

Curriculum Vita - **Curtis E. Woodcock**

Professor and Chair

Department of Earth and Environment

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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 and change detection; *Land Cover and Land Use Change*; *Terrestrial Carbon Dynamics*; *Spatial modeling and analysis*; *Digital image processing*.

Professional Activities/Service (Recent)

Science Team Leader, USGS/NASA Landsat Science Team (1/1/07-present)

2005 Senior Review of the Mission Operations and Data Analysis Program, NASA

Northern Eurasia Earth Science Partnership Initiative (NEESPI), Science Team Member (1/05-present)

NASA Land Cover and Land Use Change, Science Team Member (1/05 - present)

GOCF/GOLD Land Cover Implementation Team (team member 2/2002-present and Co-Chair 1/1/07- present)

ORNL NASA DAAC for Biogeochemistry, Member User Working Group 1996-1998, Chair, 1999-2002.

Landsat Global Data Working Group, Member (9/01-9/03). NASA Landsat Science Team (member, 10/96-12/01)

Employment and Appointments

Chair, Department of Earth and Environment, 7/12-present.

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-present

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-present.

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

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.

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.

Publications

- Strahler, A.H., Logan, T.L., and C.E. Woodcock, 1979. Forest classification and inventory system using Landsat, digital terrain, and ground sample data, *13th Int. Symp. on Remote Sensing of Environment*, Ann Arbor, Mi, p. 1541-1557.
- Woodcock, C.E., Strahler, A.H., and T.L. Logan, 1980. Stratification of forest vegetation for timber inventory using Landsat and collateral data, *14th Int. Symp. on Remote Sensing of Environment*, San Jose, Costa Rica, p. 1769-1787.
- Strahler, A.H., Woodcock, C.E., and T.L. Logan, 1980. Forest stratification for timber inventory using digital landsat and terrain model data in northern California, *Proc. of the Sixth Canadian Symposium on Remote Sensing*, p. 413-419.
- Cosentino, M.J., Woodcock, C.E., and J. Franklin, 1981. Scene analysis for wildland fire fuel characteristics in a mediterranean climate, *15th Int. Symp. On Remote Sensing of Environment*, Ann Arbor, Mi, p. 635-636.
- 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.
- Woodcock, C.E., Franklin, J., Strahler, A.H., and T.L. Logan, 1982. Improvements in forest classification and inventory using remotely sensed data, Papers Selected for Presentation at the *16th Int. Symp. on Remote Sensing of Environment*, Buenos Aires, Argentina, p. 963-974.
- Logan, T.L., and C.E. Woodcock, 1982. User alternatives in post-processing for raster-to-vector conversion, *Proceedings of the ISPRS IV, Environmental Assessment and Resource Management, ASP/ACSM*, Washington, D.C., p. 397-407.
- Strahler, A.H., Woodcock, C.E., and T.L. Logan, 1983. Spatial inventory integrating raster databases and point sample data, *Technical Papers, 49th Annual Meeting, ASP*, p. 225-232.
- Woodcock, C.E., and A.H. Strahler, 1983. Characterizing spatial patterns in remotely sensed data, *17th Int. Symp. On Remote Sensing of Environment*, Ann Arbor, Mi, p. 839-852.
- Woodcock, C.E., and A.H. Strahler, 1983. Initial exploration of the relationship between coniferous biomass and Landsat MSS data, *Proc. Second CERMA Conference on Resource Management, Energy, and Environment*, San Francisco, p. 124-137.
- Strahler, A.H., Woodcock, C.E., Li, X., and D.L.B. Jupp, 1984. Discrete object modeling of remotely sensed scenes, *18th Int. Symp. on Remote Sensing of Environment*, Paris, France, p. 465-473.
- Strahler, A.H., and C.E. Woodcock, 1984. Image variance and spatial structure in remotely sensed scenes, *Proc. Third Australian Remote Sensing Conference*, Queensland, Australia, p. 512-518.
- Woodcock, C.E., 1985. Variograms and spatial variation in remotely sensed images, *IGARSS '85 Digest*, University of Massachusetts, Amherst, p. 1078-1083.

