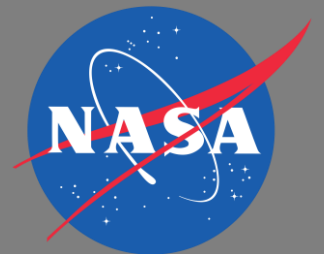
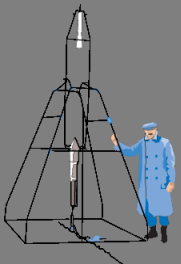


The OpenSSP Snow Particle and Scattering Property Database

Ian S. Adams, Kuo-Sen Kuo, William S. Olson, Craig Pelissier,
Thomas Clune, Matthew Lammers, Adrian Loftus, Robert S. Schrom,
S. Joseph Munchak

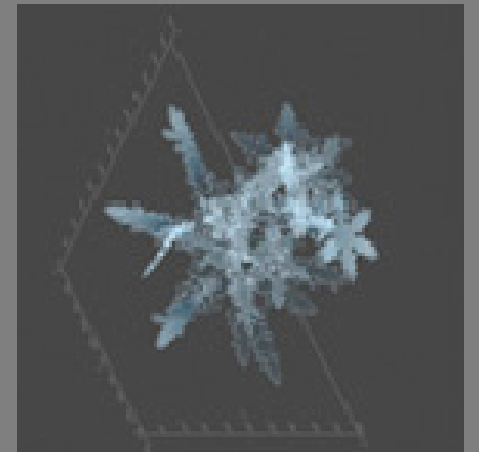
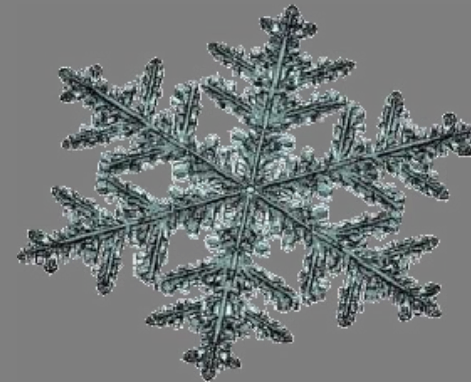
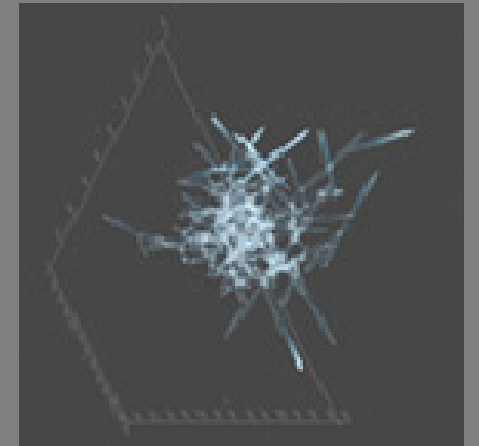


Scattering Tables

<https://storm.pps.eosdis.nasa.gov/storm/OpenSSP.jsp>

The OpenSSP database include realistic particles synthesized using quasi-physical methods

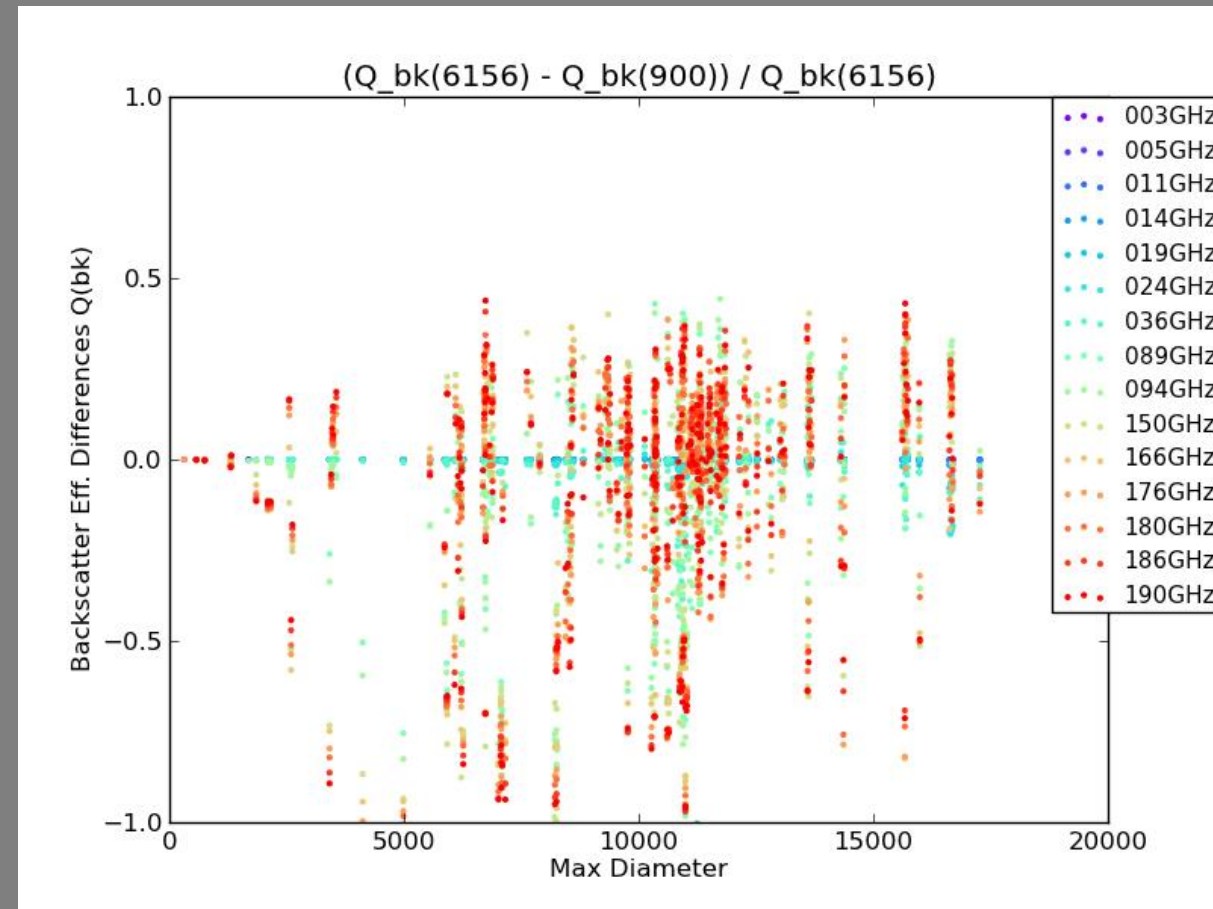
- Depositional growth
- Heuristic monohabit aggregation
- Uniformly-random orientational averaging
- ~10k particles
- 230 unique file downloads
 - Does not include database testing



