
**A Flight Projects Directorate Quarterly Publication**
**A Newsletter Published for Code 400 Employees**

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## INSIDE THIS ISSUE:



## Tracking and Data Relay Satellite: TDRS
## TDRS K – On the Way

Over the years, communication technology has advanced at lightning speeds and our desire to communicate has increased exponentially. These advances have resulted in more and more bits of data being transmitted every day and the need for reliable, fast, and cost-effective solutions for moving data from one place to another are very real. In today's world, the key to communication success is reliability, and if you understand that need then you understand the core mission of NASA's legendary Tracking and Data Relay Satellites, TDRS.

*(TDRS continued on page 4)*

**Read about the Radiation Belt Storm Probes (RBSP) Mission on page 13.**

## Landsat Data Continuity Mission
## (LDCM) Ready for Environmental Testing

Landsat Data Continuity Mission (LDCM) engineers overcame two obstacles to keep the mission on track for a launch readiness date of February 11, 2013.

The first problem occurred after the Thermal Infrared Sensor (TIRS) instrument was shipped from the Goddard Space Flight Center to Orbital Sciences Corporation, in Gilbert, AZ in February 2012, when engineers discovered that helium had

*(LDCM continued on page 8)*

## Message from the Director Of

It's hard to believe summer 2012 is drawing to a close. College students have returned to school and elementary, middle, and high school students will soon be in class if they aren't already. I hope everyone had a chance to take some needed time off to rest, relax and recharge because the fall and winter will be busy times.

Congratulations to the Mars Science Lab Curiosity Team for a perfect landing on Mars. Now it's time for our own Sample Analysis at Mars (SAM) team led by Dr. Paul Mahaffy to be in the spotlight as the instrument suite is commissioned and science data begins to come in.

Congratulations also to the Nuclear Spectroscopic Telescope Array (NuSTAR) Explorer team on a successful launch and commissioning. The data is just starting to come in and looks wonderful.

The Radiation Belt Storm Probe (RBSP) mission (2 spacecraft) is scheduled to launch from the Cape on August 23. RBSP was built by the Applied Physics Lab (APL) with Rick Fitzgerald as the Project Manager under Nick Chrissotimos and the Explorer Program. Best wishes to Rick and the entire APL and Explorer team for a successful launch and checkout of RBSP.

MetOp-B is scheduled to launch from Baikonur, Kazakhstan on September 17. While the MetOp spacecraft is built and launched by the European Space Agency (ESA) and European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), several instruments are provided by Karen Halterman and her team at GSFC through NOAA. Best of luck to Karen and the entire MetOp-B team.

In addition, Tracking and Data Relay Satellite – K (TDRS-K) will be launched in early December from the Cape. TDRS-K is managed by Jeff Gramling and is the next spacecraft in the very successful TDRS program. Good luck to Jeff and his team.

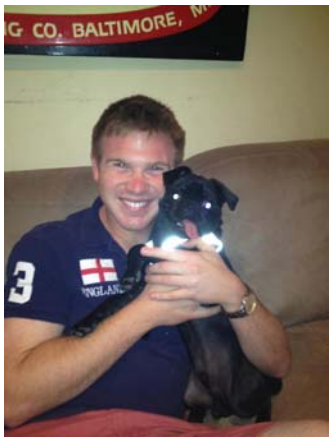
Congratulations to the Flight Projects Directorate Peer Award recipients and thanks to all who provided nominations. The awards were presented at the annual ceremony on July 24 and are listed in this issue of The Critical Path. Thanks to all who planned and supported the event. The GSFC NASA Honor Award recipients are also listed in this issue and I note that the Flight Projects Directorate and the Project Management Development Emprise program were well represented. Congratulations to all.

Lastly, with this issue, I want to take this opportunity to acknowledge the 20$^{th}$ anniversary of The Critical Path. Some of you might remember that The Critical Path was started at the request of former Director of Flight Projects, Vern Weyers, in 1992. He asked Rich Long, George Barth and Howard Ottenstein to design a magazine and title for the Directorate. While George and Rich contributed early on, Howard has remained the editor and coordinator since the beginning. Many thanks to Howard for his many years of service and for all of his contributions.

**George W. Morrow (george.w.morrow@nasa.gov )**

# PERSONALITY TINTYPE

## Chris Caldwell



Chris has served as a Resources Analyst (RA) in the Explorers and Heliophysics Program Office (Code 460) for the past 2 years, working on the Gravity and Extreme Magentism SMEX (GEMS) / X-ray Polarimeter Instrument (XPI) and Astro-H projects.

**Born:** Columbia, MD

**Residence:** Federal Hill, Baltimore

**Education:** B.A. in Economics from University of Maryland Baltimore County (UMBC)

**Life at Goddard:** Chris arrived at GSFC as an intern in Summer 2007 working Configuration Management for Tracking and Data Relay Satellite (TDRS) (Code 454) through the PAAC contract. After two summers of interning, he accepted a full-time job on TDRS as a Project Support Specialist contractor. In this role, Chris provided the TDRS project support with documenting change requests and modifications which were critical given the scope of TDRS. After a few months, an opportunity arose to transition into a Civil Servant Resources Analyst position on TDRS. Chris took the opportunity, and was given a new task of tracking TDRS' Prime Contractor, Boeing. As the lead RA on TDRS, Chris assisted with financial analysis, funding (including reimbursable funds), and budgeting of the complex ground and spacecraft contract. His duties also included Earned Value Management (EVM) analysis.

*(Caldwell Tintype continued on page 35)*

## Nancy Rosenbaum

Nancy Rosenbaum, an ARTS employee on the PAAC III Contract, is the Management System Lead in the Flight Projects Directorate (code 400).

**Born:** Jersey City, NJ. Really identifies as a New Yorker, but has lived in the DC area almost long enough to be considered a native.

**Education:** Master of Arts in Human Resources Development from George Washington University; Bachelor of Arts in English from University of Maryland

**Life at Goddard:** Nancy first came to Goddard in 1980, where she worked in the Building 23 photo lab, producing images from NIMBUS, Landsat, and Heat Capacity Mapping Mission (HCMM). As a trainer, she developed a curriculum of operations courses for several facilities, including the then-Space Lab Data Processing Facility (SLDPF) and Space Telescope Data Capture Facility (STDCF).

Nancy's interest in process improvement led her to implementing first total quality management and later ISO 9001 and Capability Maturity Model Integration (CMMI) management systems. After a sojourn as Deputy Quality Director with an architecture engineering company, she returned to Goddard to coordinate Space Act agreements, and process mapping and improvement for the Networks Integration Management Office (NIMO), Code 450.1.

*(Rosenbaum Tintype continued on page 31)*

(TDRS continued from page 1)

NASA has successfully launched nine TDRSs, each strategically placed into geosynchronous orbit. Currently the constellation consists of seven satellites communicating through three ground terminals, whose daily operations are managed by the Space Network (SN), Code 452, here at the Goddard Space Flight Center (GSFC). As the use of space communications increases everyday, the reliability of and reliance on the TDRS constellation has proven to be a major factor in the success of both NASA and non-NASA missions alike. With the anticipation of the need for additional resources, NASA is embarking on a replenishment effort that will allow this critical space communications network to be sustained for future use. The TDRS project, Code 454, is building three replenishment satellites and launching the first in the series, TDRS K this December.

Customers with spacecraft in low-Earth orbit (LEO) have not always had the luxury of using the relay network provided by TDRS. Spacecraft used to beam their data down to networks of domestic and international ground terminals. In the late 1950's, NASA established Minitrack, a network of antennas stretching across North and South America, to capture data being downlinked from the United States' first satellites. Over time, Minitrack evolved into a number of other networks, including the Spacecraft Tracking and Data Acquisition Network (STADAN) and the Manned Space Flight Networks (MSFN) of the 1960's, and the Spaceflight Tracking and Data Network (STDN) of the 1970s. Each of these networks followed the same design principle: a series of antennas placed in various locations around the globe. By placing ground terminals around the globe, orbiting spacecraft would be able to have more frequent contact with the ground.

With the transition from one network to the next, the initial task of tracking satellites evolved into the receipt of important scientific data and the transmission of satellite commands. As the United States' understanding of space grew, so did the desire to put man in space. With the start of the Mercury missions, the importance of these ground-based antenna networks soared as the shift from satellite communications to human spaceflight communications took place. Throughout the Gemini, Mercury, and Apollo missions, these ground networks were expanded to include over 20 ground-based, three ship-based (AIS) and a fleet of airborne (ARIA) antennas. It was soon realized that the limiting few minutes of downlink/uplink transmission time was not sufficient enough for the safety and execution of human space flight.

A study done in the 1970s, based on a theory proposed by Arthur C. Clarke in 1945, recommended that geosynchronous/geostationary satellites relay information to and from LEO satellites that were being used as remote data sensors. At the time, terrestrial communication networks were consistently plagued by regional, meteorological, and political issues, resulting in unreliable access to ground stations. This, in addition to the complications of only having a few minutes available to connect data and communication transmissions, resulted in a quick rise in the popularity of the concept of a SN. The TDRS Project was established in 1973 and began to build the first viable space-based communication relay network.

The SN architecture was to consist of high-performance geosynchronous satellites and associated robust ground stations. The goal was to create an unbroken link for routing essential data, a critical element to NASA missions in low-Earth orbit.

(TDRS continued on page 5)

*(TDRS continued from page 4)*

For the space segment to have constant contact with the ground while receiving information from spacecraft in various orbits, the ground terminal needed to be strategically placed. A location near Las Cruces, New Mexico was chosen because it's located near to the equator while remaining within the continental United States and a NASA facility had already been established there. Additionally the area receives an average of 350 days of sunshine per year making it an ideal place for sending and receiving transmissions to/from spacecraft. The White Sands Ground Terminal (WSGT) came online in 1978.

With the ground segment in place, NASA was ready to deploy its space-based network. TDRS-1 was launched on April 4, 1983 aboard STS-6. NASA continued to add first generation satellites until 1995. TRW, now known as Northrop Grumman in Redondo Beach, CA, built the first six satellites as a subcontractor to the Space Communications Company. Originally, only six TDRS were ordered. However, TDRS-7 was ordered from TRW after TDRS-2 was lost aboard Challenger in 1986.

WSGT currently hosts two Space-Ground Link Terminals (SGLT), three 18.3-meter Ku-Band parabolic antennas, one 10-meter S-band only Telemetry Tracking and Command (STTC) antenna, two dual S/Ku-Band 4.5-meter antennas for end-to-end testing, a data interface system and a TDRS Operational Control Center (TOCC). With anticipation of even greater data volume than initially received by the system, the Second TDRS Ground Terminal (STGT) was opened in 1994 at the White Sands Complex. STGT currently includes three SGLTs, three 19-meter S/Ku-dual band antennas, one 10-meter STTC, two dual S/Ku-band 4.5-meter antennas, a Data Interface System and, one TOCC. With three TDRS in orbit, two operational and a third reserved as a "hot backup", NASA was able to provide 100% orbital coverage for satellites above 650 miles in altitude.

