Fluorescence spikiness is real, and useful.

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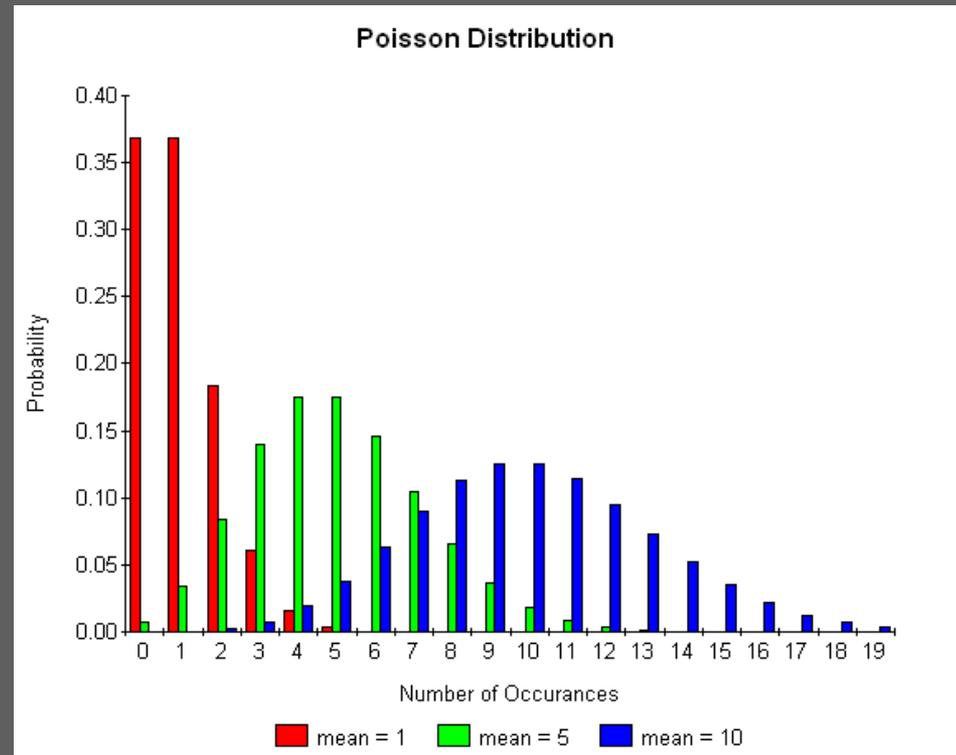
[2] School of Mathematical Sciences, University of Technology Sydney

