ICEPIC: ICE and Precipitation Initiation in Cumulus (UK)

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Investigators

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Alan Gadian	University of Leeds
John Latham	NCAR

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The Overall Goal of ICEPIC:

To understand and quantify the formation and development of ice particles and precipitation in convective clouds

Specific Objectives:

- compare the observation of the first ice particles in cumulus clouds with the IN activity spectrum

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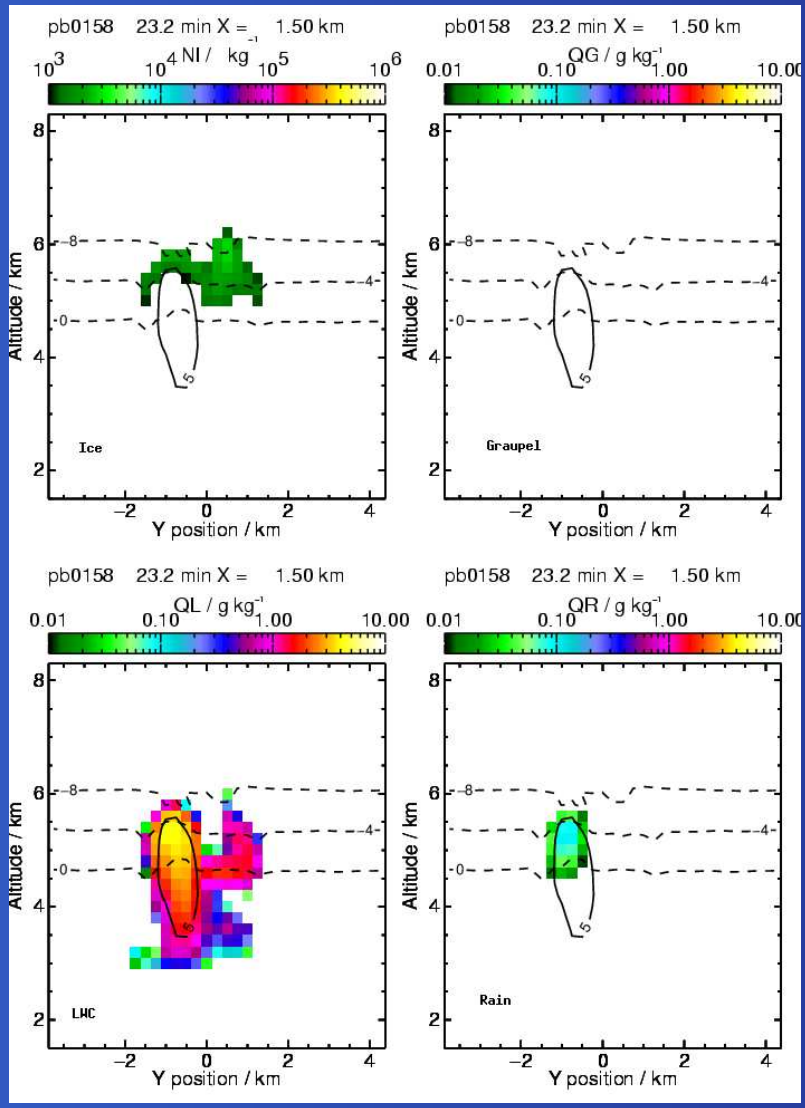
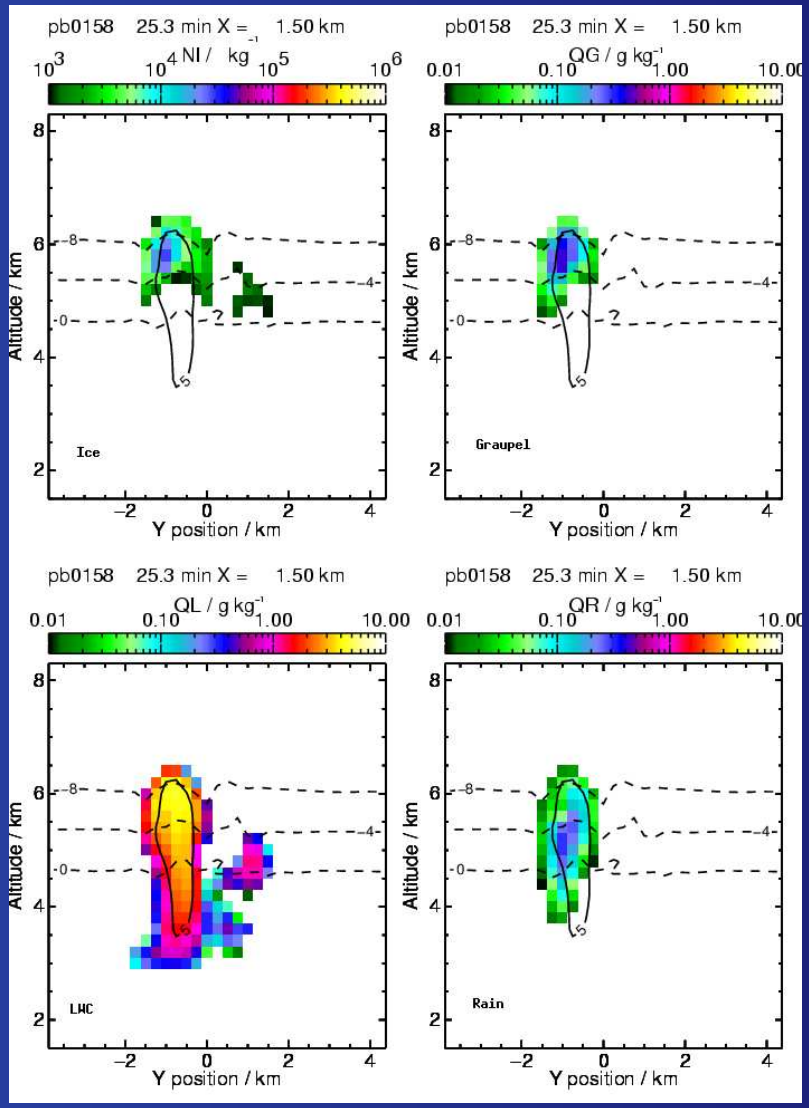
- examine whether significant ice particles are produced by the H-M process and/or other secondary ice production processes, such as fragmentation during evaporation
- test the prediction that supercooled raindrops can significantly enhance the rate of splinter production by freezing to produce an instant, efficient rimer

