

# NASA

## Airborne Science Program Student Airborne Research Program



# Presentation Outline

- Motivation for a Student Airborne Research Program
- Recruiting and selection of participants
- Program Elements
- Past program results
- SARP in the future



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>

# Meeting NASA and the Nation's Future Workforce Needs

NASA has committed to educating and training future generations of Earth scientists and engineers.

The three major education goals include:

- Strengthening NASA and the Nation's future workforce
- Attracting and retaining students in STEM disciplines
- Engaging Americans in NASA's mission ([www.nasa.gov/education](http://www.nasa.gov/education)).

A report published by NASA titled, "National Aeronautics and Space Administration Workforce Strategy," (2006) concludes there is a need to recruit and train a new workforce in order to promote the continuity of a long-term skill base.



# Student Airborne Research Program's Objectives

The SARP was designed with a goal of addressing the educational goals that have been set out by NASA

The Major Objectives envisioned specifically for SARP are:

- Expose and engage participants in NASA airborne science and its role in Earth System research, including space-based observations.
- Address future workforce needs in the aerospace, airborne science, and earth science communities.
- Provide participants with hands-on experience of the end-to-end aspects of a scientific mission using NASA research aircraft and instrumentation. Do this in such a time period that an authentic student project can be completed.
- Inspire, Motivate, and Recruit students from institutions that do not offer research experiences and who might otherwise choose fields other than Earth System Science.
- Increase future workforce diversity.
- To the maximum extent possible, perform scientifically useful measurements and anticipate the possibility of publishable results.
- Infuse fresh cross cutting ideas from other disciplines into Earth System Science research.



# Recruiting qualified applicants

**A number of avenues have been used to recruit applicants to SARP**

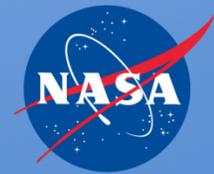
- Advertisements in EOS the weekly publication of the American Geophysical Union in November and January
- Sending >1200 emails with the SARP brochure to department chairs of physics, chemistry, biology, atmospheric science, environmental science, earth science, and engineering.
- Posted on the NASA Express listserve to >18,000 subscribers
- Requesting SARP alumni to post brochures at their institutions.
- Handing out brochures at the NASA booth during the Fall AGU meeting.
- Posting details of SARP on the NSERC web site which is linked to the Airborne Science web site.
- Facebook posting with link for junior and senior undergraduates.

**Various combinations of these approaches in 2009 and 2010 resulted in:**

**~50 applications in SARP 2009**

**~115 applications in SARP 2010**

**~85 applications received for SARP 2011**



# Selection of applicants

## Applicant requirements:

- Advanced junior or senior undergraduate or 1<sup>st</sup> year graduate students.
- Strong academic background in disciplines relevant to the Earth system, including the physics, chemistry, biology, geosciences, mathematics, engineering.
- Applicants must be a full time students at 4 year degree granting institution.
- Applicants must be US citizens (this requirement is new for SARP 2011).

## In the application process applicants are asked to provide:

- A completed web based application form with essay responses.
- At least one letter of recommendation.
- Transcripts of university course work.
- A recent resume

## Applicants are selected based on:

- Excellent academic performance.
- Promise for contributing to nation's future workforce (based on recommendation and essays)
- Evidence of interest in Earth system science and hands-on research
- Geographic, gender, university, and ethnic diversity
- Demonstration of ability to perform in teams



# Past Program Diversity

## SARP 2009

18 Advanced Undergraduates,

10 Graduate Students

20 different states represented

18 females, 10 males

26 different Liberal Arts Colleges and Research Universities

Nationwide Geographic Distribution

## SARP 2010

24 Advanced Undergraduates,

4 Graduate Students

18 different states represented

14 females, 14 males

24 different Liberal Arts Colleges and Research Universities

Nationwide Geographic Distribution



# Diversity of institutions in SARP 2009 and 2010

## SARP 2009 universities

University of Puerto Rico  
Jackson State University  
Montclair State University  
Rutgers University  
University of Michigan Ann Arbor  
Howard University  
Coastal Carolina University  
University of Florida  
Loyola Marymount University  
Slippery Rock University  
Carleton College  
University of Alaska Anchorage  
Randolph College  
Montana State University  
University of California Irvine  
Wellesley College  
Georgia Tech University  
Michigan Tech University  
South Dakota School of Mines and Technology  
University of North Dakota  
Brown University  
Texas A&M University  
Arizona State University  
University of Maryland  
University of California Santa Cruz  
University of Iowa

