SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

TELEDYNE OPTECH
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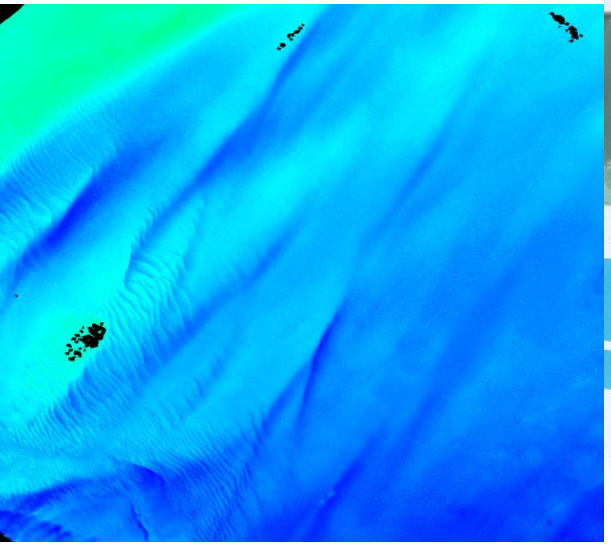

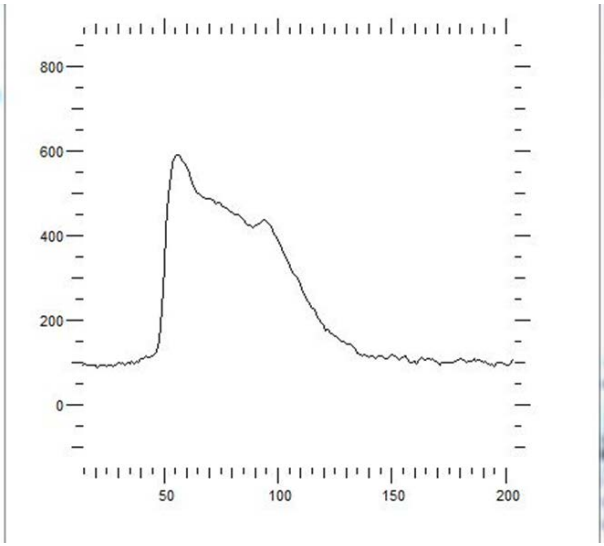

Pilot CZMIL Project in Tampa Bay, FL (and Peace River)

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Dewberry

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Software Manager
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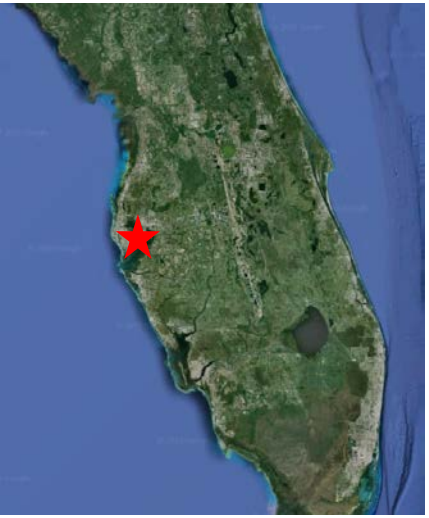
Outline

- Motivation
- Pilot Project
- Results
- Investigating CZMIL waveforms – preliminary analysis
- Conclusion and Future work

Motivation

- Tampa Bay Hard Bottom Mapping Project sponsored by Southwest Florida Water Management District
- Habitats such as seagrasses and emergent tidal wetlands are well mapped in the Bay – using photo-interpretation / sampling techniques
- No inventory of hard bottom, oyster, and tidal flat habitats – relatively small and difficult to quantify.
  - Oyster reefs provide food and habitat for numerous nekton, including sheepshead and blue crabs
  - Hard bottom habitats support sponges, soft corals, algae, and live rock
  - Tidal flats support dense populations of benthic invertebrates and are feeding areas for egrets, roseate spoonbills, and white pelicans
- Can ALB provide a high-res bathymetric map and any additional characteristics of the bottom?

Pilot CZMIL project in Tampa Bay



- Conducted in collaboration with Teledyne Optech and SWFWMD.
- System was installed in Kalus Air (KASI) Piper Navajo aircraft

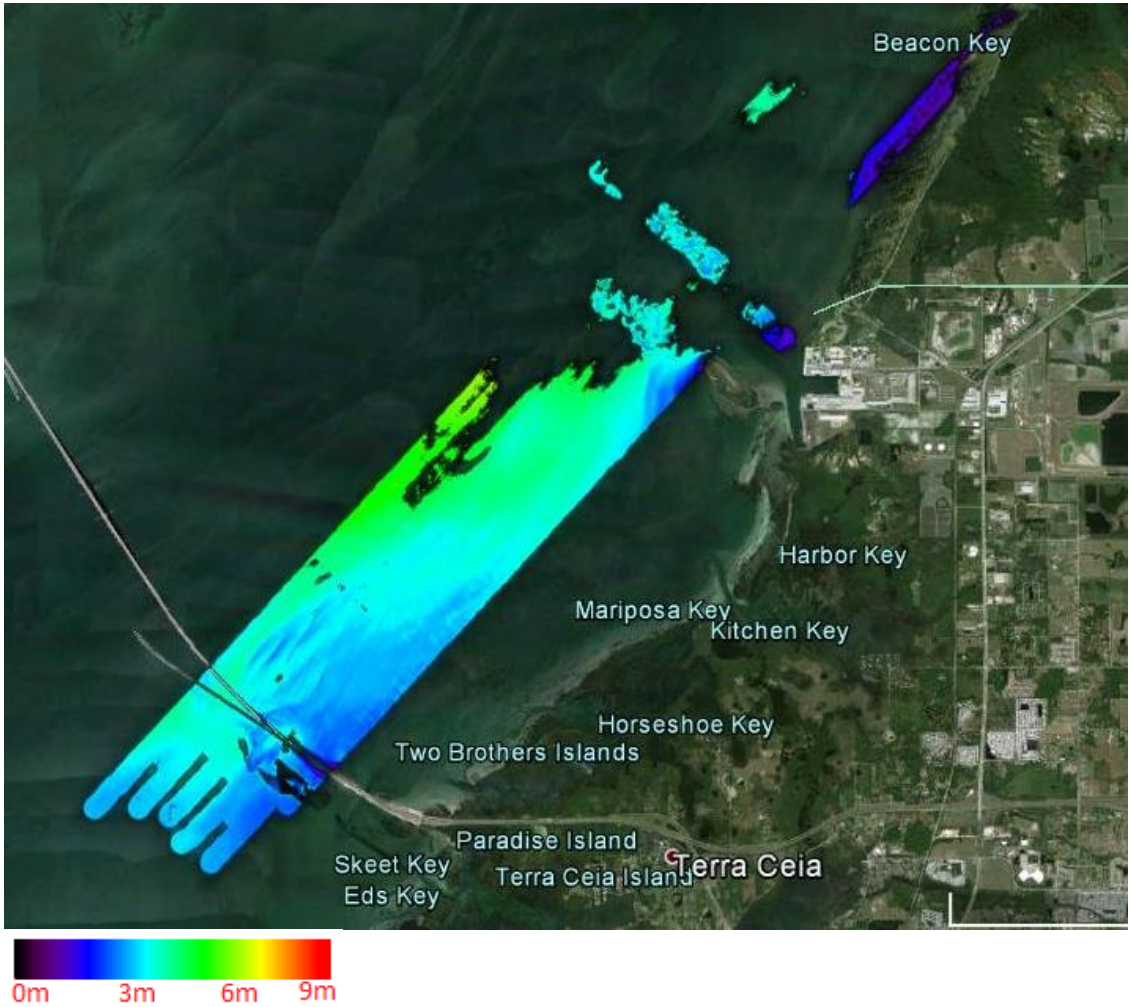
Survey Date: 03/29/2015

Number of flight lines: 11

Area: 12 km^2

Bathymetry

- Dewberry processed data in HydroFusion
- Coverage extent: 65%
- Maximum depth 6.5 m
- Great coverage SW, more turbidity in NE?



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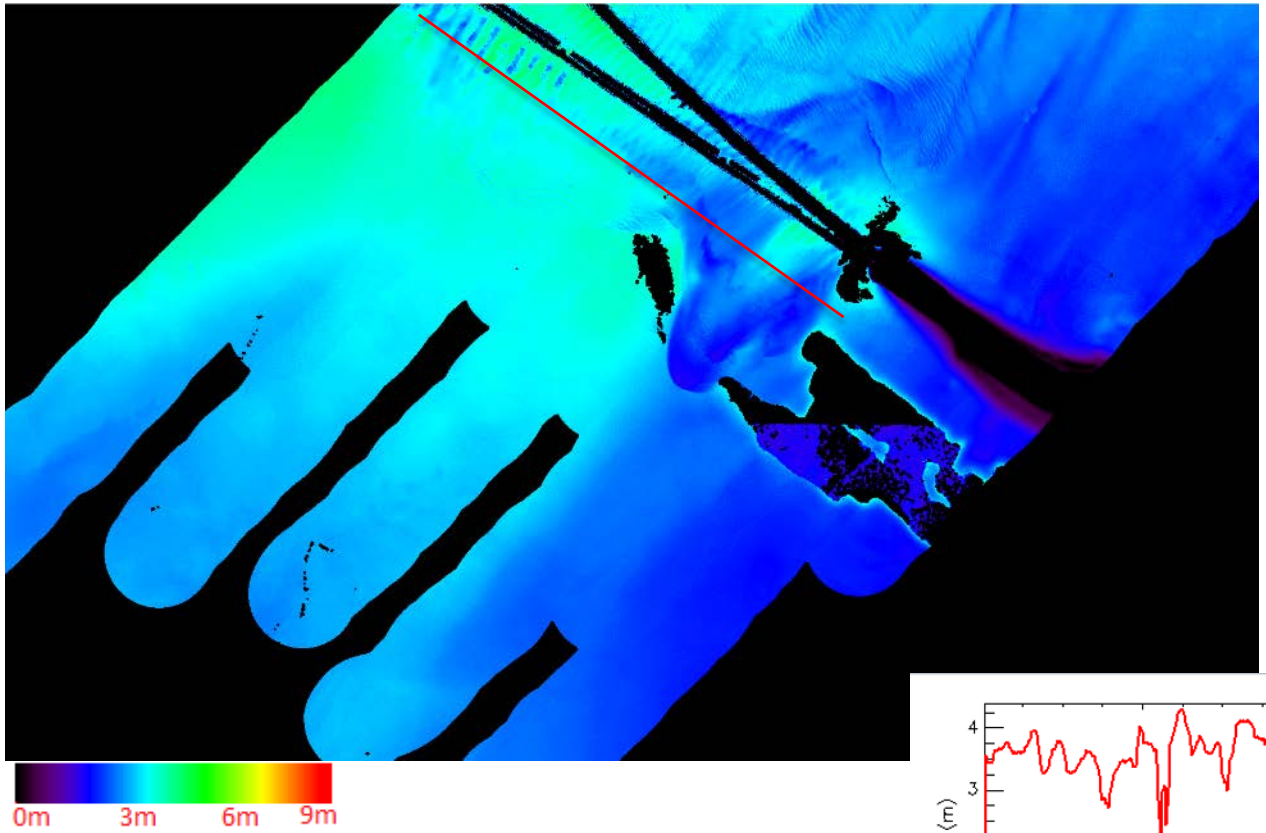
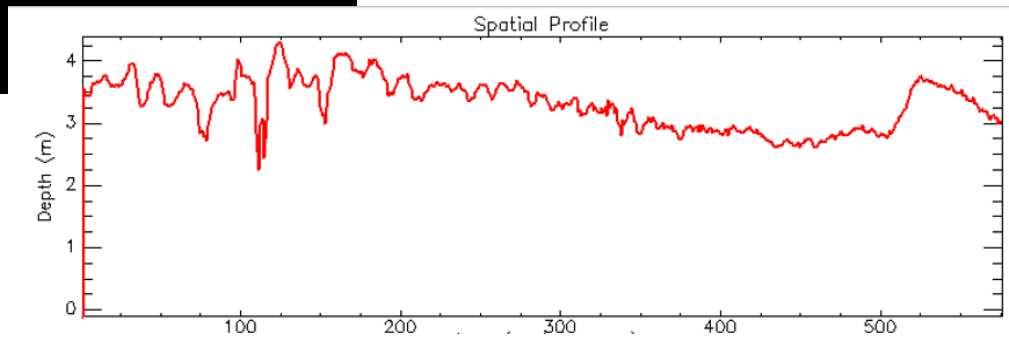
Sample Profile





