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2021 Data Fusion Contest: Geospatial Artificial Intelligence for Social Good

The 2021 Data Fusion Contest, organized by the Image Analysis and Data Fusion Technical Committee (IADF TC) of the IEEE Geoscience and Remote Sensing Society (GRSS), promotes research on geospatial artificial intelligence (AI) for social good. The global objective is to build models for understanding the state of and changes in artificial and natural environments from remote sensing data toward sustainable development. The contest is designed as a benchmark competition, following previous editions [1]–[5]. The 2021 Data Fusion Contest (Figure 1) consists of two parallel tracks:

- 1) detection of settlements without electricity (DSE)
- 2) multitemporal semantic change detection (MSD).

Track DSE, co-organized by Hewlett Packard Enterprise, SolarAid, and Data Science Experts, addresses the automatic detection of human settlements, deprived of access to electricity, using multimodal, multiresolution, and multitemporal satellite remote sensing data. *Sentinel-1* synthetic aperture radar data and *Sentinel-2*, *Landsat-8*, and Suomi Visible Infrared Imaging Radiometer Suite (VIIRS) nighttime images are used as input (see Figure 2). While the original ground sampling distance (GSD) ranges from 10 to 750 m, all images were resampled at 10 m. Semantic labels of four classes (i.e., settlements with and without electricity and no settlements with and without electricity) are provided at a GSD of 500 m for the training set. Participants are required to submit binary detection maps of settlements without electricity at a GSD of 500 m. The classification accuracy is evaluated using the F1 score. The main challenge of Track DSE is to develop robust and efficient methods to extract high-level semantic information from such heterogeneous data.



Track MSD, co-organized by Microsoft AI for Earth, focuses on automatic land cover change detection and classification from multitemporal, multiresolution, and multispectral imagery. The task of Track MSD is to create bitemporal, high-resolution land cover maps using only low-resolution and noisy land cover labels for training. Participants receive a data set covering the U.S. state of Maryland, composed of 1) 1-m multispectral aerial imagery for 2013 and 2017 from the United States Department of Agriculture's National Agriculture Imagery Program (NAIP) data; 2) 30-m multispectral satellite imagery (*Landsat-8*) for five points in time between 2013 and 2017; and 3) 30-m noisy, low-resolution land cover labels for 2013 and 2016 from the United States Geological Survey's National Land Cover Database (NLCD) data (see Figure 3). Participants are required to infer high-resolution (1-m GSD) land cover maps that identify changes between 2013 and 2017. Performance is assessed using the intersection-over-union metric averaged across eight

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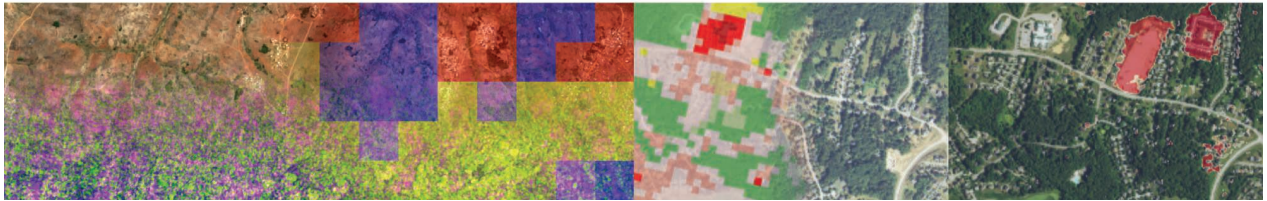


FIGURE 1. The banner for the 2021 IEEE GRSS Data Fusion Contest.

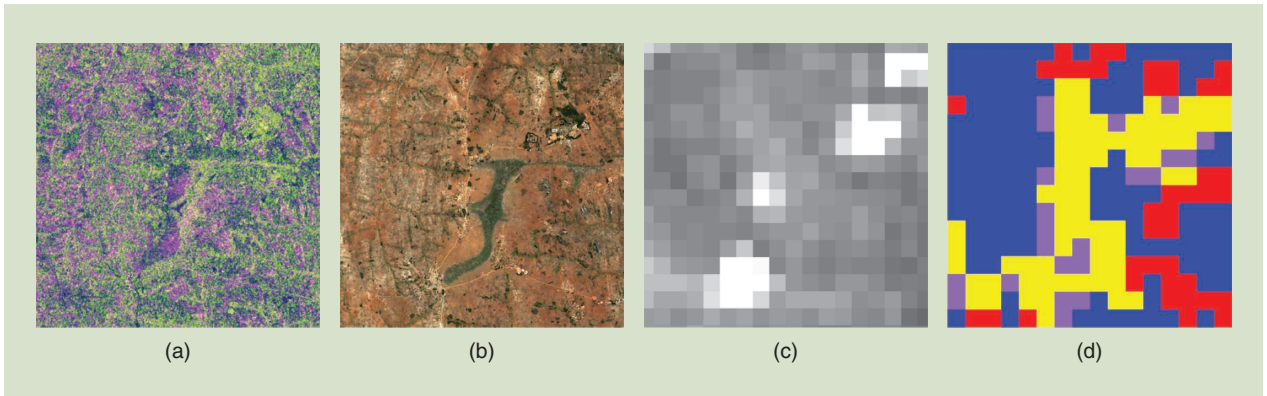


FIGURE 2. (a)–(c) Sample satellite images and (d) reference data used in Track DSE. (a) A *Sentinel-1* image [red–green–blue (RGB): VV, VH, and VV-VH]. (b) A *Sentinel-2* image (RGB: bands 4, 3, and 2). (c) A VIIRS image (nine temporal images are accumulated). (d) The reference data.



