
Electron Forecast Model — 26 Jul 2004
UHF Scintillation Map
25 Jul 2003
16:00Z
FORECAST
Scintillation Legend
Weak 1.6–4.0
Mod. 4.0–10.3
Severe > 10.3
Day/Night Terminator
Magnetic Equator
COMSAT Footprint
COMSAT Location
Degrees Longitude
CENTCOM
UFO–5, UFO–10/72.0E
Climatological Scintillation Map
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Space Weather-
Looking beyond a 'Global' fight

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The Magazine for Air Force Weather

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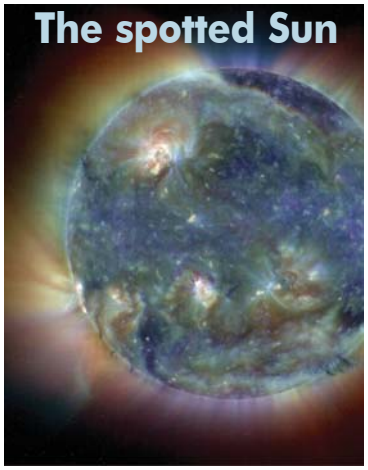
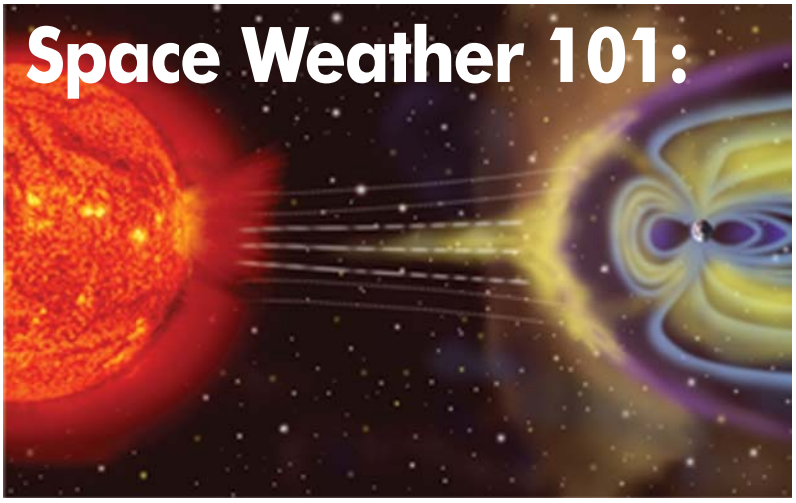
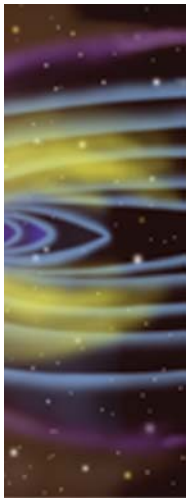
What's Inside:







On the Cover

The incorporation of space weather into military planning and at every operational level is crucial for the modern military. Space weather technicians give military planners the ability to mitigate the negative impacts of solar disturbances. This *Observer* issue is dedicated to inform the reader about space weather products, impacts, and issues. Photo illustration by Jodie Grigsby.

Editor's Note:
Due to mission requirements; there was no *Observer* published for Sep/Oct '04.

Taking it to the Next Level

by Col. Patrick Condray
Headquarters Air Combat Command,
Director of Weather
Langley AFB, Va.

All members of the Air Force Weather community can take pride in the remarkable transformation we have made in our operations over the last few years. Working through the many changes and uncertainties involved in establishing Operational Weather Squadrons and refining OWS and Combat Weather Team teamwork is dramatic enough by itself. Remember that all of these changes have been made through repeated unprecedented surges in operational tempo, while coping with tremendous shortage of experienced personnel and training the eager and talented but inexperienced wave of new members of our team. It may not be the single most remarkable thing the U.S. Air Force has accomplished, but I think it's pretty high on the list. You should be extremely proud of the part you have played in making this happen.

We will continually tweak and refine OWS-CWT teamwork to better support military operations. However, that portion of reengineering has reached about the proverbial "80 percent solution"–still being improved, but providing a solid framework to build on. It's now time to look at the next step in leveraging the benefits of reengineering: transforming how we integrate weather information into operational planning and execution at the field level.

This has been slow to develop as Air Force and Army support CWTs have focused their limited resources on meeting the challenge of wartime operations and refining their "eyes forward" teaming with their OWSs. Although current operations and their attendant challenges will no doubt continue, the manpower situation in most CWTs has improved considerably over the last two years. This planned benefit of reengineering, has allowed CWTs to start taking weather integration to a new level. We are achieving remarkable results from this effort.

A great example of this is the 20th Fighter Wing at Shaw AFB, S.C. I visited their base recently, and operators from the aircrew level to the Operations Group Commander gave great reviews on how it has helped their operations. They are very pleased with, proud of, and even proprietary towards "their" weather personnel. The following article discusses how they made it happen.

Combat Weather Team integration into operations

by Senior Airman Monica Cox
20th Operations Support Squadron CWT
Shaw AFB, S.C.

The Headquarters Air Combat Command Air Traffic Standardization and Evaluation Program team recently completed an inspection of the Shaw AFB CWT.

"This unit provides the best customer-focused weather support we've seen," said the chief inspector, Maj. Trayers.

Customer-focused support was the goal for Air Force Weather reengineering at the CWT-level. However, Air Force Manual 15-129, *Air and Space Weather Operations – Processes and Procedures* doesn't describe how to apply those concepts. It is up to each CWT to apply those concepts to their supported mission and customers. The Shaw AFB CWT has done just that.

The 20th Fighter Wing at Shaw AFB, S.C. provides, projects, and sustains combat ready air forces. The base is home to 80 F-16CJ Block 50s assigned across three fighter squadrons. The Block 50s are a multi-role aircraft specializing in suppression and destruction of enemy air defenses, employing a variety of munitions. The CWT provides continual service to Operation Noble Eagle (ONE) support requirements in defense of homeland security. They are focused on providing tailored mission support and helping the customer anticipate and exploit the weather.

However, there were significant challenges to overcome to do this sucessfully. Our biggest was manpower. The unit had low manpower, a round-the-clock support requirement, and was hit hard with deployments; we struggled just to support daily ops. We worked with the ACC Director of Weather to project our manpower based upon assurances that manpower would increase in 2004. Knowing our biggest challenge would be eased, we began to focus on understanding the mission and "big picture". Only then were we able to recognize opportunities to inject weather information into the customers' decision-making processes. We studied aircraft sensitivities, mission profiles, munitions types and their guidance systems, and critical weather thresholds. We had the intelligence flight give presentations on tactics and how they operate. We lobbied the flying leadership to gain support, starting one step at a time, showing them the value we could add.

We divided the flight into the Airfield Services Element and Mission Weather Element. Technicians in the Fighter Squadrons perform the mission weather function. The Airfield Services Element is a one-deep position performed in the base weather station. The BWS communicates with FS technicians via hand-held radio to ensure horizontal consistency. BWS notifies FS technicians of pending watches, warnings, advisories, and any other significant weather before notifying the supervisor of flying. They also perform the "eyes forward" function, resource protection, and produce planning and ONE products. The planning products allow pilots to get a "heads up" on weather before going to the mass brief and they are valid for the entire flying window. They also serve as a baseline for FS technicians who tailor the slides for each mission.

The Mission Weather Element produces the flying mission execution forecast from the FSs. They also provide planning weather, climatology briefs, supervisor of flying training, mass and

step briefs, flight weather briefs, tactical decision aids, mission watch, pilot reports, post mission analysis and operational verification. After designing and developing many of our products and services, we would bounce that product or service off of a FS DO or ADO who supported our efforts. All of our services span up to 16 hours on some days. We needed two technicians, splitting the duty day, per FS to integrate and provide quality service. Additionally, if the customer deploys and needs weather support, a technician goes with them.

Technicians know that it takes more than just being a weather geek to be a good FS technician. They are a liaison to that FS as well as a weather expert. They have to take the initiative to effectively communicate and establish trust and rapport with customers who claim the technician as "my weather guy."

The weather technicians seem to like the arrangement, because they've been given some ownership in developing our new processes and empowerment to execute the duties within their sphere of responsibility. FS technicians make their own decisions, determine their own schedule, solve their own problems, and fulfill their responsibilities. Not once has flight leadership been notified of a missed brief or a late product. The weather teams sees their contribution to mission success and they get feedback about how they are doing; good and bad. Our concept has proven its worth to the pilots and leadership who rave about this new way of support. They adjust their training based on the weather inputs we inject into their operations. Some of the results are tangible and are measured using our MEF verification program.

Many benefits to our concept are intangible. FSs used to assemble their own weather briefs, usually consisting of a TAF that was copied and pasted into a slide. Pilots had to do their own research and often didn't understand how to interpret the products. Now, a weather expert explains the impacts to them face-to-face. Our MEFs cover information from takeoff, enroute, and target area, to recovery and space impacts and are more accurate than ever. We monitor their radio frequencies. BWS has a scanner set to the supervisor of flying frequency and FS technicians listen to the top 3's radios. We use any formal pireps or feedback and the indirect information we hear over the radios for the next flight. For us, one flight serves as "recon" for another.

The effects we have on mission planning are also immeasurable. A pilot may see that he's scheduled to fly in a certain training airspace the next day so he asks the technician what the weather will be. The technician may tell the pilot weather is a "No-Go", but suggest an alternative. The technicians identify alternate flying areas to save sorties otherwise lost.

We see some of the same impacts during mission execution. They change mission profiles and airspace based on our MEF presented at mass briefs and turn back airspace as late as step briefs. Embedding technicians in FSs has also paid huge dividends during base exercises. The number one complaint prior to integration was not getting to briefings on time due to exercise scenarios. That problem is now solved since the technician is already there. Having a technician in place also pays dividends when watches, warnings, and advisories are issued. The BWS gives technicians a "heads up" on what will be issued and when. Mission adjustments can then be made as soon as possible. That was extremely valuable to leadership last spring when a tornado warning was verified. The 28th OWS and Shaw CWT "teamed" to advise the wing commander of a severe tornado-producing thunderstorm during a base employment exercise. The result was an evacuation of 26 F-16s saving lives and $750 million in combat assets. This concept works and the results cannot be denied.

The pilots get more precise forecasts tailored to their exact mission. The technicians gain much more insight into all aspects of FSs operations. They also identify more closely with the Wing's mission, have higher morale, and gain an understanding of the Air Force mission as a whole.

"This is the way it's supposed to be done," said Brig. Gen. Thomas Stickford during his visit to the Shaw CWT last December.

The Shaw CWT has capitalized on the Air Force Weather Reengineering concept. This has resulted in an increase in flight safety and aircrew training. Nevertheless, we've recognized even more opportunities to exploit the weather and will continue to shape the reengineering concept at the Shaw CWT.

A 10-step process for CWT integration into operations:

1. Review and update information about each supported customer's missions, weapon systems, and tactics in weather support documentation.

2. Identify and document critical operational (Go/No-Go) weather thresholds for each supported customer's missions, weapon systems, and tactics in all mission execution forecast processes, forecaster references, and continuation training programs.

3. Identify and document critical points and key decision makers in the planning, execution, and assessment phases of the continuous operations cycle.

4. Identify local challenges—resistance to change, clearances, work space, etc.—to integration and find ways to eliminate or mitigate challenges.

5. Identify and implement the most effective ways to communicate, automate, and accelerate sharing timely, accurate, and relevant weather information.

6. Develop procedures to effectively monitor each supported customer's operations continuously for real or potential weather impacts.

7. Develop procedures to consistently produce timely, accurate, and relevant mission planning and execution forecasts.

8. Develop procedures to continuously collect feedback and verify the accuracy of mission execution forecasts.

9. Develop procedures to use operator feedback to continuously refine mission-scale weather forecasting Tactics, Techniques, and Procedures.

10. Inform bosses and supported customers about integrated weather operations and seek support and buy in from senior leaders.

Once this 10-step process is completed CWTs should be eagerly looking forward and poised to realize their full potential by taking reengineering to the next level!

FORCE SHAPING

How will it impact the Air Force Weather career field?

by Chief Master Sgt. Jacob Lee
Air Force Weather Chief, Enlisted Matters
Washington, D.C.

I've been hearing a lot of misinformation regarding the efforts being made by the Air Force to reduce the number of people currently on active duty. I'd like to explain to all Air Force Weather Airmen what this means to you and its effects on the weather community.

Let me begin by explaining the problem. The Air Force has approximately 24,000 more people on active duty than is authorized by Congress. This costs the Air Force more than $1.4 billion a year in salary. Congress has set a deadline for the Secretary of the Air Force to reduce the manpower to authorized levels. The personnel directorate has now entered into the third phase of programs to control the number of people on active duty.

As part of the "Force Shaping" initiative, one program that has affected the weather career field was the deletion of selective reenlistment bonus. The Air Force was retaining personnel at a level above what is required to sustain the force. Therefore, cutting bonuses was one strategy used to decrease retention. Air Force Weather personnel reenlisted at an 83 percent rate through the first eight months of fiscal year 2004.

Another tool the Air Force has reinstated to control the amount of people retained on active duty is the career job reservation program, thereby, restricting the amount of people retained in the specific Air Force Specialty Codes. For the weather career field, the forecast for reenlistments from May through September were 23 people. Three people were allowed to reenlist. The remaining 20 people were given the option to either cross-train into other careers, or retain their original separation date. Starting in Fiscal Year 2005, Oct. 1, we will receive unconstrained CJRs – this means that every 1W person who is eligible and applies for a CJR will receive one.

A third program that will affect more than 120 AFSCs, but will be of minor impact for the weather career field, is a one-year reduction in the number of airmen we bring onto active duty. The Accessions Reduction Program will decrease the number of enlisted people on active duty by 11,000.

The Air Force personnel director recognized that weather personnel are a direct support to the war fighter and has included us as one of the 55 specialties that must be sustained. We will have 206 new airmen for the weather specialty; this is approximately 60 fewer than last year. This will be mitigated by bringing between 40 and 60 cross trainees, with the grade of technical sergeant, into the weather family. While it will take between two and three years for them to be fully trained to the 7-skill level proficiency, their varied backgrounds, experiences and perspectives will contribute vastly to the weather career field.

There will be two force-shaping programs that will continue for our career field through Fiscal Year 05. They are Palace Chase, for which applications will continue to be accepted; and release from active duty service commitments, for retirement eligible personnel, will be waived.

To sum up the force-shaping program for Fiscal Year 2004:

- Approximately 20 airmen were given the option to cross-train, or separate from service due to constrained CJRs.
- Others took advantage of the Palace Chase and early release programs.
- Selective reenlistment bonuses were eliminated for the weather career field.

Force shaping for Fiscal Year 2005:

- Will have little impact on the career field.
- Palace chase applications will continue to be accepted.
- Retirement eligible personnel will be allowed to forego their active duty service commitments.

However, I must stress that all eligible Airmen should apply for a CJR as soon as they are in their window of eligibility. Whether you intend to reenlist or not, you should apply. Without a CJR, Airmen are locked into only one option: separation from the Air Force. By applying, you give yourself more options when making future career decisions.

I encourage anyone with questions about force shaping, or any other questions about the weather career field to email me or call me at, (312) 224-7291. I want to make sure everyone, Airmen or senior NCOs, receives the most current information about the career field and about where we are heading in the future.

A hero among us

by Constance Torres
Air Force Weather Agency Public Affairs
Offutt AFB, Neb.

Brig. Gen. Thomas Stickford awards Capt. Jose Harris the Purple Heart, for wounds he received while serving in Iraq. Capt. Harris was injured when the convoy he was riding in was attacked. The Purple Heart is the oldest military decoration in the world in present use and the first American award made available to the common soldier. Photo by Tech. Sgt. Claudette Hutchinson.

Capt. Jose Harris joined an honored group of U.S. servicemen and women when he was presented the Purple Heart for injuries he received while supporting Operation Iraqi Freedom. The captain who was serving in Mosul, Iraq, as the 332nd Expeditionary Operations Group, Detachment 1, Weather Flight commander, was riding in a convoy that came under fire. He received six wounds to the face and neck during the attack.

"I feel privileged to serve in the United States Air Force and to have had the opportunity to defend my country and our way of life," Capt. Harris said of the incident.

Brig. Gen. Thomas E. Stickford, Air Force Director of Weather, presented Capt. Harris with the Purple Heart in a ceremony at Offutt AFB, Neb., Oct. 29. A formation of more than 200 AFWA members stood to honor the presentation. Capt. Harris' wife, two daughters and stepfather were also in attendance.

"I am honored to present this award. This is a very prestigious award that represents a moment in combat that we don't wish upon anyone. It's an affirmation of what we do and a tribute to all the men and women serving," General Stickford said during the ceremony.

The General noted, that for Capt. Harris, this particular incident in the global war on terrorism was a matter of being in the right place at the wrong time.

Captain Harris' stepfather, Lt. Cmdr. (U.S. Navy retired) Chuck Mach, also understood that with this decoration comes sacrifice, because in order for someone to receive the Purple Heart the person had to have been killed or wounded in combat.

"It's never good to hear that your son has been injured. [Therefore,] I will not congratulate him on his decoration. I want him to know how proud I am of him. He serves his country honorably, and I am proud of his courage," said Lt. Cmdr. Mach.

Capt. Harris can still vividly recall May 29, and the events that led up to the attack on the vehicle he was riding in that day. He was traveling in a convoy with Army Chaplain Timothy Vakoc, who was driving one of the Humvees, and Spc. Nathan Copas, the chaplin's assistant. The pair were returning from presiding over a mass at Camp Patriot. The five vehicle convoy consisted of: a five-ton truck, two Humvees, and two gun trucks covering the front and rear.

Capt. Harris said he recalls hearing a ringing that sounded like a pager. He says there is then a small gap in time that he cannot remember, but how long of a time he can't be sure. He said when he once again became aware, he could neither see nor hear.

The weather officer says that as his vision and hearing returned, he saw that the vehicle had been damaged and the Chaplin was injured. It was then that he knew that the vehicle had been hit. He later learned that an improvised explosive device detonated from under a median and struck the vehicle. He goes on to say the Chaplain's assistant stopped the vehicle when the Chaplain did not respond. Once the vehicle stopped, Capt. Harris quickly assessed the wounded driver's condition and followed the directions of the combat life saver, Tech. Sgt. Jason Hodges, to administer first-aid.

While many locals watched, they maintained their distance from the wreckage and no one attempted to help. The team worked diligently to keep everything under control. Capt. Harris recounted that everyone remained calm and responded very well during the situation.

After the Chaplain was safely evacuated and the team was debriefed, it was only then that Capt. Harris noticed he had been injured. Although his Kevlar Helmet and shatterproof sunglasses provided protection, concrete and glass debris managed to lodge into several places on Capt. Harris' face and neck. His sunglasses also had concrete embedded in them.

