University of Michigan
College of Engineering
MichiganEngineering
Atmospheric, Oceanic and Space Sciences

Daily Planet

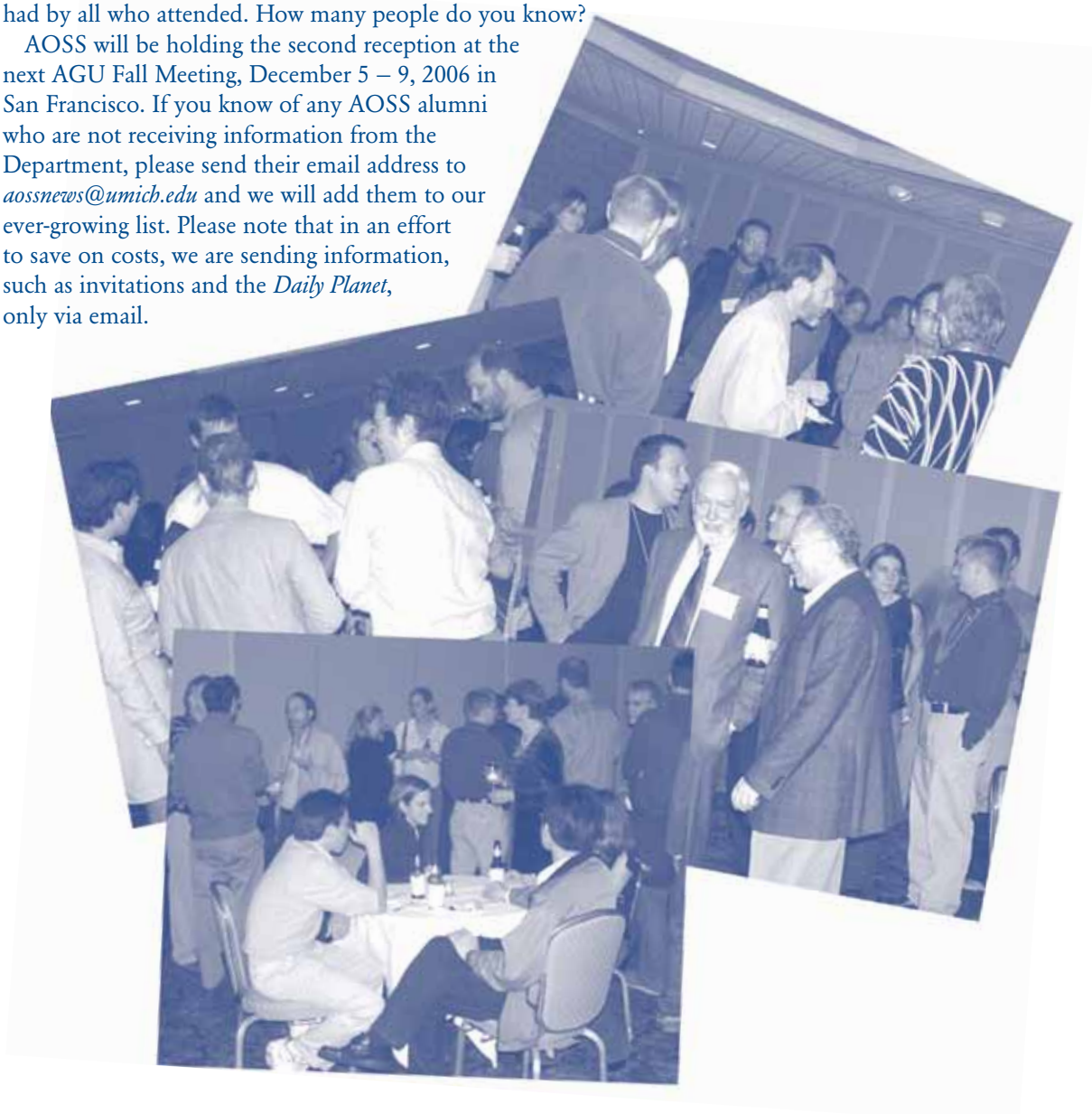
SPRING 2005

The Department of Atmospheric, Oceanic and Space Sciences Newsletter

Alumni Gather at AGU Meeting

At the American Geophysical Union (AGU) 2004 Fall Meeting, more than 200 alumni attended the first joint reception held by AOSS and Geological Sciences. A good, but crowded, time was had by all who attended. How many people do you know?

AOSS will be holding the second reception at the next AGU Fall Meeting, December 5 – 9, 2006 in San Francisco. If you know of any AOSS alumni who are not receiving information from the Department, please send their email address to *aossnews@umich.edu* and we will add them to our ever-growing list. Please note that in an effort to save on costs, we are sending information, such as invitations and the *Daily Planet*, only via email.



