Curriculum Vita - **Curtis E. Woodcock** (Feb 2025)
Professor
Department of Earth and Environment, Boston University
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Education: B.A. (1977), M.A. (1982), Ph.D. (1985) in Geography, U.C. Santa Barbara

Areas of Specialization: *Remote sensing*, particularly of forests and natural vegetation, environmental monitoring, change detection and time series analysis*; Land Cover and Land Use Change; Terrestrial Carbon Dynamics; Digital image processing.*

Professional Activities/Service (Recent and Current)
Chair, NASA Earth Science Senior Review (2023)
Science Team Leader (CoLead), USGS/NASA Landsat Science Team (1/1/07-present)
Advisory Group: REDD+ Methods and Guidance Document, Global Forest Observation Initiative

Employment and Appointments
Director, Center for Remote Sensing, Boston University, 9/18-6/21.
Chair, Department of Earth and Environment, 7/12-6/15.
Professor, Department of Earth and Environment, 7/12-present.
Chair, Department of Geography, Boston University, 9/01-6/03.
Professor, Department of Geography and Environment, Boston University, 9/98-6/12.
Research Fellow, Department of Cognitive and Neural Systems, Boston University, 2/97-2010.
Chair, Department of Geography, Boston University, 7/91-9/98.
Associate Professor, Department of Geography, Boston University, 9/90-9/98.
Director of Geographic Applications, Center for Remote Sensing, Boston University, 6/86-9/19.
Acting Director, Center for Remote Sensing, Boston University,9/85-6/86.
Assistant Professor, Department of Geography, Boston University,9/84-8/90.
Research Associate, Department of Geology and Geography, Hunter College, City University of New York,9/82-9/84.
Staff Research Associate, Geography Remote Sensing Unit, University of California, Santa Barbara, 3/79-9/82

Recognition, Honors and Awards

NASA Graduate Researchers Program (Johnson Space Center) 1980-1983.

1995 ERDAS Award for Best Science Paper in Remote Sensing, (With Sucharita Gopal) from the American Society of Photogrammetry and Remote Sensing, for the paper: Gopal, S., and C.E. Woodcock, 1994. Theory and Methods for Accuracy Assessment of Thematic Maps Using Fuzzy Sets, *Photogrammetric Engineering and Remote Sensing*, 60(2):181-188.
1996 ERDAS Award for Best Science Paper in Remote Sensing (Third Prize), (With Soren Ryherd) from the American Society of Photogrammetry and Remote Sensing, for the paper: Ryherd, S., and C.E. Woodcock, 1996.Combining spectral and texture data in the

segmentation of remotely sensed images, *Photogrammetric Engineering and Remote Sensing*, 62(2):181-194.

2000 Autometric Award for the Best Paper in Photogrammetric Interpretation, (With John Collins) from the American Society of Photogrammetry and Remote Sensing, for the paper: Collins, J.B., and C.E. Woodcock, 1999. Geostatistical estimation of resolution-dependent variance in remotely sensed images, *Photogrammetric Engineering and Remote Sensing*, 65(1):41-50.

2003 Leica Geosystems Award for the Best Scientific Paper in Remote Sensing (Second Prize) with A. Schneider, M. Friedl and D.K McIver, from the American Society of Photogrammetry and Remote Sensing, for the paper: Schneider, A., Friedl, M.A., McIver, D.K., and C.E. Woodcock, 2003.Mapping Urban Areas by Fusing Multiple Sources of Coarse Resolution Remotely Sensed Data, *Photogrammetric Engineering and Remote Sensing*, 69(12):1377-1386.

2008 John I. Davidson President's Award for Best Practical Paper, from the American Society of Photogrammetry and Remote Sensing, (with A. Baccini, M. Friedl and J. Zhu), for the paper: Baccini, A., Friedl, M.A, Woodcock, C.E., and J. Zhu, 2007. Scaling Field Data to Calibrate and Validate Moderate Spatial Resolution Remote Sensing Models, *Photogrammetric Engineering and Remote Sensing*, 73(8):945-954.

2008 Leica Geosystems Award for Best Scientific Paper (Third Prize), from the American Society of Photogrammetry and Remote Sensing, (with A. Baccini, M. Friedl and J. Zhu), for the paper: Baccini, A., Friedl, M.A, Woodcock, C.E., and J. Zhu, 2007. Scaling Field Data to Calibrate and Validate Moderate Spatial Resolution Remote Sensing Models, *Photogrammetric Engineering and Remote Sensing*, 73(8):945-954.

Erasmus Mundus Visiting Scholar, 9/2005-12/2005, University of Southampton.

*2010 Outstanding Contributions Award***,** Remote Sensing Specialty Group of the Association of American Geographers.

2012 Boeing Award for Best Paper in Image Analysis and Interpretation from the American Society of Photogrammetry and Remote Sensing (with Joe Fortier, John Rogan and Daniel Miller Runfola) for the paper: Fortier, J., Rogan, J., Woodcock, C.E., and D.M. Runfola, 2011. Utilizing Temporally Invariant Calibration Sites to Classify Multiple Dates and Types of Satellite Imagery, *PE&RS*, 77(2):181-189.