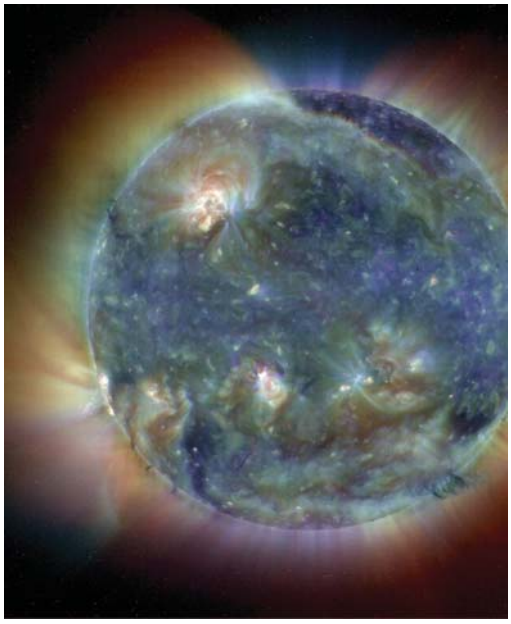
"Three days after returning home I pulled a piece of, what I believe to be concrete, from my wound. My ears still ring from time to time, accompanied by some pain, and I suffered permanent hearing loss," Capt. Harris said.

Although Capt. Harris said he is thankful to receive the Purple Heart, his thoughts are still with his fellow comrades, particularly with the Chaplin, who is still in a critical but stable condition.

"I'm glad that when the bad guys tried to kill us and stop us from accomplishing our mission to protect America and help the Iraqi people, I was able to make a positive difference for my fellow soldiers and our mission," Capt. Harris said.

the Spotted Sun

by Shauna Kinkela
Air Force Weather Agency Visiting UCAR Scientist
Offutt AF, Neb.



The Sun, by stellar classification standards, is a main sequence, type G star. In the grand scheme of things, the vast majority of stars are main sequence stars like our Sun, making it a rather average and indistinguishable member of the stellar community. Yet, because the Sun is the closest star to Earth, its emission of light and heat makes it essential to our daily lives.

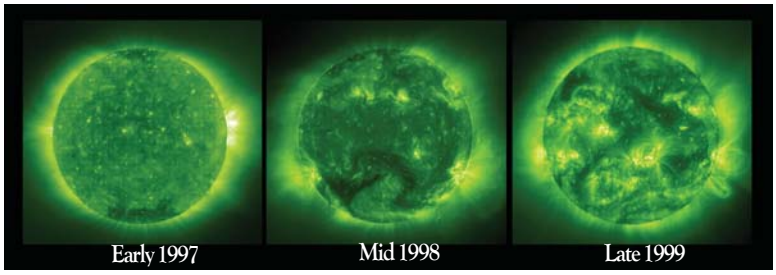
For about 4.5 *billion* years, nuclear fusion processes within its innermost region, the **core**, have maintained the Sun. At the core, which has the extreme temperature of 15,000,000 Kelvin (or about 14,999,727 degrees Celsius), 700 million tons of hydrogen is burned *per second*. It produces a staggering 3.8×10^{26} watts of solar energy output as five million tons is converted into energy. This 380,000,000,000,000,000,000,000,000 watts is enough energy per 1/1,000 of a second to support the world's power needs for 5,000 years.

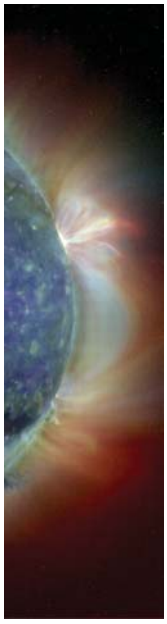
Once energy is created in the core, it begins to propagate outward through the next layer of the solar interior, the **radiative zone**. It takes about 170,000 years just for the radiation to make its trip from the core to the top of the radiative zone. This is because it is continuously absorbed and re-emitted as it propagates. The energy then makes its way through the **convective zone**: the outermost region of the solar interior.

The solar atmosphere, divided into three regions, contains the Sun's visible surface, the **photosphere**. At a "meager" 5,800 K (relative to 15 million K at the core), the photosphere is the home for **sunspots** , dark, cooler photospheric regions of strong, concentrated, emerging magnetic fields. Just above the photosphere is the **chromosphere**, or "color" sphere, named so because the emissions used to view it cause it to appear red in color. In the outer most region of the solar atmosphere, the **corona**, temperatures rise from the photosphere's 5,800 K back up to about 1,500,000 K. Visible light emitted from the photosphere swamps coronal emissions, so that an eclipse must occur or a special instrument, called a **coronagraph,** must be used in order to see it. Without a definite boundary, the corona extends into interplanetary space, carrying with it both particles and the Sun's magnetic field. This radial flow, called the **solar wind**, has an average speed of approximately 400 km/s, however, some solar wind speeds can reach three to four times that.

Sometimes we spend our day wondering about how "sunny" or hot it's going to be; what the "weather" will be like. But what some people don't realize is that these different layers of the Sun, ever changing, don't spend their time merely lighting a few hours of our day or causing us to need a dip in the pool. The many complex processes continuously evolving in the Sun create **space weather**: emissions of

The images illustrate how the level of solar activity increases significantly approaching solar maximum. Photo courtesy of SOHO.





This composite image combines three nearly simultaneous images, each at a different wavelength, to reveal solar features unique to each wavelength. Photo courtesy of SOHO.

radiation in the form of plasma (e.g. equal number of free protons and electrons) or electromagnetic radiation (e.g. X-rays) from active regions within the Sun and the effects these emissions have on the near-Earth space environment.

How active the Sun is, and in turn, how much of an effect it may have on the Earth, is primarily dependent upon the 11-year **solar (or sunspot) cycle**, which is a measure of the number of sunspots covering the solar surface over time.

At **solar minimum**, it's rare to see sunspots and those that exist are usually small and fleeting. At **solar maximum**, however, there can be 100-200 spots at a time. These spots are much larger and tend to linger.

With the rise and fall of the solar cycle, the amount of solar activity increases and decreases, respectively, because the majority of solar "events" stem from sunspots. One major type of solar event, a **solar flare**, is an intense release of energy due to magnetic field reconfiguration; usually, the more sunspots there are, the more likely a flare will occur.

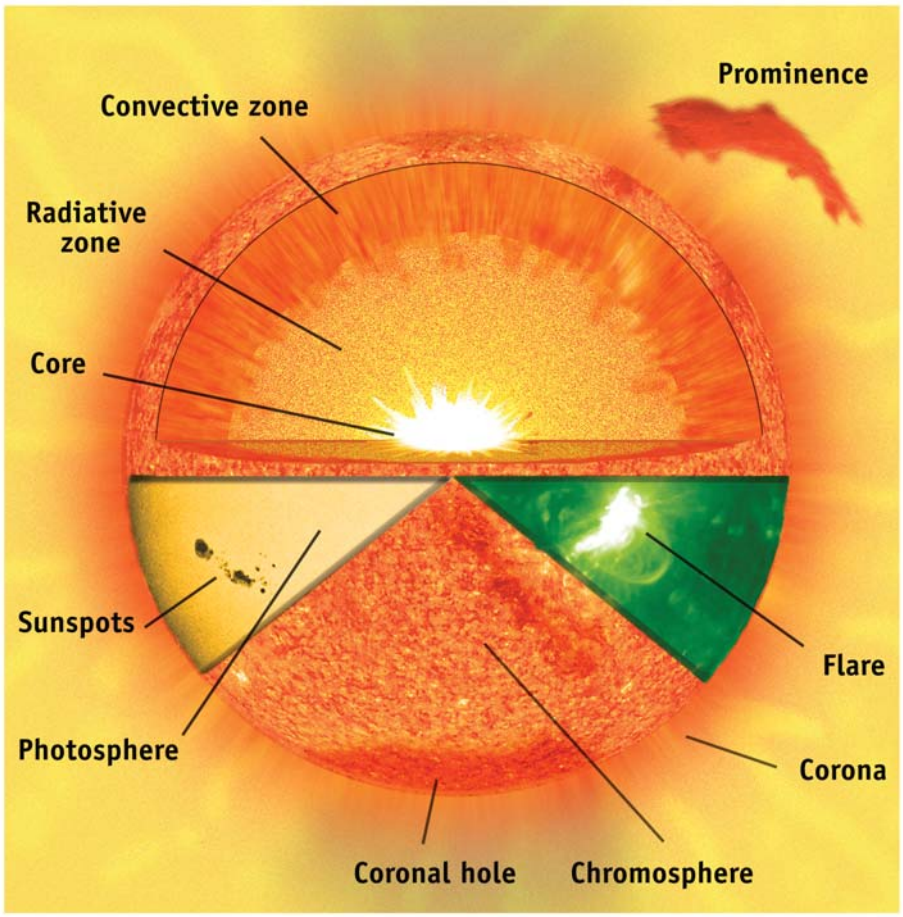
Flaring regions can emit radiation over the entire electromagnetic spectrum or may peak at specific wavelengths (e.g. X-ray, radio, and visible emissions). Energetic particles, protons or electrons, are also sometimes emitted with a flare.

Solar emissions of electromagnetic radiation take only *eight minutes* to reach the Earth, since they are moving at the speed of light. Radio and satellite communications, radar, and navigation systems can then become degraded or rendered completely unusable before we on Earth are even able to determine that an event has occurred.

Energetic particles, depending upon the energy, can reach Earth within 15 minutes to a few hours, or even a few days in some cases. Even though more warning of the event may be given in these cases, the effects are still significant. Collisional damage and electrical upsets within satellites and other spacecraft, orbit disorientation, radiation exposure to humans, and radio interference are all effects due to these particle emissions.

For the next 5.5 billion years, until the Sun has consumed all of its reserves of hydrogen, the Sun will continue burning, creating energy, and impacting the Earth in a variety of both favorable, such as keeping us alive, and unfavorable ways. The key is to understand the importance of the Sun and the space weather it creates, and how we can cope with the effects it forces upon us.

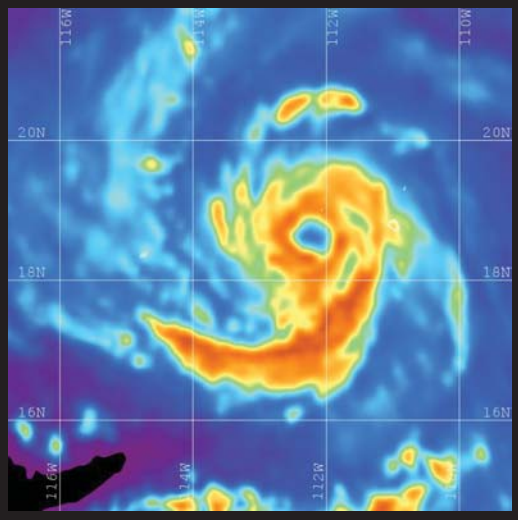
From the center out: The Sun's interior is composed of the core, the radiative zone, and the convective zone. The photosphere, chromosphere, and corona make up the Sun's atmosphere. Photo courtesy of SOHO.



The Future of Earth-sensing from Space

by Dave Jones
Reprinted with permission from the Earth Observing Magazine

This article is a part of a series on the next-generation of Polar-orbiting Operational Environmental Satellites and the benefits they provide now, and will provide in the future, to Air Force Weather users.



This microwave image, from the Advanced Microwave Sounding Unit aboard the NASA Aqua satellite, shows a hurricane off the west coast of Mexico. Weather satellites have been our eyes in the sky for more than 30 years, since the April 1960 launch of Tiros I.

Polar-orbiting and Geostationary: The Difference

Orbiting at an altitude of approximately 520 miles above the earth and traveling at speeds of up to 17,000 mph, Polar-orbiting Operational Environmental Satellites continuously observe the Earth. As the "eyes in the sky," POES orbits the planet approximately 14 times each day and are able to scan just about the entire surface of the Earth twice daily. A constellation of three satellites can cover the entire globe every four hours. Instruments mounted on the satellites continually collect and distribute data to users such as scientists, researchers, weather forecasters, military personnel, emergency management officials, space weather scientists and rescue workers.

A second type of operational environmental monitoring satellite called a Geostationary Operational Environmental Satellite also collects observations from space. As compared to polar-orbiting satellites, GOES are in more distant orbits, positioned some 22,300 miles from the earth. These satellites fly in an orbit above the equator at the same rate as the earth turns; consequently they always remain over the same point on the Earth. GOES satellites provide continuous coverage of the western hemisphere at middle and lower latitudes.

Data from instruments aboard GOES provide information to a variety of users, but are particularly important for monitoring the weather on a daily basis in near real-time.

This is an image from the SeaWiFS instrument aboard the NASA satellite. It is a high resolution image of dust over the Red Sea. C

Polar-orbiting Satellites

Currently, the Department of Defense has two primary polar-orbiting "weather" satellites that are operated by the National Oceanic and Atmospheric Administration. These satellites and their instrument are used to fulfill the mission of DoD's Defense Meteorological Satellite Program, which focuses on supplying weather and other environmental information to support military operations.

Operational uses of POES data include global measurements that are critical to determining the initial state of the atmosphere for input into numerical weather prediction models. This input is critical to maximize the accuracy of model forecasts both locally and globally. POES provides critical monitoring of near space environ-

ment. Violent solar storms and flares can interrupt critical systems on earth. The POES platforms keep monitoring incoming particles that could disrupt power generation grids, communication lines, and other satellites orbiting the earth.

Geostationary Satellites

The National Oceanic and Atmospheric Administration operates the Nation's GOES system through the National Environmental Satellite Data, and Information Service, the same organization that operates POES and DMSP.

The main federal user of U.S.-based GOES platforms currently orbiting the planet is NOAA's National Weather Service. The NWS is responsible for providing official weather forecasts, as well as issuing watches and warnings of hazardous weather events, such as hurricanes.

Together, the operational constellations of POES, DMSP, and GOES deployed by the U.S. provide a complete space-based global weather monitoring system that is critical to fulfilling the missions of NOAA and the DoD. Both agencies, in large part, are tasked to protect life and property, and provide environmental information that can be used to help enhance the national economy and to provide real-time support to military operations.

This MODIS imager high-resolution, true color visualization is from the NASA satellite, the Aqua. The image is at a 200M resolution. Aqua is one of a series of space based platforms that are central to NASA's Earth Science Enterprise, a long term study of the scope, dynamics and implications of global change.

ge from the SeaWiFS instrument aboard the NASA SeaStar high resolution image of dust over the Red Sea. Courtesy

NPOESS

The future of both NOAA and DoD's Polar-orbiting program is the National Polar-orbiting Operational Environmental Satellite System. The NPOESS program was developed to employ next-generation platforms and instruments in an integrated mission serving the nation's needs for space-based, remotely sensed environmental data.

The Department of Defense will use data collected by NPOESS satellites to support defense-related applications. NOAA will use the satellites to collect additional data for use as input to sophisticated numerical weather prediction models and to better understand how the earth's climate is changing over time.

The benefits of the POES in NPOESS

POES supplies a complete spatial view of global environmental conditions on a regular basis. Instruments aboard polar-orbiting environmental satellites collect parameters such as wind, temperature, precipitation, and air pressure with height in the earth's atmosphere. These are used to initialize weather prediction models. Without correct "initial conditions," the forecasts would be severely flawed. Historically, profiles of the atmosphere were taken only twice daily via instrument packages called radiosondes that are attached to weather balloons and launched in areas in or near population centers. Though data from the sparse global network of radiosonde stations are still useful, particularly in validating remotely sensed data, radiosondes cannot cost effectively provide the necessary data density to support improved forecasts from numerical weather prediction models. Polar-orbiting satellites allow affordable, consistent collection of millions of observations from across the globe.

In the past, the separation of NASA for research, DoD for military applications, and NOAA for civil operations resulted in separate satellite platforms being launched to monitor similar environmental parameters. To eliminate redundancies and unnecessary expense, the operational satellites being developed by the NPOESS program will serve the combined needs of NOAA, DoD, and NASA.

The advanced, cutting-edge sensors that will be launched on NPOESS satellites will increase the accuracy of weather forecasting, scientific research, and environmental monitoring. Network technology implemented to deliver NPOESS data will increase the timeliness of data delivery to users. Data will also contribute significantly to the support of general aviation, agriculture, maritime activities, U.S. military objectives, and space weather applications.

The greatest beneficiaries of NPOESS will ultimately be to the nation's citizens who will benefit from improved weather forecasting, safer and more informed military and transportation operations, more efficient agriculture, improved search and rescue, and a better understanding of the planet, including both the natural and anthropogenic influences.

underground SPACE WEATHER

by Frank Simon
Chief NORAD Support
Peterson AFB, Colo.

Nestled at the base of Colorado's majestic Rocky Mountains is an Air Force weather flight with a uniquely challenging mission. It is the 21st Space Weather Wing that supports U.S. Northern Command, North American Aerospace Defense Command, and Air Force Space Command.

Staff members at the 21st weather station monitor weather conditions at dozens of sites worldwide, as well as gauge how solar activity affects radar, communications, and satellite systems. They monitor terrestrial and space weather for a true mud-to-sun mission.

Until 1994, Cheyenne Mountain and the 50th Space Wing at Schriever AFB had separate weather support units and the AFSPC weather managers provided daily weather support to the commanders-in-chief of NORAD, USSPACE, and AFSPC. Then came the realities of Air Force downsizing.

Today, the 21st SW is responsible for all these functions. With the increased responsibility came challenges such as additional training requirements, as well as the opportunity to support a diverse customer base. The mission of the flight's 14-member team is to provide decision-makers with timely, accurate space environment and terrestrial weather information.

To accomplish this mission, the flight operates two sections. The aviation section provides aircrew briefings and local "eyes-forward" for resource protection. The NORAD support section provides continual space environmental and terrestrial weather awareness for assessing possible threats to North America, whether by air or space.

The weather team at Peterson AFB, understands the importance of environmental phenomena, both space and terrestrial, and its potential impacts to Department of Defense air, ground, and space-based systems. They must account for all environmental factors, from mud to sun.

Essentially, the NORAD forecaster is a Cheyenne Mountain Operations Center crewmember. This person monitors airfield conditions at NORAD fighter, tanker, and early warning bases. Additionally, they provide notification of severe weather and solar events that may impact the 21st SW's assets to wing leaders. The ground based radar, optical, and communication centers from the wing also contact the NORAD forecaster for help, investigating anomalies encountered at the sites.

