



Australian Government

Bureau of Meteorology

Characterising convection with C-Pol data

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Extracts from Whitepaper

ARM STM 2007

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.

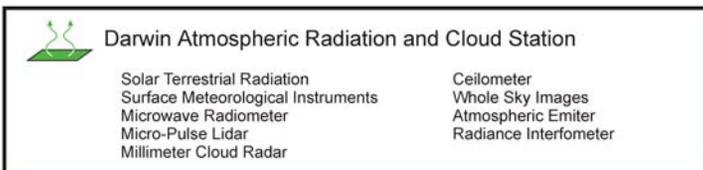
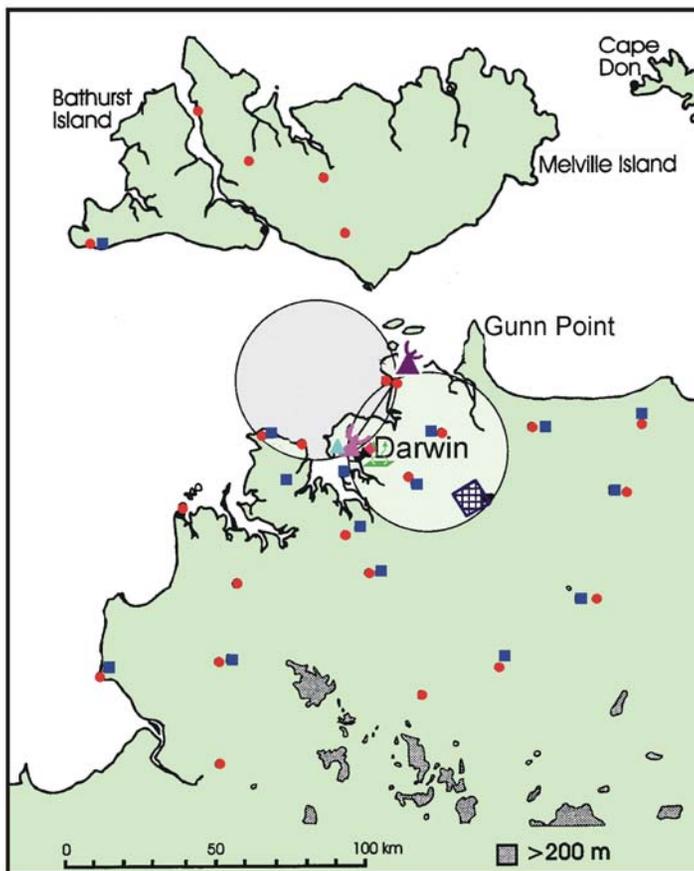
It is a significant component of the
observational suite that makes Darwin
the best instrumented site anywhere in
the tropics.

This data is available to the community
at www.arm.gov

New products being developed

Testbed for new scanning systems

Possible chemistry and aerosol coming



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, microphysical classification, cloud radar



Scan Strategy every 10 minutes

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

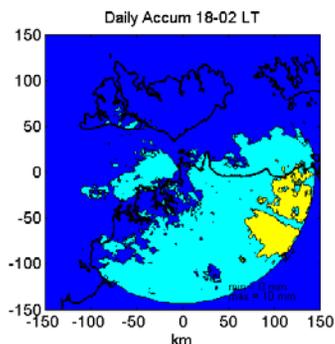
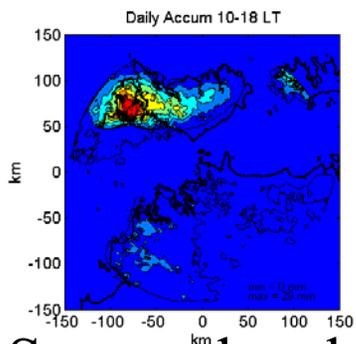
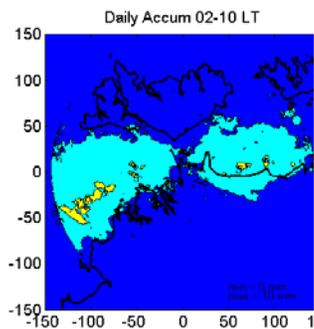
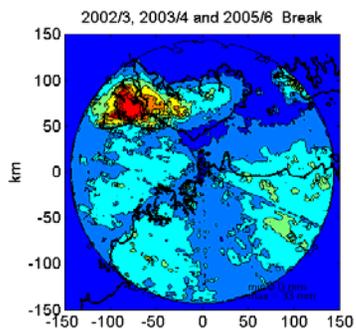
From 2 derive:

