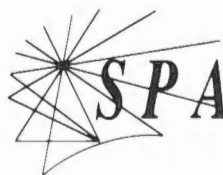
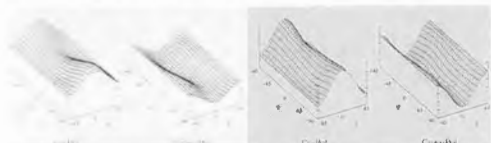
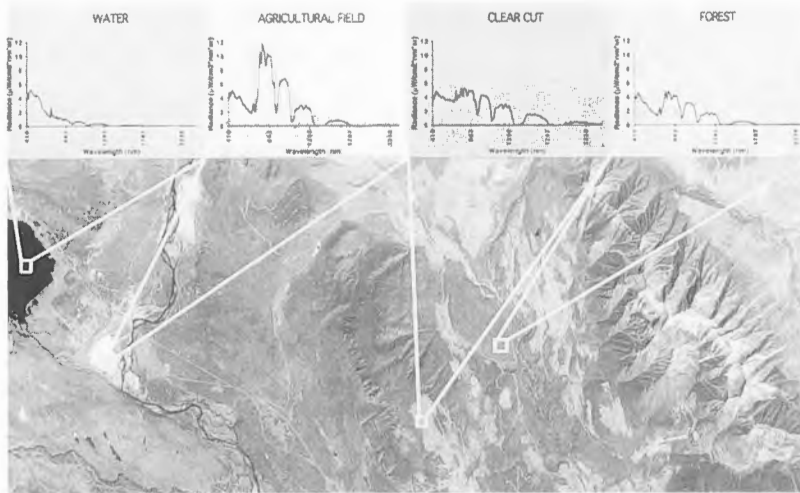
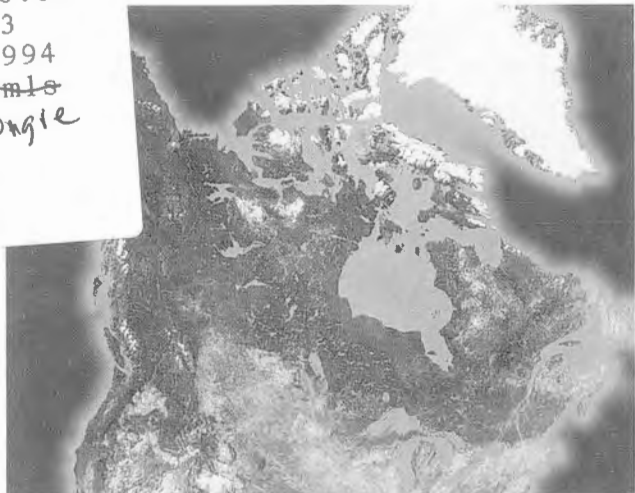


G  
70.39  
C3  
1994  
omls  
ongle

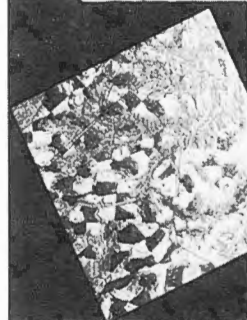
This document was produced  
by scanning the original publication.

Ce document est le produit d'une  
numérisation par balayage  
de la publication originale.



