Area_based_analysis

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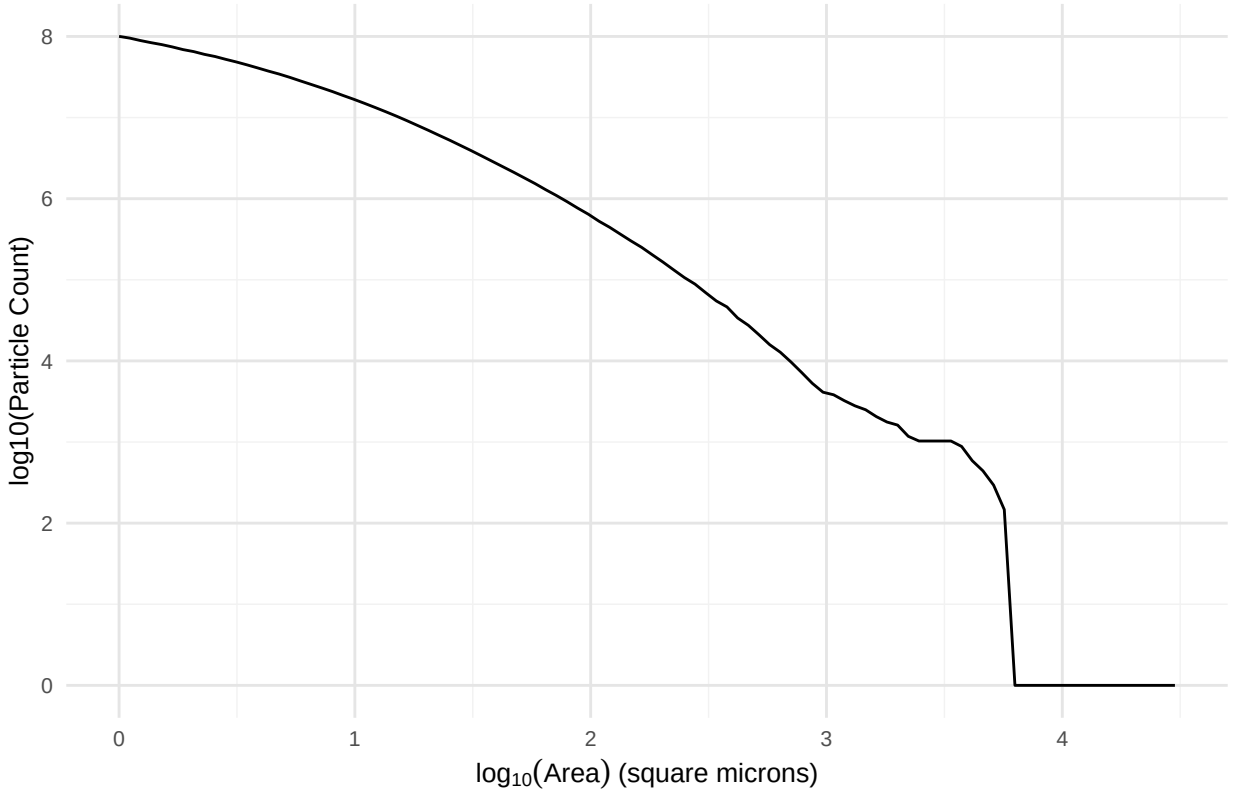
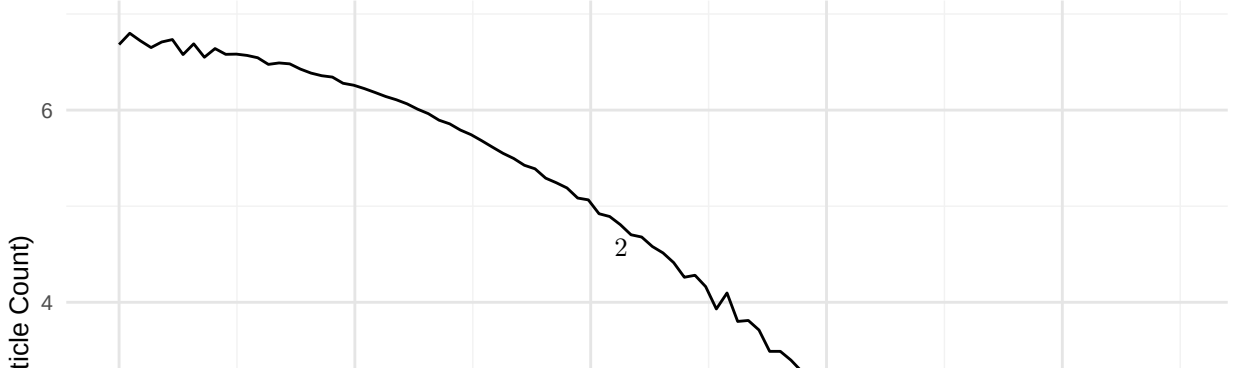
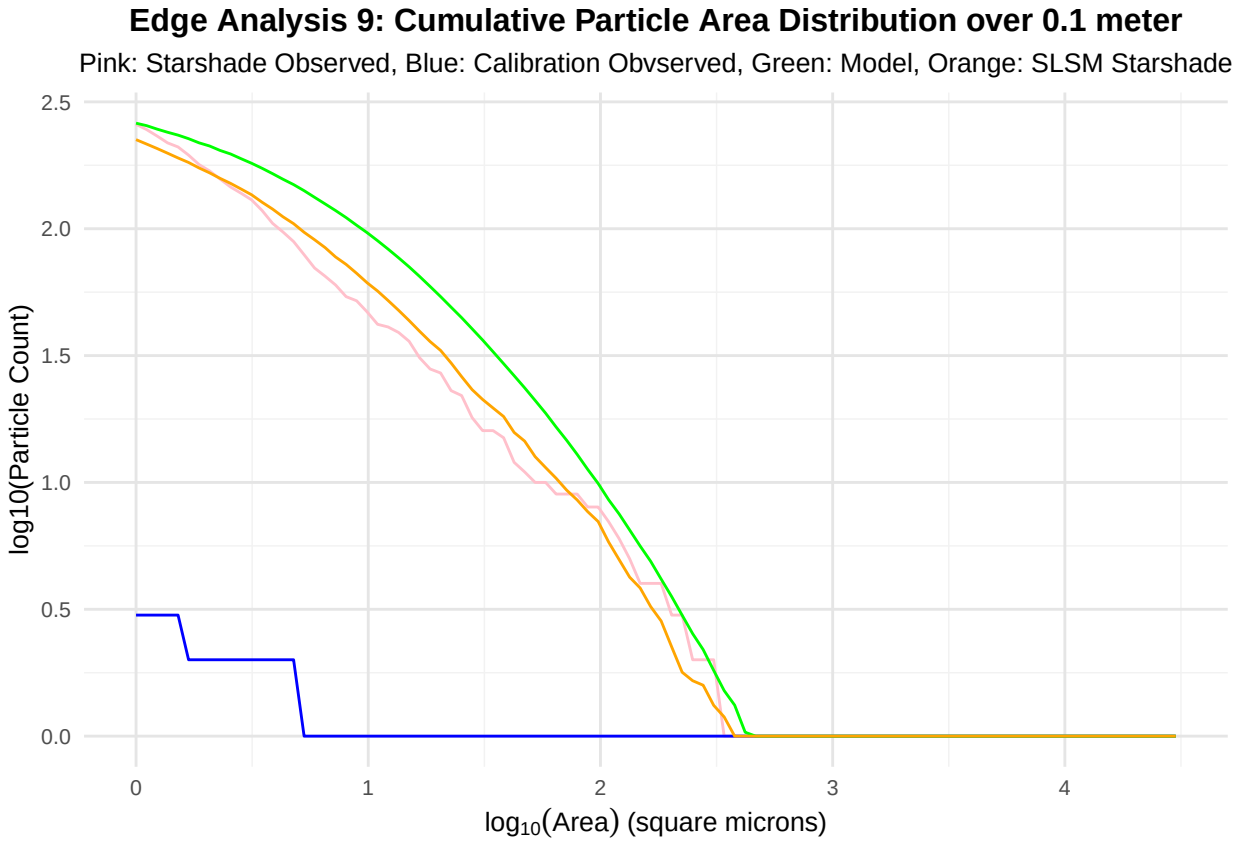
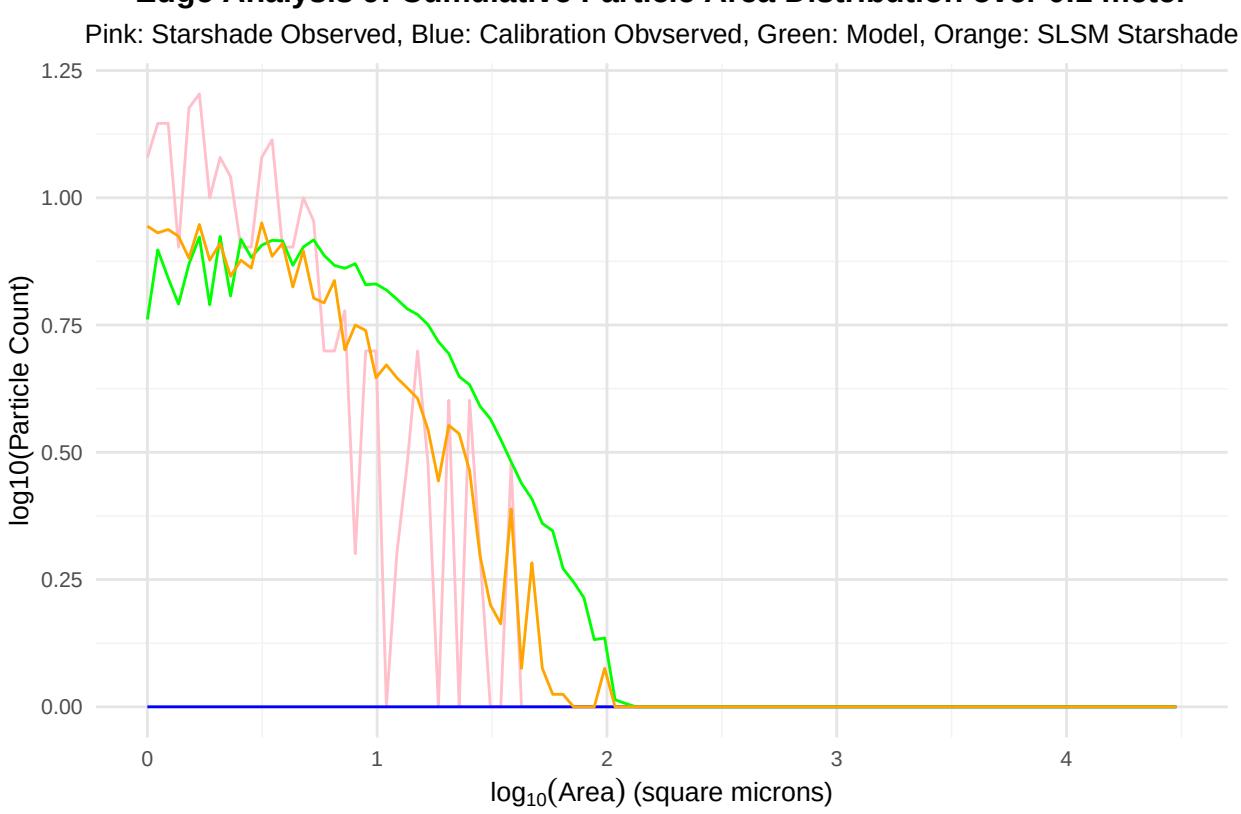
Surface Analysis 9: Cumulative Particle Area Distribution over 0.1 square meter



Surface Analysis 9: Binned Particle Size Distribution over 0.1 square meters





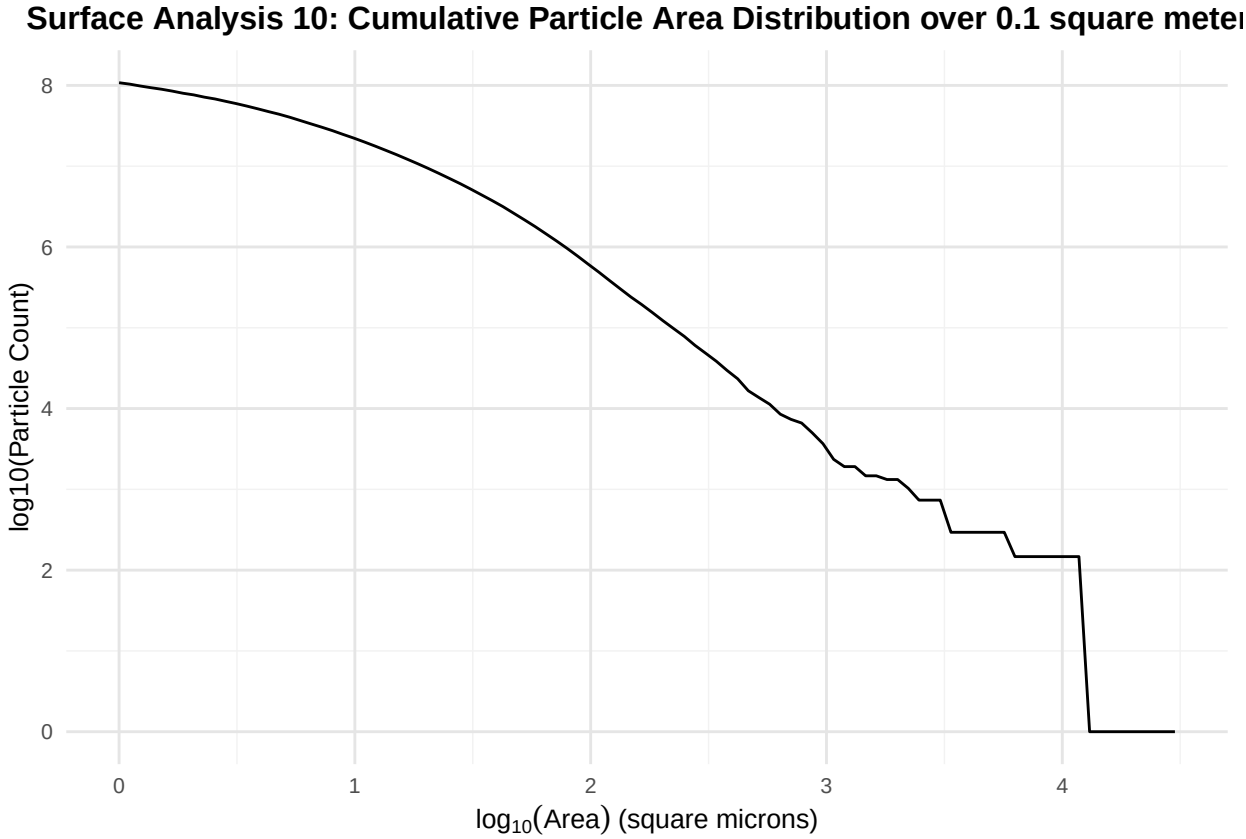


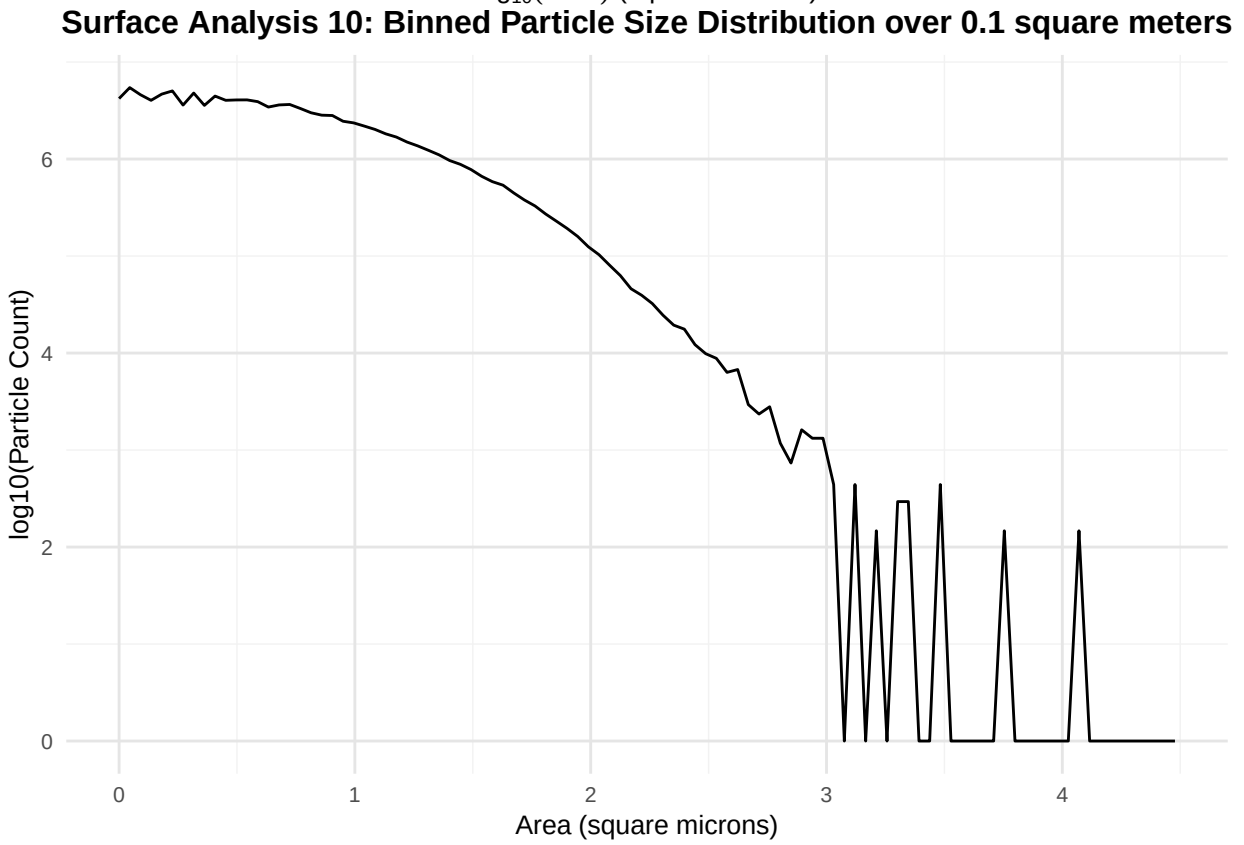

```
## Trial 9 Edge Distribution Analysis Results
```

