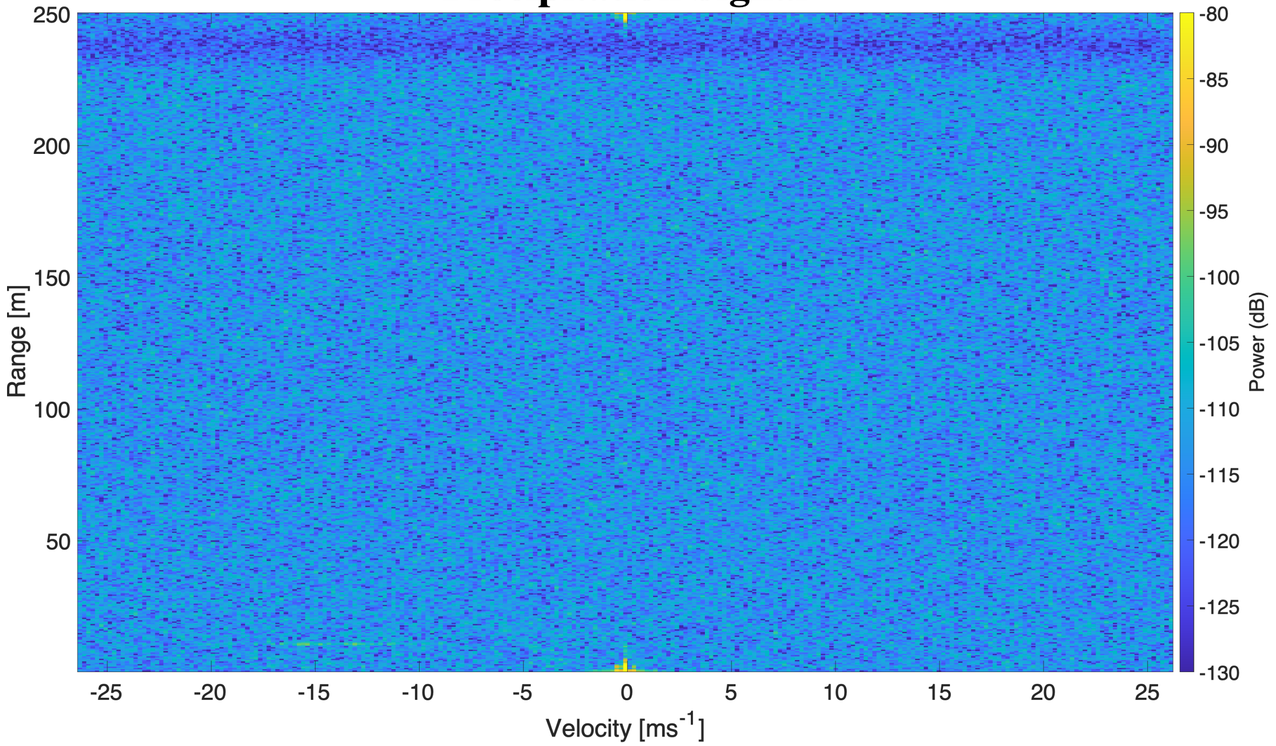

Optical Particle Counter - Ground2
Mean Count
Mean Particle Diameter [um]
0
10
20
30
40
50
60
70
80
90
0.41
0.56
0.83
1.15
1.5
2
2.65
3.5
4.6
5.85
7.25
9
11
13
15
17
19
21
23.5
26.5
29.5
32.5
35.5
38.5


Optical Particle Counter - Mission1
0 [m]
10 [m]
120 [m]
Mean Count
Mean Particle Diameter [um]
0
50
100
150
200
250
0.41
0.56
0.83
1.15
1.5
2
2.65
3.5
4.6
5.85
7.25
9
11
13
15
17
19
21
23.5
26.5
29.5
32.5
35.5
38.5

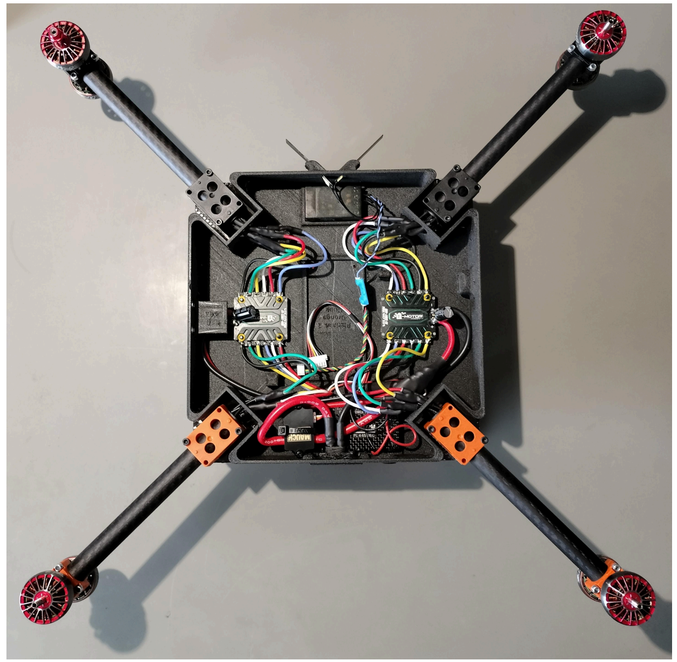
Ground 2
Precipitation Signal



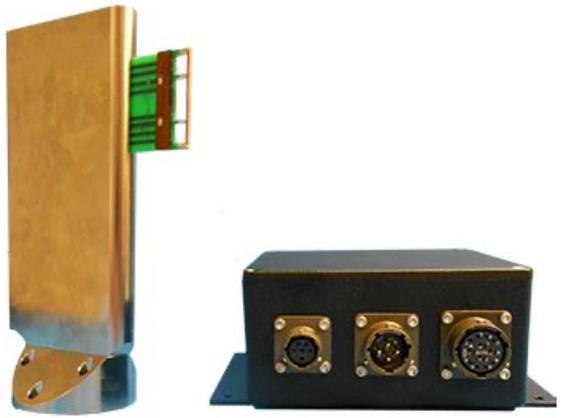
Mission 1
Precipitation Signal



Storm Trooper



What to look for



UAS-LWC

Camera Verification