**Scene Physics and Analysis Section**  
Canada Centre for Remote Sensing

## 1994 ANNUAL REPORT



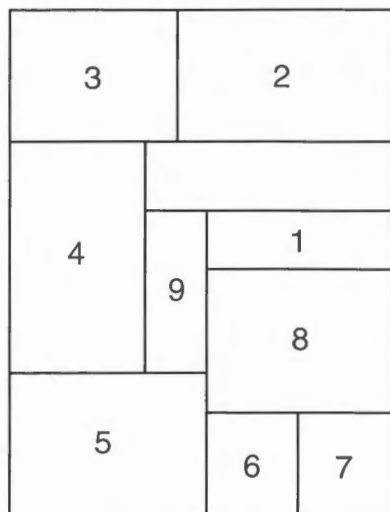
Geomatics Canada  
Géomatique Canada

Canada



## Scene Physics and Analysis Section

## Section de physique et analyse des scènes



1. Mosaic of 56 ERS-1 SAR scenes encompassing the region between Vancouver, British Columbia and Calgary, Alberta, including terrain relief corrections and radiometric normalization.
2. Composite image of AVIRIS data (694 nm band - blue, 861 nm band - green, 1645 nm band - red) acquired over Kootenay, British Columbia with radiance spectra extracted from four sites.
3. NOAA AVHRR vegetation index composite of Canada from the GeoComp system, with radiometrically calibrated AVHRR data (channel 1 - blue, channel 2 - green, NDVI - red).
4. Total power signatures extracted from two sites of a polarimetric radar image (P band - red, L band - green, C band - blue) near Whitecourt, Alberta. The image is wrapped over a digital elevation model.
5. Field measurement site near the Gun Lake, British Columbia test area during the CCRS SAR/MSS forestry experiment.
6. Fish-eye photograph of meteorological sky conditions during an atmospheric correction field measurement campaign at the Baskatong Reservoir, Québec.
7. Atmospheric optical depth measurements during airborne MEIS-2 flights near Taylor Lake, Québec using a Li-cor LI-1800 spectrometer configured for solar radiometric measurements to determine parameters for atmospheric correction.
8. Tree vectorization/architecture measurements using a Wild Total Station survey instrument in support of radar backscatter and bidirectional reflectance modelling of forest canopies.
9. Spectral measurements of tree defoliation due to spruce budworm in New Brunswick, in cooperation with the Canadian Forestry Service.



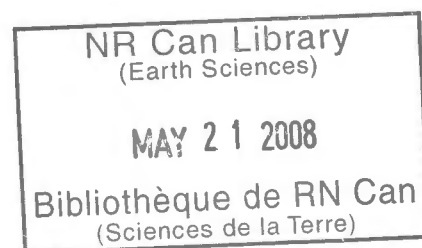
### Information:

Dr. Philippe M. Teillet  
Scene Physics and Analysis Section  
Canada Centre for Remote Sensing  
Geomatics Canada  
588 Booth Street  
Ottawa, Ontario  
Canada K1A 0Y7

# *SPAS Annual Report*

# 1994

Scene Physics and Analysis Section  
(SPAS)



Methods and Systems Division

Canada Centre for Remote Sensing

Geomatics Canada Sector

Natural Resources Canada

## *Basic Elements of SPAS R&D Activity*

### **Mandate:**

The Scene Physics and Analysis Section (SPAS) conducts research and develops new methodologies and algorithms, based on a fundamental understanding of geophysical and biophysical interactions, in order to maximize the accuracy and usefulness of quantitative information derived from satellite and aircraft imagery acquired over natural scenes.

### **Objectives:**

The main functions of SPAS are to:

- (1) undertake fundamental R&D investigations of scene understanding methodologies and techniques which have long-term application;
- (2) carry out R&D projects to produce new quantitative image processing and analysis algorithms and tools which can be readily transferred to industry;
- (3) provide consultative expertise to remote sensing projects which have potential for immediate applications benefit.

### **Current R&D Focus:**

The Scene Physics and Analysis Section is actively pursuing research and development on techniques for the correction, integration, and validation of image data products, in conjunction with the development of quantitative information extraction tools. The current focus is on the following areas:

- (1) spectral sensing research and development for environmental monitoring;
- (2) quantitative radar analysis algorithms and data product development;
- (3) physical analysis of radiometry and data integration in geographic mosaicking;
- (4) scale-space techniques for interpreting Earth observation imagery.

### **Contribution and Impact:**

The activities of SPAS represent a vigorous program of research and development in remote sensing scene physics and analysis at CCRS. The algorithms and tools from these activities are critical because they help to provide the understanding and quantitative underpinnings that are necessary for remote sensing to play a strong role in interdisciplinary investigations from local to global scales.

## Overview:

The Scene Physics and Analysis Section (SPAS) of the Canada Centre for Remote Sensing (CCRS) reports to Dr. Robert A. O'Neil, Director of the Methods and Systems Division at CCRS. In 1994, SPAS consisted of four Research Scientists (P.M. Teillet, K. Staenz, M. Lasserre, and B. Guindon (who transferred to the Global Change Systems Section as of April 1994)) and three Physical Scientists (R. Landry, G. Fedosejevs, and J.-C. Deguise). Our activities were augmented by two Research Associates under contract (D. Williams, and N. Eldridge) and one Secretary (P. Geiger, who also supported the Knowledge Based Methods and Systems Section). Additional assistance was received in 1994 from students Greg Poole (Physics, University of Waterloo), Pierre Bouffard (Génie électrique, Université de Sherbrooke), and Denis Gauthier (Electrical Engineering, McGill University). SPAS hosted Visiting Scientist Yonghao Zhu, Department of Optical Remote Sensing, Anhui University of Optics and Fine Mechanics, Hefei, China, for a six-month term working on imaging spectrometry data analysis. SPAS also hosted scientific support contractors Scott Patterson and Danielle Boucher for several months (Radarsat III Analysis project). Brian Walker and Mark Budd were also on-site for several months as scientific support contractors working on imaging spectrometry data analysis.

