

DR. MATTHEW L. CLARK

EDUCATION

- Ph.D. Geography. 2005. University of California, Santa Barbara USA
Dissertation: *An assessment of hyperspectral and lidar remote sensing for the monitoring of tropical rain forest trees*, Chair Dr. Dar Roberts
- M.S. Ecosystem Analysis and Conservation. 1998. University of Washington, Seattle USA
Thesis: *An analysis of Western Olympic Peninsula forest structure using combined synthetic aperture radar and Landsat thematic mapper images*, Chair Dr. John Vande Castle
- B.A. Environmental Science. 1993. University of California, Berkeley USA
- B.A. Integrative Biology 1993. University of California, Berkeley USA

PROFESSIONAL EMPLOYMENT AND APPOINTMENTS

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| 2017 – present | Professor, Department of Geography, Environment, and Planning, Sonoma State University, California |
| 2006 – present | Director, Center for Interdisciplinary Geospatial Analysis (CIGA), Sonoma State University, California |
| 2015 – present | Editorial Board, Remote Sensing |
| 2011 – present | Editorial Board, Remote Sensing of Environment |
| 2015 – 2021 | Editorial Board, Remote Sensing Applications: Society and Environment |
| 2012 – 2017 | Associate Professor, Department of Geography and Global Studies, Sonoma State University, California |
| 2013 - 2016 | Department Chair, Department of Geography and Global Studies, Sonoma State University, California |
| 2006 – 2012 | Assistant Professor, Department of Geography and Global Studies, Sonoma State University, California |
| 2005 – 2006 | Geospatial Scientist, The Nature Conservancy, Arlington, Virginia |

GRANTS AND CONTRACTS

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| 2024- present | NASA - <i>Deriving continuous maps of forest structure to characterize the relationship between fuels, burn severity, and post-fire vegetation transitions across California wildfires</i> (Co-I; PI – Christopher Hakkenber, Northern Arizona U.) | \$499,776 |
| 2023- present | NASA - Development of a species detection and monitoring web-based application based on bioacoustics and artificial intelligence (PI) | \$99,229 |
| 2022- present | NASA - <i>BioSoundSCape: Connecting acoustics and remote sensing to study habitat-animal diversity across environmental gradients</i> (PI) | \$492,105 |
| 2022- present | Cal Fire Forest Health - <i>Timely prediction of wildfire burn severity in California forests with spaceborne observations of 3D vegetation structure</i> (PI) | \$492,779 |
| 2019- present | Agricultural Resources Institute - <i>Remote sensing of 3D forest structure for fire fuels management and carbon accounting management approaches</i> (co-I; PI – Lisa Bentley) | \$448,020 |
| 2019- present | Cal Fire Forest Health - <i>Evaluating plot-level remote sensing tools to increase accuracy and efficiency of fuels management approaches</i> (co-I; PI – Lisa Bentley) | \$448,552 |

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| 2017-present | NASA <i>Soundscapes to Landscapes: Monitoring Animal Biodiversity from Space Using Citizen Scientists</i> (PI) | \$1,304,487 |
| 2016-2018 | NASA <i>EdgeCube: A 1U Global Monitor for Earth's Ecosystems</i> (co-I; PI – Lynn Cominsky) | \$200,000 |
| 2012-2018 | NASA HypsIRI Preparatory Airborne Activities and Associated Science – <i>Spectral and temporal discrimination of vegetation cover across California with simulated HypsIRI imagery</i> (PI) | \$604,000 |
| 2007-2012 | National Science Foundation – <i>The impact of economic globalization on human demography, land use, and natural systems in Latin America and Caribbean</i> (PI) | \$1.5 million (\$655,468 SSU) |

