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Early Warning and Crop Condition Assessment

WHEAT STRESS INDICATOR MODEL, CROP CONDITION ASSESSMENT DIVISION (CCAD) DATA BASE INTERFACE DRIVER, USER'S MANUAL

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This document gives detailed instructions on the use of the Wheat Stress Indicator Model CCAD Data Base Interface Driver. The purpose of this system is to interface the Wheat Stress Indicator Model with the CCAD operational data base. The interface driver routine decides what meteorological stations should be processed and calls the proper subroutines to process the stations.
This report describes the Alarm Development activities of the Early Warning and Crop Condition Assessment project of the AgrISTARS project.

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PREFACE

The Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing is a 6-year program of research, development, evaluation, and application of aerospace remote sensing for agricultural resources, which began in fiscal year 1980. This program is a cooperative effort of the National Aeronautics and Space Administration, the U.S. Agency for International Development, and the U.S. Departments of Agriculture, Commerce, and the Interior.

The work which is the subject of this document was performed within the Earth Resources (Research/Applications) Division, Space and Life Sciences Directorate, at the Lyndon B. Johnson Space Center, National Aeronautics and Space Administration. Under Contract NAS 9-15800, personnel of Lockheed Engineering and Management Services Company, Inc., performed the tasks which contributed to the completion of this research.
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1. GENERAL INFORMATION

1.1 SYSTEM NAME
This system is called Wheat Stress Indicator Model CCAD Data Base Interface Driver.

1.2 PRIMARY USER
The U.S. Department of Agriculture (USDA), Foreign Agriculture Service, Crop Condition Assessment Division (CCAD) personnel are the primary users of the system.

1.3 DEVELOPING ORGANIZATION
Personnel of the Lockheed Engineering and Management Services Company, Inc., developed the software that is reported in this document.

1.4 COMPUTER FACILITY DESCRIPTION
The Wheat Stress Indicator Model CCAD Data Base Interface Driver routine runs on a Programmed Data Processor, Model 11/70 (PDP 11/70) computer, with an Interactive Applications System (IAS) operating system and a Data Base Management System 11 (DBMS 11). It is implemented at the USDA Foreign Agricultural Service (FAS) in Houston, Texas.

1.5 REFERENCES
Data used for this manual were obtained from Wheat Stress Indicator Model documentation, at the CCAD Software Documentation Library, USDA FAS, Houston, Texas 77058.

2. SYSTEM DESCRIPTION

2.1 PURPOSE
The purpose of the system is to interface the Wheat Stress Indicator Model with the CCAD operational data base. The interface driver routine decides what
meteorological stations should be processed and calls the proper subroutines to process the stations.

2.2 USAGE

The system resides on the User Interface System (UIS) processor and must be executed on that processor. The PDS command is as follows.

PDS > RUN WHAZRD CR

The program will then be prepared for input from the terminal and will issue the statement:

INPUT 3 CHARACTER CROP CODE

XXX CR

INPUT RUN DEFINITION CARD. INPUT 0 TO STOP.

The run definition card is defined in figure 1. To end the run, a '0' (zero) must be input as an input card type.

3. INPUT

The model requires two types of input: disk and card, which are described as follows.

3.1 DISK

The model interfaces with the CCAD data base using the METS2P subschema. The formats used for the data and the methods of access are available from the CCAD Data Base administrator.

3.2 CARD

To run the model, two types of input cards are required, a crop card and a run definition card. The formats of the run definition cards are shown in figure 1. The format of the crop card is shown in figure 2.
Figure 1.- Run definition card formats for the Wheat Stress Indicator Model.
CROP CARD

The first card of the deck must be a crop card in the following format.

<table>
<thead>
<tr>
<th>Crop code</th>
<th>3-letter crop code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2.- Crop card format.
4. PROCESSING

4.1 INTERACTIVE

The model is designed to be operated in an interactive mode. All error messages are displayed on the cathode ray tube (CRT) terminal on which the run was initiated and will be displayed during execution. The output reports are written in files that are sent to the line printer immediately after the completion of the model run. The procedure for running the model is presented in paragraph 2.2.

4.2 BATCH

The model is not presently configured to run in a batch environment. A simple modification to the driver routine and task builder command file would be required in order to provide a batch capability.

4.3 EXECUTION FLOW

A flow chart of the model is provided in figure 3.

5. OUTPUT

Two types of output are provided from the model: disk and hard copy. They are described as follows.

5.1 DISK

For each day of meteorological data, the model creates a STN-PRODUCTS record for the day and stores it in the CCAD data base. The record contains the results of the model run for that day. The format for the STN-PRODUCTS record is available from the CCAD Data Base administrator.
RUN WHAZRO

OPEN: CLOCK.DAT
SOILM.DAT
HAZARD DDT
HAZSUM DDT

REQUEST: CROP TYPE

REQUEST: RUN DEFINITION CARD

CARD TYPE = 0

YES
STOP

NO

CARD TYPE = 1

YES

STOP LAY INPUT

NO

PROCESS STATION TO END OF DATA

NO

PRINT ERROR

YES

PROCESS STATION TO STOP DAY

1

Figure 3.- Execution flow diagram.
Figure 3.- Concluded.
5.2 HARDCOPY

Output from a model run provides as many as four possible reports. If the crop calendar runs, then the file 'CLOCK.DAT' will be printed; if the soil moisture budget runs, then the file 'SOILM.DAT' will be printed; and if both run, then the additional files 'HAZARD.DAT' and 'HAZSUM.DAT' will be printed. The content of each file is as follows.