The report outlines SPAS achievements in 1994 and includes a cumulative bibliography of the Section's publications to provide a concrete measure of the level of scientific productivity of SPAS since its formation. The R&D focus of this small but very active group is primarily directed toward improving the quantitative aspects of information derived from broadscale/spectral satellite imagery in support of land-cover monitoring and the identification and development of preferred methodologies for radar data modelling and analysis. The expertise of SPAS scientific staff is available for detailed work and consultation on a contractual basis. The group is also involved in a variety of joint R&D efforts and technical interchanges in Canada and internationally and further opportunities for possible collaborative work are always of interest.

## Contact:

For additional information on remote sensing scene physics and analysis at CCRS, please contact:

Dr. Philippe M. Teillet  
Head, Scene Physics and Analysis Section  
Canada Centre for Remote Sensing  
588 Booth Street  
Ottawa, Ontario K1A 0Y7  
Canada

Telephone: (613) 947-1251  
Fax: (613) 947-1383  
Email: teillet@ccrs.emr.ca

## *SPAS Achievements for 1994*

### **Spectral Sensing Research and Development for Environmental Monitoring**

- Examination of the effects of spectral and spatial resolutions on the Normalized Difference Vegetation Index (NDVI).
- Completion of the Phase I development of the Imaging Spectrometry Data Analysis System (ISDAS) in collaboration with Canadian industry.
- Study of the sensitivity of surface reflectance retrieval from airborne imaging spectrometer data to the use of different radiative transfer codes and different exo-atmospheric solar irradiance spectra.
- Preparation of detailed report assessing remote sensing technology for environmental monitoring, with emphasis on quantitative physics-based approaches.
- Initiated and edited the first annual report on Canadian R&D activities in terrestrial imaging spectrometry.

### **Quantitative Radar Analysis Algorithms and Data Product Development**

- Development of interactive algorithms and software for polarimetric SAR analysis, including direct linkage with forest inventory databases.
- Forest application literature review and parameter analysis for SAR sensor configuration for RADARSAT III mission planning, in collaboration with the Applications Division of CCRS.

### **Physical Analysis of Radiometry and Data Integration in Geographic Mosaicking**

- Detailed specifications for Canadian industry for implementation of a dark-target algorithm for operational atmospheric correction.
- Examination of the behaviour of the anisotropic reflectance of vegetation derived from multi-view and multi-scale imagery, in collaboration with the Data Acquisition Division of CCRS.
- Research on the directional reflectance characteristics of forested terrain continued with participation in the conception, planning and execution of field campaigns at the BOREAS test site near Prince Albert, Saskatchewan, in cooperation with the Data Acquisition Division of CCRS.

### **Scale-Space Techniques for Interpreting Earth Observation Imagery**

- Demonstration of the importance of the singular behaviour of topographic backscatter of signals in the understanding of SAR imagery.

- Canadian small business (Geoplex) spun off as a result of scale-space research and development at CCRS.
- Case study of data compression of SAR sea-ice imagery using wavelet transform and fractal methods in comparison with a JPEG standard, in cooperation with the Ice Centre of Atmospheric Environment Service, the Applications Division of CCRS, and Canadian industry (Geoplex).

## **Additional Activities**

- Collaboration with the EROS Data Center, Sioux Falls, South Dakota on the standardization of NOAA AVHRR processing methodologies.
- Co-investigators on the BOREAS Remote Sensing Science RSS-19 project (led by York University).
- Consultation on radiometry to the Canadian Forestry Service MIFUCAM project.
- Adjunct membership on the EOS MODIS Science Team, NASA GSFC, Greenbelt, Maryland.
- Membership on the EOS MODIS Level-1 Product calibration peer review panel, NASA/GSFC, Greenbelt, Maryland.
- Reviewer for EOS MODIS Algorithm Technical Background Documents for atmospheric correction and for radiometric calibration.
- Cooperative analysis related to radiometric fieldwork in British Columbia, Canada, for the Pacific Forestry Centre's SEIDAM project.
- Representative of the International Geosphere Biosphere Programme (IGBP) Data Information System (DIS) Land Cover Steering Group on optical radiometry issues.
- Collaboration with the Canadian Space Agency on data compression of imaging spectrometry data.
- Consultation on the field use of GPS receivers to Divisions of Geomatics Canada, including the Applications Division of CCRS.
- Membership on the Scientific Program Committee of the International Symposium on Physical Measurements and Signatures in Remote Sensing.
- Membership on the Technical Committee of the International Symposium on Spectral Sensing Research.
- Co-investigator on ADEOS POLDER science working team project (led by Université de Sherbrooke).
- Co-investigator on MAC-Europe '91 Campaign.
- Membership on the Canadian Advisory Committee on Imaging Spectrometry.
- Evaluation of Industrial Research Fellowship proposal for Natural Resources Canada.
- Evaluation of a South Dakota NSF-EPSCoR Program proposal.
- Adjunct professorships at Université Laval and at the Université de Sherbrooke, Québec.



