

Naval Postgraduate School
Monterey, California 93943-5138

NPS-09-02-031



***SUMMARY
OF
RESEARCH
2001***



**Center for Interdisciplinary Remotely
Piloted Aircraft Studies
(CIRPAS)**

**Robert Bluth
Director**

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Prepared for: Naval Postgraduate School
Monterey, CA 93943-5000

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NAVAL POSTGRADUATE SCHOOL
Monterey, California


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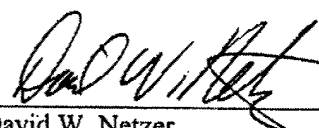
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13. ABSTRACT (Maximum 200 words.) This report contains project summaries of the research projects in the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS). A list of recent publications is also included, which consists of conference presentations and publications, books, contributions to books, published journal papers, and technical reports. Thesis abstracts of students advised by faculty in the Department are also included.				
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THE NAVAL POSTGRADUATE SCHOOL MISSION

Increase the combat effectiveness of the U.S. and allied forces and enhance the security of the U.S.A. through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense related challenges of the future.



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PREFACE

Research at the Naval Postgraduate School is carried out by faculty in the four graduate schools (School of International Graduate Studies, Graduate School of Operations and Information Sciences, Graduate School of Engineering and Applied Sciences, and Graduate School of Business and Public Policy) and three Research Institutes (The Modeling, Virtual Environments, and Simulation (MOVES) Institute, Institute for Information Superiority and Innovation (I2SI), and Institute for Defense System Engineering and Analysis (IDSEA). This volume contains research summaries for the projects undertaken by faculty in the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) during 2001. The summary also contains thesis abstracts for those students advised by the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) faculty during 2001.

Questions about particular projects may be directed to the faculty Principal Investigator listed, the Department Chair, or the Department Associate Chair for Research. Questions may also be directed to the Office of the Associate Provost and Dean of Research. General questions about the Naval Postgraduate School Research Program should be directed to the Office of the Associate Provost and Dean of Research at (831) 656-2099 (voice) or research@nps.navy.mil (e-mail). Additional information is also available at the RESEARCH AT NPS website, <http://web.nps.navy.mil/~code09/>

Additional published information on the Naval Postgraduate School Research Program can be found in:

- *Compilation of Theses Abstracts*: A quarterly publication containing the abstracts of all unclassified theses by Naval Postgraduate School students.
- *Naval Postgraduate School Research*: A tri-annual (February, June, October) newsletter highlighting Naval Postgraduate School faculty and student research.
- *Summary of Research*: An annual publication containing research summaries for projects undertaken by the faculty of the Naval Postgraduate School.

This publication and those mentioned above can be found on-line at:
<http://web.nps.navy.mil/~code09/publications.html>.

INTRODUCTION

The research program at the Naval Postgraduate School exists to support the graduate education of our students. It does so by providing military relevant thesis topics that address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain the long-term superiority of the Navy/DoD. It keeps our faculty current on Navy/DoD issues, and maintains the content of the upper division courses at the cutting edge of their disciplines. At the same time, the students and faculty together provide a very unique capability within the DoD for addressing warfighting problems. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are being rapidly developed in both the commercial and military sectors. Their unique knowledge of the operational Navy, when combined with a challenging thesis project that requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

The research program at the Naval Postgraduate School consists of both reimbursable (sponsored) and institutionally funded research. The research varies from very fundamental to very applied, from unclassified to all levels of classification.

- **Reimbursable (Sponsored) Program:** This program includes those projects externally funded on the basis of proposals submitted to outside sponsors by the School's faculty. These funds allow the faculty to interact closely with RDT&E program managers and high-level policymakers throughout the Navy, DoD, and other government agencies as well as with the private sector in defense-related technologies. The sponsored program utilizes Cooperative Research and Development Agreements (CRADAs) with private industry, participates in consortia with government laboratories and universities, provides off-campus courses either on-site at the recipient command, by VTC, or web-based, and provides short courses for technology updates.
- **Naval Postgraduate School Institutionally Funded Research (NIFR) Program:** The institutionally funded research program has several purposes: (1) to provide the initial support required for new faculty to establish a Navy/DoD relevant research area, (2) to provide support for major new initiatives that address near-term Fleet and OPNAV needs, (3) to enhance productive research that is reimbursably sponsored, and (4) to cost-share the support of a strong post-doctoral program.

