Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

DAFTAR PUSTAKA

A Wentz, E., M Nelson, D., Rahman, A., L Stefanov, W., & Sen Roy, S. (2008). *Expert system classification of urban land use/cover for Delhi, India*. *29*(15), 4405–4427. https://doi.org/10.1080/01431160801905497

Al-Najjar, H. A. H., Kalantar, B., Pradhan, B., Saeidi, V., Halin, A. A., Ueda, N., & Mansor, S. (2019). Land Cover Classification from fused DSM and UAV Images Using Convolutional Neural Networks. *Remote Sensing*, *11*(12), 1461. https://doi.org/10.3390/rs11121461

Amine, R. M., & Hadria, F. I. (2012). *Integration of NDVI indices from the Tasseled Cap transformation for change detection in satellite images*. IJCSI International Journal of Computer Science Issues.

Aqeel Ashraf, M., Jamil Maah, M., & Yusoff, I. (2011). Introduction to Remote Sensing of Biomass. *Biomass and Remote Sensing of Biomass*. https://doi.org/10.5772/16462

Barsi, J., Lee, K., Kvaran, G., Markham, B., & Pedelty, J. (2014). The Spectral Response of the Landsat-8 Operational Land Imager. *Remote Sensing*, *6*(10), 10232–10251. https://doi.org/10.3390/rs61010232

Belgiu, M., & Drăguţ, L. (2016). Random forest in remote sensing: A review of applications and future directions. ISPRS journal of photogrammetry and remote sensing, 114, 24-31.

Cascante-Bonilla, P., Tan, F., Qi, Y., & Ordonez, V. (2021). Curriculum Labeling: Revisiting Pseudo-Labeling for Semi-Supervised Learning. *Proceedings of the AAAI Conference on Artificial Intelligence*, *35*(8), 6912–6920. https://doi.org/10.1609/aaai.v35i8.16852

Jin, J., Sun, B., Wang, L., Fang, B., Chang, Y., Li, Y., Zhang, J., Lyu, X., & Chen, G. (2022). Semi-supervised semantic segmentation framework with pseudo supervisions for land-use/land-cover mapping in coastal areas. *International Journal of Applied Earth Observation and Geoinformation*, *112*, 102881–102881. https://doi.org/10.1016/j.jag.2022.102881

Chen, K., Li, W., Chen, J., Zou, Z., & Shi, Z. (2022). Resolution-Agnostic Remote Sensing Scene Classification With Implicit Neural Representations. *IEEE Geoscience and Remote Sensing Letters*, *20*, 1–5. https://doi.org/10.1109/lgrs.2022.3228287

Chen, Z., & Wang, J. (2010). Land use and land cover change detection using satellite remote sensing techniques in the mountainous Three Gorges Area, China. *International Journal of Remote Sensing*, *31*(6), 1519–1542. https://doi.org/10.1080/01431160903475381

Clabaut, É., Foucher, S., Bouroubi, Y., & Germain, M. (2024). Synthetic Data for Sentinel-2 Semantic Segmentation. *Remote Sensing*, *16*(5), 818. https://doi.org/10.3390/rs16050818

Claverie, M., Ju, J., Masek, J. G., Dungan, J. L., Vermote, E. F., Roger, J.-C., Skakun , S. V., & Justice, C. (2018). The Harmonized Landsat and Sentinel-2 surface reflectance data set. *Remote Sensing of Environment*, *219*, 145–161. https://doi.org/10.1016/j.rse.2018.09.002

Clevers, J. G. P. W., & Gitelson, A. A. (2013). Remote estimation of crop and grass chlorophyll and nitrogen content using red-edge bands on Sentinel-2 and -3.

UNIVERSITAS GADJAH MADA
Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

International Journal of Applied Earth Observation and Geoinformation, *23*, 344–351. https://doi.org/10.1016/j.jag.2012.10.008

Congalton, R. G., & Green, K. (2019). *Assessing the Accuracy of Remotely Sensed Data*. CRC Press.