- Co-supervision of Ph.D. student at Université de Sherbrooke and Ph.D. student at Université Laval.
- External examiner for Ph.D. thesis at Université Laval, Québec.
- Membership on the Geomatics Canada Sector R&D Committee (SEREDEC).
- Evaluation of Geomatics Canada information management plan with respect to target vision and migration strategy, and to business model and requirements analysis.
- Briefing of Geomatics Canada representative prior to a trade mission to South Africa.
- Membership on the CCRS Project Selection and Review Committee, the CCRS NewSAR Committee, and the CCRS Planning Team on Data Integration and Information Extraction.

## **Conferences, Workshops and Specialist Meetings**

- Sixth International Colloquium on Physical Measurements and Signatures in Remote Sensing, Val d'Isère, France.
- Second International Symposium on Spectral Sensing Research, San Diego, California.
- 1994 International Geoscience and Remote Sensing Symposium, Pasadena, California.
- Third Australasian AVHRR Workshop and Seventh Australasian Remote Sensing Conference, Melbourne, Australia.
- EUROPTO Conference on Satellite Remote Sensing, Rome, Italy.
- Fractals in Engineering Conference, Montréal, Québec.
- Sixth Canadian Conference on Geographic Information Systems and ISPRS Commission II Symposium, Ottawa, Ontario.
- Workshop on Calibration and Cross-Calibration of Sensors, EROS Data Center, Sioux Falls, South Dakota.
- First international ADEOS POLDER Science Working Team meeting, Kyoto, Japan.
- MAC-Europe 91 Campaign Final Workshop, Munich, Germany.
- BRDF Workshop at Petawawa National Forestry Institute, Chalk River, Ontario.
- CEOS Calibration/Validation Working Group and Infrared Visible Optical Sensors Subgroup meetings, Canberra, Australia, and Seattle, Washington.
- BOREAS Science Workshop, Williamsburg, Virginia.
- Environmental Monitoring and Assessment Network meeting, Hull, Québec.
- SPOT GOSS-9 meeting, Meach Lake, Québec.
- RADARSAT III technical meetings with the Canadian Space Agency and the CNES (France), Ottawa, Ontario.



# *Cumulative Bibliography (1991-Present)*

## *Scene Physics and Analysis Section*

### **External Publications in Refereed Journals**

Ahern, F.J., R.P. Gauthier, P.M. Teillet, J. Sirois, G. Fedosejevs and D. Lorente, 1991, "An Investigation of Continental Aerosols with High Spectral Resolution Solar Extinction Measurements", Applied Optics, Vol.30, No.36, pp.5276-5287.

Cihlar, J., T.A. Fisher and B. Guindon, 1994, "Information Technology for Handling Earth Observation Data", Remote Sensing Reviews, 9:225-239.

Clavet, D., M. Lasserre, and J. Pouliot, 1993, "GPS Control for 1:50,000 Scale Topographic Mapping From Satellite Images", Photogrammetric Engineering and Remote Sensing, LIX(1):107-111.

Guindon, B., 1991, "Incorporation of Azimuthal Control Methods in the Extraction of 3-Dimensional Topographic Models from Individual Space-Borne SAR Scenes", International Journal of Remote Sensing, Vol. 12, No. 11, pp. 2399-2420.

Guindon, B., and M. Adair, 1992, "Analytic Formulation for Spaceborne SAR Image Geocoding and "Value-Added" Product Generation using Digital Elevation Data", Canadian Journal of Remote Sensing, 18(1):2-12.

Guindon, B., 1992, "Development of a SAR Data Acquisition Planning Tool (SARPLAN) Based on Image Simulation", International Journal of Remote Sensing, 14(2):333-344.

Guindon, B., 1993, "Aspects of Digital Elevation Data Requirements for Operational Geocoding of Radarsat Imagery", Canadian Journal of Remote Sensing, 19(2):131-139.

