NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

2007's auspicious beginning

the great comet McNaught

Independent Verification and Validation View

VOLUME 3, ISSUE 4, OCTOBER-DECEMBER 2007

Director's Point of *View*

Dear Reader:

The cover of our last quarterly of the year serves as a reminder of how we began the year, with much to inspire us to our best endeavors. I believe that, whether by the favor of the great comet or by our own hard work and commitment, 2007 began as, and has ultimately been, an auspicious year for NASA IV&V. Auspicious, defined as "being marked by the promise of success."

We have reviewed and revised and reinvented ourselves in 2007. And yet, we have remained the same. Our vision is clear and our mission is all the more certain for the time spent in strategic thinking, program planning, challenging and mentoring our current and emerging leaders, and the exercise and application of our collective skills.

I hope, as always, you will enjoy reading about some of the work, of the mind and of the heart, that has made our efforts of this year meaningful for our Agency, our team and our community.

In the meantime, we look forward to the beginning of another year of contributing to the safety of our Agency's critical missions. Like 2007, I am confident that 2008 will also deliver on the promise of success.

Cordially,

Dr. Butch Caffall
Director

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All the Parents (special thanks to Melissa Northey)

Cover Photo:
The Magnificent Tail of Comet McNaught
Credit & Copyright: Robert H. McNaught

Explanation: Comet McNaught, the Great Comet of 2007, has grown a long and filamentary tail. The spectacular tail spreads across the sky and is visible to Southern Hemisphere observers just after sunset. The head of the comet remains quite bright and easily visible to even city observers without any optical aide. The amazing tail is visible on long exposures and even to the unaided eye from a dark location. Reports even have the tail visible just above the horizon after sunset for many northern observers as well. Comet McNaught, estimated at magnitude -2 (minus two), was caught by the comet's discoverer in the above image just after sunset last Friday from Siding Spring Observatory in Australia. Comet McNaught, the brightest comet in decades, is now fading as it moves further into southern skies and away from the Sun and Earth.

Managing Editor: Donna Ozburn *Editor:* Kathleen Millson

Please submit news items and/or photos to Kathleen.M.Millson@nasa.gov; 304-367-8445.
All submissions are subject to editing.
Next Submission Deadline: March 1, 2008

IV&V Was Out to Launch in 2007

Agronomy of Ice in the Mesosphere (AIM)

IV&V Project Manager: Raju Raymond
IV&V Contractor: Northrop Grumman
Contractor Lead: Phil Loftis
GSFC Mission Manager: Chris Savinell
http://aim.hamptonu.edu

The AIM spacecraft, part of NASA's Explorers program, was successfully launched on April 25, 2007. The AIM mission will provide unprecedented advances in the understanding of Polar Mesospheric Clouds (PMCs), also called noctilucent or "night shining" clouds. Recorded sightings of these clouds began in the late 1800s and have increased in frequency. The overall goal of the AIM mission is to study why noctilucent clouds form and why they vary. By measuring noctilucent clouds and the environment in which they form, we will learn more about the connection between these clouds and the meteorology of the mesosphere. In the end, this will provide the basis for study of long-term variability in the mesospheric climate and its relationship to global climate changes. The NASA IV&V Facility has performed IV&V on the AIM spacecraft and three on-board instruments, including the Solar Occultation for Ice Experiment (SOFIE), Cloud Imaging and Particle Size (CIPS), and Cosmic Dust Experiment (CDE). IV&V has contributed to the mission through meticulous analysis of each of the components. Additionally, IV&V participated in peer reviews and technical review boards for the mission software. The AIM project addressed technical issues associated with software requirements and flight software that IV&V identified and documented as part of its analysis efforts.

