United States Department of Agriculture
Agricultural Research Service

SCINet Newsletter: October 2023

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RESEARCH SPOTLIGHT

CameraTrapDetectoR: Detecting, Classifying and Counting Animals in Camera Trap Images

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The use of camera traps is a popular and cost-effective way to monitor animal populations, evaluate animal behavior, and study ecological processes influencing populations. However, a camera trap dataset for a single site or research question can result in millions of images that require classification to be useful for analysis. The USDA-ARS Range Sheep Production Efficiency Research Unit (Dubois, ID) has joined the USDA Animal and Plant Health Inspection Service's Center for Epidemiology and Animal Health (APHIS-CEAH) to continue developing CameraTrapDetectoR, an open-source tool that deploys deep learning object detection models to detect, classify, and count animals in camera trap images.

Figure 1. Prediction plots from CameraTrapDetectoR models (species, family, and class)

CameraTrapDetectoR is free, easy to use, allows a user to retain full control of their data and can be incorporated into analytical pipelines easily. The models can be used via the CameraTrapDetectoR R package, which includes an R Shiny application to deploy models with minimal coding; a desktop app that wraps an R installation and R Shiny application and requires no coding; or via a Python script that runs on the command line and is ideal for utilizing GPUs and running the models on SCINet. The R package also provides a suite of functions to assist with data organization and post-processing. CameraTrapDetectoR consists of six independently trained object detection models at three taxonomic levels: a general class model that detects mammals and birds, a family-level model that includes 31 taxonomic families, and a species-level model that includes 75 species. Each model also includes classes for humans, vehicles, and empty images. The current (second) generation of models was trained using a Faster R-CNN model architecture with a ResNet-50 feature pyramid network

backbone on the Atlas cluster's GPU nodes. The current verified training set contains 282,188 images contributed from over 30 participant groups across ARS, APHIS, and other government agencies and academic or private partners.

The continued development of the CameraTrapDetectoR is based on an iterative training cycle (Fig. 2), with different stages often progressing simultaneously. For example, our team is currently finalizing annotations on a new series of images (step 2) to incorporate into a third generation of models, testing updated object detection algorithms (step 3), and adding model results to image metadata to assist post-processing analyses (step 5). SCINet is a critical tool throughout the training process, and development of these models would not be possible without a high-performance computing cluster. In addition to training models and generating predictions on new data, we use SCINet to transfer images and collaborate with project contributors in the SCINet community.

Sophisticated image analysis algorithms and data processing techniques have limited impact on the challenges of accurate detection and classification without a robust, diverse database of training images. CameraTrapDetectoR's most powerful asset is the growing team of researchers who share camera trap datasets for the sole purpose of model evaluation and training and provide essential feedback on the tool's user interface and development direction. Our team would like to continue expanding within the SCINet community; please contact us via email or through our Github page for more information.

