The DLR cloud probes: Precipitation Imaging Probe (PIP) Cloud Aerosol Precipitation Spectrometer (CAPS)

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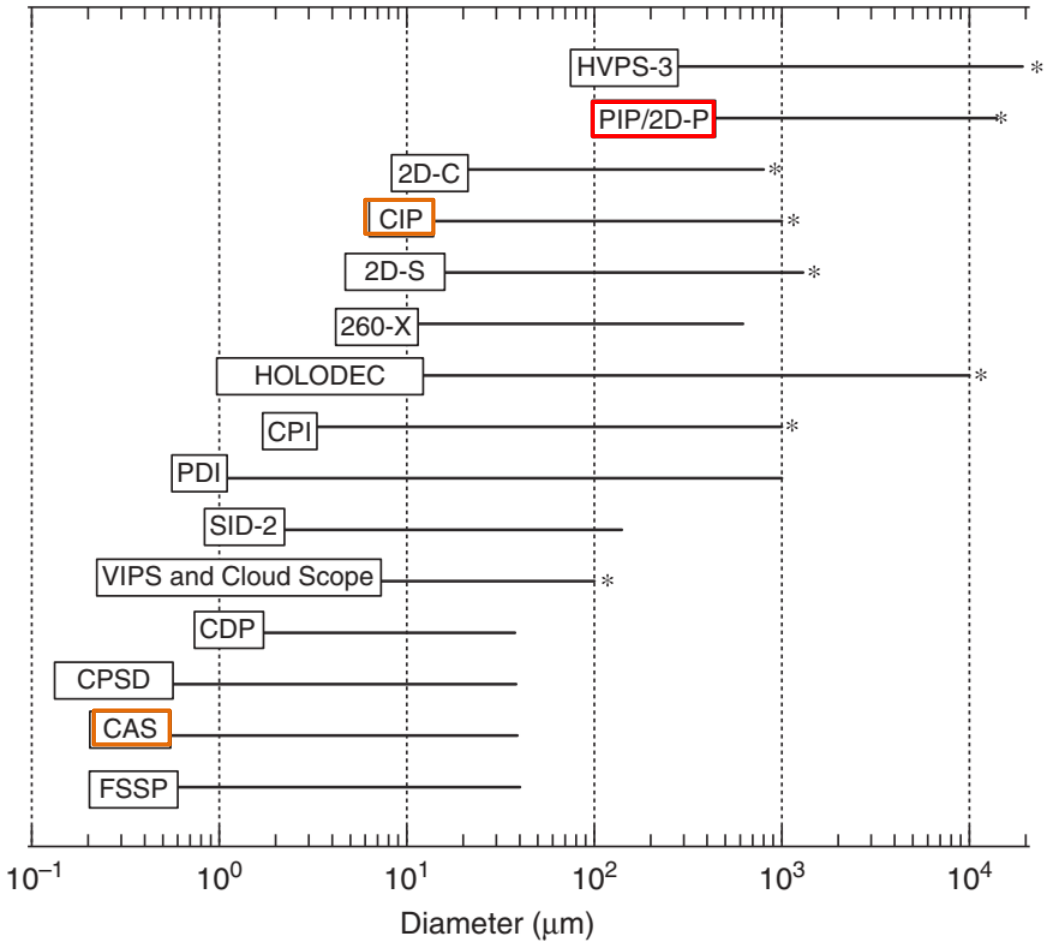
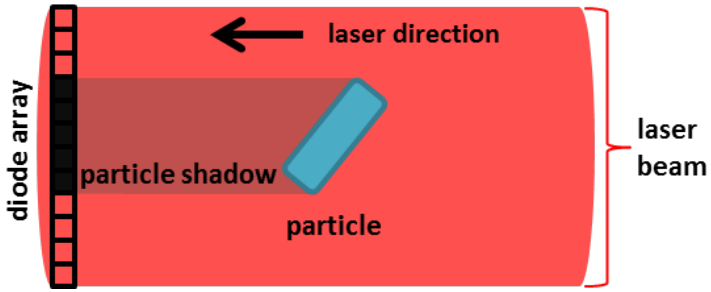
DLR

