

# 2025 IEEE GRSS Data Fusion Contest: All-Weather Land Cover and Building Damage Mapping

The Image Analysis and Data Fusion (IADF) Technical Committee (TC) of the IEEE Geoscience and Remote Sensing Society (GRSS) has been organizing the annual Data Fusion Contest (DFC) since 2006. The contest promotes the development of methods for extracting geospatial information from large-scale, multisensor, multimodal, and multi-temporal data. It aims to propose new problem settings that are challenging to address with existing techniques and to establish new benchmarks for scientific challenges in remote sensing image analysis. We are pleased to announce the 2025 GRSS DFC, which will focus on developing algorithms for all-weather land cover and building damage mapping.

With rapid advances in small synthetic aperture radar (SAR) satellite technology [1], Earth observation (EO) now provides submeter-resolution all-weather mapping with increasing temporal resolution. SAR can penetrate cloud cover and provide consistent imagery in adverse weather and at nighttime, enabling frequent monitoring of critical areas—valuable when disasters occur or when environments change rapidly [2], [3]. In contrast, optical data offer intuitive visuals and fine detail but are limited by weather and lighting conditions. Effectively exploiting the complementary properties of SAR and optical data to solve complex remote sensing image analysis problems remains a significant technical challenge.

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The 2025 GRSS DFC, organized by the IADFTC, the University of Tokyo, RIKEN, and ETH Zurich, aims to foster the development of innovative solutions for all-weather land cover and building damage mapping using multimodal SAR and optical EO data at submeter resolution (Figure 1). The contest is designed as a benchmark competition following previous editions (e.g., [4], [5], [6], [7], [8], [9], [10], [11], and [12]) and consists of two tracks focusing on mapping land cover types and building damage, respectively. It presents two main technical challenges: effective integration of multimodal data and handling of noisy labels. The training data span multimodal submeter-resolution optical and SAR images with associated land cover mapping as well as bitemporal optical and SAR images from before and after a disaster, along with associated labels mapping building damage. Across these tracks, this challenge aims to advance the accuracy of algorithms for land cover mapping and building damage mapping after disasters.

## TRACK 1: ALL-WEATHER LAND COVER MAPPING

Track 1 focuses on developing methods for land cover mapping in all weather conditions using SAR data. The training data consist of multimodal submeter-resolution optical and SAR images with eight-class land cover labels. These labels are pseudolabels derived from optical images based on pretrained models. During the evaluation phase, the models will rely exclusively on SAR to ensure that they perform well in real-world all-weather scenarios. This aims to

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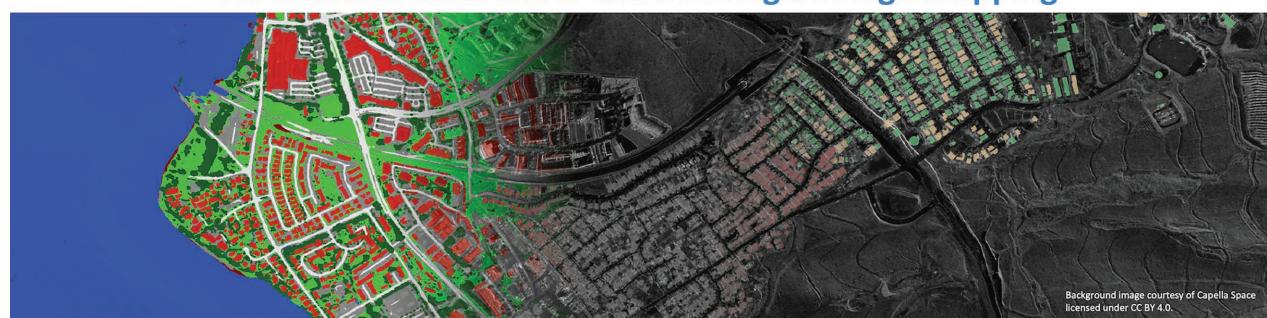


FIGURE 1. The banner image for the 2025 GRSS DFC.

improve the accuracy of land cover mapping under varying environmental conditions, demonstrating the utility of SAR data in monitoring land cover. The performance will be evaluated using the mean intersection over union (mIoU) metric.

## TRACK 2: ALL-WEATHER BUILDING DAMAGE MAPPING

Track 2 aims to develop methods for assessing building damage using bitemporal multimodal images. The training data contain optical images from before the disaster and SAR images after the disaster, all at submeter resolution, labeled with four classes: background, intact, damaged, and destroyed buildings. Mapping building damage from multimodal image pairs presents unique challenges due to the different characteristics of optical and SAR imagery. During the evaluation phase, models will be applied to predisaster optical and postdisaster SAR image pairs to produce accurate assessments of building damage, showing the extent and severity of building damage, which are essential for effective disaster response and recovery planning. The performance will be evaluated using the mIoU metric.