Guindon, B., 1994, "Performance Evaluation of Real-Simulated Image-Matching Techniques in the Acquisition of Ground Control for ERS-1 Image Geocoding", ISPRS Journal of Photogrammetry and Remote Sensing, in press.

Moran, M.S., R.D. Jackson, P.N. Slater and P.M. Teillet, 1992, "Evaluation of Atmospheric Correction Procedures for Visible and Near-Infrared Satellite Sensor Output", Remote Sensing of Environment, 41:169-184.

Running, S.W., C. Justice, V. Salomonson, D. Hall, J. Barker, Y. Kaufman, A. Strahler, A. Huete, J.-P. Muller, V. Vanderbilt, Z.M. Wan, P. Teillet, and D. Carneggie, 1994, "Terrestrial Remote Sensing Science and Algorithms Planned for EOS/MODIS", International Journal of Remote Sensing, 15(17):3587-3620.

Schanzer, D.L., 1992, "An Automatic Classification Procedure for Coping with Clouds in Landsat TM Data", Canadian Journal of Remote Sensing, 18(1):30-43.

Schreier, G., Maeda, K. and Guindon, B., 1991, "Three Spaceborne SAR Sensors: ERS-1, J-ERS-1 and RADARSAT - Competition or Synergism", Geo-Information-Systems, Vol. 4, No. 2, pp.20-27.

Staenz, K., 1991, "Quality Assessment and Preprocessing of Data Acquired with the Programmable Multispectral Imager", Canadian Journal of Remote Sensing, 17(3):231-239.

Staenz, K., 1992, "Imaging Spectrometer Data Analyzer (ISDA): A Software Package for Analysis of High Spectral Resolution Data", Canadian Journal of Remote Sensing, 18(2):90-101.

Staenz, K., 1992, "A Decade of Terrestrial Imaging Spectrometry in Canada", Canadian Journal of Remote Sensing, 18(4):184-197.

Staenz, K., R.P. Gauthier, D.J. Williams, and P.M. Teillet, 1994, "On the Behaviour of the Anisotropic Reflectance of a Pecan Orchard Derived from Multi-View and Multi-Scale Imaging Spectrometer Data", Remote Sensing of Environment, in press.

Teillet, P.M. and R.P. Santer, 1991, "Terrain Elevation and Sensor Altitude Dependence in a Semi-Analytical Atmospheric Code", Canadian Journal of Remote Sensing, Vol.17, No.1, pp.36-44.

Teillet, P.M., and K. Staenz, 1992, "Atmospheric Effects Due to Topography on MODIS Vegetation Index Data Simulated From AVIRIS Imagery Over Mountainous Terrain", Canadian Journal of Remote Sensing, 18(4):283-291.

Teillet, P.M., 1992, "An Algorithm for the Radiometric and Atmospheric Correction of AVHRR Data in the Solar Reflective Channels", Remote Sensing of Environment, 41:185-195.

Teillet, P.M., and B.N. Holben, 1994, "Towards Operational Radiometric Calibration of NOAA AVHRR Imagery in the Visible and Near-Infrared Channels", Canadian Journal of Remote Sensing, 20(1):1-10.

Teillet, P.M., G. Fedosejevs, F.J. Ahern, and R.P. Gauthier, 1994, "Sensitivity of Surface Reflectance Retrieval to Uncertainties in Aerosol Optical Properties", Applied Optics, 33(18):3933-3940.

Townshend, J.R.G., C.O. Justice, D. Skole, J.-P. Malingreau, J. Cihlar, P. Teillet, F. Sadowski, and S. Rittenberg, 1994, "The 1-km Resolution Global Data Set: Needs of the International Geosphere Biosphere Programme", International Journal of Remote Sensing, 15(17):3417-3441.

## Conference Proceedings Publications

Erickson, A.D., P.S. Leung, T.A. Fisher, P.M. Teillet, B. Guindon and R.J. Brown, 1991, "AVHRR Data Archiving and Preprocessing", Proc. of the Fourteenth Canadian Symposium on Remote Sensing, Calgary, Alberta, pp.205-210.

Fedosejevs, G., and P.M. Teillet, 1993, "Estimating Errors in Surface Reflectances Computed From NOAA AVHRR Data Using Various Radiometric Preprocessing Approaches", Proceedings of the Sixteenth Canadian Symposium on Remote Sensing, Sherbrooke, Québec, pp.823-828.

Fung, K.B., and M. Lasserre, 1993, "Factors Concerning Time in Remote Sensing and GIS", Proceedings of the Canadian Conference on GIS, Ottawa, Ontario, pp.889-895.