Gridded reflectivity and microphysical type product

Rainfall maps

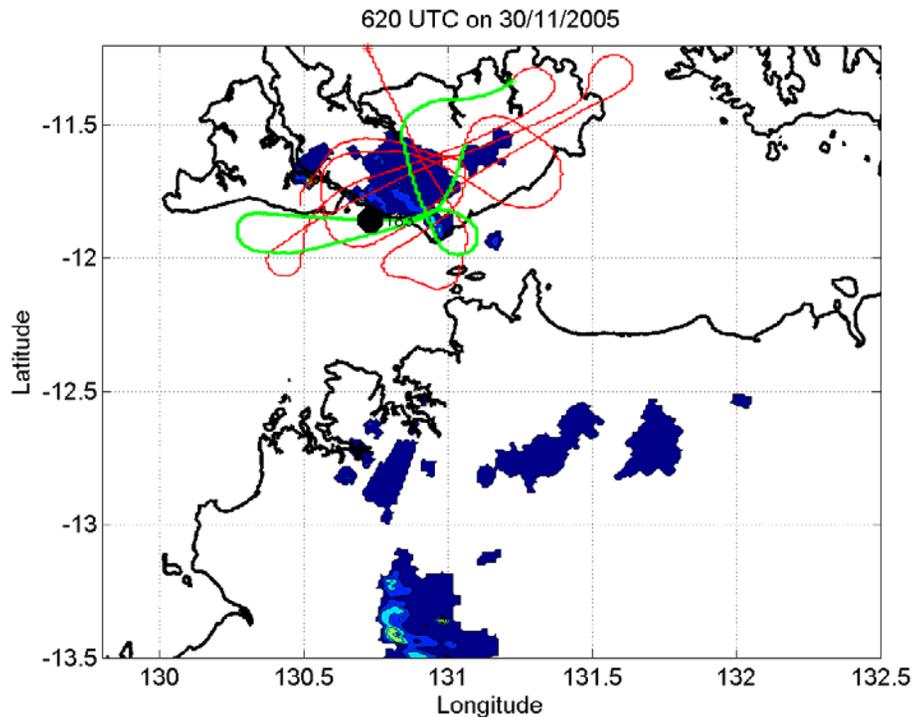
Applications 1: rain estimation

Rain maps (with overlay of aircraft tracks)

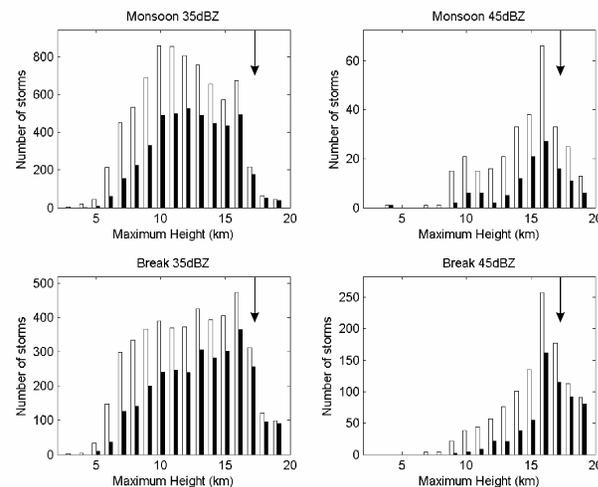


Seasonal and diurnal variations

This is for the break and build up periods.