Satellites in lower orbits had a small period in each orbit where they were not able to communicate with either TDRS operational satellite, known as the Zone of Exclusion (ZOE). The need to close the ZOE was made apparent by the failure of the tape recorders on the Gamma Ray Observatory satellite (orbiting at an altitude of 250 miles), which would now require constant communication with Earth through the SN. To address this concern, NASA opened the temporary site, Compton Gamma-Ray Observatory (GRO) Remote Ground Terminal (GRTS) in Canberra, Australia. After the GRTS site was opened, and with the Shuttle program in full swing, a proposal for a more permanent location was made to ensure the closure of the ZOE. Construction of a ground terminal in Guam began and in 1998, NASA opened the Guam Remote Ground Terminal (GRGT), located at the Naval Computer and Telecommunications Area Master Station (NCTAMS). This station essentially replaced GRTS as the Indian Ocean region dedicated ground station.

GRGT enabled 100% orbit coverage for satellites at any LEO altitude, closing the ZOE. With seven SGLT antennas available and an unwavering line of site, these ground terminals assist the TDRS constellation in relaying over 40 customers' spacecraft data everyday.

In anticipation of expanded space communication requirements, NASA added three new spacecraft to the fleet between 2000 and 2002. TDRS H, I, and J, known as the second generation TDRS, were built by Hughes, now known as Boeing in El Segundo, CA.

*(TDRS continued on page 6)*

(TDRS continued from page 5)

With more data moving today than ever before, and given that the last TDRS was launched a decade ago, NASA is preparing to deploy a third generation of spacecraft, TDRS K, L, and M, to ensure vital operational continuity. The contract to develop the third generation TDRS was awarded to Boeing in December of 2007. The TDRS K, L and M satellites have two main components; their unique telecommunications payload and their bus, the Boeing 601 satellite.

TDRS uses a derivative of the Boeing 601HP bus as its base of operations. The Boeing 601HP was introduced in 1995, bringing with it advanced battery, energy and propulsion systems. More than 80% of the bus is made of flight proven components. The Boeing 601HP can provide up to 10,000 watts of power from the triple-ultra-junction solar cells and features as many as 60 transponders. The body of the Boeing 601HP is composed of two modules.

The primary structure, or bus module, carries all launch vehicle loads and contains the propulsion system, bus electronics, and battery packs. The battery packs contain nickel-hydrogen cells that supply power to the spacecraft when it is in the shadow of the Earth and cannot generate solar power. The propulsion system contained on the Boeing 601HP is a bi-propellant design used for post-launch orbit raising via a Liquid Apogee Motor (LAM), and for on-orbit station-keeping and momentum removal.

The attitude control system is a momentum bias design, using a gimbaled momentum wheel for active three-axis torqueing and momentum storage. Continuously operating gyros, updated by Earth and sun sensors, provide accurate three-axis attitude sensing and are used to maintain an Earth pointed spacecraft attitude and provide antenna pointing control compensation.

The attitude control subsystem has an on-board processor, providing some measure of autonomy over the first generation fleet. It also provides tighter pointing capability, which is required for the narrow beam used for the Ka-band service. Additional features include fault protection and the use of a hemispherical resonating gyro rather than one of mechanical design with moving parts that can wear out.

The second component, or payload module, is a structure of honeycomb shelves that hold the communications equipment, electronics and isothermal heat pipes. This system of heat pipes, multi-layer insulation, radiators, and thermostatic heater controls, provide autonomous thermal control for all deployed operations.

Antenna reflectors, antenna feeds, and solar arrays can be mounted directly to the payload module for commercial communications applications. This modular approach allows development and test integration work to proceed in parallel, thereby shortening the manufacturing schedule and test time.

The TDRS payload module is comprised of the multiple access antenna platform, a main payload module, and deployable Single Access (SA) antennas and electronics. The main payload module has six panels that form an integral part of the main bus structure and house the principle elements of the TDRS payload.

The communications systems of the TDRS are designed to provide services to multiple missions simultaneously. Crucial to meeting customers' communications needs, the antenna complement

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*(TDRS continued from page 6)*

consists of two Single-Access (SA) dish antennas, the 1.8m Ku-band Space-to-Ground link (SGL) antenna, an S-band omnidirectional SGL antenna, and, on the bus of the spacecraft, the 32 element Multiple-Access (MA) return service antenna array and the 15 element MA forward array. The SA antennas , hosted on the TDRS payload require a large surface area, but at the same time, need to be light in weight. A solution was found in the creation of a pair of center-fed, 15-foot diameter reflectors, formed of graphite mesh. These reflectors curl around each other for launch, then "spring-back" to their original shape when deployed in space.

Before sending these satellites into space, each component of the spacecraft is meticulously tested. Boeing supports a majority of the testing efforts in their El Segundo location, while the project is managed at GSFC. The spacecraft is separated into the bus and payload modules, which undergo efficient parallel build-up, test, and integration before the modules are reunited during initial spacecraft integration. Solar arrays and antennas, built and tested separately, are added for the environmental and final integrated systems tests. Completing the cycle are the prelaunch and in-orbit tests.

Recent TDRS K spacecraft tests successfully completed include the Solar Array Fit Check and installation and Spacecraft Sine Vibration and Acoustic testing. Following the completion of these tests, the Solar Arrays and SA antennas on TDRS K were deployed to ensure a fully functioning satellite once in-orbit. The deployment showed that all modules and components were functioning properly. Now the SA antennas have been furled to allow the spacecraft to fit within the fairing and will remain so until deployment in space.

TDRS L has started environmental testing at the Boeing facility. The contract for TDRS M was awarded in November 2011 and is scheduled for a 2015 launch. Anticipation for the third generation spacecraft is building with the successful completion of each step of the testing process.

TDRS K, L, and M will facilitate years of revitalized, reliable communications, and as such, the White Sands Complex in New Mexico is getting a functional upgrade to serve the new spacecraft. While this upgrade takes place, the SN will not cease operations and customers should expect no change in the receipt of services. From installation of new command and telemetry systems, to new ground-based beamformers (the key enabler of the TDRS Demand Access Services (DAS)), to two Ka-band end-to-end test antenna systems, and SGLT upgrades, this interleaved in-process update will augment and connect to the system even as its everyday life continues uninterrupted.

TDRS means communications--for international partnerships, research science and telemetry, rescue missions, human spaceflight and more. Now into its fourth operational decade, the SN's legacy of excellence is storied and grand. It has provided critical support to NASA's human spaceflight endeavors, from the early beginnings of the Space Shuttle Program through ongoing International Space Station support today. TDRS provides communication support to over 40 science missions and numerous launch vehicles. The SN provides the ability to deliver high volumes of data with low latency and conduct real-time operations, such as satellite health monitoring and commanding. A wide variety of American interests rely on superb space-based communications, and as a dedicated expert in operations above the atmosphere, NASA regards the TDRS K, L, and M missions as essential.

**Sydney Cain / Code 454**
**E/PO Specialist**

*(LDCM continued from page 1)*

leaked from the TIRS cryogenic cooler. The cooler keeps the detectors extremely cold, which is important because the instrument detects thermal infrared radiation emitted from Earth. The leak was quickly repaired by the Ball Aerospace team from Boulder, CO who built the cooler; the cooler was then re-pressurized with helium, and TIRS was successfully re-installed onto the instrument deck of the spacecraft.

***LDCM image credit Orbital Sciences Corp.***

The second obstacle was in early April of this year when the spacecraft experienced a power short anomaly during integration and test of the flight battery. After an investigation, engineers discovered the anomaly caused some damage to components in three spacecraft electronic boxes. Orbital and Goddard worked on a recovery plan and the boxes have now been repaired and re-integrated onto the spacecraft.

"All flight projects encounter technical challenges during the development phases and LDCM has had its share," said Ken Schwer, LDCM project manager at Goddard. "All challenges have been effectively addressed and none have yet caused irreparable set-backs in terms of performance or schedule."

The engineering team at NASA's Goddard Space Flight Center in Greenbelt, Md., built TIRS on an accelerated schedule, going from a design on paper to a completed instrument in a remarkable 43 months. An instrument of this complexity usually takes another year or more to complete.

Engineers at Orbital have integrated onto the space-craft both the Goddard-built TIRS instrument and LDCM's primary instrument, the Operational Land Imager (OLI) that was built by Ball Aerospace & Technologies Corporation. The next step for the satellite is environmental testing by Orbital.

LDCM is the eighth satellite in the Landsat series and continues the Landsat program's critical role in monitoring, understanding and managing the resources needed for human sustainment such as food, water and forests. "As our population surpasses seven billion people, the impact of human society on the planet will increase," said Jim Irons, LDCM project scientist at Goddard. "Landsat monitors those impacts as well as environmental changes."

With the longest unbroken data stream of Earth's surface as seen from space, the Earth-observing Landsat fleet has provided the world with unprecedented information on land cover changes and their residual effects since 1972. NASA GSFC managed the development and launch of the six

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successful Landsat satellites (Landsat 6 failed to achieve orbit in 1993 when launched under other management). The U.S. Geological survey currently operates Landsat 5 and Landsat 7 in orbit and will operate the LDCM following launch.

The knowledge gained from 40 years of continuous data contributes to research on climate, carbon cycle, ecosystems, water cycle, biogeochemistry and changes to Earth's surface, as well as our understanding of visible human effects on land surfaces. Building off that research, the Landsat imaging data set has, over time, led to the improvement of human and biodiversity health, energy and water management, urban planning, disaster recovery and agriculture monitoring, all resulting in incalculable benefits to the U.S. and world economy.

LDCM will join the aging Landsat 5 and Landsat 7 satellites in orbit and continue to produce stunning images of Earth's surface along with a wealth of scientific data. LDCM will measure Earth's surfaces in the visible, near-infrared, short wave infrared and thermal infrared, with a moderate-resolution of 15 to 100 meters, depending on spectral frequency. The OLI and TIRS instruments aboard LDCM will offer advancements with respect to refined spectral bandwidths, two new short-wave spectral bands, two thermal spectral bands rather than one, and improved radiometric performance. The ground system also offers greater capacity for capturing, archiving, processing and distributing data.

LDCM is a collaboration between NASA and USGS, and after launch will be renamed Landsat 8. Under contract to NASA, Orbital is responsible for providing the spacecraft bus, installing the science instruments and performing system-level integration and testing of the Observatory prior to launch, while Ball Aerospace built the OLI instrument. The USGS developed the LDCM ground system and is responsible for Landsat's massive archive of more than three million images.