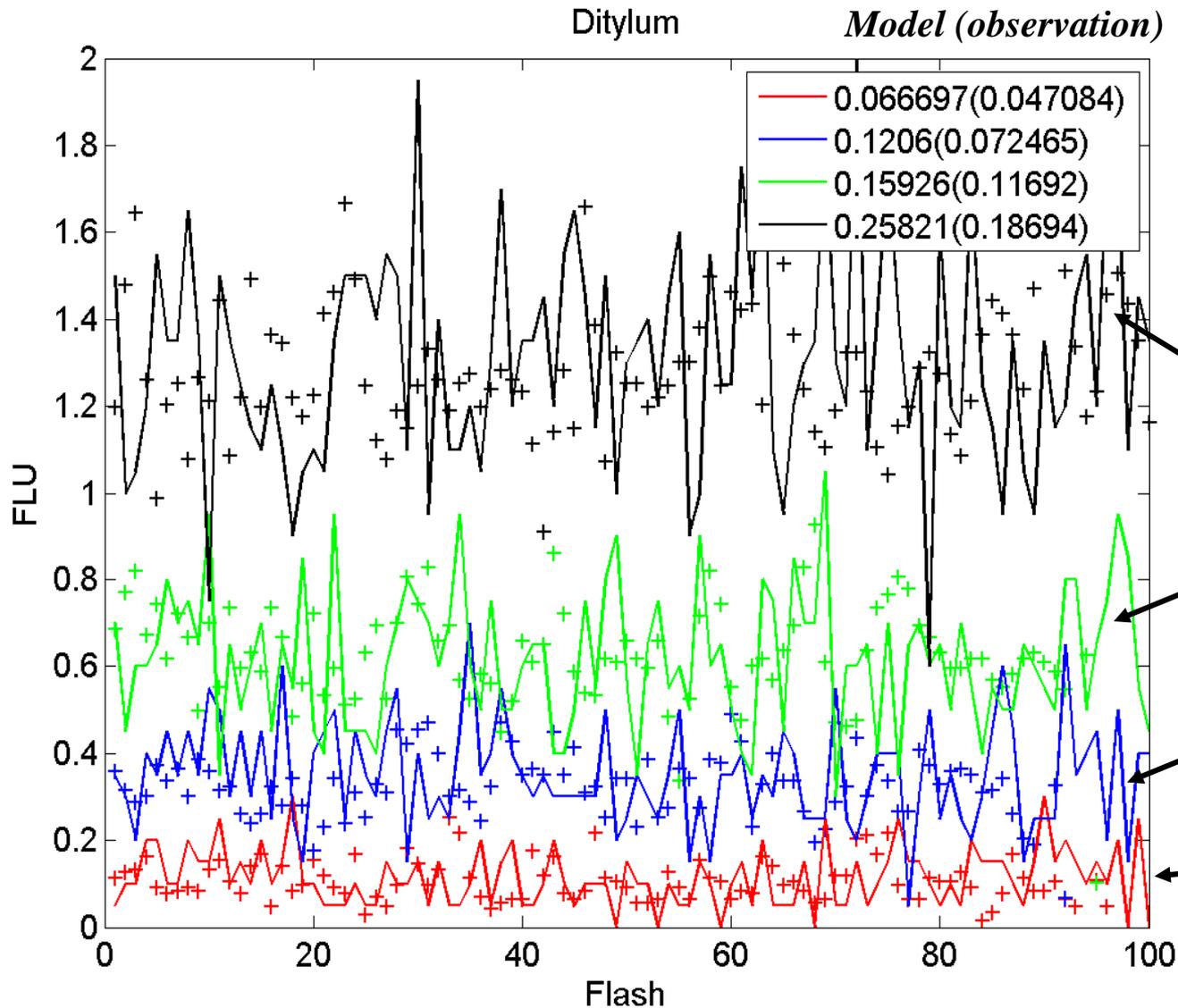[Work done by Bojana Manojlovic as part of a UTS honours project.]

Poisson distribution

- *Manufacturer states the WQM has a sample volume of 1 mL.*
- *NRS counts show biovolume (and hence FLU) is often dominated by cells with a concentration of less than 1 per mL.*
- *Is sub-sampling the source of FLU spikiness?*

- *Poisson distribution describes the probability of an occurrence given a mean probability of a given number of events occurring in a fixed interval of time and/or space if these events occur with a known average rate and independently of the time since the last event.*

Variability in laboratory experiments.

10 fold increase in chl, but 4 fold in std. dev.

80 cell mL^{-1}

40 cell mL^{-1}

20 cell mL^{-1}

8 cell mL^{-1}

Ditylum

Observation standard dev.

+	0.047084
+	0.072465
+	0.11692
+	0.18694

Could sub-sampling explain spikiness?

