Australian Government
Bureau of Meteorology

Polarimetric radar: products and applications
Darwin ARCS + DCRS

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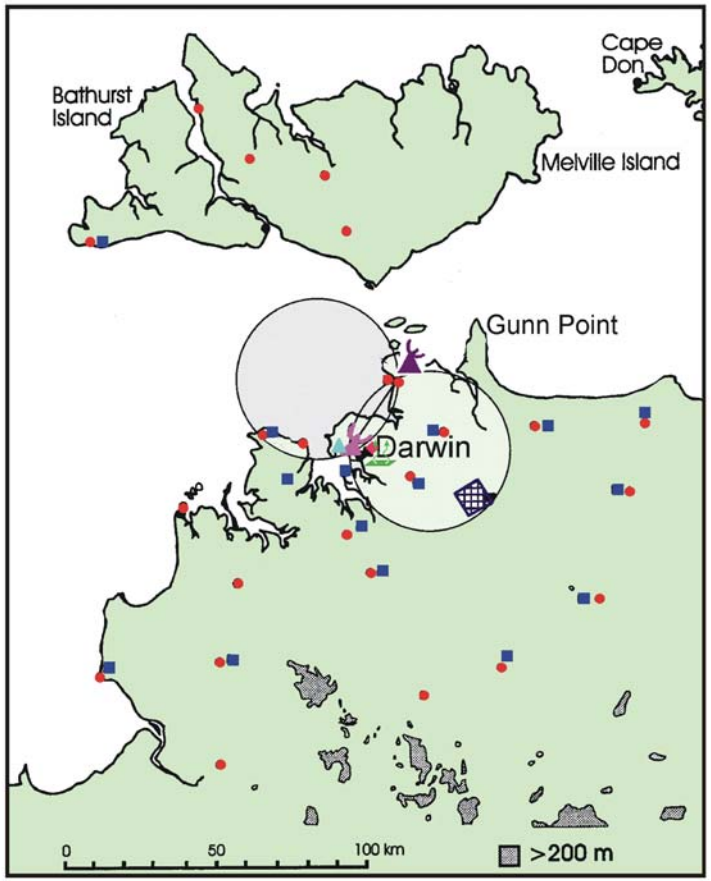

Darwin Climate Monitoring Research Station

- Radar: Doppler / Polarised (C-Band)
- Profiler (50 / 920 mHz)
- Rawinsonde
- C- Scale Raingauge
- D-Scale, M-Scale Raingauge
- Automatic Weather Station

Darwin Atmospheric Radiation and Cloud Station

- Solar Terrestrial Radiation
- Surface Meteorological Instruments
- Microwave Radiometer
- Micro-Pulse Lidar
- Millimeter Cloud Radar
- Ceilometer
- Whole Sky Images
- Atmospheric Emiter
- Radiance Interfometer

BMRC Bureau of Meteorology Research Centre
Department of the Environment and Heritage, Commonwealth of Australia

We have a multi-year data set
From the BMRC 5 cm wavelength polarimetric radar (C-Pol).

This provides details of the rainfall, reflectivity and microphysical properties of the precipitation and large cloud particles.

Significant component of observational suite that makes Darwin the best instrumented site anywhere in the tropics.

This data is available to the community at www.arm.gov
New products being developed
Testbed for new scanning systems

Polarimetric radar

Type of weather radar

Change polarisation between pulses:

Measures: Reflectivity
Differential Reflectivity - oblateness
Correlation between signals - mixed phase
Differential phase on propagation -
attenuation
rain rates

