APPENDICES

APPENDIX A
Charter of the National Space Weather Program Assessment Study Group (NSWPASG)

1. REFERENCES

Reference documents can be viewed and/or downloaded from the OFCM NSWPASG web site at: http://www.ofcm.gov/space_weather_assessment/index.htm.

2. BACKGROUND

The National Space Weather Program Assessment Study Group (NSWPASG) is part of an effort underway within the Office of the Federal Coordinator for Meteorology (OFCM) to respond to the direction of the Federal Committee for Meteorological Services and Supporting Research (FCMSSR) and Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR). Their direction was to undertake a comprehensive review of the National Space Weather Program (NSWP). The purpose is to quantify and document the progress toward meeting the NSWP stated goals in observations, research, modeling, transition of research to operations, and education and outreach; to see if the program is still on target and moving in the direction pointed to by the Strategic Plan; to determine whether the strategic goals should be adjusted at this time based on emerging/evolving requirements; and to suggest a way ahead that will form a basis for a new strategic plan covering the next 10 years.

> ACTION ITEM 2004-2.5 from the November 16, 2004, meeting of the interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR) supported the contention that the time is right to perform an interagency assessment of the National Space Weather Program (NSWP) to quantify our progress toward meeting our goals in observations, research, modeling, transition of research to operations, and education and outreach; to see if we are on target and moving in the direction pointed to by the Strategic Plan; and to determine whether our strategic goals should be adjusted at this time based on emerging/evolving requirements. Further, ICMSSR concurred that OFCM should seek FCMSSR endorsement of this comprehensive review.
>
> ACTION ITEM 2004-1.3 from the December 1, 2004, meeting of the Federal Committee for Meteorological Services and Supporting Research (FCMSSR) concurred and tasked the Committee for Space Weather (CSW) to undertake a comprehensive review of the National Space Weather Program (NSWP) to quantify our progress toward meeting our goals in observations, research, modeling, transition of research to operations, and education and outreach; to see if we are on target and moving in the direction pointed to by the Strategic Plan; and to determine whether our strategic goals should be adjusted at this time based on emerging/evolving requirements. The review methodology will be developed in conjunction with the Committee for Space Weather.

3. PURPOSE

Using all available sources (i.e. industry, academia, Federal agencies...), the NSWPASG will:

a. Review applicable documents/references on the reference web site listed in para. 1.

b. Using the 1995 NSWP Strategic Plan, determine how well have we met the original *Overarching Strategic Goal* "To achieve an active, synergistic, interagency system to provide timely, accurate, and reliable space environment observations, specifications, and forecasts within the next 10 years."

The NSWP overarching goal is further delineated by the following *Supporting Goals*.

To advance
- Observing capabilities (data collection)
- Fundamental understanding of processes
- Numerical modeling
- Data processing and analysis
- Transition of research into operational techniques and algorithms
- Space weather products and services
- Education on space weather

And to prevent or mitigate
- Under- or over-design of technical systems
- Regional blackouts of power utilities
- Early demise of multi-million dollar satellites
- Disruption of communications via satellite, HF, and VHF radio
- Disruption of long-line telecommunications
- Errors in navigation systems
- Excessive radiation doses dangerous to human health

Consider the following questions for each *Supporting Goals*, clearly stating "how" your documented findings support, or contribute to, the NSWP *Overarching Strategic Goal*:

1) Are there notable successes? What elements of the program have contributed most to these? Are there measurable benefits and, if so, will they help justify future research and technology development?

2) What gaps or shortfalls remain? Where are the weaknesses? How can any shortfalls, and weaknesses best be addressed?

3) Are new directions in light of national and agency priorities appropriate in the near and longer term? Do costs/benefits support competition with other priorities?

4) Are new directions in light of evolving customer needs appropriate? (e.g., the President's new emphasis on interplanetary travel)

5) Are new directions/methods of doing research required in the near and longer term?

6) Are new techniques necessary to optimize the transition of research to operations? Are the transition costs reasonable or prohibitive?

7) What is the status of outreach to potential customers, and are changes required? Is education for developers, providers and users keeping pace with research and transition activities?

8) Are new and/or additional methods needed to further NSWP outreach objectives?

9) What have been the roles of the academic and research communities in the NSWP, including its successes and shortcomings? Are these roles appropriate and what changes might be required in the future?

10) Are the participating agencies in the NSWP organized in an effective manner to optimize the outcomes of the Program? Can current/future partnerships (agency to agency, and agency to the outside) be considered as a program benefit multiplier?

11) Are there ways to improve operational efficiency within the NSWP? Are there capabilities that can be leveraged across agencies?

Your report should clearly document the current status of the NSWP. It should provide recommendations that will assist stakeholder Federal agencies with planning for future expenditures of resources to support the NSWP as well as provide a foundation for the creation of a new NSWP strategic plan for the next 10 years.

4. MEMBERSHIP

a. Membership will be drawn from the scientific community outside the *immediate* NSWP community yet having the expertise to perform the task at hand. The NSWPASG will be augmented as needed by Federal and non-Federal personnel to provide subject-matter or other expertise. NSWPASG membership will be coordinated through the Committee for Space Weather and the Office of the Federal Coordinator for Meteorological Services and Supporting Research.

b. The NSWPASG Chairperson will be selected by the CSW co-chairs and with coordination from the Federal Coordinator for Meteorological Services and Supporting Research.

c. The Federal Coordinator will provide the Executive Secretariat.

