Crystal Barker Schaaf, Ph.D.

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Experience

- **Professor 2011-Present**
  Department of Environmental, Earth, and Ocean Sciences,
  University of Massachusetts Boston, Boston, MA
- **Research Professor 2008-2011 (continuing as Adjunct Research Professor to present)**
- **Research Associate Professor 2000-2008**
- **Research Assistant Professor 1996-2000**
  Center for Remote Sensing, Department of Geography and Environment,
  Boston University, Boston, MA
- **Research Meteorologist 1986-1996**
  Satellite Branch, Geophysics Directorate, USAF Phillips Laboratory,
  Hanscom AFB, MA
- **Atmospheric Research Officer USAF 1982-1986**
  Cloud Physics Branch, USAF Geophysics Laboratory (AFGL),
  Hanscom AFB, MA

Academic Qualifications

- **Doctor of Philosophy in Geography (Remote Sensing) 1994**
  Boston University, Boston, MA
  Modeling the Direct-Beam Instantaneous Spectral Surface Albedo of a Forested Landscape using Geometric-Optics and a Distributed Parameter Approach
- **Master of Science in Meteorology 1982**
  Massachusetts Institute of Technology (MIT), Cambridge, MA
  Variation in tropical wind patterns (1968-1979)
- **Bachelor of Science in Interdisciplinary Sciences (Meteorology) 1982**
  Massachusetts Institute of Technology (MIT), Cambridge, MA
- **Master of Liberal Arts in Archaeology 1988**
  Harvard University, University Extension, Cambridge, MA
  Establishment and demise of Moche V: Assessment of the climatic impact

Satellite Science Teams

- **MODerate resolution Imaging Spectroradiometer (MODIS) on board NASA's Aqua and Terra Earth Observing System Platforms:** Science Team Member and Principal Investigator for the MODIS BRDF/Albedo Product, 2004-present; Associate Science Team Member, 1999-2003.
- **Visible/Infrared Imager/Radiometer Suite (VIIRS) on board the Suomi National Polar-orbiting Parternship (NPP) and future NOAA/NASA Joint Polar Satellite Systems (JPSS):** Science Team Member and Principal Investigator for the VIIRS Albedo Environmental Data Records, 2004-present.

Awards

- **NASA Group Achievement Award: Aqua Mission Team,** August, 2003
- **Goddard Space Flight Center Group Achievement Award: Earth Observing System (EOS) Aqua Mission Team,** May, 2003
- **2009 Editors' Citations for Excellence in Refereeing (JGR-Atmospheres)**

NASA Data Active Archive Center (DAAC) Advisory Boards

- **Oak Ridge National Laboratory (ORNL) DAAC** 2004–2009
- **USGS Earth Resources Observation and Science Land Processes DAAC** 2010-present

Teaching and Advising Roles

- ### Courses

UMassBoston: EEOS370/625 Intro to Remote Sensing
Introduction to the principles of remote sensing and image analysis for environmental applications.
Boston University: GE510 Physical Principles of the Environment
The basic science of global environmental change, including greenhouse effects, biogeochemical cycling, and impacts on terrestrial and marine ecosystems.
Boston University: GE502 Advanced Topics in Remote Sensing
Examines advanced concepts in radiative transfer and information extraction relevant to remote sensing with an emphasis on applications of digital image processing.
Boston University: GE302 Remote Sensing of Environment
Introduction to remote sensing, sensor systems, image analysis and ways in which remotely sensed data is used in scientific investigations and resource management.
Northeastern University: RMS-6250, Remote Sensing of Vegetation
An online course on the satellite imaging techniques used in monitoring vegetation canopies.
Northeastern University: RS-3130, Remote Sensing and Global Change
An online course on global change science with a focus on the use of remote sensing data.

