UNDERWATER COLORIMETRY

LIGHT ATTENUATION LAB

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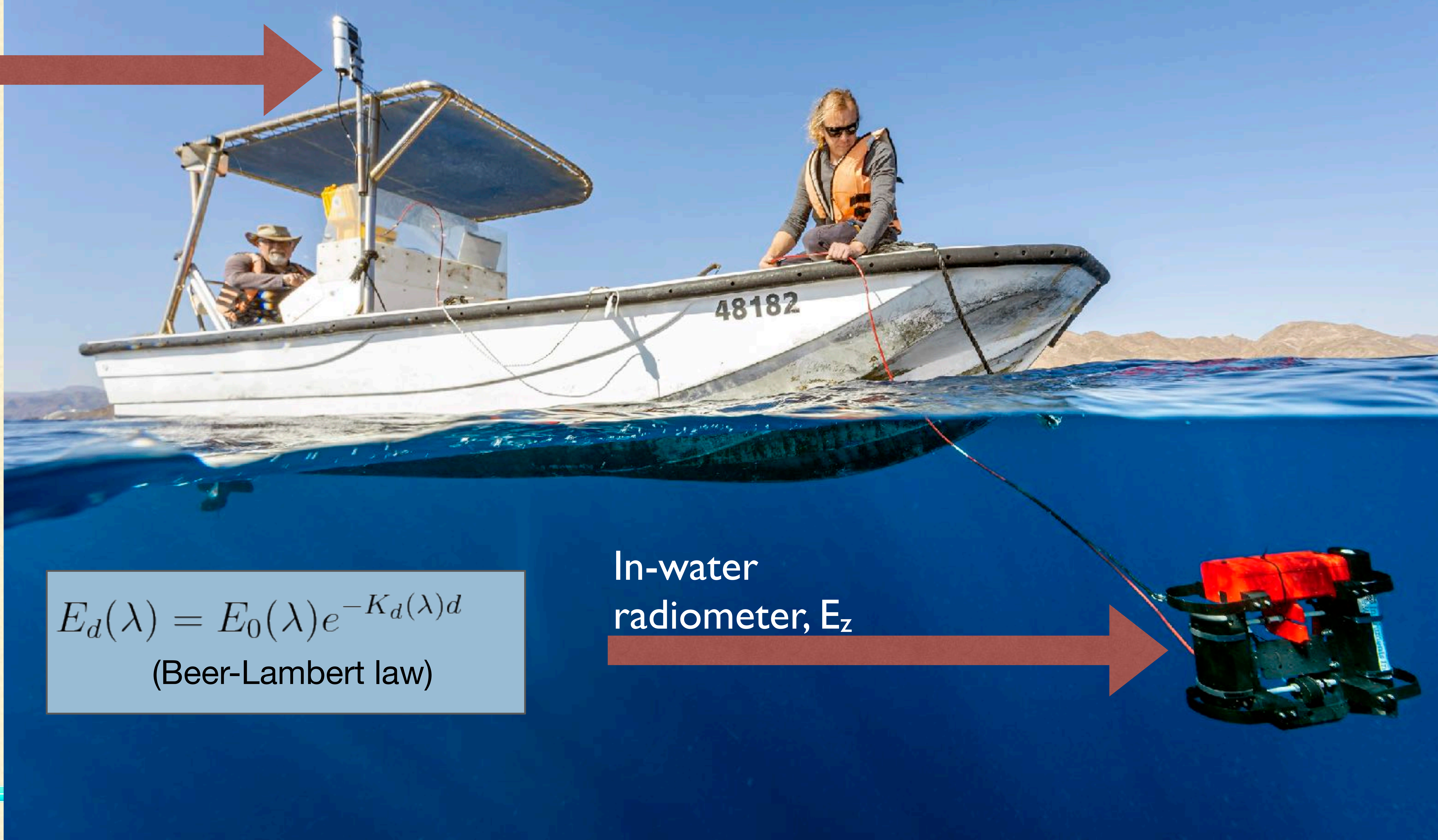
Measuring K_d (Diffuse Downwelling Attenuation Coefficient)

