1. DATA FAMILIARIZATION AND PARSING

File contains

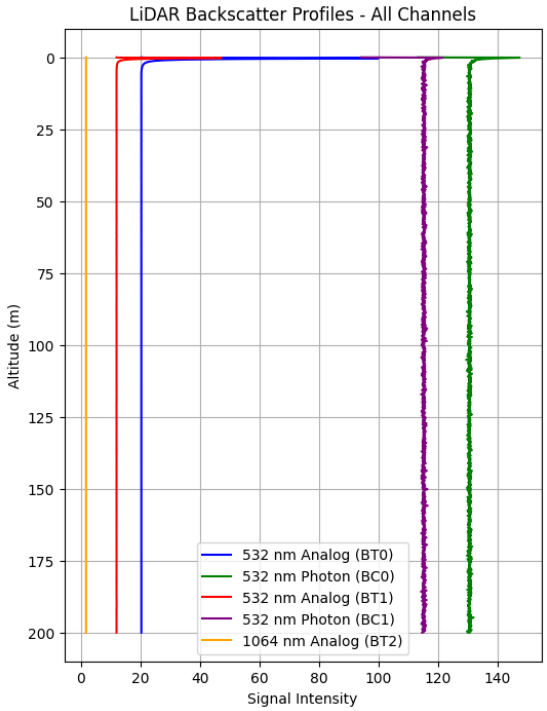
Code	Type	Wavelength	Notes
BT0	Analog	532 nm	.o = some polarization
BC0	Photon	532 nm	.o
BT1	Analog	532 nm	.p = different pol
BC1	Photon	532 nm	.p
BT2	Analog	1064 nm	.o

- Explored the structure of the Licel LiDAR data files.
- Verified header details, mapped signal columns to channels:
  - 532 nm Analog (BT0)
  - 532 nm Photon (BC0)
  - 532 nm Analog (BT1)
  - 532 nm Photon (BC1)
  - 1064 nm Analog (BT2)
- Purpose: To ensure data was interpreted and processed correctly before analysis.

2. RAW PROFILE PLOTTING

- Plotted raw backscatter profiles for all channels combined (log scale).
- Plotted individual channel profiles (linear scale).
- Purpose: To observe if any vertical variations or wave-like structures were present in the raw data.

Image 1: Raw backscatter profiles (all channels, log scale)



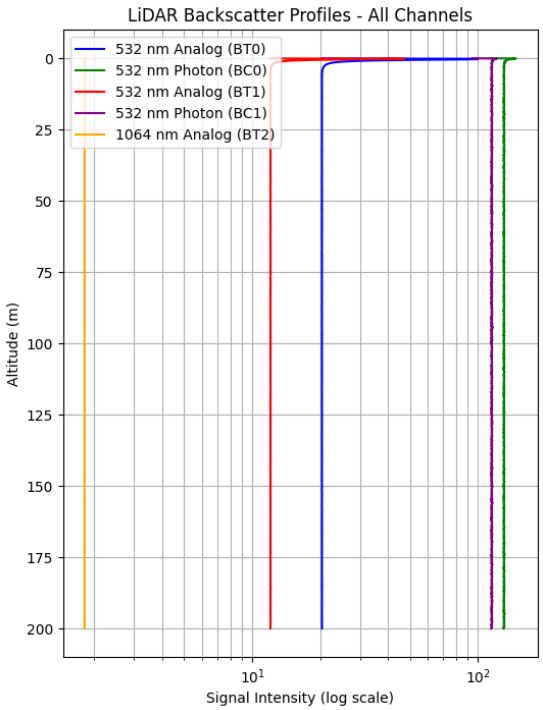
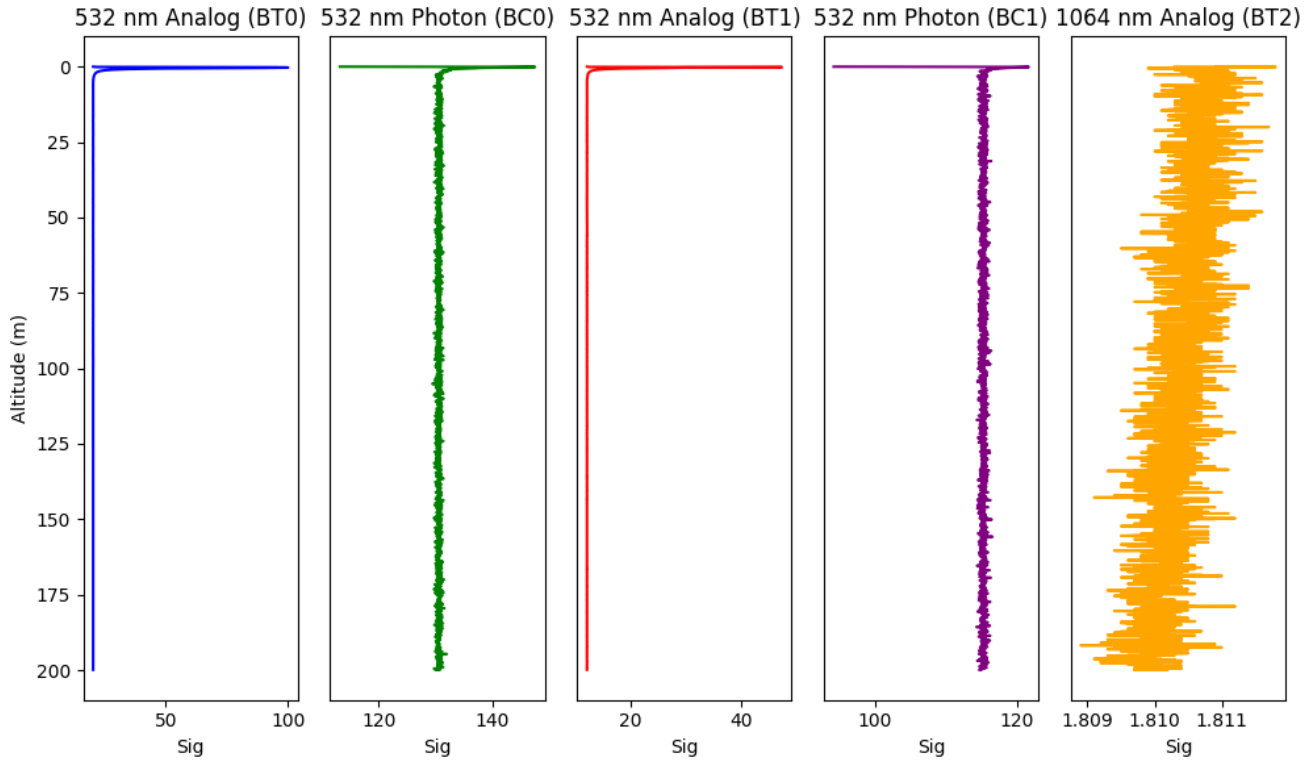