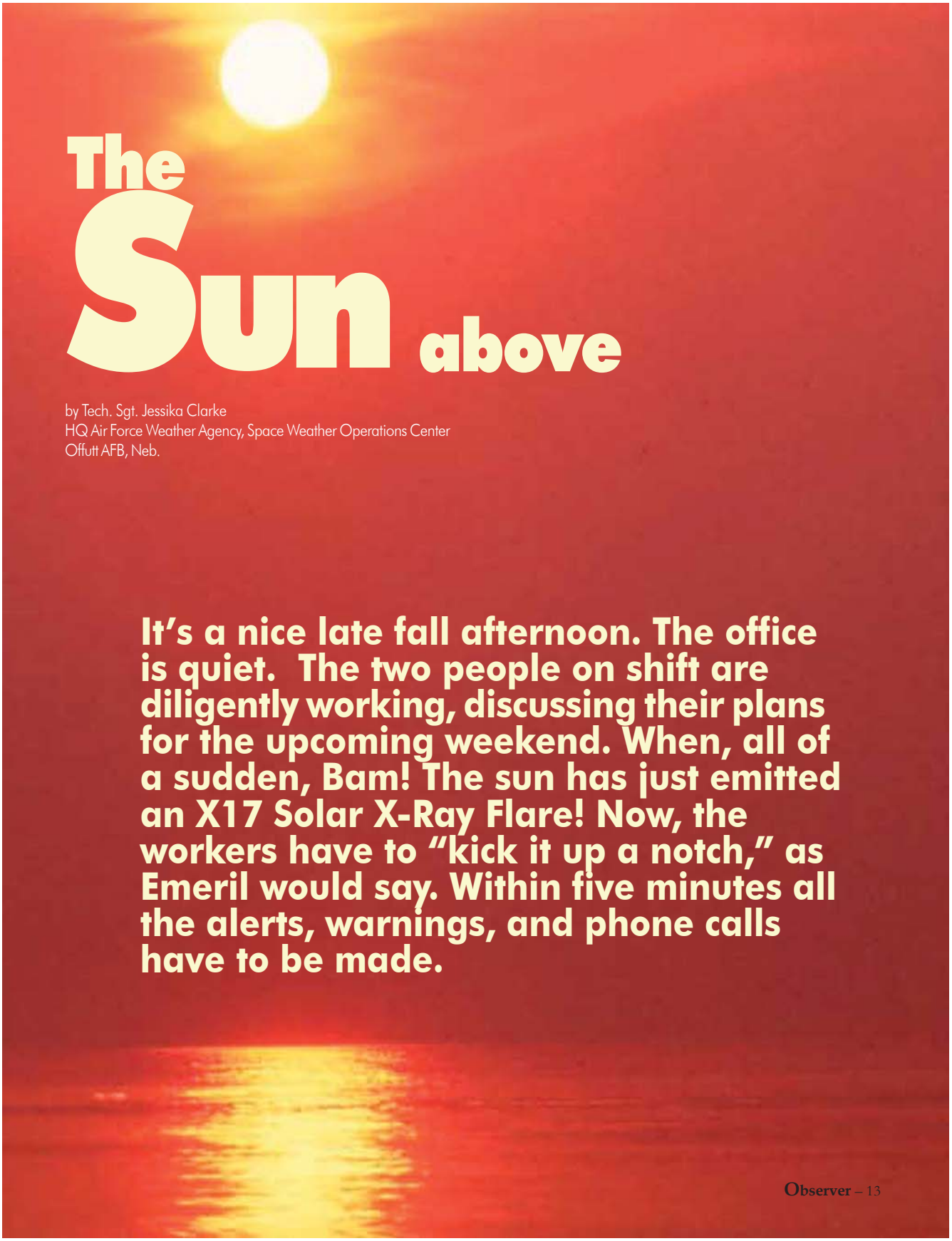
The support is not limited to tropospheric weather. The NORAD forecaster uses forecasts, bulletins, and graphical products from various agencies, including products from the Air Force Weather Agency, and the NOAA Space Environment Center, to monitor solar phenomena such as flares, high-energy particle flows, and solar bursts of energy emitted within various frequency bands. Near-earth phenomena such as geomagnetic storms, meteor showers, and atmospheric refractive conditions are also tracked.

These data are necessary for the forecaster to provide the NORAD Command Director with a complete picture of environmental effects on military operations. It is important that forecasters do not view space weather and tropospheric weather as independent phenomena. They must fuse all data inputs and effectively assess a completely integrated environmental picture.

The fused space and terrestrial weather focus does not stop at the operations support level. Staff members of the 21st weather flight brief wing leaders, and provide space and terrestrial support to 43 geographically separated units, located in five countries and across nine time zones. The briefings are an integrated picture of environmental conditions including both space and terrestrial weather data. Additionally, the staff provides environmental support to the U.S. Northern Command Mobile Consolidated Command Center, which manages both U.S. and NORAD forces during times of conflict.

The hard work and efforts of the 21st SW staff have not gone unnoticed. The flight was awarded the Grimes-Williams Award in 2001, 2002, and 2003 acknowledging them as best weather flight in Air Force Space Command. The mud and the sun are indeed the only boundaries for the 21st OSS weather flight team members.

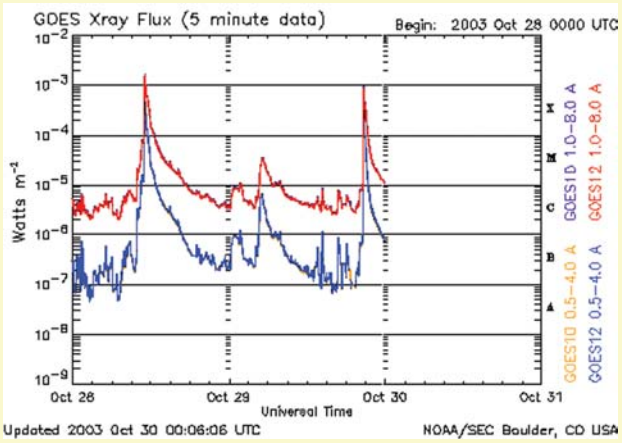
This image shows the NORAD Command Center. In 1956, the idea of a hardened command and control center was conceptualized as a defense against Soviet bombers. Cheyenne Mountain was selected based on three key criteria: geographically centered in North America, an area of low seismic activity, and an already established military presence in Colorado Springs.



The Sun above

by Tech. Sgt. Jessika Clarke
HQ Air Force Weather Agency, Space Weather Operations Center
Offutt AFB, Neb.

It's a nice late fall afternoon. The office is quiet. The two people on shift are diligently working, discussing their plans for the upcoming weekend. When, all of a sudden, Bam! The sun has just emitted an X17 Solar X-Ray Flare! Now, the workers have to "kick it up a notch," as Emeril would say. Within five minutes all the alerts, warnings, and phone calls have to be made.



This X-Ray Trace product is from the Space Environment Center. The AFWA Space Weather Branch partners with the SEC to form a cooperative effort in monitoring solar impacts.

The sun emits optical and x-ray flares, radio bursts, radio sweeps, and coronal mass ejections, all of which may disrupt communications across the entire radio spectrum. A solar flare can initially be seen as a bright area on Hα imagery through plage, white, areas. Flares are classified from zero to four, four is the largest, and by intensity of Faint, Normal, or Brilliant, with Brilliant being the brightest. We issue a WOXX51 Solar Optical Flare warning when a flare reaches 3B.

X-ray intensity typically rises with the onset of a flare. Once an x-ray flare reaches M1, event level, there is a potential for the flare to cause interruptions to communications, damage to satellites, and dangerously high radiation levels for high-flying aircraft. As soon as we reach an event level flare, we immediately call customers to inform them of a Short Wave Fade event. A SWF indicates that high frequency radio is unusable over a period of time, depending on the intensity of the flare. When this occurs, there is a possibility for communication outages. We issue an initial SWF warning as a WOXX50. As the flare intensity continues to climb and reaches M5, there is a potential for protons to bombard the Earth's atmosphere. We issue a Proton Alert at M5 and use additional tools to determine if we will receive a significant amount of radiation.

The sun also emits radio bursts across the entire radio spectrum. Depending on the operating range, these radio frequencies may not be useable. We issue radio burst warnings for 5,000, 10,000, and 50,000 Solar Flare Units, a measure of radio signal intensity from the sun. We transmit radio burst warnings to Early Warning Radar operators around the world and to NORAD so they are informed of the potential for radar operations to be adversely affected.

On occasion, the sun will have areas that become so magnetically complex that a large mass of hot plasma, a coronal mass ejection, will be expelled out into space. Plasma typically arrives at the Earth's magnetosphere, which is right on our doorstep, in about three to four days. However, when we received the X17 flare on Oct. 28, 2003 we were bombarded with the plasma cloud in only 17 hours. Since the Earth is approximately 93 million miles away from the sun, in order for plasma to hit our magnetosphere that quickly, it was traveling at a rate of almost six million mph, six times greater than normal!

The SpaceWOC utilizes a vast array of data, models, and tools to determine if we will receive a significant amount of energetic protons or increased radiation, and which frequency ranges may be affected. With the help of our skilled forecasters and space weather models available, we are able to predict, within six hours, when a plasma cloud will hit the Earth. As soon as the Earth is inundated by the plasma cloud, the northern lights can be seen dancing above. However, some warfighters may lose all communications, depending on their location and equipment. This phenomenon, called geomagnetic storming, can last from several hours to several days.

Once all of our warnings are issued and everyone has been notified, we monitor the situation until the increased solar activity subsides. After we have settled down to the calm after the storm, we call customers again to obtain a final report of degraded operations during the space weather event. Finding and reporting impacts is how we provide the most benefit to warfighters. We record these impacts to enhance our knowledge of future impacts from similar solar events. So the next time you lose communications or your satellites are no longer usable, give us a ring – we would love the opportunity to document it, so that we may continue to improve our value to the warfighter.

Space weather *questions?*

If you need information about Space weather, the Air Force Weather Agency Requirements Branch is available to provide the answers you need about space weather, to support mission requirements. You can contact them in the following ways:

1. Submit a support assistance request on JAAWIN-U, S, or SCI. Look for the SAR button under the services link on the entry page.

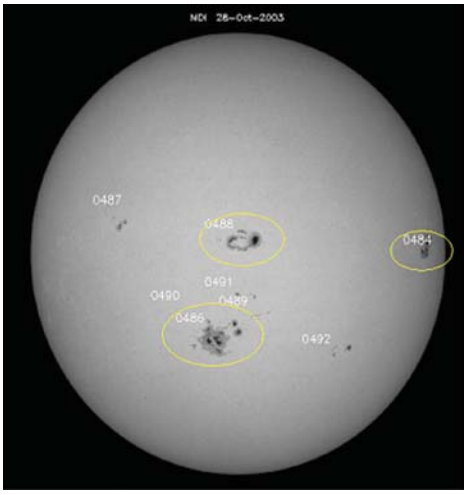
2. Request support by contacting the AFWA Space Weather Requirements Manager at (402) 294-1399 or DSN 271-1399.

They can help you with information on AFWA's current and future space weather support capabilities.

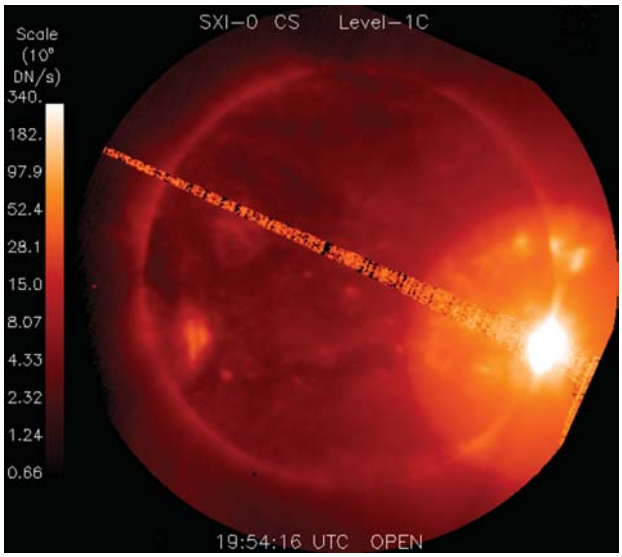
3. In an emergency situation, call the AFWA's Space Weather Operations Center directly at (402) 232-8087 or DSN (STU) 272-8087. The Space Weather team is standing by to provide customer service 24-hours daily.

Halloween Storm

by Lt. Col. Trey Cade
Air Force Weather Agency, Applied Technology Division
Offutt AFB, Neb.



This image shows the solar active regions responsible for the Halloween Storm events. Together, these groups, were designated sunspot regions 484, 486, and 488. Image courtesy of the National Oceanic and Atmospheric Administration.



This image shows the largest x-ray flare ever recorded, an X28, on Nov. 28, 2003. The energy given off by this solar flare is equivalent to 100-megaton hydrogen bombs exploding at one time. Image courtesy of the National Aeronautics and Space Administration.

During the last week of October 2003, the sun unleashed a massive assault on the earth. This assault took the form of electromagnetic energy, giant clouds of ionized gas, and deadly high-intensity radiation. The subsequent sequence of events, now termed the 'Halloween Storm', includes a vast array of technological systems that were damaged or destroyed.

Three sunspot groups were active on the sun by Oct. 27, 2003. Together, these groups, designated active regions 484, 486, and 488, produced a series of violent explosions, solar flares, on the sun's surface. Each of the solar flares was equivalent to over a billion nuclear detonations. From Oct. 22 to Nov. 4, these regions produced 80 M-level, the second highest category, solar flares and 24 X-level, the highest category, solar flares; including three of the top ten most intense flares ever recorded. The most intense solar flare ever, an X28, was recorded on Nov. 4. The energy from these flares disrupted worldwide radio communication systems and over-the-horizon radar operations.

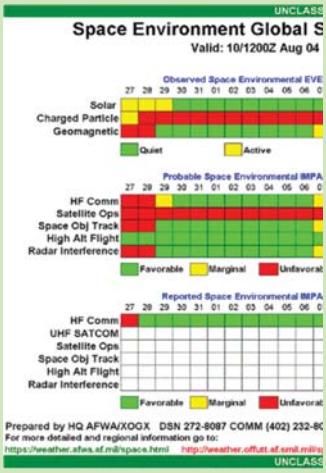
The clouds of gas ejected by the flares, traveling at over a million miles per hour, arrived at the earth two to three days after each flare and caused several large disturbances in the earth's magnetic field, called geomagnetic storms. These severe storms produced further loss of communication systems, including military satellite communication, degraded Global Positioning System navigation, and induced commercial power problems in the United States and Northern Europe. In the most extreme instance, the disruption caused a power outage in Sweden that affected 20,000 homes.

Perhaps the most devastating effect of these flares were high-energy protons. The largest proton event, the fourth largest ever recorded, began on Oct. 28 and lasted for three days. Hurtling towards the earth at near the speed of light, these subatomic bullets caused great havoc with the world's satellite systems. Many satellite operators took protective measures to prevent problems, but even so 30 satellites experienced significant problems, including the permanent loss of a $650 million Japanese commercial satellite. We were not able to track thousands of satellites for days. The radiation from these particles also posed a significant danger to aircraft operations, causing airlines to re-route flights to avoid the polar regions, the areas most susceptible to the intense radiation. The FAA issued its first-ever radiation alert for airline passengers above 25,000 feet. In addition, the astronauts on the International Space Station were moved into a radiation-protected area to prevent exposure.

In the end, that week went down in history as one of the most significant space weather events ever. The Halloween Storm is a reminder that, with little warning, severe space weather can disrupt systems all over the earth – systems we rely upon for both civilian uses and military operations.

A product of space weather

by Capt. Keith Anderson
Air Force Weather Agency, Space Weather Operations Center
Offutt AFB, Neb.



This image is the Events and Impacts product. The product is not intend use, it is only used to give the big picture of solar flare impacts. The pr the more than 11,000 products issued daily by the Air Force Weather Weather Branch.

Just like any other product on the market: if nobody knows about it, nobody uses it. Hopefully, this article will begin to solve that problem by educating users about some of the space weather products available from the Air Force. In many cases, users seldom exploit these products because they aren't aware of what is available or even that their systems are affected by space weather. Three basic types of space weather products are available to remedy this situation: warnings of space weather events, products designed to support specific communication or navigation systems, and space situational awareness products.

Space weather is similar to terrestrial weather. Warnings are issued when specific space weather thresholds are forecasted to occur or when the actual observed criteria is met for customers. Space weather customers include: radar operators, aircraft maintainers, radio operators, satellite communication users, satellite drivers, and high-flying aircraft pilots. An example of a space weather warning is the geomagnetic storm warning. This product is similar to a thunderstorm warning because it shows both the times that the storm will affect the customer and the potential impacts to the customer's operations.

WOXX54 KGWC 270515
SUBJECT: AFWA EVENT WARNING REPORT ISSUED AT 0515Z 27 JUL 2004
PART A. GEOMAGNETIC EVENT IN PROGRESS (UPDATE):
THE GEOMAGNETIC FIELD IS AT SEVERE STORM LEVELS.
THE 3-HOUR AP WAS 153 AND THE 24-HOUR AP WAS 56 AT 27/0515Z
THE DISTURBANCE IS FORECAST TO CONTINUE AT SEVERE
STORM LEVELS THROUGH 27/1115Z (BASED ON 24-HOUR AP)
WHEN VALUES WILL DECREASE TO ACTIVE LEVELS.
THIS PRODUCT WILL BE UPDATED EVERY 6 HOURS UNTIL THIS EVENT ENDS.
PART B.
POSSIBLE EFFECTS ARE SATELLITE DRAG ON LOW EARTH ORBIT SATELLITES, SATCOM SCINTILLATION, HF RADIO COMMUNICATION INTERFERENCE OR LAUNCH TRAJECTORY ERRORS.
PART C. REMARKS:
ISSUED BY THE AIR FORCE WEATHER AGENCY, OFFUTT AFB, NE.
IF YOU HAVE QUESTIONS OR REQUIRE FURTHER INFORMATION, CALL THE DUTY FORECASTER AT DSN 272-8087, COMMERCIAL 402-232-8087.

The above image shows a space weather warning. The warnings can be used to forecast an event and cancel a forecast event if it is no longer expected to occur. Additionally, these text bulletins can be used to let customers know an event is in progress, give updates on a specific event and notify customers that the event has ended.

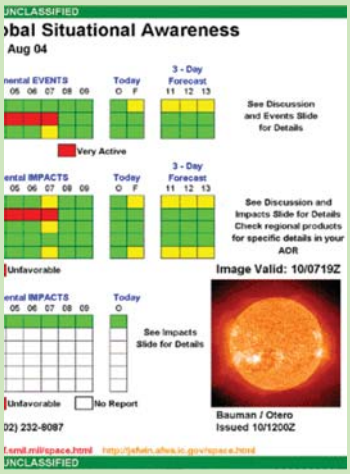
The second type of product, designed to support communication and navigation systems, is intended for customers in either theater or tactical level areas of operation. These products cover three modes of communication: High Frequency, Ultra-High Frequency, including Satellite Communication, and Global Positioning System frequencies.

