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NEWS IN THIS QUARTER

An Update from JCSDA's Community Radiative Transfer Model (CRTM) Project

Benjamin T. Johnson (JCSDA), Cheng Dang (JCSDA), Isaac Moradi (NASA), Nick Nalli (NOAA), Quanhua Liu (NOAA), and Yingtao Ma (NOAA)

The Community Radiative Transfer Model (CRTM) is a critical resource developed and maintained by the Joint Center for Satellite Data Assimilation (JCSDA) in collaboration with NOAA, NASA, and University partners. The CRTM allows us to make the best use of the billions of dollars spent on earth-observing satellites through operational data assimilation, calibration and validation, and post-processing applications. It is the current operational forward model for satellite data assimilation in multiple federal agencies (NOAA, NASA, DoD) and within many other service organizations, both domestically and internationally.

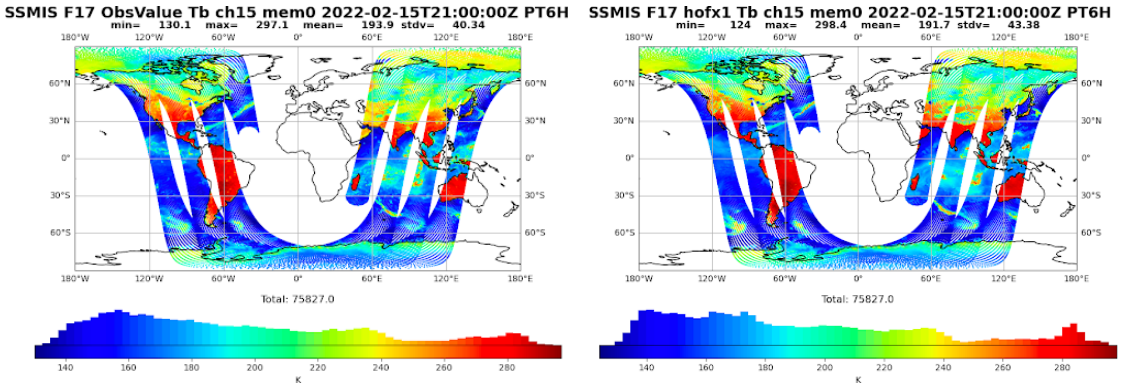
The JCSDA CRTM project has three primary objectives:

(1) Accurately simulate satellite-based radiances (i.e., a satellite simulator).
(2) Compute the radiance sensitivity to a change in the atmospheric/surface state (i.e., a radiance interpreter). This response is called the Jacobian output.
(3) Accelerate the time required to enable the simulation of a given satellite instrument, and increase the capability of adding new instrument types through our coefficient generation package.

Developed over a period of 18+ years, the CRTM is a true community model; dozens of researchers have made unique contributions to the CRTM code, several of whom began contributions within the past 5 years. We continue to encourage and expand that aspect of CRTM development through open-access modern software development methodologies.

One of the standout features of CRTM is its adaptability to a wide array of sensors. Whether dealing with passive or active sensing technologies, CRTM can effectively simulate radiances across different spectral, angular, and polarization states. This versatility is particularly beneficial in today's rapidly evolving remote sensing landscape. Moreover, CRTM isn't restricted to simulating clear sky conditions; it can also tackle complex atmospheric scenarios, including cloudy and rainy conditions. An additional utility of CRTM is its ability to provide Jacobians, essential mathematical elements for assimilating satellite data into numerical weather prediction models.

Operational application is where CRTM really shines; the model is already embedded in the workflows of NOAA, NASA, and the US Navy. CRTM is a core component that enhances the assimilation of satellite data into real-time numerical weather prediction models, leading to more accurate and timely forecasts. Beyond that, CRTM is instrumental during the developmental stages of new remote sensing technologies. By simulating expected radiances, it provides invaluable data that guides the design and implementation of new sensors. Once these sensors are in orbit, CRTM serves as a calibration and validation tool, ensuring that the sensors meet performance metrics. Additionally, CRTM is employed for ongoing monitoring tasks to maintain sensor health and data quality, and enables the retrieval of atmospheric and surface state parameters when used within a remote sensing framework.