Danoedoro, P., Widayani, P., Hidayati, I. N., Sari, C., & Alfani, F. (2024). Incorporating landscape ecological approach in machine learning classification for agricultural land-use mapping based on a single date imagery. *Geocarto International*, *39*(1). https://doi.org/10.1080/10106049.2024.2356844

Dong, R., Li, W., Fu, H., Gan, L., Yu, L., Zheng, J., & Xia, M. (2019). Oil palm plantation mapping from high-resolution remote sensing images using deep learning. *International Journal of Remote Sensing*, *41*(5), 2022–2046. https://doi.org/10.1080/01431161.2019.1681604

Dong, S. W., Li, H., Sun, D. F., Zhang, W. W., & Zhou, L. D. (2013). Application Research of Remote Sensing in the Field of Land Use and Land Cover. *Advanced Materials Research*, *765-767*, 2374–2378. https://doi.org/10.4028/www.scientific.net/AMR.765-767.2374

Dong, S., Chen, Z., Gao, B., Guo, H., Sun, D., & Pan, Y. (2020). Stratified even sampling method for accuracy assessment of land use/land cover classification: a case study of Beijing, China. *International Journal of Remote Sensing*, *41*(16), 6427–6443. https://doi.org/10.1080/01431161.2020.1739349

Dopido, I., Li, J., Marpu, P. R., Plaza, A., Bioucas Dias, J. M., & Benediktsson, J. A. (2013). Semisupervised Self-Learning for Hyperspectral Image Classification. *IEEE Transactions on Geoscience and Remote Sensing*, *51*(7), 4032–4044. https://doi.org/10.1109/tgrs.2012.2228275

Engelen, J. E. van, & Hoos, H. H. (2019). A Survey on semi-supervised Learning. *Machine Learning*, *109*. https://doi.org/10.1007/s10994-019-05855-6

European Space Agency (ESA). (2025). Data Quality Report Sentinel-2 L1C MSI January 2025. *Mission Performance Centre*.

Fahrland, E., Jacob, P., Schrader, H., & Kahabka, H. (2022). Copernicus Digital Elevation Model Product Handbook (Version 5.0). Airbus Defence and Space GmbH.

Fitzpatrick-Lins, K. (1981). Comparison of sampling procedures and data analysis for a land- use and land-cover map. Photogrammetric Engineering & Remote Sensing, 47(3), 343–351.

Foody, G. M. (2002). Status of land cover classification accuracy assessment. *Remote Sensing of Environment*, *80*(1), 185–201. https://doi.org/10.1016/s0034-4257(01)00295-4

Giri, C. P. (2012). *Remote sensing of land use and land cover : principles and applications*. Crc, Cop.

Gui, B., Sam, L., Bhardwaj, A., Gómez, D. S., Peñaloza, F. G., Buchroithner, M. F., & Green, D. R. (2025). Optimizing object-based agricultural and ecological land use classification via multi-band fusion and seasonal spectral differences. *International Journal of Remote Sensing*, *46*(16), 6157–6188. https://doi.org/10.1080/01431161.2025.2532837

Gurjar, S. K., & Tare, V. (2019). Estimating long-term LULC changes in an agriculture-dominated basin using CORONA (1970) and LISS IV (2013–14) satellite images: a case study of Ramganga River, India. *Environmental Monitoring and Assessment*, *191*(4). https://doi.org/10.1007/s10661-019-7356-9

UNIVERSITAS
GADJAH MADA
Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Hamedianfar, A., Shafri, H. Z. M., Mansor, S., & Ahmad, N. (2014). Improving detailed rule-based feature extraction of urban areas from WorldView-2 image and lidar data. *International Journal of Remote Sensing*, *35*(5), 1876–1899. https://doi.org/10.1080/01431161.2013.879350

Han, W., Feng, R., Wang, L., & Cheng, Y. (2018). A semi-supervised generative framework with deep learning features for high-resolution remote sensing image scene classification. *ISPRS Journal of Photogrammetry and Remote Sensing*, *145*, 23–43. https://doi.org/10.1016/j.isprsjprs.2017.11.004

Hao, F., Ma, Z.-F., Tian, H.-P., Wang, H., & Wu, D. (2023). Semi-supervised label propagation for multi-source remote sensing image change detection. *Computers & Geosciences*, *170*, 105249–105249. https://doi.org/10.1016/j.cageo.2022.105249

Hao, M., Dong, X., Jiang, D., Yu, X., Ding, F., & Zhuo, J. (2024). Land-use classification based on high-resolution remote sensing imagery and deep learning models. *PLoS ONE*, *19*(4), e0300473–e0300473. https://doi.org/10.1371/journal.pone.0300473

Hapfelmeier, A., & Ulm, K. (2013). A new variable selection approach using Random Forests. *Computational Statistics & Data Analysis*, *60*, 50–69. https://doi.org/10.1016/j.csda.2012.09.020

Hu, H., Wei, F., Hu, H., Ye, Q., Cui, J., & Wang, L. (2021). Semi-Supervised Semantic Segmentation via Adaptive Equalization Learning. *ArXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2110.05474

Hu, Z., Yang, Z., Hu, X., & Ram Nevatia. (2021). SimPLE: Similar Pseudo Label Exploitation for Semi-Supervised Classification. *ArXiv (Cornell University)*. https://doi.org/10.1109/cvpr46437.2021.01485