**Rani Gran / Code 130**
**Public Affairs Specialist**

## Cultural Tidbits

**Did you Know…….**

The United States' full embargo on Cuba was established in 1962 and has been in place for 50 years. Cuba is the largest land area in the Caribbean and the most populated island nation with 11 million people. Cuba has experienced the fertilization of many cultures which is reflected in many aspects. One example is music and dance. Cuba has influenced Argentinean tango, Ghananian and Spanish flamenco. One of the most popular forms of Cuban music is called Son, which is a foundation for salsa music.

Do you have a cultural tidbit to share? Send it to the Code 400 Diversity Council c/o Matthew Ritsko at matthew.w.ritsko@nasa.gov and we'll publish it in a future issue.

# Landsat Looks and Sees – Some History

The American sage Yogi Berra once said: “You can see a lot by just looking.”

The Landsat program is the longest continuous global record of Earth observations from space – ever. Since its first satellite went up in the summer of 1972, Landsat has been looking at our planet. The view of Earth that this 40-year satellite program has recorded allows scientists to see, in ways they never imagined, how the Earth’s surface has transformed, over time.

In the 1970s Landsat captured the first views from space of the Amazonian rainforest and continued to track the area year after year after year, giving the world an unprecedented view of systemic and rapid deforestation. This view from space let us see an activity that was taking place in an exceptionally remote part of our world. These now iconic-images of tropical deforestation spurred the global environmental community to rally in an unprecedented way, and resulted in worldwide attention and action.

Landsat looked, and the world saw.

Antarctica is arguably the most hostile and remote landscape on Earth. Researchers studying the snow, ice, wildlife and weather near the South Pole face exceptional difficulties. Even gathering the most basic data as wind speeds and temperatures push the limits of human endurance. Landsat’s view from space as it flies over Antarctica 16 times a day is the first ever large-scale true-color map of this continent. Scientists have used it for everything from tracking climate change’s effects on glaciers to finding new colonies of penguins.

Landsat looked, and the world saw.

In the 1970s, just after the launch of the first Landsat satellite, scientists working on the Large Area Crop Inventory Experiment wanted to see if they could tell which plants were being grown and where. The project demonstrated that crops could be monitored worldwide from space, and in 1979 it was used to assess total yield of the Soviet wheat crop before the harvest. Remarkably these estimates came within 90 percent of official Soviet figures released months after the harvest, providing the validity of satellite crop monitoring and providing information for use in worldwide food estimates, government policies and international trading decisions.

Landsat looked, and the world saw.

NASA and the U.S. Department of the Interior through the U.S. Geological Survey (USGS) jointly manage the Landsat program with NASA building and launching the satellites and the USGS preserving and distributing an archive of more than three million Landsat images to people in over 180 nations and territories. Together they continue an unprecedented and continuous view of the transformations on Earth’s surface, year after year after year.

Landsat looks, and the world sees.

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*(Landsat continued from page 10)*

Forty Years of Earth

The data-rich USGS archive built from the Landsat satellites since 1972, with more than three million images, represents the surface of Earth over a 40-year period, a story of our physical world unparalleled in the history of science.

It is practical science, knowledge of things we need to watch for, to be warned of; information to help us do things better, to find a way of accommodating seven billion people on one small planet. It describes over two generations, the human impact on Earth, and the impact of Earth on humanity.

For more information on Landsat, visit:
www.nasa.gov/landsat\

*Abstracted from an article by Joel Shurkin /*
*NASA Earth Observatory (NASA Earth Science website*)

## Social News

- Congratulations to Cassandra Scott (474) and her husband Randolph on the birth of their son. Ryan Christopher Scott was born on June 14, 2012, weighing 7.1 pounds and was 21 inches long.

- Patricia Gregory (452) is a grandma for the second time. Aiden Michael was born on June 5 at 7:10 p.m., weighing 6 pounds 11 ounces and was 20 inches long. Congratulations Grandma, mom, Maggie and dad, Michael!

- Steve Padgett (403) and Kellie Murray (111) joyfully announce the birth of their first child, Sean Christopher on August 9 at 8:45 a.m. Sean weighed in at 7 pounds and was 20 inches long. Mother, father, and Sean are all doing well.

- Barbara Haskell (476) has a lot to be proud of these days. Her son, SSG Daniel Haskell will marry Nancy Lynn Dowen on July 28, 2012. Daniel is an Explosive Ordnance Disposal Tech with the 55th EOD Company at Fort Belvoir, Virginia. He has been deployed in both Iraq and Afghanistan. Nancy was recently promoted to the position of Store Manager of the Safeway located on Housley Road in Annapolis.

- The Durning clan, John (443), Pat and Taylor, successfully completed the grueling 4-mile Spartan Sprint race up Blue Mountain in Pennsylvania. The race entails over-coming more than 24 obstacles as you race up the mountain, with a change in elevation of ~1,000 feet, TWICE. They had great fun – and have already signed up to do it again next year! Great job, Durning family!

# Ray Pages' Big Dreams

When Raymond Pages graduated from Central Virginia Community College in 1978, he never imagined he would land a job working on NASA space shuttles. Instead, the self-described late bloomer was lucky to be graduating at all.

"In the spring of my second year, I was on the verge of being kicked out of CVCC…" said Pages. "It seems neither [the Dean] nor the two security guards appreciated the fact that I had ridden my motorcycle through the cafeteria at lunch hour."

Pages, who heads the Ground System Development Office at the Goddard Space Flight Center and who has put in several stints in Code 400, delivered a rousing keynote address during CVCC's 44th commencement exercises earlier this year. Hundreds of families packed the Vines Center at Liberty University to honor more than 840 graduates. One by one, they crossed the stage in bright blue caps and gowns, earning diplomas in fields ranging from the liberal arts to welding. It was a night of milestones for the CVCC community. The college graduated its first class of Early College students — a group of high school seniors who simultaneously earned their associate's degree. The Region 2000 Machine Industry Program also honored its inaugural class of ten students. A collaboration with Old Dominion Job Corps and Babcock & Wilcox, CVCC launched the program in 2010 to address the region's shortage of machinists.

The most poignant remarks came from Pages, who described how CVCC laid the foundation for his career at NASA.

With degrees from CVCC and Virginia Tech under his belt, Pages beat out 500 applicants for one of two positions at the Goddard Space Flight Center in 1985. Pages discovered he got the job because his associate's degree from CVCC gave him more hands-on experience than students who went straight for their bachelor's. Pages and his team of engineers worked on 39 space flight missions from 1989 to 2011, including the Hubble Space Telescope, the 2009 Lunar Reconnaissance Orbiter and the 2010 Solar Dynamics Payload Missions.

Pages left the graduates with three bits of advice: always have a goal; don't underestimate the power of a community college degree, and don't get hung up on the timing of your career progress. "I was almost 30 when I got hired by Goddard Space Flight Center and almost 40 when my career really started to take off," he said. Pages recounted a moment when one of his NASA colleagues invited him to check out the cockpit of a space shuttle two days before take-off. Lying on his back in launch position, Page remembers staring up at the moon and wondering, "How in the world did I get from Lynchburg to here?"

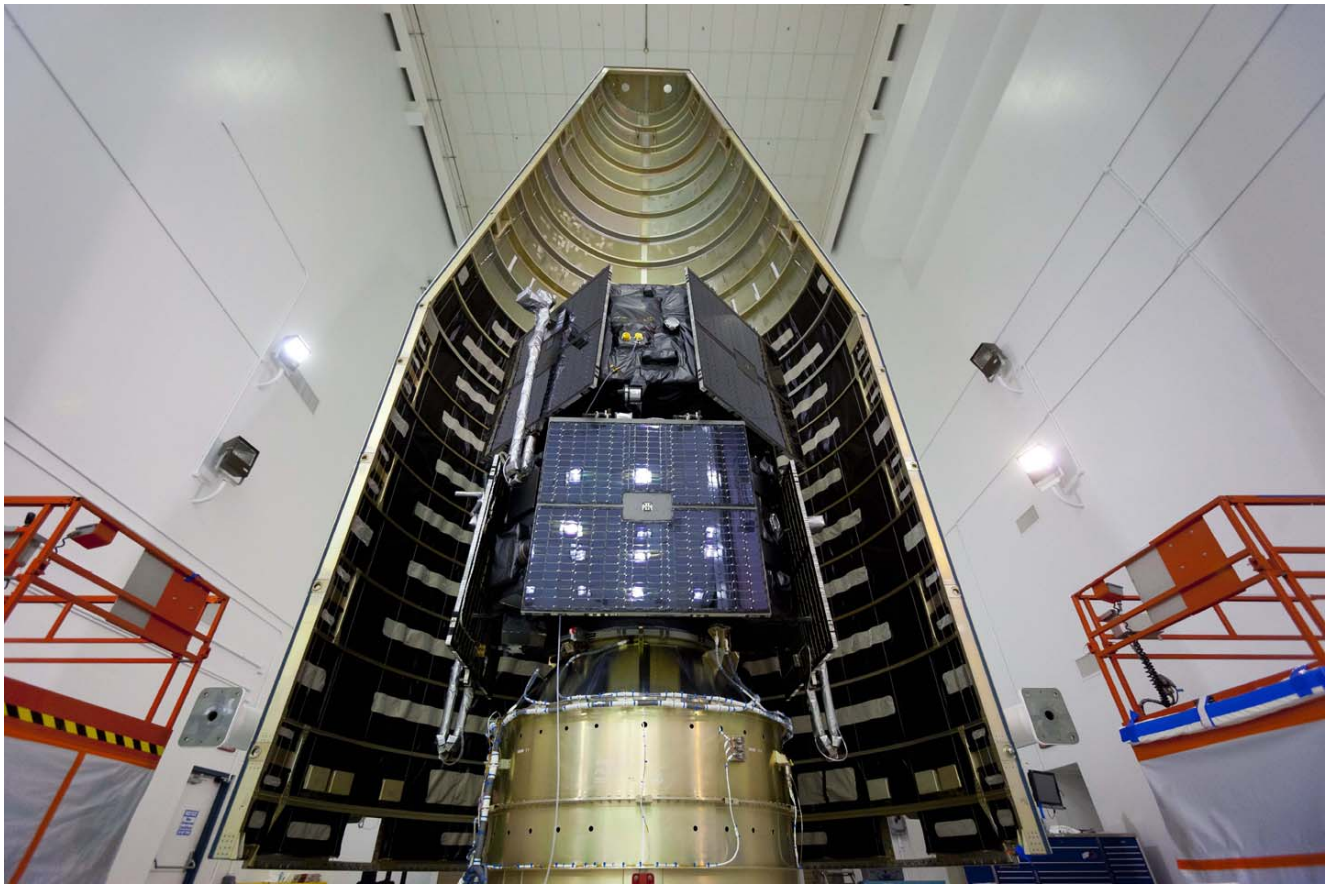
He encouraged students to dream big: "Have two goals — one for the head and one for the heart."