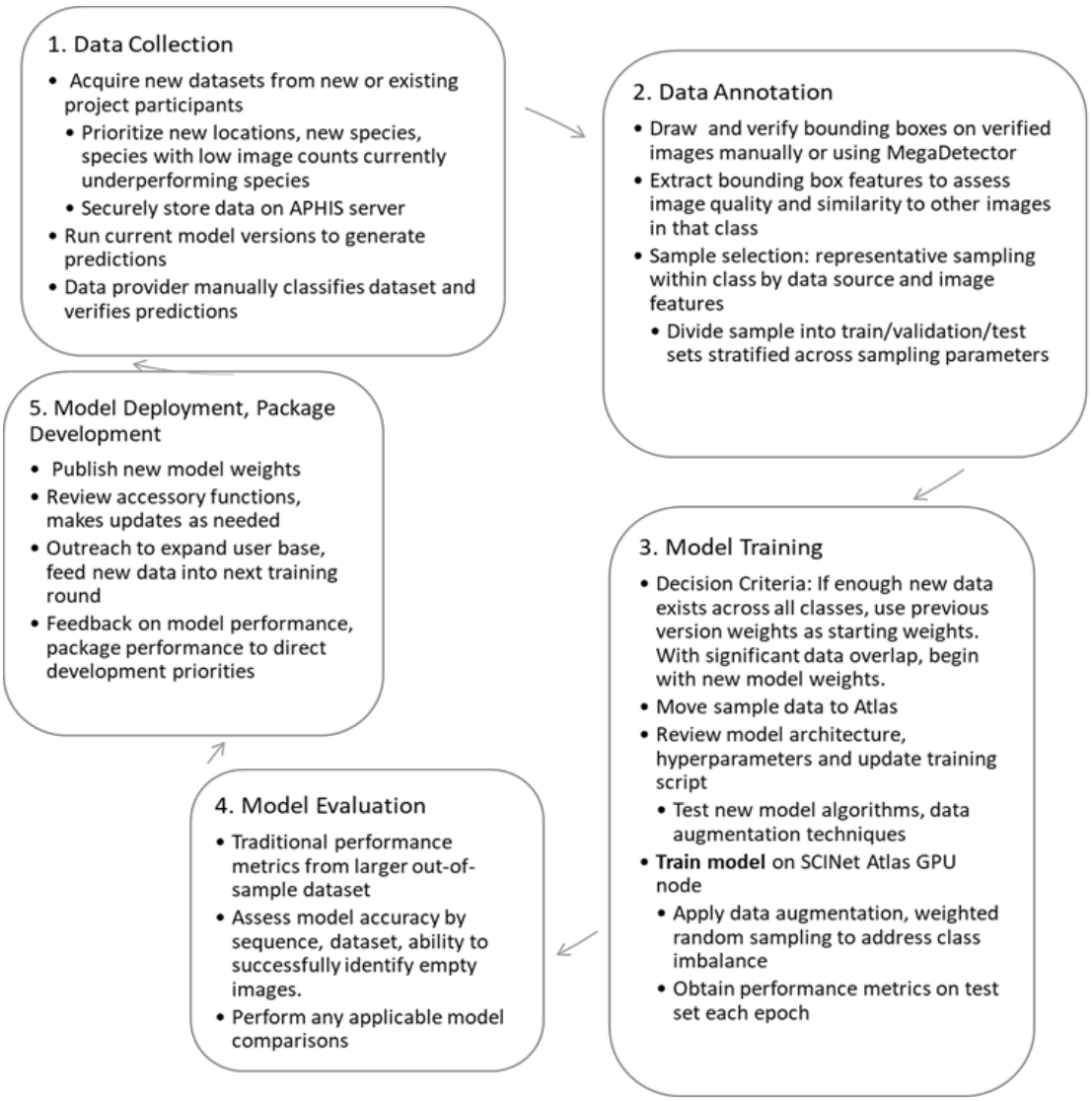


Figure 2 CameraTrapDetectoR Iterative Training Cycle

SCINet and AI-COE Fellows

Please welcome our newest SCINet and ARS Artificial Intelligence Center of Excellence (AI-COE) fellows!

Dr. Raphael Bidese is currently working on the VitisGen project under the mentorship of Dr. Lance Cadle-Davidson at the Grape Genetics Research Unit and Dr. Yu Jiang at Cornell AgriTech in Geneva, NY. He obtained a B.S. and M.Sc. in Electronics Engineering from the Federal University of Santa Catarina (Brazil) before moving to Auburn, AL to pursue a M.Sc. in Data Science and a Ph.D. in Biosystems Engineering. For his doctoral dissertation at Auburn University, he worked on applied computer vision for precision agriculture, developing a mmWave-based radar sensor for peanut yield estimation and a computer vision-based tractor implement for inventory estimation in forestry.

He joined VitisGen to further expand his knowledge in plant pathology, self-supervised methods in computer vision and AI tools for scientific discovery. His research focus is the use of computer vision for high throughput plant phenotyping from microscopy images and he is interested in capturing spatiotemporal features from image sequences to provide high quality traits for grape breeders.