Applications – QPE, Hydrology, Storm microphysics

BMRC
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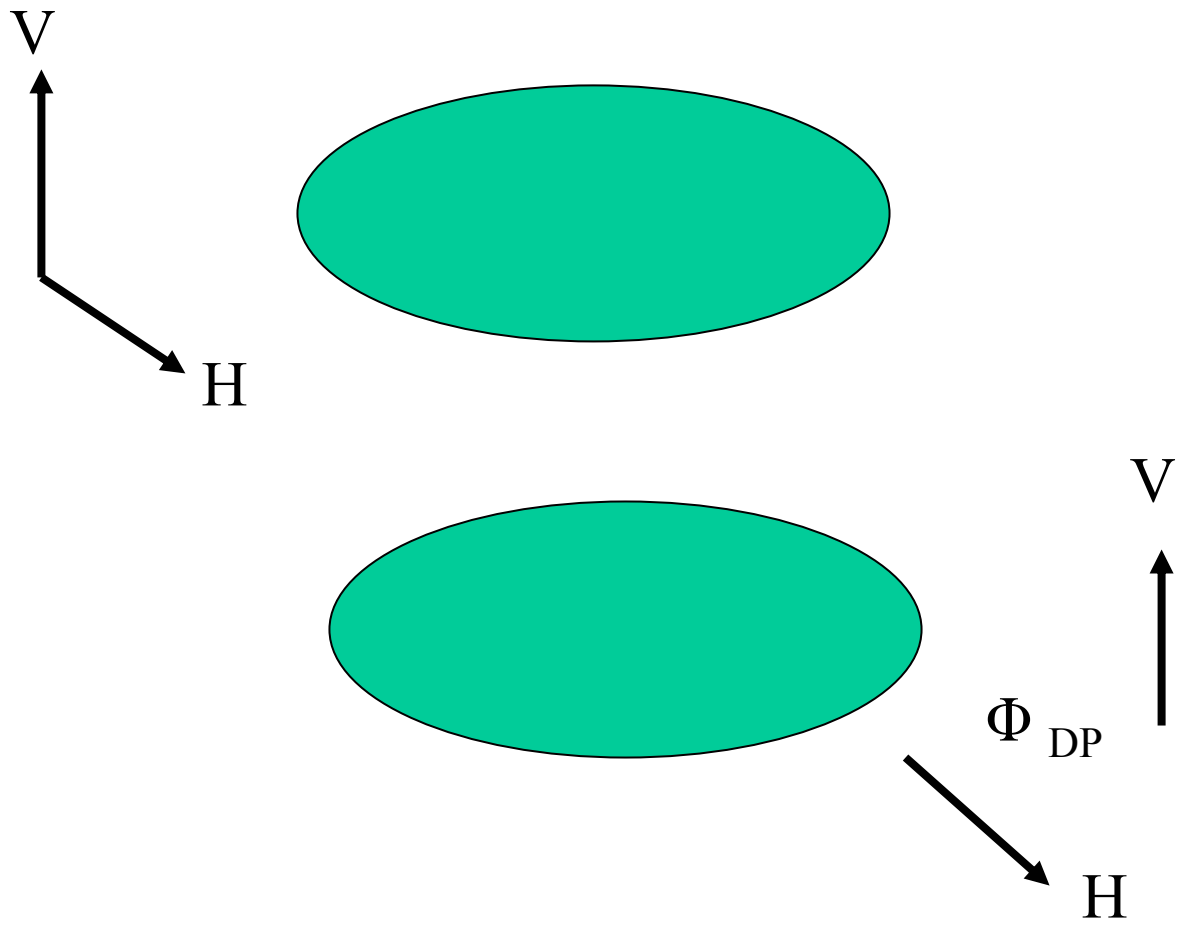
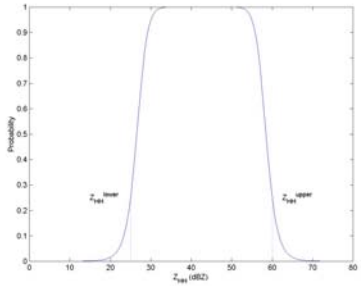


Reflectivity is different for the two polarisations

Speed of propagation is different

Microphysical classification with polarimetric radar

Use combinations of estimators and fuzzy logic to estimate most Likely hydrometeor type:



Z: 45-80dBZ Z_{DR}: -1 – 6 dB $\rho_{HV}(0)$: >0.9

K_{DP}: 0 – 20 °/km T: -10 – 10°C ➔Rain/hail mix

Classification types:

Drizzle	Rain	
Snow (dry low density)	---- Snow (dry high density)	Snow(melting
Graupel (dry)	Graupel (wet)	
Hail (D < 2 cm)	Hail (D > 2cm)	Rain/Hail mix

Scan Strategy every 10 minutes

1) Long range low elevation scan
2) 17 tilt Volume scan up to 45^{o}, range 150 km
3) RHI Scan over ARCS, Profiler sites (high vertical resolution)
4) Vertical mode

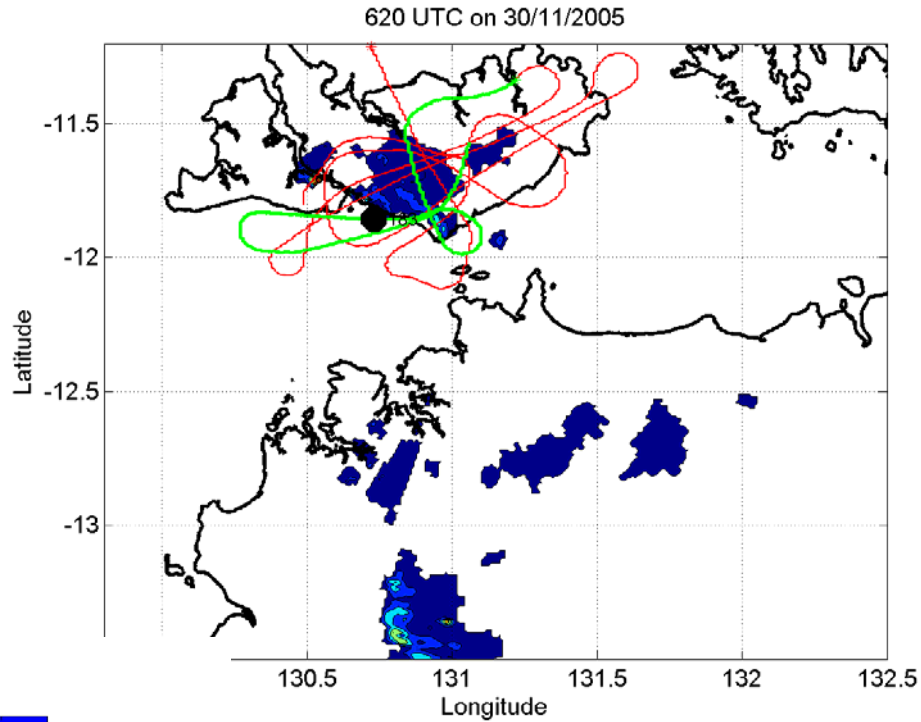
From 2 derive:

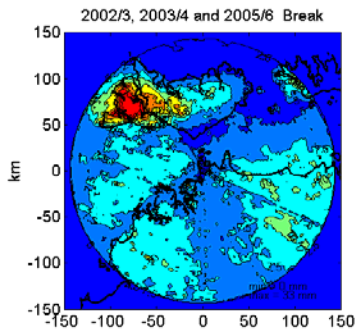
Gridded reflectivity and microphysical type product

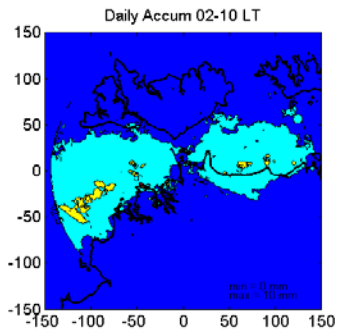
Rainfall maps

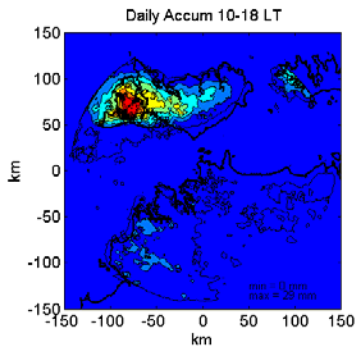
Applications 1: rain estimation

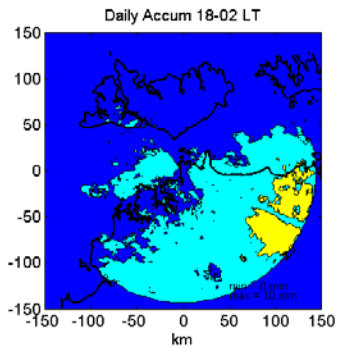
Rain maps (with overlay of aircraft tracks)