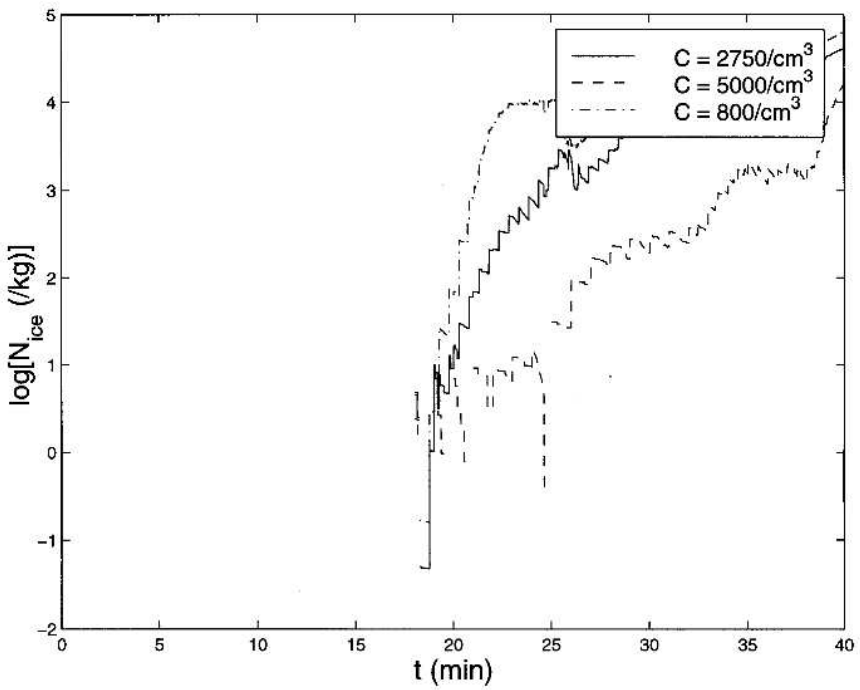
Cloud Resolving Model (NM CuCg)