Image 2: Separate channel raw profiles (linear scale)



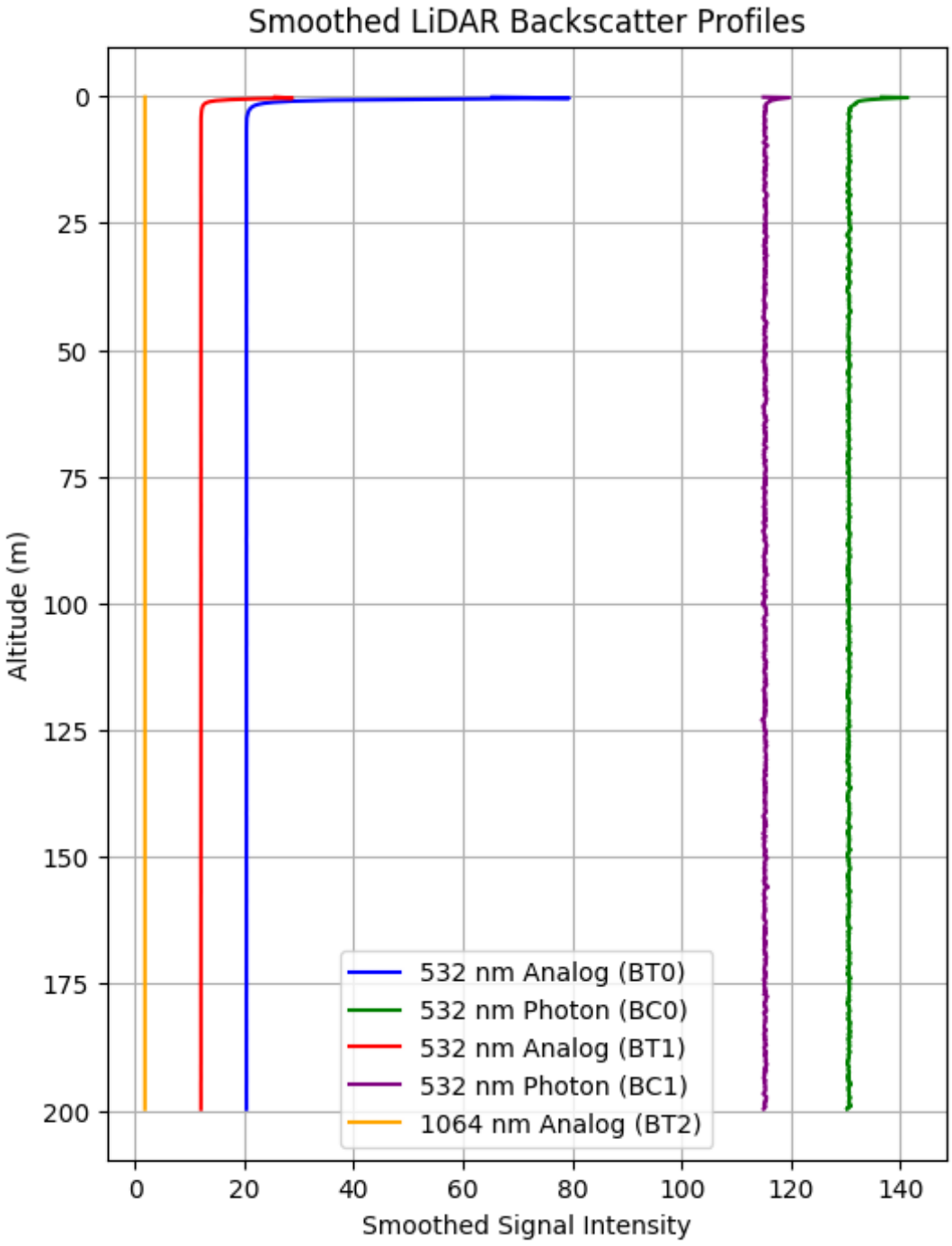
Observation:

- Profiles appeared nearly vertical, with constant signal intensity at different altitudes (0–200 m). No wave-like patterns were visible.

3. SMOOTHING USING MOVING AVERAGE

- Applied moving average smoothing on each channel's vertical profile.
- Purpose: To reduce noise and reveal any small-scale fluctuations that could indicate hidden wave patterns.

Image 3: Smoothed backscatter profiles (all channels)



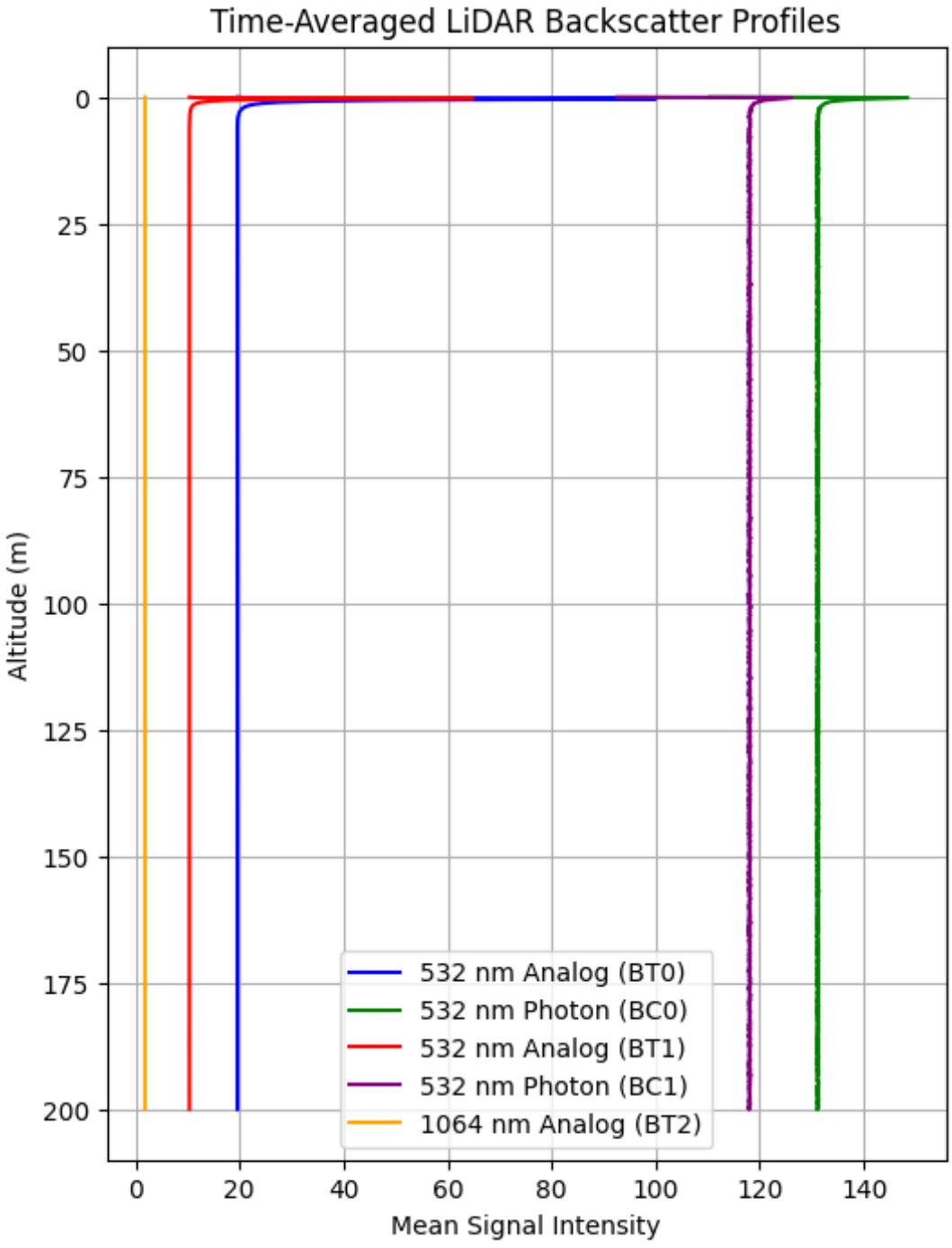
Observation:

- Smoothing did not reveal any new features. The profiles remained flat without noticeable vertical variations.

