PACE Applications to Case II Waters:

Backscatter Response to Particle Composition and Morphology

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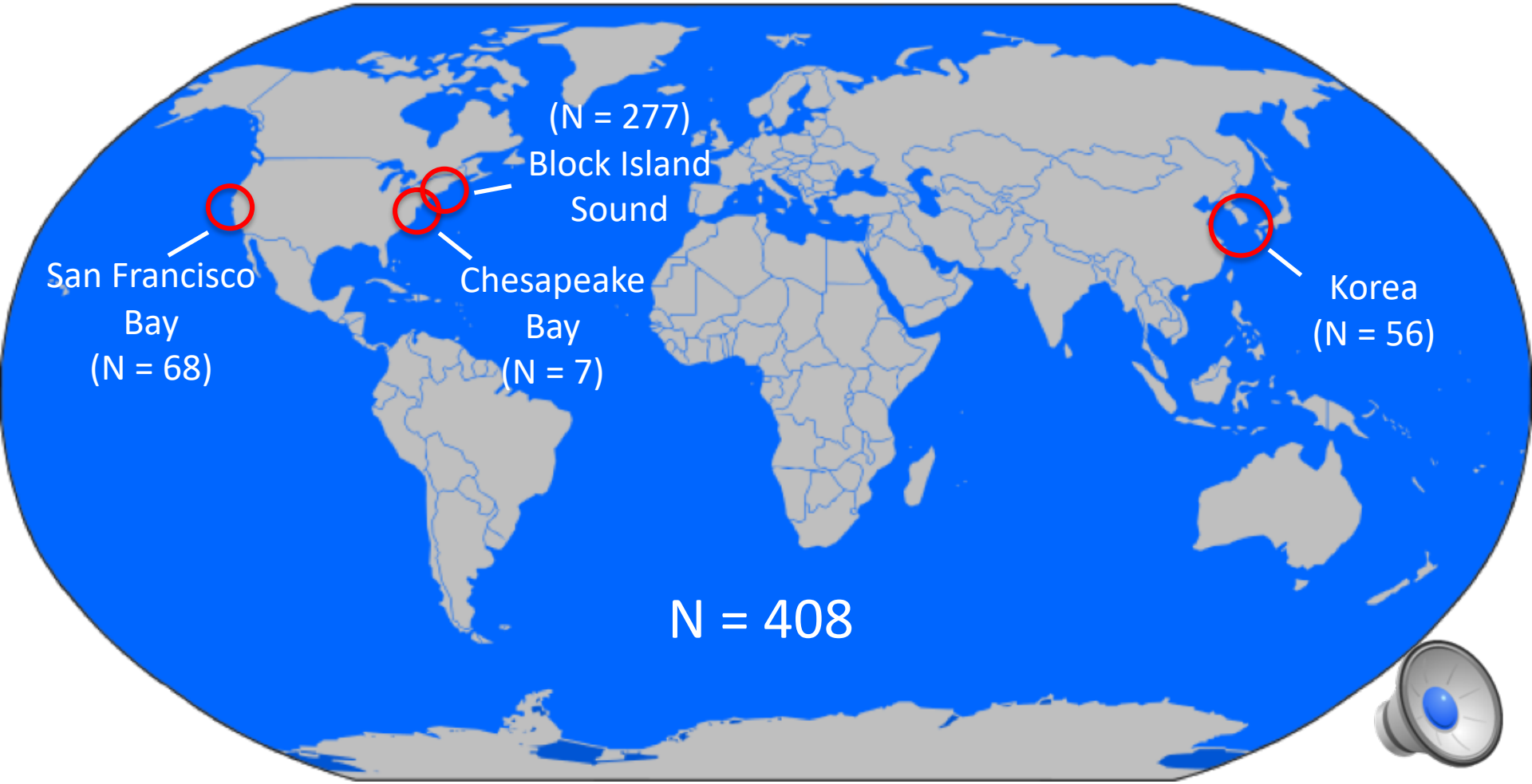


Definitions

Particle Composition (*water samples*)

Suspended Particulate Mass: SPM g m^{-3}

Particulate Organic Carbon: POC g m^{-3}

Particle Morphology (*LISST 100X*)

Sauter Diameter: $D_s = 6 * V_p A_p^{-1}$ μ

Apparent Density: $\rho_a = SPM\ V_p^{-1}$ kg m^{-3}

Particle Backscatter Properties (*ac and b_b sensors*)

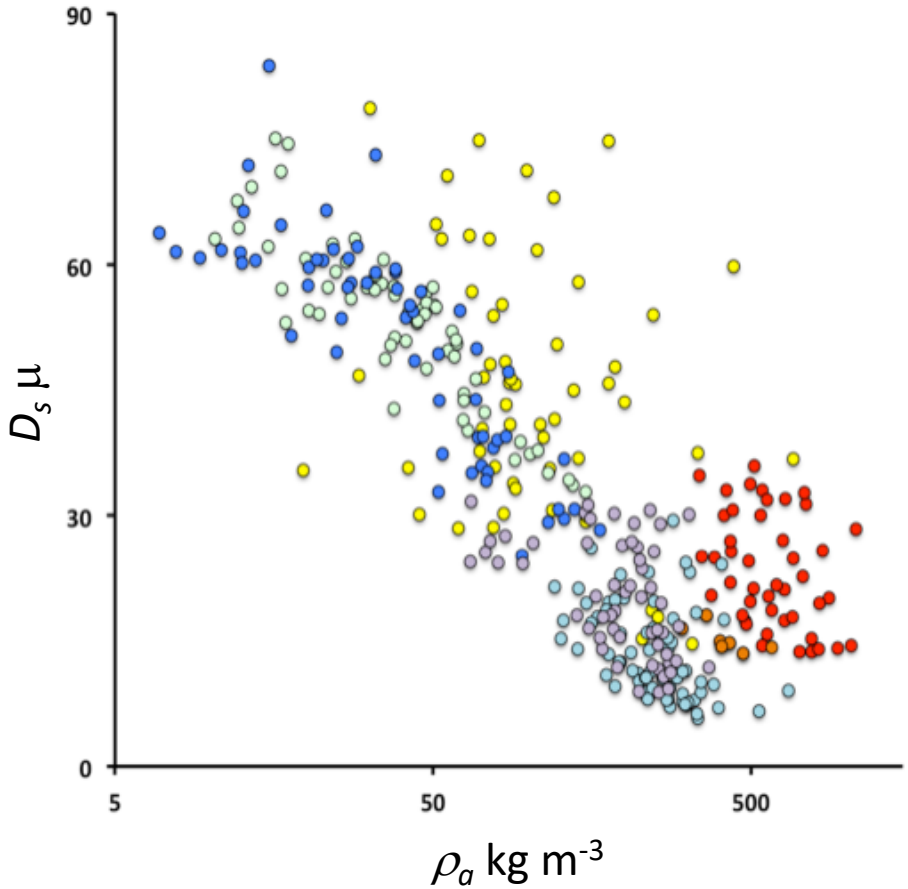
Backscatter Ratio: $\tilde{b}_{bp} = b_{bp}\ b_p^{-1}$