Surface radiometer, E_0

Measure light spectrum E at different depths & solve for Kd



In-water radiometer, E_z

$$E_d(\lambda) = E_0(\lambda)e^{-K_d(\lambda)d}$$

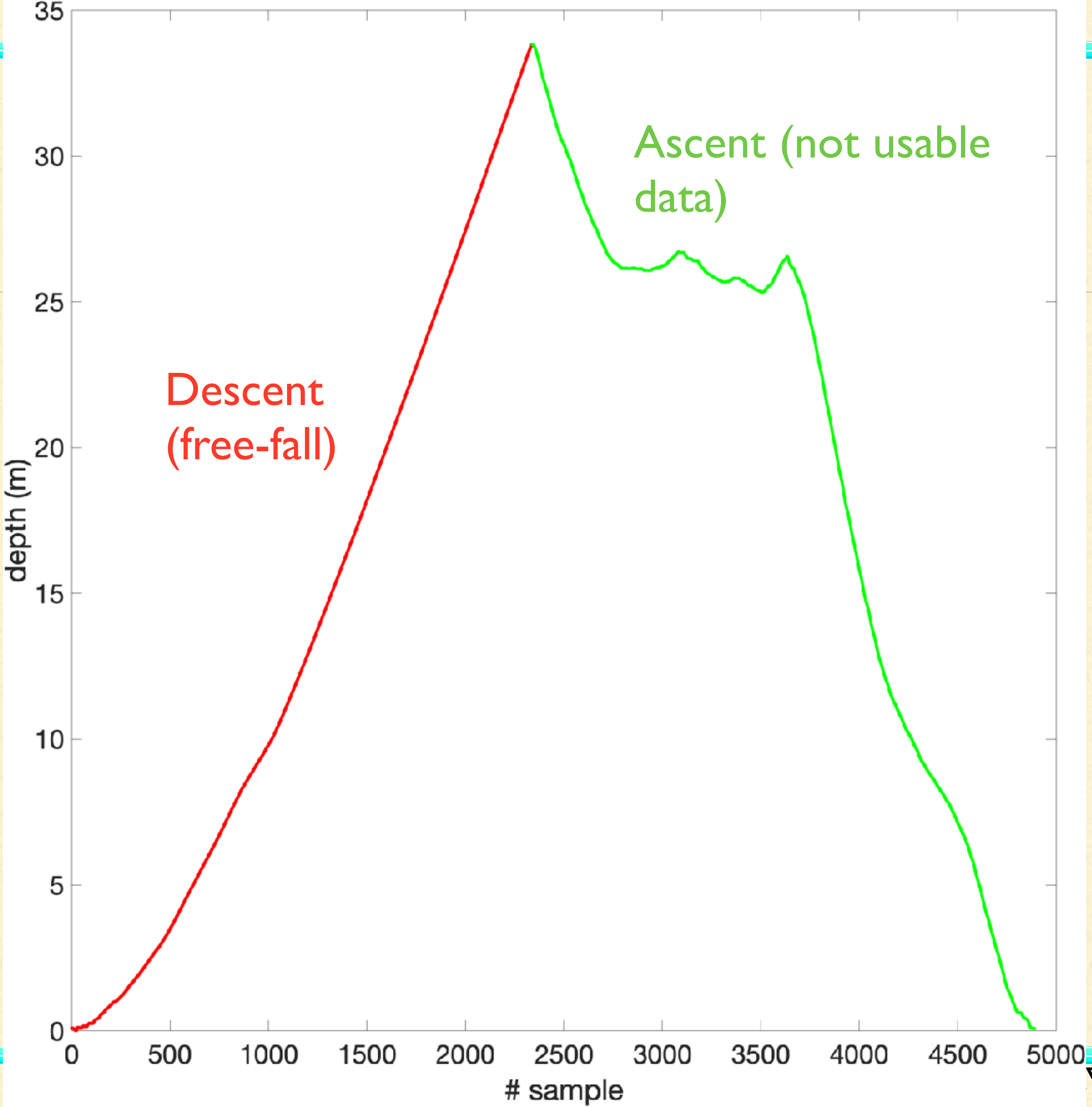
(Beer-Lambert law)

FREEFALL

During the descent (red part of the curve), the radiometer is free-falling.

As it free-falls, it records the light spectrum at 19 wavelengths at 15 Hz. This deployment went to ~35m.

After it reaches the desired depth, we simply pull the instrument back up to the boat (green part of the curve). This data is not usable for anything.