DAWN

IV&V Project Manager: Stephanie Ferguson
IV&V Contractor: L3-Com/Titan Group
Contractor Lead: Van Casdorph
JPL Project Manager: Keyur Patel
http://dawn.jpl.nasa.gov/

The NASA IV&V team continued to inspect the DAWN mission-critical software to ensure that the software will perform as intended. This year the team has performed code and test case analysis activities to ensure that DAWN mission will be successful. The key areas of analysis focus were on the Ion Propulsion System, On Board Computer software, and the Fault Protection software. Additionally, the NASA IV&V team supported a number of major milestone reviews leading up to the DAWN launch on September 27, 2007. Throughout our involvement, the DAWN project has been very supportive of IV&V activities and has agreed with the majority of our findings. DAWN's goal is to characterize the conditions and processes of the Solar System's earliest epoch by investigating in detail very different asteroids, Ceres and Vesta, which reside in the asteroid belt between Mars and Jupiter. Using an array of instruments, Dawn will investigate the internal structure, density and homogeneity of the two protoplanets. Dawn records the protoplanets' elemental and mineral composition to determine their thermal history and evolution and provides context for meteorites (asteroid samples already in hand). Dawn images Ceres and Vesta's surfaces to determine their bombardment and tectonic history, uses gravity and spin state to limit the size of any metallic core, and infrared and gamma ray spectrometry to search for water-bearing minerals. Mission-critical software aboard DAWN will be used to control its advanced Ion Propulsion System, which provides the thrust necessary to carry the spacecraft to its destinations. The remainder of the on-board software is involved in the control of the spacecraft attitude and maneuvering along with orbit operations at the asteroids; solar array positioning; science data capture, storage, and transmission; and command receipt and execution from the ground controllers. The fault protection system monitors spacecraft health and status data and performs automated sequences in response to faults.

Mars Scout Phoenix Lander (PHOENIX)

IV&V Project Manager: Dan Solomon
IV&V Contractor: L3-Com/Titan Group (May 11, 2005 – August 3, 2005) Lead – Travis Dawson
Northrop Grumman (August 4, 2005 – August 31, 2007) Lead – Shirley Savarino, Lisa Nicklow, Phil Loftis
JPL Project Manager: Barry Goldstein
http://phoenix.lpl.arizona.edu

The Phoenix mission is the first chosen for NASA's Scout program, an initiative for smaller, lower-cost, competed spacecraft. Named for the resilient mythological bird, Phoenix uses a lander that was intended for use by 2001's Mars Surveyor mission prior to its cancellation. It also carries a complex suite of instruments that are improved variations of those that flew on the lost Mars Polar Lander. Phoenix was launched from KSC on August 4, 2007. The IV&V Facility performed IV&V for the Flight Software that includes analysis activities for the Spacecraft and Payload subsystems. The team has supported all major milestone reviews since the PDR in March 2005. The IV&V team completed analysis of the software and interface requirements and design, as well as the code and test artifacts. IV&V found no issues that could prevent accomplishment of any essential capability. The team has discovered several issues, which could have adversely affected the accomplishment of essential capabilities. Corrections have been implemented for all of these issues.

Phoenix mission-critical software will control all phases of the mission including maneuvers during cruise, descent and landing on Mars, digging up samples, chemical analyses, and relay of data back to Earth. During the course of the 150 Martian day mission, Phoenix will deploy its robotic arm and dig trenches up to half a meter (1.6 feet) into the layers of water ice. These layers, thought to be affected by seasonal climate changes, could contain organic compounds that are necessary for life. To analyze soil samples collected by the robotic arm, Phoenix will carry an oven and a portable laboratory. Selected samples will be heated to release volatiles that can be examined for their chemical composition and other characteristics.

Imaging technology inherited from both the Pathfinder and Mars Exploration Rover missions will also be implemented in Phoenix's stereo camera, located on its 2-meter (6.6-foot) mast. The camera's two "eyes" will reveal a high-resolution perspective of the landing site's geology, and will also provide range maps that will enable the team to choose ideal digging locations. Multi-spectral capability will enable the identification of local minerals. To update our understanding of Martian atmospheric processes, Phoenix will also scan the Martian atmosphere up to 20 kilometers (12.4 miles) in altitude, obtaining data about the formation, duration and movement of clouds, fog, and dust plumes. It will also carry temperature and pressure sensors.