Guindon, B., 1991, "Application of SAR Simulation Techniques to Improve the Understanding of Spaceborne SAR Scenes of Moderate to Rugged Terrain", Proc. of the Eleventh EARSeL Symposium, Graz, Austria, pp.100-109.

Guindon, B., 1993, "Derivation of Digital Elevation Data Requirements for Operational Satellite Image Geocoding", Proceedings of the International Symposium on Operationalization of Remote Sensing, Enschede, The Netherlands, Vol.6, pp.1-13.

Guindon, B. and M. Adair, 1991, "Utilization of Large Area Digital Elevation Data in the Analysis of Spaceborne SAR Images", Proc. of the Fourteenth Canadian Symposium on Remote Sensing, Calgary, Alberta, pp.365-370.

Guindon, B., T.A. Fisher, and F.E. Guertin, 1992, "The Evolution of Operational Satellite Image Geocoding in Canada", Proceedings of the ISPRS Congress XVII, Washington, D.C., in press.

Itten, K.I., P. Meyer, K. Staenz, T. Kellenberger, and M. Schaepman, 1992, "Evaluation of AVIRISwiss-91 Campaign Data", Proceedings of the Fourth JPL Airborne Geoscience Workshop, Pasadena, California, pp.108-110.

Itten, K.I., M. Schaepman, P. Meyer, J. Keller, and K. Staenz, 1994, "Extraction of Environmentally Sensitive Parameters from Quantitative Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) Data in Rugged Terrain", Proceedings of the MACEurope'91 Final Results Workshop, Lenggries, Germany, in press.

Lang, R.H., R. Landry, O. Kilic, N. Chauhan, N. Khadr, and D. Leckie, 1993, "Effects of Species Structure and Dielectric Constant on C-Band Forest Backscatter", Proceedings of the 1993 International Geoscience and Remote Sensing Symposium (IGARSS '93), Tokyo, Japan, pp.583-586.

Lang, R.H., R. Landry, O. Kavakhoglu, and J.C. Deguise, 1994, "Simulation of Microwave Backscatter from a Red Pine Stand", Proceedings of SPIE EUROPTO '94, Rome, Italy, in press.

Lasserre, M., and F. Gemmell, 1992, "The Investigation of Small Target Detection With Response Surfaces and Hough Transforms", Proceedings of the Fifteenth Canadian Symposium on Remote Sensing, Toronto, Ontario, pp.423-427.

Lasserre, M., and D. Clavet, 1993, "The Sherbrooke Data Set: Imagery and Topographic Data for Research, Education and the Development of Industrial Applications", Proceedings of the Sixteenth Canadian Symposium on Remote Sensing, Sherbrooke, Québec, pp.895-900.

Meyer, P., R.O. Green, K. Staenz, and K.I. Itten, 1994, "Geometric and Radiometric Preprocessing of Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) Data in Rugged Terrain for Quantitative Data Analysis", Proceedings of the Sixth International Colloquium on Physical Measurements and Signatures, Val d'Isère, France, pp.111-118.

Moran, M.S., R.D. Jackson, P.N. Slater and P.M. Teillet, 1991, "Comparison of Atmospheric Correction Procedures for Visible and Near-IR Satellite Sensor Output", Proc. of the Fifth International Colloquium on Physical Measurements and Signatures in Remote Sensing, Courchevel, France, ESA SP-319, pp.7-12.

Moran, M.S., R.D. Jackson, P.N. Slater, and P.M. Teillet, 1993, "Simplified Procedures for Retrieval of Land Surface Reflectance from Landsat TM Sensor Output", Proceedings of the DLPO Workshop on Atmospheric Correction of Landsat Imagery, Torrance, California, pp.85-89.

Pouliot, J., D. Clavet, and M. Lasserre, 1992, "Génération d'images géocodées par contrôle GPS pour l'intégration dans un SIG", Actes de la Troisième Conférence SIG, Ottawa, Ontario, pp.739-749.

Roach, D., and M. Lasserre, 1993, "Topographic Roughness Exponent Estimates from Simulated Remote Sensing Images", Proceedings of the Sixteenth Canadian Symposium on Remote Sensing, Sherbrooke, Québec, pp.793-798.

Robertson, B., A. Erickson, J. Friedel, B. Guindon, T. Fisher, R. Brown, P. Teillet, M. D'Iorio, J. Cihlar, and A. Sanz, 1992, "Geocomp, A NOAA AVHRR Data Geocoding and Compositing System", Proceedings of ISPRS Congress XVII, Commission II, Washington, D.C.

