



United States Department of Agriculture  
Agricultural Research Service

## SCINet Newsletter: October 2022

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### RESEARCH SPOTLIGHT

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## Use of UAS Imagery to Detect Prairie Dog Burrows, Map Burrow Density, and Estimate Colony Acreage



*Figure 1. A black-tailed prairie dog at the entrance to one of its burrows at the Central Plains Experimental Range in Colorado.*

*By Dr. Sean Patrick Kearney; Spatial Ecologist; USDA-ARS Rangeland Resources and Systems Research Unit, Fort Collins, Colorado; Thunder Basin Prairie Ecosystem Association, Douglas, Wyoming*

Dr. Kearney is using unmanned aerial system (UAS) imagery to detect individual prairie dog burrows, map burrow density and, ultimately, estimate colony acreage within managed rangelands. Prairie dog colony mapping is critical to a number of rangeland management decisions on public lands; however, regular ground mapping of colonies is untenable in most areas due to high costs, extensive and rough terrain, and the dynamic boom-bust nature of prairie dog populations.

This project is utilizing SCINet resources to analyze the multi-terabyte datasets associated with UAS imagery and train a deep neural network for burrow detection. The ongoing project is a collaboration between USDA-ARS, USFS's Geospatial Technology and Application Center (GTAC) and the Thunder Basin Prairie Grasslands Ecosystem Association (TBGPEA) and was funded, in part, through a 2021 ARS AI Center of Excellence Innovation Fund award. The study was conducted at the USDA-ARS Central Plains Experimental Range, an LTAR site with extensive ground data for training and validation. GTAC conducted the UAS flights and initial image processing.

To digitize training and validation data from the imagery, Dr. Kearney set up an interactive Python app utilizing JupyterHub on Ceres, one of SCINet's two high-performance computing (HPC) clusters. He and other team members used this app to label burrows visible in RGB, NDVI and fine-scale topographic position layers developed in a separate Python workflow also run on Ceres. The next step was to train a deep neural network image segmentation model that could classify individual burrows using the RGB, NDVI and topographic position layers as inputs, and then validate the model against an independent test dataset. Since the goal of this project was to inform future operational mapping efforts, it was important to understand which input layers were required, and whether coarser resolution imagery would be adequate. Therefore, the training and validation procedure was repeated for different combinations of inputs and at progressively coarser spatial resolutions, resulting in dozens of iterations. The large, distributed computing and GPU resources of Ceres were essential for conducting this iterative analysis efficiently.

Initial results are very encouraging. Precision and recall of individual burrows were about 85% using imagery at its original spatial resolution, and imagery could be coarsened to up to 15 cm before results were no longer acceptable. Total acreage estimations were within about 10% of ground measurements (which themselves contain known errors) using all image resolutions between 2 – 15 cm. The final workflow to predict colony extents from the original imagery can be run in just a few hours on the Ceres cluster.

This workflow may prove to be a game-changer in rangeland monitoring, not only for prairie dogs but for vegetation (e.g., shrub detection, species or community mapping), hydrology (e.g., seasonal water sources or playas) and other applications. The ability to develop in Python using Jupyter notebooks on SCINet will facilitate transfer of the workflow to an operational monitoring system in the future.



*Figure 2. Cattle observing the UAS system used to acquire imagery for the study. The vertical take-off and landing capability and fixed-wing design allowed efficient image acquisition over large areas, resulting in a very large dataset requiring SCINet resources for processing.*

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## SCINet and AI COE Fellows

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Welcome **Dr. Rebecca Clement**, SCINet Postdoctoral Fellow. Dr. Clement recently completed her PhD (2022) in Biological Sciences at the Computational Biology Institute at George Washington University (GWU) in Washington, DC. Her dissertation focused on evolutionary patterns and community ecology of Australian termites and their microbial symbionts. Rebecca received an undergraduate degree from Brigham Young University (BYU) and was an NSF Graduate Research Fellow at GWU. In addition to her termite work Rebecca has published peer-reviewed manuscripts on the ecology and evolution of several other insect groups, SARS-CoV-2, and bovine microbiomes. She has extensive molecular biology and computational experience and finds opportunities for outreach and science communication as well.