Covering the entire range of hydrometeor sizes



Brenguier and Wendisch et al. 2013

The Precipitation Imaging Probe (PIP)



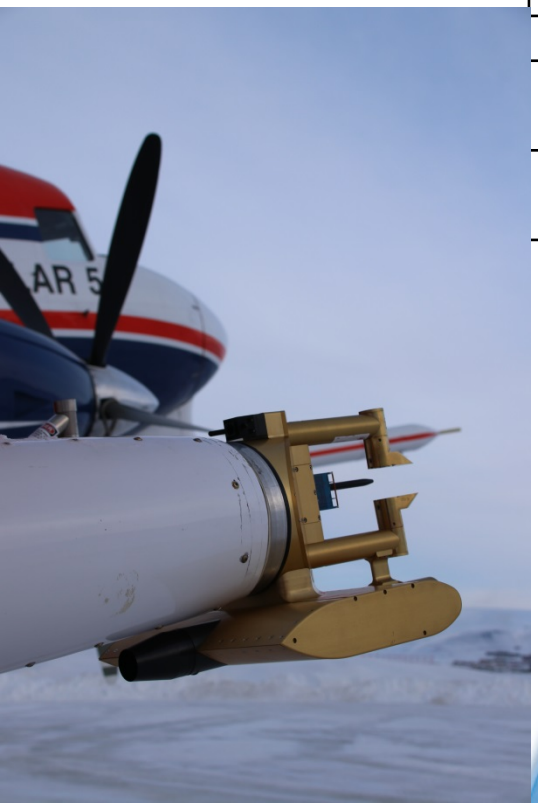
adapted from PIP manual, DMT, 2017

	Precipitation Imaging Probe (PIP)
technique	optical array probe; end diodes reject
particle diameter	0.1 - 6.2 mm
# pixel/ resolution	64 / 100 µm
upper concentration	100 cm^{-3}
sampling frequency	0.1 - 10 Hz particle-by-particle

The Cloud, Aerosol, and Precipitation Spectrometer (CAPS)

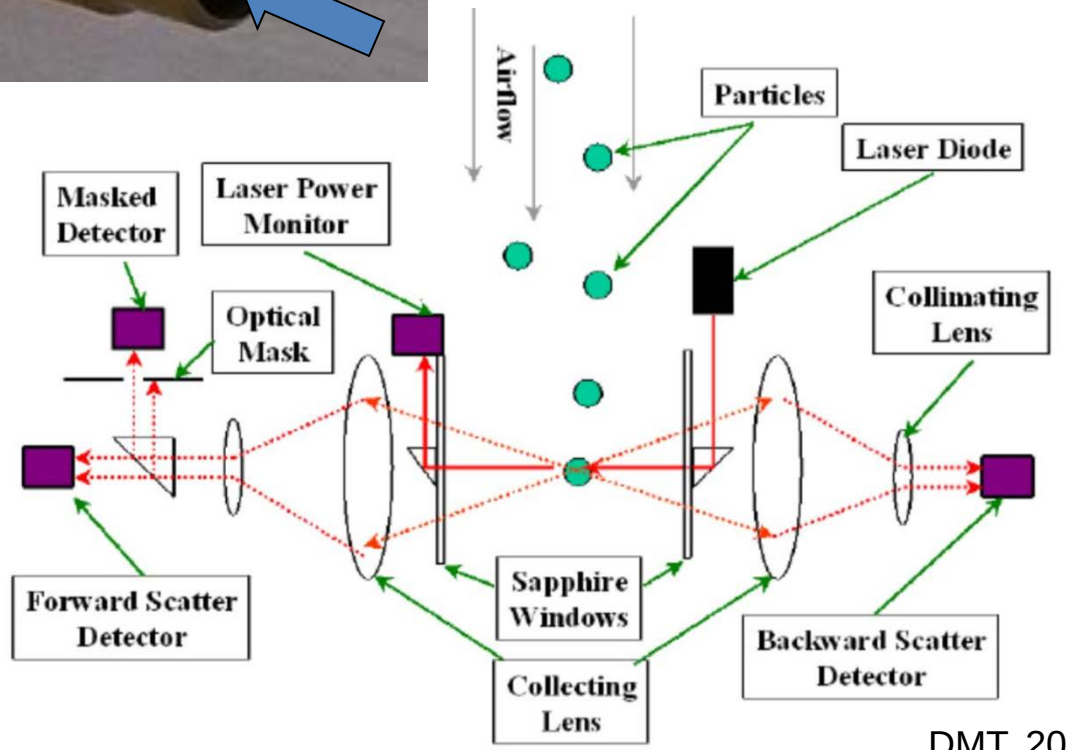
Consists of three individual sensors:

	Cloud Aerosol Spectrometer (CAS)	**Cloud Imaging Probe (CIP)**	**Liquid Water Sensor**
technique	scattering collection angles: 4° - 12°, 168° - 176° non-absorbing refractive index: 1.3 – 1.7	optical array probe; end diodes reject	temperature-controlled hot-wire sensor
particle diameter	0.51 - 50 µm	15 - 960 µm	LWC: 0.01 - 3 g/m^3
# pixel/ resolution	10,20,30 or 40	64 / 15 µm	n/a
upper concentration	> 1,000 cm^{-3}	500 cm^{-3}	3 g/m3
sampling frequency	0.1 – 10 Hz	0.1 – 10 Hz, particle-by-particle	0.1 – 10 Hz



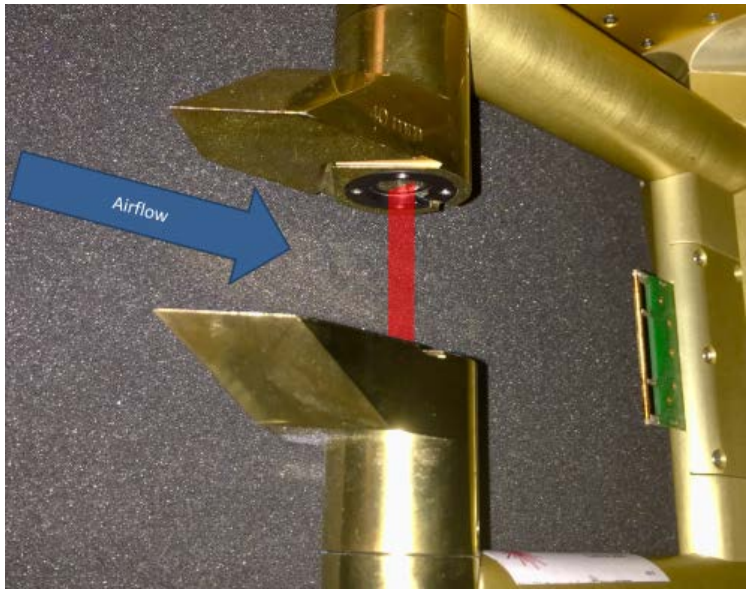
The Cloud Aerosol Spectrometer (CAS)

