

From particle size distributions to radar measurements: closing the gap

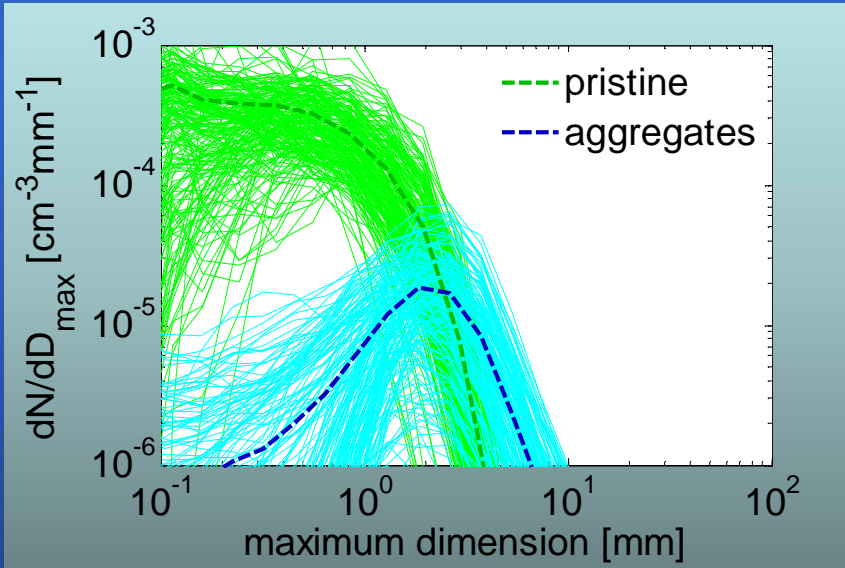
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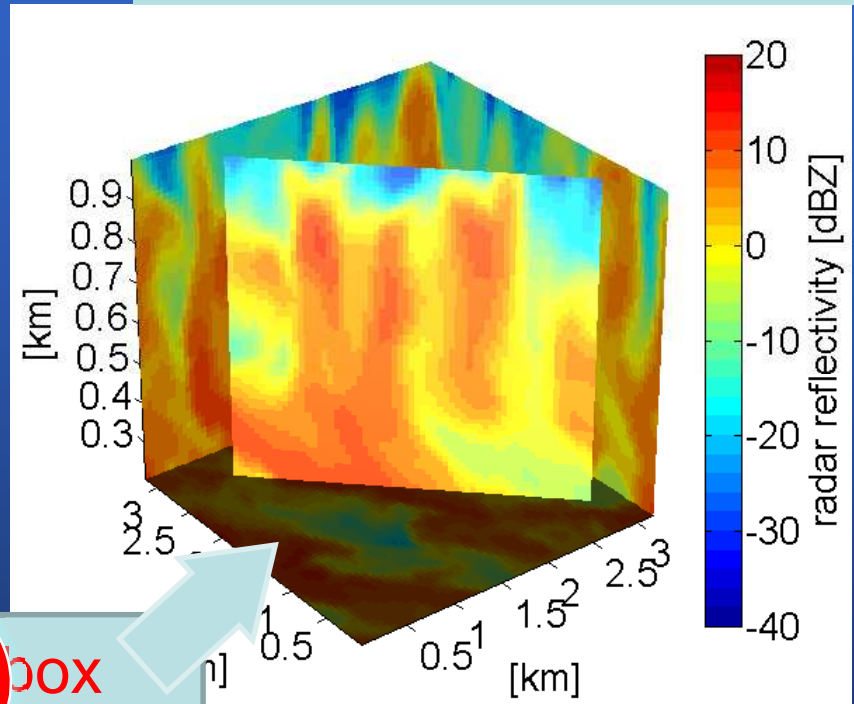


