Area_based_analysis

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1. Data Loading and Preprocessing

1.1 Edge Data

1.2 Surface Data

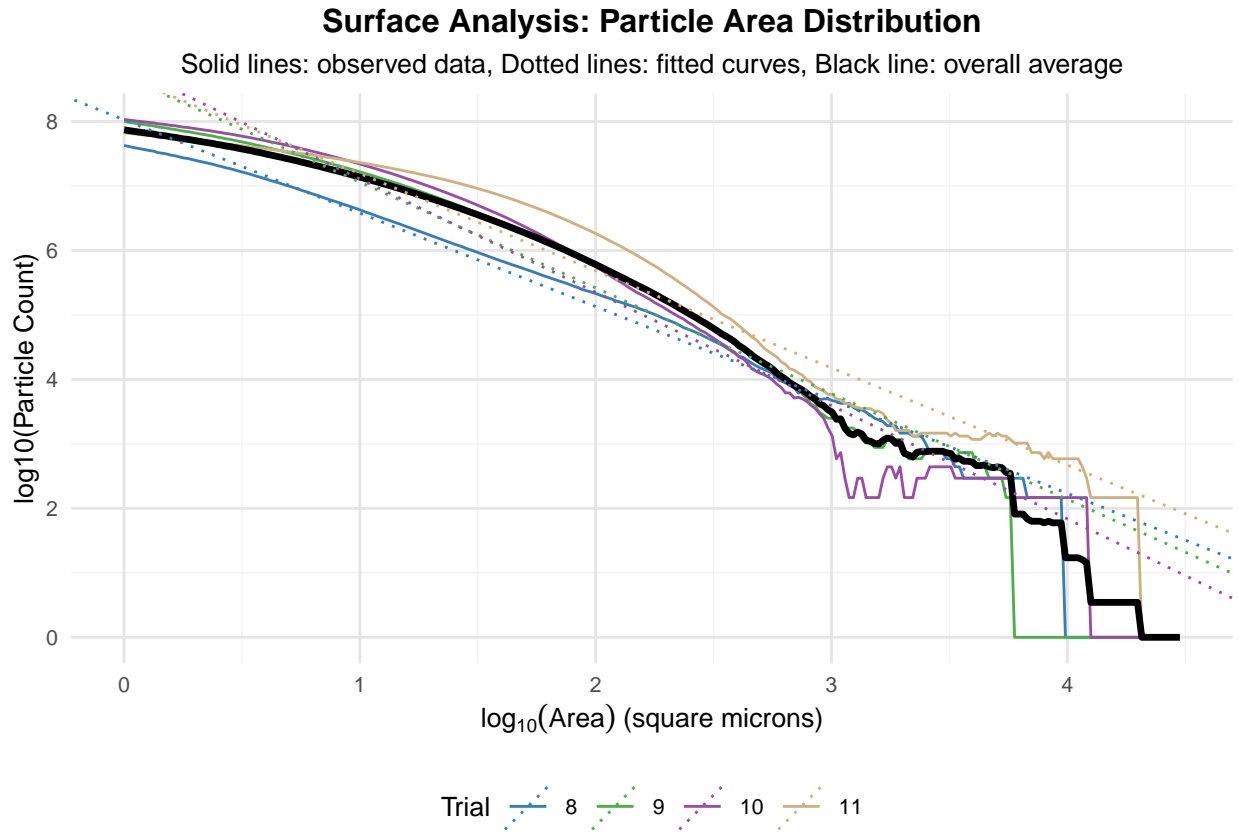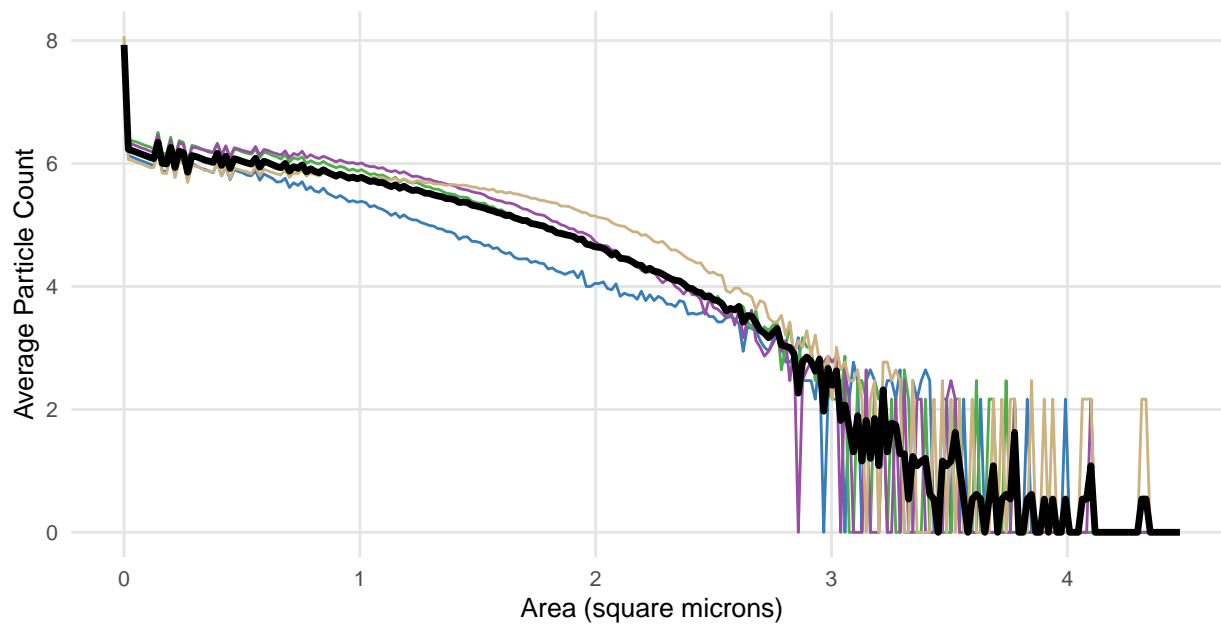### 1.3 Calibration Wafer Data

2. Surface Area Distribution Analysis

Surface Analysis: Particle Area Distribution

Solid lines: observed data, Dotted lines: fitted curves, Black line: overall average

Table 1: PCL and Slope Statistics for Surface Analysis

Trial	slope	intercept	PCL
8	-1.448641	8.027225	347704.0
9	-1.639517	8.699482	202359.9
10	-1.757251	8.866243	111050.4
11	-1.507035	8.699415	592291.9