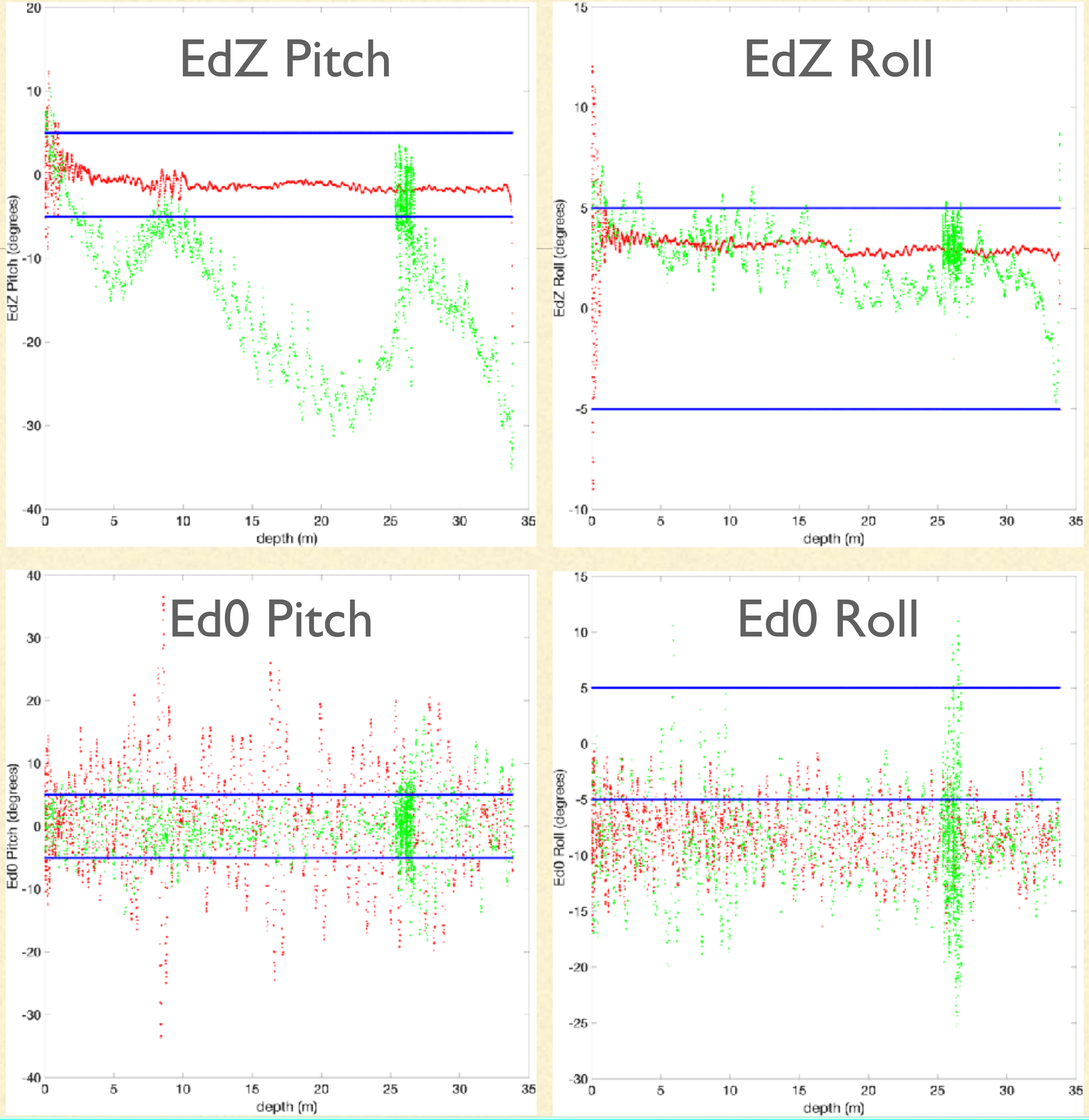
PITCH/ROLL/TILT

We are measuring downwelling light, which by definition is travelling vertically down.

If either the surface unit (E0) or the water unit (EZ) has tilt/pitch/roll values > |+-5|, we cannot use the data. The blue lines in these plots show the limits.

