



MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

Michigan Radiological UAV

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Radiological Protection

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Topics

- Making a Drone Program
 - Pilot Considerations
 - Airspace
- Research and Development
- Early Operations
 - NPP Response
- Current Operating Picture

Making a Drone Program



Pilot Considerations

- FAA Part 107 Certification
- Monthly Fit-for-Service
- Active Pilot Status
- Recurrent Training

Airspace



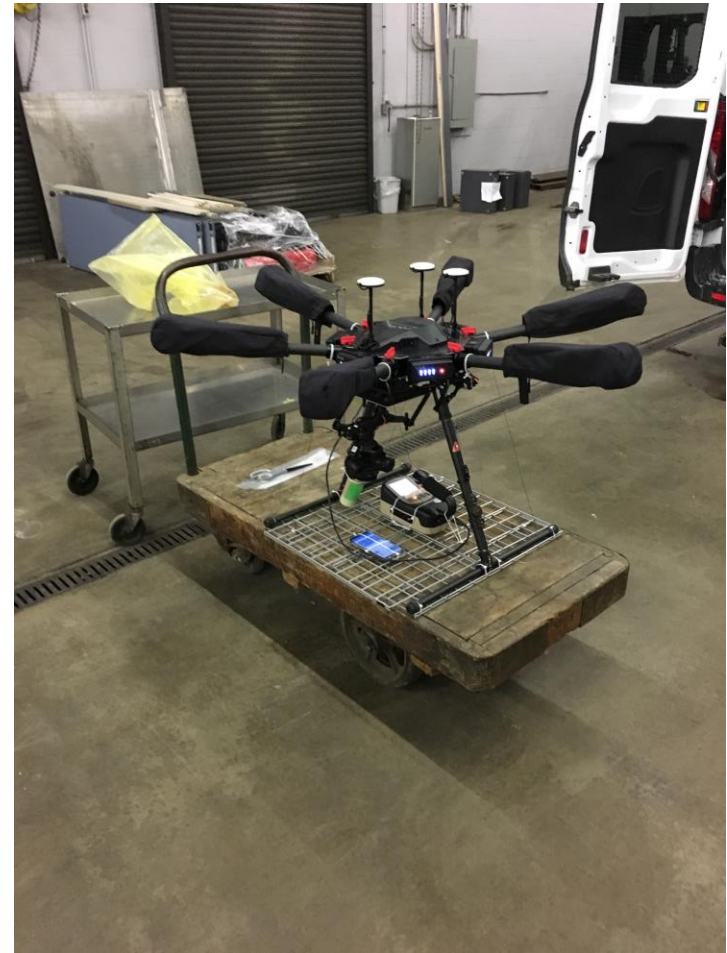
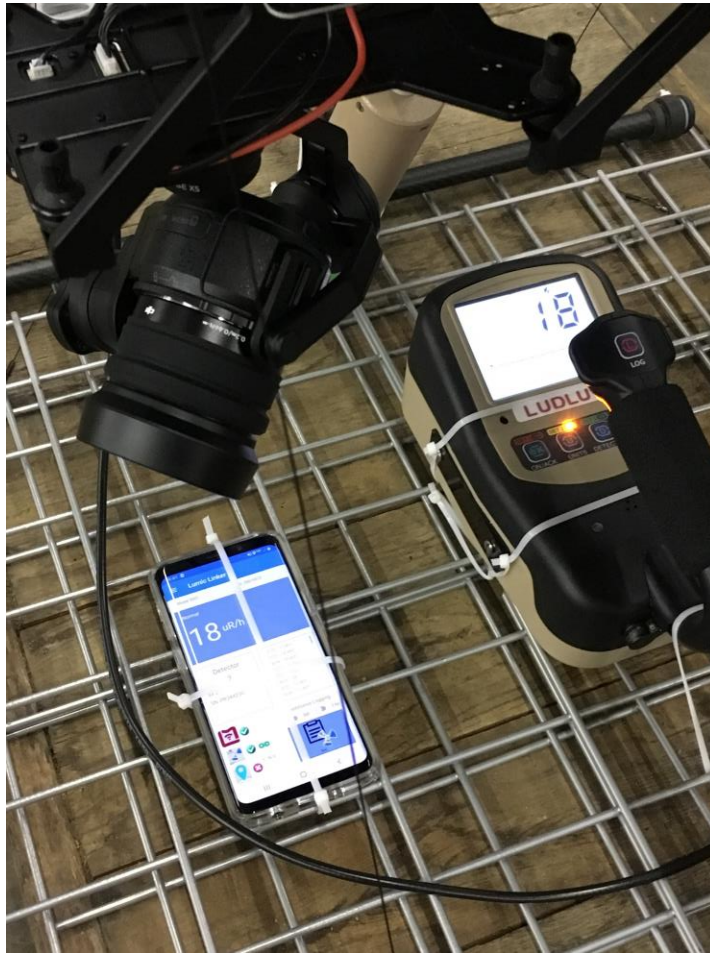
Airspace