- ### Ph.D. Dissertation Committees

Xiaoyuan Yang, 2012, BU, *Using a Ground-based Lidar Instrument (Echidna®) to Reconstruct Three-dimensional Forest Structure for Biophysical and Ecological Studies*
Feng Zhao, 2011, BU, *Measuring the Leaf Area Index and Foliage Profile of Forest Canopies Using a Ground-Based Lidar Instrument (Echidna®)*
Zhuosen Wang, 2011, BU, *The MODerate-resolution Imaging Spectoradiometer (MODIS) Reflectance Anisotropy and Albedo of Dormant and Snow-covered Canopies*
Yanmin Shuai, 2010, BU, *Tracking Daily Land Surface Albedo and Reflectance Anisotropy with the MODerate-resolution Imaging Spectroradiometer (MODIS)*
Miguel Roman, 2009, BU, *The MODIS BRDF/Albedo Product: Assessment of Pixel-Specific Accuracy through Synergistic use of In-Situ and Remotely Sensed Data*
Qingling Zhang, 2009, BU, *A Global Spatially and Temporally Complete Reflectance Anisotropy Database to Improve Surface Characterization for Environmental Modeling*
Ziti Jiao, 2009, BU, *The Use of MODIS Reflectance Anisotropy to Recover Land Surface Properties*
Wenze Yang, 2006, BU, *Analysis, Improvement, and Application of MODIS Leaf Area Index Products*
Jiannan Hu, 2005, BU, *Assessment and Refinement of the MISR LAI and FPAR Product*
Yufang Jin, 2003, BU, *Evaluation, Improvement, Application of Surface BRDF Albedo from MODIS*
Nikolay Shabanov, 2002, BU, *Application of Stochastic Radiative Transfer to Remote Sensing Vegetation*
Nicholas Strugnell, 2001, BU, *Retrieval of Land Surface Albedos from Satellite Measurements*

- ### Master Thesis Committees

Jonathan Salomon, 2006, *Validation of the MODIS Bidirectional Reflectance Distribution Function and Albedo Retrievals Using Combined Observations from the Aqua and Terra Platforms*
Adeline Wong, 2000, *Estimating Cloudy-Sky Surface Temperature of Sea Ice: Implications for Satellite RS*

Research Efforts

- MODIS Albedo, Nadir Reflectance, and Reflectance Anisotropy for Environmental Modeling and Monitoring; C.L.B Schaaf (PI), NASA, $590,606; 1/11-12/13.

- Albedo and Bidirectional Reflectance Climate Data Records from NPP/VIIRS, C.L.B. Schaaf (PI), NASA, $555,615; 3/11-2/14.

- Land-to-Sea Carbon Export from the Northeast Watersheds of North America.W. Balch (PI-Bigelow Lab for Ocean Sciences), C.L.B. Schaaf (UMB-PI), NASA, $140,775; 10/11-3/15.

- Albedo Trends Related to Land Cover Change and Disturbance: A Multi-sensor Approach; J. Masek; (NASA-PI) C. L. B. Schaaf (UMB-PI), NASA $152,792; 3/11-2/14.

- NPP Albedo Environmental Data Record Validation, C. Schaaf (PI), NOAA, $61,923.00, 9/11-8/12.

- Mapping Changes in Shrub Abundance and Biomass in Arctic Tundra using NASA Earth Observing System Data and Geometric Optical Modeling; MontclairU-PI, M. Chopping; C.L.B. Schaaf, BU-PI; $206,956; 7/1/09-6/30/12

- Development of a Dual-Wavelength, Ground-Based, Echidna® Lidar (DWEL) for Structural Characterization and Virtual Reconstruction of Forest Canopies, A. Strahler, (PI); C. Schaaf (Co-I); NSF Major Research Instrumentation Program (MRI) Program NSF 09-502, $2,081,140; 9/09-9/13.

- 6/1/2011-5/31/2012Cooperative Institute for climate and satellites: Assessments of Albedo and Surface Type, C.L.B. Schaaf (BU-PI); Friedl, Co-I; NOAA (UMD); $1,000,000; 7/09-6/11.