4. TIME-AVERAGING OF PROFILES

- Averaged multiple profiles across different files to compute time-mean profiles.
- Purpose: To enhance persistent features by reducing random fluctuations.

Image 4: Time-averaged backscatter profiles (all channels)



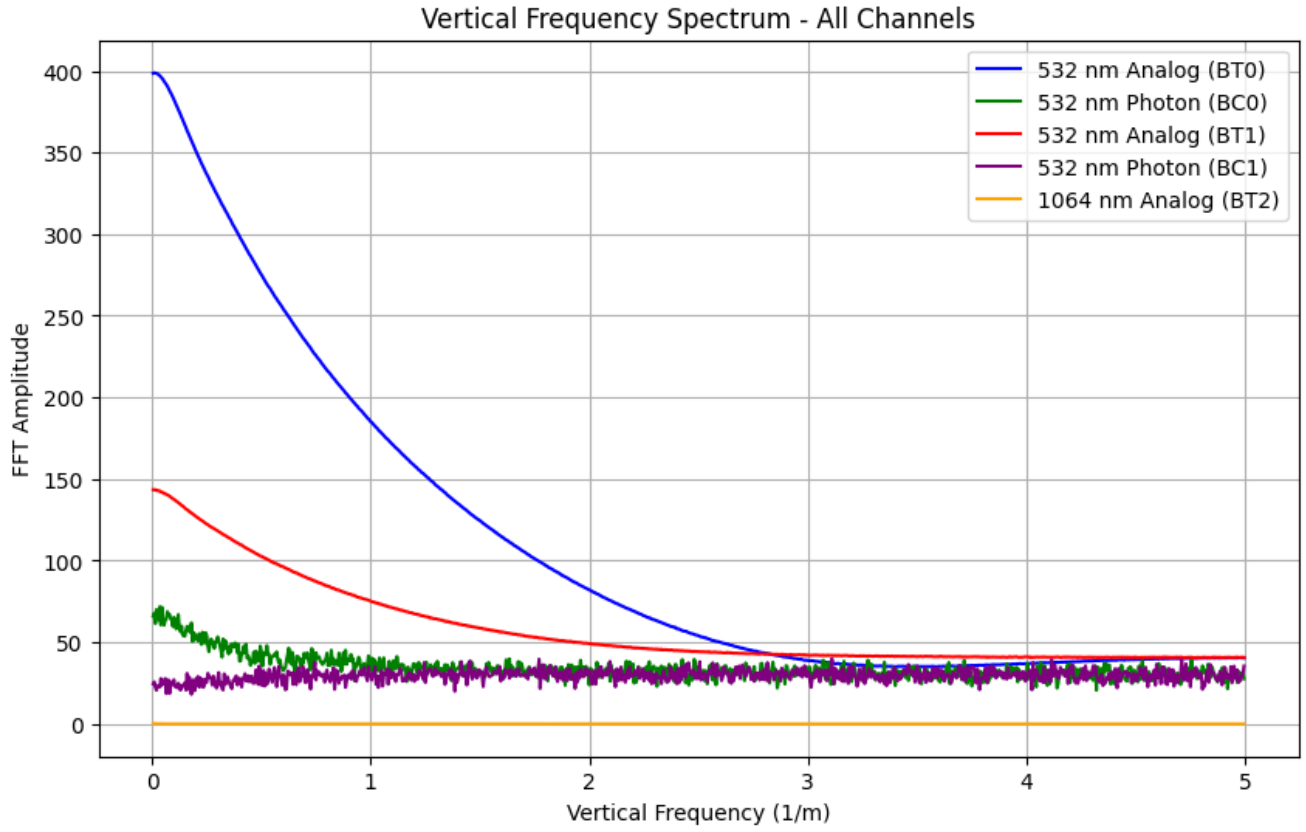
Observation:

- Time-averaged profiles were consistent with individual profiles. No vertical wave patterns were detected.