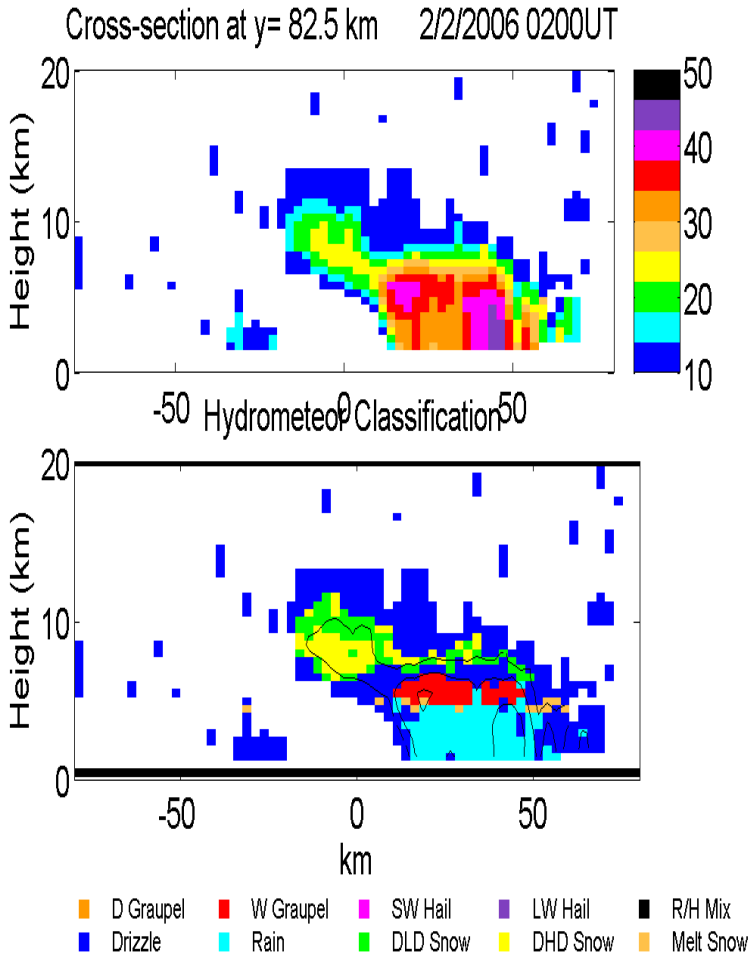


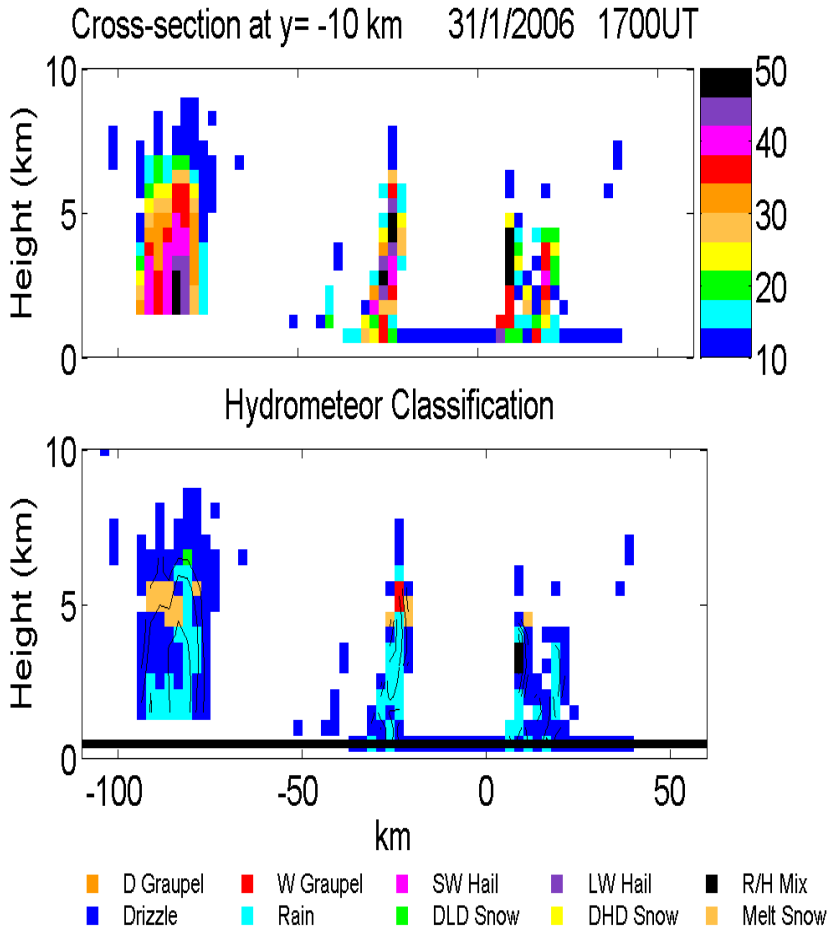


Seasonal and diurnal variations

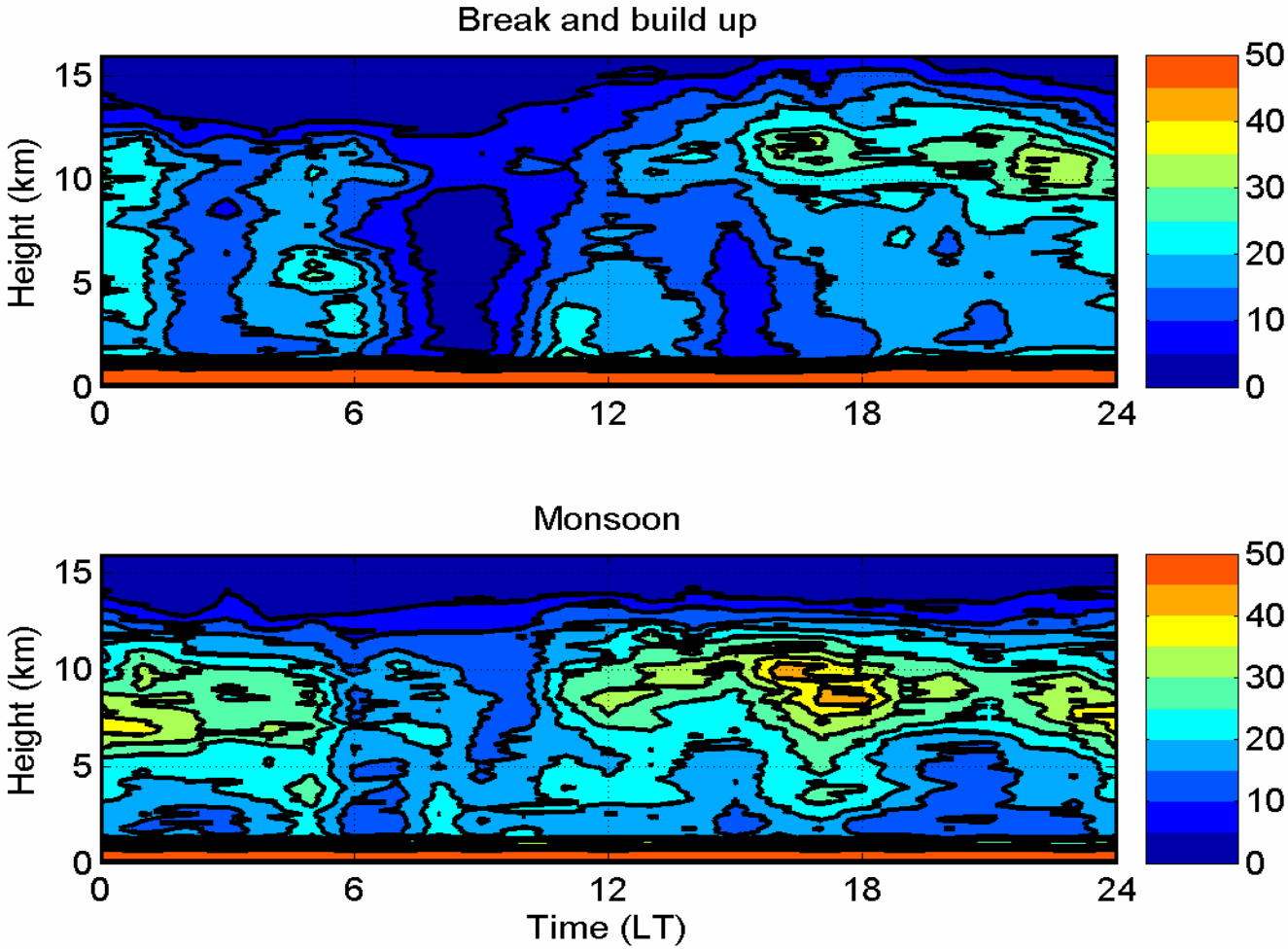
This is for the break and build up periods.

