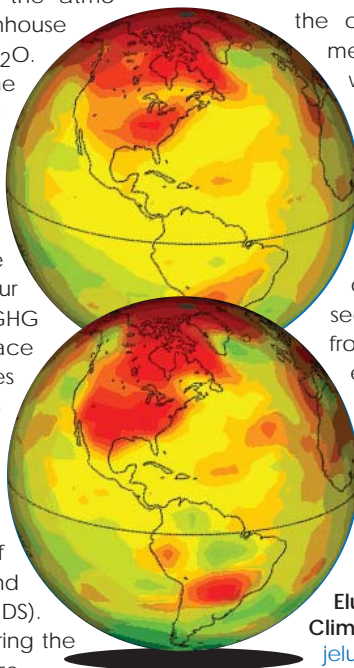




Simulating Greenhouse Gases At Policy-Relevant Scales

In collaboration with NASA, NOAA, NSF, academia, and private industry, AER has developed a regional transport model for simulating the atmospheric concentrations of the main greenhouse gases (GHGs), including CO₂, CH₄, and N₂O. At the heart of our model lies a version of the Weather Research and Forecasting (WRF) model that we have customized for driving the Lagrangian model STILT. The high fidelity of the WRF simulations, coupled with the inherent ability of the Lagrangian approach to resolve fine details of the atmospheric flow, make our model a natural tool for simulating GHG concentrations and estimating their surface fluxes at fine spatial and temporal scales relevant to policy-making (e.g., the Kyoto protocol and its successors).

AER, in collaboration with our partners, is currently applying the model to simulate GHG data from a variety of platforms, including towers, aircraft and future satellites (OCO, GOSAT, and ASCENDS). Examples of the model's performance during the COBRA-NA campaign in May-June 2003 are



described in the recent paper published in Geophysical Research Letters by Kort et al.¹ In that paper, we were able to conclude that, at least for one episode (spring 2003), the currently adopted emission inventories of methane for North America were accurate, while the emissions for nitrous oxide were underestimated by more than a factor of 2. We were able to draw these conclusions relying on the accurate representation of atmospheric transport by means of our WRF/STILT model, so that an accurate simulation of one gas (methane) allowed conclusions to be drawn with regard to the second (nitrous oxide). Currently, with funding from the National Science Foundation, we are extending this multi-species approach to other data sets for CO₂, CH₄, and N₂O, and longer time periods, and plan to apply it to the simultaneous measurements of CO₂ and CH₄ from the Japanese GOSAT satellite.

For more information, contact: **Janusz Eluszkiewicz, Senior Scientist, Radiation & Climate Group** at +1.781.761.2288 or jeluszkiewicz@aer.com.

¹ Kort, E. A., J. Eluszkiewicz, B. B. Stephens, J. B. Miller, C. Gerbig, T. Nehrkorn, B. C. Daube, J. O. Kaplan, S. Houweling, and S. C. Wofsy (2008). Emissions of CH₄ and N₂O over the United States and Canada based on a receptor-oriented modeling framework and COBRA-NA atmospheric observations. *Geophys. Res. Lett.*, 35, L18808, doi:10.1029/2008GL034031.

In this Issue

This issue of AER Insight comes to you from the 89th AMS Annual Meeting in sunny Phoenix! Over the next three days, scientists from all over the world will gather to hear about the science initiatives in a number of different tracks from space weather to climate variability to policy & socio-economic research to integrated observing & assimilation systems and many more. Over the next three days, we will be reporting on the work presented by AER scientists in the various sessions for those who may have not made the trip, as well as those who couldn't possibly attend every session or hear every paper.

Today's issue introduces a new space-related software product (SEET) and some innovative work being done in regional carbon modeling by a group of scientists that extends beyond

AER. This WRF/STILT effort shows great promise in becoming a valuable climate tool. Simulating greenhouse gas concentrations and estimating their surface fluxes at fine spatial and temporal scale is within the reach of this group. Couple this with new decadal survey sensors (ASCENDS & CLARREO) and new international satellites (JAXA's GOSAT), that are collecting observations for comparison and ground-truth, and the synergies multiply.