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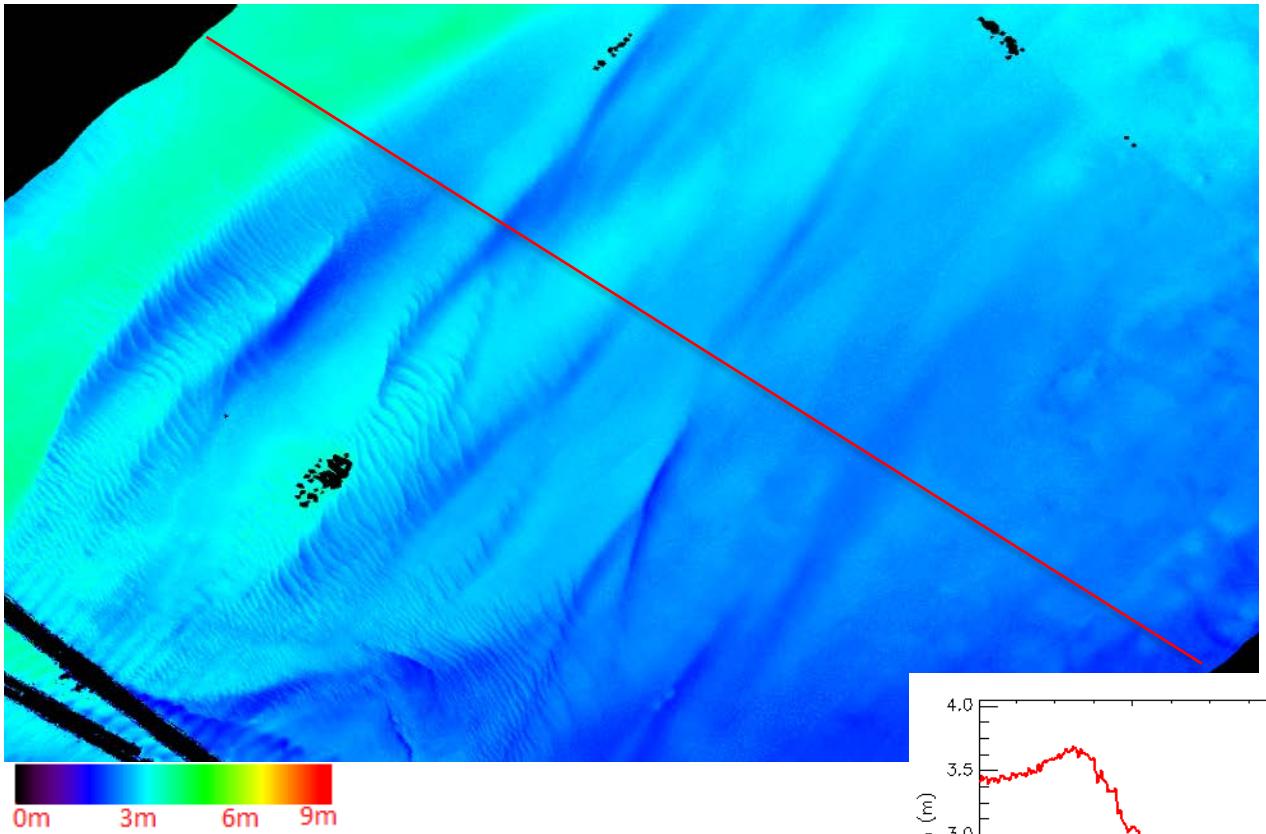
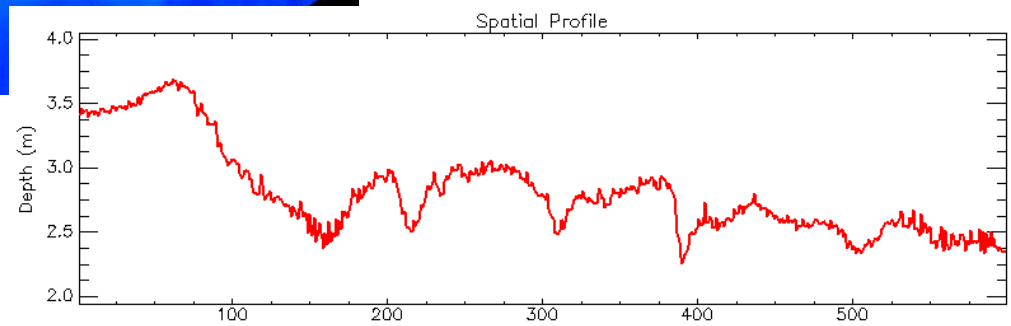
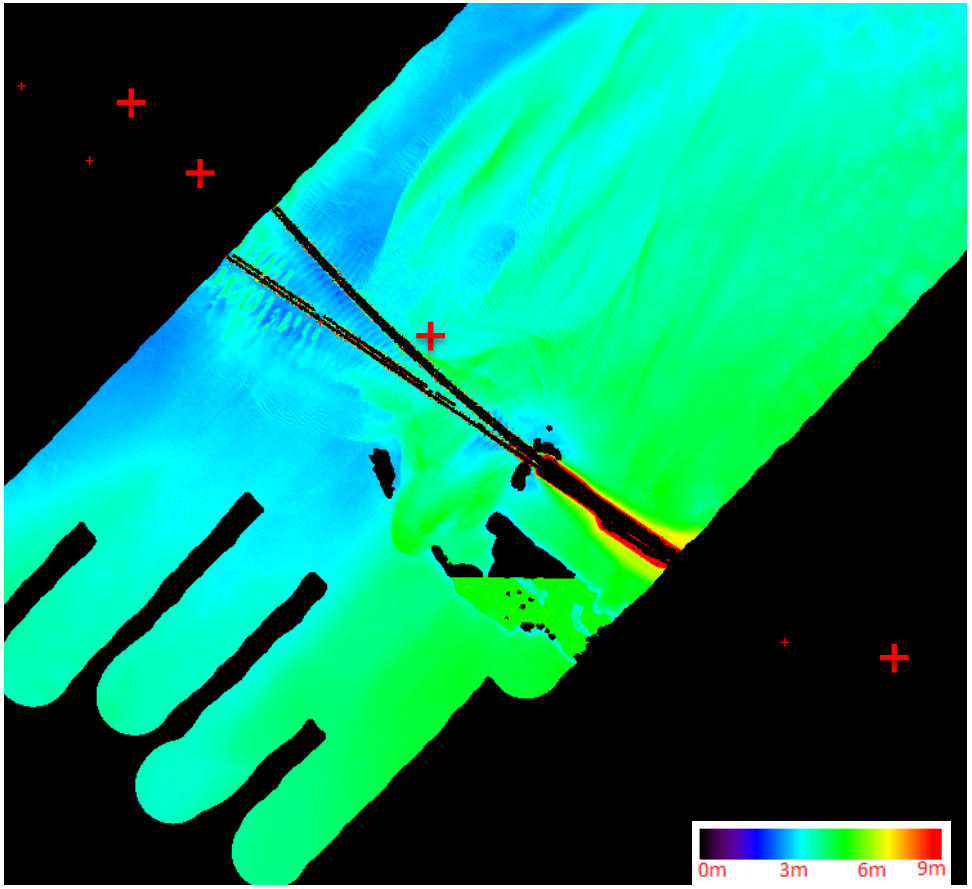




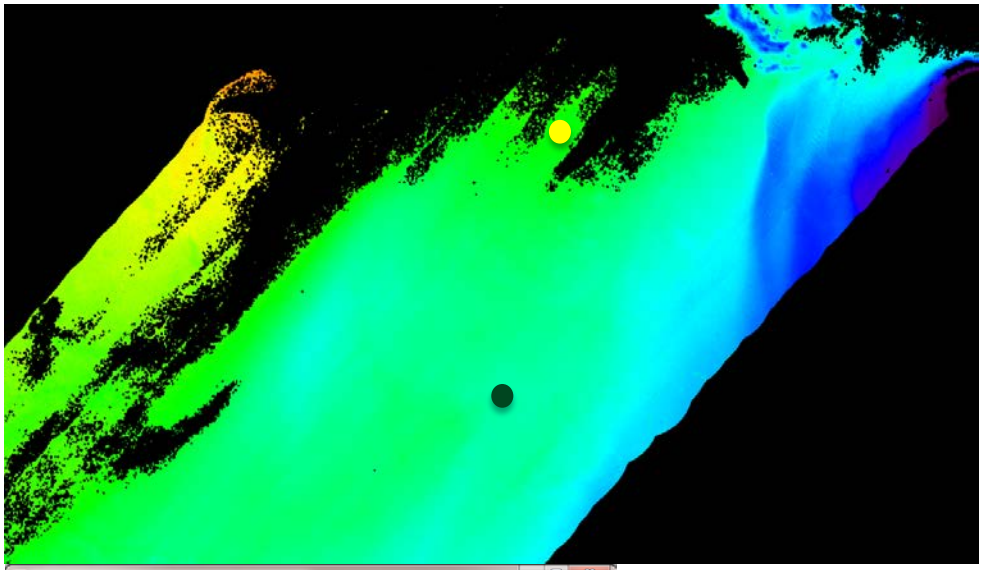
Measured Secchi Depths

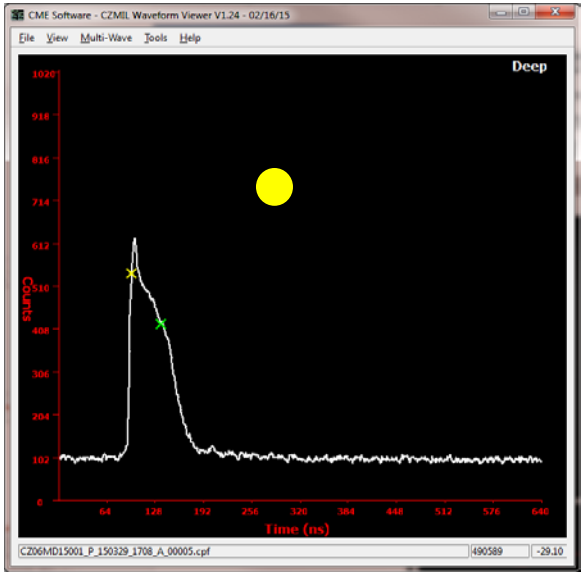


- Secchi Depth Measurement: 3.0m
- Depth: ~4m

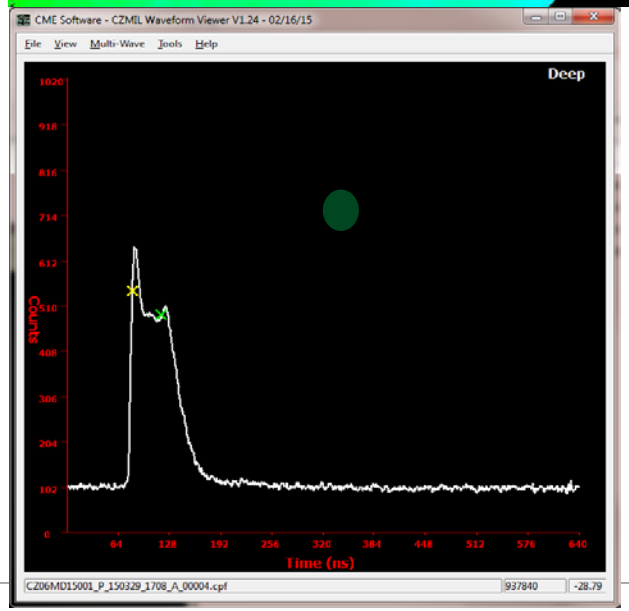
Source: SecchiReadings_TampaAOI.shp, received from SWFWMD.

