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ASTER CONSULTING ASSOCIATES, INC.

4245 Marietta Drive
Binghamton, N.Y. 13903

FINAL REPORT

on

'BIOPHYSICAL AND SPECTRAL MODELING

for

CROP IDENTIFICATION AND ASSESSMENT'

for

NASA-JOHNSON SPACE CENTER,HOUSTON

by

ASTER CONSULTING ASSOCIATES INC.
4245 Marietta Drive,Binghamton,N.Y.

DR. NARENDRA S. GOEL
Principal Investigator

Contract No. NAS9-16662
Technical Monitor: I.DALE BROWNE
Mail code SG3

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institutions were invited to review the status of the modeling of vegetation canopy reflectance,to critically debate the various issues and to then recommend a future strategy. A detailed report titled "Modeling of Vegetation Canopy Reflectance: Status,Issues and Recommended Future Strategy " edited by the principal investigator has been issued (see R4 of the appendix).

One of the key recommendations is to test various models of vegetation canopy reflectance against a common data base. This recommendation was implemented. The results were reported on October 14,1982 in a session on 'Model "cookoff" ' at NASA-Johnson Space Center,chaired by the principal investigator.This session brought together many modelers and experimentalists. Shortcoming as well strengths of various models as well as some errors in the measurements were highlighted in this session. The outcome of this session as well as future directions for this activity are documented in a memo report (see R3 of the appendix).

Other key recommendations have begun to be either implemented or discussed for possible implementations.

Othe technical presentations and briefings related to the coordination effort are noted in the appendix on reporting of the progress (see reports P1,P3, P4 and P5)

3. DEVELOPMENT OF THE MODELS

The principal investigator and his associates, keeping in mind the needs for synergy,cooperation and coordination between all the modeling effort, focussed their efforts on two areas:

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(1) Inversion of canopy reflectance models to estimate agronomic variables from in-situ reflectance measurements.

(2) Possible uses of ecological models in analyzing temporal profiles of greenness.

After initial investigations and discussions with other investigators, we decided to focuss on the first area, which has been recognized for sometime as a key area requiring serious investigation. However,no significant work had been undertaken presumably because of the anticipated problems. These problems are : non-uniqueness of the estimated agronomic variables and the sensitivity of the estimation to the errors in the measurement of the canopy reflectance. We looked into both of these problems and developed techniques for the inversion of the canopy reflectance models. Initially we limited our investigations to the estimation of leaf area index (LAI). We showed that using Suits' model LAI can be successfully estimated as lon as some of the other agronomic parameters are known to within reasonable measurement errors. The results are documented in a report.(see report R2 of the appendix). A paper based on these investigations has been submitted for possible publication in a professional journal (Remote Sensing of Environment).

Some initial effort on the use of ecological models in anlyzing temporal profiles of greenness has been documented (see repor- P8 in the appendix).

4. RECOMMENDED FUTURE ACTIVITIES

We recommend that the activ-ties on the inversion of vegetation canopy reflectance models be vigourously pursued further. These activities should still focus on the estimation of LAI but should be aimed at relaxing the requirements for knowing some of the agronomic parameters like vegetation canopy components reflectance and transmittance. The investigations should include use of other canopy reflectance models like CUPID model and those involving numerical integration of the radiative transfer equation and use of experimental data on several crops (corn, soybean etc.). The eventual goal of these activities should be a computer model which requires as its input the measured in-situ canopy reflectance and gives as its output LAI. If this goal is achieved, the effort could pay handsomely in reducing the cost of collecting experimental data. Here it should be recalled that LAI measurement is very labor intensive. Further, this effort could eventually lead to the estimation of LAI from remotely sensed reflectance data.

APPENDIX

REPORTING OF THE PROGRESS

In this appendix we will list the reporting of the progress made throughout the tenure of this contract. The reporting was done both in the form of briefing as well as in the form of technicel reports and memoranda by the principal investigators as well as by other personnel associated with the contract. It should be noted that some of the technical results reported were only partially supported by this contract.

(a) TECHNICAL PRESENTATIONS AND BRIEFINGS

* P1: N.S.GOEL " General Introduction (to workshop on modeling of crop reflectance) ",July 14,1982 at the Pingree Park workshop on 'Modeling of Crop Reflectance'.

* P2: N.S.GOEL "Determination of Agronomic Variables from Reflectance Data-Inverse Problem", July 15,1982, Pingree Park workshop.

P3: N.S.GOEL " Presentation of a Strawman Strategy for Modeling" July 22,1982, Pingree Park workshop.

P4: N.S.GOEL " Development of Strategy for Modeling Including Resolution of Specific Issues ",July 23,1982,Pingree Park workshop.

P5: N.S.GOEL " Modeling of Vegetation Canopy Reflectance: Status, Issues and Recommended Future Stategy ",Sept.1,1982, NASA-Johnson Space Center.

P6: N.S.GOEL " Determination of Agronomic Variables from Reflectance Data-Inverse Problem",Aug.30,1982,LARS,Purdue University.

P7: N.S.GOEL " On the Inversion of the One-layer Suits Canopy Reflectance Model: Estimation of Leaf Area Index from In-situ Spectral Reflectance Measurements ",oct.16, 1982, Quarterly Technical Interchange Meeting, NASA-Johnson Space Center

* P8: D.E.STREBEL
" Possible Uses of Ecological Models in Analyzing Temporal Profiles",July 20,1982,Pingree Park workshop.

* P9: J.KAPLAN & R.MASALAWALA
"On the Inversion of Suits and Other Models of Crop Reflectance ", July 20,1982, Pingree Park workshop.

(b) TECHNICAL REPORTS AND MEMORANDA

** R1: N.S.GOEL (editor)
"Modeling of Vegetation Canopy Reflectance: Status, Issues and Recommended Future Stategy",77 pages, Aug. 30,1982

** R2: N.S.GOEL & D.E.STREBEL
" On the Inversion of Vegetation Canopy Reflectance Models for Estimating Agronomic Variables I: Problem Definition and Initial Results Using Suits Model", 37 pages (submitted to Remote Sensing of Environment for possible publication).

R3: N.S.GOEL
"Model Cookoff " memo to distribution,Oct.20,1982, 4 pages.

R4: P.CARIANI
" LAI-Greenness Time Lags- A Conjecture " memo, Aug. 19,1982, 16 pages.

* Copies of these presentations are part of a report " Minutes of the Workshop on Modeling of Crop Reflectance" which is in cutody of NASA-Johnson Space Center, Supporting Research Project.

** It is expected that these two reports will be issued as AgRISTAR Reports.