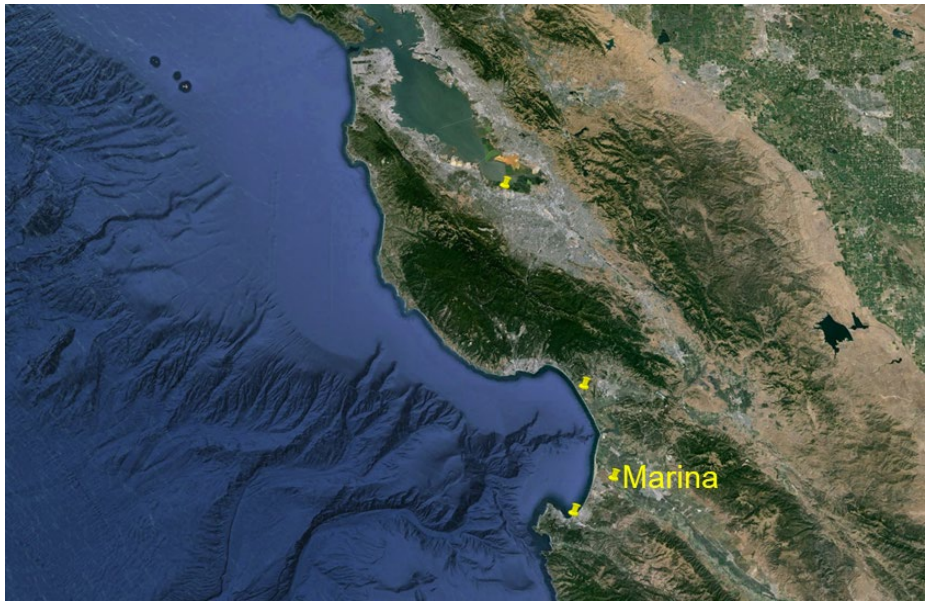
NPS-CIRPAS Airborne Research Facility
2024-2025 Accomplishments/Plans

Contact: Anthony.Bucholtz@nps.edu

NPS-CIRPAS Facility Overview

Marina Airport, Marina, CA



- 10 miles north of Monterey, CA
- Approx. 2 hr drive from Silicon Valley
- 30,000 sq ft maintenance hangar
- Instrumentation and calibration laboratories
- Machine shop
- Guest scientist laboratory and work spaces

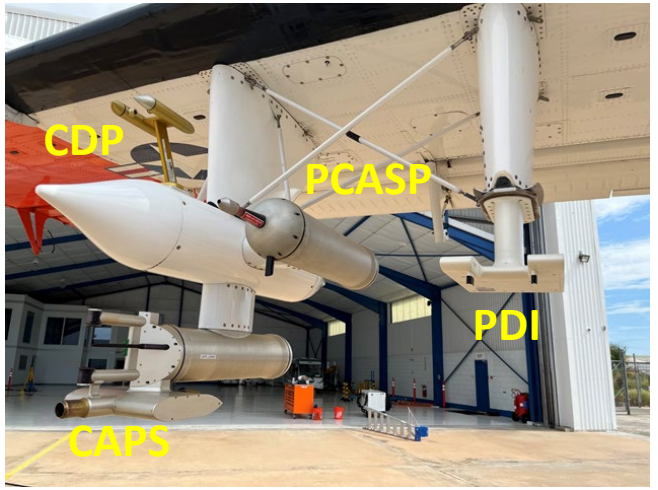
NPS-CIRPAS Aircraft Overview
Twin Otter DH-6-300 (UV-18A)

- Research Capacity: 1500 lbs (aircraft is unpressurized)
- Research Power (DC): 5600 W at 28 VDC
- Research Power (AC): 4000 W 115 VAC 60 Hz
- Speed: 100-140 kts
- Minimum Altitude: 100 ft over the ocean with good visibility
- Practical Ceiling: 18,000 ft
- Duration: 3-5 hours

NPS-CIRPAS Instrumentation Overview
Facility Instrumentation

CIRPAS Twin Otter Facility Instrumentation:

- **Navigation**: Latitude/Longitude, altitude, pitch, roll, heading, etc…
- **Meteorology:** Temperature, Pressure, relative humidity, winds
- **PCASP**: Passive Cavity Aerosol Spectrometer Probe 0.1 – 3.0μm
- **CAPS**: Cloud, Aerosol and Precipitation Spectrometer
  - **CIP**: Cloud Imaging Probe, 12.5μm-1.55mm @25μm resolution
  - **CAS**: Cloud Aerosol Spectrometer, 0.6μm-50μm
  - **LWC**: Liquid Water Content, 0.01 – 3 g/m3
- **CDP:** Cloud Droplet Probe, 2-47 μm
- **TSI WCPC 3789**: Water-based Condensation Particle Counter 2nm-1.0μm
- **TSI CPC 3025A**: Ultrafine Condensation Particle Counter Dp>3nm
- **TSI Nephelometer**: aerosol scattering at 450, 550, 700nm
- **PSAP**: Radiance, Inc. Particle Soot Absorption Spectrometer, aerosol absorption at 467, 530, 660nm
- **Gerber PVM-100A**: Cloud PSA (Particle Surface Area), LWC (Liquid Water Content), Re (effective radius)
- **Li-COR LI-7500**: H2O (0-60 mmol/mol) and CO2 (0-3000 ppm) gas concentrations



NPS-CIRPAS Instrumentation Overview
Facility Instrumentation

CIRPAS Twin Otter Facility Instrumentation (continued):

- **KT-19 Downlooking**: Surface, SST, cloud top temperatures
- **KT-19 Uplooking**: Sky, cloud bottom temperatures
- **BBR Radiometers:** Solar and Infrared (IR) Broadband Radiometers (up- and down-looking), solar/IR radiative fluxes
- **SPN-1:** Solar Pyranometer (up-looking), total/direct/diffuse solar radiative fluxes
- **Video Cameras**: Cockpit-forward view; Wing-fuselage/down view
- **SATCOM Downlink**: Allows researchers on the ground to view subset of the aircraft data in real-time
- **MX-15 Capable:** The aircraft is capable of mounting a user's MX-15

CIRPAS Mentored Instrumentation:

- **PDI**: Artium Phased Doppler Interferometer, cloud droplet size distribution (2μm-1mm) (operated by CIRPAS, mentored by Mikael Witte - NPS)
- **DWL**: Doppler Wind Lidar, vertical and horizontal winds above, below and ahead of the aircraft (operated by CIRPAS, mentored by Dave Emmitt – Simpson Weather Associates)

NPS-CIRPAS Instrumentation Overview
Project Support

Guest instrumentation:

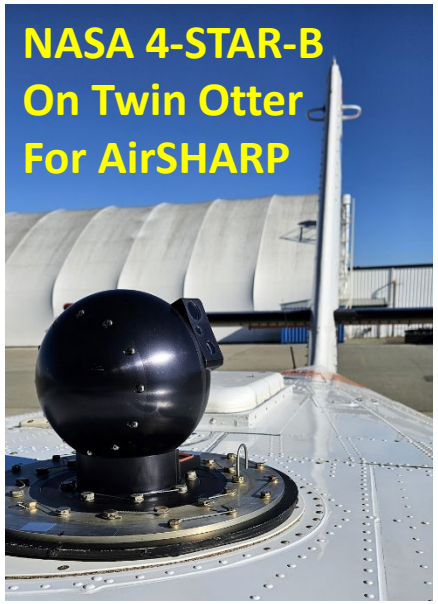
Ability to mount guest instrumentation for a given project:

- **Engineering support:** Provide engineering and technical support to integrate your instrument onto the aircraft
- **Flight Certification support:** Work directly with project team to provide engineering, technical and flight testing support to meet NAVAIR (or given agency) flight certification requirements.

Project support:

Small, flexible, experienced team (scientist, technician, pilots and aircraft mechanics) works directly with your project team:

- **Site operations:** can operate anywhere in the country and internationally
- **Flight planning:** pilots work directly with project team
- **Flight scientists:** communicate directly with pilots in-flight
- **Student involvement:** students can be directly involved in the whole process: instrument integration, flight planning, flying onboard, etc…



FY24 Twin Otter Missions

1. **SWESARR: (Phase 2:** October 2023 - 2 weeks; 26 Flt hrs) – **Completed**
   - **PI:** Batu Osmanoglu, NASA-Goddard
   - **Location:** Fairbanks, AK
   - **Goal:** Study to remotely measure the amount of water in the snowpack in the northern Alaska region
   - **Sponsor:** NASA

2. **Twin Otter Upgrades: (**Oct 2023 - Nov 2024) - **Completed**
   - **PI:** Anthony Bucholtz, NPS
   - **Location:** Rocky Mountain Aircraft, Calgary, CA; CIRPAS, Marina, CA
   - **Goal:** Major upgrades to aircraft to greatly enhance its research capabilities: new nose, zenith/nadir ports, avionics
   - **Sponsor:** DURIP-CA