Huang, W., Shi, Y., Xiong, Z., Wang, Q., & Xiao Xiang Zhu. (2023). Semi-supervised bidirectional alignment for Remote Sensing cross-domain scene classification. *ISPRS Journal of Photogrammetry and Remote Sensing*, *195*, 192–203. https://doi.org/10.1016/j.isprsjprs.2022.11.013

Huete, A. R. (1988). A soil-adjusted vegetation index (SAVI). *Remote Sensing of Environment*, *25*(3), 295–309. https://doi.org/10.1016/0034-4257(88)90106-x

Immitzer, M., Vuolo, F., & Atzberger, C. (2016). First Experience with Sentinel-2 Data for Crop and Tree Species Classifications in Central Europe. *Remote Sensing*, *8*(3), 166. https://doi.org/10.3390/rs8030166

Iscen, A., Tolias, G., Avrithis, Y., & Chum, O. (2019). *Label Propagation for Deep Semi-Supervised Learning*. https://doi.org/10.1109/cvpr.2019.00521

Issa, S., & Sultan, M. (2024). Land use and land cover mapping using Google Earth Engine: A comparative analysis of machine learning algorithms. *Seventh International Conference on Engineering Geophysics, al Ain, UAE, 16–19 October 2023*, 147–151. https://doi.org/10.1190/iceg2023-034.1

Jensen, J. R. (2016). *Introductory digital image processing : a remote sensing perspective* (4th ed.). Pearson Education, Inc.

Jin, H., & Mountrakis, G. (2022). Fusion of optical, radar and waveform LiDAR observations for land cover classification. *ISPRS Journal of Photogrammetry and Remote Sensing*, *187*, 171–190. https://doi.org/10.1016/j.isprsjprs.2022.03.010

Jin, Y., Liu, X., Chen, Y., & Liang, X. (2018). Land-cover mapping using Random Forest classification and incorporating NDVI time-series and texture: a case study of central Shandong. *International Journal of Remote Sensing*, *39*(23), 8703–8723. https://doi.org/10.1080/01431161.2018.1490976

UNIVERSITAS
GADJAH MADA
Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Johnson, B. (2015). Scale Issues Related to the Accuracy Assessment of Land Use/Land Cover Maps Produced Using Multi-Resolution Data: Comments on "The Improvement of Land Cover Classification by Thermal Remote Sensing". Remote Sens. 2015, 7(7),8368–8390. *Remote Sensing*, *7*(10), 13436–13439. https://doi.org/10.3390/rs71013436

Johnson, N., Treible, W., & Crispell, D. (2022, June 1). *OpenSentinelMap: A Large-Scale Land Use Dataset using OpenStreetMap and Sentinel-2 Imagery*. IEEE Xplore. https://doi.org/10.1109/CVPRW56347.2022.00139

Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). ImageNet Classification with Deep Convolutional Neural Networks. *Communications of the ACM*, *60*(6), 84–90. https://proceedings.neurips.cc/paper_files/paper/2012/file/c399862d3b9d6b76c8436e924a68c45b-Paper.pdf

Laine, S., & Aila, T. (2017, March 15). *Temporal Ensembling for Semi-Supervised Learning*. ArXiv.org. https://doi.org/10.48550/arXiv.1610.02242

Lambin, E. F. (2001). Remote Sensing and Geographic Information Systems Analysis. *Elsevier EBooks*, 13150–13155. https://doi.org/10.1016/b0-08-043076-7/04200-5

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep Learning. *Nature*, *521*(7553), 436–444. https://doi.org/10.1038/nature14539

Lee, J. A., Lee, S. S., & Chi, K. H. (2010). Development of an urban classification method using a built-up index. *In Proceedings of the Sixth WSEAS International Conference on Remote Sensing, Iwate Prefectural University, Iwate, Japan*.

Li, B., Wang, Q.-W., Liang, J.-H., Zhu, E.-Z., & Zhou, R.-Q. (2023). SquconvNet: Deep Sequencer Convolutional Network for Hyperspectral Image Classification. *Remote Sensing*, *15*(4), 983. https://doi.org/10.3390/rs15040983

Li, C., Ma, Z., Wang, L., Yu, W., Tan, D., Gao, B., Feng, Q., Guo, H., & Zhao, Y. (2021). Improving the Accuracy of Land Cover Mapping by Distributing Training Samples. *Remote Sensing*, *13*(22), 4594. https://doi.org/10.3390/rs13224594