Dr. Nicholas Greatens recently joined the lab of Dr. Rachel Koch-Bach at the Foreign Disease-Weed Science Research Unit, where he will work on the genomics of high-consequence fungal pathogens. His main research project will examine genomic data of historic and contemporary isolates of the devastating coffee leaf rust pathogen, Hemeleia vastatrix, to discover how changes in the pathogen may have contributed to the loss of host resistance.

Dr. Greatens completed his Ph.D. in plant pathology at the University of Minnesota in 2023. His dissertation focused on the distribution, description, and phylogenetics of several newly observed rust fungi in Minnesota and North America, including some close relatives of important cereal rust fungi. He was co-advised by Dr. Pablo Olivera Firpo of the University of Minnesota and Dr. Yue Jin of the USDA ARS Cereal Disease Laboratory.

Dr. Carl Hutter earned a B.A. in Wildlife Ecology from the University of Wisconsin¬-Madison in 2010 and earned a M.A. from Stony Brook University in Applied Ecology in 2012. He then began his Ph.D. at the University of Kansas in Ecology and Evolutionary Biology as an NSF Graduate Research Fellow. Dr. Hutter's dissertation research focused on the evolutionary drivers of frog mating calls in noisy habitats in addition to creating a standard set of genomic resources to use across all frogs. Additionally, Dr. Hutter was awarded an NSF Postdoctoral Research Fellowship in Biology in 2020 to study the phylogenomic relationships among all frogs globally. Dr. Hutter is interested in analyzing large phylogenomic datasets and generating resources for other researchers to use in their own study systems.

As an ORISE postdoc, Dr. Hutter is working with ARS scientist Dr. Tavis Anderson to study within-host evolution and transmission of swine influenza A virus. Dr. Hutter is excited to work with massive genomic datasets to understand how viruses evolve after transmission into new hosts.

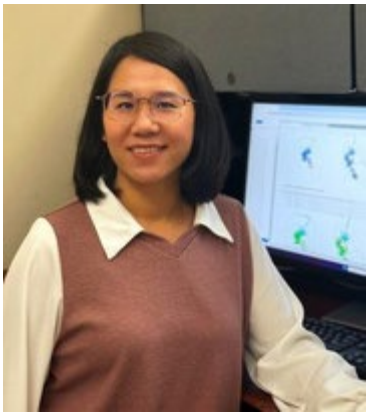
Dr. Aaron Koop received his Ph.D. from the University of Kansas in 2022 with a research focus on pedology and soil hydrology. His Ph.D. research focused on quantifying soil development and soil-vegetation-water balance relationships to understand the impact of climatic and land use changes on ecosystem services (e.g., water storage, food security). This included developing generalizable indices of soil development and examining the role of soils and vegetation in controlling macroporosity, ecohydrology, and the land-atmosphere water cycle at continental and regional scales.

Currently, he is working under the mentorship of Dr. Octavia Crompton (Hydrology and Remote Sensing Laboratory, Beltsville, MD). He is focusing on machine and deep learning approaches used to infer hydrological processes occurring at point/site scales and bridging of this process-based understanding to modeling at larger scales. Analyzing this relationship and potentially considering other research offshoots using a variety of data will hopefully provide insights on catchment and ecosystem function and changes occurring across the conterminous US.

Aaron is very grateful for the opportunity to collaborate with Dr. Crompton as well as the ARS and SCINet communities.

As a SCINet fellow under the mentorship of Dr. Patrick Clark, **Dr. John Park** is working on the project: “AI modeling of Grazing Land Animal Behavior". Dr. Park is developing novel deep learning methods to enhance the accuracy of grazing land animal GPS tracking data by mitigating positioning errors. Higher accuracy will allow for improved understanding of animal interactions with environmental changes and management policies. Dr. Park is interested in developing optimal encoder-decoder networks for modeling GPS data, which will help detect outliers and reconstruct accurate animal movement trajectories. He is also interested in multimodal learning incorporating both GPS and high-resolution satellite data for more precise positioning error correction.

