

# Introductory Remarks: ARM AVP Workshop on Advances in Airborne Instrumentation

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# Genesis of this workshop

- ARM UAV mutated into ARM Aerial Vehicles Program (AVP) in 2006
- Several key people believed strongly that AVP should have an instrument development component
- Greg McFarquhar wrote the AVP whitepaper with three goals:
  - routine flights over ARM sites
  - traditional field campaign flights
  - instrument maturation
- I pressed for a workshop to gather cloud instrument developers, assess the state of the art, and crystal-ball the next quantum leap

# How is AVP fundamentally different from ARM UAV?

- Routine flights have highest priority
- *Gee-whiz* aircraft no longer a high priority
- Measuring in situ, not just remote sensing
- No development of instruments from scratch
- Use of SBIR to bring instruments to a Technical Readiness Level close to operational
- ALL THESE AFFECT AVP INSTRUMENT STRATEGY

# Internal debates about AVP instrument maturation strategy

- Timing of funding: yearly? every other year?
- Too-small funding (\$2.7M/yr)
- Instruments expensive relative to AVP budget
- Ownership of instruments
- Role of avant garde instruments in routine flights
- Need to appear active, flight-wise, in years when fund instrument maturation
  - Cessna?

# Boom-bust cycle in cloud instruments

- Small companies struggling to stay afloat
- Feast or famine situation
- NASA and NSF are prime funders, but...
  - university planes have almost disappeared
  - NASA has retrenched in recent years
  - NSF has focused around HIAPER
- A regular pipeline of funding is needed but ARM cannot provide that alone

# The Big Lacunae are...

- miniaturization
- after almost 30 yr, need the next big revolution in cloud sampling strategy
  - comparable to switch to optical sampling
  - should be designed specifically to help models
- larger sample volumes: need  $\gg m^3$ 
  - can't spatially match in situ and remote sensing
  - can't continue to collect drops one by one
  - need rapidly-sampled drop size dist'n, not 500-m avg
- synoptic meas'ts: many places at same time
  - for validating dynamical models
  - small UAVs

# More Big Lacunae

- leveled radiation flux meas'ts at multiple levels
- vertical velocity
- entrainment & ice crystal fall speed: two major determinants of climate sensitivity according to [climateprediction.net](http://climateprediction.net)
- 3D structure of clouds, at a level useful for rad'n parameteriz'ns of same
- Models are headed for 1-km resolution; cloud instrum's need to play with those new models

# Aerosols

- Heavily represented here, but need to recognize that ARM is primarily a cloud program...
- So aerosol instrum's need to be useful for indirect effect to be fundable by AVP
- DOE's ASP Program has > \$10M/yr just for aerosol campaigns and instruments
- Aerosols are "hot" and well-funded compared to clouds; multiple funding sources, while only ARM and Hal Maring at NASA seem to care about clouds