HydroFusion Waveform Processing





Detection method – HydroFusion Turbid Water Module (TWM)



Detection method – traditional depth extraction

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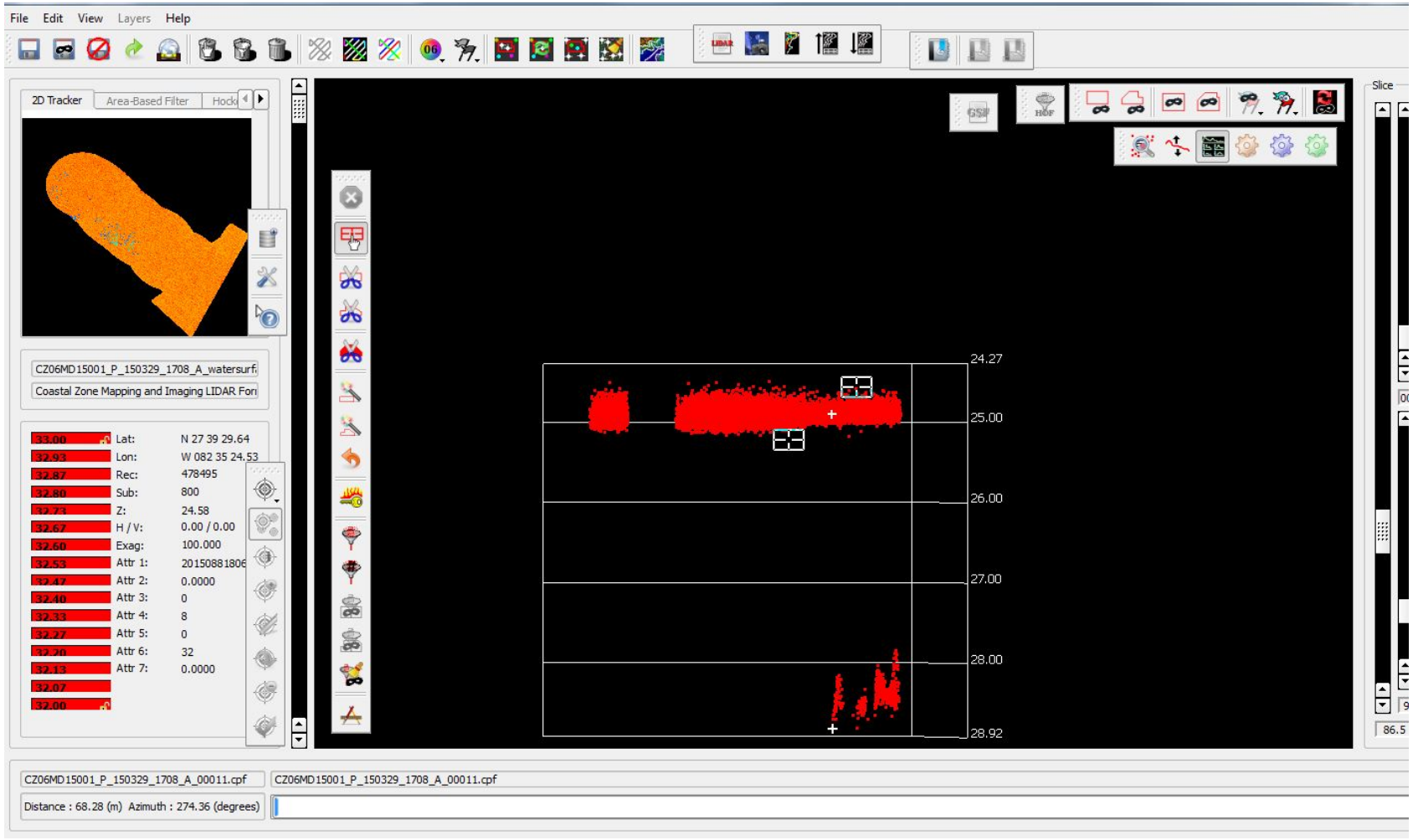
Investigating CZMIL waveforms

Using other techniques to “process” these waveforms

- Determining decay of laser pulse as it traverses through the water column in different types of water (clear, moderately turbid, turbid, extremely turbid, etc.)
  - Based on original work of Wayne Wright when he worked at NASA and then implemented it for the EAARL waveforms in ALPS
- Investigating signal processing techniques based on neighborhood statistics and analysis
  - Probability and Maximum likelihood statistics

Investigating waveforms in Area Based Editor (PFMABE)



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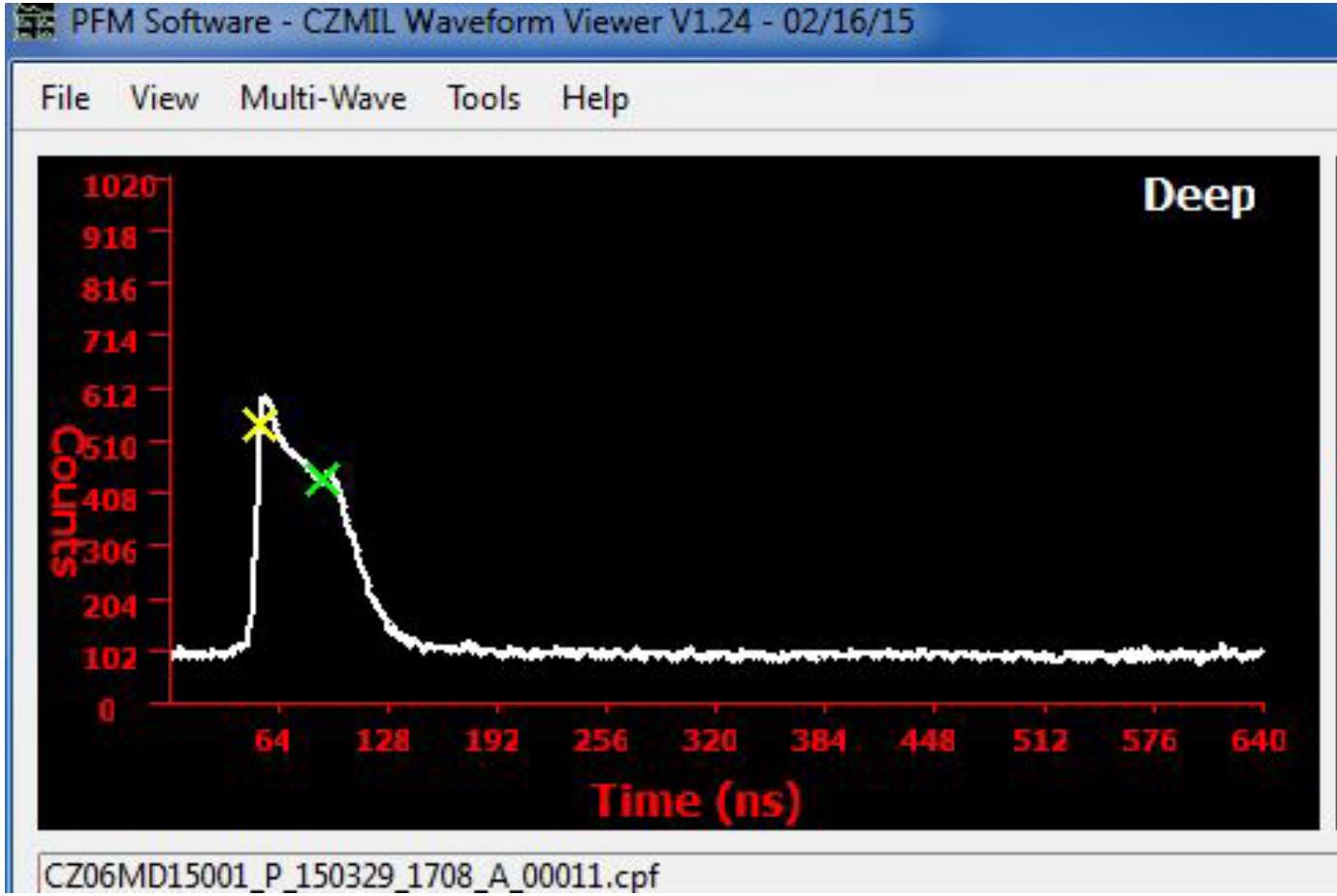
CZMIL waveform

- Bottom successfully "picked" for this lidar pulse



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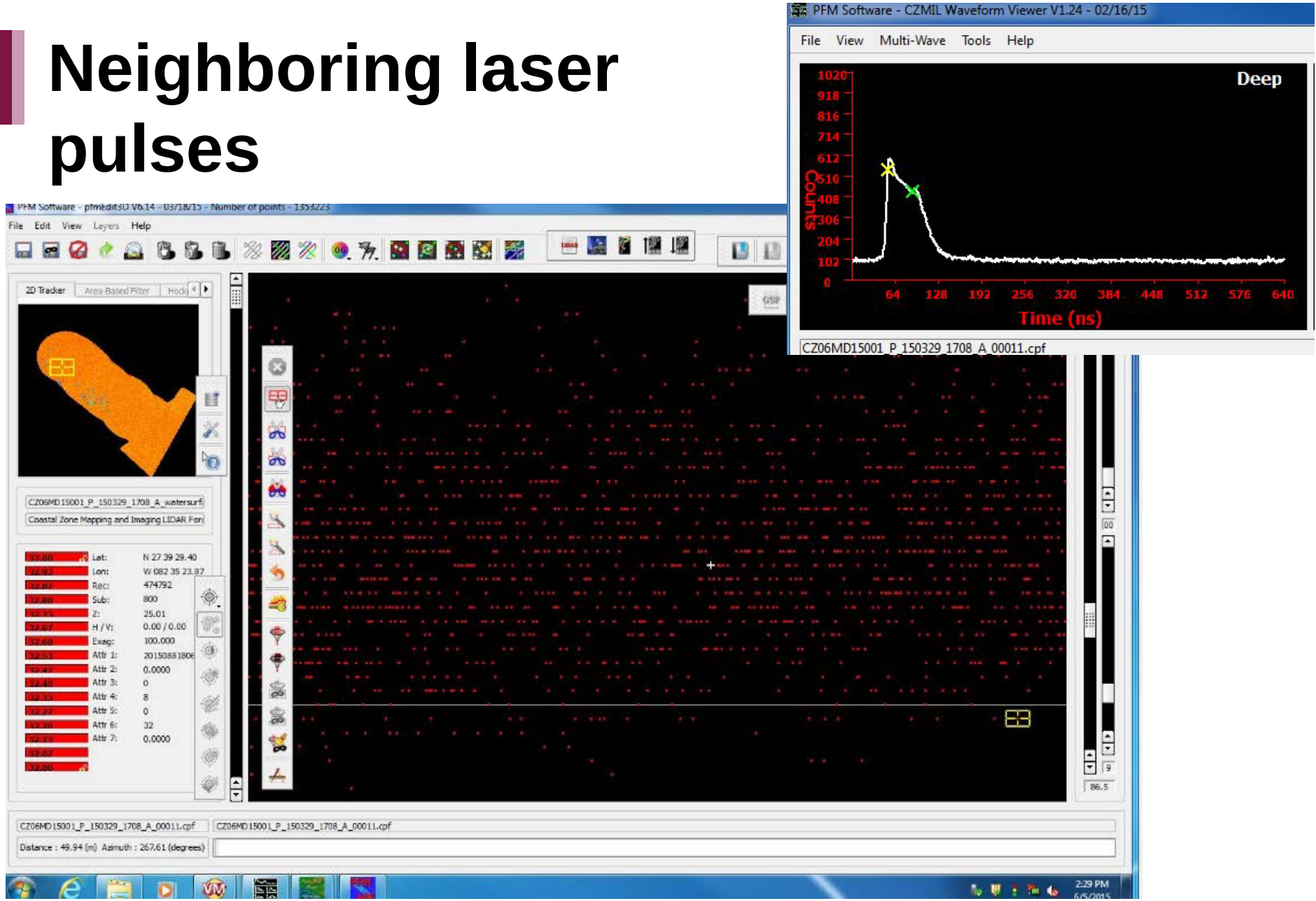
Neighboring laser pulses