5. PROCEDURES

a. Meetings shall be called by the study group chair, or his designee, and shall normally be convened in facilities provided by the Federal Coordinator. Typically, the final agenda item for each meeting will be to tentatively establish when, or if, an additional meeting is required. The

meeting agenda, to the greatest extent possible, will normally be finalized as soon as possible prior to meetings. The group will meet, in person, or telephonically, as needed until its business is completed.

b. Group decisions should be by unanimous agreement of all members. Members may reserve their position pending the gathering of additional information or instructions. Decisions may be reached during a face-to-face meeting or through correspondence (including e-mail) circulated to the members by the Chair, his designee, or the Executive Secretary (on the Chair's behalf).

c. If members are unable to reach agreement, the Chair will report the matter, with full documentation, to the Committee for Space Weather for resolution or elevation to the NSWP Council.

d. Previously established action items should be reviewed at the start of each meeting; new action items should be agreed upon and documented prior to the meeting being adjourned. The Executive Secretary will send the draft action items to the study group members to review and comment normally within 5-10 working days after a meeting. The Executive Secretary will document the action items along with other major decisions in brief, informal meeting minutes. Typically, final meeting minutes will be available within 30-45 working days after a meeting. Meeting minutes will generally be distributed by e-mail and available at the referenced web page above. Documentation may also include copies of presentations and/or other material presented at the meetings.

e. Amendments to this charter will be agreed to by all group members and coordinated with the co-chairs of the Committee for Space Weather.

6. REPORTS AND RECORDS

a. The group shall prepare reports and publications identified in this charter and others as requested by the Committee for Space Weather co-chairs.

b. Reports from the group will be considered as guidance documents for use by NSWP Council and Committee for Space Weather. The endorsement of the group's report by the CSW and/or the NSWPC in no way implies a commitment for stakeholder Federal agencies to provide resource support for any suggested initiatives.

c. Records of the group shall be maintained in the Office of the Federal Coordinator for Meteorology.

7. TERMINATION

To facilitate agency consideration during the budgetary planning processes, the group's target is 1 September 2005 for interim assessment results that can be distributed to the FCMSSR members. The target for the final assessment report is 15 January 2006. The NSWPASG shall be terminated by the Committee for Space Weather unless additional tasks are assigned.

Appendix B
Committee Membership

Dr. Louis J. Lanzerotti, Chair

Education
B.S., University of Illinois, 1960
A.M., Harvard University, 1963
Ph.D., Harvard University, 1965

Dr. Lanzerotti is currently a Distinguished Research Professor of Physics in the Center for Solar-Terrestrial Research at the New Jersey Institute of Technology in Newark, New Jersey, and a Consultant to Bell Laboratories, Lucent Technologies, where he spent the first 37 years of his career.

Dr. Lanzerotti's principal research interests have included space plasmas, geophysics, and engineering problems related to the impacts of atmospheric and space processes and the space environment on space and terrestrial technologies. He has co-authored one book, co-edited three books, and is an author of more than 500 refereed engineering and science papers. He is the founding editor of *Space Weather, The International Journal of Research and Applications*, published by the American Geophysical Union. He has seven patents issued or filed.

Dr. Lanzerotti has been elected a member of the National Academy of Engineering and of the International Academy of Astronautics. He is also a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), the American Institute of Aeronautics and Astronautics (AIAA), the American Geophysical Union (AGU), the American Physical Society (APS), and the American Association for the Advancement of Science (AAAS). He is the recipient of two NASA Distinguished Public Service Medals, the NASA Distinguished Scientific Achievement Medal, the COSPAR William Nordberg Medal, and the Antarctic Service Medal of the United States. He was appointed to the National Science Board in 2004.

Dr. Daniel N. Baker

Education
M.S., University of Iowa, 1973
Ph.D., Iowa, 1974

Dr. Baker is Director of the Laboratory for Atmospheric and Space Physics, University of Colorado–Boulder, and is Professor of Astrophysical and Planetary Sciences there. His primary research interest is the study of plasma physical and energetic particle phenomena in planetary magnetospheres and in the Earth's vicinity. He conducts research in space instrument design, space physics data analysis, and magnetospheric modeling.

Dr. Baker is engaged in the analysis of large data sets from numerous NASA and operational spacecraft. His current research involves the study of solar wind-magnetospheric energy coupling and theoretical modeling of magnetotail instabilities. Dr. Baker is also involved in the study of magnetosphere-atmosphere coupling and applying space plasma physics to the study of astrophysical systems. His research is used to understand magnetospheric substorms and geomagnetic storms. Dr. Baker has special interest in the use of computer systems and networks to enhance the acquisition, dissemination, and display of spacecraft data. He is engaged in the teaching of space physics and public policy, as well as public outreach to space technology community and general public.

Following postdoctoral work at the California Institute of Technology, Dr. Baker joined the Physics Division research staff at Los Alamos National Laboratory, where he became Leader of the Space Plasma Physics Group in 1981. From 1987 to 1994, he was the Chief of the Laboratory for Extraterrestrial Physics at NASA Goddard Space Flight Center. In 1994, Dr. Baker went to University of Colorado–Boulder, where he continues his studies of space weather and the effects of the space environment on human technological systems.

Dr. Baker has published over 700 papers in the refereed literature and is a Fellow of the American Geophysical Union and the International Academy of Astronautics. He has won numerous awards for his research efforts and for his management activities. In 2002, Dr. Baker was recognized by the Institute for Scientific Information as being “Highly Cited,” meaning that his work is among the top 100 most-cited researchers in space science. In 2003 he was selected for the Mindlin Foundation Lectureship and Prize at the University of Washington. Dr. Baker recently served as President of the Space Physics and Aeronomy section of the American Geophysical Union (2002-2004). He serves on advisory panels of the National Academy of Sciences, the National Science Foundation, the U.S. Air Force, and NASA. He presently serves on several national and international scientific committees including being Chair of the National Research Council Committee on Solar and Space Physics. Dr. Baker is an investigator on several current NASA space missions including the MESSENGER mission to Mercury, the ESA/NASA Cluster mission, and the NASA Magnetospheric Multi-Scale mission.

Dr. Tammy E. Jernigan

Education
B.S., Stanford University, 1981
M.S., Stanford University, Engineering Science, 1983
M.S., University of California-Berkley, 1985
Ph.D., Rice University, 1988.