AFWA's Space Weather Branch produces three types of HF products. These are forecaster in the loop products, regional model output data for specific HF sites, and point-to-point forecasts between HF transmitters and receivers.

Another product, for use in theater and tactical arenas, is a map depicting the estimated potential amount of performance degradation, or signal fade, of UHF as a result of ionospheric scintillation. Although DoD SATCOM uses the entire UHF radio band, these UHF Scintillation maps apply only to UHF SATCOM between 225 MHZ and 400 MHZ (the lower portion of the UHF spectrum is impacted more than the higher end). Areas of light, moderate, and severe UHF degradation are depicted for seven geographical regions.

Limited qualitative assessments of the absorption of SATCOM signals, due to scintillation based on geomagnetic and ionospheric observations, are available upon request. Analyses are performed along a specified signal path from a ground location to a satellite on a case-by-case basis using ionospheric and geomagnetic data.

Customers can use this product to develop planning guidance as well as relatively precise mission-support information for operations using UHF communications. The satellite and signal paths used can be specified,



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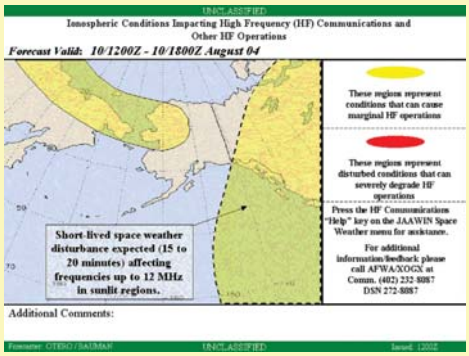
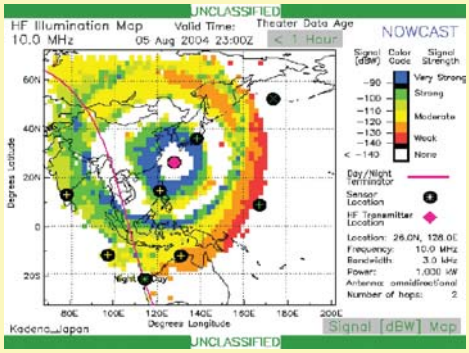
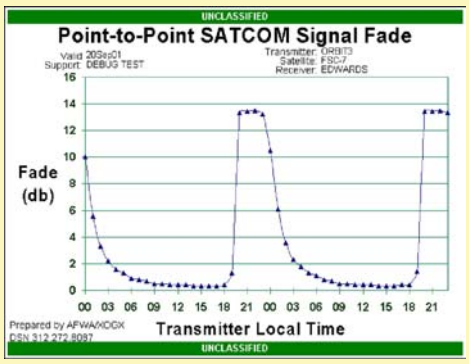


This FITL product includes regional HF observed analysis and forecasted charts created every six hours (i.e. 00Z, 06Z, 12Z, and 18Z). The forecast is for the next six hours and the analysis is for the previous six hours. In general, these products give an overall potential impact to HF communication by graphically representing the degradation caused by space weather events.

This HF communication product shows how far and how strong an HF signal at a particular frequency will be received in a theater. HF communication is achieved by "bouncing" a signal off the atmospheric layer called the ionosphere. The internal ring, is the first bounce off the ionosphere. If a HF radio wave continues on after the first "hop", it again reflects off the Earth and back up to the ionosphere. The second bounce off the ionosphere produces the external ring.





The most popular HF product is the point-to-point forecast, which is model driven. It has two features: it provides a 24 - 72 hour forecast and shows a value for the best HF frequency to use to communicate from one point to another. One disadvantage is that space weather events affecting HF communication are not factored into this product. Three outputs are depicted on this product for HF users: the best frequency to use, the maximum usable frequency, and the lowest usable frequency. If the LUF exceeds the MUF, HF communication is impossible.

allowing users to customize this product for their particular needs.

The GPS Error product displays errors in total position (latitude, longitude, and height), horizontal position (latitude only), and altitude position (height only) caused by space weather.

Customers can use this product for situational awareness and to develop planning guidance for operations using single-frequency GPS systems.

The third category of space weather products focuses on situational awareness. An example of this type of product is the Events and Impacts Slide, which contains space environmental conditions and their potential impacts to worldwide military operations. It is a "high-level" product designed for predictive battlespace awareness. This slide is divided into a top half and a bottom half. The top portion reports potential space environment impacts to five major categories of space related operations. The bottom portion of this slide reports the space weather event that caused the impact to operations. The events can be solar flares, radio bursts, energetic particle precipitation, or geomagnetic storming.

There are dozens of different types of Space Weather Products available, with many of these tailored to the customer's specific needs. In total, the Space Weather Branch puts out about 12 thousand different products a day. However, if customers don't know what is available and how to use them then our efforts are wasted. Take the time to familiarize yourself with what is available and what we can create for your specific requirements. The AFWA Space Weather Branch is here to help.

Space Weather | making an impact

by Bryan Davis
Air Force Weather Agency, Space Weather Operations Center
Offutt AFB, Neb.

One of the first questions for a lot of people may be, "What is space weather?" In elementary school we were taught that space is a vacuum, and there is nothing in a vacuum. Protons and electrons are part of an atom, which are very, very small particles. The sun is very hot. It is a big fusion reactor and contains the fourth state of matter, plasma (okay, maybe we didn't learn that in fourth grade). We learned it takes light just over eight minutes to travel from the sun to the earth. And we are orbiting around this ball of plasma, on the third satellite (at approximately 93 million miles away).

It isn't that we were not taught correctly in our formative years, but there were a few details left out. Outer space is not a *true* vacuum. Those small protons and electrons stream outward from our star, as well as other stars, to populate this pseudo-vacuum between our sun and us, impacting us in three different ways.

Believe it or not, most people in and out of the weather career field have seen space weather impacts but never knew it. Have you ever seen all the bars on your cell phone and then suddenly lose a signal? Or have you been watching satellite TV after a mid shift, you're winding down, enjoying your favorite team's highlights and you LOSE THE SIGNAL?!

That blip on the radar is also caused by space weather. What caused it? The WSR-88D operates at a wavelength of 10.7 centimeters, which is near 2800 MHz in the radio spectrum. The radio output from the sun at that particular frequency is what caused this false radar return. The sun emits radio waves not only at this frequency, or centimeter wavelength, but also across the entire electromagnetic spectrum. Its output impacts other systems like missile detection radars or any other radar that happens to "look" at or near the sun during a space weather event.

What about the mission in theater and winning the fight on the ground? A radio communications blackout during the day caused by an emission from the sun can last up to eight hours and can be an annoyance when out in the field doing an exercise. But in theater, this can mean a potential loss of wartime capability to a theater commander. What space weather

Field communications can be interrupted by Space Weather events. An individual may be prevented from using a satellite phone or radio to communicate with other deployed units or

Launching space aircraft into a hazardous space environment can cause failure to various systems on the vehicle, degrading communication, surveillance and navigational systems.

High-energy particles streaming from the sun can cause actual physical damage to spacecraft, blind aircraft sensors, and degrade the life of the satellite.

Radio output from the sun can mask radar output, negatively impacting the effectiveness of Early Warning Radar support. If a disruption takes place, a commander's ability to discern if a missile has been launched may be degraded.

events can cause these problems? Solar flares, explosions on the sun thousands times more powerful than a nuclear explosion, are one way space weather impacts ground operations, confusing radars and making radios unusable or the person on the other end hard to talk to.

Let's go back and talk about protons. The old adage says, "What we can't see can't hurt us." To all of us that are below 60,000 feet, that is true in the case of solar protons. For those flying or riding above that altitude, it's not so true.

During a large solar event, the sun not only emits radio signals but also spits out protons at a speed greater than half the speed of light. Yes, protons are small, but when tens to hundreds of thousands of protons are streaming by every second, bad things can happen. The earth's atmosphere protects us, but get high enough, say in the Space Shuttle or the International Space Station, and this proton radiation is like going to the doctor and getting x-rayed a hundred times all at once – not good. Other than being radiated, I'm sure you have all heard about those metal things with electronics flying around in orbit. With enough of those positively charged protons bombarding the satellite, physical and electrical damage to the spacecraft has occurred, and today it still can.

How much are satellites used today? Communication, imaging, and navigation satellites are just a few of the types of spacecraft used in operations today. Everyone has seen satellite communications done on the news. Even some of you have used SATCOM in the field. Did you ever call overseas or back home on DSN and wonder why there was a brief delay? SATCOM. Imaging uses – there are a few, like forecasting for an area without observations. In such situations, satellite shots become even more important.

In the old days, navigation consisted of a map and a compass, and that'll get you close to where you want to go, but with the advent of the Global Positioning System, knowing where you are and where your're going was never so easy –but space weather can change all that and can throw you off by a hundred meters. Big deal you say? What about GPS aided munitions? Putting "warheads on foreheads"– that's a big deal.

Finally the last space weather phenomenon that we'll discuss – for people stationed in Alaska or in the northern CONUS they have already seen something called the *aurora borealis*, or the Northern Lights. This visible evidence of Space Weather impacts HF communications widely used by the Army, and lower VHF frequencies used by aircraft. This generally won't impact the New York to Los Angeles flight, but during transoceanic flights doing the great circle route, aircraft can lose communications.

Another big impact is for the avionics mechanic calibrating aircraft navigational instruments. Everyone who has filled out a dash-1 or a 3803 knows about converting from magnetic direction to true direction. If the space weather environment is disturbed enough it can distort the Earth's magnetic field, making avionics calibration pointless. Other impacts from so-called geomagnetic storming include overloading of power grids, causing transformers to blow, as in the case of the Northeast blackout of 1989. After this, power companies became very interested in space weather. The Alaskan oil pipeline companies became more informed when strong geomagnetic storms set up electric currents using the pipeline itself, corroding the fittings holding the pipeline together and increasing the potential for oil spills harming the environment.

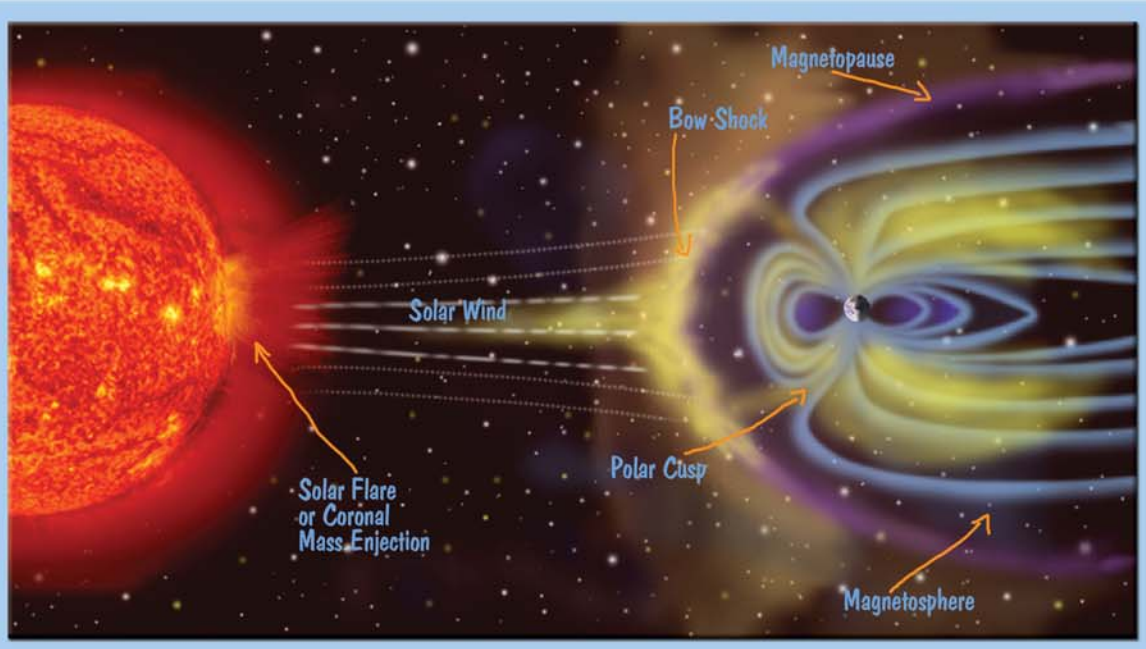
Numerous impacts, all coming from one source: the sun. It may seem to be a pretty average star, as stars go. However, none of the other stars in the universe has a bigger impact to our communication, navigation, exploration, and commerce than the one just 93,000,000 miles away.

Space Weather events can cause Radiation Hazards to high flying aircraft and spacecraft. Prolonged exposure to radiation can degrade equipment and may be a health hazard to aircrews.

Satellite and aircraft communications can be interrupted by space weather events. The disruption can cause a mission to fail, or seriously degrade its effectiveness.

Space Weather events can create GPS errors. The errors may negatively effect the accuracy of GPS guided munitions, causing targets to be missed, unintentional collateral damage or loss of life.

Space Weather 1



Bow Shock- This is whe
tiny particles in the solar wind
around the Earth in a curve, du
magnetic field. Essentially, the
magnetic field is an obstacle in
Similar to the way water makes
in front of a boat, the solar win
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Magnetosphere- Is an extension of the Ionosphere. It is the area of space, around the Earth, that is controlled by the Earth's magnetic field. The Magnetosphere prevents most of the particles from the sun, carried in Solar Wind, from hitting the Earth.

Solar Wind- It streams off of the Sun in all directions at speeds of about 400 km/s (about 1 million miles per hour). The source of the Solar Wind is the Sun's hot Corona. The Solar Wind contains roughly equal number of electrons and protons, along with a few heavier ions, and blows continuously from the surface of the Sun at an average velocity of about 400 km per second. Solar Wind, and the magnetic field it carries along, modify the shape of the Magnetosphere, by pushing it in on the dayside and creating a long Magnetotail on the night side.

Polar Cusp- The magne
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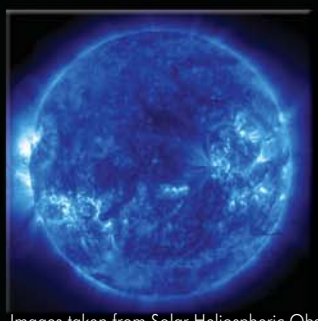
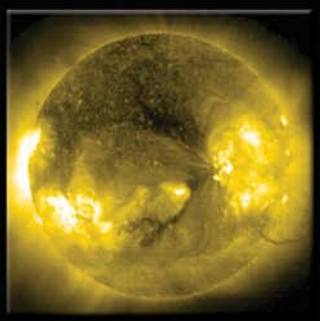
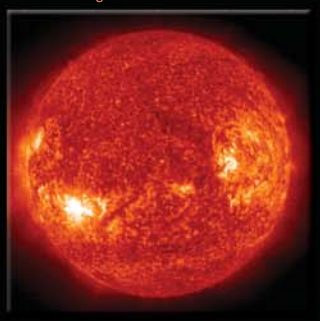
This image depicts the middle to upper Corona of the Sun, used to look for active regions rotating onto the visible disk. Space weather technicians are able to predict the flare potential of a region before it becomes effective.



This shows the upper Corona of the Sun. It is used to look for Coronal Holes or areas where plasma is able to escape into the Solar Wind via high speed streams. Upon the plasma's arrival, usually in 2-6 days the Aurora Borealis will appear as far south as central United States.



The lower Corona or upper Chromosphere of the Sun is shown in this image. This filter is used to look for areas were solar regions are active or flaring.



The upper Corona of the sun is show
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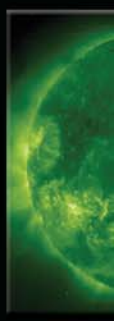

Images taken from Solar Heliospheric Observatory

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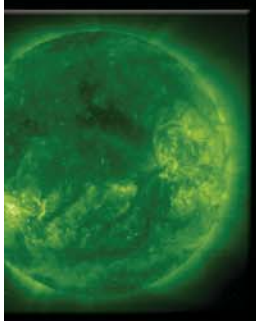
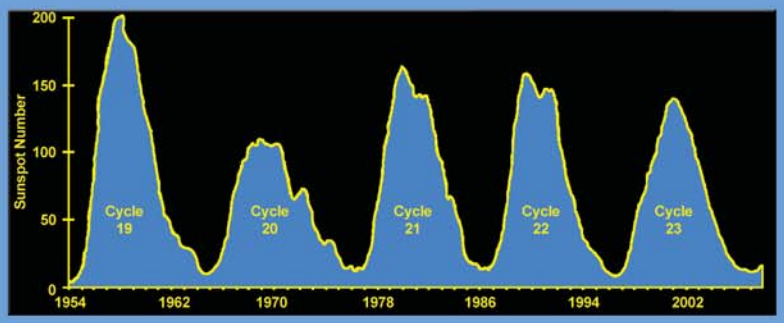
Bow Shock- This is where most of the tiny particles in the solar wind are pushed around the Earth in a curve, due to the Earth's magnetic field. Essentially, the Earth's magnetic field is an obstacle in the Solar Wind. Similar to the way water makes a curved wave in front of a boat, the solar wind makes a curve in front of the Earth. After passing through a shock wave at the bow shock, the wind flows around the magnetosphere and stretches it into a long tail. The Bow Shock is located approximately 94,500 km, or 15 times the Earth's radius, away from the Earth, on the Sun side.

Magnetopause- This outer boundary of the Magnetosphere is located about 63,000 km from the Earth on the Sun side. It is a transition area, much like the Tropopause in terrestrial weather, which marks the boundary of the Earth's Magnetosphere with the Interplanetary Field. In the first approximation, the Magnetopause is formed at a distance where the Solar Wind dynamic pressure equals the magnetic pressure of Earth's field.

Polar Cusp- The magnetic field lines of the Earth can be divided into two parts according to their location on the day or night side of the planet. The Polar Cusp, is the near zero magnetic field area between these two parts on both hemispheres. These funnel-shaped areas provide a direct entry for the Magnetosheath Plasma into the Magnetosphere.

The upper Corona of the sun is shown here. The image is used to look for Coronal Holes or areas were plasma is able to escape into the Solar Wind via high speed streams. Also, it is used to look for active regions rotating onto the visible disk.





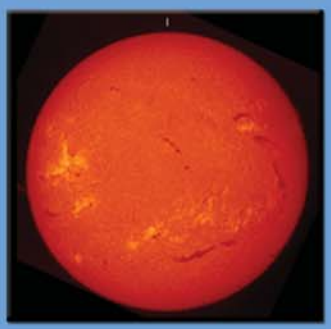
This graph shows the Sun's 11-year cycle. The years are at the bottom of the chart, and the Sunspot Number is at the left. The Sunspot Number is derived from the Wolf Sunspot Number formula (10 X the number of sunspot groups + the number of individual sunspots counted). Essentially the higher the Sunspot Number the more solar activity, however, a higher number does not necessarily indicate increased solar impacts. Each cycle of solar activity is named, a process that dates back to the 1600's.