2016 William T. Pecora Award from NASA and the Department of the Interior. Lifetime achievement award for "outstanding contributions toward understanding the Earth by means of remote sensing".

2018, 2019, 2020, 2021, 2022, 2023, 2024 Clarivate Analytics Highly Cited Researcher.

2023 John I. Davidson President's Award for Practical Papers - 1st Place - Tie (for the paper "Seeing our Planet Anew: Fifty years of Landsat"

2023 Research.com Environmental Sciences in United States Leader Award

2023 ScholarGPS Highly Ranked Scholar – Lifetime. "Top Percentage Ranks … above 0.05 %

of all scholars due to highly significant impact and quality of their scholarly contributions based on lifetime contributions" (based on publications). (Ranks of 4 in "Social Environment", 8 in "land cover" and 9 in "remote sensing")

Media

Earth's Forests from Space, 2010, Interview on EarthSky: available at http://earthsky.org/earth/curtis-woodcock-earths-forests-from-space

Ten Thousand Shovels: Rapid Urban Growth in China, 2006, Karen Seto, Producer, Curtis E. Woodcock, Associate Producer.

An idea that worked, 2007, comments on the vision of Stuart Udall and Landsat.

Time Series Analysis using Landsat, Episode 38 of Eyes on Earth, produced by the USGS, November 2020
https://www.usgs.gov/media/audio/eyes-earth-episode-38-time-series-analysis-landsat

The Landsat Science Team Episode of podcast series *Eyes on Earth*, produced by the USGS, June 2023
https://www.usgs.gov/centers/eros/science/eyes-earth-episode-95-eros-50th-landsat-science-team

Publications: Journals

Woodcock, C.E., Franklin, J., and A.H. Strahler, 1982. The role of remote sensing in land management and planning, *Environmental Management*, 7(3):223-238.

Franklin, J., Logan, T.L., Woodcock, C.E., and A.H. Strahler, 1986. Coniferous forest classification and inventory using Landsat and digital terrain data, *IEEE Transactions on Geoscience and Remote Sensing*, GE-24(1):139-149.

Strahler, A.H., Woodcock, C.E., and J.A. Smith, 1986. On the nature of models in remote sensing, *Remote Sensing of Environment*, (20):121-139.

Woodcock, C.E., and A.H. Strahler, 1987. The factor of scale in remote sensing, *Remote Sensing of Environment*, (21):311-332.

Jupp, D.L.B., Strahler, A.H., and C.E. Woodcock, 1988. Autocorrelation and regularization in digital images I: Basic theory, *IEEE Transactions on Geoscience and Remote Sensing*, 26(4):463-473.

Woodcock, C.E., Strahler, A.H., and D.L.B. Jupp, 1988. The use of variograms in remote sensing: I. Scene models and simulated images, *Remote Sensing of Environment*, 25:323-348.

Woodcock, C.E., Strahler, A.H., and D.L.B. Jupp, 1988. The use of variograms in remote sensing: II. Real digital images, *Remote Sensing of Environment*, 25:349-379.

Jupp, D.L.B., Strahler, A.H., and C.E. Woodcock, 1989. Autocorrelation and regularization in digital images II, Simple image models , *IEEE Transactions on Geoscience and Remote Sensing*, 27(3):247-258.

Woodcock, C.E., Sham. C.H., and B.J. Shaw, 1990. Comments on selecting a geographic information system for resource management, *Environmental Management*, 14(3):307-315.

Woodcock, C.E., and V.J. Harward, 1992. Nested-hierarchical scene models and image