You'll read about AER's involvement with these sensors and the decadal survey missions. Scientists here have a system simulation infrastructure that tests sensor concepts and validates spacecraft measurements and algorithms. To be involved from both sides of the equation makes it all the more interesting. Enjoy...

Visit us in Booth #712 to learn more about AER's award-winning research and its application to supporting National Security interests.

Also In This Issue

Simulating Greenhouse Gases At Policy-Relevant Scales

p1

Leveraging Joint AFRL/AER Research to Develop AER's SEET
ASCENDS & CLARREO - Decadal Survey Missions

p2

p3

ISO Acquires AER

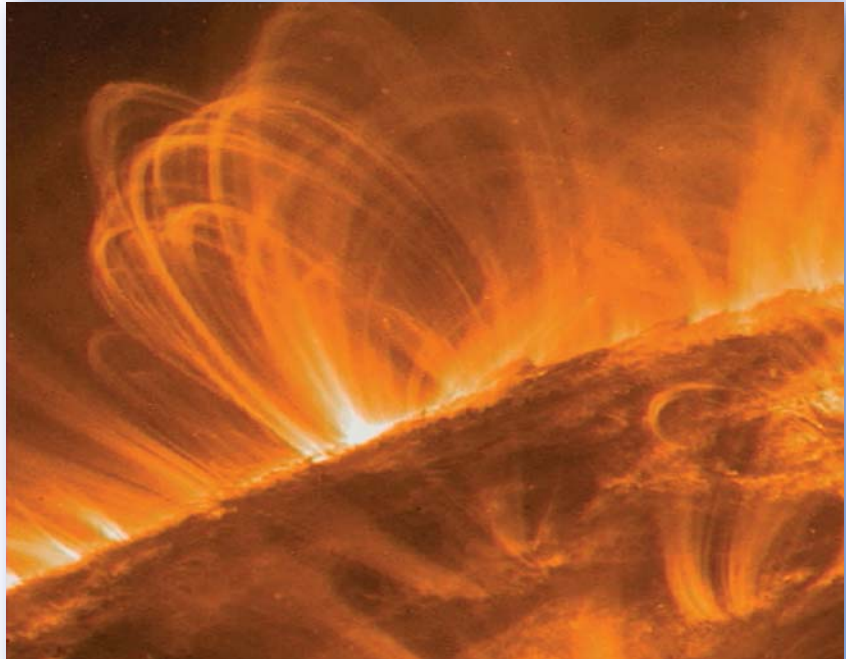
p3

GOSAT Validation Studies to Begin

p4

Leveraging Joint AFRL/AER Research to Develop AER's Space Environment and Effects Toolkit

For over 20 years, AER's Space Weather and Effects Division has worked closely with the Air Force Research Laboratory to conduct basic research on the geospace environment. One outgrowth of that collaboration during the last 10 years has been the development of one of AFRL's flagship products, the AF-GeoSpace modeling and visualization suite (figure below). AER has taken this R&D program one step further by developing the Space Environment and Effects Toolkit (SEET) for AGI's industry-leading Satellite Toolkit, STK.



SEET-STK delivers state-of-the-art Space Weather modeling of the near-Earth space environment and its impacts on space systems. Designed for satellite engineers and mission planners and operators, capabilities include estimation of short-and long-term radiation damage effects, particle flux estimates and transit times through the South Atlantic Anomaly, probabilistic small meteorite and space debris damage estimates, and mean vehicle temperature due to solar and reflected Earth radiation.

AER's planned release for SEET-STK is Q1 2009 with AGI's STK version 9.01. Software is available through

AGI. Stop by AER's booth (#712) to speak with our space environment experts and hear more about SEET-STK.