INSIDE

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AOSS Accolades

PROFESSOR KOZYRA SELECTED AS NEW AGU FELLOW

Janet Kozyra, AOSS Research Professor , was recently elected as a Fellow of the American Geophysical Union. Each year, only 0.1% of the AGU membership may join this select group of scientists. According to AGU bylaws, "A Fellow of AGU shall be a scientist who has attained acknowledged eminence in the geophysical sciences." Kozyra's research concentrates on the impacts of magnetospheric inputs; global scale solar wind; physics of magnetic storms; and, aeronomical consequences of heavy ion and neutral precipitation at Earth and other planets.

Faculty

Stephen W. Bougher, AOSS Research Professor, was awarded the University of Michigan Research Faculty Achievement Award.

C. Robert Clauer, AOSS Research Professor, received the College of Engineering *Outstanding Research Scientist Award*.

J. Hunter Waite, AOSS Professor, received the Department's *Award for Outstanding Accomplishment*.

Thomas Zurbuchen, AOSS Associate Professor, received the College of Engineering *Service Excellence Award*. He also gave a presentation, *Scientific Exploration of the Solar System: The Road to the Final Frontier*, to congressional members and staff organized by the Science Coalition, whose mission is to expand and strengthen the federal government's investment in university-based scientific, medical, engineering and agricultural research. The presentation is available online at: http://aoss.engin.umich.edu/finalfrontier/index.html.

Four AOSS faculty members were promoted by the Regents this year: Nilton Renno, Associate Professor with tenure; Thomas Zurbuchen, Associate Professor with tenure; Aaron Ridley, Research Associate Professor; and, Frank Marsik, Associate Research Scientist.

Michael Combi, AOSS Research Professor, was selected as a member of the Vice President for Research Search Committee.

Guy A. Meadows, AOSS and NAME Professor, received the Purdue University School of Science *Distinguished Alumnus Award*.

Students

AOSS sophomore **Aimee A Covert** received a NASA Institute for Advanced Concepts (NIAC) Student Fellows Prize for her proposal, *Advanced Concept for Detection of Weather Hazards on Mars*. The total award is for $9,000. Aimee and co-author **Dhruv Sarna** were also selected to participate in the Michigan Undergraduate Research Forum held in the Michigan State Capital in late March.

Atmospheric, Oceanic and Space Sciences graduate students **Xia Cai, Anna DeJong, Yue Deng and Xiaohua Fang** received Outstanding Student Paper Awards in Space Physics and Aeronomy at the latest American Geophysical Union Meeting. The University of Michigan was the only institution to have four student awardees.

Thanks to all AOSS staff, students and faculty who donated to this year's holiday gift drive.

The winning papers were:

- *Ionospheric Convection Pattern for Sawtooth Events from AMIE Simulation*, Xia Cai and Xiaohua Fang.
- *Steady Magnetospheric Convection Events as Measured by Polar UVI*, Anna DeJong.
- *Examining the Effects of Periodic High Latitude Forcing on the Joule Heating and Thermospheric Temperature Structure*, Yue Deng.

At the 2005 College of Engineering Student Honors Brunch, held Sunday, March 20, three AOSS students were recognized for their achievements.

- **Mark Ostermyer**, a graduating senior, received the 2005 *Undergraduate Distinguished Achievement Award*. Mark maintained a 4.00 grade point average as an AOSS student, while continuing as an adjunct mathematics instructor at Mott Community College in Flint.
- **Xia Cai**, whose area of study is space science, received the 2005 *Graduate Distinguished Achievement Award*. Xia has maintained an 8.31 grade point average, is an AOSS graduate research assistant, a grader and a Kiwanis volunteer.
- **Robyn Boeke**, also an AOSS undergraduate, received an honorable mention and $350 in the *Roger M. Jones Poetry Contest*. This award honors the former U-M professor who encouraged students to approach every aspect of their lives humanistically and to write poetry. Robyn's winning submission consisted of five diverse poems.

Staff

What is the future for Defined Benefit Plans and the Pension Benefit Guarantee Corporation (PBGC), a paper by **Lana Tyrrell**, AOSS Single Point of Administrative Contact (SPC), was selected as a finalist by the Financial Executives International in it's thesis essay contest.

Poems by Robyn Boeke

Break Up

Heavy, hot breath that lingers on my lips.
My eyes shut, then open.
Those Friday nights where nothing else mattered
and his fingers splayed on the small of my back contained my entire world.
Eyes wrinkled, lips stretched, teeth teasing a bottom lip when he smiled.
That smile that was for me.