In 2001, the level of research effort overall at the Naval Postgraduate School was 148 faculty work years and exceeded \$48 million. The reimbursable program has grown steadily to provide the faculty and staff support that is required to sustain a strong and viable graduate school in times of reduced budgets. In FY2001, over 93% of the research program was externally supported. A profile of the sponsorship of the Naval Postgraduate School Research Program in FY2001 is provided in Figure 1.

INTRODUCTION

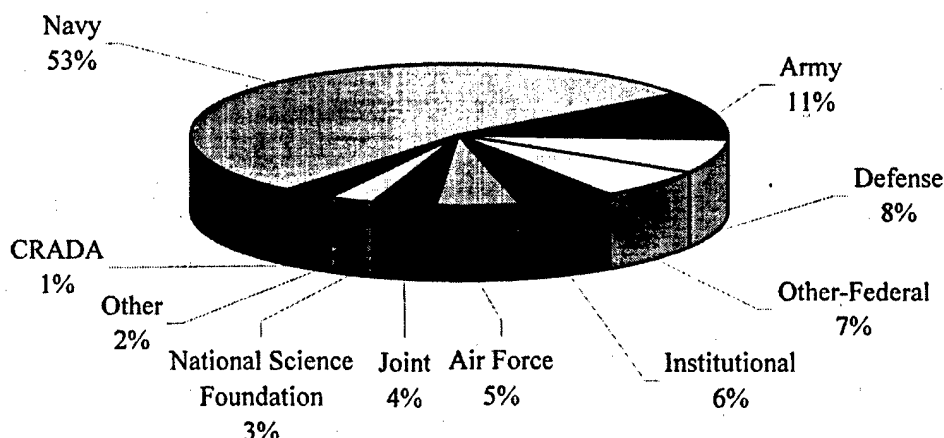


Figure 1. Profile of NPS Research and Sponsored Programs (\$52M)

The Office of Naval Research is the largest Navy external sponsor. The Naval Postgraduate School also supports the Systems Commands, Warfare Centers, Navy Labs and other Navy agencies. A profile of external Navy sponsorship for FY2001 is provided in Figure 2.

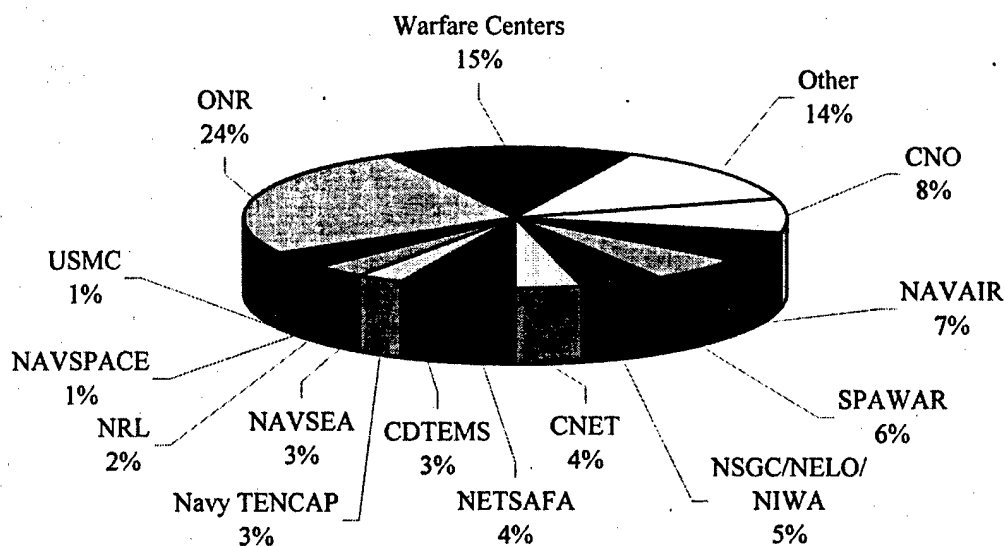


Figure 2. Navy External Sponsors of NPS Research and Sponsored Programs (\$29M)

These are both challenging and exciting times at the Naval Postgraduate School and the research program exists to help ensure that we remain unique in our ability to provide education for the warfighter.