5. FREQUENCY DOMAIN ANALYSIS (FFT)

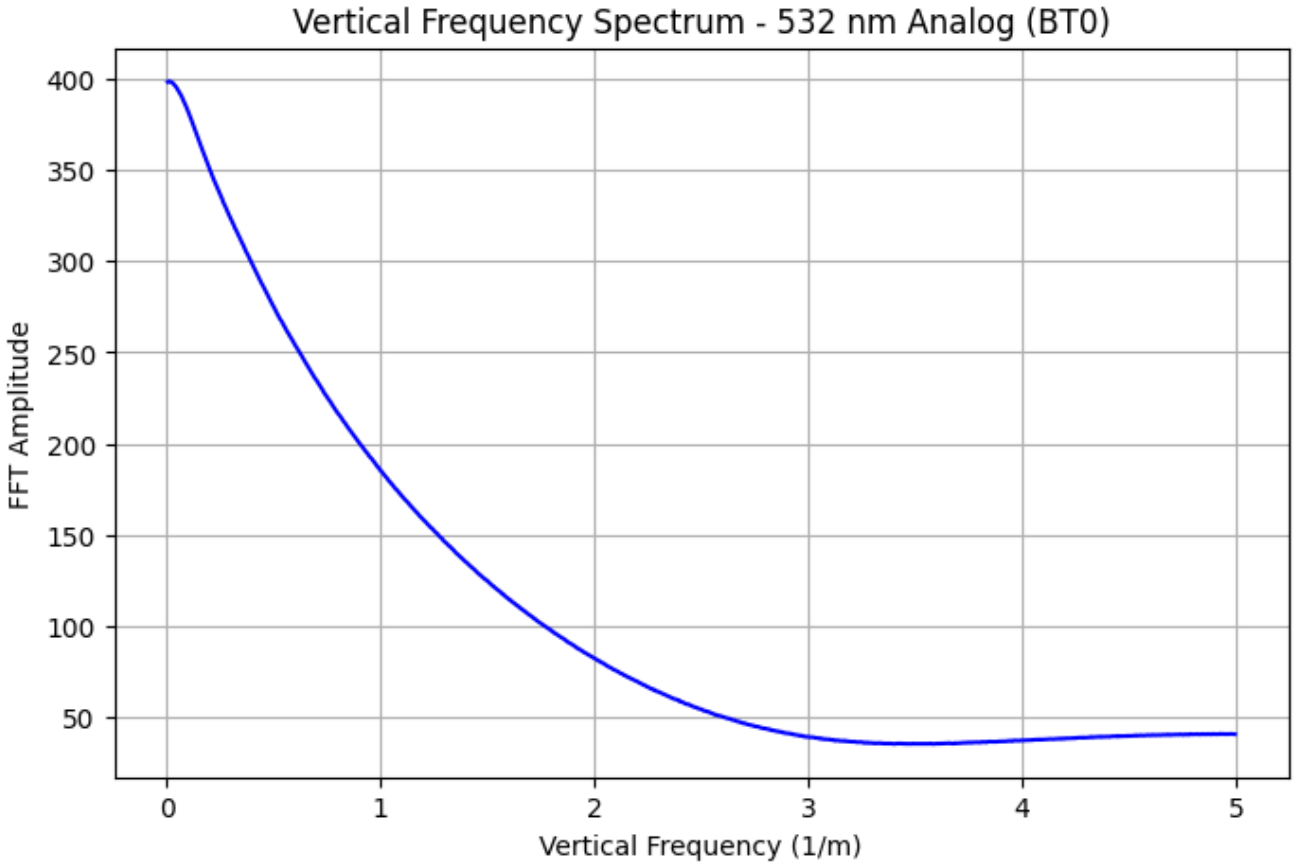
- Applied Fast Fourier Transform (FFT) to vertical profiles of each channel.
- Purpose: To detect dominant vertical frequency components that might indicate wave structures not visible in profile plots.