The Sun is a large sphere of gas. It rotates on its axis, but unlike the solid Earth, the equator of the Sun rotates more rapidly than the poles. The rotation period is about 24 days at the equator and about 34 days at the poles. This differential rotation is frequently used to explain why the Sun displays enhanced solar activity.

It causes the Sun's magnetic field to become twisted and concentrated into specific regions. When this stored energy is released, in the form of solar activity, the field relaxes back to its initial state. The most common indication of locally enhanced magnetic fields is Sunspots.

Western Sunspot records start with the first telescopic observations by Galileo in 1610. Since that time, we've found the number of sunspots follows a roughly 11-year cycle, called the "Sunspot" or "Solar Cycle." Generally, there is a 4-year rise to a "Solar Maximum," followed by a gradual 7-year decline to a "Solar Minimum."

Solar and geophysical activity can and does occur even during "Solar Minimum." That is because not all solar activity and therefore system impacts are solar flare induced; flares are only the primary cause.



(Top Right) This image shows the Sun on Oct. 1, 1996, during a Solar Minimum. You can see from this image there is very little activity during this phase. **(Bottom Right)** This image shows the Sun during a Solar Maximum, Oct. 31, 2000. In this image you can clearly see blemishes on the surface of the sun; these blemishes are Sunspots. Sunspots appear as dark spots on the visible surface of the sun, the photosphere. The intense magnetic field within a sunspot region confines the gas within the spot and reduces interaction between the gas within the spot and the surrounding gas. In part, this lack of interaction allows the gas in the spot to cool and thus creates its dark appearance. The complexity of the sunspot group, the group's magnetic field structure and the group size indicate its instability.

Bridging the gap

by Capt. Leonard Berman
Air Force Weather Agency Air and Space Models Branch
Offutt AFB, Neb.

When most people think of weather modeling, they often think about Mesoscale Model Five or Advect Cloud. They rarely think about space.

However, space is more and more relevant to today's warfighter. Therefore, the Space Weather Models Team was created. The team, a recent addition to the Air and Space Models Branch, is tasked with integrating the latest technology from Research and Development communities into Air Force operations. These tools assist in evaluating current space weather conditions and forecasting the state of space and its environmental effects on the Air Force weapon systems.

Aircraft, precision guided munitions, and other systems relying on Global Positioning Systems for guidance, can be degraded in distances up to 100 meters by ionospheric effects. Additionally, Department of Defense operations rely on space and ground systems. A degradation or failure of these systems, can directly affect the success of critical missions. Failure could mean the loss of life, loss of billions of dollars or resources, or ultimately the failure to meet military objectives.

As ground, air, and space operations integrate to achieve battlespace dominance, we must increase awareness of how space weather affects the warfighter. The challenge is to observe and forecast space weather to help mitigate new vulnerabilities, by finding ways to minimize space weather impacts on operations. Space is no longer just a concern of the future. The future is here today and now it is time to start improving our capabilities.

Until now, we had to rely on persistence, climatology, and a few rules of thumb to predict space weather. However, as a result of new space weather models, this has become a thing of the past. Many of the new models began as research projects, offered through programs such as the University Partnering for Operational Support and Community Coordinated Modeling Center.

Unfortunately, most of this code is of research quality and often does not meet operational requirements. This is where the Space Weather Models team comes in; they prepare these models for operations. As additional models are used in operations, they expand and enhance our ability to specify and forecast space weather. The result is the Department of Defense and national program customers are provided with better data to enhance operations.

The Hakamada-Akasofu-Fry Kinematic Solar Wind Model, is one of the first models that AFWA is transitioning to operations. This model predicts solar wind conditions such as speed, density, and the magnetic field between sun and Earth, based on observations of the sun. Solar Wind data is a key input to forecasting geomagnetic disturbances that impact space operations.

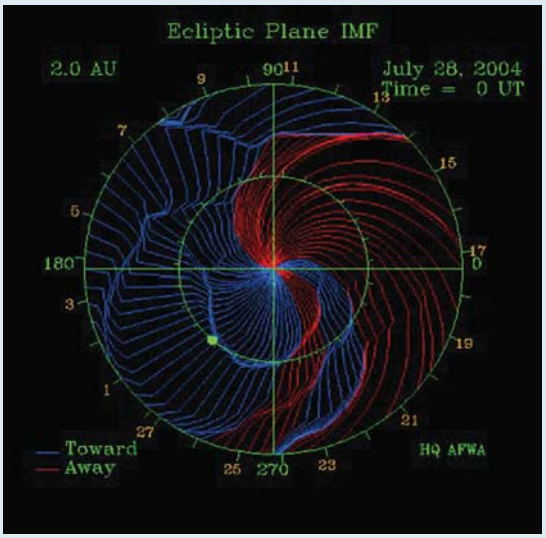
Another model in transition is the Relativistic Electron Forecast Model. AFWA has an operational requirement to forecast electron fluence, a concentration of electrons over a certain amount of time. Electronic fluence is a key parameter critical to supporting AFWA's spacecraft charging forecast mission.

The impact of these high-energy electrons on orbiting satellites can cause electric discharges across internal satellite components, much like a static discharge from rubbing your feet across the carpet. This in turn leads to spacecraft upsets or complete satellite failures. The Relativistic Electron Forecast Model will give our technicians the ability to predict the occurrence of these electrons in geosynchronous orbit.

A third operational requirement of Space Weather Models Team, is to forecast Dual Frequency Global Positioning Systems Error. While the technology to do this is not presently available, AFWA is taking the first step by visualizing GPS scintillation data. Scintillation causes disruptions in the GPS signal and can cause loss of lock with the satellite.

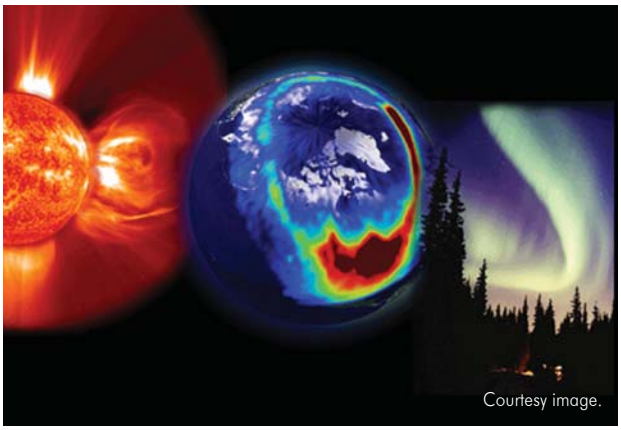
Our goal is to bridge the gap between space weather research and DoD. This will help achieve the goal of the National Space Weather Program, to model the energy flow from the sun to the earth and determine the interaction of this flow within the near-earth environment. Bridging the gap will help in forecasting space weather events and relate these forecasts to the effects here on earth.

In the end, AFWA hopes to develop space weather models and products that allow the warfighter to anticipate and exploit the space environment, rather than to cope or avoid it. This will ensure that the next legion of warfighters has the tools necessary to predict the ever-changing forces of nature.



View of the magnetic field lines (IMF) emanating from the Sun. Blue and red colors denote IMF moving away or towards the Sun. Green dot is the location of the Earth at one astronomical unit (1 AU = 149,597,970 km). Note the "scrunching" of magnetic field lines denoting the approach of the shockwave moving towards the Earth.

Meeting the Nation's Space Weather Needs


Courtesy image.

by Lt. Col Frank L. Estis and
Lt Col Robert J. Rizza
Office of the Federal Coordinator for
Meteorological Services and
Supporting Research
Silver Spring, Md.

The National Space Weather Program began in 1994, to highlight the strategic nature of space science research.

The elements of the NSWP include: basic research, modeling, observations, technology transition, operational forecasting, and education. The NSWP emphasizes the treatment of the space environment as an integrated system encompassing the sun, solar wind, magnetosphere, ionosphere, and thermosphere.

In June 1994, the official definition for Space Weather was created. Space Weather refers to conditions on the sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the performance and reliability of space-borne and ground-based technological systems and can endanger human life or health. Adverse conditions in the space environment can cause disruption of satellite operations, communications, navigation, and electric power distribution grids, leading to a variety of socioeconomic losses.

The NSWP inspired the DoD's Space Architect study on space weather. The Space Architect is an office under the Under-Secretary of Defense responsible for developing a strategy to meet warfighter requirements over the next 25 years. Space weather was recognized as an aspect of the future military environment that needed to be addressed. In this DoD-led effort, scientists and experts on space weather operations created a plan, known as "Vector". The plan outlined the steps to be achieved to meet the warfighter requirements of the 21st Century.

There are obvious differences between these plans and those by the NSWP. First, the Space Architect plan extends out to 2025, while the NSWP plan covers only a ten-year period.

Second, the Space Architect study emphasizes those activities necessary to meet DoD requirements, while the NSWP includes commercial interests.

There are some similarities in the plans, both emphasize the need for comprehensive space weather research, observations and modeling, and the importance of effective procedures for transitioning research and technology into the operational environment.

By 1997, agency participation in the NSWP blossomed. The Federal Aviation Administration and other DoD agencies, drawn in by the Space Architect study, joined the NSWP. The growing attention to space weather and the huge success of solar missions with the Air Force Space Command led to a strategic partnership involving the DoD, NASA, and NOAA. The purpose of the partnership was to see how the agencies could work together to address space weather issues of mutual interest.

Similarly, another NSWP success story is the Center for Integrated Space Weather Modeling – a National Science Foundation Science and Technology Center. The CISM has as its overarching vision "To understand our changing Sun and its effect on the Solar System, life, and society."

CISM focuses its activities around the development of a series of ever-improving versions of a comprehensive, physics-based simulation model that describes the space environment from the Sun to the Earth. After having fully tested and validated these models, CISM will use them for research, make them available to the wider research community, transition them as appropriate into operational specification and forecasting tools, and use them as learning tools.

A vital element in the success of the NSWP has been its ability to put into context the space weather efforts of individual government agencies. The NSWP does not attempt to sculpt agency programs into a grand plan, but provided the clay from which each agency molds its own strategies.

Agencies involved in achieving the NSWP objectives have been very successful in creating and disseminating information on the space weather environment. The success of the NSWP shows the value of the interagency coordinating infrastructure as an effective way to gather and define user requirements, identify ways to leverage already existing programs, avoid duplication of effort among Federal agencies, and build consensus on overarching roadmaps in various areas to obtain and enhance meteorological capabilities required by the Nation.

Contributions to the article: Dr. Robert M. Robinson and Dr. Richard A. Behnke, National Science Foundation, Arlington, Va.

Weather officers key to la

Provide critical weather data to support launch missions

by Master Sgt. Lloyd Conley
30th Space Wing Public Affairs
Vandenberg AFB, Calif.

A great deal of preparation goes into launching a missile or rocket at Vandenberg AFB, Calif.; logistics, maintenance, and operations are a few essential aspects.

One critical piece of Team Vandenberg's launch mission is determining and evaluating weather conditions up to the second the vehicle lifts off from a pad or blasts out of a silo.

Though weather is sometimes taken for granted, it can delay or postpone a launch just as easily as a mechanical, technical or software failure.

As a lead weather officer on a launch team, Vandenberg's weather officers determine the weather go or no-go for launch, said Capt. Paul Lucyk, 30th Weather Squadron.

"It's the most exciting job a weather officer can have in the Air Force," he said.

In its search for clear skies, the Vandenberg weather team starts its preparations well before each launch.

"We start our weather forecast ten days out from a launch," said Capt. Breea Lemm, another of Vandenberg's weather officers. Forecasting normally involves observing typical weather patterns and predicting how those patterns will affect a launch, she said. That gives an overall picture of what the meteorological conditions might be in the area at launch time.

Weather technicians like Airman 1st Class Emily Williams, 30th WS, provide toxic hazard forecasts to the weather officer. Airman Williams said she can reasonably predict where fumes will travel after or during a launch based on information from weather monitoring sensors and equipment. From that information, she can also forecast the direction and speed fumes will travel in the event of a catastrophic accident or release of hazardous materials into the atmosphere.

Seasonal weather conditions also factor into launch planning, Capt. Lucyk said.

"While summertime can be calmer, winter weather here is more dynamic in terms of wind, temperature and visibility," he said. Natural or triggered lightning, rain, and high winds can all adversely affect a launch.

Natural lightning is typically encountered in thunderstorms, he explained. Triggered lightening occurs when a launch vehicle hits charged ice crystals in the clouds as its altitude and velocity increase after launch. Those charged ice crystals combined with the friction produced by contact with the launch vehicle's surface at high speeds could trigger a lightning strike, which can severely damage and

Launch Weather Officers, Capt. Breea Lemm and Capt. Paul Lucyk, lead the Va Team through another launch.

Weather officers career path

Company Grade Officers

- A new lieutenant's first assignment will be at an Operational Weather Squadron.
- This is where company grade officers build their depth and expertise.
- They analyze and evaluate meteorological data, prepare short and long-range forecasts, brief aircrews and staff personnel, and provide weather advisories and warnings.
- After a two to three year tour, they attend the weather flight course, and then move on to become a flight commander. Graduate school is often the next step in their career track.
- Many officers seek to obtain a master's degree through a school sponsored by the Air Force Institute of Technology - some now go to the Naval Post Graduate School.
- Nearly 25 to 35 percent of the positions in the weather career field require an advanced academic degree.

ey to launch mission

ultimately destroy a launch vehicle. Natural lightning produces the same results, Capt. Lucyk added.

Rain too can have a damaging affect as a missile or rocket approaches sub-sonic or super sonic speeds. Water droplets have the same impact as thousands of pebbles striking the spacecraft continuously and simultaneously, Capt. Lucyk said. Water also freezes at higher altitudes and can coat the launch vehicle in ice.

Besides damaging a vehicle itself, high winds and heavy rains can also affect the trajectory of a missile or rocket and could lead to its being destroyed if it veers dangerously off course, Capt. Lucyk said.

Weather observations aren't limited to Earth alone, Capt. Lemm said. Solar activity can also adversely affect sensors in satellites.

"Predicting where a weather system will be on launch day is an aspect about being a weather officer I truly like," Capt. Lemm said. "It's exciting to see whether or not my prediction was right."

reea Lemm and Capt. Paul Lucyk, lead the Vandenberg Launch Weather

In order to nail those real-time launch weather predictions, officers here need more than just guesswork.

Weather officers normally have degrees in meteorology or another technical field but physics and calculus is an integral facet for forecasting, Capt. Lemm said. The officer's technical training is about three months.

Technical training for enlisted weather forecasters is almost a year at Keesler, AFB, Miss.

A great deal of the training is on-the-job and hands-on, Capt. Lemm said. It can take a while to understand the physics of the atmosphere here.

Luckily, the weather squadron isn't carrying the burden alone. Predicting and forecasting the weather here is a team effort. In addition to the five civilians, nine officers and 11 enlisted members who make up the squadron, contractors and other base units combine to produce the synergy needed to give Team Vandenberg the right information to make sound decisions.

The squadron works closely with Central Coast Weather Associates, which conducts weather balloon releases here, Capt. Lemm said. Sensors on the weather balloons provide valuable information like wind speed and temperature, she said.

Employees from a high-technology firm specializing in information technology, science and engineering monitors information and collection equipment on the base like wind towers and radar wind profilers. The equipment provides wind direction and speed at different altitudes, Capt. Lucyk said.

Members of the 30th Space Communications Squadron maintain the airfield's meteorological equipment as well as the base's NEXRAD weather radar.

The launch weather forecaster combines information from all these sources to produce a realistic picture on launch day.

"It's most rewarding to see your forecast in action – the fruits of your labor," Capt. Lucyk said. "The excitement of launch day is in providing that critical piece of information."

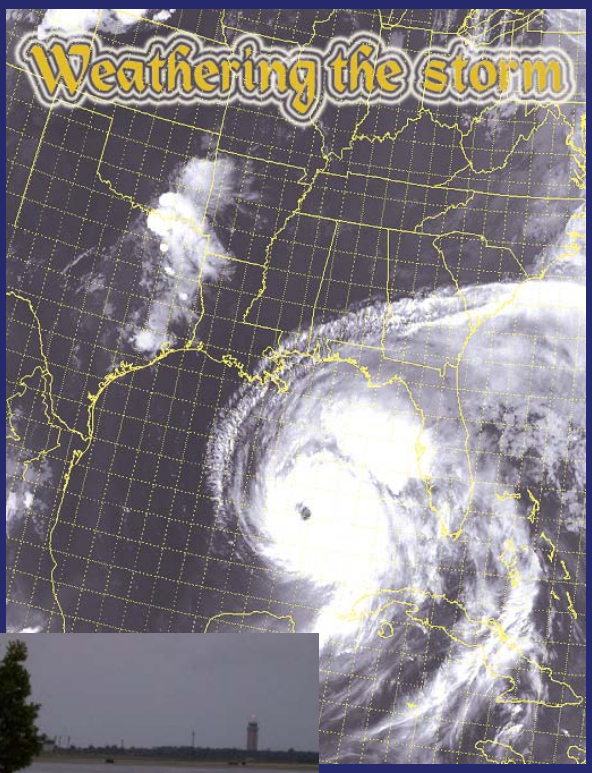
Weather officers career path

Field Grade Officers

- At the field grade officer level, the emphasis shifts from depth to breadth of experience.
- There are numerous staff assignment opportunities available within the Air Force Weather Agency, Air Staff and Major Commands. In addition, there are also positions at the Air Force Academy and AFIT.
- What field grade officers should strive for is a combination of command and high-level staff assignments that demonstrate leadership and responsibility.
- A successful Air Force weather career normally includes a strong technical and operational base, with high-level staff experience, and challenging leadership positions.

Weathering the storm

by Lois Walsh
96th ABW Public Affairs
Eglin AFB, Fla.



Observing contractor Rick Boyer returning from taking an observation before Ivan came on shore.

Trying to outguess Mother Nature is a game no one's willing to play, especially with a hurricane barreling towards the gulf coast.

The 46th Test Wing's Weather Squadron used the latest technology, experience and a bit of instinct to prepare commanders for Hurricane Ivan's arrival and ensure more than 80 aircrafts were ready to get out of harm's way.

A week out, the forecasters knew they were dealing with a storm unlike the previous ones that hit Florida—this one was heading into the Gulf of Mexico. Not knowing the exact landfall, each base along the coast began working to determine how the tract would affect the weather at their location.

"The National Hurricane Center puts an official track out and we progressively watch it from there," said 1st Lt. John Raczkowski, interim operations flight commander. "Those guys are the smart guys, they do this for a living; they are always staring at the hurricane."

The hurricane center also puts out an error cone that shows where the storm could make landfall. While the track is updated every six hours, a continuous loop of satellite imagery allows forecasters to keep a constant eye on the storm.