Observed (left) versus CRTM simulated (right) brightness temperatures for SSMIS Channel 15. See https://skylab.jcsda.org/ for more visualized data across multiple sensors and time frames.

The recent release of Version 3.0 has brought several enhancements to CRTM including expanded support for the latest generation of satellite sensors, which is crucial as new platforms are launched. The update also features refined cloud and aerosol parameterizations, leading to more accurate radiative transfer calculations. Importantly, computational efficiency has been improved, making the model better suited for high-performance computing environments and the demands of operational modeling suites.

The CRTM remains an indispensable tool in both the research and operational spheres of meteorology and remote sensing. Its utility stretches across different platforms and applications, making it a universally valuable asset. For those interested in learning more or contributing to its development, the JCSDA provides extensive documentation and community support.

JEDI and Skylab Prepare for Groundbreaking TEMPO Data

Jérôme Barré (JCSDA)

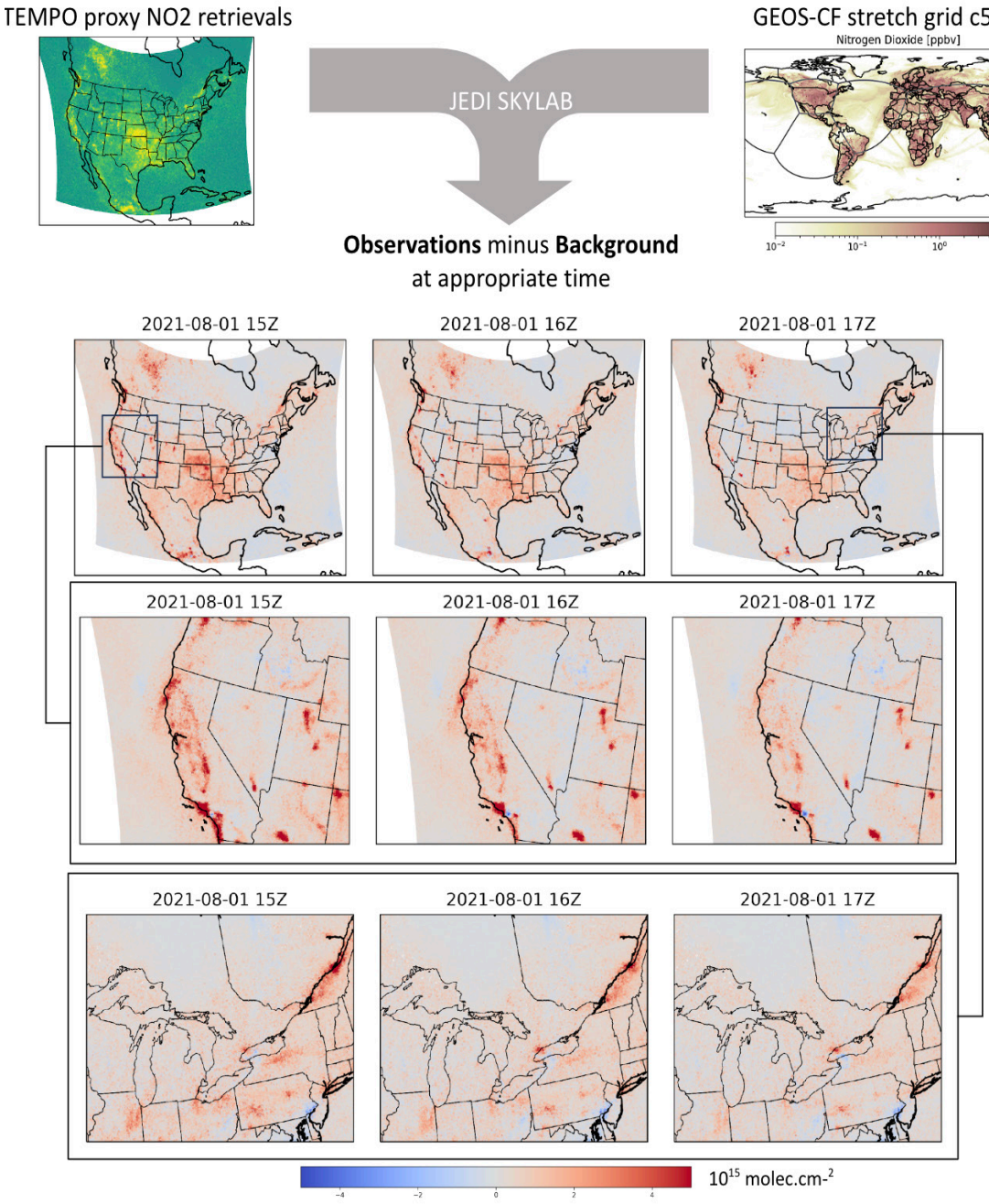
TEMPO (Tropospheric Emissions: Monitoring of Pollution), an unprecedented satellite mission to measure key air pollutants every hour at a 4km resolution, was launched on April 7, 2023. This mission and the data it generates will play a key role for air quality improvement and emissions reductions over the entire United States. However, that data won't be very useful until it can be integrated within prediction systems, though–and that's where the JEDI COMPO (composition) team comes in.