PUBLICATIONS

- Quinn, C.A., Jantz, P., Salas, L., Goetz, S., **Clark, M.** (2024). Soundscape mapping: understanding regional spatial and temporal patterns of soundscapes in the context of remotely-sensed predictors and wildfire disturbance. *Environmental Research: Ecology*.
<https://iopscience.iop.org/article/10.1088/2752-664X/ad4bec/meta>
- Quinn, C., Burns, P., Hakkenberg, C. R., Salas, L., Pasch, B., Goetz, S., & **Clark, M.** (2023). Soundscape components inform acoustic index patterns and refine estimates of bird species richness. *Frontiers in Remote Sensing*, 4, 35. <https://doi.org/10.3389/frsen.2023.1156837>
- Krause, P., Forbes, B., Barajas-Ritchie, A. **Clark, M.**, Disney, D., Wilkes, P., Patrick Bentley, L. (2023). Using terrestrial laser scanning to evaluate non-destructive aboveground biomass allometries in diverse Northern California forests. *Frontiers in Remote Sensing*. 4.
<https://doi.org/10.3389/frsen.2023.1132208>
- Clark, M. L.**, Salas, L., Baligar, S., Quinn, C. A., Snyder, R. L., Leland, D., Schackwitz, W., Goetz, S.J. & Newsam, S. (2023). The effect of soundscape composition on bird vocalization classification in a citizen science biodiversity monitoring project. *Ecological Informatics*, 102065.
- Quinn, Q.A., Burns, P., Gill, G., Baligar, S., Snyder, R.L., Salas, L., Goetz, S.J., **Clark, M.L.** (2022). Soundscape classification with convolutional neural networks reveals temporal and geographic patterns in ecoacoustic data. *Ecological Indicators*, 138.
<https://doi.org/10.1016/j.ecolind.2022.108831>.
- Snyder, R., **Clark, M.**, Salas, L., Schackwitz, W., Leland, D., Stephens, T., Erickson, T., Tuffli, T., Tuffli, M., Clas, K. (2022). The Soundscapes to Landscapes Project: Development of a Bioacoustics-Based Monitoring Workflow with Multiple Citizen Scientist Contributions. *Citizen Science: Theory and Practice*. 7(1), p.24. DOI: <http://doi.org/10.5334/cstp.391>
- Forbes, B., Reilly, S., **Clark, M.**, Ferrell, R., Kelly, A., Krause, P., Matley, C., O’Neil, M., Villasenor, M., Disney, M., Wilkes, P., Bentley, LP. (2022) Comparing remote sensing and field-based approaches to estimate ladder fuels and predict wildfire burn severity. *Frontiers in Forests and Global Change*, 5. <https://doi.org/10.3389/ffgc.2022.818713>
- López-Carr, D., Ryan, S. J., **Clark, M.** (2022). Global economic and diet transitions drive Latin American and Caribbean forest change during the first decade of the century: a multi-scale analysis of socioeconomic, demographic, and environmental drivers of local forest cover change. *Land*, 11(3), 326. <https://doi.org/10.3390/land11030326>
- Clark, M.L.**, Ruiz, J., Fandino, M.C., López-Carr, D. (2021). Conservation priorities in terrestrial protected areas for Latin America and the Caribbean based on an ecoregional analysis of woody vegetation change, 2001–2010. *Land*, 10(10):1067. <https://doi.org/10.3390/land10101067>
- Reilly, S., **Clark, M.**, Bentley, L.B., Matley, C., Piazza, E., Oliveras, I. (2021). The potential of multispectral imagery and 3D point clouds from unoccupied aerial systems (UAS) for