My chest is punched, my stomach drops.
My eyes cannot steal a glance while he is not looking,
my hand does not brush his as we pass.
His voice is not for me anymore; I am too small to see.

This is the first time I can see the world.
People going about their business like ants scurrying in a crack.
Face flattened, head hammered to the floor,
No happiness anymore.

I would forget him the next morning,
lying on the creaky futon-
stomach in my throat and throat swelled up
like a clogged drain-
but now soft skin and sweet-scented hair envelops me,
like plunging a hand into a sack of grain.

Red Stiletto

Kli-Klack
A two-syllable knock on the wood-paneled floor.
A curious turn of heads in the quiet café.
Eyes trailing from black and white books.
Kli-Klack
A red heel stirs the stagnant mood;
a drip of rich coffee in a clean white mug.
Kli-Klack
Its strapping curves steal eyes.
Like a droplet of rain in the desert,
it is gone as soon as it comes,
yet its visit is not forgotten.

For Granted

A girl with sinewy hair smokes a joint,
while a man with a briefcase passes her on the sidewalk.
Overlooking the grassy park in the building next door,
my math professor grades my test as he dreams about the girls in his class.
I sun bathe in the Diag.
A fiery burst of magma jets from the earth's crust,
dulled by black, salty ocean water.
The earth rolls on its axis and loops the sun,
which it warms the skin on my back.

AOSS Exceeds Enrollment Goals

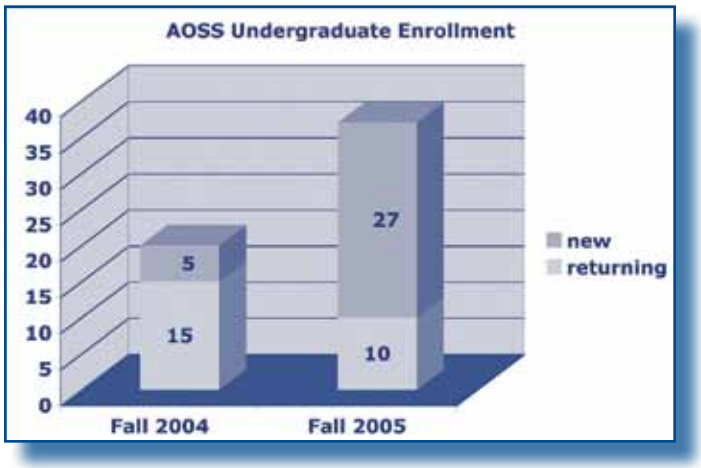
One of the Departments' goals for this past year was to grow undergraduate enrollment. With the relatively high number of graduating seniors and relatively little time to publicize the new Earth System Science Enigineering (ESSE) program, we knew this would be a challenge. Thus, special emphasis was placed on reaching out to undergraduates in 100 and 200 level courses, ENG 110 and on a special recruiting event, *March Major Madness*.

OF SPECIAL NOTE:

- *At least half of the new students will be pursuing a concentration in space weather.*
- *About half of the declared undergraduates are female.*
- *One-fifth of our declared undergraduates are underrepresented minorities.*

At the end of March, AOSS Associate Chair Perry Samson had the pleasure of announcing that 27 new undergraduates had enrolled in the ESSE program for the academic year, guaranteeing that there will be **more undergrads in the fall than the Department has had in recent history**. And the number has continued to grow.

Professor Samson went on to state, "This is excellent progress considering we have just begun to formulate our plans for "marketing" our new degree programs to high schools (and to freshmen engineering advisors). My sincere thanks to those who've helped with the outreach and particularly John Barker for organizing the *March Madness* and Margaret Reid for helping guide the enrollment process. It is also worth mentioning that many of the declaring students cite our web page as a resource they used to make their decision."



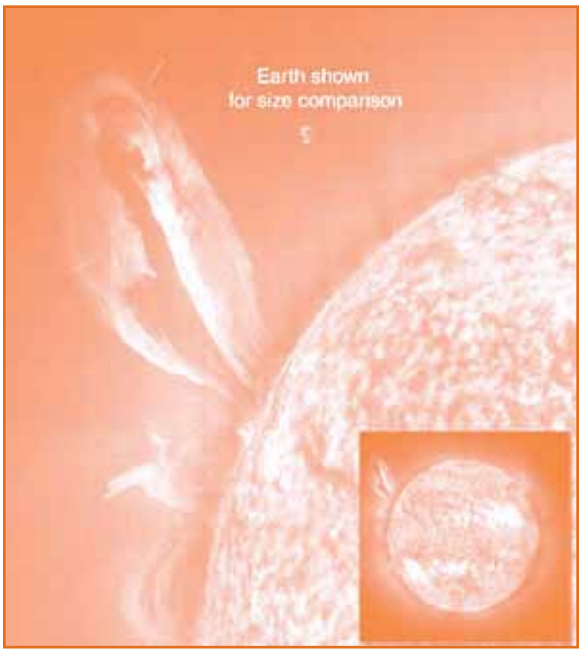
Forecasting the Heavens

New 'space weather' field aims to expand the reaches of meteorology to the final frontier