Working closely with NASA GMAO, the team implemented a new type of geometry in Skylab, the stretch cubed sphere grid. This enables a background analysis at a resolution that nearly matches that of TEMPO over the continental US; keeping the resolution lower over the rest of the globe keeps the model forecast and analysis much more cost effective for the first rounds of TEMPO data assimilation. To test how Skylab will work with TEMPO, the team configured it with a 3DFGAT and 6-hourly window, which allows the revisit time to also be set to hourly during daytime. Using a synthetic TEMPO dataset (that used information from high resolution GEOS-CF model outputs from 2013), the team demonstrated that the TEMPO data can be assimilated along other air chemistry and quality instruments including TROPOMI using the UFO Column Retrieval Operator. Cloud cover was ignored in the proxy data in order to demonstrate that JEDI Skylab can integrate the maximum possible amount of data without any problems.

The next step to utilizing TEMPO data to its full potential is 4DVar, which adds time as a dimension in the data assimilation, increasing the accuracy of the analysis as a result. JCSDA is making excellent progress towards deploying 4DVar in Skylab and using ensemble information to hybridize the data assimilation flavors (such as 4DEnVar or HybridTLM4EnVar approaches). These advances by JCSDA are paving the road for an accurate system of air quality and greenhouse gas emissions monitoring using TEMPO data and other present and future satellite missions.

The work now being done by the JCSDA COMPO team and their partners will ensure the JEDI system is ready to make the most of TEMPO's data as soon as it is available. The TEMPO instrument will be calibrated and the initial data screened for quality by the NASA retrieval team before it's released for use, which is planned for April 2024!

Figures on next page


TEMPO proxy NO2 retrievals
GEOS-CF stretch grid c540r25
Nitrogen Dioxide [ppbv]
JEDI SKYLAB
Observations minus Background
at appropriate time
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EDITOR'S NOTE

Welcome back to the JCSDA Quarterly Newsletter - or more accurately, welcome to the new JCSDA Quarterly Newsletter. The Newsletter had become something of a victim of its own success, containing articles that were much longer and more scientifically detailed than originally envisioned, requiring more effort to write and edit, and consequently being less timely and newsy. The reconstituted format is intended to address this and provide faster, more agile communication.

In this issue you'll find two short feature articles. One describes NASA's recently launched TEMPO (Tropospheric Emissions: Monitoring of Pollution) satellite, and collaborative efforts by JCSDA to ensure that observations from this mission can be assimilated using JEDI framework when they are released. This work is at the heart of the JCSDA mission: To accelerate the use of new and newly available satellite data in environmental analyses and forecast systems. The second article describes one of the JCSDA's flagship projects, the Community Radiative Transfer Model (CRTM), and its critical role as a forward modeling resource for the assimilation of numerous satellite sensors, as well as delineating the new features and capabilities of the current Version 3.0.

An important aspect that has been retained from the old format is the Welcome to New JCSDA colleagues. Quite a few staff have joined us since the last issue. Brief biographical sketches for them are provided, so that you can learn who these folks are, what they are working on, and a little bit about their personal interests.