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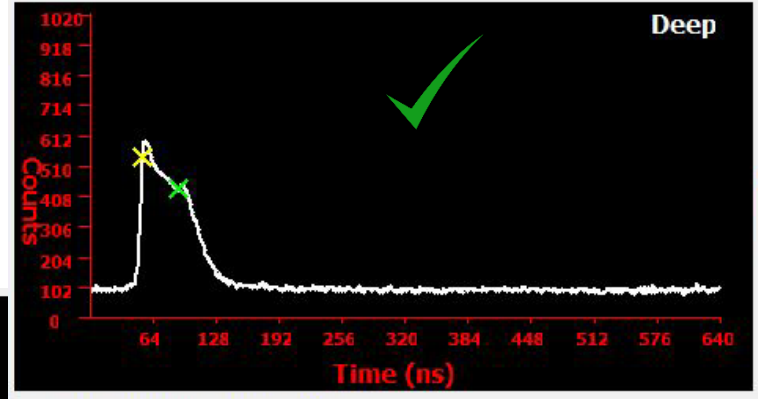
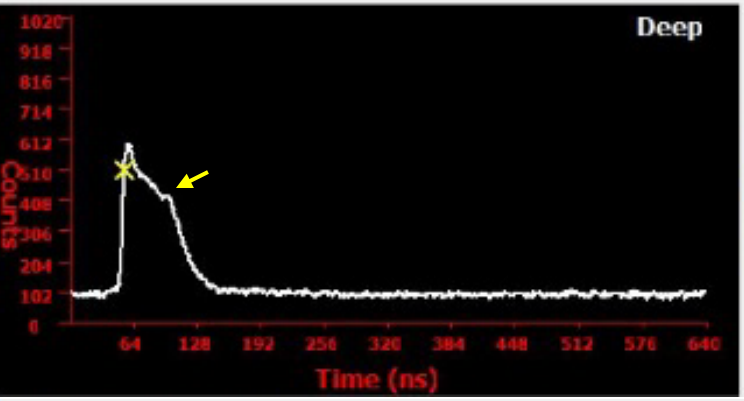
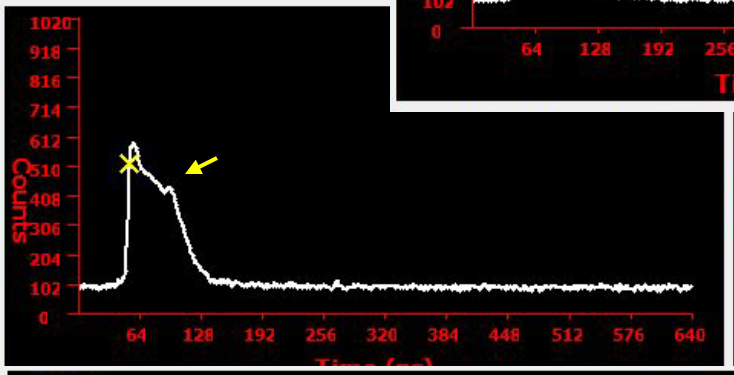
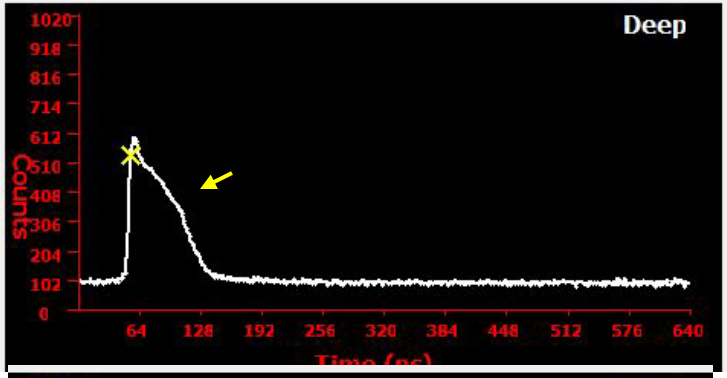
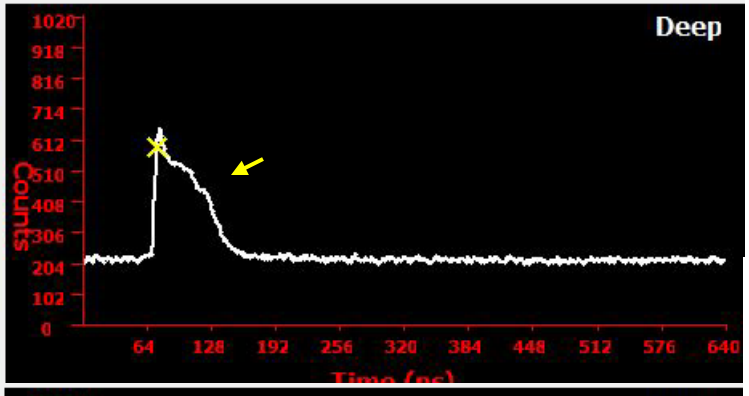
Neighboring laser pulses

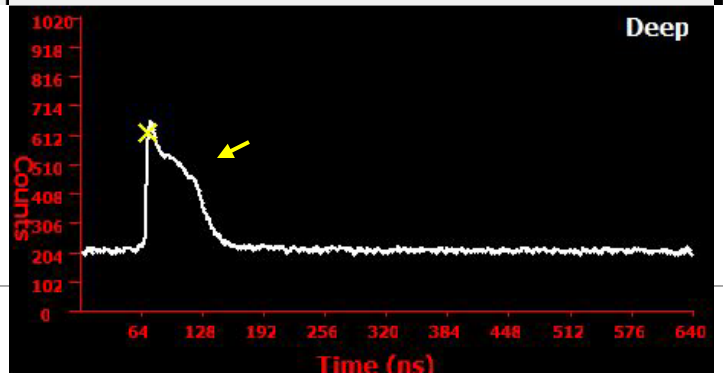


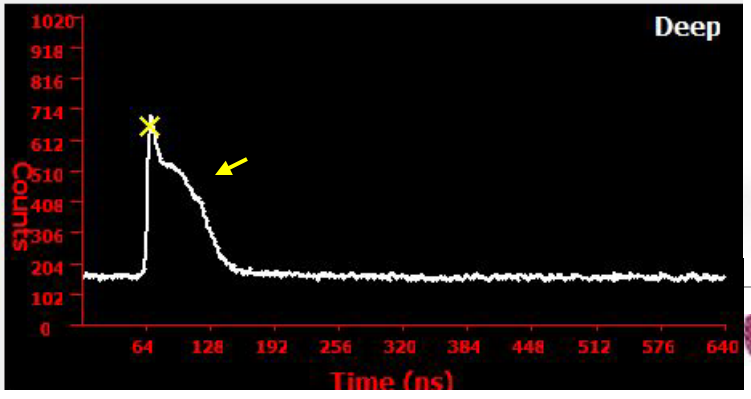












Are these bottom returns?

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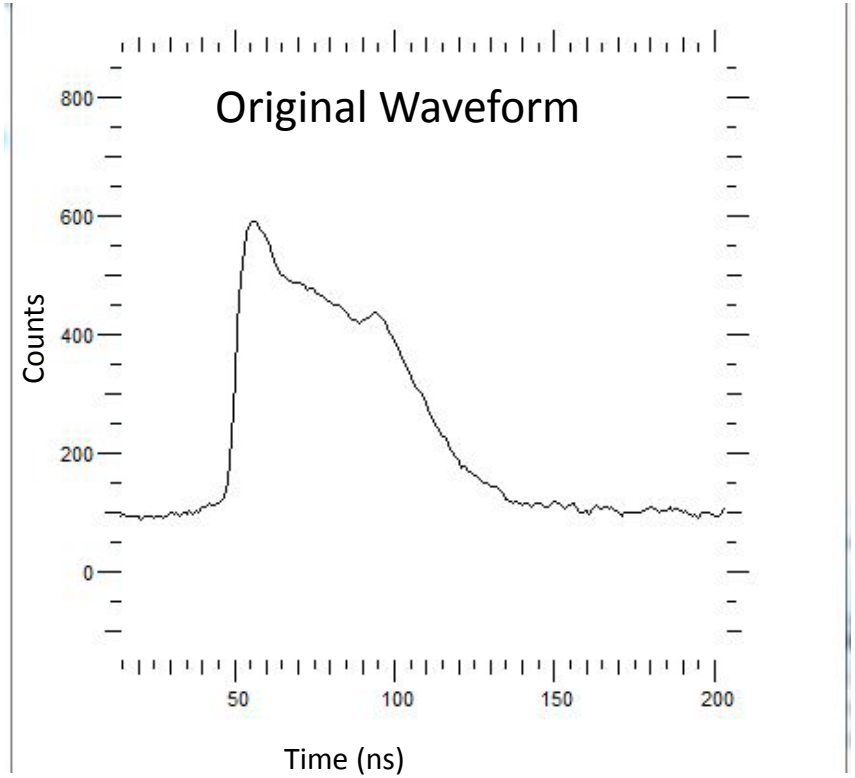
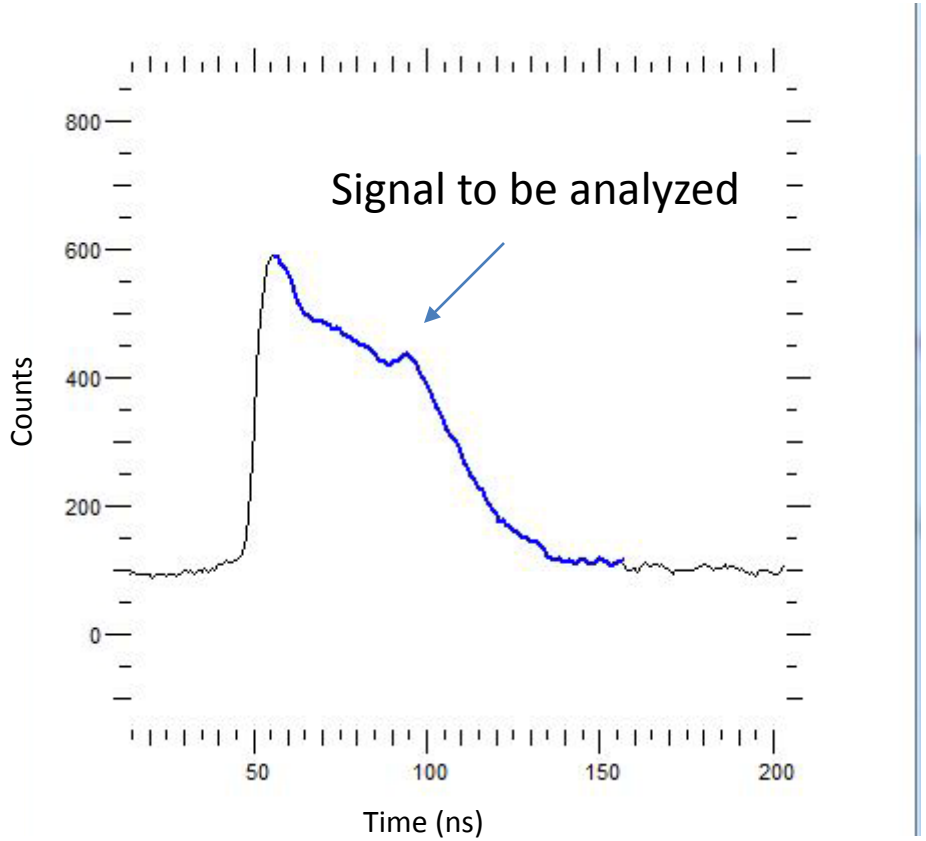
Waveform Analysis