## COMPETITION PHASES

The contest in both tracks will consist of two phases:

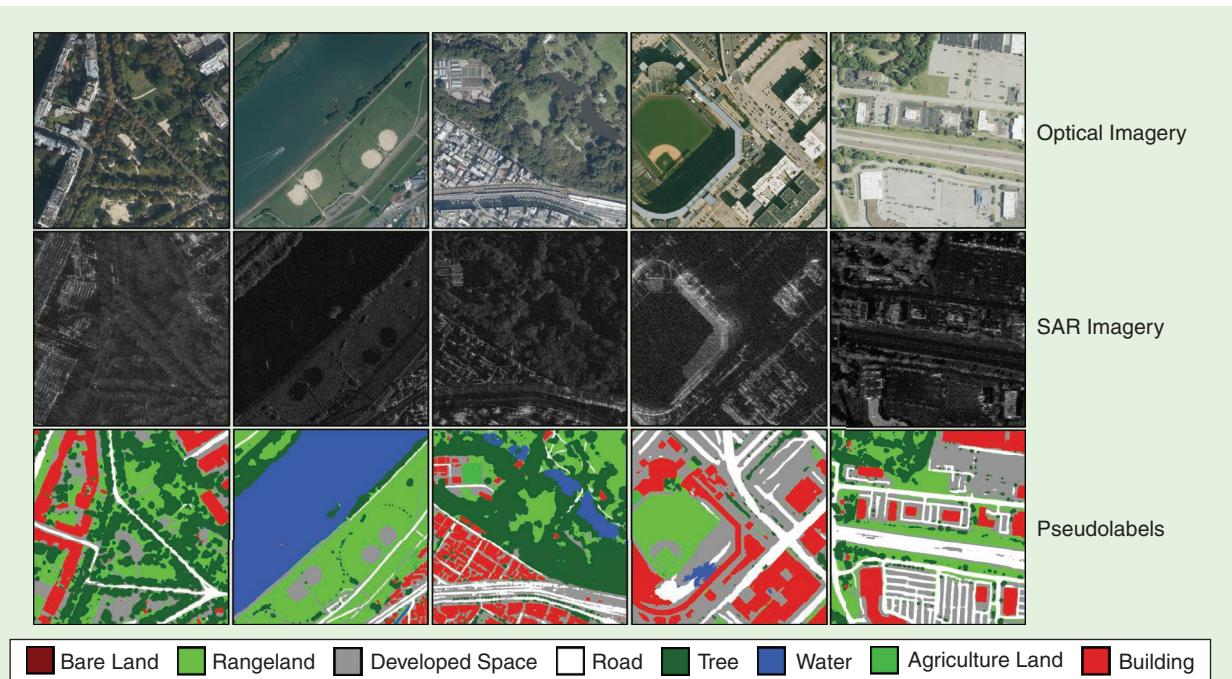
- **Phase 1 (development phase):** Participants are provided with training data and additional validation images

(without any corresponding reference data) to train and validate their algorithms. Participants can submit prediction results for the validation set to the CodaLab competition website to get feedback on their performance. The performance of the best submission from each account will be displayed on the leaderboard. In parallel, participants submit a short description of the approach used to be eligible to enter phase 2.