Some Monsoon TWPICE examples: put ARCS3 etc into context





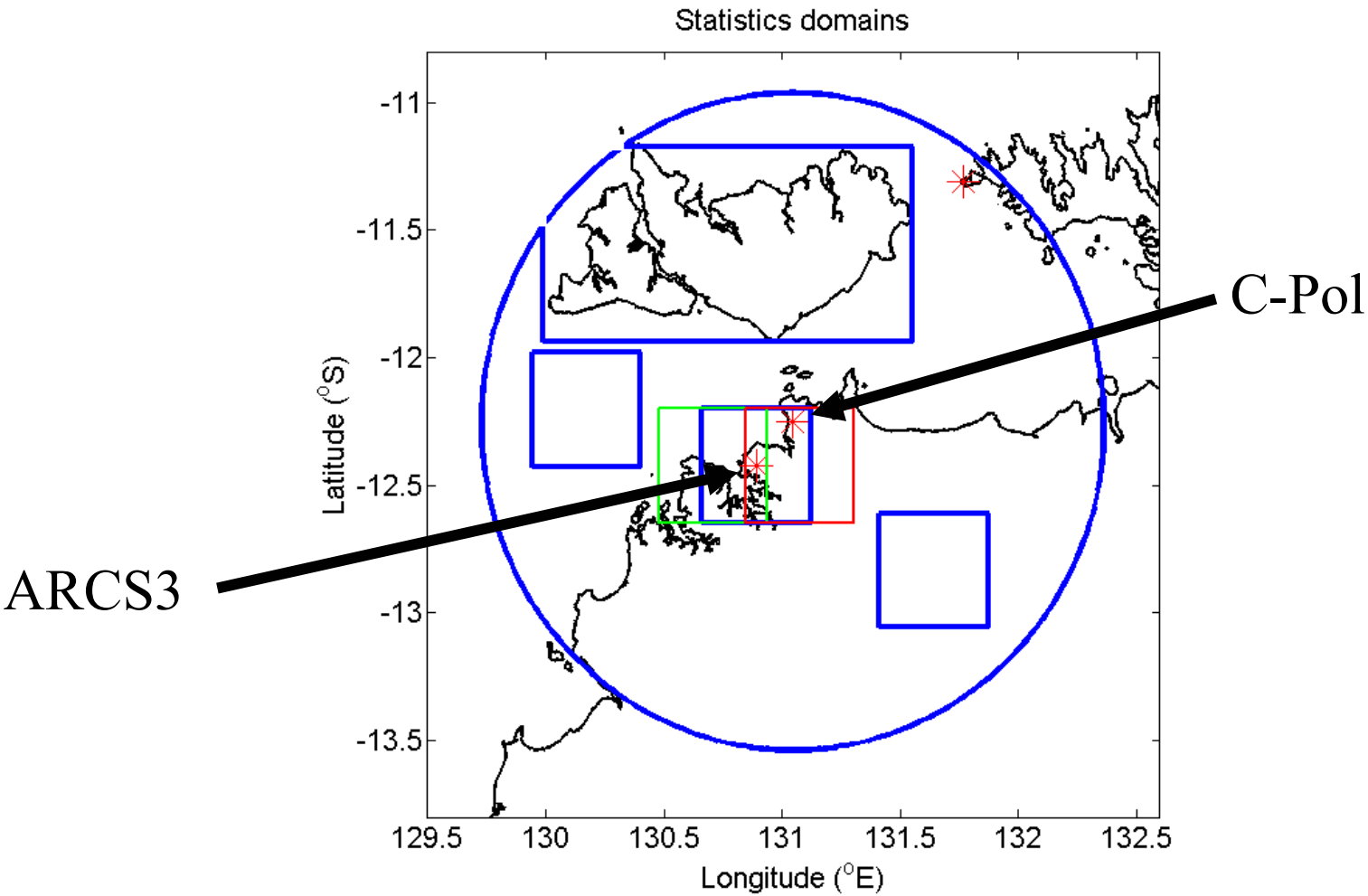
Applications 2 – second cloud radar
e.g. mean diurnal variation of "cloud" cover (Z> -18 dBZ)



Resulting "cloud cover" at Gunn Point in % for 2003/4 wet season
(as determined by radar, so miss lots of thin cirrus)
c.f. MMCR – can extend the time record, spatial variations

New Products – “Kind of 3D ARSCL like”