Measured particle size: 0.51 - 50 µm

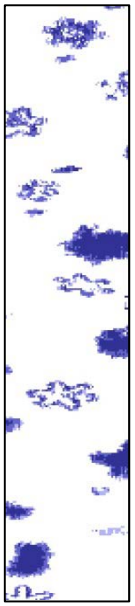


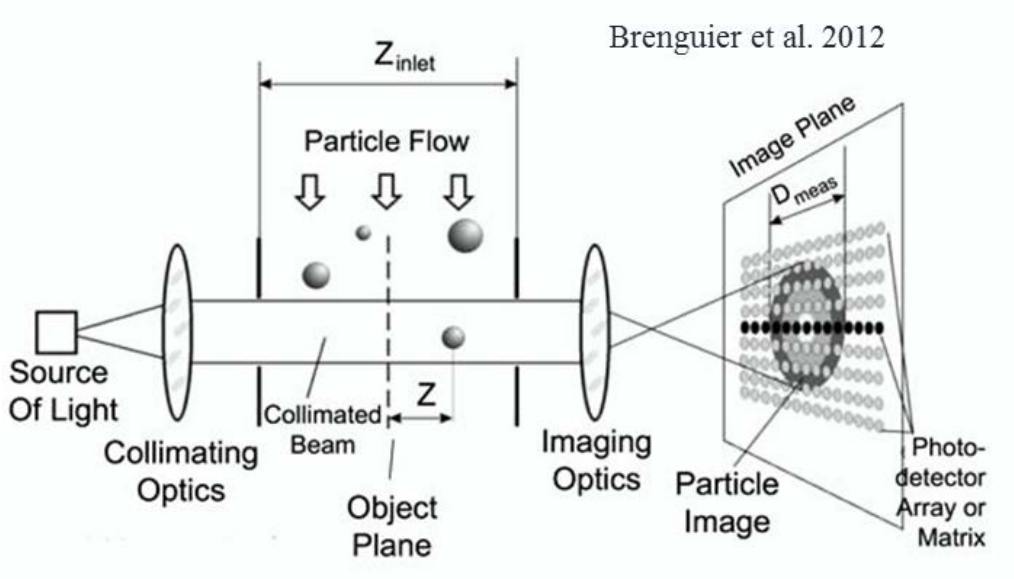
DMT, 2011

The Cloud Imaging Probe (CIP)



- 64 x 15 µm photodiodes
- Particle size: 15 – 960 µm



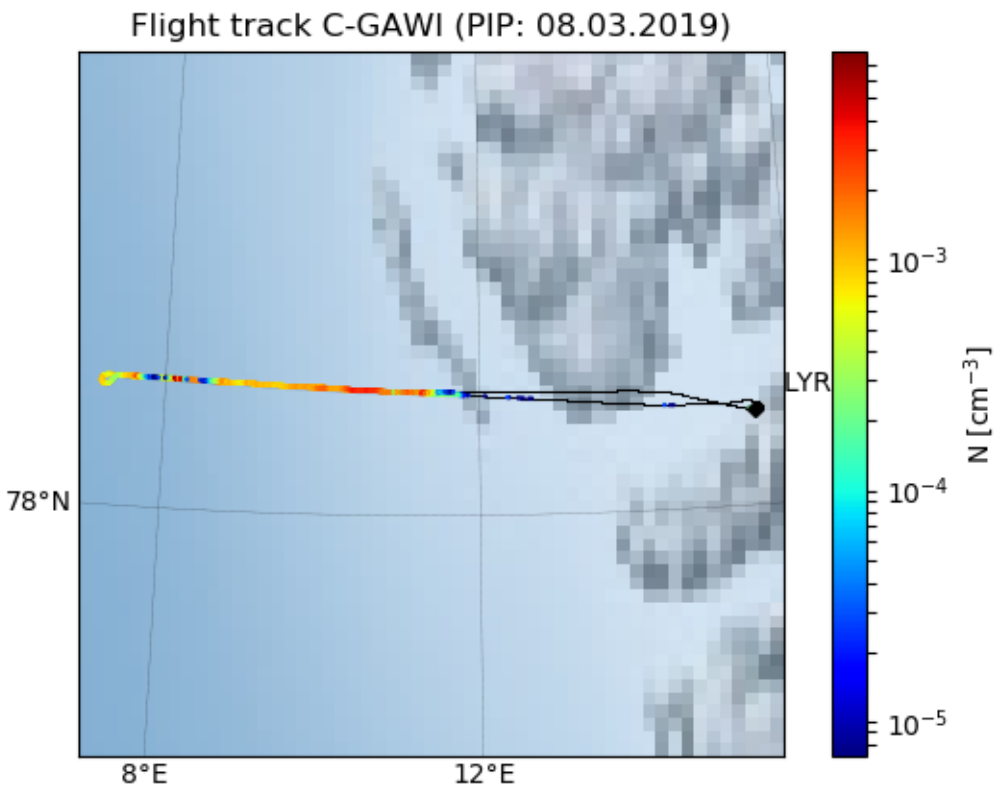


Liquid Water Sensor (‘King’-probe)