segmentation, *International Journal of Remote Sensing*, 13(16):3167-3187.
Chen, R., Woodcock, C.E., Strahler, A.H., and D.L.B. Jupp, 1993. Nonlinear estimation of scene parameters from digital images using zero-hit run-length statistics, *IEEE Transactions on Geoscience and Remote Sensing*, 31(3):735-746.
Gopal, S., and C.E. Woodcock, 1994. Theory and methods for accuracy assessment of thematic maps using fuzzy sets, *Photogrammetric Engineering and Remote Sensing*, 60(2):181-188.
Moody, A., and C.E. Woodcock, 1994. Scale-dependent errors in the estimation of land-cover proportions--implications for global land-cover datasets, *Photogrammetric Engineering and Remote Sensing*, 60(5):585-594.
Woodcock, C.E., Collins, J.B., Gopal, S., Jakabhazy, V.D., Li, X., Macomber, S., Ryherd, S., Wu, Y., Harward, V.J., Levitan, J., and R. Warbington, 1994. Mapping forest vegetation using Landsat TM imagery and a canopy reflectance model, *Remote Sensing of Environment*, 50:240-254.
Macomber, S., and C.E. Woodcock, 1994. Mapping and monitoring conifer mortality using remote sensing in the Lake Tahoe Basin, *Remote Sensing of Environment*, 50:255-266.
Collins, J.B., and C.E. Woodcock, 1994. Change detection using the Gramm-Schmidt transformation applied to mapping forest mortality, *Remote Sensing of Environment*, 50:267- 279.
Li, X., C.E. Woodcock, and R. Davis, 1994. A hybrid geometric optical and radiative transfer approach for modeling pyranometer measurements under a Jack Pine forest, *Geographic Information Science*, 1(1):27-33.
Li, X., Strahler, A.H., and C.E. Woodcock, 1995. A hybrid geometric optical-radiative transfer approach for modeling albedo and directional reflectance of discontinuous canopies, *IEEE Transactions on Geoscience and Remote Sensing*, 33(2):466-480.
Moody, A. and C.E. Woodcock, 1995. The influence of scale and the spatial characteristics of landscapes on land-cover mapping using remote sensing, *Landscape Ecology*, 10(6):363-379.
Ryherd, S., and C.E. Woodcock, 1996. Combining spectral and texture data in the segmentation of remotely sensed images, *Photogrammetric Engineering and Remote Sensing*, 62(2):181-194.
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Pax Lenney, M., Woodcock, C.E., Collins, J.C., and H. Hamdi, 1996. The status of agriculutural lands in Egypt: The use of multitemporal NDVI features dervied from Landsat TM, *Remote Sensing of Environment*, 56(1):8-20.
Collins, J.B., and C.E. Woodcock, 1996. An assessment of several linear change detection techniques for mapping forest mortality using multitemporal Landsat TM data, *Remote Sensing of Environment*, 56(1):66-77.
Gopal, S., C.E. Woodcock, and G. Unis, 1996. Labeling map polygons using remote sensing: Calibrating decision rules, *Geographical Systems*, 3:243-258.
Moody, A., and C.E. Woodcock, 1996. Calibration-based models for correction of area estimates derived from coarse resolution imagery, *Remote Sensing of Environment,* 58(3):225-241.

Ni, W., Li, X., Woodcock, C.E. and A.H. Strahler, 1997. Parameterization of spectral component signatures for geometric optical canopy reflectance modeling, *Journal of Remote Sensing* (China),1:102-108 (in English).

Woodcock, C.E., Collins, J., Jakabhazy, V.D., Li, X., Macomber, S.A., and Y. Wu, 1997. Inversion of the Li-Strahler canopy reflectance model for mapping forest structure, *IEEE Transactions on Geoscience and Remote Sensing*, 35(2):405-414.

Carpenter, G.A., Gjaja, M.N., Gopal, S., and C.E. Woodcock, 1997. ART neural networks for remote sensing: vegetation classification from Landsat TM and Terrain Data, *IEEE Transactions on Geoscience and Remote Sensing*, 35(2):308-325.

Pax Lenney, M., and C.E. Woodcock, 1997. Monitoring agricultural lands with multitemporal Landsat TM imagery: How many images are needed?, *Remote Sensing of Environment*, 59(3):522-529.

Pax Lenney, M., and C.E. Woodcock, 1997. The effect of spatial resolution on monitoring the status of agricultural lands, *Remote Sensing of Environment*, 61(2):210-220.

Ni, W., Li, X., Woodcock, C.E., Roujean, J.L., Davis, R.E., 1997. Transmission of solar radiation in boreal conifer forests: modeling and measurements, *Journal of Geophysical Research*, 102(D24):29,555-29,566.

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Davis, R.E., J.P. Hardy, W. Ni, C. Woodcock, J.C. McKenzie, R. Jordan, and X. Li, 1997. Variation of snow cover ablation in the boreal forest: a sensitivity study on the effects of conifer canopy, *Journal of Geophysical Research*, 102(D24):29,389-29,396.

Hardy, J.P., Davis, R.E., Jordan, R., Woodcock, C.E., and W. Ni, 1998. Snow ablation modelling in a mature aspen stand of the boreal forest, *Hydrologic Processes*, 12:1763-2778.

Collins, J.B., and C.E. Woodcock, 1999. Geostatistical estimation of resolution-dependent variance in remotely sensed images, *Photogrammetric Engineering and Remote Sensing*, 65(1):41-50.

Gopal, S., Woodcock, C.E., and A.H. Strahler, 1999. Fuzzy neural network classification of global land cover from a 1-degreeAVHRR data set, *Remote Sensing of Environment*, 67(2):230-243.

Ni, W., Li, X., Woodcock, C.E., Caetano, M.R., and A.H. Strahler, 1999. An analytical hybrid GORT model for bidirectional reflectance over discontinuous plant canopies, *IEEE Transactions on Geoscience and Remote Sensing*, 37(2):987-999.

Ni, W., Woodcock, C.E., and D.L.B. Jupp, 1999. Variance in Bidirectional Reflectance over Discontinuous Plant Canopies, *Remote Sensing of Environment*, 69(1):1-15.

Carpenter, G.A., Gopal, S., Martens, S., and C.E. Woodcock, 1999. A neural network method for mixture estimation for vegetation mapping*, Remote Sensing of Environment*, 70(2):138-152.

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Carpenter, G.A., Gopal, S., Macomber, S., Martens, S., Woodcock, C.E., and J. Franklin, 1999. A neural network method for efficient vegetation mapping, *Remote Sensing of Environment*, 70(3):326-338.

