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SUN ANGLE AND BACKGROUND EFFECTS ON SPECTRAL RESPONSE OF SIMULATED FOREST CANOPIES

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ABSTRACT

Remote sensing measurements are useful for monitoring the amount and status of phytomass and leaf area index (LAI) of the world.s forests This information is important for models relating LAI to net primary production of global forest ecosystems. The measured reflectance of a forest canopy can vary diurnally because of changing sun angle. The reflectance can vary seasonally because of sun angle, as well as changes in the canopy understory or background reflectances.

An experiment was performed to examine the effects of changing sun angles and backgrounds on the reflectance of three canopies of small balsam fir (Abies Balsamea (L.) Mill.). These simulated forest canopies were arranged with different densities on a 4 m diameter rotating platform. The average reflectance from thirty-seven observations for each of three backgrounds (grass sod, white-, and black-painted boards) were obtained for a wide range of solar zenith angles. Sun angle strongly affected canopy reflectance, especially when the background reflectance was high. Canopy reflectances and spectral vegetation indices were significantly different due to backgrounds at solar zenith angles of less than 50°. At larger sun angles, shadows reduced the effect of the underlying background reflectance.

The relationships among canopy characteristics and spectral response were also evaluated. Both linear and allometric model forms described these relationships well under certain conditions In general, cases with higher contrast between background and coniferous canopy produced stronger relationships.

Sun angle and background effects are important factors to consider when using remote sensing data to inventory and monitor coniferous forests. However, the potential of using multitemporal data that make use of differences in the background appears promising.

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K. Jon Ranson is a Research Agronomist at the Laboratory for Applications of Remote Sensing (LARS), Purdue University. He has a B.S. in Watershed Sciences and M.S. in Earth Resources/Remote Sensing from Colorado State University, and Ph.D. from Purdue University. He has been active in remote sensing research since 1970 and has authored several publications dealing with remote sensing of agricultural and natural resources as well as optical and thermal canopy modeling. Dr. Ranson has participated in research efforts involving classification of Landsat MSS and Skylab data and in numerous field and laboratory remote sensing investigations. Before coming to LARS, he was a research associate in the Forest and Wood Sciences Department at Colorado State University. He coordinated research activities on several projects and supervised graduate and undergraduate students. He is a member of the Soil Conservation Society of America and Sigma Xi. While at Purdue, his activities have included examining the bidirectional reflectance characteristics of agricultural and forest scenes and related modeling studies.

Craig S.T. Daughtry, Senior Research Agronomist, Department of Agronomy and LARS, has B.S. and M.S. degrees from the University of Georgia in Agronomy and the Ph.D. degree from Purdue University in

Agronomy (crop physiology). Dr. Daughtry has taught a graduate course in environmental crop physiology. He is a member of the American Society of Agronomy, Crop Science Society of America American Society of Photogrammetry, and several honorary societies. He is the author of more than 20 publications on the spectral properties of crops and applications of remote sensing technology to estimate agronomic characteristics and yields of crops. He served as chairman of the Plant Science Committee of ASP and associate editor of the journal Photogrammetric Engineering and Remote Sensing.

Dr. Daughtry.s research in crop physiology has included field and lab experiments to evaluate effects of the plant.s environment on its photosynthesis, water relations, and chemical composition. He has been actively involved in the development of several computer models which simulate growth and development of corn and soybeans. Since joining LARS in 1976, Dr. Daughtry has participated in design, implementation, analysis, and interpretation of several remote sensing experiments sponsored by NASA.

Larry L. Biehl, Research Engineer in the Measurements Program Area at LARS, has a B.S. degree in Electrical Engineering and a M.S. degree in Engineering from Purdue University. He has had key roles in NASA.s Thematic Mapper Study, the LACIE Field Measurements Project, and the AgRISTARS Supporting Research Project. His present roles include overseeing spectral data acquisition, calibration and preprocessing, coordinating entry of the field research data into the library, and developing improved software for more efficient analysis of spectral data. He is a member of the Institute of Electrical and Electronics Engineers.