Mass-Specific Backscatter: $b^*_{bp} = b_{bp}\ SPM^{-1}$ m^2 g^{-1}

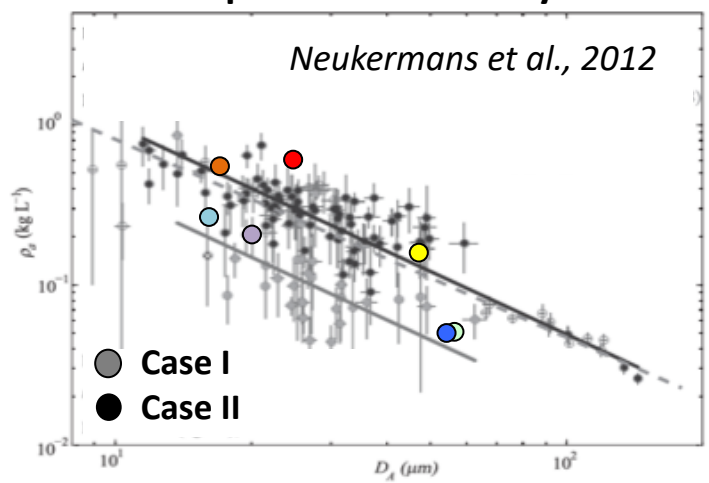
Spectral Slope: $\eta = \ln[b_{bp}(\lambda)/b_{bp}(\lambda_o)]/(\lambda_o/\lambda)$

Particle Size and Apparent Density

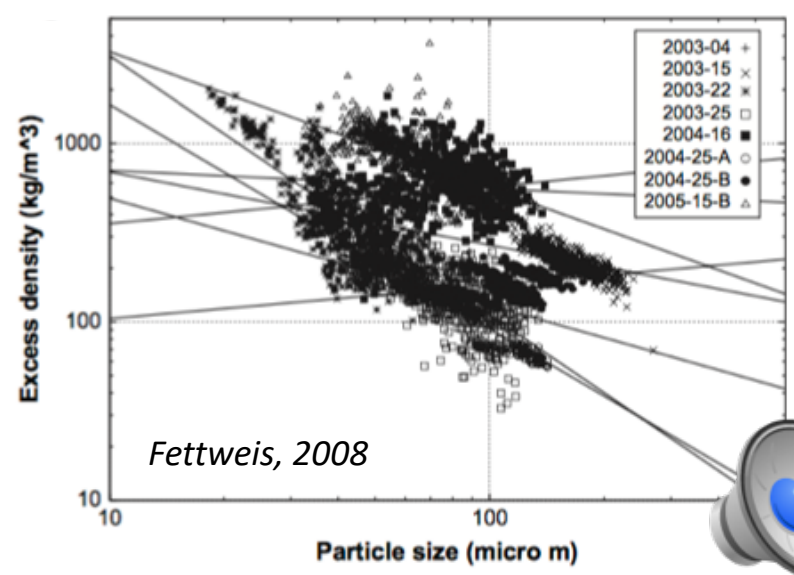
SFB/D Chs. Bay BIS_0613 BIS_0813 BIS_1113 BIS_0114 Korea



Europe and French Guyana



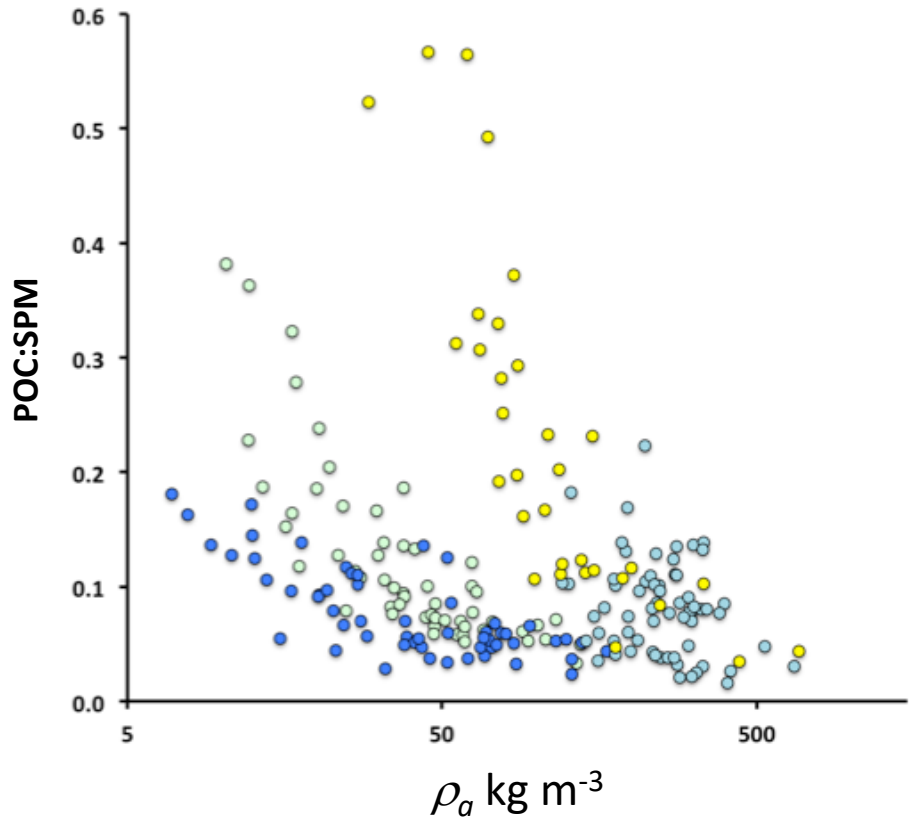
North Sea

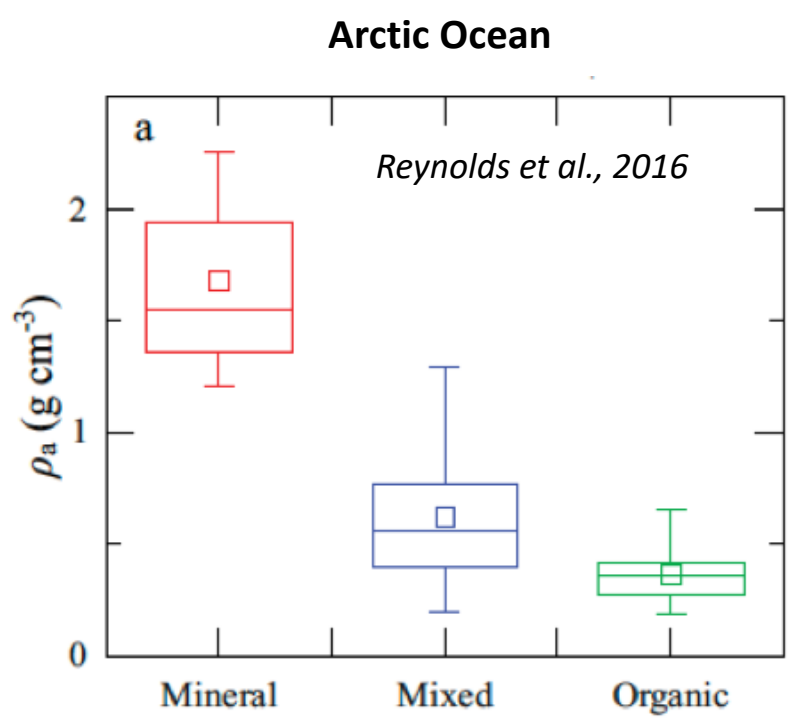


Particle size and apparent density (and excess density) are inversely correlated.