Surface Analysis: Binned Particle Size Distribution

Particles binned by area thresholds
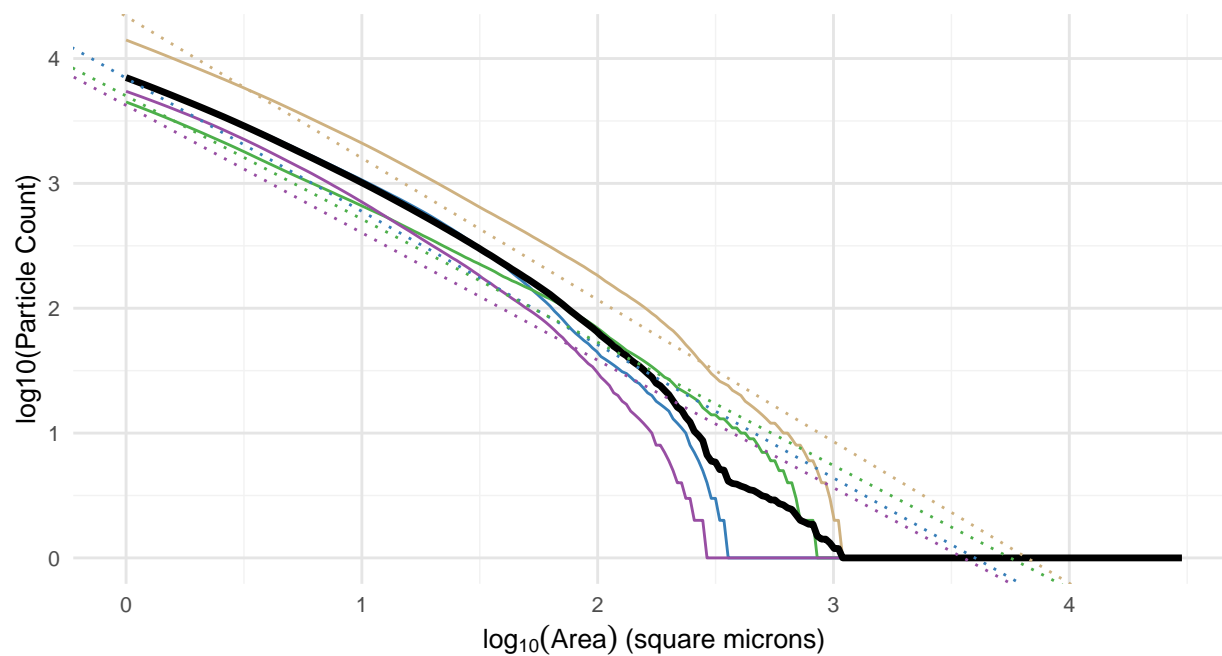Black line: overall average

3. Edge Area Distribution Analysis

Edge Analysis: Particle Area Distribution

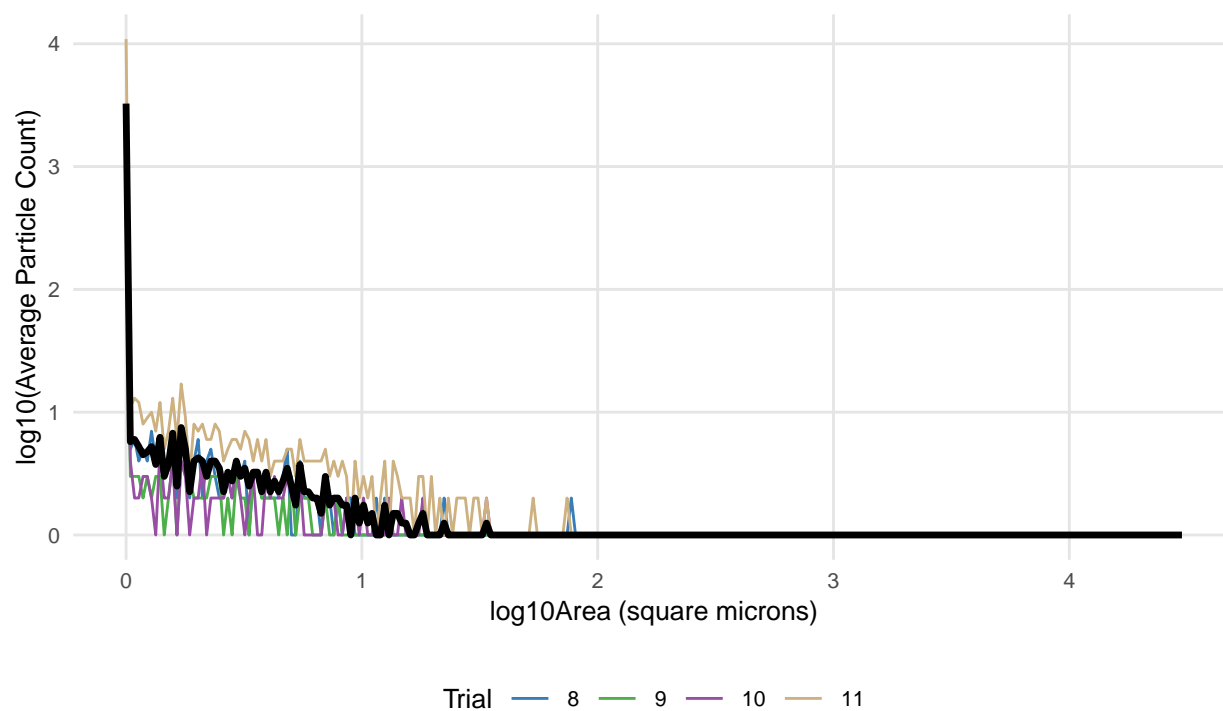Solid lines: observed data, Dotted lines: fitted curves, Black line: overall average

Table 2: Edge Analysis Summary Statistics

Trial	PCL	slope
8	3983.212	–1.0674936
9	5625.376	–0.9868734
10	3554.201	–1.0209514
11	6622.308	–1.1352296