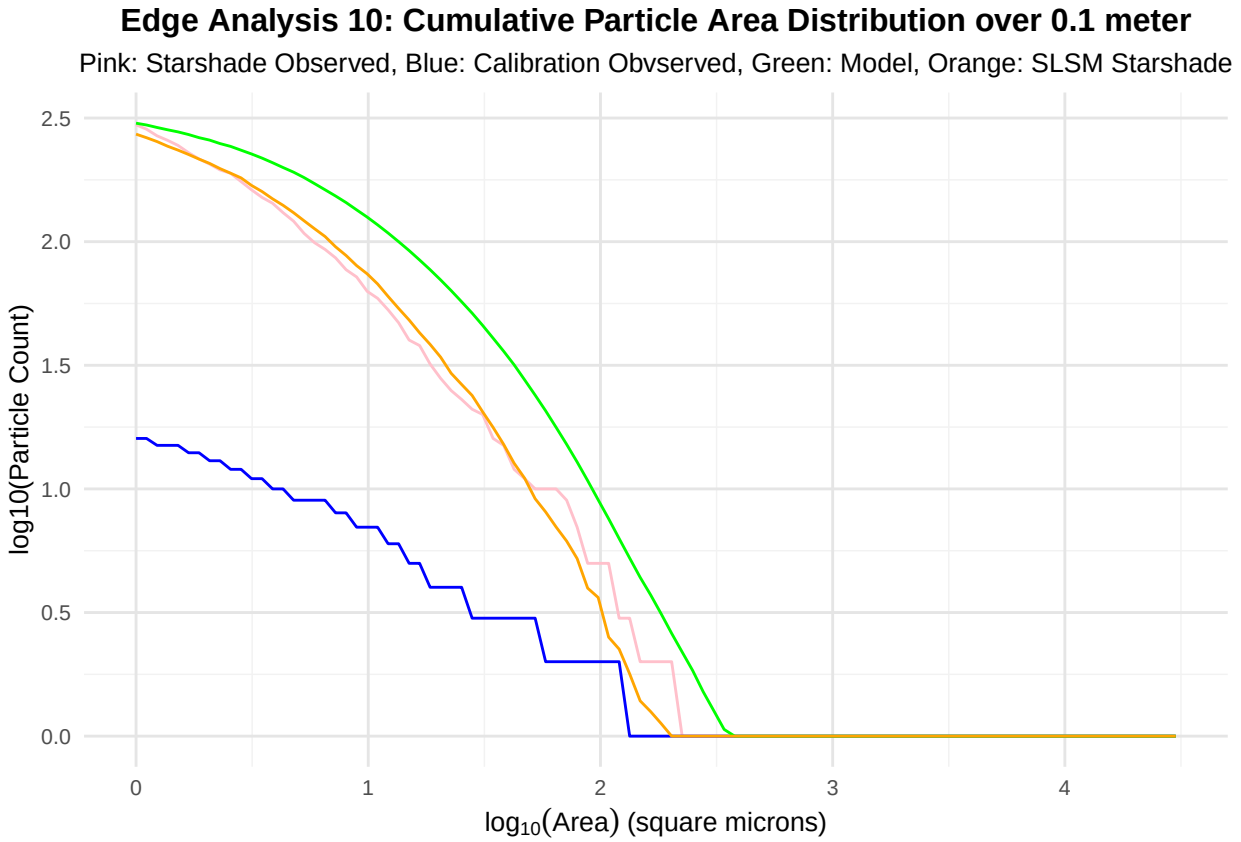
```
##
## 1. Correlation Analysis:

##                                     comparison pearson_r       p_value
## cor  Starshade Observed vs Calibration Observed 0.7027197  3.674915e-16
## cor1                Starshade Observed vs Model 0.9941039  2.254190e-96
## cor2       Starshade Observed vs SLSM Starshade 0.9973604 1.924980e-113
## cor3              Calibration Observed vs Model 0.6331472  1.569586e-12
## cor4     Calibration Observed vs SLSM Starshade 0.6735214  1.616574e-14
## cor5                    Model vs SLSM Starshade 0.9972677 1.041258e-112

##
## 2. Kolmogorov-Smirnov Test Results:

##                                   comparison ks_statistic      p_value
## D  Starshade Observed vs Calibration Observed         0.51 1.011651e-11
## D1                Starshade Observed vs Model         0.10 6.993742e-01
## D2       Starshade Observed vs SLSM Starshade         0.04 9.999982e-01
## D3              Calibration Observed vs Model         0.52 3.611663e-12
## D4     Calibration Observed vs SLSM Starshade         0.50 2.777589e-11
## D5                    Model vs SLSM Starshade         0.06 9.937649e-01

##
## 3. Root Mean Square Error Between Distributions:

##                                   comparison       rmse
## 1 Starshade Observed vs Calibration Observed 1.07333580
## 2                Starshade Observed vs Model 0.16901537
## 3       Starshade Observed vs SLSM Starshade 0.06837033
## 4              Calibration Observed vs Model 1.21696978
## 5     Calibration Observed vs SLSM Starshade 1.10196579
## 6                    Model vs SLSM Starshade 0.13266971

##
## 4. Regression Analysis for Each Distribution:

##                         source       slope intercept r_squared      p_value
## log_area    Starshade Observed -0.62147529 2.1990516 0.8991446 1.285514e-50
## log_area1 Calibration Observed -0.06477496 0.2019875 0.3950164 2.546405e-12
## log_area2                Model -0.68339436 2.4479841 0.9030513 1.851215e-51
## log_area3       SLSM Starshade -0.63532983 2.2429598 0.8907273 6.559785e-49

## [1] "\n5. Area Under Curve Analysis:\n"

## # A tibble: 4 x 2
##   source                auc
##   <chr>                <dbl>
## 1 Calibration Observed 0.247
## 2 Model                4.10
## 3 SLSM Starshade       3.66
## 4 Starshade Observed   3.60

## [1] "\n6. Distribution Summary Statistics:\n"

## # A tibble: 4 x 6
##   source              mean_log_count median_log_count sd_log_count min_log_count
##   <chr>                        <dbl>            <dbl>        <dbl>         <dbl>
## 1 Calibration Observ~         0.0570            0           0.135             0
## 2 Model                       0.918             0.654       0.944             0
```

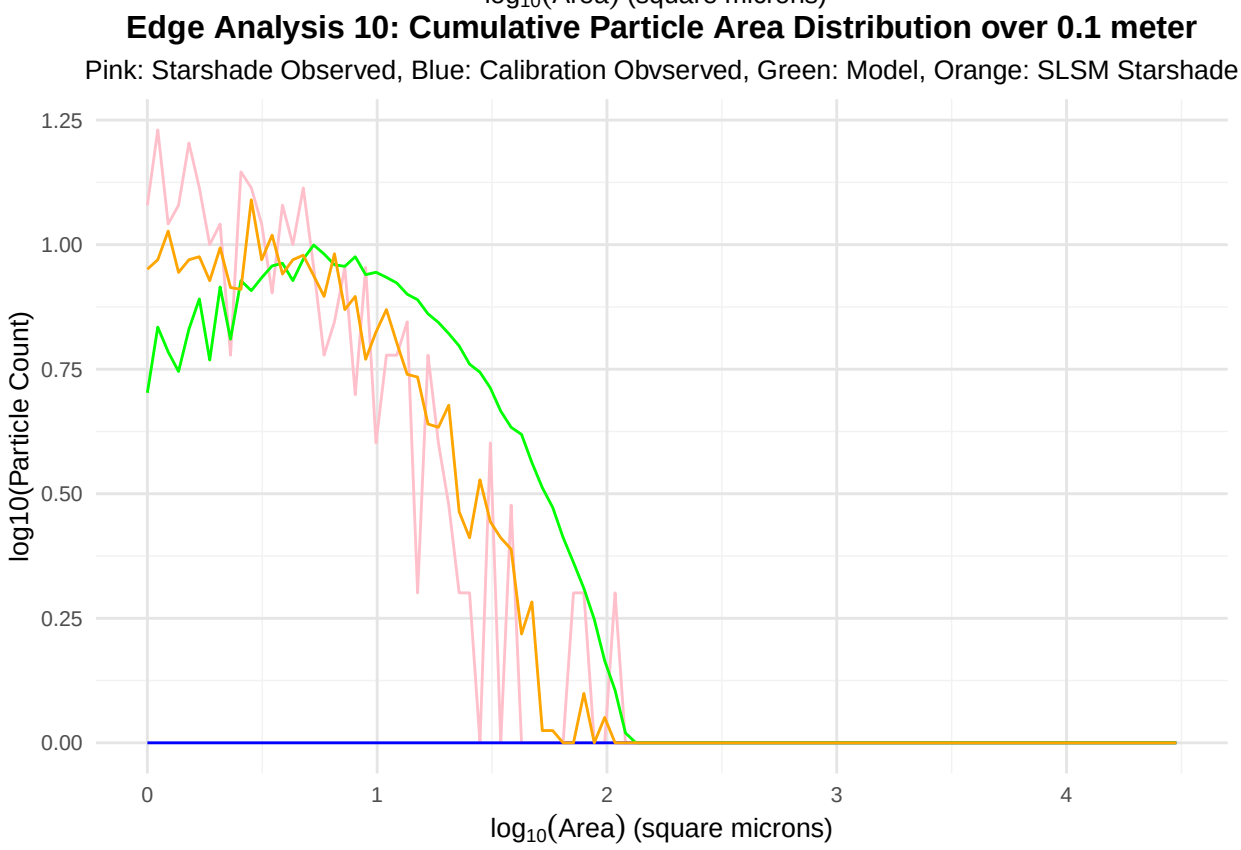
```
## 3 SLSM Starshade              0.821             0.482        0.883             0
## 4 Starshade Observed          0.808             0.602        0.860             0
## # i 1 more variable: max_log_count <dbl>
```

8.2 Trial 10


Surface Analysis 10: Cumulative Particle Area Distribution over 0.1 square meter
log10(Particle Count)
0
2
4
6
8
0
1
2
3
4
log10(Area) (square microns)


Surface Analysis 10: Binned Particle Size Distribution over 0.1 square meters
log10(Particle Count)
0
2
4
6
0
1
2
3
4
Area (square microns)



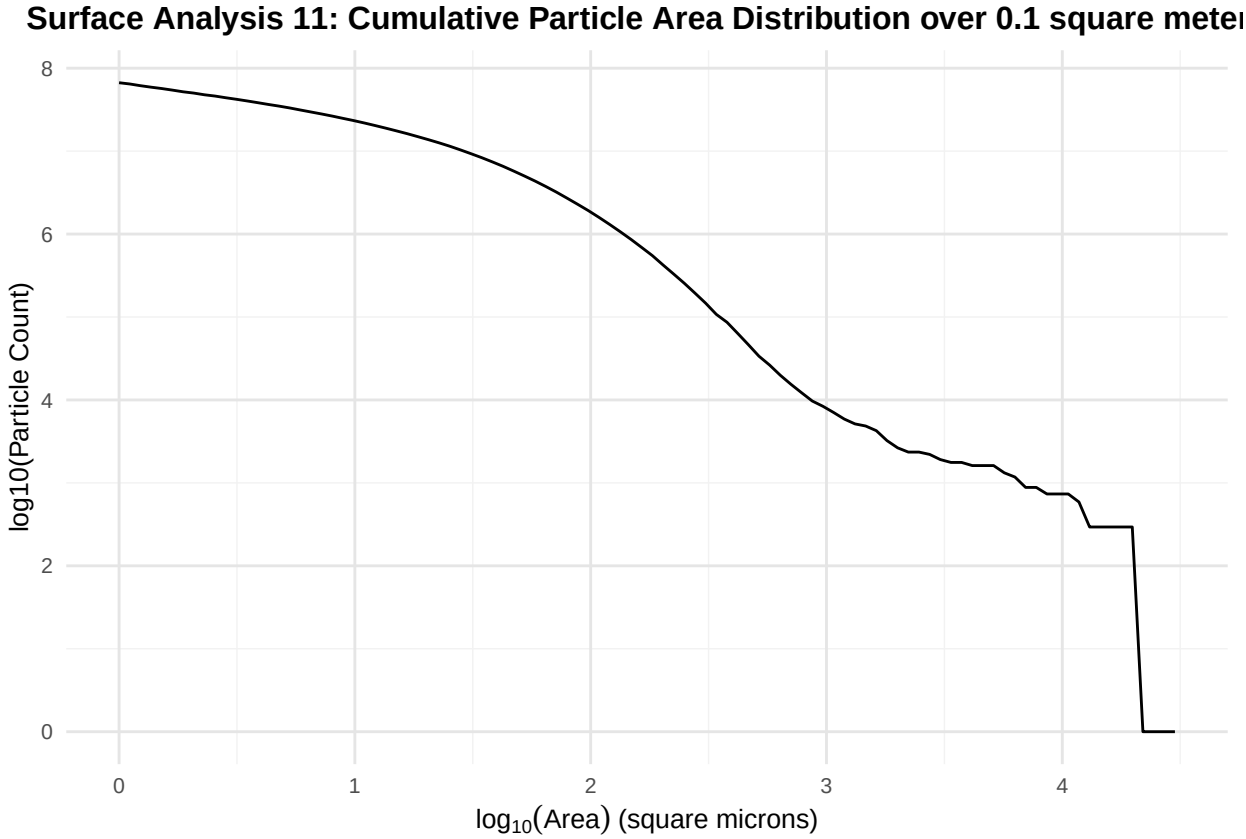


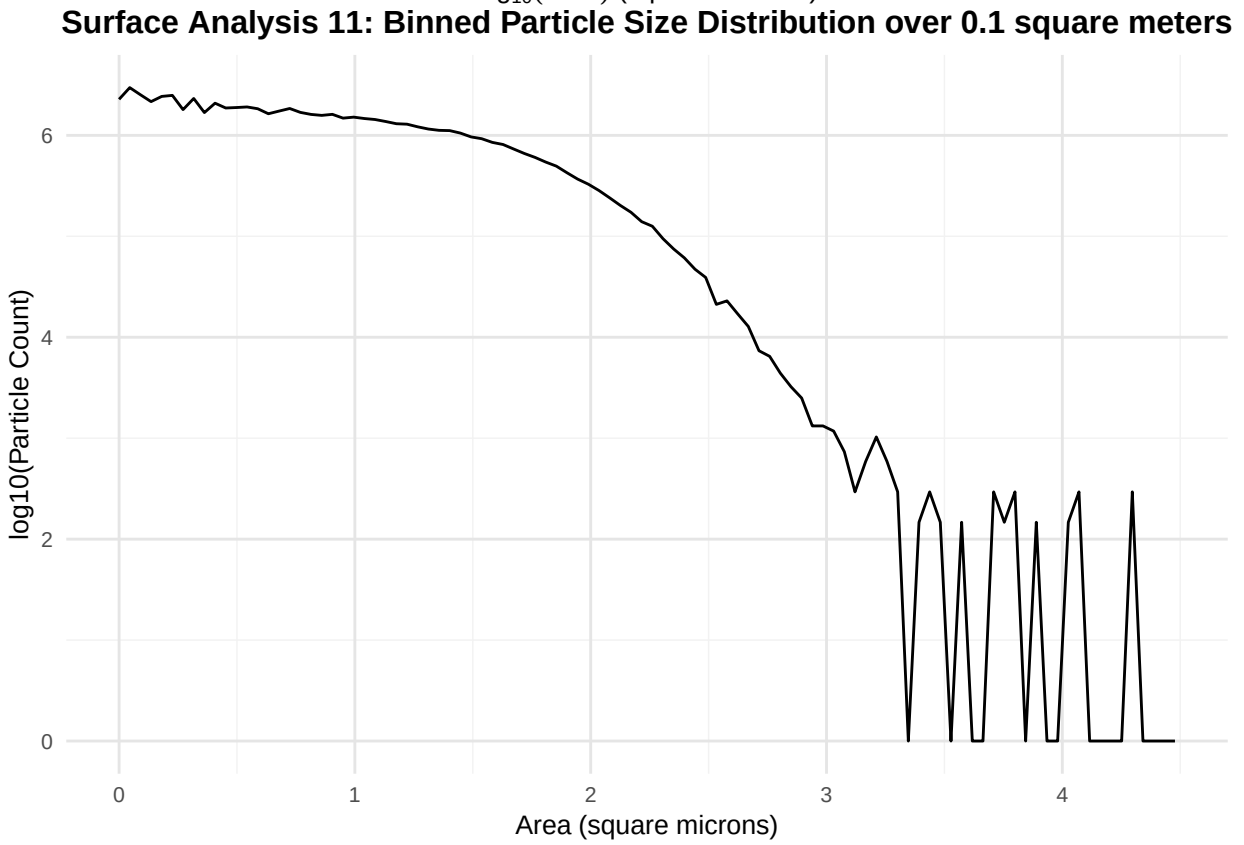

```
## Trial 10 Edge Distribution Analysis Results
```