Particle Apparent Density and Carbon Content

BIS_0613 BIS_0813 BIS_1113 Korea

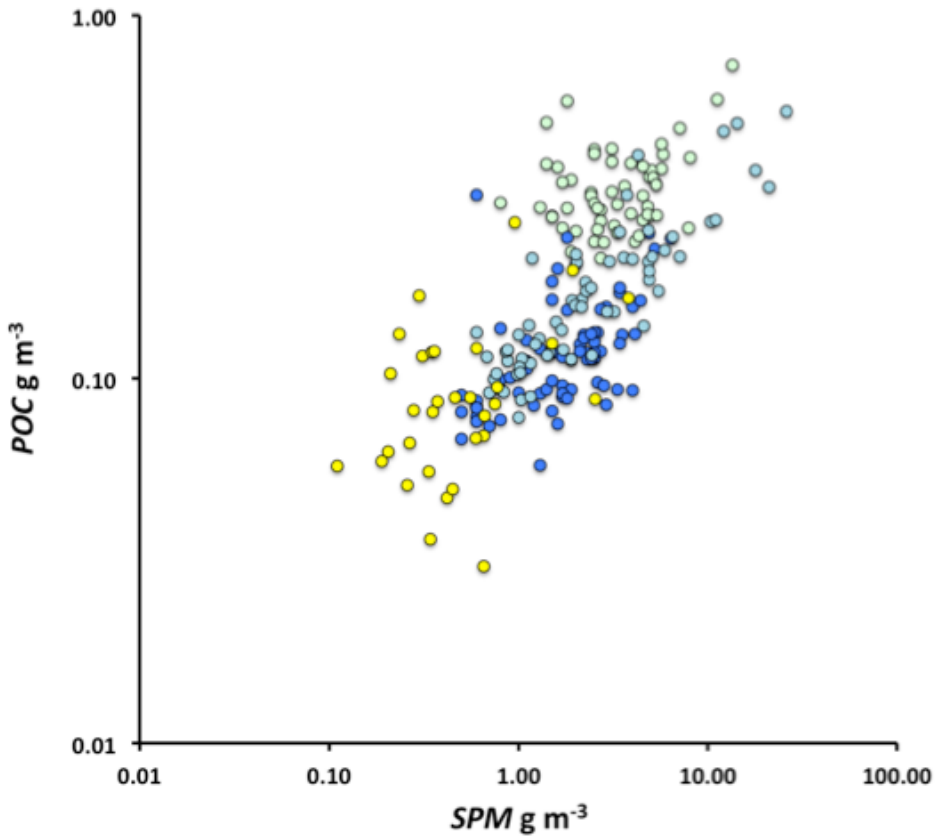




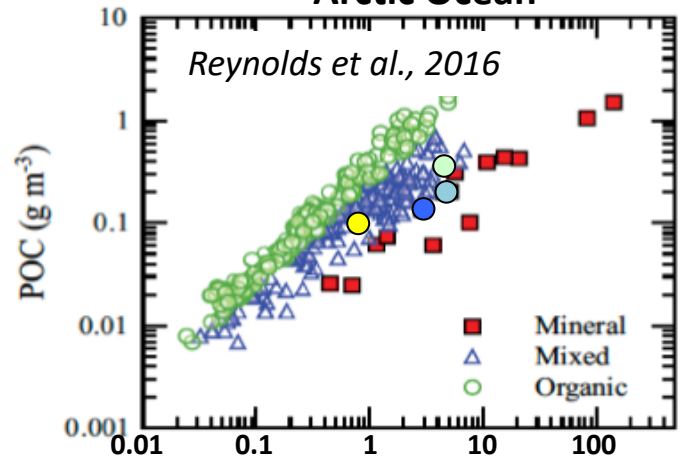
Particle apparent density decreases with increasing POC content.