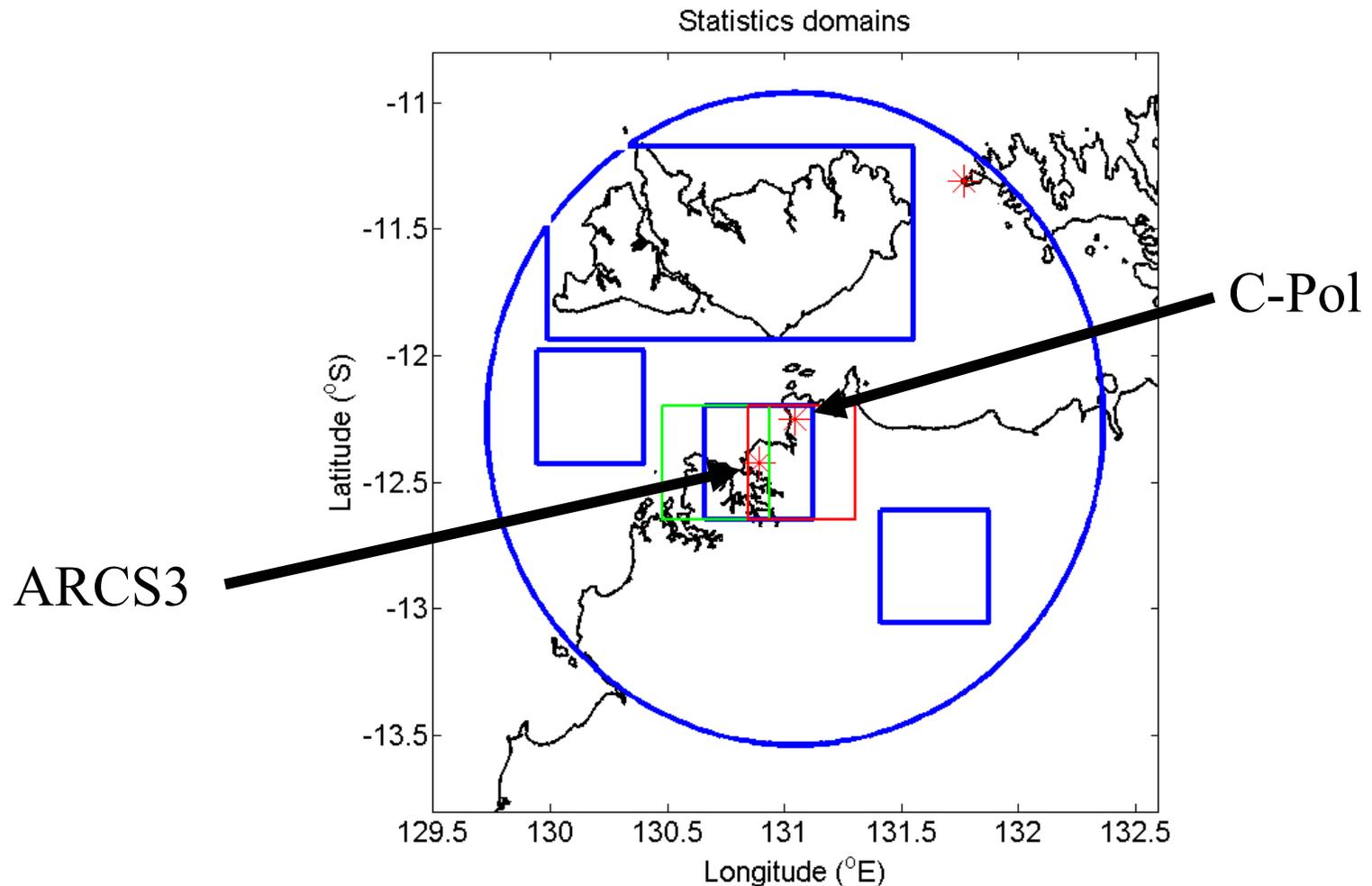


Cell statistics: product?