Jim Yoe
Editor

PEOPLE

Dom Heinzeller

Dom Heinzeller is a computational scientist and the JEDI infrastructure lead at the Joint Center for Satellite Data Assimilation. His career spans from theoretical astrophysics to numerical weather prediction, work that he pursued in Japan, New Zealand, Germany and the United States.

Born and raised in the beautiful Bavarian Alps in southern Germany, Dom graduated from the Ruprecht Karls University of Heidelberg with a M.Sc. in physics in 2005 and a PhD in astronomy in 2008. He pursued his first postdoc in Kyoto, Japan, working on radiative properties of black hole accretion disks and on the physical and chemical evolution of protoplanetary disks. He then accepted a position as research scientist at the Meteorological Service of New Zealand Ltd in Wellington, New Zealand. The next move brought him back to his home town Garmisch-Partenkirchen, where he worked at the Institute of Meteorology and Climate Research Atmospheric Environmental Research of the Karlsruhe Institute of Technology. His job duties covered regional climate modeling, extreme scaling experiments with global NWP models, HPC system administration, and the installation and maintenance of automatic weather stations and Eddy covariance flux towers in Sub-Saharan West Africa. In 2017, he moved to higher grounds (5400-ish feet) and joined CU/CIRES and NOAA-GSL in Boulder, Colorado, as lead developer of the Common Community Physics Package (CCPP) and as code manager for the NOAA Unified Forecast System. In 2021, he joined JCSDA across town.

In his free time, Dom enjoys trail running, rock climbing, mountaineering, nordic skiing, backcountry skiing, and camping in the magnificent Colorado Rocky Mountains. He is also an aspiring DIYer working endlessly (too much according to his family) on his house, the family car fleet and the camping trailer.

Sydney Moore

Sydney, the JCSDA project manager/scrum master, is a Washington native and a Washington state university graduate who recently relocated to Denver. Sydney has 6 years of project management spanning over the industries of retail, sports marketing, executive events, tech and fintech. She has recently finished projects for the companies of Nike and PayPal.

When Sydney has free time she enjoys hiking, snowboarding, spending time with friends and exploring the city of Denver.

Jérôme Barré

Jérôme joined the JCSDA in October 2021. He leads the effort on atmospheric composition data assimilation (DA). Jérôme has experience in operations and research for atmospheric composition applications using variational, ensemble and hybrid systems. He had the opportunity to work on regional and global scale systems for air quality applications and global monitoring of pollutants.

He started his career at Météo-France where he focused on satellite 3D-Variational DA of ozone and carbon monoxide with a specific focus on pollution transport between the troposphere and the stratosphere. He then started to work at NCAR in 2013 focusing on observation simulation system experiments, ensemble DA methods and source inversion techniques. In 2017, he moved back to Europe to work at ECMWF where he maintained and developed the Copernicus Atmosphere Monitoring Service's greenhouse gases operational 4D-Variational DA system. He also contributed to the development of the source inversion capability in the IFS system. He also served as a technical officer for the CAMS regional operational forecast ensemble that includes 11 models and teams across Europe. He recently developed an interest in machine learning to make the best use of operational products, such as automatic detections and classification of emissions and accurate assessment of air quality changes during pandemic lockdowns.

He now leads the COMPO team at JCSDA which aims to push the frontier of atmospheric composition data assimilation capability for air quality, emission monitoring and numerical weather prediction.

Evan Parker

Evan Parker is a software engineer who joined the JEDI infrastructure team at the Joint Center for Satellite Data Assimilation in February 2023. He focuses on technical infrastructure, cloud infrastructure, developer tooling, and testing.

Prior to his role at JCSDA, Evan worked as a data infrastructure software engineer at Verily Life Sciences, where he worked on data pipelines, self-serve data analysis tooling, and cloud infrastructure. Before joining Verily, Evan worked as a technical solutions engineer in Google Fiber's construction operations team. Evan's educational background includes a B.S. in Chemistry from California State University Stanislaus and graduate coursework in Chemistry and Computational Methods at UC Davis.

Outside of work, Evan stays busy with his three children and DIY projects such as gardening, home remodeling, and raising backyard chickens.