SPM Versus Composition

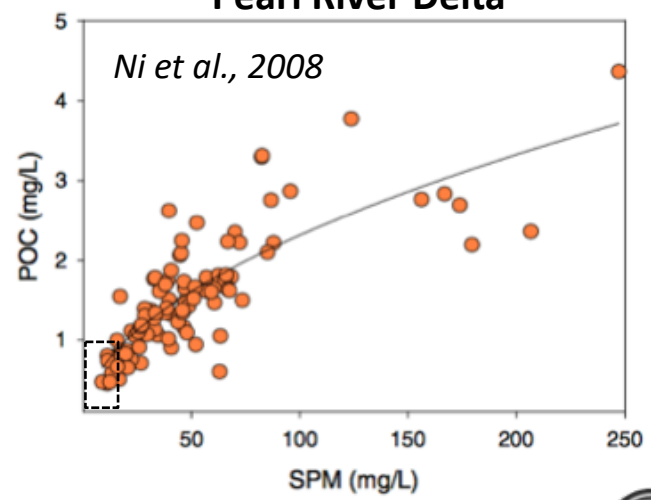
BIS_0613 BIS_0813 BIS_1113 Korea



Arctic Ocean



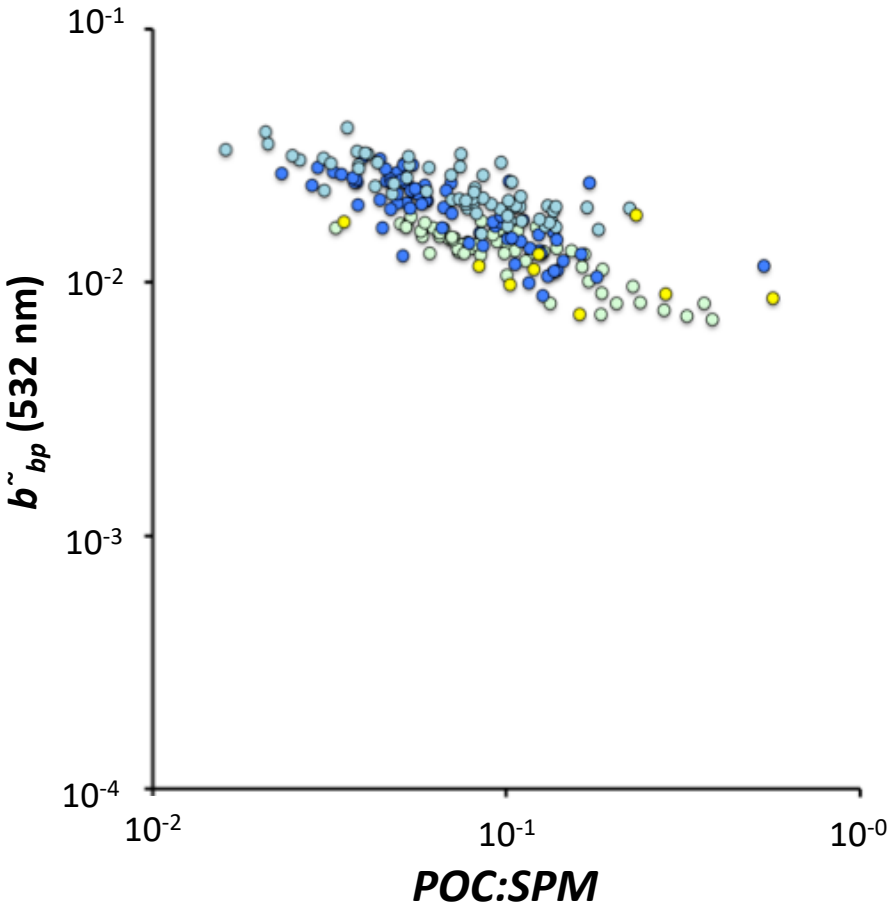
Pearl River Delta

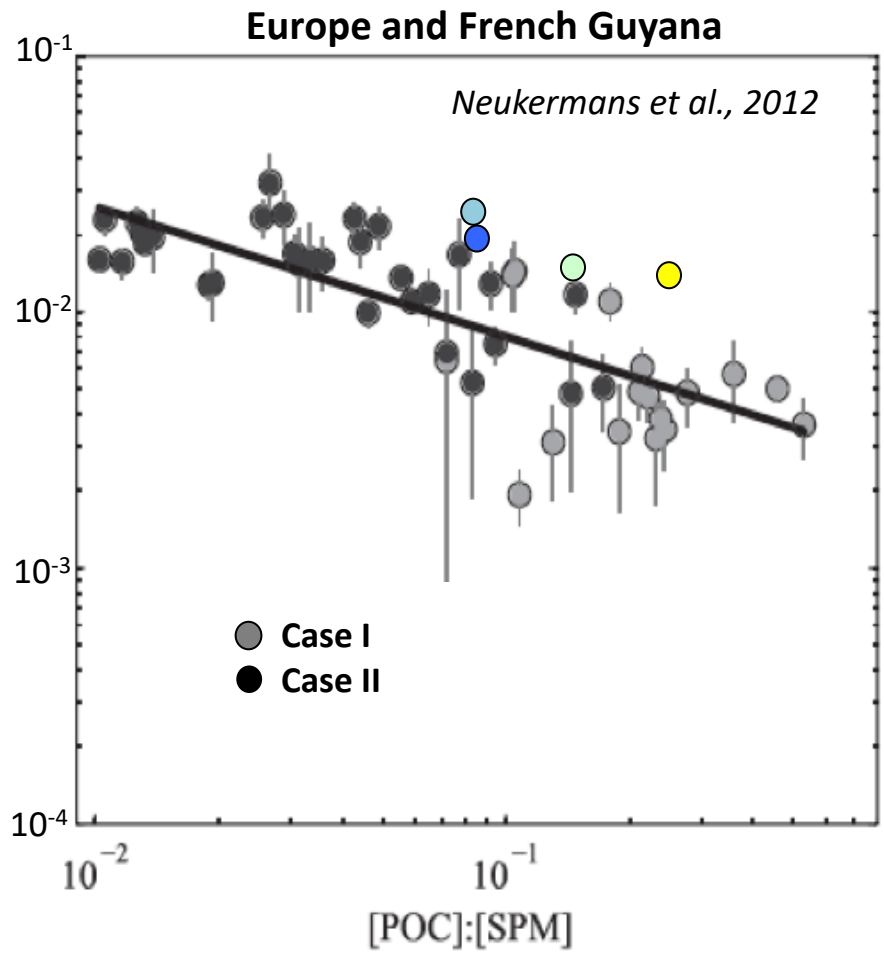


Particulate organic carbon concentration is positively correlated with the concentration of suspended particulate mass.