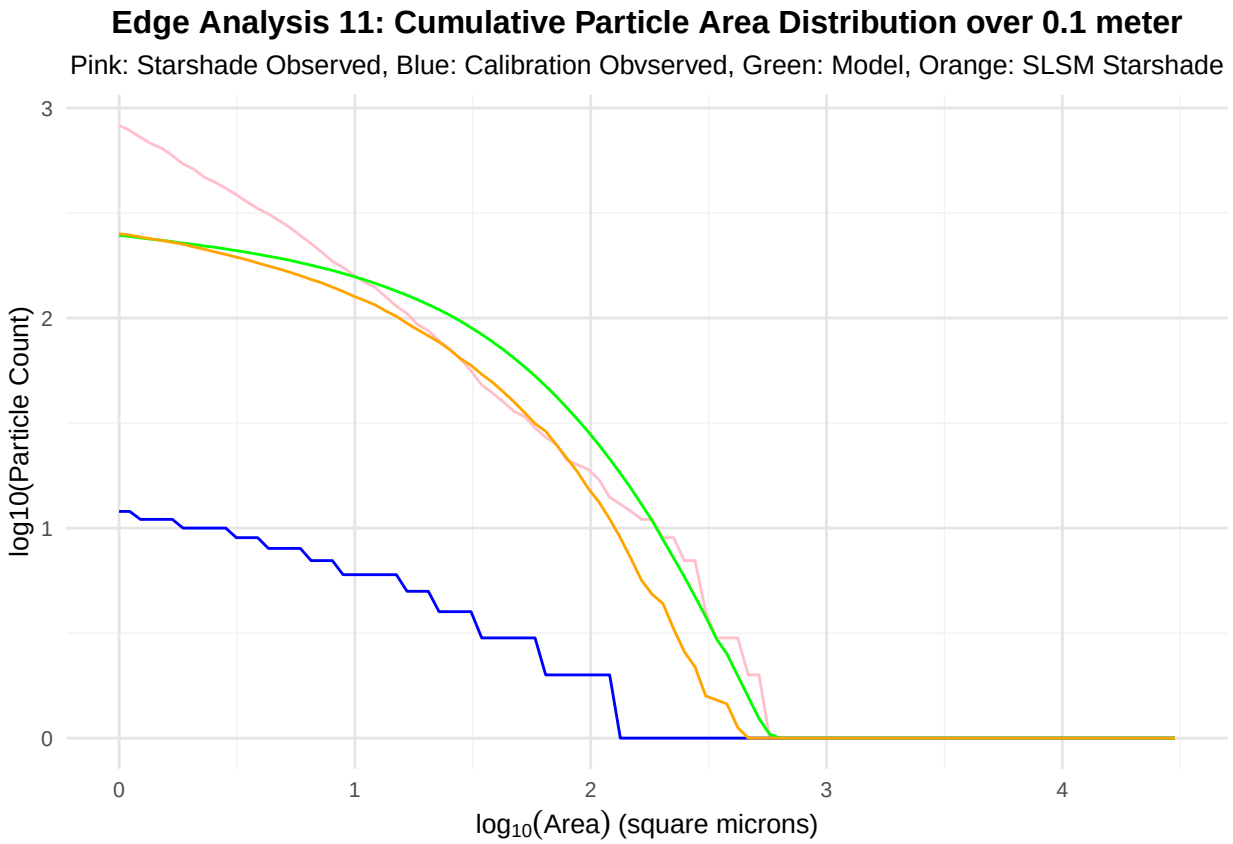
```
##
## 1. Correlation Analysis:

##                                     comparison pearson_r       p_value
## cor  Starshade Observed vs Calibration Observed 0.9923160  9.350211e-91
## cor1                Starshade Observed vs Model 0.9912269  6.030821e-88
## cor2       Starshade Observed vs SLSM Starshade 0.9965625 7.881738e-108
## cor3              Calibration Observed vs Model 0.9737756  7.992211e-65
## cor4     Calibration Observed vs SLSM Starshade 0.9838473  4.943497e-75
## cor5                    Model vs SLSM Starshade 0.9973955 9.980779e-114

##
## 2. Kolmogorov-Smirnov Test Results:

##                                   comparison ks_statistic      p_value
## D  Starshade Observed vs Calibration Observed         0.34 1.908033e-05
## D1                Starshade Observed vs Model         0.09 8.127483e-01
## D2       Starshade Observed vs SLSM Starshade         0.06 9.937649e-01
## D3              Calibration Observed vs Model         0.41 1.001244e-07
## D4     Calibration Observed vs SLSM Starshade         0.36 4.705150e-06
## D5                    Model vs SLSM Starshade         0.12 4.675586e-01

##
## 3. Root Mean Square Error Between Distributions:

##                                   comparison       rmse
## 1 Starshade Observed vs Calibration Observed 0.65600409
## 2                Starshade Observed vs Model 0.20110698
## 3       Starshade Observed vs SLSM Starshade 0.08328987
## 4              Calibration Observed vs Model 0.81652691
## 5     Calibration Observed vs SLSM Starshade 0.64818000
## 6                    Model vs SLSM Starshade 0.17726385

##
## 4. Regression Analysis for Each Distribution:

##                         source      slope intercept r_squared      p_value
## log_area    Starshade Observed -0.6502636  2.260122 0.8648647 2.206654e-44
## log_area1 Calibration Observed -0.3047132  1.041860 0.8289008 2.367129e-39
## log_area2                Model -0.7143903  2.539565 0.8857097 5.935652e-48
## log_area3       SLSM Starshade -0.6353298  2.242960 0.8907273 6.559785e-49

## [1] "\n5. Area Under Curve Analysis:\n"

## # A tibble: 4 x 2
##   source                auc
##   <chr>               <dbl>
## 1 Calibration Observed  1.60
## 2 Model                 4.20
## 3 SLSM Starshade        3.66
## 4 Starshade Observed    3.58

## [1] "\n6. Distribution Summary Statistics:\n"

## # A tibble: 4 x 6
##   source              mean_log_count median_log_count sd_log_count min_log_count
##   <chr>                        <dbl>            <dbl>        <dbl>         <dbl>
## 1 Calibration Observ~          0.360            0            0.439             0
## 2 Model                        0.940            0.533        0.996             0
```

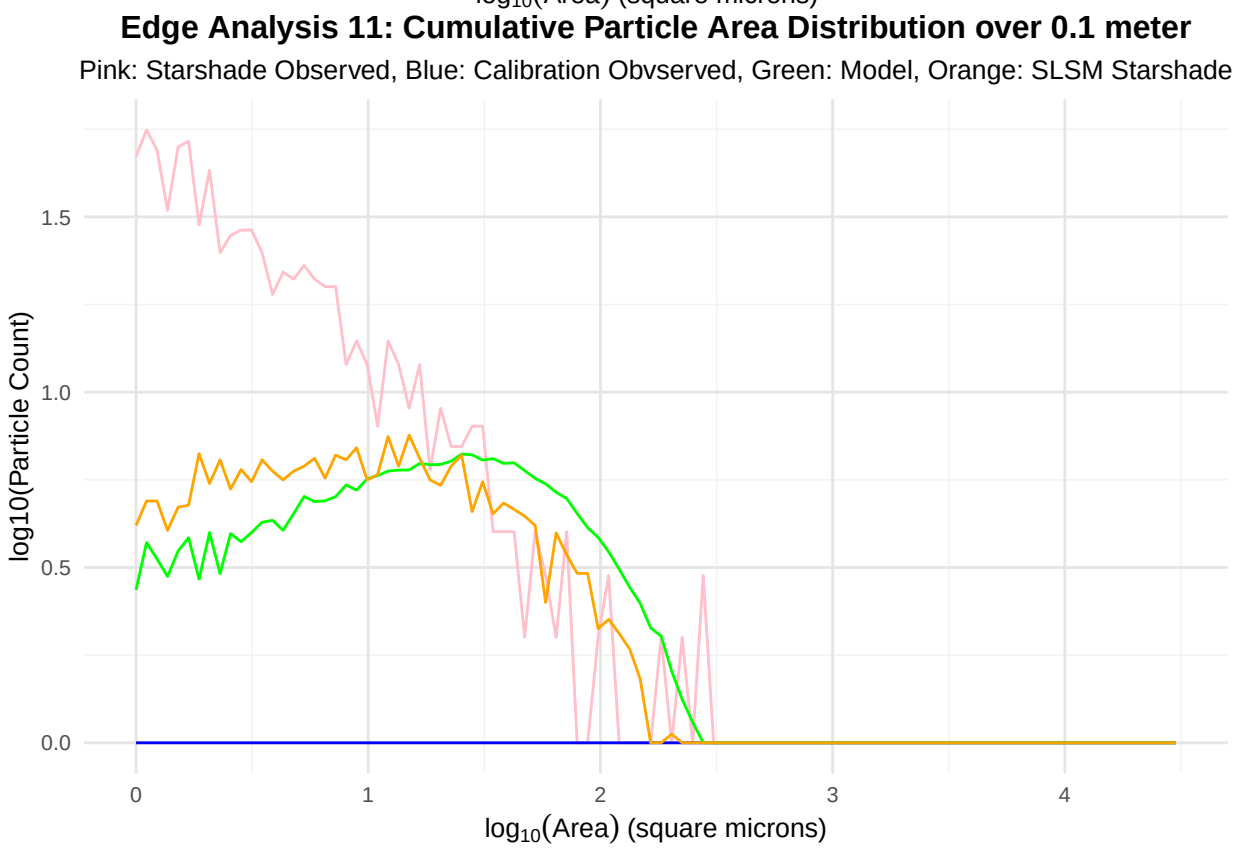
```
## 3 SLSM Starshade               0.821           0.482       0.883            0
## 4 Starshade Observed           0.804           0.301       0.917            0
## # i 1 more variable: max_log_count <dbl>
```

8.3 Trial 11


Surface Analysis 11: Cumulative Particle Area Distribution over 0.1 square meter
log10(Particle Count)
0
2
4
6
8
0
1
2
3
4
log10(Area) (square microns)


Surface Analysis 11: Binned Particle Size Distribution over 0.1 square meters
log10(Particle Count)
0
2
4
6
0
1
2
3
4
Area (square microns)



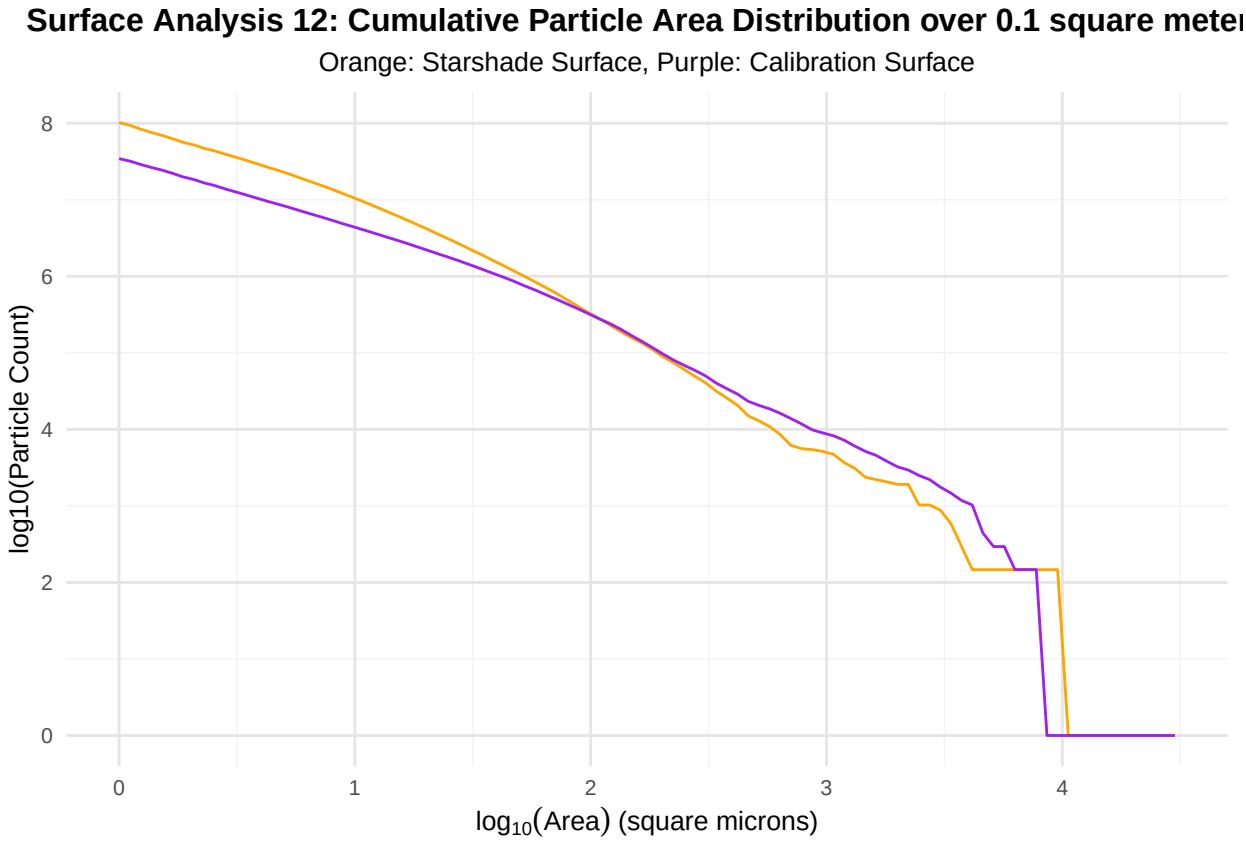


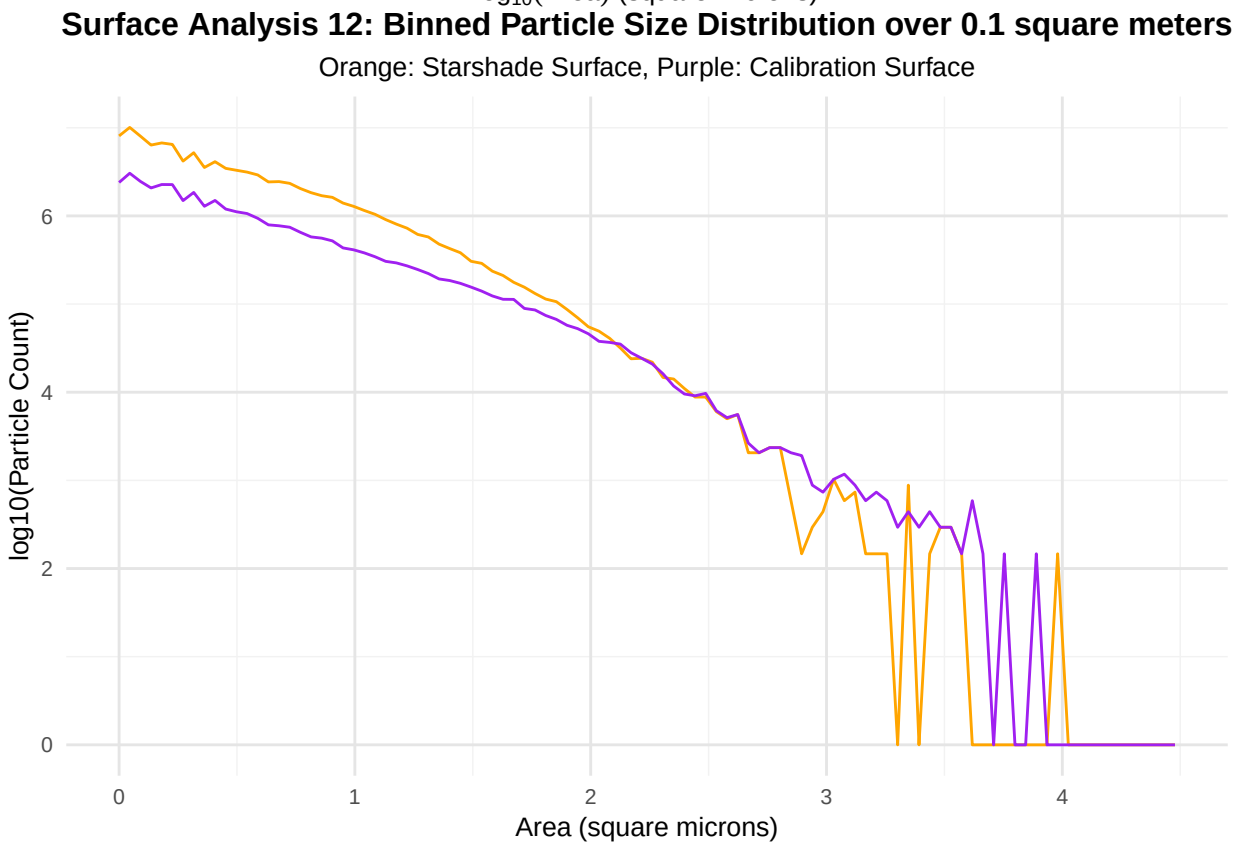

```
## Trial 11 Edge Distribution Analysis Results
```