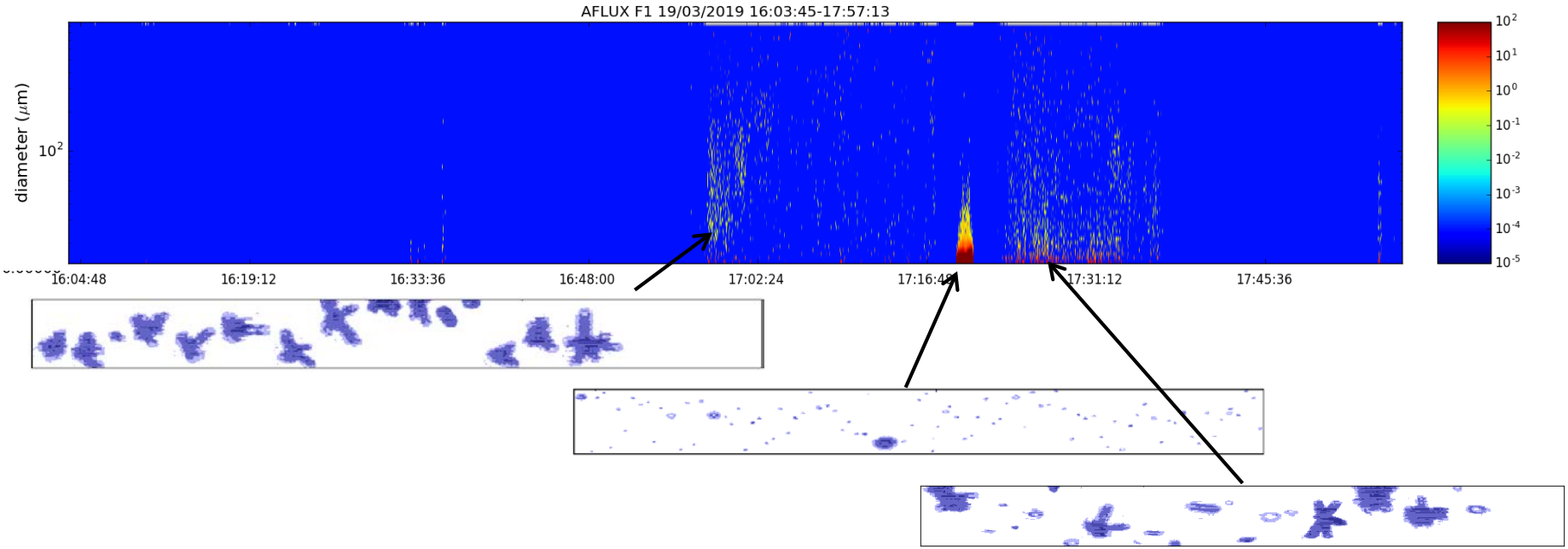
Measures the power necessary to keep coil at constant temperature (>100°C) when droplets are evaporated

LWC is proportional to power loss difference between total power and convective power loss