By Steve Antalics, For the Michigan Daily (reprinted with permission)

Anyone who has spent time in Michigan knows how difficult accurate weather forecasting can be – and that's just here on Earth. Imagine having to predict conditions across the entire chasm of space that lies between the Earth and the sun. Yet that daunting task is exactly what Atmospheric, Oceanic and Space Science prof. Robert Clauer, and researchers like him, are hoping to do.

Clauer, co-director of the Center for Space Environment Modeling at the University's Space Physics Research Lab, hopes to one day develop models that will be comparable in accuracy to terrestrial meteorology.



While the distance between the sun and earth spans for millions of miles, the effects of the explosive weather on the star can extend even to our planet by disrupting satellites and electrical equipment on the ground.

Clauer said, as of now, the field of space weather is still lagging behind current weather forecasting on the earth in terms of accuracy. "We're kind of where the meteorologists were 20 years ago," he said.

Despite the gap between technologies, Clauer added that, "The weather models have become accurate, in part, because they have a lot of data to put into those models. We don't think it's going to take 20 years because we're building on their experience and their work, although we have some new problems to overcome."

The problem, according to Clauer, lies in the physical size of the area that researchers are trying to model, the sparse data on solar activity and the fact that matter between the Earth and the Sun is distributed very unevenly, with some areas having much denser distributions than others.

"We probably are never going to have (a high) level of data," Clauer said. "We're trying to develop data assimilation methods that will work with the sparse data we have."

But Clauer said their research utilizes the most advanced computer models that are specifically geared toward predicting the weather on the sun.

Adaptive mesh refinement, a computing technique that allows multiple computers to work simultaneously with rapidly changing areas of space that are both empty and dense, is one such model, Clauer explained.

> *"The electrical currents have consequences — spacecrafts can get charged and have arcing between their components."*

To understand those different areas in space, one must look to the activity of the sun.

"Space weather is basically looking at how the sun and activity on the sun actually affects conditions around the Earth," said Susan Lepri, a research fellow in the AOSS Department. "The sun has a continuous solar wind that's always blowing charged particles in into space."

Solar wind is a continuous stream of charged particles originating from the sun's atmosphere, the corona. In addition to the solar wind, which carries with it a magnetic field, the super-hot atmosphere of the Sun often erupts in what are known as solar flares and coronal mass ejections.

According to Lepri the solar flares release primarily X-ray radiation, which can harm astronauts in space, but they also release relatively small amounts of charged particles.

Coronal mass ejections, on the other hand, can release tens of billions of tons of charged particles into space.

The real damage to the Earth, Lepri and Clauer said, comes from those

CONTINUED ON PAGE 8

New Grants

(Only AOSS Principal Investigators are listed)

Stephen Bougher; *Response of the Titan Upper Atmosphere to Solar and Saturn Magnetospheric Forcing: A Cassini Era TGCM Study*; NASA; through November 2007; $240,000.

Roger DeRoo, A C-Band Radio Frequency Interference (RFI) Detection and Mitigation Testbed; EMAG Technologies, Inc.; through July 2005; $23,363. University of Florida L Band Radiometer Upgrade; University of Florida; through August 2005; $33,488.

Charles Edmonson, MSL/SAM Phase A Study; NASA/GSFC; through June 2005; $24,850. Phoenix/TEGA Electronics Design and Fabrication; University of Texas-Dallas; through June 2005; $412,144. NOAA/GLERL/CILER Real-time Networked Buoy Fabrication; NOAA; through May 2006; $54,272. Open task order for engineering support; Michigan Aerospace Corp.; through September 2005; $100,000.

Lennard A. Fisk, *Supporting Theoretical Studies of the Processes that Control the Topology and Evolution of the open Magnetic Flux of the Sun*; NASA; through 2007; $400,881. *WIND-SMS Investigation*; NASA; through November 2007; $210,000.

Jason Gilbert, GSRP, *New Instruments for Exploring the Composition and Dynamics of Pickup Ions*

George Gloeckler, *Fast Imaging Plasma Spectrometer (FIPS) in Support of the Energetic Particle and Plasma Spectrometer (EPS) Investigation for the MESSENGER Mission to Mercury: Phase E*; NASA/ Carnegie Institution of Washington; through September 2011 $1,885,702

Tamas I. Gombosi, *U.S. Rosetta Project for Phase E, ROSINA INSTRUMENT*; JPL/NASA; through September 2008; $572,919. *MURI Comprehensive Solar-Terrestrial Environment Model (COSTEM) for Space Weather Predictions*; Air Force Office of Scientific Research; through November 2005; $949,096 (extended with additional funding).