## SARP 2010 universities

Minnesota State University at Mankato  
Western Washington University  
University Wisconsin-Madison  
Loyola University Chicago  
Northern Arizona University  
Carleton College  
Florida Gulf Coast University  
Concord University  
Creighton University  
University of Michigan-Dearborn  
Wellesley College  
University of Houston  
University of California Irvine  
University of New Hampshire  
University of Florida  
Pennsylvania State University  
University of Michigan Ann Arbor  
University of Iowa  
Purdue University  
Cornell University  
University of California Davis  
University of Wisconsin  
University of New Mexico  
West Virginia University

## SARP 2011 universities

Gustavus Adolphus College  
Creighton University  
Slippery Rock State University  
University of Michigan  
Oklahoma State University  
UC Irvine  
Florida State University  
UCLA Steven F. Austin State  
University College of Staten Island  
Oregon State University  
SUNY Stony Brook  
Embry-Riddle Aeronautical University  
University of Illinois Chicago  
MIT  
University of Wisconsin, Parkside  
University of North Florida  
Washington University  
Cornell University  
Univ of North Carolina, Charlotte  
Rutgers University  
Indiana University  
University of New Orleans  
University of San Francisco  
University of Houston  
Cal State Long Beach  
Murray State University  
Univ of North Carolina Wilmington  
Case Western Reserve University



# SARP 2010 Participants



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>

# NASA's Student Airborne Research Program Elements

- Introductory Icebreaker to meet faculty, staff, and other participants. Includes participant posters of research interests and personal information
- Lectures on NASA research, airborne science, instrumentation, meteorology, atmospheric chemistry research, remote sensing, oceanography, agricultural practices, instrument integration, airborne data systems, and sustainability and the environment. Lectures are posted on the web at (<http://www.nserc.und.edu/learning/SARPmm.html?2010>)
- Hands on experience with instrument integration, flight planning, and data collection on two flights on the NASA DC-8.
- Research projects include the atmosphere, oceans and land.
- Exposure to both remote sensing and in situ sampling techniques.
- Field trips for ground truth validation measurements.
- Sample and data analysis in the lab after the research flights.
- Formal presentations of results and conclusions.



## SARP 2010 started with a Student Poster Session at UC Irvine on June 20th



The 28 students from 24 different universities in 18 states talking about their varied research interests with other students and SARP faculty and staff.

Students presented posters on their varied research interests in:

- Geoscience
- Atmospheric Chemistry
- Oceanography
- Biology
- Aerospace Engineering
- Environmental Chemistry
- Physics
- Chemical Engineering
- Computer Science



# SARP 2010 Distinguished Faculty



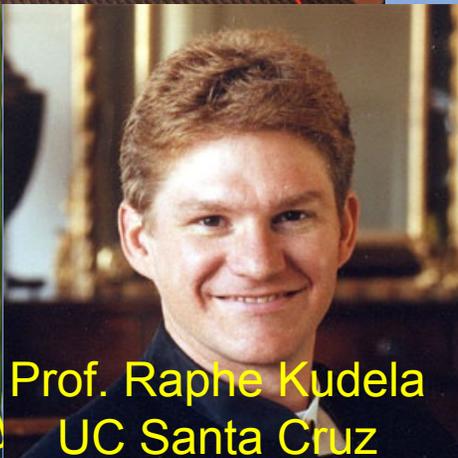
Prof. Susan Ustin  
UC Davis



Prof. Don Blake  
UC Irvine



Prof. Henry Fuelberg  
Florida State University



Prof. Raphe Kudela  
UC Santa Cruz



Dr. Clarissa Anderson  
UC Santa Cruz



**NSERC**

National Suborbital Education and Research Center

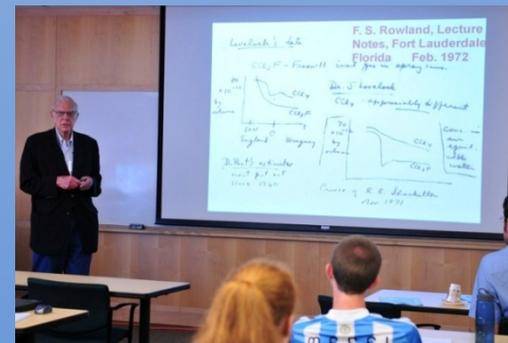
UNIVERSITY OF NORTH DAKOTA



## SARP 2010 lectures were given by NASA HQ program managers and research professors at UC Irvine and in Palmdale the first week