Edge Analysis: Binned Particle Size Distribution

Particles binned by logarithmic area thresholds
Black line: overall average

4. Calibration Wafer Analysis

Calibration Wafer Analysis: Particle Area Distribution

Solid lines: observed data, Dotted lines: fitted curves, Black line: overall average
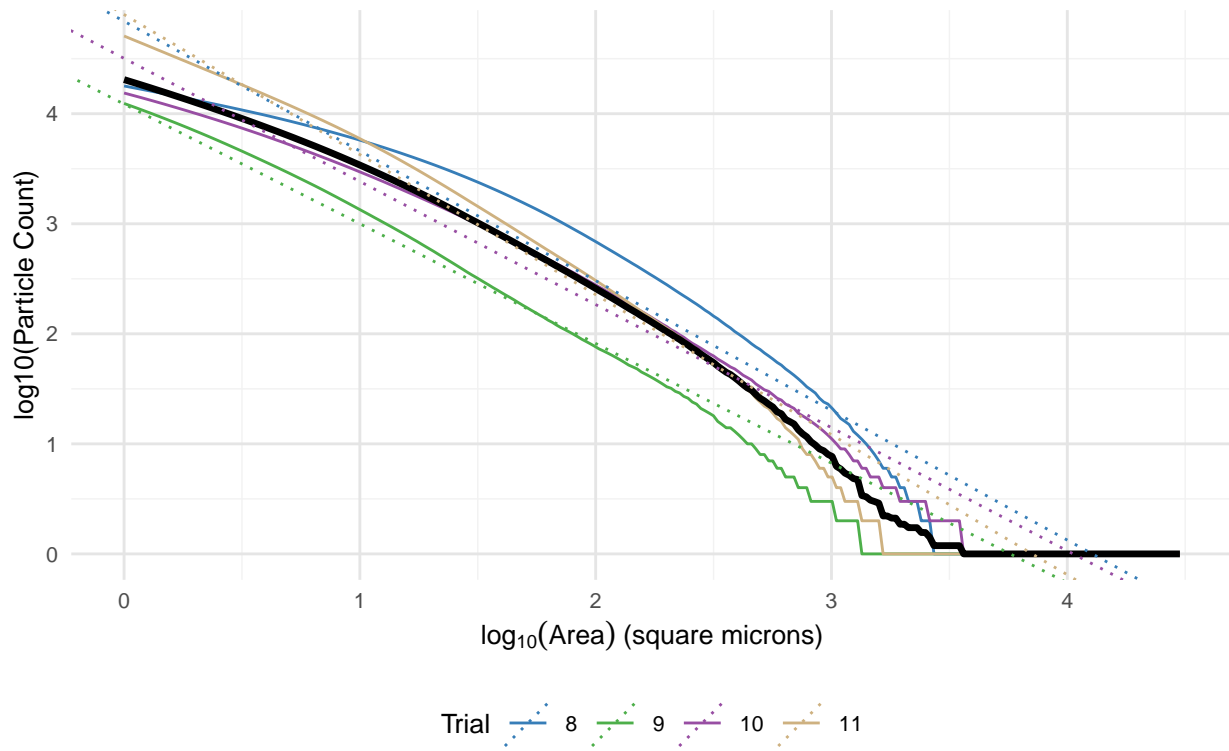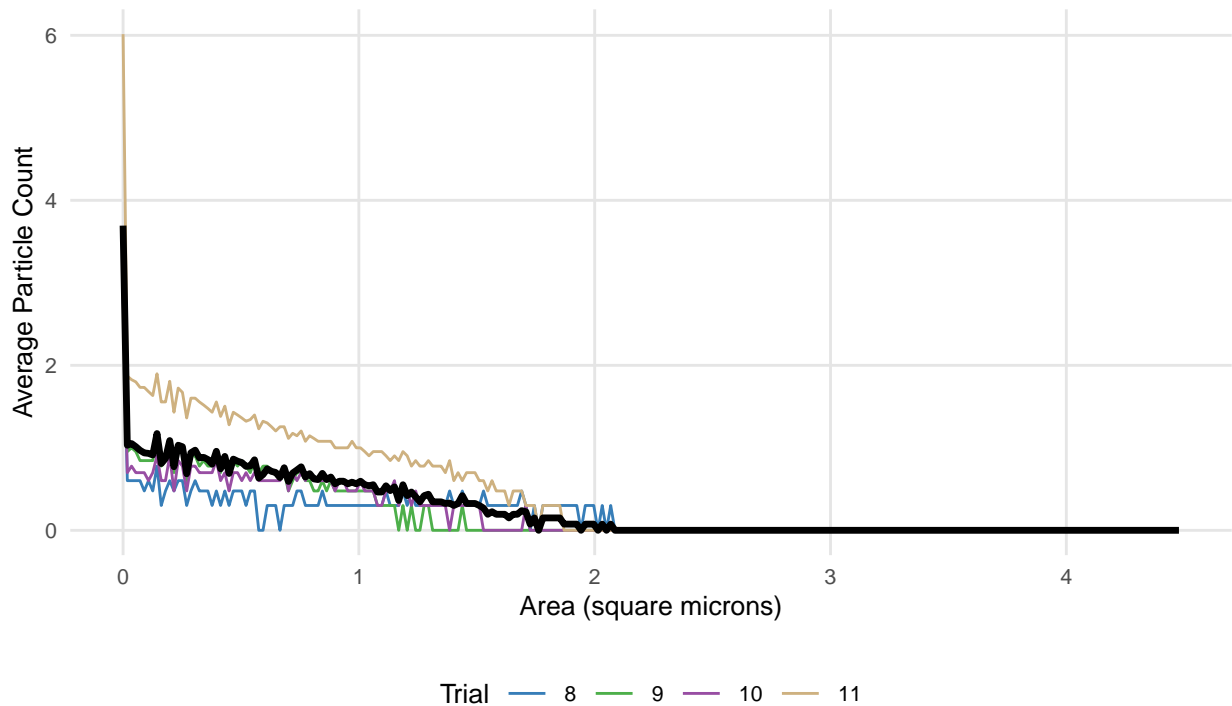

Table 3: Calibration Wafer Analysis Summary Statistics

Trial	slope	intercept	PCL
8	-1.178606	4.839839	12776.409
9	-1.087750	4.087671	5726.823
10	-1.118686	4.502859	10595.725
11	-1.272620	4.901119	7099.086