- monitoring forest structure and the impacts of wildfire in Mediterranean-climate forests. *Remote Sensing*, 13, 3810. <https://doi.org/10.3390/rs13193810>
- Okujeni, A., Jänicke, C., Cooper, S., Frantz, D., Hostert, P., **Clark, M.**, Segl, K., van der Linden, S. (2021). Multi-season unmixing of vegetation class fractions across diverse Californian ecoregions using simulated spaceborne imaging spectroscopy data. *Remote Sensing of Environment*, 264, 112558. <https://doi.org/10.1016/j.rse.2021.112558>
- Green, K., Tukman, M., Loudon, D., Schichtel, A., Gaffney, K., **Clark, M.** (2020). Sonoma County Complex Fires of 2017: Remote sensing data and modeling to support ecosystem and community resiliency. *California Fish and Wildlife 2020 Special Fire Issue*. <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=184827&inline>
- Cooper, S., Okujeni, A., Jänicke, C., **Clark, M.**, van der Linden, S., Hostert, P. (2020). Disentangling fractional vegetation cover: regression-based unmixing of simulated spaceborne imaging spectroscopy data. *Remote Sensing of Environment*. 246, 111856. <https://doi.org/10.1016/j.rse.2020.111856>
- Burns, P., **Clark, M.**, Salas, L., Hancock, S., Jantz, P., Leland, D., Dubayah, R., Goetz, S. (2020). Incorporating canopy structure from simulated GEDI lidar into bird species distribution models. *Environmental Research Letters*. 15, 095002. <https://doi.org/10.1088/1748-9326/ab80ee>
- Ackerly, D.D., Kling, M.M., **Clark, M.L.**, Papper, P., Oldfather, M.F., Flint, A.L., Flint, L.E. (2020). Topoclimates, refugia, and biotic responses to climate change. *Frontiers in Ecology and Environment*. <https://doi.org/10.1002/fee.2204>.
- Clark, M. L.** (2020). Comparison of multi-seasonal Landsat 8, Sentinel-2 and hyperspectral images for mapping forest alliances in Northern California. *ISPRS Journal of Photogrammetry and Remote Sensing*, 119, 228-245.
- Jänicke, C., Okujeni, A., Cooper, S., **Clark, M.**, Hostert, P., & van der Linden, S. (2020). Brightness gradient-corrected hyperspectral image mosaics for fractional vegetation cover mapping in northern California. *Remote Sensing Letters*, 11(1), 1-10.
- Ackerly, D.D., Kozanitas, M., Papper, P. Oldfather, M., **Clark, M.** (2019). Mortality and resprouting in California oak woodlands following mixed-severity fire. Pp. 23-30. Proceedings of the International Oak Society, Davis CA.
- Clark, M. L.**, Buck-Diaz, J., Evens, J. (2018). Mapping of forest alliances with simulated multi-seasonal hyperspectral imagery and machine learning classifiers. *Remote Sensing of Environment*, 210, 490–507.
- Blundo, C., Gasparri, N. I., Malizia, A., **Clark, M.**, Gatti, G., Campanello, P. I., ... & MacDonagh, P. (2018). Relationships among phenology, climate and biomass across subtropical forests in Argentina. *Journal of Tropical Ecology*, 34(2), 93-107.
- Clark, M. L.** (2017). Comparison of simulated hyperspectral HypSIIRI and multispectral Landsat 8 and Sentinel-2 imagery for multi-seasonal, regional land-cover mapping. *Remote Sensing of Environment*, 200, 311-325.
- Guidici, D., & **Clark, M. L.** (2017). One-dimensional convolutional neural network land-cover classification of multi-seasonal hyperspectral imagery in the San Francisco Bay Area, California. *Remote Sensing*, 9(6), 629.
- Clark, M.L.**, & Kilham, N.E. (2016). Mapping of land cover in northern California with simulated hyperspectral satellite imagery. *ISPRS Journal of Photogrammetry and Remote Sensing*, 119, 228-245.
- Aide, T.M., **Clark, M.L.**, Grau, H.R., López-Carr, D., Levy, M., Redo, D., Bonilla-Moheno, M., Riner, G. , Andrade-Núñez, M. J., & Muñiz, M. (2013). The deforestation and reforestation of Latin America and the Caribbean (2001-2010). *Biotropica*, 45(2), 262–271.
- Álvarez-Berrios, N., Redo, D., Aide, T.M., **Clark, M.L.**, & Grau, H.R. (2013). Land Change in the Greater Antilles between 2001 and 2010, *Land*, 2(2), 81-107.