Editor's Note: Ray was voted most distinguished CVCC alumnus for 2012.

*Abstracted from a news article in The News and Advance newspaper, Lynchburg, VA.*

# RBSP Ready for Launch!

The Radiation Belt Storm Probes (RBSP) is designed to provide a better understanding of the Sun's influence on Earth and Near-Earth space by studying the Earth's radiation belts on various scales of space and time. The instruments on NASA's Living With a Star (LWS) Program's RBSP mission will provide the measurements needed to characterize and quantify the plasma processes that produce very energetic ions and relativistic electrons. The LWS program missions were formulated to explore fundamental processes that operate throughout the solar system and those that generate hazardous space weather effects in the vicinity of Earth and phenomena that could impact solar system exploration. RBSP instruments will measure the properties of charged particles that comprise the Earth's radiation belts (named for the discoverer of the inner belt, James Van Allen), the plasma waves that interact with them, the large-scale electric fields that transport them, and the particle-guiding magnetic field.



***Radiation Belt Storm Probes stacked spacecraft in the launch vehicle fairing***

The RBSP mission consists of two spacecraft that will have nearly identical eccentric orbits and will cover the entire region of the radiation belts. The two spacecraft will lap each other several times over the course of the mission. In utilizing two spacecraft instead of one, RBSP takes simultaneous measurements at different locations to determine whether an event occurs at the same time throughout the belts or instead travels across the belts, changing over time and space. The two RBSP spacecraft carry identical instruments. Each eight-sided satellite is approximately 6 feet

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*(RBSP continued from page 13)*

across, 3 feet high, and weighs 1,475 pounds (including 62 pounds of propellant). The orbits lie nearly in the Earth's equatorial plane and are highly elliptical, coming in as close as 375 miles and reaching out almost to 20,000 miles above Earth's surface, thus traveling through diverse areas within the belts.

A crucial part of a larger space weather system, the radiation belts absorb energy and particles from the sun that can in turn harm the satellites that pass through the region. The belts can also pass energy on to Earth's atmosphere in ways that in extreme cases can effectively cripple communications systems or electric power grids. The location and shapes of the belts change but, in general, the inner belt begins some 60 miles above Earth's surface and extends up to 6,000 miles. The second belt stretches from 8,400 to 36,000 miles above Earth's surface. While the most immediate practical reason for studying the radiation belts is to protect humans and electronic assets that are in space from geomagnetic storms and to understand our local space weather, scientists are interested in this area for other reasons as well. RBSP will help determine how particles make their way into the belts, where they disappear to, and what processes accelerates them to such high speeds and energies. Scientists also wish to understand how energy from the radiation belts can affect the composition of Earth's atmosphere and ozone layer. Finally, the Van Allen belts are the closest place to study the fast-moving, electrically charged gas, called plasma, which flows along skeletal structures within the universe made of invisible magnetic fields. Understanding this environment is essential to understanding the makeup of every star and galaxy in the cosmos.

The RBSP mission will identify and map out the processes that generate the radiation belts and cause them to change. Specifically, RBSP will provide the information needed to understand and predict how the particles reach high energies and what causes them to escape from the belts. To understand the extreme variability of the high-energy electrons and protons in Earth's radiation belt, RBSP will map out the various processes that affect the particles throughout the near-Earth environment. These observations will help to develop new models for the belts, which in turn can be used by engineers to design radiation-hardened spacecraft as well as by forecasters to predict space weather phenomena and alert astronauts and spacecraft operators to potential hazards. The instruments addressing the overarching science questions are:

- Radiation Belt Storm Probes Ion Composition Experiment (RBSPICE), Louis Lanzerotti, Principle Investigator, New Jersey Institute of Technology.
- Relativistic Proton Spectrometer (RPS), Joseph Mazur, Principle Investigator, The Aerospace Corporation.
- Electric Field and Waves (EFW) suite, John Wygant, Principle Investigator, University of Minnesota, Minneapolis.
- Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS), Craig Kletzing, Principle Investigator, University of Iowa, Iowa City
- Energetic Particle, Composition, and Thermal Plasma (ECT) suite, Harlan Spence, Principle Investigator, University of New Hampshire.

*(RBSP continued on page 15)*

*(RBSP continued from page 14)*

RBSPICE focuses on a separate, but related, component of space weather called the ring current. The ring current is an electric current circling Earth around the equator. An integral part of Earth's electromagnetic environment, it changes in response to solar and geomagnetic activity and affects the particles moving through the radiation belts. RBSPICE measures the composition (the amount of protons, helium, and oxygen) and pressure of the ring current. These factors can impact the shape of the magnetic fields in Earth's magnetosphere. Scientists will use this information to understand how and why the ring current changes during geomagnetic storms and how this, in turn, affects the particles in the belts.

RPS focuses on the inner radiation belt, an area that houses some of the highest energy protons in Earth's magnetic environment. These protons move fast enough that no shielding can stop them. Thus, they can easily penetrate inside a spacecraft, where they can harm electronics or astronauts. To study these particles, the RPS instrument measures the protons' energy and how their intensity varies over time. This will help scientists understand how the inner belt changes in response to solar activity.

EFW measures electric fields to help understand what processes provide energy to the particles. Some electric fields last for milliseconds and extend over only half a mile, while others last for hours and extend over 100,000 miles. So one major question is to determine which kinds of fields help accelerate the material in the belts. These electric fields are measured by metal spheres at the ends of six huge antennae, or booms, that stretch out from the main body of the spacecraft. Four of the booms stick out from the sides of the spacecraft, like the spokes of a bicycle, and are held in place by centrifugal forces. Each of these booms is a cable about as wide as a fishing line and extends 164 feet from the spacecraft. The second set of booms is rigid, and lines up with the spacecraft's spin axis. Each of these booms is some 40 feet long. At launch, the booms tuck into the spacecraft and deploy once RBSP is in orbit.

EMFISIS helps differentiate the many processes that help provide energy and speed to the particles in the belt or lead to their being ejected from the belts altogether. The instrument focuses specifically on the magnetic fields and plasma waves (the waves carrying electromagnetic fields that can charge gas particles) in the region. Past experiments have only been able to monitor such waves in a single direction, but EMFISIS will measure electric and magnetic field components in all three directions. The magnetic fields are measured with three solenoids, oriented as if they were the 90-degree angles at the corner of a cube. EMFISIS also incorporates the electric field information gathered by the EFW instrument booms.

ECT observes the types of particles that exist in the radiation belts, including electrons, protons, and charged ions of oxygen and helium. The instrument records information about the particles, such as their energy and direction of motion relative to the magnetic field and factors that can determine whether a given particle stays trapped in the belts or escapes. While it functions as a single instrument, the ECT is in fact comprised of three separate components: Helium Oxygen Proton Electron (HOPE), Magnetic Electron Ion Spectrometer (MagEIS), and Relativistic Electron Proton Telescope (REPT). These components: (a) record the lower energy and speed particles that exist throughout the solar system and play an important role in belt dynamics; (b) observe electrons and ions in the middle energy ranges and will provide the cleanest measurements of radiation belt

*(RBSP continued on page 16)*

*(RBSP continued from page 15)*

electrons so far achieved; and (c) employ a stack of solid-state detectors to capture the energy signatures left by the highest energy particles.

The RBSP mission is a partnership between the Johns Hopkins University (JHU) Applied Physics Laboratory (APL) and NASA. The JHU/APL serves as the project management organization and lead integrator, while NASA/GSFC provides the Magnetometer for the EMFISIS instrument, Instrument scientist for REPT (Shrikanth Kanekal), as well as Co-I's for EMFSIS (Bob MacDowall), EFW (Robert Pfaff and Douglas Rowland), and ECT (Shrikanth Kanekal).

RBSP is the second mission within the Living With a Star (LWS) Program, following the Solar Dynamics Observatory (SDO). The LWS Program Office support to RBSP includes Nicholas Chrissotimos (LWS Program Manager), Mike Delmont (LWS Deputy Program Manager), Pietro Campanella (LWS Deputy Program Manager for Resources), Mark Goans (Deputy Program Manager for APL Projects), Wanda Harrell (RBSP Business Manager), Chris Greco (RBSP Resource Analyst), David Sibeck (RBSP Mission Scientist), Steve Aloezos (RBSP Mission Systems Engineer), and Reggie Eason (RBSP Instrument Systems Manager).

The Radiation Belt Storm Probes will be launched on an Atlas V-401, from Cape Canaveral Air Force Station, Space Launch Complex-41, on August 23 at 4:08 a.m. EDT.

**Mark Goans, Code 460**
**Deputy Program Manager for APL Projects**
**Explorers and Heliophysics Projects Division**

## Nineteenth Annual Federal Inter-Agency Holocaust Remembrance Program

A sizable number of Code 400 employees joined other Goddard individuals on a bus to the 19th Annual Holocaust Memorial program at the Lincoln Theatre in Washington. It was the largest contingent of Goddard workers to ever attend the program, whose opening remarks were made by Pat Tamburrino, Jr., Chief of Staff to the Under Secretary of Defense for Personnel and Readiness. Guest speakers included one Polish citizen and two Germans all of whom were born in the mid-1920s and survived Hitler's rise to power in Germany and later temporary domination of most of Europe. The Polish citizen who was Jewish and members of her family were hidden in cages at the Warsaw Zoo throughout the war by the zoo keeper's family. Two British women also participated and spoke of their work at the War Crimes Trials in Nuremberg after the war ended in 1945.

The program is sponsored by 29 different Federal departments and agencies including NASA. Goddard employees have attended since the very first program. More information about the program and its history is available at: http://holocaustremembrance.org

**The Editor**

# NuSTAR

NASA's Nuclear Spectroscopic Array (NuSTAR) spacecraft was successfully launched June 13, 2012 from an Orbital Sciences' Pegasus XL rocket aboard an L-1011 aircraft over Kwajalein Atoll.

The 772-pound NuSTAR will spend at least two years observing high-energy X-rays more closely, in higher resolution, than any space telescope before it. On the electromagnetic spectrum, high-energy X-rays are beyond the scope of visible light and are challenging to detect. NuSTAR's advanced design uses two sets of 133 thin, nested shells of mirrors to capture the X-rays as they bounce off the reflecting surfaces at glancing angles. The expected result is an orbiting observatory that enables astronomers to see the universe in an additional band of light, advancing our understanding of how galaxies form and evolve.

