Depolarization of Light by Single Particles: Water/Ice/Dust Identification During ICE-T

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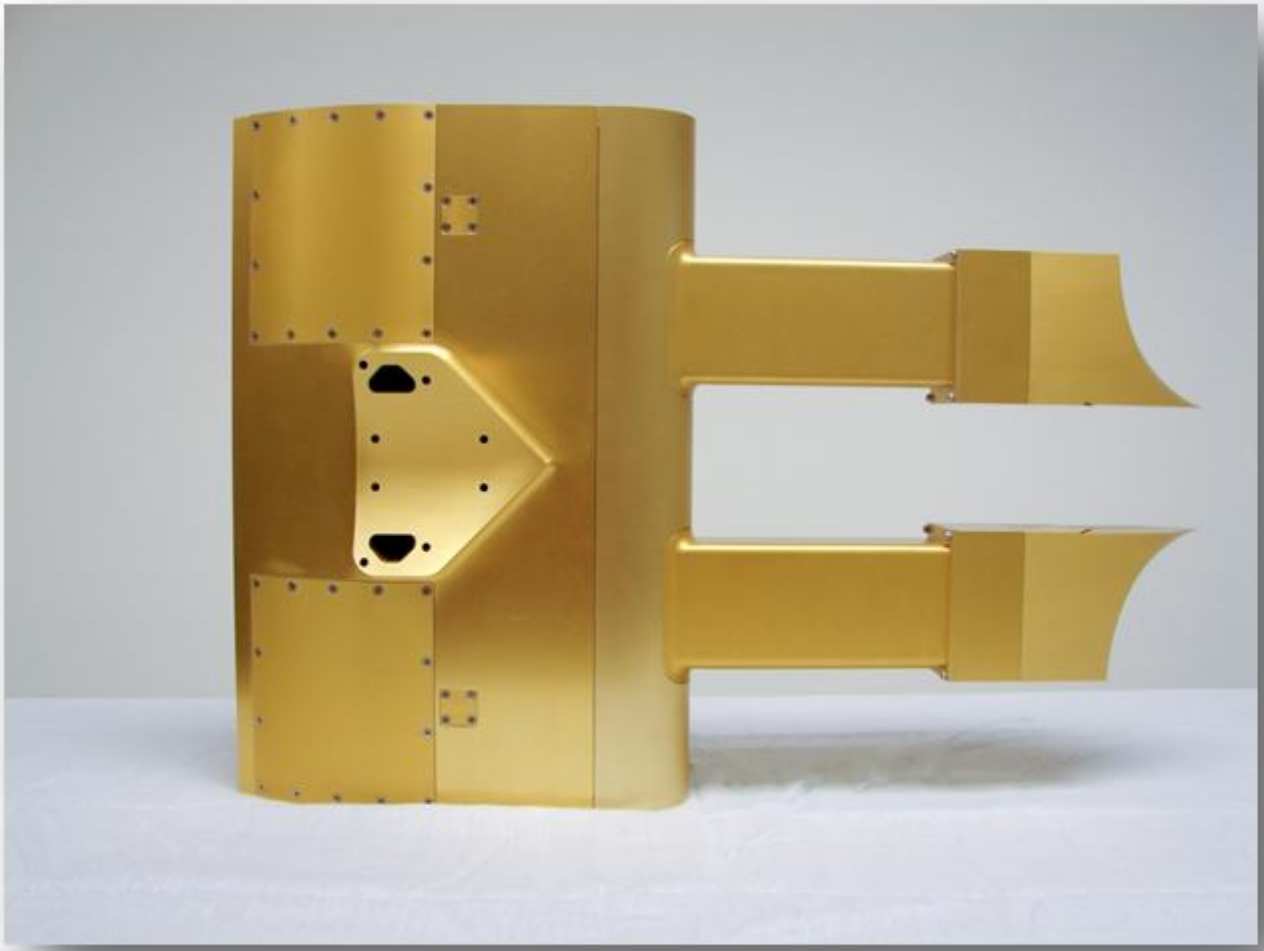