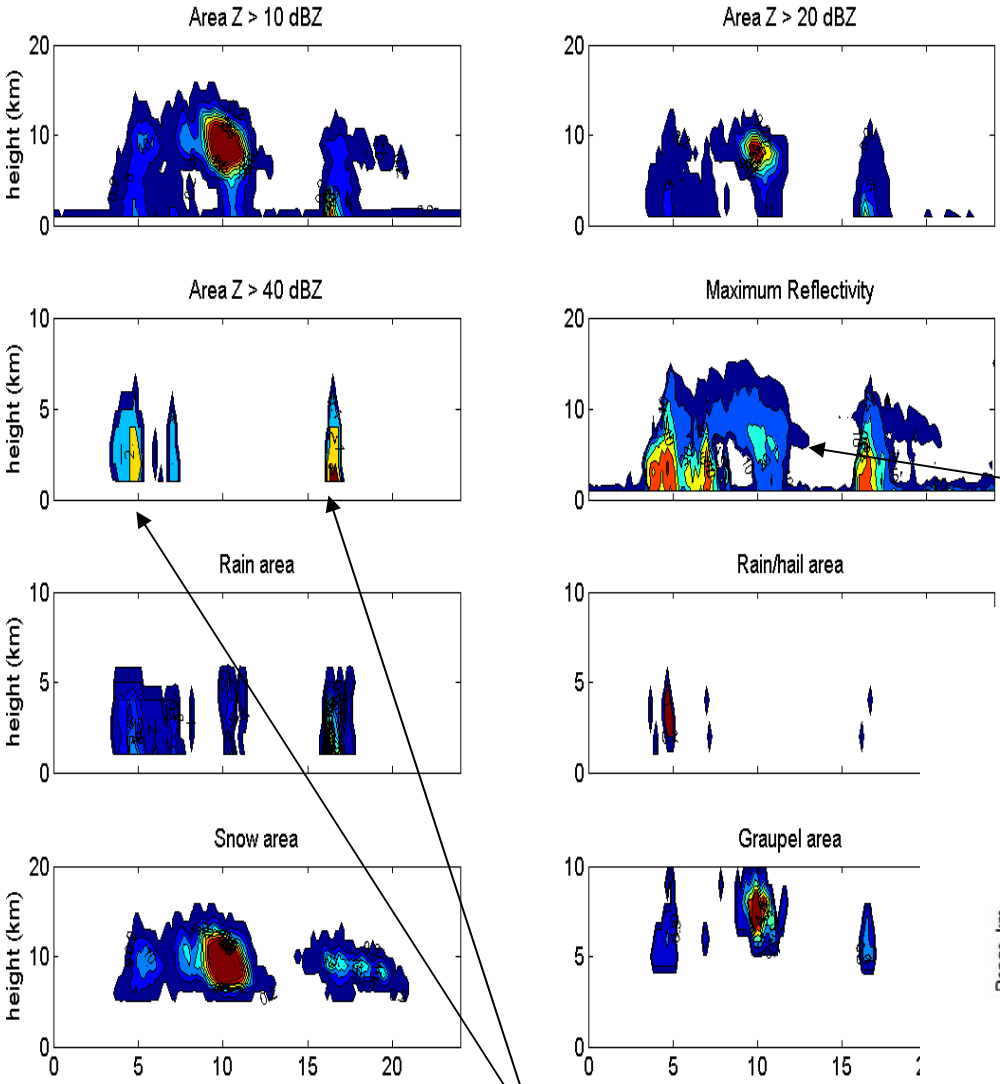
Taking grids and calculating areal statistics as a function of height and time, e.g. area Z> 10 dBZ, snow area etc
Metrics of cloud cover, convective activity …