Research and Development



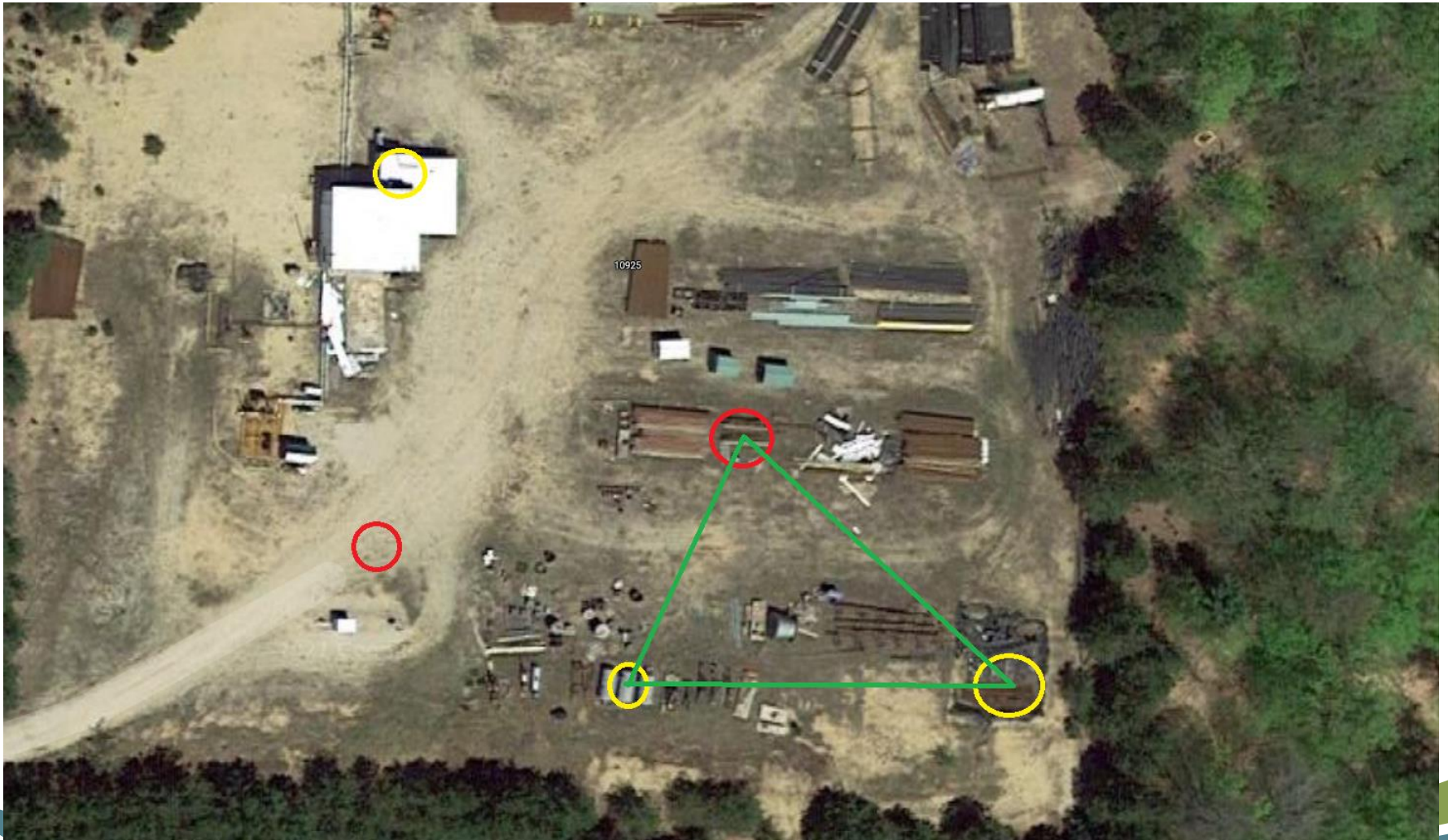
Research and Development



Research and Development



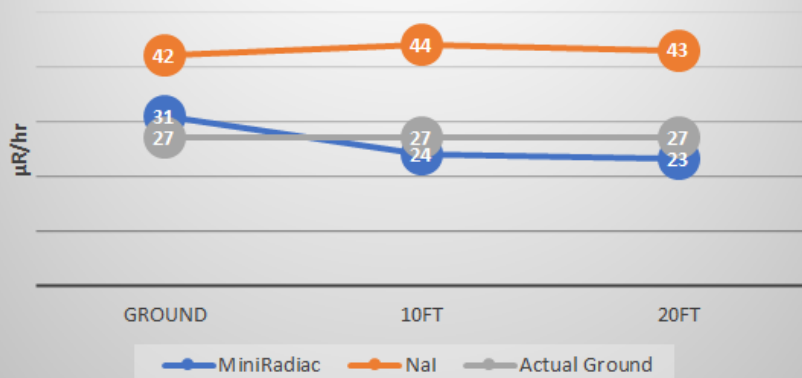
Testing



Testing

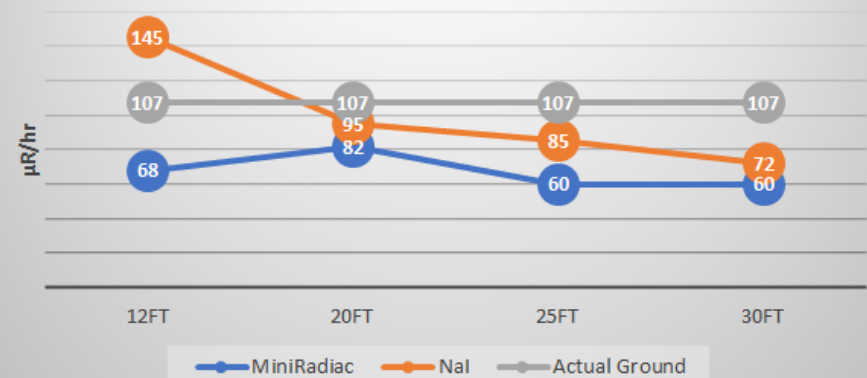
Launch Location	$\mu\text{R/hr}$		
1:21	Ground	10ft	20ft
MiniRadic	31	24	23
NaI	42	44	43
Actual (Ground)	27	27	27

Staging Takeoff/Landing



Pipes (4ft elevation from ground)	$\mu\text{R/hr}$			
1:25	12ft	20ft	25ft	30ft
MiniRadic	68	82	60	60
NaI	145	95	85	72
Actual (Ground)	107	107	107	107

Pipes Area



Current Operating Picture

- DJI Matrice 300 RTK Drone (Combo)
- DJI TB Intelligent Flight Battery
- M300 6-Battery Case
- DJI CrystalSky/Cendence – Intelligent Battery