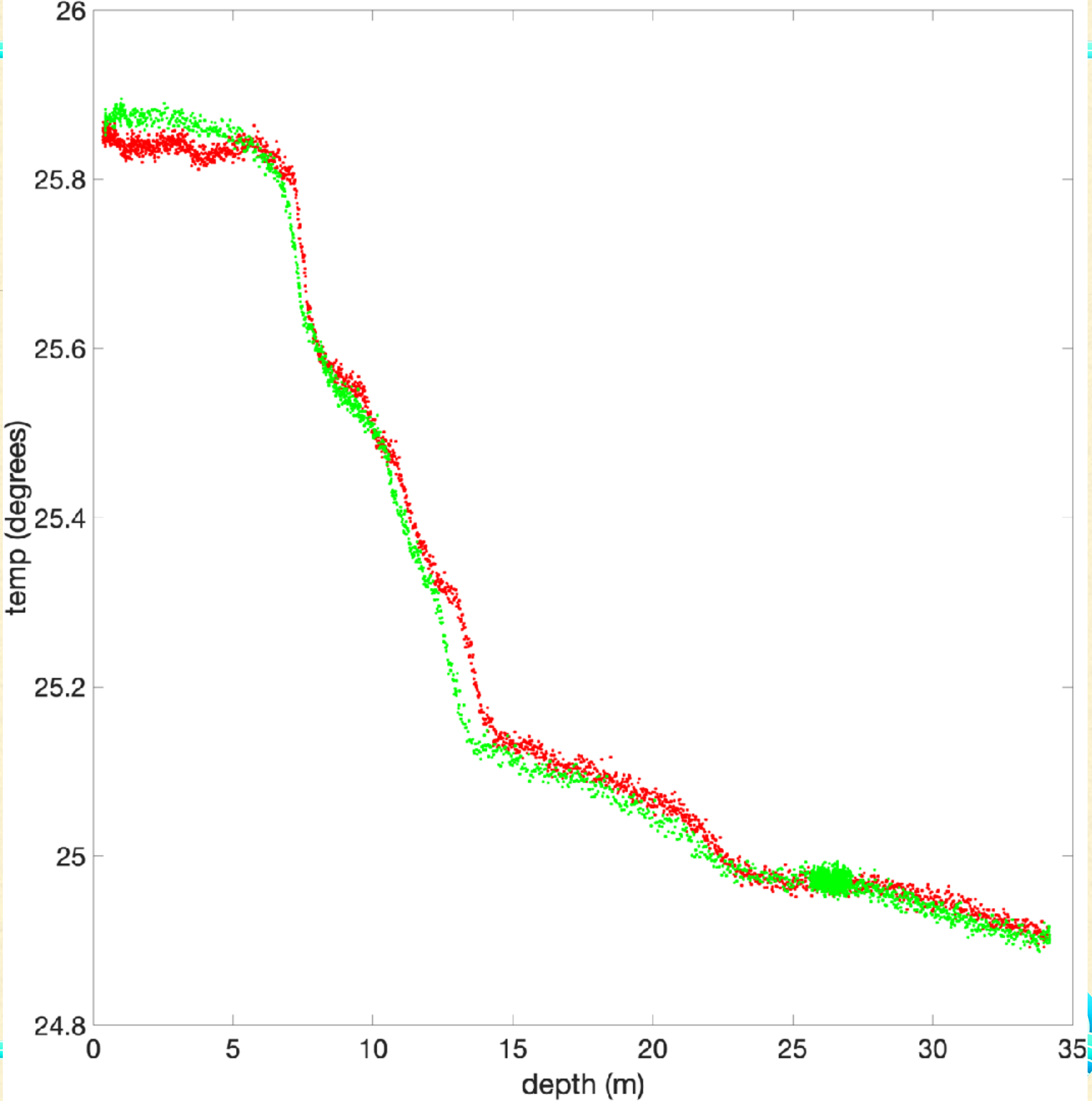
(Notice when we are pulling the instrument back up - green points- how the pitch/roll behaves. Clearly it's being yanked and the sensor is not looking vertically up).

In this dataset, while the EdZ unit behaved well, the surface unit Ed0 moved too much for reliable data. Very few data points are usable.



