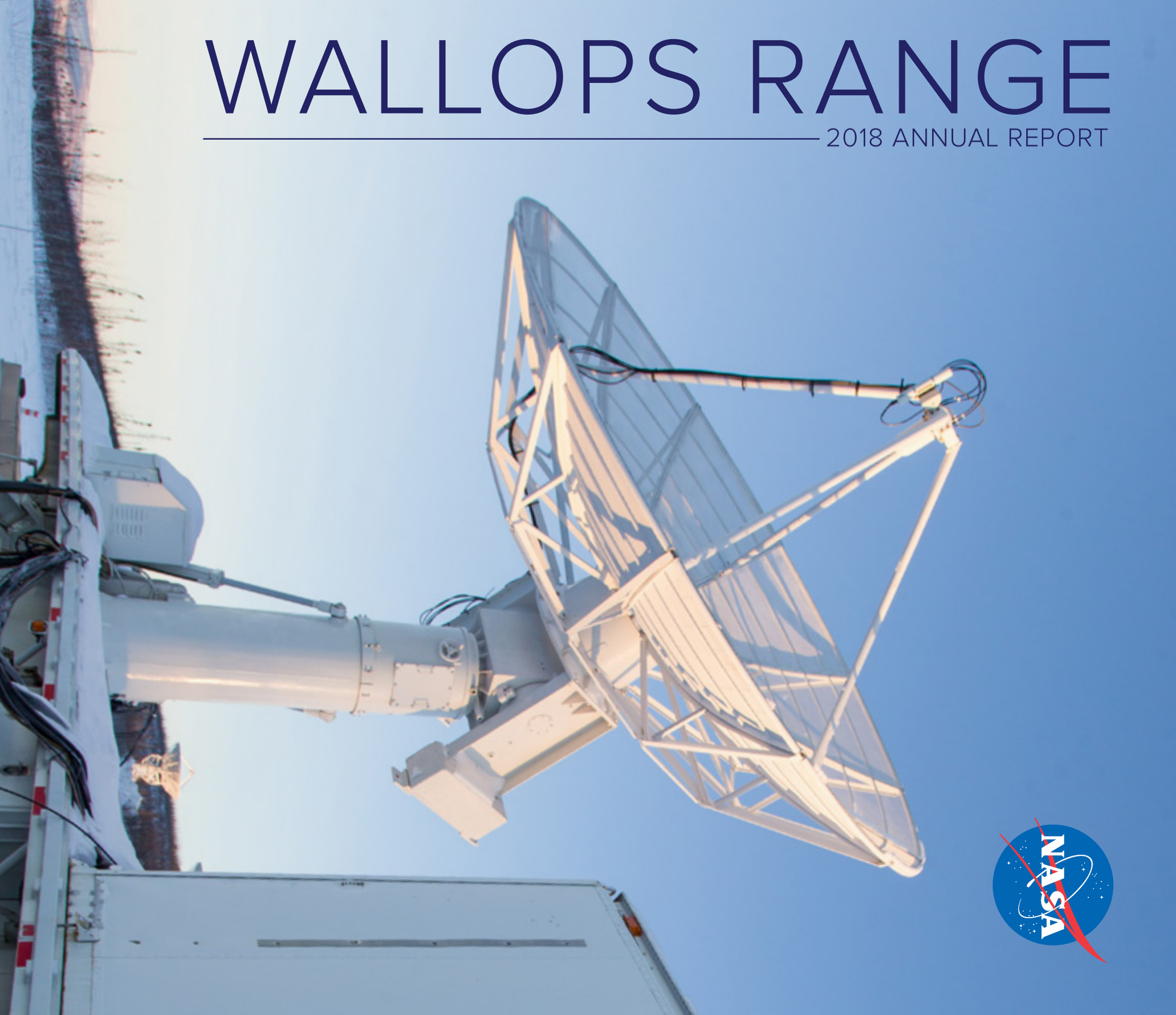
WALLOPS RANGE

2018 ANNUAL REPORT



DEDICATION

Jim Bogan

Wallops Flight Facility lost a valuable member of the community in 2018 with the passing of James “Jim” Bogan. Jim was a vital part of helping with the Range Radar systems during his 34-years at Wallops. He was a decorated veteran in the United States Marine Corps. and served as a Corporal working in the Aviation Radar field.

Jim began his tenure working in the Radar Engineering Group in 1985. He wore many hats throughout his career with the Range and NASA —He was a site lead for Radar 5, Radar Supervisor, Radar Coordinator, and the Radar Maintenance Supervisor. In 2014, he joined the Engineering and Technology Directorate Electrical Engineering Branch as a Radar Engineer and Subject Matter Expert.

The radar systems at Wallops have relied heavily on the use of C-Band radio frequency during sounding rocket and ELV launches to track vehicles throughout flight. Throughout his time at Wallops, Jim became an expert on all of the range radar systems associated with mission support. He was instrumental in keeping these systems healthy and operational before and during each mission. Along with the C-Band, he also tested and repaired S- and X-Band radar transponders. These systems are still used today for all launches from the Wallops Range thanks to Jim’s attention to detail and care.

During his career, he was involved with many important projects not only at Wallops, but around the world. At Alaska’s Poker Flat Research Range, he was part of the Pathfinder Surveillance Radar installation that was used to monitor the skies for many years for sounding rocket launches in the northern hemisphere. He was a part of the acceptance testing for the Range’s Mobile Radar Systems deployed to places like Bermuda, Norway, and Australia.

Jim’s expertise extended to projects outside of Wallops. He performed pre-launch transponder testing on the RADCAL calibration satellite launched aboard a Scout G1 from Vandenberg Air Force Base in California, which stayed in operation 15 years past its expected lifetime. He also designed and built the interface unit for the circuitry that controls the C- and S-Band calibration for the Air Force Defense Meteorological Satellite Program F-15 satellite. This satellite was also launched from Vandenberg aboard a Titan-2 launch vehicle.

Jim was widely known in the radar community through the many committees and groups in which he participated. He served on the Transponder Sub-Committee of the Range Commander’s Council (RCC) to help define transponder specifications used at all test ranges across the U.S. He also served as the RCC’s Electronic Trajectory Measurements Group (ETMG) representative, addressing all aspects of operation, maintenance, and performance of Radar systems in the U.S.

Jim’s strength was shown in his productive efforts and he always worked hard to become knowledgeable in every job he performed. His advice was widely sought by his peers, especially when mission success was at stake. He was a trusted and integral part of the Wallops community and will be dearly missed by all.

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INTRODUCTION

CONTINUED EXCELLENCE

My fellow Range members, partners and customers, it gives me great pride to introduce the tremendous achievements of the Range and Mission Management Office and the Wallops Range as a whole during 2018. This unprecedented period was full of challenges, but our staff members were up to the task each and every time. As we prepare for the opportunities coming in 2019, I want to take a look back at the accomplishments from 2018.