Current Operating Picture

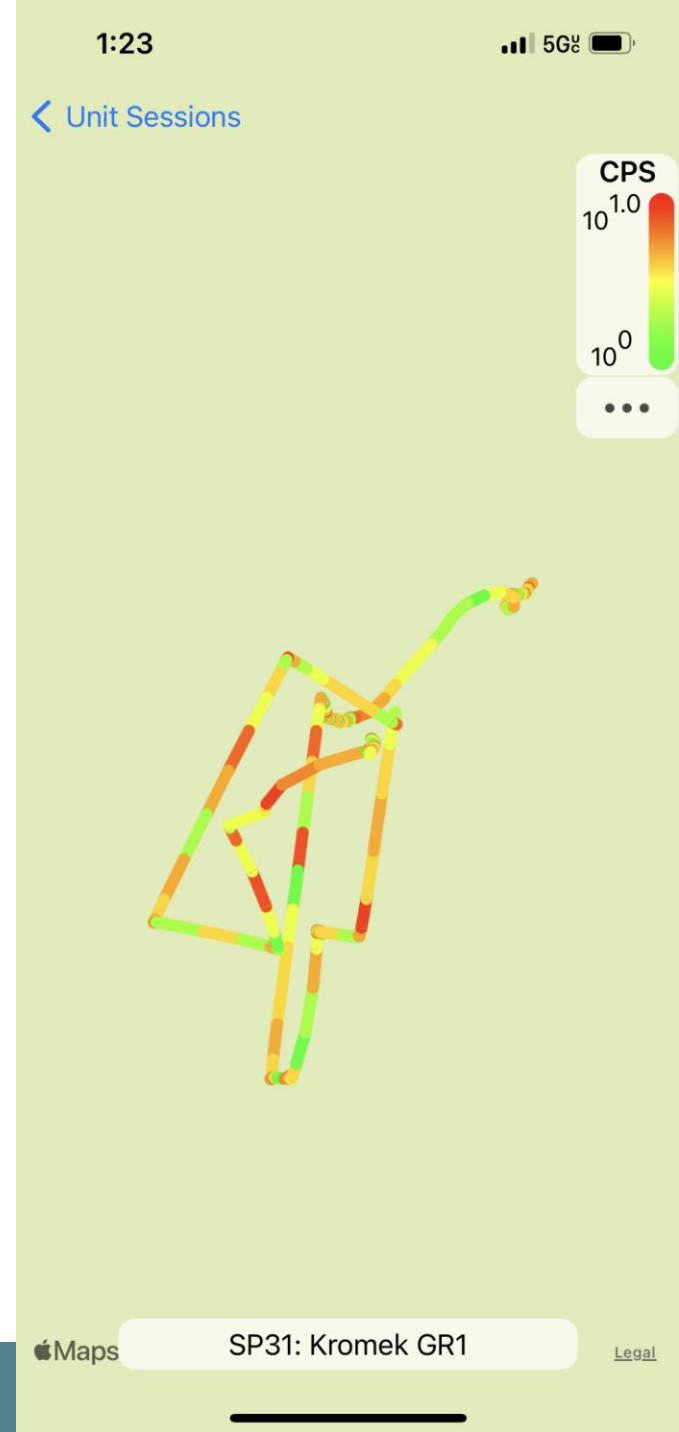
- Payload Bay (Black Box)
- Kromek GR1 10x10x10 mm CZT based detector.
- Kromek Sigma 50 25.4x25.4x25.4 mm CsI scintillation radiation detector
- Banana for scale