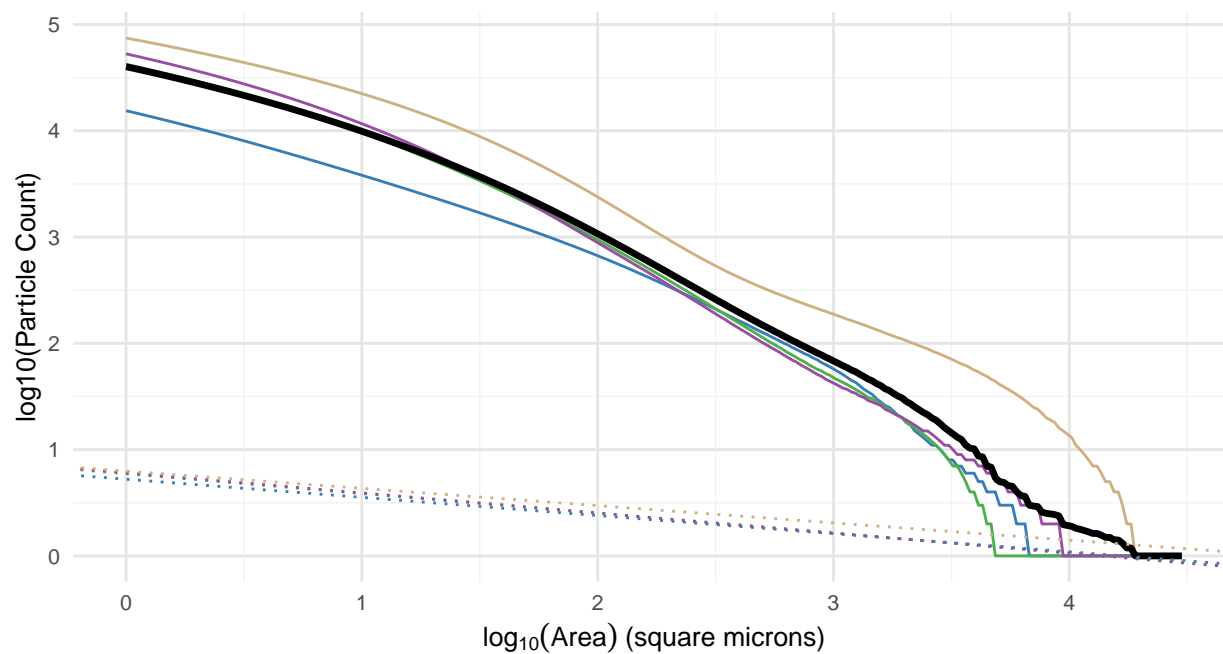# Calibration Wafer Analysis: Binned Particle Size Distribution

Particles binned by logarithmic area thresholds
Black line: overall average

5. Edge Model Analysis

Edge Model Analysis: Particle Area Distribution

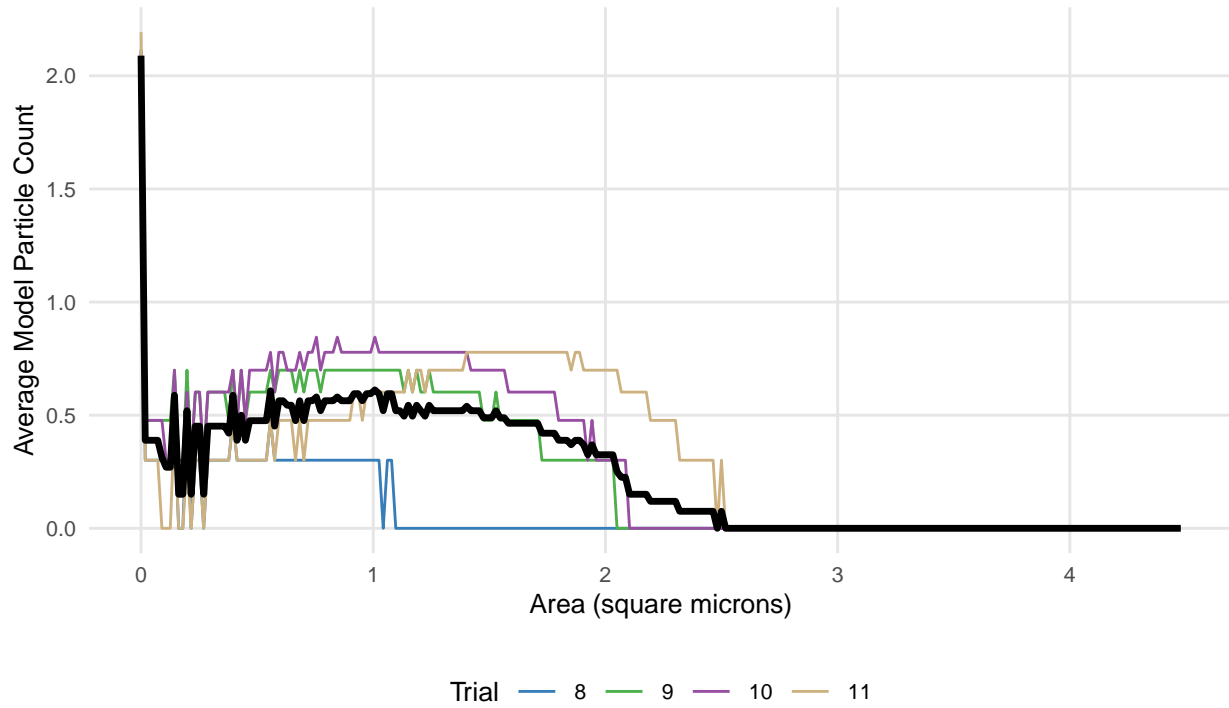Solid lines: modeled data, Dotted lines: fitted curves, Black line: overall average