While maintaining our reputation as the industry standard for assuring safe, low-cost range operations and strong commercial partnerships, 2018 continued the previous expansion into the launch capabilities that Wallops provides.

After an exhaustive nationwide search, Wallops Flight Facility (WFF) was selected as the future site for Rocket Lab's Launch Complex 2. Construction began in cooperation with the Mid-Atlantic Regional Spaceport (MARS), in preparation for a 2019 third quarter mission. When completed this facility could support around 12 missions per year and will bring a great economic influx to the area.

This year also saw our range facilities and engineering efforts gain unprecedented momentum. The Mission Operations Control Center (MOCC) construction and reviews were completed in preparation for supporting Antares launches in 2019. The completed MOCC is now a state-of-the-art facility for leading missions at Wallops, providing the ability to conduct simultaneous operations and increasing our ability to conduct classified operations. Another crowning achievement is the completion of the Bermuda downrange tracking site renovation project. The project was finished in October 2018, and a ribbon cutting ceremony was completed in November in a joint effort with the Bermuda Consulate, and NASA Headquarters. This effort will extend the life of the equipment by removing it from the harsh marine environment its exposed to and will ensure a viable NASA capability in Bermuda for supporting launches out of both Wallops and Cape Canaveral, including NASA's new manned missions.

The Research Range Services (RRS) team also earned numerous miles traveling around the world and supporting sounding rocket missions in Norway, Kwajalein, and Alaska. These missions provided the RRS team with extreme challenges of mission complexity and weather. Here at home we supported the Antares resupply mission to the International Space Station, and various launches to support educational outreach to numerous students at the university and high school level.

The team supported multiple NASA missions all around the globe without any serious injuries or incidents in 2018. Through diligent hazard assessment and proactive activities such as the Wallops Safety Awareness Campaign and the completion of more than 150 monthly safety inspections of range facilities, our personnel have ensured that the NASA mission is accomplished in a safe and environmentally sound manner.

These achievements could not be completed without the, professionalism, expertise, commitment and dedication of our most important asset: The Wallops Family. These superb individuals fuel our ability to provide our agency and the nation with tremendous return on investment, enabling state-of-the art science and aerospace development in an ever changing environment. I look forward to seeing what we can achieve in 2019.

- Robert E. Jameson

Chief, Wallops Range Office

Robert E.Jameson

NASA

WALLOPS

RANGE

NASA WALLOPS FLIGHT FACILITY GSFC

WFF

PORTFOLIO MANAGEMENT

WALLOPS ISLAND – The Range and Mission Management Office (RMMO) is a team of highly-skilled project management professionals who are charged with the responsibility of marrying the skills of scientists, engineers, NASA test directors, resource advisors, airfield managers, technicians and other personnel into one cohesive team whose objective is to conduct operations for data collection from many different flight platforms around the globe.

Working as a team and implementing sound project management strategies, we narrow our focus, reach desired goals and achieve those goals within specific time and cost parameters. As a final result everybody wins – which just may be project management's best benefit of all.

Project Management provides the Wallops Range and its customers with:

RELATIONSHIPS: Building relationships with all our stakeholders is an important part of our overall program management philosophy.

GOVERNANCE: The structure, process and procedure to control operations and changes to performance objectives. This includes metrics to indicate the health and progress of the project.

ASSURANCE: All projects must verify and validate the program, ensuring adherence to standards and alignment with the vision.

MANAGEMENT: Project managers must ensure there are thorough reviews, everyone is held accountable and that management of projects, stakeholders and suppliers are in place.

INTEGRATION: All projects ensure that component parts fit together properly to make the intended whole. Each project must optimize performance across the program value-chain, functionally and technically.

FINANCES: Projects must conform to the budget and track costs.

INFRASTRUCTURE: Project managers are charged with gathering a project team to ensure the Range's infrastructure can support the requirements of any mission.

PLANNING: Project managers must develop the overall plan and manage subsets that include resources, timescales, monitoring and control, lessons learned and other areas.

IMPROVEMENT: Not only do NASA project managers ensure mission success, they also take the time to develop and research new capabilities and systemically apply learning and knowledge to the project.

As part of RMMO, Research Range Services (RRS) supports NASA project managers and their missions by providing a myriad of services such as radar and optical tracking, telemetry down link, meteorological services, command and control, surveillance and recovery, financial analysis and engineering services to allow these missions to take place in a safe, ready environment.

The RRS team consists of many highly-experienced Range Services Managers (RSM) who work arm-in-arm with their NASA counterparts. In tandem, the Project Manager and RSM build, coordinate and manage cohesive teams that combine the efforts of engineers and technicians to configure a mobile and fixed range to provide launch range services around the globe.

From the initial thoughts of a principal investigator through the completion of data analysis, the RMMO PM in coordination with the RRS RSM is the glue that bonds the talents and efforts of the extended team of professionals needed to ensure successful completion of every mission.

All operations conducted at the Wallops Range and other remote launch ranges, such as Poker Flat Research Range, Alaska, Kwajalein, and Andøya Space Center in Norway, require state-of-the-art technologies and multi-million dollar systems to support unmanned aerial vehicles, sounding rockets, expendable launch vehicles and many other flight platforms.

In 2018, project managers were responsible for Range instrumentation support for NASA orbital and sub-orbital programs as well as programs for other government and civilian agencies. They assured near 100 percent success for a multitude of programs executed at the Wallops Range while simultaneously managing a remote maintenance campaign at tracking/command sites in Norway and Bermuda.