For more information, contact: **Rick Quinn, Staff Scientist/Staff Manager, Space Weather Division** at +1.781.761.2288 or rquinn@aer.com.

ASCENDS & CLARREO- AER's Role in Decadal Survey Missions

In 2007 the National Research Council released its decadal survey "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond". This report outlined a number of satellite-based science missions that could be undertaken to better understand global environmental change. The proposed missions were then evaluated by NASA in the context of near-term and longer-term priorities and provided initial funding for mission concept and development. AER is an active participant in two of these missions, CLARREO and ASCENDS.

CLARREO

The Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission is being developed to monitor climate change by making highly accurate radiometric measurements of the atmosphere. As envisioned by NASA, "The CLARREO mission will provide accurate, credible, and tested climate records that lay the groundwork for informed decisions on mitigation and adaptation policies that address the effects of climate change on society." Long-term measurements of

geophysical quantities such as atmospheric, land, or sea-surface temperature can suffer from measurement bias because of the way the measured radiances are converted into geophysical quantities. CLARREO addresses this issue by instead making radiometric measurements of unprecedented accuracy and precision. A time-series of radiances is then compared with the radiometric output from climate models to extract the long-term radiometric signature of environmental change and evaluate the likelihood that certain climate scenarios are occurring. AER plays a key role in this endeavor through the use of our optimal spectral sampling (OSS) radiative transfer model. When coupled with the output from climate models, the computationally-efficient OSS radiative transfer model can produce highly accurate calculations of radiometric spectra for use in both mission planning and the testing of



ISO Acquires AER, World Renowned Leader in Environmental Modeling and Prediction



ISO announced it has acquired Atmospheric and Environmental Research, Inc. (AER), a premier environmental and scientific research and predictive modeling company. Terms were not disclosed.

Climate change and its impact on economic growth and stability is an emergent risk factor in the 21st century. AER provides industry-leading solutions for sensing, simulating, modeling, and predicting weather-related phenomena in the atmosphere, ocean, and space. AER provides its services to federal agencies, including the Department of Defense, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration, to enable high-priority, mission-critical programs. AER also supports Fortune 500 defense contractors, research institutions, and commercial entities in the financial and energy industries.

AER has leveraged proprietary partnerships and technologies developed over three decades to create and refine advanced computer models, analysis tools, and databases that provide enhanced understanding and predictions of the atmosphere, ocean, and climate.

AER will complement ISO's AIR Worldwide Corporation (AIR) subsidiary, which offers analytical tools and software systems to help customers estimate and manage the risks associated with natural and man-made catastrophes, weather, and climate.

"We are extremely pleased to join the ISO family of companies," said Cecilia Sze, AER's president and CEO. "We look forward to developing new modeling and analytic solutions with ISO and AIR to further the understanding of the global environment and to enable better decision-making in response to weather and climate risks."

AER scientists serve with fellow university and government colleagues on numerous committees, such as those of the

National Research Council, as peer reviewers of research proposals, and journal publications, and on graduate student thesis committees. AER scientists also actively participate in the workings of such professional organizations as the American Meteorological Society and the American Geophysical Union; and routinely publish the results of their work in scientific research journals. AER scientists contributed to IPCC reports that helped IPCC share the 2007 Nobel Peace Prize with Al Gore. In 1993 AER received the American Meteorological Society Award for Outstanding Services to Meteorology by a Corporation.

"The acquisition of AER further supports our objective to expand ISO's reach in the energy, financial, and government markets and enhances our ability to measure and assess the impact of climate change on insured risks," said Frank J. Coyne, ISO's chairman, president, and chief executive officer. "AER's scientific expertise, coupled with AIR's advanced risk modeling solutions, offers a unique opportunity to produce new products for environmental modeling and prediction."

"With the addition of AER to the growing ISO enterprise, we continue to add resources and expertise to allow our customers to deepen their understanding of how emerging issues — such as the earth's atmosphere and global climate change — impact risk and risk-management strategies," added Coyne.