Li, E., Du, P., Samat, A., Xia, J., & Che, M. (2015). *An automatic approach for urban land-cover classification from Landsat-8 OLI data*. *36*(24), 5983–6007. https://doi.org/10.1080/01431161.2015.1109726

Li, J., Zhu, L., & Du, Z. (2024). Unsupervised Domain Adaptation. In *Machine learning*. Springer Nature. https://doi.org/10.1007/978-981-97-1025-6

Li, X., Wu, T., Liu, K., Li, Y., & Zhang, L. (2016). Evaluation of the Chinese Fine Spatial Resolution Hyperspectral Satellite TianGong-1 in Urban Land-Cover Classification. *Remote Sensing*, *8*(5), 438. https://doi.org/10.3390/rs8050438

Li, Z., Chen, B., Wu, S., Su, M., Chen, J. M., & Xu, B. (2024). Deep learning for urban land use category classification: A review and experimental assessment. *Remote Sensing of Environment*, *311*, 114290–114290. https://doi.org/10.1016/j.rse.2024.114290

Li, Z., Zou, J., Lu, F., & Zhang, H. (2022). Multi-Stage Pseudo-Label Iteration Framework for Semi-Supervised Land-Cover Mapping. *IGARSS 2022 - 2022 IEEE International Geoscience and Remote Sensing Symposium*, 4607–4610. https://doi.org/10.1109/igarss46834.2022.9884345

Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). *Remote sensing and image interpretation.* Wiley.

Lisa, F. T., Zarif Hossain, Md., Mou, S. N., Ivan, S., & Kabir, Md. H. (2022). Land Cover and Land Use Detection using Semi-Supervised Learning. *2022 25th International*

UNIVERSITAS GADJAH MADA
Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Conference on Computer and Information Technology (ICCIT), *33*, 164–169. https://doi.org/10.1109/iccit57492.2022.10055591

Long, J., Shelhamer, E., & Darrell, T. (2014). *Fully Convolutional Networks for Semantic Segmentation*. ArXiv.org. https://doi.org/10.48550/arXiv.1411.4038

Lucas, B., Pelletier, C., Schmidt, D., Webb, G. I., & Petitjean, F. (2021). A Bayesian-inspired, deep learning-based, semi-supervised domain adaptation technique for land cover mapping. *Machine Learning*. https://doi.org/10.1007/s10994-020-05942-z

Luo, Y., Zhu, J., Li, M., Ren, Y., & Zhang, B. (2017). Smooth Neighbors on Teacher Graphs for Semi-supervised Learning. *ArXiv (Cornell University)*. https://doi.org/10.48550/arxiv.1711.00258

M. Viana, C., Girão, I., & Rocha, J. (2019). Long-Term Satellite Image Time-Series for Land Use/Land Cover Change Detection Using Refined Open Source Data in a Rural Region. *Remote Sensing*, *11*(9), 1104. https://doi.org/10.3390/rs11091104

Ma, W., Karakuş, O., & L Rosin, P. (2023). Confidence Guided Semi-Supervised Learning in Land Cover Classification. *ArXiv (Cornell University)*. https://doi.org/10.1109/igarss52108.2023.10281770

Maretto, R. V., Fonseca, L. M., Jacobs, N., Körting, T. S., Bendini, H. N., & Parente, L. L. (2020). Spatio-temporal deep learning approach to map deforestation in amazon rainforest. IEEE Geoscience and Remote Sensing Letters, 18(5), 771 775.

Markham, B. L., Barsi, J. A., Kaita, E., Ong, L., Md. Obaidul Haque, Mishra, N., Czapla-Myers, J., Nima Pahlevan, & Helder, D. L. (2014). Landsat-8 operational land imager on-orbit radiometric calibration and stability. *Proceedings of SPIE*. https://doi.org/10.1117/12.2063159

McFEETERS, S. K. (1996). The use of the Normalized Difference Water Index (NDWI) in the delineation of open water features. *International Journal of Remote Sensing*, *17*(7), 1425–1432. https://doi.org/10.1080/01431169608948714

McLachlan, G. J. (1975). Iterative Reclassification Procedure for Constructing an Asymptotically Optimal Rule of Allocation in Discriminant Analysis. *Journal of the American Statistical Association*, *70*(350), 365–365. https://doi.org/10.2307/2285824

Miao, W., Geng, J., & Jiang, W. (2022). Semi-Supervised Remote Sensing Image Scene Classification Using Representation Consistency Siamese Network. *IEEE Transactions on Geoscience and Remote Sensing*, 1–1. https://doi.org/10.1109/tgrs.2022.3140485