PORTFOLIO MANAGEMENT OVERVIEW

DIRECTORATE | Science Mission Directorate

DIVISION | Heliophysics

PROGRAM EXECUTIVE | Alan Zide

PORTFOLIO MANAGER | Robert E. Jameson

LEAD CENTER | Goddard Space Flight Center

PERFORMING FACILITY | Wallops Flight Facility

PORTFOLIO TYPE | Research Range Service

RESEARCH RANGE SERVICES ASSETS: $314.04 MILLION

Telemetry Systems	Per Unit	Quantity	Total ($M)
7.3-Meter Fixed Antenna	$1.5	1	$1.5
6-Meter Fixed Antenna	$2.0	1	$2.0
7-Meter Mobile Antenna	$1.5	2	$3.0
Mobile Integrated Telemetry System	$2.5	2	$5.0
20-Foot Mobile System	$2.0	1	$2.0
Mobile Super Van	$2.5	1	$2.5
10-Foot Mobile Antenna	$0.5	1	$0.5
8-Foot System	$0.4	2	$0.8
8-Meter Antenna	$2.5	2	$5.0
9-Meter Redstone	$6.0	2	$12.0
9-Meter System	$4.0	1	$4.0
Transportable Command and Telemetry System (TCATS)	$15	2	$30.0
Ultra High Frequency (UHF)	$18.0	1	$18.0
11-Meter Antenna	$2.7	1	$2.7
Atmospheric Radars	**Per Unit**	**Quantity**	**Total**
Space Range Radar (SPANDAR)	$20.0	1	$20.0
Tracking Radars	**Per Unit**	**Quantity**	**Total**
Range Instrumentation Radar – 778	$6.0	4	$24.0
Range Instrumentation Radar – 716	$7.0	2	$14.0
Range Instrumentation Radar – 706	$70.0	1	$70.0
Multi-Frequency, Longe-Range Tracking Radars MFTR-2100	$10.0	2	$20.0
Surveillance Radars	**Per Unit**	**Quantity**	**Total**
Airport Surveillance Radar (ASR-8)	$10.0	1	$10.0
Sea Surveillance (S- and X-Band, WISSRDS)	$1.0	2	$2.0
Airborne Surveillance Radar (APS-143)	$2.5	1	$2.5
Lightweight Surveillance Target Acquisition Radar	$0.35	4	$1.4
Command & Support Systems	**Per Unit**	**Quantity**	**Total**
Fixed UHF Command System	$4.0	1	$4.0
Fixed Poker UHF Command System	$1.5	1	$1.5
Bermuda Fixed	$2.5	1	$2.5
Rollaway Command System	$1.8	1	$1.8
Mobile Range Control System	$2.1	1	$2.1
Radio Frequency Communication	$3.0	1	$3.0
Timing System	$0.8	1	$0.8
Mission Operations Voice Enhancement (MOVE) System	$4.0	1	$4.0
Optical Systems	**Per Unit**	**Quantity**	**Total**
Video Tracking Stations	$1.0	5	$5.0
Photographic Stations	$0.3	5	$1.5
Radar-Slaved Mobile Optical Tracker	$0.4	1	$0.4
Video Distribution and Recording	$2.1	1	$2.1
Meteorological Systems	**Per Unit**	**Quantity**	**Total**
Electric Field Mills	$0.02	7	$0.14
Leading and Environmental Display System	$0.30	1	$0.30
Range Control	**Per Unit**	**Quantity**	**Total**
Range Control Center Mission Operations Control Center	$20.5 $11.0	1 1	$20.0 $11.0
Mobile Power Systems	**Per Unit**	**Quantity**	**Total**
Mobile Power System	$0.25	4	$1.0

MISSIONS ACCOMPLISHMENTS

ASPIRE 2 & 3

WALLOPS ISLAND – After a successful mission in October 2017, members of NASA's Jet Propulsion Lab (JPL) returned to Wallops in March 2018 to prepare for the launch of a follow-on to the Advanced Supersonic Parachute Inflation Research Experiment (ASPIRE) mission. The primary purpose of this second flight was to once again structurally test a parachute design for use on the Mars 2020 mission.

The first launch of ASPIRE No. 1 was marked by calm winds and near perfect seas, but was not so for ASPIRE No. 2. With a launch scheduled for March, the team knew it would most likely be up against challenging environmental condition, and those conditions did not disappoint. Due to the need to recover the parachute, the project required relatively calm seas to ensure a successful recovery. The forecast for the opening of the launch window predicted a particularly nasty weather front moving through the area, bringing with it very high sea states which would violate the launch criteria. The front moved in as predicted and lingered for several days, but a small window of opportunity looked as if it would open on March 31, 2018. Based on the predictions, however, launch conditions would not clear until later in the morning and a later launch window was requested. After some coordination, the test director was able to shift the launch window to the requested time and the team geared up for what would most likely be the only launch opportunity for several days.

The day of the launch arrived and the weather patterns continued to trend in the right direction. One of the many unique aspects of this launch was the requirement to provide atmospheric data from large weather balloons launched periodically throughout the countdown. These weather balloons collected atmospheric data that allowed personnel at JPL to reconstruct the atmospheric conditions near where the parachute would deploy to see how those conditions affected the deployment. In addition to these special project balloons, Wallops RRS team members were also required to launch balloons to support Range Safety operations throughout the count. As the launch slipped past the initially planned launch time, the coordination between the project balloons and safety balloons became extremely challenging. Despite these challenges, the team was able to iron out the issues and provide the required data to all parties. Finally, at 12:19 p.m. EST, ASPIRE No. 2 roared into the sky amid sea states that were just on the hairy edge of acceptability.

The launch itself was a success, but the mission was far from over. The recovery team had spotted the descending payload and parachute, heading towards it as soon as they were released by the Range Safety Officer. Unfortunately, the choppy seas grabbed the parachute and quickly began pulling it under, making it much more difficult to find than the first ASPIRE mission. After several minutes and rising concern, the Surveillance Coordinator did some quick calculations and directed the recovery boat to a new location where they were able to quickly locate and recover the payload. Thanks to the quick thinking of the Surveillance Coordinator and the hard work and dedication of the entire RRS team, the ASPIRE No. 2 mission resulted in a successful launch and recovery of the payload, providing critical data to the Mars 2020 program.

In September, with two successful missions under their belts, JPL once again returned to Wallops to conduct the final launch of the series, ASPIRE No. 3. For this launch, the JPL team once again requested a late window because, as it turned out, the late launch time forced on ASPIRE No. 2 by the weather turned out to be a blessing in disguise. During data analysis of the second mission, the JPL team determined the sun's position provided even better observational data than the earlier launch time of first mission. This time the weather was much more cooperative and the team was able to successfully launch the vehicle on September 7, 2018. The recovery crew worked with JPL to quickly retrieve the payload and parachute without any issues. The parachute deployment was the fastest inflation in history of a parachute this size and created a peak load of almost 70,000 pounds of force.

Overall the program was deemed a resounding success and JPL was extremely happy with the data they collected during the launches. With these three successful launches from Wallops, the NASA's Mars 2020 mission management and members of its Entry, Descent, and Landing team determined that the parachute was officially approved for the Mars 2020 mission.

ASPIRE 2 FACTS

LAUNCH VEHICLE
Black Brant IX

WALLOPS ID
NRW-5792

LOCATION
Pad 2 - 50K Launcher

LAUNCH DATE
March 31, 2018

ASPIRE 3 FACTS

LAUNCH VEHICLE
Black Brant IX

WALLOPS ID
NRW-5789

LOCATION
Pad 2 - 50K Launcher

LAUNCH DATE
September 7, 2018

ANTARES OA-9

WALLOPS ISLAND – Once again, Research Range Services (RRS) played a key role in the continued support of the resupply of the International Space Station (ISS) with the build-up, check-out and launch of the Northrop Grumman (Formerly Orbital ATK) Antares rocket for the OA-9 mission on May 21, 2018.