Woodcock, C.E., and S. Gopal, 2000. Fuzzy set theory and thematic maps: Accuracy assessment

and area estimation, *International Journal of GIS*, 14(2):153-172.
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Friedl, M., Woodcock, C.E., Gopal, S., Muchoney, D., Strahler, A.H., and C. Barker-Schaaf, 2000. A note on procedures used for accuracy assessment in land cover maps derived from AVHRR data, *International Journal of Remote Sensing*, 21(5):1073-1077, (letter).
Ni, W., and C.E. Woodcock, 2000. The effect of canopy structure and the presence of snow on the albedo of boreal conifer forests, *Journal of Geophysical Research*, 105(D9):11,879-11,888.
Seto, K.C., Kaufmann, R.K., and C.E. Woodcock, 2000. Landsat reveals China's farmland reserves, but they're vanishing fast, *Nature,* 406:121, (correspondence).
Franklin, J., Woodcock, C.E., and R. Warbington, 2000. Multi-Attribute Vegetation Maps of Forest Service Lands in California Supporting Resource Management Decisions, *Photogrammetric Engineering and Remote Sensing*, 66(10):1209-1217.
Song, C., Woodcock, C.E., Seto, K., Pax Lenney, M., and S.A. Macomber, 2001. Classification and change detection using Landsat TM data: When and How to Correct Atmospheric Effects? *Remote Sensing of Environment*, 75(2):230-244.
Pax-Lenney, M., Woodcock, C.E., Macomber, S.A., Gopal, S., and C. Song, 2001. Forest Mapping with a generalized classifier and Landsat TM data, *Remote Sensing of Environment*, 77(3):241- 250.
Woodcock, C.E., Macomber, S.A., Pax-Lenney, M., and W.B. Cohen, 2001. Large area monitoring of temperate forest change using Landsat data: Generalization across sensors, time and space, *Remote Sensing of Environment*, 78(1-2):194-203.
Goward, S., Bindschadler, R., Cahalan, R., Flynn, L., Goetz, A., Moran, S., Muller-Karger, F., Palluconi, F., Price, J., Schott, J., Thome, K., Skole, D., Vogelman, J., and C. Woodcock, 2001. Open letter on the Landsat Data Continuity Mission, *Photogrammetric Engineering and Remote Sensing*, 67(8):889-890.
Zhang, Y., Tian,Y., Myneni R.B., Knyazikhin, Y., and C.E. Woodcock, 2002. Assessing the information content of multiangle satellite data for mapping biomes I. Statistical analysis, *Remote Sensing of Environment*, 80:418-434.
Seto, K.C., Woodcock, C.E., Song, C., Huang, X., Lu, J., and R.K. Kaufmann, 2002. Monitoring land-use change in the Pearl River Delta using Landsat TM, *International Journal of Remote Sensing*, 23(10):1985-2004.
Song, C., and C.E. Woodcock, 2002. The spatial manifestation of forest succession in optical imagery: The use of multiresolution imagery, *Remote Sensing of Environment*, 82(2-3):271- 284.
Song, C., Woodcock, C.E., and X. Li, 2002. The spectral/temporal manifestation of forest succession in optical imagery: The Potential of Multitemporal Imagery, *Remote Sensing of Environment*, 82(2-3):285-302.
Friedl, M.A., McIver, D.K., Hodges, J.C.F., Zhang, X.Y., Muchoney, D., Strahler, A.H., Woodcock, C.E., Gopal, S., Schneider, A., Cooper, A., Baccini, A., Gao, F., Schaaf, C., 2002. Global land cover mapping from MODIS: algorithms and early results, *Remote Sensing of Environment*, 83(1-2):287-302.
Tian, Y., Woodcock, C.E., Wang, Y., Privette, J.L., Shabanov, N.V.,Zhou, L., Zhang, Y., Buermann, W., Dong, J., Veikkanen, B., Hame, T., Andersson, K., Ozdogan,

M.,Knayazikhin, Y., and R.B. Myneni, 2002. Multiscale Analysis and Validation of the MODIS LAI Product: I. Uncertainty Analysis, *Remote Sensing of Environment*, 83:414-430.

Tian, Y., Woodcock, C.E., Wang, Y., Privette, J.L., Shabanov, N.V.,Zhou, L., Zhang, Y., Buermann, W., Dong, J., Veikkanen, B., Hame, T., Andersson, K., Ozdogan, M.,Knayazikhin, Y., and R.B. Myneni, 2002. Multiscale Analysis and Validation of the MODIS LAI Product:II. Sampling Strategy, *Remote Sensing of Environment*, 83:431-441.

Jin, Y., Schaaf, C.B., Woodcock, C.E., Gao, F., Li, X., Strahler, A.H., Lucht, W. and S. Liang, 2003. Consistency of MODIS surface bidirectional reflectance distribution function and albedo retrievals: 2. Validation, *Journal of Geophysical Research*, 108(D5):ACL3-1 - ACL3-12.

Song, C., and C.E. Woodcock, 2003. A regional forest ecosystem carbon budget model: impacts of forest age structure and land use history, *Ecological Modelling*, 164(1):33-47.

