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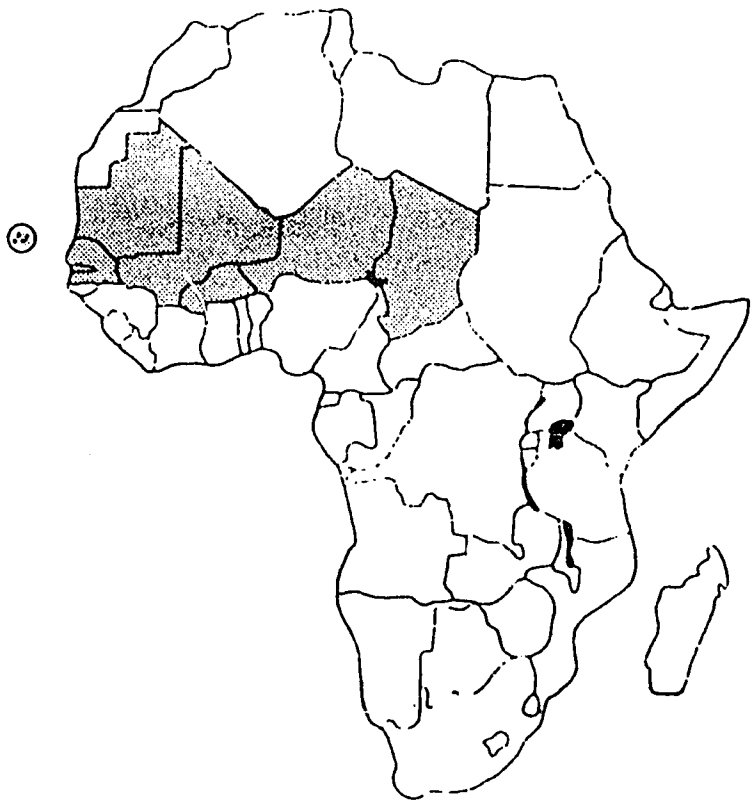
SAHEL COURSE LESSON PLANS

SPECIAL CLIMATIC IMPACT ASSESSMENT FOR CROPS AND RANGELANDS:

AGROCLIMATE AND REMOTE SENSING TECHNIQUES USED BY NOAA/NESDIS/AISC



MARCH 11 - APRIL 18, 1986

COLUMBIA, MISSOURI
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SAHEL COURSE LESSON PLANS

SPECIAL CLIMATIC IMPACT ASSESSMENT FOR CROPS AND RANGELANDS:

Agroclimate and Remote Sensing Techniques used by NOAA/NESDIS/AISC

March 11 - April 18, 1986

Columbia, Missouri
Washington, D.C.
U.S.A.

DEVELOPMENT OF COUNTRY RESOURCE MANUALS

Judy Trujillo

Tuesday, March 11 - 1:30 P.M.

Objective

1. To discuss the available data bases and resource materials.
2. To begin preparations to revise and complete Country Resource Manuals.

Abstract

Resource manuals for each country have been developed with existing data; however, much of the data is incomplete or out-of-date. These manuals will be updated by the participants and completed to provide a resource for assessors. These resource manuals will also be part of the training report to be completed by each participant.

I. Introduction

   A. Necessity of resource material for assessors
   B. Problems encountered in assembling resource information

II. Data Bases

   A. Crop Data Base (Sue Callis)

      1. Discussion of available data
      2. Preparation of data for computer entry

   B. Climate Data Base (Chris Hord)

      1. Discussion of available data
      2. Preparation of data for computer entry

III. Additional Available Resources

IV. Resource Manual Contents

   A. Administrative Boundaries
   B. Geographic Information
   C. Land Use, Crop and Rangeland Distribution
   D. Station Network (Chris Hord)
   E. Crop Calendar
   F. Rainfall Histograms and Isohyets

References

Resource manuals are available for 1) Cape Verde, 2) Gambia, 3) Senegal, 4) Mauritania, 5) Mali, 6) Burkina Faso, 7) Niger, 8) Chad, 9) Sudan, 10) Ethiopia and 11) Somalia.

CLIMATE OF THE SAHEL

Idrissa OUEDRAOGO
Ingineer in Meteorology
Data Analysis Division
Direction of Operational Activities
AGRHYMET Center Niamey

Objectives:

This course constitutes a presentation on the Sahel and of the climatic conditions affecting it. It is a study of the characteristics of rainfall to which the inhabitants must adapt and the causes of droughts taking place in Sahel. For this purpose an analysis of the situations for the years 1984 and 1985 is made.

Summary :

Sahel is characterized by low and variable rainfalls and by a sudden switch grow dry to rainy season during the year. Rainfalls generally occur during the season, while drought takes place during the cooler season. The rainfall variations in Sahel are of a continental type of anormal rainfall. A set of hypothesis have been brought forward in order to try to explain the whole mechanism concerning the variability of the climat.

Lesson plan:

I. Climatic generalities

I-1. Definition

I-2. Meteorological mechanisms

II. Cinematics of the disturbances

II-1. Rainfall regime

II-2. Rain-storm phenomenom

II-2-1. Formation of the rain-storm systems
II-2-2. Analysis of the squall-lines

III. Spatial and temporal distributions of rainfall

III-1. Examination of the 1984 and 1985 situations

III-2. Analysis of the pluviogrammes

IV. Hypothetical causes of drought in Sahel

References :

- Sahel D(82) 184 November 1982
  Dr. Sharon E. Nicholson consultant

- Agrhymet (publications n°184 and 187)

MAJOR CROPS IN THE SAHEL

Faustin GNOUMOU
Ingineer in Agrometeorology
Chief of the agrometeorological division
Direction of Training
AGRHYMET Center Niamey

Objectives:

1. Describe, briefly, main crops in Sahel.
2. Give some informations on energetic and pluviometric conditions favourising growth and development of these crops.

Summary:

In Sahel, agriculture is dominated by cereals as millet, sorghum, maize and rice, and by legumes as groundnuts, cow-pea and earn-pea.

These crops (cereals and legumes) depends on unsatisfactory pluviometric conditions in Sahel.

Lesson plan:

I. Introduction

II. The main crops in Sahel

II-1. The cereal plants

- millet
- sorghum
- maïze
- rize

II-2. The leguminous plants

- groundnut
- cow-pea
- earn-pea

II-3. Textile plants

- cotton

III. Meteorological factors affecting the development and growing of the crops

III-1. Factors related to the heat

III-2. Factors related to the water

IV. Crops calendar in Sahel

IV-1. Periods favourable to the sowings

IV-2. Vegetative cycle of the different crops

IV-3. End of the rainy season

V. Conclusion

INTRODUCTION TO REMOTE SENSING

Gary E. Johnson

Thursday, March 13 - 8:30 A.M.

Objective

1. To establish a common definition for "remote sensing."
2. To discuss characteristics common to all remote sensing systems.
3. To understand the physical basis of remote sensing.

Abstract

All definitions of remote sensing include the concept of assessing the characteristics of objects from a distance. All remote sensing systems require both a sensor and a platform. The physical basis of remote sensing is considered in relation to 1) the source of radiation, 2) the target, 3) the sensor and 4) the transmission path.

I. Introduction

   A. Definition of Remote Sensing
   B. Sensors and Platforms

II. Historical Perspective on Remote Sensing

   A. Sensor Systems
   B. Platforms
   C. Imagery types and Examples

III. The Physical Basis of Remote Sensing

   A. Radiation Source
   B. Reflectance Characteristics of Earth Surface Features
   C. Sensor Characteristics
   D. Transmission Path

      1. Atmospheric Windows
      2. The Electromagnetic Spectrum

Illustrations

A series of slides will illustrate the concepts presented in this lesson.

References

Simonett, David S. "The Development and Principles of Remote Sensing" in Manual of Remote Sensing, Second Edition, 1983, American Society of Photogrammetry, Falls Church, VA. pp. 1-36.

Suits, Gwynn H. "The Nature of Electromagnetic Radiation" in Manual of Remote Sensing, Second Edition, 1983, American Society of Photogrammetry, Falls Church, VA. pp. 37-61.

Exercise

The Physical Basis of Remote Sensing

SATELLITE AND SENSOR CHARACTERISTICS

Gary E. Johnson

Friday, March 14 - 8:30 A.M.

Objective

1. To discuss orbital characteristics of remote sensing satellites.
2. To discuss sensors and spectral bands used in remote sensing.

Abstract

Information obtained from remote sensing systems is a function of both the orbital parameters and the sensor characteristics of the system. Typical near polar-orbiting satellite systems such as Landsat, SPOT, and NOAA will be examined for similarities and differences in orbital and sensor characteristics. Geostationary satellite characteristics will also be discussed.

I. Introduction

A. Near Polar-Orbiting Satellites

1. Landsat
2. SPOT
3. NOAA

B. Geostationary Satellites

1. METEOSAT
2. GOES

II. Satellite Sensors

A. Sensor Types
B. Sensor Resolution

1. spatial
2. spectral
3. temporal

III. Data Acquisition

A. Field Station (HRPT) Data
B. Processed (Level 1B) Data

Illustrations

A series of slides will illustrate the concepts presented in this lesson. Other illustrations follow.

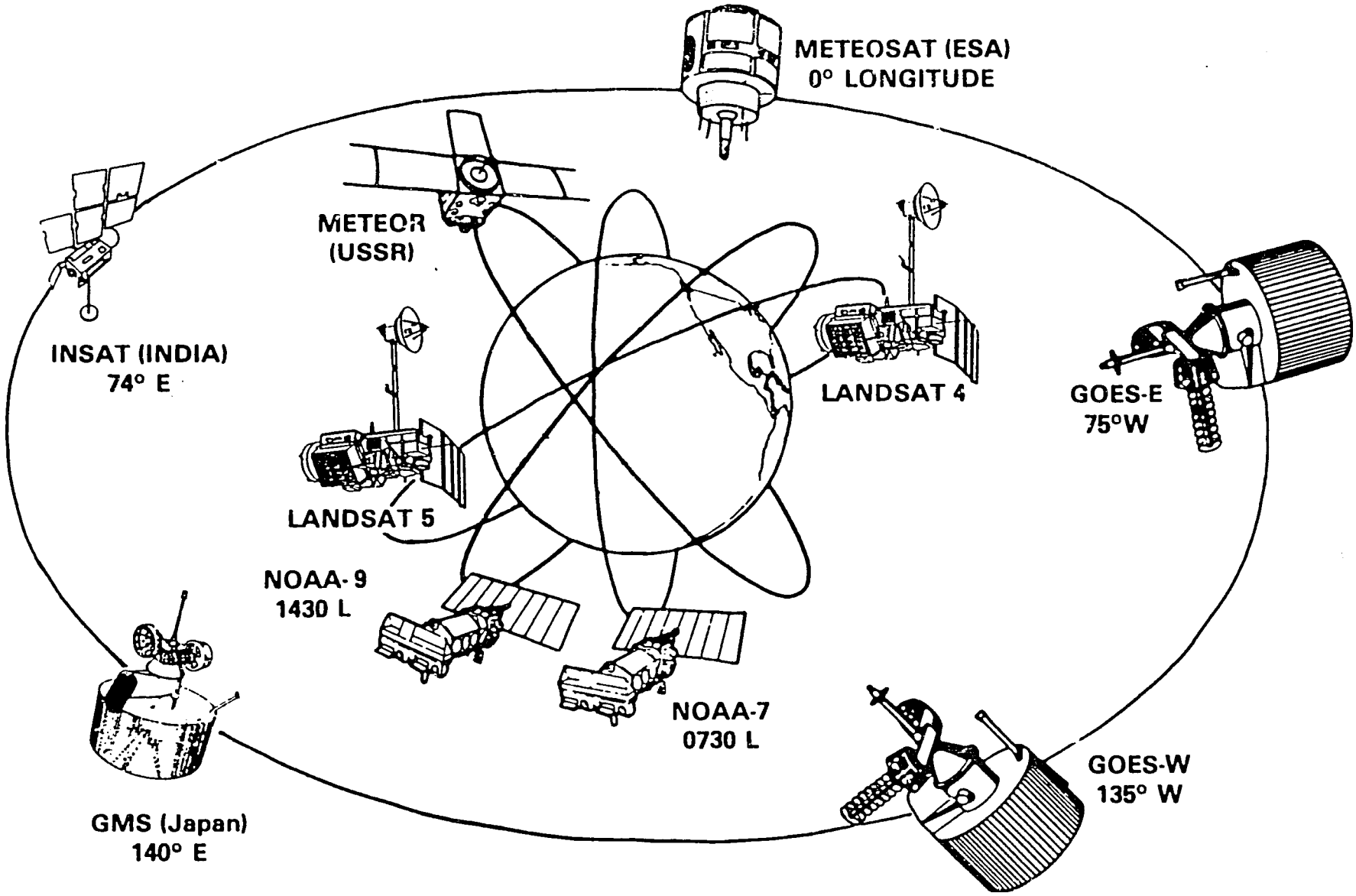
References

U.S. Navy, Operational Environmental Satellites, 1983, the Walter A. Bohon Company, Park Ridge, IL.

U.S. Department of Commerce, NESDIS Programs: NOAA Satellite Operations, 1985, U.S. Department of Commerce, Washington, D.C.

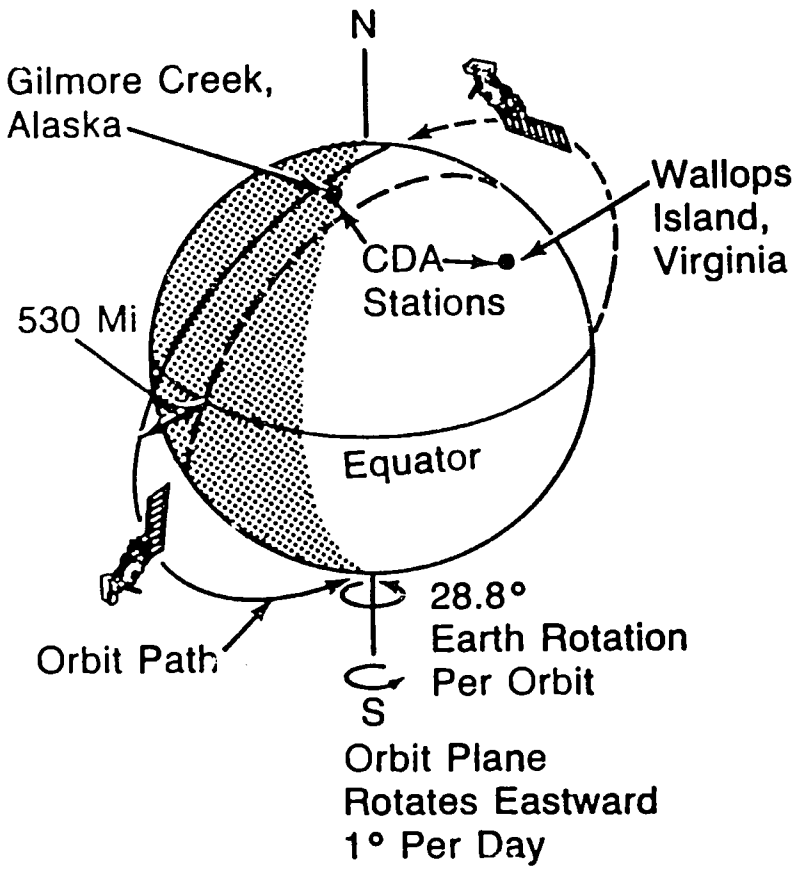
Kidwell, K. B., 1985: NOAA Polar Orbiter Data (TIROS-N, NOAA-6, NOAA-7, NOAA-8 and NOAA-9) Users Guide. NOAA/NESDIS - May, 1985.