Dr. Jernigan completed her B.S. degree in physics (with honors) and M.S. degree in Engineering Science at Stanford University in 1981 and 1983, respectively. She then joined the Astronomy Department at University of California-Berkeley to pursue a Ph.D. degree in theoretical and computational astrophysics. Her research focused on the modeling of high-velocity outflows in regions of star formation, gamma-ray bursters, and the study of radiation produced by interstellar shock waves. In 1985, she was selected as a NASA astronaut and subsequently completed her Ph.D. in space physics and astronomy at Rice University in 1988 while training for the Space Shuttle program.

Dr. Jernigan is a veteran of five Space Shuttle missions, for which she supervised the preflight planning and in-flight execution of critical activities aboard STS-40, 52, 67, 80, and 96. During these flights, Dr. Jernigan served as mission specialist on the first dedicated Life Sciences mission, STS-40, and as payload commander of STS-67. During STS-67, the crew conducted continuous ultraviolet observations of a variety of stars, planets, and distant galaxies. On Dr. Jernigan's last flight, in 1999 on STS-96, the crew performed the first docking to the International Space Station (ISS). Dr. Jernigan also executed a space walk of nearly 8 hours to attach equipment to the exterior of the station.

In October 2001, Dr. Jernigan joined Lawrence Livermore National Laboratory, where she currently serves as Principal Deputy Director of the Physics and Advanced Technologies Directorate (PAT). PAT scientists and engineers execute a broad portfolio of research and development activities ranging from basic science to applied technologies critical to the Nation's homeland security mission. Dr. Jernigan is responsible for day-to-day operations of PAT and plays a lead role in policy development and strategic planning.

In addition to her space flight experience, Dr. Jernigan held numerous management positions as an astronaut. She served as Deputy Chief of the Astronaut Office, assisting with the management of military and civilian astronauts and support personnel. As Deputy for the Space Station program, she developed and advocated Astronaut Office positions on the design and operation of the ISS. She also represented NASA management on the U.S. negotiating team in Moscow during technical interchange meetings designed to resolve crew training, crew rotation, and operational issues. Her numerous awards include the NASA Distinguished Service Medal (2000), Lowell Thomas Award, Explorer's Club (2000), five NASA Space Flight Medals (1991 to 2000), NASA Distinguished Service Medal (1997), NASA Group Achievement Award–EVA Developmental Test Team (1997), Federation Aeronautique Internationale Vladimir Komorov Diploma (1996 and 1997), NASA Outstanding Leadership Medal (1996), NASA Outstanding Performance Award (1993), NASA Exceptional Service Medal (1993), and the Laurels Award from *Aviation Week* (1991). Dr. Jernigan was named 2004 Outstanding Woman of the Year in Science and inducted into the Alameda County Women's Hall of Fame.

Dr. Delores J. Knipp

Education
B.S., University of Missouri, 1976
Ph.D., University of California, Los Angeles, 1989

Dr. Knipp is a Professor of Physics with the U.S. Air Force Academy Department of Physics, where she specializes in solar-terrestrial interactions and space weather effects. She also teaches in the Air Force Academy's interdisciplinary meteorology program. Her recent research interests include satellite drag, upper atmosphere energy budgets, and solar wind-magnetosphere-ionosphere coupling. She has mentored student research projects in satellite drag, energetics of Earth-magnetic cloud interactions, and quantifying the upper atmosphere heat budget. From 1995 to 1998, she led an international space weather storm study that helped launch the NSF-sponsored National Space Weather Program.

Dr. Knipp earned her bachelor's degree in atmospheric science from the University of Missouri in 1976 and entered the Air Force as a weather officer shortly thereafter. She was a NORAD command weather briefer before earning an MS in atmospheric science and joining the physics faculty at the Air Force Academy. In 1986 the Physics Department sponsored her to earn a doctorate in space and atmospheric physics at UCLA. She has been engaged in teaching introductory physics, meteorology, space physics, and astronomy and in researching the effects of solar activity on the near-Earth environment. In 1997 she was a recipient of the Air Force Basic Research Award. That award recognized her significant contribution in leading over 100 scientists in a coordinated study of a major solar terrestrial storm.

Dr Knipp retired in 1999 after 22 years of active duty service. Later that year, she returned to the Physics Department faculty as a Professor of Physics. She is the recipient of NASA, NSF, and AFOSR grants. She has served on the Steering Committee for the Coupling and Energetics of Atmospheric Regions (CEDAR) program, the Geospace Environmental Modeling Program (GEM), and the NSF Upper Atmospheric Research Section (UARS) Committee of Visitors. Dr. Knipp is a principal scientist in the Academy's Space Physics and Atmospheric Research Center (SPARC). This center, which she helped originate, focuses on DOD research needs in space weather, small-satellite payloads, applied physics, astronomy, and meteorology. Dr Knipp is presently writing an undergraduate text on space weather and space environment.

Dr. Ray Williamson

Education
B.A. in Physics, Johns Hopkins University, 1961
Ph.D. in Astronomy and Physics, University of Maryland, 1968

Research Professor of Space Policy and International Affairs

Expertise: Environmental security, Earth observation satellite policy, dual-purpose space technologies, and the commercialization of space-related technologies.

Dr. Williamson is Research Professor of Space Policy and International Affairs in the Space Policy Institute, The Elliott School of International Affairs, George Washington University. He has conducted numerous in-depth studies of space technology and policy.

Before joining the Institute in 1995, Dr. Williamson was Senior Associate and Project Director in the Office of Technology Assessment (OTA) of the U.S. Congress. From 1979 to 1995, he directed most of OTA's space-related studies, including U.S.-Russian Cooperation in Space (1995), Civilian Satellite Remote Sensing (1994), and Global Change Research and NASA's Earth Observing System (1994).

Dr. Williamson is a member of the International Editorial Board of the journal *Space Policy*. He is the editor of *Commercial Observation Satellites: At the Leading Edge of Global Transparency*, with John C. Baker and Kevin O'Connell (RAND and ASPRS, 2001); *Dual-Purpose Space Technologies: Opportunities and Challenges for U.S. Policymaking* (Space Policy Institute, 2001); and *Space and Military Power in East Asia: The Challenge and Opportunity of Dual-Purpose Space Technologies*, with Rebecca Jimerson (Space Policy Institute, 2001). He is also the author or editor of seven books on archeology, historic preservation, and American Indian astronomy and culture, including *Living the Sky: The Cosmos of the American Indian*.