DAVID W. NETZER
Associate Provost and Dean of Research

September 2002

**CENTER FOR INTERDISCIPLINARY
REMOTELY PILOTED
AIRCRAFT STUDIES
(CIRPAS)**

**ROBERT BLUTH
DIRECTOR**

CENTER SUMMARY

OVERVIEW:

The Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) is a research center at the Naval Postgraduate School, Monterey, California. CIRPAS provides Remotely-Piloted Aircraft (RPA) as well as manned aircraft services to the science, research, test and evaluation communities at the lowest practical costs. CIRPAS also provides an array of meteorological, aerosol and cloud particle sensors, data acquisition systems, calibration and data reduction service. CIRPAS conducts payload integration, reviews flight safety and provides logistical planning and support to research and test projects. CIRPAS also provides equipment and faculty which are used by NPS Departments for instruction purposes and supports research by faculty and students.

CIRPAS operates a variety of manned and unmanned air vehicles. The Common Ground Control Station (CGCS) is interoperable among the Center's various UAVs. CIRPAS can support a variety of payloads, data links and instrumentation to support user requirements. The facility has unique UAV flight services, which include:

- An available and centralized repository of diverse UAV assets to meet the needs of individual programs.
- Access to the UAVs and support equipment on a "lease" basis so the user is spared the cost of ownership.
- Turnkey UAV operations, including payload integration, flight safety and logistics support.
- Low cost services using shared assets.

CIRPAS provides cost effective flight services, which benefits a broad spectrum of research.

CIRPAS operates out of two facilities. The primary site is located near the NPS campus at the Marina Municipal Airport. This facility includes a 10,000 sq ft hangar, maintenance and administrative spaces for CIRPAS staff. These include a fully outfitted machine shop, electronics room and a calibration lab for the upkeep of scientific instrumentation. The second site is at McMillan Airfield, Camp Roberts, CA, 90 miles south of the Marina facility. The Camp Roberts site provides the Center with a base of operations for both manned and unmanned aerial vehicle (UAV) flight activities.

The California Institute of Technology supports CIRPAS as the prime contractor. It is also partners with NPS in providing the latest instrumentation for atmospheric research.

RESEARCH THRUSTS:

- Fleet and USJFCOM Exercises
- Support for CONOPS Development
- Atmospheric and Oceanographic Research
- Payload Test and Evaluation
- UAV Experimentation with Operational Forces supported by analysis provided by NPS Departments and Institutes

RESEARCH FACILITIES:

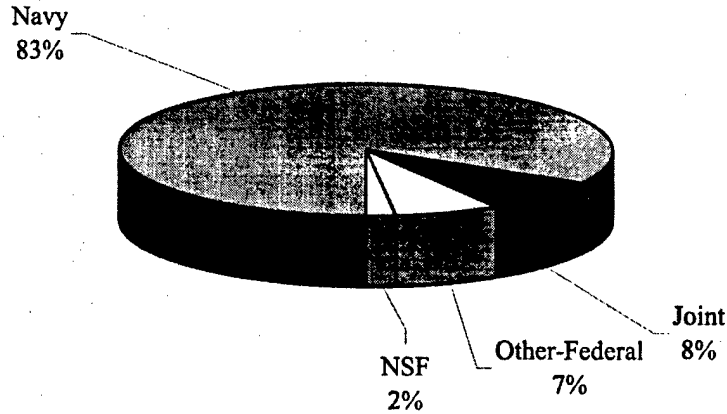
- Marina Facility
 - 10,000 sq ft maintenance hangar
 - 3000 ft runway – manned operations only
 - Naval Reserve Unit
 - Office space, flight operations
 - Maintenance facility
 - Payload development and integration
 - Logistics planning and support to research and test projects
- Camp Roberts Facility
 - Friendly airspace for testing and training (R2503)
 - Military ground maneuvers (equipment, personnel)
 - 3500 x 60 ft runway
 - 2000 sq ft hangar

CENTER SUMMARY

- Shared utilization of NRL
- Temporary office space

RESEARCH PROGRAM (Research and Academic)-FY2001:

The Naval Postgraduate School's sponsored program exceeded \$49 million in FY2001. Sponsored programs included both research and educational activities funded from an external source. A profile of the sponsored program for the Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) is provided below:



Size of Program: \$5802K

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PROJECT SUMMARIES

AURA ENGINEERING FLIGHT TEST SUPPORT

Robert Bluth, Research Associate
Center for Interdisciplinary Remotely Piloted Aircraft Studies
Sponsor: Department of Energy

OBJECTIVE: Provide ALTUS UAV flight support for AURA project. Funds provided by DOE primarily support CIRPAS administrative functions and CIRPAS scheduled and unscheduled maintenance and flight operations.

SUMMARY: The Advanced UAV Remote-Sensing Applications (AURA) program is a Department of Energy funded UAV-based ultraviolet laser induced fluorescence (LIF) instrument currently being designed by Sandia National Laboratories. The instrument was flown on Altus. The purpose of the AURA test program is to verify the feasibility of LIF technology on an unmanned air vehicle platform. All flights were conducted out of Dugway's Michael Army Airfield and within Restricted Air Space R-6402A. 22.5 flight hours were flown in support of the AURA testing program.

DoD KEY TECHNOLOGY AREAS: Other (Remote Sensing)

KEYWORDS: LIDAR, Remote Sensing, UAV.

CAMP ROBERTS OPS SUPPORT FOR NAVAL RESEARCH LABORATORY

Robert Bluth, Research Associate
Center for Interdisciplinary Remotely Piloted Aircraft Studies
Sponsor: Naval Research Laboratory

OBJECTIVE: Support NRL UAV operations at CIRPAS airfield at Camp Roberts, CA.

SUMMARY: CIRPAS supported NRL's *Dakota* UAV flight activity at Camp Robert, McMillian Airfield for two years.

DoD KEY TECHNOLOGY AREAS: Air Vehicles

KEYWORDS: NRL, Camp Roberts, McMillam Airstrip, UAV Technology

CARRIER AIR WING UAV FLIGHT SUPPORT

Robert Bluth, Research Associate
Center for Interdisciplinary Remotely Piloted Aircraft Studies
Sponsor: Naval Strike and Warfare Center

OBJECTIVE: Provide MAE UAV flight support for CAG work-ups.

SUMMARY: Support Navy UAV CONOPS development activities at NAS Fallon with Predator and Altus UAVs. Predator operations included, voice relay, video closed captioning system, and RF link to NSAWC's operations center today, so that they can receive NPS/CIRPAS payload video during the flights.

DoD KEY TECHNOLOGY AREAS: Air Vehicles

KEYWORDS: UAV, CONOPS, Predator

PROJECT SUMMARIES

CIRPAS SUPPORT FOR NASA

Robert Bluth, Research Associate

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: National Aeronautics and Space Administration

OBJECTIVE: CIRPAS supports NASA's Code Y UAV National Research Announcement (NRA) by providing development, evaluation support to potential proposers.

SUMMARY: UAV Facilitator Service to Proposers answer inquiries from potential NRA recipients about UAV capabilities, provide advice on UAV operational constraints, including regulatory constraints. Provide UAV vendor information and assist potential proposers in establishing contact with appropriate platform vendors. Maintain and update UAV technical information database based on data from vendors. Interface with other facilitators at Dryden Flight Research Center and Goddard Space Flight Center.

DoD KEY TECHNOLOGY AREAS: Other (Geophysics)

KEYWORDS: Environmental Scientific Investigation, UAVs, Program Support

KERNAL BLITZ 01 FLIGHT OPERATIONS SUPPORT

Robert Bluth, Research Associate

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: Office of Naval Research

OBJECTIVE: Provide *Pelican* flight support for AROSS operations in Kernel Blitz 01. CIRPAS provided 107 flight hours during a three-week mission window. Each sortie was no longer than eight hours per each 24-hour period.