Operational Earth Observation Satellites



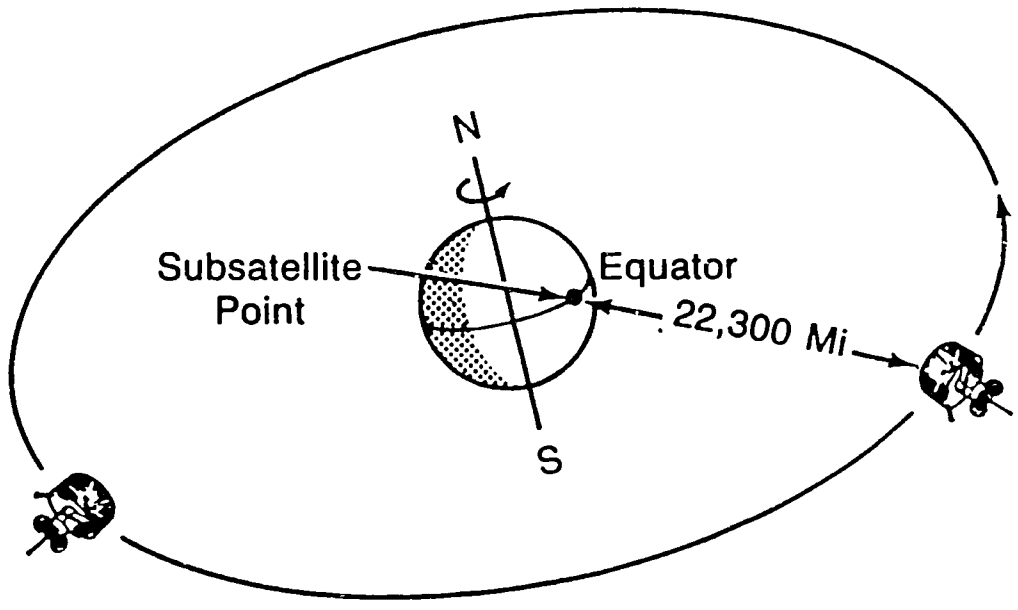
NOAA

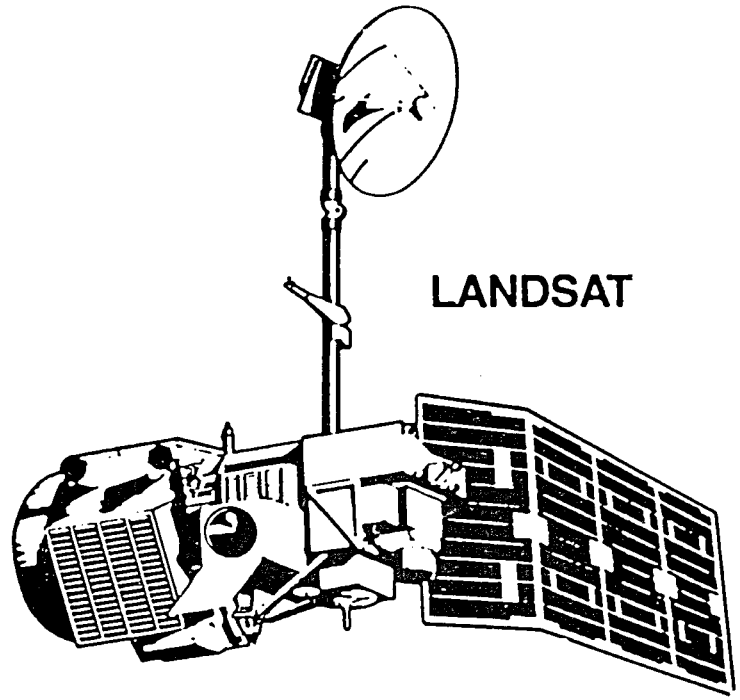
Polar Orbiting Satellites

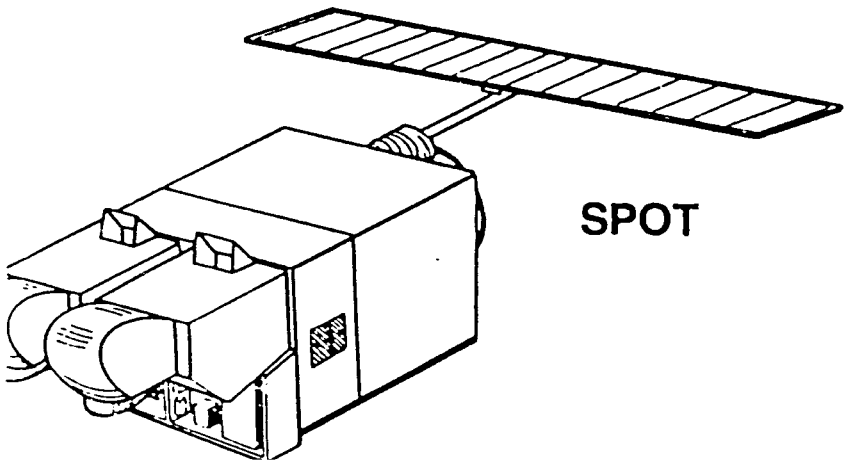


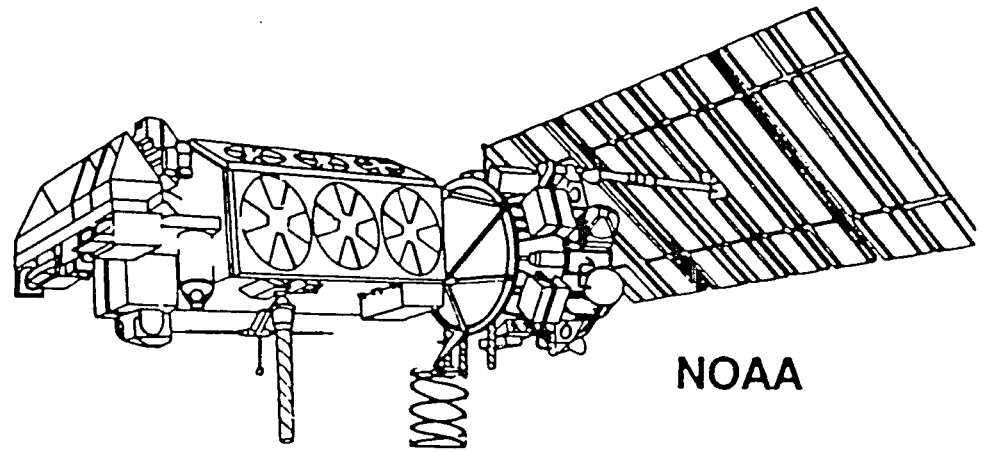
GOES

Geostationary Satellites

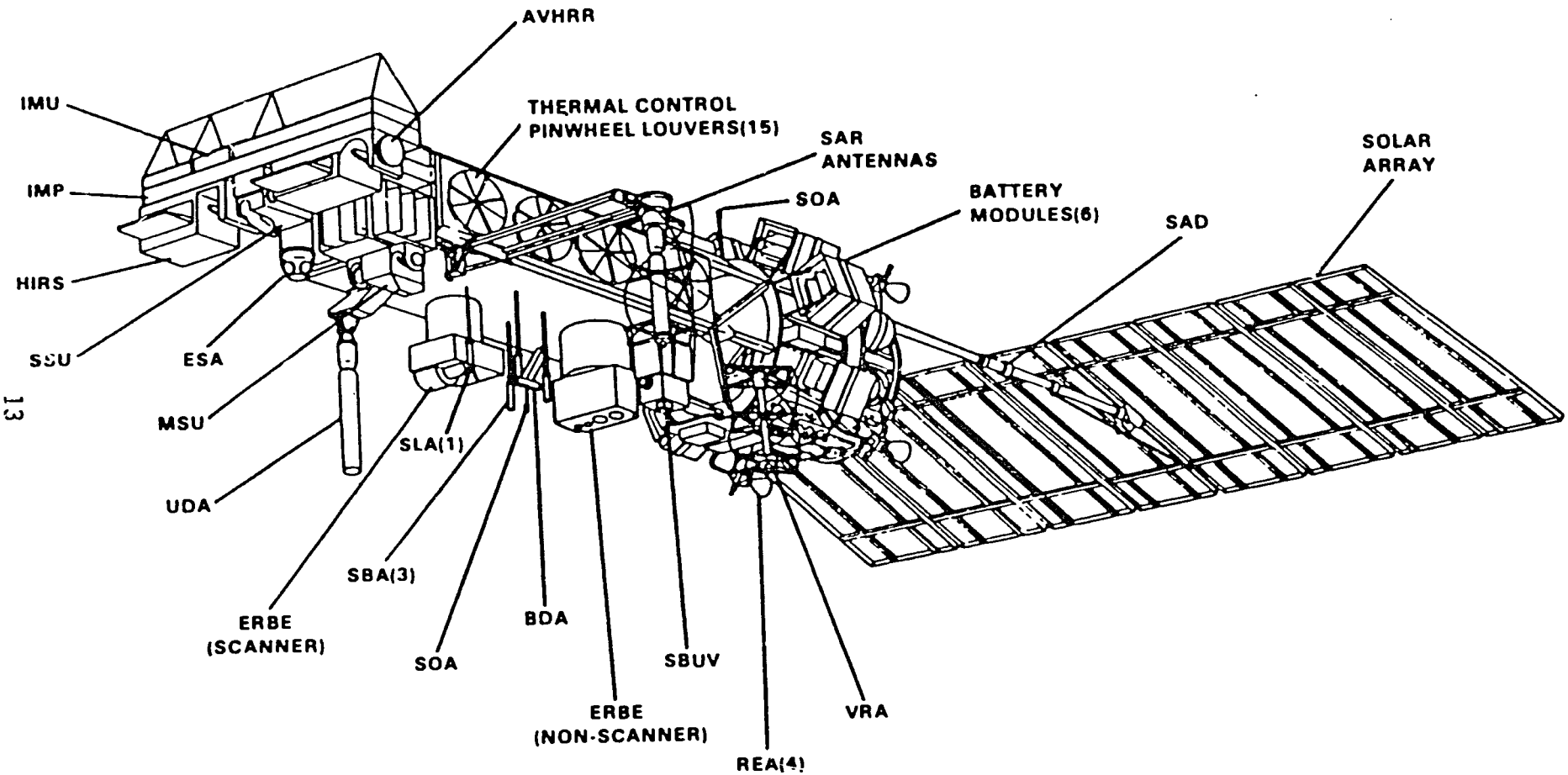



LANDSAT

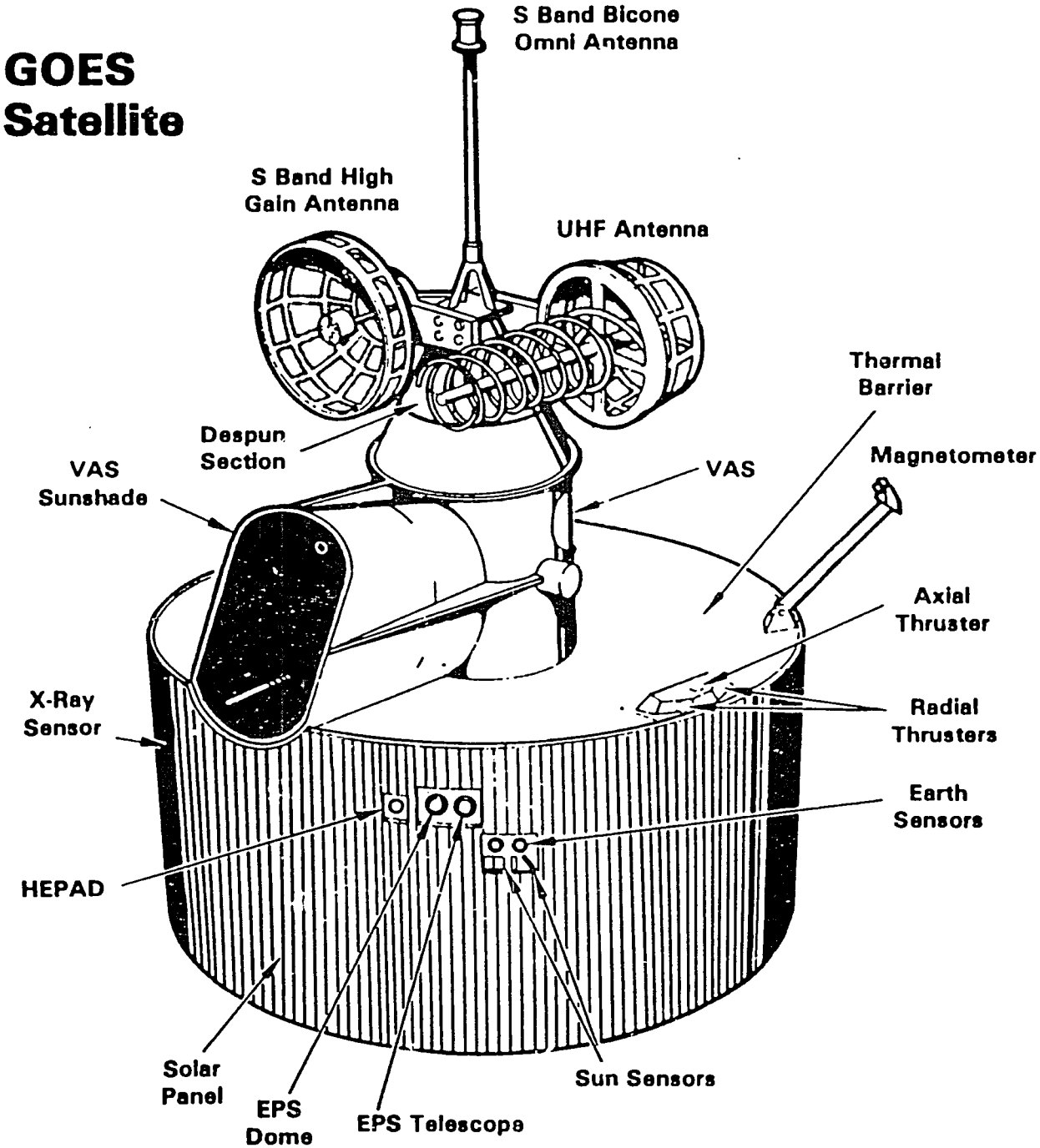

SPOT


NOAA

Advanced TIROS – N (ATN)



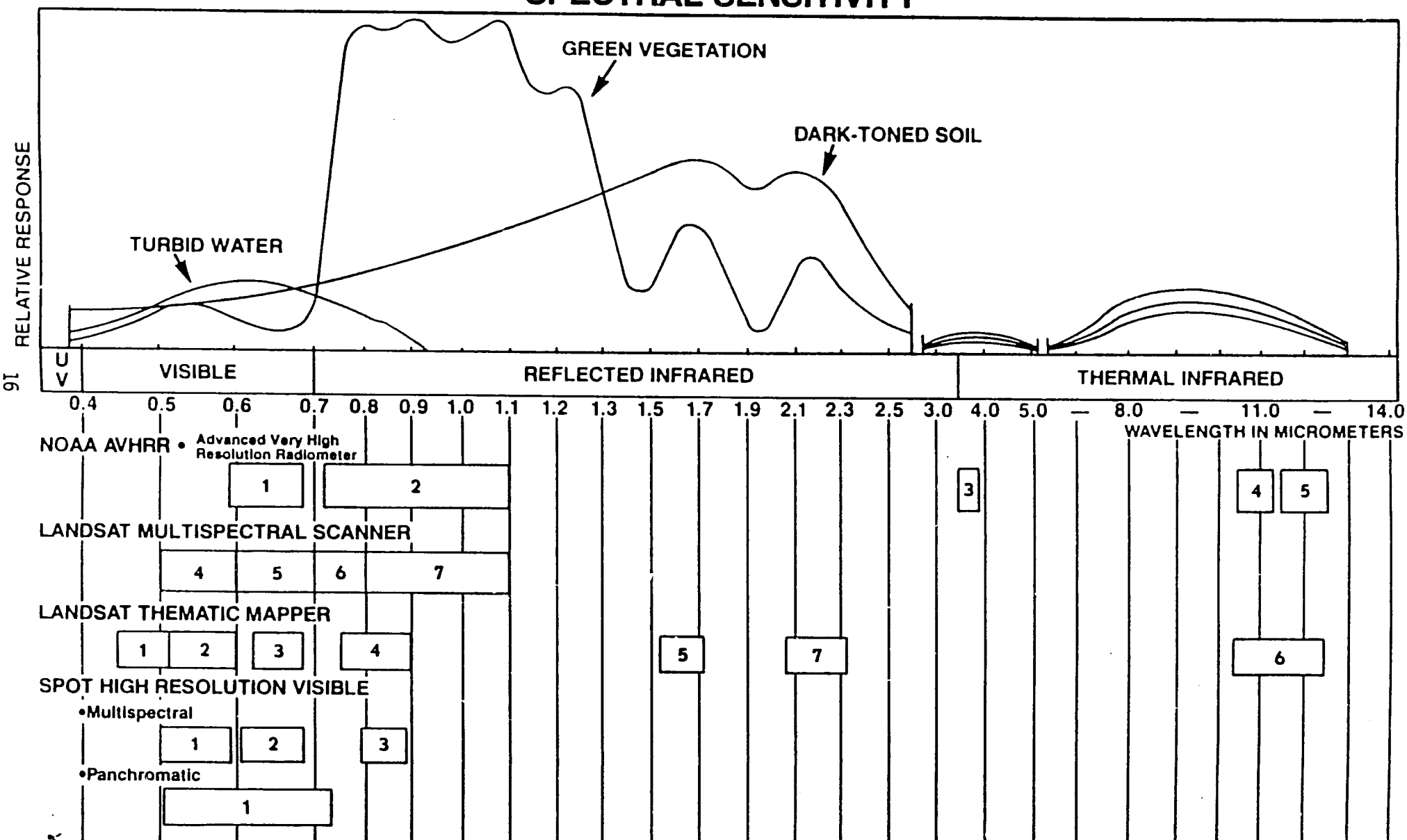
GOES Satellite



SATELLITE CHARACTERISTICS

SATELLITE	INSTRUMENT	MODE	ALTITUDE	IFOV	SWATH WIDTH	REPEAT CYCLE	BANDS
NOAA	AVHRR	multispectral	833 km	1100 m	2400 km	12 hours	5
Landsat	MSS	multispectral	705 km	80 m	185 km	16 days	4
Landsat	TM	multispectral	705 km	30 m	185 km	16 days	7
SPOT	HRV	multispectral	832 km	20 m	60 km	26 days	3
		panchromatic	832 km	10 m	60 km	26 days	1

SPECTRAL SENSITIVITY



COMPONENTS OF MICROCOMPUTERS

Thomas G. Phillips

Friday, March 14 - 10:30 A.M.