Table 4: Edge Model Analysis Summary Statistics

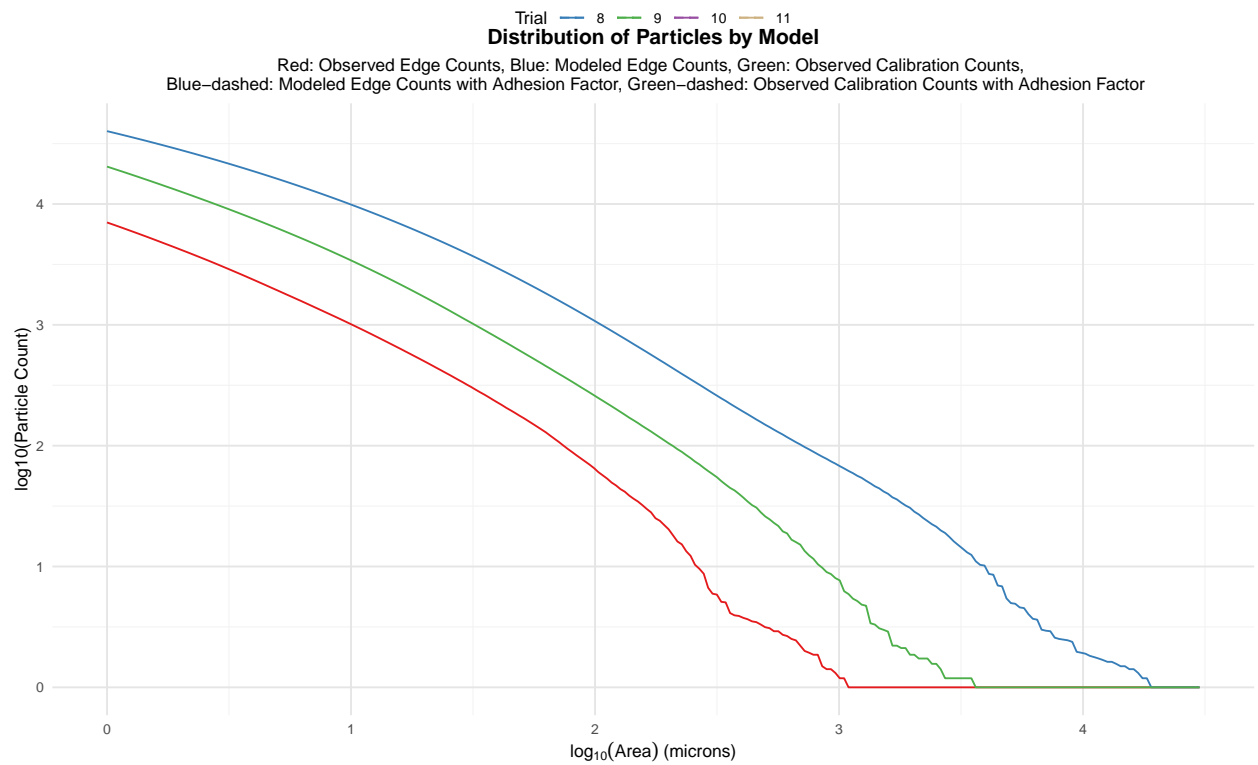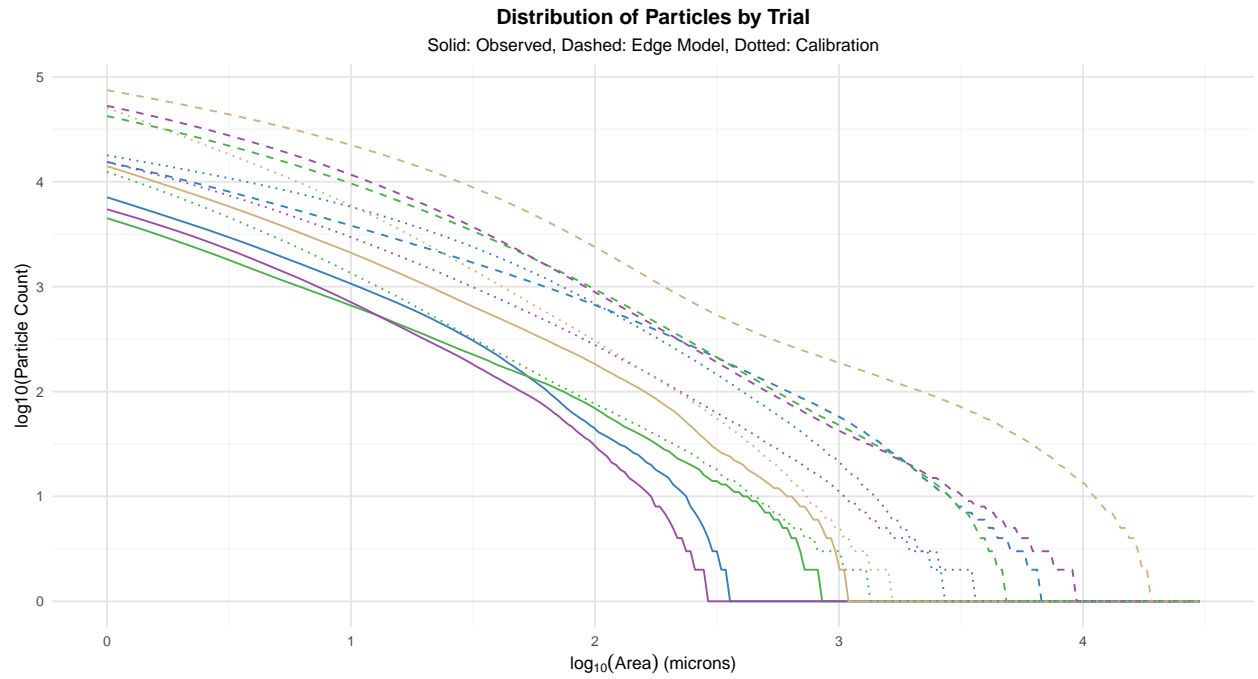| Trial	PCL	slope
8	16841.01	-0.1707850
9	14480.80	-0.1859847
10	13769.60	-0.1888140
11	81903.41	-0.1623550

Edge Model Analysis: Binned Particle Size Distribution

Particles binned by area thresholds
Black line: overall average

Trial — 8 — 9 — 10 — 11

6. Combined Analysis and Comparison

Distribution of Particles by Trial

Solid: Observed, Dashed: Edge Model, Dotted: Calibration

Distribution of Particles by Model

Red: Observed Edge Counts, Blue: Modeled Edge Counts, Green: Observed Calibration Counts,
Blue–dashed: Modeled Edge Counts with Adhesion Factor, Green–dashed: Observed Calibration Counts with Adhesion Factor