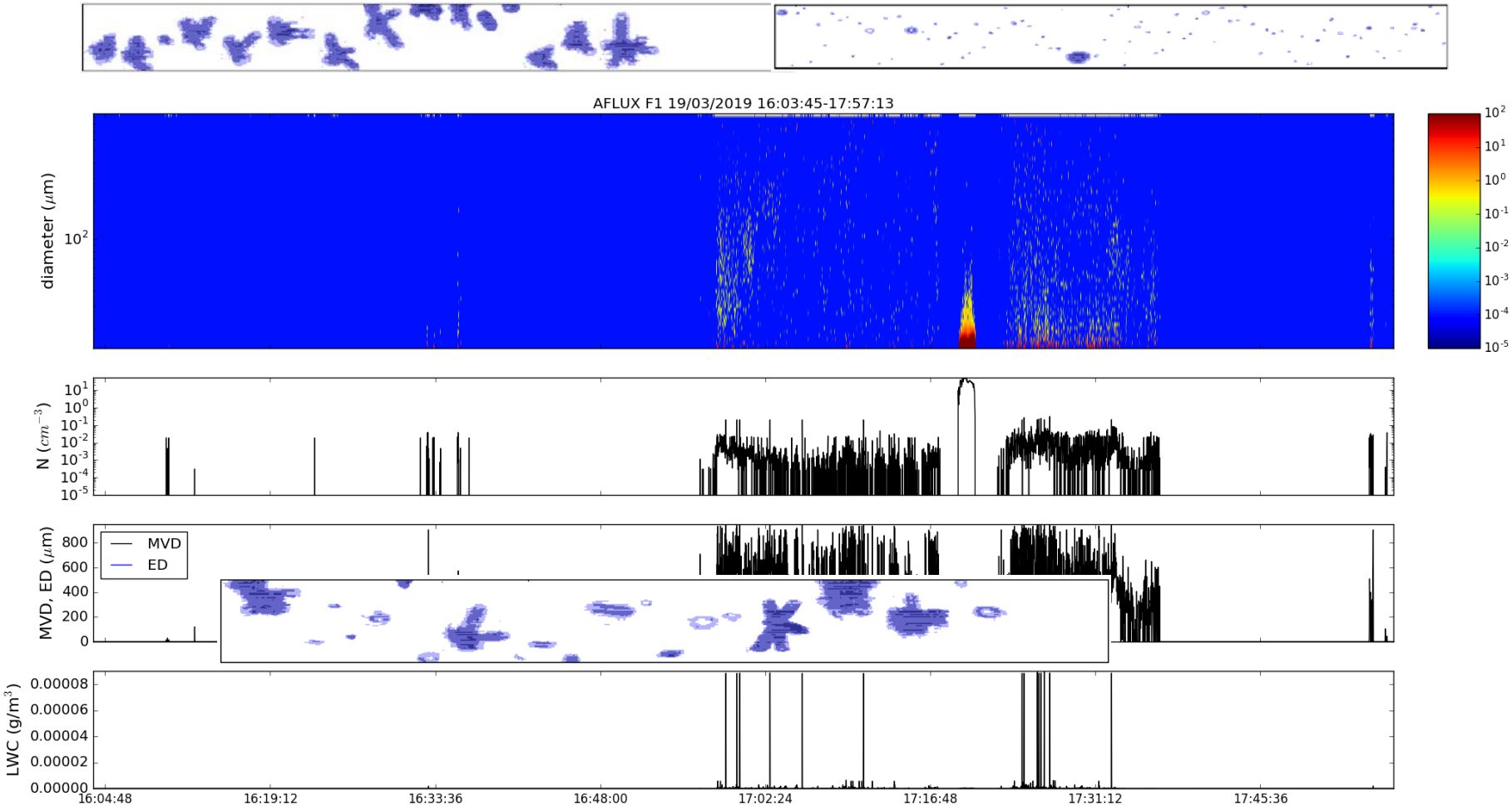
Yesterday’s flight overview