- Process waveforms to better define inflection in bathy bottom by suppressing the effect of the turbidity in the water column.
  - Laser Decay: Estimates decay of the laser pulse due to its' system properties (typically need transmit (T0) pulse).
    - Describes the surface return laser event
  - Water Decay Factor: Estimate decay of the laser signal as it traverses through the water column
    - Exponential decay of the backscatter from within the water column.
  - AGC: use to equalize returns with depth so effect of near surface water column backscatter can be minimized.

Waveform Analysis

- Select deep channel
- Extract part of the signal from peak of surface return to noise level in waveform
- Scale waveform and remove any bias.





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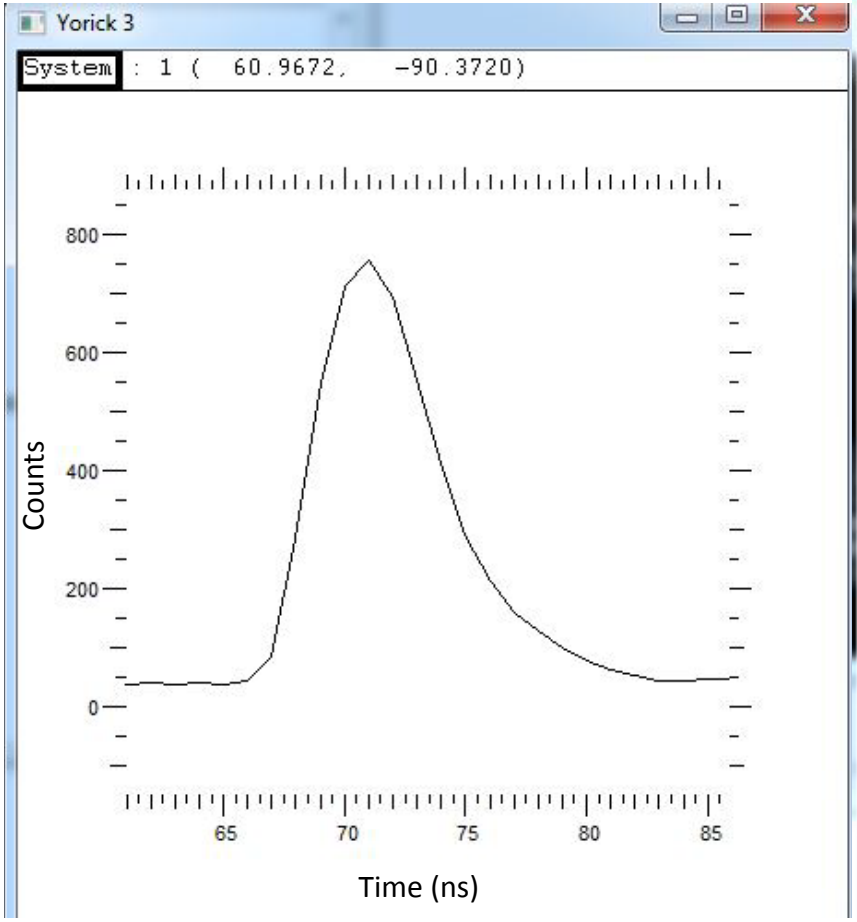
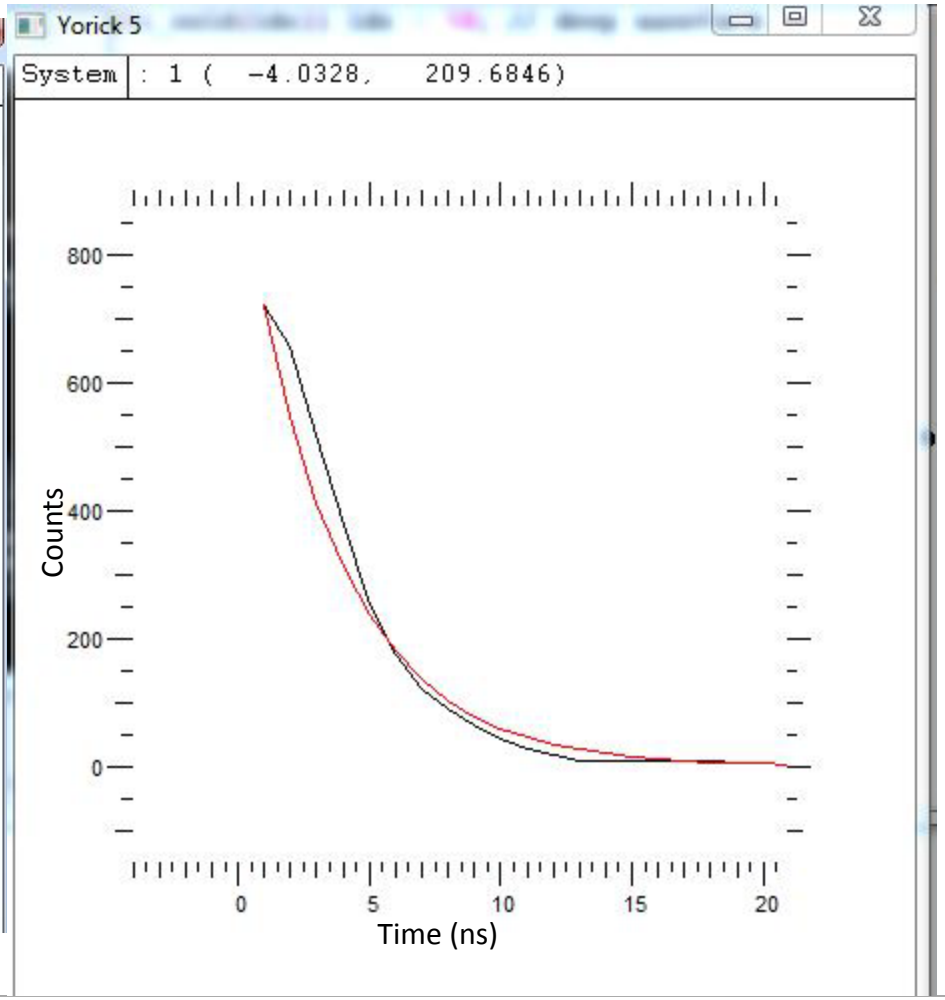
Estimating Laser Decay

Laser decay estimated from a sample “shallow” waveform acquired on the Sunshine Skyway (Bridge)





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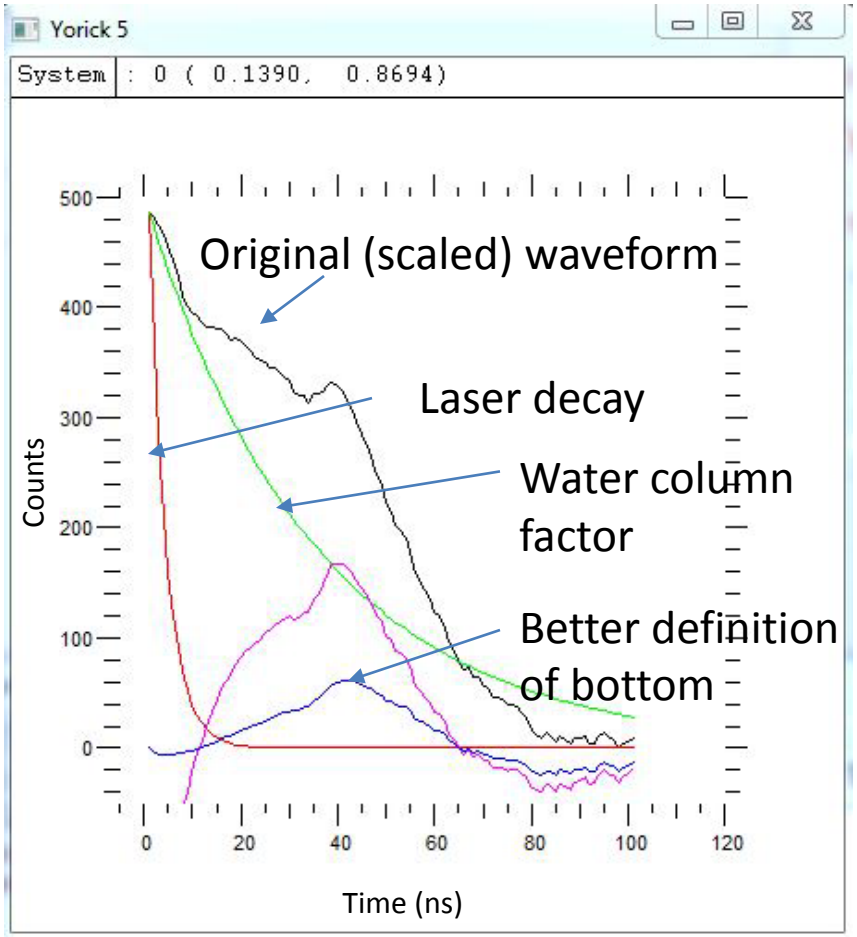
Waveform Analysis



- Subtracting exponential laser decay (red) and exponential water decay (green) results in the magenta waveform.
- Applying AGC equalizer results in blue waveform.
- Inflection in the blue waveform is possibly the bottom.