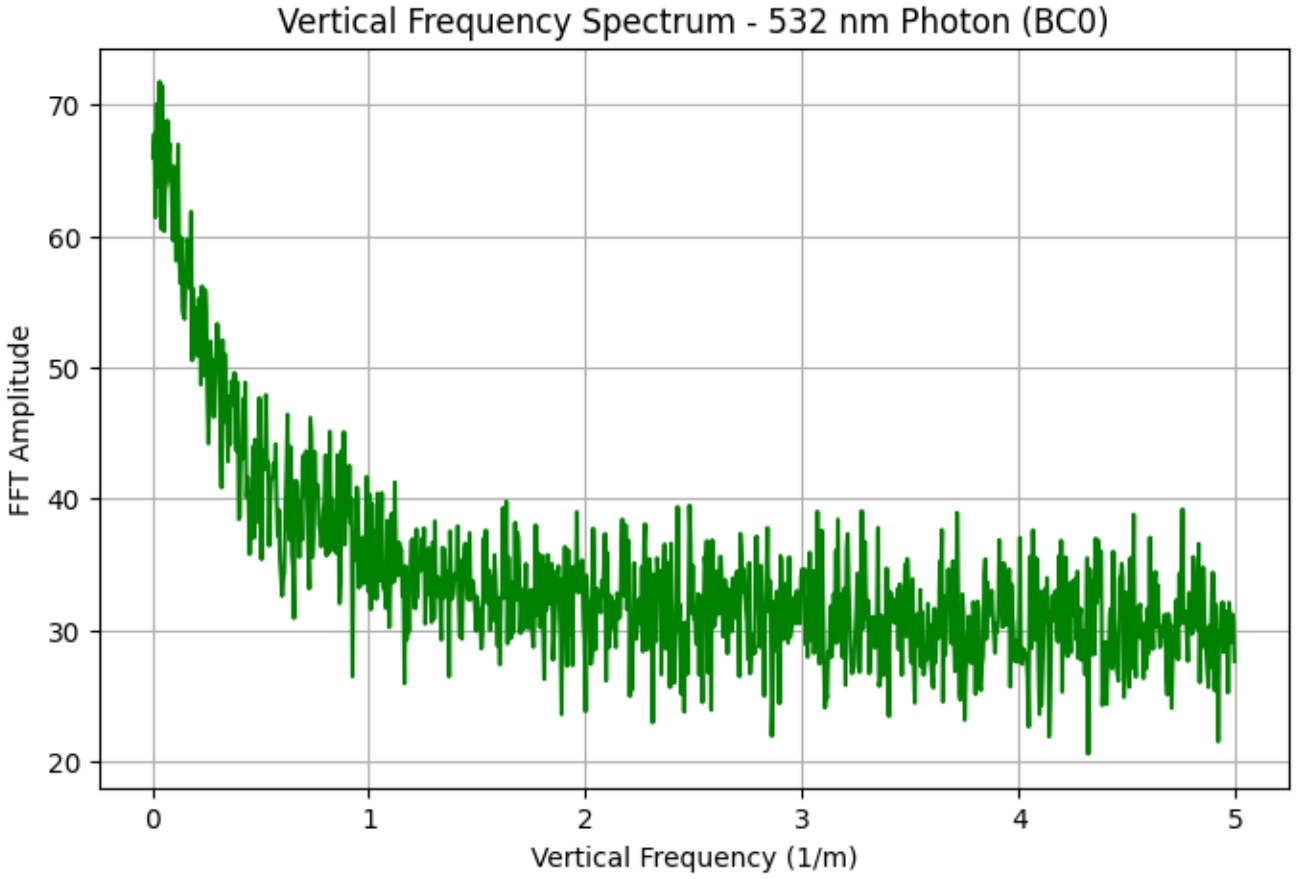
Image 5: FFT vertical frequency spectrum (all channels)