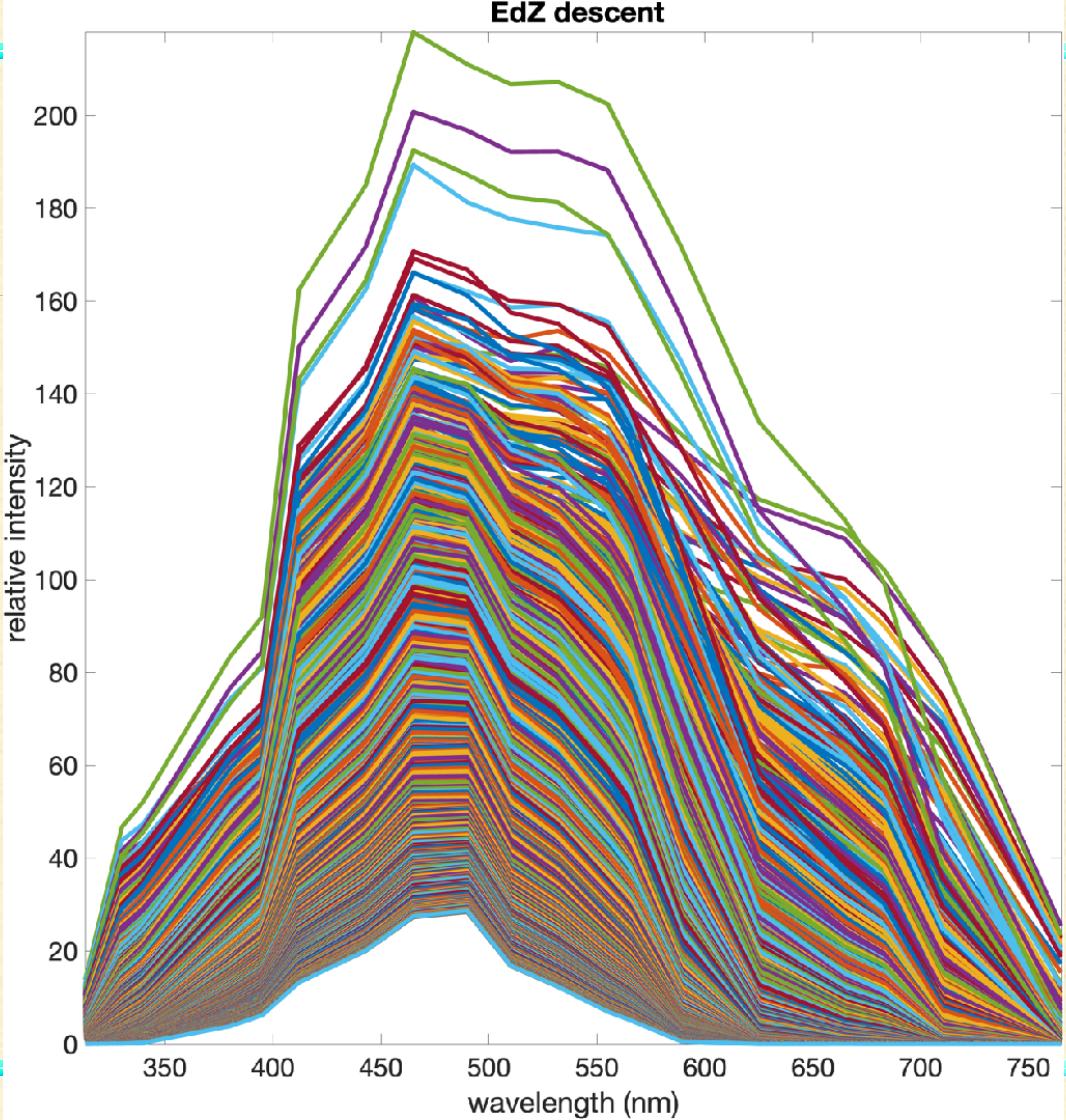
Temperature

We are not going to use the temperature data but here is a comparison of what the instrument measured during descent (red) and ascent (green).



EdZ Light Spectrum

After filtering out points that had pitch/roll/tilt > |5| degrees, we have these spectra curves recorded with the in-water unit, across all depths.