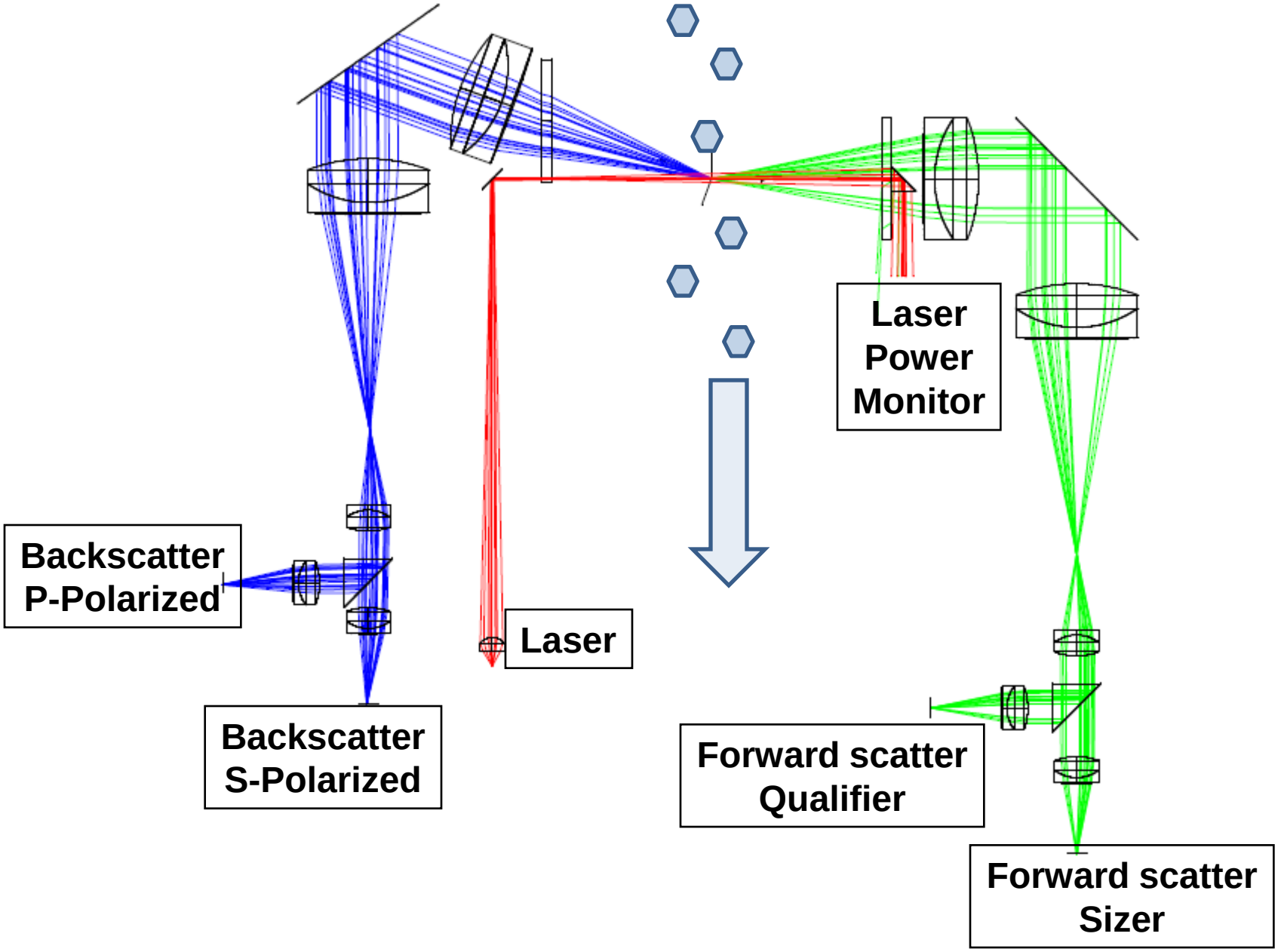
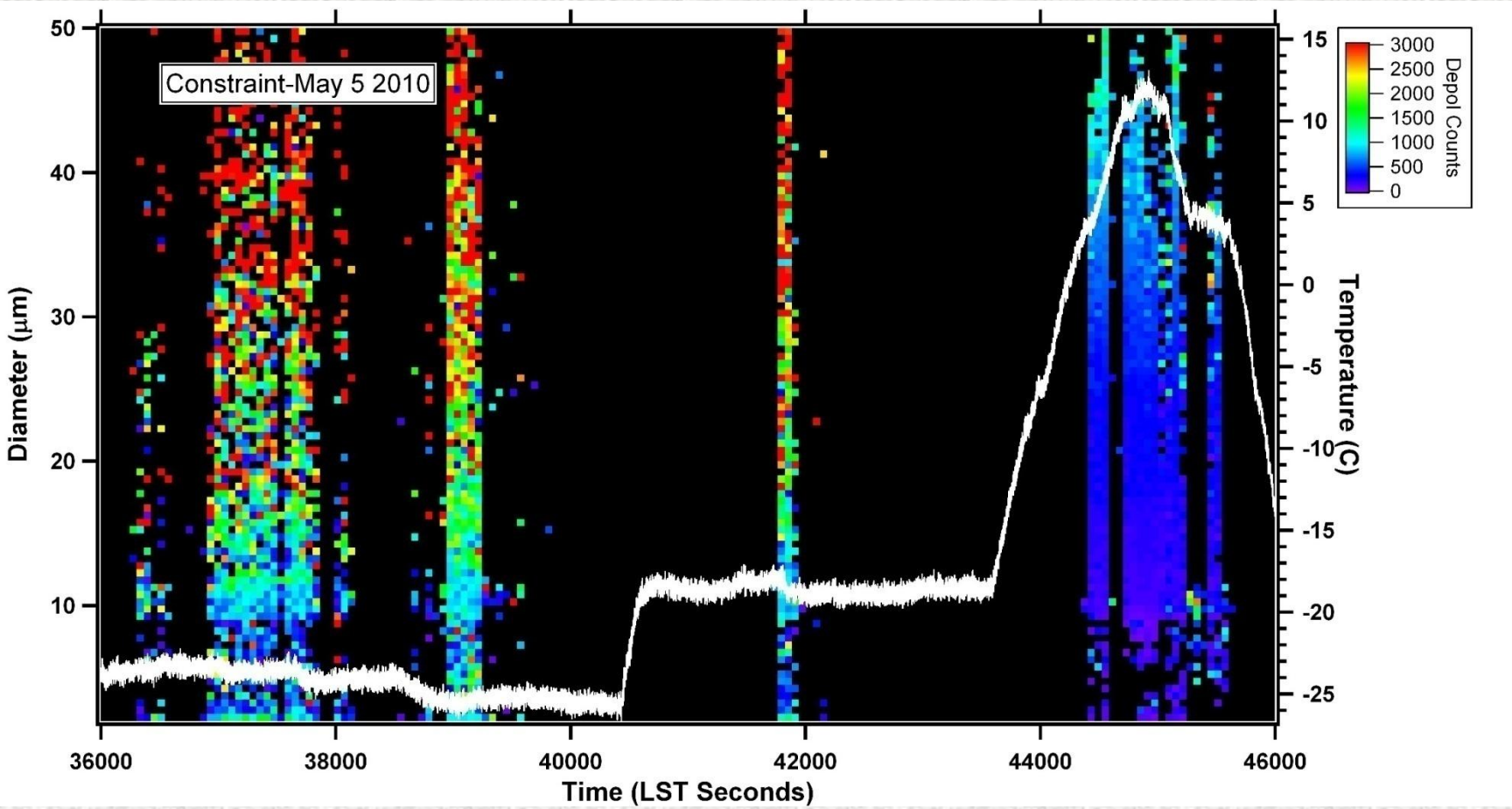
Implementation :
The Cloud Particle Spectrometer with Depolarization (CPSD)