- Global Land Surface Albedo and Anisotropy Product from MODIS and VIIRS for Climate and Vegetation Studies, C.L.B. Schaaf (PI), $1,100,649, NASA, 12/18/07 – 12/17/11.

- NSF GK-12 Graduate STEM Fellows in K-12 Education, Glacier-Global Change Initiative-Education & Research, S. Gopal, (PI), C. Schaaf, (Co-I); NSF; 3/10–2/15; 2,985,210; .25 summer months.

- Global Land Surface Albedo and Anisotropy ESDR/CDR: Instrument Specific Algorithm Refinement and Calibration/Validation Efforts; NASA Graduate Student Researchers Program (GSRP) for M. Román; C.L.B. Schaaf, (PI); $60,000, 09-2007 to 08-2009.

- Assessment and Enhancement of Albedo Derived From the MODIS BRDF/Albedo Product at the ARM SGP, C.L.B. Schaaf (PI) with A. Strahler, $188,732, DOE, 1/15/06 – 1/14/09.

- National Aeronautic and Space Administration, "Retrieval of Vegetation Structure Using Ground-based LIDAR and Scaling to Airborne and Spaceborne LIDAR," A. Strahler (PI), C. Schaaf (CoI) $464,931; 1/1/06-5/31/09.

- Algorithim Refinement for the MODIS Bidirectional Reflectance / Albedo Product, C.L.B. Schaaf (PI) with A. Strahler, X. Li, Co-I at Potsdam Institut fuer Klimafolgenforschung (PIK), $698,049, NASA, 3/31/04-3/30/07.

- A Daily BRDF/Albedo Algorithm for MODIS Direct Broadcast Sites. C.L.B. Schaaf (PI) with A. Strahler, X. Li at BU, CoI at SDSU, $582,894.00, NASA, 8/15/04 - 11/1/07.

- Assessment of aerosol, and albedo and surface type Environment Data Records (EDRs) from VIIRS, C.L.B. Schaaf (PI) with A. Strahler at BU, Co-I at UMD, $462,608, NASA, 1/04 - 2/07.

- Using EOS to Characterize Impacts of Land Use Change on Hydrological Processes in Climate Models, Robert E. Dickinson (PI-Georgia Tech), C.B. Schaaf (PI-BU) with A. Strahler, M. Friedl, R. Myneni, N. Shabanov, E. Tsvetsinskaya,Y. Knyazikhin at BU. $300,000, NASA, 8/04 - 2/08.

- Seasonal & Global Representation of Land Surface Properties from MODIS & Other EOS Instruments & Their Implications for Application in Climate Models, Robert E. Dickinson (PI-Georgia Tech), C.L.B. Schaaf (PI-BU) with N. Shabanov and E. Tsvetsinskaya at BU. $138,000, NASA, 6/1/04 - 5/31/07.

- Improving the Representation of Land in Climate Models by Application of EOS Observations, Robert E. Dickinson (PI-Georgia Tech), C.L.B. Schaaf (PI-BU) with A. Strahler, M. Friedl, R. Myneni, and Y. Knyazikhin at BU, $270,000, NASA,1/1/01-12/31/03.

- Land Surface Albedo From MERIS Reflectances Using MODIS Directional Factors, Schaaf (PI), Strahler and Gao, Co-Is at PIK, UCL, $116,910, NASA, 9/1/01-12/31/03.

- Algorithm Development for NPOESS, C.L.B. Schaaf (PI), with M. Friedl, J. Key, A.H. Strahler, and C.E. Woodcock, Co-Is at BU, $678,450, AER Inc., 1/1/97-6/16/00.

- Land Cover/Land-Cover Change, Albedo, BRDF/Directional Reflectance and Spatial Structure Products from MODIS-N and MODIS-T, NASA Office of Space Science and Applications, NASA-EOSAO, MODIS Team Member Investigation, A. H. Strahler (PI) (C.L.B. Schaaf, Associate Team Member). $9,464,991, NASA, 1/1/92 - 12/15/03.