Objective:

To briefly describe the major components of microcomputers.

Abstract:

The four major components of microcomputers, 1) the central processing unit, 2) memory, 3) the bus, and 4) input/output devices, are briefly discussed. Some aspects of microcomputer operating systems are also discussed.

I. Introduction

- A. Perspective of the Problem
- B. Objectives of Presentation

II. Components of Microcomputers

- A. The Central Processing Unit (CPU)
- B. Memory
- C. The Bus
- D. Input/Output Devices
  - 1. Keyboards
  - 2. Monitors
  - 3. Disks
    - a. Floppy
    - b. Hard
  - 4. Printers
  - 5. Modems

III. Microcomputer Operating System

- A. Brief Description of Disk Operating System
- B. Selected DOS Commands
  - 1. Directory
  - 2. Change Directory
  - 3. Format
  - 4. Copy

Illustrations (see attached)

References

Franklin, Mark; Using the IBM PC: Organization and Assembly Language Programming: Holt, Rinehart and Winston: 1984.

Morgan, Christopher L. and Waite Mitchell; 8086/8088 16-Bit Microprocessor Primer: McGraw-Hill: 1982.

Scanlon, Leo J.; IBM PC & XT Assembly Language A Guide for Programmers: Robert J. Brady Co: 1983.

METHODS TO ESTIMATE CROP PRODUCTION: AN OVERVIEW

Don Bay

Monday, March 17 - 8:30 A.M.

INTRODUCTION TO VAX 11/730

Michael A. Benzinger

Monday, March 17 - 1:30 P.M.

Objective

To briefly describe the VAX 730 and how to log-on.

Abstract

The VAX 730 minicomputer and its peripheral devices will be discussed. Practical working knowledge related to the Crop Modeling System will be presented.

I. The VAX System

   A. System Components and Diagram
   B. System Function

II. Logging On

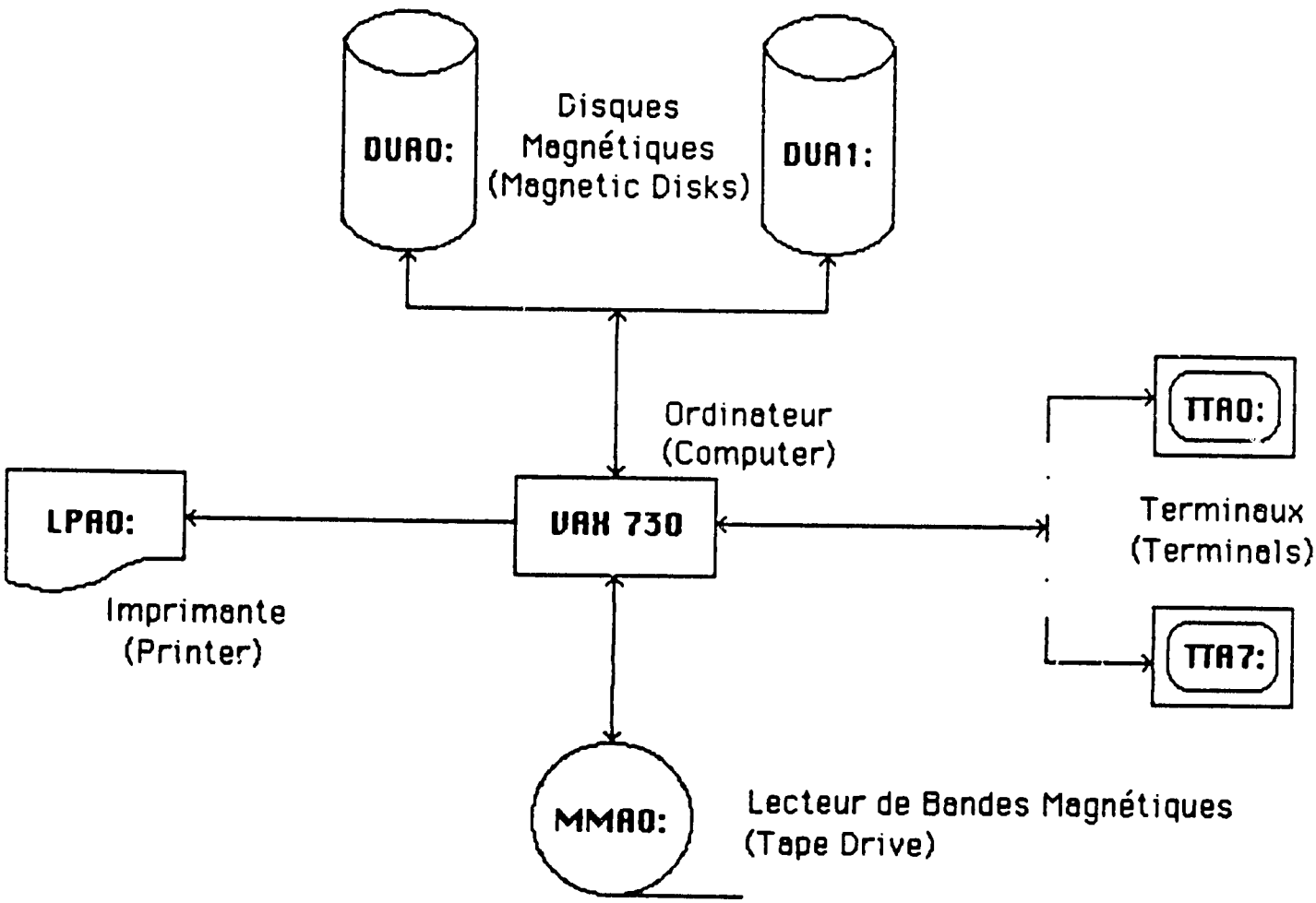
   A. Username and Password
   B. System Log-on Control
   C. What happens after successful access?

III. The Crop Modeling System

   A. Access into the System
   B. Brief Description

La Configuration du Système VAX 11/730

(System Configuration for the VAX 11/730)



Remarque: Les indications à l'intérieur des symboles désignent les appareils utilisés par le système.

(Note: The indications inside of the symbols designate the devices used by the system.)

OPERATIONAL YIELD MODELING AND METEOROLOGICAL DATA FLOW

Clarence M. Sakamoto

Tuesday, March 18 - 8:30 A.M.

Objective

1. To discuss the types of crop yield models using weather data inputs.
2. To discuss factors associated with model selection in an operational system.

Abstract

Three approaches to estimating crop yield with meteorological data inputs are suggested. These include Index Analogues (ranking), climate crop regression models and process oriented models. The selection rests with the user, who determines the scope of the model application. Factors to consider include data availability, reliability of output, timeliness, cost and consistency with scientific knowledge.

I. Introduction

A. Perspective of the Problem
B. Objectives of Presentation

II. Types of Models

A. Climatic Index Analogues (First Generation)

1. Useful when Agronomic Data are Absent
2. Example of Crop Moisture Index

(a) Normalizing data
(b) Interpretation of data

B. Climate-crop Regression Model (Second Generation)

1. Basic data requirements
2. Recognizing limitations

C. Process-Oriented Model (Third Generation)

1. Concepts
2. Limitations

III. Model Selection Criteria

A. Data Availability and Quality

Desireable to have long period of quality data. This often is not possible. Some compromises may need to be made.

B. Reliability of Output

Desirable to have consistency of result. This is related to accuracy, precision and bias.

C. Timeliness

The earlier the estimate, the greater the time available for planning and mitigating impacts.

D. Cost

Need to balance cost and information gained.

E. Consistency with Scientific Knowledge

Model should reflect scientifically known response.

Illustrations (see attached)

References

Sakamoto, Clarence M. "Climate-Crop Regression Yield Model: An Appraisal" in Application of Remote Sensing to Agricultural Production Forecasting, A. Berg, Editor. pp. 131-138. 1981.

Sakamoto, Clarence M. "Operational Yield Modeling and Meteorological Data Flow" in Application of Remote Sensing to Agricultural Production Forecasting, A. Berg, Edition, pp. 139-149.

Sakamoto, Clarence M. "The Technology of Crop/Weather Modeling" in Food Climate Interactions, W. Bach, J. Pankrath, and S. H. Schneider (editors). pp. 383-393. 1981.

Sakamoto, Clarence M. "New Generation of Crop Models." Lecture presented at the Agroclimatic Techology Program for Southeast Asia April 11-15, 1983; Bangkok, Thailand.

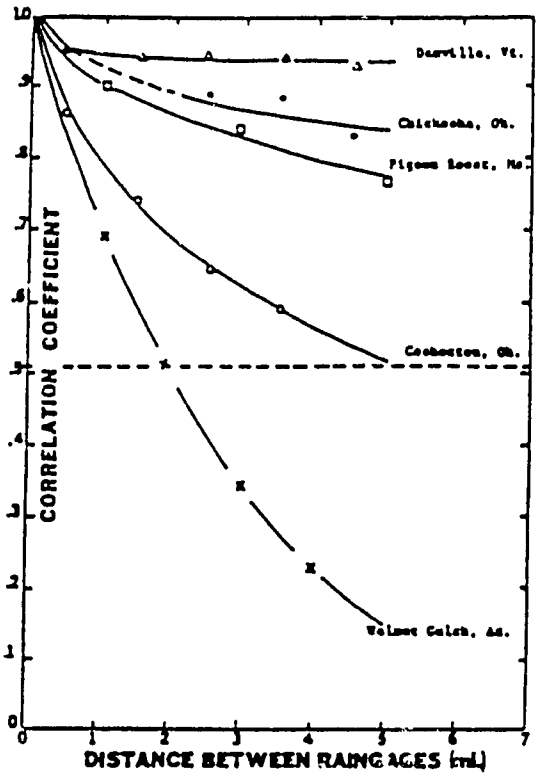
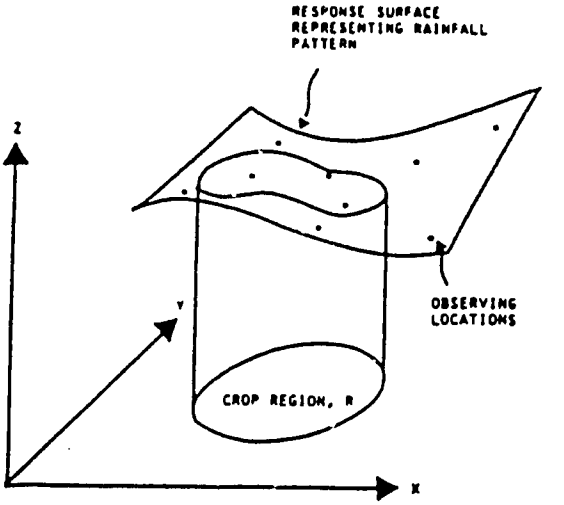
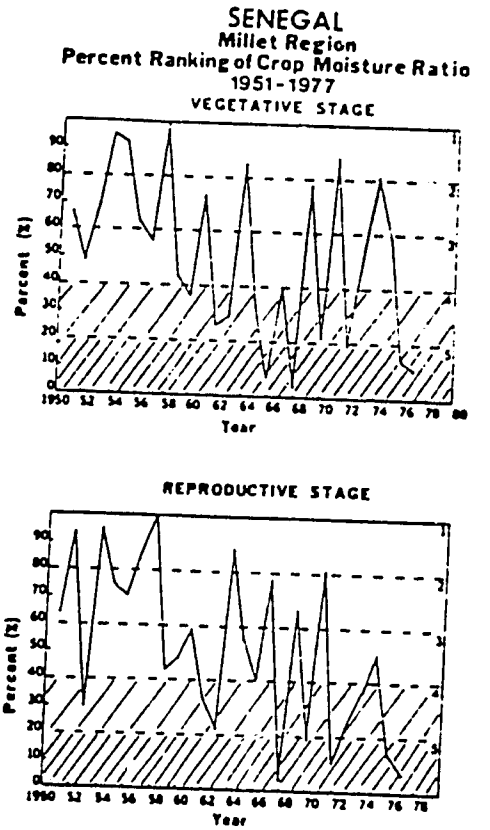


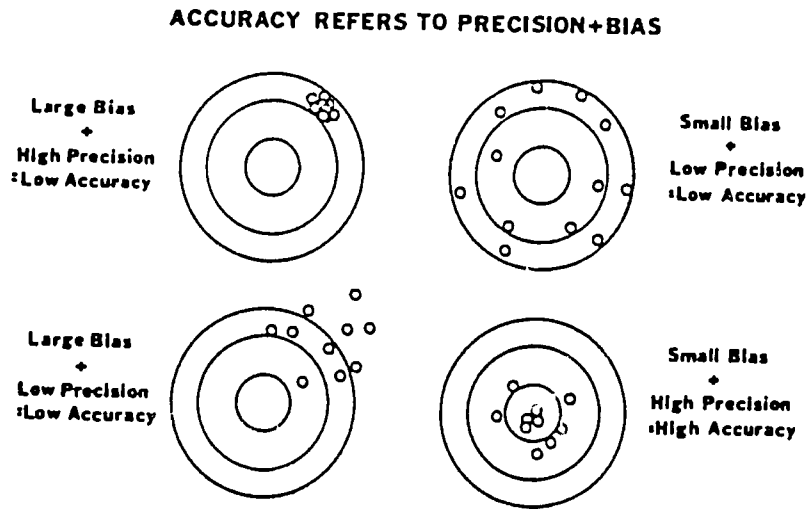
Illustration of raingage density requirement as a function of climate (after Herschfield, 1967).