Space Shuttle

IV&V Project Manager: Melissa J. Bodeau, PMP
IV&V Contractor: L3-Com/Titan Group
IV&V Contractor Project Manager: John W. Bradbury, PMP
Manager, Space Shuttle Flight Software Office: Darrell Stamper/Johnson Space Center
http://spaceflight.nasa.gov/shuttle/ or http://www.nasa.gov/centers/johnson/missions/shuttle.html For information on the Space Flight Awareness Award, visit http://sfa.jsc.nasa.gov/index.cfm

The Space Shuttle is the world's first reusable spacecraft and the first spacecraft in history that can carry large satellites to and from orbit. It provides US and International Partner access to the International Space Station (ISS) for crew, cargo, and ISS components. The Shuttle is the only vehicle capable of bringing the final pieces of ISS into space to achieve our goal of "assembly complete". The Shuttle will visit the Hubble Space Telescope for one last servicing mission in 2008 in addition to supporting the ISS. The Space Shuttle and its software are immensely complex systems. IV&V of Shuttle software is crucial to providing the high level of safety and mission assurance necessary when human life is at stake. IV&V's work on the Shuttle in 2007 included our standard analysis of safety-critical changes to the software in the onboard General Purpose Computers (GPCs) and Multi-function Electronic Display Subsystem (MEDS), in the Space Shuttle Main Engine Controllers (SSMEC), and in the Miniaturized Airborne GPS Receivers (MAGRS-3S) flown onboard. Each change is analyzed with appropriate requirements, design, code, test, and systems analysis tasks to ensure both the correctness of the final software and that there are no unintended consequences to the unchanged areas.

This year saw the successful first use of "three string GPS" on STS-118, marking the first time the Shuttle had navigated to landing using only its GPS receivers, without the use of the TACAN system. IV&V has been involved with the MAGRS-3S for a number of years and has identified many significant issues with the MAGRS-3Sfirmware and system that were resolved prior to NASA certifying STS-118 ready to fly safely with three-string GPS.

Additionally, this year we performed two Independent Assessments (IAs). The first IA was performed on selected software in the new Solid Rocket Booster Command Receiver/Decoder, first flown on STS-118. The CRD receives signals from the Range Safety System and would be the mechanism by which the SRBs were destroyed in-flight if certain safety parameters were violated. Thus, it's important that the CRD work perfectly, both when it is needed for a destruct and when it isn't. One of our analysts, David Wirkkala, was named a Space Flight Awareness Honoree for his contribution to this team effort. This prestigious award is presented to employees for their dedication to quality work and flight safety. The IA found no safety of flight issues, and provided that assessment, along with a more detailed report, to the Office of Safety and Mission Assurance as well as to various Shuttle project offices.

Space Shuttle *continued*

The second IA was related to flying the Shuttle over the end of the calendar year, referred to as Year-End Roll-Over (YERO). YERO occurs when the Shuttle's Master Timing Units (MTUs), which are highly accurate time sources for the on-board computers (GPCs), experience rollover of Greenwich Mean Time (GMT) from 365 days to 0 days. The GPCs have a second time source, internal clocks, which are less accurate than the MTUs. The GPCs' internal clocks were not designed to roll over but continue to count up to 366 days and so on. Once the end of the calendar year occurs, the two time sources are no longer synchronized, with the MTUs showing day 0 and the GPC internal clocks showing day 366. As a protection, the GPCs are designed to use internal time instead of MTU time if the two are out of sync. In order to successfully deorbit and land the orbiter after YERO, use of MTU time by all five GPCs must be re-established on-orbit. Previously this required the crew and ground to follow a lengthy and complicated procedure that had limited testing on the ground and had never been performed in flight. The Shuttle Program implemented GPC flight software changes to simplify and shorten the procedure and provide greater flexibility to fly the Shuttle with fewer schedule constraints. The Shuttle IV&V team used operational scenario analysis, supported by modeling techniques, of the modified software and the "system" of the modified YERO procedure to look for flaws and safety concerns. The IA found no safety of flight issues and provided that assessment, along with a more detailed report, to the Office of Safety and Mission Assurance as well as to various Shuttle project offices.

In 2007, IV&V supported four Shuttle missions. Before each Shuttle mission, we reported on our analysis at the Software Readiness Review conducted by the Shuttle Program's Flight Software Office. IV&V is also a voting participant in each mission's Safety and Mission Success Review, co-chaired by astronaut Bryan O'Connor, the Agency's Chief of Safety and Mission Assurance, and Michael Ryschkewitsch, the Agency's Chief Engineer.

All the members of the Shuttle IV&V team are proud of our continuing contribution to the safety of the Shuttle Program and look forward to the five scheduled Shuttle missions in 2008, which include STS-125, the final Hubble Space Telescope servicing mission.