Publications

1. He, L., J. M. Chen, J. Pisek, C. B. Schaaf, A. H. Strahler, Global clumping index map derived from the MODIS BRDF product, Remote Sensing of Environment, 119, 118-130, 2012.

2. *Wang, Z., C. B. Schaaf, M. J. Chopping, A. H. Strahler, J. Wang, M. O.Román, A. V. Rocha, C. E. Woodcock,Y. Shuai, Evaluation of Moderate-resolution Imaging Spectroradiometer (MODIS) snow albedo product (MCD43A) over tundra, Remote Sensing of Environment, doi:10.1016/j.rse.2011.10.002, 2012.

3. O'Halloran, T., B. Law, M. L. Goulden, Z. Wang, J. Barr, C. Schaaf, M. Brown,J. D. Fuentes, M. Gockede, A. Black, V. Engel, Radiative forcing of natural forest disturbances, Global Change Biology, doi: 10.1111/j.1365-2486.2011.02577.x, 2011.
ScienceDaily Research News: http://www.sciencedaily.com/releases/2011/10/111019171740.htm

4. *Jiao, Z., C. Woodcock, C. B. Schaaf, B. Tan, J. Liu, F. Gao, A. Strahler, X. Li, J. Wang, Improving MODIS land cover classification by combining MODIS spectral and angular signatures in a Canadian boreal forest, Canadian Journal of Remote Sensing, 37, 1-20, 2011.

5. Hill, M. J., M. O. Román, C. B. Schaaf, Dynamics of vegetation indices in tropical and subtropical savannas defined by ecoregions and Moderate Resolution Imaging Spectroradiometer(MODIS) land cover, Geocarto International, 1-39, DOI:10.1080/10106049.2011.626529.

6. Shuai, Y., J. G. Masek, F. Gao, C. B. Schaaf, An algorithm for the retrieval of 30-m snow-free albedo from Landsat surface reflectance and MODIS BRDF, Remote Sensing of Environment, 115, 2204-2216, 2011.

7. *Yao, T., X. Yang, F. Zhao, Z. Wang, Q. Zhang, D. Jupp, J. Lovell, D. Culvenor, G.Newnham, W.Ni-Meister,C. B. Schaaf,C. Woodcock, J. Wang, X. Li, A. H. Strahler, Measuring forest structure and biomass in New England forest stands using Echidna ground-based lidar, Remote Sensing of Environment, doi:10.1016/j.rse.2010.03.019, 2011.

8. *Román,M. O., C. K. Gatebe, C. B. Schaaf, R. Poudyal, Z. Wang, M. D. King, Variability in surface BRDF at different spatial scales (30 m - 500 m) over a mixed agricultural landscape as retrieved from airborne and satellite spectral measurements , Remote Sensing of Environment, 115, 2184-2203, 2011.

9. Chopping, M., C. B. Schaaf, F. Zhao, Z. Wang, A. W. Nolin,G. G. Moisen,J. V. Martonchik, M. Bull, Forest structure and aboveground biomass in the southwestern United States from MODIS and MISR, Remote Sensing of Environment, doi:10.1016/j.rse.2010.08.031, 2011.

10. Schaaf, C. L. B., J. Liu, F. Gao and A. H. Strahler, MODIS Albedo and Reflectance Anisotropy Products from Aqua and Terra, In Land Remote Sensing and Global Environmental Change: NASA's Earth Observing System and the Science of ASTER and MODIS, Remote Sensing and Digital Image Processing Series, Vol. 11, B. Ramachandran, C. Justice, M. Abrams, Eds., Springer-Verlag, 873 pp., 2011.