AER will continue to operate from its corporate headquarters in Lexington, Massachusetts. Its location facilitates collaboration with faculty members and scientists at Harvard University, the Massachusetts Institute of Technology, and other research institutions in the greater Boston area. Additional AER offices are located on the grounds of Hanscom Air Force Base in Bedford, Massachusetts; Omaha, Nebraska; San Francisco, California; Norman, Oklahoma; and Suffolk, Virginia.

For more information, contact: **Stephen Walker, Marketing & Communications, Commercial Division** at +1.781.761.2288 or swalker@aer.com.

ASCENDS & CLARREO- AER's Role in Decadal Survey Missions- Cont'd

various climate scenarios under both scattering and clear-sky conditions.

ASCENDS

The goal of an Active Sensing of CO₂ Emissions over Nights, Days, and Seasons (ASCENDS) mission is to enhance understanding of the role of carbon dioxide in the global carbon cycle. Using laser absorption spectroscopy, ASCENDS will help to quantify the spatial distribution of carbon dioxide by producing global concentration maps. This data will be used in conjunction with numerical models to quantitatively verify and validate terrestrial and oceanic sources and sinks of CO₂ and provide a scientific basis for future projections of CO₂ sources and sinks. For ASCENDS, AER is part of a team with ITT,

NASA-Langley and Climate Central that has developed prototype sensor and algorithm technology to advance the technical readiness level of the ASCENDS components. AER is developing the system simulation infrastructure to test sensor concepts and validate aircraft measurements and algorithms. The team has recently completed another round of aircraft-based measurements and has demonstrated the viability of our approach for a space-based mission. During these flights the AER algorithm system was used in near-real-time to assess the data quality and resulting data products.

For more information, contact: **Ned Snell, Senior Staff Scientist and VP, Sensor Applications and Modeling Division** at +1.781.761.2288 or hsnell@aer.com.

Greenhouse Gases Observing Satellite (GOSAT) Validation Studies to Begin

For over 25 years AER has been at the forefront in the development of state-of-the-art algorithms for modeling and simulation of the atmosphere. These include the radiative transfer and geophysical parameter retrieval algorithms implemented for a number of operational and research satellite programs. To facilitate these activities we have developed a software testbed infrastructure for the development and testing of new algorithm concepts, as well as the validation of existing algorithms. This infrastructure will be used in support of two AER research projects that were selected by the Japan Aerospace Exploration Agency (JAXA), the National Institute for Environmental Studies (NIES) and the Ministry of the Environment (MOE) as part of the First Research Announcement for the Greenhouse gases Observation SATellite (GOSAT) Science Team.



The first project, "Trace Gas Remote Sensing Using Near-Infrared and Longwave-Infrared Spectra" is

led by Dr. Richard Lynch and Mr. Mark Shephard. This work will focus on the validation of trace gas remote sensing techniques. The second project, "Validation of a Laser-Based System for the Measurement of CO₂" led by Dr.

Hilary E. Snell and Dr. T. Scott Zaccheo, focuses on the use of GOSAT measurements to develop and validate laser techniques for the satellite-based measurement of carbon dioxide.

The use of GOSAT data enhances on-going validation activities at AER by extending algorithm validations into the short-wave infrared region of the spectrum and provides the ability to directly compare the data with other measurement technologies operating in this spectral region.

For more information, contact: **Ned Snell, Senior Staff Scientist and VP, Sensor Applications and Modeling Division** at +1.781.761.2288 or hsnell@aer.com.

AER Presenters at the 89th Annual AMS Meeting

Monday, 12 January 2009

Ross Hoffman, S. V. Vinogradov and S. M. Leidner - 4:00 PM-5:30 PM, **4.6** Ensemble data assimilation simulation experiments for the coastal ocean: Towards automatic localization.

Michael Sze, T. Connor and D. Hogan - 2:30 PM-4:00 PM, Fourth Symposium on Policy and Socio—Economic Research **P1.22** Error Characteristics of Cumulative Temperature Ensemble Forecasts.