Schanzer, D., 1991, "Spatial and Spectral Integration, Illustrated for Identification of Cloud, Haze and Other Targets in Landsat TM Data", Proc. of the Fourteenth Canadian Symposium on Remote Sensing, Calgary, Alberta, pp.324-329.

Schanzer, D., and K. Staenz, 1992, "Discussion of Band Selection and Methodologies for the Estimation of Precipitable Water Vapour from AVIRIS Data", Proceedings of the Fourth JPL Airborne Geoscience Workshop, Pasadena, California, pp.135-137.

Singhroy, V., B. Rivard, B. Guindon, and P. Barnett, 1994, "Enhanced SAR Image Techniques for Geological Applications", Proceedings of the Tenth ERIM Thematic Conference on Geologic Remote Sensing, San Antonio, Texas, in press.

Staenz, K. and D.G. Goodenough, 1991, "Spectroscopic Analysis of Imaging Spectrometer Data for Classification Purposes", Proc. of the Fifth International Colloquium on Physical Measurements and Signatures in Remote Sensing, Courchevel, France, ESA SP-319, pp.223-227.

Staenz, K., D. Schanzer and C. Kushigbor, 1991, "Classification of Forest Stands in British Columbia Using AVIRIS Data: A Preliminary Investigation", Proceedings of the Second JPL Airborne Geoscience Workshop, Pasadena, California, pp.173-182.

Staenz, K., 1992, "Development of Imaging Spectrometry in Canada", Proceedings of the International Symposium on Spectral Sensing Research, Kauai, Hawaii, pp.226-238.

Staenz, K., P.M. Teillet, P. Meyer, D.J. Williams, and K.I. Itten, 1993, "Low Altitude Radiance Measurements in Support of Surface Reflectance Retrieval From AVIRIS Data", Proceedings of the Twenty-Fifth International Symposium on Remote Sensing and Global Environmental Change, Graz, Austria, pp.I-112 - I-122.

Staenz, K., R.P. Gauthier, P.M. Teillet, and D.J. Williams, 1993, "Bidirectional Reflectance Effects Derived from ASAS Imagery of a Pecan Orchard", Proceedings of the SPIE International Symposium on Aerospace Science and Sensing. Imaging Spectrometry of the Terrestrial Environment, Orlando, Florida, in press.

Staenz, K., D.J. Williams, M. Truchon, and R. Fritz, 1993, "Estimation of Crown Closure From AIVRIS Data Using Regression Analysis", Proceedings of the Fourth Annual JPL Airborne Geoscience Workshop, Washington, D.C., pp.169-172.

Staenz, K., D.J. Williams, G. Fedosejevs, and P.M. Teillet, 1994, "Surface Reflectance Retrieval from Imaging Spectrometer Data Using Three Atmospheric Codes", Proceedings of SPIE EUROPTO '94, SPIE Vol. 2318, Rome, Italy, pp.17-28.

St-Onge, B.A., F. Cavayas and P.M. Teillet, 1991, "Étude de la Signature Spatiale des Courverts Forestiers par Modélisation Géométrique-Optique", Proc. of the Fifth International Colloquium on Physical Measurements and Signatures in Remote Sensing, Courchevel, France, ESA SP-319, pp.671-674.

Teillet, P.M., 1991, "Radiometric and Atmospheric Correction Procedures for AVHRR Preprocessing in the Solar Reflective Channels", Proc. of the Fifth International Colloquium on Physical Measurements and Signatures in Remote Sensing, Courchevel, France, ESA SP-319, pp.101-104.

Teillet, P.M. and R. Santer, 1991, "Altitude Dependence in a Semi-Analytical Atmospheric Code", Proc. of the Fifth International Colloquium on Physical Measurements and Signatures in Remote Sensing, Courchevel, France, ESA SP-319, pp.95-100.

Teillet, P.M., K. Staenz and G. Fedosejevs, 1991, "A Prototype Atmospheric Correction Scheme for Airborne Imaging Spectrometer Data", Proc. of the Fourteenth Canadian Symposium on Remote Sensing, Calgary, Alberta, pp.394-399.

Teillet, P.M., G. Fedosejevs, F.J. Ahern, R.P. Gauthier and J. Sirois, 1991, "Atmospheric Code Sensitivity to Uncertainties in Aerosol Optical Depth Characteristics", Proc. of SPIE 1492, Earth and Atmospheric Remote Sensing, Orlando, Florida, pp. 213-223.