Backscatter Convergence

Backscatter is particularly sensitive to the number of orientations used in orientational averaging

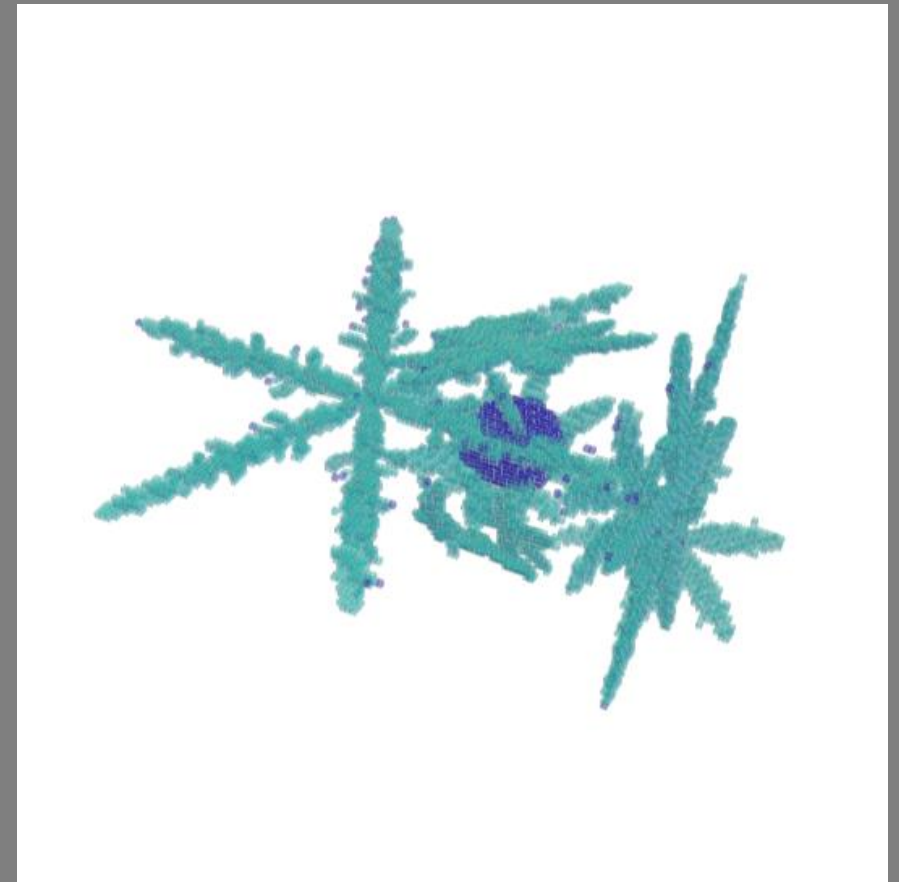
- Far more sensitive than extinction
- Frequency dependent
- Non-uniform zenith distributions may impact results for azimuthally-random particles



Melting Particles

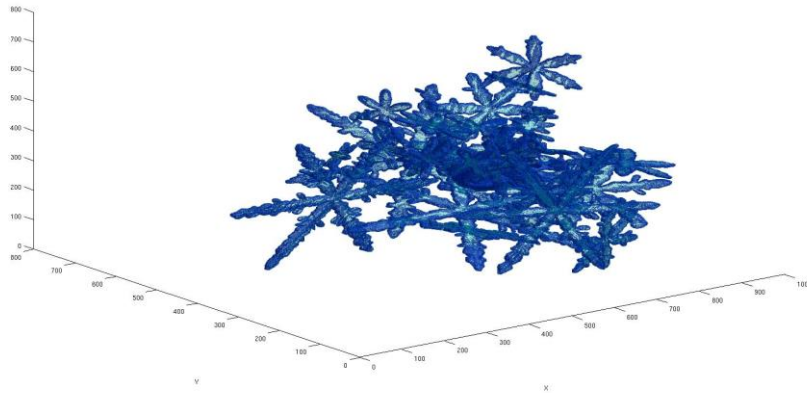
Melting particles are the largest gap across the various particle databases

- Currently performing scattering calculations on Dr. Ben Johnson's melted particles
 - 25 of Kuo's aggregates
 - Increased surface tension to avoid breakup
- Implemented smooth particle hydrodynamics
 - 1e6 particles
 - Finalizing code
- High-resolutions particles costly for DDA
 - Blurring method to reduce resolution, conserve mass