Janet Kozyra, *University of Michigan contributions to Mars Express Data Analysis*; Southwest Research Institute; through September 2005; $27,000.

Prashant Patel, GSRP, *Spacecraft Optimization: Coupling Trajectory, Propulsion, and Power Systems*

Joyce Penner, *A Summary of Progress and Needs for Aerosols in the GMI Model*; NASA; through January 2006; $152,000.

Thomas Zurbuchen, *Ionic Charge States of the Solar Wind and ICMEs: ACE, Ulysses*; NASA; through March 2006; $248,755. *Constraining Solar Wind and CME Models Using In Situ Ionic Composition Observations*; NSF; through December 2007; $299,847.

AOSS IN TOP 10 AND TOP 100

In January, ***Astrobiology Magazine*** published its list of the Top 10 astrobiology stories for 2004. Number seven on the list was "Mysterious Martian Methane" — and one of the biggest contributors to the story was AOSS Professor Sushil Atreya. In the article, Professor Atreya is quoted, "Methane is a potential biomarker, if a planet has methane we begin to think of the possibility of life on the planet. On Earth, methane is almost entirely derived from biological sources." For more in-depth information about methane on Mars, see the Fall 2004 issue of the ***Daily Planet,*** available online at: http://aoss.engin.umich.edu/DailyPlanet.

Also in January, ***Discover*** ran its list of Top 100 science stories for 2004 and AOSS was involved with two of them. Coming in at number four was the Cassini-Huygens spacecraft reaching Saturn. A number of current and former AOSS/SPRL faculty have been busy with this mission to Saturn: Tamas Gombosi, Hunter Waite, Sushil Atreya, Andy Nagy, and the whole crew who worked on the Gas Chromatograph Mass Spectrometer (GCMS). (See article on page 9.)

The Halloween Solar Storms of 2003 came in at number 86 on ***Discover's*** list of top science stories. In addition to the article in this and previous issues of the ***Daily Planet***, more information about space weather and solar storms can be found online at http://aoss.engin.umich.edu/Solar_Storm/sws2.php.

Alumni News

Paul Gross, Atmospheric & Oceanic Sciences '83 — Received an EMMY from the National Association of Television Arts and Sciences for his half-hour documentary, *Krakatoa: Mountain of Fire*. He researched, wrote and produced the program, which ran on Detroit's WDIV-TV, about volcanoes and how they affect our weather, with special emphasis on the devastating 1883 eruption of Krakatoa, an Indonesian volcano.

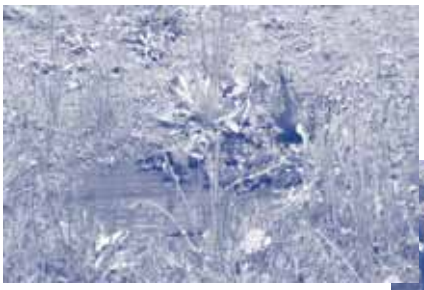
Keith C. Heidorn, PhD, Meteorology & Oceanography, '69 BS, '71 MS – Recently published *The BC Weather Book: From the Sunshine Coast to Storm Mountain*; information can be found at Dr. Heidorn's web site, *The Weather Doctor*, at http://www.islandnet.com/~see/weather/doctor.htm.

Ryan N. Maue, Atmospheric Science, '02 – Successfully defended his MS thesis, *Frontal Evolution Associated with Extratropical Transitioning Hurricanes*, at Florida State University; currently FSU PhD student at the Center for Ocean-Atmospheric Prediction Studies. "The reason I am not finishing Law School right now is oftentimes unclear to me. During my senior year at the University of Michigan, I made a decision to pursue the theoretical half of my brain and someday come back to my argumentative half. There, Dr. Bill Kuhn taught me the foundations of my meteorological understanding and said I could be a professor one day. Nothing is more encouraging than people being proud of you."

— Excerpted from thesis "Acknowledgements" page

SRB Ducks Get New Digs

For at least four years, the Space Research Building courtyard has been home to Matilda and her yearly brood. This year, AOSS staff, faculty and students greeted the latest generation of Matilda's ducklings with a new, expanded pool. Fit in during lunch one day, the new pool area was constructed and landscaped and has been a success ever since!



A drain hole is no place for a family of 12 to swim.

Matilda looks like the patient one in the family.

A job for all.

"You missed a spot."

Finally, room enough to move.

Everyone into the pool!