From PSD to radar reflectivity



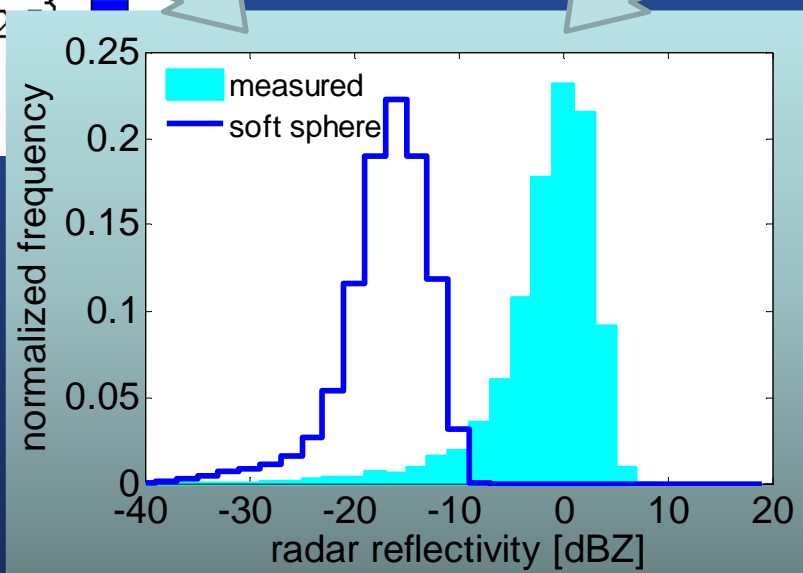
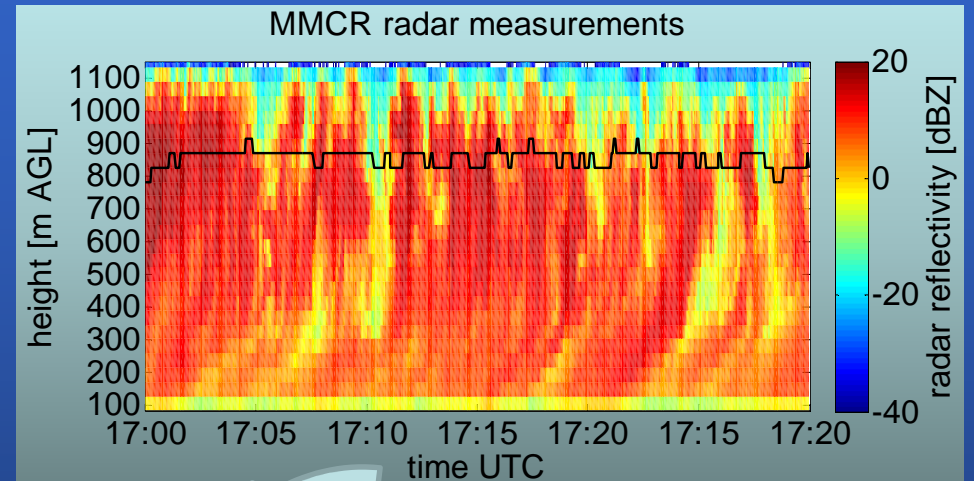
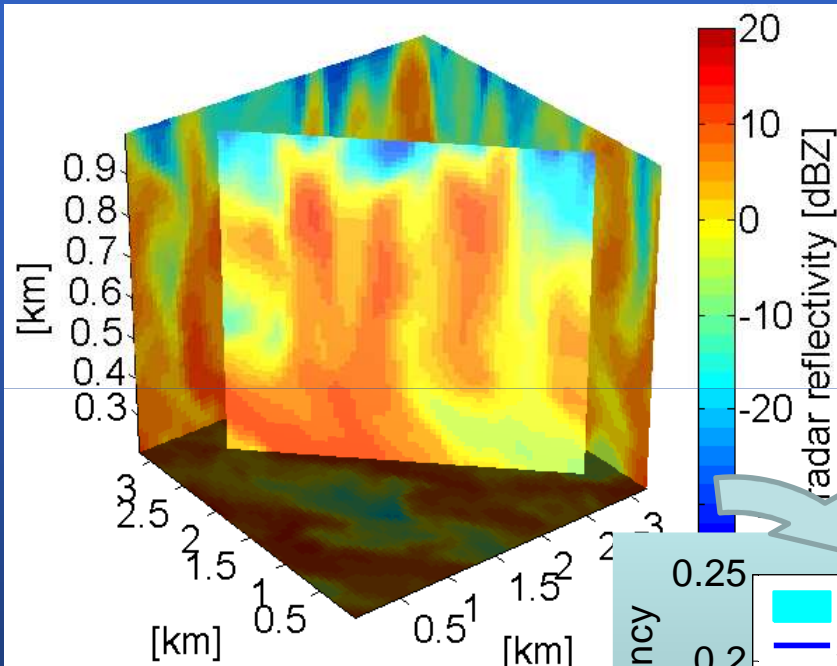
ice hydrometeor PSD