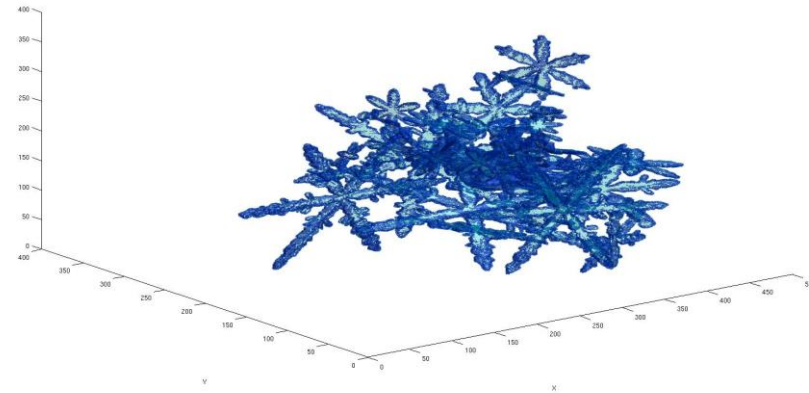


Particle Blurring

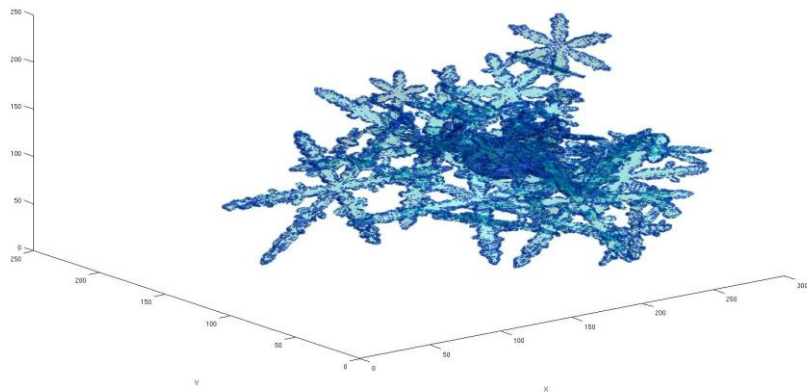
Original resolution



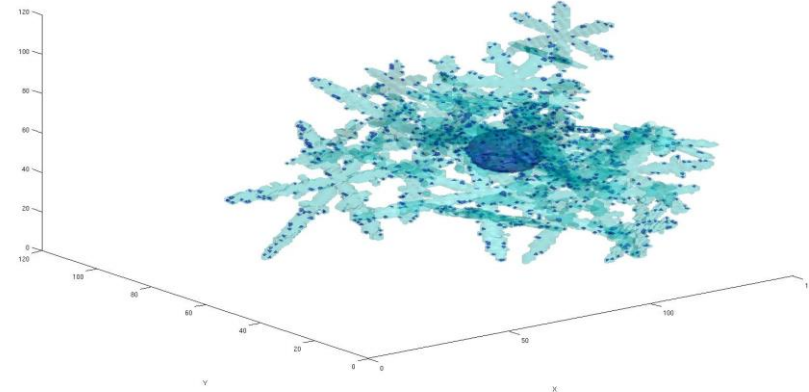
2 X 2 X 2



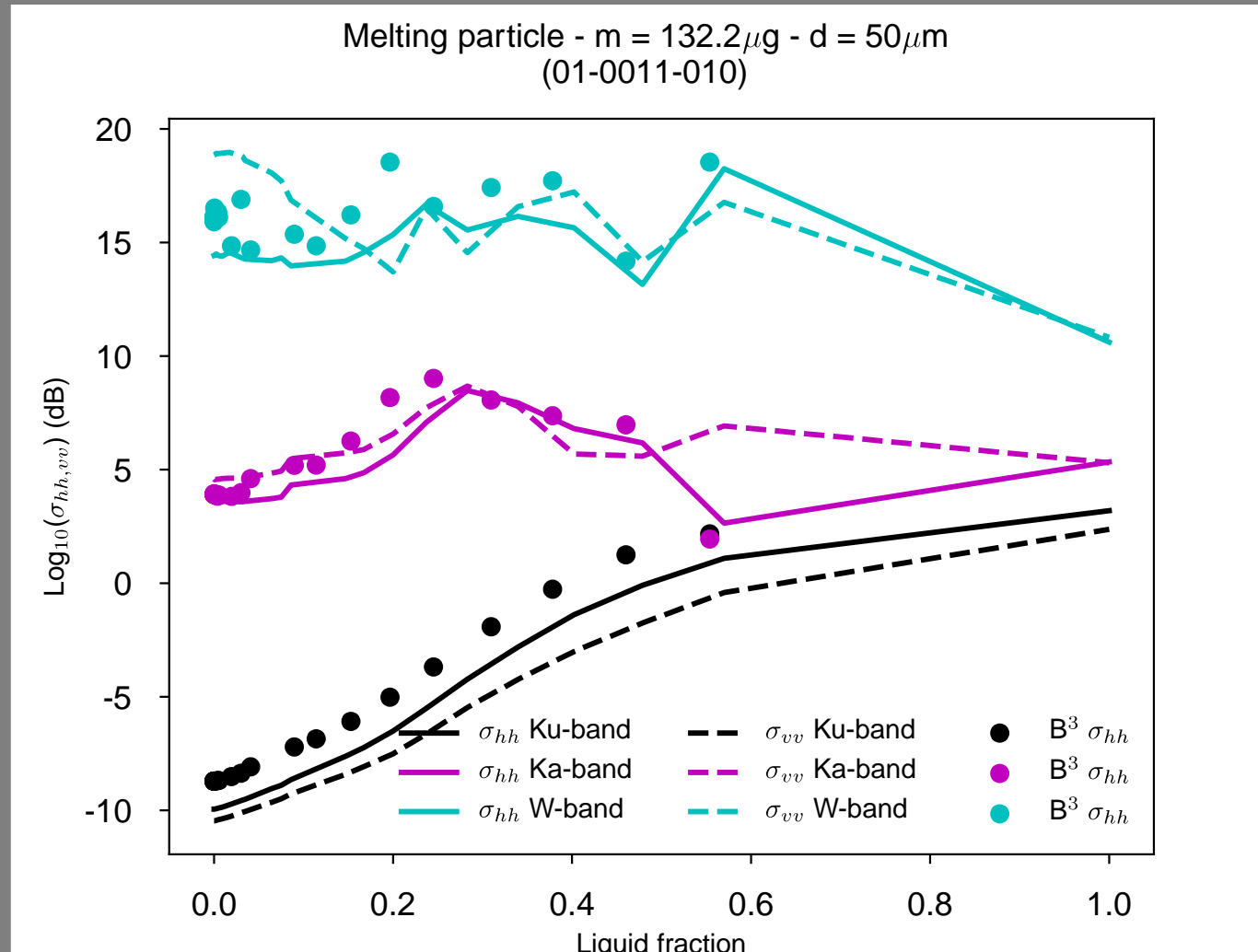