The RRS team over the course of six months of preparation supported vehicle processing and testing for the Cygnus spacecraft and Antares vehicle before the May launch timeframe. The RRS program manager spliced together all aspects of range operations to establish that everything would be green and ready to go before May 2018.

The RRS ground operations team again supported Cygnus spacecraft move, fueling, and processing in V-55 before being transported to the HIF for final mating and cargo load. Once all testing was complete, the RRS ground operations team supported the final leg of the journey to Pad 0A. Final launch pad checks, range systems checks, and launch readiness reviews were complete and all eyes were on the skies as impactful weather looked to be rolling in.

The RRS weather team was a crucial part in the success of the mission. After poor weather was forecasted for the initial day of launch, the decision was made to delay the count by 24 hours for better conditions, but weather was still the prime issue as rain bands moved through the area and threatened the launch. However, the RRS weather team feverishly pressed on with their efforts and forecasted a clear opportunity at the very end of the launch window. A new T-0 was coordinated and without a hitch, the Antares rocket soared into the sky to the ISS.

The Cygnus spacecraft docked with the ISS on May 24, 2018, carrying a quantum research experiment, an investigation into the properties of concrete in space, fresh food and other provisions for the six-person crew.

MISSION FACTS

LAUNCH VEHICLE
Antares

WALLOPS ID
CRW-5840

LOCATION
Pad 0A

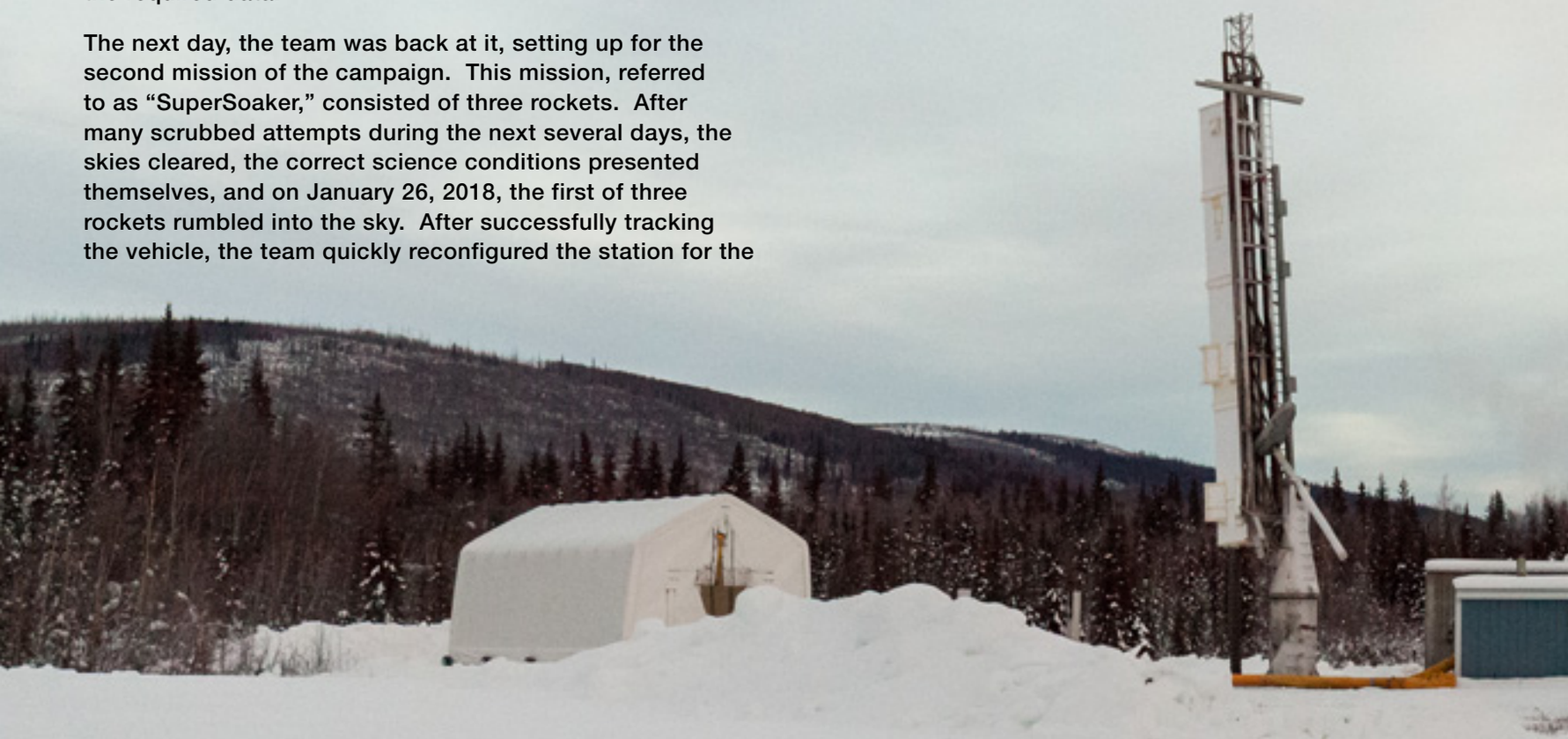
LAUNCH DATE
May 21, 2018

ALASKA CAMPAIGN

POKER FLAT RESEARCH RANGE, Alaska – The Research Range Services (RRS) team as it traditionally has done for the last forty years travelled north to battle the bitter temperatures of the Alaskan interior to launch rockets into the aurora. Because the earliest launch window opened in mid-January, a small team of telemetry technicians accompanied members of the NASA Sounding Rocket Program Office (NSROC) to Poker Flat Research Range (PFRR) in early December to begin setup and testing of equipment. They returned with the remainder of the RRS support team just after New Year's to continue setting up and preparing for the upcoming launches. The 2018 Alaska Campaign consisted of two missions with four rockets total. The first mission, Diffuse X-Rays from the Local Galaxy (DXL), was scrubbed for the first several days of its launch window mostly due to bad science conditions. Then, on January 19, 2018, the first rocket of this year's campaign roared into the night sky. All RRS instrumentation and personnel performed exceptionally, tracking and collecting the required data.

The next day, the team was back at it, setting up for the second mission of the campaign. This mission, referred to as "SuperSoaker," consisted of three rockets. After many scrubbed attempts during the next several days, the skies cleared, the correct science conditions presented themselves, and on January 26, 2018, the first of three rockets rumbled into the sky. After successfully tracking the vehicle, the team quickly reconfigured the station for the next launch. Just over 30 minutes later, the second of the three rockets roared into the air as the RRS team assigned to that vehicle tracked it throughout its flight. Ninety seconds later, the second rocket launched and the remaining RRS team members got their turn to track as the third and final rocket of the campaign lifted off into the night. This rocket had a payload designed to detonate and spray water throughout the surrounding atmosphere. The water would then freeze in the extremely cold atmospheric temperatures, allowing the scientists to observe the dispersion pattern of the water.