On July 31, 2012, NuSTAR passed its Post-Launch Assessment Review, clearing the way for the mission to enter into its science operations phase in August. Having unfurled its unique, lengthy mast, NuSTAR has already snapped the first focused images of the high-energy X-ray universe.

During its two-year primary mission phase, NuSTAR will map selected regions of the sky to:

1. Take a census of collapsed stars and black holes of different sizes by surveying regions surrounding the center of our own Milky Way Galaxy and performing deep observations of the extragalactic sky;
2. Map recently-synthesized material in young supernova remnants to understand how stars explode and how elements are created; and
3. Understand what powers relativistic jets of particles form the most extreme active galaxies hosting supermassive black holes.

NuSTAR is a Small Explorer (SMEX) mission. Principal Investigator is Fiona Harrison, from the California Institute of Technology. Mission Manager is Tom Venator (Code 460).

*Abstracted from NASA and CalTech sources.*

# MetOp-B

Met-Op-B is scheduled to launch on September 17 from Baikonur, Kazakhstan. Built and to be launched by the European Space Agency (ESA) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), MetOp carries aboard several POES heritage instruments provided by a team led by Karen Halterman (Code 421). MetOp-B is the latest in a series of European Polar Orbiting satellites.

# RESOURCE ANALYSIS OFFICE (RAO)
# The "new" Code 405

Thanks George, Steve and members of the Code 400 family for the warm open-armed reception and greetings we received before our first day back in Code 400 as the Resource Analysis Office, Code 405. To start off with a funny anecdote, during our first two weeks in our newly realigned Code, we were getting bombarded with questionable authorization e-mail requests for approving travel requests and travel voucher approvals but we didn't know why? We later found out that the "old usage" of Code 405 was for the Integrated Enterprise Management Project (IEMP) *"the old full costing management group*" in Code 400 and that the paperwork of the disestablishment of the old office and the repurposing of the Code number for our office use had not caught up with each other and had not taken effect prior to our arrival. Why did I say back in Code 400? Here is today's history lesson:

## RAO History

- A long, long time ago, the office started out as the Cost Experience Group under the Business Management Office in the A&M Directorate (Code 200; William Mecca was the A&M Director at the time) in the late-60's/early 70's. Most of our current analysts were not even born yet.

- The office was later reorganized and renamed the Resource Planning Office (Code 213; Dr. Charles Buffalano was the Office Head, my first boss). The office consisted of two integrated work groups, operations research; and cost modeling/resources estimation.

- The office responsibilities were: to build quantitative, prediction resource models (cost; work-force; manpower phasing; schedule; risk; others); cost estimation; data collection; data base; data and trend analysis; and to work closely with Code 100 (Advanced Planning Office; William Stroud, David Wood, et al.).

- On April 12, 1976, the office was formally realigned and chartered under Code 400 with all similar roles and responsibilities by Mr. Robert N. Lindley, Director of Flight Projects, Code 400. The office was renamed the Resource Analysis Group (RAG; Paul Villone was the Office Head) as originally chartered. The primary focused working relationship was with the Preliminary Systems Design Group (PSDG; Marjorie Townsend was the Office Head) for mission concepts and with on-going flight projects.

- In 1980, the office functions were moved to the newly established Office of the Comptroller (Code 150) to mirror NASA Headquarters' organization chart. The office function and personnel moved from Code 400 to Code 152 under this realignment. The office was renamed Resource Analysis Office (RAO), the name currently in use.
  - Office of the Comptroller was later renamed Office of the Chief Financial Officer (CFO) in 1996.

*(RAO continued on page 19)*

*(RAO continued from page 18)*

- In 2000, the office function was moved to the newly established Systems Management Office (SMO; Code 300) in response to Dr. Mulville's letter to IPOs and Center Directors on May 28, 1999 from the NASA Administrator. On October 1, 2000, the office work function and personnel moved from Code 152 to Code 305. Added Center responsibilities incorporated and aligned to the SMO were:
  1. Expanded work function with the New Business Office and in direct support and reporting responsibility to the New Business Committee;
  2. Review of all Step-1 and Step-2 proposals where Goddard is the lead or has a major contribution to the proposal. Provide independent resource assessments (i.e., cost, schedule, manpower, risk) to the Cost Sanity Reconciliation, GPMC and the NBC;
  3. Provide independent resource assessments of Study projects moving from pre-Phase A through confirmation (i.e., GPMC process) go-ahead; and
  4. Provide ad hoc cost trade study support for pre-formulation Center proposals, as directed.
- Center Director Robert Strain announced organizational changes effective September 26, 2011, including work function and personnel realignment of Code 305 within Code 400 as Code 405.
  - Direct office reporting to: Code 400/ Deputy Director for Planning & Business Management (Steve Shinn).
  - Previous use of Code 405 had been for the **I**ntegrated **E**nterprise **M**anagement **P**rojects (IEMP) Office. "Full circle to opening story…"

So, we've been around the block a few times. I hope you enjoyed hearing the history lesson of RAO's evolved beginning and to get a view of where we came from.

Extra note: Thanks to Howard (Ottenstein) for giving us the opportunity to share our story and for also knowing him all these years when he was in the PSDG with Margie Townsend.

**Harry Mar Born, Code 405**
**Deputy Chief, Resource Analysis Office**

# New Business News
## *- An Update on FPD "New Business" Activities -*

*Looking at the recent past…*

Discovery AO – In my last report I shared with all of you that congratulations were in order for the Comet Hopper (CHopper) Step-2 Capture Team and that the selection decision was expected in July. Well, that decision timeframe has slipped. The latest information we have suggests a decision could come in late August, about the time The Critical Path is published.

It is worth noting that activities outside of GSFC focusing on the production of the Advanced Stirling Radioisotope Generator (ASRG) – *a key component in the CHopper design* – are aggressively continuing inside NASA and the Department of Energy. With our proposed Fall-2017 launch readiness date, launch window flexibility when compared to traditional planetary missions, ASRG risk reductions (e.g., elimination of winter-2017 transportation constraints) and predefined choices of scientifically interesting backup targets…the CHopper Team has proposed a fantastic opportunity to advance the ASRG and comet science while reducing overall risk! Now that is an example of GSFC adding value to our stakeholders!

Office of the Chief Technologist (OCT)/Technology Demonstration Mission (TDM) Proposals – "Green Propulsion" is the latest thing in propulsion systems. Unlike standard hydrazine systems "green" refers to new propellants that are minimally hazardous, have equal or better performance, are easier to ship and can be cost-effective. Talk about a game changer!

GSFC is a leader in the new era of our country's utilization of these new propellants. An example of this leadership is our central role on the High Performance Green Propulsion (HPGP) Project that includes a diverse project team spanning: GSFC, MSFC, private industry and the Swedish Space Agency. The OCT announcement is expected before end-FY12.

"Celebrating the Effort" – Being a member of a capture team is not easy; actually, it can be down-right hard. What's worse, all of the innovative ideas, concerted efforts and short-term sacrifices do not guarantee a winning proposal. Compound this with FPD's expectation that each of its participants on a Center capture team will contribute in a meaningful way to increasing the overall "Execute-ability" of the mission proposal that is submitted, and you have a professionally rewarding but very challenging job experience indeed. Remember: FPD would rather see our Center *not* propose a

*(New Business continued on page 21)*

*(New Business continued from page 20)*

mission than see it propose a mission that is not executable for the technical, budget, schedule or risks defined!

FPD recognizes the unique challenges that being on a capture team represents for its workforce. That is why the Directorate "Celebrates the Effort" of its new business participants twice a year: in the summer and winter. The last event was held in June at the GEWA Pavilion for the very first time. This was a great event and we look forward to the numbers of participants growing in the future!

*Looking at the present…*

Explorers AO – The finish line is very near for the Center's two Explorers/Step-2 capture teams where the FPD new business community is actively participating: the Atmosphere-Space Transition Region Explorer (ASTRE) mission and the Transiting Exo-planet Survey Satellite (TESS) mission. Unless a last minute change to the dead-line is announced, both capture teams will be working to a Concept Study Report submission date of September 21st. Good luck to the ASTRE and TESS Teams, as well as to the Center's Explorers/Mission of Opportunity proposal NICER!

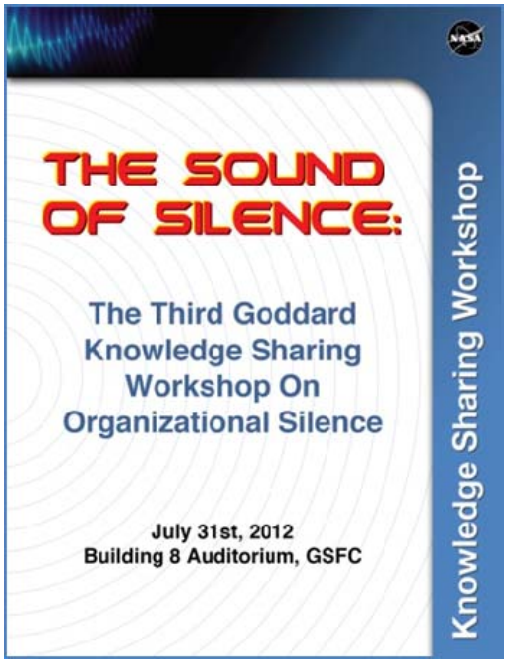
Jupiter Icy Moon Explorer (JUICE) – The JUICE mission is a planned European Space Agency (ESA) spacecraft to visit Jupiter and will focus on three moons: Ganymede, Callisto, and Europa. There are two opportunities for the GSFC science community to participate on this mission: as a selected NASA instrument or as a member of an ESA selected instrument team. Normally the FPD would not be involved in instrument proposals. For JUICE this is different as the Advanced Concepts and Formulation Office (ACFO) has been asked by Code 670 and Code 101/New Opportunities Office to join Dr. Nick Paschalidis's capture team and leverage its expertise in the definition of project plans and financial data for a plasma instrument contribution to an ESA instrument.

*Did you know?* →


**Bob Menrad / Code 401**
**Associate Director for Formulation**

# Knowledge Management Corner

## Goddard Knowledge Sharing Events: The Sound of Silence




The July 31 center-wide event—The Sound of Silence—was the third such knowledge sharing workshop focused on organizational silence at Goddard. Previous workshops had been held in 2006 and 2009. This year's agenda included a mix of external speakers such as Marsha Coleman-Adebayo, Amy Edmondson, Andrew Chaikin, Robin Dillon, and NASA speakers and panelists such as Judy Bruner, George Morrow, Dennis Andrucyk, Michael Ryschkewitsch, and Bryan O'Connor (retired).

The event was sponsored by the GSFC Office of the Chief Knowledge Officer, the GSFC Ombudsman Program, the NASA Safety Center, GSFC Office of Human Capital Management, and APPEL-NASA HQ.

