# 3rd ICLR Workshop on Machine Learning for Remote Sensing

## Workshop summary

Machine learning for remote sensing (ML4RS) has emerged as a critical and exciting area of research, with the potential to address some of the most pressing global challenges, including climate change, food security, disaster management, and conservation. Remote sensing data, collected from diverse instruments capturing the Earth across various spatial, temporal, and spectral dimensions, offers unique research opportunities and challenges for the ML community. Unlike traditional data modalities, these datasets are high-dimensional, extremely multi-modal, and contain patterns at a multitude of spatial and temporal scales. These characteristics often require specialized approaches in cross-cutting ML topics like self-supervised/semi-supervised learning, domain adaptation/generalization, and multi-modal learning/data fusion to unlock their full potential. Our workshop will foster discussion and feedback on early-stage work that is critical to impactful applications and new developments in machine learning for remote sensing.

Our proposed workshop will continue building upon the success of previous editions at ICLR 2023 and 2024, which brought together local stakeholders, researchers, and domain scientists from organizations like the Rwanda Space Agency and CMU Africa (2023 in Kigali) and the European Space Agency (2024 in Vienna) to tackle regionally important challenges. This year, we aim to expand this trans-disciplinary exchange by inviting leading global researchers in ML for remote sensing (e.g., Stefano Ermon, Stanford University) and leading experts from local organizations such as NASA's international SERVIR Southeast Asia Hub and the Earth Observatory of Singapore. We will amplify these local experts' perspectives in a panel discussion about Local vs Global Models in Machine Learning for Remote Sensing. Through keynote presentations, interactive panels, and poster/coffee break discussions, our workshop will facilitate a vibrant exchange of ideas and solutions, positioning ML4RS as a pivotal research frontier in the ICLR community.

By fostering collaborations between ML researchers and remote sensing domain experts, our workshop promises to break new ground in advancing both the methodologies and applications of ML for remote sensing, setting the stage for future advances in this field. We hope our workshop will advance topics and questions including (but not limited to):

- Self-supervised and semi-supervised learning: How can we leverage large volumes of unlabeled satellite data to improve the generalization and robustness of models, especially in data-scarce regions?

- Domain adaptation and generalization: What are the most effective techniques for ensuring ML models trained in one geographic or environmental region transfer well to other regions with different characteristics?
- Multi-modal learning and data fusion: How can we effectively combine remote sensing data from different sensors (e.g., optical, radar, LiDAR) and modalities to enhance the performance of ML models across various applications?
- Scalability of ML models: What are the challenges and solutions for scaling ML models to handle global, high-resolution satellite datasets, which can consist of petabytes of multi-temporal data?
- Explainability and trustworthiness in ML models: How can we improve the interpretability of machine learning models in remote sensing to build trust and ensure actionable insights for decision-makers and stakeholders?
- Local vs. global models: When should we prioritize the development of localized models tailored to specific regions or conditions versus global models with broader applicability?
- Ethical and responsible AI in remote sensing: What frameworks should guide the development and application of SatML models to ensure ethical outcomes, particularly in sensitive areas such as disaster management and biodiversity conservation?

**Location-specific focus**

This ML4RS edition will continue the tradition established by our 2023 and 2024 workshops of integrating local researchers and stakeholders by inviting panelists from Asia and particularly Southeast Asia. Singapore has a vibrant community of researchers and practitioners in machine learning and remote sensing and is well-positioned to gather experts from regions across East and Southeast Asia. The keynote speakers (one from Hong Kong, China and one from Stanford, US) highlight the greater applicability of remote sensing data while the panel speakers (all current or former members of E/SE Asian institutions) highlight regional needs and challenges to consider when developing machine learning solutions for remote sensing data.

## Tentative schedule

| start-end time | topic |
| --- | --- |
| 9:00-9:10 | Introduction and opening remarks |
| 9:10-9:40 | Keynote: Stefano Ermon (Stanford), "Towards Generative Foundation Models for Remote Sensing Data" |
| 9:40-10:00 | Coffee break (possibility to set up posters with initial discussions) |
| 10:00-10:30 | Poster Spotlights (15 x 2 min each. Questions later on posters) |
| 10:30-12:00 | Poster Session |
| 12:00-13:30 | Lunch (opportunity to visit posters and have discussions) |
| 13:30-14:00 | Keynote: Dit-Yan Yeung (Hong Kong University of Science and Technology), "Machine learning for short-range and medium-range weather forecasting" |

