ARM Aerial Vehicle Program (AAVP): Future Directions

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Aerosol/Radiative Working Groups

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

Outline

1. Reminder: 3 goals for AAVP
2. Difficulties in Implementing these Goals
3. Paradigm for Operation of AVP
4. Future Directions for AVP: need input

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

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

Implementation Difficulties

1. **Flat Budgets & Size of IOPs**
   - **CLASIC, ISDAC/RISCAM large IOPs have left little money for instruments**
   - **Proposals for next FY similar in size/scope**
2. **Varied Nature of Campaigns**
   - **Aircraft platform varied from year to year (Proteus high flier in-situ observations; ER-2 high flier remote sensing observations; Convair mid-altitude large platform; plans for next year different platforms)**
   - **Large spin-up costs and different type of observations**

Paradigm

How do we maximize amount of science we can obtain with AVP resources?

- **Maintain flexibility to address important research questions that arise**
- **User facility has proposal selected in competitive process**
- **Money put aside for instrument development only beneficial if instruments USED in projects**

➔ **Focus program to**

  - **Develop key instruments needed for upcoming campaigns**
  - **Not starting from scratch every year**

Instrument Development

Instrument development cannot be considered in isolation of upcoming campaigns

- **Develop instruments that will be used in upcoming campaigns**

Can we say over next ~ 3 years we will primarily be flying certain types of missions?

In-situ? Remote sensing? Slow/low UASs? High fliers? Large aircraft? Small aircraft with more flight hours?

Working Group Input

What role do you envision for airborne resources in the next 3 years?

Are there certain classes of projects that are needed to solve most pressing questions in aerosol/radiation research?

Are there certain instruments that need to be placed into workable form/bench or lab tested, etc. to be used on such projects

Recommend that future calls to AVP will be more focused on certain types of problems

Examples of platforms

ER-2: High flying remote sensing aircraft

Examples of platforms

Proteus: High flying in-situ & remote sensing aircraft

Examples of platforms

NRC Convair: Mid-level in-situ aircraft

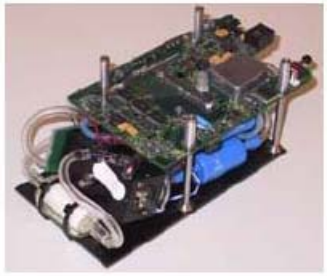
Examples of platforms

Cessna: Smaller, lower in-situ aircraft

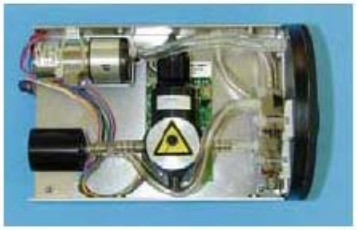
Examples of platforms

Uninhabited aerospace systems: Smaller aircraft more appropriate for in-situ observations

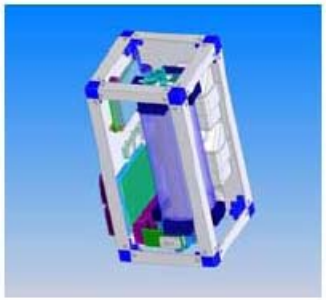
Examples of instruments



Condensation Particle Counter
Weight: 0.87 kg
Dimensions: 250 x 120 x 70 mm
Measure: # /cc for D > 10 nm



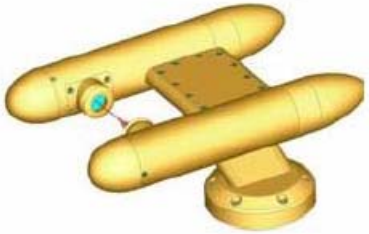
Optical Particle Counter
Weight: 0.30 kg
Dimensions: 96 x 60 x 34 mm
Measure: size distr. 0.3 - 3 um



Cloud Condensation Nuclei Counter
Weight: 3 kg
Dimensions: ca. 100 x 100 x 200 mm
Measure: # /cc for supersat. > 0.2%

Aethalometer
Weight: 0.8 kg
Dimensions: 140 x 110 x 75 mm
Measure: absorbing aerosol

Aerosol Inlet
Weight: 0.037 kg
Dimensions: 10 Ø x 200 mm
Designed to minimize bias to aerosol size distribution



Cloud Droplet Probe
Weight: 1.42 kg
Dimensions: 216 x 115 x 100 mm
Measure: drop size distr. 0.7 - 70 µm
NOTE: electronics in fuselage

Pyranometer
Weight: 0.2 kg
Dimensions: 80 Ø x 100 mm
Measure: Irradiance 305 – 2800 nm

PAR radiometer
Weight: 0.03 kg
Dimensions: 24 Ø x 25 mm
Measure: Irradiance 400 – 700 nm

Spectral Radiometer
Weight: NA
Dimensions: 150 x 90 x 15 mm
Measure: 350 - 1150 nm 256 channels

Examples of instruments

Remote sensors: Lidar (polarized & dual wavelength, up and down looking), radar (94 GHz for retrieving cloud properties)

Larger in-situ probes for measuring ice cloud properties (fast response, bulk and size resolved properties, measurements of small crystals, lab tests of existing probes)

Stabilized platform for flux radiometric measurements

Grating spectrometers to measure fluxes at 3 to 5 nm resolution to accurately determine heating rates in multi wavelengths;

Fast response measurements of state parameters including humidity and vertical velocity

Aerosol size distribution, CCN concentrations at multiple humidities, Angstrom coefficients, extinction/backscatter coefficients, etc.

Other ideas? Need to be developed in context of experiments & platforms for future deployments

Summary: Input Sought

- What type of projects do you foresee for future?
  - IOPs and routine observations
- What type of instruments need to be developed or improved for such projects?
  - Send any thoughts/ideas to me

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