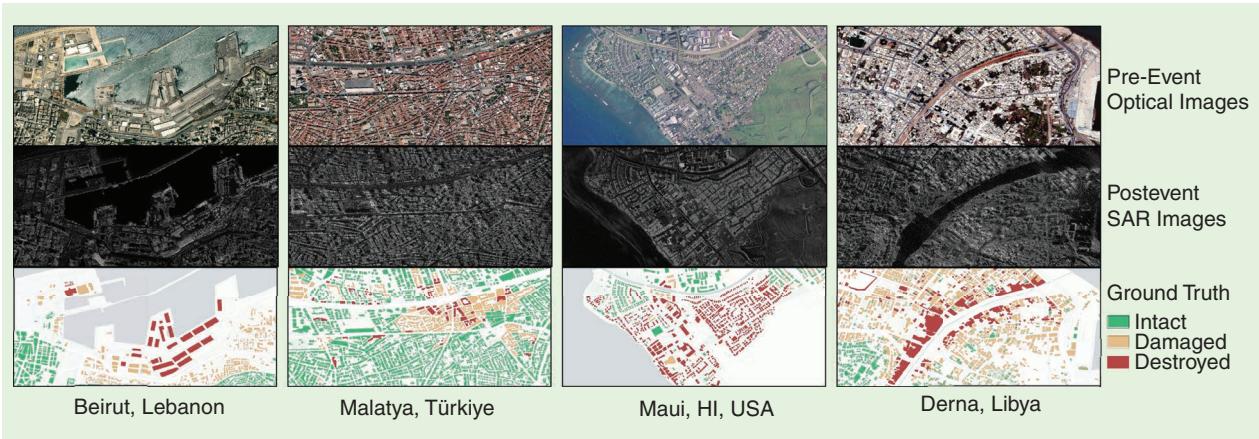
- **Phase 2 (test phase):** Participants receive the test dataset (without the corresponding reference data) and submit their results within five days from the release of the test dataset. After evaluation of the results, four winners from the two tracks are announced. Following this, they will have one month to write their manuscript, which will be included in the IEEE International Geoscience and Remote Sensing Symposium (IGARSS) proceedings. Manuscripts are four-page IEEE-style formatted. Each manuscript describes the addressed problem, the proposed method, and the experimental results.

## THE DATASET

In track 1 (Figure 2), we provide a multimodal dataset of optical and Umbra SAR images, consisting of approximately 4,300 aerial red-green-blue (RGB) and SAR image pairs with eight-class land cover pseudolabels for the training. The SAR images are provided as 8-b single-channel TIFF tiles, with pixel spacing between 0.15 and



**FIGURE 2.** Example images in the dataset for track 1. (SAR image: Umbra Lab; used under CC BY 4.0 license. Optical images of the first and third columns: French National Institute of Geographic and Forest Information; used under CC BY 2.0 license. Optical image of the second column: Geospatial Information Authority of Japan; used with permission. Optical images of the fourth and fifth columns: U.S. National Agriculture Imagery Program; used with permission.)



**FIGURE 3.** Example images in the dataset for track 2. From left to right, the disaster types are explosions, earthquakes, wildfires, and floods. (Optical images of Beirut, Malatya, and Derna: MAXAR; used under CC BY-NC 4.0 license. Optical image of Maui: National Oceanic and Atmospheric Administration Office for Coastal Management; used with permission. SAR image: Capella Space; used under CC BY 4.0 license.)



**FIGURE 4.** The IADF TC logo.

0.5 m and a tile size of  $1,024 \times 1,024$  pixels. The aerial images are also 8-b RGB TIFF tiles, with the same tile size of  $1,024 \times 1,024$  pixels, matching the SAR image resolution. The eight classes include bare land, rangeland,

developed space, road, tree, water, agriculture land, and building. The pseudolabels are generated from pretrained OpenEarthMap models [13], [14], [15], [16], [17]. For validation and testing, only SAR images are used for metric evaluation, with selected urban areas manually labeled by experts to provide high-quality evaluation data.

In track 2 (Figure 3), we provide the following multimodal very high-resolution dataset. This dataset encompasses over 10 natural and human-made disaster events across the globe, covering six types of disasters: earthquakes, wildfires, volcanic eruptions, floods, storms, and explosions. Approximately 3,000 multimodal image pairs are available, each consisting of a predisaster optical image and a postdisaster SAR image, accompanied by building damage labels, with a standard tile size of  $1,024 \times 1,024$  pixels. The dataset provides labels for four classes: background, intact buildings, damaged buildings, and destroyed buildings. All images have a ground sampling distance of 0.3–1 m, and both images and labels are in 8-b TIFF format. In this track, events independent of the training and validation sets are used as test data. This setup allows us to evaluate the model's generalization ability to unseen disaster events.

#### GET THE DATA AND ENTER THE CONTEST

The training and validation datasets were made available on 13 January 2025 via the Zenodo platform. The evaluation server with a public leaderboard also opened on 13 January so that participants could submit prediction results for the validation set to the CodaLab competition to get feedback on the performance of their approaches. Participants must submit a short description of the approach used by 28 February to enter the test phase. The test phase is scheduled from 3 to 7 March. The test phase is kept short to ensure an objective and fair comparison among methods. Participants have an opportunity to provide an updated (final) description of

#### Contest Data

The data from DFC25 will remain available to the GRSS community to allow researchers to benchmark their algorithms and publish resulting research outcomes. The data are usable free of charge for scientific purposes, but the contest terms and conditions on the contest webpage remain applicable. Users of the data are encouraged to read these carefully at [www.grss-ieee.org/technical-committees/image-analysis-and-data-fusion/?tab=data-fusion-contest](http://www.grss-ieee.org/technical-committees/image-analysis-and-data-fusion/?tab=data-fusion-contest).