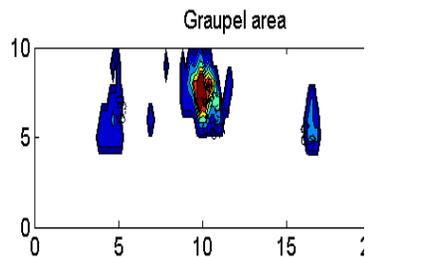
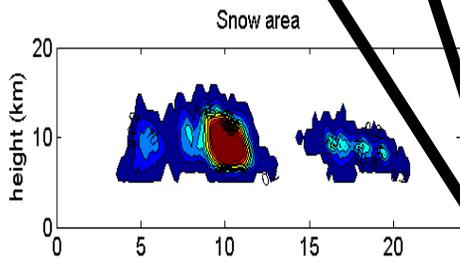
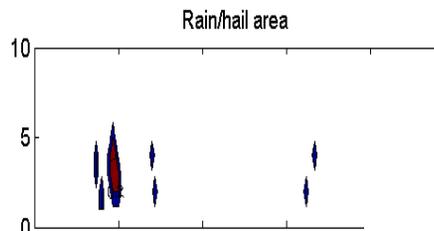
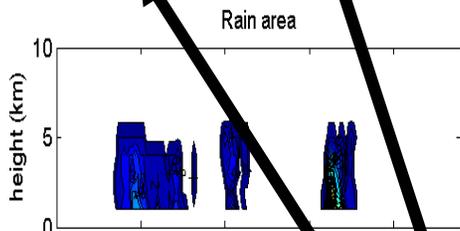
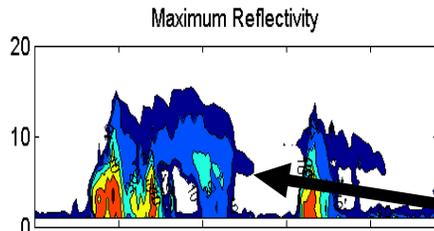
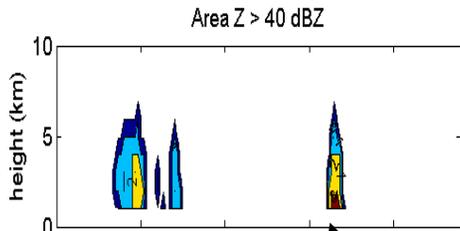
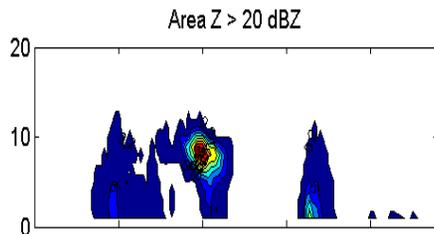
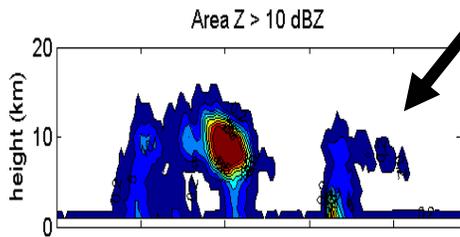


New Products – “Kind of 3D ARSCL like”

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 ...