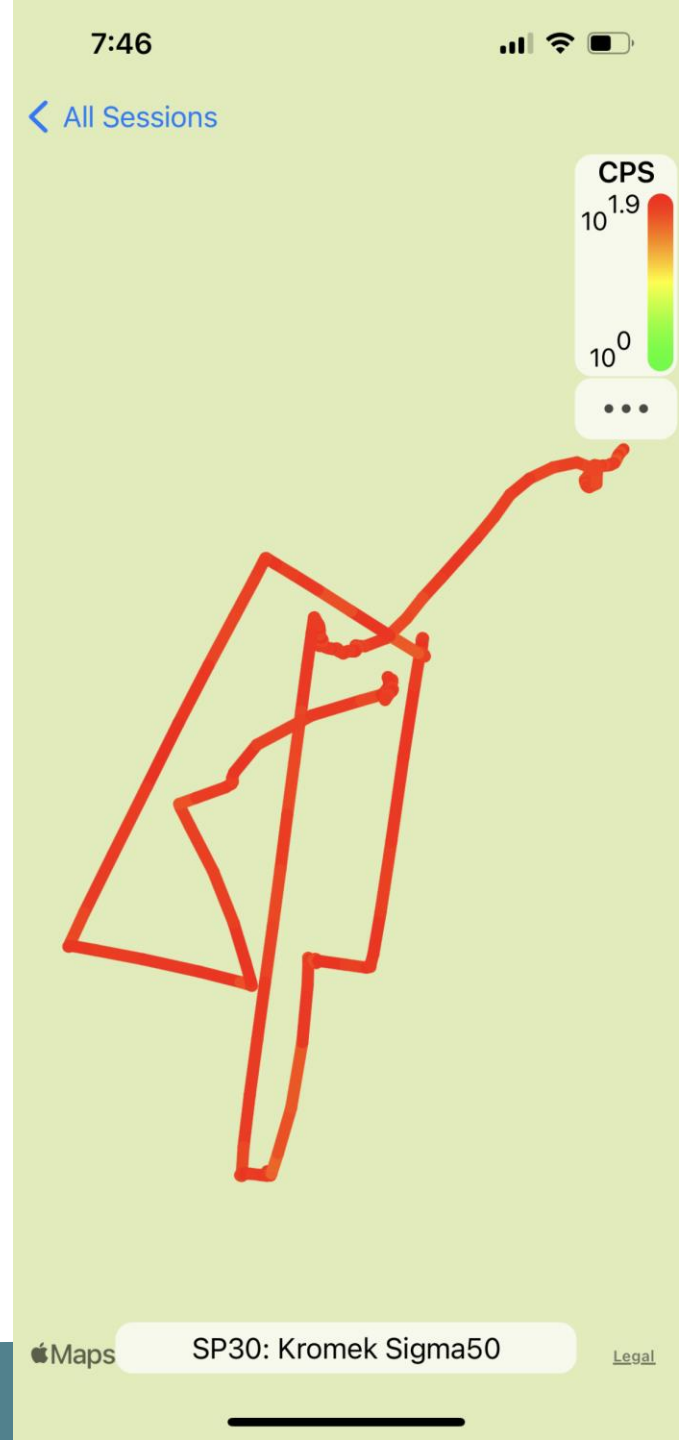


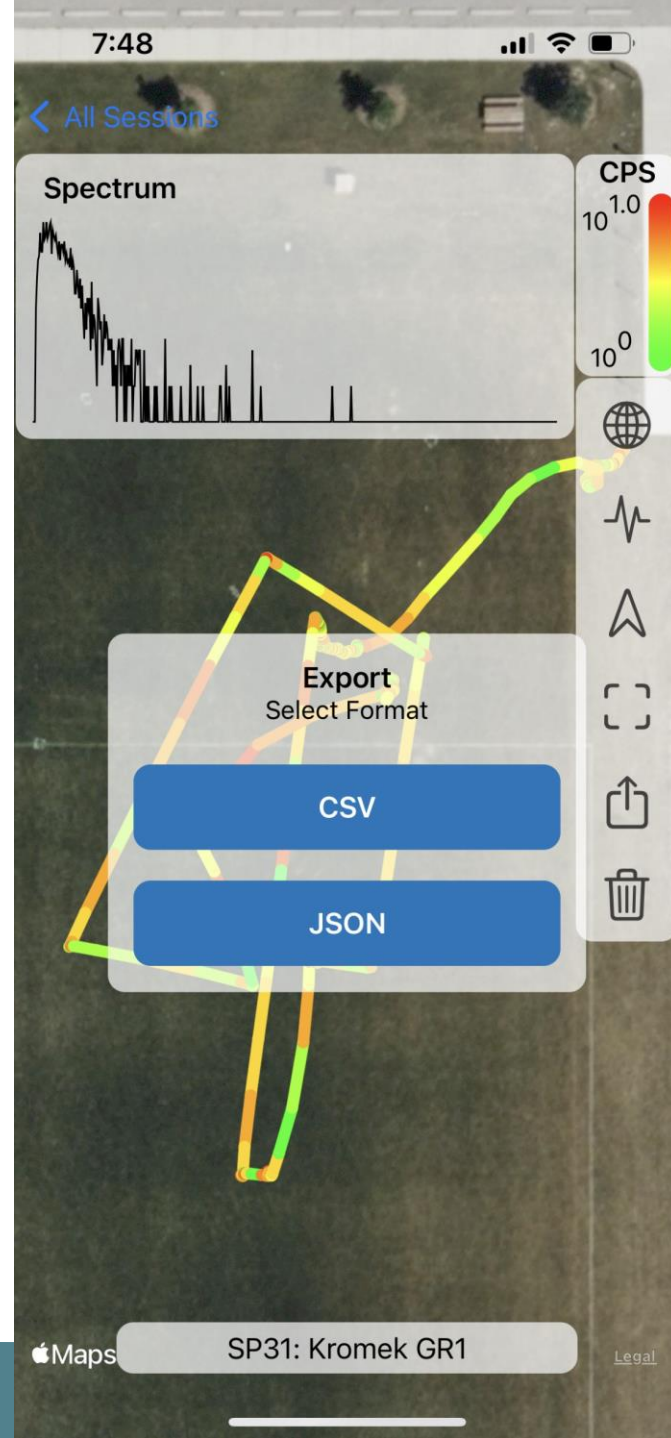


Data Collection



Data Collection





# Location and spectrometry from ImiTec AARM unit 150962									
# Sample Rate 1.0 Hz									
# Sensor Packs:									
#SP31 Kromek GR1 (Serial: 1757) - No GNSS									
#SP30 Kromek Sigma50 (Serial: 8124) - Ublox Neo M8N									
# Columns:									
#Time: ISO-8601									
#Lat: WGS84 latitude in degrees									
#Lon: WGS84 longitude in degrees									
#Alt: MSL altitude in meters									
#Lidar: Lidar distance in meters									
#SP31 Gamma Counts: Number of events recorded by sensor									
#SP31 Gamma Spectrum: List of energies recorded by sensor in keV									
#SP30 Gamma Counts: Number of events recorded by sensor									
#SP30 Gamma Spectrum: List of energies recorded by sensor in keV									
Time	Lat	Lon	Alt	Lidar	SP31 Gam	SP31 Gam	SP30 Gam	SP30 Gamma Spectrum	
2022-08-01	42.76194	-84.5632	258.48	0.02	1	667.82	30	75.75,920.89,120.16,278.68,87.79,116.77,998.11,103.23,155.10,231.86,130.82,134.70,176.53,78.64,96.96,166.78,375.69,87.31,122.10,126.46,134.70,242.68,291.55,379.70,395.24,305.43,143.92,135.67,228.91	
2022-08-01	42.76194	-84.5632	258.62	0.02	1	87.13	27	95.99,174.09,116.77,172.63,175.07,222.53,146.35,264.36,137.61,145.38,159.96,171.17,313.37,129.85,191.18,301.96,1186.32,93.58,191.67,237.76,288.08,153.15,1144.66,524.74,144.89,153.15	
2022-08-01	42.76193	-84.5632	259.01	0.02	2	472.25,132	27	131.79,245.63,333.76,584.62,258.44,110.48,904.89,90.20,143.43,152.18,279.18,170.19,215.17,422.89,123.06,110.48,141.49,151.69,232.35,325.30,169.71,216.15,259.43,134.70,283.63,1194.57	
2022-08-01	42.76193	-84.5632	259.25	0.02	3	112.44,215	26	144.41,128.88,275.22,279.18,102.27,257.95,120.64,200.96,117.74,243.66,251.54,382.71,118.22,140.04,505.90,248.58,493.19,91.65,232.84,197.05,218.60,241.69,853.33	
2022-08-01	42.76193	-84.5632	259.38	0.02	1	239.89	23	136.15,159.96,193.14,243.66,305.92,299.97,152.18,163.86,203.41,237.76,218.60,124.52,354.20,649.07,350.21,388.22,108.06,158.50,1884.34,133.73,165.32,171.66,275.72	