Mirpulatov, I., Illarionova, S., Shadrin, D., & Burnaev, E. (2023). Pseudo-Labeling Approach for Land Cover Classification Through Remote Sensing Observations With Noisy Labels. *IEEE Access*, *11*, 82570–82583. https://doi.org/10.1109/access.2023.3300967

Miyato, T., Maeda, S., Koyama, M., & Ishii, S. (2018, June 27). *Virtual Adversarial Training: A Regularization Method for Supervised and Semi-Supervised Learning*. ArXiv.org. https://doi.org/10.48550/arXiv.1704.03976

Moore, I. D., Grayson, R. B., & Ladson, A. R. (1991). Digital terrain modelling: A review of hydrological, geomorphological, and biological applications. *Hydrological Processes*, *5*(1), 3–30. https://doi.org/10.1002/hyp.3360050103

Nayeem Rizve, M., Duarte, K., S. Rawat, Y., & Shah, M. (2021, April 19). *In Defense of Pseudo-Labeling: An Uncertainty-Aware Pseudo-label Selection Framework for Semi-Supervised Learning*. ArXiv.org. https://doi.org/10.48550/arXiv.2101.06329

UNIVERSITAS
GADJAH MADA
**Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan**
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Nijland, W., Addink, E. A., Jong, & van. (2009). Optimizing spatial image support for quantitative mapping of natural vegetation. *Remote Sensing of Environment*, *113*(4), 771–780. https://doi.org/10.1016/j.rse.2008.12.002

OECD. (2019). Glossary of Statistical Terms. In Organisation for Economic Co operation and Development. United Nations Statistical Division's data dictionary of official definitions.

Ojwang, G. O., Ogutu, J. O., Said, M. Y., Ojwala, M. A., Kifugo, S. C., Verones, F., Graae, B. J., Buitenwerf, R., & Olff, H. (2024). An integrated hierarchical classification and machine learning approach for mapping land use and land cover in complex social-ecological systems. *Frontiers in Remote Sensing*, *4*. https://doi.org/10.3389/frsen.2023.1188635

OTB Development Team. (2024). *Orfeo ToolBox 9.1.0 Documentation: LargeScaleMeanShift*. Retrieved from https://www.orfeo-toolbox.org/CookBook/Applications/app_LargeScaleMeanShift.html

Pal, M., & Mather, P. M. (2004). Assessment of the effectiveness of support vector machines for hyperspectral data. *Future Generation Computer Systems*, *20*(7), 1215–1225. https://doi.org/10.1016/j.future.2003.11.011

Pasternak, M., & Filipiak, K. P. (2022). The Evaluation of Spectral Vegetation Indexes and Redundancy Reduction on the Accuracy of Crop Type Detection. *Applied Sciences*, *12*(10), 5067–5067. https://doi.org/10.3390/app12105067

Peng, J., Huang, Y.-F., Sun, W., Chen, N., Ning, Y., & Du, Q. (2022). Domain Adaptation in Remote Sensing Image Classification: A Survey. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, *15*, 9842–9859. https://doi.org/10.1109/jstars.2022.3220875

Petrushevsky, N., Manzoni, M., & Monti-Guarnieri, A. (2021). Fast Urban Land Cover Mapping Exploiting Sentinel-1 and Sentinel-2 Data. *Remote Sensing*, *14*(1), 36. https://doi.org/10.3390/rs14010036

Phan, T. N., Kuch, V., & Lehnert, L. W. (2020). Land Cover Classification using Google Earth Engine and Random Forest Classifier—The Role of Image Composition. *Remote Sensing*, *12*(15), 2411. https://doi.org/10.3390/rs12152411

Piedelobo, L., Hernández-López, D., Ballesteros, R., Chakhar, A., Del Pozo, S., González-Aguilera, D., & Moreno, M. A. (2019). Scalable pixel-based crop classification combining Sentinel-2 and Landsat-8 data time series: Case study of the Duero river basin. *Agricultural Systems*, *171*, 36–50. https://doi.org/10.1016/j.agsy.2019.01.005

Ran, L., Li, Y., Liang, G., & Zhang, Y. (2024). Pseudo Labeling Methods for Semi-Supervised Semantic Segmentation: A Review and Future Perspectives. *IEEE Transactions on Circuits and Systems for Video Technology*, 1–1. https://doi.org/10.1109/tcsvt.2024.3508768

Reddy, G. M. (2018). *Satellite Remote Sensing Sensors: Principles and Applications*. 21–43. https://doi.org/10.1007/978-3-319-78711-4_2

Ronneberger, O., Fischer, P., & Brox, T. (2015). *U-Net: Convolutional Networks for Biomedical Image Segmentation*. ArXiv.org. https://doi.org/10.48550/arXiv.1505.04597

Rouse, J. W., Haas, R. H., Schell, J. A., & Deering, D. W. (1973). *Monitoring Vegetation Systems in the Great Plains with ERTS*. In Proceedings of the Third ERTS Symposium. NASA SP-351; NASA: Washington, DC, USA.