Cloud cover

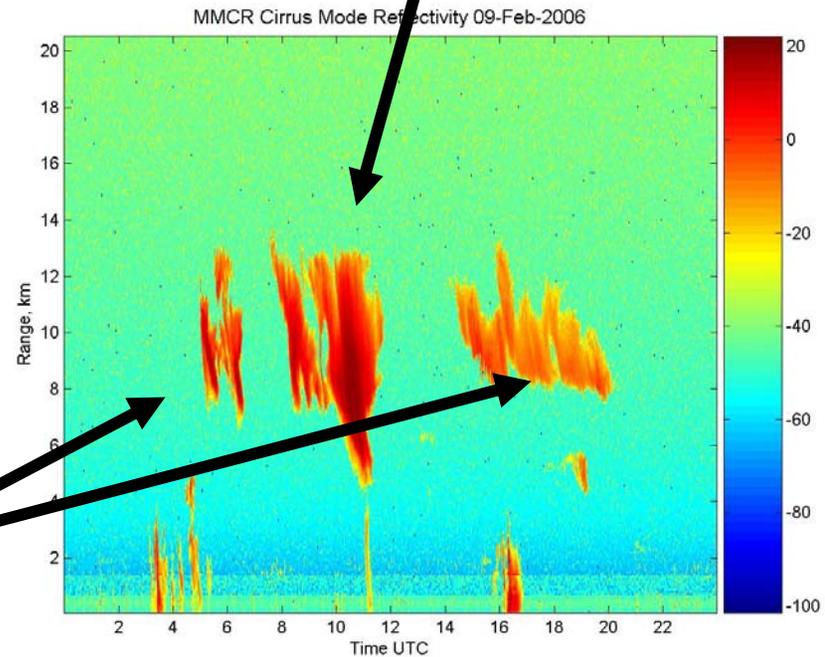


Applications 3

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

Aged – stratiform

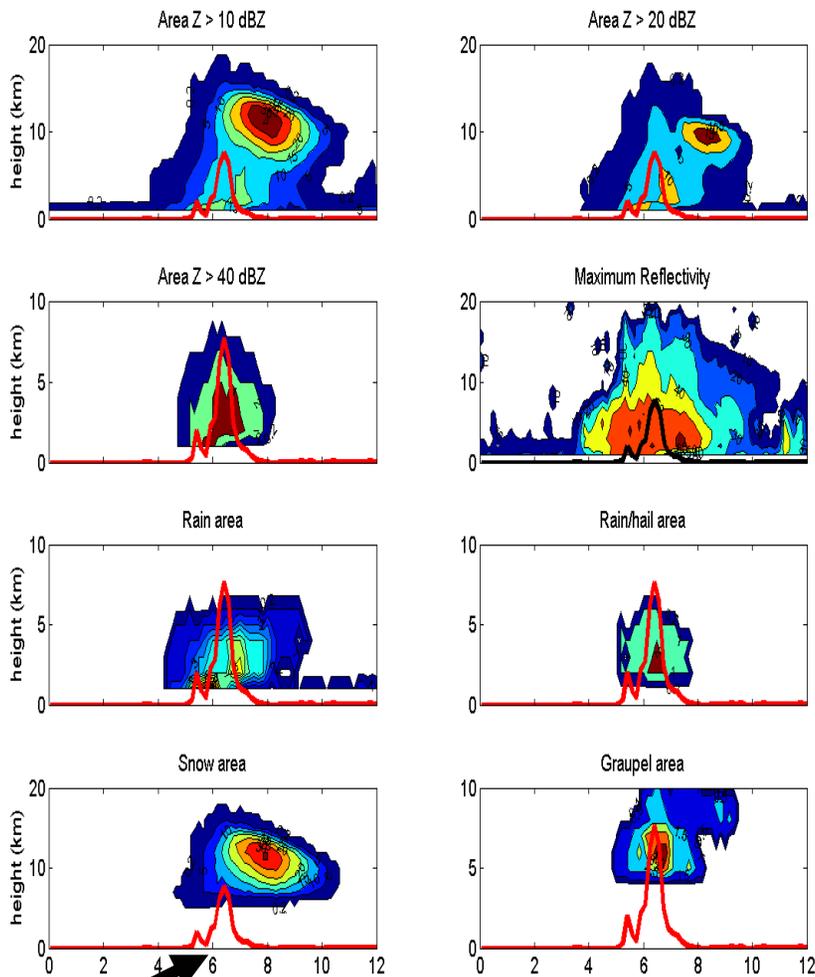
“fresh cirrus”