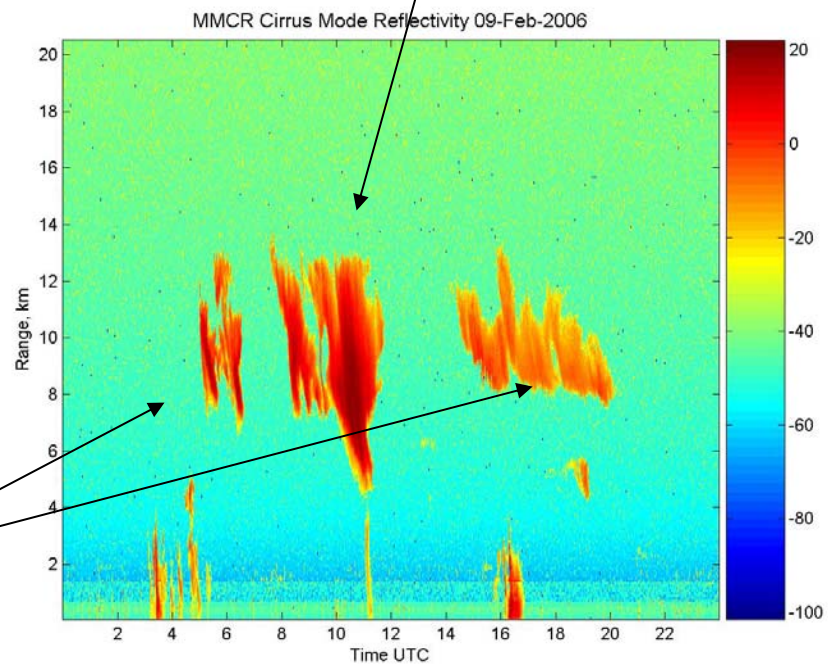


Applications 3

Put ARM obs into context
e.g. Feb 9, 2006

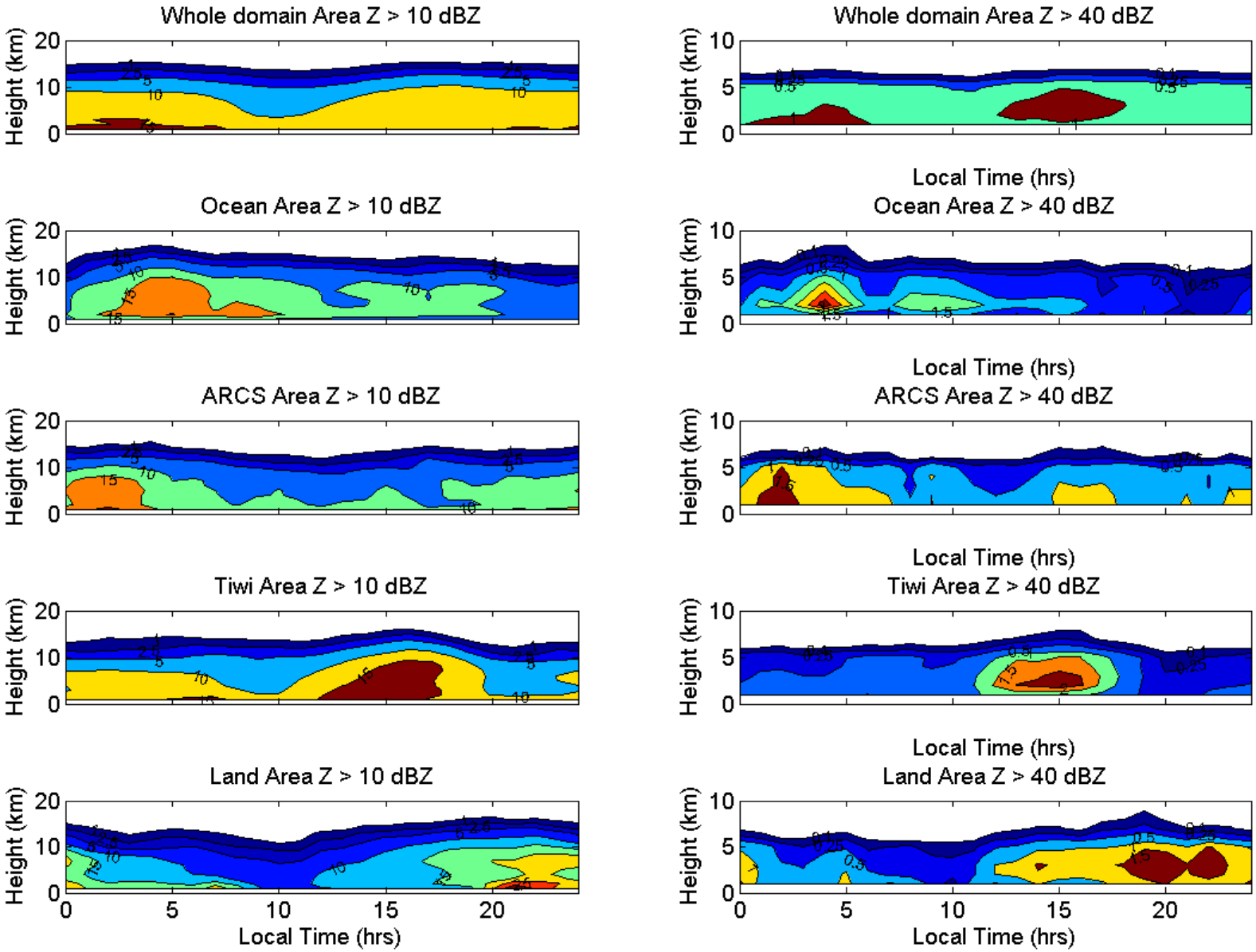
Aged – stratiform





"fresh cirrus"