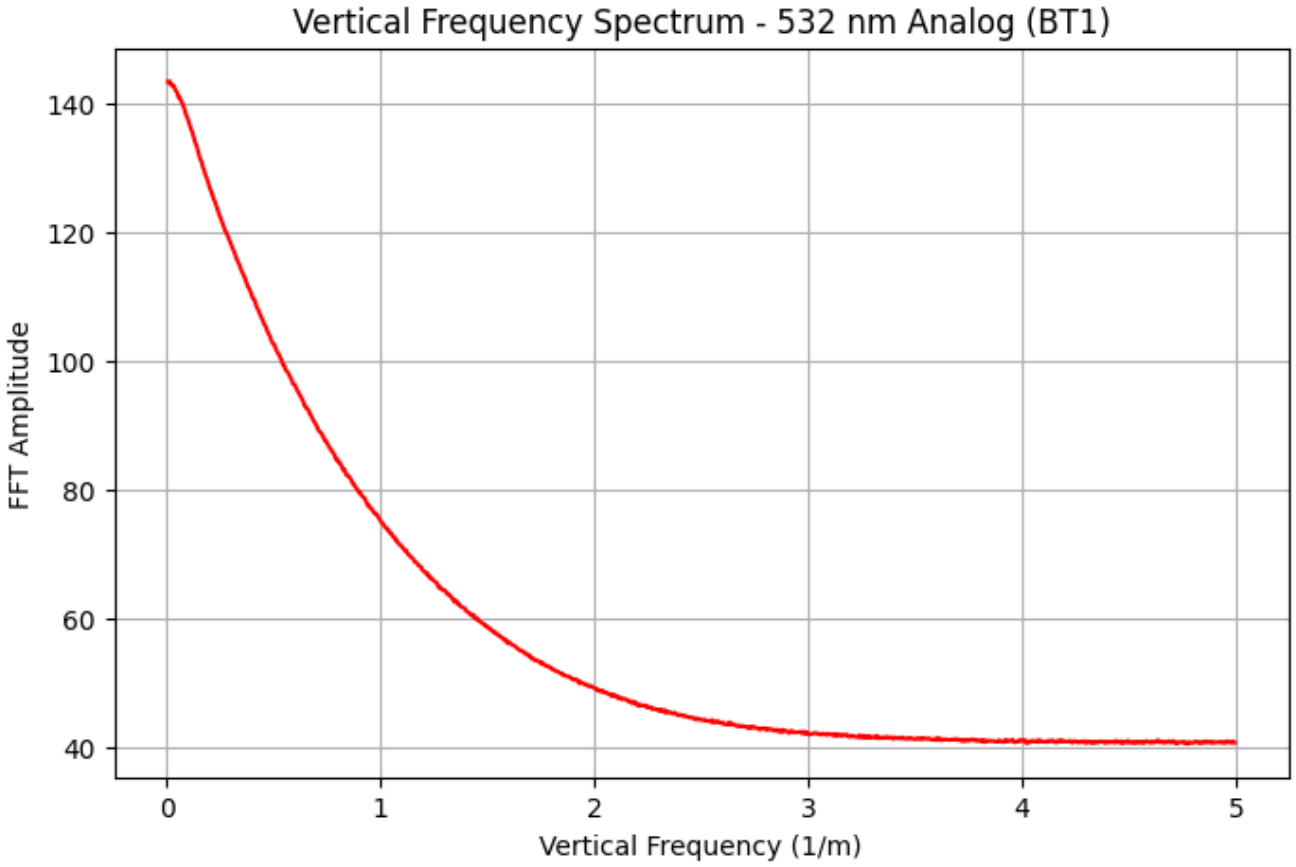


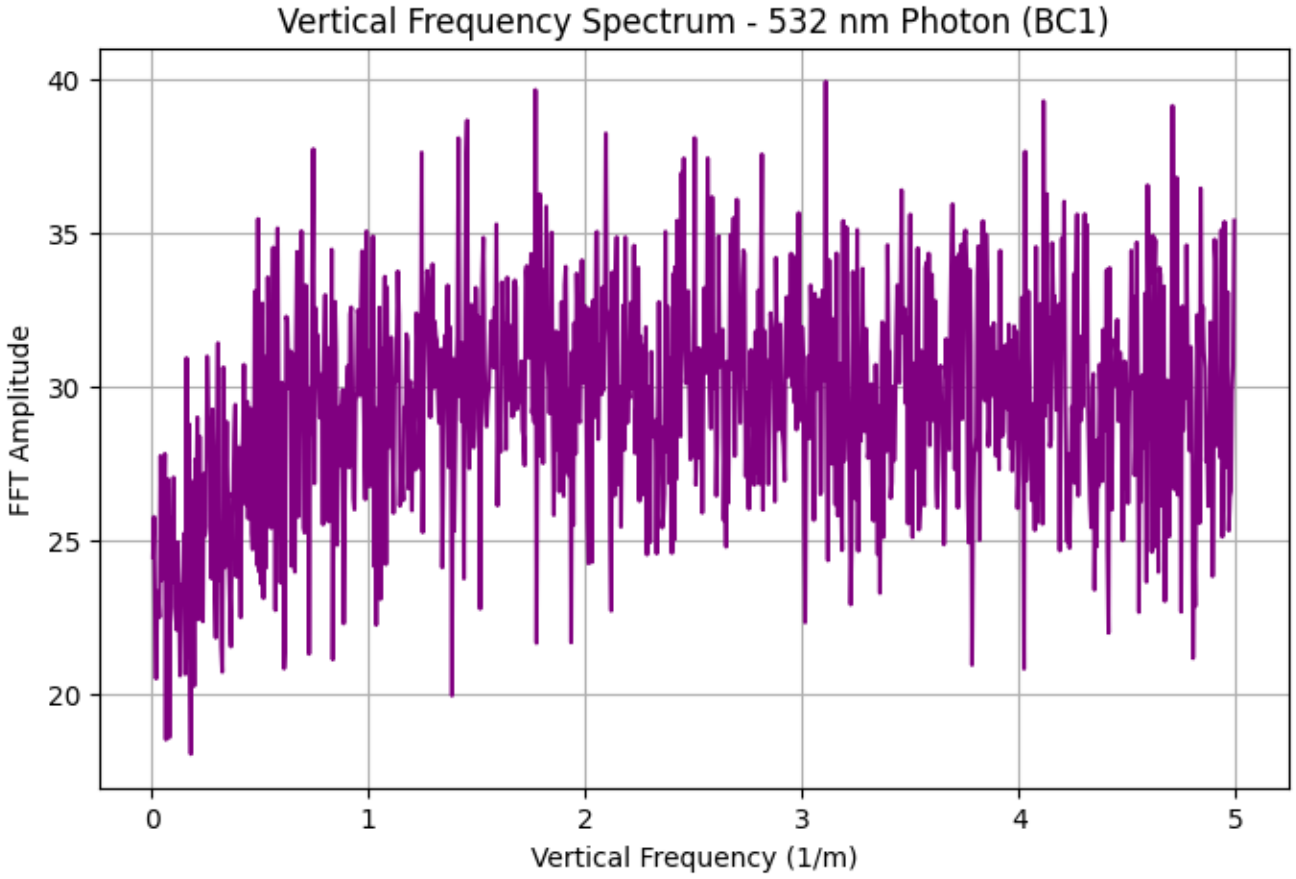
Observation:

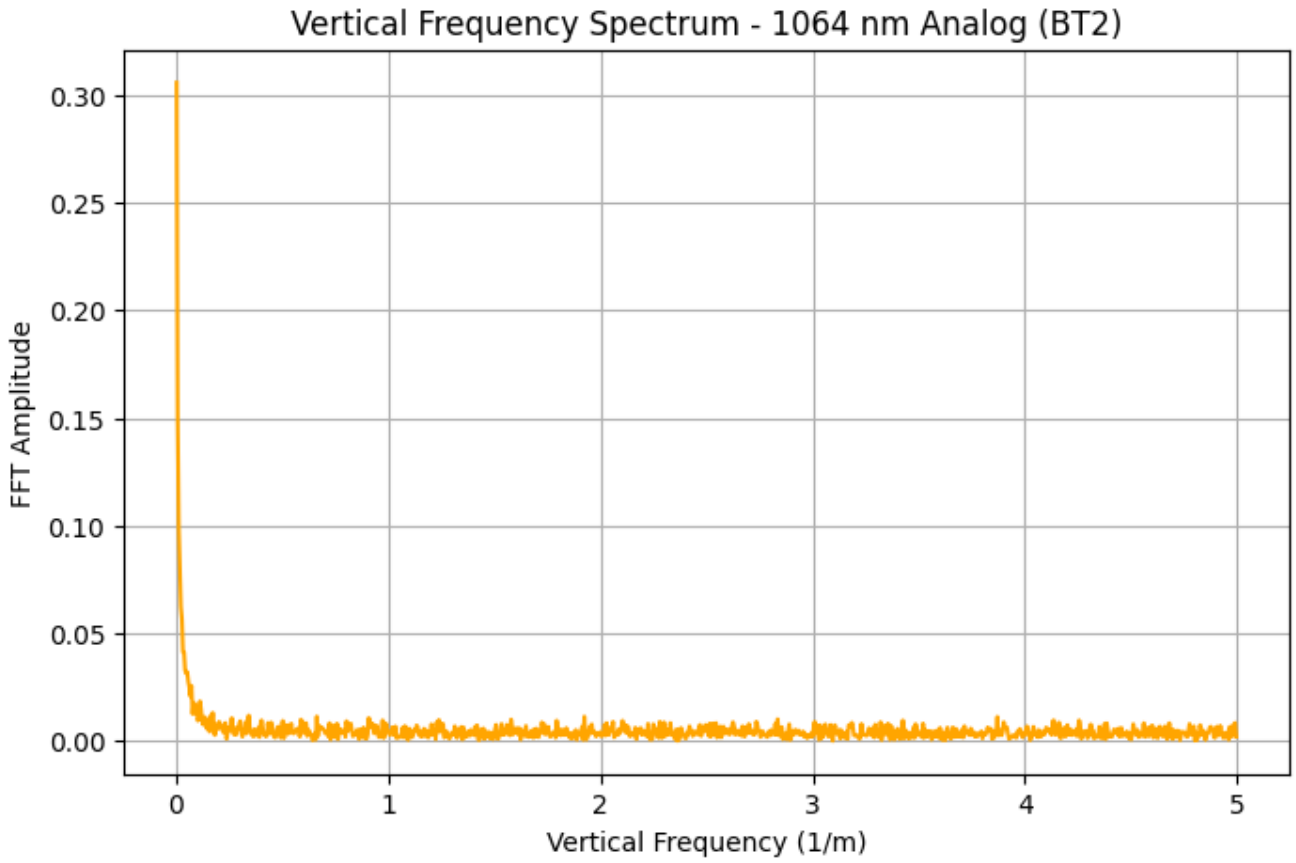
- FFT showed strong low-frequency (DC) components due to flat signal. No sharp peaks at higher frequencies were detected, indicating absence of vertical periodicity.


Vertical Frequency Spectrum - 532 nm Analog (BT0)
FFT Amplitude
400
350
300
250
200
150
100
50
0
1
2
3
4
5
Vertical Frequency (1/m)


Vertical Frequency Spectrum - 532 nm Photon (BC0)
FFT Amplitude
70
60
50
40
30
20
0
1
2
3
4
5
Vertical Frequency (1/m)


Vertical Frequency Spectrum - 532 nm Analog (BT1)
FFT Amplitude
140
120
100
80
60
40
0
1
2
3
4
5
Vertical Frequency (1/m)


Vertical Frequency Spectrum - 532 nm Photon (BC1)
FFT Amplitude
40
35
30
25
20
0
1
2
3
4
5
Vertical Frequency (1/m)



6. BATCH PLOTTING AND CONSISTENCY CHECK

- Plotted profiles from multiple files for comparison.
- Purpose: To confirm consistency across time and ensure no features were missed.

Observation:

- Profiles were consistent across files. No significant variation was observed.

SUMMARY OF WORK

- Data structure was explored and signal channels correctly identified.
- Raw profiles plotted and inspected; no wave-like structures found.
- Smoothing and time-averaging applied; no hidden structures detected.
- FFT applied; no dominant vertical frequency components detected.
- Batch consistency checks confirmed stable profiles over time.