A. 'CLOCK.DAT': For each day for which data are processed, a record is kept containing the station identification (ID), date (both Julian and calendar), clock acceleration/deceleration factor (FMULT), planting day (Julian day/year), daily crop calendar increment (ACC), and cumulative crop calendar (STAGE).

B. 'SOILM.DAT': For each day for which data are processed, a record is kept containing the station ID, total precipitation (P), mean temperature (T), potential evapotranspiration (PE), topsoil moisture (SS), subsoil moisture (SU), available water capacity (AWC), computed evapotranspiration (ET), computed recharge moisture (R), computed runoff (RO), and date (Julian and calendar).

C. 'HAZARD.DAT': A daily record is kept indicating each stress condition. The records show the station ID, the clock (stage of crop development), calendar date, and a textual message stating the specific stress condition. A list of stress conditions and their corresponding data base flags is included in table 1.

D. 'HAZSUM.DAT': For each station, a summary is provided showing the total number of growing days, optimal days, and hazard (stress) days with respect to the stage of crop development.

6. SPECIAL INSTRUCTIONS OR RESTRICTIONS

The Wheat Stress Indicator Model requires several inputs to run. The following rules have been implemented in the driver program.
### TABLE 1 - HAZARD MATRIX

<table>
<thead>
<tr>
<th>Stage Description</th>
<th>Stage</th>
<th>Flag</th>
<th>Stress Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preplanting</td>
<td>Up to 10 days before planting</td>
<td>A1</td>
<td>Surface moisture $&lt;.12$ in. (poor reseeding moisture)</td>
</tr>
<tr>
<td>Preplanting and Postplanting</td>
<td>From 10 days before planting to 12 days after planting</td>
<td>A2</td>
<td>Surface moisture $&gt;.8$ in. or precipitation $&gt;.2$ in. (tractability problem-planting delay)</td>
</tr>
<tr>
<td>Preemergence</td>
<td>$0 \leq$ Stage $&lt; 1.0$</td>
<td>B1</td>
<td>Surface moisture $&lt;.12$ in. (poor germination possible)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B2</td>
<td>Minimum temperature $&lt; 37^\circ$ F (poor germination possible)</td>
</tr>
<tr>
<td>Emergence</td>
<td>$1 \leq$ Stage $&lt; 1.2$</td>
<td>C1</td>
<td>Surface moisture $&lt;.12$ in.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>Minimum temperature $&lt; 19^\circ$ F (severe frost damage possible)</td>
</tr>
<tr>
<td>Tillering</td>
<td>$1.2 \leq$ Stage $&lt; 2.0$</td>
<td>D1</td>
<td>Subsurface moisture $&lt; 25%$ of capacity (AWC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D2</td>
<td>Minimum temperature $&lt; 19^\circ$ F (severe frost damage possible)</td>
</tr>
<tr>
<td>Jointing</td>
<td>$2.0 \leq$ Stage $&lt; 3.0$</td>
<td>E1</td>
<td>Subsurface moisture $&lt; 40%$ of capacity (AWC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E2</td>
<td>Minimum temperature $&lt; 19^\circ$ F (severe frost damage possible)</td>
</tr>
<tr>
<td>Heading</td>
<td>$3.0 \leq$ Stage $&lt; 3.6$</td>
<td>F1</td>
<td>Subsurface moisture $&lt; 40%$ of capacity (AWC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F2</td>
<td>Minimum temperature $&lt; 32^\circ$ F (frost damage possible)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F3</td>
<td>Maximum temperature $\geq 107^\circ$ F (sterilization possible)</td>
</tr>
<tr>
<td>Soft dough</td>
<td>$36 \leq$ Stage $&lt; 4.0$</td>
<td>G1</td>
<td>Subsurface moisture $&lt; 25%$ of capacity (AWC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>G2</td>
<td>Minimum temperature $&lt; 32^\circ$ F (frost damage possible)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>G3</td>
<td>Maximum temperature $\geq 107^\circ$ F (sterilization possible)</td>
</tr>
<tr>
<td>Ripening</td>
<td>$4.0 \leq$ Stage $&lt; 4.5$</td>
<td>H1</td>
<td>Subsurface moisture $&lt; 10%$ of capacity (AWC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H2</td>
<td>Minimum temperature $&lt; 19^\circ$ F (severe frost damage possible)</td>
</tr>
</tbody>
</table>
a. If any of the following data items are missing from the crop-station record (STN-PRODUCTS record), the soil moisture portion of the model will not process that station.

COEFF1-COFB (CONB)
COEFF2-COFI (CONI)
COEFF3-FMULT (FMULT)
WHC-S-COMPOSITE (AWC)

b. If the planting date (DATE-PLANTING) is missing from the crop-station record, the crop calendar portion of the model will not process that station.

c. At least one STN-PRODUCTS record per station must be stored in the data base to initialize the model for the run. If the STN-PRODUCTS record for a station is missing, the station will not be processed.

d. If any of the following data items are missing from the STN-PRODUCTS record, the soil moisture portion of the model will not process that station.

EST-CDS (CROP STAGE)
EST1-SOIL-MST (SURFACE MOISTURE)
EST2-SOIL-MST (SUBSURFACE SOIL MOISTURE)