The lieutenant said the squadron's workload of daily flight operation requirements didn't change just because the storm was on its way. That's one reason why the squadron leaves the forecasting to the experts.

"You don't want different agencies putting out different forecasts because that just creates confusion in the public," he said. "You want one voice speaking together."

Duty forecaster, Staff Sgt. Travis Harrington, said there was a large cone of error when Ivan arrived in the southern Gulf of Mexico.

"At that point, some were saying Ivan would go into Louisiana," Sergeant Harrington said. "We were seeing more middle of the road; we talked about sea surface temperatures and that was going to swing it back toward us."

Sergeant Harrington said the water sensors in the gulf and their inside contacts helped make that determination. Rich Henning, a civilian forecaster with the squadron, is a reservist with the hurricane hunters at Keesler Air Force Base, Miss. He called to keep the base updated. But even with the inside track, Sergeant Harrington acknowledges that storms are unpredictable even with the latest technology.

As the weekend progressed, the weather squadron provided continuous information to the commanders who made the ultimate decision to evacuate both personnel and planes Sept. 13.

"At that point, we went to the operations mode; it was a normal day, providing weather briefings for aircrews leaving the area," Lieutenant Raczkowski said. "We put together a satellite picture of the United States, current observations here, a forecast where they are flying to and any hazards along the way."

Briefings were delivered to Duke and Air Force Special Operations Command personnel along with the 46th Test Wing and 33rd Wing.

"It was busy, like a surge week in a few days; every jet that's capable of leaving was leaving on that same day," Sergeant Harrington said.

Once the planes left, the waiting game began for the 10-man ride out team.

"Then there was a lull, we kept watching the storm, waiting for new updates to come out and keeping the leadership advised," Lieutenant Raczkowski continued.

"We watched for any deviation from the track," he continued. "There was one moment four hours before landfall when Ivan jogged to the right. It was a very intense 30 minutes until it turned back."

"I literally had lifted the phone off the hook to dial up the base commander and recommend that he pull everyone into the Category 4 shelter," said Lt. Col. John Knowles, squadron commander. "If it kept on that northeast jog, we would have experienced here what happened in Pensacola."

"It was a fun 30 minutes with 10 weather guys staring at the weather satellite chanting 'change, change,'" Lieutenant Raczkowski added.

After the storm passed Sept. 16, the squadron continued to put out advisories, so the commanders knew when it was safe to fly damage assessment missions.

"The gulf season is open now; instead of two weeks, storms can form in the gulf in two or three days," Lieutenant Raczkowski said. "We'll be keeping an eye on it."

Their work never stopped during Ivan. It never stopped until the hurricane season was over Nov. 30.

Senior Airman Jasson Sjoberg pours water into the tactical meteorological observation system as part of a function check to make sure the device, which measures precipitation, is still operational. (Courtesy photo)

As (un)predictable as the weather

by Master Sgt. Andrew Gates
455th Expeditionary Operations Group Public Affairs
Bagram Air Base, Afghanistan

No matter what the season, the weather changes quickly in the Afghanistan Mountains. Within 30 minutes, the skies can go from clear blue to dark and stormy, or the wind can pick up drastically, picking up dust and reducing visibility to nearly zero.

With air and ground forces conducting operations around the clock, many organizations need to know what the weather is, or what it will be in the future. A team of Airmen here makes sure those organizations get accurate information.

"We provide support to all the coalition forces here at Bagram or at any other location in Afghanistan – including the forward operating bases," said Maj. Ann Gravier, lead weather officer for 12 forecasters at Bagram.

"We support on-going operations, protect resources and help with planning," she said. "For instance, if a commander knows he will be operating in a certain area in five days, he'll get with us to find out what the projected weather is for the area – that way, he can determine how weather can impact his operation."

Accurately predicting the weather is extremely important. "Commanders will make a decision whether a particular mission will go or not," said Staff Sgt. Sherdean Brisendine, 455th Expeditionary Operations Group forecaster.

We have to make sure we give the commander the information he needs to make a wise decision based on the weather – it gives him additional situational awareness."

Since wind speeds can go from 11 to 35 knots (12 to 40 mph) in about 30 minutes, said Sergeant Brisendine, "we also report rapidly changing conditions and warn of thunderstorms and high winds."

Without many of the traditional tools, forecasters have to go back to basic observing skills to determine the weather. "You have to go outside and look – find out 'what does it look like out there?'" said Sergeant Brisendine.

This gives the weather forecasters additional information to improve future predictions.

"It's important to be able to observe the weather around the clock. We really rely on forecasting skills and knowledge," said Major Gravier.

That knowledge is also useful during the weather briefings. Most of the forecasters have had experience in the units they provide assistance for – for example, Sergeant Brisendine is from Eielson AFB, Alaska, the home of the A-10 unit currently stationed at Bagram. On the other hand, Staff Sgt. Alison Long hails from Wheeler Army Air Field in Hawaii. She provides weather forecasting for Army ground forces deployed here from Hawaii.

"It's helpful that I have worked and trained with these people long before I got here," she said. "I know their specific sensitivities, and know what they will need to know about weather. Many of the weather briefings I do are for helicopter pilots – they need to know different information from the fixed wing pilots."

There are significant differences between briefing pilots of fixed wing aircraft like the A-10 Thunderbolt IIs and those piloting helicopters used at Bagram like the CH-47 Chinook and AH-64 Apache. Helicopters travel much lower than fixed wing aircraft, said Sergeant Long, and since the weather can be more turbulent closer to the ground, it can be more challenging to brief.

"The people who are regularly embedded with Army units are able to provide weather information important to that unit's mission," said Major Gravier. "They will know how particular weather will impact the unit and the unit's equipment. It really pays off for both the weather forecasters and the unit. We are able to bring people into a deployment environment who are familiar with the weapons system."

"We learn what kind of weather the pilots can fly in," said Sergeant Brisendine, "What crosswinds they can take and what weather they need for the weapons they fly with."

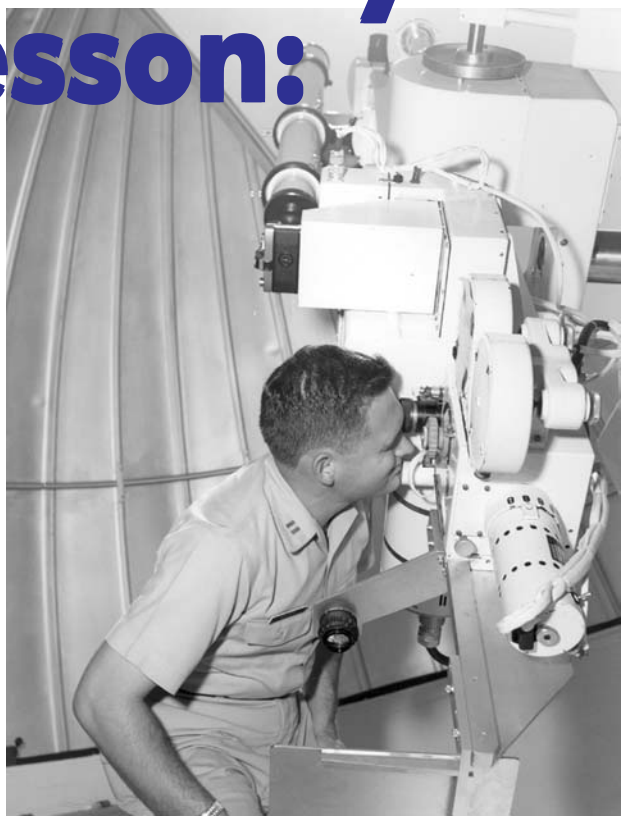
An Air Force forecaster working with the Army isn't unusual – the Air Force regularly provides weather support to Army units. "This is a part of the joint environment," said Major Gravier.

That mission is vital to the success of Operation Enduring Freedom, now moving into a phase where forces are supporting preparations for elections. The forecasters are well aware of their impact.

"I'm very proud to be here in this crucial time," said Sergeant Brisendine. "It's great to be here to give men and women, especially women, some of the equal opportunities that I have stateside."

Sergeant Blanch agrees. "I am awestruck by the fact that I am contributing to the pages of a future history book, a book that will describe how a coalition of many countries provided the means for a democratic process to become possible."

A history lesson:



Moments in History

1613 Galileo discovers sunspots.

1859 Heinrich Schwabe announces discovery of the sunspot cycle.

1859 Richard Carrington discovers solar flares.

1895 Marconi invents the radio.

1942 J.S. Hey discovers solar radio emission.

1957 The Soviet Union launches Sputnik, the first artificial satellite.

1958 "Score", the first communications satellite launched by the United States.

1969 First manned mission to the moon.

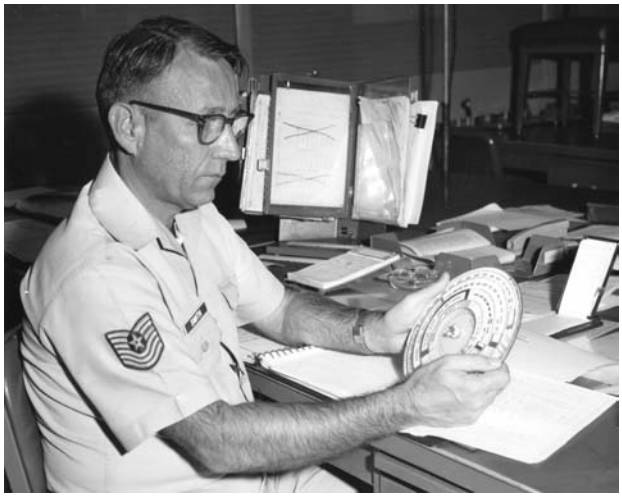
1980 Launch of the *Solar Maximum Mission* satellite.

1981 First flight of the space shuttle.

Information courtesy of the NASA website.

(Right) This circa 1970s photo shows Capt. Lyman L. Kaiser, solar astronomer, as he observes the sun's chromosphere through an H-alpha flare patrol telescope at the Ramey Solar Observatory, Ramey AFB, Puerto Rico. The Ramey Solar Observatory, inactivated May 1, 2003. Closing the solar observatory eliminated redundant solar observing pattern and provided savings to fund improvements to the Solar Electro-Optical Network. Photos courtesy the Air Force Weather Agency History Office.

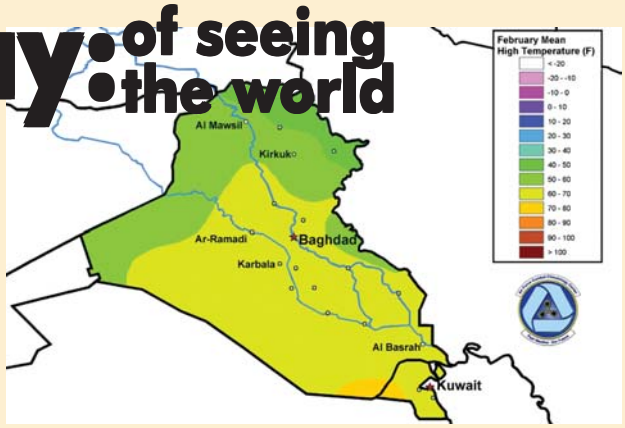
(Above) This photo, taken circa 1970's, shows some of the personnel who worked at the Ramey Solar Observatory, Ramey AFB, Puerto Rico.



(Right) Master Sgt. Jesse B. Smith, Solar Forecast Center, computes solar flare probability on a Solar Flare Calculator, circa 1970.

A new way: of seeing the world

by Tech. Sgt. Benjamin Wretlind
Air Force Combat Climatology Center
Asheville, N.C.



This image of Kuwait Iraq, and surrounding countries, displays examples of some of the layers used by the Air Force Combat Climatology Center to create its maps. These data layers include country boundaries and the February mean high temperature derived from Operational Climatic Data Summaries data. Any number of additional features could be added, such as: terrain, water features, roads, digital orthophotos, cities, or agricultural zones.

In February, the Air Force Combat Climatology Center launched its new Spatial Climatology Initiative. This was the first step toward redefining map-based climatology as it applies to mission planners, warfighters, and operational weather forecasters. The Spatial Climatology Web site provides the most comprehensive library of climate information available on the Web. It uses Geographic Information System technology to provide quick access to diverse information.

The GIS is mapping software that links information about where things are located with data about what things are like. Unlike a paper map, of "what you see is what you get," a GIS map can be designed to display specific sets of information in any combination the user chooses.

A paper map is a flat representation of cities and roads, mountains and rivers, railroads and political boundaries. Small dots or circles represent cities, roads could be black, blue or red lines, mountain peaks show up as tiny triangles, and lakes are blue areas. A digital map created by GIS will also have dots, lines and other symbols to represent features on a map.

However with the GIS version, this information is stored in a database and is shown only if the user selects it. The database stores point locations, road lengths, as well as lake areas. The information on the map is stored in layers which can be turned on or off according to the needs of the user. The user can select a layer that shows all the rivers in an area, another could present the mean annual temperatures in the same area, or it could depict the regional airports or any other parameter of preference.

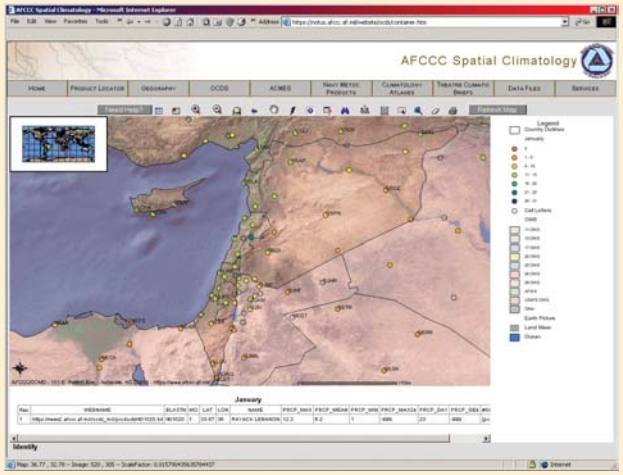
Why is the ability to select layers important? A GIS map is more powerful than a paper map because, in just minutes, you can design a map that displays only the information you need while with a paper copy it's fixed and it can take months to update.

Tapping the boundless possibilities of emerging GIS technology in combination with cutting-edge Internet technology, provides exciting new ways to visualize climate in a format familiar to you and your customers ... the map. This reduces research time and guesswork plus provides access to thousands of climatological products at the click of the mouse.

AFCCC has kept a small GIS presence on the Web for the last few years, but the launch of the new Spatial Climatology Web site is the first step in a bold and expanding project to present data in new ways and refine the storage, processing, and delivery based on the customers needs. Future initiatives include reprocessing old products, constructing new applications, and reorganizing the GIS database to adapt to new and emerging database storage technologies. Perhaps most exciting for the future, is a plan to bring to customers the ability to select an area with little or no data and visualize the climate of that region in seconds.

For more information, call DSN: 673-9018 or Commercial (828) 271-4235

The Spatial Climatology website allows the user to navigate anywhere in the world and visualize Operational Climatic Data Summaries parameters. Users can select which layers to display, which features to turn off and on, and design the layout of their display. They can then print the page or create an image suitable to save for future use. This portion of the website is just one example of the services that have been created for your use.



SERVICE BEFORE SELF

by Tech. Sgt. Claudette Hutchinson
Air Force Weather Agency Public Affairs
Offutt AFB, Neb.

It's time to bid farewell. After 44 years of service, Mr. George N. Coleman III, Air Force Weather Agency Plans and Programs Deputy Director, said goodbye to friends and colleagues during a retirement ceremony, Oct. 29.

One doesn't have to talk to Mr. Coleman very long to sense his passion for the Air Force and the Air Force Weather team, and why it has been his chosen lifelong path.

"The military is a way of life. In the '50s the military was a means of finding yourself. You didn't just join because of patriotism. But, patriotism was the reason you stayed," he said.

His journey didn't just start when he joined the Air Force in 1960, but really started 18 years earlier, the day he was born. As the son of an Army veteran, he experienced his first permanent change of station move by his first birthday, with numerous others to follow. By the time he was 18 years-old he was seasoned military "Brat" with more than seven PCS moves under his belt. After his high school graduation he headed off to college.

"After the first semester, I became disillusioned with college. I began searching for what I wanted to do with my life," he said.

His search brought him full circle, back to the Air Force. His career path was unknown when he laced up his boots and marched full speed ahead, to basic military training. After basic training he was told he would work in the weather career field.

"The Air Force gave me a career. They said, 'you're going to be in weather,' I asked, 'what's that?'" said Mr. Coleman.

His question was answered when he received training as a weather observer and was assigned his first weather observing duty at Chanute AFB, Ill.

"It (weather) has been a love affair for 44 years," Mr. Coleman said.

His military relationship with weather continued for 24 years of military service. He moved through the ranks and bore the numerous responsibilities in his beloved field. As an Airman and junior NCO he observed and forecasted the weather, and with increased rank he served as the NCO in charge of weather stations and as the chief of various weather detachments.

He climbed the ranks to chief master sergeant and in April 1984, he traded in his Air Force blues for civilian attire, when he retired from active duty.

"I only had two career goals. One, to be a chief, and two to spend 20 years as a civil servant," he said.

As he crossed the first goal off his list, he embarked on the second. Six months later he returned to Air Weather Service, at Scott AFB, Ill., where he worked as acquisition manager of weather systems. After a series of promotions, and a total of 17 years at Scott AFB, Mr. Coleman endured one more move. He packed up his family and headed to the Air Force Weather Agency, Offutt AFB, Neb.

He said he used his 24 years of experience in the military as a guide to his civilian career.

Airman 1st Class Jason Geyer, a member of AFWA's Color Guard, presents Mr. George Coleman a flag at Mr. Coleman's retirement ceremony. Mr. Coleman retired from the Air Force as a Chief Master Sgt., in 1984, after 24 years of military service. He went on to spend 20 years in civil service. Photos by Marea Whittaker-Bishop.

In this photo a then Tech. Sgt George deployed to Vietnam from Septembe Vietnam, he was the Weather Foreca

In this photo a then Tech. Sgt George Coleman receives an Air Force Commendation medal from Maj. Don Bahr. He was deployed to Vietnam from September 1972 to February 1973 and received the medal on his return. During his time in Vietnam, he was the Weather Forecast Advisor to the Vietnam Air Force, stationed at the Vietnamese Air Force Base, Phu Cat.

"The technical knowledge I got in the military was the foundation of my civilian career. With technological advances I believe the sky is the limit for the weather career field," he explained.

Taking a stroll back down memory lane, he recalled the not so distant past of weather observing and forecasting.

"In 1960 we hand plotted all the charts, and sending observations once an hour. By the 1980s we were sending observations as soon as the weather changed. Now it's astronomical in the speeds transmissions are made, and about two years from now things will happen even quicker," he said.