Ratio of Particles per Experiment

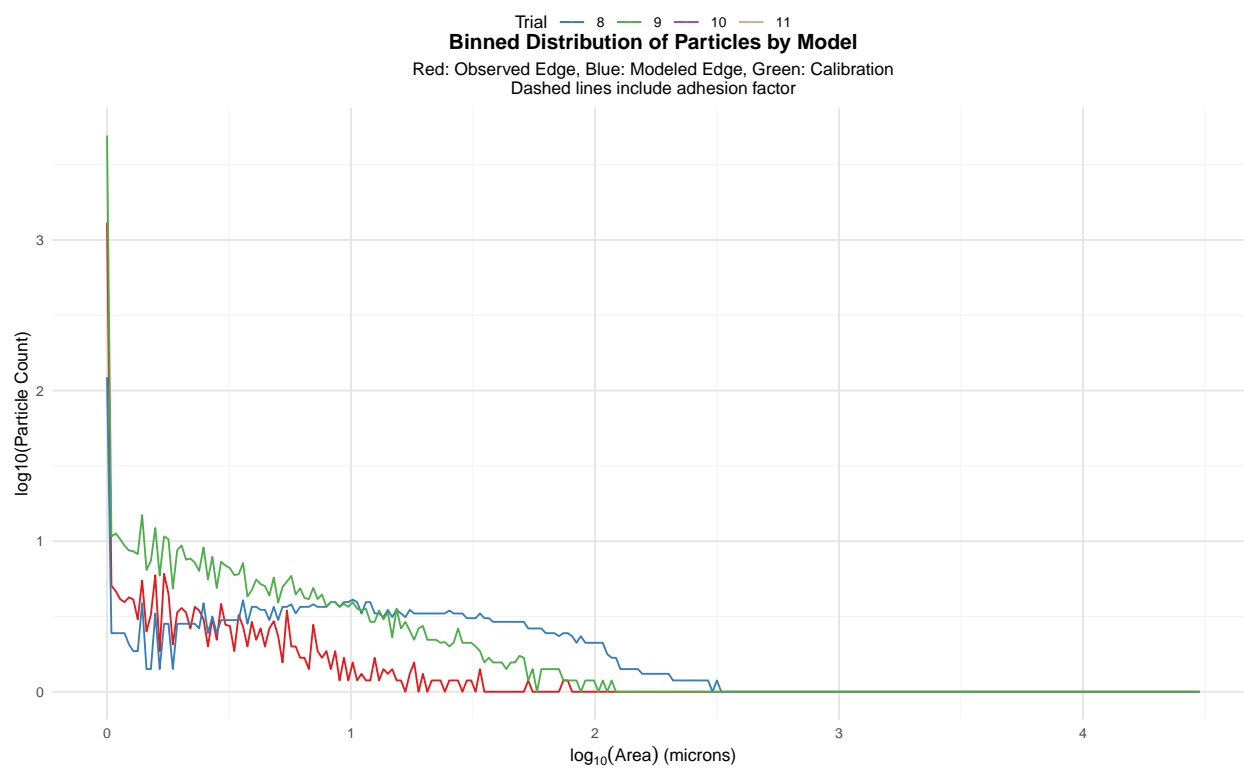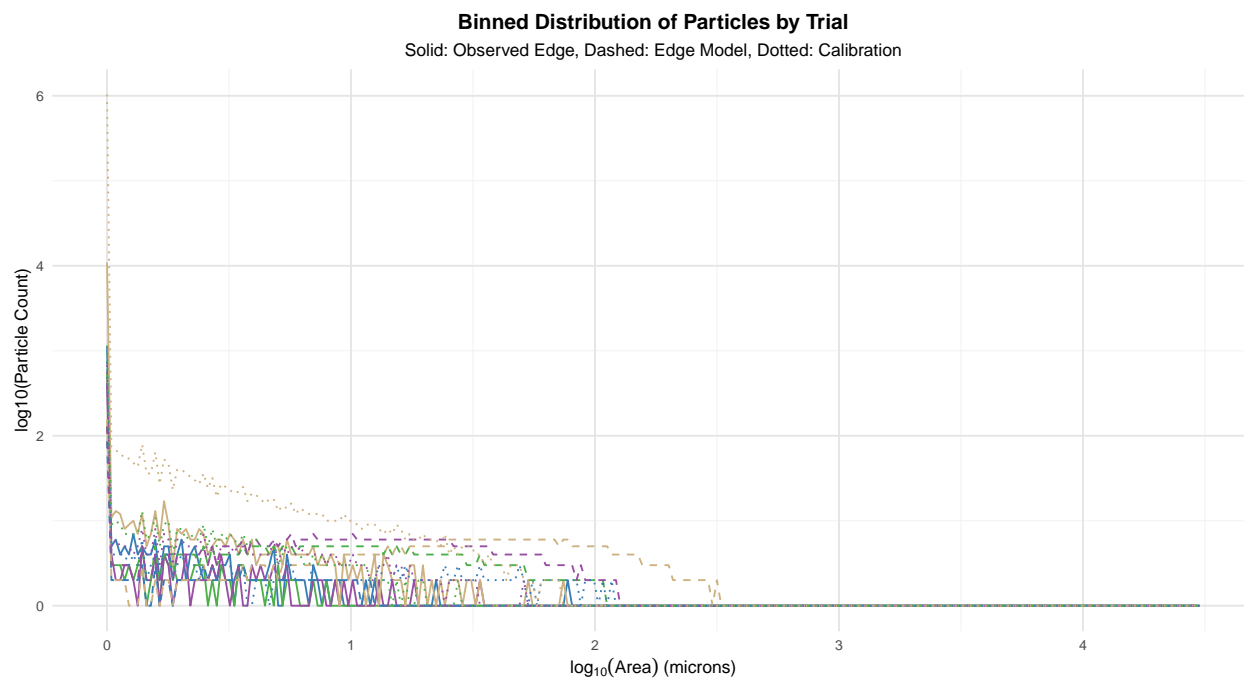