UNIVERSITAS
GADJAH MADA
**Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan**
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Rousset, G., Despinoy, M., Schindler, K., & Mangeas, M. (2021). Assessment of Deep Learning Techniques for Land Use Land Cover Classification in Southern New Caledonia. *Remote Sensing*, *13*(12), 2257. https://doi.org/10.3390/rs13122257

Roziani Jamru, L., Nazril Sharil, M., Jafar, A., Valentine Eboy, O., Atang, C., & Abdul Talib, M. (2023). The Effectiveness of Remote Sensing Techniques for Land use Classification in Kota Belud, Sabah. *Asian Journal of Research in Education and Social Sciences*. https://doi.org/10.55057/ajress.2023.5.2.10

Saini, R., & Rawat, S. (2023). *Land Use Land Cover Classification in Remote Sensing Using Machine Learning Techniques*. https://doi.org/10.1109/ihcsp56702.2023.10127126

Sajan, A., & M, D. (2023). *Performance Assessment of Various Machine Learning Classification Methods for Classifying the Landcover Using Landsat 8 OLI*. https://doi.org/10.1109/conit59222.2023.10205822

Sajjadi, M., Javanmardi, M., & Tasdizen, T. (2016). Mutual Exclusivity Loss for Semi-Supervised Deep Learning. *ArXiv (Cornell University)*. https://doi.org/10.48550/arxiv.1606.03141

Scaioni, M., Longoni, L., Melillo, V., & Papini, M. (2014). Remote Sensing for Landslide Investigations: An Overview of Recent Achievements and Perspectives. *Remote Sensing*, *6*(10), 9600–9652. https://doi.org/10.3390/rs6109600

Scudder, H. (1965). Probability of error of some adaptive pattern-recognition machines. *IEEE Transactions on Information Theory*, *11*(3), 363–371. https://doi.org/10.1109/tit.1965.1053799

Settles, B. (n.d.). *Active Learning Literature Survey*. Retrieved September 19, 2019, from http://axon.cs.byu.edu/~martinez/classes/778/Papers/settles.activelearning.pdf

Slaton, M. R., Raymond Hunt, E., & Smith, W. K. (2001). Estimating near-infrared leaf reflectance from leaf structural characteristics. *American Journal of Botany*, *88*(2), 278–284. https://doi.org/10.2307/2657019

Silvestre Macarringue, L., Luis Bolfe, É., & Roberto Mendes Pereira, P. (2022). Developments in Land Use and Land Cover Classification Techniques in Remote Sensing: A Review. *Journal of Geographic Information System*, *14*(01), 1–28. https://doi.org/10.4236/jgis.2022.141001

Sohn, K., Berthelot, D., Li, C.-L., Zhang, Z., Carlini, N., Cubuk, E. D., Kurakin, A., Zhang, H., & Raffel, C. (2020). FixMatch: Simplifying Semi-Supervised Learning with Consistency and Confidence. *Neural Information Processing Systems*, *33*, 596–608.

Sørensen, R., Zinko, U., & Seibert, J. (2006). On the calculation of the topographic wetness index: evaluation of different methods based on field observations. *Hydrology and Earth System Sciences*, *10*(1), 101–112. https://doi.org/10.5194/hess-10-101-2006

Southworth, J., Smith, A. C., Safaei, M., Rahaman, M., Alruzuq, A., Tefera, B. B., Muir, C. S., & Herrero, H. V. (2024). Machine learning versus deep learning in land system science: a decision-making framework for effective land classification. *Frontiers in Remote Sensing*, *5*. https://doi.org/10.3389/frsen.2024.1374862

Stefanov, W. L., & Netzband, M. (2005). Assessment of ASTER land cover and MODIS NDVI data at multiple scales for ecological characterization of an arid urban center. *Remote Sensing of Environment*, *99*(1-2), 31–43. https://doi.org/10.1016/j.rse.2005.04.024

UNIVERSITAS GADJAH MADA
Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Stehman, S. V. (2009). Sampling designs for accuracy assessment of land cover. *International Journal of Remote Sensing*, *30*(20), 5243–5272. https://doi.org/10.1080/01431160903131000