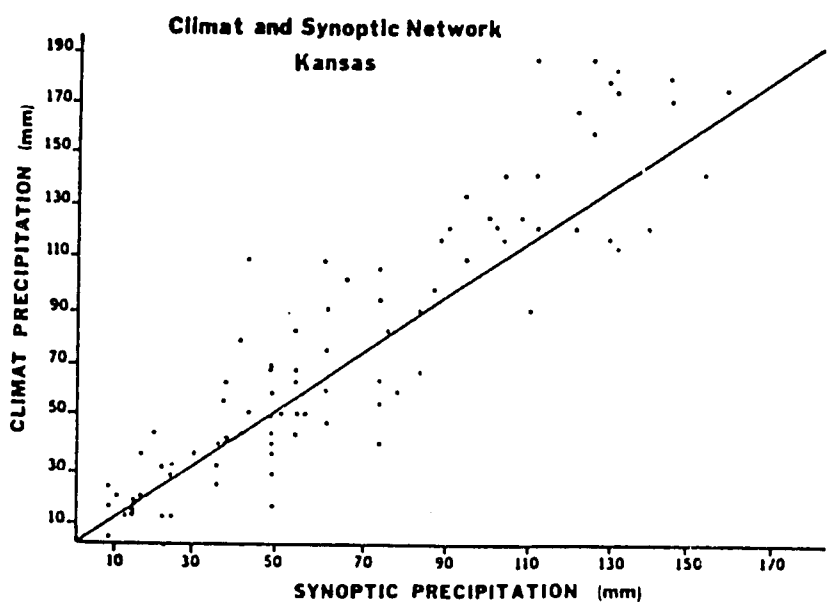
Depiction of spatial and temporal variation of precipitation over a crop region.



Senegal millet model with yield estimates for 1974-1978, based on the crop moisture index.



Pictorial depiction of accuracy, precision and bias.



Comparison of monthly precipitation estimate from synoptic station and cooperative (climate) station reports.

PREPARATION OF DATA BASE: METEOROLOGICAL AND CROP

Rao Achutuni

Wednesday, March 19 - 8:30 A.M.

Objective

To discuss basic concepts and techniques involved in the preparation of meteorological and crop data bases for use in assessments.

Abstract

Procedures for quality control of both meteorological and crop data are discussed. Three methods of estimating rainfall data are presented. Spatial and temporal scales for meteorological and crop data and methods for aggregating data are also presented.

I. Meteorological Data Base

A. Quality Control of Data

1. Homogeneity of Data
2. Criteria for Station Selection
3. Station Density
4. Flagging Outliers

B. Estimation of Missing Data

1. Inverse-weighted Distance Averages
2. Least Squares Quadratic Fit
3. Least Squares Cubic Fit

C. Spatial and Temporal Scales

1. Station Aggregation
2. Time Scales in Meteorological Analysis

D. Establishing Operational Procedures for Updating of Meteorological Data

1. Some common problems in obtaining data on an operational basis
2. Identifying operational stations

3. Receiving, documenting and coding data on an operational basis
4. Quality control of real-time data prior to entering in operational data base

II. Crop Data Base

A. Quality Control of Crop Data

1. Flagging outliers
2. Flagging repeating values

B. Aggregating Crop Data

1. Regional Aggregation for large area Modeling
2. Combining Crop Data from several regions in order to develop covariance crop models with limited years of data.

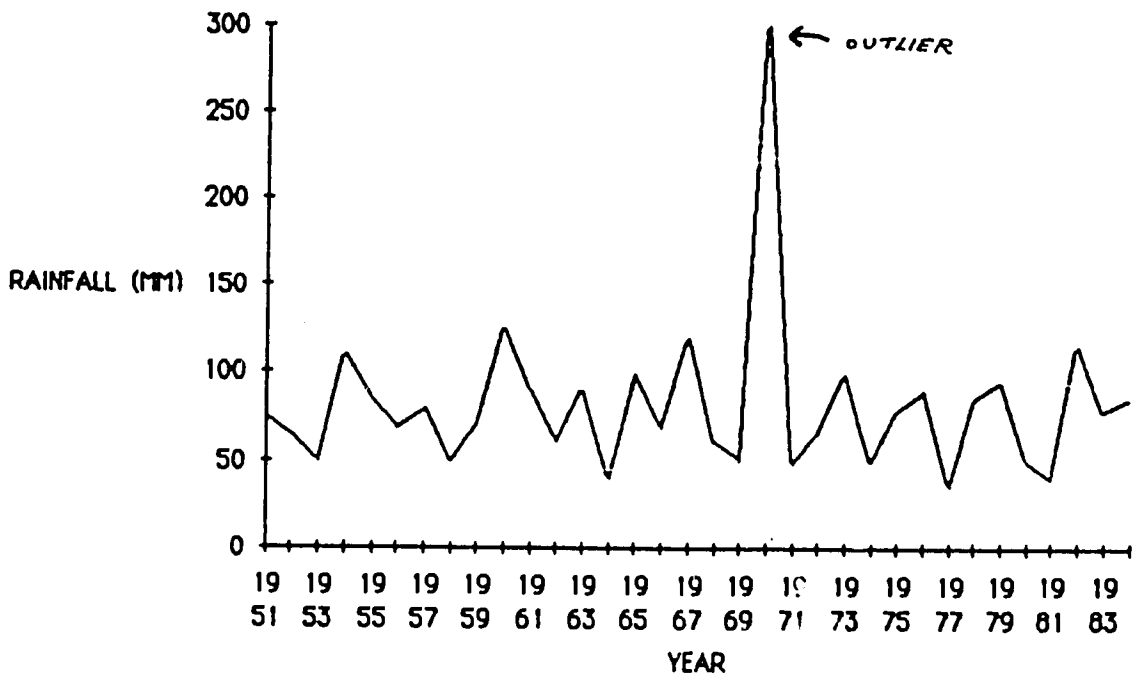
Illustration

Sudan is used as an example in the following Figures.

SUDAN
OPERATIONAL AND HISTORICAL STATIONS
WADI HALFA
20°
PORT SUDAN
ABU HAMED
DONGOLA
GEBEIT
KARIMA (60-70)
TOKAR (60-70)
ATBARA
SHENDI
16°
KHARTOUM
KASSALA
KUTUM (60-70)
WAD MEDANI
SHOWAK
SODIRI
ED DUEIM (60-70)
EL FASHER
GEDAREF
GENEINA
SENNAR
ZALINGEI
EL OBEID
SINGA
EN NAHUD (60-70)
KOSTI
NYALA
TOZI (ABU NAAMA)
ER ROSEIRES/ DAMAZINE
RENK
KURMUK
KADUGLI
KOLOGI
BURAM
RADOM
MELUT
KODOK
AWEIL
MALAKAL (60-70)
RAGA
MESHRA ER REQ (60-70)
NASIR
8°
WAU
RUMBEK
PIBOR POST
STATION WITH PERIOD OF RECORD AS INDICATED
HISTORICAL STATION PERIOD OF RECORD 1951-64.
BOR
(60-70)
YAMBIO
MARIDI
JUBA
KAPOETA
TORIT (50-60)
YEI
MAGICHOT
24°
28°
36°

Figure 1.

FIG 2. TIME SERIES OF AUGUST RAINFALL



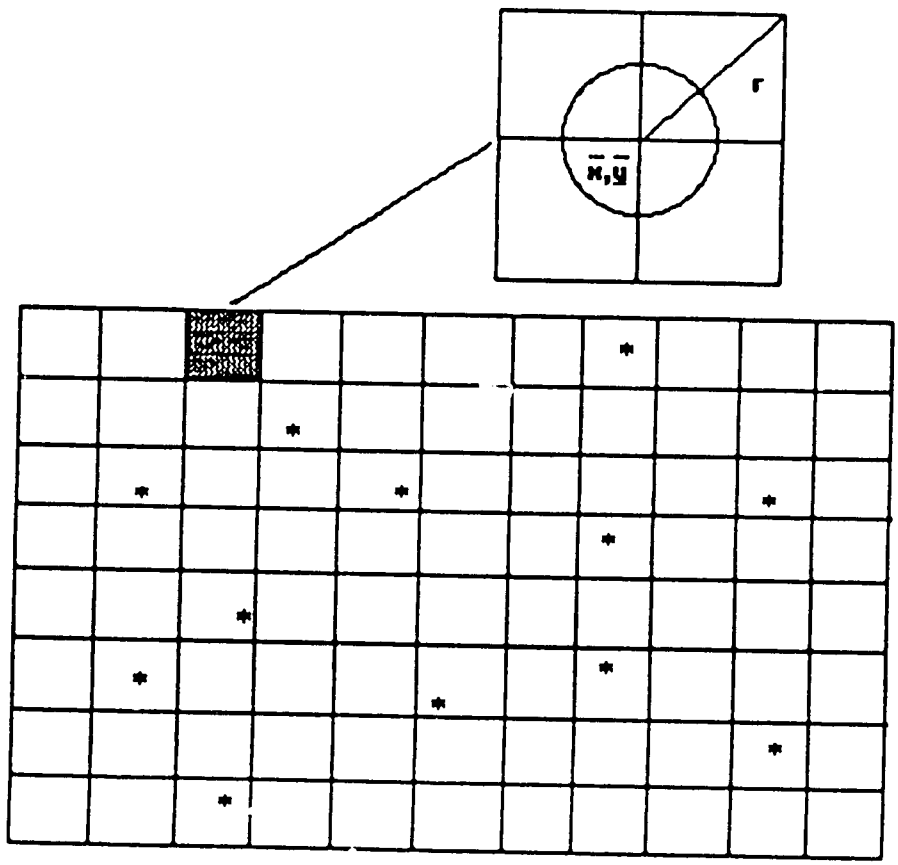


FIG 3. Station Locations (*) and Corresponding Grid Overlay for Rainfall Estimation.

--- INPUT GRID MATRIX ---

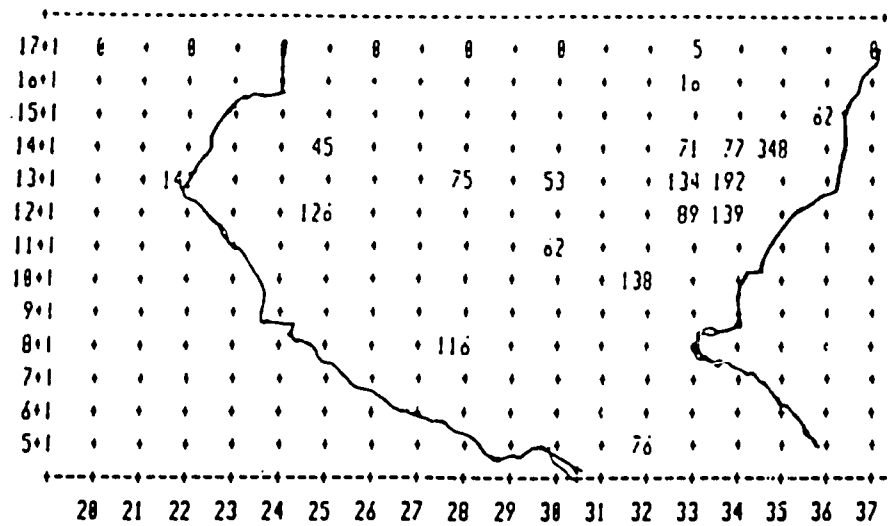


Figure 4a. Observed station rainfall for Sudan during July 1985.

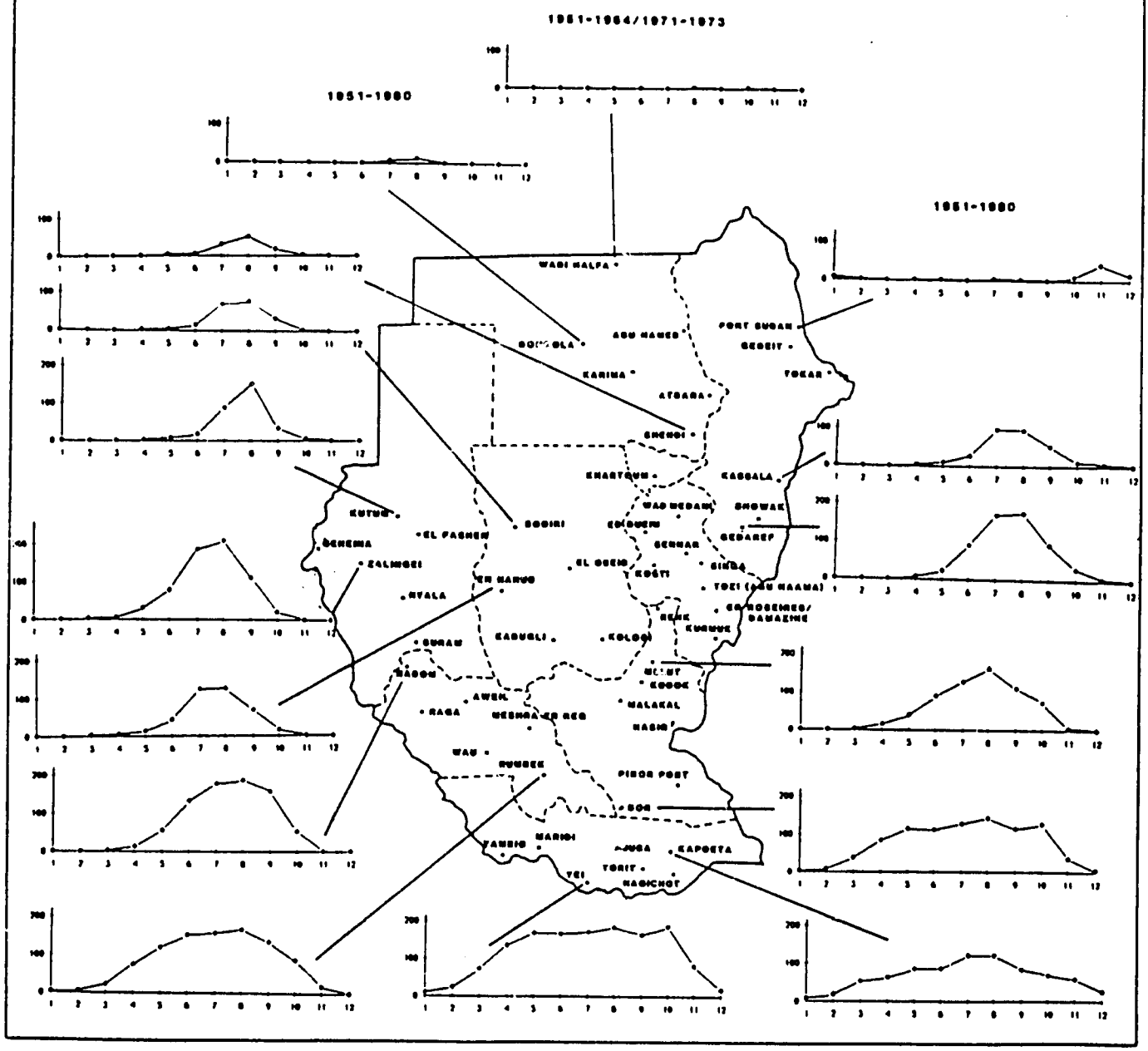
--- OUTPUT GRID MATRIX ---

17	0	0	0	0	0	0	0	0	0	0	0	0	11	5	11	23	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	11	16	11	62	31	31
15	47	56	52	41	29	22	24	26	26	24	23	27	33	39	56	141	62	62
14	141	141	113	86	64	47	50	53	52	45	43	50	60	71	95	322	205	62
13	141	141	139	117	100	89	82	77	74	59	54	67	89	130	188	316	348	205
12	141	141	140	130	124	124	106	91	78	64	60	74	87	94	141	200	210	348
11	141	141	138	133	130	127	114	99	83	70	64	87	106	111	129	147	152	212
10	141	141	136	132	129	125	117	106	95	90	93	113	136	131	132	135	139	146
9	141	136	131	128	125	122	118	112	100	106	110	120	131	129	127	128	133	139
8	134	126	125	123	121	119	118	116	116	113	110	110	113	113	112	115	124	136
7	126	126	123	119	118	117	117	117	117	114	101	93	92	92	92	92	97	110
6	126	126	121	116	116	116	116	116	116	116	89	76	76	76	76	76	83	85
5	126	122	116	116	116	116	116	116	116	99	76	76	76	76	76	76	76	79
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37

Figure 4b. Smoothed profile of data shown in Fig. 4a.