Dr. Williamson received his B.A. in physics from Johns Hopkins University and his Ph.D. in astronomy from the University of Maryland. For 10 years, he taught philosophy, literature, mathematics, physics, and astronomy at St. John's College in Annapolis, where he also served as Assistant Dean for 5 years.

Dr. Simon P. ("Pete") Worden

Education
B.S. in physics and astronomy, University of Michigan, 1971
Ph.D., University of Arizona, 1975

Brig. Gen. Simon P. Worden (USAF, ret.) is currently a Research Professor of Astronomy, Optical Sciences, and Planetary Sciences at the University of Arizona where his primary research direction is the development of large space optics for national security and scientific purposes and near-earth asteroids. In addition, he is working on topics related to space exploration and solar-type activity in nearby stars. He is a recognized expert on space issues—both civil and military. General Worden has authored or coauthored more than 150 scientific and technical papers in astrophysics, space sciences, and strategic studies. Moreover, he served as a scientific co-investigator for two NASA space science missions.

General Worden also serves as a consultant to the Defense Advanced Research Projects Agency on space-related issues. During the 2004 Congressional session, General Worden worked as a Congressional Fellow with the Office of Senator Sam Brownback (R-KS), where he served as Senator Brownback's chief advisor on NASA and space issues.

General Worden retired in 2004 after 29 years of active service in the United States Air Force. His final position was Director of Development and Transformation, Space and Missile Systems Center, Air Force Space Command, Los Angeles Air Force Base, Calif. In this position, he was responsible for developing new directions for Air Force Space Command programs and was instrumental in initiating a major Responsive Space Program designed to produce space systems and launchers capable of tailored military effects on timescales of hours.

General Worden was commissioned in 1971 after receiving a B.S. degree from the University of Michigan. He entered the Air Force in 1975 after graduating from the University of Arizona with a doctorate in astronomy. Throughout the 1980s and early 1990s, General Worden served in every phase of development, international negotiations, and implementation of the Strategic Defense Initiative, a primary component in ending the Cold War. He twice served in the Executive Office of the President. As the staff officer for initiatives in the George Bush administration's National Space Council, General Worden spearheaded efforts to revitalize U.S. civil space-exploration and earth-monitoring programs.

General Worden commanded the 50th Space Wing, which is responsible for more than 60 DOD satellites and more than 6,000 people at 23 worldwide locations. He then served as Deputy Director for Requirements at Headquarters, Air Force Space Command, as well as the Deputy Director for Command and Control with the Office of the Deputy Chief of Staff for Air and Space Operations at Air Force headquarters.

Appendix C
Committee Meeting Agendas

National Space Weather Program Assessment Committee
7– 8 July 2005
Office of the Federal Coordinator for Meteorology
Silver Spring, Maryland

Thursday, July 7, 2005

9:00 am	Welcome from the Federal Coordinator (Mr. Sam Williamson)
9:05 am	Welcome and Introductions by Group Chair (Dr. Lou Lanzerotti)
9:15 am	Administrative comments (Lt Col Rob Rizza)
9:20 am	Charter Discussion – Finalizing the Task Definition (All)
10:00 am	Break
10:15 am	Space Weather Community Presentations Dr. Ernie Hildner (Director, NOAA Space Environment Center; Manager, NOAA Space Weather Program) Dr. Rich Behnke (National Science Foundation)
1:30 pm	Space Weather Community Presentations Dr. Dick Fisher (National Aeronautics and Space Administration) Col. Harold Elkins (Department of Defense)
3:30 pm	Break
4:00 pm	Discussion of presentations; questions to presenters
5:30 pm	Adjourn

Friday, July 8, 2005

9:00 am	Strategy Session (Closed) – Revisit the Task Definition following what we have heard and learned. Discuss who we need to visit, when, how, objective of each visit. Timelines (schedule), etc.
11:00 am	Document any Action Items (Closed)

Noon Adjourn

National Space Weather Program Assessment Committee
15–16 September 2005 Itinerary

Thursday Sep 15, 2005

8:00 - 9:00	NPOESS Briefing/Discussion	Lt Col Mike Bonadonna
9:00 – 11:00	NASA	
(30 min)	CCMC	Dr. Mike Hesse
(20 min)	Research to Ops Challenges	Dr. Ron Birk
(25 min)	Status of Present Assets, Future Plans	Dr. Chuck Holmes
11:30 – 1:00	Lunch	
1:00 – 1:30	OFCM	Mr. Sam Williamson
1:30 – 2:30	NWS Interview	
2:30 – 3:30	NSF Interview	Dr Rich Behnke
3:30 – 4:30	Navy Interview	Dr. Bob McCoy, Dr. Herb Gursky
4:30 – 5:30	Assessment Team Meeting	

Friday Sep 16, 2005

0730	Meet at Pentagon	
8:00 – 9:00	National Security Space Office (4C1000)	Mr. Jay Parness
9:00 – 10:00	Director of Weather (4A1084)	Brig Gen Stickford
10:00 – 12:00	Transit to NRO and Lunch	
12:00 – 1:00	NRO	Dr. Pete Rustan

National Space Weather Program Assessment Committee
12–14 December 2005
Colorado/Omaha Itinerary

Monday Dec 12, 2005

Travel to SEC

9:00 – 10:00am Sun-to-Earth Modeling — 2C406 David Skaggs Bldg, SEC
Tom Bogdan
Emily CoBabe-Ammann

10:15 – 11:00am Meet with USGS — 2C406 David Skaggs Bldg, SEC
Dr. Jeff Love

11:00am – 1:00pm Lunch

1:00 – 4:00pm Visit the Space Environment Center — 2C406 Davis Skaggs Bldg, SEC
Dr. Ron Zwickl