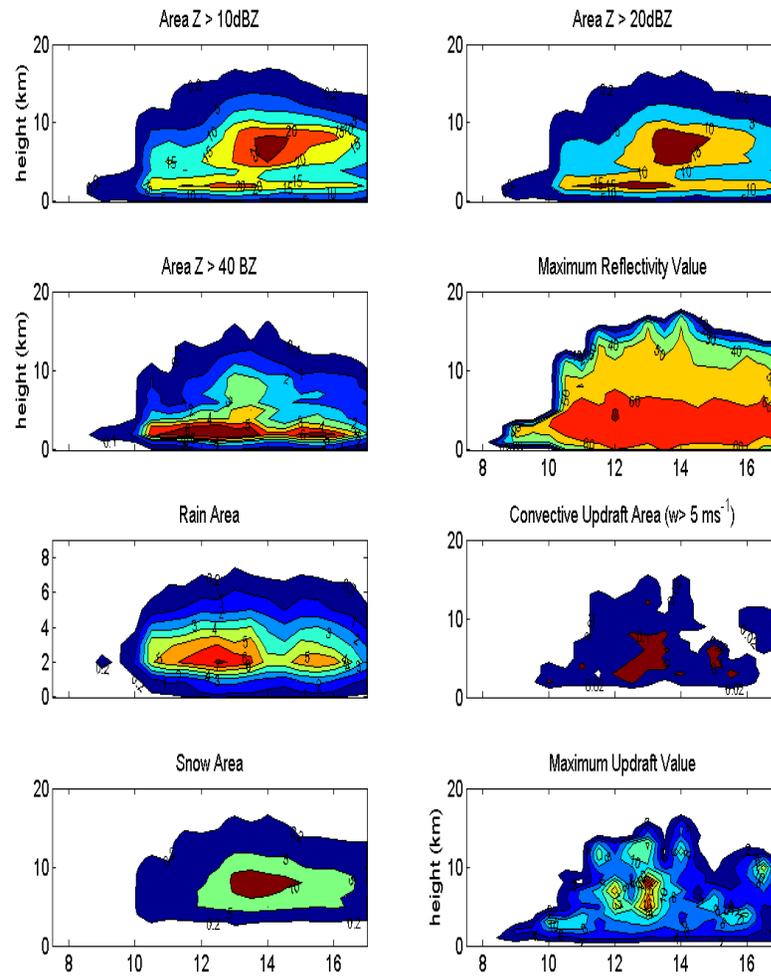
Applications 5: Model validation

Observations over Tiwi Is Feb 10, 2006

Todd Lane CRM of Hector



lightning → Time UTC



Local Time (UTC+9.5)

The fields can be quantitatively compared.

One Possible Approach:

Fractions Skill Score (FSS) which is a variation on the Brier skill score.

$$FSS = 1 - \frac{FBS}{\frac{1}{N}[\sum_{j=1}^N (p_j^2 + \sum_{j=1}^N o_j^2)]} \quad FBS = \frac{1}{N} \sum_{j=1}^N (p_j - o_j)^2$$

where $0 \leq p_j \leq 1$ is the forecast fraction, $0 \leq o_j \leq 1$ is the observed fraction and is a version of the Brier score.

where fractions are compared.

20 dBZ fraction	0.51
40 dBZ fraction	0.30
Rain (up to 8 km)	0.51
Snow fraction	0.57

Potential Application 1

Additional products:

Fields of (precipitation) water and ice content

Need to quantify uncertainties

Potential Application 2

Area average rainfall +NWP for forcing data sets – Shaocheng,
MingHua, Hume, Jakob

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.

Current C-Pol status

Operating but is getting old (been in field since 1995).

Multiple critical points of failure.

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

C-Pol is relocatable and could be deployed, e.g. with mobile facility – but needs replacement of C-Containers.

Limited ARM support is needed (~\$50K/yr for two years)

Builds on significant Bureau contributions – matching additional funds.