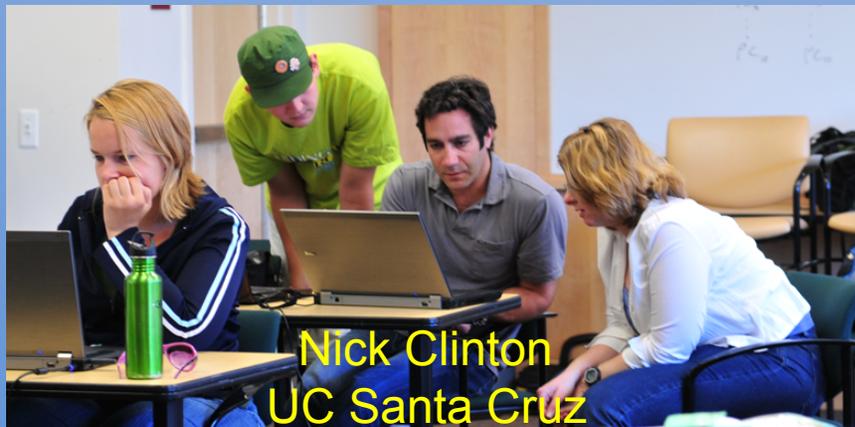
| Speaker               | Organization  | Lecture Topic                                 |
|-----------------------|---------------|---|
| Mr. Randal Albertson  | NASA HQ       | NASA's Airborne Science Program               |
| Dr. Hal Maring        | NASA HQ       | NASA and Atmospheric Composition Research     |
| Dr. Jay Al Saadi      | NASA HQ       | Tropospheric Chemistry Research               |
| Dr. Susan Ustin       | UC Davis      | Remote Sensing and Agricultural Practices     |
| Dr. Nicholas Clinton  | UC Santa Cruz | MASTER instrument                             |
| Dr. Clarissa Anderson | UC Santa Cruz | Ocean Optics and Giant Kelp                   |
| Dr. Donald Blake      | UC Irvine     | Atmospheric Chemistry and Gulf Oil Spill data |
| Dr. Sherwood Rowland  | UC Irvine     | Ozone depletion and Climate Change            |
| Dr. George Seielstad  | BAERI         | Sustainability and the Environment            |
| Dr. Henry Fuelberg    | Florida State | Meteorology for Airborne Science              |
| Dr. Edward Browell    | New Hampshire | Lidar Technology and ASCENDS                  |
| Ms. Stephanie Vay     | NASA LaRC     | Atmospheric Carbon Dioxide Measurements       |
| Mr. Adam Webster      | NSERC         | Instrument Integration Engineering            |
| Mr. David Van Gilst   | NSERC         | Airborne Data Systems and Communications      |
| Mr. Eric Buzay        | NSERC         | Airborne Facility Instrumentation             |

Lectures on ozone depletion and climate change were given by Nobel Laureate Dr. Sherwood Rowland



The slide presentations of all of the speakers are available on the SARP 2010 web site. Videos of almost all of the presentations are also currently available at the site.

# Research Mentors



## Crucial Strengths of SARP mentors

- Fully committed to students
- Extremely knowledgeable
- Constantly accessible
- Provide guidance, not spoon-feeding
- Very personable



**NSERC**

National Suborbital Education and Research Center  
UND THE UNIVERSITY OF NORTH DAKOTA



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>

# SARP 2009

## SARP 2009 Research Topics

Evapotranspiration of almond and cotton fields, Central Valley

*Dr. Susan Ustin, UC Davis*

Air quality effects of commercial dairy operations, Central Valley

*Dr. Don Blake, UC Irvine*

Algal Blooms, Monterey Bay

*Dr. John Ryan, MBARI*

## DC-8 was used for two 6-hour data flights

Instruments employed were:

**MASTER** for remote sensing of algal blooms and agricultural processes

**Whole Air Sampler (WAS)** for in situ gas sampling



**50** applications for admission

**Student Profile:** 18 Female/10 Male

**Average GPA:** 3.60

**Academic Disciplines:**

Earth Sciences 41%

Atmospheric Science 21%

Engineering 17%

Chemistry, Physics, Biology 17%

**26 Universities from 20 states**

**5 week program: 7/12/2009-8/13/2009**

The program concluded with the students presenting their research results in formal presentations