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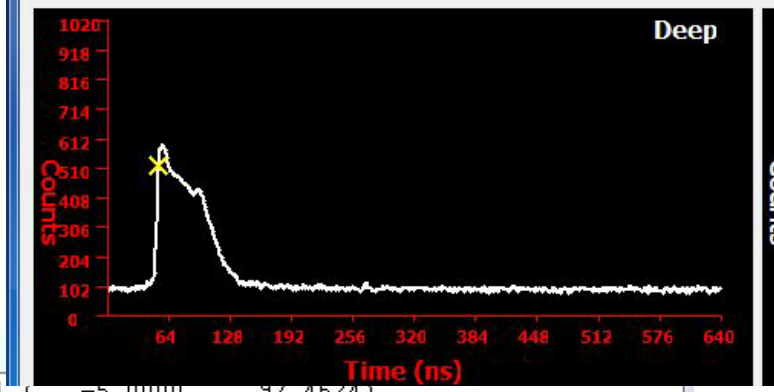
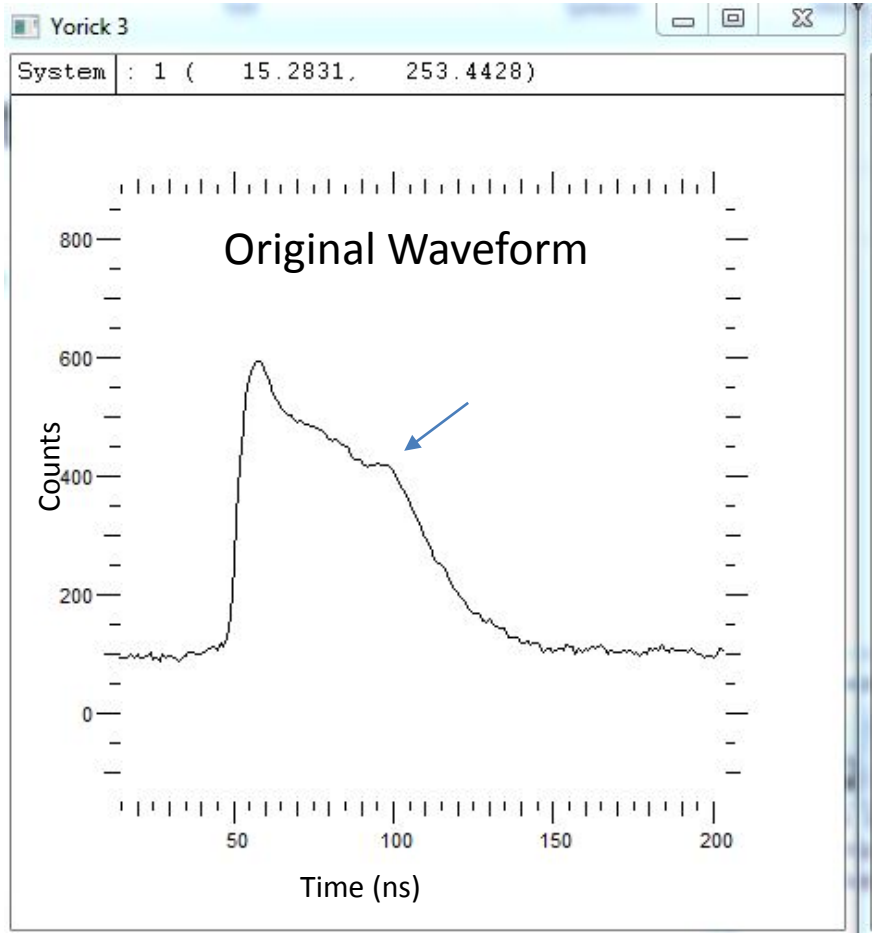
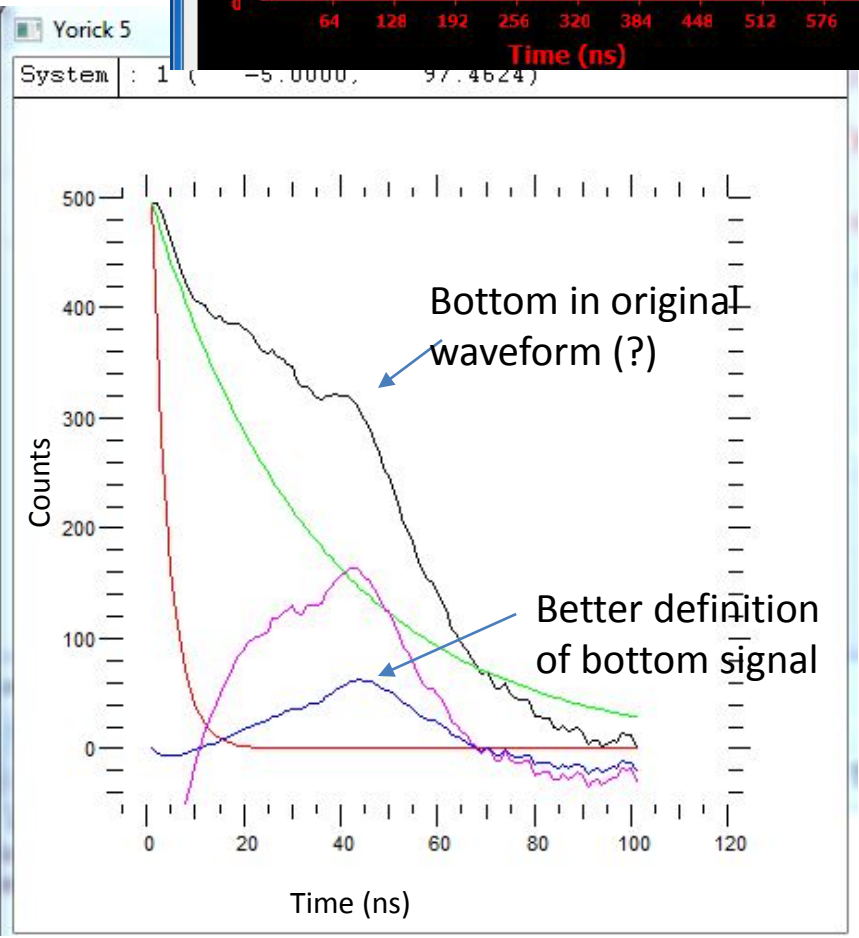
Analysis – Wf 4







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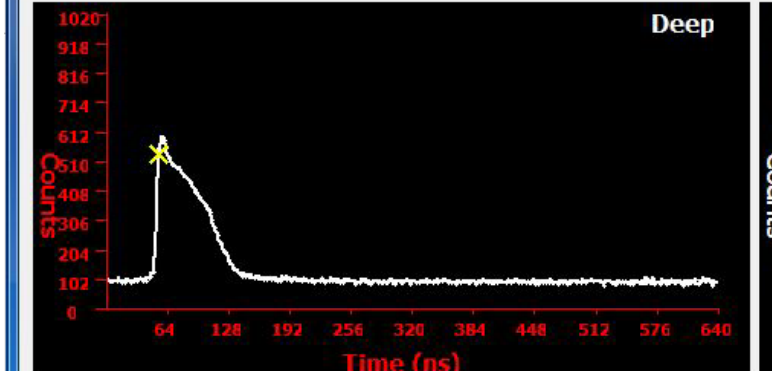
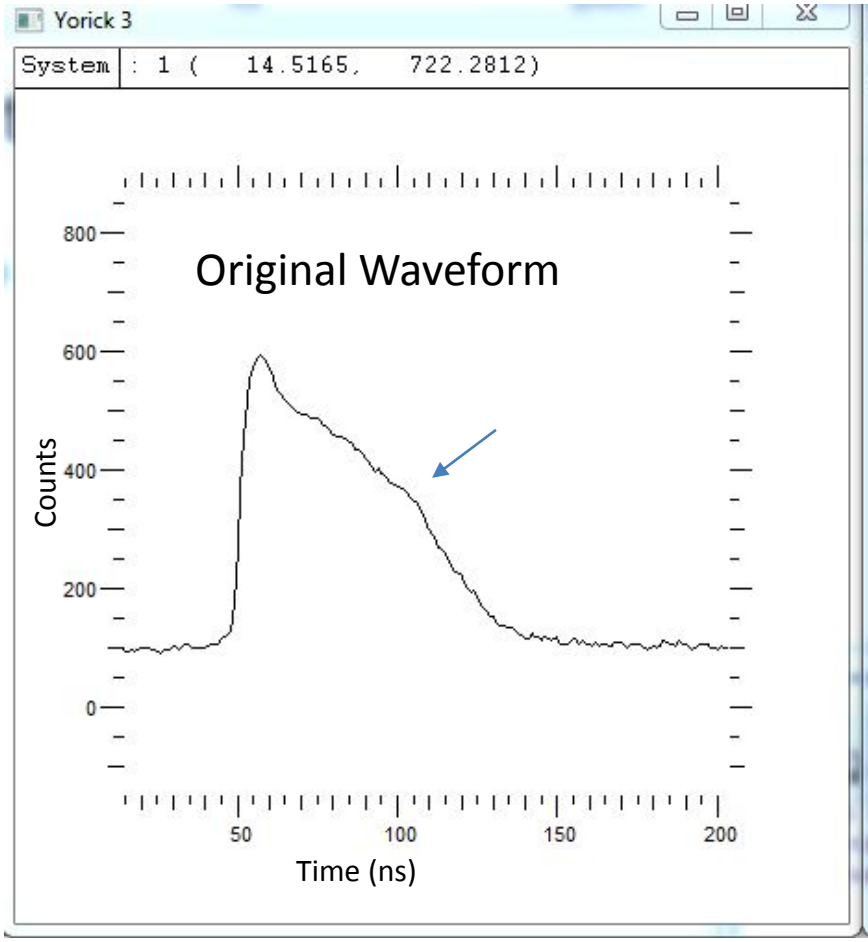
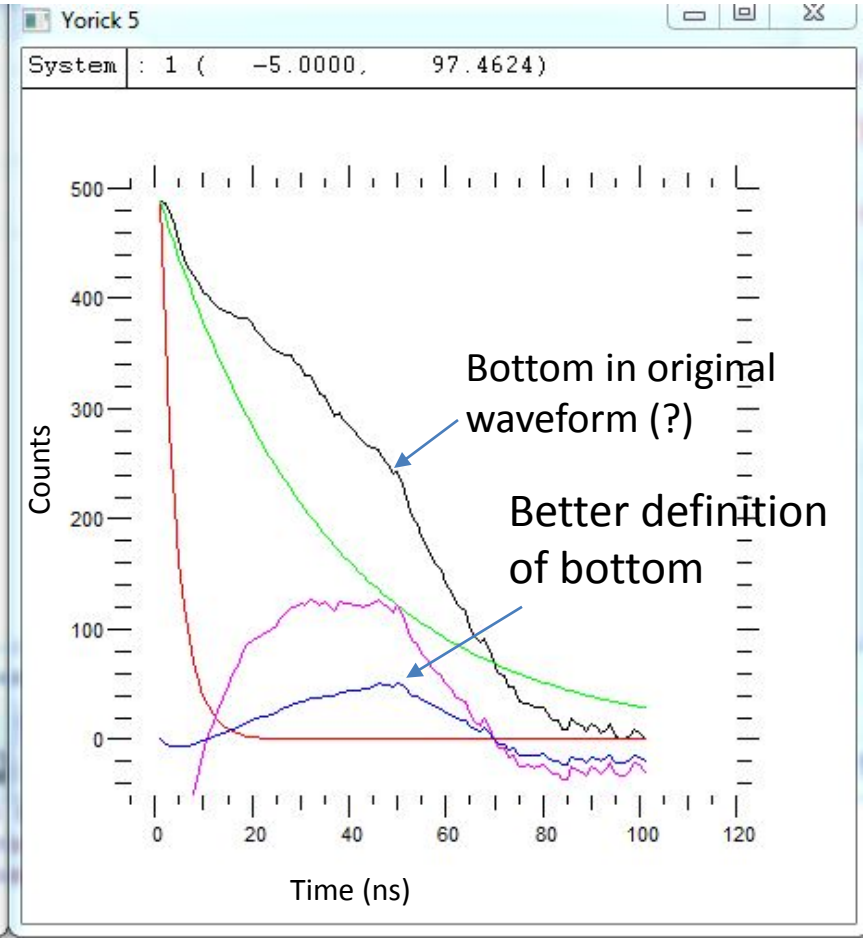
Analysis – Wf 5