3 X 3 X 3



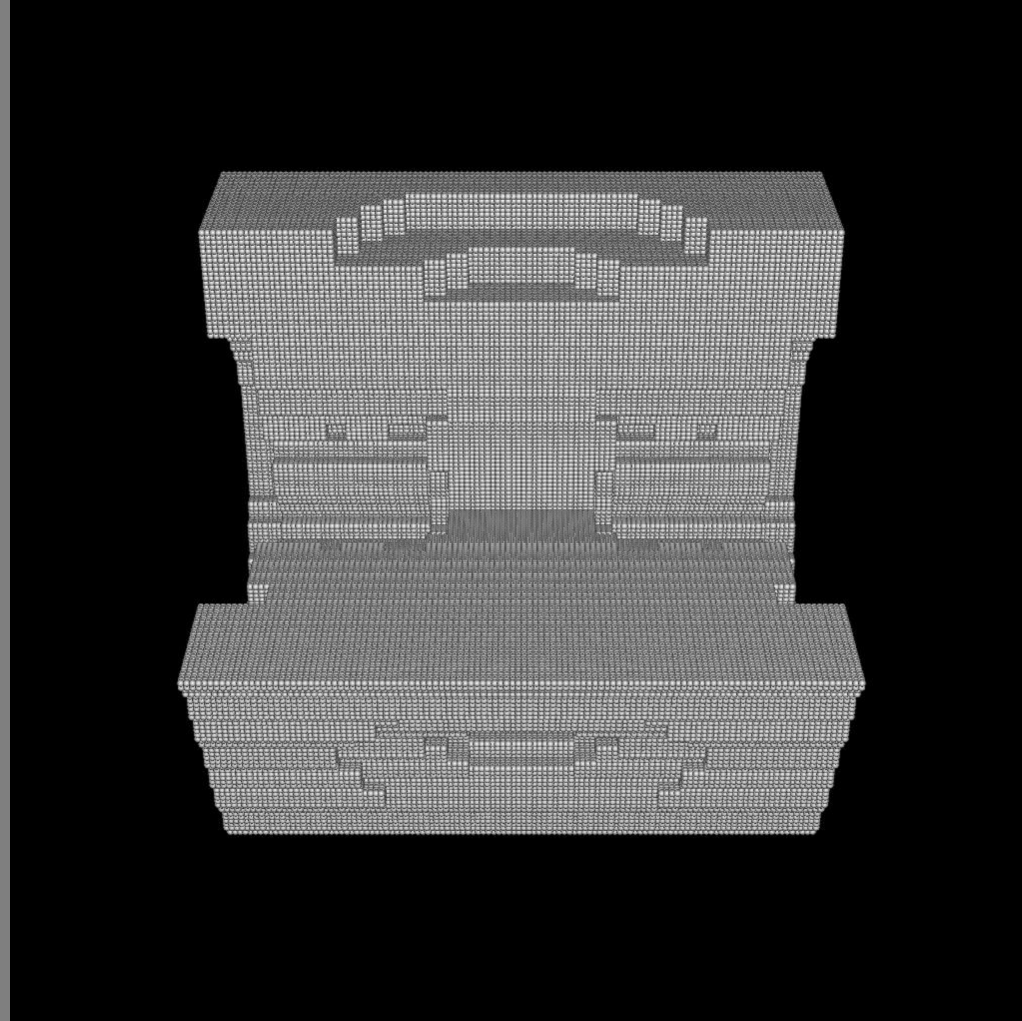
6 X 6 X 6



Backscatter: Full resolution vs blurred



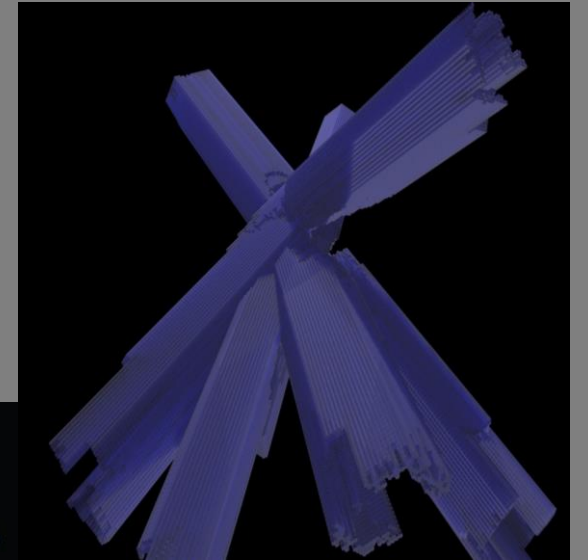
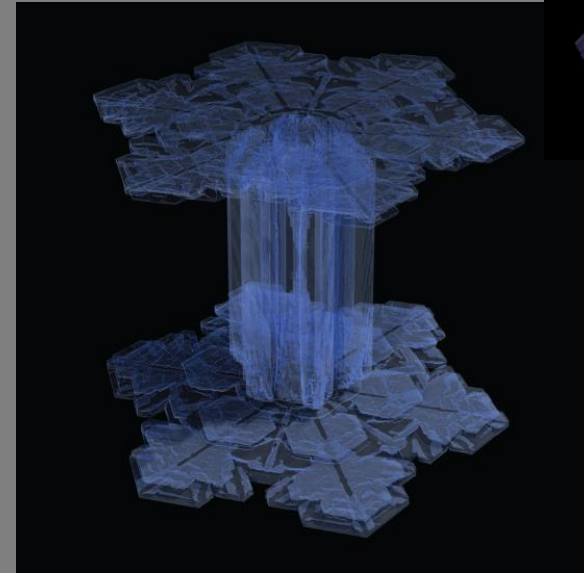
Particle Melting using SPH