Fractional Backscatter, $\tilde{b}_{bp}$

BIS_0613 BIS_0813 BIS_1113 Korea

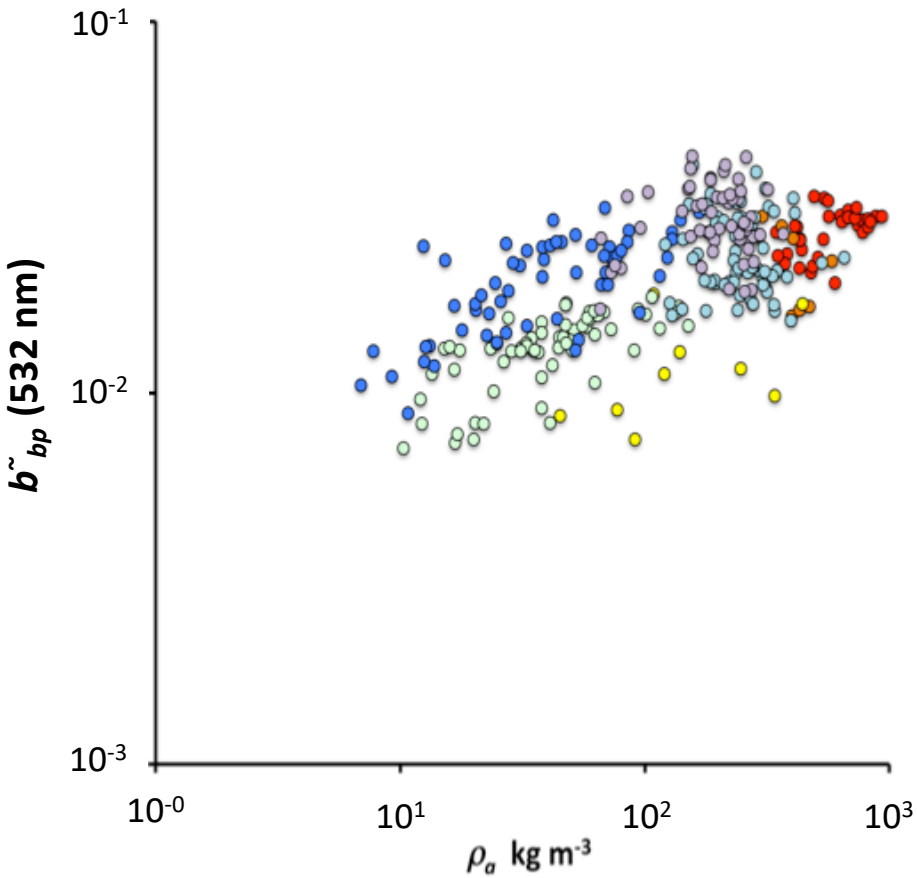


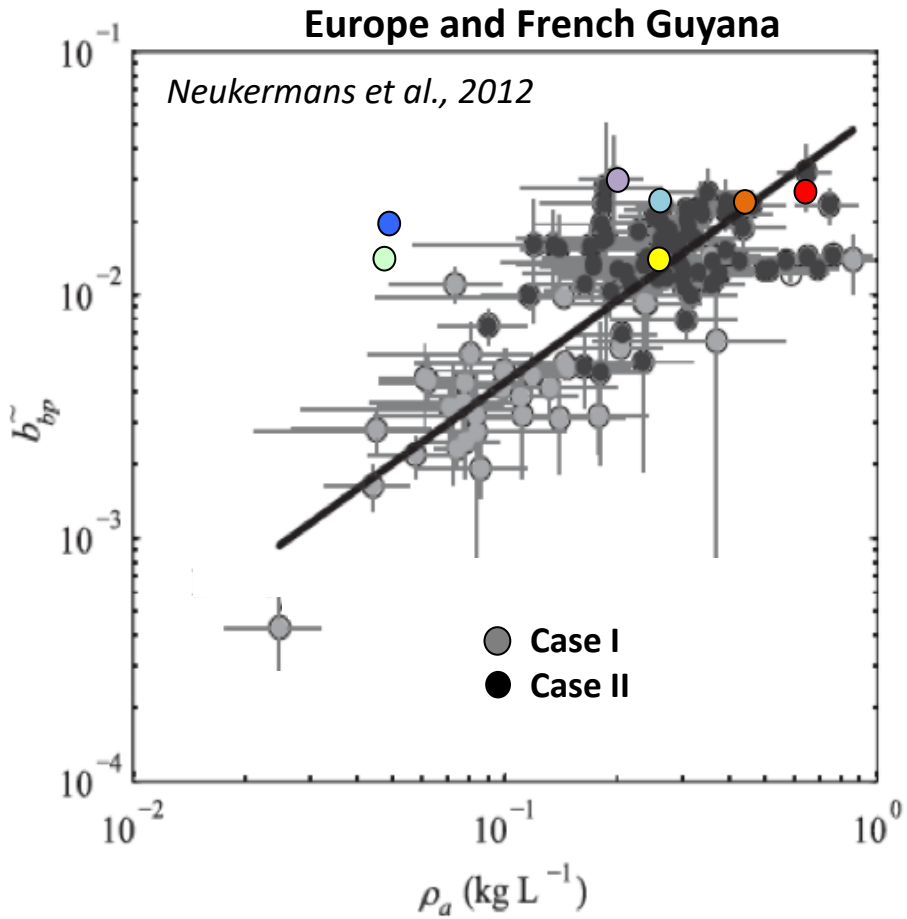


Backscatter ratio is negatively correlated with the fraction of organic carbon.

Fractional Backscatter, $\tilde{b}_{bp}$

SFB/D Chs. Bay BIS_0613 BIS_0813 BIS_1113 BIS_0114 Korea

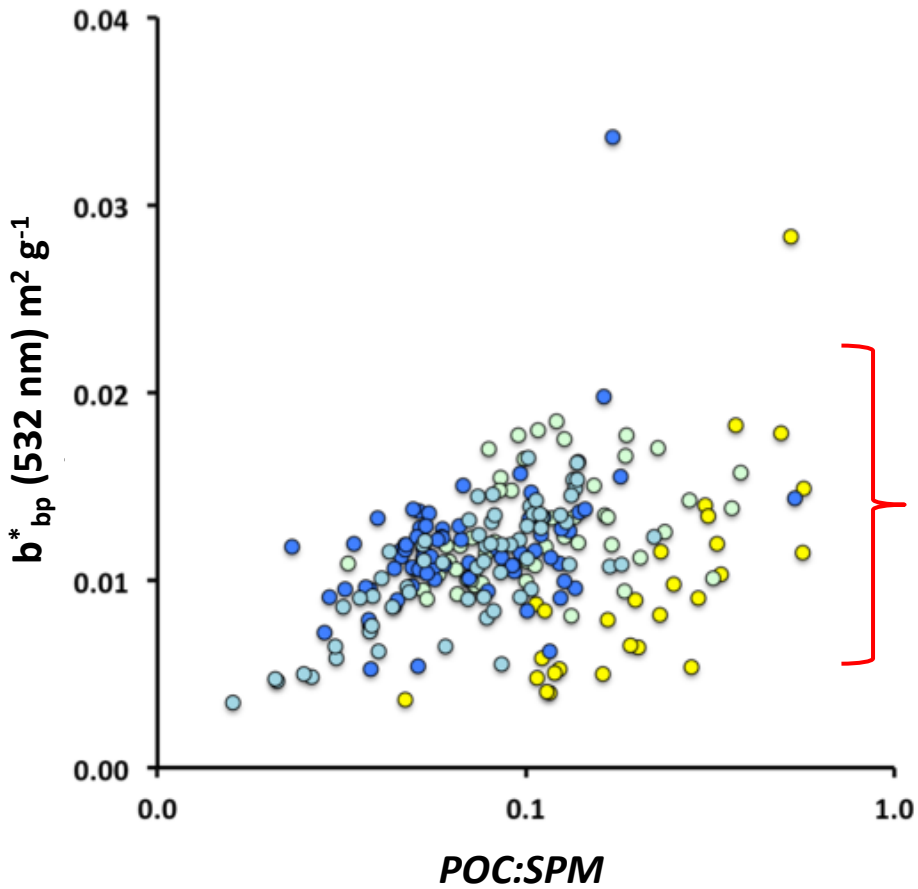


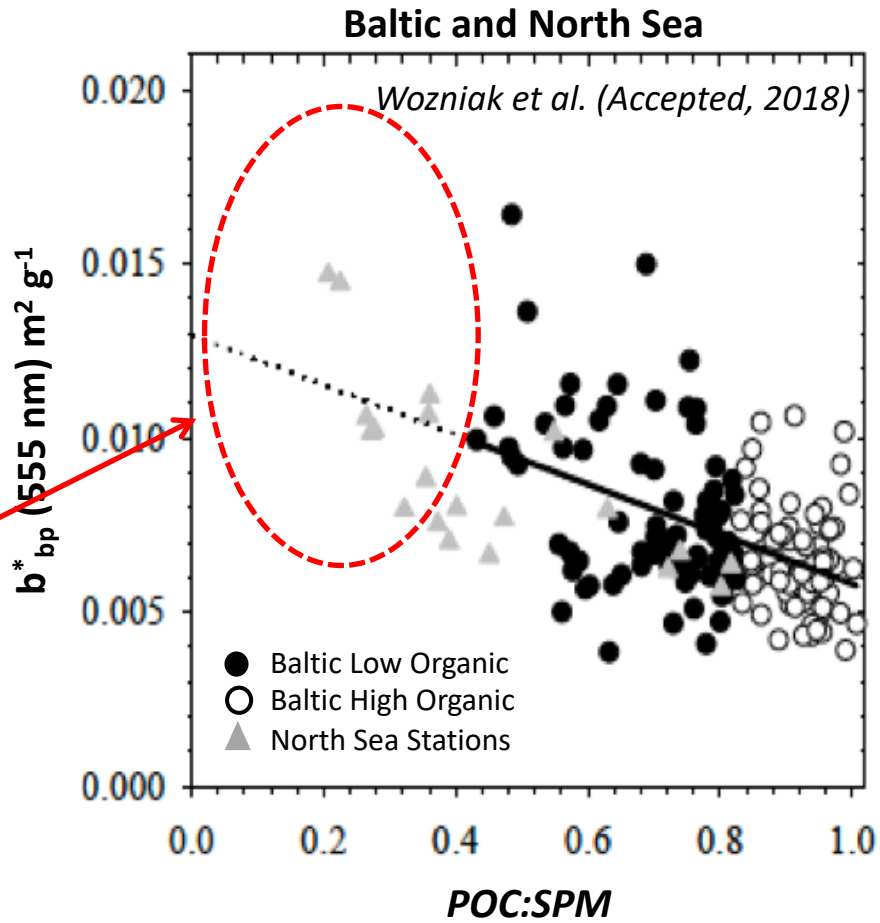


Backscatter ratio is positively correlated with particle apparent density.