3. **REDSAW: (**April-May 2024 - 3 weeks; 30 Flt hrs) - **Completed**
   - **PI:** Qing Wang, NPS
   - **Location:** Salton Sea, CA
   - **Goal:** Quantify refractivity profiles in the stable boundary layer and their impact on EM propagation over water
   - **Sponsor:** ONR

4. **PACE-PAX: (**September 2024 - 4 weeks; 60 Flt hrs) - **Completed**
   - **PI:** Kirk Knobelspiesse, NASA-Goddard
   - **Location:** Marina, CA
   - **Goal:** Gather aerosol validation data for the Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) satellite mission
   - **Sponsor:** NASA

FY25 Twin Otter Missions

1. **AirSHARP: (Phase 1:** October 2024 - 2 weeks; 20 Flt hrs) - **Completed**
   - **PI:** Liane Guild, NASA-Ames
   - **Location:** Marina, CA
   - **Goal:** Assessment of hyperspectral aerosol optical depth and water-leaving reflectance products for PACE OCI (Ocean Color Instrument) and polarimeter validation
   - **Sponsor:** NASA

2. **SHIMMER: (**Nov-Dec 2024 - 5 weeks; 60 + 20 Flt hrs) - **Completed**
   - **PIs:** Jeff Reid (NRL), Qing Wang (NPS)
   - **Location:** Marina, CA
   - **Goal:** Investigate processes that regulate the lower marine atmosphere, clouds, precipitation, turbulence, and composition
   - **Sponsor:** ONR, Air Force (added 20 flt hrs)

3. **AirSHARP: (Phase 2:** May 2024 - 2 weeks; 20 Flt hrs) - **Planned**
   - **PI:** Liane Guild, NASA-Ames
   - **Location:** Marina, CA
   - **Goal:** Assessment of hyperspectral aerosol optical depth and water-leaving reflectance products for PACE OCI (Ocean Color Instrument) and polarimeter validation
   - **Sponsor:** NASA

4. **Aircraft Inspection – D-Check: (**Summer/Fall 2025 – 4-8 weeks) – **Planned and Required**
   - **Aircraft Mechanic:** Greg Cooper
   - **Location:** Marina, CA
   - **Goal:** Major inspection of the airframe, engines and landing gear – **Required every 5 years**

Twin Otter Upgrades: FY24 - FY25

To enhance and extend the aircraft's research capabilities –

1. **New Zenith Instrumentation Port:**
   - **~20% larger** than previous zenith port
   - Increased structural integrity
2. **New Nadir Instrumentation Port:**
   - 27" x 36" – **much larger** than previous two smaller, circular ports
3. **Upgraded Electrical and Navigational Aids Package**
   - **Garmin 600 with dual flight displays**
     - Includes Attitude and heading reference system (AHRS), air data computer (ADC), dual Garmin GTN-750Xi navigators with integrated class A Terrain Awareness System (TAWS), dual Jupiter Avionics JA95 audio panels, Garmin GWX weather radar, GTX345 transponders, and GTS-855 active traffic system
     - **Increased safety and reliability of flight**
     - **Significant weight reduction** (~10% of aircraft weight)

Completed: April, 2024

4. **New Nose Assembly**: -
   - Series 400 Twin Otter long nose – **lighter**, **stronger** carbon fiber
   - **Specialized optical port hard points:**
     - Capable of mounting Wescam **MX-15 or MX-20**
   - **Retains instrument capabilities of previous nose**

Nov 2024

New zenith port

New nose assembly

New nadir port

Garmin 600

➢ Completed: November 2024

FY24/25 Publications/Conference Presentations

CSM: (Sept 2020-ONR)

- Zeider, K., G. Betito, **A. Bucholtz**, P. Xian, A. Walker, and A. Sorooshian (2024). Differences in aerosol and cloud properties along the central California coast when winds change from northerly to southerly, **Atmos. Chem. Phys**., 24, 9059-9083, https://doi.org/10.5194/acp-24-9059-2024 2024

RECAP-CA: (June 2021-CARB)