Dr. Park obtained a B.S. in Mathematics from Yonsei University in Seoul, South Korea and a B.S. in Neuroscience and Physiology from Purdue University in Indiana. Dr. Park earned a Ph.D. in Botany at the University of Florida. Under the supervision of Prof. Jeremy Lichstein, his dissertation research focused on assessing the yearly phenological pattern of a 50-ha tropical forest dynamics plot and relating that pattern to species-level plant functional traits. Subsequently, he joined New York Botanical Garden as a bioinformatics postdoctoral associate under the supervision of Dr. Damon Little, for an NSF-funded project developing automatic classification tools for herbarium specimen images using computer vision and artificial intelligence.



Dr. Li Wang earned her Ph.D. in Plant Pathology from the University of Georgia. Her dissertation focused on the fungicide resistance of Phytophthora capsici. She assembled a haplotype-resolved chromosome-level reference genome and pioneered the first pangenome for P. capsici. She further delved into fungicide resistance mechanisms, employing genome-side association studies (GWAS) for her work. Before her Ph.D., Dr. Wang completed her M.S. in Olericulture at Huazhong Agricultural University in China. Here, her research revolved around the genetic variability and pathogenic diversity of Ralstonia solanacearum. Her academic journey commenced with a B.S. from Shandong Agricultural University, China, where she specialized in Seed Science and Engineering.

Today, Dr. Wang works with Dr. Jeremy Edwards and Dr. Yulin Jia at the USDA-ARS Dale Bumpers National Rice Research Center, located in Stuttgart, AR. Her project centers on identifying novel rice blast disease-resistance genes via advanced AI protein structure prediction techniques. Furthermore, she leverages the capabilities of deep convolutional neural networks (CNNs) for precise image analysis, aiming to quantify the symptoms of rice blast disease accurately.

NEWS

Apply Now to Serve as an AI-COE/SCINet Graduate Student Internship Mentor in 2024!

We are excited to announce that we are accepting applications to serve as an AI-COE/SCINet graduate student internship mentor in 2024!

These remote internships allow graduate students with strong data science and computational skills to spend either a summer or a semester working full time with an ARS mentor (or mentors) on an ARS research project. Each 10-week internship includes a competitive stipend and travel funding for the participant to spend time onsite with their ARS mentor(s). We are working with six partner universities to recruit student participants. We want each of our interns to have an outstanding experience, which means we need outstanding ARS mentors and research projects!

If you are interested in participating, please visit our mentor application form for more information about how to prepare and submit your application. Applications are due by COB Friday, November 24, 2023.

FY24 SCINet/AI-COE Postdoctoral Fellowships Call for Proposals

SCINet and the AI-COE are again offering postdoctoral fellowship funding to ARS scientists who wish to mentor SCINet/AI-COE fellows working in their labs.

These fellowships provide an exciting opportunity for participants to address agricultural problems by developing and applying new and emerging scientific computing technologies, including big data analytics, artificial intelligence, and machine learning. Fellows will be able to conduct research in collaboration with ARS scientists, use SCINet's high-performance computing clusters and other computational resources, and access the numerous training opportunities available through SCINet and the AI-COE.

For information and to submit a proposal, please visit the SCINet/AI-COE fellowships page on the SCINet website. Please note that FY23 awardees are not eligible for an FY24 award. The deadline for applications is COB on Friday, December 15, 2023.

FY24 AI Innovation Fund Awards Call for Proposals

The ARS AI-COE is again sponsoring AI Innovation Fund awards to support research projects that apply AI and machine learning (ML) methods to agricultural research or that develop new software tools or data products that use AI or ML techniques.

We expect to fund 4 to 6 projects of up to $100,000 each. Funds will need to be spent this fiscal year, so projects should have a short budget timeline or involve partnerships that can be funded through collaborative agreements.

Please visit the AI Innovation Fund page for more information and for application instructions.

Please note that FY23 awardees are not eligible for an FY24 award. The deadline for applications is COB on Friday, December 15, 2023.

New GPU Nodes on Atlas Now Available

We are pleased to announce that five new computing nodes are now available on Atlas, each of which has 8 NVIDIA A100 GPUs (graphics processing units).