Mass-Specific Backscatter

BIS_0613 BIS_0813 BIS_1113 Korea

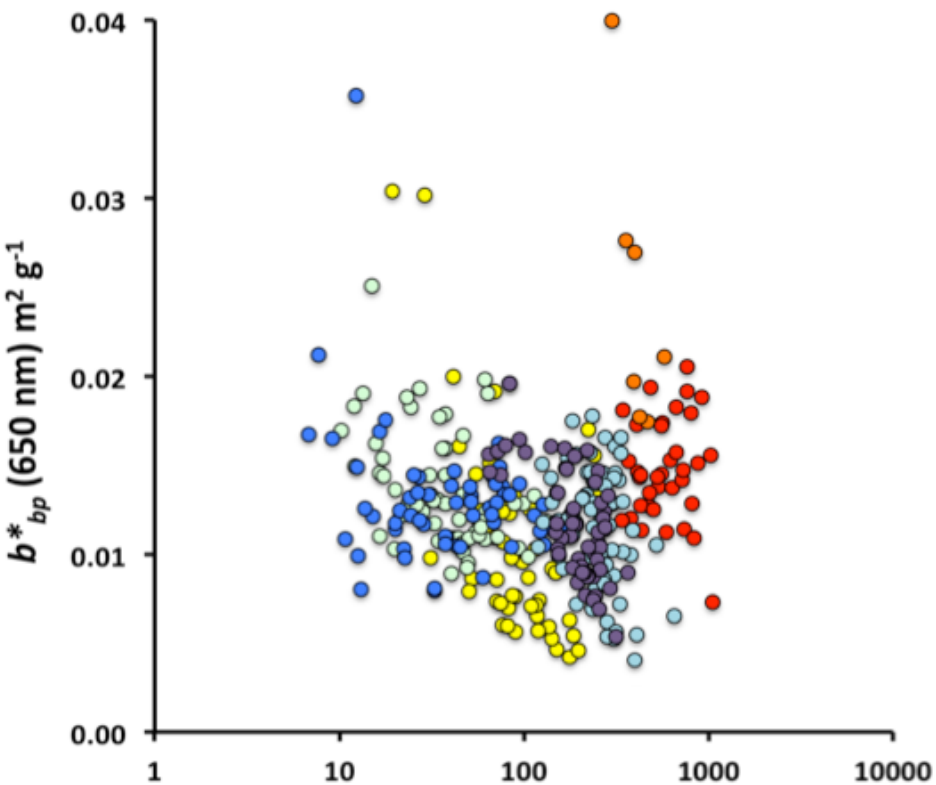


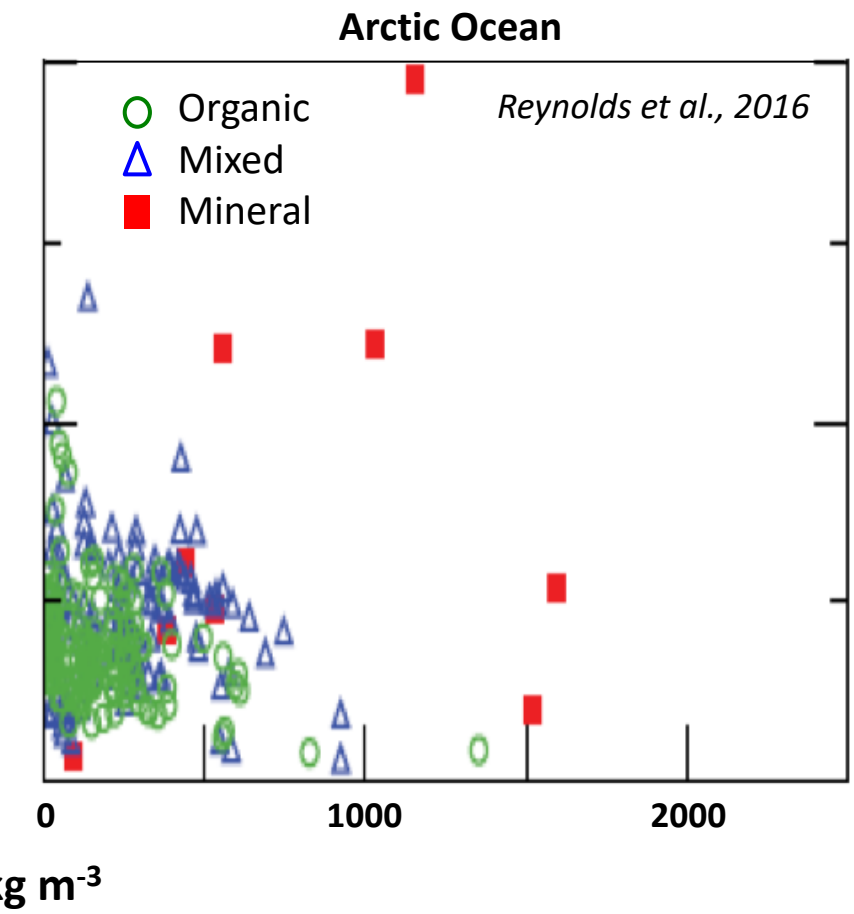


The spectral slope of backscatter appears to increase with the fraction of organic matter, contrary to previous reports.