- 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., 1986. Remote sensing: new scales of environmental analysis, *The Bulletin of the Center for Energy and Environmental Studies*, Vol II(1):4-10.
- 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.
- Woodcock, C.E., 1989. Spatial analysis of forest images, chapter in *Remote Sensing and Resource Management*, International Center for Theoretical Physics, Trieste, Italy, F. El-Baz, M.H.A. Hassan, and V. Cappellini, editors, p. 233-270.
- 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., and S.L. Ryherd, 1989. Generation of texture images using adaptive windows, *Technical Papers, 55th Annual Meeting ASPRS*, 2:11-22.
- Michelson, A.R., Woodcock, C.E., and C.S. Yentsch, 1989. Modeling tidal mixing in the Boston Harbor using a raster-based GIS, *Proceedings of GIS/LIS '89*, 1:108-115.
- 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., Strahler, A.H., Wu, Y., and X. Li, 1990. Estimating forest stand parameters through inversion of a canopy reflectance model, *IGARSS '90 Digest*, p. 1203-1208.
- Ryherd, S.L., and C.E. Woodcock, 1990. The use of texture in image segmentation for the definition of forest stand boundaries, *23rd Int. Symp. on Remote Sensing of Environment*, Bangkok, Thailand, April 18-25, 2:1209-1213.
- Woodcock, C.E., Harward, V.J., Jakabhazy, V., Macomber, S., Ryherd, S., Strahler, A.H., and Y. Wu, 1990. An Overview of a new timber inventory system, *Protecting Natural Resources with Remote Sensing*, ASPRS, Bethesda, Md, p. 321-333.
- Woodcock, C.E., Jakabhazy, V., Macomber, S., Ryherd, S., Strahler, A.H., and Y. Wu, 1990. Timber inventory using Landsat Thematic Mapper imagery and canopy reflectance models, *23rd Int. Symp. On Remote Sensing of Environment*, Bangkok, Thailand, April 18-25, 2:937- 948.
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- Macomber, S., Woodcock, C.E., Warbington, R., and K. Casey, 1991. Modeling species associations for vegetation maps using terrain rules, *GRASS '91 Users Conference*, Berkeley, Ca, p. 137-148.
- Woodcock, C.E., Ryherd, S.L., Jakabhazy, V.D., El-Khattib, H., Hawela, F., Abdel-Samad, F.A., and R. El-Toudy, 1991. Testing a satellite-based agricultural crop area estimation procedure in the Nile Delta of Egypt, *Proceedings of the Conference on The application of Remote Sensing to Sustainable Agricultural Development*, Cairo, Egypt, p. 223-230.
- Woodcock, C.E., 1992. Mapping forest vegetation using TM imagery and a canopy reflectance model, *Proceedings of IUFRO: Integrating Forest Information over Space and Time*, Australian National University, p. 420-428.
- Woodcock, C.E., and S. Gopal, 1992. Accuracy assessment of the Stanislaus forest vegetation map using fuzzy sets, *Proceeding of the Fourth Biennial Remote Sensing Applications Conference*, Orlando, Florida, April 1992, 378-394.
- Jupp, D.L.B., and C.E. Woodcock, 1992. Variance in directional radiance of open canopies, *IGARSS '92 Digest*, 2:1490-1492.
- Jupp, D.L.B., Harrison, B.A., Gray, R.C., Byrne, G.T., McDonald, E.R., Strahler, A.H., Woodcock, C.E., and Li, X., 1992. Monitoring vegetation structure using geo-optical modelling and directional radiance, *Proceedings of the Asian Conference on Remote Sensing*, 10p.
- Woodcock, C.E., and V.J. Harward, 1992. Nested-hierarchical scene models and image segmentation, *International Journal of Remote Sensing*, 13(16):3167-3187.
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- 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.
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- 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.
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- 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.
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- 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.
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- Moody, A. and C.E. Woodcock, 1995. Calibration-based methods for correcting coarse resolution estimates of land-cover proportions, *Proceedings ASPRS Conference*, 3:684-693.
- Pax-Lenny, M., C.E. Woodcock, and J.B. Collins, 1995. Identification of agricultural lands of reduced productivity in Egypt using satellite remote sensing, *Proceedings ASPRS Conference*, 2:309-317.
- Collins, J.B., Woodcock, C.E., and D.L.B. Jupp, 1995. Spatial dependence and nested hierarchical scene models, *Proceedings ASPRS Conference*, 3:535-544.
- Woodcock, C.E., and S. Gopal, 1995. Remote sensing of forests: New data layers for GIS, *Proceedings ASPRS Conference*, 2:420-428.
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- 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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- Gopal, S., and C.E. Woodcock, 1996. Remote sensing of forest change using artificial neural networks, *IEEE Transactions on Geoscience and Remote Sensing*, 34(2):398-404.
- Woodcock, C.E., 1996. On roles and goals for map accuracy assessment: A remote sensing perspective, *Spatial Accuracy Assessment in Natural Resources and Environmental Sciences: Second International Symposium*, May, Fort Collins, Co, 535-540p.
- Collins, J.B., and C.E. Woodcock, 1996. Explicit consideration of multiple landscape

- scales while selecting spatial resolutions, *Spatial Accuracy Assessment in Natural Resources and Environmental Sciences: Second International Symposium*, May, Fort Collins, Co, 121-128p.
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- 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.
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- Li, X., Ni, W., Woodcock, C.E., and A.H. Strahler, 1996. A simplified hybrid model for radiation under discontinuous canopies, *IGARSS '96*, Lincoln, Nebraska, May, 1996, 1:293-295.
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- 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.
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- 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.
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- "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,

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- “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.
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- “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.
- “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, \$615K.
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- “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.
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- “Synthesis 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.
- “4-D Modeling of the Regional Carbon Cycle in and Around Urban Environments: An Interdisciplinary Study to Advance Observational and Modeling Foundations,” M.A. Friedl, PI, C.E. Woodcock, L. Hutyrá, S. Wofsy, A. Dunn and K. Chance, Co-Is, NASA Interdisciplinary Science Program, 8/12-7/15, \$1,282,141.
- “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.
- “Support for Silvacarbon, GEO FCT and GFOI”, IPA with USGS for C.E. Woodcock, 12/10/12-12/9/13, \$58,468.
- “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.
- “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.

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