Explicit Microphysics Model

NM Cumulus Congestus



Supercooled raindrops in UK clouds

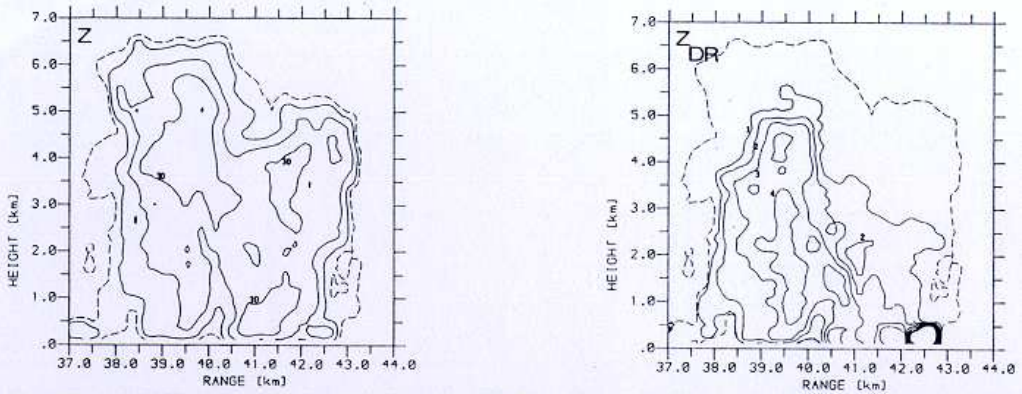


Figure 7. An RHI at 1641.10 h through the cell in Fig. 5 at azimuth 95° showing the development of a narrow column of positive Z_{DR} above 4 dB which extends almost 2 km above the freezing level.