11. Hill, M., M. O. Román, C. B. Schaaf,L. Hutley, C. Brannstrom, Characterizing vegetation cover in global savannas with an annual foliage clumping index derived from the MODIS BRDF product , Remote Sensing of Environment, doi:10.1016/j.rse.2011.04.003, 2011.

12. *Zhao, F., X. Yang, M. A. Schull, M. O. Román,T. Yao, Z. Wang, Q. Zhang, D. L. B. Jupp, J. L. Lovell, D. S. Culvenor, G. J. Newnham, A. D. Richardson, W. Ni-Meister, C. L. Schaaf, C. E. Woodcock, and A. H. Strahler Measuring effective leaf area index, foliage profile, and stand height in New England forest stands using a full-waveform ground-based lidar ,Remote Sensing of Environment,doi:10.1016/j.rse.2010.08.030, 2011.

13. *Wang, Z., C. B. Schaaf, P. Lewis,Y. Knyazikhin, M. A. Schull, A. H. Strahler, T. Yao, R. B. Myneni, M. J. Chopping and J. B. Blair, Retrieval of canopy height using moderate-resolution imaging spectroradiometer (MODIS) data, Remote Sensing of Environment, 115, 1595-1601, 2011.

14. Schaaf, C. B., Z. Wang and A. H. Strahler, Commentary on Wang and Zender-MODIS snow albedo bias at high solar zenith angles relative to theory and to in situ observations in Greenland, Remote Sensing of Environment, 115, 1296-1300, 2011.

15. Hill, M. J., M. O. Román, M. O. and C. B. Schaaf, Biogeography and Dynamics of Global Savannas: A Spatio-Temporal View. In, Hill, Michael J. and Hanan, Niall P. eds (2011). *Ecosystem Function in Savannas: Measurement and Modeling at Landscape to Global Scales*. (CRC Press, Boca Raton, Florida) pp 3 – 37, 2011.

16. *Román, M. O., C. B. Schaaf, P. Lewis, F. Gao, G. P. Anderson, J. L. Privette, A. H. Strahler, C. E. Woodcock, M. Barnsley, Assessing the coupling between surface albedo derived from MODIS and the fraction of diffuse skylight over spatially-characterized landscapes, Remote Sensing of Environment, 114, 738-760,2010.

17. Ni-Meister,W.,S. Lee, A. H. Strahler, C. E. Woodcock, C. B. Schaaf, T. Yao, K.J. Ranson, G. Sun, and J.B. Blair Assessing general relationships between aboveground biomass and vegetation structure parameters for improved carbon estimate from lidar remote sensing,Journal of Geophysical Rsearch, 115, G00E11, doi:10.1029/2009JG000936,2010.

18. Lyapustin, A.,C. K. Gatebe, R. Kahn, R. Brandt,J. Redemann, P. Russell, M. D. King, C. A. Pedersen, S. Gerland, R. Poudyal, A. Marshak, Y. Wang, C. Schaaf, D. Hall, and A. Kokhanovsky, Analysis of snow bidirectional reflectance from ARCTAS Spring-2008 Campaign,Atmospheric Chemistry and Physics, 10, 4359-4375,2010.

19. Wang, Y.,A. Lyapustin, J.L. Privette, R.B. Cook, S.K. SanthanaVannan, E.F.Vermote, C.Schaaf,Assessment of biases in MODIS surface reflectance due to Lambertian approximation, Remote Sensing of Environment, 114,2791-2801,2010.

20. Ju, J.,D. Roy, Y. Shuai, C. Schaaf, Development of an approach for generation of temporally complete daily nadir MODIS reflectance time series,Remote Sensing of Environment, doi:10.1016/j.rse.2009.05.022,1-20, 2010.

21. Schaaf, C.B., J. Cihlar, A. Belward, E. Dutton, and M. Verstraete, Albedo and Reflectance Anisotropy, ECV-T8: GTOS Assessment of the status of the development of standards for the Terrestrial Essential Climate Variables, ed., R. Sessa, Global Terrestrial Observing System (GTOS), FAO, Rome, 2009.