As a USDA-ARS SCINet and AI Center of Excellence Postdoctoral Fellow, Dr. Clement will work with Dr. Chris Owen and Dr. Gary Miller on projects that aim to determine the pervasiveness and the drivers of hybridization and introgression in agriculture using crop aphids as the focal system. In addition to her postdoctoral research, she will be initiating and leading a USDA-ARS working group focused on biological invasions.





Welcome **Dr. Kayla Pennerman**, SCINet Postdoctoral Fellow. Dr. Pennerman is a molecular biologist and bioinformatician who focuses on the genomics and transcriptomics of fungal plant pathogens. She earned her doctorate from Rutgers University in 2019. Dr. Pennerman has since held postdoctoral positions at the USDA in Athens, GA and at the University of Maryland and FDA's Joint Institute for Food Safety and Applied Nutrition. Dr. Pennerman's current research involves using SCINet's capabilities to analyze hundreds of whole genome sequences of *Macrophomina phaseolina*, a plant pathogen fungus, collected by the lab of Dr. Peter Henry in Salinas, CA and by global collaborators.

This effort intends to characterize the genetic diversity, evolutionary path, and genotype-to-pathogenicity associations of this cosmopolitan fungus that is often noted to have a wide host range and significant negative impacts on common high-value food crops such as strawberry.



Welcome **Dr. Tatum Katz**, SCINet Postdoctoral fellow. Dr. Katz received her B.A. in Biology from Occidental College in 2017 where she first became interested in disease and data science. She received her M.A. in Applied Statistics in 2021, and her PhD in Ecology, Evolution, and Marine Biology in 2022, both from the University of California Santa Barbara. Her PhD focused on investigating reservoirs and vectors of the amphibian-killing chytrid fungus *Batrachochytrium dendrobatidis* using field work, laboratory experiments, and quantitative methods.

As a SCINet fellow, Dr. Katz combines her training in disease ecology with her passion for data science and machine learning to support a team of 18 ARS scientists and 22 stakeholder organizations to identify solutions to reduce salmonellosis from meat and poultry products. She is especially excited by transdisciplinary research, model selection and validation, and getting the colors just right for her ggplots.

<https://TatumSKatz.weebly.com>



Welcome **Dr. Sharu Paul Sharma**, SCINet Postdoctoral Fellow. Dr. Sharma completed his undergraduate degree in Biotechnology from Punjab Agricultural University, Ludhiana, India. He then moved to the US to earn his Ph.D. in Genetics and Genomics from Iowa State University, Ames, IA. His dissertation involved the study of complex structural rearrangements and other impacts of the Ac/Ds transposon system in maize. He recently joined the Genome Informatics Facility at ISU as a Visiting Scientist under the ORISE Program. He is broadly working on the development of genomic resources for agricultural organisms, and toward the management of pests that hinder the full potential of crops,

livestock, and aquaculture. Under the mentorship of Dr. Andrew Severin, Sharu is learning a diverse array of bioinformatic analyses to solve big data problems and contribute to developing workshops and tutorials for USDA scientists.

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## NEWS

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### FY23 SCINet/AI-COE Postdoctoral Fellowships Call for Proposals

SCINet and the ARS AI-Center of Excellence (AI-COE) are again offering 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 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. Leadership opportunities will also be provided. The call for proposals is now open. Please visit the proposal [application page](#) for detailed instructions. We expect to fund up to 18 proposals. FY22 awardees will not be eligible for an FY23 award. The deadline for applications is **close of business on Friday, December 23, 2022**.

### FY23 AI Innovation Fund Awards

The ARS Artificial Intelligence Center of Excellence (AI-COE) is again sponsoring AI Innovation Fund awards to support research projects that apply artificial intelligence (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. FY22 awardees will not be eligible for an FY23 award. The deadline for applications is **close of business on Friday, December 23, 2022**.