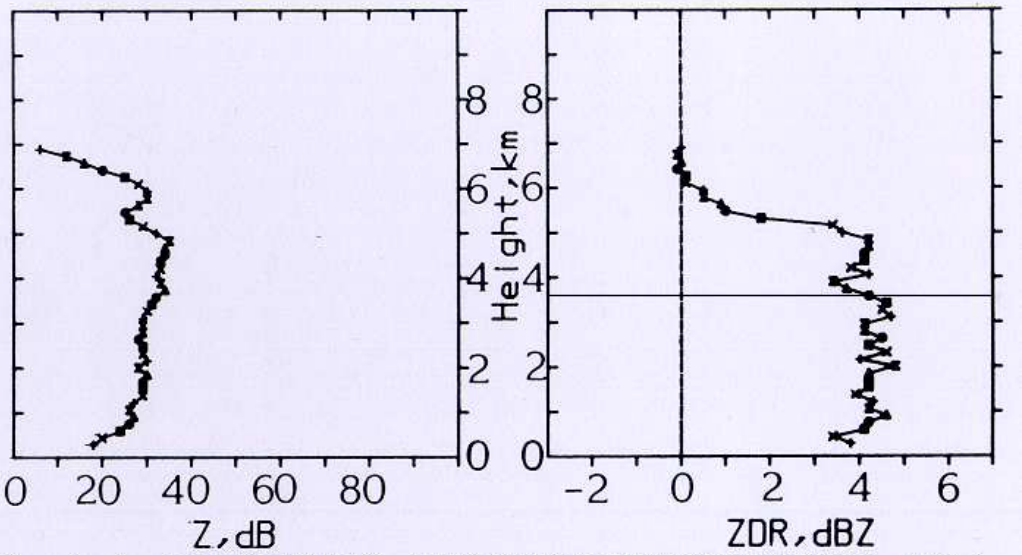
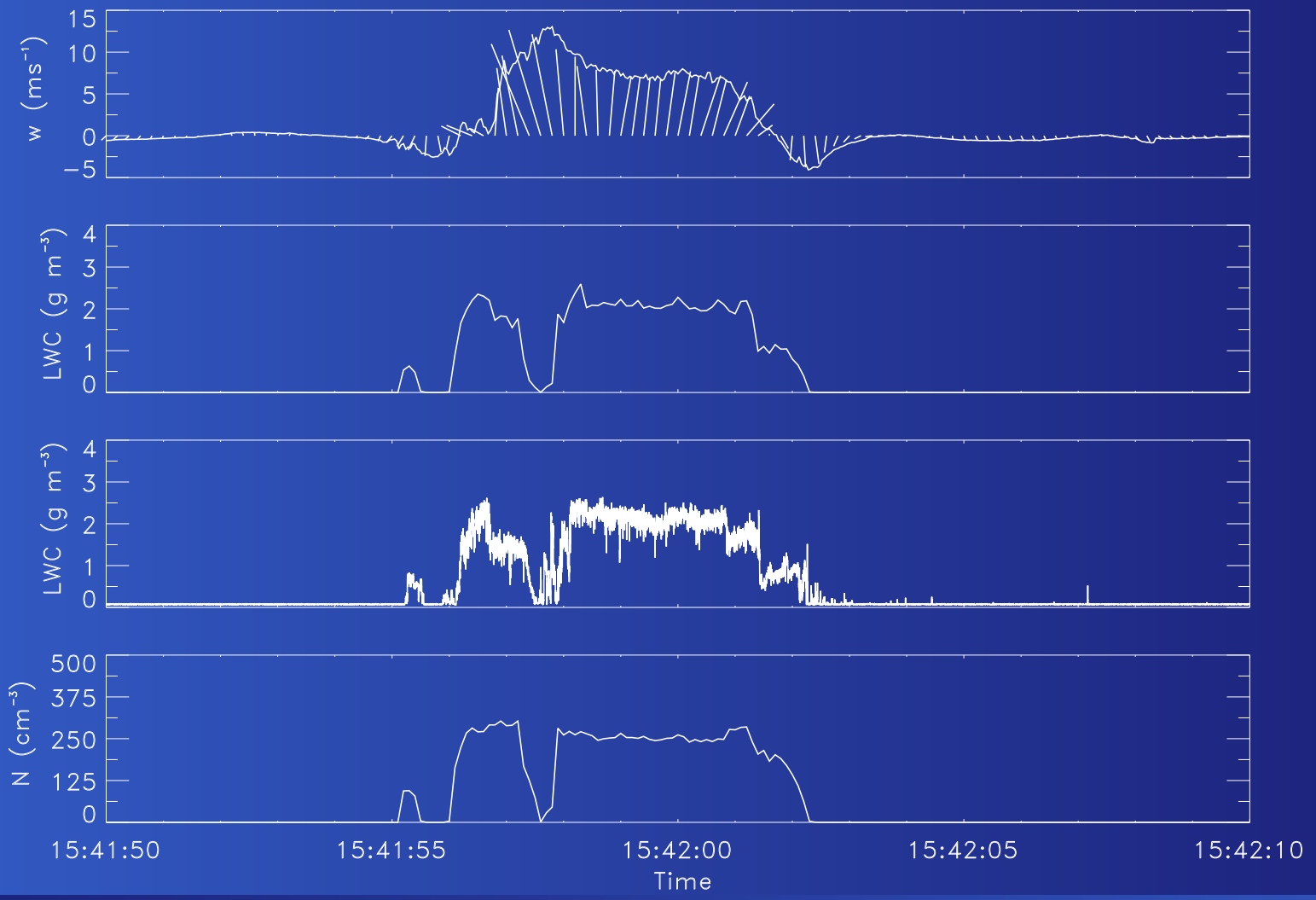


Figure 8. A vertical profile of Z and Z_{DR} at range 39·9 km through the column of positive Z_{DR} in Fig. 7.