22. Román, M. O., C. B. Schaaf, C. E. Woodcock, A. H. Strahler, X. Yang, R.H. Braswell, P. Curtis, K.J. Davis, D. Dragoni, M. L. Goulden, L. Gu, D. Y. Hollinger, T. E. Kolb, T.P. Meyer, J. W. Munger, J.L. Privette, A.D. Richardson, T.B. Wilson, S. C. Wofsy, The MODIS (Collection V005) BRDF/albedo product: Assessment of spatial representativeness over forested landscapes, Remote Sensing of Environment, 113, 2476-2498,2009.

23. Hall, D. K., S. V. Nghiem, C. B. Schaaf, N. E. DiGirolamo, and G. Neumann, Evaluation of surface and nearsurface melt characteristics on the Greenland ice sheet using MODIS and QuikSCAT data,J. Geophys. Res., 114, F04006, doi:10.1029/2009JF001287,2009.

24. Rutan, D., F. Rose, M. Roman, N. Manalo-Smith, C. Schaaf, and T. Charlock, Development and assessment of broadband surface albedo from Clouds and the Earth's Radiant Energy System Clouds and Radiation Swath data product, J. Geophys. Res.,114, D08125, doi:10.1029/2008JD010669,2009.

25. Zhang, X., M. Friedl, and C. Schaaf, Sensitivity of vegetation phenology detection to the temporal resolution of satellite data. Int. J. Remote Sens., 30:8,2061-2074,2009, 2009.

26. Liu, J., C. Schaaf, A. Strahler, Z. Jiao, Y. Shuai, Q. Zhang, M. Roman, J. A. Augustine, E. G. Dutton, Validation of MODIS Albedo Retrieval Algorithm: Dependence of Albedo on Solar Zenith Angle, J. Geophys. Res., 114, D01106,doi:10.1029/2008JD009969,2009.

27. Moody, E., M. D. King, C. B. Schaaf, and S. Platnick, MODIS-Derived Spatially Complete Surface Albedo Products: Spatial and Temporal Pixel Distribution and Zonal Averages, Journal of Applied Meteorology and Climatology, 47,2879-2894,2008.

28. Dickinson, R.E., L. Zhou, Y. Tian, Q. Liu, T. Lavergne, B. Pinty, C. B. Schaaf, and Y. Knyazikhin, A 3-Dimensional Analytic Model for the Scattering of a Spherical Bush., *J. Geophys. Res.*, 113, D20113, doi:10.1029/2007JD009564, 2008.

29. Knobelspiesse, K. D., B. Cairns, B. Schmid, M. O. Román, and C. B. Schaaf, Surface BRDF estimation from an aircraft compared to MODIS and ground estimates at the Southern Great Plains site, J. Geophys. Res., 113, D20105, doi:10.1029/2008JD010062, 2008.

30. Coddington, O., K. S. Schmidt, P. Pilewskie, W. J. Gore, R. W. Bergstrom, M. Román, J. Redemann, P. B. Russell, J. Liu, and C. C. Schaaf, Aircraft measurements of spectral surface albedo and its consistency with ground-based and space-borne observations, J. Geophys. Res., 113, D17209, doi:10.1029/2008JD010089,2008.

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32. Hill, M., C. Averill, Z. Jiao, C. Schaaf, and J. Armston, Relationship of MISR RPV parameters and MODIS BRDF shape indicators to surface vegetation patterns in an Australian tropical savanna, Can. J. Remote Sensing, Vol. 34, Suppl. 2, S247-267, 2008.