1:00pm	Introductions and agenda confirmation	Dr. Zwickl
1:05pm	Committee introductions and status	Dr. Lanzerotti
1:15pm	NOAA's Space Weather Program and contributions to NSWP	Dr. Zwickl
2:15pm	NGDC Stewardship of space weather data	Dr. Kihn
2:30pm	Break	
2:40pm	Tour of forecast center and test bed	Drs. Kunches and Doggett
3:00pm	Recommendations of future directions	Drs. Singer and Onsager
4:00pm	Adjourn	

4:00 – 6:00pm Travel to Colorado Springs, Check into the Radisson Inn

Tuesday Dec 13, 2005

7:00am Breakfast/Travel to SSAIO office in General Dynamics Bldg

8:00 – 9:00am Meet with USAF Space Command
Col Ron Grundman
Maj Kelly Hand

9:00 – 10:30am Meet w/ Space Situational Awareness Information Officer
POC: Lt Col Bruce Cessna
Lt Col Ken Philippart

11:00am – 12:00pm Small Space Environment Sensors
Dr. M. Geoff McHarg

National Space Weather Program Assessment Committee
12–14 December 2005
Colorado/Omaha Itinerary—Continued

Wednesday Dec 14, 2005

8:00 – 11:00am	Offut Air Force Base, Air Force Weather Agency Col Ray Clark Maj Tim Nobis	
8:00am	Mission Briefs with manager-level discussions	
9:30am	AFWA/CV	
10:00am	Space WOC tour and discussions with personnel	
11:00 – 11:45am	Team meeting	
11:45am – 12:45pm	Lunch O-Club with LCDR Mike Rocheleau	
1:00 – 2:00pm	Meet with U.S. Strategic Command Leadership Mr. John Gipson Associate Dir, Capability & Resource Integration Mr. Chip Coy: Deputy Chief, ISR and Space Division LCDR Mike Rocheleau	

National Space Weather Program Assessment Committee
19-20 December 2005
NCR Itinerary

Monday Dec 19, 2005

AM	Travel to Silver Spring	
2:30 – 3:30pm	Meet with FAA	Ms. Lisa Bee Mr. Steve Albersheim
3:30 – 4:15pm	Discuss ongoing NSF funded Space Weather impacts on aviation study	Dr. Genene Fisher (AMS)

Tuesday Dec 20, 2005

8:00 – 8:30am	Conference call with Kathie Olsen	
9:00 – 10:00am	Meet with NWS Leadership	Brig Gen (R) D.L. Johnson Mr. David Caldwell
10:00 – 10:15am	Break	
10:15 – 11:15am	Meet with GOES-R Personnel	Mr. Ben Diedrich
11:15 – 1:00pm	Lunch	
1:00 – 3:00pm	Assessment team working meeting	

Depart

National Space Weather Assessment Committee
6 January 2006
Air Force Research Laboratory Itinerary

Friday Jan 6, 2006

8:30am NSWP Overview (Dr. Lanzerotti)

9:00am AFRL Center of Excellence Overview (Mozer)

9:40am Long-term goal: 72-120-hour space weather forecasting, SEEMs (Cooke)

10:00am Break

10:10am Space Weather Products Overview (led by Ginet)

GeoSpace	(Ginet)
SCINDA/OPSEND	(Groves)
SEEFS	(Hilmer)
NASCAP-2K	(Cooke)
SMEI/SRBL/SpaN	(Mozer)
Satellite Drag	(Huang)

11:10am Projects/Programs (led by Cooke)

C/NOFS	(Odile)
DSX	(Ginet)
AFRL/CISM collaborations	(Arge)

11:55am Issues (Odile)

12:30 – 2:30pm Assessment team working lunch and meeting

Adjourn

Appendix D
Questionnaires

NSWP Community Input Questionnaire

The United States National Space Weather Program (NSWP) began ten years ago as a collaborative enterprise between the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD). The NSWP has operated under the auspices of the Office of the Federal Coordinator for Meteorology (OFCM) and is based upon a Strategic Plan and an Implementation Plan which can be found at the following Web site: http://www.nswp.gov/nswp_docs.htm.

The OFCM, in conjunction with its Committee for Space Weather is now supporting a decadal review of the NSWP. This review is to quantify and document the progress toward meeting program goals. An **Assessment Committee***, comprised of researchers with meteorological, space physics, astrophysics, and policy backgrounds is gathering input from the broad communities in the United States involved in space weather research and applications, including operations. The assessment committee will perform a comprehensive review, which it can best achieve with very strong community participation. All those interested in the NSWP are strongly encouraged to comment on successes, shortfalls, and possible future directions of the program. Brief or extended comments are most welcome for the following questions:

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0) Is your primary space weather activity research (military, civil), design, civil operations, military operations, commercial, or other? (Please specify).

1) What have you seen as the roles of the academic and research communities in the NSWP, including its successes and shortcomings? Are these roles appropriate and what changes might be required in the future?

2) As seen from your perspective, are there notable successes of the NSWP? What elements of the program have contributed most to these successes? Are there measurable benefits to your research program, commercial efforts, or civil/military operational program and, if so, will they help justify future research and/or technology development?

3) Where are the present weaknesses in the NSWP as you see them? How would you suggest addressing any shortfalls and/or weaknesses in the program?

4) Are new directions in the program in light of national priorities or recent research breakthroughs needed in the near and longer term?

5a) For those respondents with primarily commercial or governmental operational interests, are new directions in light of evolving customer needs appropriate?

5b) For those respondents with primarily research interests, are new directions/methods of doing research required in the near and longer term (e.g., because of the President's new emphasis on interplanetary travel)?

6) What new techniques, if any, are necessary to optimize the transition of your research to operations?

7) Is education about the NSWP for developers, providers and users keeping pace with research and transition activities? What new educational priorities would most serve the needs of the space weather research, governmental, or commercial community?

8) What new and/or additional methods are needed to further NSWP outreach objectives?

9) Any general comments on NSWP successes, shortfalls, and possible future directions of the program?

10) Please include any special instructions you may have for the disposition of your submitted comments (i.e. are your comments confidential, etc.)