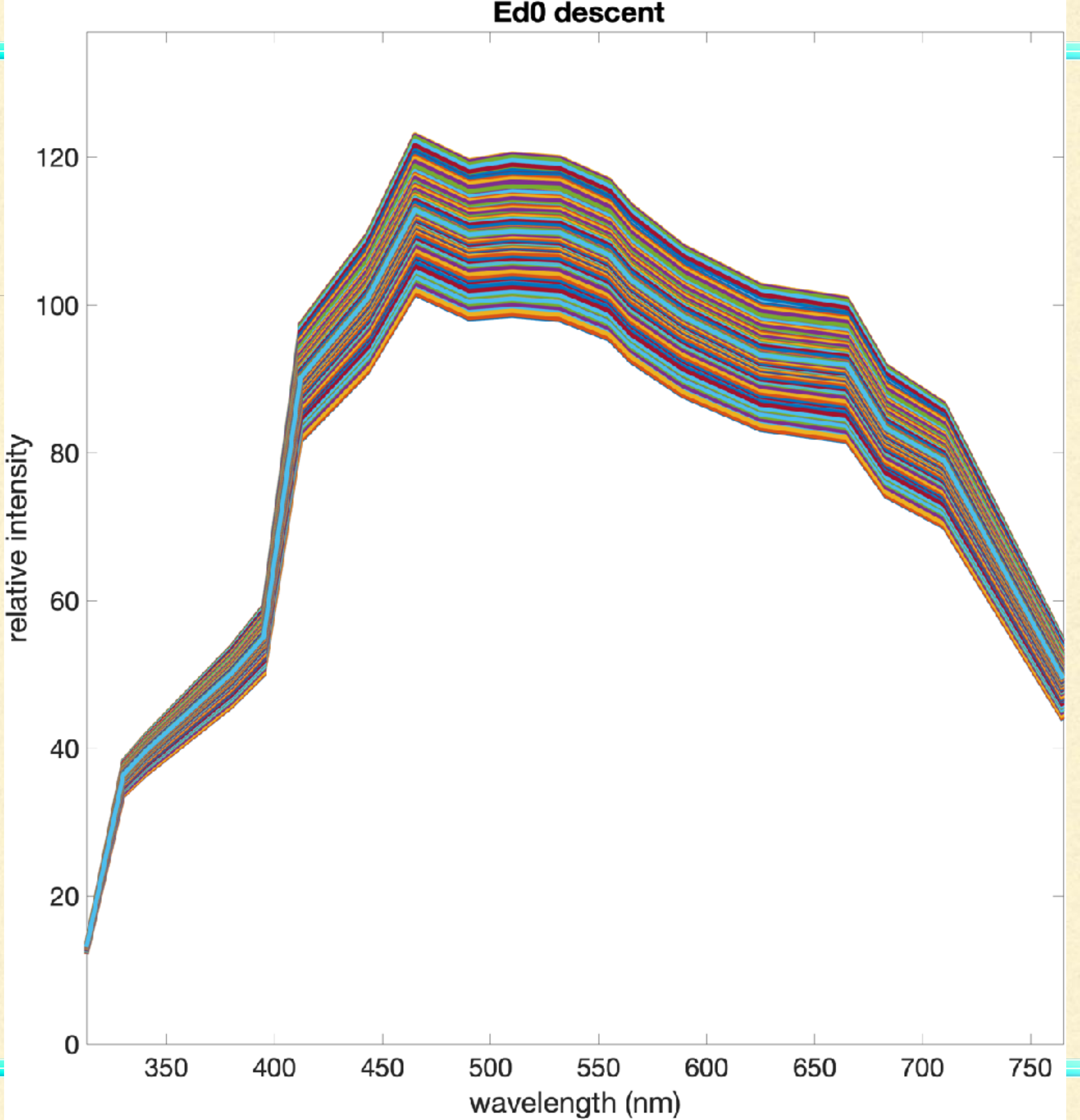


Ed0 Light Spectrum

After filtering out points that had pitch/roll/tilt > |5| degrees, we have these spectra curves recorded with the surface unit, across all time.

Note that during this experiment, the surface spectrum stayed same in shape, but changed in intensity quite a bit. This could be due to natural variations due to sun position (the time of day), or related to boat motion.