**In addition the top 3 student presentations were given at the NASA booth during the Fall AGU meeting in San Francisco**

All of the lectures and student presentations were videotaped and are available on the internet

**SARP 2009 Facebook page** 102 fans that follow SARP 2009

<http://www.facebook.com/#!/pages/Student-Airborne-Research-Program-SARP-2009/61457681433?ref=ts>



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>

# SARP 2010



**115 Applications for admission**  
**Student Profile: 14 Female/14 Male**  
**Average GPA: 3.67**

**Academic Disciplines:**  
Earth Sciences 35%  
Atmospheric Science 14%  
Engineering 17%  
Chemistry, Physics, Biology 31%

**24 Universities from 18 states**

**6 week program: 6/20/2010-7/30/2010**

The program concluded with the students presenting their research results in formal presentations

In addition the top 3 student presentations were given at the NASA booth during the 2010 Fall AGU meeting in San Francisco

All of the lectures and student presentations were videotaped and are available on the internet

## SARP 2010 Research Topics

Evapotranspiration of almond and pistachio orchards, Central Valley  
*Dr. Susan Ustin, UC Davis*

Air quality effects of commercial dairy operations, Central Valley  
*Dr. Don Blake, UC Irvine*

Kelp growth and biomass, Monterey Bay  
*Dr. Raphael Kudela, UC Santa Cruz*

## DC-8 was used for two 6-hour data flights

Instruments employed were:

**MASTER** for remote sensing of kelp and agricultural processes

**Whole Air Sampler (WAS)** for in situ gas sampling

**Digital Mapping System (DMS)** for multi-angle imaging

**4 ASCENDS** instruments piggybacked on the flights to perform engineering testing

**SARP 2010 Facebook page**

82 fans of SARP 2010

<http://www.facebook.com/#!/pages/Grand-Forks-ND/SARP-2010/299754969335?ref=ts>



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>

# SARP 2011



**85** Applications for admission  
**Student Profile:** 14 Female/15 Male  
**Average GPA:** 3.63

**Academic Disciplines:**  
Earth Sciences 33%  
Atmospheric Science 10%  
Engineering 3%  
Chemistry, Physics, Biology 51%

**29 Universities from 21 states**

**6 week program: 6/19/2011-7/29/2011**

The program concludes with the students presenting their research results in formal presentations

In addition the top 3 student presentations will be given at the NASA booth during the 2011 Fall AGU meeting in San Francisco

All of the lectures and student presentations will be videotaped and available on the internet

## SARP 2011 Research Topics

Evapotranspiration of almond orchards and vineyards, Central Valley

*Dr. Susan Ustin, UC Davis*

Air quality effects of commercial dairy operations and pollution, Central Valley

*Dr. Don Blake, UC Irvine*

Kelp growth and biomass, Monterey Bay

*Dr. Raphael Kudela, UC Santa Cruz*

## DC-8 was used for two 6-hour data flights

Instruments employed were:

**MASTER** for remote sensing of kelp and agricultural processes

**Whole Air Sampler (WAS)** for in situ gas sampling

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## SARP 2011 Facebook page

<http://www.facebook.com/#!/pages/Grand-Forks-ND/SARP-2010/299754969335?ref=ts>



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>

# Research Projects for SARP 2010

- **Atmospheric Effects of emissions from dairies and anthropogenic pollution, California's Central Valley**
- **Evapotranspiration from almond orchards and vineyards, California's Central Valley**
- **Distribution and Abundance of Giant Kelp, Santa Barbara Channel and Monterey Bay, CA**

## Field trips for ground truth validation measurements.

- **Measurements of crop parameters in almond fields and vineyards during DC-8 overflight**
- **Air sampling on the ground surrounding a dairy farm and in large cities**
- **Collection of reference spectra from a boat in the Santa Barbara Channel**



# SARP 2010 DC-8 Science Flight 07/1/10



Satellite



# Learning about data relationship on all scales

In situ and  
Remote sensing



Ground based



# Tour of Dryden Flight Research Center



← Group photo at the X-1E at Dryden Flight Research Center

Chris Naftel explaining the Global Hawk platform capabilities to the students →



# National Research Council finding

## Revitalizing NASA's Suborbital Program: Advancing Science, Driving Innovation, and Developing Workforce

Committee on NASA's Suborbital Research Capabilities

Space Studies Board

Division on Engineering and Physical Sciences

THE NATIONAL ACADEMIES PRESS

In addition to the inherent training that is accomplished in every field experiment, ASP conducts activities whose primary focus is on student training. One particular example is the NASA Student Airborne Research Program (SARP) in Earth system science, organized by the National Suborbital Education and Research Center at the University of North Dakota.