While challenging, these campaigns and the data they provide are critical to learning more about our atmosphere and the science behind the stunning auroras that grace the night sky during the frigid Alaskan winters.



SUPER SOAKER FACTS

LAUNCH VEHICLES:
Terrier-Improved Orion

WALLOPS ID:
NRO-5795; NRO-5796; NRO-5797

LOCATION:
PFRR - Pad 1, Pad 2, Pad 3

LAUNCH DATE:
January 26, 2018

DXL FACTS

LAUNCH VEHICLE:
Black Brant IX

WALLOPS ID:
NRO-5798

LOCATION:
PFRR – Pad 4

LAUNCH DATE:
January 19, 2018

KWAJALEIN CAMPAIGN

ROI NAMUR, KWAJALEIN ATOLL – In February 2018, as Wallops Flight Facility (WFF) was still deep in the grip of winter, a lucky few members of the Research Range Services (RRS) team had the opportunity to travel to Kwajalein Atoll and support a launch in much warmer weather.

Though small, the deployed RRS team had vital roles in the day-to-day operations up until and during launch day. A comms technician coordinated with the Sounding Rocket Program Office (SRPO) team to lay fiber lines from the launcher to blockhouse for testing and operations to ensure communications between SRPO and the rocket were without issue. A two-man team of meteorological technicians launched weather balloons daily before and during operations to determine if wind levels were satisfactory for launch. A whole surveillance system was setup and maintained by a RRS optical technician to monitor pad operations at all times during the mission to guarantee eyes were always on the vehicle. RRS technicians also set up systems to uplink commands to the payload, and also received readout telemetry back from the vehicle.

For this year's campaign, the team was supporting two launches. The first was the Penn State Water-Recovery X-Ray Rocket (WRX-R), which was designed to make observations of soft X-ray emissions from the Vela Supernova Remnant. The second mission was the Colorado high-resolution Echelle Stellar Spectrograph (CHESS-4) experiment, which was studying the Local InterStellar Medium (LISM) by sampling sightlines in the lower edge of the translucent cloud regime between the diffuse and dense phases of the ISM targeting gamma Ara.

On April 4, 2018, the first mission, WRX-R, was successfully launched at the opening of the first day of the launch window. Once complete, the team began to set up for CHESS-4. Unlike its predecessor, the launch conditions required for a "go" for CHESS-4 proved to be elusive. The team counted several nights in a row until finally, on April 17, 2018, with less than 15 minutes left on the last day of the launch window, CHESS-4 screamed into the night sky. The team was once again able to successfully receive and record data from the vehicle and provide it to the customers for further study.

This mission saw the first use of the new Roll-Away Command System (RACS). This system was used to provide uplink command capabilities during the CHESS-4 mission which allowed the scientists to "talk" with their experiments during flight. The system performed flawlessly and served as a pathfinder for the upcoming Australia 2020 mission, which will have a similar requirement.

With these successful launches, the RRS team looks forward to supporting further missions from Kwajalein in 2019.

MISSION FACTS

LAUNCH VEHICLE
Both Black Brant IX

WALLOPS ID
NRO-5790 and NRO-5791

LOCATION
Roi Namur

LAUNCH DATE
April 4 & April 17, 2018

UAS PROJECTS

WALLOPS ISLAND – Research Range Services (RRS) was able to expand its support of many different Unmanned Aerial Systems (UAS) in 2018 with the completion of the North UAS runway managed by Virginia Space. With the capability of being able to launch from within the restricted airspace to directly offshore of Wallops Island, Wallops Range was able to pull in customers from the U.S. military and other NASA agencies to test their systems.

BLACK DART

RRS supported the Navy Warfare Development Command (NWDC) by flying AeroStar and Outlaw UAS systems for the Black Dart Maritime experiment in June 2018 to support integration operations with a U.S. Navy fleet offshore.

The experiment involved flying UAS targets off Wallops Island along a predefined track through the restricted airspace located offshore. Program managers coordinated with Virginia Space to support the use of the North UAS Runway for the project. Safety and ground support equipment were also allocated to assure the public's safety.

The mission was a success for NWDC and the customer plans to return in 2019 for further testing.

Outlaw UAS

Aerostar UAS

UAS PROJECTS CONTINUED

SEAMOB

SEAMOB was one of the more interesting projects supported by the Wallops Range. The mission involved launching an expendable UAS system, the Coyote UAS, from an Unmanned Service Vessel (USV) located offshore to a coordinated location on the North UAS Runway. The RRS program manager worked with the Naval Surface Warfare Center, the Wallops Safety Office and Virginia Space to bring the project onboard in September 2018.

For this project, an operator controlled the Coyote UAS launched from the USV. The USV travelled along a predetermined path in the water offshore from the target location. Once the ideal conditions were meet, the operator initiated the launch of the Coyote UAS. It travelled along its preprogrammed flight path before reaching it's coordinated location on the North UAS Runway.

The operation was a success and the customer took away many lessons-learned for its return flights planned in 2019.

North UAS Runway

AIRBORNE SCIENCE SUPPORT

WALLOPS ISLAND – In addition to the support of rockets and other range missions, Research Range Services (RRS) provides project management support to aircraft-based research missions funded through the Airborne Sciences Program in the Science Mission Directorate.

The RRS project manager (PM) coordinates the activities of the aircraft maintenance and operations contractor, the various science team members, Wallops Flight Facility (WFF) Aircraft Office, WFF Engineering and Technology Directorate team members, and other WFF support organizations to ensure all campaign objectives are met. A primary function is developing plans and documentation for the campaign and nurturing the collective team through the airworthiness certification process culminating in a final flight release. Airborne science instruments vary in form and function — some are mounted in racks inside the fuselage, while others are mounted to or protrude from the aerodynamic surfaces. These instruments can change the airflow around the aircraft and it is critical to flight safety and mission success that the final compliment of instruments have been analyzed and tested in flight configuration.

Aircraft Office missions are conducted on one of the Wallops-owned aircraft or on a contracted aircraft. Campaigns are conducted at locations across America and throughout the world.

ORACLES CAMPAIGN

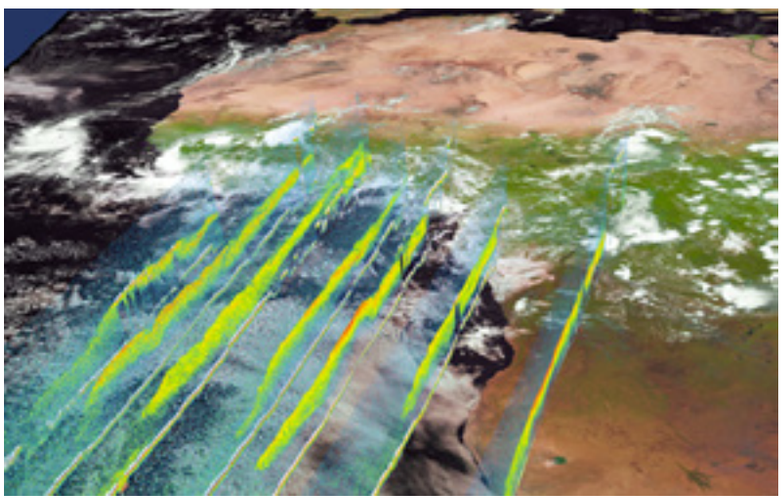
SÃO TOMÉ, Central Africa – The snow and Ice had barely melted from the aircraft when it was reloaded with an entirely new component of research tools and directed to fly halfway around the globe in support of a new mission.