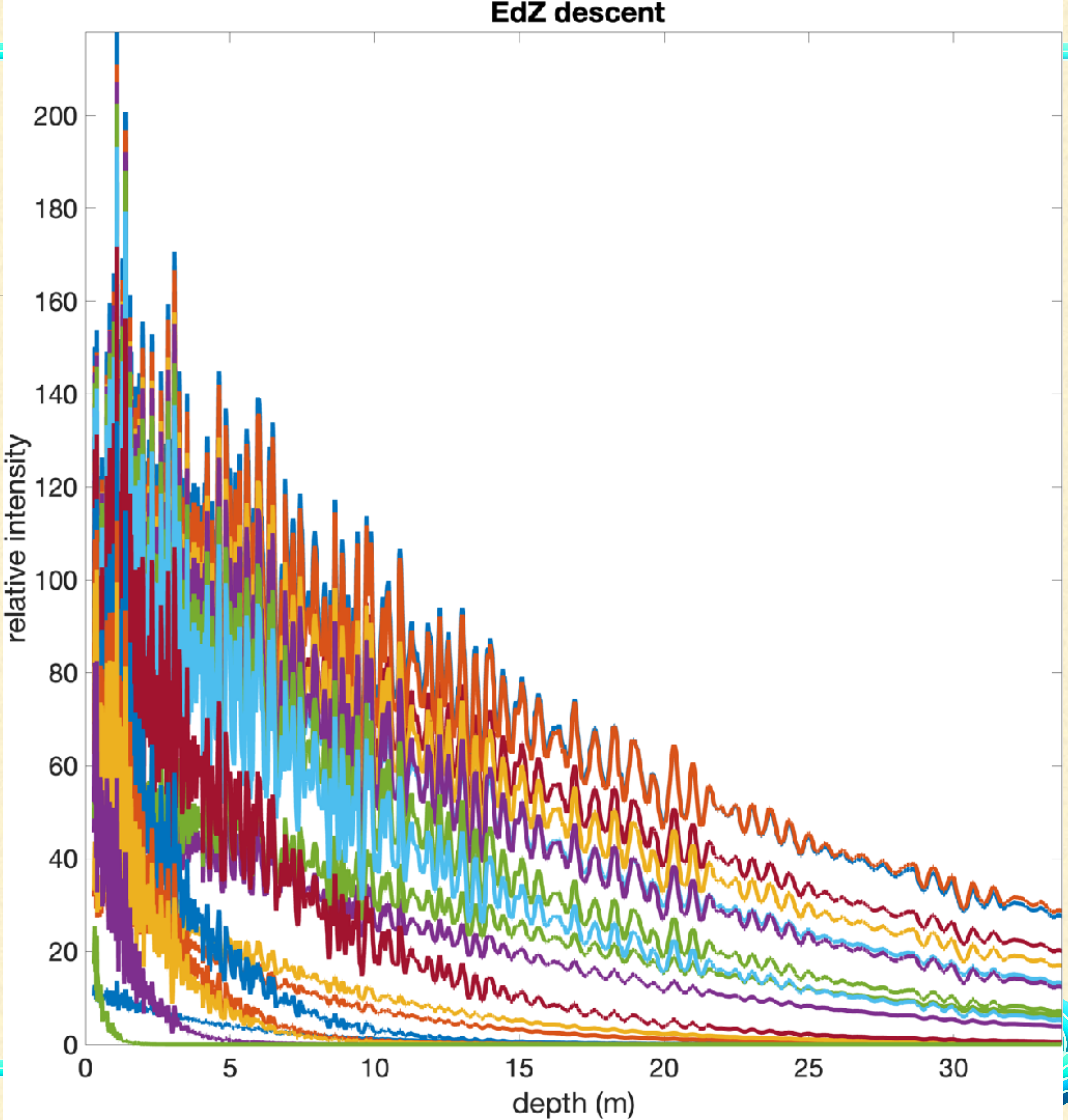
Think about whether you would just average these data, or only take certain timepoints, etc.



EdZ Light Spectrum

Here is how light per a given wavelength attenuated with depth. The curves are not labeled, but represent the 19 wavelengths the instrument is sensitive to.

Ed0 data would look similar to those at 0m depth.