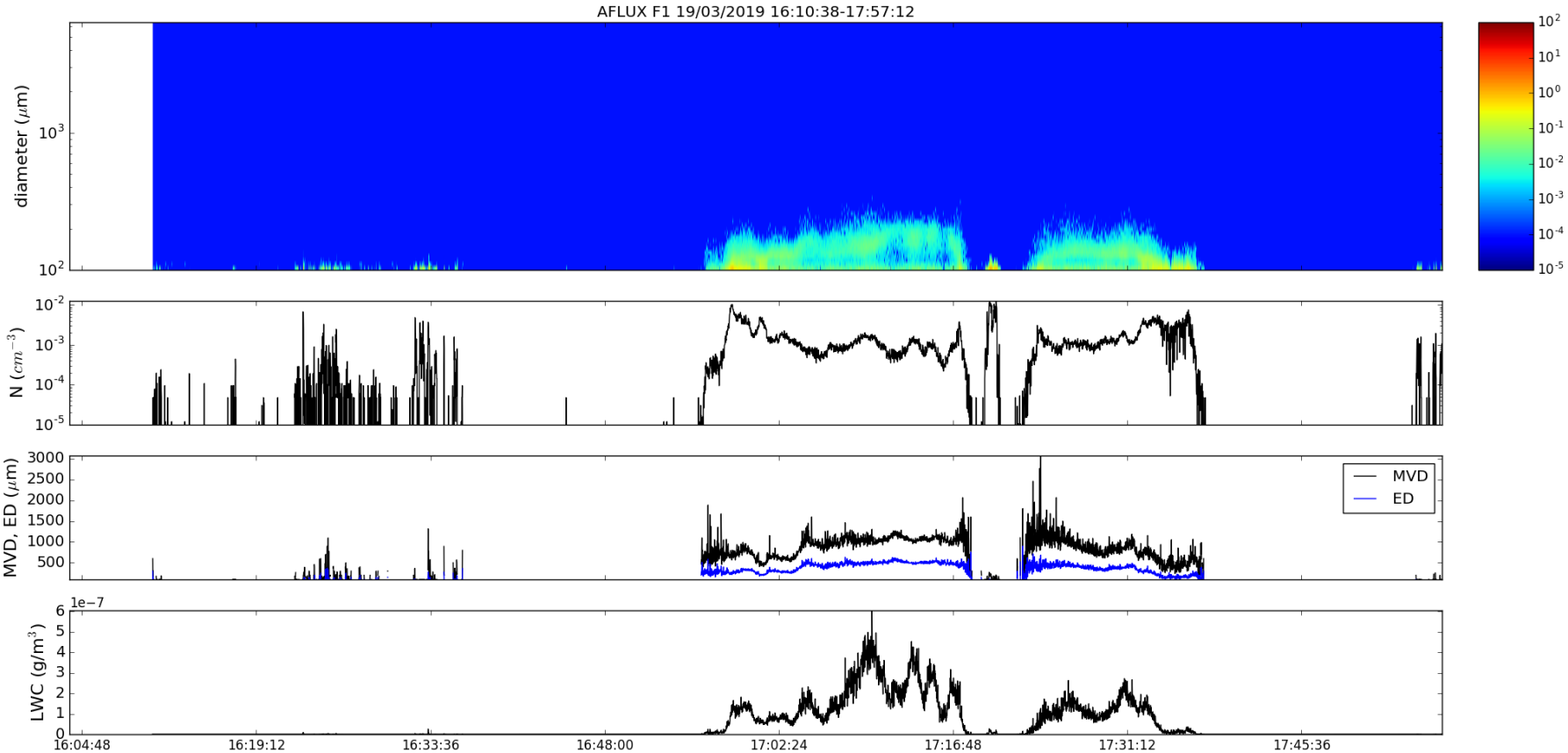
Yesterday's flight's result: CIP: 15< d < 960 µm