The science objectives of the Observations of Clouds above Aerosols and their Interactions (ORACLES) campaign were to understand the processes that control the radiation balance and cloud properties over the South East Atlantic, which affect the regional and global distribution of surface temperatures and precipitation, and determine the impact of African BB (Biomass Burning) aerosol on cloud properties and the radiation balance over the South Atlantic. The goal was to acquire a process-level understanding of aerosol-radiation interactions, the resulting cloud adjustments, and aerosol-cloud interactions.

With all instrumentation successfully loaded on the aircraft, the team conducted numerous instrumentation and airworthiness test flights. With all maintenance issues documented and resolved, the team departed on schedule on September 21, 2018.

The team was fortunate enough to overnight on the coast of Barbados, followed by Cape Verde, before arriving t the coast of Africa.

Including test flights and transit the team was able to complete 110 total hours of flying time. The team also exceeded expectations; minimum success requirements for the mission were to conduct 1 science flight while performing data collection from 1 instrument.



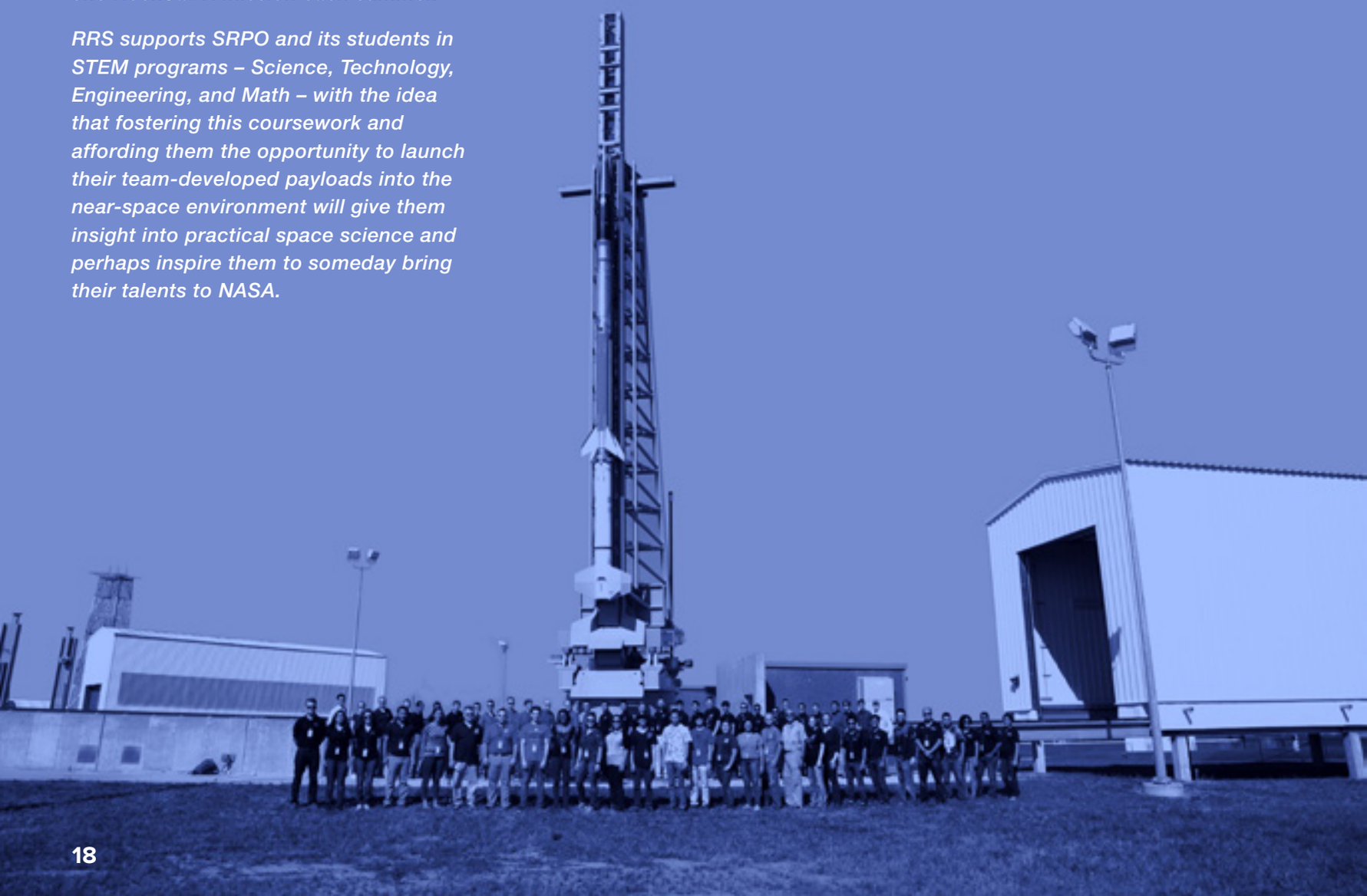
The team performed 13 science flights, with all 19 scientific instruments collecting data, making this the most successful ORACLES campaign to date. The valuable information provided by the team will be critical in providing further understanding of the regional and global climate systems.

The team was thankful to return home on October 27, 2018, after a hard yet extremely successful campaign.

STEM ENGAGEMENT AND PUBLIC OUTREACH

Every year, Research Range Services (RRS) supports the NASA Sounding Rockets Program Office (SRPO) STEM Engagement and Public Outreach by providing Range services to multiple student launches. These student-driven missions introduce students to the world of NASA rocketry. Usually, the annual missions consist of one RockOn! and one RockSat-X mission each summer.

RRS supports SRPO and its students in STEM programs – Science, Technology, Engineering, and Math – with the idea that fostering this coursework and affording them the opportunity to launch their team-developed payloads into the near-space environment will give them insight into practical space science and perhaps inspire them to someday bring their talents to NASA.



ROCKON! 2018

WALLOPS ISLAND — The RockOn! 2018 mission successfully launched aboard a two-stage Terrier MK12 – Improved Orion sounding rocket from the Wallops Range on June 21, 2018. The rocket carried more than 20 student experiments as its payload from the RockOn/ RockSat-C program.