Kd Estimation

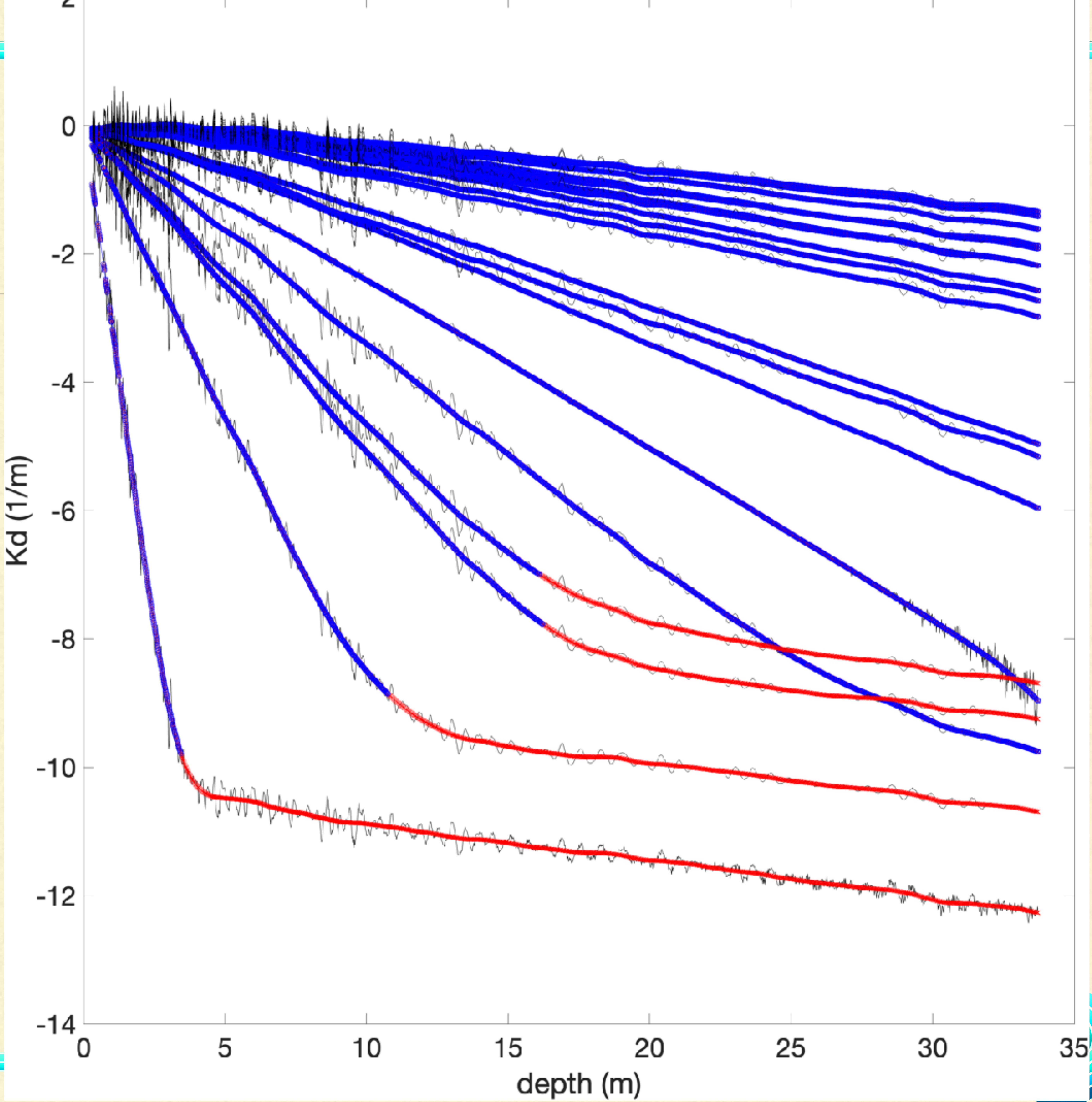
$$E_d(\lambda) = E_0(\lambda)e^{-K_d(\lambda)d}$$

(Beer-Lambert law)

This is an example of how Kd per wavelength looks like,(wavelengths are not labeled), per depth.

As you see, some wavelengths attenuate faster than others. Those that attenuated too fast (red parts of each curve) will bias the Kd estimation.

For a given wavelength (curve) you should not use the data marked after an "elbow" (here marked in red).



Kd Estimation

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In the end, your Kd as a function of wavelength will look something like this. If it was a cloudy day, you must use your E0 data. If the sky was clear, using any two pairs of EZ data should give you the same result. Try for yourself!