- **Individual particle liquid/ice discrimination > 1 μm (Depolarization)**
- **Size Distribution 1 – 50 μm**
- **Korolev anti-shatter tips**

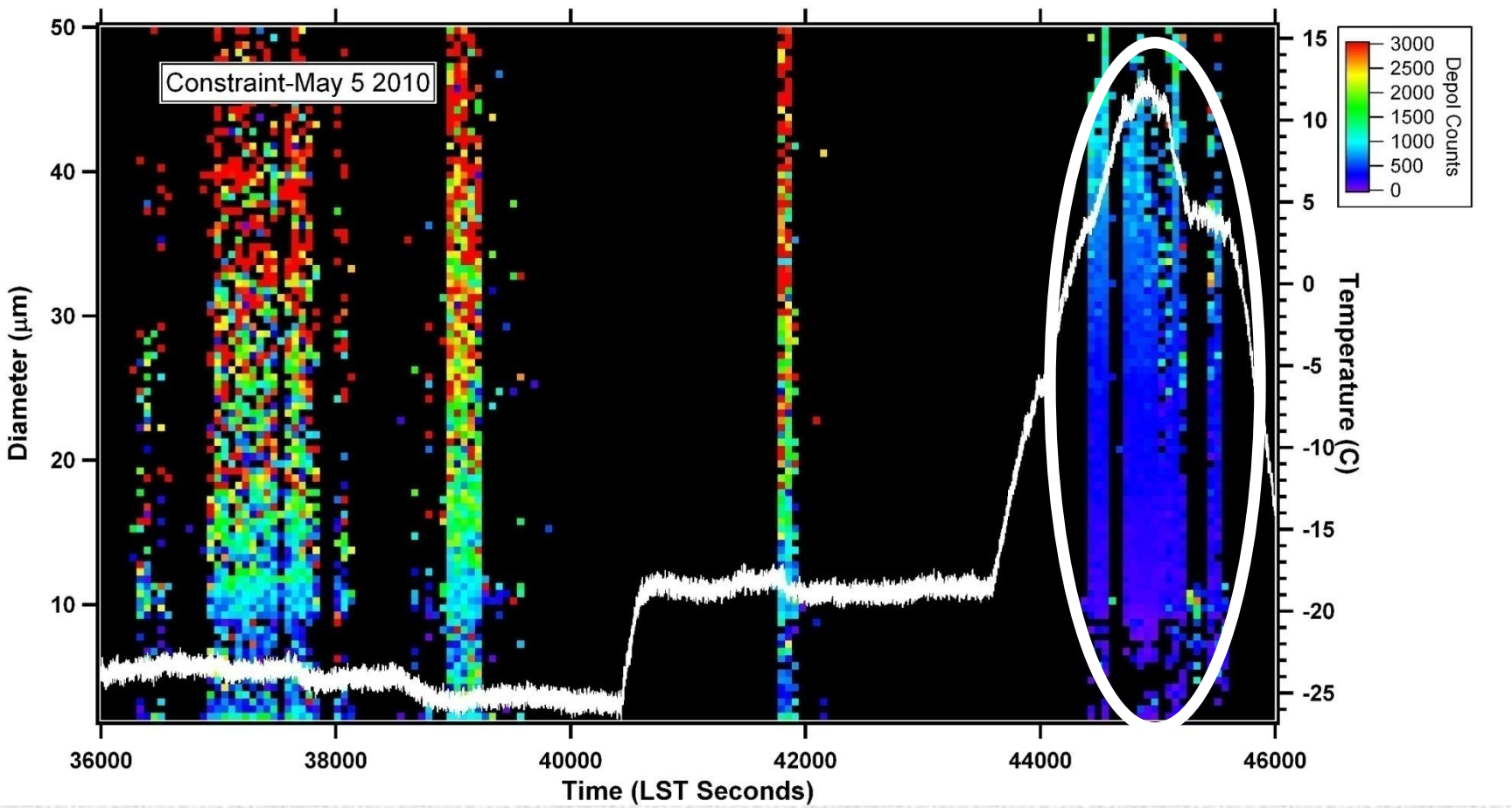

Backscatter
P-Polarized
Backscatter
S-Polarized
Laser
Laser
Power
Monitor
Forward scatter
Qualifier
Forward scatter
Sizer

The CAS-DPOL was flown on the British Met office aircraft in spring of 2010. Here we show the response of the depolarization detector as a function of time and particle diameter. The white trace is the temperature.