Illingworth et al. (1987) *QJRMS*, **113**

Hole in Updraft

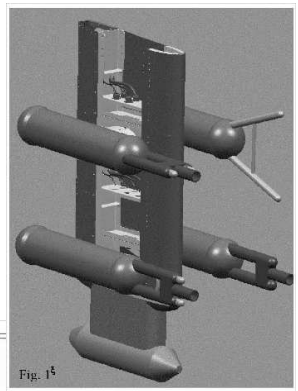


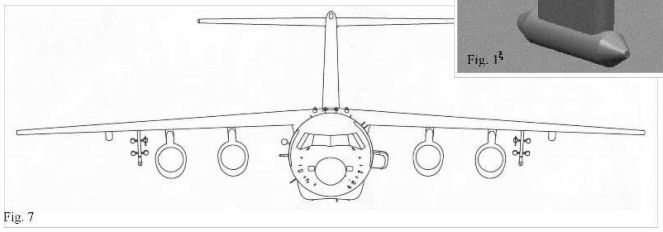
New UK BAE 146 Aircraft

- Small Ice Detector 2 (Kaye and Hirst)
- Cloud Particle Image (SPEC)
- PMS probes
- Airborne Droplet Analyser
- IN Counter
- Aerosol Mass Spec
- Counter flow Virtual Impactor

Canister mounted probes

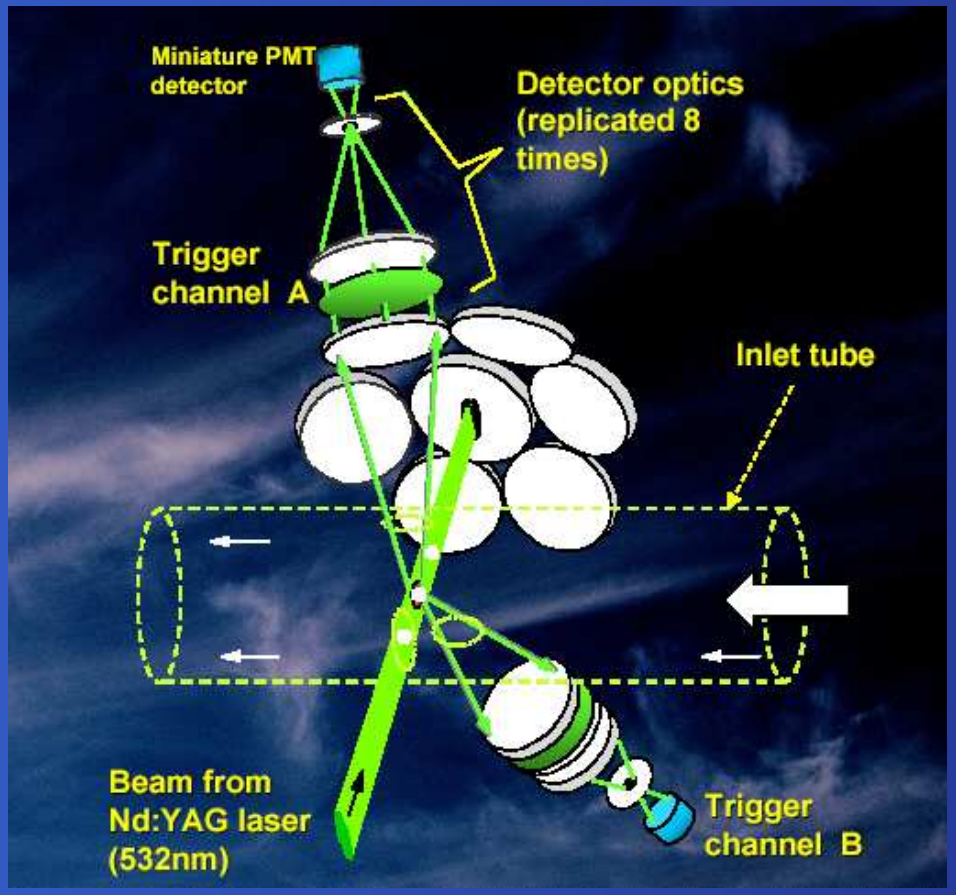
Total of 10 positions but some restrictions