Name (optional):
Email Address (optional):

NSWP User Input Questionnaire

The United States National Space Weather Program (NSWP) began ten years ago as a collaborative enterprise between the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD). The NSWP has operated under the auspices of the Office of the Federal Coordinator for Meteorology (OFCM) and is based upon a Strategic Plan and an Implementation Plan which can be found at the following website: http://www.nswp.gov/nswp_docs.htm.

The OFCM, in conjunction with its Committee for Space Weather is now supporting a decadal review of the NSWP. This review is to quantify and document the progress toward meeting program goals. An **Assessment Committee***, comprised of researchers with meteorological, space physics, astrophysics, and policy backgrounds is gathering input from the broad communities in the United States involved in space weather research and applications, including operations. The assessment committee will perform a comprehensive review, which it can best achieve with very strong community participation. All those interested in the NSWP are strongly encouraged to comment on successes, shortfalls, and possible future directions of the program. Brief or extended comments are most welcome for the following questions:

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1. What is your primary professional activity or interest as they relate to space weather?

- ☐ Electric Power Industry
- ☐ Radar
- ☉ Spacecraft and Space Operations
- ☐ Oil or Gas Pipeline
- ☐ Aviation
- ☐ Media
- ☐ GPS, Navigation, Surveying, Drilling
- ☐ Aurora Viewing
- ☐ DOD Operations
- ☐ Ham Operator
- ☐ Land-line Communications
- ☐ HF, UHF Communications
- ☐ Other

2. What source do you prefer to use in acquiring space weather information?
NOAA/SEC
Other Government Agency
Private Vendor
Educational Facilities
Foreign Source (e.g., IPS, Kyoto, ESA, etc.)
Other (Please Specify)

3. How would you rate your understanding of space weather and its potential impact on your area of interest?

4. What can the space weather community do to improve your understanding of space weather?

5. Which space weather products or data are used by you or your organization?

6. How would you rate the accuracy of the forecast products provided by space weather service providers?

7. What other products and services could the space weather service providers offer in order to serve you better?

8. In your opinion, what is the greatest shortfall in today's operational space weather service industry?

9. What would be the impact(s) on your operations if upstream solar wind and charged particle data such as that currently provided by the Advanced Composition Explorer (ACE) Satellite would not be available at some time in the future?

10) Please include any special instructions you may have for the disposition of your submitted comments (i.e. are your comments confidential, etc.)

Name:
Email Address:

Appendix E
NATIONAL SECURITY SPACE ARCHITECT (NSSA)
SPACE WEATHER ARCHITECTURE STUDY
Final Report
22 March 1999

Key Study Recommendations

To guide future investment, development and acquisition of space and space-related capabilities, the NSSA recommends:

Space Weather Architecture Vector
- Increase emphasis on Operational Model development
- Ensure improved Operational Capabilities based on User Needs
  - National Security priorities include Ionospheric and Radiation Environment Specifications and Forecasts
  - Civil priorities also include Geomagnetic Warnings and Forecasts
- Evolve to improved Forecast Capabilities, as phenomenology is better understood, models mature, and user needs are better defined

Space Weather Importance Awareness
- Integrate Space Weather information (system impacts and space weather environment data) into User Systems through inclusion in:
  - User Education
  - Simulations
  - Wargaming and Training
  - Concept of Operations (CONOPS)
  - Contingency Planning
  - System Anomaly Resolution
  - Damage Assessment and Reporting

Space Weather Requirements
- Develop a set of Approved Validated Space Weather Requirements focused on User Needs
- Update Requirements as User Needs and Technology evolve

Coordinated Space Weather Architecture Acquisition
- Identify a cognizant organization in DOD to:
  - Manage the Acquisition of DOD Operational Space Weather Architecture and focus DOD Space Weather Research and Development
- Ensure Validated Models are developed in conjunction with Sensors and User Needs
- Ensure effective transitioning of R&D into Operations
  - Coordinate Acquisition and Integration of Space Weather Resources across Civil agencies and National Security Interest

Space Weather Information Archive

- Consolidate and Expand the Existing Archival System
  - Capture Space Weather Environmental Data and System Impacts
- The Archival System should be:
  - Centrally Managed
  - User Focused
  - Incorporate Standard Formats
  - Accommodate Multi-level Security

Integrated User Information

- Provide Space Weather Information:
  - In User Impact Terms
  - Routinely Available through Common Dissemination Channels
  - Integrated with Other User Information as required

Integrated Space Weather Center

- Evolve to an Integrated Space Weather Center capability to include:
  - Space Weather Expertise available for User Consultation and Support
  - A National Security Support Cell to produce Tailored Products
  - Back-up capability to provide support in the event of Natural Emergencies or Catastrophic Equipment Failures

Space Weather Research and Development

- Provide a Robust space weather Research and Development Program to:
  - Develop and Implement the Improved Models
  - Provide options for further growth
- Continue to Leverage Research and Development Missions
  - Enhance Operational Products until Operational Systems are ready
- Develop and Implement Standardized Processes to rapidly and efficiently Transition R&D into needed Operational Products

Space Weather and Man-Made Effects Information Coordination

- Support the Space Control Protection Mission by providing timely Space Weather Information
- Incorporate the Operational Specification and Forecasting of Space Environmental Effects of Man-made (Primarily Nuclear) Events (MMEs) as a Mission into the Space Weather Architecture

Appendix F
Recommendations from
U.S. Department of Commerce Service Assessment, April 2004

Intense Space Weather Storms October 19–November 07, 2003

Observations

Recommendation: NOAA should make the coronagraph a baseline instrument on future GOES spacecraft or other space-based platform. If the coronagraph is not deployed as an operational instrument, NOAA will suffer degradation in its current capability to provide space weather alerts and warnings.
Recommendation: NOAA should either procure, launch, operate, and acquire data from a series of real-time solar wind monitors placed near the Sun-Earth line, or NOAA should buy such data from a commercial supplier.