Polycrystals

A significant number of observed “pristine” particles comprise polycrystals

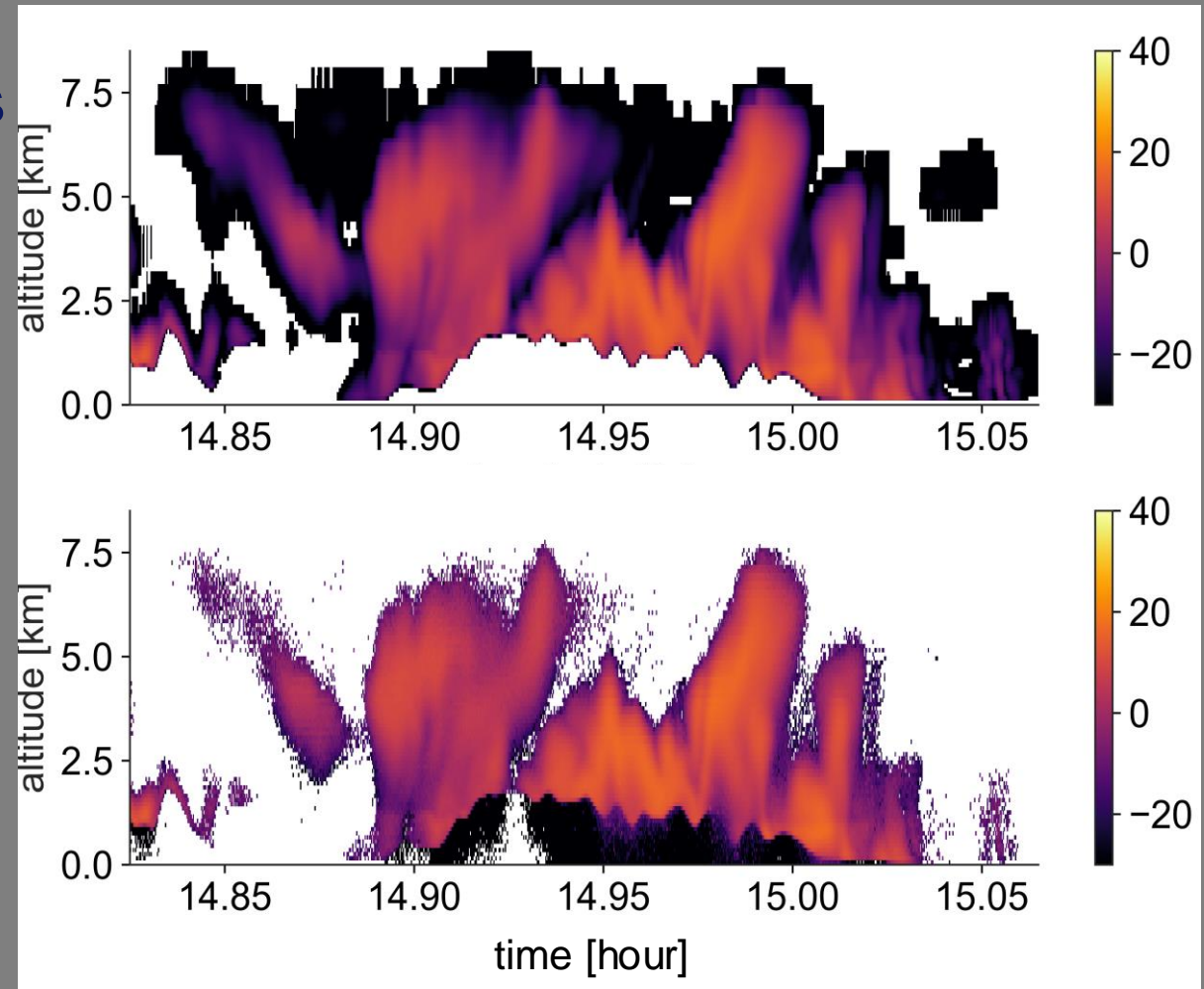
- Rosettes
- Capped columns
- Extending depositional growth model to produce quasi-physical polycrystals
- Currently implementing adaptive mesh for more efficient calculations



Hydrometeor Effects on Radar Multiple Scattering

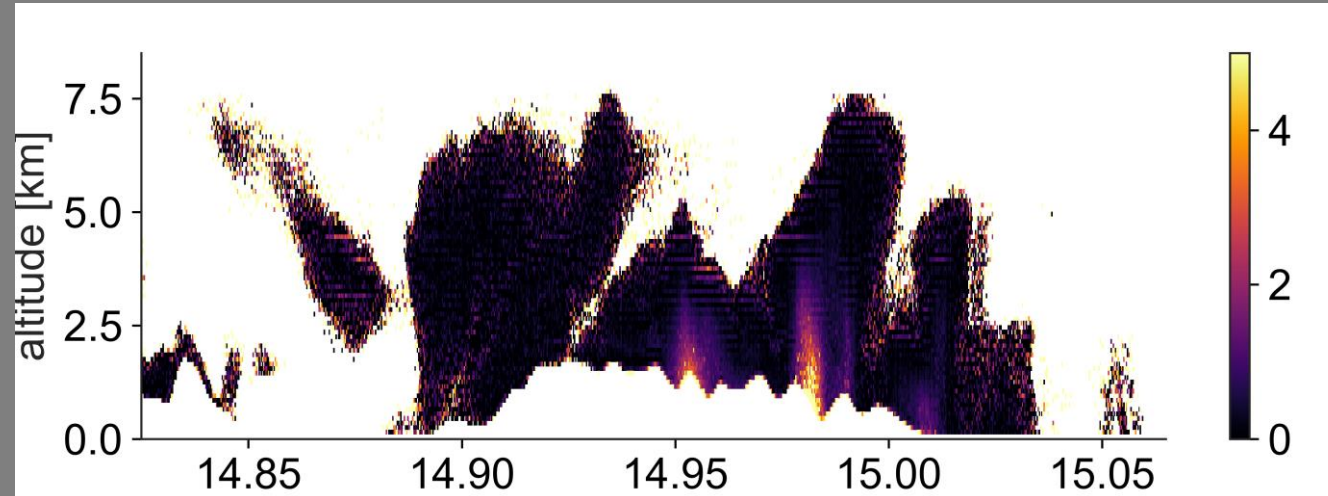
Observational studies suggest graupel is a significant contributor to multiple scattering

- Demonstrated with OLYMPEX simulation
- Morrison 2M, 3 ICE
- Uniformly-random snow and graupel
- Azimuthally-random cloud ice
 - Invariant Imbedding T-Matrix Method (IITM)