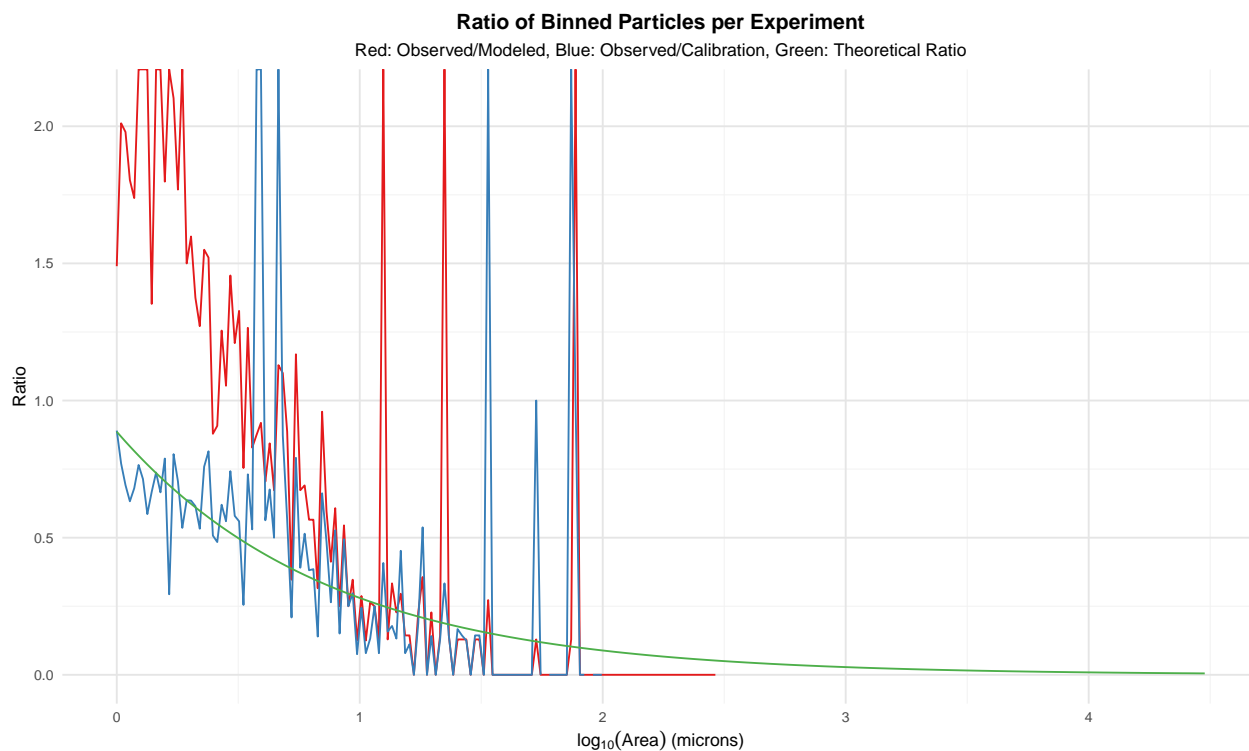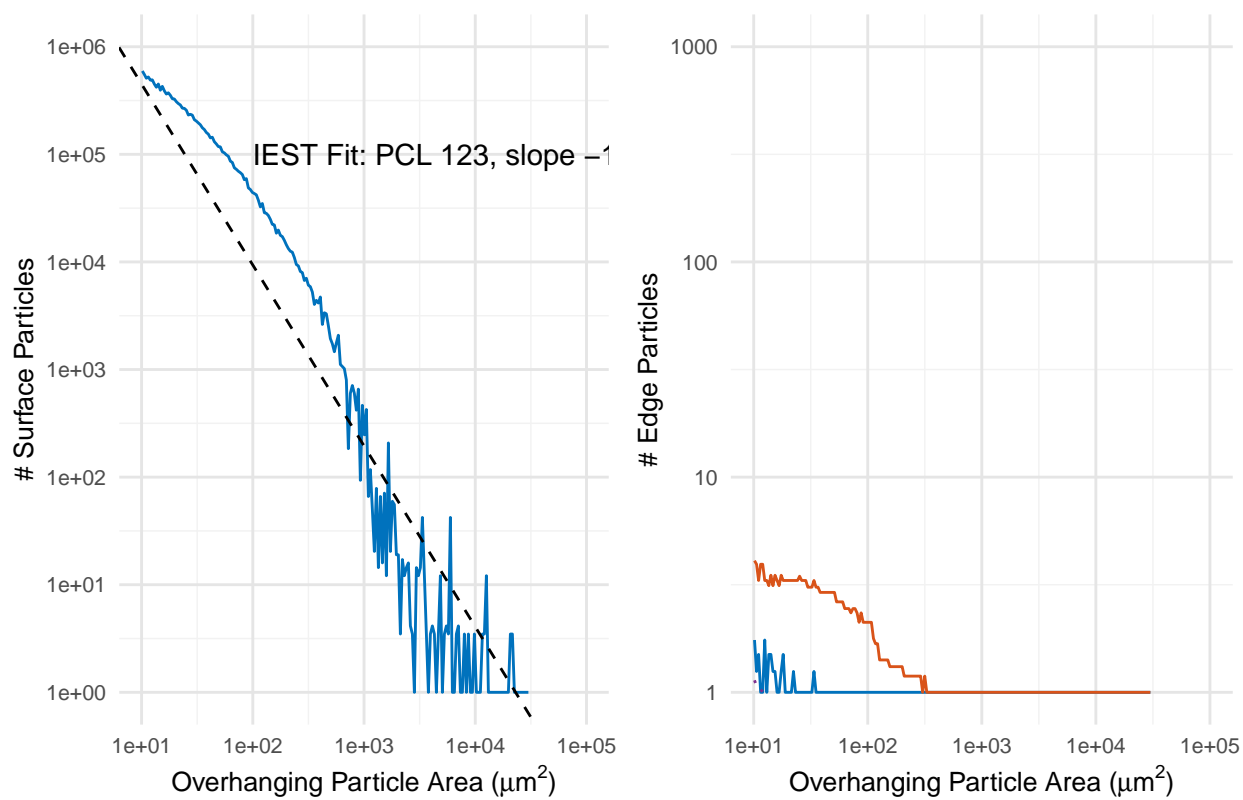Comparison of measurement methods against theoretical ratio