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| 14:00-15:00 | Accepted paper oral talks (3 x 15 min each with audience Q&A) |
| 15:00-15:30 | Coffee break (opportunity to visit poster and have discussions) |
| 15:30-16:30 | Panel - Local vs Global Models in Machine Learning for Remote Sensing (with a focus on Asia/SE Asia)<br>● Dr. Ying Tu, Cornell University<br>● Dr. Ate Poortinga, Spatial Informatics Group and NASA SERVIR–Mekong<br>● Others to be invited after the workshop decision |
| 16:30-17:30 | Accepted paper oral talks (3 x 15 min each with audience Q&A) |
| 17:30-17:35 | Closing remarks and adjourn |

## Invited speakers and panelists

### Confirmed keynote speakers

1. **Stefano Ermon** is an Associate Professor of Computer Science in the CS Department at **Stanford University** where he is affiliated with the Artificial Intelligence Laboratory. His research is centered on techniques for probabilistic modeling of data and is motivated by applications in the emerging field of computational sustainability. He has won several awards, including multiple Best Paper Awards, a NSF Career Award, ONR and AFOSR Young Investigator Awards, Microsoft Research Fellowship, Sloan Fellowship, and the IJCAI Computers and Thought Award. Stefano earned his Ph.D. in Computer Science at Cornell University in 2015.
2. **Dit-Yan Yeung** received his BEng degree in electrical engineering, MPhil degree in computer science from the University of Hong Kong (HKU), and PhD degree in computer science from the University of Southern California (USC). He started his academic career as an Assistant Professor at the Illinois Insitute of Technology (IIT) in Chicago. Later he joined the Hong Kong University of Science and Technology (HKUST) where he is currently a Chair Professor in the Department of Computer Science and Engineering. He served as Head of the Department from 2018 to 2022. Since he was an MPhil student, his primary research interests have been machine learning including both theoretical and practical research problems. On the theoretical and methodological aspects, over the years he has proposed various machine learning models and algorithms that belong to multiple approaches, including neural networks and deep learning, probabilistic graphical models, kernel methods, and other statistical models. In addition, he has also developed novel machine learning methods for many computer vision problems as well as applications in earth sciences, cybersecurity, and education. In particular, his work on developing machine learning models for weather forecasting and related generative tasks over the past decade has aroused a great deal of interest among both researchers and practitioners in the AI and meteorology communities.

- **Dr. Ying Tu** is a Postdoctoral Associate in the Department of Global Development at Cornell University. She specializes in remote sensing, geospatial analysis, and quantitative methodologies. Her research focuses on harnessing satellite remote sensing and computational approaches to monitor global environmental changes in support of sustainable development. Specifically, she is interested in large-scale land cover/land use mapping, agricultural sustainability, human development, and environmental justice. Prior to joining Cornell, Ying earned her Ph.D. in Ecology from Tsinghua University in 2024. Her doctoral work concentrated on monitoring high-resolution cropland dynamics in China and examining its relationship with urbanization, where she developed a cost-effective annual cropland mapping framework using machine learning and change detection techniques.
- **Dr. Ate Poortinga** is a Senior Scientist and Google Earth Engine Specialist with the Environmental Mapping Team at Spatial Informatics Group, working on the SERVIR–Mekong project in Bangkok. He has expertise in a variety of scientific disciplines including water resources management, environmental management, and the application of new technologies for spatial intelligence. Ate develops sophisticated cloud-based data processing systems that are used in a variety of applications such as detecting floods, mapping land cover, and identifying deforestation hotspots. He is involved in the implementation of big Earth data mining and artificial intelligence technologies for spatial intelligence.

Other potential panel speakers to be invited after the workshop decision:
- [Xian Sun](), Chinese Academy of Sciences
- [Alok Talekar](), Google Deep Mind (Bangalore, India)
- [Alessandro Crivellari](), National Taiwan University
- [Zhang Liangpei](), Wuhan University
- [Naoto Yokoa](), University of Tokyo
- [Xiao Xiang Zhu](), Technical University of Munich

## Organizers and biographies

1. **[Hannah Kerner]()** (workshop lead 2025/2023) is an Assistant Professor in the School of Computing and Augmented Intelligence at Arizona State University. Her research focuses on advancing the foundations and applications of machine learning to foster a more sustainable, responsible, and fair future for all. As the AI Lead for NASA's agriculture programs, NASA Harvest and NASA Acres, she is deploying research methods in real applications across the globe; her projects have directly resulted in optimized agricultural planning, disaster response, and financial relief in various regions worldwide. The impact of Kerner's research was recognized in Forbes 30 Under 30 and the International Research Centre On Artificial Intelligence's Top 10 projects solving problems related to the UN's Sustainable Development Goals with AI.
2. **[Marc Rußwurm]()** (workshop lead 2024) is an Assistant Professor for Machine Learning and Remote Sensing at Wageningen University, Netherlands. He works with time series classification and transfer learning across geographic locations through meta- and

few-shot learning. Application-wise, we have published works covering crop-type mapping, deforestation, and marine debris and plastic litter detection from satellite imagery.