SUDAN

AVERAGE MONTHLY RAINFALL (MM) FOR SELECTED STATIONS COMPUTED FOR THE PERIOD 1951-1979



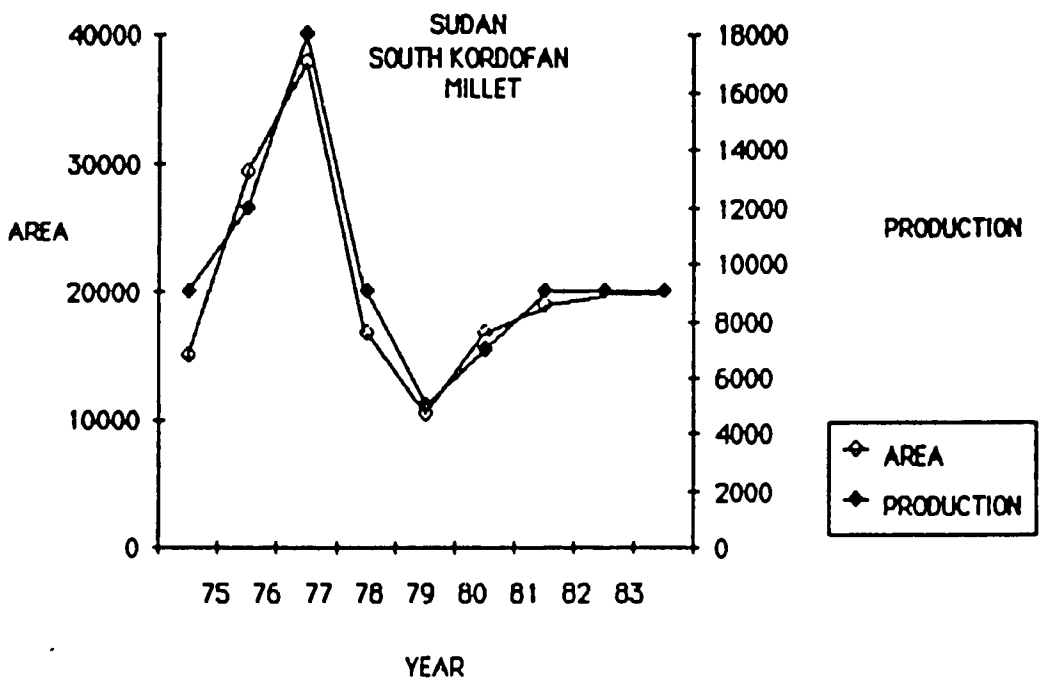


Figure 6. Time Series of Area and Production of Millet in the South Kordofan Region of Sudan.

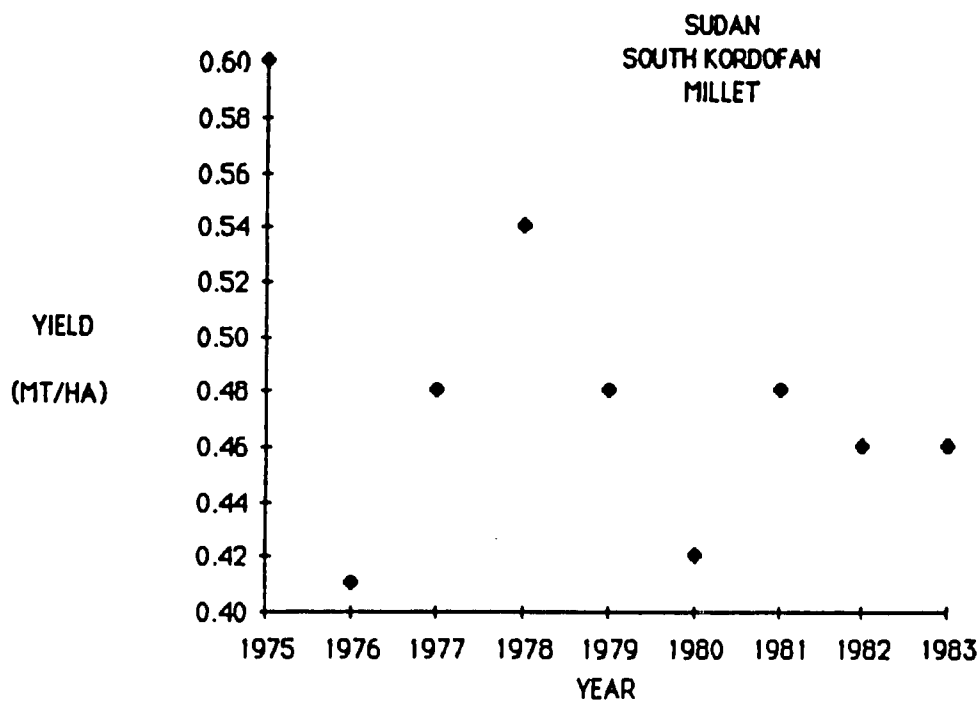


Figure 7. Time Series of Millet Yield in the South Kordofan Region of Sudan.

PREPARATION OF DATA BASE: SATELLITES

Albert van Dyk

Wednesday, March 19, 10:30 A.M.

Objectives

1. To explain the difference and relationship between LAC, GAC and PSG and to explain weekly composite.
2. To locate available yield data, biomass data, and precipitation in each of the following:

   ½ x 1° grid
   1 x 2° grid
   region

Abstract

The data from AVHRR are available from the satellite in three modes, each representing a different resolution:

1. LAC (Local Area Coverage): on-board recording of data from selected portions of each orbit of all spectral channels for central processing. The LAC pixel represents an area of 1.1 x 1.1 km^2.

2. GAC (Global Area Coverage): global on-board recording of low resolution data from all spectral channels. GAC data is generated from LAC data as follows: for every three scan lines of LAC data the second and third scan lines are skipped. The pixels which are kept are placed into groups of five. The first four pixels of every group are averaged to make one GAC pixel, and the fifth LAC pixel is dropped. One GAC pixel represents an area of about 16 km^2 and has a resolution of 1.1 x 1.2 km^2.

3. PSG (Polar Stereographic Data): PSG data is generated from GAC data. The GAC pixels are mapped into a polar stereographic array, one for each hemisphere. Each GAC pixel is assigned as being contained within a specific PSG pixel. The PSG pixel is assigned spectral responses the same as the last GAC pixel in a four by four grid on a given day. The sampled PSG pixel represents an area from 225 km^2 at the equator up to 900 km^2 at the poles.

4. Weekly Composite PSG Data: The daily PSG arrays within a week are used to generate a weekly composite PSG array. The goal is to choose for each PSG pixel the corresponding pixel from the daily arrays which has the least clouds. For each composite period of seven days the data for the pixel from the daily array having the greatest value of (Channel 2-Channel 1)/(Channel 2 + Channel 1), i.e., the normalized vegetation index value, are retained at each location. The data retained are Channel 1, Channel 2 and DVI + 100 (Channel 2 - Channel 1 + 100). They are selected for the composite arrays for the same day as the day of the maximum normalized vegetative index within that week.

The cloud, haze and look angle effects are reduced in this process to provide a better indication of vegetation.

I. Introduction

A. Perspective of the Problem
B. Objectives of Presentation

II. Types of NOAAn Satellite Data

A. LAC
B. GAC
C. PSG
D. Weekly Composite

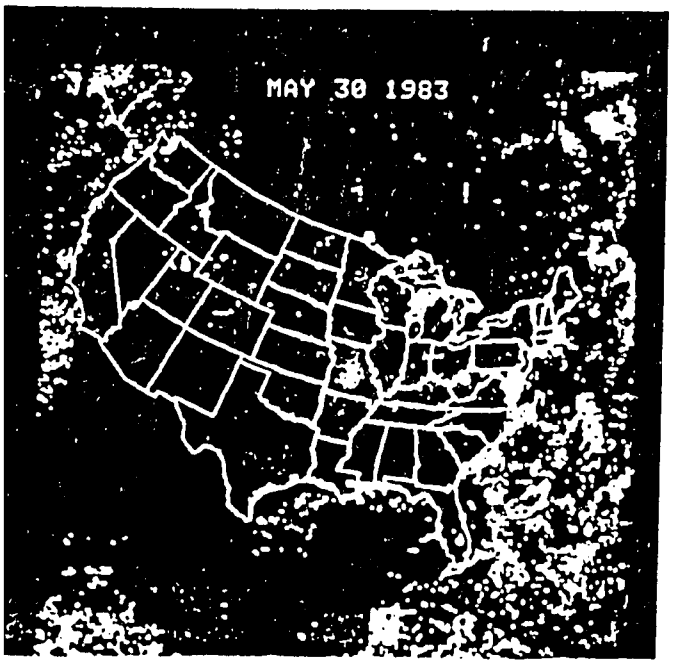
III. Gridcells

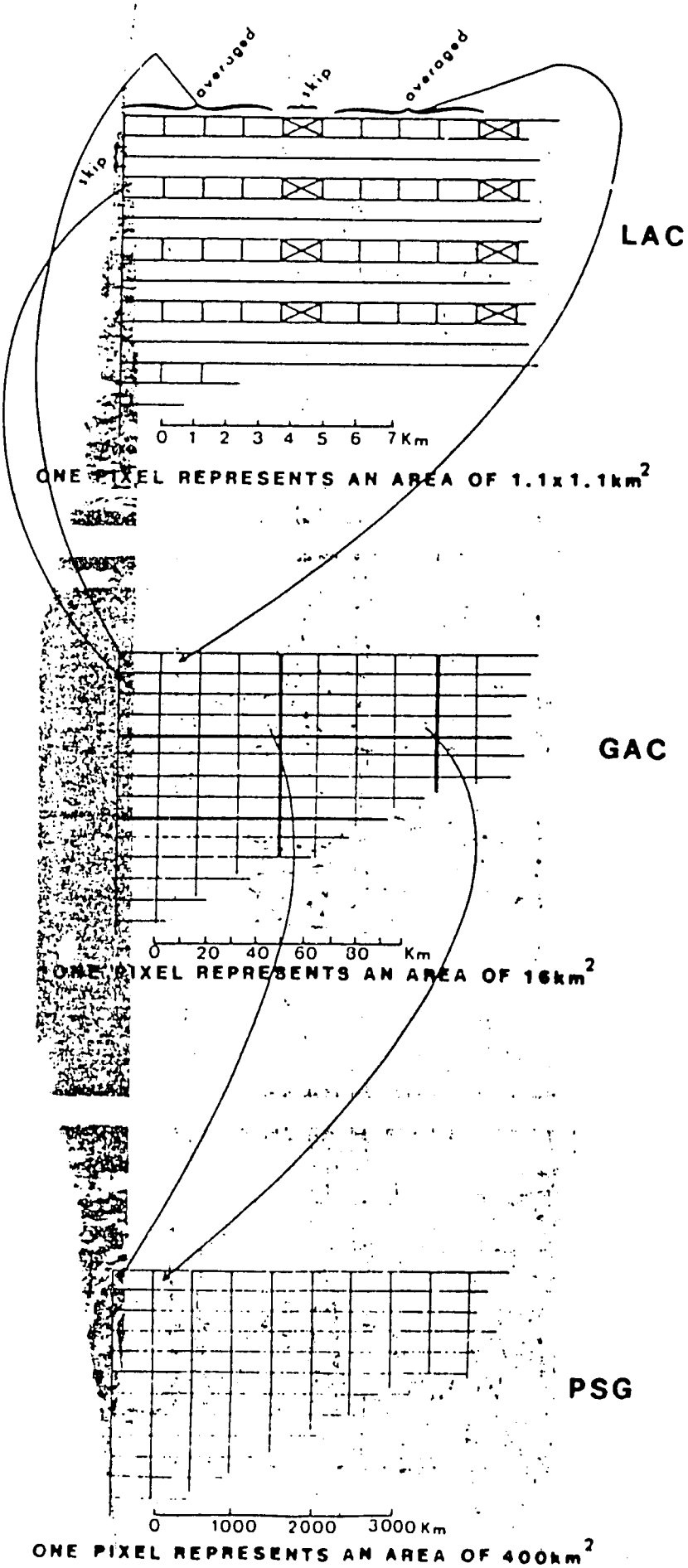
A. 1 x 2° Lat./Long.
B. ½ x 1° Lat./Long.
C. Area

Reference

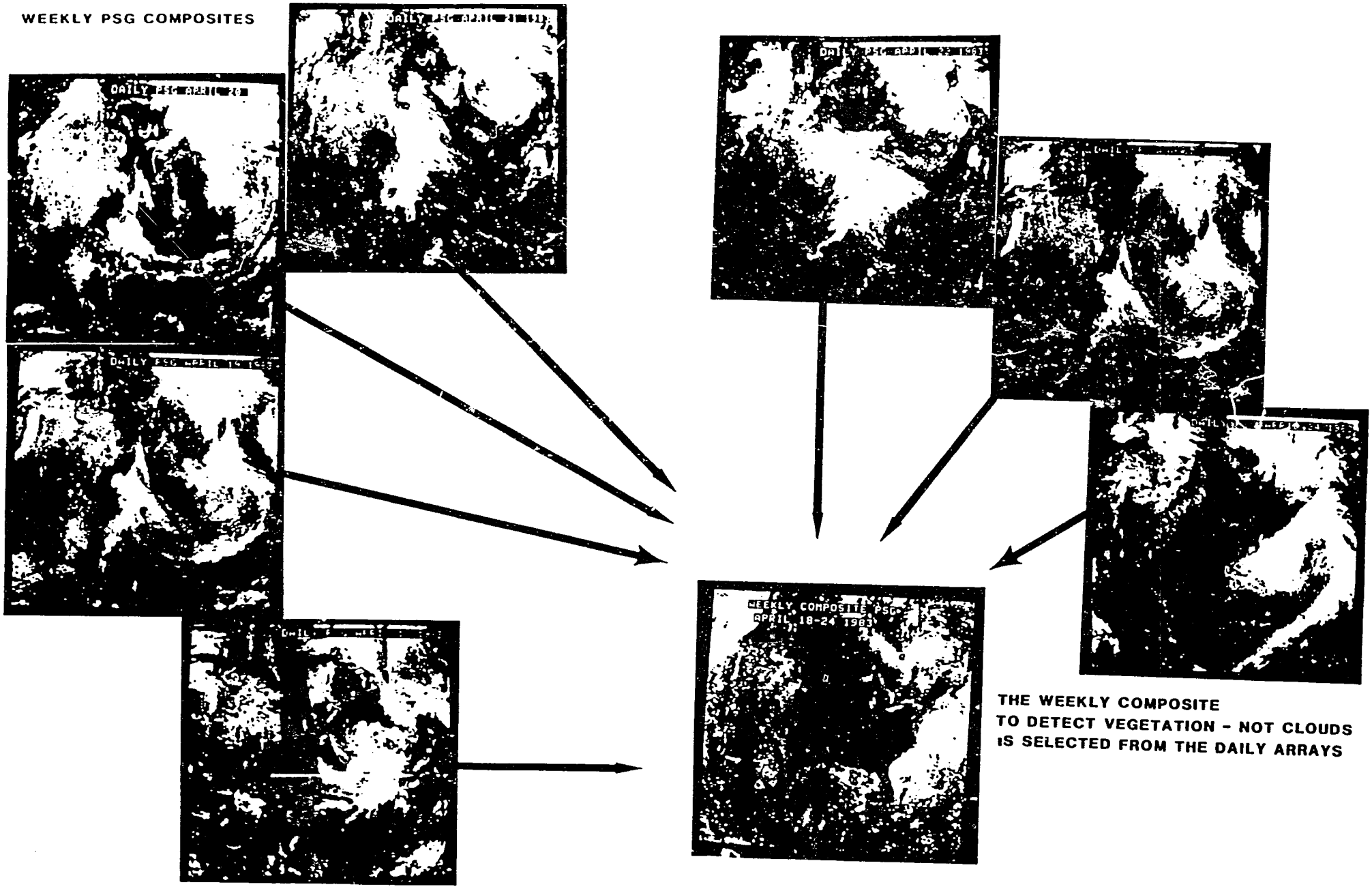
AVHRR Training Set, by Albert van Dyk, NOAA/AISC, Columbia, MO.

1) PSG DATA GENERATION





WEEKLY PSG COMPOSITES



THE WEEKLY COMPOSITE
TO DETECT VEGETATION - NOT CLOUDS
IS SELECTED FROM THE DAILY ARRAYS

AVHRR EXERCISES

by: Dr. Gary Johnson March 19, 1986 1:30 P.M.

Following is a table of 98 values representing digital data acquired from Channel 1 and Channel 2 of the AVHRR sensor. Seven columns or pixel locations (P1, etc.) are noted at the top of the table. Fourteen rows "interleaved by channel" are labeled at the left of the table.