GPUs are essential for modern AI and deep learning workflows, but they can also significantly accelerate a wide range of data science and scientific computing tasks. One node is available to provision full A100 GPUs, while the other four nodes have each A100 partitioned into 7 virtual GPUs, providing a total of 224 virtual GPUs. Overall, this new hardware represents a more than 22-fold increase in SCINet's GPU computing capacity.

These new nodes may be accessed in the "gpu-a100" Slurm partition/queue. More information is available as part of Atlas's user documentation.

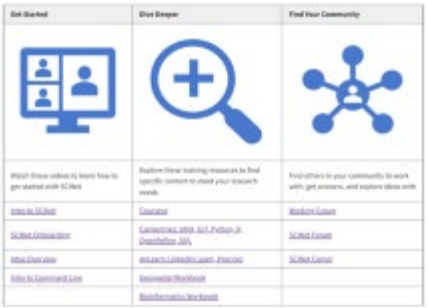
SCINet-X Expansion Project Status

The SCINet-X initiative, launched in early 2021, aims to provide all ARS locations with high-speed connections to SCINet as fast as possible while balancing economic, technological, and local constraints. So far, SCINet-X has been deployed to 45 sites. For updates on SCINet-X progress, you can visit the SCINet-X page on our website.

Thank you to the ARS locations who are working with us to help make SCINet-X a success!

TRAINING

Training Opportunities



Getting Started: With the expansive list of free training available online, finding the right training to meet your learning needs can be daunting. Take the first steps in getting started with the SCINet Introductory Learning Pathway. Learn about SCINet, how to sign up for an account, and what is possible when supported by SCINet infrastructure. Then dive in with hands-on tutorials available across multiple searchable platforms to find the information you need for just in time learning

Unoccupied Aerial System (UAS) workshop: The focus of this workshop is to process Unoccupied Aerial System (UAS) image data using the open-source software Open Drone Map (ODM) on Atlas. The sessions will go through the entire process of image processing, from collecting UAS imagery and corresponding Ground Control Points (GCPs), to creating the GCP file needed for processing, to moving UAS images to Atlas and submitting a SLURM script using ODM in a container. There will also be discussion about improvements to the workflow and creating a working group.

There will be four sessions from November 7-9. To register, please fill out this form.

Practicum AI: Developed and presented by the University of Florida and customized for USDA-ARS with funding from ARS's AI-COE, *Practicum AI* is a hands-on applied artificial intelligence curriculum intended for learners with limited coding and math background. Using hands-on exercises and graphically based, conceptual content, the program starts from introductory content and builds your AI knowledge, enabling you to design and conduct AI work. This fall, the University of Florida Research Computing team is offering a series of courses to help ARS researchers begin using AI. Although the first set of four courses is already at capacity, a more advanced course on computer vision will be added for January.

For more information about the courses, please see the Practicum AI event page.

There is no cost for ARS researchers to participate. To join the waitlist for future offerings of these courses, please fill out the registration form. There is no cost for ARS researchers to participate.

Coursera.org Courses: The SCINet Office and the AI-COE are excited to provide training opportunities through Coursera. Coursera licenses are available to ARS scientists and support staff for training focused on scientific computing, data science, artificial intelligence, and related topics. Successful completion of courses and specializations result in widely recognized certificates and credentials. Please visit the SCINet Coursera Training Page to request a license. Licenses will be assigned on a rolling basis and are active for three months. Users may be able to extend their licenses upon request.

Training opportunities are continually being updated on the SCINet Upcoming Events webpage. For more information on any of the above trainings, registration questions or suggestions, please email SCINet-training@usda.gov.

Workshop Reports

Geospatial Research Working Group Annual Workshop:

The SCINet Geospatial Research Working Group held its 2023 Annual Workshop on September 25-28. This year's theme was Machine Learning and Deep Learning in Geospatial Research.

Sessions included twelve lightning talks from SCINet Fellows, ARS researchers, and collaborators, plus hands-on tutorials for spatial modeling with machine learning, geospatial deep learning with Raster Vision, and GPU-based computing.