SUMMARY: KB01 is a CINCPAC-sponsored training exercise involving 3DFLT and the First Marine Expeditionary Force (I MEF) forces. The exercise will simulate reestablishing freedom of navigation through the Straits of Catalina and clearing a conventional amphibious operating area in support of 1st Marine Expeditionary Brigade (MEB) operations. NPS/CIRPAS supported the Office of Naval Research (ONR), the Naval Surface Warfare Center (NSWC) during KB01 by providing payload integration, an airborne platform and crew for Areté Associates' Airborne Remote Optical Spotlight System (AROSS). The experiment took place off the coast of southern California near Camp Pendleton and La Jolla, CA in the Kernel Blitz area of operations. Areté provided AROSS operators, analysts and engineers to support flight operations, conduct data collection, provide data analysis and produce Mine-Like Object (MLO) detection and Meteorological/Oceanographic (METOC) products. Real-time transmission of AROSS imagery and metadata was achieved through a collaboration with NSWC. The objective for the Kernel Blitz support were to demonstrate timely response to Fleet MLO and Meteorological/Oceanographic (METOC) requirements for mine countermeasures and battlespace characterization in support of Ship-to-Objective Maneuver amphibious operations. The Kernel Blitz 01 deployment to McClellan-Palomar Airport in Carlsbad, CA occurred 16 - 31 March 2001.

DoD KEY TWCHNOLOGY AREAS: Other (Mine Detection)

KEYWORDS: Pelican, AROSS, Kernel Blitz, Mine Detection

PROJECT SUMMARIES

**NAVAL POSTGRADUATE SCHOOL /CIRPAS SUPPORT
OF NAVSEA UAV COMRELAY DEMONSTRATION**
Robert Bluth, Research Associate
Center for Interdisciplinary Remotely Piloted Aircraft Studies
Sponsor: Naval Sea Systems Command

OBJECTIVE: Naval Postgraduate School Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) provided flight operations support for the NAVSEA UAV COMRELAY Demonstration with the operation of CIRPAS UV-18A research aircraft. CIRPAS carried relay radio equipment aloft and demonstrate the benefits of UAVs as communications relay platforms in support of Marine Corps operations.

DoD KEY TECHNOLOGY AREAS: Other (Flight Operations)

KEYWORDS: Flight Operations, NAVSEA UAV COMRELAY

PREDATOR FLIGHT OPERATION AT CHERRY POINT, NC FOR JTFEX01-3
Robert Bluth, Research Associate
Center for Interdisciplinary Remotely Piloted Aircraft Studies
Sponsor: U.S. Joint Forces Command

OBJECTIVE: Support Joint Forces Command Predator MAE UAV flight operations at Cherry Point, NC for JTFEX-01-3. CIRPAS provided 30 flight hours over an 8-day mission window with level IV or less operations dependent on specific level of TCS status.

SUMMARY: CIRPAS provided UAV imagery support to the Time Critical Targeting (TCT)/Time Critical Strike (TCS) portion of the JTFEX01-3 exercise. TCT/TCS is a JFCOM-directed 'experimental' adjunct to the JTFEX series and overlays and integrates with the primary mission of the JTFEX - to train deploying Carrier Battle Groups (CVBGs) and Amphibious Ready Groups (ARGs). The TCT/TCS goal is to blend the intelligence process with the targeting process and identify shortfalls in DOTMLPF for time critical strike operations. Naturally, the forces available to participate in and support TCT/TCS each JTFEX varies. UAVs have not been a regular player in JTFEXs, and CIRPAS provides for that eventuality.

DoD KEY TECHNOLOGY AREAS: Other (UAV Technology)

KEYWORDS: Predator, UAV, JFC, JTFEX01-3

PREDATOR FIGHT OPERATION AT WEBSTER FIELD FOR AUVSI DEMO
Robert Bluth, Research Associate
Center for Interdisciplinary Remotely Piloted Aircraft Studies
Sponsor: Naval Air Systems Command

OBJECTIVE: Support PMA-263 predator MAE UAV flight operations at Webster field, Patuxent River, MD for AUVSI demonstration. CIRPAS provided flight support over a one-day mission window.

SUMMARY: CIRPAS provided Predator flights at Webster Field, MD. Due to the low ceiling Predator was close to the airfield during the air show. CIRPAS provided a video feed to the crowd via a 50 ft jumbo screen for the entire show. At the conclusion, an imagery show was presented.