Lines join 100 random samples from Poisson dist

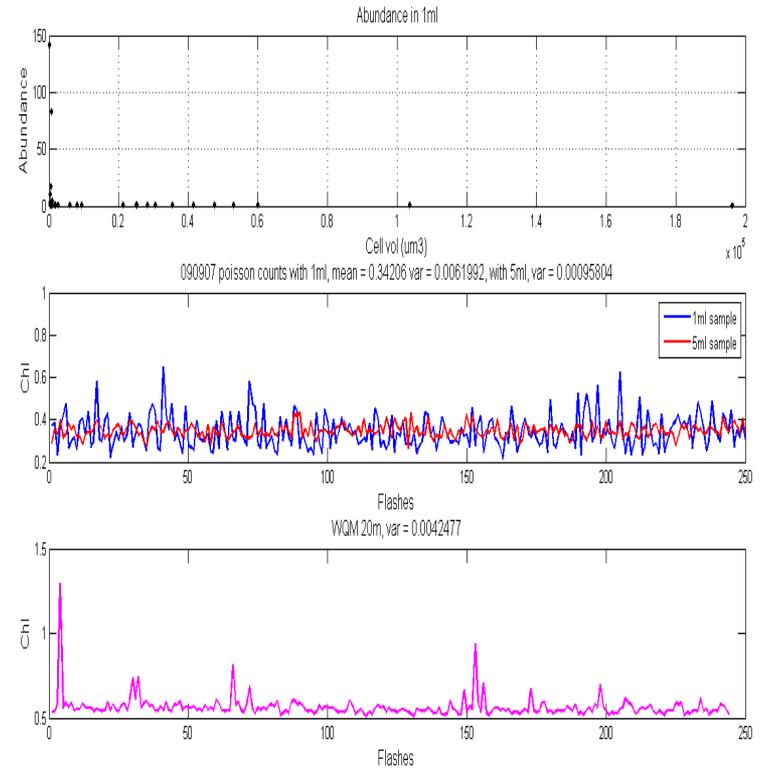80 cell mL^{-1}

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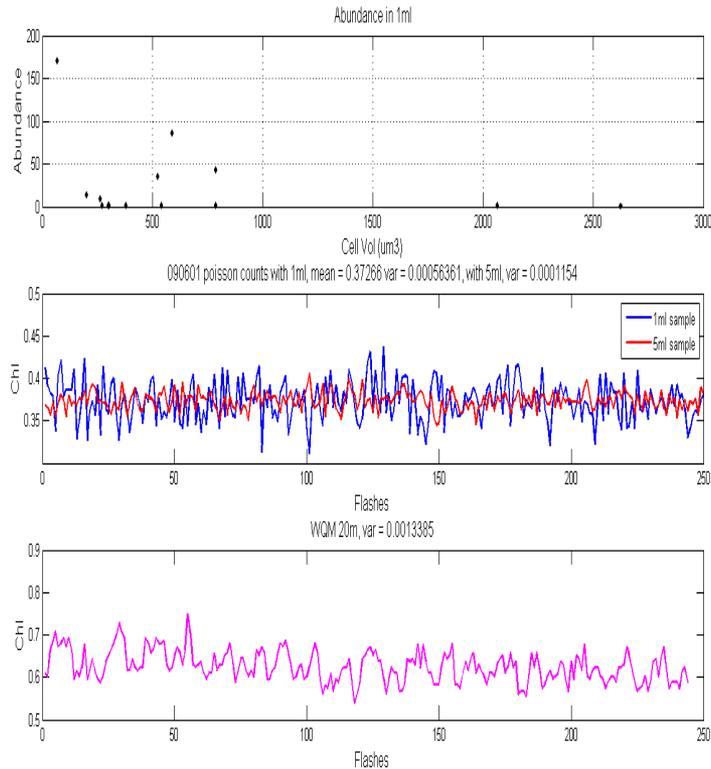
# Does WQM's 1 mL sample volume explain variance at Maria Island ?
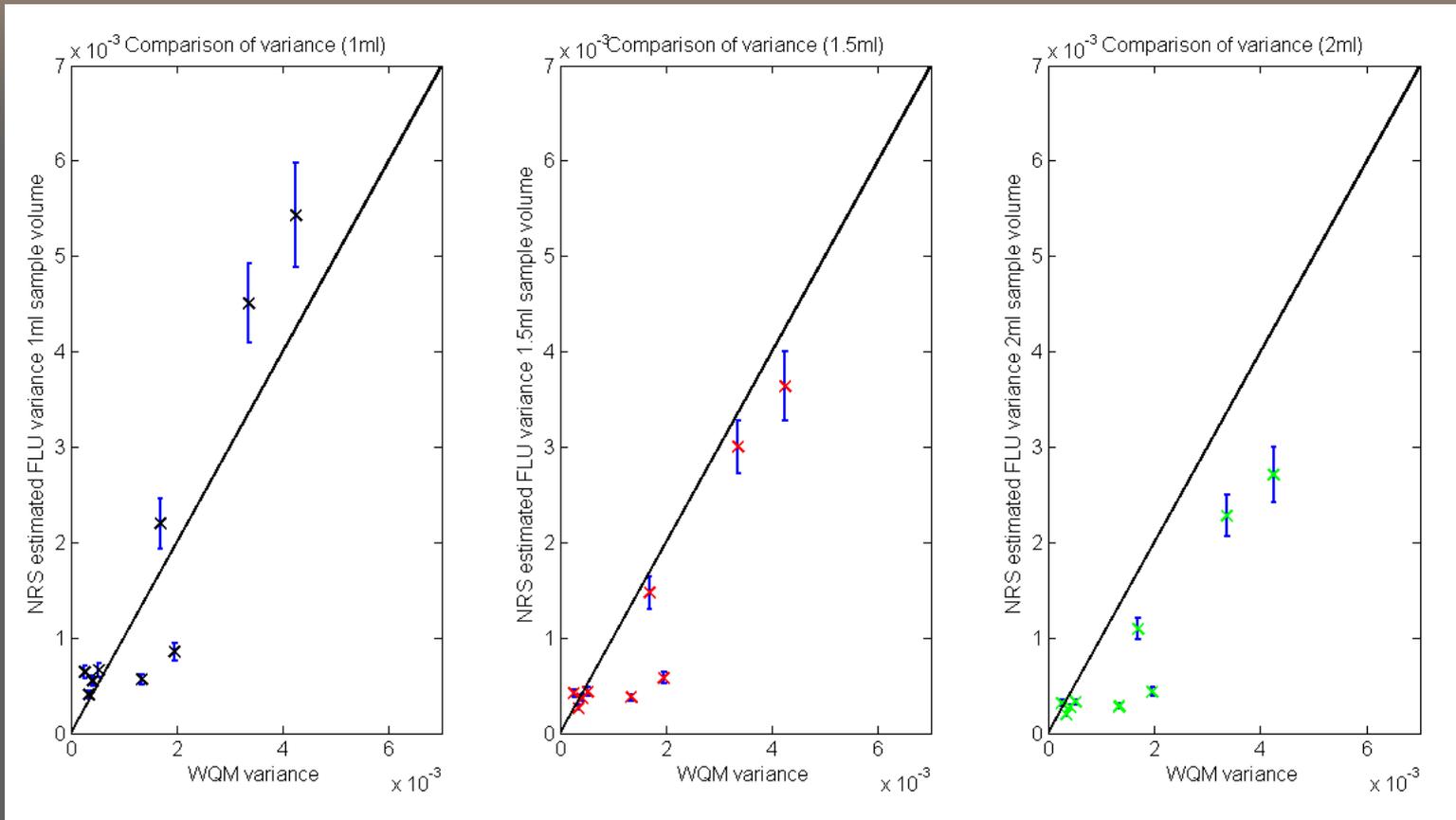
Variability of Maria Island WQM at 20 m vs. variability of the Poisson distribution from NRS phytoplankton counts. A sample volume of between 1 and 1.5 mL explains the spikiness.

What can we learn from the nature of the spikiness ?