However, he cautions that even with the advance in technology weather technicians should still have a basic knowledge of weather operations.

"The enlisted weather person still has to understand the basic operations of the weather instrument. Forecasters have to be prepared to make a forecast with just an observation at a point. You can't tell a pilot that the computer is down when he is expecting a service. So, they have to be prepared to provide that service regardless of what's available," he said.

In his own way, Mr. Coleman has touched many lives.

"In his 24 years not only has he impacted the people who worked with him, but everyone who uses weather equipment; and in his 44 years he has touched every aspect of every mission that the Air Force does. He has touched every pilot who uses weather equipment," said Master Sgt. (retired) Scott Price.

As Mr. Coleman embarked on the next phase of his journey, with wife Joyce, he'll take with him some great memories. He said it has been great life for him and his family.

"I'd do it all over again. I had a great profession in meteorology, and supporting the aviators," he said.

When asked what he plans on doing after his retirement, he said he plans to take life a lot easier.

"It's time to move on," he said. But, you could tell by the way he said the words, this would not be the last we would hear from him.

He continued by saying, "My mind is still active. I plan on staying mentally active in meteorology for as long as I can."

It's clear that the bond between Air Force Weather and Mr. Coleman will never be broken. AFW will never forget Mr. Coleman's lasting contributions, and he will always remember his 44 years of service.

Top Ten things learned from Mr. George Coleman

The following ten leadership and management lessons were taken from remarks made at Mr. Coleman's retirement dinner by Col. Ray Clark, AFWA Vice Commander. Col. Clark said he learned these lessons from working with Mr. Coleman.

1. Never forget that we do this for the young warriors out in the field – they are depending on us.
2. Learn how to take responsibility for your mistakes. Pride can be deadly.
3. Make sure of your position and the righteousness of your cause if you're going to point out the flaws of others.
4. Never miss an opportunity to impart wisdom to those coming behind you – Mentor!
5. Never miss an opportunity to learn something new.
6. Don't take the daily grind personally.
7. Do your homework and save yourself the embarrassment.
8. Learn how to separate what's important from the unimportant.
9. Don't let your desire for perfection prevent fielding of needed capabilities.
10. Thou shall not change the baseline.

Making the difference

by Lt. Col. Tom Guinn
1st Weather Squadron
Ft. Lewis, Wash.

The last thing most people think about when they are deployed or on a temporary duty assignment is to volunteer. However, for one 1st Weather Squadron staff sergeant from Fort Lewis, Wash., TDYs and deployments are just the excuse she needs to forge more volunteer opportunities.

(Background photo) Students at their newly renovated school look out of the window. (right) Staff Sergeant Supria Calvert-Reisner greets the students who performed in the ceremony. Courtesy photo.

Staff Sgt. Supria Calvert-Reisner, a weather technician with the 1st WS, has become a true ambassador and whether it's her service in the Air Force or volunteering in a community, any community, she always finds time to serve.

While assigned to Bagram Air Base, Afghanistan she devoted all the off-duty time she could muster to support the Adopt-A-Village program by collecting clothing and food donations for local families.

And although her past efforts have been for worthy causes, her latest endeavor packs a bigger punch as it hits a bit closer to home. A

native of Thailand, she had the rare opportunity to return home, this time wearing the U.S. Air Force uniform.

Sergeant Calvert-Reisner participated in the U.S. Army Exercise Cobra Gold 2004. Exercise Cobra Gold is the largest annual war games for American forces in Asia, with almost 20,000 personnel from the United States, Thailand, and other allies training in anti-terror and peacekeeping exercises.

Sergeant Calvert-Reisner was born in Thailand and raised by her grandmother before leaving for Indonesia and eventually migrating to the United States at age 16. According to Sergeant Calvert-Reisner, returning home was an opportunity of a lifetime – she could serve her adopted country, the United States, and at the same time give back to her homeland, Thailand.

She said, growing up in Thailand she learned first-hand what it's like to live without the day-to-day conveniences. So when she got the opportunity to help the local children she jumped at the chance. She coordinated with exercise team members, to lead a major fund-raising effort, the Combined Task Force in Khorat, Thailand. The group wanted to renovate a local school.

The first step was to select the school most in need. Sergeant Calvert-Reisner, along with three 1st Corps staff, toured several schools near Khorat and decided on a school which was originally built by the U.S. Air Force during the Vietnam War. The fundraiser had two goals: to improve the quality of life for the students, and to provide resources necessary to improve their academic capability.

The fundraising effort was a huge success. In the end the committee collected almost $7,000 in donations for the school, from soldiers, airmen, sailors, and Marines.

Numerous people volunteered to complete the multiple projects. The school was in total disrepair when they started, and the first priority was to repair the restrooms. The school's restrooms consisted of four toilets for nearly 700 children, and only one functioned properly.

"If you took a Port-a-Potty, that's completely full, and left it in the sun unattended for several months, you would come close to replicating the odor in the bathroom," according to one of the command sergeant majors.

The entire septic system was replaced, eliminating the odor and ensuring the repairs lasted. In addition to the toilets that were repaired, four additional toilets were added. Next, the ceiling in the library was replaced and fans were added for a more comfortable study environment for the children. The volunteers increased the size of the outdoor shelters and assembly areas and improved the ventilation system. Other projects included repairing the library, upgrading the assembly area, and improving the lunch facility. Finally, people volunteered to sand and paint tables and chairs in the children's outdoor lunch area.

Upon completion of the project, the students and faculty prepared a small lunch banquet for the participants, and celebrated with singing and dance performances.

The volunteers and their efforts were truly a positive representative of the Air Force and the United States. Their efforts are a true example of the Air Force core values, "Integrity First, Service Before Self, and Excellence in All We Do."

The leadership of Sergeant Calvert-Reisner, and teamwork and support of all the volunteers, did not just successfully build a school, but their care and compassion helped build a stronger bond between nations.

A Story of Survival

by Staff Sgt. Sharon Wood
26th Operational Weather Squadron
Barksdale AFB, La.

October was Breast Cancer Awareness Month. One Air Force Weather Airman, Staff Sgt. Sharon Wood, 26th Operational Weather Squadron, discovered she had breast cancer and has battled with the disease for more than a year. Thanks to the unconditional support of family, friends and her Air Force family this has strengthened her determination for survival.

I am a breast cancer survivor. When I mention this to others their reaction is usually, "but you are so young, I didn't think women had to worry about that until they were much older." Unfortunately, this misconception is the greatest enemy against early diagnosis and treatment of breast cancer, the most treatable form of cancer.

In July 2002, I felt an unusual swelling in my neck and a lump in my right breast; so, I went to have it examined. Considering my age and that I did not have a family history of breast cancer the physician seemed optimistic. I was advised to monitor myself and if any changes occurred return for further evaluations. I left the office feeling assured.

I thought nothing more of it until March 2003, while deployed to Guam as part of the 7th Air Expeditionary Wing, at Andersen AFB. While getting dressed, I felt the lump and it seemed to have gotten slightly bigger. I mentioned it to my roommate, who was a nurse. She said, "You need to get it checked again, and do it soon," she urged.

The next day I went to the clinic, they immediately scheduled me for a mammogram. A mammogram can be an unpleasant experience, however, the professionalism of the technicians eased my fears. The procedure was a bit uncomfortable, but tolerable.

The lump remained elusive and the result of the mammogram was inconclusive.

I returned for a biopsy; it would take a week or two to get the results. The wait was terrifying. I was determined not to sit around and brood, I volunteered for extra responsibilities, and a TDY to another forward operating location to help divert my mind.

At this new location, I enjoyed the time I spent there. I went to meet with my commander to request an extension of my tour. But, my meeting with the commander would take a different turn, and the conversation seemed like a bad dream. "Sharon, I would love for you to stay, it makes sense to do what you are suggesting, but..." he paused, and then continued as if in slow motion, all I could remember hearing was "your test results were inconclusive."

"What do you mean inconclusive," I asked.

"They are still not sure if it is cancer or not, you need to go back for more tests," he said. I needed my family with me now more than ever. I kept a lot of the information from my husband, Tech. Sgt. Burtice Glenn Wood, also a forecaster at Barksdale AFB, because I didn't want to worry him. The airplane ride home seemed like an eternity. Seeing family made everything seem real, and I couldn't hold back the emotions anymore. I broke down in tears.

On April Fools Day Glenn and I went to the hospital for a scheduled biopsy. This seemed like a cruel joke. Why not? I dabbled into a false sense of reassurance, and nervously joked to myself, "how could anything serious happen on April Fools Day?"

Our friend, 1st Lt. Robert Toner met us at the doctors' office, to provide support when we got the results. "Sharon, I am sorry to say that the sample we removed came back positive for cancer," the doctor said. It was a horrifying moment, I looked at my husband, fear washed over his face. I began to cry. He nervously quizzed the doctor about everything. Lieutenant Toner held my hand and told me I was strong; I'd get through this. I felt as if the room was spinning and I was on a Ferris wheel going a million miles per hour.

The doctor said the tumor was small and that the surrounding tissue was not affected. More samples were taken to ensure the cancer didn't spread to other areas of my body. On the way home neither Glenn nor I said much. It was as if we had dined on a bad meal and couldn't digest it. My thoughts were just spinning out of control, "This had to be a mistake. I am too

Breast Cancer Facts

- More than 200,000 new breast cancer cases are diagnosed each year in the United States.
- In the U.S. today, there are more than two million breast cancer survivors, and every woman is at risk.
- **Breast cancer is the most common form of cancer in women, and can also be diagnosed in men. Male breast cancer is a disease in which malignant cancer cells form in the tissues of the breast. Men at any age may develop breast cancer, but it is usually detected in men between 60 and 70 years of age. Male breast cancer makes up less than 1 percent of all cases of breast cancer.**

young for this to be happening to me," I thought to myself.

However this was a normal reaction. According to information resources on breast cancer, there are four stages of emotion that a person experiences when faced with a traumatic situation: shock, denial, anger and finally acceptance. This usually take days or even weeks for them to get through each stage. However, I think I went through the first three stages during the car ride home.

When we got home I sat on the couch, immobile, for about 30 minutes. For the next six months I was on a steady cocktail of medication, at times I felt as if I was in a haze cloud. It was a difficult time for everyone. The attitudes of Glenn and the children made all the difference to me and it got me through the tough moments. The children were wonderful; they made me laugh when I was down; they were always hugging me and telling me they were proud of me. Glenn was my biggest source of strength, always showing a positive attitude even through the roughest times. Our Air Force Weather teammates were also very sympathetic and provided my family support during these trying times.

The results from the surgery to remove my lymph nodes came back with good news; they showed no signs of cancer. This was the first bit of good news we've had in months. But, our celebration was short lived. I developed a serious infection in my affected breast and had to be rushed in for emergency surgery. I went on a second round of chemotherapy. This was the toughest moment yet. I'm sure you've heard the expression "sometimes the cure is worse than the illness." It got so bad that at one point I refused to take some of the medication; much to the disappointment of everyone, especially our children. I will never forget the fear on my children's faces when they found out I had refused treatment. Glenn was by far the strongest one of our family during my illness. He took care of everything that I was unable to do, and never complained. Sometimes people don't realize how essential love is, and how much family and friends mean to you until something like this happens.

Even after the surgeries and treatments, I was still considered to be high-risk for the cancer recurring. I decided to have a double mastectomy and reconstruction. Due to the lymph node removal I am still unable to do a lot of things I used to, but that's a small price to pay for the chance of growing old with family. I was given the all clear, and returned to work, one year and two months after my diagnosis.

People are often curious about how I was able to stay positive throughout my illness; I rarely cried and seemed to always be smiling. It was hard at times, but the love and support from family, and our Air Force Weather family made the whole ordeal easier.

- **Breast cancer can develop at any age, but your risk increases as you grow older.**
- **Your chances of developing breast cancer are twice as great at age 70 as they are at age 50.**
- **More than 70 percent of all women with breast cancer have no family history of the disease. In fact, except for growing older, most women with breast cancer have no strong risk factors.**
- **Early diagnosis of breast cancer means better chances of survival.**
- **Mammography is a safe and effective screening tool, finding most breast cancers before they can be felt. But it is important to be examined regularly by your physician in addition to performing monthly breast self-examination.**

Source:http://www.mydna.com/health/breast_cancer/overview/bc_risk.html

LIGHTNING STRIKES TWICE

by Staff Sgt. Sharon Wood
26th Operational Weather Squadron
Barksdale AFB, La.

Who said lightning doesn't strike the same place twice? They must not have heard my story. I returned home from my temporary duty assignment in Guam, for follow-up diagnosis and possible treatment of breast cancer. That night after everyone was settled in I received an email from my parents, who live in England. Due to the time difference, I generally correspond with them by email, especialy while I was deployed. I opened the email, and it began ...

"Dear Sharon, I hate to write and tell you this with you being deployed (because I hadn't told them anything, they thought I was still in Guam) and promise me you won't get upset and worry about anything, we are sure it is nothing. But your mother found a lump in her breast. She is going in for a needle-guided biopsy on, April 1, so if you want to call her before she goes in, you can. We love you,"

~ Dad

I read it again and again, hoping that somehow I was just confused and it wasn't real. I called home the next morning. I had to know what was happening.

I talked to my dad, first, and asked him how mum was doing. I didn't mention that I was home for the same reason, because he had enough to worry about. My mother got on the phone and I could hear the fear in her voice. I tried to comfort and assure her that everything would be okay. I told her that I really understood what she was going through.

"Mum, it will be okay, please don't tell dad this, but I am home for the same reason. I'm here with Glenn and the kids. I am going to the hospital later this morning to see about getting my lump removed," She got really quiet.

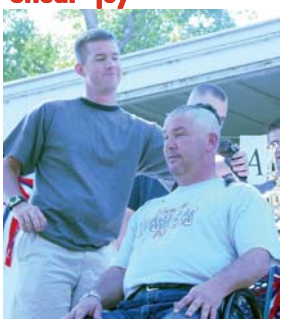
I was nervous that the news would upset her, but also wanted to reassure her, so I took the gamble. While, on one hand, it seemed to have helped, because now she knew she was not alone, she also started worrying about me. This must really be an April's Fool joke, I thought. What were the odds that both of us could have this disease, and that both of were being diagnosed for breast cancer, within the same time frame. I tried to console her as best as I could, and by the end of our conversation her voice seemed more relaxed, and we were laughing and talking about everything else.

Before I hung up, I expressed my love and reassured her that everything would be okay. She laughed and said, "Sounds odd hearing you say that to me, it should be the other way around.

At the end of their rope ...

Participants try to hang on as their opponents fight for the rope during the Tug-o-War competition. Photos by Tech. Sgt. Claudette Hutchinson.

'Shear' joy



Airman 1st Class Jarod Scott shaves Mr. Ronald Duggins' head as part of an incentive to raise money for the Combined Federal Campaign. A total of $1,600 was raised towards the campaign. The money will be earmarked for the Offutt AFB Youth Programs. "I wanted to encourage maximum participation in the CFC drive," said Mr. Duggins.

Attack!

Mr. Ronald Duggins, AFWA Communications and Information Directorate, takes on his opponent for a competition in Sumo Wrestling during AFWA's Annual Sports Day event, Oct. 8. The competition was used to raise money in support of the Combined Federal Campaign.

Fit to fight = marathon readiness

Twelve runners from 28th Operational Weather Squadron, Shaw AFB, S.C., participated in the 7th Annual U.S. Air Force Marathon, Wright-Patterson AFB, Ohio, Sept. 19. The team was organized as part of the Chief of Staff of the Air Force's vision, "fit to fight."

According to Lt. Col. John Coulter, training for the marathon started several months before the actual event. Colonel Coulter said he and his team members credit the squadron's rigorous fitness program for their success in completing the marathon. All runners who completed the race were considered winners and received a medallion, he said.

There were three relay teams:
Lightening - 19th place
Finish time: 3:31:53
Thunder - 11th place
Finish time - 3:07:53
Storm - 24th place
Finish time: 3:47:05

Team members were:
Lt. Col. John Coulter, Capt. Jennifer Bailey, Capt. Stephen Phillips, 1st Lt. Shawn Beskar, 1st Lt. Trent Cloer, Senior Airman Jacqueline Miller, Senior Airman Josh Woods, Airman 1st Class Nathan Fried, Airman 1st Class Benjamin Larrew, Airman 1st Class Trenton Seegmiller, Airman 1st Class Zachariah Viets, and Airman 1st Class Nathan Wingert. (*Information courtesy of the 28th OWS*)

Weather Warrior

Staff Sgt. David J. Strickland
19th ASOS, 101st Airborne Division, Ft. Campbell, Ky.
Combat Weather Team Weather Technician
Years in Service: Six years
Hometown: Cadiz, Ky.
Role Model: My father, who is currently a command sergeant major. He is a Green Beret and he participated in three combat tours with the 5th Special Forces Group (Airborne). He continues to serve his country with 30 years of active duty service.
Hobbies: Hunting and fishing
Most memorable Air Force Weather experience: Before crossing the berm into Iraq with the 101st Airborne Division, I was working shift in the Brigade Tactical Operations Center; there was a friendly fire incident reported at the next camp just south of us. During all the confusion, the Patriot missile battery opened fire on what was thought to be an incoming Iraqi Scud missile attack. The missile exploded in a fireball overhead and everyone in the TOC immediately went into Mission-Oriented Protective Posture Level 4. We later found out that a British Tornado fighter jet was shot down overhead and I realized then, that this was just the beginning of a long and hard deployment.

Salutes

RETIREES

Chief Master Sgt. Forrest Hendricks, 146th WF, Coraopolis, Pa.

Awards and Decorations

PURPLE HEART

Capt. Jose Harris, HQ AFWA Offutt AFB, Neb.

BRONZE STAR

Master Sgt. David Oginski, 154th WF, Little Rock, Ark.

DEFENSE MERITORIOUS SERVICE MEDAL

Lt. Col. John Knowles, HQ AMC Scott AFB, Ill.
Capt. Jon Saul, AFRL, Kirtland AFB, N.M.
Master Sgt. Lawrence McCoy Jr., HQ AMC, Scott AFB, Ill.
Master Sgt. James Moffit, 45th WS Patrick AFB, Fla.
Tech. Sgt. Daniel Oiens, 45th WS, Patrick AFB, Fla.

AIR FORCE COMMENDATION MEDAL

Capt. Darren Murphy, 45th WS, Patrick AFB, Fla.
1st Lt. Michael Jennings, 45th WS, Patrick AFB, Fla.
2nd Lt. Tim Slayton, 208th WF, St. Paul Minn.
Master Sgt. Joseph Federico, 25th ASOS Wheeler AAF, Hawaii
Tech. Sgt. Jessica Dahlquist, 159th WF Camp Blanding, Fla.