Mass-Specific Backscatter

SFB/D Chs. Bay BIS_0613 BIS_0813 BIS_1113 BIS_0114 Korea

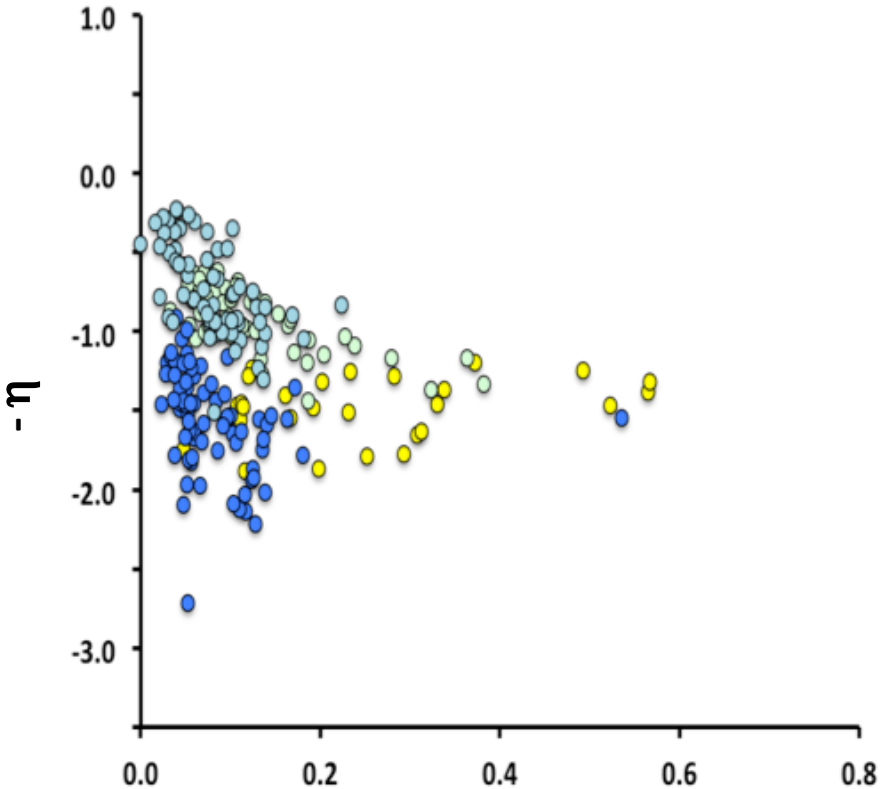




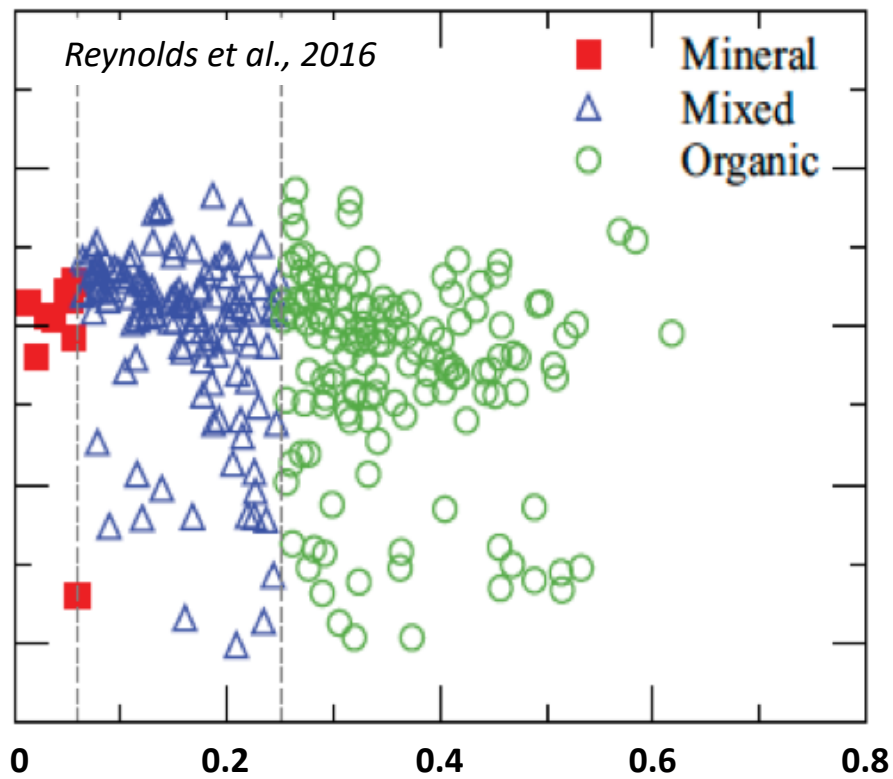
Mass-specific backscatter and apparent particle density appear poorly correlated