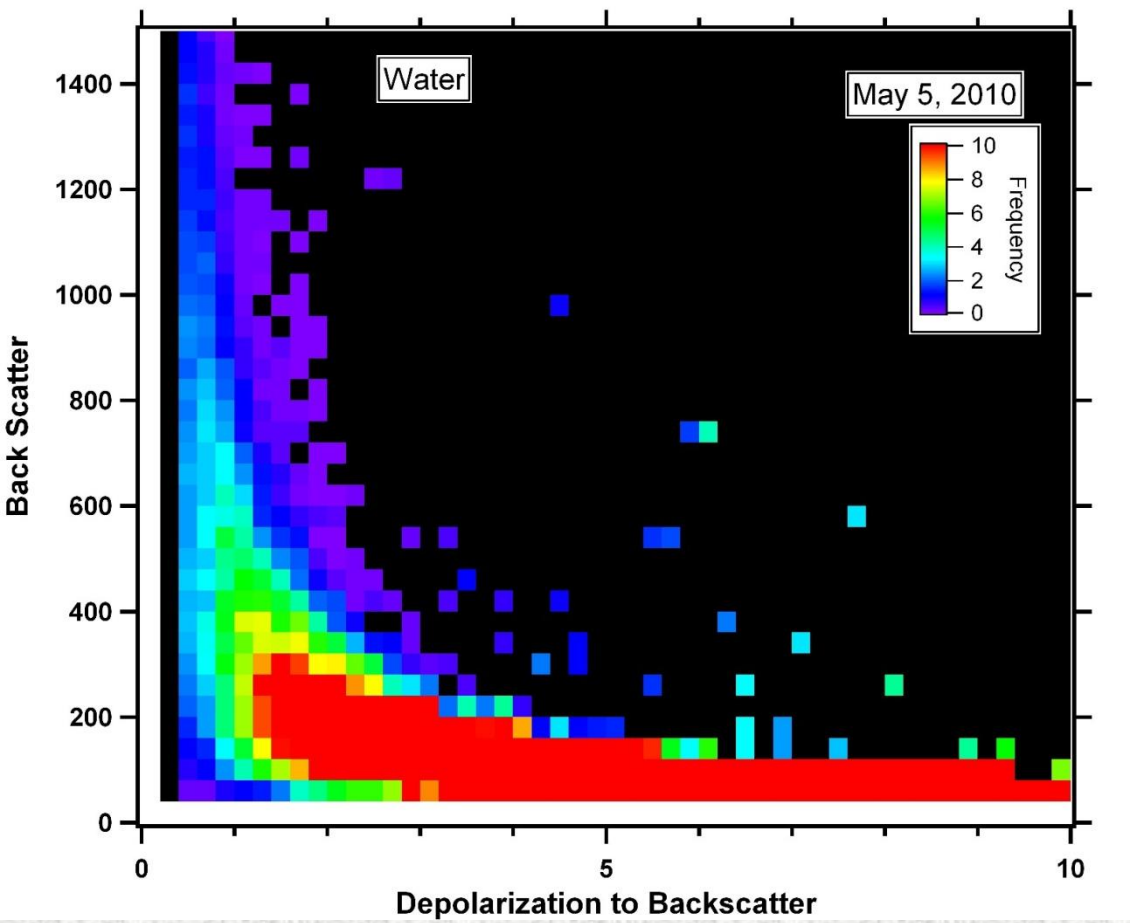


In warm clouds, when the temperature was > 10^0, the depolarization signal is quite low, < 500 counts