The speakers and panelists addressed the theme of organizational silence from different angles. While Marsha Coleman-Adebayo's personal story of determination and courage in the face of harassment and retaliation at the EPA moved the audience and increased the audience's awareness of existing laws and ongoing efforts to protect whistleblowers (see Book Highlight #1 for details), Amy Edmondson (see Book Highlight #2) and Dr. Robin Dillon contributed their research-based insights suggesting that organizational silence can be pervasive within organizations at much lower levels of intensity. Ironically, it's easier to notice organizational and personal conflicts and shouting matches in meetings—which were quite common in the Apollo era according to space historian Andrew Chaikin—than it is to notice organizational silence or the absence of voice in daily meetings taking place around the organization. High stakes meetings (such as Flight Readiness Reviews) have established processes to ensure that dissenting opinions are formally recorded and discussed. However, it is also important to consider the potential impact of silence within everyday work.

Silence can easily be interpreted as agreement or consensus, or it may hide dangerous elements of groupthink. Similarly, a near-miss tends to be interpreted as a success, when, in fact, it is truly a chance to evaluate the mission for better ways to avoid a failure next time. Dr. Dillon recommended that we spend more time analyzing successes to identify not just what we've done well and contributed to success, but also what went wrong but somehow didn't cost us the mission; because the next time around, it may very well cost us the mission.

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Tackling organizational silence requires a dual approach.

1. **Encourage employees to speak up**
   Employees must feel safe about speaking up and must be aware of avenues available to them to raise issues and concerns when they feel that their concerns are not being addressed by immediate supervisors.

   **Tips for speaking up effectively**
   - Attitude: Be respectful and civil. A dose of humility also helps.
   - Dealing with uncertainty: Don't wait to be 100% sure or to have all the data to back up your position. Some issues are time sensitive. Speak up early. Express your concern, be as specific as possible, and be open and honest about your own uncertainty.
   - Don't just talk to your peers (and potentially start the rumor mill). Think about proper avenues for voicing a concern, which may be a function of the nature of the issue, the time sensitivity of the issue, the stakes involved, etc.
   - Don't give up. Getting some feedback and/or resolution may take some time, but keep pushing to get a resolution.

***Figure 1. Afternoon Panel: Bryan O'Connor, Amy Edmondson, Mike Ryschkewitsch, and Robin Dillon***

2. **Ensure that when employees are speaking up, they are listened to**. Supervisors and managers must practice active listening and even proactively seek out voices; ask for opinions. When conflicts arise or issues/concerns are brought to their attention, they should be addressed with the maximum degree of objectivity, but never dismissed or ignored.

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**Tips for Listening Effectively**

- Walk the talk about the open door policy: An open door policy is only a starting point. Managers and supervisors must walk the talk. Rather than just having an open door policy and waiting for people to come to them, managers and supervisors must seek out voices and opinions.
- Get into the employees' shoes: Realize that there are many factors that may prevent employees from speaking up, some of which are quite subtle. It's not always a scary supervisor who unconsciously discourages speaking up. It could simply be a new employee who isn't quite sure about how things are done yet and isn't comfortable questioning what he/she is observing or hearing.

The two sides of this coin can only be combined effectively in a work environment where everyone with a NASA badge (whether civil servant or contractor, whether supervisor or line employee) is held accountable for mission success.

For example, listening and being aware of what is happening in a conversation is everyone's responsibility. If you notice that people in a meeting are talking past each other, do something about it, especially if it is a high-stakes conversation.

> *"I am never going to let myself sit through another meeting and let two people talk past each other. I don't have the right to be silent when I know something is wrong."* Bryan O'Connor
> http://www.nasa.gov/offices/oce/appel/ask-academy/issues/volume2/AA_2-8_F_goddard.html

In addition, practicing effective communication applies to everyone.

- Don't use jargon and acronyms when the parties to the conversation are not familiar with them;
- Confirm your understanding of what has been said; ask for clarification if you're uncertain of what has been said or what was meant to be said;
- Ensure all voices and opinions are heard;
- Be present and focused (watch out for the impact of technological distractions and multi-tasking);
- Use the right tools and be aware of the communication preferences of the intended target of your message.

**Ask Yourself**

- What are YOU going to do to practice effective communication in your daily work?

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**Book Highlights: Two books, two ways of looking at organizational silence.**

The first book mentioned below, No Fear, is a personal account of a whistleblower's experience within a U.S. Government agency and the author's efforts to ensure others don't have to go through the same ordeal. The second book highlighted below, Teaming, is based on extensive research, yet very readable and highly relevant to NASA's work environment. Both authors, Amy Edmondson and Marsha Coleman-Adebayo, visited Goddard on July 31 to participate in The Sound of Silence, a Center-wide event focused on organizational silence.

**Book Highlight #1**

**Title**: No Fear: A Whistleblower's Triumph Over Corruption and Retaliation at the EPA

**Author**: Marsha Coleman-Adebayo

As a young social scientist working at the EPA, Marsha Coleman-Adebayo was working with Al Gore's special commission to assist post-apartheid South Africa. When she couldn't get the agency to investigate allegations that a multinational corporation was responsible for the deaths of hundreds of South Africans mining vanadium, a vital strategic mineral, she blew the whistle. The agency retaliated. Coleman-Adebayo fought back. After prevailing in court, she organized a grassroots struggle to bring protection to all federal employees facing discrimination and retribution from the government. After a two-year long battle, the No Fear Coalition she organized culminated in the passage of the first civil rights and whistleblower law of the 21st century, the Notification and Federal Employee Antidiscrimination and Retaliation Act of 2002, also known as the NO FEAR Act. This book is a detailed account of her story as a whistleblower and her fight for justice.

Dr. Coleman-Adebayo continues to work toward improved legislation to protect whistle-blowers in the federal government.

Throughout the day, speakers and panelists pointed to a number of avenues available to employees to raise an issue. At Goddard, employees (civil servants and onsite contractors) can speak about issues or concerns to the Ombudsman. The Ombudsman program was established in 2005, based on the recommendations of the Columbia Accident Investigation Board. It provides an informal, independent, confidential neutral channel for employees to raise significant issues and concerns they perceive as having an impact on safety, organizational performance, mission success, or other aspects of NASA's work.

The Ombudsman program provides an informal avenue for communications and complements other existing mechanisms.

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## Ask yourself

- What are some appropriate avenues for raising issues or concerns within the GSFC environment?
- How would you follow through on an issue if it is not getting the attention you think it deserves?
- As a manager, how would you handle an employee who keeps bringing up an issue that (in your opinion) has already been adequately addressed?

For additional information, visit the GSFC Ombuds website: http://ombuds.gsfc.nasa.gov

**Have a concern? Need to talk? Here's where to go at Goddard**

- Your management chain – start with your immediate supervisor
- Your union, if applicable
- Alternative Dispute Resolution (ADR): Program Manager, 6-0482
- Diversity and Inclusion – Special Assistant for Diversity 6-0475
- Employee Assistance Program (EAP), 6-4600
- Employee Relations – Program manager, 6-3729
- EEO Complaints/Disability Accommodation: Equal Employment Opportunity Programs Office, 6-7348 (Greenbelt), 7-1412 (Wallops)
- Ethics (Legal): Ethics Officer, 6-9181
- Inspector General: Investigations Field Office, 6-7776
- Labor Relations: Labor Relations Officer, 6-8545
- Ombudsman: 6-2374; Alternate Ombudsman 240-393-5678
- Security: Protective Services, 6-7233 (Greenbelt), 7-1111 (Wallops)
- Workplace Harassment: Anti-Harassment Coordinator, 6-6582.

## Book Highlight #2

**Title:** Teaming: How Organizations Learn, Innovate, and Compete in the Knowledge Economy

**Author**: Amy Edmondson

Amy Edmondson is a Harvard Business School professor who teaches courses in leadership, organizational learning, and operations management.

In her latest book on teams and teaming, Edmondson draws on her 20 years of research on teams to show how and why organizational success or failure depends on the team's ability to learn and adapt to their environment and to each other. Using examples from a wide range of organizational settings, Edmondson describes the teaming activities and conditions that determine how work gets done, how leaders help make it happen, and how a safe interpersonal environment frees up people to focus on innovation. Chapter 4 in the book addresses the topic of psychological safety in the workplace. Psychological safety describes "a climate in which people feel free to express relevant thoughts and feelings" (p. 118). In other words, "psychological safety makes it possible to give tough feedback and have difficult conversations without the need to tiptoe around the truth" (p. 118).

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However, as Edmondson points out in the book, psychological safety doesn't imply a permissive or undisciplined organizational atmosphere. Psychological safety must be complemented by accountability. Accountability defines the degree to which people are expected to adhere to high standards and pursue challenging goals. "When both accountability and psychological safety are high, people can easily collaborate, learn from each other, and get the job done" (p. 131). (Upper right corner of Figure 2.)

| | | | |
|---|---|---|---|
| Psychological Safety | High | Comfort Zone | Learning Zone |
| | Low | Apathy Zone | Anxiety Zone |
| | | Low | High |
| | | Accountability | |

***Figure 2. Psychological Safety and Accountability***

**Ask yourself**

- Within NASA, the related concept of dissenting opinion is very important. How do these related concepts manifest themselves during the project life cycle?
- What can you do as a Project Manager to ensure the right mix of accountability and psychological safety?
- What are the barriers to psychological safety within the complex organizational environment of a GSFC project?
- Have you ever failed to speak up? Why? What stopped you?
- How does psychological safety relate to communications management? How much do you say or not say to higher levels of management? To partners?
- How does psychological safety relate to innovation? What happens to innovation when questioning what's been done before and new ideas or suggestions for doing things differently are continuously shot down?

