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TECHNICAL MEMORANDUM
ACCURACY ASSESSMENT'S EVALUATION PLAN
FOR TY MULTILABELING

By
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16. Abstract The plan describes the evaluation of analyst small-grains omission and commission errors from Large Area Crop Inventory Experiment Transition Year Multilabeling in four U.S. Northern Great Plains spring wheat states: Montana, North Dakota, Minnesota, and South Dakota. The document also describes the coding system used for labeling data and the proposed analyses required for the evaluation. Two evaluation plan schedules, for Accuracy Assessment ground truth digitization and for manual ground truth interpretation, are presented.					
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1. INTRODUCTION

Preliminary investigations on labeling error characterization from Phase III blind sites in Colorado, Minnesota, Montana, North Dakota, and Oklahoma indicate the need for a continued evaluation of omission errors. Transition Year (TY) multiple category labeling (called multilabeling) is an extension of the current Classification and Mensuration Subsystem (CAMS) processing procedures in which the analysts label a variety of crops and categories collectively categorized as nonwheat in Phase III. The study will be conducted to evaluate spring-grains omission and commission errors from TY multilabeling and to determine if labeling specific crop categories improves the labeling accuracy for small grains. To accomplish this task, analyst labeling data for the blind sites will be passed to the Accuracy Assessment Section in a prescribed computer card format. CAMS will process a total of 71 blind sites (11 from Minnesota, 15 from Montana, 31 from North Dakota, and 14 from South Dakota). It is anticipated that each segment will be interpreted 2 or 3 times during the upcoming spring processing season.

The purpose of the multilabeling task is to evaluate analyst small-grains omission and commission errors in four U.S. Northern Great Plains (USNGP) spring wheat states — Montana, North Dakota, Minnesota, and South Dakota. The following factors will be studied at the state level:

- a. The confusion crops/categories associated with small-grains omission and commission errors and the frequency of occurrence of these errors
- b. The separability of the nonsmall-grains categories and the confusion crops associated with these categories
- c. Any significantly recurring crop that is not listed as a nonsmall-grains category in table I
- d. If possible, any improvement in the labeling accuracy of small grains as a result of the analyst requirements to label specific nonsmall-grains categories

TABLE I.— MULTILABELING CATEGORIES

Group I — Small grains, including wheat

Code	Description
W*	Winter small grains
S*	Spring small grains
G*	Total winter and spring small grains
B*	Barley

Group II — Field crops, not small grains

Code	Description
H	All cultivated hays and grasses, such as alfalfa and clover
C	Corn
J	Sorghum
E	Sugarbeets
L	Sunflowers
Y	Soybeans
D	Any identified crop not listed in Group II

Group III — Other signatures, identified

Code	Description
K	Idle cropland, clean tilled
M	Idle cropland, residue/stubble remaining or weeds/field cover growing
P	Natural grasses and pastures
T	Trees, timber, and shrubs
Z	Nonagriculture, includes lakes, rivers, ponds, sand hills, mountains, dry lake beds, highways, cities, airfields, etc.
X*	Clouds, haze, shadows, and other obstructions

Group IV — Other signatures, not identified

Code	Description
N*	No identification is discernible. Note: This code is used <u>only</u> after all other category codes have been exhausted.

*Sent to classifier with coded category; all others changed to code N.

2. LABELING DATA

Table I lists the category codes that will be used by CAMS for dot labeling. The four groups are: I, small grains; II, nonsmall-grains field crops; III, identified signatures that are neither small-grains nor nonsmall-grains field crops; and IV, signatures that are not identified. Labeling type 1 and type 2 dots for multilabeling remains exactly as established in the CAMS detailed analysis procedures except that the analysts substitute a specific nonsmall-grains, multilabeling category code in place of the more general nonwheat code ordinarily used. The analyst dot labeling data will be sent to the Accuracy Assessment Section on computer cards.

Type 1 dots are pixels used in the clustering algorithm, which initiates and labels clusters. Type 2 dots are pixels used in computation of bias correction; this set is completely separate from the dot 1 set.