Lindsey Mattson

Lindsey Mattson joined JCSDA in February 2022 as a Postdoctoral Scholar working with the observations team. She is working on a project testing different types of observation error estimation for data assimilation.

Originally from Oregon, Lindsey grew up in Colorado where she received a BS in Meteorology from Metropolitan State University of Denver. She then moved to Missouri, where she received her MS in Meteorology from Saint Louis University and later to Texas, receiving her PhD in Coastal and Marine Systems Science from Texas A&M University - Corpus Christi in 2022.

Lindsey enjoys indoor hobbies such as reading, table top games, and D&D as well as outdoor hobbies such as hiking, biking, and skiing. She currently lives south of Boulder, with her husband Jeremy.

Christian Sampson

Christian is an applied mathematician with a background in Climate and Earth science. He has studied and modeled physical processes in sea ice and traveled to both the Arctic and Antarctic for field work. More recently he had been involved in data assimilation as it applies to problems in weather and climate. He is excited to continue in this field at JCSDA!

Besides a love of mathematics and science Christian enjoys hiking, camping, kayaks, and coffee shops.

Patrick Nichols

Patrick joined the JCSDA in April of 2022 as a software engineer for the OBS team.

He received his PhD in physics from Texas Tech for a quantum chemistry approach to positron-molecule scattering. Since that time, he has worked in several fields including quantum chemistry, electronic structure theory, machine learning, and parallel global address spaces as well as MPI approaches for parallel computing.

Outside of work, Patrick's interests include hiking, reading and spending time with his young daughter.

Sam Maticka

Sam Maticka joined JCSDA in March 2023 as a Computational Scientist on the OBS (observations) team. She works on the integration of observational data into the data assimilation system, where she applies her background of ocean fluid mechanics and scrappiness with data and computer sciences.

Sam completed her PhD at Stanford in Environmental Fluid Mechanics (Civil Engineering), where she studied the governing physics and thermal dynamics in coral reef lagoons through field experiments and applied math. During the PhD she was a visiting researcher at University of Western Australia for vessel-based experiments.

Interested in the intersection of data science and earth sciences, she worked at Airbus' research division (Acubed) as a Data Scientist on weather reanalysis after her PhD. Then, searching for that euro-lifestyle, she tested the waters in France doing a postdoc configuring a hydrodynamic model (computational fluid dynamics) of a reef lagoon.

In her spare time she enjoys outdoor activities (primarily rock climbing and trail running), experimenting in the kitchen, and nature. Originally from Florida, she is a foreigner to snow and will try this thing called 'skiing' that everyone seems so jazzed about.

Kammie Carrillo

Kammie Carrillo joined UCAR in July 2023 as an Administrative Assistant III. She primarily works with JCSDA as the Designated Property Administrator and supports the program's travel, purchasing, event coordination, and overall logistics. As a member of the Business Shared Services within EODS, Kammie also assists COSMIC and UNIDATA with event coordination.

Kammie is a recent graduate from Regis University and received her undergraduate degree from Colorado State University. Go Rams! As a previous educator of eight years, Kammie has mastered multi-tasking, event planning, and working with diverse stakeholders.

After recently moving back to Colorado from Indiana, Kammie enjoys exploring Colorado hikes and local restaurants with her new fiance. She loves staying active by going hiking, swimming, and working out. Balance is key to all things in life, so when Kammie isn't out and about she loves reading on her Kindle and binge-watching her favorite TV shows.

Ashley Griffin

Ashley joined the JEDI infrastructure team at the Joint Center for Satellite Data Assimilation as a software engineer in February 2023. Her primary focus on the team is setting up and maintaining real-team systems and research and development systems in the cloud and on HPCs. She is excited to continue to utilize her background in atmospheric and computer science together!