To join the working group and be kept informed about upcoming geospatial trainings, please contact co-leads Heather Savoy and Amy Hudson.

Data Carpentry Genomics Workshop:

On October 23-25, ARS and SCINet, in collaboration with The Carpentries, taught the Data Carpentry Genomics workshop curriculum to ARS staff, postdocs, and collaborators.

The workshop filled to capacity, with 35 registered participants. Workshop participants learned a wide variety of skills, from data management to variant calling. Given the strong response to this training opportunity, we will likely offer this workshop again in the near future.

SUPPORT

Getting Started with SCINet is as Easy as 1,2,3

If you do not already have a SCINet account, we hope you will consider joining the 2,300+ researchers who do. Follow the steps below to get your SCINet account

1. Request a SCINet account to get started.

2. Read the SCINet FAQs covering general info, accounts/login, software, storage, data transfer, support/policy/O&M, parallel computing, and technical issues.

3. Register for a SCINet Forum account to connect to other users, ask questions, and learn how SCINet can enable your research.

P.S. Don't forget to complete your annual security training! This is required to maintain your account.

For technical assistance with your SCINet account, please email scinet_vrsc@usda.gov.

Support email addresses

All requests for help with user accounts, login problems, resource requests, or support for the Ceres HPC cluster should be sent to the SCINet Virtual Research Support Core (VRSC) at scinet_vrsc@usda.gov . Help requests specific to the Atlas HPC cluster should be sent to help-usda@hpc.msstate.edu.

Many emails are currently being sent to other SCINet email boxes. For the most expedient response to your support requests, be sure to send them to scinet_vrsc@usda.gov or to help-usda@hpc.msstate.edu for Atlas-specific requests.

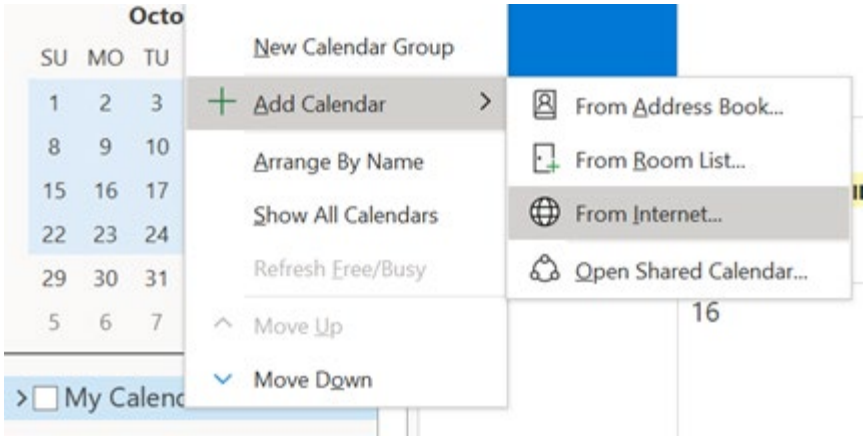
SCINet User Tip

The SCINet website now has a way to add upcoming planned downtime to your Outlook calendar.

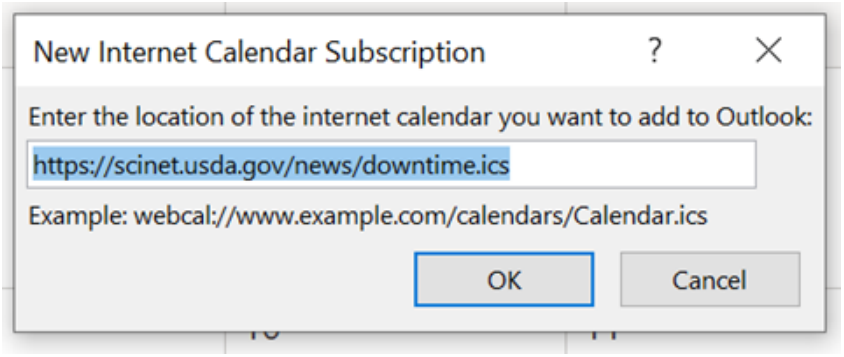
If you want to manually add the downtime currently on the website, visit our **Downtime Calendar** and click the blue “Add to your calendar” button below the table. It will download an iCalendar file that can be opened with Outlook to add the event to your calendar. If there is no upcoming planned downtime in the calendar, this download option will not be visible.