The Research Range Services (RRS) team supported the mission with multiple services, including radar, command and control, optical tracking, surveillance, payload recovery, and many other elements that help enable the launch of a sounding rocket.

The mission was a continuation of the annual RockOn! Sounding Rocket Workshop which represents the collaborative effort of the Colorado Space Grant Consortium, the Virginia Space Grant Consortium, and Wallops Flight Facility (WFF). It marked the eleventh mission through the RockOn! Program and the tenth for RockSat-C.

Approximately 88 college and university students participated in the launch from Wallops. In addition, Cubes-in-Space, a nationwide program for middle school students, flew multiple small cubes with experiments on this mission.

List of Universities:

- Stevens Institute of Technology
- Hobart and William Smith Colleges
- University of Delaware
- West Virginia University
- Fairmont State University
- Blue Ridge Community and Technical College
- Washington & Jefferson College
- University of Wisconsin
- Sheboygan & Milwaukee
- Arizona Space Grant Consortium
- Oregon Institute of Technology
- Langston University

MISSION FACTS

LAUNCH VEHICLE
Terrier MK12 — Improved Orion

WALLOPS ID
NRW-5785

LOCATION
Pad 2 — MRL Launcher

LAUNCH DATE
June 21, 2018

ROCKSAT-X

WALLOPS ISLAND – The annual RockSat-X again captivated students from colleges and universities from around the U.S. by allowing them the chance to be a part of NASA and the process of launching a rocket into sub-orbital space.

On August 14, 2018, a Terrier Mk12 - Improved Orion carried student payloads into the morning sky. Students participated from the University of Puerto Rico, College of the Canyons, Community Colleges of Colorado, University of Maryland, Capital College, Virginia Tech, Temple University, Colorado University, and West Virginia Space Collaboration.

The usual suite of services was offered by the RRS team, including radar, telemetry, command and control, optical tracking, payload recovery, and surveillance. During the count, the range was red due to boat traffic in the recovery area. With the coordination of the RRS surveillance coordinator, range safety, and surveillance aircraft in the area, the situation was quickly resolved by directing boats safely out of the area.

The RockSat-X mission was developed to provide students with an enhanced learning experience of the day-to-day operations of creating and launching a rocket. This program provides a great opportunity to expose the next generation to the science and engineering involved in launching a rocket to space to gather data of interest. Students are able to gain valuable skills and information to hopefully farther interest in working in the field of science in the near future.

MISSION FACTS

LAUNCH VEHICLE
Terrier MK12 — Improved Orion

WALLOPS ID
NRW-5884

LOCATION
Pad 2 — ARC Launcher

LAUNCH DATE
August 14, 2018

USIP

WALLOPS ISLAND – On March 25, 2018, the denizens of Wallops Island once again heard the familiar sounds of a Sounding Rocket piercing the early morning mist, before heading downrange in the name of science and technology development.

This launch was in support of the Science Mission Directorate (SMD) Undergraduate Student Instrument Program (USIP). USIP provides flight research opportunities for university and college undergraduate students to build science, technical, leadership and project skills by offering real engineering experience in developing and flying science or technology experiments relevant to NASA's mission. USIP is an educational flight opportunity to promote the science, technology, engineering, mathematics (STEM) program.

Four universities participated in the mission:

Utah State: Conducted an experiment on 3-D printed propulsion systems for small spacecraft, using nontoxic nonexplosive recyclable materials.

University of Nebraska: Tested a retractable boom for microgravity payload operations.

Florida Institute of Technology: Conducted an investigation of a Polyimide Wire Repair System in a microgravity environment.

University of Kentucky: Tested and demonstrated a communications system, release mechanism, and Thermal Protection System (TPS).

MISSION FACTS

LAUNCH VEHICLE
Terrier MK12 — Improved Malemute

WALLOPS ID
NRW-5841

LOCATION
Pad 2 — ARC Launcher

LAUNCH DATE
March 25, 2018

RCC TOURS

WALLOPS ISLAND – RRS Personel conducted 17 tours of the Range Control Center this year. Groups ranged from local businesses to colleges and universities. Groups with multiple visits are listed below.

- Salisbury University
- Nanticoke Senior Center
- Delaware Technical Community College
- Ocean Pines Community Center
- Chincoteague National Wildlife Refuge
- Parkside High School
- Goddard Flight Facility Personnel

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ENGINEERING PROJECTS

BERMUDA TRACKING STATION PROJECT

BERMUDA – After three years of planning, many reviews and meeting more than 600 requirements, 2018 marked the completion of the Bermuda Tracking Station project. The station relocates the mobile command, telemetry and radar at Cooper's Island, Bermuda, into protected shelters and a consolidated operations center which integrates six range systems. With the cooperation of two nations, NASA headquarters, Goddard Space Flight Center (GSFC) and Wallops Flight Facility (WFF), the site is ready to continue supporting ELV launches with its new and improved setup.

Telemetry receiving and control systems in the Bermuda operations center.

The Bermuda Tracking Station, located on the northeastern tip of Cooper's Island has long played host to NASA launch support operations, starting with the first tracking station which was operational from the 1960s to 2000. Beginning in 2012, support resumed with radar, telemetry and command destruct systems deployed as mobile assets. This project addressed renovating the old NASA operations and administration building to house the new Operations Center and Command system antennas and site the telemetry and radar systems in environmental structures that will protect them from the harsh ocean conditions.

Major building renovations were completed and a state-of-the-art Heating, Ventilation and Air Condition (HVAC) system was installed which will ensure operations center equipment will remain within specific temperature and humidity parameters. A triple-redundant power system was installed that guarantees constant, safe, and regulated power.

Telemetry antenna in its new protective radome.

A telemetry pad was constructed and the 7-meter antenna was relocated to its new site. A new spherical radome was erected around the system equipped with its own HVAC system to protect the antenna from the harsh beach environment. The two command antennas were secured inside the operations center with a unique design that allows them to be deployed through the center roof during launch support. Finally, a 20-foot radar tower was delivered and constructed onsite and ready for the installation of Radar 8 in 2019.

The payoff for the comprehensive design phase with extensive roundtables and reviews was evident once the telemetry and command racks arrived onsite for installation in July 2018. The installation and testing went so smoothly that final range end-to-end testing was conducted two weeks ahead of schedule. Due to continuing work to complete radar 8 refurbishment, the system was tested with the current mobile radar integrated into the operations center. The project was presented to the Operational Readiness Review (ORR) board in October 2018 for acceptance to support missions.

A ribbon cutting ceremony was held on November 5, 2018, attended by NASA headquarters, GSFC, WFF guests, the U.S. consulate and Bermuda Ministry officials

Another project milestone was reached when the new operations successfully supported the Antares NG-10 ELV launch to the International Space Station. The site also supported the ICON Pegasus launch attempt and plans to suport the next attempt in 2019.

