DOE ARM AVP Workshop on Advances in Airborne Instrumentation for Measuring Aerosols, Cloud Radiation & Atmospheric State Parameters

14 to 16 October 2008

Champaign, IL

http://www.atmos.uiuc.edu/~mcfarq/aavp.whitepaperoverview.pdf

Introduction & Logistics

- **Men's Restrooms on 2nd & 4th Floors**
- **Women's Restrooms on 1st & 3rd Floors**
- **Breakfast available Tues. thru. Thur.**
- **Lunch available on 2nd floor, Tues & Wed.**
- **Wireless internet (UIUCnet) available: username & password in registration packet**
- **Map in registration packet**
- **Parking passes for sale in Levis office (park in U of I lots only!)**

Introduction & Logistics cont.

- Tour of NOAA Cessna 206 at Champaign airport Tuesday night
- Graduate students acting as scribes for each section (will also assist in loading ppt presentations prior to session)
- Lots of discussion periods included in agenda
- There are 2 dedicated poster sessions at lunch/breaks
- Steering committee will meet in atmospheric sciences building Thursday afternoon

The ARM Aerial Vehicle Program (AVP): An overview

Greg McFarquhar, University of Illinois

15 October 2008

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Outline

1. Past efforts of ARM Airborne Science
2. Why AVP was implemented
3. Three goals of AVP
4. Role of Instrument Incubator Program in AVP

Past ARM Airborne Science: ARM UAV Program

The ARM-UAV Program was established by DOE to

- **address the largest source of uncertainty in global warming:**
  the interaction of clouds and solar/thermal energy
- **support the climate change community with valuable data sets**
- **develop measurement techniques and instruments suitable for use with the new class of high altitude, long endurance UAS**
- **demonstrate these instruments and measurement techniques in field measurement campaigns**

ARM-UAV conducted 12 major field campaigns

Field Campaigns to date:

- Fall 1993, Edwards AFB, CA
- Spring 1994, Northern OK
- Fall 1995, Northern OK
- Spring 1996, Northern OK
- Fall 1996, Northern OK
- Fall 1997, Northern OK
- Spring 1999, PMRF Kauai, HI
- Summer 1999, Monterey, CA
- Winter 2000, Northern OK
- Fall 2002, Northern OK
- Fall 2004, North Slope, AK
- Winter 2006, Darwin, Australia

Proteus(F04, W06)

GA-ASI "GNAT 750" (F93, S94)

Grob "Egrett" (F95, S96)

GA-ASI "Altus I" (F96, F97)

GA-ASI "Altus II" (Su99)

Twin Otter (F93, S94, F95, S96, F96, F97, Sp99, Su99, W00)

Major Accomplishments of ARM UAV

- **Used piloted & unpiloted aircraft for:**
  - **First science flight using UAV (1993)**
  - **Stacked flight of UAV & piloted aircraft for cloud absorption measurements (1995)**
  - **Use of unescorted UAV in general flight space (1996)**
  - **26 hour flight of UAV over SGP (1996)**
  - **Compact instruments for UAVs used (1990s/2000s)**
  - **Instruments & payload operated from ground**
  - **Collected data enhanced understanding of clouds/aerosols/ radiation in global change (2002 IOP, M-PACE 2004, TWP-ICE 2006)**

ARM Airborne Science Refocused in 2006

- To maximize science return from program
- ARM UAV had reached mature state:
  - Need to transition to a program that took advantage of instrument/technique development to make an impact on science
- Change name to ARM Airborne Vehicle Program (AVP) to be consistent with current strategy of using both piloted & unpiloted aircraft
- AVP refocused to make observations during not only 1-month long IOPs, but also to make them routinely over long time periods to get representative statistics on clouds needed for climate models

Why Renamed?

- **Get a better description of what we are doing**
  - **Not exclusively using UAVs**

- **Rename ARM AVP (ARM Aerial Vehicle Program)**
  - **Use piloted & unpiloted aircraft depending on platform suitability & availability**

Three Goals of AVP

1. **Routine observations of clouds, aerosols and radiative properties**
2. **Participation in IOPs designed to contribute to our fundamental understanding of clouds, radiation and aerosols and their effects on global change**
3. **Foster instrument incubator program where miniaturized in-situ and remote sensing instruments will be purchased or developed,**
   - **small size and modularity of instruments will make them amenable to UAVs and larger aircraft**

Both piloted & unpiloted platforms will be used for these activities depending on platform suitability and availability

Routine Observations

- **Move concept of making routine observations of cloud properties into operation phase**
  - **ARM was conducting twice-weekly observations of aerosols & carbon over SGP —this could serve as model**
  - **White paper recommended starting with observations of cloud microphysics over SGP (RACORO 2009, CIRPAS Twin Otter)**
  - **Goal is to eventually extend to under-sampled regions (e.g., oceans off Barrow, Darwin, pristine oceans in S.H.)**
  - **Pseudo-randomized sampling of clouds (e.g., veer certain # of kms or certain angles from set paths)**
  - **More statistics on cloud properties, help with satellite and ground-based retrievals, etc.**
  - **Avoid dependence on the "case study" & big IOPs**

Participation in IOPs

- **Routine observations need to be supplemented by focused in-situ & remote sensing observations**
  - **IOPs focused on specific science questions still needed**
  - **Specialized data contribute to understanding of cloud & radiative effects on global environment (e.g., impacts of oceanic convection on environment, explaining longevity of mixed-phase Arctic clouds, etc.)**
  - **Some science questions require large & heavily instrumented aircraft not appropriate for routine observations**
  - **Ideally, integrate with routine observations (e.g., 2003 Aerosol IOP)**

Instrument Development

- **Routine observations & IOPs rely on continued integration of state-of-art instrumentation on aircraft platforms**
  - **Instruments should be miniaturized, platform independent and highly modular**
  - **Work on both slow/low and high/fast planes**
  - **In-situ mixed- and ice-phase cloud instruments, aerosol instruments & compact remote sensing devices needed**
  - **E.g., of some specific instrument needs in white paper**
  - **At this meeting we would like to identify other instruments suitable for support by AVP**

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Weighting of three goals?

Routine Observations and IOPs have equal weights for AVP Science

- judged by impacts on science priorities of AVP

Instrument Program

- important that instrument development not be neglected
- crucial for success of future campaigns
- cannot be considered in isolation of future airborne research programs

Purpose of this meeting

1. **Identify state-of-the-art techniques for measuring aerosols, clouds, radiation and atmospheric state parameters;**

2. **Determine emerging instruments and technologies in these areas that can be made flight ready and reach maturation within ~ 1 year;**

3. **Identify gaps in existing airborne instruments, where new developments are needed to answer key science questions in climate science.**

- **DOE AVP expects that funding will be available for testing and developing instruments that can be made flight ready within ~ 1-year in the next proposal call anticipated in Jan. 2009**

- **The results of this workshop will be used to help set future instrument priorities for the AVP program.**

- **DOE AVP expects that in FY11 funding will be available for testing and developing instruments that can be made flight ready within ~ 1-year. Proposals need to be submitted to the next ACRF call anticipated in Jan. 2009**