DoD KEY TECHNOLOGY AREAS: Other (UAV Technology)

KEYWORDS: Predator, UAV, PMA-263, AUVSI

PROJECT SUMMARIES

PRAIRIE DOG II UAV FLIGHT SUPPORT

Robert Bluth, Research Associate

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: Tactical Exploitation of National Capabilities (TENCAP) Office

OBJECTIVE: Provide ALTUS UAV flight support for Prairie Dog II. CIRPAS provided ALTUS UAV flight support for Prairie Dog II. CIRPAS provided 40 ALTUS flight hours during a two-week mission window. Each sortie was no longer than eight hours per each 24-hour period.

SUMMARY: Prairie Dog II is a Navy TENCAP-sponsored signals intelligence (SIGINT) payload similar in function to the Radiant Copper payload flown on Predator P030 at NAS Fallon in September 1999. The WESCAM 14TS/QS payload was integrated into the Altus ST UAV to image the target once it had been geolocated. The Prairie Dog II deployment occurred at Camp Pendleton, CA.

DoD KEY TECHNOLOGY AREAS: Other (UAV Technology)

KEYWORDS: Prairie Dog II, ALTUS, UAV, Navy TENCAP

TCS DEVELOPMENTAL TESTING FLIGHT OPERATIONS SUPPORT

Robert Bluth, Research Associate

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: Naval Air Systems Command

OBJECTIVE: Provide predator UAV flight support for Prairie Dog II. CIRPAS provided 30 flight hours during a three-week mission window.

SUMMARY: TCS provides joint war-fighters with interoperable and scalable command, control, communications, and data dissemination systems for the family of present and future Medium Altitude Endurance (MAE) and tactical Unmanned Aerial Vehicles (UAVs). TCS will also receive and disseminate data for the High Altitude Endurance (HAE) UAVs. The TCS program is managed by PMA-263. Fundamental to TCS definition is a series of demonstrations and tests to gain war-fighter recognition and feedback on user needs. CIRPAS has been asked to support the developmental testing (DT) of Engineering Development Unit #2 (EDU2). EDU2 is the Raytheon-manufactured TCS slated for delivery to JTFCOM. DT will include Level 5 flight activity.

DoD KEY TECHNOLOGY AREAS: Other (UAV Technology)

KEYWORDS: UAV, Predator, TCS

FORMATION AND PERPETUATION OF RIFTS AND GRADIENTS IN OPTICAL AND MICROPHYSICAL PROPERTIES OF MARITIME STRATUS

Hafliði Jonsson, Research Assistant Professor

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: National Science Foundation

OBJECTIVE: Measurements of the physical characteristics of in cloud-free areas (rifts) embedded in stratus and stratocumulus.

SUMMARY: A rift came into the range of the CIRPAS Twin Otter during the DECS experiment in 1999, and was explored in detail. Analysis of the data obtained has been performed by Neil Smith in the Meteorology Department, who completed a Master's thesis on the topic, and by a graduate student at the University of Miami, who is still working on a project. The last year's funding has been extended to obtain further measurements should an opportunity present itself during the CARMA and DECS-II experiments scheduled to take place in Marina, CA, in August-October 2002.

PROJECT SUMMARIES

DoD KEY TECHNOLOGY AREAS: Other (Geosciences)

KEYWORDS: Stratus, Stratocumulus, Rifts, Visibility Marine Boundary Layer

INTEGRATION OF AEROSOL AND WIND LIDAR ONTO CIRPAS' TWIN OTTER

Hafliði Jonsson, Research Assistant Professor

Robert Bluth, Research Associate

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: National Oceanic and Atmospheric Agency

OBJECTIVE: Installation and flight-testing a new aerosol and wind lidar.