33. Ni-Meister, W., A. H. Strahler, C. E. Woodcock, C. B. Schaaf, D. L.B. Jupp, T. Yao, F. Zhao, and X. Yang, Modeling the hemispherical scanning, below-canopy lidar and vegetation structure characteristics with a geometric-optical and radiative-transfer model, Can. J. Remote Sensing, Vol. 34, Suppl. 2, pp. S385-S397, 2008

34. Stone, R. S., G. P. Anderson, E. P. Shettle, E. Andrews, K. Loukachine, E. G. Dutton, C. Schaaf, and M. O. Roman III, Radiative impact of boreal smoke in the Arctic: Observed and modeled, J. Geophys. Res., Vol. 113, D14S16, doi:10.1029/2007JD009657, 2008

35. Schaaf, C. L., J. Martonchik, B. Pinty, Y. Govaerts, F. Gao, A. Lattanzio, J. Liu, A. H. Strahler, and M. Taberner, Retrieval of Surface Albedo from Satellite Sensors,in *Advances in Land Remote Sensing: System, Modeling, Inversion and Application*, S. Liang, Ed., Springer, ISBN 978-1-4020-6449-4, page 219-243, 2008.

36. Roy, D.P., Ju, J., Lewis, P., Schaaf, C., Gao, F.,Hansen, M., Lindquist, E.,, Multi-temporal MODIS-Landsat data fusion for relative radiometric normalization, gap filling, and prediction of Landsat data, Remote Sensing of Environment,112:3112-3130,2008.

37. Schaaf, C., Albedo and Reflectance Anisotropy, Terrestrial Essential Climate Variables for Climate Change Assessment, Mitigation and Adaptation., GTOS-52, Eds. R. Sessa and H. Dolman, FAO, Rome, 28-29, January 2008.

38. *Shuai Y., C. B. Schaaf, A. H. Strahler, J. Liu, Z. Jiao (2008), Quality assessment of BRDF/albedo retrievals in MODIS operational system, Geophys. Res. Lett., 35, L05407, doi:10.1029/2007GL032568.

39. Fang, H., S. Liang, H.-Y. Kim, J. R. Townshend, C. L. Schaaf, A. H. Strahler, R.E. Dickinson, Developing a spatially continuous 1km surface albedo dataset over North America from Terra MODIS products, J. Geophys. Res., 112, D10125, doi:10.1029/2006JD008377, 2007.

40. Schaaf, C. L., The Sunlit Earth. In *Our Changing Planet: The View from Space*, M. D. King, C. L. Parkinson, K. C. Partington, R. G. Williams, Eds., Cambridge University Press, 129-135, 2007.

41. Moody, E. G., M. D. King, C. B. Schaaf, D. K. Hall, and S. Platnick, 2007: Northern Hemisphere five-year average (2000-2004) spectral albedos of surfaces in the presence of snow: Statistics computed from Terra MODIS land products. *Remote Sens. Environ.*, **111**, 337-345.

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45. *Salomon, J., C. B. Schaaf, A. H. Strahler, F. Gao, Y. Jin, Validation of the MODIS Bidirectional Reflectance Distribution Function and Albedo Retrievals Using Combined Observations from the Aqua and Terra Platforms, IEEE Trans. Geosci. Remote Sens. Vol. 44, No. 6, June 2006.

46. Gao, F., C. Schaaf, A. Strahler, A. Roesch, W. Lucht, and R. Dickinson, The MODIS BRDF/Albedo Climate Modeling Grid Products and the Variability of Albedo for Major Global Vegetation Types, J. Geophys. Res., 110, D01104, doi:10.1029/2004JD005190, 2005.

47. Moody, E. G., M. D. King, S. Platnick, C. B. Schaaf, and F. Gao, Spatially complete global spectral surface albedos: Value-added datasets derived from Terra MODIS land products. IEEE Transactions on Geoscience and Remote Sensing, Vol. 43, 144-158, 2005.

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49. Myhre, G., Kvalevag, M.M. and Schaaf, C.B. 2005, Radiative forcing due to anthropogenic vegetation change based on MODIS surface albedo data set, Geophys. Res. Let. 32:L21410, doi:10.1029/2005GL024004.

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