Robert P. d'Entremont, G. B. Gustafson, J. L. Moncet and A. Lipton - 2:30 PM-4:00 PM, Fifth Annual Symposium on Future Operational Environmental Satellite Systems - NPOESS and GOES-R **JP1.6** Real-Time Global Retrievals of Cloud Spatial, Radiative, and Microphysical Properties.

Alan E. Lipton, J. L. Moncet, R. P. d'Entremont, G. B. Gustafson, R. Aschbrenner, J. B. Eylander, and S. Sarasamma - 2:30 PM-4:00 PM **JP1.5** Cloud property variational retrieval for global real-time applications.

Robert P. D'Entremont, G. B. Gustafson and J. B. Eylander - 2:30 PM-4:00 PM **JP1.14** Operational cloud analysis in polar regions.

Tuesday, 13 January 2009

Robert Atlas, NOAA/AOML, Miami, FL; and **R. N. Hoffman, J. Ardizzone, S. M. Leidner** and J. C. Jusem - 8:30 AM-9:30 AM, **4B.1** Development of a new cross-calibrated, multi-platform (CCMP) ocean surface wind product.

James M. Griffin, R. Aschbrenner, T. Connor, W. Gallery, and H. E. Snell - 8:30 AM-9:45 AM, **4.1** Demonstrating the space weather nowcasting and forecasting capabilities of the phenomena-based environmental effects predictor.

Charles S. Carrano and K. M. Groves - 4:00 PM-5:00 PM, **7.1** Impacts of Ionospheric Scintillation on GPS Positioning Accuracy

S. Mark Leidner, J. Ardizzone, J. C. Jusem, E. Brin and R. Atlas - 11:00 AM-12:00 PM, **5B.4** Ocean-surface wind impacts in regional and global models.

S. Mark Leidner and M. Pirone - 3:30 PM-5:30 PM, **4.4** Probabilistic evaluation of convective forecasts.

Robert Atlas, **R. N. Hoffman, J. Ardizzone, S. M. Leidner** and J. C. Jusem - 8:30AM-9:30AM, **4B.1** Development of a new cross-calibrated, multi-platform (CCMP) ocean surface wind product.

Robert P. d'Entremont and D. L. Mitchell - 9:45 AM-10:45 AM, **1.24** A Causal Argument for the Influence of Contrail Ice-particle Shape on Thermal Infrared Radiance Observations.

Wednesday, 14 January 2009

T. Scott Zaccheo, H. E. Snell, J. Dobler, M. E. Dobbs, E. V. Browell and B. Moore - 8:30 AM-10:00. **6.4** End-to-end testbed for rapid analysis of laser remote sensing data and application to flight data in preparation for ASCENDS.

Edward V. Browell, M. E. Dobbs, J. Dobler, S. Kooi, Y. Choi, F. W. Harrison, B. Moore and **T. S. Zaccheo** - 8:30 AM-10:00 AM. **6.1** First airborne laser remote measurements of atmospheric carbon dioxide.

Jeremy Dobler, M. E. Dobbs, **T. S. Zaccheo, J. Nagel, F. W. Harrison, E. V. Browell and B. Moore** - 8:30 AM-10:00 AM, **6.5**. CW Fiber Laser Absorption Spectrometer for O₂ Column Measurements in support of the ASCENDS Mission.

John M. Henderson, T. Nehrkorn, J. B. Eylander, and C. Carlson - 2:30 PM-4:00 PM, **JP6.16**. Global capability for AFWA's Diagnostic Cloud Forecast system.

Thursday, 15 January 2009

T. Scott Zaccheo, M. Sze, E. J. Kenedy and D. B. Hogan - 1:30 PM-3:00 PM, **J19.5**. Design of web-based GIS tools to support routine quality monitoring of remote sensed products from next generation LEO and GEO missions.



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