	P1	P2	P3	P4	P5	P6	P7
L1, Ch1	115	110	110	90	25	27	26
L1, Ch2	111	107	106	89	50	52	52
L2, Ch1	115	114	100	28	27	27	28
L2, Ch2	110	110	96	53	53	53	54
L3, Ch1	117	110	20	25	26	25	27
L3, Ch2	112	106	26	49	52	52	54
L4, Ch1	100	22	21	20	25	26	27
L4, Ch2	98	27	27	26	49	51	53
L5, Ch1	21	21	20	20	20	18	17
L5, Ch2	27	27	25	26	25	16	15
L6, Ch1	20	20	21	21	21	19	18
L6, Ch2	26	25	27	27	26	17	16
L7, Ch1	20	21	20	21	21	18	17
L7, Ch2	27	28	28	27	27	16	15

You are to analyze this data in the following manner:

1. Create a "map" of channel 1 data values. To do this you should use graph paper and prepare a 7 x 7 array of channel 1 data values "mapped" to their correct spatial location.
2. Create a "map" of channel 2 data values.
3. Prepare a "scatter diagram" of the data values with channel 1 on the Y axis and channel 2 on the X axis. Remember that if this is 8 bit data, the possible range of values is 0-255.
4. Prepare a histogram of both the channel 1 and channel 2 data. The range of values should be along the X axis. Plot the frequency of occurance of the values on the Y axis.
5. Calculate a normalized vegetation index (NVI) value for each "pixel."
6. "Map" the NVI to its correct spatial location.
7. Prepare a histogram of the NVI values.

Based upon your data analysis and knowledge, answer the following questions.

1. What is the wavelength of AVHRR channel 1?

2. What is the wavelength of AVHRR channel 2?

3. What is the corresponding visible color of channel 1?_____

4. Assuming that the area you have "mapped" is at the satellite sub-point or nadir, what is the ground area of your map? _____ square kilometers. _ _____square miles.

5. Based upon your analysis of the AVHRR data, how many distinct cover types do you think are represented?_____Why?

6. What might the cover types you have indicated in the previous question correspond to in the real world?

7. Assuming there are clouds present in this data, where are they located on your "map"?_____

8. Assuming there is water present in this data, where is it located on your "map"?_____

9. What is the lowest NVI value you calculated?_____

   Where is it located on your "map"?_____

   _____

10. What is the lowest channel 2 value you found?_____

Where is it located on your "map" and what cover type is it likely to be?_____

_____

_____

PRINCIPLES OF IMAGE INTERPRETATION

Gary E. Johnson

Thursday, March 20 - 8:30 A.M.

Objective

To review the elements of image interpretation and apply them in an interpretation excercise.

Abstract

The interpretation of remotely sensed data is based upon: established procedures which set forth the basic principles of interpretation; an understanding of the factors which govern the interpretability of the imagery; a systematic interpretation methodology; and an understanding of the image elements or characteristics which allow an interpreter to locate, delineate, identify and evaluate image features.

I. Introduction

II. Basic Principles of Image Interpretation

III. Factors Governing the Interpretability of Images

IV. The Interpretation Process - Image Elements

A. shape	E. shadow
B. size	F. pattern
C. tone or color	G. location or association
D. texture	H. parallax

References

Lillesand, Thomas M. and Ralph W. Kiefer, Remote Sensing and Image Interpretation, 1979, John Wiley and Sons, New York, N.Y. pp. 95-99.

Exercise

Image Interpretation Exercise

Image Interpretation Exercise

Objectives:

This exercise is designed to acquaint you with several forms of remotely sensed imagery which have been acquired by various sensors from various platforms. The exercise will permit you to apply the principles of image interpretation in a systematic fashion to identify various image features.

Exercises:

Using the accompanying forms, you are to identify as specifically as possible the five (5) features which have been indicated on each of the images provided. You should begin by examining each image. Then, study the feature indicated and provide your interpretation of what the feature is. Check the appropriate column on the exercise to indicate which "image characteristics" were of assistance in making your interpretation. Finally, answer the questions which are specific to each image.

Note:

The numbers on each overlay have an arrow which points directly to each "specific" feature which you are asked to identify. If there is no arrow associated with the number, you are to identify the larger feature upon which the number lies.

BASIC PRINCIPLES OF IMAGE INTERPRETATION: WORKSHOP EXERCISE

IMAGE # 1

Feature or Condition	IMAGE CHARACTERISTICS								
	Shape	Size	Tone or Color	Texture	Shadow	Pattern	Parallax	Location	Association
1.)									
2.)									
3.)									
4.)									
5.)									

What sensor acquired this image? _____

From what platform? _____

Is this a small, medium, or large scale image? _____

When was this image acquired? _____ (date)

For what purpose was this image acquired? _____

BASIC PRINCIPLES OF IMAGE INTERPRETATION: WORKSHOP EXERCISE

IMAGE # 2

Feature or Condition	IMAGE CHARACTERISTICS								
	Shape	Size	Tone or Color	Texture	Shadow	Pattern	Parallax	Location	Association
1.)									
2.)									
3.)									
4.)									
5.)									

What sensor acquired this image? _____

From what platform? _____

Is this a small, medium, or large scale image? _____

When was this image acquired? _____ (date)

For what purpose was this image acquired? _____

BASIC PRINCIPLES OF IMAGE INTERPRETATION: WORKSHOP EXERCISE

IMAGE # 3

Feature or Condition	IMAGE CHARACTERISTICS								
	Shape	Size	Tone or Color	Texture	Shadow	Pattern	Parallax	Location	Association
1.)									
2.)									
3.)									
4.)									
5.)									

What sensor acquired this image? _____

From what platform? _____

Is this a small, medium, or large scale image? _____

When was this image acquired? _____ (date)

For what purpose was this image acquired? _____

BASIC PRINCIPLES OF IMAGE INTERPRETATION: WORKSHOP EXERCISE

IMAGE # 4

Feature or Condition	IMAGE CHARACTERISTICS								
	Shape	Size	Tone or Color	Texture	Shadow	Pattern	Parallax	Location	Association
1.)									
2.)									
3.)									
4.)									
5.)									

What sensor acquired this image? _____

From what platform? _____

Is this a small, medium, or large scale image? _____

When was this image acquired? _____ (date)

For what purpose was this image acquired? _____

BASIC PRINCIPLES OF IMAGE INTERPRETATION: WORKSHOP EXERCISE

IMAGE # 5

Feature or Condition	IMAGE CHARACTERISTICS								
	Shape	Size	Tone or Colur	Texture	Shadow	Pattern	Paral-lax	Location	Associ-ation
1.)									
2.)									
3.)									
4.)									
5.)									

What sensor acquired this image? _____

From what platform? _____

Is this a small, medium, or large scale image? _____

When was this image acquired? _____ (date)

For what purpose was this image acquired? _____

COLOR COORDINATE SYSTEMS FOR USE WITH REMOTELY SENSED IMAGERY

Gary E. Johnson

Thursday, March 20 - 1:30 P.M.

Objectives

1. To discuss the various color coordinate systems used to display remotely sensed data.
2. To become familiar with the ACCS.
3. To display and manipulate the ACCS on an IBM-PC system.

Abstract

The dimension of color adds more information for interpretation. Colo may be represented several ways and the addition of "invisible" near infrared radiation to the visible portrayal of an image presents an additional challenge. Traditional red, green, and blue (RGB) color schemes, intensity, hue, and saturation (IHS) schemes, and the Ambroziak Color Coordinate System (ACCS) will be examined. An opportunity will also be provided for "hands-on" display and manipulation of the ACCS on the IBM-PC system.

I. Introduction

II. Color on Film

- A. Color Film
- B. Near Infrared Color Film

III. The Red-Green-Blue Color Scheme

IV. The False Color Infrared Color Scheme

V. The Intensity-Hue-Saturation Color Scheme

VI. The Ambroziak Color Coordinate System

- A. Evaluation of the System
- B. Display on the IBM-PC

References

Ambroziak, R. A., 1984: A new method of incorporating meteorological satellite data into global crop monitoring. Proceedings of the XVIII Symposium on Remote Sensing of Environment, Paris, France, 1984.

PCIP Users Manual

USING THE IBM-PC (PCIP) AND PRODUCING IMAGERY FROM THE HIGH RESOLUTION MONITOR (CRT)

Gary E. Johnson

Friday, March 21 - 8:30 A.M.

Objectives

1. To gain experience in image display and manipulation on the IBM-PC system.
2. To review methods of photographing the image display.
3. To gain experience in the use of the Dunn Camera.

Abstract

Software on the IBM-PC permits the display and manipulation of ACCS images. It's often desireable to create "hard copy" images from the screen. This may be done through the use of a conventional camera placed in front of the monitor or by using a separate Dunn camera. Experience in the use of this equipment will be provided to all participants.

I. Introduction to the Equipment

II. Photographing the CRT

III. Use of the Dunn Camera

Reference

Dunn Camera Users Manual

Exercise

Photographing the Monitor with the Dunn Camera

STATISTICAL CONCEPTS: OVERVIEW

Sharon LeDuc

Monday, March 24 - 8:30 A.M.

Objective

To better understand and incorporate the randomness of climatological and related variables.

Abstract

The use of statistical methods requires various assumptions. These assumptions, the consequences of violations of assumptions and capabilities provided by some statistical techniques will be discussed.

I. Introduction

   A. Climatological data available
   B. Current weather data

II. Assumptions for Climatological Predictions

   A. Population has remained the same
   B. Independence

III. Climatological Series

   A. Examples - Monthly Precipitation
   B. Derived Variables

IV. Adjustments of Climatological Series

   A. Location Adjustment
   B. Scalar Adjustment

V. Empirical Distribution

   A. Example - relate to histogram
   B. Interpretation as Probability
   C. Smoothness of the Function

VI. Theoretical Distribution

A. Why use Theoretical Distributions?
B. Examples

1. Gamma
2. Normal

C. Testing for the validity of the Theoretical Distribution

Illustrations

Handout will be provided.

Reference

Handout will be provided.

Exercise

Climatological series for precipitation in each country will be provided on which to:

- Estimate Deciles from Empirical Distribution
- Fit Theoretical Distribution
- Test fit of Theoretical Distribution
- Estimate Deciles from Theoretical Distribution

STATISTICAL CONCEPTS: CORRELATION

Sharon LeDuc

Tuesday, March 25 - 8:30 A.M.

Objective

To introduce correlation and to present an innovative method of exploratory analysis for determining the relationship between weather and crop yield.

Abstract

The calculation of a correlation coefficient will be presented. Values of the correlation coefficient will be associated with scatter diagrams of the data. The correlation triangle will be introduced as a method to discover the relationship between yield and the timing of precipitation.

I. Introduction

   A. Correlation Coefficient (Parametric and Nonparametric)
   B. Correlation Coefficient measures linear relationship, but does not identify cause and effect.

II. Computation of Correlation Coefficient (r)

   A. Computational Equation
   B. Examples of r and corresponding scatter diagrams

III. Yield vs. Precipitation

   A. Total precipitation over adjacent time periods
   B. Correlation of yield with precipitation over each of these time periods
   C. Position of r in correlation triangle
   D. Detrending yield
   E. Defining time periods

Illustrations

Computational equation for r
Scatter Diagrams
Correlation Triangle

Reference

Proceedings of Training Course in Niamey, Niger - April, 1985

Exercise

Using millet yield and monthly precipitation for recent years for each country.

- Generate Correlation Triangle
- Determine Period most highly correlated with Millet Yield
- Interpret the Results

FACTORS AFFECTING CROP YIELD MODEL SELECTION

Susan Callis

Tuesday, March 25 - 10:30 A.M.

Objective

To dicuss criteria for selecting the most appropriate crop yield model from several possible models.

Abstract

Though a particular crop yield model may stand out statistically over several others, the most appropriate model must be agronomically reasonable and based on sound crop and meteorological data. Trends in the yield data must also be considered.

I. Reliability of Crop and Meteorological Data

   A. Quality
   B. Technology and Weather Trends
   C. Quantity
   D. Availability

II. Agronomic Reasonableness

III. Favorable Statistics

IV. Summary

STATISTICAL CONCEPTS: REGRESSION ANALYSIS

Sharon LeDuc

Wednesday, March 26 - 8:30 A.M.

Objective

To acquaint participants with Multiple Linear Regression.

Abstract:

Multiple linear regression is presented as a tool for estimating crop yield. Emphasis will be on the design matrix for regression and how various types of relationships are formulated in the design matrix.

I. Matrices

Complete handout has been prepared and participants will be provided with this prior to this session. They will be expected to be familiar with contents.

II. Design Matrix for Regression

A. Matrix equation for relationship
B. Matrix equation for coefficient estimates

III. Various factors affecting yield and incorporation of these factors into design matrix.

A. Dummy variables
B. Linear variables
C. Covariance assumptions

IV. Interpretation of Regression

A. Significance of Regression
B. Overfit

Illustrations

Prinlouts from Benzinger software.

- Scatter diagram of Yield vs. Precipitation
- Time-Series of Yield
- Design Matrix
- Regression Statistics

Reference

Matrix handout

Exercise

All students will work with same country and will be asked to generate:

- simple model
- trend model
- covariance model

SATELLITE OVERVIEW: NORMALIZED VEGETATION INDEX

Albert van Dyk

Thursday, March 27 - 8:30 a.m.

Objectives

1. To explain principle and rationale of Vegetation Index.
2. To discuss the different vegetation indexes that can be calculated using Channels 1 and 2.
3. To select an ideal vegetation index.
4. To explain principles of NVI time-series - "profiles."
5. To explain resmoothing of profiles.
6. To explain principles of interpretation of profiles.

Abstract

Vegetation indexes are designed to condense spectral information, to discriminate vegetation from nonvegetation, and to assess crop conditions for a very large range of agricultural, seasonal and meteorological conditions. In principle, a vegetation index is a ratio or a difference of reflectance values in the Near Infrared (NIR) and the visible region of the spectrum. The result is that objects with about the same reflectance in the visible and NIR (e.g., soil, asphalt, and concrete) will have very low vegetation index values (near zero), while objects such as vegetation with a large difference in reflectance in the visible and the NIR will have high values. The vegetation index can be seen as a measure of the amount of green vegetation.

One of the main advantages of satellite data is the economical repetitive coverage. A time-series of vegetation indexes through the year (profile) is based on the repetitive coverage and represents the dynamics of the vegetation in an area.

The profile has a noise component caused by the disturbing effect of the atmosphere. By applying an effective smoother the noise is eliminated.

I. Introduction

A. Perspective of the Problem
B. Objective of Presentation

II. Why Vegetation Index?

III. Different vegetation indices of Channel 1 and Channel 2

1. $DVI = Ch_2 - Ch_1$

2. $RVI = Ch_2/Ch_1$

3. $NVI = \frac{Ch_2 - Ch_1}{Ch_2 + Ch_1}$

IV. Selection of ideal Vegetation Index

A. No difference between the three
B. RVI preferred

V. Principles of NVI time-series profiles

VI. Smoothing of Profiles

A. Signal & Noise
B. Different smoothers

1. polynomial
2. Fourier
3. mean
4. median
5. compound smoothers

C. Limitations and Merits

VII. Principles of Interpretation of Profiles

A. Relation VI and Weather Rainfall (P - CMR)
B. Critical periods for crops

<u>Reference</u>

Training Notes by Albert van Dyk et al.