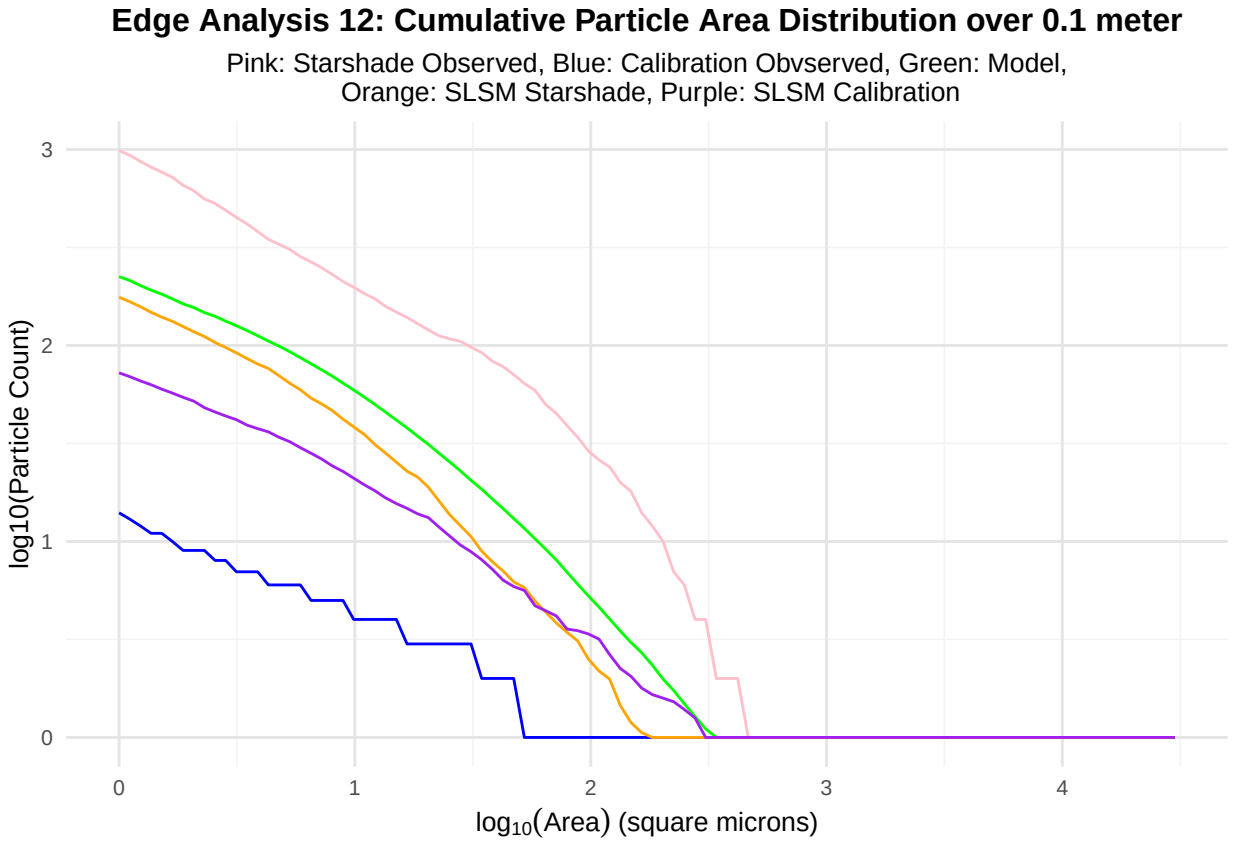
```
##
## 1. Correlation Analysis:

##                                     comparison pearson_r      p_value
## cor  Starshade Observed vs Calibration Observed 0.9630816 1.175188e-57
## cor1                Starshade Observed vs Model 0.9866425 4.779898e-79
## cor2       Starshade Observed vs SLSM Starshade 0.9882531 9.153851e-82
## cor3              Calibration Observed vs Model 0.9355902 4.226939e-46
## cor4     Calibration Observed vs SLSM Starshade 0.9891492 1.915228e-83
## cor5                    Model vs SLSM Starshade 0.9703348 3.094399e-62

##
## 2. Kolmogorov-Smirnov Test Results:

##                                   comparison ks_statistic      p_value
## D  Starshade Observed vs Calibration Observed         0.48 1.971901e-10
## D1                Starshade Observed vs Model         0.17 1.111333e-01
## D2       Starshade Observed vs SLSM Starshade         0.19 5.410262e-02
## D3              Calibration Observed vs Model         0.50 2.777589e-11
## D4     Calibration Observed vs SLSM Starshade         0.39 4.959192e-07
## D5                    Model vs SLSM Starshade         0.16 1.545381e-01

##
## 3. Root Mean Square Error Between Distributions:

##                                   comparison      rmse
## 1 Starshade Observed vs Calibration Observed 1.0134880
## 2                Starshade Observed vs Model 0.1791888
## 3       Starshade Observed vs SLSM Starshade 0.3633847
## 4              Calibration Observed vs Model 0.9687954
## 5     Calibration Observed vs SLSM Starshade 0.6767168
## 6                    Model vs SLSM Starshade 0.3626231

##
## 4. Regression Analysis for Each Distribution:

##                         source      slope intercept r_squared      p_value
## log_area    Starshade Observed -0.7813268 2.8501815 0.9318638 5.698289e-59
## log_area1 Calibration Observed -0.2847471 0.9822747 0.8393564 1.070844e-40
## log_area2                Model -0.7282105 2.7050619 0.9033761 1.570240e-51
## log_area3       SLSM Starshade -0.6353298 2.2429598 0.8907273 6.559785e-49

## [1] "\n5. Area Under Curve Analysis:\n"

## # A tibble: 4 x 2
##   source                auc
##   <chr>               <dbl>
## 1 Calibration Observed  1.53
## 2 Model                 4.81
## 3 SLSM Starshade        3.66
## 4 Starshade Observed    4.91

## [1] "\n6. Distribution Summary Statistics:\n"

## # A tibble: 4 x 6
##   source              mean_log_count median_log_count sd_log_count min_log_count
##   <chr>                        <dbl>            <dbl>        <dbl>         <dbl>
## 1 Calibration Observ~          0.345            0           0.408             0
## 2 Model                        1.07             1.07        1.01              0
```

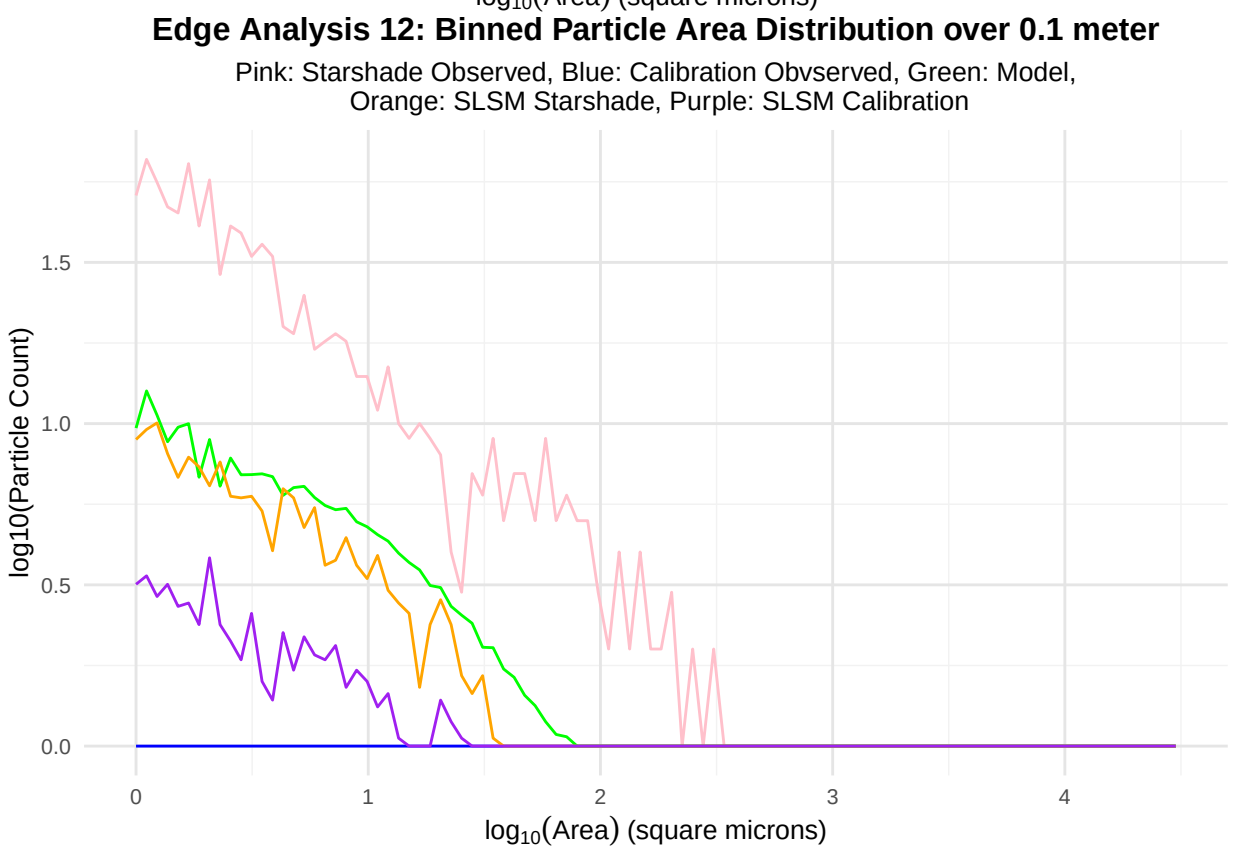
```
## 3 SLSM Starshade               0.821            0.482        0.883             0
## 4 Starshade Observed           1.10             1.04         1.06              0
## # i 1 more variable: max_log_count <dbl>
```

8.4 Trial 12


Surface Analysis 12: Cumulative Particle Area Distribution over 0.1 square meter
Orange: Starshade Surface, Purple: Calibration Surface
log10(Particle Count)
log10(Area) (square microns)
0
2
4
6
8
0
1
2
3
4


Surface Analysis 12: Binned Particle Size Distribution over 0.1 square meters
Orange: Starshade Surface, Purple: Calibration Surface
log10(Particle Count)
Area (square microns)
0
2
4
6
0
1
2
3
4






```
## Trial 12 Edge Distribution Analysis Results
```

```
##
## 1. Correlation Analysis:

##                                     comparison pearson_r       p_value
## cor  Starshade Observed vs Calibration Observed 0.8856474  2.034191e-34
## cor1                Starshade Observed vs Model 0.9808596  1.882959e-71
## cor2       Starshade Observed vs SLSM Starshade 0.9858298  8.468498e-78
## cor3              Calibration Observed vs Model 0.9496741  3.334913e-51
## cor4     Calibration Observed vs SLSM Starshade 0.9422237  2.415028e-48
## cor5                    Model vs SLSM Starshade 0.9994352 3.118802e-146

##
## 2. Kolmogorov-Smirnov Test Results:

##                                   comparison ks_statistic      p_value
## D  Starshade Observed vs Calibration Observed         0.49 7.475143e-11
## D1                Starshade Observed vs Model         0.21 2.431031e-02
## D2       Starshade Observed vs SLSM Starshade         0.21 2.431031e-02
## D3              Calibration Observed vs Model         0.37 2.267454e-06
## D4     Calibration Observed vs SLSM Starshade         0.38 1.071070e-06
## D5                    Model vs SLSM Starshade         0.03 1.000000e+00

##
## 3. Root Mean Square Error Between Distributions:

##                                   comparison       rmse
## 1 Starshade Observed vs Calibration Observed 1.19592655
## 2                Starshade Observed vs Model 0.47497254
## 3       Starshade Observed vs SLSM Starshade 0.44501388
## 4              Calibration Observed vs Model 0.74702009
## 5     Calibration Observed vs SLSM Starshade 0.76972481
## 6                    Model vs SLSM Starshade 0.03724995

##
## 4. Regression Analysis for Each Distribution:

##                         source      slope intercept r_squared      p_value
## log_area    Starshade Observed -0.8194974 2.9920279 0.9171047 8.542547e-55
## log_area1 Calibration Observed -0.2493649 0.8291678 0.7464043 5.891392e-31
## log_area2                Model -0.6280351 2.2044739 0.8812621 3.863310e-47
## log_area3       SLSM Starshade -0.6353298 2.2429598 0.8907273 6.559785e-49

## [1] "\n5. Area Under Curve Analysis:\n"

## # A tibble: 4 x 2
##   source                auc
##   <chr>               <dbl>
## 1 Calibration Observed  1.20
## 2 Model                 3.56
## 3 SLSM Starshade        3.66
## 4 Starshade Observed    5.17

## [1] "\n6. Distribution Summary Statistics:\n"

## # A tibble: 4 x 6
##   source              mean_log_count median_log_count sd_log_count min_log_count
##   <chr>                        <dbl>            <dbl>        <dbl>         <dbl>
## 1 Calibration Observ~          0.271            0            0.379             0
## 2 Model                        0.798            0.401        0.878             0
```

```
## 3 SLSM Starshade               0.821            0.482        0.883             0
## 4 Starshade Observed           1.16             1.11         1.12              0
## # i 1 more variable: max_log_count <dbl>
```

```
## Trial 12 Surface Distribution Analysis Results
```

```
##
## 1. Correlation Analysis:
```

```
##                                     comparison pearson_r      p_value
## cor Starshade Observed vs Calibration Observed 0.9859644 5.323202e-78
```

```
##
## 2. Kolmogorov-Smirnov Test Results:
```

```
##                                   comparison ks_statistic   p_value
## D Starshade Observed vs Calibration Observed         0.12 0.4675586
```

```
##
## 3. Root Mean Square Error Between Distributions:
```

```
##                                   comparison      rmse
## 1 Starshade Observed vs Calibration Observed 0.4265422
```

```
##
## 4. Regression Analysis for Each Distribution:
```

```
##                         source     slope intercept r_squared      p_value
## log_area    Starshade Observed -1.815463  8.791456 0.9580624 2.641805e-69
## log_area1 Calibration Observed -1.681296  8.392893 0.9160102 1.625447e-54
```

```
## [1] "\n5. Area Under Curve Analysis:\n"
```

```
## # A tibble: 2 x 2
##   source                 auc
##   <chr>                <dbl>
## 1 Calibration Observed  20.8
## 2 Starshade Observed    21.2
```

```
## [1] "\n6. Distribution Summary Statistics:\n"
```

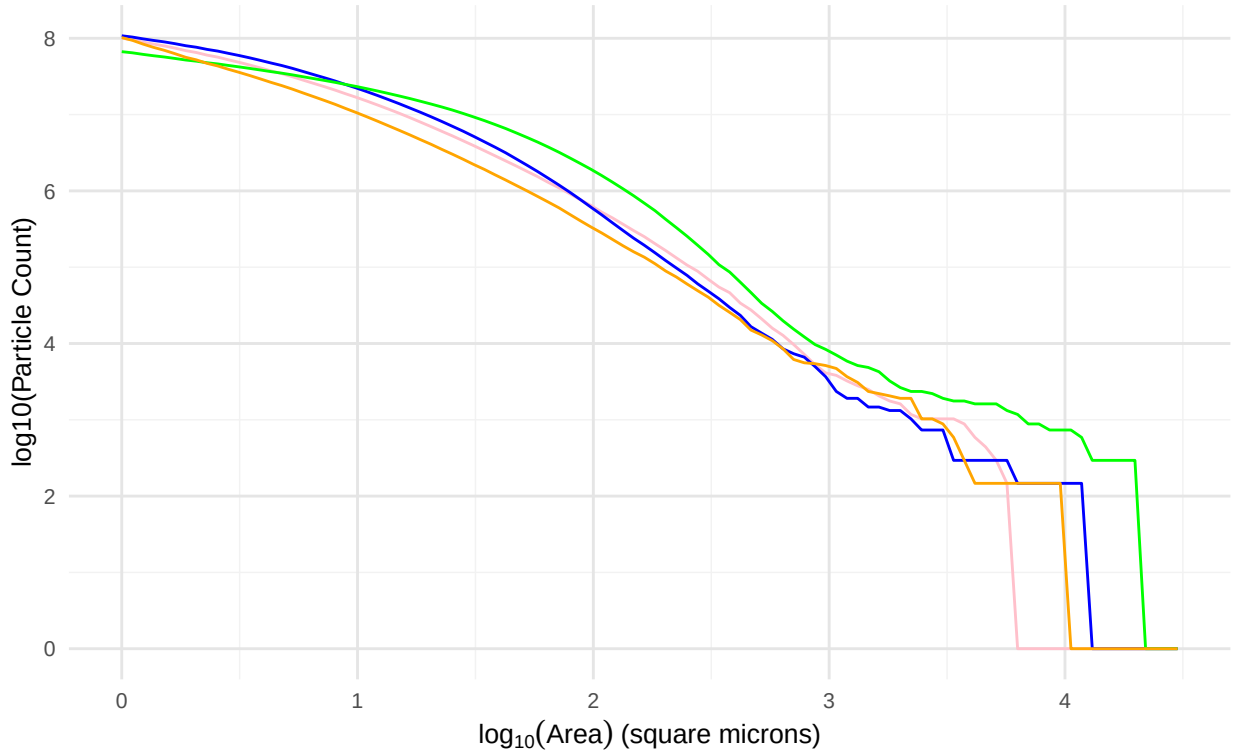
```
## # A tibble: 2 x 6
##   source              mean_log_count median_log_count sd_log_count min_log_count
##   <chr>                        <dbl>            <dbl>        <dbl>         <dbl>
## 1 Calibration Observ~           4.63             5.11         2.31             0
## 2 Starshade Observed            4.73             5.09         2.43             0
## # i 1 more variable: max_log_count <dbl>
```