Notoriety comes to those who wait

AOSS Associate Chair Perry Samson and Google founder Larry Page meet at CoE commencement.

AOSS Associate Chair Perry Samson had a close encounter with a U-M alumnus at this year's commencement.

Prof. Samson was somewhat surprised when a CoE alumnus whom he didn't recognize singled him out of the pre-ceremony crowd with praises for the *Weather Underground*. (The *Weather Underground*, developed by Prof. Samson, was the first up-to-date web-based weather site, complete with searchability.)

It was only well into the conversation with the alumnus, who continued to comment on how Prof. Samson's work really helped in designing his own site that the light of recognition occurred! It was nonother than Larry Page, founder of Google and 2005 CoE commencement speaker.

Forecasting

CONTINUED FROM PAGE 5

charged particles, known as plasma, and their interactions with everything from satellites to power grids.

"The electrical currents have consequences – spacecrafts can get charged and have arcing between their components."

"Both commercial and military communications satellites can be affected," Clauer added. The electric field induced by changing current, he said, can wreak havoc even if it is very small, if it's conducted across large systems such as pipelines or power grids. This current can even blow up power transformers, causing blackouts.

One of the largest blackouts in history, which affected nearly six million people in Quebec in 1989, was attributed to a solar storm.

The most recent storm, caused by a coronal mass ejection, occurred on Jan. 20, causing a brilliant aurora in Europe but had otherwise no effect on the earth. Nevertheless, power companies are particularly interested in when the next solar storm may occur.

"If (power companies) know there is something coming," Clauer explained, "they can cut back or they can re-route power into smaller segments. But it costs money. So you have to be able to make a prediction that's reliable. We're not really there yet."

AOSS scientists and engineers vital participants in mission to Titan

While most were probably done oooh-ing and ahhhing over the astonishing pictures of an alien world that the Huygens probe sent back to us in mid-January, AOSS scientists had only begun to decipher an unexpected wealth of data about Titan, a moon of the planet Saturn.

"The Huygens probe has discovered a new world," said Professor Sushil Atreya. "And there is so much more to learn."

Atreya and Professor Emeritus George Carignan have waited more than seven years, as the Huygens probe rode out to Saturn on the side of the Cassini orbiter. The orbiter set Huygens free on Christmas Day 2004, and on Friday, January 14, 2005, the probe descended through Titan's atmosphere and crash-landed on its surface.

It collected data for a full two hours during its descent through Titan's atmosphere and beamed it up to Cassini overhead before hitting Titan, where scientists and mission planners had hoped the craft would operate for a meager three minutes. However the resilient Huygens Probe kept sending data for an astonishing one hour and ten minutes from the surface.

In fact, had Cassini not gone over the horizon, Huygens might have continued to transmit data for another two hours. The carrier frequency from Huygens, like the dial tone of a telephone, was detected by radio telescopes on Earth for at least two hours after it lost contact with Cassini.

On behalf of AOSS I would like to congratulate the entire GCMS (Gas Chromatograph Mass Spectrometer) team of the very successful Huygens Probe mission.

The GCMS instrument was built under the leadership of Hasso Niemann, a former member of SPRL. The science team includes the late Tom Donahue (he is smiling up there), George Carignan and Sushil Atreya. Part of the instrument was built at SPRL by an outstanding technical team composed of Kenneth Arnett, Rick Baker, Bruce Block, David Boprie, Curt Cooper, John Eder, Heinz Grassl, Peter Hansen, Sandee Hicks, Mark Huetteman, Frank Lee, John Maure, Ryan Miller and Charles Navarre.

The GCMS instrument and the entire Huygens probe performed extremely well under very difficult conditions. The data are safely on Earth and the science team is already working on the analysis.

Congratulations to the entire scientific and technical team!

Tamas Gombosi

AOSS Chair

A main element of the success of the Huygens mission was due to the hardiness of the Gas Chromagraph Mass Spectrometer (GCMS), an instrument built in part by engineers at the U-M Space Physics Research Laboratory.

"The GCMS data provide strong evidence of a thick cloud or haze layer of methane in Titan's middle troposphere around 20 km above the surface," Atreya said. "And there is a reservoir of liquid methane on the surface. On Titan, methane seems to play a similar role as water in the Earth's meteorology."

The GCMS is a versatile gas chemical analyzer designed to identify and measure chemicals in Titan's atmosphere. During descent, the GCMS also analyzed aerosol samples that were collected, heated, and vaporized by the ACP (Aerosol Collector Pyrolyzer), another instrument on Huygens on which Atreya is also an investigator. Finally, the GCMS measured the composition of Titan's surface. All of this unexpected data means more exciting work for the team of scientists

"The big question for Titan is how the methane gets replenished," Atreya explained "In the absence of recycling it would be destroyed by the Sun's ultraviolet light in ten million years, which would in turn lead to a gradual collapse of Titan's atmosphere. The GCMS measurements, together with supporting data from the other Huygens instruments, is beginning to provide some important clues to the source and recycling of methane on Titan, and we expect a clearer picture to emerge in the months to come."