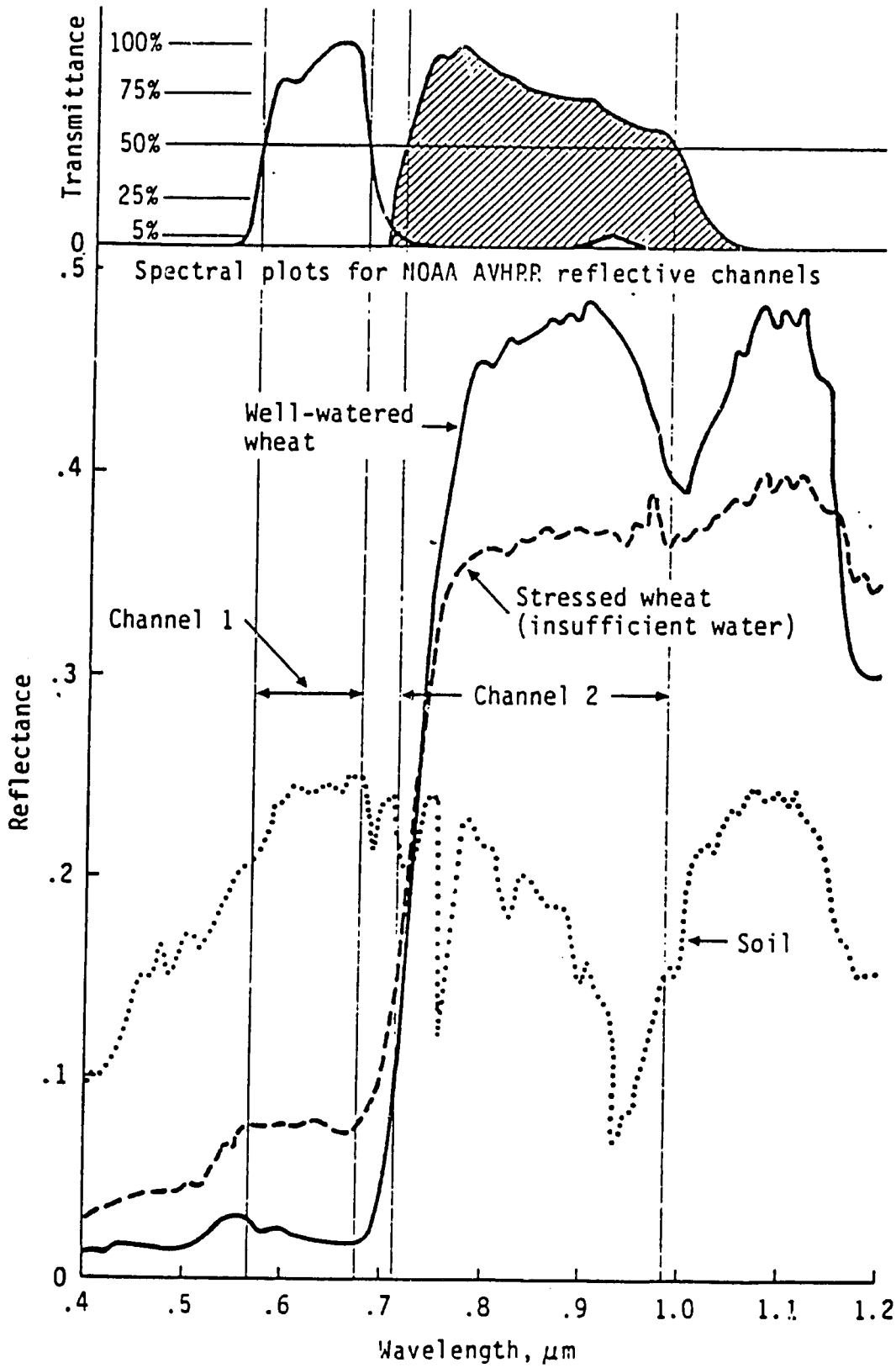
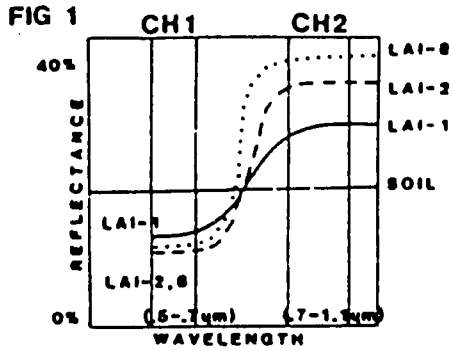
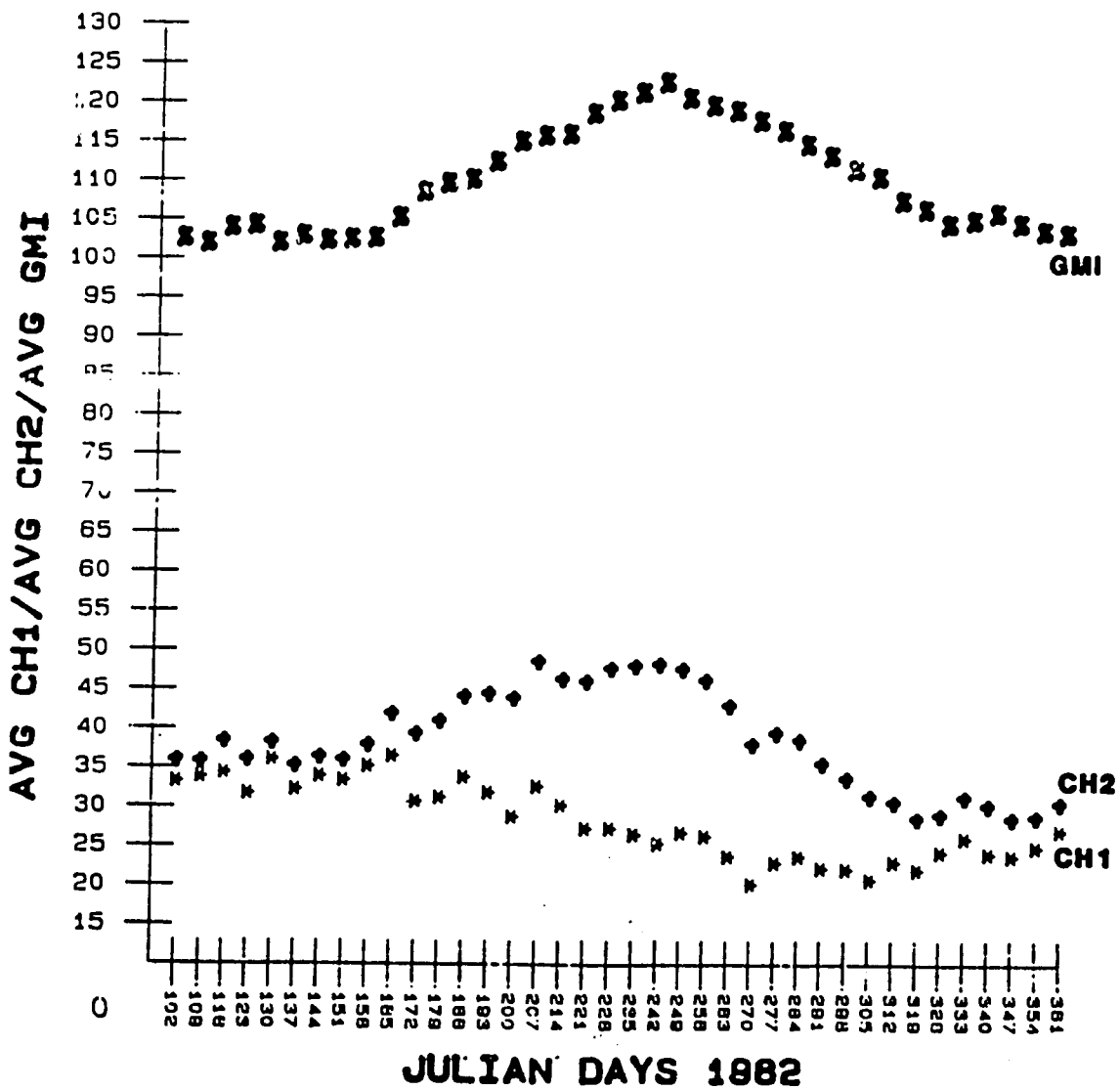


Figure -1.- Response of NOAA AVHRR reflective channels (wheat). [From ref. 4]

FIG 1





Prepared by GRC

COMPARISON OF 3 VEGETATION INDICES

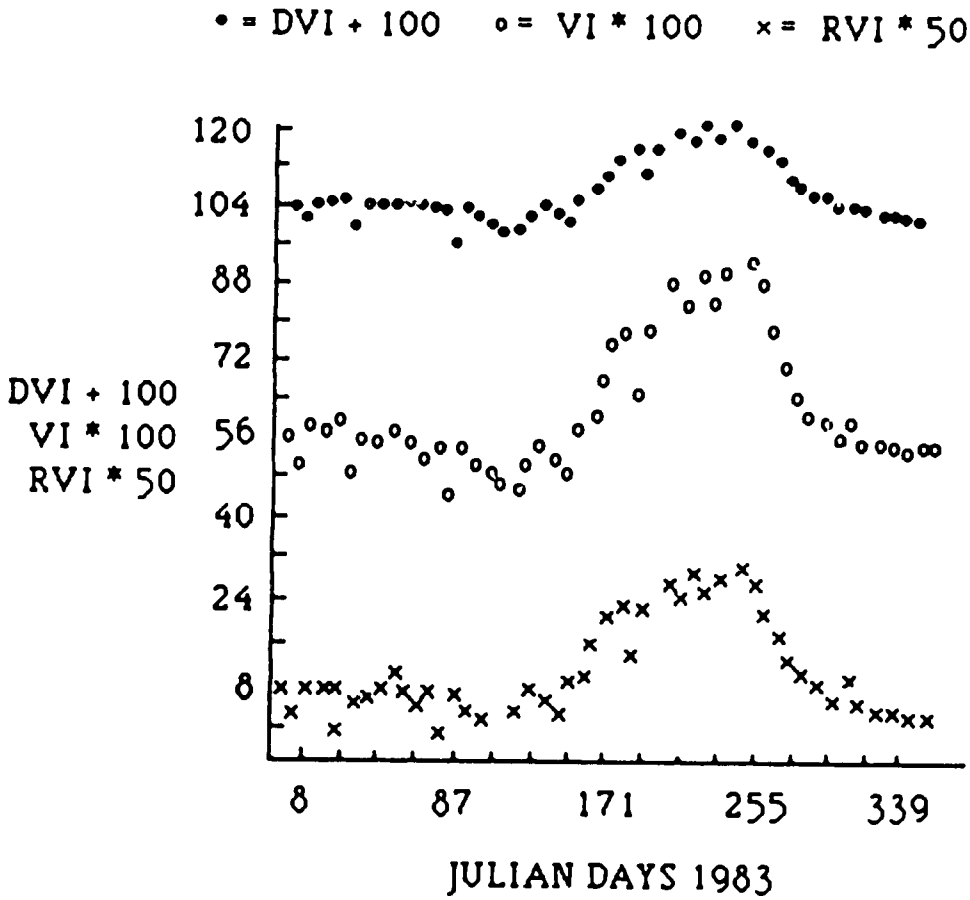


FIGURE 3

PLOT OF STANDARD DVI (SDVI) VS STANDARD VI (SVI)

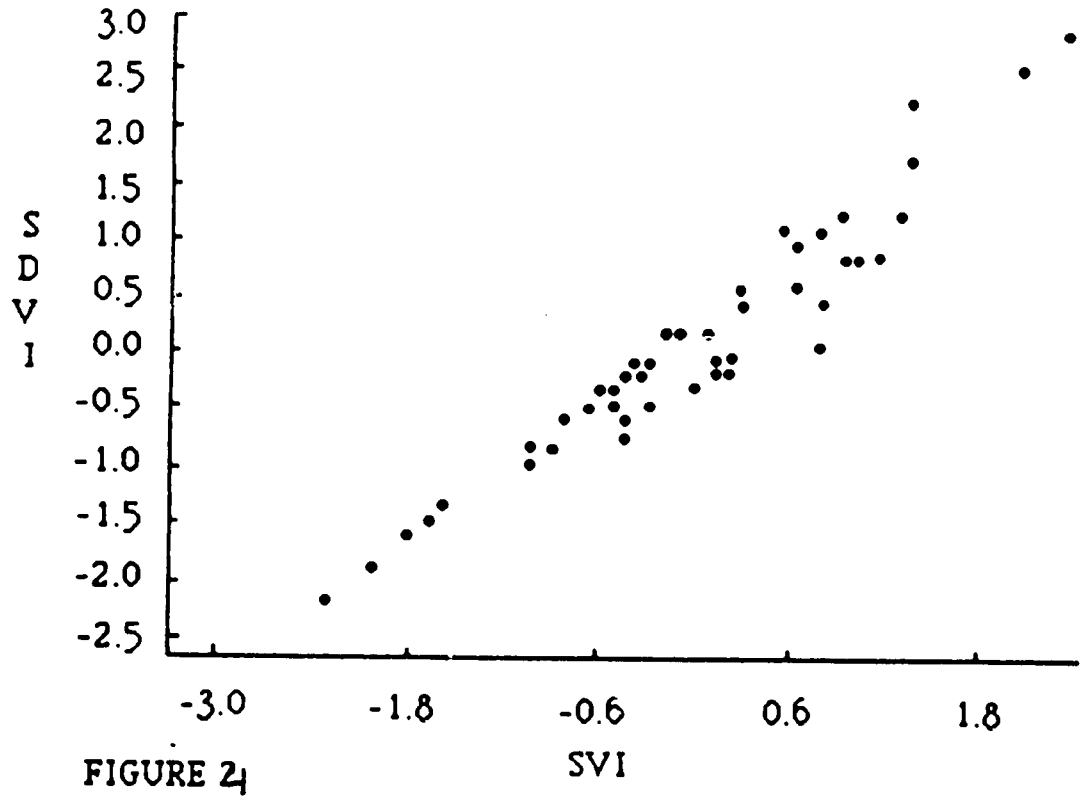


FIGURE 4

PLOT OF STANDARD DVI (SDVI) VS STANDARD VI (SVI)