Time History of Events and Macroscale Interactions During Substorms (THEMIS)

IV&V Project Manager: Judi Connelly
IV&V Contractor: NGIT/Keylogic
Contractor Lead: Eric Sylvania
GSFC Mission Manager: Frank Snow
http://ds9.ssl.berkeley.edu/themis/flash.html

NASA's THEMIS five probe mission launched successfully on February 17, 2007 at 6:01 p.m. EST from Pad 17-B at Cape Canaveral Air Force Station, Florida. In December 2007, From 2003 to Launch, IV&V focused tasking in flight software for instruments and flight avionics. These software components are critical for the successful collection of science data as well as various orbit maneuvering required throughout the mission lifetime. Critical Flight Software functions were identified in each of three main subsystems: Instrument Data Processing Unit (IDPU), Bus Avionics Unit (BAU) and Attitude Control and Orbit Maneuvering components of the Ground System. The THEMIS Mission Team (Vassilis Angelopoulos, Principal Investigator and Peter Harvey, Project Manager, both of Space Sciences Laboratory, University of California, Berkeley, CA) received a Goddard " Exceptional Achievement Award" at the Goddard Annual Honor Awards Ceremony.

THEMIS will study the onset and evolution of Magnetospheric Substorms that produce aurorae borealis. The THEMIS probes will time the sequence of electric and magnetic field changes from solar particle interaction with the Earth's magnetic field. These space probe measurements are coordinated with ground-based measurements from cameras stationed throughout Alaska and Canada. Magnetometers to measure local magnetic field fluctuations are located at regional k-12 schools as a unique part of the THEMIS' Education and Public Outreach Program. Local students actively participate in observations. The result of THEMIS efforts will answer 30-year-old questions in Magnetospheric Physics, such as: What is the sequence of events that triggers the aurorae borealis? How does the Earth's magnetosphere process solar wind energy? What is the delineation between the cause and effect of main substorm processes? One theory proposes that the solar wind disrupts a sheet of moving charged particles about 10 Earth radii down the magnetotail, triggering the eruption and, a minute later, causing the Earth's magnetic field to cross-link or "reconnect." A second theory proposes that magnetic reconnection happens first, at about 25 Earth radii, which then disrupts the sheet of current to trigger the substorm a couple of minutes later. The answers to these questions are important for understanding the dynamics of the Sun-Earth Environment in which we live.

Green With Efficiency

Q: How many environmentalists does it take to change a light bulb?
A: We don't know yet - their long-lasting eco-bulbs still don't need to be changed!

Using compact fluorescent light bulbs (CFL) uses 60 percent less energy, cuts lighting costs by 75 percent, and lasts 8 times longer than standard incandescent bulbs! The U.S. Department of Energy reported that in the average home, 34% of the home-energy is used on lighting and appliances - that could mean some serious energy savings!

Right now, the DOE is sponsoring a **Change a Light!** campaign. "The ENERGY STAR Change a Light Campaign is a national challenge to encourage every American to help change the world, one light — one energy-saving step — at a time. You can show your commitment by pledging to replace at least one light in your home with one that has earned the ENERGY STAR." For more information, visit: http://www.energystar.gov/index.cfm?fuseaction=cal.showPledge .

Introducing the NASA IV&V Facility Research Interns

The goal of the research intern program is to provide valuable hands-on experience for college-level students by utilizing and fostering their skills to help meet the needs of the IV&V Facility. Students in the program are selected by the NASA IV&V Research Team from a pool of applicants solicited by the West Virginia NASA Space Grant Consortium. The students are typically full-time students from West Virginia colleges and universities.

For the past several months, the following students from West Virginia University and Fairmont State University have been working with the Research Management Team to evaluate research Infusion technologies and develop evaluation reports, perform robustness testing on flight software, and begin revamping the Facility research web pages. As the students' current tasks and projects continue, they will also begin performing activities to support projects within the Facility. These students will get the opportunity to work alongside fellow students and NASA employees to help achieve the Facility's goals.

Current interns include Robert Ball, Kayla Medina, and Jonathan Meyer.

Robert Ball is currently a senior at Fairmont State University. He is pursuing both a bachelor's degree in Computer Science and a bachelor's degree in Computer Security. He is also a member of the Fairmont State Honors Program, and has been featured in the Fairmont State Student Spotlight. He plans to pursue a master's degree and a PhD in Computer Science. During Robert's internship at the Facility, he has completed an evaluation on CodeSonar, produced CodeSonar supplementary documentation, and performed robustness testing on GLAST LAT flight software.