FIGURE 3. Four of the input layers in Track MSD. (a) NAIP 2013, (b) NAIP 2017, (c) NLCD 2013, and (d) NLCD 2016.

change types. The challenge is twofold: detecting which parts have changed between two high-resolution aerial images and identifying the class of change based on weak labels.

The 2021 Data Fusion Contest tackles fundamental technical issues grounded in real problems: 1) analysis of multisensor, multiresolution, and multitemporal data and 2) learning from weak supervision. Both are major open challenges in a wide range of fields, from Earth observation to computer vision and machine learning. The main feature of the 2021 Data Fusion Contest is that it is directly connected to social concerns, such as energy equality and environmental conservation. The results of

the contest will have a great impact not only in terms of technological development but also as a tool for solving actual social problems.

GET THE DATA, AND ENTER THE CONTEST

All the data sets for training were made publicly available on 3 December 2020. The data sets for Track DSE are provided through the IEEE DataPort (<https://iee-dataport.org/competitions/2021-ieee-grss-data-fusion-contest-track-dse>). For Track MSD, the data sets are stored on Azure in a read-only blob container. The evaluation servers with public leaderboards were opened on 4 January 2021 so that

participants can submit prediction results for the validation set to the Codalab competition website (<https://competitions.codalab.org/competitions/27943>, <https://competitions.codalab.org/competitions/27956>) to get feedback on the performance of their approaches. To enter the test phase, participants must have submitted a short description of their approach by 28 February 2021. The test phases of the two tracks are organized sequentially: 1–5 March 2021 for Track DSE and 8–12 March 2021 for Track MSD. The test phases are kept short to ensure an objective and fair comparison among methods. Participants should submit source code for internal review by 12 March and 19 March 2021 for Track DSE and Track MSD, respectively, to be eligible to win. After a final check of the submitted classification maps compared with the undisclosed ground truth for testing, winners are to be announced on 26 March 2021. The evaluation server will be reopened after the announcement for further development in the field (see “Using the Data and Joining the Image Analysis and Data Fusion Technical Committee”).

More information about downloading the data and registering on the evaluation server can be found at the IADF TC website (<http://www.grss-ieee.org/community/technical-committees/data-fusion/>). Questions and comments about the data and the contest can be submitted to the IADF TC LinkedIn group (<https://www.linkedin.com/groups/3678437/>). Contest updates will also be published via the IADF Twitter channel, @grssiadf.

AWARDEES, AWARDS, AND PRIZES

The first-, second-, third-, and fourth-ranked teams in both tracks will be declared winners. They will be invited to submit their manuscripts to the 2021 IEEE International Geoscience and Remote Sensing Symposium (IGARSS) scheduled to be held in Brussels, Belgium. Each manuscript will describe the method used to achieve the winning results. All papers will be presented by the winners in oral invited sessions dedicated to the contest at IGARSS 2021. They will also be included in the IGARSS 2021 proceedings.

The eight winning teams will be awarded IEEE Certificates of Recognition. The first-, second-, and third-ranked teams in both tracks will receive a special prize. The first- and second-ranked teams in both tracks will coauthor journal papers, which will summarize the outcome of the contest and be submitted, with open access, to *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. The GRSS will cover the costs of the open-access fees. The organizing partners will sponsor the prizes for the winning teams. The winners of Track DSE will receive a total of US\$10,000 in prizes. The winners of Track MSD will receive a total of US\$20,000 in Azure cloud credits.

ACKNOWLEDGMENTS

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Using the Data and Joining the Image Analysis and Data Fusion Technical Committee

The 2021 Data Fusion Contest data will remain available to the IEEE Geoscience and Remote Sensing Society (GRSS) community for benchmarking algorithms and publishing research. The data are usable free of charge for scientific purposes, but the contest terms and conditions remain applicable. Please carefully read the stipulations at <http://www.grss-ieee.org/community/technical-committees/data-fusion/2020-ieee-grss-data-fusion-contest/>.

You can contact the GRSS Image Analysis and Data Fusion Technical Committee (IADF TC) chairs at iadf_chairs@grss-ieee.org. If you are interested in joining the IADF TC, please fill out the form at <http://www.grss-ieee.org/community/technical-committees/data-fusion/> or send an email including the following:

- ▶ first and last name
- ▶ institution/company
- ▶ country
- ▶ IEEE membership number (if available)
- ▶ email address.

Members receive information regarding research and applications related to image analysis and data fusion topics and updates about the Data Fusion Contest and other IADF TC activities. Membership is free. Also, you can join the LinkedIn IEEE GRSS Data Fusion discussion forum: <http://www.linkedin.com/groups/IEEE-GRSS-Data-Fusion-Discussion-3678437>.

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