SUMMARY: Funding from ONR and the IPO has enabled ~ 15 hours of airborne Doppler Wind Lidar (DWL) operations to conduct experiments related to lidar surface returns from water surfaces and to explore several issues related to the cal/val of any future space-based DWL. The first series of flights (February 9 - 15) was spent in the vicinity of Monterey, CA. Another series of flights took place near Boulder, Colorado (March 12 -15) where the airborne DWL was compared with a ground based lidar, a microwave sounder, and measurements from an instrumented tower. The lidar's scanner was mounted in the door of the CIRPAS Twin Otter and permitted scanning up, down, and sideways in a variety of patterns. While a 2 micron coherent system was used in these experiments, some of the questions being addressed apply generally to direct detection as well. Some "quicklook" data and a description of the experiments are provided at the TODWL (Twin Otter Doppler Wind Lidar) web site www.swa.com/TODWL. The lidar is being transferred to a trailer for use by the PI between airborne experiments. The intent is to reinstall the lidar on the Twin Otter for future participation in field campaigns, special underflights of other airborne instruments, and DWL cal/val activities.

DoD KEY TECHNOLOGY AREAS: Sensors, Other (Marine Meteorology)

KEYWORDS: Lidar, NPOESS, Winds, Aerosol

NAVAL POSTGRADUATE SCHOOL/CIRPAS SUPPORT OF OFFICE OF NAVAL RESEARCH AIRBORNE RESEARCH

Hafliði Jonsson, Research Assistant Professor

Robert Bluth, Research Associate

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: Office of Naval Research and National Oceanic and Atmospheric Agency

OBJECTIVE: The projects were carried out using the CIRPAS Twin Otter, UV-18A and various scientific instruments from CIRPAS' airborne and calibration suites. Operations were supported by CIRPAS' scientific and flight operations personnel. CIRPAS provided GPS, and meteorological data to the projects, and also measurements from other facility instruments as requested for each project. CIRPAS provided a data system consisting of several computers, networked and synchronized to GPS time. The data system not only serviced the facility equipment, but also the special research instruments maintained and operated by the PIs themselves, their Co-PIs, and students.

SUMMARY: CIRPAS supported the airborne research objectives of the Office of Naval Research (ONR). Four individual research projects were supported independently using CIRPAS personnel, instrumentation, and aircraft. These projects were: 1) ACE-ASIA – A study of Asian dust transported off the continent. PI was Professor John Seinfeld of California Institute of Technology. 2) HALO – A study of water vapor in vicinities of clouds and its effects on the Earth's radiation budget. PI was Professor John Seinfeld of California Institute of Technology. 3) CLOUD – A study of entrainment into stratus and stratocumulus clouds. PI was Professor Bruce Albrecht of the University of Miami. 4) RED – A multifaceted study of scintillation effects on light and signal transmission in the marine boundary layer, aerosol and cloud chemistry and micro-physics, and turbulence. A science team consisting of Mr. Ken Anderson and Dr. Jeff

PROJECT SUMMARIES

Reid from SPAWAR, San Diego, Dr. Dean Hegg of University of Washington, Professor Carl Friehe of University of California, Irvine, and Dr. Haf Jonsson, NPS directed the mission and defined individual flight objectives.

DoD KEY TECHNOLOGY AREAS: Other (Geosciences)

KEYWORDS: Meteorology, Aerosol, Optical depth, Visibility

THE OPTICAL PROPERTIES OF THE MARITIME AEROSOL AND THEIR CORRELATION TO THE ELECTRICAL CONDUCTIVITY IN THE MARINE BOUNDARY LAYER

Hafliði Jonsson, Research Assistant Professor

Robert Bluth, Research Associate

Center for Interdisciplinary Remotely Piloted Aircraft Studies

Sponsor: Office of Naval Research

OBJECTIVE: Aircraft measurements of aerosol/optical properties and size spectra, along with simultaneous measurements of the electrical conductivity of the air were used to investigate the feasibility waves in the marine boundary layer.

SUMMARY: Measurements of size distributions, extinction and conductivity were obtained during the RED experiment in Hawaii in the summer of 2001. Analyses of the measurements has yet to be performed.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications

KEYWORDS: Conductivity

**REMOTELY PILOTED
AIRCRAFT STUDIES
(CIRPAS)**

**2001
Faculty Publications
and Presentations**

PUBLICATIONS/PRESENTATIONS

JOURNAL ARTICLES

Baumgardner, D., H. Jonsson, W. Dawson, D. O'Connor and R. Newton, The cloud, aerosol and precipitation spectrometer (CAPS): A new instrument for cloud investigations, *Atmospheric Research*, Vol. 59-60, pp. 251-264, 2001.

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