Song, C., and C.E. Woodcock, 2003. Estimating Tree Crown Size from Multiresolution Remotely Sensed Imagery, *Photogrammetric Engineering and Remote Sensing*, 69(11):1263-1270.

Song, C., and C.E. Woodcock, 2003. Monitoring forest succession with multitemporal Landsat images: Factors of uncertainty. *IEEE Transactions on Geoscience and Remote Sensing*, 41(11):2557-2568.

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Morisette, J.T., Niceson, J.E., Davis, P., Wang, Y., Tian, Y., Woodcock, C.E., Shabanov, N., Hansens, M., Cohen, W.B., Oetter, D.R., and R.E. Kennedy, 2003. High spatial resolution satellite observations for validation of MODIS land products: IKONOS observations acquired under the NASA Scientific Data Purchase, *Remote Sensing of Environment*, (88)1-2:100-110.

Baccini, A., M. A. Friedl, C. E. Woodcock, and R. Warbington, 2004. Forest biomass estimation over regional scales using multisource data, *Geophysical Research Letters*, 31, L10501, doi:10.1029/2004GL019782.

Wang, Y., Woodcock, C.E., Buermann, W., Stenberg, P., Voipio, P., Smolander, H.,Hame, T., Tian, Y., Hu, J., Knyazikhin, Y., and R.B. Myneni, 2004. Evaluation of the MODIS LAI algorithm at a coniferous forest site in Finland, *Remote Sensing of Environment*, 91(1):114- 127.

Liu, W., Seto, K.C., Wu, E.Y., Gopal, S., and C.E. Woodcock, 2004. ART-MMAP: A neural network approach to subpixel classification, *IEEE Transactions on Geoscience and Remote Sensing*, 42(9):1976-1983.

Liu, W.G., Gopal, S., and C.E. Woodcock, 2004. Uncertainty and confidence in land cover classification using a hybird classifier approach, *Remote Sensing of Environment*, 70(8):963- 971.

Liu, J.C., Melloh, R.A., Woodcock, C.E., Davis, R.E., and E.S. Ochs, 2004. The effect of viewing geometry and topography on viewable gap fractions through forest canopies, *Hydrological Processes*, 18(18):3595-3607.

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irrigated crop area and water use in Southeastern Turkey from 1993-2002: Implications for current and future water resources, *Water Resources Management,* 20(3):467-488.

Ozdogan, M., and C.E. Woodcock, 2006. Resolution dependent errors in remote sensing of cultivated areas, *Remote Sensing of Environment*, 103:203-217.

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"The Use of Spatial Features in Image Segmentation", NASA Goddard Space Flight Center, *C.E. Woodcock, Principal Investigator*, $14,608, 4/15/87 - 4/14/88.

"Remote Sensing of Natural Plant Communities", NASA Graduate Researchers Program, NASA Headquarters, Washington D.C., *C.E. Woodcock, Principal Investigator* (for participant C. Brown), $18,000, 9/1/87 - 8/31/88.

"The Center for Remote Sensing at Boston University: Year II", The W.M. Keck Foundation, J.R. Wiseman, Project Director, C.E. Woodcock, Collaborator, $410,000, 1/1/87 - 12/31/87.

"Development of a Prototype Geographic Information System Design for North Atlantic Regional Parks", North Atlantic Region of the National Park Service, C.H. Sham, Principal Investigator, C.E. Woodcock, Co-Investigator, $29,755, 5/1/87 - 4/31/88.

"Development, Application, and Operational Implementation of a Forest Inventory System Using Satellite Remote Sensing", Region 5, US Forest Service, *C.E. Woodcock, Principal Investigator,* A.H. Strahler, Co-Investigator, $657,736, 7/18/88-12/31/91.

"GIS Technology in the Cape Cod National Seashore", North Atlantic Region of the National Park Service, C.H. Sham, Principal Investigator, C.E. Woodcock, Co-Investigator, $54,000, 9/1/88- 8/30/89.

"Remote Sensing for Resource Management" (Training Course), Government of Jordan, F. El-Baz and *C.E. Woodcock, Principal Investigators*, $30,000, August, 1988.

"Equipment and Program Support for the Center for Remote Sensing", The W.M. Keck Foundation,J.R. Wiseman, Project Director, C.E. Woodcock, Collaborator, $600,000, 1/1/89- 7/1/90.

"Evaluation of the use of Canopy Models for Mapping Old Growth", US Forest Service, *C.E. Woodcock, Principal Investigator*, A.H. Strahler, Co-Investigator, $191,916, 2/1/89-1/31/90.

"Analysis of the Spatial and Temporal Variability of Primary Production in the Boston Harbor and Massachusetts Bay", Massachusetts Water Resources Authority, C. Yentsch, Principal Investigator, C. Woodcock, Co-Investigator, $40,000, 10/1/89-9/30/90.

"Development of a Beach Community Habitat Model for Cape Cod National Seashore", *C.E.*

Woodcock, Principal Investigator, North Atlantic Region of the National Park Service, $7,544, 9/30/91-12/31/91.