Liquid Phase

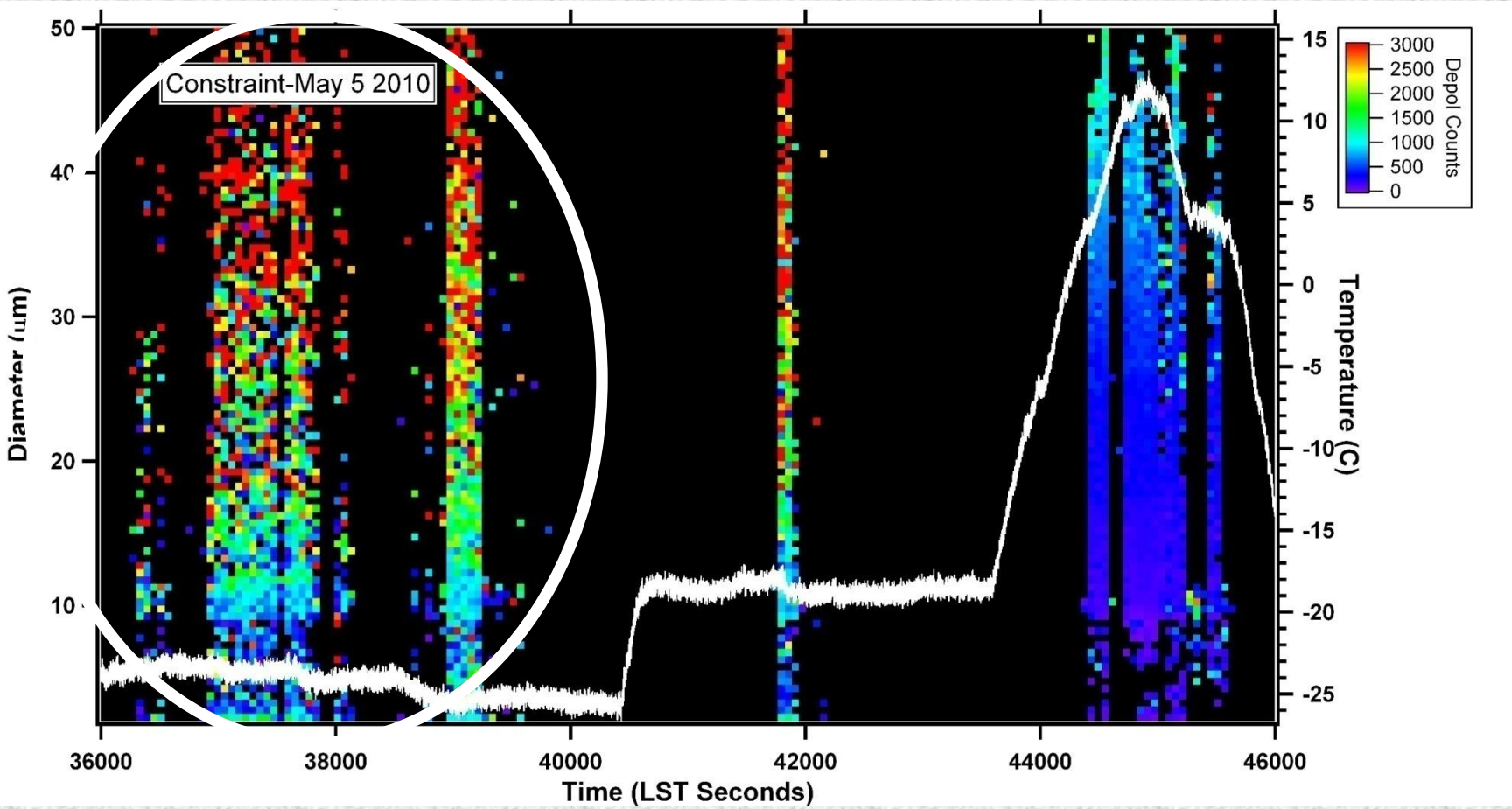


And the "liquid water fingerprint", created by making a map of the back scattering to depolarization ratio, is a way to identify water droplets. Here the depolarization ratio is defined as the signal from the depolarization detector divided by the back scattering signal.