2022-08-01	42.76193	-84.5632	259.61	0.01	4	142.23,124	24	98.89,86.83,160.45,401.27,642.34,76.71,95.99,111.45,193.63,196.56,109.03,176.04,787.87,118.71,206.35,222.53,243.17,108.06,122.58,180.44,131.79,169.71,280.17,1269.10	
2022-08-01	42.76193	-84.5632	259.78	0.02	1	123.61	34	110.48,200.47,119.67,162.89,167.76,232.84,94.54,171.66,196.07,104.68,164.83,153.64,178.00,277.70,297.49,98.40,113.38,143.43,199.50,207.33,346.22,651.14,93.58,215.17,88.76,131.79,170.19,323.31,659.43,84.42,94.06,148.29,209.	
2022-08-01	42.76193	-84.5632	259.88	0.02	2	120.63,126	25	590.27,124.03,149.26,380.70,145.86,274.73,470.36,552.32,657.87,182.88,308.90,117.25,345.72,81.53,203.41,140.52,162.89,165.32,188.74,263.37,217.13,341.73,89.24,148.29,842.21	
2022-08-01	42.76193	-84.5632	260.05	0.02	0		34	453.66,1210.53,98.40,148.29,783.13,449.12,107.10,109.51,110.48,151.21,198.03,121.13,182.88,222.04,336.75,137.12,325.30,592.33,61.81,206.35,494.21,101.30,181.41,191.67,221.55,254.50,277.70,414.84,983.58,1143.56,1304.63,166	
2022-08-01	42.76193	-84.5632	260.66	0.02	1	56.61	31	185.32,275.72,110.97,160.94,94.06,143.43,324.30,258.44,353.70,442.05,96.96,99.85,160.45,168.73,354.20,490.65,1000.80,1460.49,93.58,122.58,157.05,169.71,197.05,244.15,291.55,305.43,484.05,121.13,182.88,220.56	
2022-08-01	42.76192	-84.5632	261.14	0.01	1	81.92	28	262.88,413.33,107.10,108.06,191.18,587.70,150.72,163.86,207.82,285.11,809.46,134.21,174.09,152.18,247.60,360.19,136.64,139.55,147.32,440.03,1184.68,126.94,277.70,370.19,120.16,122.58	
2022-08-01	42.76192	-84.5632	261.54	0.02	1	43.96	31	114.35,218.11,225.47,131.30,89.72,124.03,126.46,133.24,477.46,618.59,105.17,212.23,350.21,441.04,1254.15,2153.49,146.35,286.60,82.97,121.61,132.76,149.75,222.53,261.40,391.23,96.47,103.72,107.10,289.07,292.54,365.69	
2022-08-01	42.76191	-84.5632	261.95	0.02	4	184.71,575	24	219.09,803.66,272.26,280.66,437.51,101.78,147.32,255.97,268.31,483.54,105.17,332.26,129.85,505.39,86.83,206.84,210.76,351.20,382.21,82.49,114.35,115.32,132.76,170.19	
2022-08-01	42.76191	-84.5632	262.42	0.01	2	67.03,188.	27	135.67,163.37,503.35,516.59,100.33,125.97,350.21,457.71,190.69,274.73,153.15,110.48,131.30,134.21,191.18,219.09,795.23,140.52,203.41,233.33,479.49,170.19,330.27,142.46,169.71,238.25	