For more information visit http://www.esa.int/SPECIALS/Cassini-Huygens/index.html

NASA's Computational Technologies Project

New Framework Confronts a Monster Space Weather Event

By Jarret Cohen, NASA Goddard Space Flight Center/GST, Inc. (reprinted with permission_)

Covering the whole physics from the Sun to the Earth, a new simulation tool is being applied to the biggest solar event in recent history, a month-long series of outbursts dubbed the "Halloween 2003 space storms." This Space Weather Modeling Framework (SWMF) is the product of a Computational Technologies (CT) investigation at the University of Michigan.

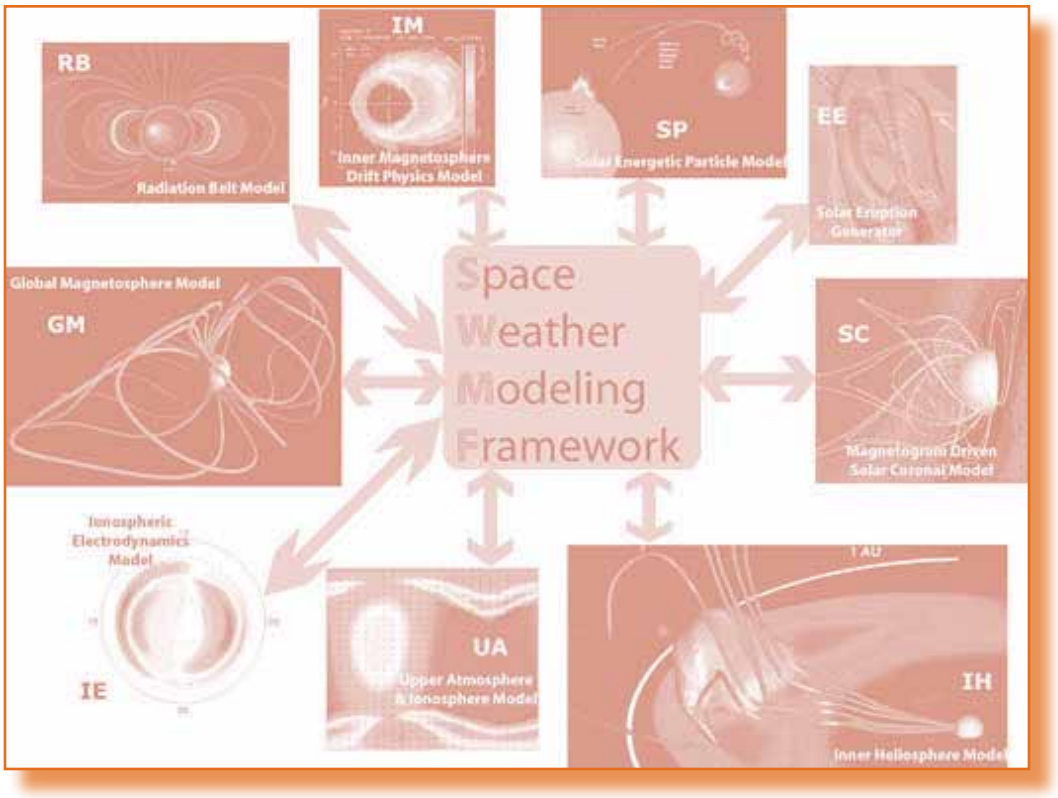
"With the help of the CT Project, we just delivered our last major milestone, which is a fully operational framework with nine models working together," said SWMF principal investigator Tamas Gombosi, who is chair and professor of the Department of Atmospheric, Oceanic, and Space Sciences at Michigan. "This is the first time that we have exercised this brand new tool for a very challenging major event. It is a fortunate combination of simulation advances and the Sun cooperating in a very exciting way."