Spectral Slope of Backscatter, η

BIS_0613 BIS_0813 BIS_1113 Korea



Arctic Ocean

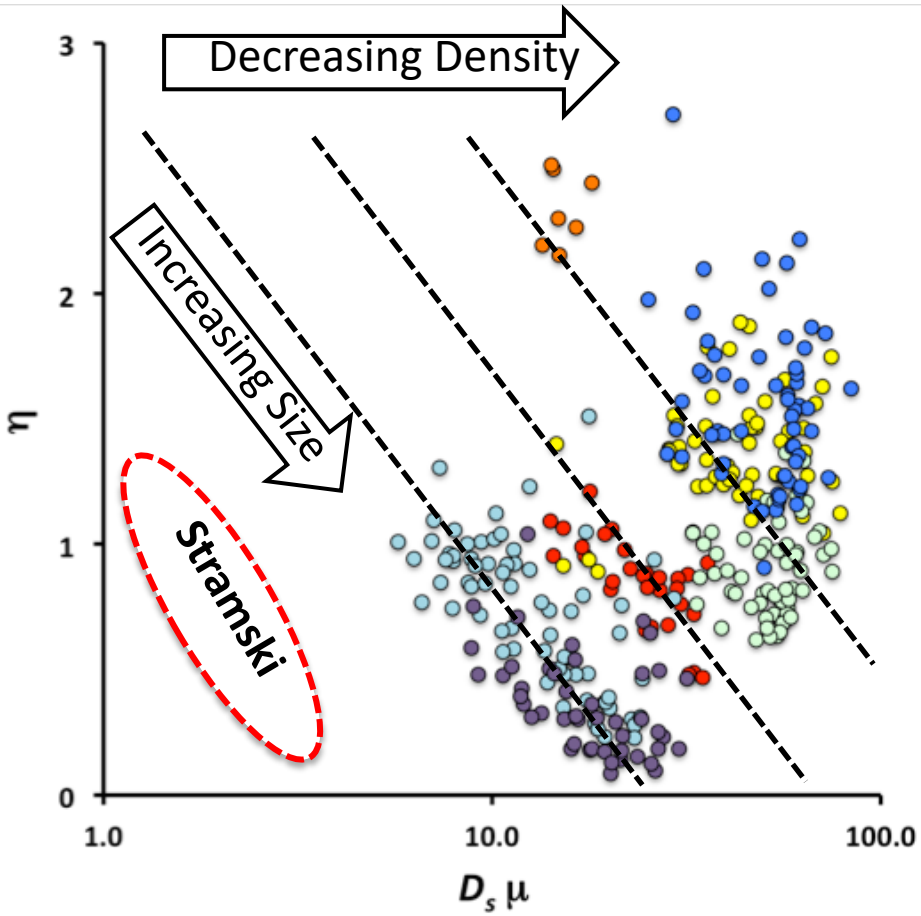


POC:SPM

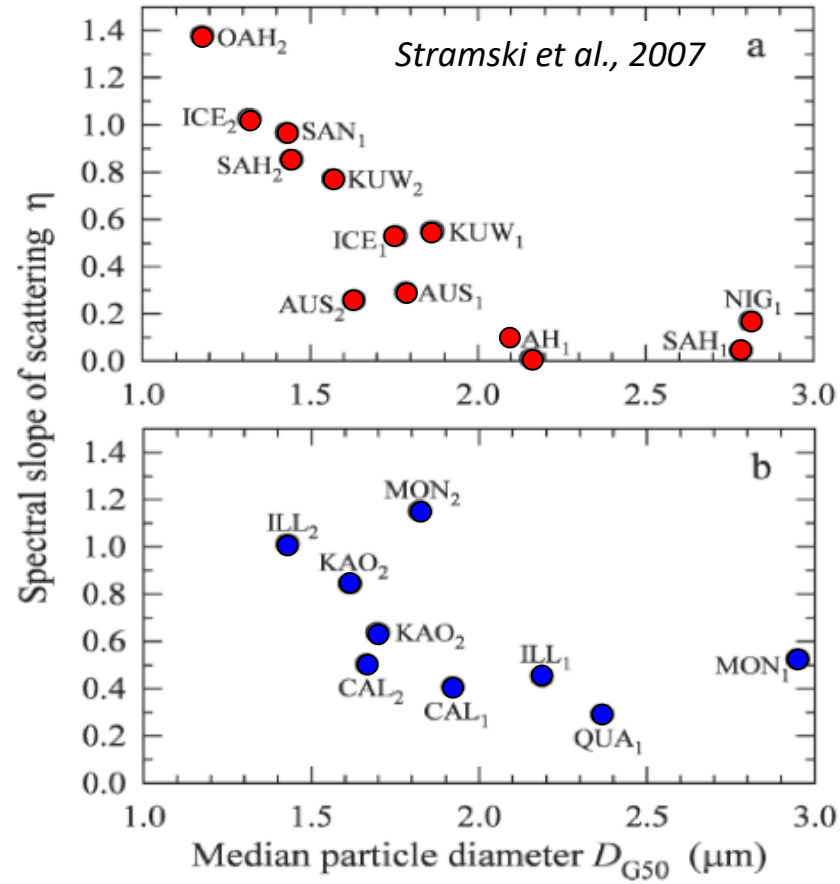
The spectral slope of backscatter appears to be highly variable at low fractions of particulate carbon, but converge to a stable, intermediate value as the fraction of POC increases.

Spectral Slope, η

SFB/D Chs. Bay BIS_0613 BIS_0813 BIS_1113 BIS_0114 Korea



Mixed (●) and Single-Mineral (●) Clay

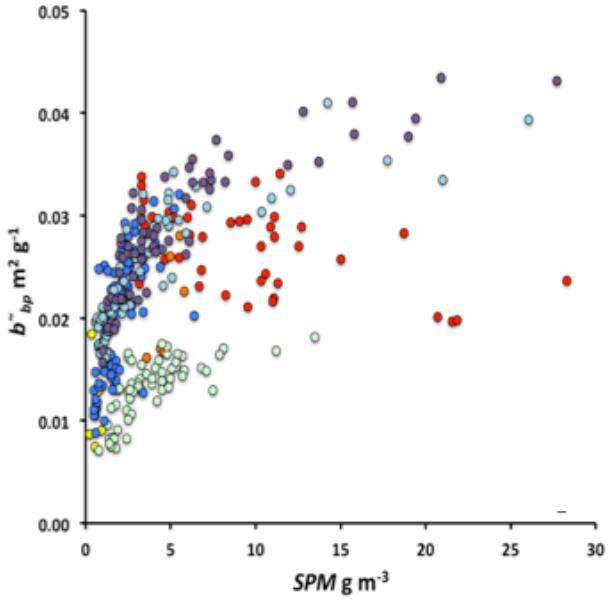


The spectral slope of backscatter measured in situ appears to increase with particle size, contrary to laboratory measurements of clay suspensions.

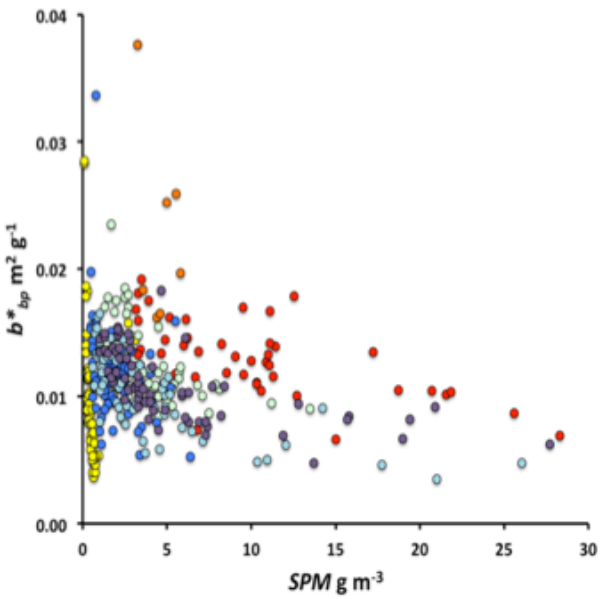
SPM and Backscatter

● SFB/D ● Chs. Bay ● BIS_0613 ● BIS_0813 ● BIS_1113 ● BIS_0114 ● Korea

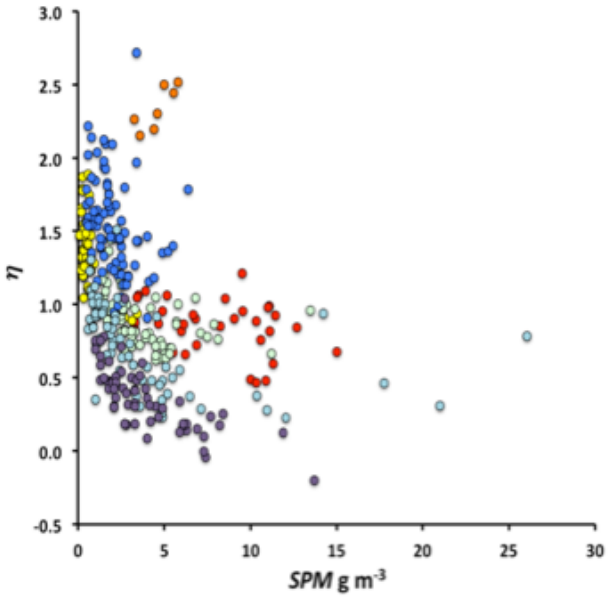
RATIO



MASS-SPECIFIC



SPECTRAL SLOPE



- Backscatter ratio tended to increase with increasing SPM
- Mass-specific backscatter is highly variable
- Spectral slope tended to decrease with increasing SPM

Summary

- Results support current ideas about the relationships between marine particle composition, morphology, and backscatter.

- There remains a great deal of uncertainty in these and previously published results, but teasing apart sources from fiend measurements is difficult;
  - Sampling methods
  - Sensor bias/error

- In response to increasing SPM:
  - Backscatter ratio tends to increase (POC:SPM decreases)
  - Mass-specific backscatter is highly variable
  - Spectral slope tends to decrease (decreasing aggregate size?)