"Forest Mapping and Accuracy Assessment", US Forest Service, *C.E. Woodcock, Principal Investigator, $270,096*, 10/1/91-5/31/93.

"Evaluation of the Utility of Satellite Remote Sensing for Detecting Conifer Mortality", US Forest Service, *C.E. Woodcock, Principal Investigator*, $91,957, 10/1/91-5/31/93.

"Desertification of Agricultural Lands in Egypt by Remote Sensing", Egyptian Ministry of Agriculture and Land Reclamation and the US Department of Agriculture, *C.E. Woodcock, Principal Investigator*, $280,666, 10/1/92-9/31/94.

"Forest Influences on the Shortwave Radiation Regime over Snow Surfaces", U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Geophysical Sciences Branch, *C.E. Woodcock, Principal Investigator*, A.H. Strahler and X. Li, Co-Invesigators, $230,000, started 10/1/93-10/31/2000.

"Mapping Existing Vegetation Using Landsat TM Imagery and Digital Terrain Data for Four National Forests in the Southern Region of California," J. Franklin, Principal Investigator, C.E. Woodcock, Co-Investigator, $764,143, 10/1/93-9/30/96 (funded through San Diego State University).

"Monitoring Conifer Mortality," Pest Management, Region 5, U.S. Forest Service, *C.E. Woodcock, PI*, J. Collins, Co-Investigator,8 /1/94-7/31/95, $50,261.

"Resolving Map and Tree Size Accuracy and Modifications to Cover Estimates," C. E. Woodcock, US Forest Service, Region 5 Remote Sensing Laboratory, 6/1/95-5/30/96, $22,000 (funded through San Diego State University).

"Providing Secondary Labels for Map Polygons in the Plumas National Forest," *C. E. Woodcock Principal Investigator*, US Forest Service, Region 5 Remote Sensing Laboratory,9/15/95-3/15/96, $24,750 (funded through San Diego State University).

"Assessment of Landuse and Landcover Change Using Remote Sensing and Artificial Neural Networks," S. Gopal, Principal Investigator, and C.E. Woodcock, Co-Investigator, NSF, 8/1/96-7/31/99, $190,000.

"Monitoring Change in Temperate Coniferous Forest Ecosystems," NASA - Landsat Science Team, *C.E. Woodcock, PI*, 10/1/96-6/30/01, $915,000.

"Modeling and Forecasting Effects of Land Use Change in China Based on Socioeconomic Drivers," R. Kaufmann, Principal Investigator, D. Dye, K. Seto and C.E. Woodcock, Co-Investigators, NASA Land Use and Land-Cover Change Program, 6/1/97-5/30/01, $295,000.

"Center for Excellence in Remote Sensing at Boston University," *C.E. Woodcock, PI*, F. El-Baz, C. Cleveland, M. Friedl, S. Gopal, R. Kaufmann, J. Key, D. Dye, R. Myneni, G. Salvucci, A. Strahler, Co-Is.NASA, $380,000, 10/1/97-9/30/98.

"Algorithm Development for NPOESS," C.L.B. Schaaf, PI, M. Friedl, J. Key, A.H. Strahler, and C.E. Woodcock, Co-Is, AER Inc.,$606,450,1/1/97-12/31/99.

"An Ultra-Compact, High-Definition Hyperspectral Imaging System," A.H. Strahler, PI, C.E. Woodcock, Co-I, in conjunction with Flight Landata, Inc, NASA STTR, 9/1/00-8/31/01, BU portion, $23,369.

"Urbanization as a Component of Global Change*," C.E. Woodcock, PI,* for student Annemarie Schneider, NASA Earth System Science Fellowship, $66K, 9/1/01-8/31/03.

"The Effects of Agricultural Expansion on Regional Hydrology in Southeastern Turkey", Principal Investigator: Guido Salvucci, Co-Is, M.K. Friedl, B. Anderson, and C.E

Woodcock, NASA Land Cover and Land Use Change Program, $541,982, 6/1/01-5/31/04.

"Developing Next-Generation Tools for Remote Sensing in Support of LANDFIRE", Mark Friedl, Principal Investigator, C.E. Woodcock and A. Baccini, Co-Is, $164,693, 7/15/02-7/14/05, United States Geological Survey.

"Field site improvement at Sargent Center for education and research activities," N. Phillips, Principal Investigator, T.H. Kunz, C.E. Woodcock, R. Rubendal, Co-Is, NSF, $116,304, 1/1/2002-6/30/2002.

"Vegetation Mapping in Support of Conservation Planning", *C.E. Woodcock, PI,* Manomet Foundation, $26,995, 1/1/02-8/31/02.

"Scattering of Light by Vegetation Canopies: Theory and Applications of a Discrete Object Approach", A.H. Strahler, PI, C.E Woodcock and X. Li, Co-Is. NSF International Program, $34,480, 9/01/02-8/31/03.

"The effect of forest canopies on the remote sensing of the land surface," *C.E. Woodcock, PI*., Cold Regions Research and Engineering Laboratory, Army Corps of Engineers, 11/01/02-present, $359,465.