2022-08-01	42.76191	-84.5632	262.95	0.02	1	199.62	39	110.48,151.69,174.09,196.56,200.47,238.25,249.08,158.50,254.99,757.94,108.06,157.53,309.89,377.70,187.76,196.56,203.90,422.89,597.99,933.18,174.58,188.25,172.63,197.54,309.40,159.48,259.92,350.71,105.17,163.86,302.45,145.	
2022-08-01	42.7619	-84.5632	263.55	0.01	1	118.4	25	198.03,300.47,129.85,222.04,282.64,303.94,1329.14,148.29,153.15,230.88,266.33,271.77,104.68,223.02,450.13,298.98,383.71,102.75,113.87,123.55,165.32,156.07,266.83,734.90	
2022-08-01	42.7619	-84.5632	264.1	0.01	3	113.19,575	27	185.81,221.55,287.09,131.79,145.86,150.24,162.40,211.74,924.63,180.92,385.21,112.90,184.34,239.72,680.18,259.43,903.29,292.54,1271.87,87.31,132.27,133.24,462.77,206.35,590.27	
2022-08-01	42.7619	-84.5632	264.56	0.01	2	136.28,131	18	134.21,153.64,297.99,936.39,162.40,883.06,326.79,423.90,117.74,423.90,544.14,176.53,184.34,247.60,258.44,144.41,162.89,173.12	
2022-08-01	42.7619	-84.5632	264.83	0.02	1	86.38	21	168.24,175.56,195.09,1537.63,70.94,105.17,143.92,182.88,175.07,88.27,195.09,238.25,244.15,356.70,397.75,105.65,149.26,222.53,248.09,427.42	
2022-08-01	42.7619	-84.5632	265.03	0.02	0		32	135.67,182.39,525.25,873.49,93.10,106.61,146.83,249.57,356.20,160.94,77.19,102.27,105.17,201.94,240.22,255.48,108.06,229.40,264.36,285.61,150.24,223.51,1124.98,128.39,196.56,240.22,262.88,86.35,115.32,165.32,158.02	
2022-08-01	42.76189	-84.5632	265.16	0.02	2	201.11,58.	26	164.35,179.46,393.74,984.65,152.67,220.07,134.21,136.15,139.06,2105.38,138.58,124.52,560.00,183.85,565.64,859.70,887.31,71.90,105.65,147.81,181.41,195.09,224.98,292.54,118.71,128.88	
2022-08-01	42.76189	-84.5632	265.2	0.02	1	81.17	24	89.24,136.64,161.43,163.37,58.45,315.85,1478.02,98.89,269.30,1074.35,78.16,279.67,323.31,231.86,415.84,77.68,97.92,121.61,102.75,109.03,281.16,101.78,248.09,250.55	
2022-08-01	42.76189	-84.5632	265.3	0.02	3	106.48,206	20	133.24,158.02,188.74,326.79,120.16,184.83,386.21,481.51,82.49,919.79,158.02,237.27,98.98,148.78,937.99,67.09,94.54,70.94,283.13,304.93	



Questions?

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