- Science Paper: Pfannerstill, E. Y., C. Arata, Q. Zhu, B. C. Schulze, R. Ward, **R. Woods**, C. Harkins, R. H. Schwantes, J. Seinfeld, **A. Bucholtz**, R. C. Cohen, and A. H. Goldstein (2024) Temperature-dependent emissions dominate aerosol and ozone formation in Los Angeles. **Science**, Vo. 384, Issue 6702, pp 1324-1329, https://doi.org/10.1126/science.adg8204 , 20 June 2024.
- Zhu, Q., Schwantes, R. H., Coggon, M., Harkins, C., Schnell, J., He, J., Pye, H. O. T., Li, M., Baker, B., Moon, Z., Ahmadov, R., Pfannerstill, E. Y., Place, B., Wooldridge, P., Schulze, B. C., Arata, C., **Bucholtz, A.**, Seinfeld, J. H., Warneke, C., Stockwell, C. E., Xu, L., Zuraski, K., Robinson, M. A., Neuman, J. A., Veres, P. R., Peischl, J., Brown, S. S., Goldstein, A. H., Cohen, R. C., and McDonald, B. C.: A better representation of volatile organic compound chemistry in WRF-Chem and its impact on ozone over Los Angeles, **Atmos. Chem. Phys**., 24, 5265–5286, https://doi.org/10.5194/acp-24-5265-2024 , 2024.
- Schulze, B. C., R. X. Ward, E. Y. Pfannerstill, Q. Zhu, C. Arata, B. Place, C. Nussbaumer, P. Wooldridge, **R. Woods, A. Bucholtz**, R. C. Cohen, A. H. Goldstein. P. O. Wennberg, and J. H. Seinfeld: Methane Emissions from Dairy Operations in California's San Joaquin Valley Evaluated Using Airborne Flux Measurements, **Environ. Sci. & Technol**., 57, 48, 19519-19531, https://doi.org/10.1021/acs.est.3c03940, 2023
- Rebecca Helen Schwantes; and Q. Zhu, C. B. Francoeur, Q. Z. Rasool, J. He, Y. He, M. Akbarzadeh, H. Luo, S. H. Jathar, C. Harkins, C. Lyu, M. M. Coggon, C. Stockwell, J. Schnell, R. Ahmadov, K. Yu, H. Pye, M. Li, A. Middlebrook, A. Piasecki, S. Albertin, E. Y. Pfannerstill, B. Place, P. Wooldridge, B. C. Schulze, C. Arata, **A. Bucholtz**, J. Seinfeld, L. Xu, K. Bates, C. Warneke, K. Zuraski, M. A. Robinson, J. Neuman, J. Gilman, A. Lamplugh, P. R. Veres, J. Peischl, A. Rollins, E. Waxman, N. Schafer, A. H. Goldstein, R. Cohen, D. K. Henze, S. S. Brown, and B. McDonald. Improving Cooking and VCP Chemistry in WRF-Chem to More Confidently Quantify Co-Benefits of Zero-Emission Vehicle Adoption on CO2 Emissions and Air Pollutants in Los Angeles (Invited Presentation). Abstract 2B.3, presented at **AMS 105th Annual Meeting**, New Orleans, LA, 13 Jan 2025.

SWEX: (April-May 2022-NSF/ONR)

- Carvalho, Leila M. V., G-J Duine, C. Clements, S. F. J. De Wekker, H. J. S. Fernando, D. R. Fitzjarrald, R. G. Fovell, C. Jones, Z. Wang, L. White, **A. Bucholtz,** M. J. Brewer, W. Brown, M. Burkhart, E. Creegan, M. Deng, M. de Orla-Barile, D. Emmitt, S. Greco, T. Hock, J. Kasic, K. Malarkey, G. Modjeski, S Oncley, A. Rockwell, D. Seto, C. Thompson, and H. Vomel:... (2024) The Sundowner Winds Experiment (SWEX) in Santa Barbara, California. **Bulletin of the American Meteorological Society**. https://doi.org/10.1175/BAMS-D-22-0171.1, 2024.
- Greco, S., D. Emmitt, S. Wood, G. J. Duine, L. V. Carvalho, and C. Jones (2024). Airborne Doppler Wind Lidar Measurements of a California Coastal Jet During 2022 SWEX, presented at **AMS 104th Annual Meeting**, Baltimore, MD, 28 Jan 2024.
- Carvalho, L., D. Seto, G. J. Duine, M. de Orla-Barile, C. Jones, C. B. Clements, Z. Wang, S. F. J. De Wekker, H. J. S. Fernando, G. Modjeski, W. O. J. Brown, and L.D White (2024). Windstorms in coastal mountains: observing and modeling mesoscale features and boundary layer interactions during the Sundowner Winds Experiment (SWEX). Presented at **AMS 21st Conference on Mountain Meteorology**, Boise, Idaho, 22-26 July 2024.
- Gert-Jan Duine, Leila Carvalho, Marian de Orla-Barile, Stephan De Wekker, Griffin Modjeski, Charles Jones, Daisuke Seto, William O J Brown, Craig B Clements, Harindra J.S. Fernando and Loren D. White, (2024). Modeling and observing downslope winds during the Sundowner Winds Experiment (SWEX). presented at **AGU Fall Meeting**, Washington, DC, 13 Dec 2024.