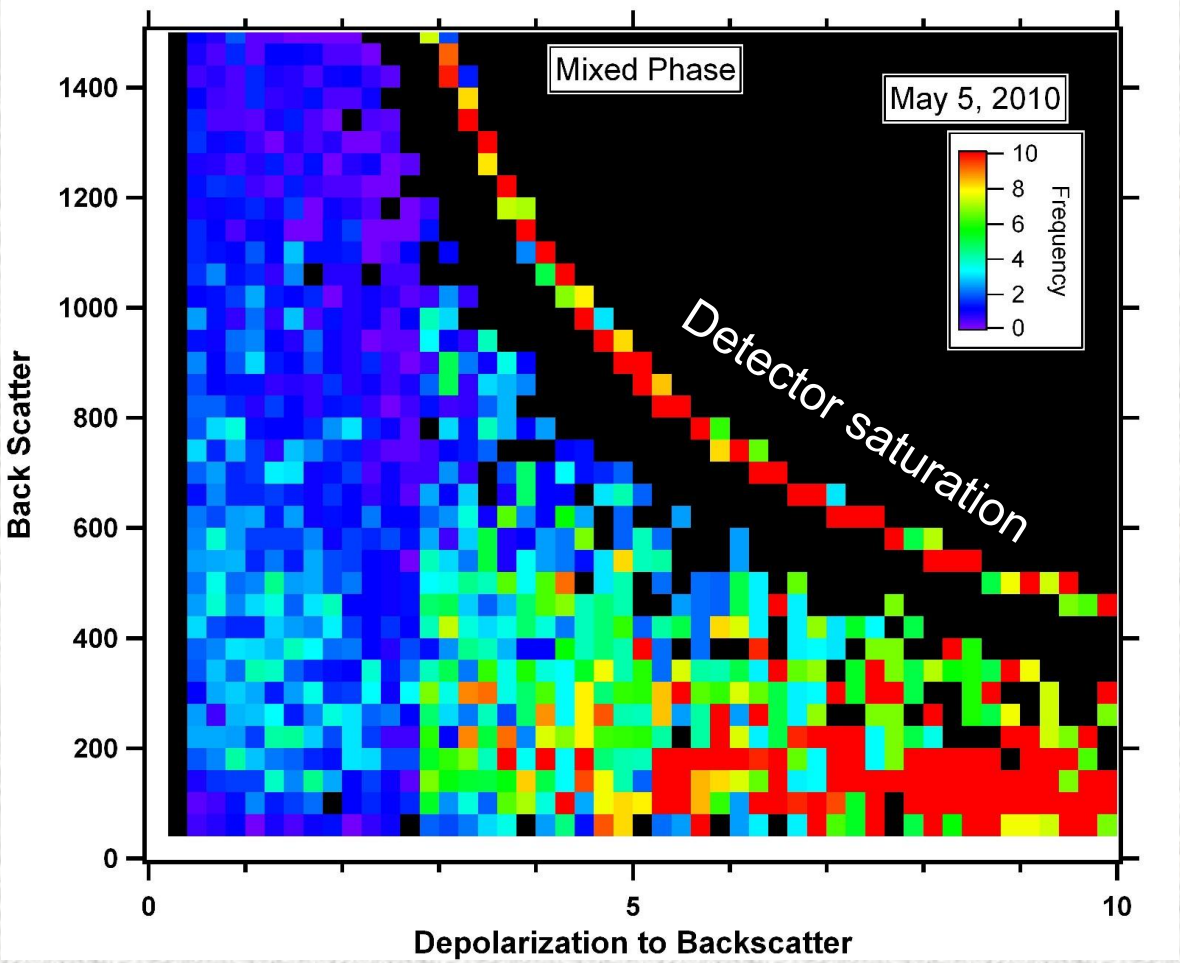


Likewise in cold clouds, when the temperature was < 0^0, the depolarization signal is much higher, > 1000 counts (relative signal.)