"Quantifying the Effects of Land Use Change on the Carbon Budgets of the Black Sea Region," *C.E. Woodcock, PI*., R.A. Houghton and M. Ozdogan, Co-Is, NASA LCLUC Program, 2/1/05-1/31/08, $642,320.

"The Use of Variograms to Characterize Errors in Gap Filling in the Landsat SLC-Off Era", *C.E. Woodcock, PI*, NASA Goddard Space Flight Center, 10/1/05-9/30/06, $18,000.

"NELDA: Monitoring and Validating the Distribution and Change in Land Cover across Northern Eurasia", O. Krankina, PI., includes many others, including M.A. Friedl and C.E. Woodcock from Boston University, NASA Land Cover and Land Use Change Program, 1/1/06-12/31/08, (BU portion $198K).

"Retrieval of Vegetation Structure and Carbon Balance Parameters Using Ground-Based Lidar and Scaling to Airborne and Spaceborne Lidar Sensors", NASA, A. H. Strahler, PI, C. E. Woodcock, C. Schaaf, and W. Ni, Co-Is, 1/1/06-12/30/08, $458,592.

"Toward Operational Global Monitoring of Landcover Change", *C.E. Woodcock, PI*, USGS/NASA Landsat Science Team (Leader), USGS, 10/1/06-9/30/11, $700,000.

"Accuracy Assessment of Global Land Cover Products and Production of a 'Best Available' Land Cover Map: a GOFC-GOLD Initiative, NASA Land Cover and Land Use Change Program, *C.E. Woodcock, PI*, Steve Stehman, Co-I, 6/1/08-5/31/10, $390,000.

"Quantifying the accuracy and uncertainty in remote sensing products of land use changing implications for carbon monitoring", NASA, *C.E. Woodcock, PI,* 6/1/11-12/1/12, $74,966.00.

"Research and Training in support of SilvaCarbon", USGS, *C.E. Woodcock, PI*, (IPA for Woodcock, summer 2011), $64,828, 6/1/11-8/31/11.

"Research and Training in support of SilvaCarbon", USGS, *C.E. Woodcock, PI*, (IPA for Pontus Olofsson, $105,535, 8/1/11-7/31/12.

"Support for Silvacarbon, GEO FCT and GFOI", IPA with USGS for *C.E. Woodcock*, 12/10/12-12/9/13, $58,468.

"Enhancing Compatibility of Sentinel 2 and Landsat products for improved monitoring of the Earth System", NASA, Earth Science US Participating Investigator Program, *PI, C.E. Woodcock*, Co-I, Eric Vermote, 1/1/2011-12/31/2014, $725K (extended to 12/31/15).

"Snythesis of Studies on Institutional Change and LCLUC Effects on Carbon, Biodiversity, and Agriculture After the Collapse of the Soviet Union,", V. Radeloff, PI, *C.E. Woodcock, PI* of BU portion $77,520. 1/1/12-12/31/14.

"Development of a Dual-Wavelength, Ground-Based, Echidna® Lidar (DWEL) for Structural Characterization and Virtual Reconstruction of Forest Canopies", NSF MRI Program, A.H. Strahler, PI, C.E. Woodcock, S. Chakrabarti, T. Cook, and C. Schaaf, Co-Is, $1,662,384.

"Towards a Land Cover Climate Data Record from VIIRS", NASA, M.A. Fried, PI, C.E. Woodcock, Co-I, 6/1/11-5/30/14, $628,995.

"Using MODIS to Monitor Dynamics in Land Cover and Phenology at Seasonal to Decadal Time Scales", NASA, M.A. Fried, PI, C.E. Woodcock, Co-I, 6/1/11-5/30/14, $588,725.00.

"4-D Modeling of the Regional Carbon Cycle in and Around Urban Environments: An Interdisciplinary Study to Advance Observational and Modeling Foundations," M.A. Friel d, PI, C.E. Woodcock, L. Hutyra, S. Wofsy, A. Dunn and K. Chance, Co-Is, NASA Interdisciplinary Science Program, 8/12-7/15, $1,282,141.

"Making better use of Landsat images: Time series algorithms to screen clouds, shadows and snow as well as find deforestation and land cover change." *Woodcock, C.E. Principal Investigator*, Google, $41,567, 12/12-6/13.

"Support for LCMAP", IPA from USGS for *C.E. Woodcock*, 8/1/15-7/31/16, $101,689.

"Better Use of the Landsat Temporal Domain: Monitoring Land Cover Type, Condition and Change", *C.E. Woodcock, PI*, M.A. Friedl and P. Olofsson, Co-Is, USGS Landsat Science Team, $1,000,000, 10/12-9/17.

"Landsat Time Series Analysis for LCMS", USDA Forest Service, *C.E. Woodcock, PI,* 8/31/13-8/30/15, $73,251.

"Improving the Sentinel 2 cloud, cloud shadow, and snow detection algorithm," NASA Landsat Program, C.E. Woodcock, PI, 10/1/16-10/1/17, $48,871.

"Creating Synthetic Images for the Carbon Monitoring System", *C.E. Woodcock, PI*, USDA Forest Service, 7/1/14-6/30/17, $75,000.