### Geospatial Annual Workshop

The Geospatial Research Working Group held their annual workshop from August 29 to September 2. Highlights included lightning talks by ARS scientists presenting how they utilize SCINet in their geospatial research, an introduction to the Geospatial Common Data Library, and sessions on how to use R and Python for geospatial research on SCINet. Recordings of the presentations and tutorials are posted on the workshop [website](#). Tutorial instructions modified for general use by any SCINet user are available in the [Geospatial Workbook](#). Please contact the Geospatial Working Group leaders for more information

(Heather Savoy, [heather.savoy@usda.gov](mailto:heather.savoy@usda.gov); John Humphreys, [john.humphreys@usda.gov](mailto:john.humphreys@usda.gov)).

# Protein Function and Phenotype Prediction Working Group

The newly established Protein Function and Phenotype Prediction Working Group had their quarterly meeting on September 29th. Dr. Hye-Seom Kim and Dr. Carson Andorf presented on prediction of 3D protein structures using AlphaFold on SCINet and integrating AlphaFold protein structures in an organismal database. Drs. Kim and Andorf were also selected to lead the working group. The next quarterly meeting for the working group will be held Wednesday, January 11, 2023 at 2 pm EST. If you would like to learn more about the working group or participate in future meetings and workshops, please contact the group leaders (Hye-Seon Kim, [hyeseon.kim@usda.gov](mailto:hyeseon.kim@usda.gov); Carson Andorf, [carson.andorf@usda.gov](mailto:carson.andorf@usda.gov))

## SCINet Website Update

**USDA SCINet Scientific Computing**  
U.S. DEPARTMENT OF AGRICULTURE

Home About News User Guides Research Training and Events Support Opportunities

**High Performance Computing. Training. Network Improvements.**  
[Learn More](#)

**What is SCINet?**  
The SCINet initiative is an effort by the USDA Agricultural Research Service (ARS) to improve the USDA's research capacity by providing scientists with access to high-performance computing clusters, cloud computing, improved networking for data transfer, and training in scientific computing.

**Get Started with SCINet**  
ARS scientists/collaborators:  
[Register for an account](#)  
[Get Started](#)

**Upcoming Training and Events**

<b>Oct</b> <b>18</b>	<a href="#">Introduction to Atlas</a> An introduction to Atlas Tuesday October 18, 10:00am-11:00am CT Registration: <a href="#">Register Here to</a> Instructor: Adam Thrash Prerequisites: None
<b>Nov</b> <b>10</b>	<a href="#">Introduction to Atlas</a> An introduction to Atlas Thursday November 10, 10:00am-11:00am CT Registration: <a href="#">Register Here to</a> Instructor: Adam Thrash Prerequisites: None
<b>Dec</b> <b>8</b>	<a href="#">Introduction to Atlas</a> An introduction to Atlas Thursday December 8, 2:00pm-3:00pm CT Registration: <a href="#">Register Here to</a> Instructor: Adam Thrash Prerequisites: None

[See the Full Calendar](#)

[Have an Account? Access the SCINet Forum](#)

An overhaul of the SCINet website is currently under development!

The redesigned site will include a consolidated event calendar, improved user guide navigation, and a more informative landing page. As development progresses, we would like your feedback! [Browse our demo of the redesign](#) frequently to check out progress, and please send feedback to Moe Richert, Lead Developer ([moe.richert@usda.gov](mailto:moe.richert@usda.gov)).

# GeoCDL Released

The Geospatial Common Data Library (GeoCDL) is a community-driven product inspired by the computational needs identified in geospatial working group discussions. This effort was motivated by the desire to reduce duplication of effort across ARS scientists in downloading and curating large geospatial datasets, avoid the storage of duplicate data on HPC resources, and lower the barrier of entry to new users interested in leveraging SCINet computing resources to analyze large and complex geospatial data. The GeoCDL is still under active development, but a beta release is available now to SCINet users. A tutorial on how to access and use the GeoCDL can be found in the [Geospatial Workbook](#), and a video tutorial is also available [here](#).