Kayla Medina is a student at West Virginia University, where she is pursuing degrees in mechanical and aerospace engineering. Kayla has been working at the NASA IV&V Facility for the past two summers as a high school Science Engineering Apprenticeship Program intern. During this time, she analyzed requirements and their traceability for the LRO and SDO missions and also provided support in the planning and execution of the annual Software Assurance Symposium (SAS). Due to her concern for the health of the earth, she hopes to work for NASA in the future as an aerospace engineer, designing vehicles that will search for resources and energy sources outside of our world.

Jonathan Meyer is currently pursuing his Computer Science degree at West Virginia University. Jonathan was previously responsible for preparing test cases for NASA Flight Software, as well as executing them to ensure the robustness of the software. In addition to his work with Robustness testing, Jonathan performed evaluations of emerging Software Engineering tools and methodologies to determine their usefulness and means by which they can be most quickly adopted by the Facility. Throughout his internship he has become skilled in the use of Source Navigator, Tornado IDE, Reactis, and Xception fault injection software.

Community Outreach Goes Global

Have you ever wondered who uses the instrument shelter or the automated weather station on the IV&V property? Well, they are both tools used by the Educator Resource Center (ERC) to run workshops on NASA's GLOBE Program. The Global Learning and Observations to Benefit the Environment Program is an international educational initiative that partners students with scientists to learn more about our planet through an Earth system science approach. Teachers and students from 110 countries worldwide collect local data on Soils, Atmosphere, Hydrology, Land Cover, and Seasons which they share with one another and NASA scientists through GLOBE's online database. Due to the ERC's success training over 400 WV educators in GLOBE our trainers and teachers have become known worldwide as leaders in the promotion which has resulted in invitations to share our knowledge with countries that are just joining the program. One such invitation came from the governor of the Ondo State Government in Nigeria and the Sunshine State e-Technology Center in Akure, Ondo State. (see map).

Akure is the capital of Ondo State, Nigeria

Nigeria's Ondo State Hosts Third GLOBE Workshop

The third Global Learning and Observation to Benefit the Environment (GLOBE) workshop took place on December 17-20, 2007, in Nigeria at the Sunshine State e-Technology Center in Akure, Ondo State. This training is the second in a series which will certify at least two GLOBE teachers at each of Ondo State's 250 secondary schools and provide the school with a complete set of equipment to measure GPS, atmosphere, soils, hydrology, and land cover protocols. The Governor of Ondo State, His Excellency Dr. Olusegun Agagu, has sponsored this long-term initiative, including a sustained professional development program for teachers, with the goal of inspiring future generations of scientists by providing opportunities for students in mathematics, science, and technology. This opportunity would not have become a reality with out the dedication of Dr. Raifu Durodoye, Professor of Mathematics at North Lake College in Texas, USA. "Duro," as he is affectionately known by his friends and family, coordinated the workshop, established a partnership with the Federal University of Technology, Akure (FUTA) to ensure program sustainability, secured over 100 GLOBE school kits, and brought together GLOBE Master Trainers from Nigeria, Cameroon, and the United States.

Dr. Deb Hemler (WV, USA) guides teachers in use of GPS and com-

Teachers learning about Atmosphere Site Definition at the Sunshine State e -Technology Center, Akure, Ondo-State Nigeria.

Thirty-five secondary teachers from twenty-three schools were certified in GLOBE protocols, and four university professors earned their GLOBE Trainer certification. Ondo State provided each school and FUTA with a GLOBE kit which included all equipment needed to measure location (GPS and compass), air, water and soil temperature, precipitation, relative humidity, water conductivity, pH, transparency, dissolved oxygen, soil chemistry (N,P, K), soil bulk density, soil profiles, and land-cover sample sites. The FUTA professors have agreed to train additional Ondo teachers and to assist schools without Internet access by uploading their data. Additionally, these and future meteorology Ph.D. candidates will work closely with the GLOBE schools, which will become the largest and most coordinated environmental monitoring system in the region. "Throughout our combined experiences, which include over 50 years of teacher professional development in a half dozen countries, we have never seen such strong support from the state government and a University as you have in Ondo State," stated Todd Ensign (West Virginia, USA), speaking to the

Ondo State teacher carrying her new GLOBE equipment back to her school.