"Using Three Decades of Landsat Data to Characterize Changes and Vulnerability of Temperate and Boreal Forest Phenology to Climate Change", Mark Friedl, Principal Investigator, Curtis Woodcock and Eli Melaas, co-Investigators, $680,450 for period 1/1/14-12/31/16, National Aeronautics and Space Administration.

"Time Series Fusion of Optical and Radar Imagery for Improved Monitoring of Activity Data, and Uncertainty Analysis of Emission Factors for Estimation of Forest Carbon Flux", Josef Kellndorfer, PI, C.E. Woodcock, R. Houghton, P. Olofsson, Co-Is, NASA Carbon Monitoring System, 8/1/13-7/31/16, $894,735 (BU portion $317,054.

"Direct Measurement of Aboveground Carbon Dynamics in Support of Large Area CMS Development", W. Walker (Woods Hole Research Center), PI, M. Carvalho and C.E. Woodcock, Co-I, $186,232 (BU Portion), 1/1/15-12/31/17, NASA Carbon Monitoring System.

"Near real-time monitoring of land cover disturbance by fusion of MODIS and Landsat data," NASA (Science of Terra and Aqua), *C.E. Woodcock, PI*, P. Olofsson, Co-I, 6/1/14-5/31/17, $689,833 (extended to May 2019).

"Landscape-Scale Histories and Active Monitoring of Disturbance, Seasonality and Greenness Trends for ABoVE from Landsat", C.E. Woodcock, PI, M.A. Freidl, Co-I, $300,000, 8/24/15-8/23/18, NASA Terrestrial Ecology.

"Improved Activity Data for Carbon Emissions from Forest Degradation Through Multi-Sensor Time Series Analysis in Southeast Asia", C.E. Woodcock, PI for participant Eric Bullock, NASA Earth System Science Fellowship, 9/1/16-8/31/19,

"Tracking carbon emissions and removals by time series analysis of the land surface: prototype application in tropical MRV systems compliant with IPCC Tier 3, P. Oloffson, PI, L. Hutyra and C.E. Woodcock, Co-Is, NASA Carbon Monitoring System, 9/1/2016-8/31/2019, $828,715.

"Combining novel remote sensing methods with FIA data to evaluate effects of drought and gypsy moth defoliation on tree mortality at landscape scales", University of Virginia, C.E. Woodcock, PI, for support for Valerie Pasquarella, $28,356, 9/1/18-8/31/20.

"Mapping and Estimation of the areas of deforestation, forest degradation and reforestation in the Peruvian Amazon", USGS SilvaCarbon, C.E. Woodock, PI., 10/19-10/20, $49,683.

"Comprehensive analysis of thirty years of land change in Georgia: patterns, carbon dynamics and drivers." P. Olofsson, PI, C.E. Woodcock and R.D. Garrett, Co-Is, NASA Land-Cover and Land-Use Change Program, $640,385, 5/1/18-4/30/21.

Olofsson, P. (PI), A. Baccini, L. Hutyra and C.E. Woodcock (Co-Is). A pantropical monitoring system of carbon emission and removals from deforestation, forest degradation and forest recovery. NASA Carbon Monitoring System, 2019-2022, $951,962.

"New Opportunities Using the Landsat Temporal Domain: Monitoring Ecosystem Health, Condition and Use", USGS Landsat Science Team, C.E. Woodcock, PI, Friedl, M.A., and P. Olofsson, Co-Is, 12/10/17-12/9/22, $1,238,013.

"A Moderate Spatial Resolution Data Record of 21st Century Global Land Cover, Land Use, and Land Cover Change", Mark Friedl, Principal Investigator, Curtis Woodcock, Pontus Olofsson and Tom Loveland, Co-Investigator, $4,039,454 for period 6/15/2018-6/14/2023, NASA.

Olofsson (PI) and Woodcock (Co-I). Supporting continuous monitoring and sample-based estimation of land change and forest degradation in West Africa. NASA SERVIR Applied Science Team, 2019- 2022, $661,755

"MUTATED – MODELING and UNDERSTANDING using TEMPORAL ANALYSIS of TRANSIENT EARTH DATA", IARPA BAA:19-04,Technical Areas 1 & 2, PI, Marc Bosc, Boston University PI, Woodcock, C.E., 1/1/2021-12/31/2024, $788K.

"Near-real-time monitoring of tropical forest disturbance by fusion of Landsat, Sentinel-1, and Sentinel-2 data", Group on Earth Observations, PI, C.E. Woodcock, CoIs, X, Tang and P. Olofsson), 11/1/2021-10/30/2022, $58K.

"Continued support for estimation and monitoring of land change and forest degradation in West Africa", NASA SERVIR, X. Tang, PI, C.E. Woodcock, Co-PI, 12/23/22-12/24/25, $281K (BU portion).

Continuation and Improvement of a Moderate Resolution Data Record of 21st Century Global Land Cover and Land Cover Change, NASA Measures, P. Arevalo, PI, M.A Friedl and C.E. Woodcock, Co-Is, 1/1/23-12/31/27, $1.375K.