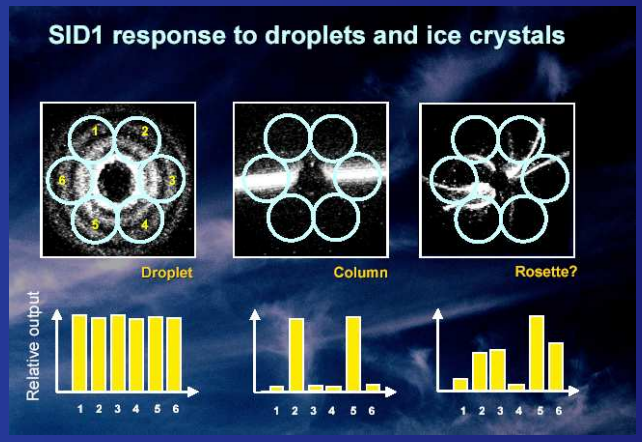


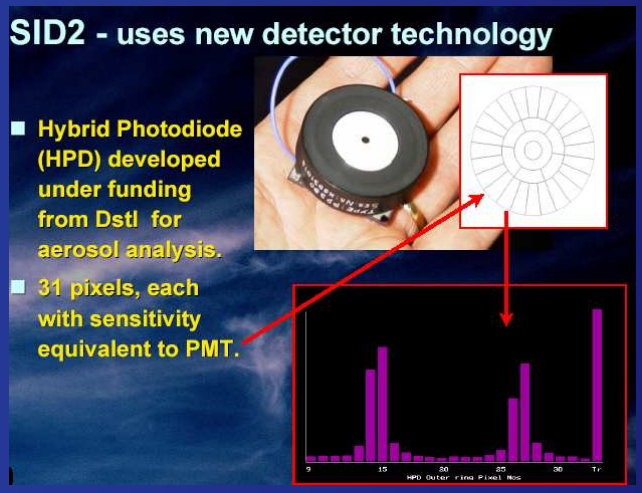


Small Ice Detector (SID)