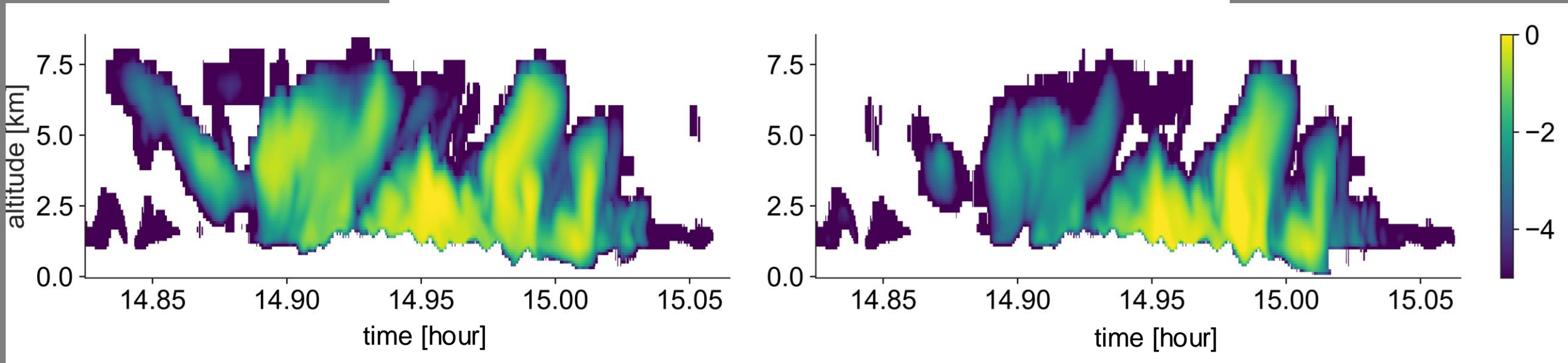


Multiple Scattering Enhancement

Snow Mixing Ratio

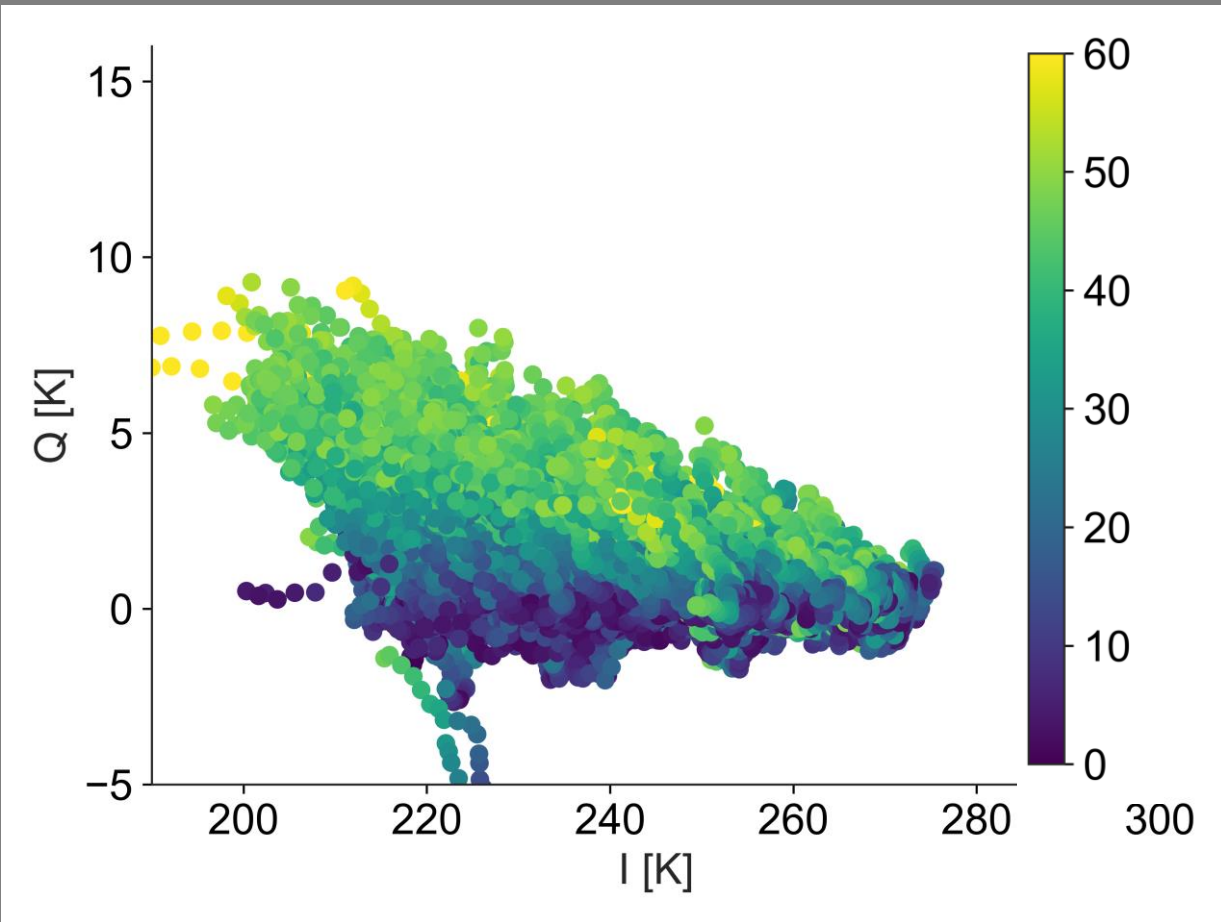


Graupel Mixing Ratio

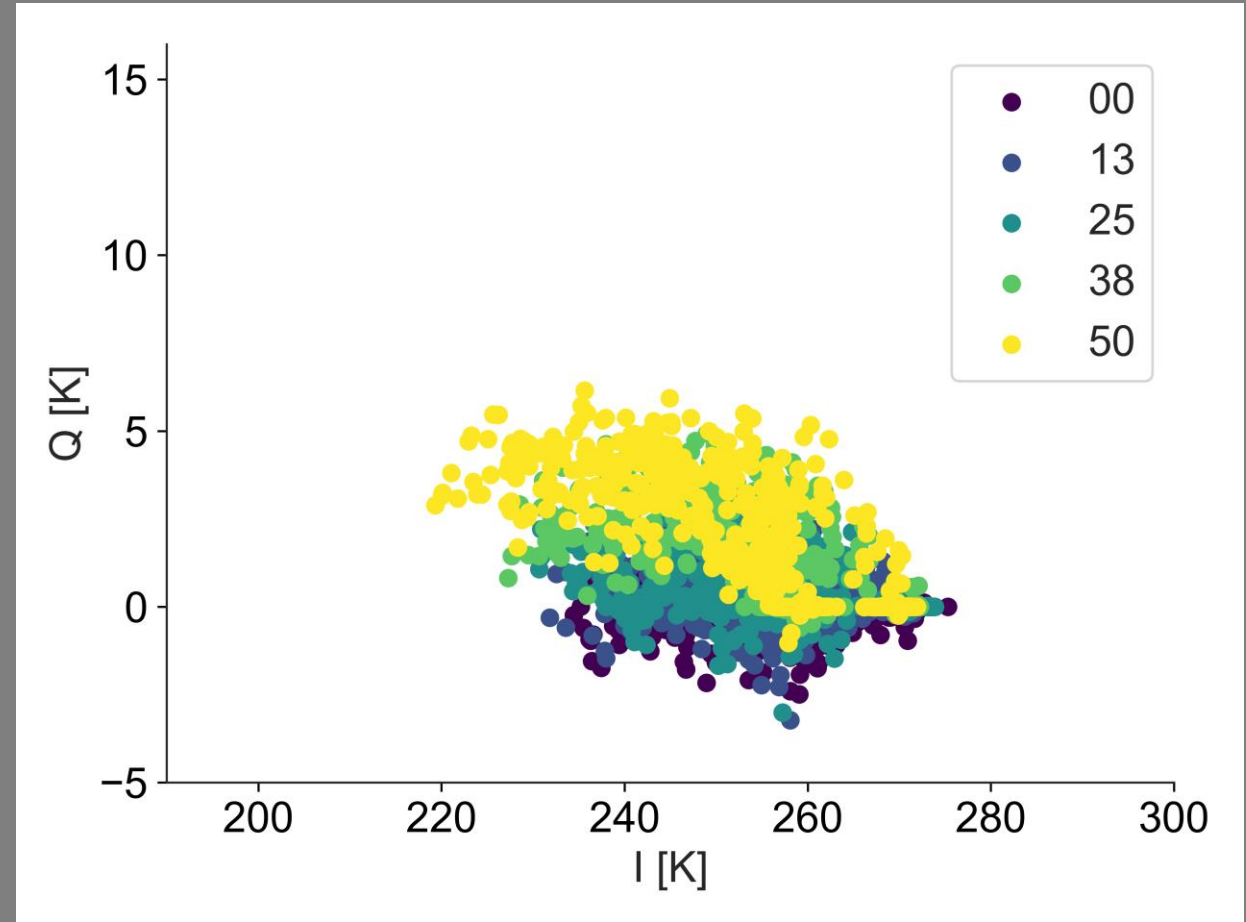


Radiometer Simulation (OLYMPEX, 20151203, 1500 UTC)