3. TEST APPROACH

The analyst-interpreter (AI) dot labels for each blind site will be compared with the corresponding ground truth (GT) labels and the results will be tabulated (fig. 1) at the state level to identify the confusion crops associated with small-grains omission and commission errors. The analyst dot labeling data deck will be processed by the computer routine SPATL to compute the frequency of occurrence of the omission and commission errors associated with each category. The percent correct labeling for each category will be computed at the segment level; for example, for winter small grains,

$$W = \frac{(AI = W \cap GT = W)}{GT \text{ total for } W} \times 100$$

where $(AI = W \cap GT = W)$ is the number of dots labeled winter small grains by both the analysts and the ground truth label.

Also, the overall labeling accuracy (OLA) for each blind site will be calculated as follows:

$$OLA = [(AI = W \cap GT = W) + (AI = S \cap GT = S) + \dots + (AI = N^* \cap GT = N^*)] / \text{Grand total}$$

For each USGP spring wheat state, the average percent correct labeling for each category and the average overall labeling accuracy will be determined.

To assess whether the analyst requirement to label specific nonsmall-grains categories improves the small-grains labeling accuracy, a t-test¹ of the average overall labeling accuracy of small-grains and specific nonsmall-grains categories (OLA1) versus the average overall labeling accuracy of small-grains

¹Test to determine whether the difference between any two treatments is different from zero.

and specific nonsmall-grains categories (OLA2) will be conducted. OLA1 and OLA2 will be computed as follows:

$$\text{OLA1} = [(\text{AI} = \text{Grp I} \cap \text{GT} = \text{Grp I}) + (\text{AI} = \text{Grp II} \cap \text{GT} = \text{Grp II}) + (\text{AI} = \text{Grp III} \cap \text{GT} = \text{Grp III})] / \text{Grand total}$$

$$\text{OLA 2} = [(\text{AI} = \text{Grp I} \cap \text{GT} = \text{Grp I}) + (\text{AI} = \text{H} \cap \text{GT} = \text{H}) + (\text{AI} = \text{C} \cap \text{GT} = \text{C}) + \dots + (\text{AI} = \text{N*} \cap \text{GT} = \text{N*})] / \text{Grand total}$$

Since each segment will be interpreted 2 to 3 times during the upcoming spring processing season, the changes in labeling accuracy due to additional acquisitions will also be evaluated.

ANALYST LABEL	GROUND TRUTH LABEL																		Group			AI TOTAL
	W	S	G	B	H	C	J	E	L	Y	D	K	M	P	T	Z	X	N	I	II	III	
W/																						
S																						
G																						
B																						
Group I																						
H																						
C																						
J																						
E																						
L																						
Y																						
D																						
Group II																						
K																						
M																						
P																						
T																						
Z																						
X																						
Group III																						
N																						
Grp II + III																						
GT TOTAL																						

Figure 1.— Multilabeling dot distribution by category.

4. RESOURCES

1. Analysts (CAMS) - Nine to 10 CAMS operational analysts will perform TY dot multilabeling during the test period. Estimated 9 to 10 man-equivalents (M/E) for 109 man-days (M/D).
2. Test Coordinator (Research, Test, and Evaluation Department) - Two M/E for approximately 75 M/D to organize, tabulate, and reduce data, run Accuracy Assessment (AA) SPATL analysis, document, and present results.

Two alternatives are given for using the evaluation: AA ground truth digitization (Schedule A); and manual ground truth interpretation (Schedule B).

Schedule A shows an estimated completion date of mid-March 1979, assuming required resources are available when needed.

Schedule B, an alternative approach for obtaining more timely GT labels, shows an estimated completion date in January 1979. This plan uses ground truth photographs along with the corresponding field overlays to identify manually the labels of the 209 dots for each blind site. The CAMS dots labels will be compared to these corresponding ground truth labels. For each blind site, a summary of the dot distribution (refer to fig. 1) by category will be performed. The percent omission and commission errors will be computed manually instead of using the computer routine SPATL. The results will be tabulated and summarized at the state level.

ACCURACY ASSESSMENT'S EVALUATION PLAN FOR TY MULTILABELING

