Evidence for Homogeneous Freezing in DC3 Anvils and Implications for Anvil Chemistry

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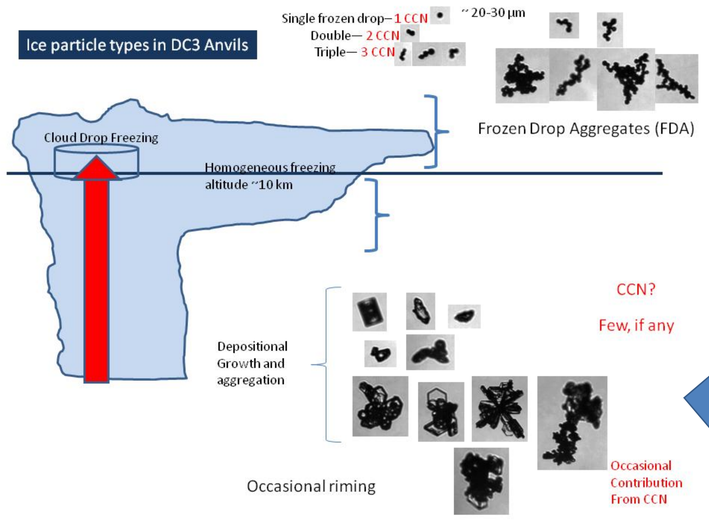
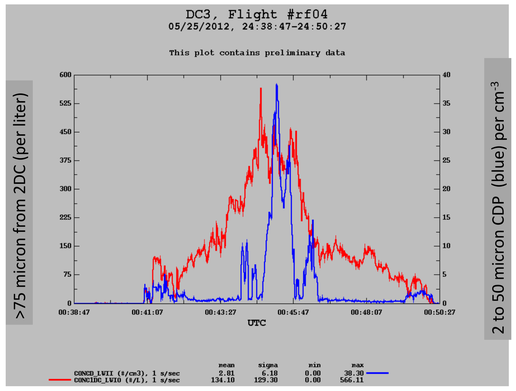


Frequent occurrence of frozen droplets in anvils colder than ~-38 °C.

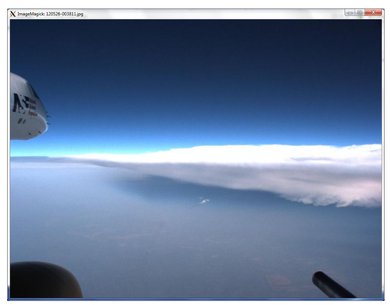
- Probably a consequence of homogeneous freezing of droplets in the strong updrafts of the storm
- Rapid aggregation occurs, probably aided by electrical forces in the storm (see references)
- Ice particles generally show little further growth by deposition or evaporation, suggesting conditions are near ice saturation.
- Frozen Drop Aggregates (FDA) contain far more CCN than crystals grown from deposition—suggesting a high degree of nucleation scavenging is present in these regions.
- Frozen drops and FDAs are not easy to identify using standard diode-shadowing probes (pixel size of 10 to 25 microns), but can be resolved by the SPEC CPI (2.3 micron resolution) when images are in focus.

• In warmer anvil regions, ice particles are grown to large sizes by depositional growth and aggregation

- Some riming also is found, but most heavily rimed particles have likely fallen out closer to the storm
- A consequence is that ice in this region is likely to contain far fewer CCN—less influence from nucleation scavenging than in cold anvil regions.



The results from a pass at a temperature of -52 C through an anvil from a strong storm on May 25, 2012. High concentrations of small frozen ice particles are found. Particle images (such as above) suggest that the small particles are frozen droplets.



Selected References

Overview of the influence of electric fields on aggregation (note Fig. 3 adaption of Lawson et al., 2003 work in Colorado Anvils): Connolly et al., 2005. J. Royal. Met. Soc., 131, 1695-1712

Other observations of FDAs: Gayet et al., 2012, Atmos. Chem. Phys., 12, 727-744.

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