JOINT SERVICE COMMENDATION MEDAL

Maj. William Darling, 208th WF, St. Paul Minn.

Education

WEATHER OFFICER'S COURSE

Maj. Sehnee Chatwilai, Thailand
2nd Lt. Morton Barlett, USAFE OWS Sembach, Germany
2nd Lt. Adam DeMarco, 20th OWS, Yokota AB, Japan
2nd Lt. Charles Dorssom, 25th OWS, Davis Monthan AFB, Ariz.
2nd Lt. Brandon Drake, 15th OWS, Scott AFB, Ill.
2nd Lt. Matthew Ellis, 26th OWS, Barksdale AFB, La.
2nd Lt. David Finlay, 28th OWS, Shaw AFB, S.C.
2nd Lt. Christopher Higgins, 131st FW, Missouri ANG-St Louis, Mo.
2nd Lt. Daniel MacKeen, 15th OWS, Scott AFB, Ill.
2nd Lt. Brian Miller, 28th OWS, Shaw AFB, S.C.
2nd Lt. Stephen Moorhead, 17th OWS, Hickam AFB, Hawaii

WEATHER CRAFTMAN'S COURSE

Tech. Sgt. James Morris, Det. 12, 7th WS, Vicenza, Italy
Staff Sgt. Nicky Brown, Det. 1, 18th WS, Ft. Eustis, Va.
Staff Sgt. Michelle Carnot, 140th WF, Willow Grove ARS, Pa.
Staff Sgt. Andrew Carpenter, 25th OWS, Davis-Monthan Ariz.
Staff Sgt. Raymond Decker, 26th OWS, Barksdale AFB, La.
Staff Sgt. Sharay Dixon, 89th OSS, Andrews AFB, Md.
Staff Sgt. Cory Green, 92nd OSS, Fairchild AFB, Wash.
Staff Sgt. Samuel Gutierrez, 15th OWS, Scott AFB, Ill.
Staff Sgt. Timothy Henry, 3rd WS, Ft. Hood, Texas
Staff Sgt. Dale Herschlag, HQ AFWA, Offutt AFB, Neb.
Staff Sgt. Catherine Lee, 621st OSW, McGuire AFB, N.J.
Staff Sgt. Christopher Walton, 48th OSS, RAF Lakenheath, England

WEATHER FORECASTER APPRENTICE COURSE

Tech. Sgt. Anthony Fiorentino, 210th WF, March AFB Calif.
Tech. Sgt Michael VanDenburgh, 25th OWS, Davis-Monthan AFB, N.M.
Tech. Sgt. Jason Ziemba, 25th OWS, Davis-Monthan AFB, Ariz.
Staff Sgt. James Cunningham, 199th WF, Wheeler AAF, Hawaii
Staff Sgt. Douglas Spires, 28th OWS, Shaw AFB, S.C.
Staff Sgt. Szilvia Szekely, Szolnok AB, Hungary
Senior Airman Steven Davies, 105th WF, Nashville, Tenn.
Senior Airman James Fiecabrino, 116th WF, Camp Murray, Wash.
Senior Airman Michael Johnson, 200th WF, Sandston, Va.
Senior Airman Timothy Lindstrom, 25th OWS, Davis-Monthan AFB, Ariz.
Senior Airman Chas Kuhn, 165th WF, Louisville, Ky.
Senior Airman David Moscato, 104th WF, Camp Fretterd, Md.
Senior Airman Jon Taber, 138th WF, Tulsa, Okla.
Senior Airman Brandon Titus, 25th OWS, Davis-Monthan AFB, Ariz.
Airman 1st Class Esteban Acosta, 26th OWS, Barksdale AFB, La.
Airman 1st Class Christian Boehm, 26th OWS, Barksdale AFB, La.
Airman 1st Class Christopher Brannock, USAFE OWS, Sembach AB, Germany
Airman 1st Class Wesley Brinson, 20th OWS, Yokota AB, Japan
Airman 1st Class David Brown, 11th OWS, Elmendorf AFB, Alaska.
Airman 1st Class Robert Dalton, 26th OWS, Barksdale AFB, La.
Airman 1st Class Kevin Caguitla, 28th OWS, Shaw AFB, S.C.
Airman 1st Class Shannon Cooper, 15th OWS, Scott AFB, Ill.
Airman 1st Class Jamie Creamer, 26th OWS, Barksdale AFB, La.
Airman 1st Class Mark Dellandre, 26th OWS, Barksdale AFB, La.
Airman 1st Class Jamie Emmons, 15th OWS, Scott AFB, Ill.
Airman 1st Class Karl Fernando, 25th OWS, Davis-Monthan AFB, Ariz.
Airman 1st Class Margaret Fitzpatrick, 25th OWS, Davis-Monthan AFB, Ariz.
Airman 1st Class James Foutz, 20th OWS, Yokota AB, Japan
Airman 1st Class Zachary Frakes, 17th OWS, Hickam AFB, Hawaii
Airman 1st Class Benjamin Hall, 17th OWS, Hickam AFB, Hawaii
Airman 1st Class Benjamin Hartzell, 25th OWS, Davis-Monthan AFB, N.M.
Airman 1st Class John Gleese, USAFE OWS, Sembach AB, Germany
Airman 1st Class Kekoa Gonzales, 199th WF, Wheeler AAF, Hawaii
Airman 1st Class Ashley Gordon, 25th OWS, Davis-Monthan AFB,Ariz.
Airman 1st Class Eric Goulet, 26th OWS, Barksdale AFB, La.
Airman 1st Class Junnhaou Huang, 20th OWS, Yokota AB, Japan
Airman 1st Class Trever Humphries, 25th OWS, Davis-Monthan AFB, Ariz.
Airman 1st Class Jeffery Hunter, 26th OWS, Barksdale AFB, La.
Airman 1st Class Michael Jackson, 15th OWS, Scott AFB Ill.
Airman 1st Class Jeffrey Jarlett, 28th OWS, Shaw AFB, S.C.
Airman 1st Class Bradley Johnson, 20th OWS, Yokota AB, Japan
Airman 1st Class Dominic Kirsch, 25th OWS, Davis-Monthan AFB, Ariz.
Airman 1st Class Derek Krahn, 11th OWS, Elmendorf AFB, Alaska
Airman First Class Kellan Kroening, 128th RW, Mitchell Field, Wis.
Airman 1st Class Megan Mahoney, 159th WF, Camp Blanding, Fla.
Airman 1st Class Emily Maris, 26th OWS, Barksdale AFB, La.
Airman 1st Class Jason Matthews, 25th OWS, Davis-Monthan AFB, Ariz.
Airman 1st Class Randy Muth, 202nd WF, Otis ANGB, Mass.
Airman 1st Class Joseph Oney, 165th WF, Louisville, Ky.
Airman 1st Class Eric Parlin, 28th OWS, Shaw AFB, S.C.
Airman 1st Class Stephen Patterson, 26th OWS, Barksdale AFB, La.
Airman 1st Class Debra Roney, 26th OWS, Barksdale AFB, La.
Airman 1st Class Susan Russell, 17th OWS, Yokota AB, Japan
Airman 1st Class Christina Smith, USAFE OWS, Sembach Germany
Airman 1st Class Dylan Staples, USAFE OWS, Sembach AB, Germany
Airman 1st Class Billy Tate, 28th OWS, Shaw AFB, S.C.
Airman 1st Class Timothy Turner, 28th OWS, Shaw AFB, S.C.
Airman 1st Class Tiffany Vasso, 25th OWS, Davis-Monthan AFB, Ariz.
Airman 1st Class Andrew Vines, 26th OWS, Barksdale AFB, La.
Airman 1st Class Charles Washington, 26th OWS, Barksdale AFB, La.
Airman 1st Class Nicholas Williams, 199th WF, Wheeler AAF, Hawaii
Airman 1st Class Lisa Wulff, 25th OWS, Davis-Monthan AFB, Ariz.
Airman Trevor Branch, 17th OWS, Hickam AFB, Hawaii
Airman Andrew Camp, 15th OWS, Scott AFB, Ill.
Airman Joy Eggler, 17th OWS, Hickam AFB, Hawaii
Airman Megan Guptill, 28th OWS, Shaw AFB, S.C.
Airman Jerrell Lawson, USAFE OWS, Sembach, Germany
Airman Dustin Markle, USAFE OWS, Sembach AB, Germany
Airman Brenda McClain, 25th OWS, Davis-Monthan AFB, Ariz.
Airman Jennifer Nunn, 26th OWS, Barksdale, La.
Airman Sheri Stonecipher, 26th

General's Coin

Light rain begins to fall from an overcast sky as Brig. Gen. Thomas Stickford, Air Force Director of Weather, presents a coin to **Senior Airman Sean Thomas,** a 352nd Operational Support Squadron weatherman, for his outstanding work in support of the "Quiet Professionals" assigned to 352nd Special Operations Group at RAF Mildenhall, United Kingdom. Photos by Tech. Sgt. Dennis Brewer.

Ironically, grey overcast skies produce light precipitation as Brig. Gen. Thomas Stickford, Air Force Director of Weather, prepares to coin **Senior Airman Jason Osborn**, a 352nd Operation Support Squadron weatherman stationed at RAF Mildenhall in the United Kingdom. The aircraft in the background are MH-53 Pave Low IV Helicopters, which both Airmen support with weather forecasts each day.

OWS, Barksdale AFB, La.
Airman Steven Stolze, 25th OWS, Davis-Monthan AFB, Ariz.
Airman Sarah Strength, USAFE OWS, Sembach AB, Germany
Airman Amber Weighill, 25th OWS, Davis-Monthan AFB, Ariz.
Airman Zachariah Viets, 28th OWS, Shaw AFB, S.C.

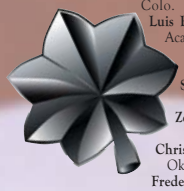
COMBAT WEATHER TEAM OPERATIONS COURSE
1st Lt. Christopher Chase, OL-A, 607th WS, Camp Stanley, Korea
1st Lt. Jeffrey Gipson, 51st OSS, Osan AB, Korea
1st Lt. Howard Moore, 607th WS, Yongsan AIN, Korea
Tech. Sgt. Angela Ellis, Det. 1, 607th WS, Camp Red Cloud, Korea
Staff Sgt. Nicklaus Reed, JSOC/WX, Ft. Bragg, N.C.
Staff Sgt. Andrew Robinson, 28th OWS, Shaw AFB, S.C.
Staff Sgt. Brenda Tillman, 81st OSW, Keesler AFB, Miss.
Staff Sgt. Duane Willson, 28th OWS, Shaw AFB, S.C.
Senior Airman Daniel Blankinship, OL-A, 607th WS, Seoul, Korea
Senior Airman Travis Boyer, Det. 5, 10th CWS, Ft. Bragg, N.C.
Senior Airman Nicole Carpenter, 15th OWS, Scott AFB, Ill.
Senior Airman Amy Dynan, 52nd OSS/OSW, Spangdahlem AB, Germany
Senior Airman Pawnsawan Harkins, 20th OSS/OSW, Shaw AFB, S.C.
Senior Airman Michael Humphreys, USAFE OWS, Sembach AB, Germany
Senior Airman Lydia Martinez, 607th WS, Yongsan AIN, Korea
Senior Airman Rachel Pettengill, 11th OWS, Elmendorf AFB, Alaska
Senior Airman Tiffany Reddick, USAFE OWS, Sembach AB, Germany
Senior Airman Lee Shipley, Det. 2, 7th WS, Hanau, Germany
Airman 1st Class Cassandra Camberos, OL-C Det. 1, 607th WS, Camp Stanton, Korea
Airman 1st Class Sara Festavan, OL-A, 607th WS, Seoul, Korea

SPACE ENVIRONMENT COURSE
Mary Bedrick, 88th WS, Wright Patterson, Ohio
2nd Lt. Brian Yates, 46th WS, Eglin AFB, Fla.
Senior Master Sgt. Michael Carmody, USAFE OWS, Sembach AB, Germany

NEW TATICAL FORCAST SYSTEMS COURSE
Mr. John Diorio, HQ AFWA, Offutt AFB, Neb.
Tech. Sgt Christopher Campbell USAFE OWS, Sembach, Germany
Staff Sgt. James Funkhouser, 366th OSW, Mountain Home AFB, Idaho
Staff Sgt. Nicolas Ruiz, 56th OSW, Luke AFB, Ariz.

The following AFW Warriors were selected for promotion:

TO LIEUTENANT COLONEL
Jeffrey Cetola, Kirtland AFB, N.M.
Douglas Clark, Scott AFB, Ill.
Rodney Clements, Washington, D.C.
Ronald Comoglio, Stuttgart, Germany
Jeffery Cox, Washington, D.C.
Patrick Dowling, Osan AB, Korea
Daniel Edwards, HQ AFWA, Offutt AFB, Neb.
Shawn Filby, Washington, D.C.
Ann Gravier, Asheville, N.C.
Clark Groves, Maxwell AFB, Ala.
Alison Hamilton, Buckley AFB, Colo.
Gettys Harris, Shaw AFB, S.C.
Kenneth Hart, USAF Academy, Colo.
David Lawyer, Peterson AFB, Colo.
Porfirio Munoz, Yongsan AIN, Korea
Karl Pfeiffer, Monterey, Calif.
Allen Rabayda, Suffolk,Va.
James Rickman, USAF Academy, Colo.
Luis Rios, U.S. Military Academy, N.Y.
Stephen Rose, Ft. Bragg, N.C.
Sylvia Taylor, Asheville, N.C.
Zena Tucker, Ramstein AB, Germany
Christine Wasdin, Altus AFB, Okla.
Frederick Williams, Heidelberg, Germany



TO LIEUTENANT COLONEL (ANG)
Ann Hollis, 116th WF, Camp Murray, Wash.
Stephen Longobardi, 159th WF, Camp Blanding Fla.

TO CAPTAIN
Mark Cooke, HQ AFWA, Offutt AFB, Neb.
Meera Daroy, HQ AFWA, Offutt AFB, Neb.
Kimberly Evans, HQ AFWA, Offutt AFB, Neb.
Jason Kollars, HQ AFWA, Offutt AFB Neb.
Darren Murphy, 45th WS, Patrick AFB, Fla.
Karen Shelton-Mur, 121st WF, Andrews AFB, Md.

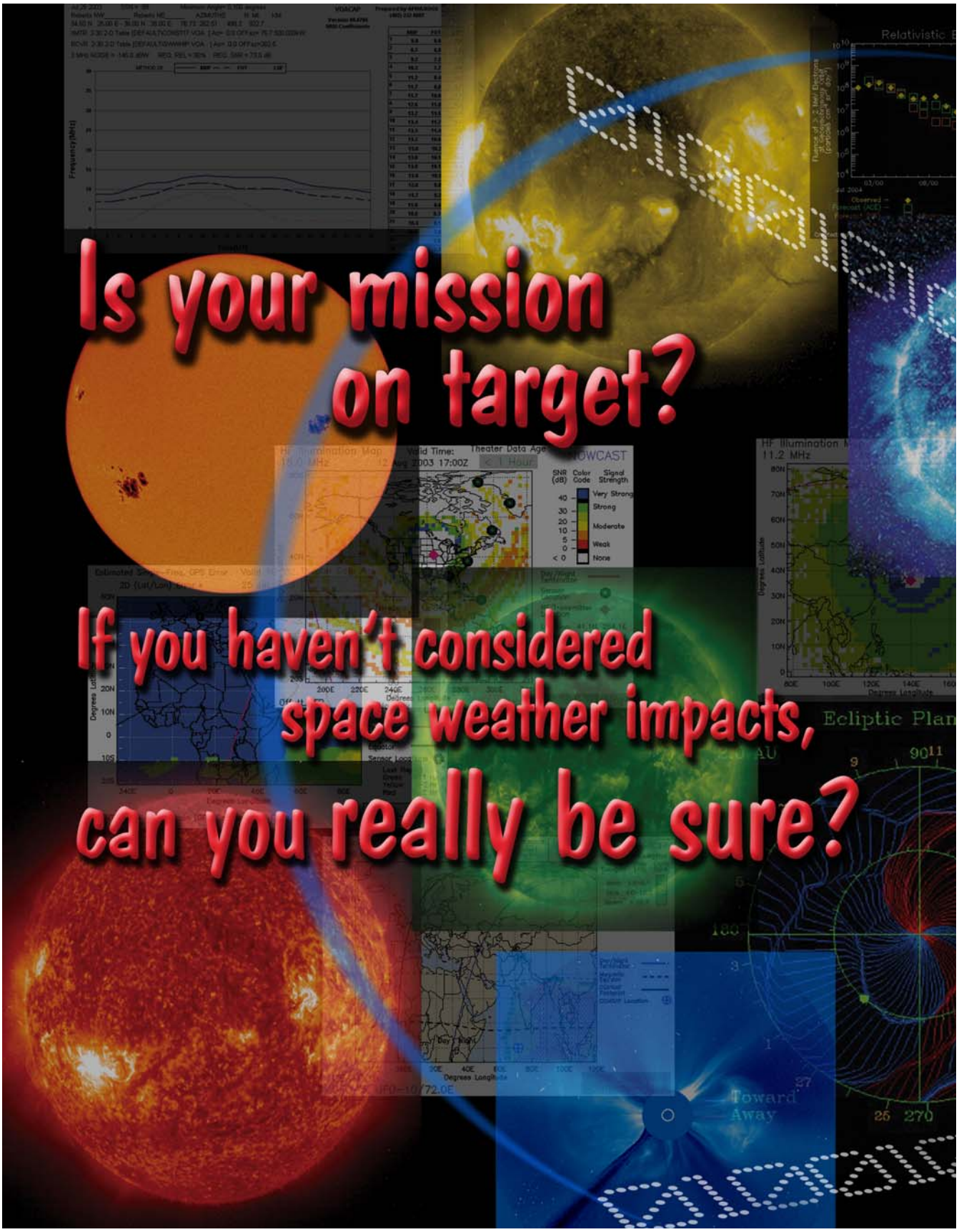
TO SENIOR MASTER SERGEANT
Robert Simpkins, 208th WF, St. Paul, Minn.

TO MASTER SERGEANT
Micholas Barnhardt, 159th WF, Camp Blanding Fla.
TeLara Owczarski, 116th WF, Camp Murray, Wash.

TO TECHNICAL SERGEANT
Eric Apple, 116th WF, Camp Murray, Wash.

TO STAFF SERGEANT
Elissa Magee, 208th WF, St. Paul, Minn.
Bridgett Rocheleau, 208th WF, St. Paul, Minn.

SENIOR AIRMAN BELOW - THE - ZONE
Michael Johnson, 200th WF, Sandston, Va.
Kent McCoy, HQ AFWA, Offutt AFB, Neb.


Is your mission on target?
If you haven't considered space weather impacts, can you really be sure?