SWMF has its origins in Michigan's BATS-R-US code developed under the CT Project (then known as the Earth and Space Sciences Project) beginning in 1996. Many of the SWMF models are considered world-class, Gombosi said, "but coupled together, they are better than the sum of their parts." The current SWMF links 9 models to represent the complex physics of space weather:

* A Solar Coronal model (SC) represents the Sun's corona (atmosphere) using solar observation data.
* An Eruptive Events Generator (EE) inputs a coronal mass ejection (CME) into the initial conditions of the simulation. The CME then propagates outward through the SC and Inner Heliosphere models self-consistently.
* A Solar-energetic Particles model (SP) describes the transport, acceleration, and scattering of these particles from the solar event to the Earth's atmosphere.
* An Inner Heliosphere model (IH) simulates the solar wind from the outer boundary of the corona (SC) to the Earth's magnetosphere and beyond, based on magnetohydrodynamics (MHD).
* A Global Magnetosphere model (GM) describes the connection between the inner heliosphere and the outer portion of the Earth's magnetosphere, based on MHD.
* A Radiation Belt model (RB) tracks trapped particles.
* An Inner Magnetosphere model (IM) calculates the dynamic behavior of particles and the electric fields and currents in the Earth's inner magnetosphere and computes their effects on the inner magnetosphere and upper atmosphere.
* An Upper Atmosphere model (UA) simulates the dynamics of the Earth's thermosphere and ionosphere.
* An Ionospheric Electrodynamics model (IE) calculates the electric potential in the Earth's ionosphere.

The Halloween 2003 storms are the first real application of the complete SWMF. "There were several unique features, which is why it is very important to exercise simulation tools," Gombosi said. Beginning in late October and lasting through early November, three sunspots, including one the size of Jupiter, launched a series of solar eruptions. Among the 60 solar flares was the most massive ever observed, an X-28 flare accompanied by a CME on November 4. The Sun spewed out several billion tons of matter at an astonishing 8 million kilometers per hour. Although this blob of charged gas did not hit Earth, geomagnetic storms resulting from multiple Earth-bound flares and CMEs had widespread effects: Two satellites were knocked out of commission, and 28 more were damaged. Airlines diverted their planes. Sweden suffered a power outage. Astronauts on the International Space Station had to take cover several times. The Northern Lights reached as far south as Florida.

The Michigan team's Halloween 2003 simulation is a monster in its own right. "This is the biggest simulation we have done," Gombosi stressed. "No one has ever attempted such a simulation." To fully represent the Sun-Earth connection, SWMF must traverse 150 million kilometers of space, beginning 100 meters above the Sun's surface (the



The Space Weather Modeling Framework (SWMF) couples 9 models to simulate the physics from the Sun to the Earth (Image credit: Darren De Zeeuw, AOSS).

corona) and ending 100 kilometers above the Earth (the ionosphere).

Following solar gas and particles through space, boxes in the computational mesh divide up to 15 times to cover scales down to 200 kilometers. Without employing this adaptive mesh refinement (AMR) technique, the simulation could not be run on today's supercomputers. Even with AMR, the simulation will ultimately consume 500,000 processor-hours on NASA's new Columbia supercomputer, an SGI Altix system at Ames Research Center in Moffett Field, CA. With a highly scalable code, "we can run faster than real time with 1,000 processors," Gombosi said. His group is running the simulation using 512 processors, so it will take 40 days of computing time to model the 30 days of space weather.

Since the Halloween 2003 space storms were well observed from ground-based telescopes and orbiting spacecraft, there is a useful collection of data for comparison. Validating the simulation will help prepare SWMF as a community tool. Michigan is transferring the software to GSFC's Community Coordinated Modeling Center and NOAA's Space Environment Center in Boulder, CO. Researchers in these organizations will use SWMF codes for operational solar and space weather forecasting as well as scientific analysis.

Alumni – Stay Connected!

If you're an AOSS alumni and have information you'd like to share with others in the AOSS community, please send the information to *aossnews@umich.edu* and we'll include it in an upcoming issue of the Daily Planet. You can also update your contact information with the University from the AOSS web site. Visit http://aoss.engin.umich.edu and click on ALUMNI at the top of the page.

Make a Michigan Difference Today

Your tax-deductible gift to AOSS will provide opportunities for students and keep our program strong. AOSS strives to offer our students the best possible educational and research opportunities. Your gift to the Department will enable us to make awards to AOSS students who have financial need, are outstanding students or have exemplified exceptional leadership and character. The Department has been working hard to make the recently established Thomas M. Donahue Memorial Student Fund an endowment that will benefit AOSS students for years to come. We are very close to the goal and would encourage you to be a part of a long-lasting endeavor to assist others in their academic endeavors.

Please use the form below to make a Michigan Difference today.

Thomas M. Donahue Memorial Student Fund

Enclosed is my gift of $_____ for the Thomas M. Donahue Memorial Student Fund.

Name(s) _____

Address _____

City _____ State _____ Zip Code _____

Daytime Phone ( ) _____ Email _____

☐ Please do not send acknowledgment note to the Thomas M. Donahue Family.
(The amount of your gift will remain confidential.)

Questions? Contact Mary Nehls-Frumkin at maryln@umich.edu

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