Yesterday's flight's result: CIP: 15< d < 960 µm

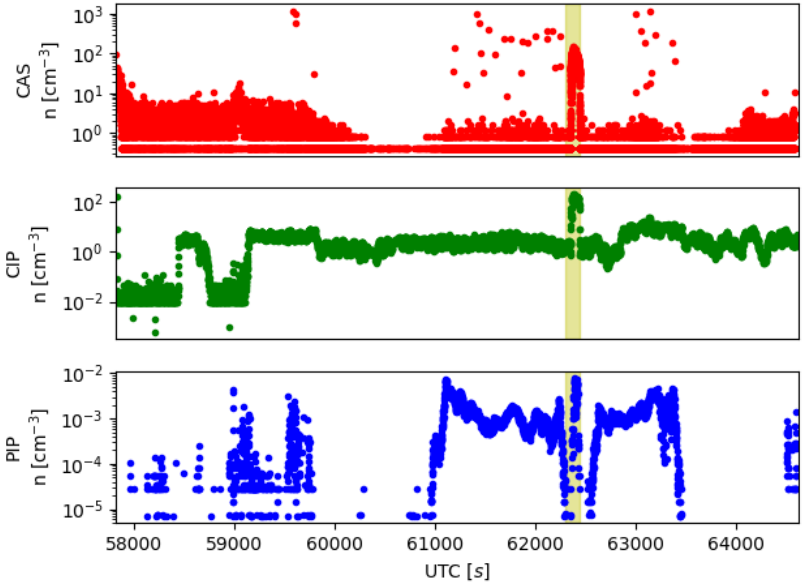


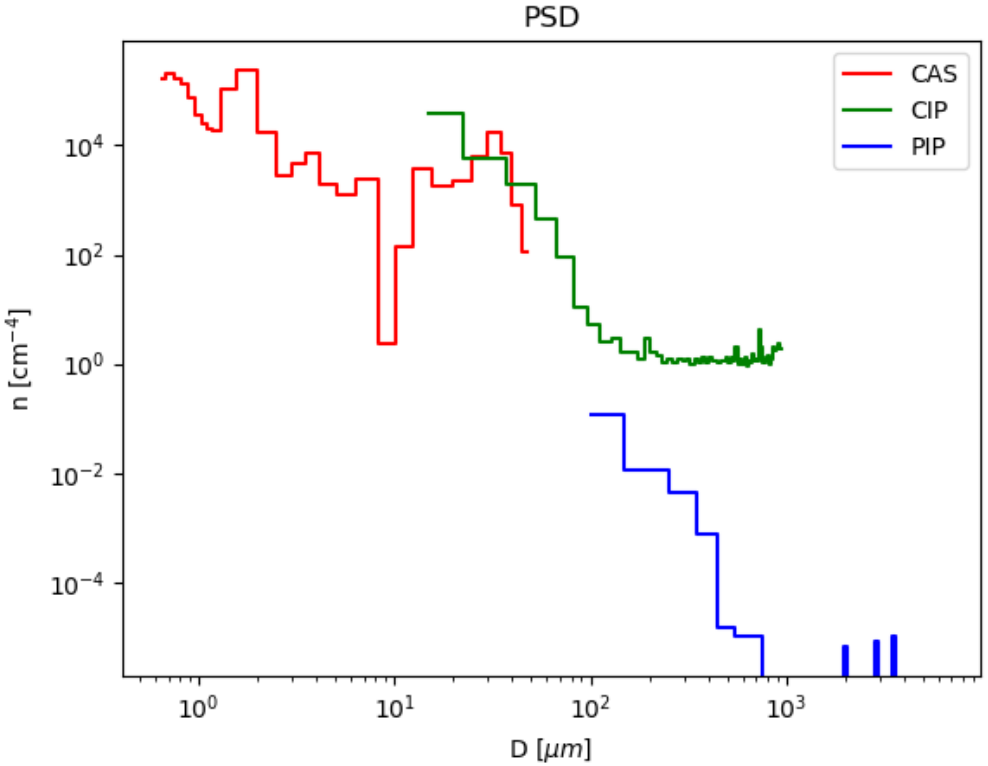
Yesterday’s flight’s result: PIP: d>100µm



17:13:32.068

Yesterday's flight's result: Particle size distribution





Summary of properties we measure/retrieve:

- Cloud particle number concentration
- Cloud particle size distribution ➔ MVD, ED,…
- Crystal shapes
- Phase of small cloud particles
- Liquid/ice water content

What we are interested in:

- How are ice phase vs. water phase distributed in Arctic mixed-phase clouds?
  (in different cloud types, vertically/horizontally, different temperatures)

- Comparing n_{ice} to radar retrievals in different cloud regimes

- *Aerosol-cloud interactions (marine organic emissions ➔ effect on n_{ice}, PSD)*