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## TRAINING

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### Training Opportunities

Get Started	Find a Topic	Find Your Community
		
Search these videos to learn how to get started with SCINet	Explore these training resources to find specific content to meet your research needs	Join others in your community to work with, get answers, and explore ideas with
<a href="#">SCINet Overview</a>	<a href="#">SCINet Overview</a>	<a href="#">SCINet Overview</a>
<a href="#">SCINet Overview</a>	<a href="#">SCINet Overview</a>	<a href="#">SCINet Overview</a>
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<a href="#">SCINet Overview</a>	<a href="#">SCINet Overview</a>	<a href="#">SCINet Overview</a>

**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.

**AI Practicum Series:** We are excited to announce a new collaboration with the University of Florida (UF) to provide hands-on, practical training for ARS scientists who want to apply artificial intelligence (AI) methods and techniques to their research. UF has developed a new, in-house AI training curriculum in support of a major initiative to deploy AI throughout UF's research enterprise. The SCINet Office is working with the UF training team to customize this curriculum for ARS, including developing new training modules to address specific ARS training needs. We plan to offer the first workshops in this series, designed for learners who are new to AI, in early 2023. If you are interested in participating, please sign up [here](#). Once we have a core group of participants signed up, we will decide on a workshop schedule.

In addition, the first new training module we will develop with the UF team will cover AI methods for biological sequence analysis. We are looking for ARS scientists who would like to participate in a steering committee to guide module content and development. If you are interested, please contact Dr. Brian Stucky ([brian.stucky@usda.gov](mailto:brian.stucky@usda.gov)) or Dr. Ryan Lucas ([ryan.lucas@usda.gov](mailto:ryan.lucas@usda.gov)).

**The Carpentries Geospatial Workshop:** The SCINet Office is hosting The Carpentries Geospatial Workshop November 29-30, 2022. If you are interested in taking this course, you can register [here](#).

**Courses by Mississippi State University:** Mississippi State regularly offers [Introduction to Atlas](#) courses. Additionally, there are waiting lists available for several other courses, including an Intensive R course to help scientists with no R experience become familiar with the programming language and start performing statistical analyses in 4 days. [Sign up](#) to get notified when these courses are offered.

**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 continuously being updated on the [SCINet Upcoming Training webpage](#). For more information on any of the above trainings, registration questions or suggestions, please email [SCINet-training@usda.gov](mailto:SCINet-training@usda.gov).

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## SUPPORT

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

In October, we reached the milestone of having 2,000 registered SCINet users. If you do not already have a SCINet account, we hope you will consider joining the 2,000+ 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](mailto:scinet_vrsc@usda.gov).**



# SCINet User Tip

When working on either Ceres or Atlas, you can use the **seff** command after a job runs to see how it ran and how much memory it used:

```
seff 7881978 # job ID
Job ID: 7881978
Cluster: ceres
User/Group: <user/group>
State: FAILED (exit code 130)
Nodes: 1
Cores per node: 4
CPU Utilized: 00:00:01
CPU Efficiency: 2.50% of 00:00:40 core-walltime
Job Wall-clock time: 00:00:10
Memory Utilized: 0.00 MB (estimated maximum)
Memory Efficiency: 0.00% of 11.72 GB (2.93 GB/core)
```

**Do you have tips to share? Email them to [SCINet-Newsletter@usda.gov](mailto:SCINet-Newsletter@usda.gov) to be included in future newsletters.**

## SCINet Corner: Third 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 in December 2022. The SCINet Corner Team is seeking your input for the best day and time for the new SCINet Corner timeslot. The team will send out a survey in the near future for you to provide your input.

You can register for future SCINet Corners at <https://forms.gle/7DcBoBvbGcjQDBP38>

**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/>.**

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# CONNECT

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## 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-Newsletter@usda.gov](mailto:SCINet-Newsletter@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, Acting SCINet Project Manager  
Adam Rivers, Science Advisory Committee (SAC) Chair  
Steve Kappes, Associate Administrator

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