9. Combined Analysis and Comparison

9.1 Cumulative Comparison

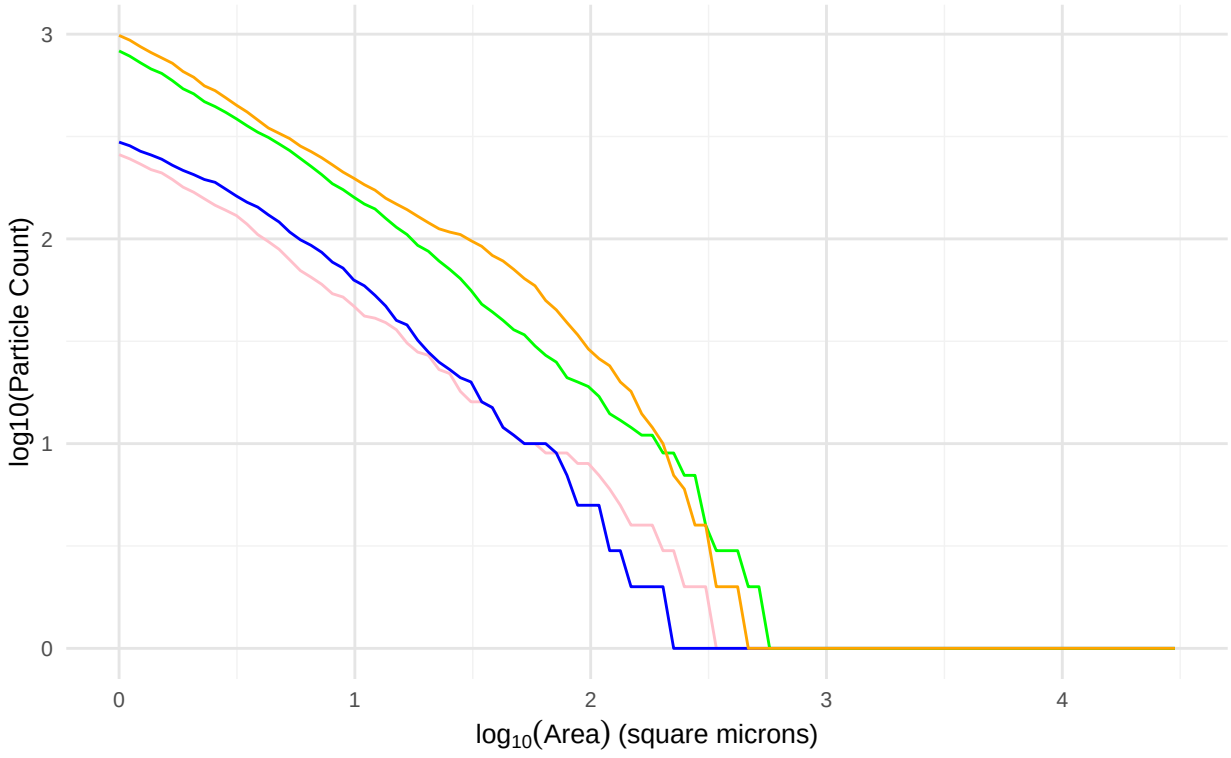
tarshade Surface Analysis: Cumulative Particle Area Distribution over 0.1 square m

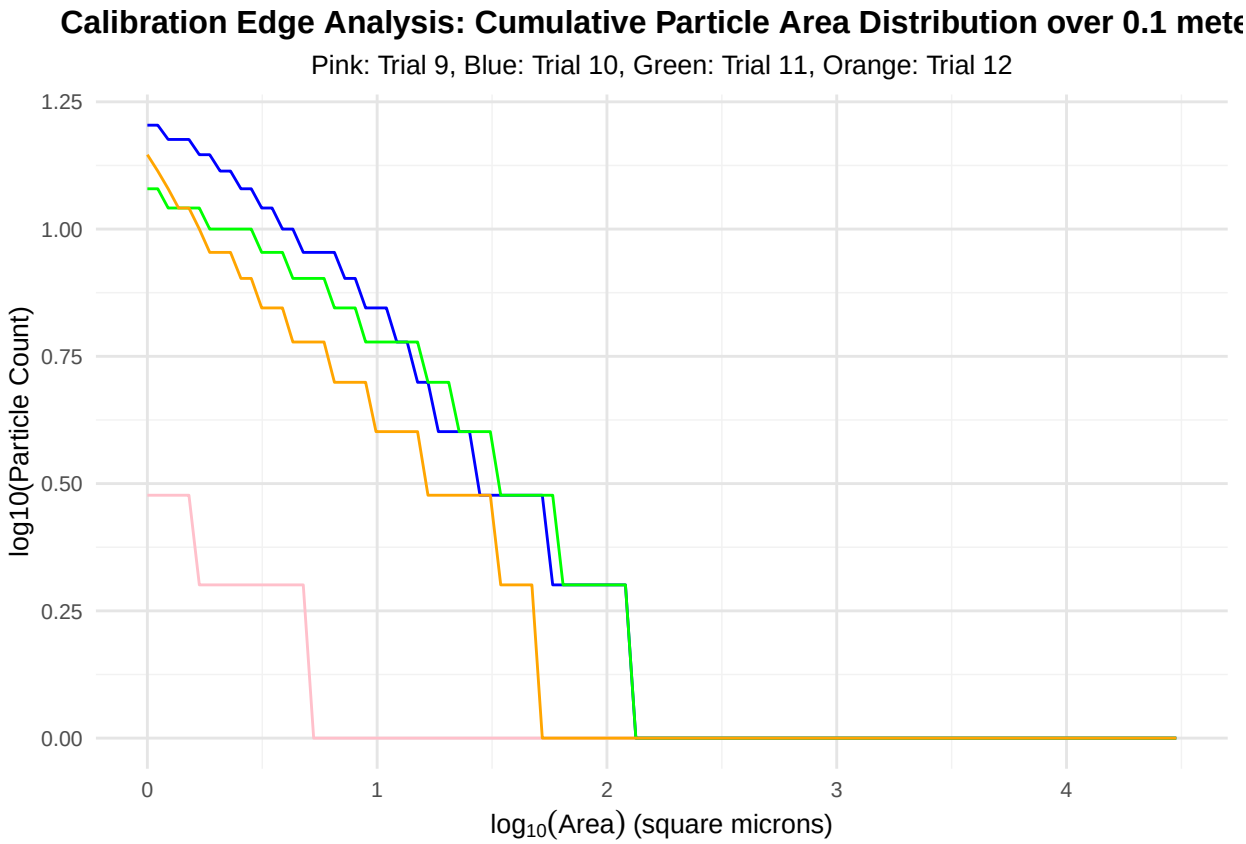
Pink: Trial 9, Blue: Trial 10, Green: Trial 11, Orange: Trial 12

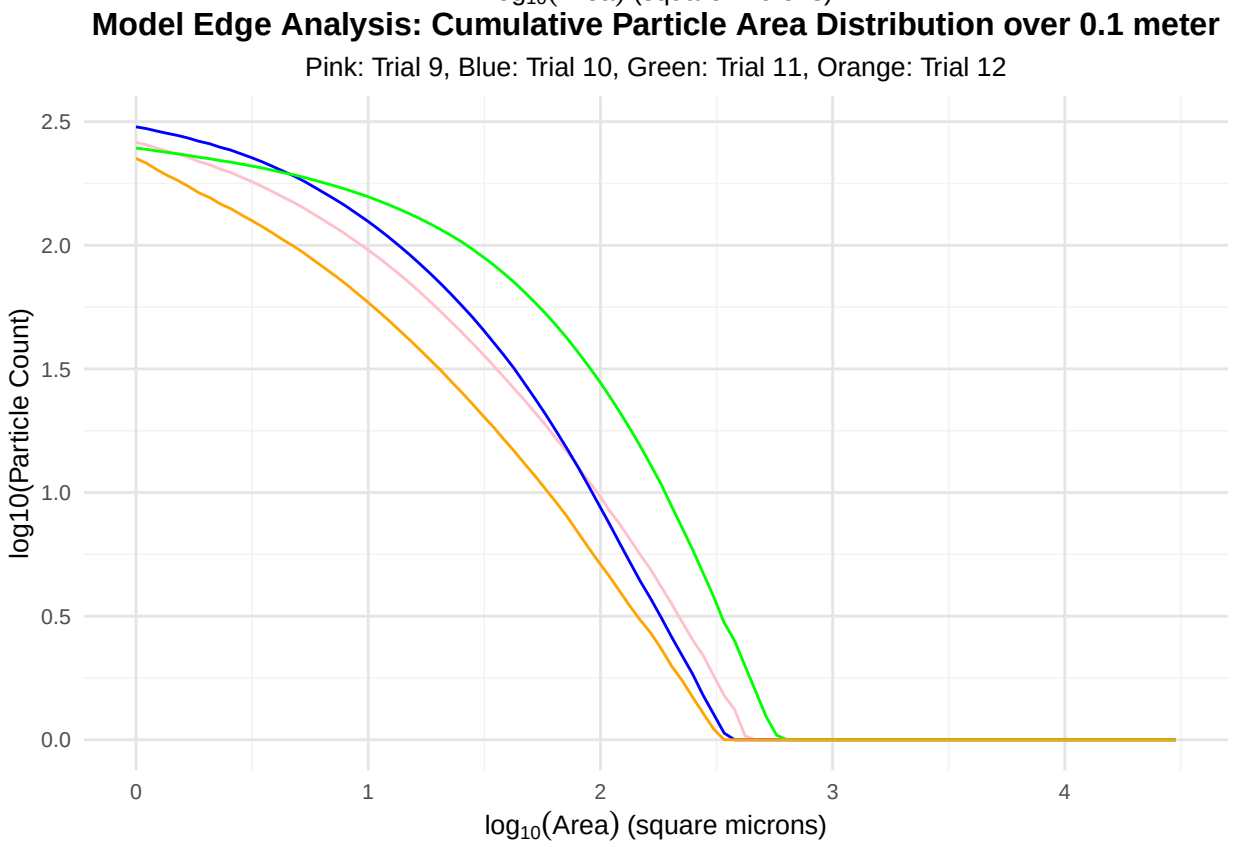


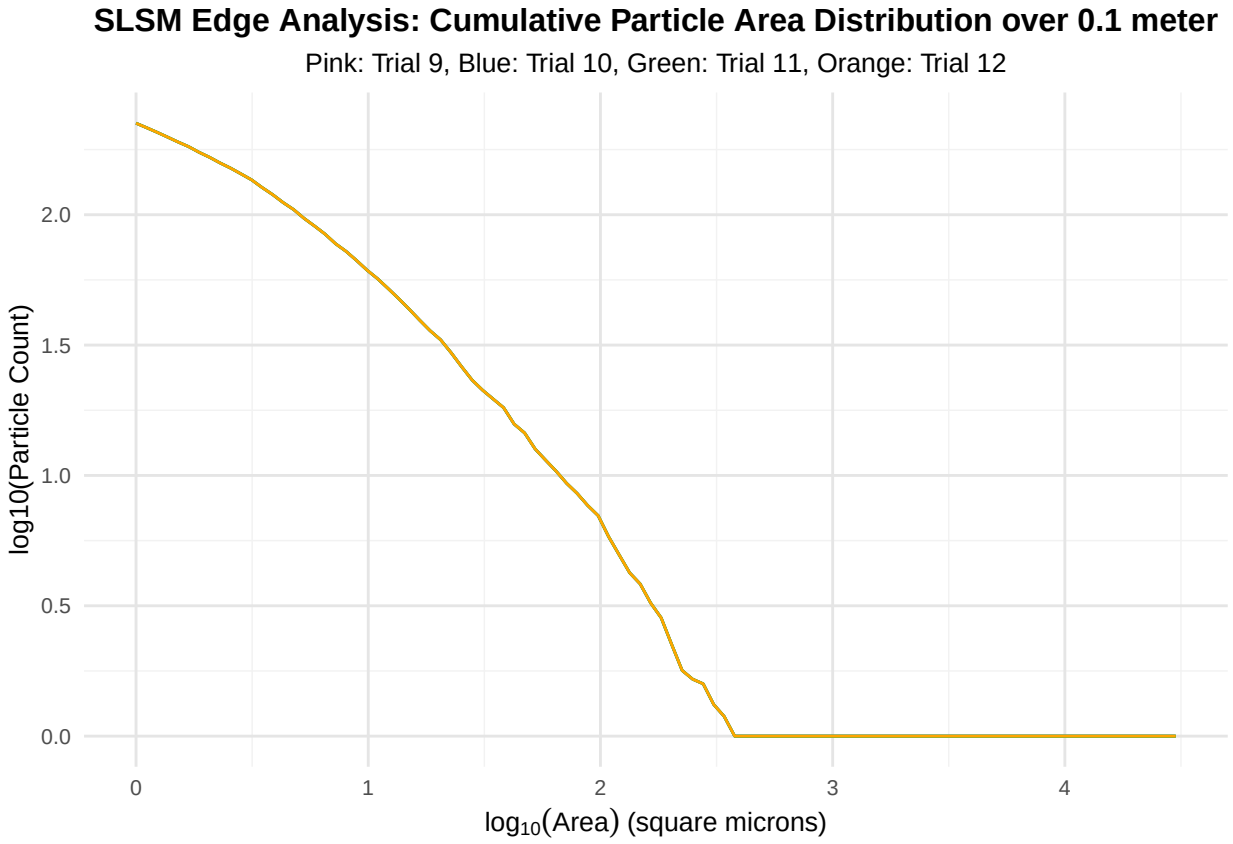
Starshade Edge Analysis: Cumulative Particle Area Distribution over 0.1 meter

Pink: Trial 9, Blue: Trial 10, Green: Trial 11, Orange: Trial 12




Calibration Edge Analysis: Cumulative Particle Area Distribution over 0.1 mete
Pink: Trial 9, Blue: Trial 10, Green: Trial 11, Orange: Trial 12
log10(Particle Count)
1.25
1.00
0.75
0.50
0.25
0.00
0
1
2
3
4
log10(Area) (square microns)


Model Edge Analysis: Cumulative Particle Area Distribution over 0.1 meter
Pink: Trial 9, Blue: Trial 10, Green: Trial 11, Orange: Trial 12
log10(Particle Count)
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
log10(Area) (square microns)




```
## All Trials Surface Distribution Analysis Results

##
## 1. Correlation Analysis:

##                comparison pearson_r      p_value
## cor   Trial 9 vs Trial 10 0.9767104 2.554861e-67
## cor1  Trial 9 vs Trial 11 0.9605212 2.953926e-56
## cor2  Trial 9 vs Trial 12 0.9819394 1.122806e-72
## cor3 Trial 10 vs Trial 11 0.9817243 1.995089e-72
## cor4 Trial 10 vs Trial 12 0.9906245 1.539446e-86
## cor5 Trial 11 vs Trial 12 0.9710947 8.835377e-63

##
## 2. Kolmogorov-Smirnov Test Results:

##              comparison ks_statistic   p_value
## D   Trial 9 vs Trial 10         0.07 0.9670685
## D1  Trial 9 vs Trial 11         0.13 0.3667264
## D2  Trial 9 vs Trial 12         0.05 0.9996333
## D3 Trial 10 vs Trial 11         0.13 0.3667264
## D4 Trial 10 vs Trial 12         0.07 0.9670685
## D5 Trial 11 vs Trial 12         0.16 0.1545381

##
## 3. Root Mean Square Error Between Distributions:

##             comparison      rmse
## 1  Trial 9 vs Trial 10 0.5892228
## 2  Trial 9 vs Trial 11 0.9925532
```

```
## 3  Trial 9 vs Trial 12 0.5236460
## 4 Trial 10 vs Trial 11 0.6850030
## 5 Trial 10 vs Trial 12 0.3781914
## 6 Trial 11 vs Trial 12 0.8432413
```

```
##
## 4. Regression Analysis for Each Distribution:
```

```
##             source     slope intercept r_squared      p_value
## log_area   Trial 9 -1.948892  9.125252 0.9367151 1.523466e-60
## log_area1 Trial 10 -1.850231  9.040215 0.9603213 1.750396e-70
## log_area2 Trial 11 -1.565777  8.799607 0.9329998 2.498670e-59
## log_area3 Trial 12 -1.815463  8.791456 0.9580624 2.641805e-69
```

```
## [1] "\n5. Area Under Curve Analysis:\n"
```

```
## # A tibble: 4 x 2
##   source     auc
##   <chr>    <dbl>
## 1 Trial 10  22.0
## 2 Trial 11  23.8
## 3 Trial 12  21.2
## 4 Trial 9   21.4
```

```
## [1] "\n6. Distribution Summary Statistics:\n"
```

```
## # A tibble: 4 x 6
##   source   mean_log_count median_log_count sd_log_count min_log_count
##   <chr>             <dbl>            <dbl>        <dbl>         <dbl>
## 1 Trial 10           4.90             5.24         2.48             0
## 2 Trial 11           5.29             5.79         2.13             0
## 3 Trial 12           4.73             5.09         2.43             0
## 4 Trial 9            4.76             5.35         2.64             0
## # i 1 more variable: max_log_count <dbl>
```

```
## All Trials Edge Distribution Analysis Results
```

```
##
## 1. Correlation Analysis:
```

```
##                comparison pearson_r       p_value
## cor   Trial 9 vs Trial 10 0.9929732  1.188271e-92
## cor1  Trial 9 vs Trial 11 0.9907104  9.827838e-87
## cor2  Trial 9 vs Trial 12 0.9866390  4.839999e-79
## cor3 Trial 10 vs Trial 11 0.9757956  1.651127e-66
## cor4 Trial 10 vs Trial 12 0.9704842  2.425167e-62
## cor5 Trial 11 vs Trial 12 0.9957379 2.909056e-103
```