If you would prefer, you can have your calendar automatically update when the Downtime Calendar updates.

To do this in Windows, open your Outlook Calendar, right click on one of your calendar groups such as “My Calendars,” then select “Add Calendar” and “From Internet.”



You will get a New Internet Calendar Subscription popup. Paste https://scinet.usda.gov/news/downtime.ics into the provided space and click OK.

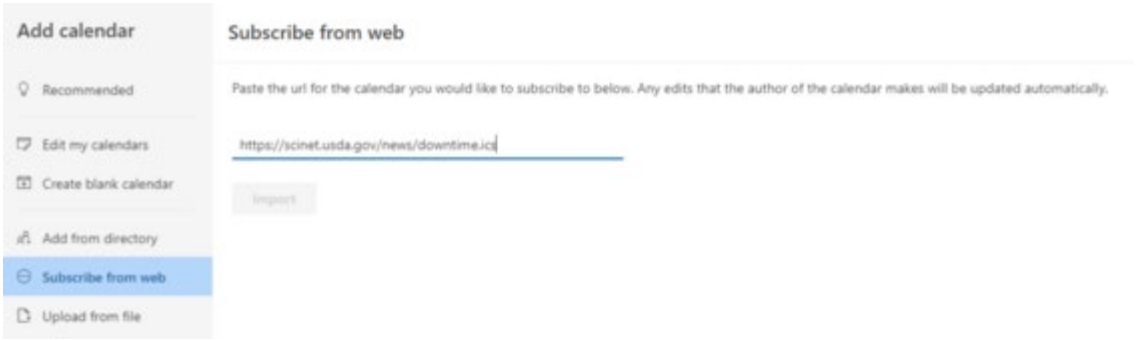


You will get a popup asking to “Add this Internet Calendar to Outlook and subscribe to updates.” Click “Yes.”

This will add the “SCINet Downtime” calendar to the folder you right clicked and it will refresh every 12 hours.

Adding the calendar to Outlook on the web is a similar process.

Open your calendar, click the "Add Calendar" button, then click the "Subscribe From Web" tab. Enter the https://scinet.usda.gov/news/downtime.ics address into the provided space. Once you are finished, click Import.



Only upcoming planned SCINet downtime will be displayed. For communications about emergency outages, see the SCINet Forum Announcements page. Information about past outages can be found in the Downtime Archive.

Do you have tips to share? Email them to SCINet-Office@usda.gov to be included in future newsletters.

SCINet Corner: First Thursdays Each Month

SCINet Corner is a VRSC-moderated virtual space for people to share knowledge, discuss best practices, learn about new opportunities, and explore resources to support progress on their projects.

The next SCINet Corner will be held Thursday, Nov 16 at 1 pm EST.

Fill out the SCINet Corner registration form to register for all upcoming SCINet Corner monthly meetings. You can find recordings of past SCINet Coners on the SCINet Corner event page.

Have a question that just can't wait? Want to see what other users are doing? Reach out to the ever-expanding SCINet Forum community for ideas, support, or just someone to bounce ideas off of at https://forum.scinet.usda.gov/.

CONNECT

The SCINet Team

Every newsletter highlights SCINet community members as a way to connect the ARS scientific computing community. To see all the SCINet community and review past newsletters, visit the Newsletter Archive.

Contribute

Do you use SCINet for your research? We would love to share your story! Email SCINet-Office@usda.gov to contribute content, ask questions, or provide feedback on the SCINet newsletter or website.

SCINet Leadership Team

Brian Stucky, Acting Chief Science Information Officer
Rob Butler, SCINet Program Manager
Jeremy Edwards, Science Advisory Committee (SAC) Chair
Steve Kappes, Associate Administrator

Note: This newsletter is edited to comply with ARS editorial standards.

SCINet Website

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