Internal and External Coordination

Recommendation 1a: Develop a website for the airline user community. Pending developments in the private sector, post the applicable services and explanations that apply to airline operational needs.
Recommendation 2a: Provide training for airline staff and management. Best options are for SEC staff to visit airline companies and/or facilitate a workshop for all interested parties (airline personnel, FAA, DOT, medical, etc).
Recommendation: Improve the SEC web page to better facilitate the needs of media and the NOAA Public Affairs Office. Make plain language forecasts, Space Weather Bulletins, Alerts, Watches, and Warnings readily available and easily accessible. This would help alleviate the distraction during high solar activity.

Models and Guidance

Recommendation: Pending developments in the private sector, improve the D-Region Absorption Plot to include impacts of radiation storms and geomagnetic storms on communications, or develop a product for airlines that would depict high latitude HF and VHF communication effects.
Recommendation: Complete Major Event database and interactive software and install in the Forecast Center.
Recommendation: NOAA and SEC must assist in and support modeling efforts such as the Center for Integrated Space weather Modeling (CISM) and the Community Coordinated Modeling Center (CCMC) as well as other research and commercial institution modeling capabilities. Fully functional Rapid Prototyping Centers (RPCs), operations testbeds, or commercially outsourced engineering implementation contracts must be in place for rapid, focused development and transition of required models into Space Weather operations. The recent activity highlighted the need for the following models:

- Coronal Mass Ejection Propagation - CME characterization (mass, speed, direction, and magnetic structure) for predicting time of CME arrival and onset and intensity of geomagnetic storming.
- Solar Energetic Particles (SEP) - SEP spectra for airlines, satellite anomaly, and manned space flight hazard prediction. Airline companies and satellite operators requested more detailed SEP onset time and duration predictions.

- Radiation Belt Particle distribution (>100 keV) for satellite upset prediction. Precipitating particle characterization (location, energy, timing) for polar ionosphere prediction. Requested by both government and commercial satellite companies.
- Ionosphere - Global EDP for radar and communications signal path bending prediction. Global TEC for radar and communications signal path delay prediction. Global ionospheric currents for ionospheric event propagation prediction - A three-dimensional Global Assimilative Ionospheric Model (GAIM)**.** This would help meet the communication needs identified by HF users including airlines.
- Polar Scintillation - Arctic spatial and frequency distribution for communications, radar, and navigation signal corruption and outage prediction. Both DOD and commercial high latitude interests identified this need.
- Neutral Environment - Global neutral density and composition (>90 km) for accurate satellite, space debris, and missile orbit prediction. Global neutral winds (>90 km) for accurate communications, radar, and navigation signal corruption and outage prediction. Global neutral temperature (>90 km) for accurate communications, radar, and navigation signal corruption and outage prediction.

Warnings and Forecasts

Recommendation: Utilize developments in modeling efforts, including those in the academic and vendor community, to provide improved radiation storm warnings to include maximum flux expected.
Recommendation: Establish requirements for amending the (daily) forecast or develop a new web-based dynamic forecast product.

Dissemination

Recommendation: Establish a permanent networking agreement with the NOAA Network Operations Center (NOC) to continue this expanding (Web site) service.

Appendix G
Recommendations from *The Sun to the Earth—and Beyond: A Decadal Research Strategy in Solar and Space Physics*

Source: NRC 2002.

Space Weather Commentary and Recommendations from chapter 5

• The National Space Weather Program

A key function of the National Space Weather Program is to develop processes and policies for monitoring the space weather environment.

Finding: The federal agencies that have important research and/or mission interests in the solar-terrestrial environment are undertaking strong initiatives to establish, nurture, and evolve an effective national program in space weather. There is growing interest in the private sector in the provision of space weather products to both the private and the public sectors. As a result of all of these activities, numerous research and research policy issues have arisen that demand new attention from all parties interested in space weather.

• Monitoring the solar-terrestrial environment

Effective monitoring of the space environment requires identification of those research instruments and observations that are needed to provide the basis for modeling interactions of the solar-terrestrial environment with technical systems and for making sound technical design decisions.

Recommendation: NOAA and DOD, in consultation with the research community, should lead in an effort by all involved agencies to jointly assess instrument facilities that contribute key data to public and private space weather models and to operational programs. They should then determine a strategy to maintain the needed facilities and/ or work to establish new facilities. The results of this effort should be available for public dissemination.

Recommendation: NOAA should assume responsibility for the continuance of space-based measurements such as solar wind data from the L1 location as well as near Earth and for distribution of the data for operational use.

Recommendation: NASA and NOAA should initiate the necessary planning to transition solar and geospace imaging instrumentation into operational programs for the public and private sectors.

• The transition from research to operations

An important task facing the space weather community during the coming decade will be to establish, maintain, and evolve mechanisms for the efficient transfer of new models of the solar-terrestrial environment into the user community.

Recommendation: The relevant federal agencies should establish an overall verification and validation program for all publicly funded models and system-impact products before they become operational.

Recommendation: The operational federal agencies, NOAA and DOD, should establish procedures to identify and prioritize operational needs, and these needs should determine which model types are selected for transitioning by the Community Coordinated Modeling Center and the Rapid Prototyping Centers. After the needs have been prioritized, procedures should be established to determine which of the competing models, public or private, is best suited for a particular operational requirement.

• Data acquisition and availability

Developing successful space weather mitigation strategies involves the ability to predict space weather effects on specific technological systems as well as to predict space weather in general; it also requires knowledge of extreme space environmental conditions.

Recommendation: DOD and NOAA should be the lead agencies in acquiring all the data sets needed for accurate specification and forecast modeling, including data from the international community. Because it is extremely important to have real-time data, both space- and ground-based, for predictive purposes, NOAA and DOD should invest in new ways to acquire real-time data from all of the ground- and space-based sources available to them. All data acquired should contain error estimates, which are required by data assimilation models.

Recommendation: A new, centralized database of extreme space weather conditions should be created that covers as many of the relevant space weather parameters as possible.