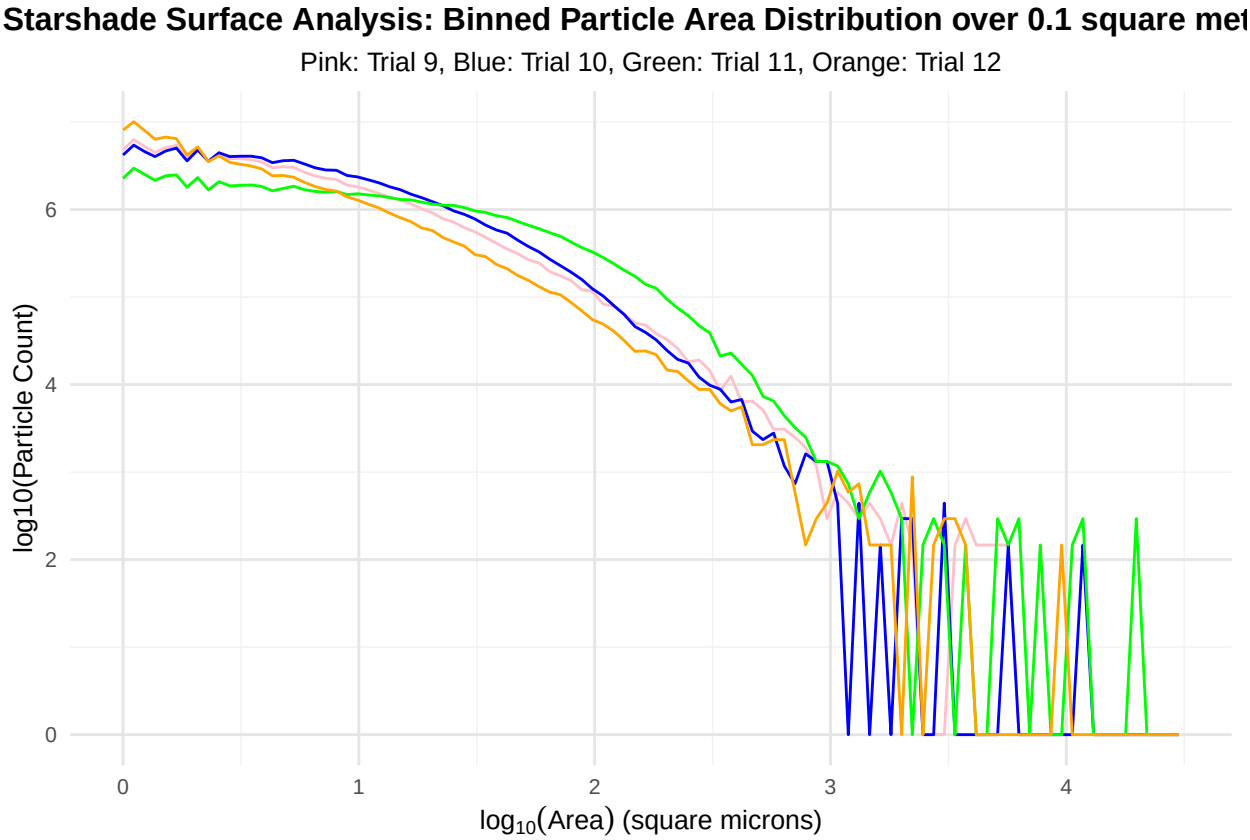
```
##
## 2. Kolmogorov-Smirnov Test Results:
```

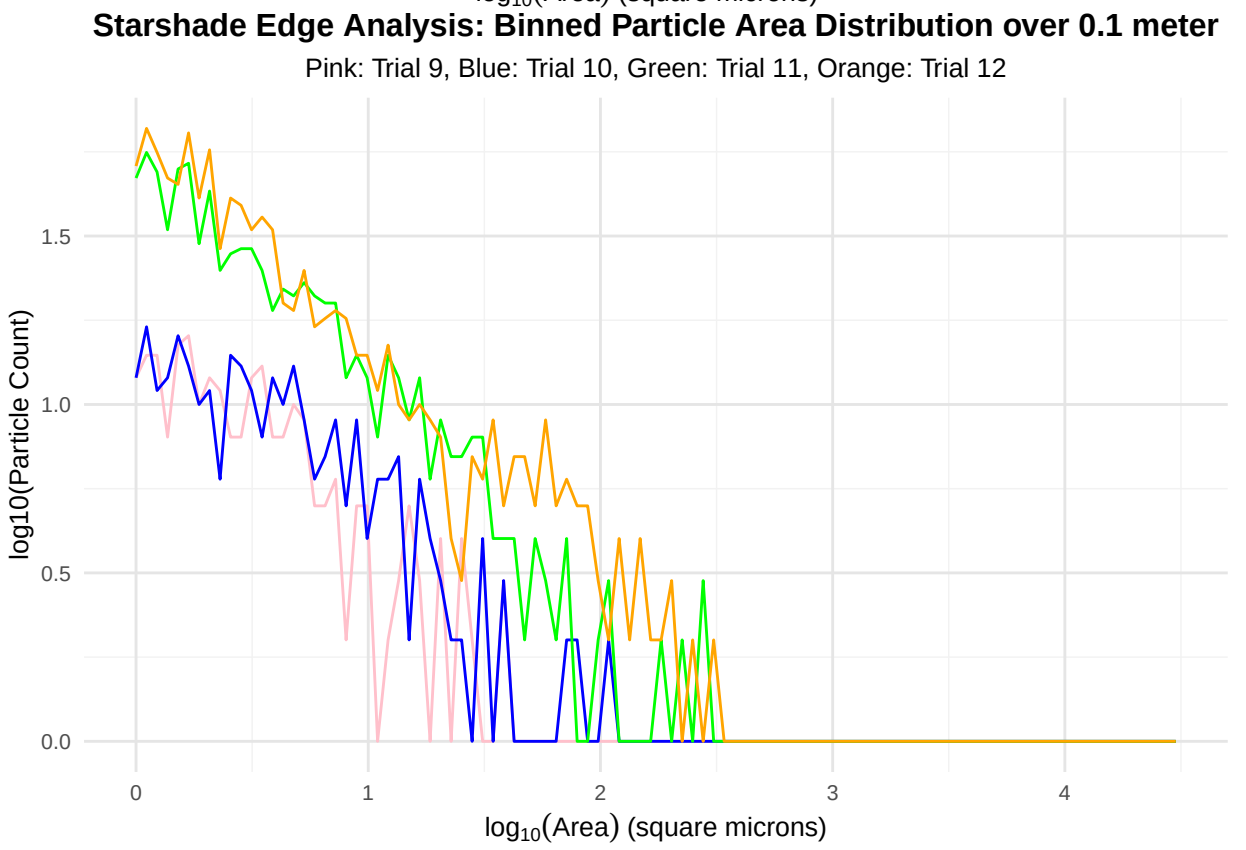
```
##              comparison ks_statistic    p_value
## D   Trial 9 vs Trial 10         0.05 0.99963329
## D1  Trial 9 vs Trial 11         0.17 0.11113334
## D2  Trial 9 vs Trial 12         0.21 0.02431031
## D3 Trial 10 vs Trial 11         0.15 0.21055163
## D4 Trial 10 vs Trial 12         0.17 0.11113334
## D5 Trial 11 vs Trial 12         0.07 0.96706849
```

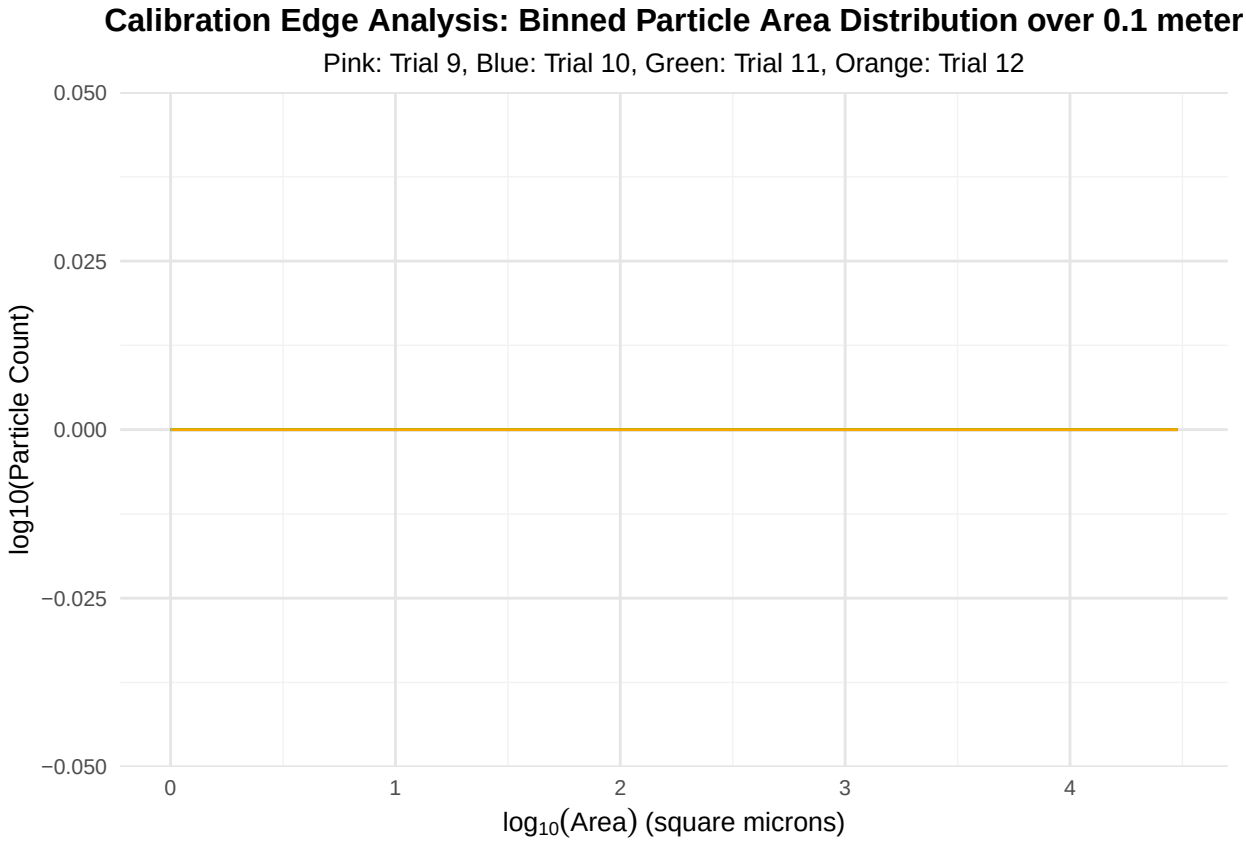
```
##
```

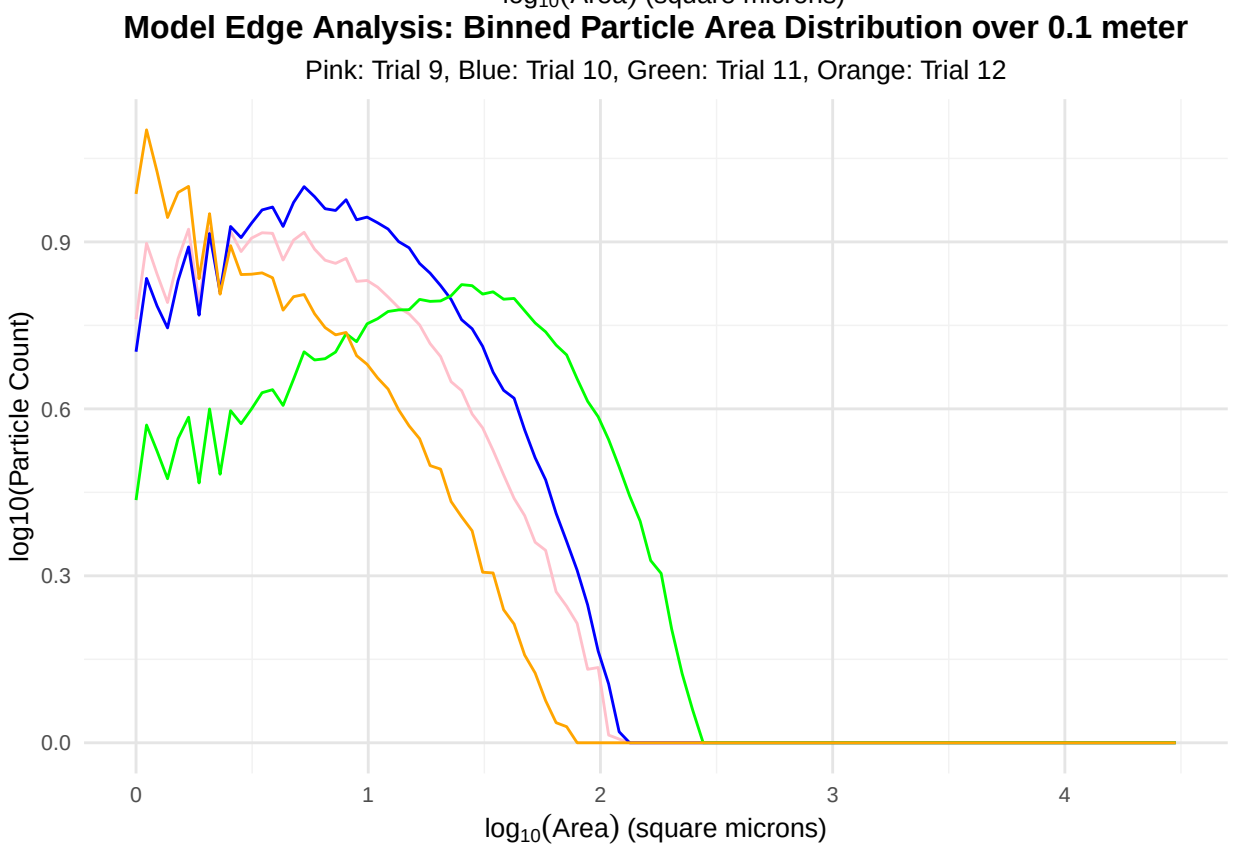
```
## 3. Root Mean Square Error Between Distributions:

##             comparison      rmse
## 1  Trial 9 vs Trial 10 0.1194225
## 2  Trial 9 vs Trial 11 0.3784343
## 3  Trial 9 vs Trial 12 0.4649738
## 4 Trial 10 vs Trial 11 0.3941772
## 5 Trial 10 vs Trial 12 0.4760085
## 6 Trial 11 vs Trial 12 0.1300165

##
## 4. Regression Analysis for Each Distribution:

##             source      slope intercept r_squared      p_value
## log_area   Trial 9 -0.6214753  2.199052 0.8991446 1.285514e-50
## log_area1 Trial 10 -0.6502636  2.260122 0.8648647 2.206654e-44
## log_area2 Trial 11 -0.7813268  2.850182 0.9318638 5.698289e-59
## log_area3 Trial 12 -0.8194974  2.992028 0.9171047 8.542547e-55

## [1] "\n5. Area Under Curve Analysis:\n"

## # A tibble: 4 x 2
##   source     auc
##   <chr>    <dbl>
## 1 Trial 10  3.58
## 2 Trial 11  4.91
## 3 Trial 12  5.17
## 4 Trial 9   3.60

## [1] "\n6. Distribution Summary Statistics:\n"

## # A tibble: 4 x 6
##   source   mean_log_count median_log_count sd_log_count min_log_count
##   <chr>             <dbl>            <dbl>        <dbl>         <dbl>
## 1 Trial 10          0.804            0.301        0.917             0
## 2 Trial 11          1.10             1.04         1.06              0
## 3 Trial 12          1.16             1.11         1.12              0
## 4 Trial 9           0.808            0.602        0.860             0
## # i 1 more variable: max_log_count <dbl>
```