The SARP's objectives were to strengthen NASA's and the nation's workforce in Earth system science and related fields by

- Introducing students to NASA airborne science and its role in Earth system research,
- Providing students with hands-on experience of end-to-end aspects of a scientific mission, and
- Addressing future workforce needs in the aerospace and airborne science community

**Finding:** Programs such as the “2009 Student Airborne Research Mission,” which utilized the DC-8 aircraft, are very effective.



# Lessons Learned from two programs

- Students achieve to expectations.
- Collaborations essential to Earth System research do form.
- Students become resources for each other.
- Active Learning more powerful than Passive Learning.
- Serving a societal need motivates student learning.
- Closure (i.e., formal presentations) is necessary.



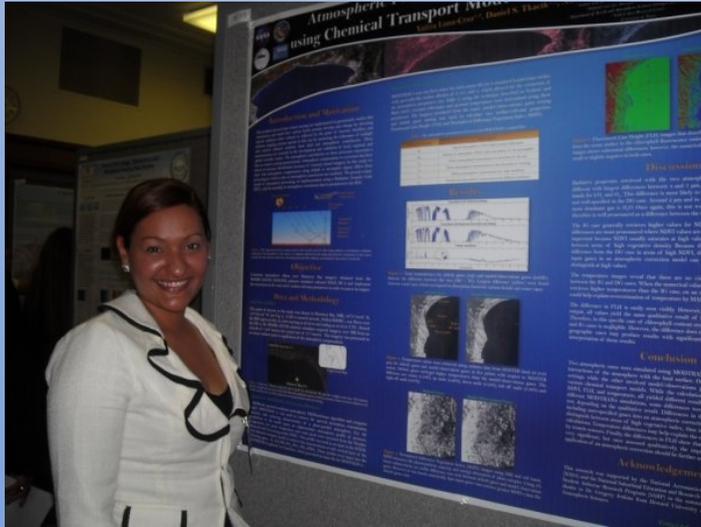
# Some results from the program so far

- 4 SARP 2009 participants gave presentations at 2009 AGU meeting
- 10 SARP 2009 and 2010 participants gave presentations at 2010 AGU meeting
- Participants gave presentations of SARP data results at other professional society conferences (NOAA and GSA meetings)
- The first publication jointly written by SARP mentors and SARP participants using SARP 2009 data:  
“Atmospheric Correction for MASTER Imagery using Localized Modeled and Observed Meteorology and Trace Gases”, accepted for publication in *Remote Sensing Letters*.



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>

## SARP 2009 Alumni Yaitza Luna-Cruz Wins Poster Competition:



SARP 2009 Alumni Yaitza Luna-Cruz won first place in the NOAA-Educational Partnership Program Science Forum poster competition for her poster highlighting research she did during her participation in SARP. Yaitza's SARP research focused on atmospheric correction of remote sensing data. Multi-spectral remote sensing data was collected over Monterey Bay using the MASTER instrument on board the NASA DC-8. Yaitza was on board the DC-8 helping to collect this data and analyzing it with other participants in SARP, including her co-authors SARP alumni Daniel Tkacik and SARP mentor Nicholas Clinton.

**SARP 2010 alumni Christy Steffke** presented a poster on "Estimated Marine Sediment Concentration in the Santa Barbara Channel Using the MODIS/ASTER Airborne Simulator" at the Geological Society of America 2010 in the session "Marine/Coastal Science Geology":



For more SARP pictures please visit <http://www.nserc.und.edu/learning/SARPmm.html>



## From a West Virginia University press release

# WVU junior one of 29 students across the country chosen for NASA internship

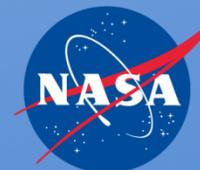
William Brezinski is shown at his internship in California running an air sample through an instrument to determine its carbon monoxide and carbon dioxide levels.

[West Virginia University](#) junior chemistry major William Brezinski used the research skills he learned here to take to the skies in California and identify pollution. Brezinski, a native of Athens, W.Va., joined 28 other college students from across the country in California, to participate in the Student Airborne Research Program internship, a NASA affiliate program.