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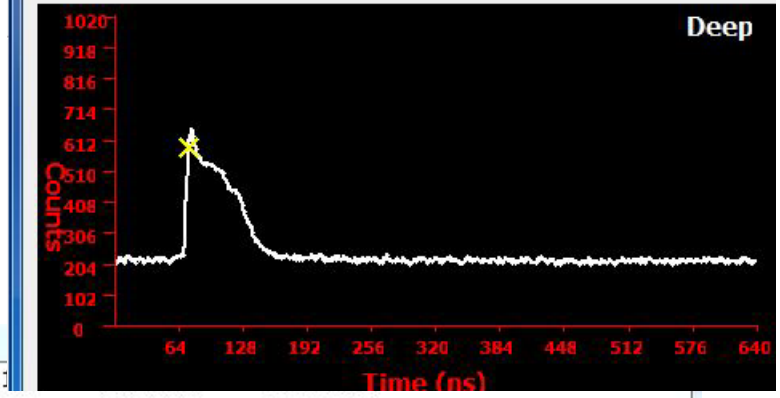
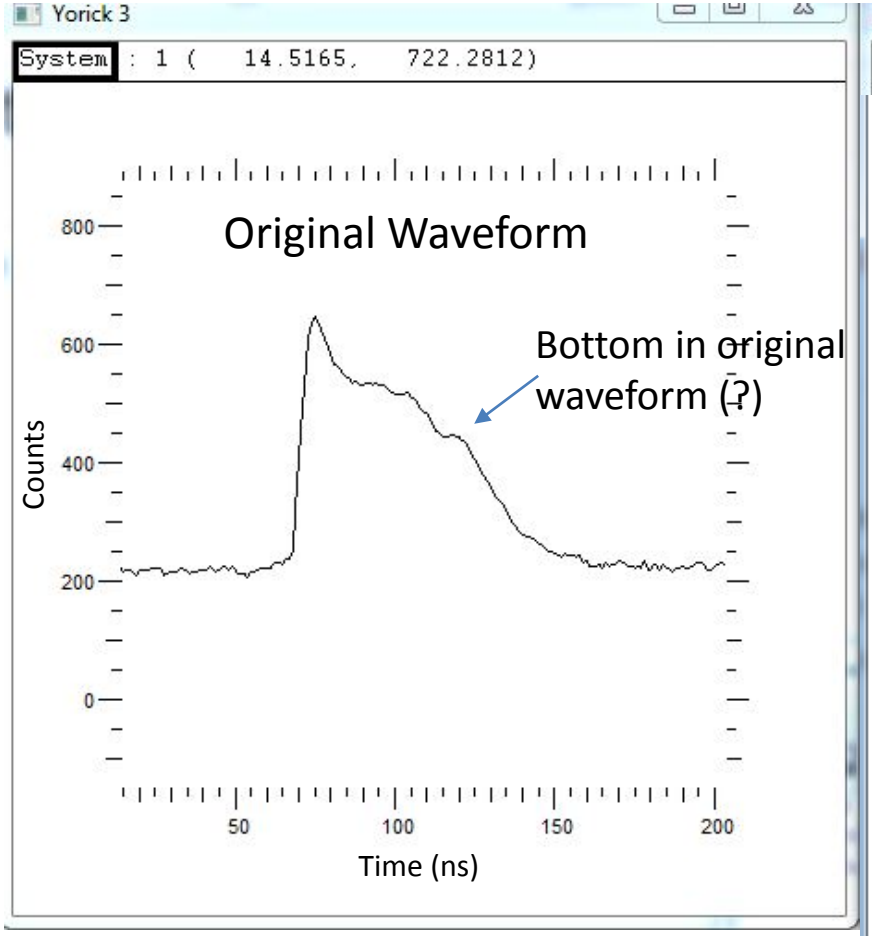
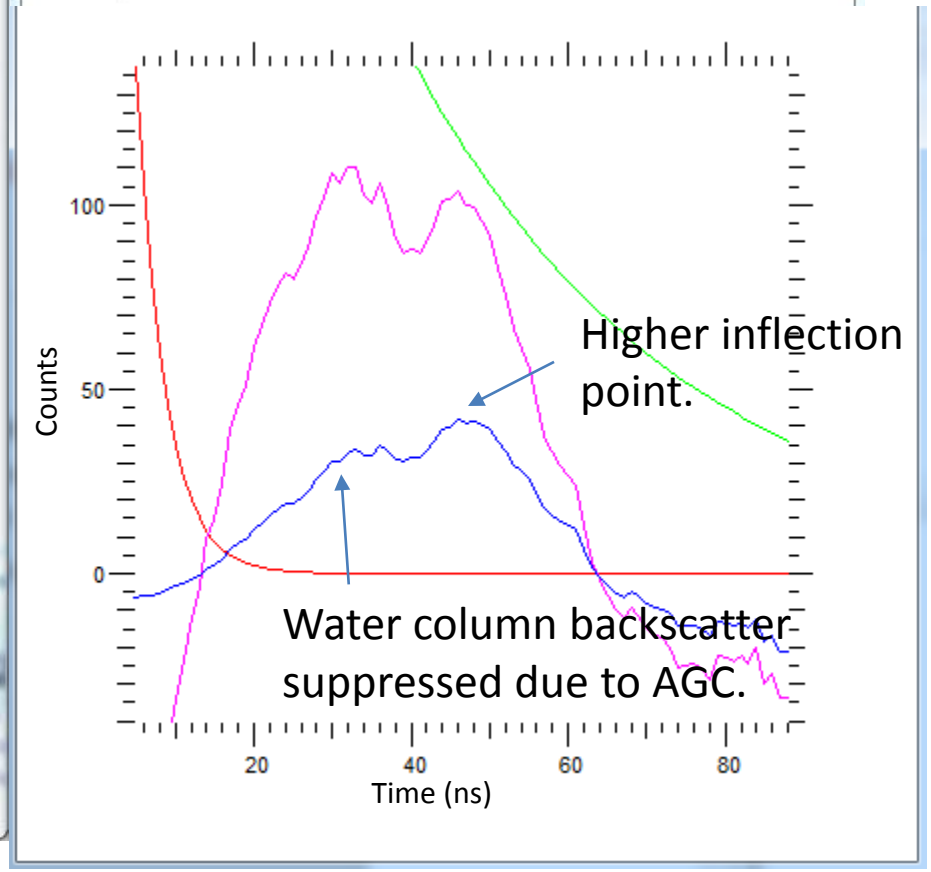
Analysis – Wf 7







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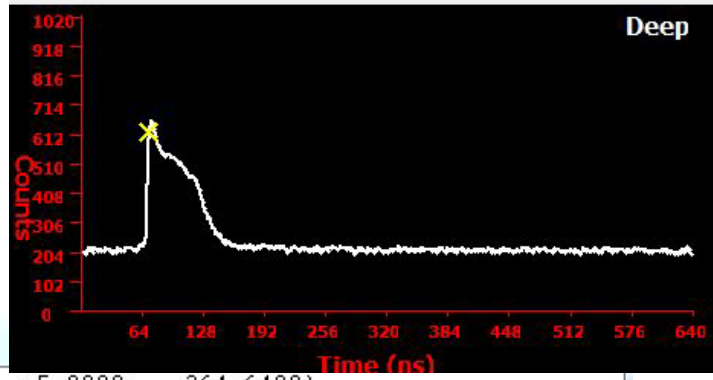
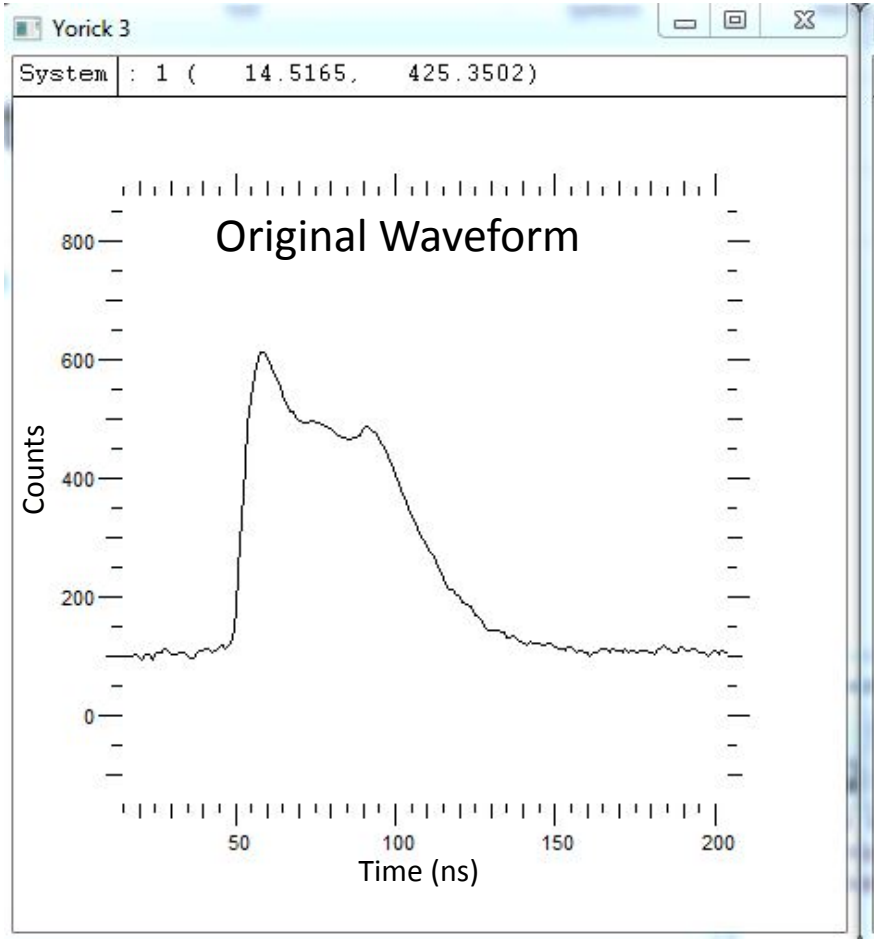
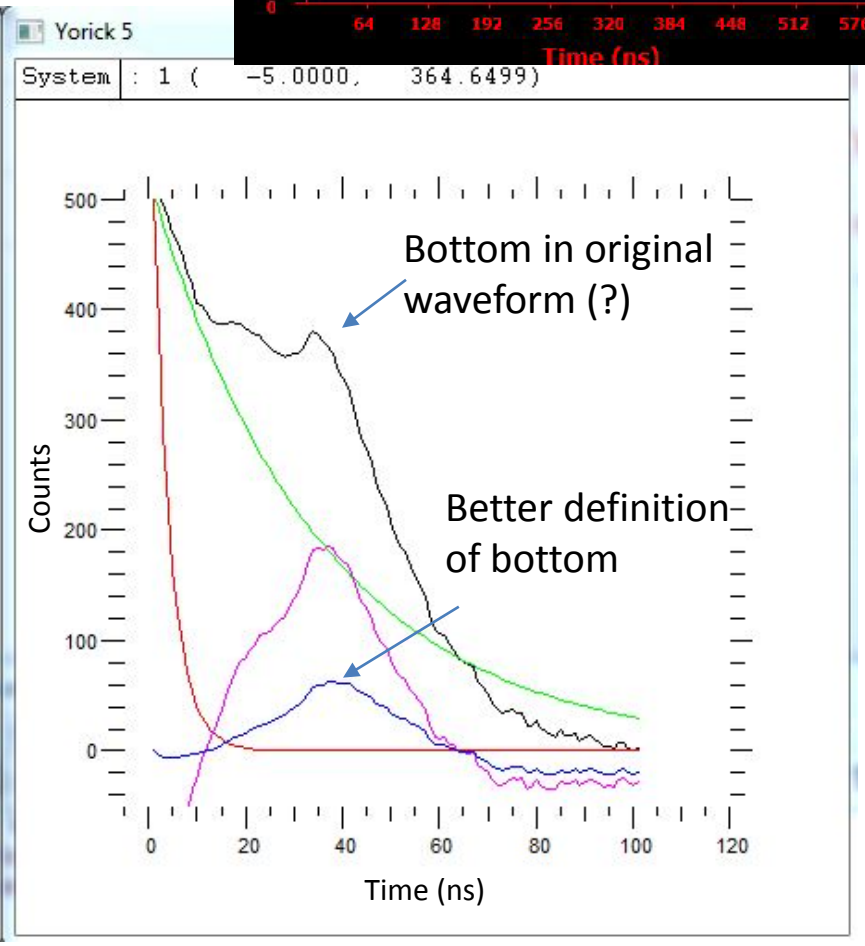
Analysis Wf – 11