Outreach Goes Global *continued*

governor at his residence in Akure. "It is clear that Ondo State is making a long-term commitment to improving the scientific and technological literacy of Nigerian school students.

The trainers maximized the training time by guiding the 35 new teachers through hands-on learning activities and use of their new GLOBE equipment while the FUTA professors focused their efforts on developing training and implementation strategies for future workshops. The international training team consisted of GLOBE trainers Mr. George Nditifon from Cameroon and three trainers from West Virginia, USA, including Mr. Todd Ensign, Dr. Deb Hemler, and Mrs. Tiffany Litton. Although the team members came from many areas, they all shared a common enthusiasm for GLOBE in Nigeria.

Todd Ensign (WV, USA) works on data entry with the FUTA Meteorology professors: Balogun Ifeoluwa Adebowale, Ajayi Vincent Olanrewaju, Adefisan Elijah Adesanya, and Abatan Abiodun Abayomi.

Dear GLOBE Pioneers:

On behalf of Ondo State Government and the people of Nigeria, I would like express gratitude for the hard work and selfless service during the Third GLOBE Workshop at Akure. I have also discovered that you have devoted additional responsibility on the article entitled The Third GLOBE Workshop.

To this development and a well as others, Nigeria will forever remember you NOT only as the pioneers of GLOBE program, but as selfless professionals who are the paradigm of change in the instructions of Mathematics, Science and Technology education.

Thank you, History and Providence will reward you the most.

Duro
Raifu Durodoye

Dear GLOBE Pioneers:

Congratulations to all! It will be very good to submit an article to be featured as a STAR on the GLOBE Web site. On behalf of everyone at the GLOBE Program Office, we thank you all for the hard work that went into ensuring this event was such a success.

Best regards,
Teresa

Dr. Teresa Kennedy
Deputy Director of GLOBE

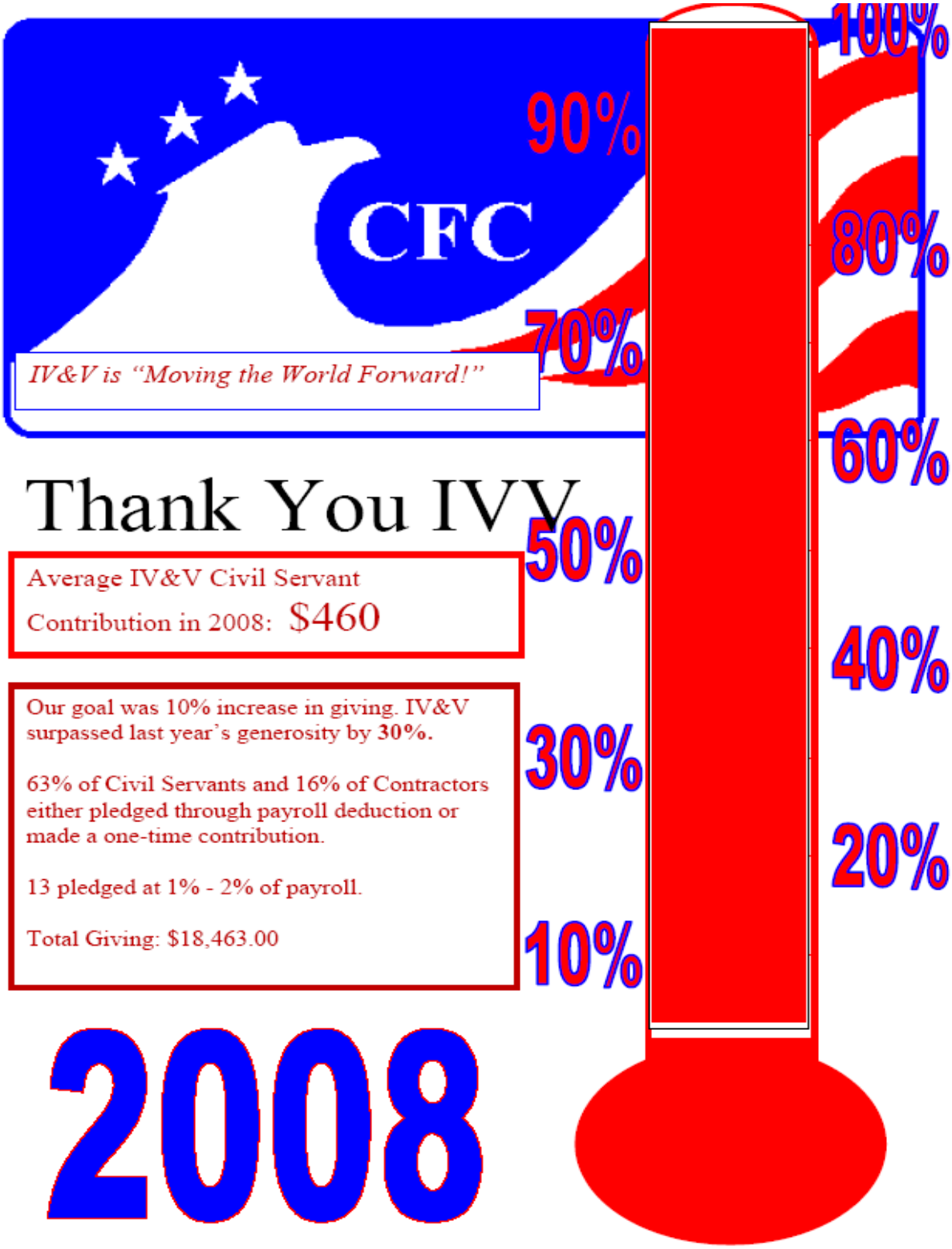
From Nigeria to West Virginia, interesting and valuable work is being done by the ERC team. Our own Facility Ops Manager even took advantage of the opportunity to bring his son Camron to a GIS workshop. Geographic Information Systems are key to increasing student understanding of relationships between data and visualizations. You can learn about free GIS software and work with the software and a GIS professional to discover the potential for student research.