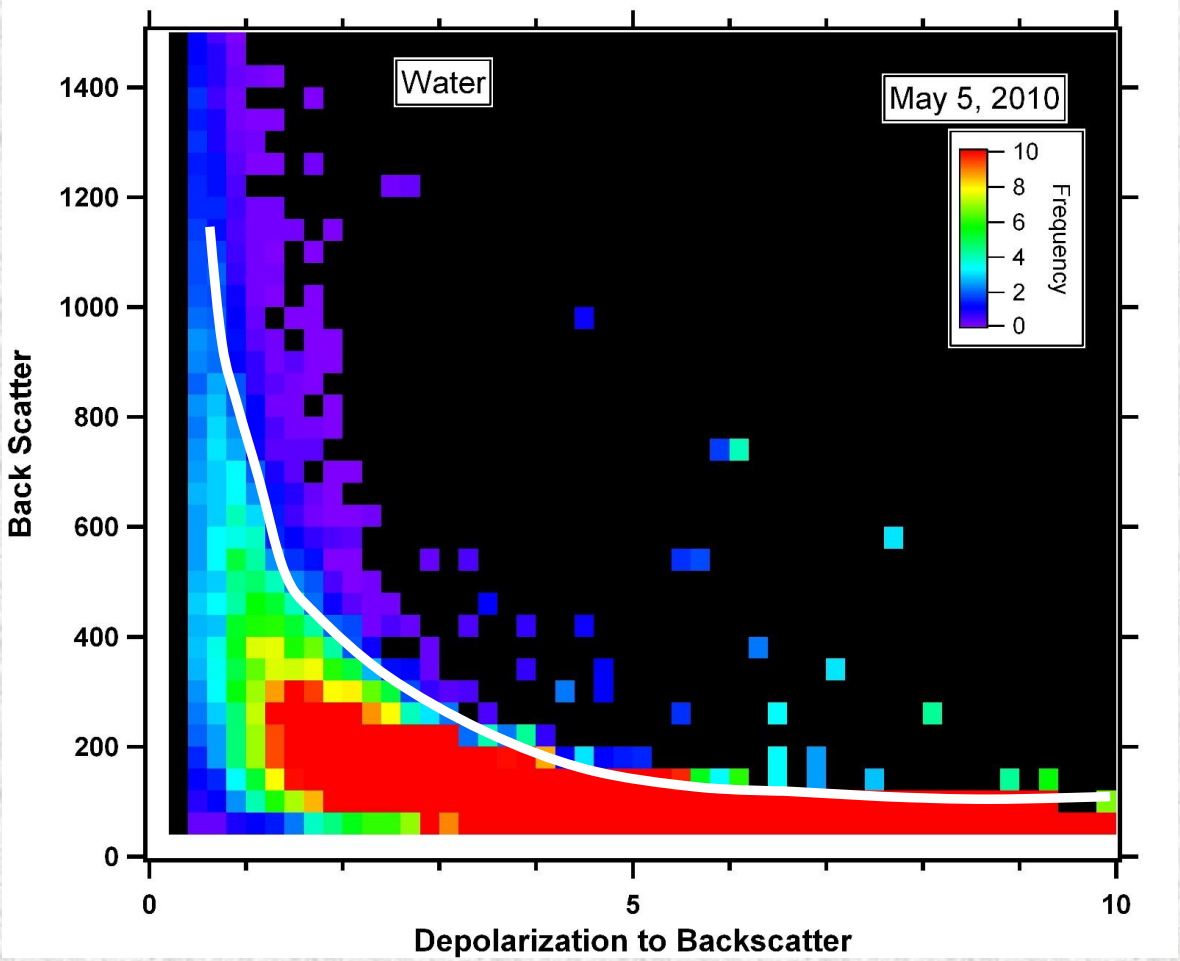
Mixed Phase



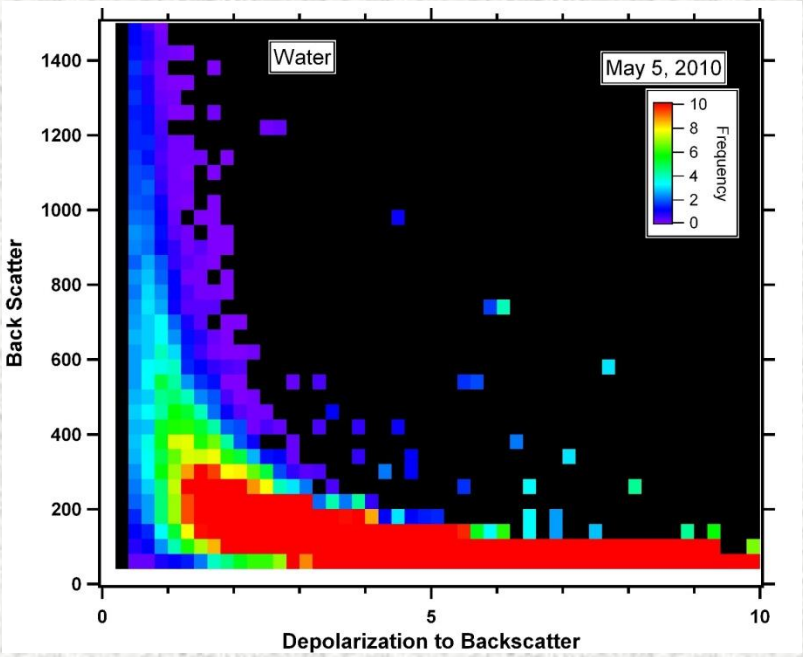
And the “mixed phase fingerprint” is a combination of liquid and ice.

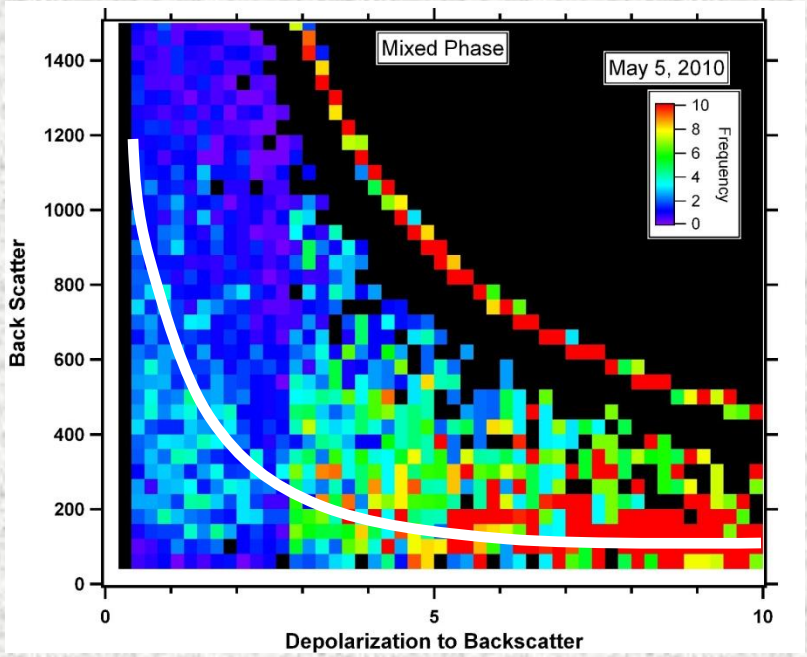


The white line shows the approximate threshold for liquid water droplets.