### Join the IADF TC

Anyone interested in DFC25 or our earlier contests/data can contact the IADF TC chairs at [iadf\\_chairs@grss-ieee.org](mailto:iadf_chairs@grss-ieee.org). If you are interested in joining the IADF TC, please fill in the form on our website: <https://www.grss-ieee.org/technical-committees/image-analysis-and-data-fusion>. Members receive information regarding research and applications on IADF topics and updates on the annual DFC and on all other activities of the IADF TC. Membership in the IADF TC is free! Also, you can join the LinkedIn GRSS Data Fusion Discussion Forum (<https://www.linkedin.com/groups/3678437/>) and X (formerly Twitter) channel (@GrssIadf).

their approach. After the final check of the submitted semantic segmentation results, comparing them with the undisclosed ground truth for testing, winners will be announced on 21 March. The evaluation server will be reopened after the winners announcement for further development in the field.

More information regarding the data download and registration to the evaluation server can be found at the IADF TC (Figure 4) website (<https://www.grss-ieee.org/technical-committees/image-analysis-and-data-fusion/?tab=data-fusion-contest>). Questions and comments on the data and the contest can be sent to IADF chairs ([iadf\\_chairs@grss-ieee.org](mailto:iadf_chairs@grss-ieee.org)). Updates about the contest will also be published via the IADF X (formerly Twitter) channel @grssiadf and the IADF TC LinkedIn group (<https://www.linkedin.com/groups/3678437/>).

### AWARDEES, AWARDS, AND PRIZES

The mIoU metric will be used to rank the results on the phase 2 test output. The first- and second-ranked teams in both tracks will be recognized as winners. To be eligible for the prize, teams must contribute to the community by sharing their code openly, such as on GitHub. The winning teams will 1) present their approaches in a dedicated DFC25 session at IGARSS 2025; 2) publish their manuscripts in the proceedings of IGARSS 2025; 3) receive IEEE certificates of recognition; 4) be awarded during IGARSS 2025, in Brisbane, Qld., Australia, in August 2025; 5) be awarded travel support of up to US\$4,500<sup>1</sup> per team to attend IGARSS 2025; and 6) coauthor a journal paper summarizing the DFC25 outcomes, which will be submitted with open access to *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. The costs for open access publication will be supported by the GRSS. The winning team prize is sponsored by Mitsubishi Electric.

### ACKNOWLEDGMENT

The IADF TC chairs would like to thank the University of Tokyo, RIKEN, and ETH Zurich for providing the data; the GRSS for continuously supporting the annual DFC through funding and resources; and Mitsubishi Electric for sponsoring the winner team prize.

<sup>1</sup>Subject to adjustment based on currency exchange rates.

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# High-Performance and Disruptive Computing in Remote Sensing: The Fourth Edition of the School Organized by the HDCRS Working Group of the GRSS Earth Science Informatics Technical Committee

The Research Center on Intelligent Technologies (CiTIUS) of the University of Santiago de Compostela hosted the fourth edition of the "High Performance and Disruptive Computing in Remote Sensing" school from 1 to 4 June 2024. The event, organized by the High-Performance and Disruptive Computing in Remote Sensing (HDCRS) Working Group (WG), under the IEEE Geoscience and Remote Sensing Society's (GRSS) Earth Science Informatics (ESI) Technical Committee (TC), supported the WG's mission to promote education and research in advanced computing technologies.

## INTRODUCTION

The vast and high-dimensional remote sensing (RS) datasets, accessible through various governmental and research institutions, have given rise to a big data paradigm in RS,

necessitating innovative solutions for data storage, access, and processing [1]. While real-time processing is not always mandatory, it is essential to provide adequate infrastructure for efficient and cost-effective data access and processing, ensuring reduced execution times. Additionally, a lack of sufficient computational resources can significantly hinder the deployment of advanced models driven by artificial intelligence (AI) [2].

To overcome these challenges, adopting advanced computational strategies is essential. These strategies range from distributed systems, such as supercomputers and cloud environments, to specialized hardware accelerators, including GPUs and field-programmable gate arrays. Furthermore, emerging computing paradigms like quantum computing (QC) and neuromorphic computing are effectively providing solutions for RS data analysis, broadening the possibilities for future innovations [3].

Despite these advancements, the rapidly evolving nature of this interdisciplinary field makes it challenging for

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