After Todd taught a great class on the GIS basics, my son Camron (9yrs old) found his first cache.

Todd did a great job.

Dave Sheldon

The 2008 Combined Federal Campaign: the gift that keeps on giving

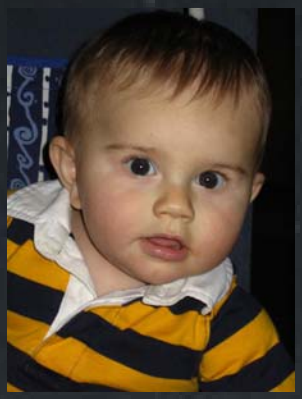


Safety, Respect, Teamwork, Balance, Excellence, Innovation, Integrity

In addition, nearly $1,000 worth of clothing, toys and gifts were donated for the family of nine that we adopted for the Holidays, plus a $100 Kroger Grocery card. An additional $80 gift card to Kroger, a $30 gift card to Sheetz gas stations, and three $30 gift cards to Target were added to be sure our gift would keep on giving. We also saw amazing generosity from all of our IV&V team members to the local food pantries. It is a blessing to be involved in these efforts with such caring colleagues. Thank you one and all.

Our Value-Ables: IV&V's auspicious beginnings...it's personal

Abigail Amber Fisher
Daughter of Marcus Stephen Fisher
and Hailie Amber Fisher



Isaiah Evan Irons
Son of Joseph Evan Irons
and Melissa Elaine Irons

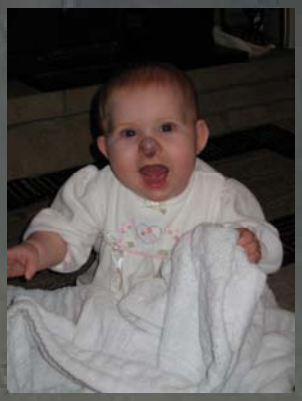
Jeremiah Eckard Rogers
Son of Paige Eckard and Robert Rogers

Angelica Michelle Thompson
Daughter of Donnie and Lilibeth Thompson

Levi Wesley Robert Williams
Son of Jerry and Kim Williams

Elijah John Collins
Son of Sean and Christy Collins

Daniel Antonio Wirkkala
Son of David and Erika Wirkkala



Tiffani Louise Titus
Daughter of Jeremy and Adrienne Titus

William James Northey
Son of Melissa and Jeff Northey

Hayden Charles Casdorph
Son of Heidi and Van Casdorph

Cadence Faith Kelley
Daughter of Ben and Angie Kelley