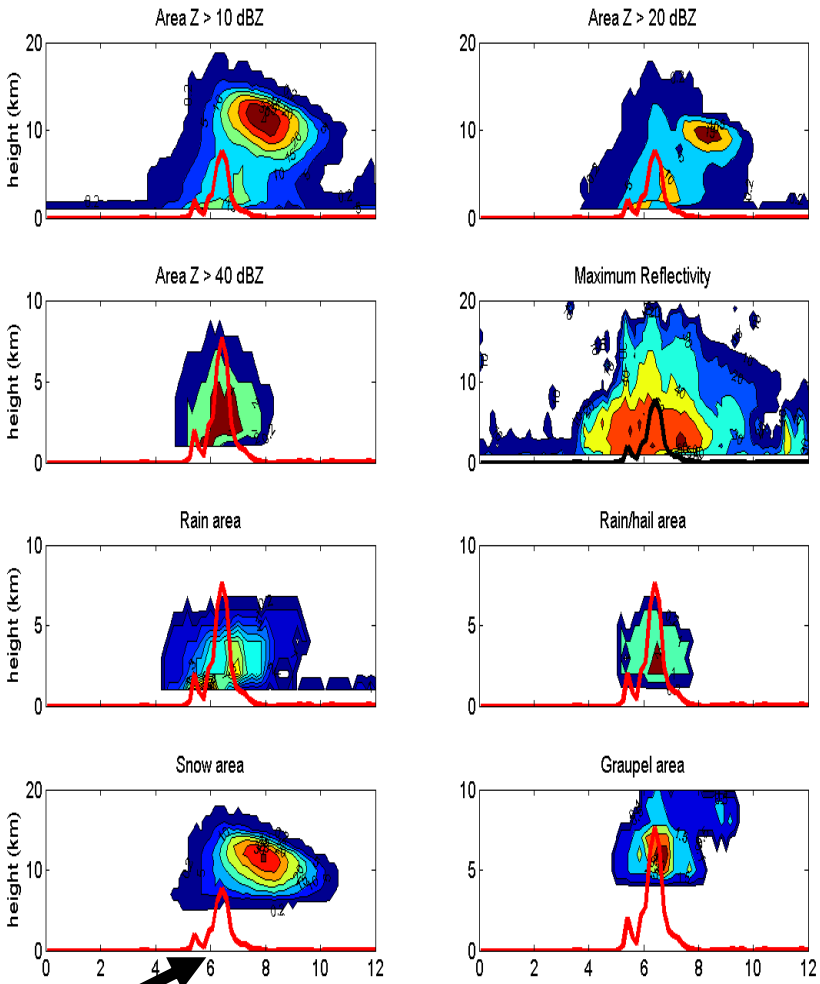
Applications 4: Site characterisation – e.g. diurnal cycle



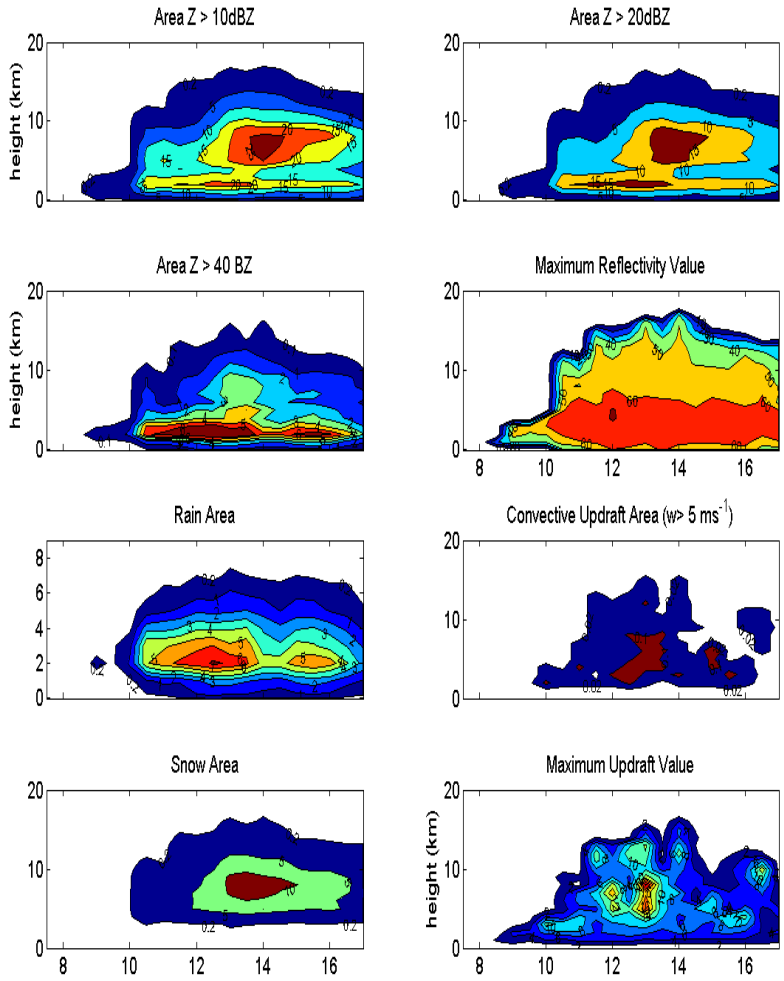
Break/build up from 2005/6 west season

Applications 5: Model validation

Observations over Tiwi Is Feb 10, 2006



Todd Lane CRM of Hector



Application 6?

Additional products:
Fields of (precipitation) water and ice content
Need to quantify uncertainties

Application 7?

Area average rainfall +NWP for forcing data sets

Largest uncertainties in Forcing calculation is dependence
On precipitation (e.g. cf surface fluxes).

Can use model analyses for advective terms?

There is work to be done.

C-Pol status

Operating but is getting old (been in field since 1995).
BMRC has been putting funds into refurbishment, salaries, operations

However, won't cover needed upgrades of system.
e.g. Receiver system is circa~ 1992
– no replacements for computers etc

Limited ARM support is needed (~$40K/yr)

C-Pol is relocatable and could be deployed, e.g. with mobile facility.