FY24/25 Publications/Conference Presentations (continued)

SWEX: (April-May 2022–NSF/ONR) - continued

- Emmitt, D., S. Greco, and S. Wood (2024). Utilizing Airborne Doppler Wind Lidar Data to Characterize the Surface Layer Over the Ocean: Winds, Foam, Sea Spray and Surface Currents, presented at **AMS 104th Annual Meeting**, Baltimore, MD, 28 Jan 2024.
- Emmitt, D., S. Greco, and S. Wood (2024). Recent Airborne Doppler Wind Lidar Investigations of OLEs over the Marine Atmospheric Boundary Layer off the Coast of Central California, presented at **AMS 104th Annual Meeting**, Baltimore, MD, 28 Jan 2024.
- Greco, S., D. Emmitt, S. Wood, G. J. Duine, L. V. Carvalho, and C. Jones (2024). Airborne Doppler Wind Lidar Measurements of a California Coastal Jet During 2022 SWEX, presented at **AMS 104th Annual Meeting**, Baltimore, MD, 28 Jan 2024.

SCILLA: (May 2023-ONR)

- NPS Masters Thesis: Bollinger, S. M. (2024) Characterizing and Understanding the Aerosol-Cloud Interactions Over the Southern California Bight and its Effects on the Marine Environment. Master Thesis, Naval Postgraduate School, Monterey, CA https://hdl.handle.net/10945/73074
- Nimya Sheena Sunil, Lisa R Welp, Patrick Y Chuang, Alessia Molino, Mason Leandro, **Anthony Bucholtz** and Mikael Witte. Vertical Moisture Exchange in the Marine Stratocumulus Boundary Layer using Stable Isotopes in Atmospheric Water Vapor: Insights from the SCILLA Airborne Campaign. Abstract PP51F-0616, presented at **AGU Fall Meeting**, Washington, DC, 13 Dec 2024.
- Witte, M. K. (2025). Island Wakes as a Mechanism for Mixing of Free Tropospheric Aerosol into Marine Stratocumulus, presented at **AMS 105th Annual Meeting**, New Orleans, LA, 12-16 Jan 2025.

MAGPIE: (Aug 2023-ONR)

- Melvin, E. C., J. S. Reid, H. J. Park, Z. Wang, W. J. Marais, Q. Wang, and **A. Bucholtz** (2024). Sampling, Tracking, and Analyzing Roll Features in Large Eddy Simulations of the Marine Atmospheric Boundary Layer. presented at **AMS 104th Annual Meeting**, Baltimore, MD, 28 Jan 2024.
- James Anthony Hlywiak; and D. Flagg, J. D. Doyle, J. S. Reid, C. Jackson, R. Yamaguchi, J. Ruiz-Plancarte, Q. Wang, and **A. Bucholtz**. Island Wake Atmospheric Boundary Layer Characteristics across the Lesser Antilles. Abstract 4.1, presented at **AMS 105th Annual Meeting**, New Orleans, LA, 13 Jan 2025.

REDSAW: (May 2024-ONR)

- Wang, Q., C. Yardim, T. Rogers, J. Mccammon, P. Bidgare, Z. Wang, R. Yamaguchi, J. Ruiz-Plancarte, R. Hoheisel, T. Hansen, K. Mulreany, and D. Eleuterio: *An Overview of REDSAW and its 2024 Field Campaign*, **2025 National Radio Science Meeting** in Boulder, Colorado, 7-10 January 2025.
- Mulreany, K., Q. Wang: *Ducting Conditions During the 2024 REDSAW Campaign*, **2025 National Radio Science Meeting** in Boulder, Colorado, 7-10 January 2025.
- Bidigare, P., I. Heintz, D. Chang, and C. Obranovich: *Dual-Polarized Multi_Emitter RF Propagation Collection with Large Vertical Array at the Salton Sea*, **2025 National Radio Science Meeting** in Boulder, Colorado, 7-10 January 2025.
- Shi, E. A., C. Yardim, J. Vinci, Q, Wang, R. Yamaguchi, and J. Ruiz-Plancarte: REDSAW *Tethered Drone-Based Meteorological Measurements*, **2025 National Radio Science Meeting** in Boulder, Colorado, 7-10 January 2025.
- Vinci, J., C. Yardim, E. Shi, Q. Wang, R. Yamaguchi, and J. Ruiz-Plancarte: *Preliminary Range-dependent Measurements during the Radar and Electromagnetic Ducting in Stable Atmosphere over Water Campaign*, **2025 National Radio Science Meeting** in Boulder, Colorado, 7-10 January 2025.

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Questions?