CoSMIR

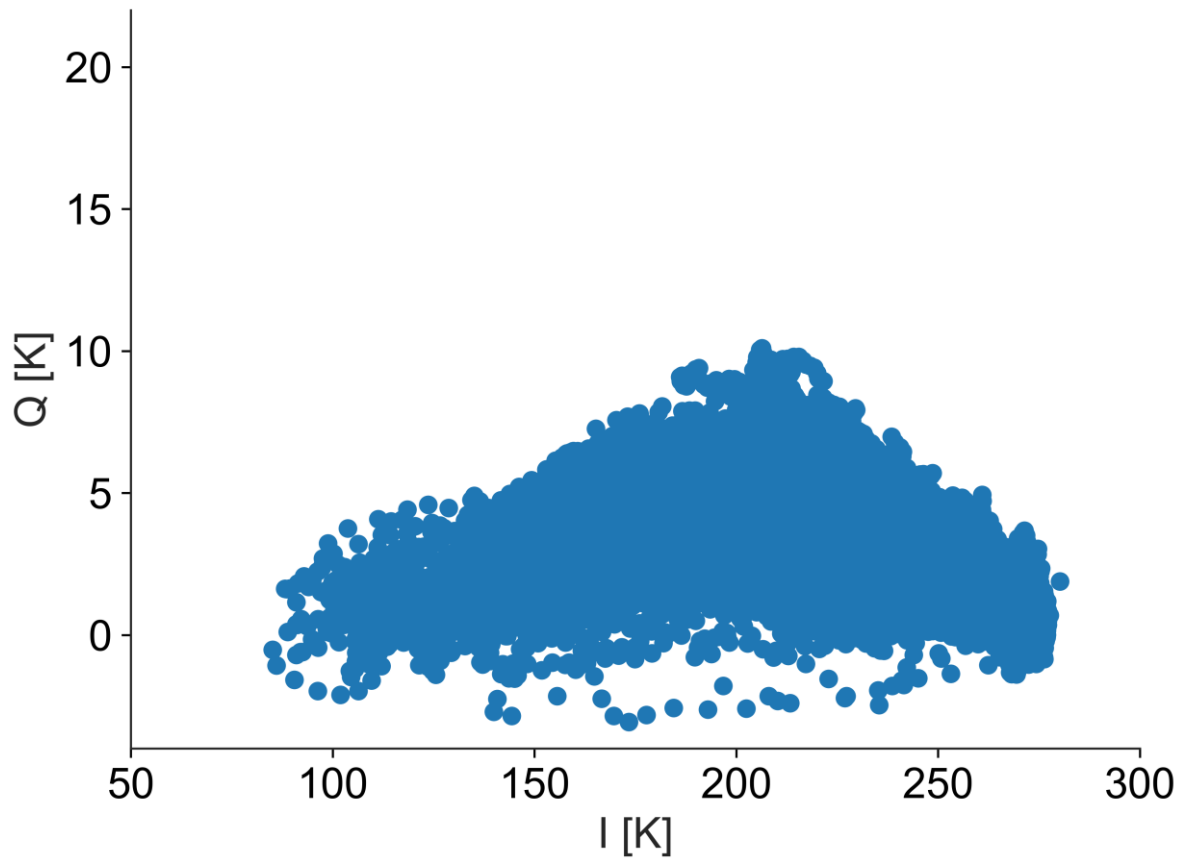


Holloway
Mates Columns

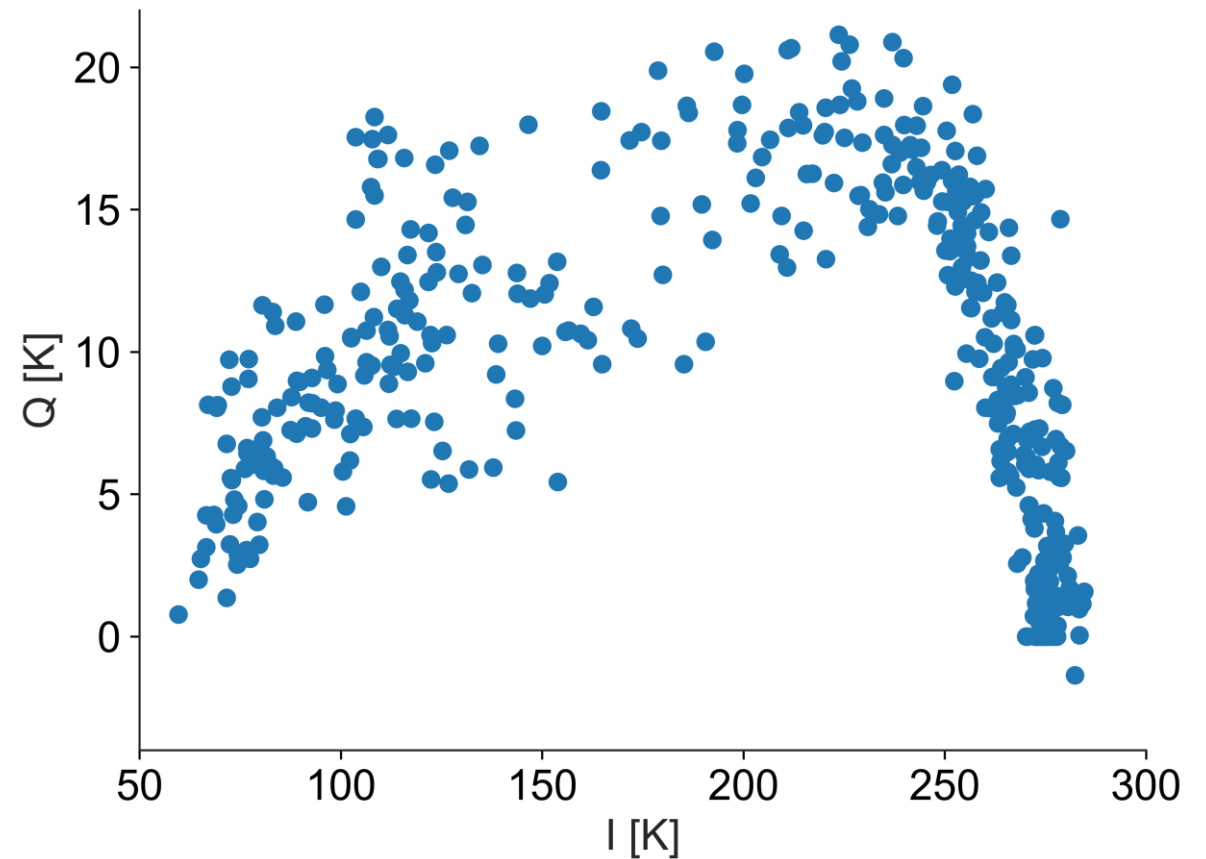


Convective Radiometer Simulations (MC3E)

CoSMIR



Hollow Columns
Plates



Web Interface Enhancements

Pristine

Aggregate

Modeled PSD

m-D & PSD

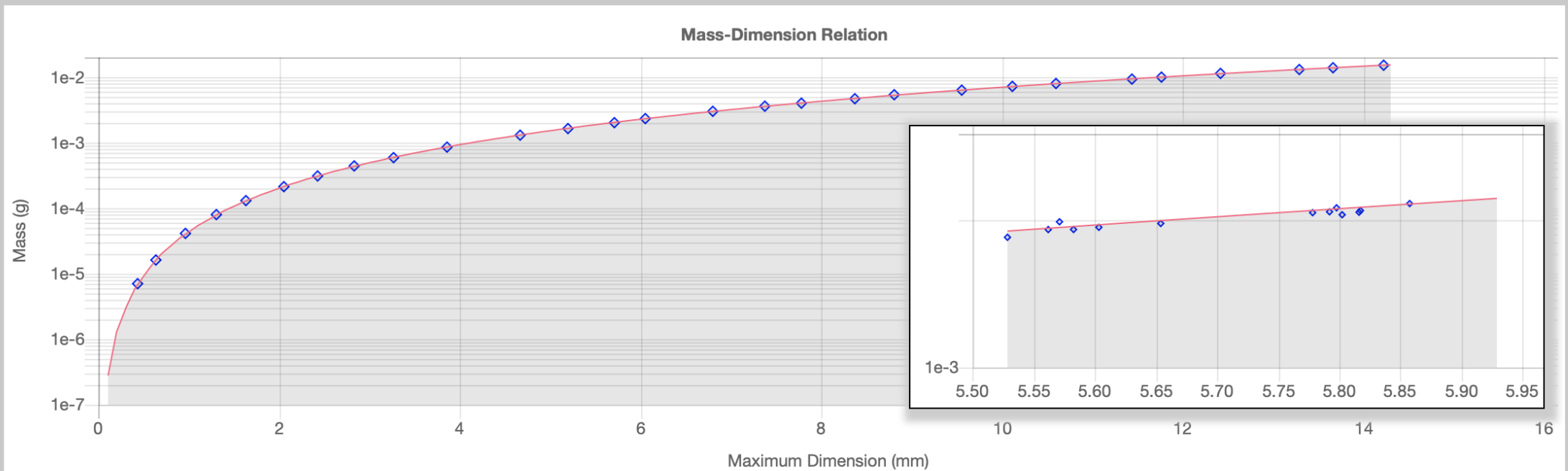
Scattering Data Package

Particle Structure

Development Data

Particle Size Distribution

Mass-Dimension Relation



Back to Inputs

Export to PNG

Export Data

Email Data

Conclusion

- Free online database
- Pristines and aggregates
 - Level 0
 - Level 2+
- Finishing melting and polycrystals
- Employing other EM methods
- Useful for understanding observations

<https://storm.pps.eosdis.nasa.gov/storm/OpenSSP.jsp>

The screenshot displays the OpenSSP web interface. At the top, there are navigation tabs: Pristine, Aggregate (selected), Modeled PSD, m-D & PSD, Scattering Data Package, Particle Structure, and Development Data. The main content area is divided into several sections:

- Family:** A 3x3 grid of snowflake images labeled p-13, p-14, p-04, p-16, p-29, p-19, p-46, p-44, and p-43. The p-43 image is highlighted in yellow.
- Aggregate Examples:** Two 3D renderings of snowflake aggregates.
- Size [um]:** A list of size values with checkboxes. The value 200 is highlighted. The list includes: 187.1673, 191.2374, 195.1412, 200, 202.5121, 204.2731, 207.7069, 211.0307, 212.6542, 215.8286, 217.3814, 220.4220, 221.9113, 223.3810, 229.0748, 231.8184, 237.1189, 239.6826, 240.9441, and 244.6516.
- Selected:** Two columns for selecting size and frequency. The size column is currently empty.
- Frequency [GHz]:** A list of frequency values with checkboxes: 3.00, 5.00, 10.66, 13.61, 18.71, 23.82, 35.53, 89.06, 94.07, 150.10, 165.62, 176.42, 180.43, 186.43, and 190.43.

At the bottom right, there are buttons for "Submit API Query" and "Email Data".