- Bonilla-Moheno, M., Redo, D.J., Aide, T.M., **Clark, M.L.**, and Grau, H.R. (2013). Differences in vegetation change among land tenure regimes in Mexico: a country-wide analysis. *Land Use Policy*, 30(1), 355-364.
- Redo, D.J., Aide, T.M., **Clark, M.L.** (2013). Vegetation change in Brazil's dryland ecoregions and the relationship to crop production and environmental factors: Cerrado, Caatinga and Mato Grosso, 2001-2009. *Journal of Land Use Science*, 8(2), 123-153.
- Bonilla-Moheno, M., Aide, T.M., **Clark, M.L.** (2012). El efecto del cambio poblacional en el de uso del suelo en México [The effect of population change on land use in Mexico], *Investigación ambiental. Ciencia y política pública*, 4(2), 87-100.
- Clark, M.L.**, Aide, T.M., and Riner, G.R. (2012). Land change for all municipalities in Latin America and the Caribbean assessed from 250-m MODIS imagery (2001-2010), *Remote Sensing of Environment*, 126, 84-103.
- Bonilla-Moheno, M., Aide, T.M., **Clark, M.L.** (2012). The influence of socioeconomic, environmental, and demographic factors on municipality-scale land-use/land-cover change in Mexico. *Regional Environmental Change*, 12(3), 543-557.
- Clark M.L.**, Roberts D.A. (2012). Species-level differences in hyperspectral metrics among tropical rainforest trees as determined by a tree-based classifier. *Remote Sensing*, 4(6), 1820-1855.
- Izquierdo, A.E., **Clark, M.L.** (2012). Spatial analysis of conservation priorities based on ecosystem services in the Atlantic Forest region of Misiones, Argentina. *Forests*, 3, 764-786.
- López-Carr, D., Davis, J., Jankowsk, M., Grant, L., López-Carr, A.C., **Clark, M.L.** (2012). Space versus place in complex human-natural systems: Spatial and multi-level models of tropical land use and cover change (LUCC) in Guatemala. *Ecological Modeling*, 229(24), 64-75.
- Redo, D.J., Aide, T.M., **Clark, M.L.** and Andrade-Núñez, M.J. (2012). The impact of internal and external policies on land change in Uruguay, 2001 to 2009. *Environmental Conservation*, 39, 122-131.
- Redo, D.J., Grau, H.R., Aide, T.M., and **Clark, M.L.** (2012). Asymmetric forest transition related to the interaction of socio-economic development and forest type in Central America, *Proceedings of the National Academy of Sciences*, 109, 8839-8844.
- Redo, D.J., Aide, T.M., **Clark, M.L.** (2012). The relative importance of socio-economic and environmental variables in explaining land change in Bolivia, 2001-2010. *Annals of the Association of American Geographers*, 102(4), 778-807.
- Sánchez-Cuervo, A.M., Aide, T.M., **Clark, M.L.**, Etter, A. (2012). Land cover change in Colombia: surprising forest recovery trends between 2001 and 2010. *PLoS ONE*, 7(8), e43943. doi:10.1371/journal.pone.0043943
- Clark, M.L.** (2011). Identification of Canopy Species in Tropical Forests Using Hyperspectral Data. In *Hyperspectral Remote Sensing of Vegetation*, eds. Thenkabail, P.S., Lyon, J.G., and Huete, A. CRC Press/Francis & Taylor, Boca Raton, FL.
- Clark, M.L.**, Roberts, D.A., Ewel, J.J., and Clark, D.B. (2011). Estimation of tropical rain forest aboveground biomass with small-footprint lidar and hyperspectral sensors. *Remote Sens. of Env.*, DESDynI VEG-3D Special Issue, 115(11), 2931-2942.
- Clark, M.L.** and Aide, T.M. (2011). Virtual Interpretation of Earth Web-Interface Tool (VIEW-IT) for collecting land-use/land-cover reference data. *Remote Sensing*, 3(3), 601-620.
- Clark, M.L.**, Aide, T.M., Grau, H.R., & Riner, G. (2010). A scalable approach to mapping annual land-cover at 250 m using MODIS time-series data: A case study in the Dry Chaco ecoregion of South America. *Remote Sens. of Env.*, 114(11), 2816-2832.
- Helmer, E.H., Kennaway, T.A., Pedreros, D.H., **Clark, M.L.**, Tieszen, L.L. Ruzycski, T.S., Marcano, H., Schill, S.R., & Carrington, C.M.S. (2008). Land cover and forest formation

- distributions for St. Kitts, Nevis, St. Eustatius, Grenada and Barbados from decision tree classification of cloud-cleared satellite imagery. *Caribbean Journal of Science*, 44(2):175–198.
- Clark, M.L.**, Roberts, D.A., & Clark, D.B. (2005). Hyperspectral discrimination of tropical rain forest tree species at leaf to crown scales. *Remote Sens. of Env.*, 96(3-4), 375-398.
- Clark, M.L.**, Clark, D.B., & Roberts, D.A. (2004). Small-footprint lidar estimation of sub-canopy elevation and tree height in a tropical rain forest landscape. *Remote Sens. of Env.*, 91(1), 68-89.
- Powell, R.L., Matzke, N., de Souza, Jr., C, **Clark, M.L.**, Numata, I., Hess, L.L., & Roberts, D.A. (2004). Sources of error in accuracy assessment of thematic land-cover maps in the Brazilian Amazon. *Remote Sens. of Env.*, 90, 221-234.
- Clark, D.B., Read, J.M., **Clark, M.L.**, Murillo Cruz, A., Fallas Dotti, M., & Clark, D.A. (2004). Application of 1-m and 4-m resolution satellite data to studies of tree demography, stand structure and land-use classification in tropical rain forest landscapes. *Ecol. App.*, 14(1), 61–74.