Table 5: Statistical Summary of Model Comparisons

log_area.x	Observed_by_Modeled	Observed_by_Calibration	Modeled_by_Calibration	Ratio
Min. :0.000	Min. :0.0000	Min. :0.0000	Min. :1.070	Min. :0.005114
1st Qu.:1.119	1st Qu.:0.0000	1st Qu.:0.4415	1st Qu.:1.144	1st Qu.:0.018555
Median :2.239	Median :0.5539	Median :0.8101	Median :1.313	Median :0.067324
Mean :2.239	Mean :0.4282	Mean :0.6289	Mean : Inf	Mean :0.172028
3rd Qu.:3.358	3rd Qu.:0.7478	3rd Qu.:0.8567	3rd Qu.: Inf	3rd Qu.:0.244266
Max. :4.478	Max. :0.8378	Max. :0.8930	Max. : Inf	Max. :0.886227
NA	NA's :12	NA's :52	NA's :12	NA

Binned Distribution of Particles by Trial

Solid: Observed Edge, Dashed: Edge Model, Dotted: Calibration

Binned Distribution of Particles by Model

Red: Observed Edge, Blue: Modeled Edge, Green: Calibration
Dashed lines include adhesion factor

Ratio of Binned Particles per Experiment

Red: Observed/Modeled, Blue: Observed/Calibration, Green: Theoretical Ratio

Etched Samples

IEST Fit: PCL 123, slope −1

Comparative Analysis

Normalized Edge Particulate Distributions
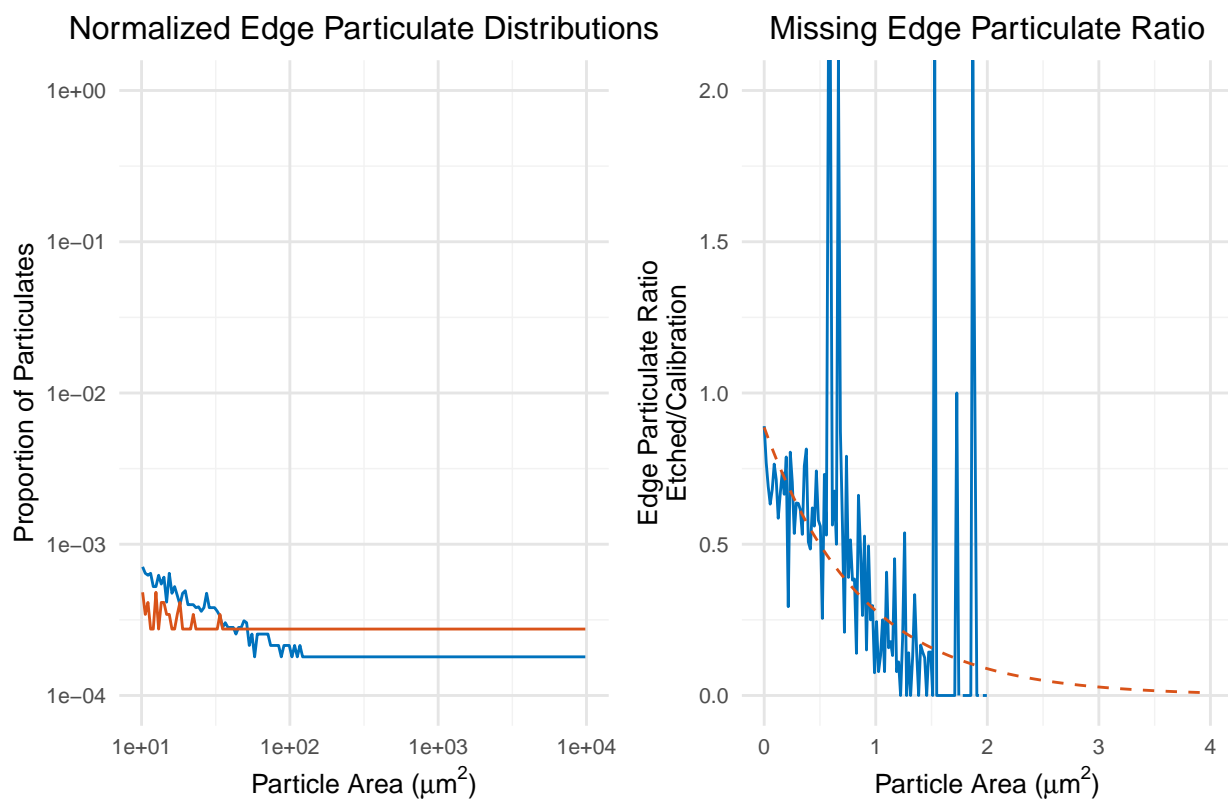

Missing Edge Particulate Ratio

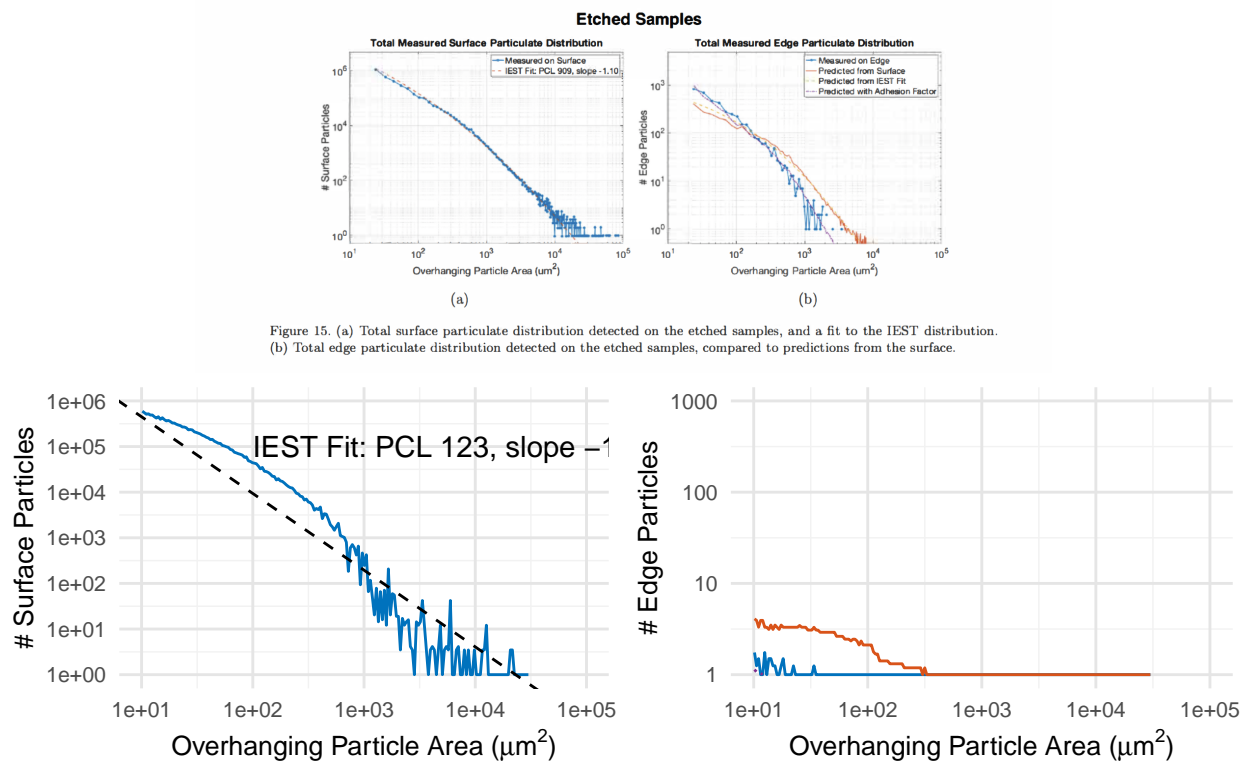## Figure 15: Etched Samples Comparison

Figure 15. (a) Total surface particulate distribution detected on the etched samples, and a fit to the IEST distribution.
(b) Total edge particulate distribution detected on the etched samples, compared to predictions from the surface.
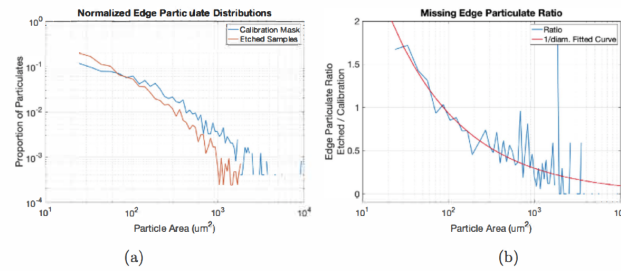
Figure 16: Comparative Analysis Comparison

Figure 16. (a) Normalized edge particulate distributions for the calibration mask and the etched samples. Each distribution has been normalized based on the total number of edge particulates. (b) Ratio of the normalized edge distributions, representing the portion of particulates missing from the etched samples. The ratio decreases with particulate size inversely proportional to the particle diameter.