The coming year will see the delivery and installation of the radar into the operations center and the placement of Radar 8 on the radar tower under its own environmental shelter, along with a final project ORR and project acceptance and completion.

MOCC

WALLOPS ISLAND – As NASA's only owned and operated launch range, Wallops Flight Facility (WFF) needed to be able to provide the necessary operational environment required to ensure safe and successful flight operations for multiple launch vehicles, aircraft, Unmanned Aerial Systems, and a myriad of missions that only happen at WFF. Even after the renovations to the Range Control Center (RCC) completed in 2017, it was abundantly clear that in order to meet mission requirements for the future a capability needed to be addressed in the command and control arena.

To that effect, the 11 million dollars, multi-year Mission Operations Control Center (MOCC) project was born and completed in April 2018. The 14,000-square-foot building can support up to 120 on-console operators and serve as the mission operations hub at WFF for project teams to interface and provide critical command and control missions. This state-of-the-art facility allows for multiple missions to operate simultaneously, increasing the command and control capability threefold. The facility boast two Launch Control Centers and one Mission Control Center, each with their own conference rooms, data rooms and individual Ground Support Equipment (GSE) rooms that will provide data over the customer network and Range Mission Network. All systems are also fully integrated with the RCC.

State-of-the-art video walls measuring 40-feet wide and 8-feet tall provide mission situational awareness to each control room. Fully customizable IP selectable video and data sources at each station give users information at the touch of a screen. The facility also boasts a Sensitive Compartmented Information Facility (SCIF), providing a secure place where sensitive information can be viewed and discussed.

Creature comforts are also major part of the building design, including a kitchen, a break area for the building occupants and a guard station for security control.

Lastly but most importantly, the MOCC is Leadership in Energy and Environmental Design (LEED) silver-certified. This groundbreaking facility will serve the denizens of Wallops and its future clients for many years to come.

MISSION SUPPORT

ROLL-AWAY TM GROUND STATION

The purpose of the Moblile Roll-Away TM Readout Station was to design, build, test, and integrate existing readout telemetry equipment into mobile transportable racks. The Range needed a standard deployable readout station to reduce the associated time and cost of buildup and take-downs at remote locations.

The system is designed to be a small rack-mounted modular system and roll-away for ease of transportation and integration in support facilities. The system was built using common architecture to be rapidly deployable and include dedicated power conversion and nominal UPS backup power.

The system was successfully shipped and installed at the Ny-Ålesund Research Station in Svalbard and supported the Norway Grand Challenge mission.

The Roll-Away Telemetry Ground Station seen supporting the Norway Grand Challenge.

6M ANTENNA REPLACEMENT

The purpose of the 6-meter Medium Gain Antenna System replacement for the 7.3M-2 telemetry system is two-fold; the first purpose is to provide a new non-obsolescent L- and S-Band telemetry tracking antenna to be used on the Wallops Range. The second is to decommission the 7.3M-2 so that adequate sparing is available for the 7.3M-1. Most components of the 7.3M-1 are non-supported and obsolescent. Due to the obsolescent parts and sub-systems comprising both of the 7.3M systems, it was a desire to ensure sparing would be available in case the 7.3M-1 experiences a critical fault.

The 7.3M medium gain antennas have been on the range more than 30 years and have degrading radio frequency (RF) performance and growing obsolescence concerns. RMMO directed the replacement of the 7.3M No. 2 with a system of higher RF gain performance and one that meets all existing telemetry tracking requirements. The newly-procured 6-meter Medium Gain Antenna System allows the range to take advantage of the latest and best technologies that have come out since the 7.3M systems were developed. The 6-meter system is able to support sounding rocket campaigns, ELV launches, and provide PAX River support.

The newly installed 6-meter medium gain antenna system.

ROLL-AWAY COMMAND SYSTEM (RACS)

The Roll-Away Command System (RACS) is a rapidly deployable and transportable command uplink system for supporting remote missions. The system operates in the 410-450Mhz frequency range and provides left- and right-hand circular polarization antennas. RACS is considered a non-safety-critical system for operation by NASA Wallops Flight Facility.

In just a few short months, the team gathered requirements, developed the design, built, and tested the system. Immediately following the conclusion of testing, the RACS was packed and shipped in support of its first remote operation at Roi-Namur in the Marshall Islands where it was successfully used to send uplink commands to two NASA Sounding Rocket missions. It is planned to be deployed to support a future Australia campaign.

Roll-Away Command System seen supporting the Kwajalein campaign.

REDSTONE ANTENNA

The purpose of this project was to design, install and test a new Antenna Control Unit (ACU) and S-Band telemetry feed on both Redstone Antenna Systems at Poker Flat Research Range in Alaska. The original ACU's and S-Band feeds were obsolete and required upgrades. The obsolete ACU's were replaced with an updated system and the feed was replaced with a newly improved design. The new ACU's eliminate obsolescence concerns and provide enhanced slaving capabilities. The enhanced S-Band Feed design provides higher G/T performance.

The Redstone antennas are the primary Telemetry tracking and receiving antennas for Poker Flats Mission support.

The Redstone Antenna System located in Poker Flat Research Range.

OPTICAL DOME INSTALLATION IN ALASKA

Wallops Range completed the installation of the new permanent Optical Dome up at PFRR. The dome will allow better insulation and protection of high speed and DSLR cameras during launch activities in Alaska.

The Optical Systems Group for the past couple years had been using a modified shipping container to setup cameras for launches. While it served its purpose, it wasn't the most ideal setup for mission support and was starting to see wear-and-tear from travel.

Back at Wallops, most of the camera systems are housed under an Astro Dome with the capability of remote opening and closing support. The team realized that utilizing this technology up at PFRR would allow technicians to keep the cameras covered as long as possible, up until mere minutes before a launch would occur. This would also more effectively protect the systems from the harsh weather conditions that occur at PFRR.

The newly installed Optical Dome located in Poker Flat Research Range.

After working with PFRR personnel, the final arrangements were made to construct a permanent deck and ship a dome up to PFRR for installation in October 2017 ahead of the next campaign. Technicians traveled to PFRR to install the dome and remote operating system on the newly constructed deck. The rail system to hold the cameras will be installed on a future maintenance trip.

The dome was first used during the Alaska 2018 campaign and allowed technicians to operate the dome from inside the nearby telemetry building. The new dome operated normally even in temperatures near -40° degrees Fahrenheit. The dome enclosure allowed technicians to set field-of-views and focus on camera systems in the rare daylight hours and protect the equipment throughout the campaign.

As many know, the countdown for science missions regularly holds for long periods of time waiting on just the right conditions to launch. The remote capability of opening and closing the dome allowed the camera systems to remain at constant operating temperature for as long as possible in the count, which greatly increases the reliability of the electronics, batteries and lenses.

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RANGE