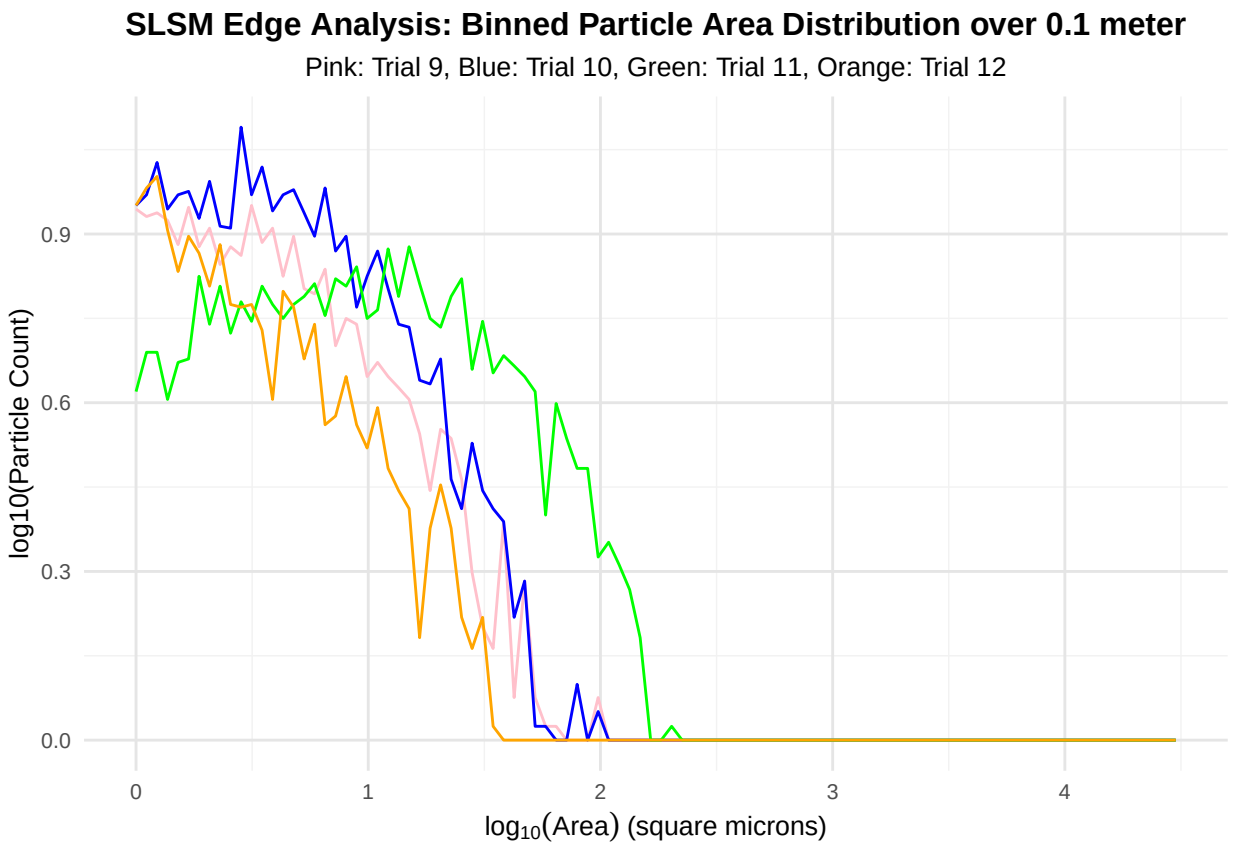
9.2 Binned Comparison



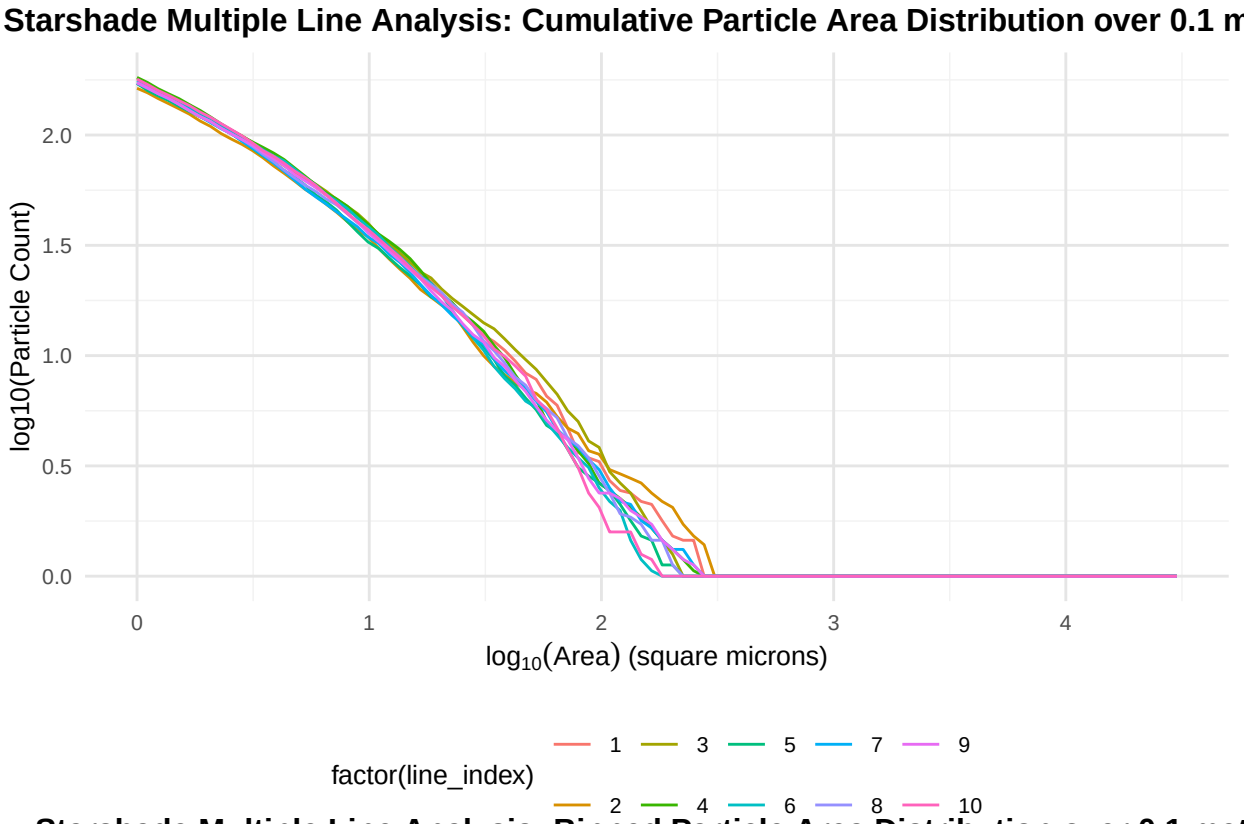


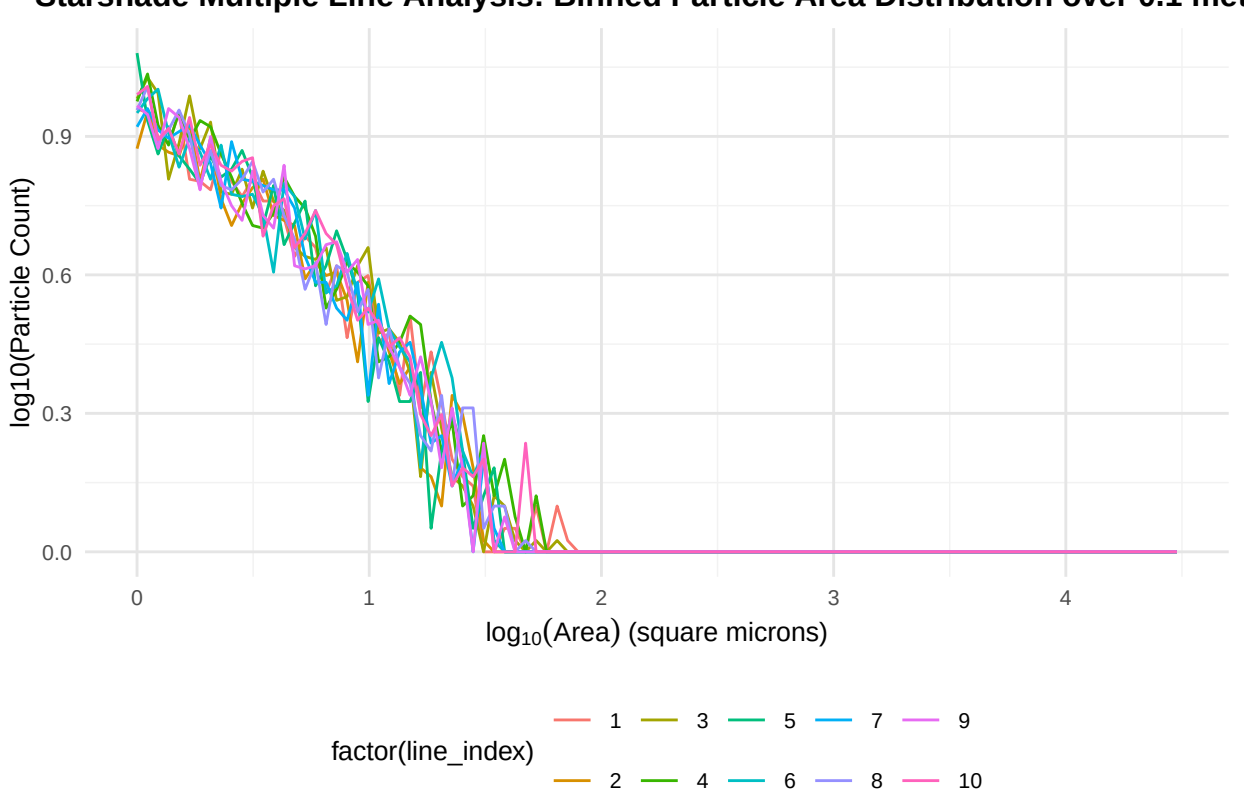

Calibration Edge Analysis: Binned Particle Area Distribution over 0.1 meter
Pink: Trial 9, Blue: Trial 10, Green: Trial 11, Orange: Trial 12
0.050
0.025
0.000
−0.025
−0.050
log10(Particle Count)
0
1
2
3
4
log10(Area) (square microns)

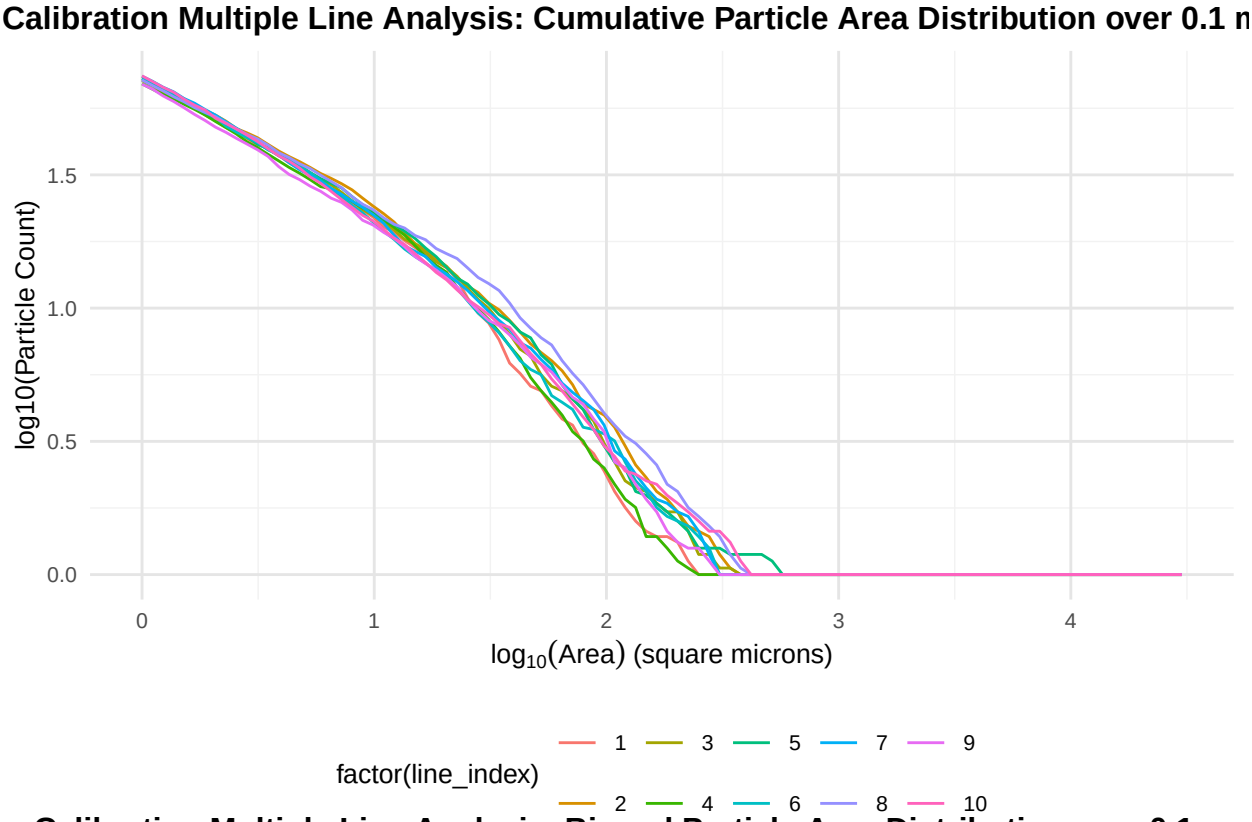

Model Edge Analysis: Binned Particle Area Distribution over 0.1 meter
Pink: Trial 9, Blue: Trial 10, Green: Trial 11, Orange: Trial 12
0.9
0.6
0.3
0.0
log10(Particle Count)
0
1
2
3
4
log10(Area) (square microns)

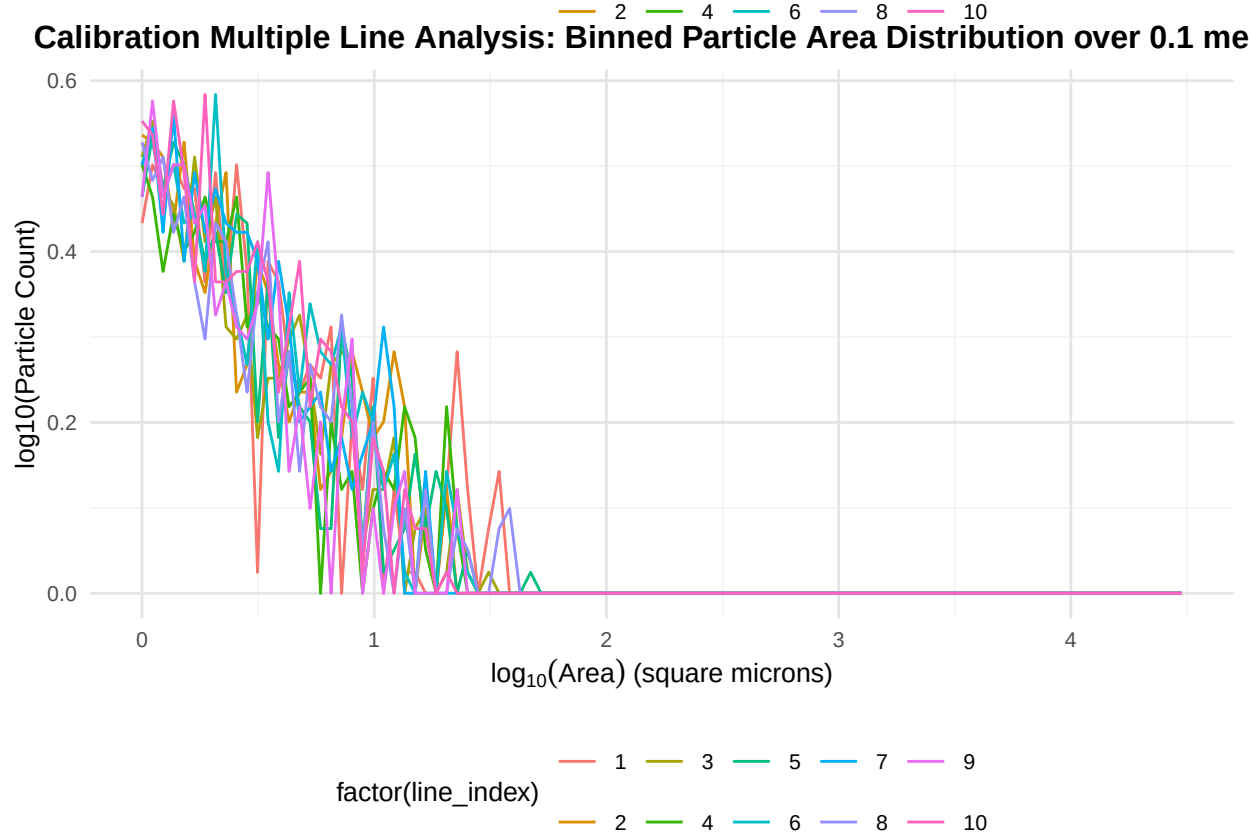

SLSM Edge Analysis: Binned Particle Area Distribution over 0.1 meter
Pink: Trial 9, Blue: Trial 10, Green: Trial 11, Orange: Trial 12
log10(Particle Count)
0.0
0.3
0.6
0.9
0
1
2
3
4
log10(Area) (square microns)