Brezinski and the other students studied earth system processes, calibration and prototyping instruments for possible satellite missions during the internship. As a member of the internship's atmospheric chemistry program, Brezinski was qualified to operate instruments onboard a DC-8 aircraft to collect atmospheric chemical samples while flying over Palmdale, Calif. After spending two days in intense classes at the University of California, Irvine, the participants began flights and lab testing at the Dryden Flight Research Center.

"We analyzed every peak of every graph from the more than 600 samples six times," Brezinski said. "It was a lot of work. I was already familiar with working in a lab from my chemistry classes, so that helped with finding my way around." Then Brezinski and the other students had to take an aspect of their findings and create individual 10-minute presentations. "At first the presentation was daunting because there was a lot of data and equations to sift through, but I started with a simple outline and went from there," Brezinski said. Brezinski chose to focus on a special man-made solvent that is used in the dry-cleaning process but can also successfully trace urban pollutants.

**He now plans to focus on the environment and atmospheric chemistry during the rest of his college career, an interest he credits his internship with sparking and developing.**



# Industry recruiting SARP alumni

Dear Mr. Shetter,

I saw the description of the SARP program, and it looks like a great program.

Brandywine Photonics is currently under contract to build the NASA Ames Enhanced MODIS Airborne Simulator (EMAS), and the NASA Goddard GeoCape Airborne Simulator Spectrograph, and are looking for bright young scientists/engineers with hands-on experience.

Positions are both for Co-op and full-time starting January 2011. On the job training would be provided. Projects will include both airborne Hyperspectral instrument and potentially Earth Venture Class -2 satellite designs. Job descriptions include field support, remote sensing calibration, embedded real-time programming (FPGAs and GPUs), instrument performance analysis (Matlab), optical design (Zemax), and mechanical design (Solidworks). Experience with atmospheric lidar also a plus. They would work on instruments for the ER-2 Superpod, GlobalHawk, B-200, and Twin Otter.

Feel free to forward this email to your graduates, to send me with their resume.

John

John Fisher  
President/Sr. Optical Engineer  
Brandywine Photonics, LLC



# Participant feedback on Facebook



## Student Airborne Research Program SARP 2011

Share your thoughts on the Student Airborne Research Program experience!



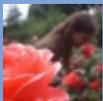
### Samiah Moustafa

**Best experience of my life! Hands-on research is defined in a whole NEW way in this program. Not one regret from this program :)**



### Steven Walsh

**Awesome project and awesome people! This program helped me to affirm/shape what my further education goals are. SARP reveals the exciting and important topics in science and society that we will be addressing in our future careers. SARP has been the highlight of my student career thus far.**



### Cassie Knierim

**It was definitely an incredible experience. I'd never done any real research before - so I came in with no background in airborne science (I'm a physics major) and no experience. I was worried I'd be out-of-place and far behind. What I found was a very diverse group of students of different majors, experience, knowledge, years in school, etc. But, I think it was so much better that way. Everyone brought something different to the table, and I think we all worked very well together.**

**I left having learned a lot about research, data analysis (specific knowledge I am applying now in my current research), airborne science and possible careers, building good connections, and great friendships.**



# Future of SARP

- The SARP 2011 planning and application process is currently underway.
- Possible expansion to 4 research groups could add 10 additional participants.
- Future year use of other platforms (based on availability in the time frame) , additional instruments, and different faculty is possible.
- There may be interest in designing a similar program for high school students to entrain them at an early age.



## Thanks to a number of you here at Headquarters for your support of the program

- Jack Kaye and Ming-Ying Wei for their encouragement and support.
- Andy Roberts and Bruce Tagg of ASP for providing the financial support and guidance.
- Jack Kaye, Hal Maring, Ken Jucks, Jay Al-Saadi, Jim Crawford and Randy Albertson for taking the time to come to SARP and present overviews of the NASA research programs.

**Thanks also to the faculty, mentors, and NSERC staff who have made SARP possible**



# More SARP Information

NASA Earth Observer 22, Nov-Dec 2010

[http://eosps0.gsfc.nasa.gov/eos\\_observ/pdf/Nov\\_Dec\\_final.pdf](http://eosps0.gsfc.nasa.gov/eos_observ/pdf/Nov_Dec_final.pdf)



Or visit <http://www.nserc.und.edu/learning/SARP.html>



Thanks for your attention

Questions?