3. **Hamed Alemohammad** is an Associate Professor in the Graduate School of Geography at Clark University and also the Director of the new Center for Geospatial Analytics. His research interest lies at the intersection of GISciences and geography to use observations and analytical methods through machine learning to better understand the changing Earth system.

4. **Gedeon Muhawenayo** is a Ph.D. student at Arizona State University focusing on Machine Learning for Remote Sensing. He is also part of the Rwanda Space Agency (RSA) Geospatial team, where he contributes to developing machine learning systems that leverage satellite imagery for real-world applications.

5. **Gabriel Tseng** is a Ph.D. student at McGill / Mila - Quebec AI Institute and a Machine Learning Engineer at NASA Harvest. His research investigates machine learning applications to remote sensing data, focussing on learning with few labels. His work bridges methodological advances and the deployment of machine learning models for real-world remote sensing applications.

6. **Ribana Roscher** is a Professor of Data Science for Crop Systems at the University of Bonn, Germany. She heads the same-titled group at the Institute of Bio- and Geosciences at Research Center Jülich, Germany. She develops machine learning methods to address challenges in environmental sciences and sustainable agriculture. She specifically focuses on techniques for sophisticated feature learning, data-centric, and explainable machine learning.

7. **Ronny Hänsch** leads the Machine Learning Team in the Signal Processing Group of the SAR Technology Department at the Microwave and Radar Institute of the German Aerospace Center (DLR). His research interest is computer vision and machine learning with a focus on remote sensing (in particular, SAR processing and analysis). He has extensive experience in organizing remote sensing community competitions, serves as the GRSS representative within SpaceNet, and was the technical lead of the SpaceNet 8 Challenge.

8. **Evan Shelhamer** (new 2025) is a senior research scientist at Google DeepMind and incoming assistant professor at the University of British Columbia in Vancouver. His research focuses on visual recognition, self-supervision for learning without labels, and adaptation to new/different data. He was the lead developer of the Caffe deep learning framework, led academic and industry tutorials on deep learning, and shared the Everingham service award for Caffe at ICCV'17. He is now focused on self-supervised learning for remote sensing including for interactive mapping (CVPR 2024 demo track).

9. **Esther Rolf** (new 2025) is an Assistant Professor in the computer science department at the University of Colorado, Boulder. Her research is in statistical and geospatial machine learning, and blends methodological and applied techniques to study and design machine learning algorithms and systems with an emphasis on usability, data-efficiency and fairness. Her research has been recognized with best paper awards at ICML and the

Workshop on AI for Social Good at Neurips, and a "SDG Digital Gamechangers award (2023) from the UNDP and the ITU.

10. **Mirali Purohit** (new 2025) is a Ph.D. student at Arizona State University, working on building and evaluating the efficiency of foundation models. Her research primarily aims to build a robust foundation model for planetary science (particularly for the Mars science task) and create a comprehensive evaluation benchmark for Martian science. She also works on evaluating the effectiveness of Geospatial foundation models, particularly in relation to spatial data distribution.

## Anticipated audience size

Based on the 2023 and 2024 editions of our workshop, we expect an attendance of approximately 50-100 participants. This is also in line with related tutorials (e.g., Machine Learning for Remote Sensing: Agriculture and Food Security tutorial at CVPR 2022) and workshops (e.g., EarthVision workshop at CVPR 2024). We expect a much larger audience online who will benefit from the materials that we host in perpetuity on our workshop website.

## Plan to get an audience for a workshop (advertising, reaching out, etc.)

We will build on the promotion and outreach channels established in the last two years and will provide a 2025 website consistent with last year's site. We have contacts with newsletters of Remote Sensing Societies, such as Geoscience and Remote Sensing eNewsletter, ISPRS e-Bulletin, and the IAPR-TC7 newsletter. We will also promote the workshop in relevant Google groups, such as the Women in Machine Learning Group, as done in this post. Further, most of the organizers have active Twitter/X profiles with a combined number of roughly 11.6k followers. We will also ask our diverse network of program committee members to promote the workshop in their networks.

## Diversity Commitment

We took care to reflect different viewpoints and backgrounds throughout the organizing committee and invited speakers and panelists. The organizing committee has members born in four continents (North America, Europe, Africa, and Asia) and is gender balanced. Our organizers also span a range of career stages, including assistant and associate professors, senior researchers, and PhD students. We invited speakers from diverse regions, demographic groups, areas of expertise, career stages, and institution types for our panel and keynotes. With this composition, we hope to reach a diverse community of global researchers aiming to address the pressing questions of our time with ML for remote sensing research.