10. Multiple Line analysis










```
## All Lines Starshade Surface Model Distribution Analysis Results
##
```

```
## 1. Correlation Analysis:
```

	comparison	pearson_r	p_value
cor	1 vs 2	0.9988358	7.564024e-131
cor1	1 vs 3	0.9989636	2.552176e-133
cor2	1 vs 4	0.9991493	1.607047e-137
cor3	1 vs 5	0.9981329	8.397415e-121
cor4	1 vs 6	0.9968097	2.044465e-109
cor5	1 vs 7	0.9992770	5.555589e-141
cor6	1 vs 8	0.9988692	1.823520e-131
cor7	1 vs 9	0.9990585	2.302382e-135
cor8	1 vs 10	0.9968905	5.832676e-110
cor9	2 vs 3	0.9971344	1.071306e-111
cor10	2 vs 4	0.9976550	5.872171e-116
cor11	2 vs 5	0.9965330	1.196001e-107
cor12	2 vs 6	0.9946640	1.717183e-98
cor13	2 vs 7	0.9983562	1.644275e-123
cor14	2 vs 8	0.9970609	3.700220e-111
cor15	2 vs 9	0.9978239	1.511973e-117
cor16	2 vs 10	0.9938425	1.876590e-95
cor17	3 vs 4	0.9985084	1.412129e-125
cor18	3 vs 5	0.9977402	9.603163e-117
cor19	3 vs 6	0.9967342	6.428044e-109
cor20	3 vs 7	0.9985922	8.307438e-127
cor21	3 vs 8	0.9989090	3.146807e-132
cor22	3 vs 9	0.9980707	4.178564e-120
cor23	3 vs 10	0.9967482	5.206339e-109
cor24	4 vs 5	0.9995119	2.453363e-149
cor25	4 vs 6	0.9988176	1.618303e-130
cor26	4 vs 7	0.9997190	4.352269e-161
cor27	4 vs 8	0.9996894	5.934717e-159
cor28	4 vs 9	0.9998563	2.327759e-175
cor29	4 vs 10	0.9985817	1.195578e-126
cor30	5 vs 6	0.9994688	1.546511e-147
cor31	5 vs 7	0.9994843	3.603954e-148
cor32	5 vs 8	0.9995238	7.277024e-150
cor33	5 vs 9	0.9996181	1.473628e-154
cor34	5 vs 10	0.9990339	8.161006e-135
cor35	6 vs 7	0.9986209	3.027076e-127
cor36	6 vs 8	0.9990423	5.309737e-135
cor37	6 vs 9	0.9988178	1.604735e-130
cor38	6 vs 10	0.9991555	1.122184e-137
cor39	7 vs 8	0.9995994	1.528436e-153
cor40	7 vs 9	0.9997220	2.560420e-161
cor41	7 vs 10	0.9981863	2.027753e-121
cor42	8 vs 9	0.9995264	5.556977e-150
cor43	8 vs 10	0.9988575	3.009166e-131
cor44	9 vs 10	0.9986334	1.940138e-127

```
##
## 2. Kolmogorov-Smirnov Test Results:
```

	comparison	ks_statistic	p_value
D	1 vs 2	0.03	1.0000000
D1	1 vs 3	0.03	1.0000000

```
## D2      1 vs 4         0.03 1.0000000
## D3      1 vs 5         0.04 0.9999982
## D4      1 vs 6         0.06 0.9937649
## D5      1 vs 7         0.03 1.0000000
## D6      1 vs 8         0.04 0.9999982
## D7      1 vs 9         0.03 1.0000000
## D8     1 vs 10         0.06 0.9937649
## D9      2 vs 3         0.04 0.9999982
## D10     2 vs 4         0.04 0.9999982
## D11     2 vs 5         0.05 0.9996333
## D12     2 vs 6         0.07 0.9670685
## D13     2 vs 7         0.04 0.9999982
## D14     2 vs 8         0.06 0.9937649
## D15     2 vs 9         0.05 0.9996333
## D16    2 vs 10         0.08 0.9062064
## D17     3 vs 4         0.03 1.0000000
## D18     3 vs 5         0.04 0.9999982
## D19     3 vs 6         0.04 0.9999982
## D20     3 vs 7         0.04 0.9999982
## D21     3 vs 8         0.03 1.0000000
## D22     3 vs 9         0.03 1.0000000
## D23    3 vs 10         0.05 0.9996333
## D24     4 vs 5         0.03 1.0000000
## D25     4 vs 6         0.04 0.9999982
## D26     4 vs 7         0.02 1.0000000
## D27     4 vs 8         0.02 1.0000000
## D28     4 vs 9         0.02 1.0000000
## D29    4 vs 10         0.05 0.9996333
## D30     5 vs 6         0.03 1.0000000
## D31     5 vs 7         0.03 1.0000000
## D32     5 vs 8         0.02 1.0000000
## D33     5 vs 9         0.03 1.0000000
## D34    5 vs 10         0.03 1.0000000
## D35     6 vs 7         0.05 0.9996333
## D36     6 vs 8         0.04 0.9999982
## D37     6 vs 9         0.05 0.9996333
## D38    6 vs 10         0.03 1.0000000
## D39     7 vs 8         0.02 1.0000000
## D40     7 vs 9         0.02 1.0000000
## D41    7 vs 10         0.05 0.9996333
## D42     8 vs 9         0.02 1.0000000
## D43    8 vs 10         0.04 0.9999982
## D44    9 vs 10         0.05 0.9996333
##
## 3. Root Mean Square Error Between Distributions:
##    comparison       rmse
## 1      1 vs 2 0.04560622
## 2      1 vs 3 0.03944914
## 3      1 vs 4 0.03633549
## 4      1 vs 5 0.06031709
## 5      1 vs 6 0.07218678
## 6      1 vs 7 0.03888501
## 7      1 vs 8 0.04315660
```

```
## 8      1 vs 9 0.04105515
## 9     1 vs 10 0.07106682
## 10     2 vs 3 0.07168801
## 11     2 vs 4 0.06417193
## 12     2 vs 5 0.07237352
## 13     2 vs 6 0.09106474
## 14     2 vs 7 0.04919926
## 15     2 vs 8 0.06610239
## 16     2 vs 9 0.05758095
## 17    2 vs 10 0.09753202
## 18     3 vs 4 0.04743684
## 19     3 vs 5 0.07060149
## 20     3 vs 6 0.07576008
## 21     3 vs 7 0.05579387
## 22     3 vs 8 0.04758050
## 23     3 vs 9 0.05937966
## 24    3 vs 10 0.07452611
## 25     4 vs 5 0.03960796
## 26     4 vs 6 0.04504994
## 27     4 vs 7 0.03031912
## 28     4 vs 8 0.02497469
## 29     4 vs 9 0.02235435
## 30    4 vs 10 0.04750144
## 31     5 vs 6 0.03103146
## 32     5 vs 7 0.02843356
## 33     5 vs 8 0.02972391
## 34     5 vs 9 0.02612048
## 35    5 vs 10 0.04105053
## 36     6 vs 7 0.04678188
## 37     6 vs 8 0.03814762
## 38     6 vs 9 0.04202460
## 39    6 vs 10 0.03396742
## 40     7 vs 8 0.02474454
## 41     7 vs 9 0.02011513
## 42    7 vs 10 0.05355944
## 43     8 vs 9 0.02505910
## 44    8 vs 10 0.04159827
## 45    9 vs 10 0.04546680

##
## 4. Regression Analysis for Each Distribution:

##           source      slope intercept r_squared      p_value
## log_area       1 -0.5745947  1.991477 0.8626897 4.831235e-44
## log_area1      2 -0.5615357  1.951405 0.8707654 2.467110e-45
## log_area2      3 -0.5815099  2.014236 0.8589816 1.786614e-43
## log_area3      4 -0.5778383  1.990227 0.8490061 5.116960e-42
## log_area4      5 -0.5636019  1.932306 0.8397044 9.626891e-41
## log_area5      6 -0.5716532  1.955292 0.8314698 1.126230e-39
## log_area6      7 -0.5655892  1.948491 0.8516637 2.140208e-42
## log_area7      8 -0.5702904  1.962300 0.8465250 1.138847e-41
## log_area8      9 -0.5688896  1.957308 0.8475658 8.154343e-42
## log_area9     10 -0.5735963  1.962319 0.8304943 1.495185e-39

## [1] "\n5. Area Under Curve Analysis:\n"
```

```
## # A tibble: 10 x 2
##    source   auc
##     <dbl> <dbl>
##  1      1  3.14
##  2      2  3.09
##  3      3  3.17
##  4      4  3.10
##  5      5  2.98
##  6      6  3.00
##  7      7  3.04
##  8      8  3.05
##  9      9  3.04
## 10     10  3.02
```

```
## [1] "\n6. Distribution Summary Statistics:\n"
```

```
## # A tibble: 10 x 6
##    source mean_log_count median_log_count sd_log_count min_log_count
##     <dbl>          <dbl>            <dbl>        <dbl>         <dbl>
##  1      1          0.705           0.289         0.812             0
##  2      2          0.694           0.358         0.790             0
##  3      3          0.712           0.191         0.823             0
##  4      4          0.697           0.191         0.823             0
##  5      5          0.671           0.107         0.807             0
##  6      6          0.675           0.0123        0.823             0
##  7      7          0.682           0.191         0.804             0
##  8      8          0.686           0.163         0.813             0
##  9      9          0.684           0.199         0.811             0
## 10     10          0.678           0.0379        0.826             0
## # i 1 more variable: max_log_count <dbl>
```

```
## All Lines Calibration Surface Model Distribution Analysis Results
```

```
##
## 1. Correlation Analysis:
```

```
##       comparison pearson_r       p_value
## cor       1 vs 2 0.9951516 1.585809e-100
## cor1      1 vs 3 0.9980309 1.133750e-119
## cor2      1 vs 4 0.9996635 2.967063e-157
## cor3      1 vs 5 0.9972659 1.074680e-112
## cor4      1 vs 6 0.9977437 8.888355e-117
## cor5      1 vs 7 0.9963519 1.443638e-106
## cor6      1 vs 8 0.9912174  6.357962e-88
## cor7      1 vs 9 0.9974059 8.211316e-114
## cor8     1 vs 10 0.9960779 4.987475e-105
## cor9      2 vs 3 0.9990980 2.826783e-136
## cor10     2 vs 4 0.9956136 1.186185e-102
## cor11     2 vs 5 0.9989762 1.398791e-133
## cor12     2 vs 6 0.9988876 8.141502e-132
## cor13     2 vs 7 0.9995798 1.590111e-152
## cor14     2 vs 8 0.9990443 4.795013e-135
## cor15     2 vs 9 0.9990832 6.262543e-136
## cor16    2 vs 10 0.9988805 1.114875e-131
## cor17     3 vs 4 0.9980244 1.331972e-119
## cor18     3 vs 5 0.9994264 6.612416e-146
```

```
## cor19     3 vs 6 0.9993988 6.650110e-145
## cor20     3 vs 7 0.9994928 1.600257e-148
## cor21     3 vs 8 0.9973050 5.318698e-113
## cor22     3 vs 9 0.9994168 1.496608e-145
## cor23    3 vs 10 0.9989620 2.743538e-133
## cor24     4 vs 5 0.9976441 7.370042e-116
## cor25     4 vs 6 0.9976520 6.252802e-116
## cor26     4 vs 7 0.9964772 2.614028e-107
## cor27     4 vs 8 0.9917808  2.501950e-89
## cor28     4 vs 9 0.9978268 1.417424e-117
## cor29    4 vs 10 0.9960215 1.003350e-104
## cor30     5 vs 6 0.9986322 2.027655e-127
## cor31     5 vs 7 0.9990655 1.601072e-135
## cor32     5 vs 8 0.9975328 7.051565e-115
## cor33     5 vs 9 0.9991998 8.012992e-139
## cor34    5 vs 10 0.9989044 3.859015e-132
## cor35     6 vs 7 0.9993785 3.372592e-144
## cor36     6 vs 8 0.9964680 2.967844e-107
## cor37     6 vs 9 0.9991261 5.993121e-137
## cor38    6 vs 10 0.9989494 4.960029e-133
## cor39     7 vs 8 0.9981711 3.053264e-121
## cor40     7 vs 9 0.9995037 5.519521e-149
## cor41    7 vs 10 0.9990765 8.956911e-136
## cor42     8 vs 9 0.9970648 3.466921e-111
## cor43    8 vs 10 0.9977610 6.102946e-117
## cor44    9 vs 10 0.9983836 7.216465e-124
##
## 2. Kolmogorov-Smirnov Test Results:
##     comparison ks_statistic   p_value
## D       1 vs 2         0.06 0.9937649
## D1      1 vs 3         0.05 0.9996333
## D2      1 vs 4         0.02 1.0000000
## D3      1 vs 5         0.08 0.9062064
## D4      1 vs 6         0.05 0.9996333
## D5      1 vs 7         0.06 0.9937649
## D6      1 vs 8         0.07 0.9670685
## D7      1 vs 9         0.04 0.9999982
## D8     1 vs 10         0.08 0.9062064
## D9      2 vs 3         0.03 1.0000000
## D10     2 vs 4         0.07 0.9670685
## D11     2 vs 5         0.05 0.9996333
## D12     2 vs 6         0.04 0.9999982
## D13     2 vs 7         0.02 1.0000000
## D14     2 vs 8         0.03 1.0000000
## D15     2 vs 9         0.04 0.9999982
## D16    2 vs 10         0.03 1.0000000
## D17     3 vs 4         0.05 0.9996333
## D18     3 vs 5         0.06 0.9937649
## D19     3 vs 6         0.02 1.0000000
## D20     3 vs 7         0.02 1.0000000
## D21     3 vs 8         0.04 0.9999982
## D22     3 vs 9         0.03 1.0000000
## D23    3 vs 10         0.04 0.9999982
```

```
## D24     4 vs 5         0.09 0.8127483
## D25     4 vs 6         0.05 0.9996333
## D26     4 vs 7         0.06 0.9937649
## D27     4 vs 8         0.07 0.9670685
## D28     4 vs 9         0.04 0.9999982
## D29    4 vs 10         0.08 0.9062064
## D30     5 vs 6         0.06 0.9937649
## D31     5 vs 7         0.06 0.9937649
## D32     5 vs 8         0.04 0.9999982
## D33     5 vs 9         0.06 0.9937649
## D34    5 vs 10         0.04 0.9999982
## D35     6 vs 7         0.03 1.0000000
## D36     6 vs 8         0.05 0.9996333
## D37     6 vs 9         0.03 1.0000000
## D38    6 vs 10         0.03 1.0000000
## D39     7 vs 8         0.03 1.0000000
## D40     7 vs 9         0.03 1.0000000
## D41    7 vs 10         0.03 1.0000000
## D42     8 vs 9         0.05 0.9996333
## D43    8 vs 10         0.04 0.9999982
## D44    9 vs 10         0.05 0.9996333
##
## 3. Root Mean Square Error Between Distributions:
##    comparison       rmse
## 1      1 vs 2 0.08061827
## 2      1 vs 3 0.04924833
## 3      1 vs 4 0.01778867
## 4      1 vs 5 0.06143171
## 5      1 vs 6 0.04950316
## 6      1 vs 7 0.06588700
## 7      1 vs 8 0.10817392
## 8      1 vs 9 0.05213392
## 9     1 vs 10 0.06769087
## 10     2 vs 3 0.03571660
## 11     2 vs 4 0.07835248
## 12     2 vs 5 0.03250816
## 13     2 vs 6 0.04315720
## 14     2 vs 7 0.02461213
## 15     2 vs 8 0.03347406
## 16     2 vs 9 0.04698409
## 17    2 vs 10 0.03780540
## 18     3 vs 4 0.04949169
## 19     3 vs 5 0.02538749
## 20     3 vs 6 0.02480585
## 21     3 vs 7 0.02255071
## 22     3 vs 8 0.06117038
## 23     3 vs 9 0.02850054
## 24    3 vs 10 0.03200326
## 25     4 vs 5 0.05885528
## 26     4 vs 6 0.05018166
## 27     4 vs 7 0.06518483
## 28     4 vs 8 0.10606138
## 29     4 vs 9 0.04777213
```

```
## 30    4 vs 10 0.06794804
## 31     5 vs 6 0.03988339
## 32     5 vs 7 0.02958268
## 33     5 vs 8 0.05366749
## 34     5 vs 9 0.03778891
## 35    5 vs 10 0.03318666
## 36     6 vs 7 0.02772706
## 37     6 vs 8 0.07122050
## 38     6 vs 9 0.02927052
## 39    6 vs 10 0.03309176
## 40     7 vs 8 0.05017981
## 41     7 vs 9 0.03078581
## 42    7 vs 10 0.02992986
## 43     8 vs 9 0.07199508
## 44    8 vs 10 0.05542910
## 45    9 vs 10 0.04207640
```

```
##
## 4. Regression Analysis for Each Distribution:
```

```
##           source      slope intercept r_squared      p_value
## log_area       1 -0.4799373  1.655257 0.8485806 5.874869e-42
## log_area1      2 -0.4913128  1.725389 0.8838731 1.297678e-47
## log_area2      3 -0.4839446  1.688698 0.8727120 1.171503e-45
## log_area3      4 -0.4782786  1.650797 0.8486298 5.781843e-42
## log_area4      5 -0.4866653  1.705628 0.8794854 8.006856e-47
## log_area5      6 -0.4805276  1.674285 0.8729008 1.089199e-45
## log_area6      7 -0.4857015  1.699302 0.8789826 9.821404e-47
## log_area7      8 -0.4926665  1.743552 0.8943796 1.237636e-49
## log_area8      9 -0.4752808  1.656676 0.8706598 2.567988e-45
## log_area9     10 -0.4818688  1.689285 0.8850458 7.886536e-48
```

```
## [1] "\n5. Area Under Curve Analysis:\n"
```

```
## # A tibble: 10 x 2
##    source   auc
##     <dbl> <dbl>
##  1      1  2.58
##  2      2  2.79
##  3      3  2.70
##  4      4  2.58
##  5      5  2.74
##  6      6  2.66
##  7      7  2.73
##  8      8  2.86
##  9      9  2.64
## 10     10  2.72
```

```
## [1] "\n6. Distribution Summary Statistics:\n"
```

```
## # A tibble: 10 x 6
##    source mean_log_count median_log_count sd_log_count min_log_count
##     <dbl>          <dbl>            <dbl>        <dbl>         <dbl>
##  1      1          0.581            0.143        0.684             0
##  2      2          0.625            0.297        0.686             0
##  3      3          0.605            0.252        0.680             0
##  4      4          0.580            0.121        0.681             0
```

```
##  5      5          0.616            0.252        0.681             0
##  6      6          0.598            0.235        0.675             0
##  7      7          0.612            0.275        0.680             0
##  8      8          0.641            0.375        0.684             0
##  9      9          0.593            0.199        0.668             0
## 10     10          0.610            0.318        0.672             0
## # i 1 more variable: max_log_count <dbl>
```

11. Paper Comparisons