CRM simulated radar reflectivity



Some black box
 computing the radar
 back-scattering
 cross-section
 σ_b

Comparison between CRM output and radar measurements

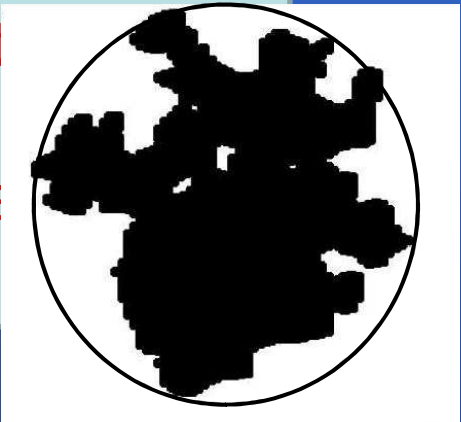


CRM simulated radar reflectivity: using all the grid-volume points within appropriate height range (or a random sample of those)

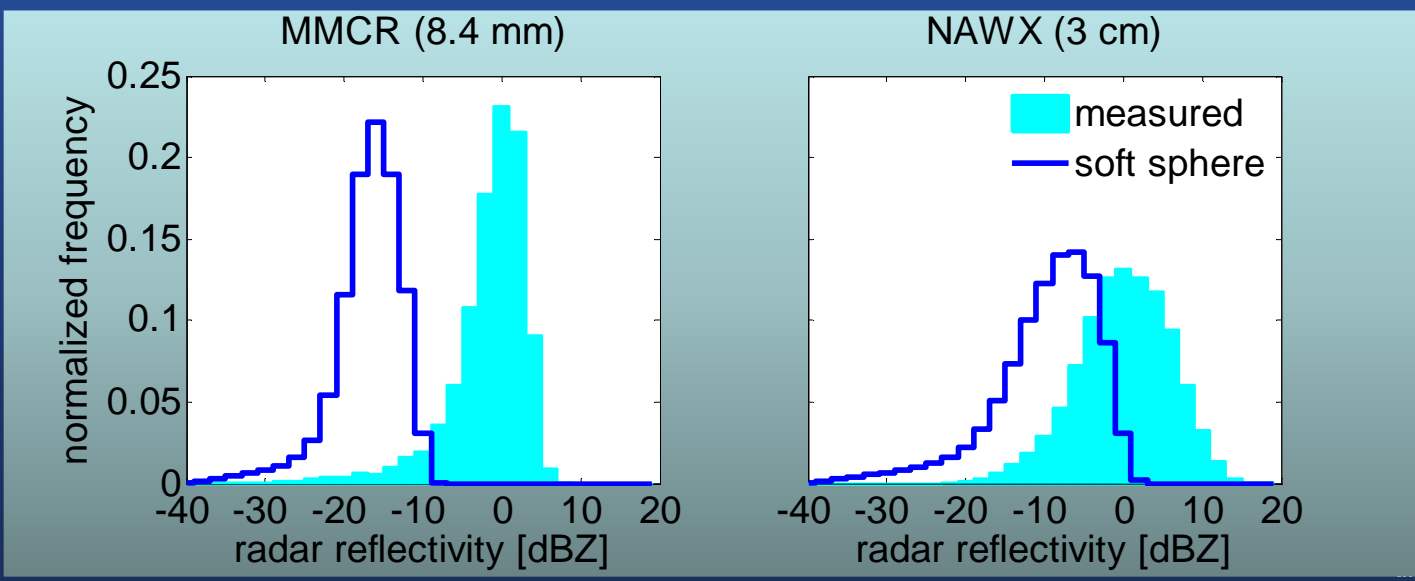
measured radar reflectivity: using all the valid points within appropriate height range and selected time frame