**Learning Across Projects -**
**Introducing the Flight Project Directorate's Knowledge Exchange**

The Knowledge Exchange is a knowledge sharing hub for the Flight Projects Directorate (FPD) with a primary objective of pulling together knowledge resources of high value to projects. Its focus is on project management. Technical issues are not the main focus, but

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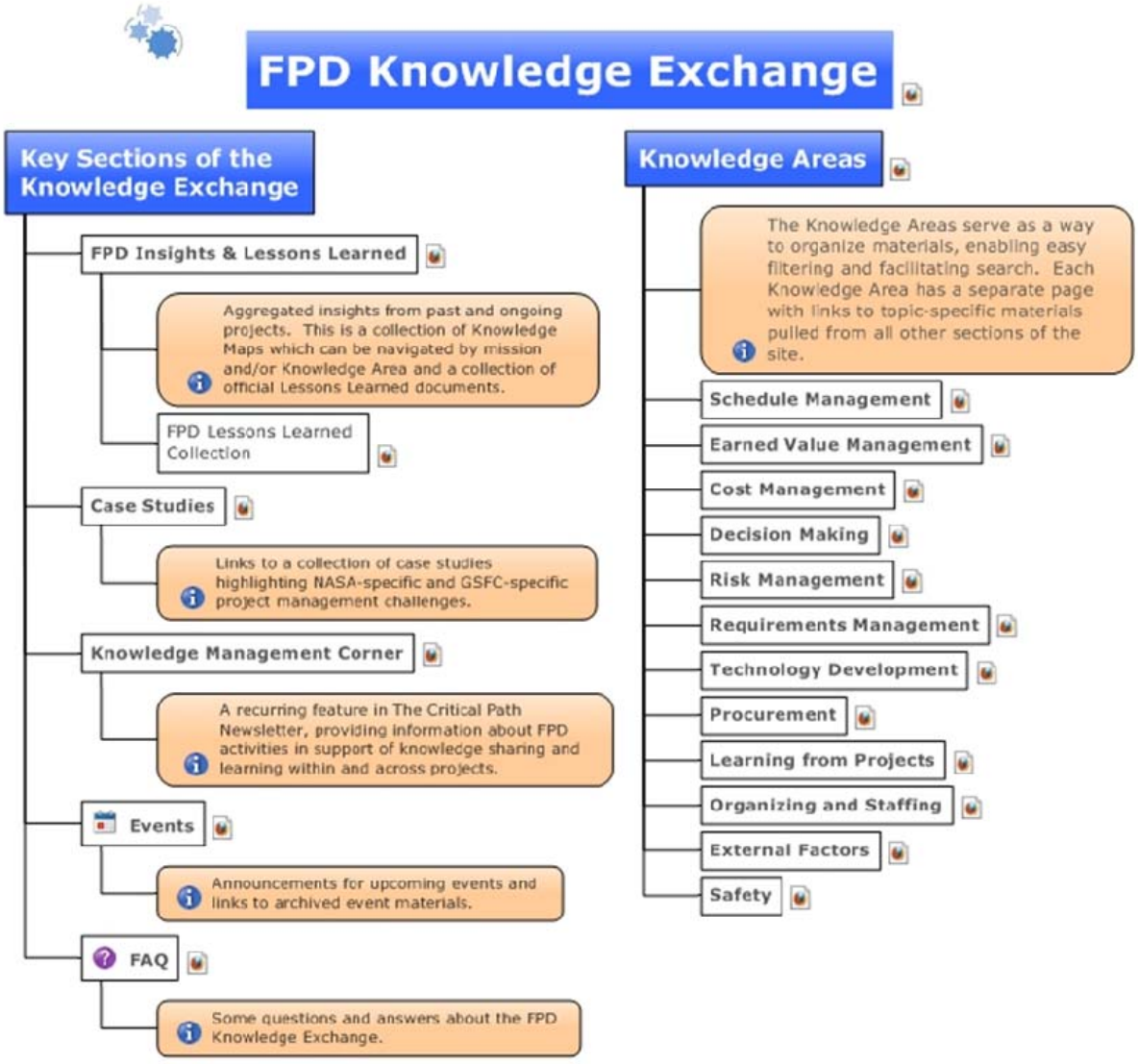


they are addressed from the point of view of a project management team rather than an engineer's or scientist's point of view.

Over time, Best Practices documents and additional guidance emerging from related efforts such as the Business Change Initiative will be integrated within relevant areas of the Knowledge Exchange.

The core content areas of the Knowledge Exchange are 1) the FPD Insights and Lessons Learned; and 2) the Knowledge Areas.

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The FPD Insights and lessons learned consist of a collection of interlinked knowledge maps developed, based on insights and lessons from past and ongoing GSFC missions. The knowledge maps are either mission specific or topic specific. These maps are meant for browsing, navigating from higher level insights down to more detailed explanations and contextual background.

The Knowledge Areas are repositories of resources organized around key project management topic areas. Each repository typically lists relevant policy and official guidance documents for the respective knowledge areas, as well as other GSFC and more broadly, NASA resources, including ASK magazine articles, case studies, and websites.

To stay with the theme of this Knowledge Corner, how would anyone find information about organizational silence within the Knowledge Exchange and what kind of information would be found?

- Project-based insights about issues related to organizational silence can be found in the Communications map within the FPD Insights.
- Resources and related information can be found through the Events section since we have held multiple Workshops on the subject.
- Related case studies can be identified in the Case Studies section.

The Knowledge Exchange will be presented to projects for beta testing in the next couple of months in order to gather feedback, make necessary adjustments, and then open it up for broader access in Fall 2012 when more information about access will be provided. If you would like your project to get a demo of the site and insights into how it may benefit you and your team, contact Barbara Fillip at barbara.fillip@nasa.gov or 301- 286-4666.

**Barbara Fillip, Code 100**
**Knowledge Management Project Manager**

# 2012 Agency Honor Awards Selections
# Code 400 Awardees

## Distinguished Service Medal

Philip Sabelhaus/427

## Distinguished Public Service Medal

Peter Phillips/Aerospace Corporation/427

## Outstanding Leadership Medal

Paul Brandinger/420
Richard Burley/441
Sergey Krimchansky/422
Kenneth Schwer/429

## Outstanding Public Leadership Medal

William Sullivan/Raytheon IIS/474
David Wampler/ITT Information Systems/450

## Exceptional Achievement Medal

Garry Gaukler/474
Robert Lilly/427
Margaret Pavlik/470
Lisa Shears/429
Janice Smith/474

## Exceptional Service Medal

Robert Buchanan/454
Carolyn Ellenes/420
Larissa Graziani/Sgt. Inc./429
Susan Sparacino/432
Lyle Tiffany/429

## Exceptional Public Achievement Medal

Sonja Harding/ITT Corporation/450.S
Colleen Higgins/Raytheon IIS/474

## Exceptional Public Service Medal

Clay Deyarmin/Qwaltec, Inc./429
Dan Linebarger/Raytheon IIS/474

*(Agency Awards continued on page 31)*

(Agency Awards continued from page 30)

David Venzor/ASRC Aerospace Corporation/450.S
Carrie White/Honeywell/444

**Silver Achievement Medal [Individual]**

Marco Midon/450

**Silver Achievement Medal [Team]**

MSI&T and Operations Readiness Team

**Group Achievement Award**

Earth Observing System Flight Dynamics Team
ESMO Modernization Team
James Webb Space Telescope OTE Team
Joint Polar Satellite System (JPSS) Group Project Team
Joint Polar Satellite System Transition Team
NPP Solar Array Tiger Team
NPP VIIRS On-Orbit Anomaly Team
Suomi NPP Mechanical Systems Team

As it is too early to note the citations for the awards, they will be printed in the next issue of The Critical Path.

(Rosenbaum Tintype continued from page 3)

What she likes best about her current position as the Management System Lead is the opportunities to touch the many projects in the Flight Projects Directorate. Every day is different – from coordinating directives reviews, working through the nuances of configuration management, helping to prepare for audits, or navigating corrective actions and process improvement initiatives.

Nancy serves as president of the Goddard Photo Club, where she gets inspiration from club members to improve her photographic eye. A rotating exhibit of club members' work will open in the Building 1 cafeteria toward the end of August.

**Life Outside of Goddard:** Nancy lives in Washington, DC with her husband, Gil Glass, and their two cats. She enjoys city living and has been trying her hand at urban gardening - with mixed success. When she has the opportunity, she likes to travel and meet people from different places. Nancy and Gil have been active in the Couchsurfing program, which provides a way for travelers to connect with locals. They have "couchsurfed" in several cities in the US and abroad, and in the past 5 years have hosted nearly 300 people from six continents and many countries.

# Code 400 Peer Award Winners for 2012

## Boundless Energy

**Carolyn Ellenes, Code 420**
"Carolyn is a new member of ESMPO and has proven her skills in business management. Carolyn's dedication and professionalism is a true asset to the Agency."

**Jeanne Behnke, Code 423**
"In recognition of the tremendous energy, dedication and commitment you bring to the EOSDIS Project"

**Kenny Harris, Code 543**
"For Your Perseverance and Leadership in Building Four MMS Flight Structures."

**Karla J. Kahler, Code 427**
"For service above and beyond her own job and more, demonstrating agility, balance, and most of all dedication, Karla Kahler is truly deserving of the Boundless Energy award."

**Robert Gable, Code 474**
"For your continued support above and beyond scheduling to ensure a successful mission."

**Teresa Dorsey, Code 407**
"In recognition of outstanding support to various HQ offices and to her outreach activities with other NASA Centers, Teresa Dorsey is honored with the Boundless Energy peer award."

## Diversity

**Helen Sullivan, Code 450**
"For her selfless efforts in striving to make a positive difference in the work environment by valuing and respecting differences."

## Mentor

**Charisse Dorrell, Code 422**
"The individual who goes that extra mile to mentor, train, and help others in achieving success in career development."

**Donald Chu, Code 417**
"For Don's sincere focus on the development of others both within the Project and throughout the Center."

## Mission Impossible

**Lance Seman, Code 474**
"For your leadership in doing the impossible – bringing up a second JPSS ground station at Fairbanks in five days during the NPP communications emergency."

*(Awards continued on page 33)*

(Awards continued from page 32)

**Mark D. Underdown, Code 597**
"For successfully bringing the GOES-R low thrust rocket engine assembly from concept to reality."

**William Bolingbroke, Code 470**
"In Recognition of Your Outstanding Support of JPSS Flight Project."

**Christy Hansen, Code 615**
"For her creative leadership, long hours, and on-time deliveries in defining and developing the RRM Operations, an RRM Control Center, and trained RRM Mission Teams."

**Laura Walker, Code 408**
"For exceptional contributions, from the routine to the impossible, on the Argon Rendezvous and Proximity Operations Sensor Test Campaign."

**Timothy Wasserman, Code 408**
"For his creative initiative, long hours, and on-time deliveries in defining and developing the RRM Ground Support Equipment, an RRM Control Center, and trained RRM Ops Teams."

## Rookie of the Year

**Jacklyn Mattson, Code 408**
"For outstanding performance in her rookie year as Project Support Manager in the Satellite Servicing Capabilities Office."

**Matthew Strube, Code 596**
"For exceptional achievements on the Argon project towards advancing U.S. Government capability for non-cooperative Rendezvous and Proximity Operations."

**Ricardo Martinez-Serrano, Code 470**
"For your significant contribution as a new Resources Analyst, and your efforts to improve JPSS financial reporting and tools."

**Adam Wilson, Code 470**
"Adam Wilson hit the ground running when he came to JPSS from ODIN. Adam received kudos from customers immediately, and he continues to exceed standards in providing support."