Stoimchev, M., Levatić, J., Kocev, D., & Džeroski, S. (2024). Semi-Supervised Multi-Label Classification of Land Use/Land Cover in Remote Sensing Images With Predictive Clustering Trees and Ensembles. *IEEE Transactions on Geoscience and Remote Sensing*, *62*, 1–16. https://doi.org/10.1109/tgrs.2024.3426981

Sun, R., Masson, C., Gilles Hénaff, Thome, N., & Cord, M. (2023). Semantic augmentation by mixing contents for semi-supervised learning. *Pattern Recognition*, *145*, 109909–109909. https://doi.org/10.1016/j.patcog.2023.109909

Sun, Y., Bi, F., Gao, Y., Chen, L., & Feng, S. (2022). A Multi-Attention UNet for Semantic Segmentation in Remote Sensing Images. *Symmetry*, *14*(5), 906. https://doi.org/10.3390/sym14050906

Sutanto. (2010). REMOTE SENSING RESEARCH: A User's Perspective. *Indonesian Journal of Geography*, *42*(2). https://doi.org/10.22146/ijg.2287

Szabó, S., Gácsi, Z., & Balázs, B. (2016). Specific features of NDVI, NDWI and MNDWI as reflected in land cover categories. *Landscape & Environment*, *10*(3-4), 194–202. https://doi.org/10.21120/le/10/3-4/13

Taha, K. (2023). Semi-supervised and un-supervised clustering: A review and experimental evaluation. *Information Systems*, 102178. https://doi.org/10.1016/j.is.2023.102178

Talukdar, S., Singha, P., Mahato, S., Shahfahad, Pal, S., Liou, Y.-A., & Rahman, A. (2020). Land-Use Land-Cover Classification by Machine Learning Classifiers for Satellite Observations—A Review. *Remote Sensing*, *12*(7), 1135. https://doi.org/10.3390/rs12071135

Tarvainen, A., & Valpola, H. (2017). Mean teachers are better role models: Weight-averaged consistency targets improve semi-supervised deep learning results. *ArXiv (Cornell University)*. https://doi.org/10.48550/arxiv.1703.01780

Teillet, P. (1997). Effects of spectral, spatial, and radiometric characteristics on remote sensing vegetation indices of forested regions. *Remote Sensing of Environment*, *61*(1), 139–149. https://doi.org/10.1016/s0034-4257(96)00248-9

Toure, S. I., Stow, D. A., Shih, H., Weeks, J., & Lopez-Carr, D. (2018). Land cover and land use change analysis using multi-spatial resolution data and object-based image analysis. *Remote Sensing of Environment*, *210*, 259–268. https://doi.org/10.1016/j.rse.2018.03.023

Triguero, I., García, S., & Herrera, F. (2013). Self-labeled techniques for semi-supervised learning: taxonomy, software and empirical study. *Knowledge and Information Systems*, *42*(2), 245–284. https://doi.org/10.1007/s10115-013-0706-y

Usman, M., Liedl, R., Shahid, M. A., & Abbas, A. (2015). Land use/land cover classification and its change detection using multi-temporal MODIS NDVI data. *Journal of Geographical Sciences*, *25*(12), 1479–1506. https://doi.org/10.1007/s11442-015-1247-y

USTIN, S. L., ROBERTS, D. A., GAMON, J. A., ASNER, G. P., & GREEN, R. O. (2004). Using Imaging Spectroscopy to Study Ecosystem Processes and Properties. *BioScience*, *54*(6), 523. https://doi.org/10.1641/0006-3568(2004)054%5B0523:uistse%5D2.0.co;2

UNIVERSITAS
GADJAH MADA
**Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan**
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Wang, R., & Pun, M.-O. (2021). Robust Semisupervised Land-Use Classification Using Remote Sensing Data With Weak Labels. *IEEE Access*, *10*, 43435–43453. https://doi.org/10.1109/access.2021.3109989

Wang, R., Collins, L. M., Bradbury, K., & Malof, J. M. (2018). *Semisupervised Adversarial Discriminative Domain Adaptation, with Applicationto Remote Sensing Data*. https://doi.org/10.1109/igarss.2018.8518096

Wittke, S., Yu, X., Karjalainen, M., Hyyppä, J., & Puttonen, E. (2019). *Comparison of two-dimensional multitemporal Sentinel-2 data with three-dimensional remote sensing data sources for forest inventory parameter estimation over a boreal forest*. *76*, 167–178. https://doi.org/10.1016/j.jag.2018.11.009

Wu, K., Jia, Z., & Duan, Q. (2023). The Detection of Kiwifruit Sunscald Using Spectral Reflectance Data Combined with Machine Learning and CNNs. *Agronomy*, *13*(8), 2137–2137. https://doi.org/10.3390/agronomy13082137