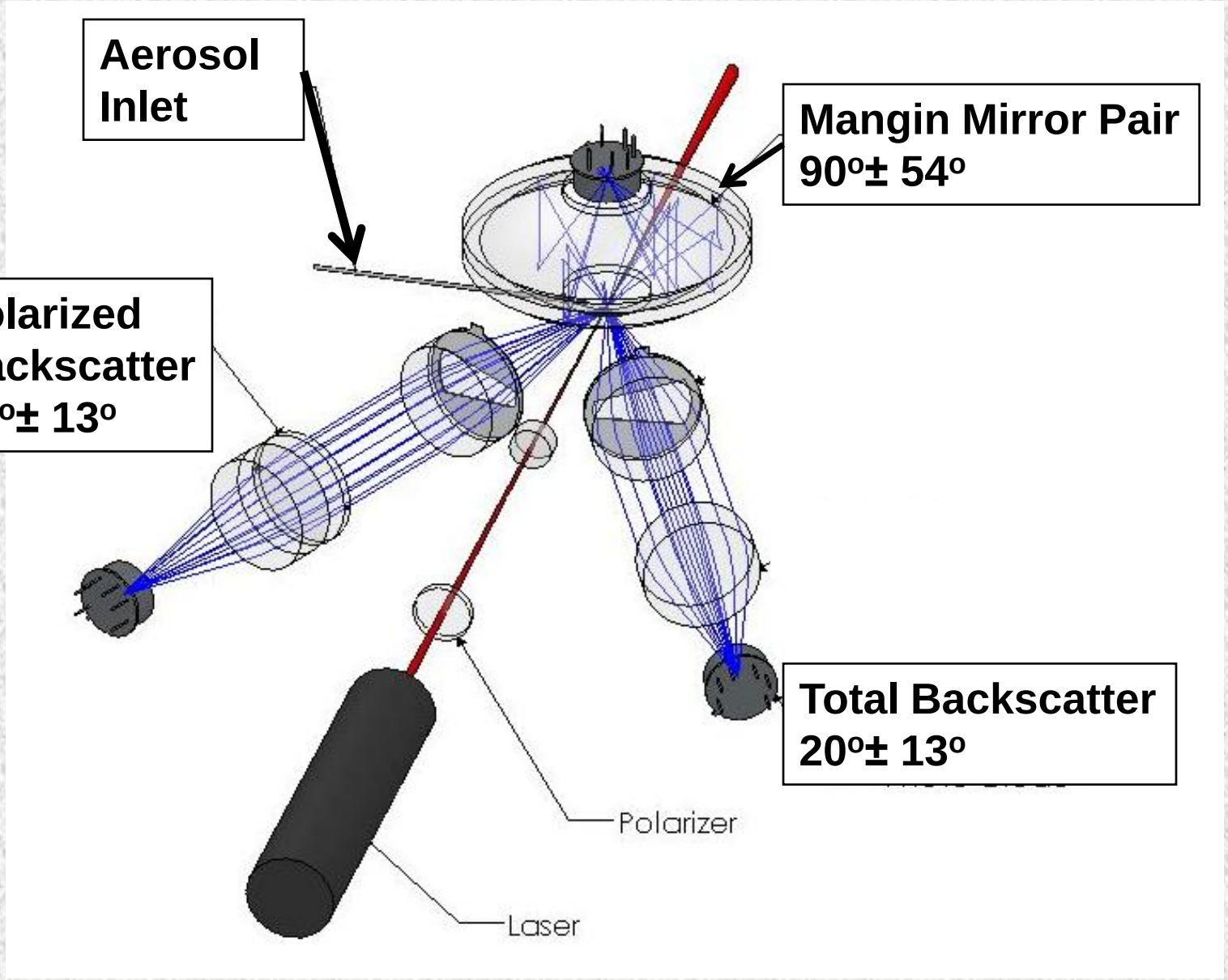


And can be used to distinguish the liquid part of mixed phase clouds. Here we see that most of the particles were ice.

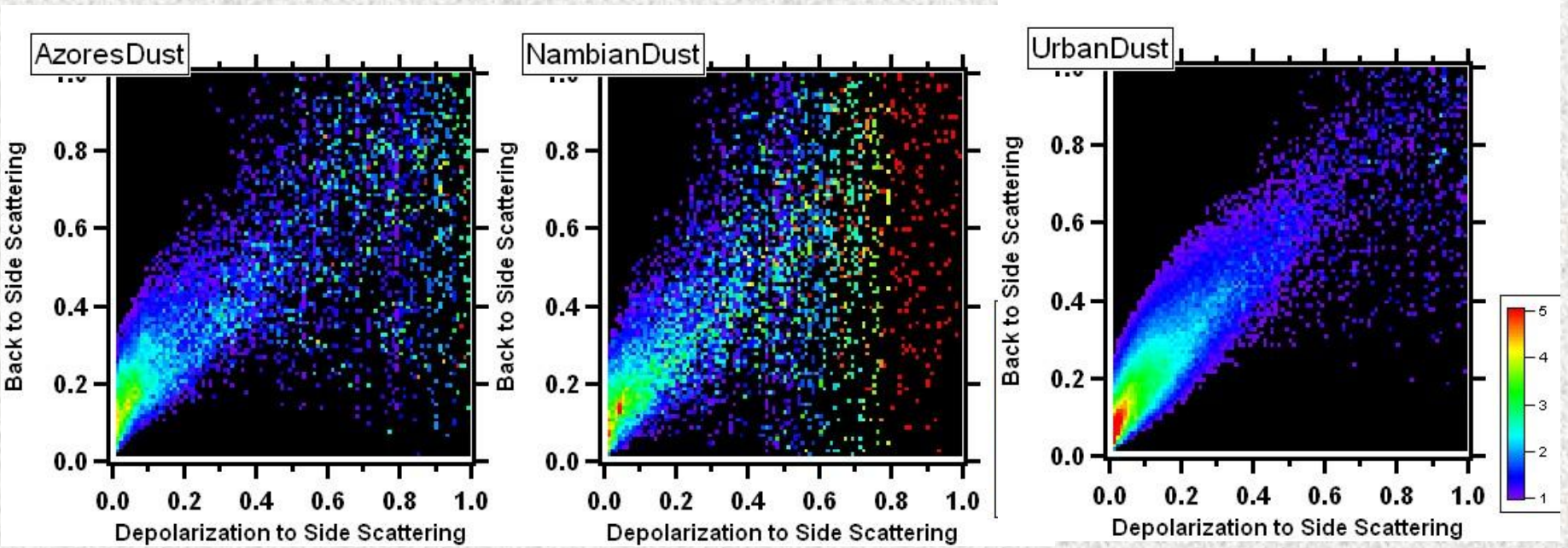




Aerosol Particle Spectrometer with Depolarization (APSD)



The maps of the frequency of back to side scattering versus depolarization to side scattering highlight differences in the optical properties of different ambient particles.



The APSD will be sampling behind the CVI, along with the SP2, in order to identify different types of ice residuals by their morphology.