**Christopher Derkacz, Code 432**
"In grateful recognition of outstanding scheduling support from a relative newcomer to the Mars Atmosphere and Volatile EvolutioN (MAVEN) Project."

**Peter W. Ondrus, Code 427**
"For his impressive ability to get up to speed with the LDCM Project's financial responsibilities,

(Awards continued on page 34)

(Awards continued from page 33)

demonstrating both agility and dedication, Peter Ondrus is truly deserving of the Rookie of the Year Award."

## Silo Slammer

**Jonathan Bryson, Code 403**
"For outstanding leadership and selfless commitment to promote cross-directorate learning and business initiatives."

## Steady Helm

**Bill Ochs, Code 443**
"For your steady hand and good nature leading the JWST through trying times."

**Larissa Graziani, Code 546**
"In recognition of your outstanding technical insights and perseverance in solving the 2011 NPP VIIRS On-Orbit Degradation Issue."

**Russell Katz, Code 417**
"For demonstrating dynamic leadership, creating and maintaining team focus and bringing to successful completion the GLM Sensor Unit electronics redesign activity."

## Unsung Hero

**Cecilia Czarnecki, Code 700**
"This individual is the ACE of Hearts for ACES and expects nothing less than a Royal Flush for FPD IT! What a Hero!"

**Charlette M. Johnson, Code 422**
"An integral member of the NPP Resources Team for the past 6 years. During this time she has demonstrated her in depth knowledge of the Agency's financial system."

**Robin Krause, Code 416**
"In recognition of her commitment to causing a breakthrough in Directorate Performance through the Creating a New Future Initiative, this award is presented to Robin Krause."

**Kelly Hyde, Code 444**
"Our Unsung Hero is such a delight to work with and deserves to be recognized for all the hard work she puts forth to make our jobs a lot easier because she excels in hers."

**Leslie Cusick, Code 432**
"In grateful recognition of behind-the-scenes contributions and extraordinary support to the Mars Atmosphere and Volatile EvolutioN (MAVEN) Project."

(Awards continued on page 35)

*(Awards continued from page 34)*

**Sarah DiMarco, Code 427**
"For service meeting the needs of her customers and co-workers with a "can do" attitude, dedication and teamwork, Sarah DiMarco is truly deserving of the Unsung Hero Peer Award."

**Shanita Drakeford, Code 421**
"For stepping up in a time of need, learning new responsibilities, and keeping the Resource Team for POES/MetOp moving forward through an extraordinary time of transition."

## Wild Card

**Gerard Daelemans, Code 440**
"For dedication, teamwork and leadership in the FPD Creating a New Future Initiative and support for the Relationship Subgroup."

**Chrysoula Bevard, Code 279**
"Who are you going to call when the building ails? That Wonderful FOM - Chrissy Bevard."

**Gary Won, Code 461**
"For Outstanding Accomplishments in Pursuit of MMS Mission Success."

**Megan Gorham, Code 454**
"Megan's outstanding contributions to the Mission Operation - On Orbit Test (OOT) team have allowed the team to meet their quality and schedule commitments."

*(Caldwell Tintype continued from page 3)*

One year later, Chris was offered a position in the Explorers Program Office (Code 460) to work as an Resources Analyst on an in-house, Principal Investigator (PI)-led, instrument build (Astro-H). Along with working on Astro-H, Chris also supported GEMS and the XPI in-house instrument build. On GEMS, Chris served as the lead RA for the in-house instrument and provided financial support to technical management in both Code 400 and Code 500.The experiences gained from working a GSFC in-house instrument (Astro-H and GEMS), paired with the Prime Contractor (TDRS/Boeing) aspect of a flight project has given Chris a broad understanding of the Flight Projects Directorate in his 5 years at GSFC thus far.

Chris also serves as the lead for Code 400's Combined Resources Forum and is a member on the Code 400 Business Change Initiative Team for EVM reporting.

**Life outside of GSFC:** Chris can be found supporting the Orioles/Ravens, playing golf, skiing, or at a concert.

# 2012 Flight Projects Directorate (FPD) Secretarial Award Winners

The Flight Projects Directorate recognized Angela Conley/460 and Karen Rogers/400 as the 2012 FPD Secretarial Award winners. Abstracts of their award citations are shown below.

Ms. Angela Conley from the Explorers and Heliophysics Projects Division (EHPD), has taken MAVEN under her wing and since 2008, provided remote secretarial support, most notably managing travel authorizations and travel reports for MAVEN's orphan staff. She corrals the many travelers and makes certain that they provide the information she needs. In all this, she has balanced MAVEN requirements with EHPD workload that includes travel, badging, correspondence, report and meeting coordination, and many other activities. Angela juggles customers and workload from multiple organizations, and MAVEN definitely benefits from the expertise she brings from her EHPD work. Angela has clearly gone above and beyond the responsibilities of her position in taking on another project and another set of bosses.

Ms. Karen Rogers was selected for her exceptional can-do attitude, selfless support to the code 400 staff, and her continued willingness to help others within the Flight Projects Directorate and beyond. Karen is the "rock" that keeps the front office functioning. The Directorate office can be chaotic, demanding, and constantly changing. Through all of the turmoil, Karen is able to remain calm, supportive, and upbeat. Karen effortlessly ensures everything runs smoothly and keeps key activities on schedule. She accomplishes this through her willingness to always learn and to help others. She consistently demonstrates excellent customer service by taking that extra step to help someone. Karen takes great pride in acting as the ambassador for Flight Projects, providing excellent customer service. This year, Karen stepped up to the plate and offered to be the Code 400 representative for the Combined Federal Campaign at NASA/GSFC. She tirelessly attended meetings, campaigned for the program, solicited donations from Goddard's civil servants and helped NASA reach its goal. The Flight Projects Directorate is extremely fortunate to have someone like Karen on its staff!

# PMDE Activities

At a brief ceremony held in the Code 400 suite last month, Flight Project Directorate (FPD) Director Of George Morrow presented graduation certificates to the most recent Project Management Development Emprise (PMDE) graduates: Kimberly Banks; Lorrie Eakin; Priti Vesudeva, and Matt Ritsko. Also present were several PMDE Advisory Board members: Dave Scheve; Steve Shinn; Linda Greenslade, and Sandra Cauffman. Code 400 anticipates announcing a new, updated PMDE program class in 2013.


***PMDE graduates (front row):***
***Lorrie Eakin, Kimberly Banks, Priti Vasudeva, and Matt Ritsko.***

***PMDE Advisory Board Members shown (back row):***
***George Morrow (Chairperson), Dave Scheve, Linda Greenslade, Steve Shinn, and Sandra Cauffman.***

***Picture Credit: Karen Rogers***

**Howard Ottenstein, Code 403**
**PMDE Facilitator**

# Quotes To Think About

"If your parent is just, revere him; if not, bear with him."
— Syrus Publilius

"I am only one, but still I am one. I cannot do everything,
but still I can do something; and because I cannot do everything,
I will not refuse to do the something that I can do."
— Edward Everett Hale

"A trifling rumor may cause a great calamity."
— Syrus Publilius

"Besides the noble art of getting things done, there is the noble art
of leaving things undone. The wisdom of life consists in the
elimination of nonessentials."
— Lin Yutang

"Why do you ask me these questions (about V-2 bombs)? Why don't you ask
your own rocket pioneer, Dr Goddard? We learned these things
by studying him."
— Captured German scientist after World War II

"The great tragedy of Science – the slaying of a beautiful hypothesis
by an ugly fact."
— Aldous Huxley

"There comes a time in a man's life when to get where he has to —
if there are no doors or windows —
he walks through a wall."
— Bernard Malamud

# Comings & Goings
# April 1 thru June 30, 2012

**Comings:**

* Kevin Hartnett [from 581] to 441 / HST Operations Project, Science Operations Manager
* Andrew S. Carson [from HQs/SMD] detailed to 401/Advanced Concepts & Formulation, TESS Mission, Deputy Project Manager
* Sharon Straka [from 546] detailed to 420 / ESPD Earth Systematic Mission Program, Mission Manager
* Marco Midon [from 567] to 450 / Exploration & Space Communications Projects Division, Lab Director
* Brett Gillard [from 703] to 450 / Exploration & Space Communications Projects Division, Senior Resources Analyst
* Richard Lynch [from 599] to 443 / JWST Project, Deputy Observatory Manager
* Julie Hostetler [from 603] to 423 / ESDIS Project, Resources Analyst
* Gallette (Tracy) Borden [from 201] to 450.1 / NIMO Project, Financial Manager

**Goings:**

* Kenneth Olson retires from 408 / Satellite Servicing Capabilities Office, EVA Operations Crew Training Manager
* Donna Montgomery [from 450.1] to 603 / Business Management Officer
* Holly Bryant's detail to 474 / JPSS Ground Project, Resources position ends
* Sheila Stanford [from 408] to Code 200 / Management Analysis
* Barb Vargo retires from 441 / HST Operations Project, Financial Manager
* Byron Wong [from 405] to 703 / Financial Manager
* Roseline Kamara [from 441] to 153 / Program Analyst
* Sandy Phillips retires from 472 / JPSS Flight Project, Senior Resources Analyst
* Jim Lohr [from 448] to 323 / Chief, Safety and Mission Assurance Officer

**Lisa Hoffman, Administrative Officer**
**Code 400**

## Note From The Editor

This issue of The Critical Path marks the completion of 20 years of publication. It has been an interesting journey and a work of joy and fulfillment to serve as its editor since the first issue in December, 1992. Many thanks to Paula Wood for her many years of service as Editorial Assistant and to Laura Paschal as Production Assistant. A fond remembrance as well to Nancy White, who served a lengthy time as Laura's predecessor and who sadly, passed away in 2011, and to all those who helped prepare The Critical Path in earlier years.

Howard KO

| FUTURE LAUNCHES CY 2012 | |
|---|---|
| Radiation Belt Storm Probes (RBSP) Mission | AUGUST |
| MetOp-B (non-NASA) | SEPTEMBER |
| Tracking and Data Relay Satellite-K (TDRS-K) | DECEMBER |

## ATTENTION INTERNET BROWSERS:

We're on the WEB
http://fpd.gsfc.nasa.gov/news.html
Or via the New "Code 400" Homepage
http://fpd.gsfc.nasa.gov

**The Critical Path**

Published by the Flight Projects Directorate

*— In April, August, and December —*

**Howard K. Ottenstein,**
*Editor*

**Laura Paschal,**
*Production Assistant*

**Paula L. Wood,**
*Editorial Assistant*

**If you have a story idea, news item, or letter for The Critical Path, please let us know about it. Send your note to Howard Ottenstein via email: Howard.K.Ottenstein@nasa.gov, Mail: Code 403, or Phone: 6-8583. Don't forget to include your name and telephone number. Deadline for the next issue is November 16, 2012.**