Xia, J., Broni-Bediako, C., & Naoto Yokoya. (2025). Generating national very high-resolution land cover product of France without any labels: A comparative study. *Remote Sensing Applications Society and Environment*, *38*, 101542–101542. https://doi.org/10.1016/j.rsase.2025.101542

Xie, Q., Dai, Z., Hovy, E., Luong, M.-T., & Le, Q. V. (2020, November 5). *Unsupervised Data Augmentation for Consistency Training*. ArXiv. https://doi.org/10.48550/arXiv.1904.12848

Xu, H. (2008). A new index for delineating built-up land features in satellite imagery. *International Journal of Remote Sensing*, *29*(14), 4269–4276. https://doi.org/10.1080/01431160802039957

Xu, H.-G. (2005). A Study on Information Extraction of Water Body with the Modified Normalized Difference Water Index (MNDWI). *Journal of Remote Sensing*, *0*(5), 589–595. https://doi.org/10.11834/jrs.20050586

Xu, Y., Zhou, J., & Zhang, Z. (2024). A new Bayesian semi-supervised active learning framework for large-scale crop mapping using Sentinel-2 imagery. *Isprs Journal of Photogrammetry and Remote Sensing*, *209*, 17–34. https://doi.org/10.1016/j.isprsjprs.2024.01.023

Yu, Y.-C., & Lin, H.-T. (2023). *Semi-Supervised Domain Adaptation with Source Label Adaptation*. https://doi.org/10.1109/cvpr52729.2023.02308

Zha, Y., Gao, J., & Ni, S. (2003). Use of normalized difference built-up index in automatically mapping urban areas from TM imagery. *International Journal of Remote Sensing*, *24*(3), 583–594. https://doi.org/10.1080/01431160304987

Zhang, B., Wang, Y., Hou, W., Wu, H., Wang, J., Okumura, M., & Shinozaki, T. (2022, January 28). *FlexMatch: Boosting Semi-Supervised Learning with Curriculum Pseudo Labeling*. ArXiv.org. https://doi.org/10.48550/arXiv.2110.08263

Zhang, C., Sargent, I., Pan, X., Li, H., Gardiner, A., Hare, J., & Atkinson, P. M. (2019). Joint Deep Learning for land cover and land use classification. *Remote Sensing of Environment*, *221*, 173–187. https://doi.org/10.1016/j.rse.2018.11.014

Zhang, X., Huang, L., Lv, J., & Yang, M. (2024). Self Adaptive Threshold Pseudo-labeling and Unreliable Sample Contrastive Loss for Semi-supervised Image Classification. *ArXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2407.03596

UNIVERSITAS
GADJAH MADA
Komparasi Efektivitas Supervised Learning (Random Forest & U-Net) Dengan Semi-Supervised Learning
Berbasis Pseudo-Labeling Untuk Pemetaan Penggunaan Lahan
Diniyarti, Projo Danoedoro, M.Sc., Ph.D. ; Dr. Iswari Nur Hidayati, M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Zhao, S., Tu, K., Ye, S., Tang, H., Hu, Y., & Xie, C. (2023). Land Use and Land Cover Classification Meets Deep Learning: A Review. *Sensors*, *23*(21), 8966–8966. https://doi.org/10.3390/s23218966

Zhu, L., Suomalainen, J., Liu, J., Hyyppä, J., Kaartinen, H., & Haggren, H. (2018). A Review: Remote Sensing Sensors. *Multi-Purposeful Application of Geospatial Data*. https://doi.org/10.5772/intechopen.71049

Zhu, X. (2005). Semi-supervised learning literature survey. *University of Wisconsin-Madison*.

Zhu, X. X., Tuia, D., Mou, L., Xia, G.-S., Zhang, L., Xu, F., & Fraundorfer, F. (2017). Deep Learning in Remote Sensing: A Comprehensive Review and List of Resources. *IEEE Geoscience and Remote Sensing Magazine*, *5*(4), 8–36. https://doi.org/10.1109/mgrs.2017.2762307

Zhu, X., & Goldberg, A. B. (2009). Introduction to Semi-Supervised Learning. In *Synthesis Lectures on Artificial Intelligence and Machine Learning*. Springer International Publishing. https://doi.org/10.1007/978-3-031-01548-9

Zurqani, H. A., Post, C. J., Mikhailova, E. A., Schlautman, M. A., & Sharp, J. L. (2018). Geospatial analysis of land use change in the Savannah River Basin using Google Earth Engine. *International Journal of Applied Earth Observation and Geoinformation*, *69*, 175–185. https://doi.org/10.1016/j.jag.2017.12.006