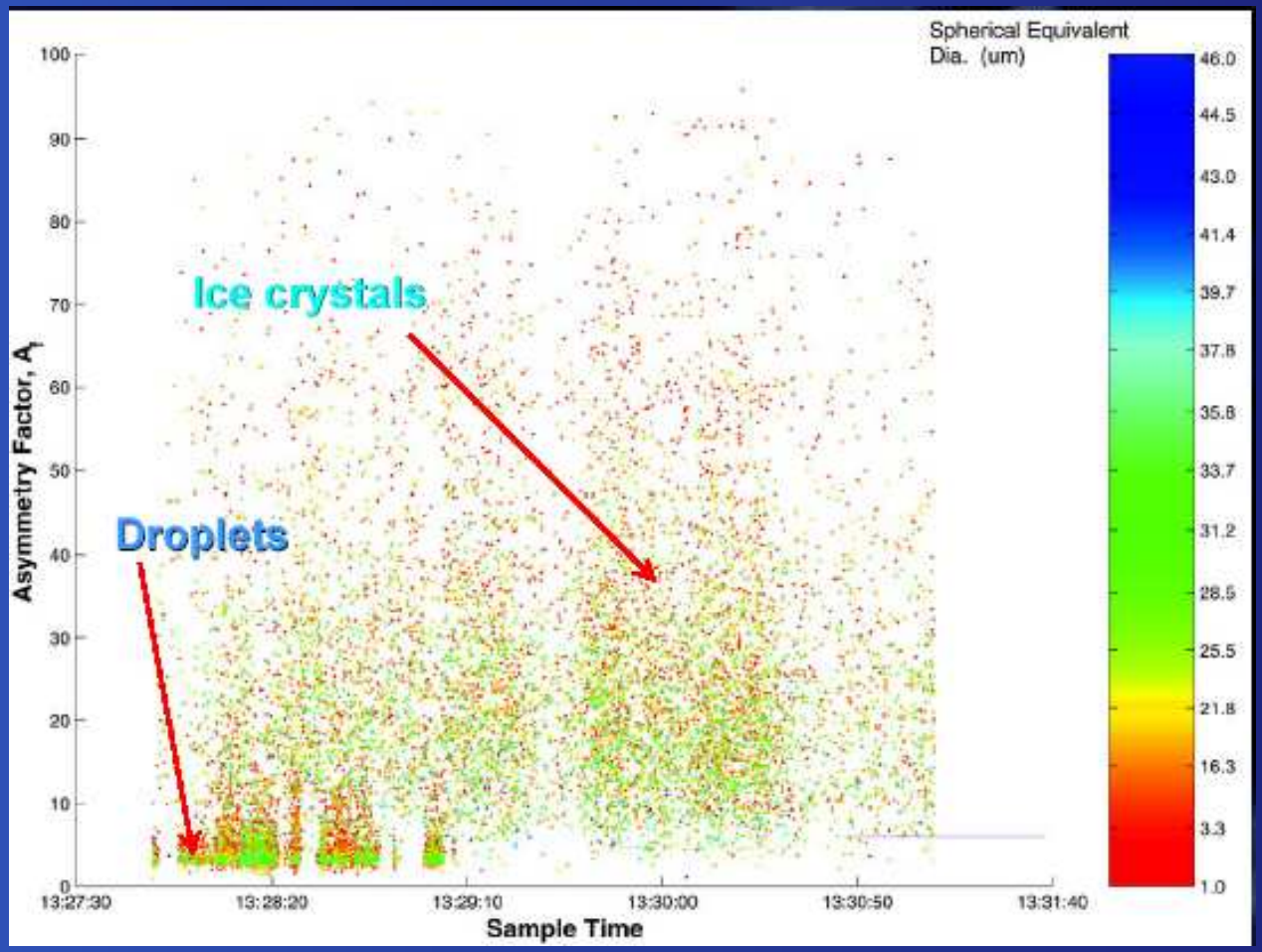
Courtesy of Paul Kaye and Edwin Hirst







SID (cont)


Spherical Equivalent
Dia. (um)
46.0
44.5
43.0
41.4
39.7
37.8
35.8
33.7
31.2
28.5
25.5
21.8
16.3
3.3
1.0
Ice crystals
Droplets
Asymmetry Factor, A_f
100
90
80
70
60
50
40
30
20
10
0
13:27:30
13:28:20
13:29:10
13:30:00
13:30:50
13:31:40
Sample Time

Dual-polarization, Doppler radar

Chilbolton Advanced Meteorological Radar (CAMRa)

- Wavelength: 10 cm
- Antenna diameter: 25 m
- Peak power: 560 kW
- Pulse width: 0.5 μm
- Elevation slew rate: 1°/ s
- Azimuth slew rate: 2°/ s
- Beam width: 0.28°
- Max. range resolution: 75 m
- Max digitised range: 160 km
- Unambiguous velocity: 15 m/s

Field Experiment

Flights with 146 near Chilbolton radar UK; June - August 2005 in conjunction with CSIP

Predictions to test:

- First ice occurs in the centre of the thermal or in the edge downdrafts

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Predictions to test:

- First ice occurs in the centre of the thermal or in the edge downdrafts
- The glaciation of cumulus clouds is dominated by the Hallett-Mossop process
- Supercooled raindrops play a significant role in the glaciation of Cu clouds by short-circuiting H-M process