On the left, abundance is more evenly spread across size-classes than on the right which has mainly small cells. This result in a different spikiness signal. Can we use these different signals to determine the nature of the phytoplankton community?
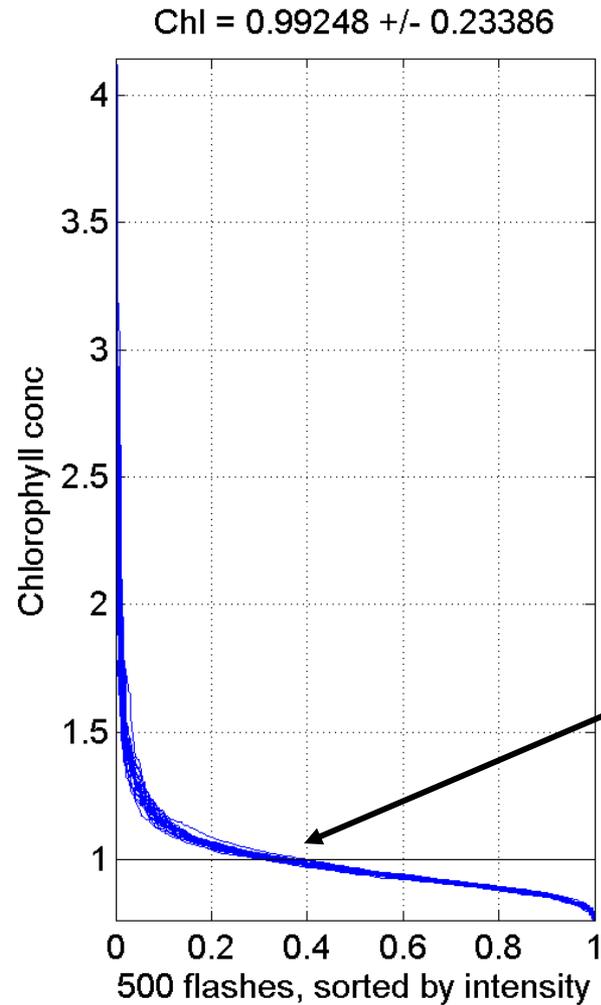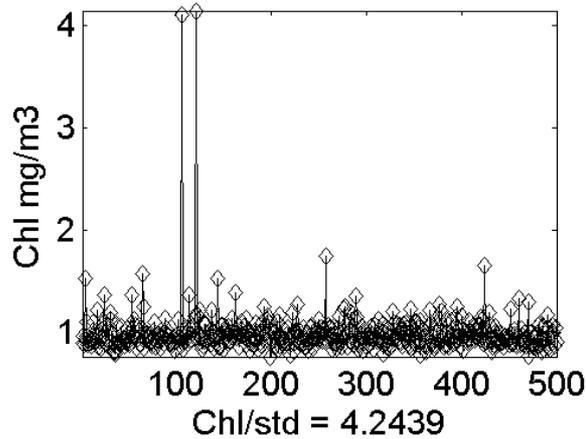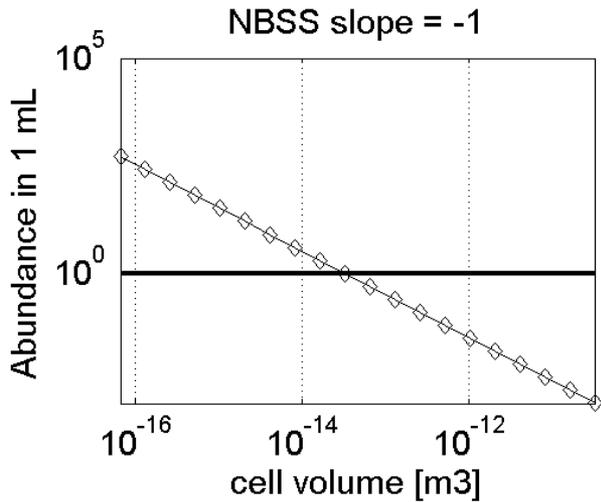
Can we predict the distribution of phytoplankton sizes from FLU spikiness?
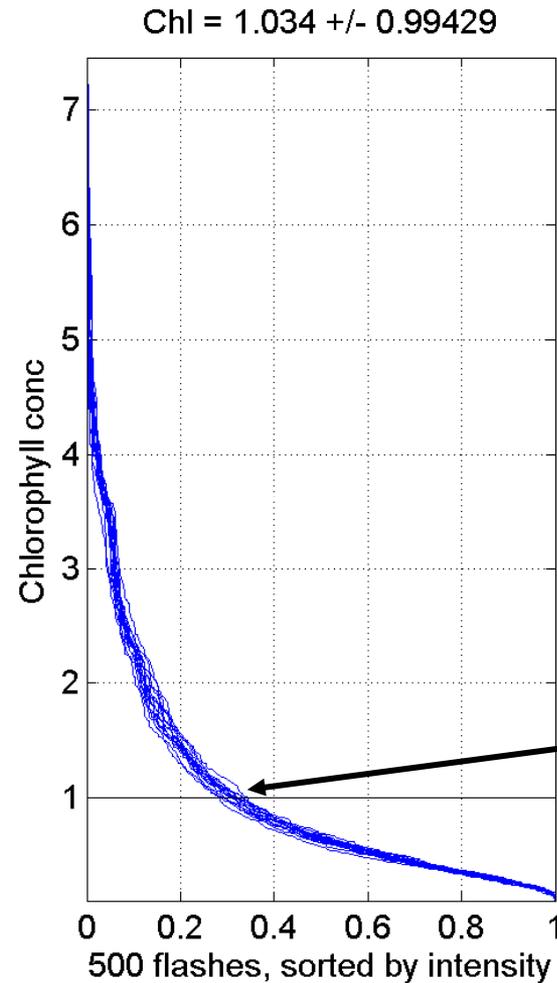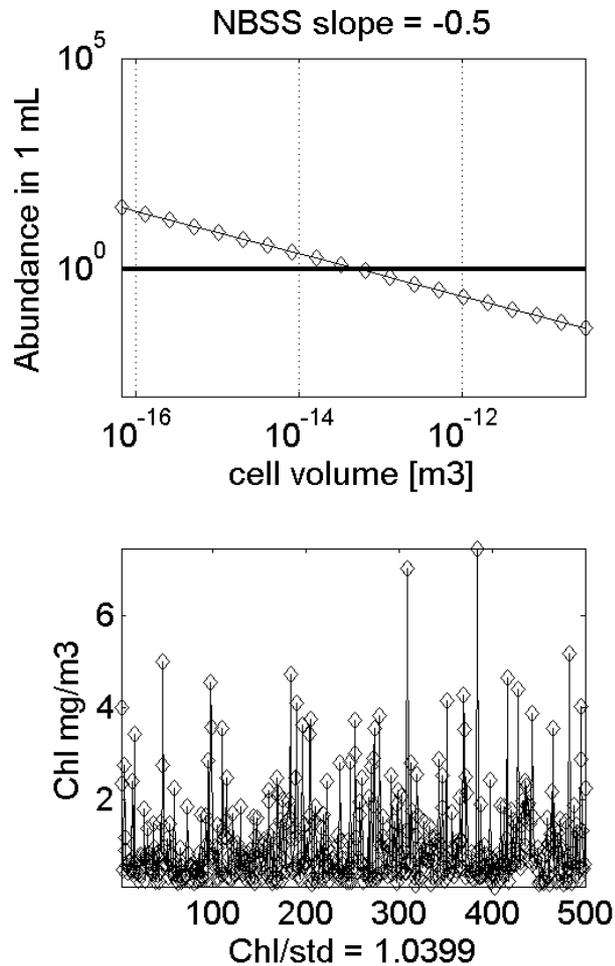
Shallow slope results in many spikes.
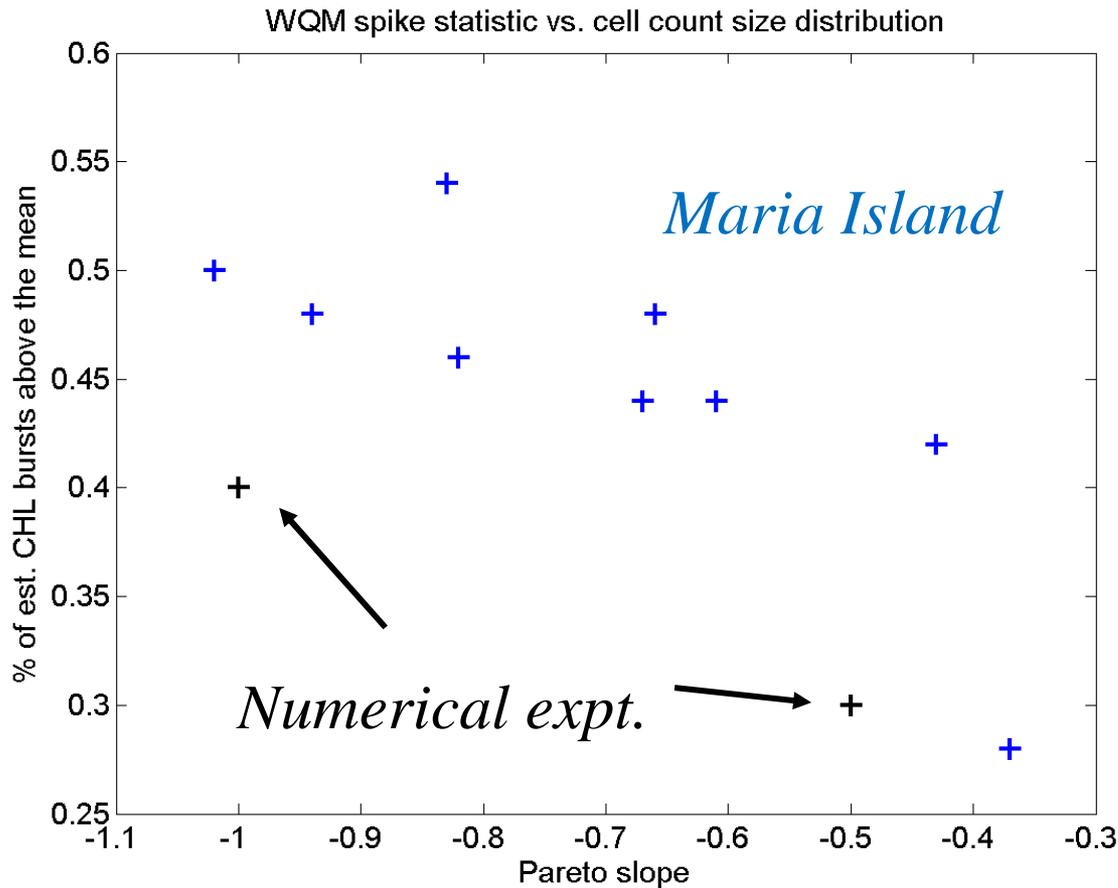
*-0.5 slope: **30 %** of flashes above mean*

Now steepen the slope (less big cells)

Steep slope results in very large spikes.

*-1.0 slope: **40** % of flashes above mean*

Can we predict the distribution of phytoplankton sizes from FLU spikiness?

WQM spike statistic vs. cell count size distribution

Maria Island

Numerical expt.

• *The spikiness statistic appears to be capturing the trend in size-distributions.*

• *Spikiness caused by cells occurring in approximately the range of 0.01 – 100 cell mL^{-1}, which at 1 mg Chl m^{-3} is generally nanoplankton. If the slope of the size distribution is too difficult to resolve, then fraction of nanoplankton (to picos and micros) may be a more reliably metric of size distribution.*

Future work

• *Further analysis of NRS cells counts and WQMs at 25 m to verify relationships between spikiness and phytoplankton size distribution.*

• *Apply relationships validate for Maria Island WQMs to the entire network of NRSs (and gliders, moorings etc.)*

• *Further theory is required to extract the maximum amount of information from a single pixel receiver of a large number of moving, radiation point sources with intensity decaying by an inverse square law. CSIRO is building such as system in WA – we might be able to borrow some signal processing ideas from this $2.5b project.*