Inside the black box: soft sphere

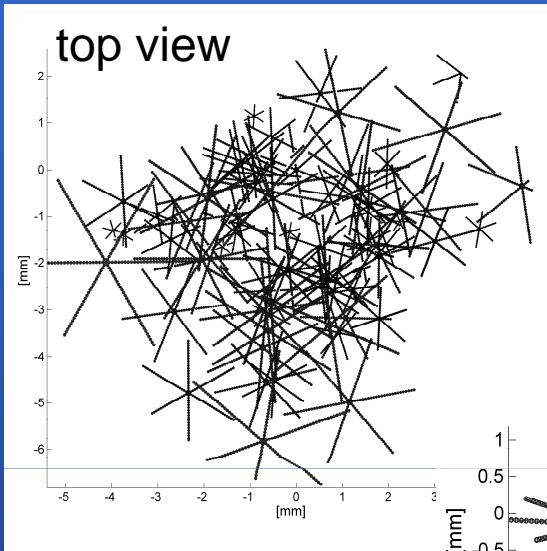
Some black box
computing the
back-scatter
cross-section
 σ_b



$$\epsilon_{eff}(m, D)$$

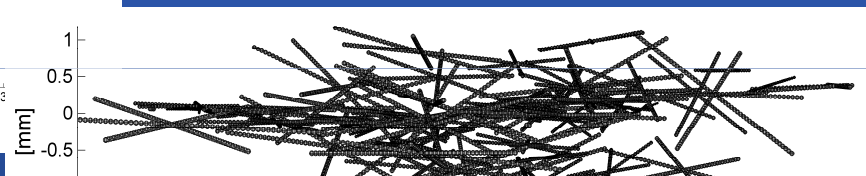


A more accurate E.M. model



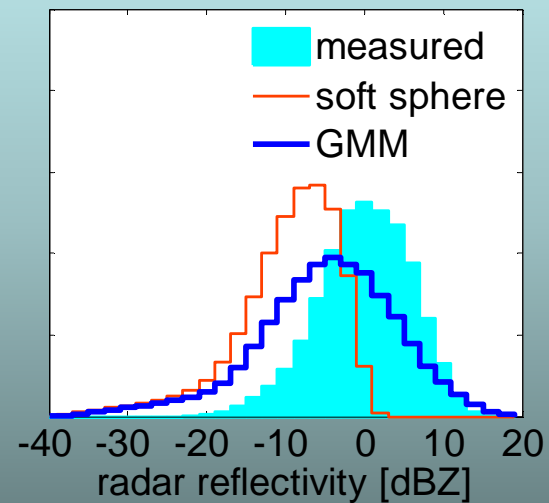
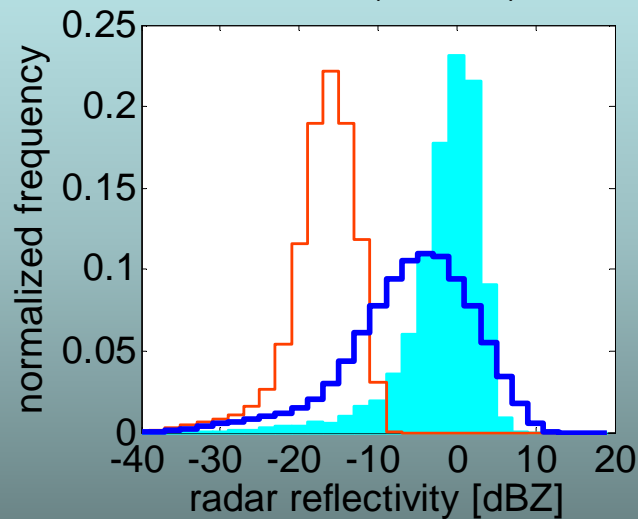
Random aggregate realizations: clusters of tiny ice spheres

Sphere Cluster E.M. Scattering Code: Generalized Multiparticle Mie (**GMM**) Method



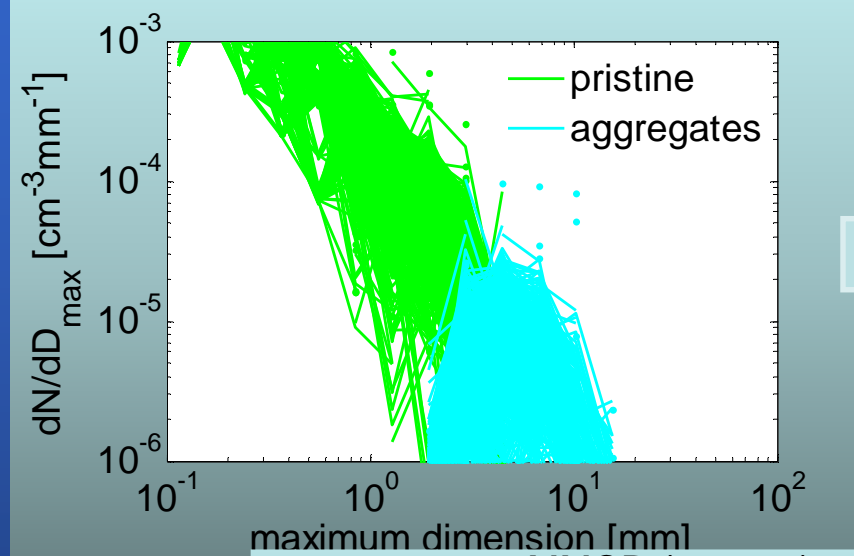
MMCR (8.4 mm)