Teillet, P.M., B. Guindon, K. Staenz, M. Lasserre, R. Landry, J. Pouliot, G. Fedosejevs, M. Adair, and D. Schanzer, 1992, "Recent Advances in Scene Physics and Analysis at the Canada Centre for Remote Sensing", Proceedings of the Fifteenth Canadian Symposium on Remote Sensing, Toronto, Ontario, pp.397-402.

Teillet, P.M., and K. Staenz, 1992, "Influence of Terrain Elevation on Vegetation Indices Derived From NOAA AVHRR and EOS MODIS Data", Proceedings of the Central Symposium of the ISY Conference on Space in the Service of the Changing Earth, ESA SP-341, Munich, Germany, pp.37-42.

Teillet, P.M., and B.N. Holben, 1992, "A Multi-Level Electronic Database for Documentation and Dissemination of Time-Dependent NOAA-AVHRR Calibration Coefficients for the Solar Reflective Channels", Proceedings of the Sixth Australasian Remote Sensing Conference, Wellington, New Zealand, pp.3-100 to 3-109.

Teillet, P.M., 1994, "A Status Review of Atmospheric Corrections for NOAA AVHRR Shortwave Data", Proceedings of the AVHRR Workshop at the Seventh Australasian Remote Sensing Conference, Melbourne, Australia, pp.23-29 and 81-99.

Teillet, P.M., 1994, "Reflections on the Quantitative Radiometry of Satellite Image Data Providing Broadscale Coverage at High Spectral Resolution", Proceedings of the Seventh Australasian Remote Sensing Conference, Melbourne, Australia, pp. 83-90.

Teillet, P.M., K. Staenz, and D.J. Williams, 1994, "Effects of Spectral and Spatial Resolutions on NDVI", Proceedings of the Second International Symposium on Spectral Sensing Research (ISSSR '94), San Diego, California, pp.365-374.

Xu, G., F. Ahern, and R. Landry, 1993, "SAR Simulation of Boreal Forest With MIMICS", Proceedings of the Sixteenth Canadian Symposium on Remote Sensing, Sherbrooke, Québec, pp.411-416.

Xu, Q.F., N.T. O'Neill, A. Royer, D.J. Williams, A. Tarussov, P. Shepherd, and P.M. Teillet, 1993, "Reflectance Extraction Over a Forestry Site Using the Compact Airborne Spectrographic Imager", Proceedings of the Sixteenth Canadian Symposium on Remote Sensing, Sherbrooke, Québec, pp.851-856.

## External Reports

Cihlar, J., and P.M. Teillet, 1992, "Pre-processing Procedures", Chapter 4 (8 pages + 2 pages in Appendix 1) in "Improved Global Data for Land Applications, A Proposal for a New High Resolution Data Set", IGBP Report No.20, Edited by J.R.G. Townshend, IGBP Secretariat, The Royal Swedish Academy of Sciences, Box 50005, S-10405, Stockholm, Sweden, 87 pages.

Gauthier, R.P., F.J. Ahern, P.M. Teillet, G. Fedosejevs, and R. Fournier, 1991, "Report on the Specialist Meeting on the Derivation of Bidirectional Reflectance Distribution Functions for Various Ground Cover Types", (Tempe, Arizona, 27-29 November 1990), Canada Centre for Remote Sensing, Ottawa, Ontario, 48 pages.

Gauthier, R.P., P.M. Teillet, K. Staenz, R. Landry, G. Fedosejevs, R. Fournier, and C. Morasse, 1992, "A Measurement Program for the Validation of Forest Canopy Models", Technical Note, Canadian Journal of Remote Sensing, 18(4):293-296.

Staenz, K., and P.M. Teillet, 1993, "MODIS Data Simulation From AVIRIS Data", Remote Sensing in Canada, Canada Centre for Remote Sensing, Ottawa, Ontario, pp.1-3.

Staenz, K., R. Landry, G. Deblonde, R. Fournier, and M. Penner, 1993, "Tree Architecture and LAI Measurements", BOREAS Report of the Remote Sensing Disciplinary Group, Canada Centre for Remote Sensing, Ottawa, Ontario, Canada, 14 pages.

Staenz, K., (Editor), 1994, "Canadian Activities in Terrestrial Imaging Spectrometry, Annual Report 1993", Canada Centre for Remote Sensing, Ottawa, Ontario, Canada, 43 pages.

Teillet, P.M., and G. Fedosejevs, 1994, "Vegetation Index Monitoring: Radiometric Considerations", Remote Sensing in Canada, 22(1):8-9.