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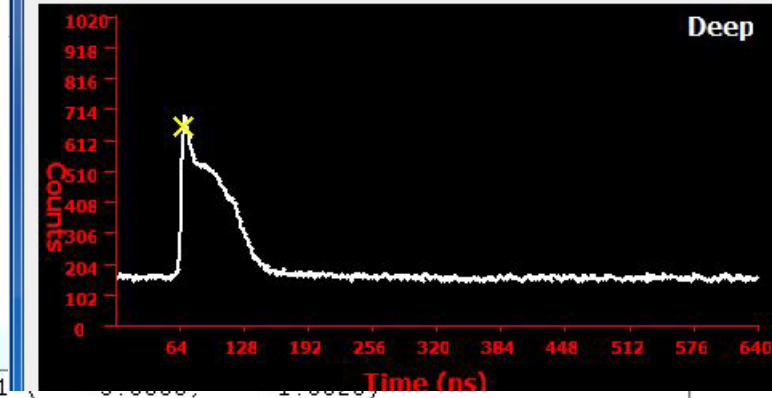
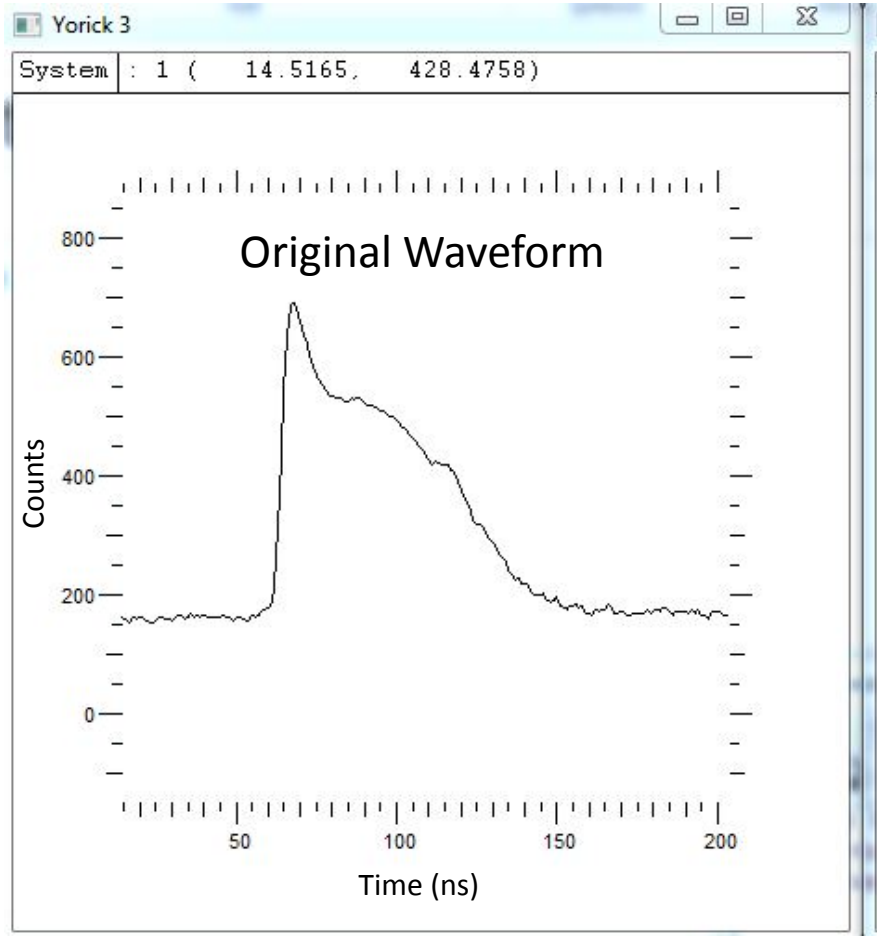
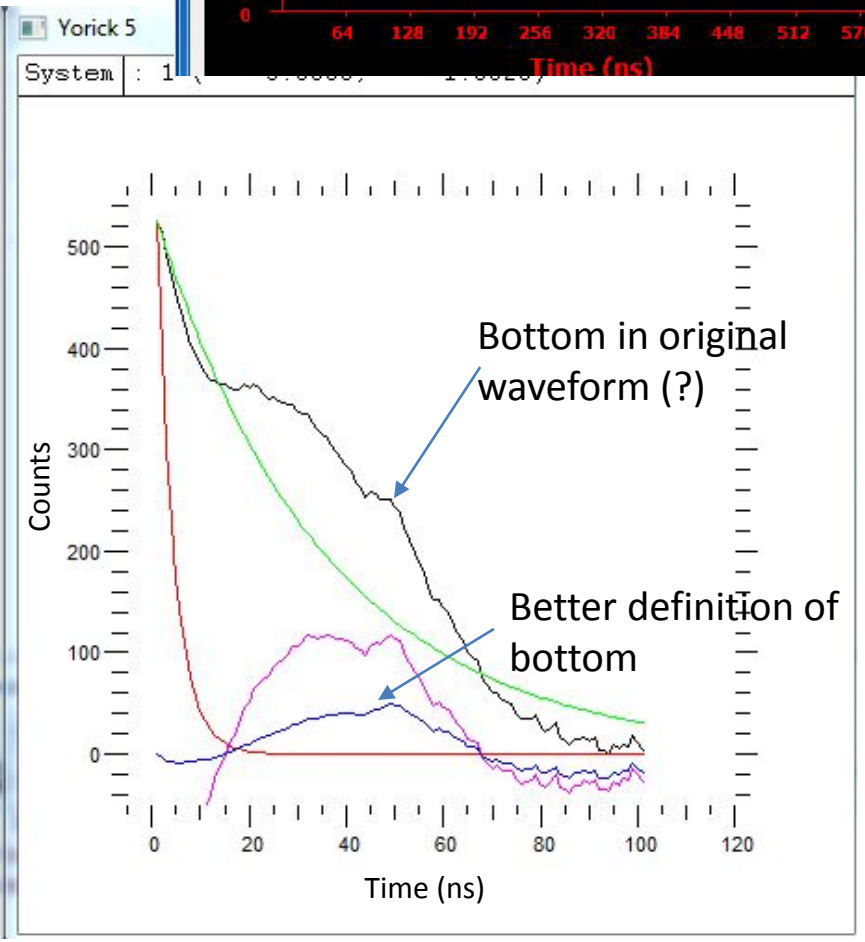
Analysis – Wf 13







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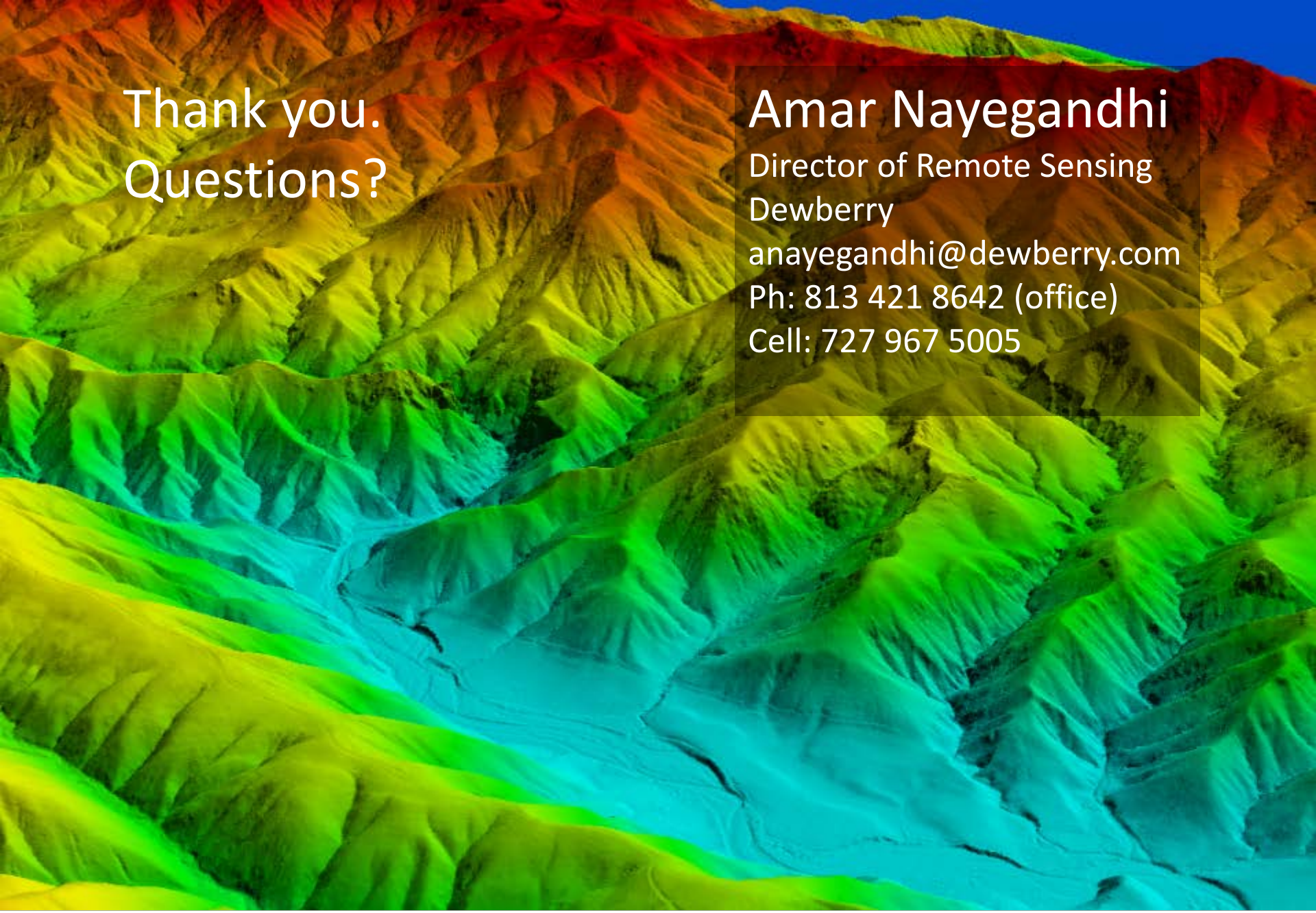
Conclusion and Future Work

- Successful pilot project in Tampa Bay
  - 65% coverage
- Turbidity is always an issue
- Investigating waveforms in turbid water
  - Method discussed to suppress effect of turbidity in the water column is promising
  - Next step is to apply this technique to a large area and use bottom detection algorithms to determine ranges that will result in a true bottom return.



Thank you.
Questions?

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