In 2017, Ashley graduated from Purdue University with a BS in Atmospheric Science. She participated in undergraduate research spanning from Arctic sea ice to tornado climatology. After graduation, she continued on the research track but under the guidance of Professor Matthew Huber working with paleoclimate models and using NCAR's Community Earth System Model (CESM). She graduated with her Master's in Atmospheric Science in 2019. That year, Ashley attended a CESM tutorial in Boulder and was thrilled with the idea of eventually working in the beautiful foothills! Following graduation she worked as a software engineer at the National Center for Environmental Prediction's (NCEP) Central Operations (NCO) in Maryland. Her position on NCO Integrated Dissemination Program's Onboarding team allowed her to work on a variety of water and weather focused applications. With COVID forcing remote work, Ashley and her now husband moved across the country to Denver for the mountain adventures. This opened the door for her to pursue a career at UCAR.

Ashley enjoys learning and participating in many different action sports such as skiing, snowboarding, trail running, wakeboarding, sailing, kiteboarding, and surfing. She loves playing competitive volleyball, especially grass volleyball in the summer months. Unfortunately injuries have kept her out of commision for sports these recent years, but she enjoys a variety of artistic hobbies (weaving, photography, painting, drawing), going to breweries, reading, and fostering adorable dogs from a local rescue organization.

Kristin Smith

Kristin Smith joined JCSDA as a communications specialist in June 2023. She is a science and technical writer with a focus on earth science. She has worked as a magazine editor, freelance writer, and mountain guide, building strong communication skills for any situation. In her free time Kristin enjoys hiking, climbing, skiing, biking, sailing, and learning how to knit shapes other than rectangles.

Nate Crossette

Nate Crossette joined the JEDI algorithms team as a Computational Scientist in August of 2023. He works on incorporating background error covariances in the data assimilation process which is part of the SABER (System-Agnostic Background Error Representation) repository.

Nate completed his PhD in physics at the University of Colorado Boulder in 2022, where he worked on modeling errors in social networks. Having also worked on projects in computational plasma physics and high energy nuclear physics, Nate has experience applying computation to a wide range of scientific problems.

Outside of the office, Nate is often exploring the mountains and fly fishing. Having grown up in southeastern Pennsylvania, he also closely follows the Philadelphia Phillies.

Victor Marchais

Victor Marchais is a French engineer who graduated from Ponts et Chaussées and École Normale Supérieure in France, with a focus on AI and machine learning. Victor's journey with JCSDA began in 2019 when he interned with the organization. During this time, he worked on the development of Tangent Linear Models (TLM) and Adjoint models for physical systems using machine learning techniques. In April of the following year, he rejoined JCSDA, and he is currently working with NASA's Global Modeling and Assimilation Office (GMAO) to apply AI and machine learning in the creation of physical models for data assimilation purposes.

Shih-Wei Wei

Dr. Shih-Wei Wei is a Postdoctoral Fellow with the Joint Center for Satellite Data Assimilation (JCSDA/UCAR) and the Atmospheric Sciences Research Center (ASRC) at State University of New York (SUNY) at Albany. He currently is a member of the composition team for the Joint Effort for Data Assimilation Integration (JEDI). Shih-Wei received his PhD from SUNY Albany in May 2023. His thesis focused on enhancing the usage of thermal infrared satellite measurements affected by aerosols (i.e., under hazy-sky conditions). Before he joined the PhD program at SUNY Albany, Shih-Wei worked in the numerical weather prediction (NWP) group in the Central Weather Bureau in Taiwan. Shih-Wei's research interests include aerosol modeling, data assimilation, and the interactions between NWP and air quality. Besides doing research, Shih-Wei enjoys cooking and playing tennis when the weather permits. Hiking is also on his activity list, but it is limited given his busy life.

SCIENCE CALENDAR

TITLE	DATE	LOCATION	WEBSITE
KIAPS International Symposium on the Global NWP System Modeling	November 6-8. 2023	Seoul, Korea	https://www.kiaps-symposium.com/#2
International Cooperative for Aerosol Prediction (ICAP) 13th Working Group Meeting	November 8-10. 2023	Germany	
AI4NWP	November28-29. 2023	Boulder, CO	
AGU Fall Meeting	December 11-15. 2023	San Francisco, CA	https://www.agu.org/fall-meeting
AMS 104th Annual Meeting	January 28-February 1, 2024	Baltimore, MD	https://annual.ametsoc.org/index.cfm/2024/

CAREER OPPORTUNITIES

Opportunities in support of JCSDA may be found at www.jcsda.org/news as they become available.