## Virtual access to workshop materials and outcomes

Our workshop will be fully in-person, but we are committed to making the information and insights shared in our workshop available to a broader online audience as follows:

- **Online papers:** The submissions in this workshop are non-archival. However, we will publish them on the website as in last year's workshop and encourage authors to share accepted papers on arXiv.

- **Online posters:** We will post PDFs of all posters on our website for remote viewership, as in last year's workshop.
- **Summary videos for all papers:** We will feature 15 short (2-minute) poster spotlights and 3 long (15-minute) oral presentations in the live workshop. We will record these and post them on the workshop website. In addition, we will offer all authors the opportunity to record a 2-minute summary presentation to post on the website alongside their paper.
- **Special journal issue:** We will offer authors of accepted papers the (completely optional) opportunity to submit their paper for publication in a special issue of *Geoscience and Remote Sensing Letters*, organized for the ICLR workshop submissions. We will accelerate the review process by forwarding the reviews from the workshop (with reviewer consent) for use as the journal reviews.
- **Podcast recaps:** We will contact Robin Cole, host of the Satellite Image Deep Learning podcast, to do a special episode recapping the talks and discussions that took place during the workshop. We will also contact other podcasts for similar episodes, such as On Orbit, This Week In ML (TWIML), and The Scene from Above.

## Previous related workshops

This is the third edition of ML4RS (website link) with some returning organizers and some new co-organizers (E. Shelhamer, E. Rolf, M. Purohit). The first workshop in ICLR 2023 in Kigali (led by H. Kerner) successfully worked with local students, researchers, and professors at CMU Africa and the Rwanda Space Agency to discuss and emphasize locally relevant research. The invitation of speakers from the Rwanda Space Agency and other African countries (e.g., Google Accra, AIMS South Africa) connected the methodologies presented in the workshop with relevant applications needed in this local context, such as building footprint detection or crop mapping. The 2023 workshop was extremely successful: there were more than 100 attendees (more chairs had to be added to the room!), including more than 40 students from local Rwandan universities who were sponsored to attend by CMU Africa. We had 45 paper submissions and 18 accepted papers. Many attendees expressed their enthusiasm about the discussions and research presented at the workshop and their desire for the workshop to continue in future years.

Our second edition in Vienna in 2024 continued and strengthened our focus on innovative ML for remote sensing research and discussion of locally relevant topics raised by leading regional researchers and stakeholders. Our workshop had more than 100 attendees and attracted 71 paper submissions, of which we accepted 36 posters and 7 orals. Two keynote speakers (USA & Europe) presented their research in the intersection of machine learning and remote sensing, and five panelists shed light on their experiences with benchmark datasets' role in advancing science between machine learning research and impacting applications. The event was generously sponsored by commercial and governmental agencies, which enabled us to support the travel of three students financially, provide a monetary award for the best poster and best paper, and have a joint pre-workshop dinner with all invited speakers, panelists, and oral presenters.

## Distinguishing factors of this workshop vs. previous related workshops

We are well-connected to the CVPR EarthVision workshop series through common organizers H. Kerner and R. Hänsch and to the ICPR workshop Pattern Recognition in Remote Sensing (PRRS), co-organized by M. Rußwurm and R. Roscher. We believe that this ML4RS workshop placed at a machine learning and representation learning venue nicely augments the EarthVision and PRRS workshops for relevant environmental problems beyond pattern recognition, vision, and high-resolution imagery. For instance, we aim to include more topics such as time series to capture the dynamic nature of our planet and its shift with climate change, to fundamentally discuss transfer learning approaches, or how to mitigate domain shift on remote sensing data. The non-archival option of our ICLR workshop also provides a complementary opportunity for researchers to present early-stage and in-progress innovative research with a higher probability for acceptance than EarthVision, which has a low acceptance rate due to its archival place in the CVPR proceedings. This opportunity is especially important for early-career researchers and those from under-resourced or less research-intensive institutions who have not yet "broken into" the mainstream ML conference space.

On the other hand, joining an international event can be difficult for researchers if it does not include a peer-reviewed publication. Thus, in contrast to previous events, we will offer the post-workshop opportunity to submit a 3-5 page paper into a Special Stream of the IEEE Geoscience and Remote Sensing Letters (GRSL). The Editor in Chief of this journal (R Hänsch) is among the workshop organizers, allowing for a smooth publication process. While not mandatory for all authors, this provides an excellent opportunity to combine free collaborative exchange at the workshop with a valuable academic publication.