NAWX (3 cm)



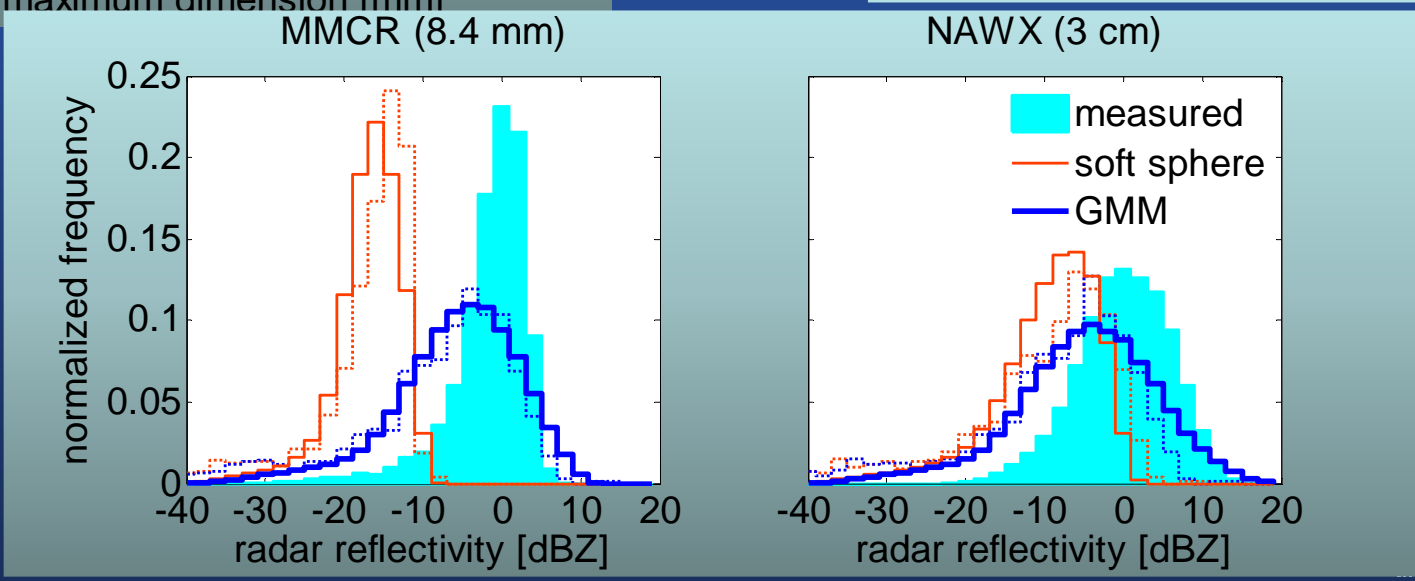
Measured PSD comparison

in situ measured PSD



Simulated radar reflectivity

dotted line: in situ PSD reflectivity



Where to go from here?

- Random aggregate realizations are generated through M-D relationship and component crystal type (needle, stellar, plates, etc. from observations)
 - Size-projected area relationship ($A_{\text{eff}}-D$) can be estimated from the realizations
 - M-D and $A_{\text{eff}}-D$ together determine the fall speed of the particle which can be fed into the CRM for improved self-consistency in model, tested by radar
- Measurements of aggregate size, mass, aspect ratios (vertical and horizontal), component crystals would be useful to better constrain the electromagnetic model



Conclusions

- To exploit the high complexity and accuracy of CRMs for comparison with radar measurements, the electromagnetic model must be accurate as well
- The soft sphere approach must be used with caution and possibly replaced with more advanced electromagnetic models
- The M-D relationship chosen in the CRM must match the one in the electromagnetic model (i.e. beware of lookup tables!)
- Comparison with radar measurements can help identify the right M-D relationship