• The public and private sectors in space weather applications

Both the government and private industry are involved in acquiring, assessing, and disseminating information and models related to the solar-terrestrial environment in the context of its relevance for technological systems. Therefore, it is important to determine the appropriate roles for each sector in space-weather–related activities.

Recommendation: Clear policies should be developed that describe government and industry roles, rights, and responsibilities in space weather activities. Such policies are necessary to optimize the benefits of the national investments, public and private, that are being made.

Education and Public Outreach, Chapter 6

• University faculty and curricula

Augmentation of university faculty in solar and space physics is essential for the support of a strong national solar and space physics research program in the coming decade.

Recommendation: The NSF and NASA should jointly establish a program of "bridged positions" that provides (through a competitive process) partial salary, start-up funding, and research support for four new faculty members every year for 5 years.

Appendix H
Acronyms

ACE	Advanced Composition Explorer
AFRL	Air Force Research Laboratory
AFWA	Air Force Weather Agency
AFSPC	Air Force Space Command
AMISR	Advanced Modular Incoherent Scatter Radar
APV	vertical guidance approach
CAMI	Civil Aerospace Medical Institute
CCMC	Community Coordinated Modeling Center
CEDAR	Coupling, Energetics and Dynamics of Atmospheric Regions [NSF program]
CEOS	Committee on Earth Observation Satellites
CISM	Center for Integrated Space Weather Modeling
CME	coronal mass ejection
COSMIC	Constellation Observing System for Meteorology, Ionosphere and Climate
CONUS	contiguous United States
CRPL	Central Radio Propagation Laboratory
CSEM	Center for Space Environmental Modeling
CSW	Committee for Space Weather
DARPA	Defense Advanced Research Projects Agency
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
DISS	Digital Ionospheric Sounding System
DMSP	Defense Meteorological Satellites Program
DREAM	Dynamic Radiation Environment Assimilation Model
Dst	Disturbance Storm Time [Index]
ESA	European Space Agency
ESSA	Environmental Science Services Administration
EUMETSAT	European Meteorological Satellites
EUV	extreme ultraviolet
FAA	Federal Aviation Administration
FAST	Fast Auroral Snapshot Explorer
FCMSSR	Federal Committee for Meteorological Services and Supporting Research
GAIM	Global Assimilation of Ionospheric Measurements
GEM	Geospace Environment Modeling [NSF program]

GEO	geosynchronous Earth orbit
GOES	Geostationary Operational Environmental Satellite system
GONG	Global Oscillation Network Group
GPS	Global Positioning System
HF	high frequency [region of the radio wave spectrum]
ICMSSR	Interdepartmental Committee for Meteorological Services and Supporting Research
ICSU	International Council for Science
IMAGE	Imager for Magnetopause-to-Aurora Global Exploration
IMS	Ionospheric Measuring System
ISES	International Space Environment Service
ISP	Ionosphere Storm Probes
ISS	International Space Station
ISTP	International Solar-Terrestrial Physics Project
LANDSAT	Land Remote-Sensing Satellite [System]
LANL	Los Alamos National Laboratory
LASCO	Large Angle and Spectrometric Coronagraph
LEO	low Earth orbit
LWS	Living With a Star
MEO	medium Earth orbit
MESSENGER	Mercury Surface, Space Environment, Geochemistry and Ranging [NASA Mission]
MetOp	Meteorological satellites in the EUMETSAT Polar System
MME	man-made events
MURI	Multidisciplinary University Research Initiative
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NRL	Naval Research Laboratory
NRO	National Reconnaissance Office
NSF	National Science Foundation
NSSA	National Security Space Architect
NSTC	National Science and Technology Center
NSWP	National Space Weather Program
NSWPASG	National Space Weather Program Assessment Study Group
NSWPC	National Space Weather Program Council
NWS	National Weather Service

OFCM	Office of the Federal Coordinator for Meteorological Services and Supporting Research
OMB	Office of Management and Budget
OpSEND	Operational Space Environment Network Display
OSTP	Office of Science and Technology Policy
OTA	Office of Technology Assessment
PNT	positioning, navigation, and timing
POES	Polar-orbiting Operational Environmental Satellite [Program in ESE]
RBR	Radiation Belt Remediation
RBSP	Radiation Belt Storm Probes
RHESSI	Ramaty High Energy Solar Spectroscopic Imager
RISE	Radiative Inputs of the Sun to Earth [NSF program]
RPC	Rapid Prototyping Center
SAMPEX	Solar Anomalous and Magnetospheric Particle Explorer
SAR	search and rescue
SCINDA	Scintillation Network Decision Aid
SDO	Solar Dynamics Observatory
SEC	Space Environmental Center [of NOAA/NCEP]
SEM	Space Environment Monitor
sfu	solar flux unit
SHF	superhigh frequency [region of the radio wave spectrum]
SHINE	Solar and Heliospheric Interplanetary Environment [NSF program]
SPARC	Space Physics and Atmospheric Research Center [U.S. Air Force Academy]
SOHO	Solar and Heliospheric Observatory
SOLIS	Synoptic Optical Long-term Investigation of the Sun
SOON	Solar Optical Network
SMEI	Solar Mass Ejection Imager
SNOE	Student Nitric Oxide Explorer
STEREO	Solar Terrestrial Relations Observatory
SWOC	Space Weather Operations Center
SuperDARN	Super Dual Auroral Radar Network
TEC	Total Electron Content [model]
TIMED	Thermosphere * Ionosphere * Mesosphere * Energetics and Dynamics
TR&T	Targeted Research and Technology
TRACE	Transition Region and Coronal Explorer
UARS	Upper Atmosphere Research Section (of NSF)
UHF	ultrahigh frequency [region of the radio wave spectrum]
UPOS	University Partnering for Operational Support
USGS	U.S. Geological Survey
USMCC	U.S. Mission Control Center [NOAA entity]

USU	Utah State University
USC	University of Southern California
UV	ultraviolet
VHF	very high frequency [region of the radio wave spectrum]
WAAS	Wide Area Augmentation System
WMSCR	Weather Message Switching Center Replacement