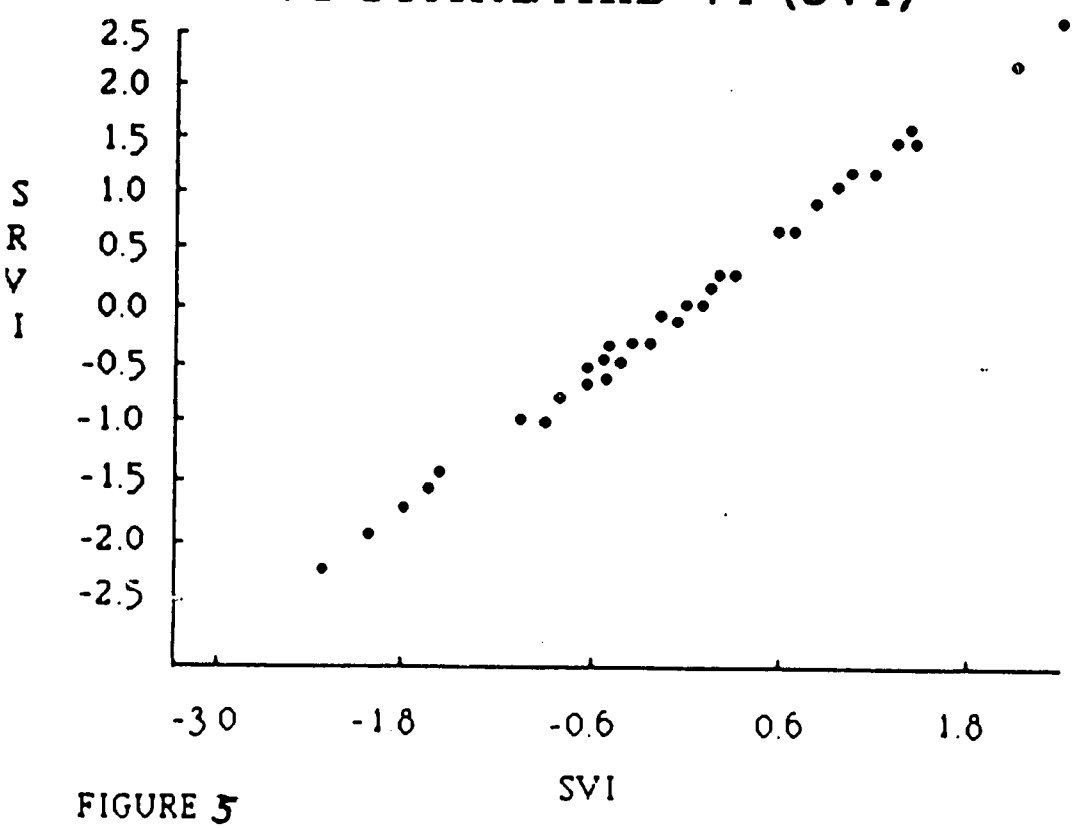
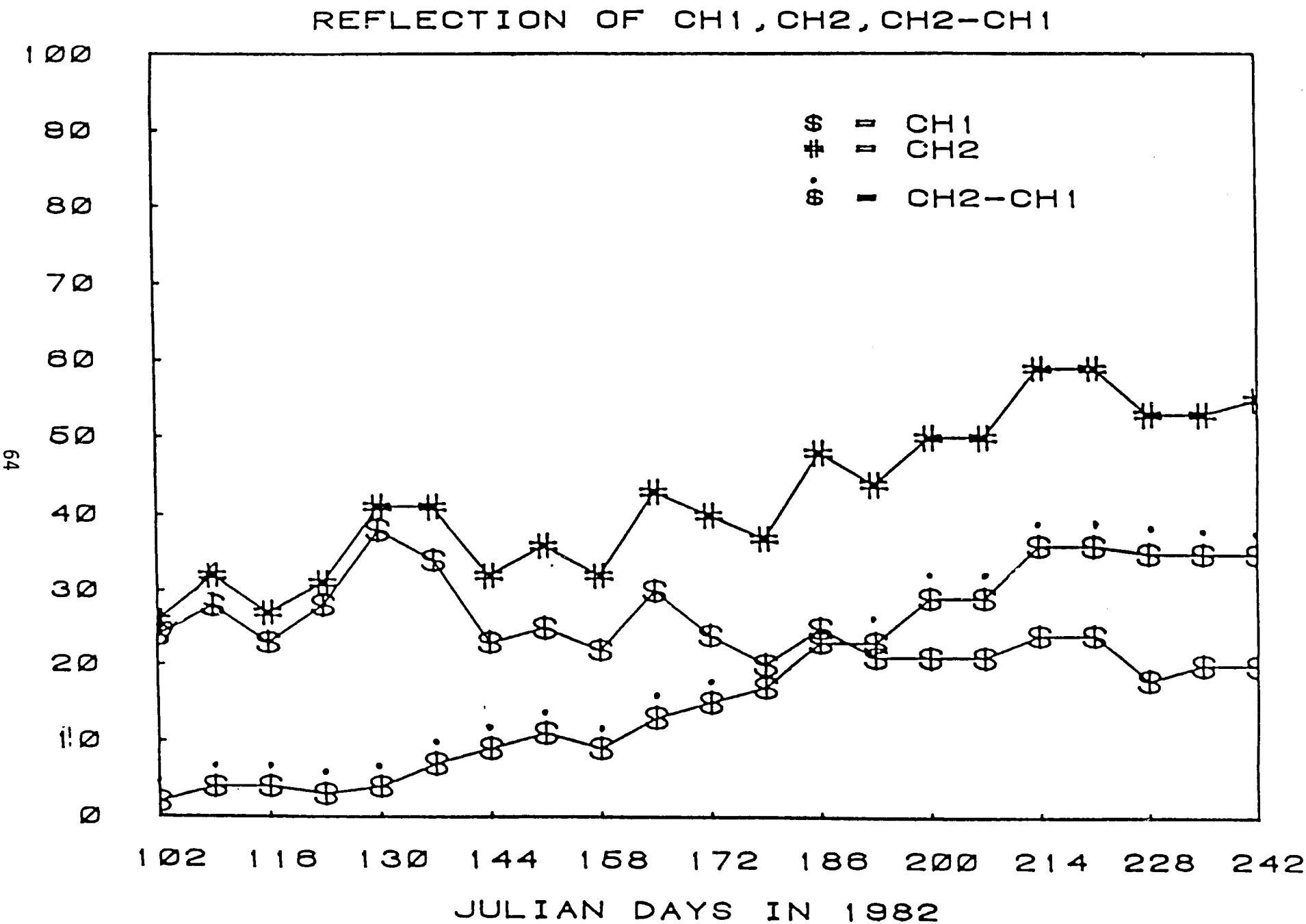
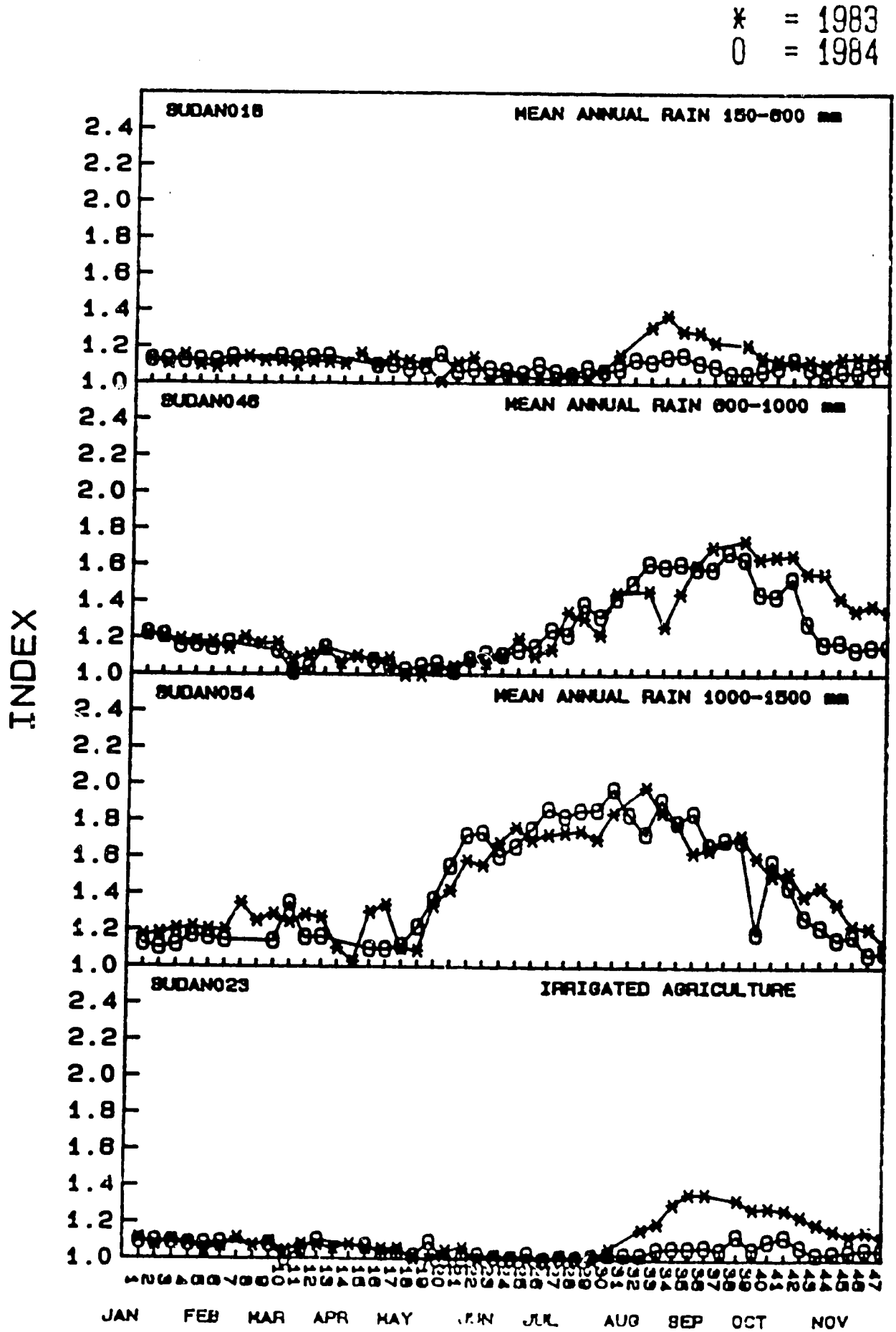


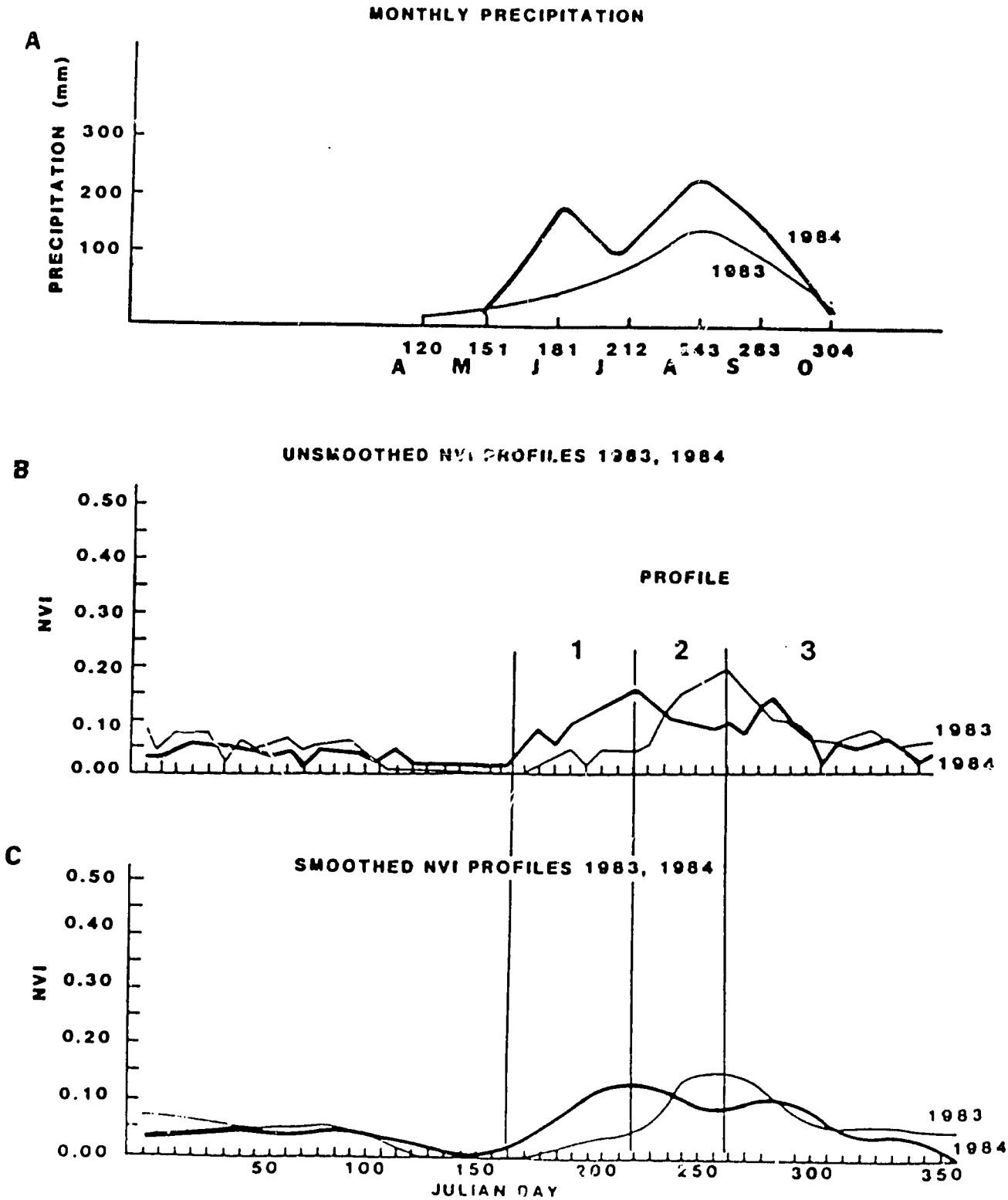
FIGURE 5


REFLECTION OF CH1,CH2,CH2-CH1
$ = CH1
# = CH2
$ = CH2-CH1
100
90
80
70
60
50
40
30
20
10
0
102
116
130
144
158
172
186
200
214
228
242
JULIAN DAYS IN 1982

REGIONAL AVERAGE RATIO CH2/CH1



COMPARISON OF 1983, 1984 PRECIPITATION DATA (A) VS NVI FOR 1983 AND 1984; UNSMOOTHED (B) AND SMOOTHED (C) OF SENEGAL.



SATELLITE OVERVIEW: DEVELOPMENT OF NVI AND CROP YIELD

Albert van Dyk

Friday, March 28 - 8:30 A.M.

Objectives

1. To discuss why satellite data is used for yield estimation.
2. To explain the procedures.

Abstract

Several researchers have devoted their efforts to estimating yield in the U.S. using satellite data. They obtained mixed results. The results of a method developed by CIAM look quite encouraging, mainly because of the simpler agricultural practices in Africa.

I. Introduction

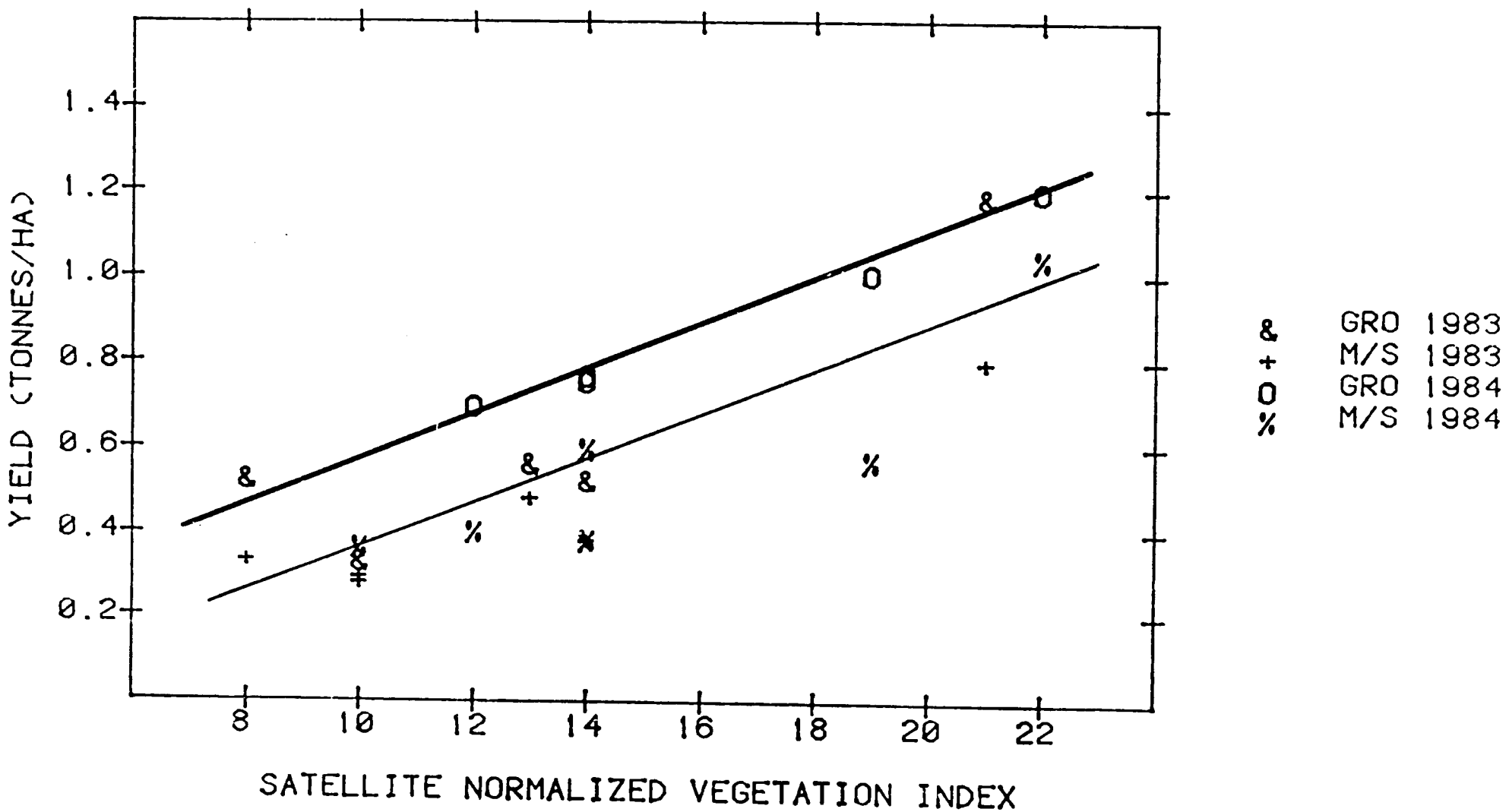
   A. Perspective of the Problem
   B. Objectives of the Presentation

II. Review

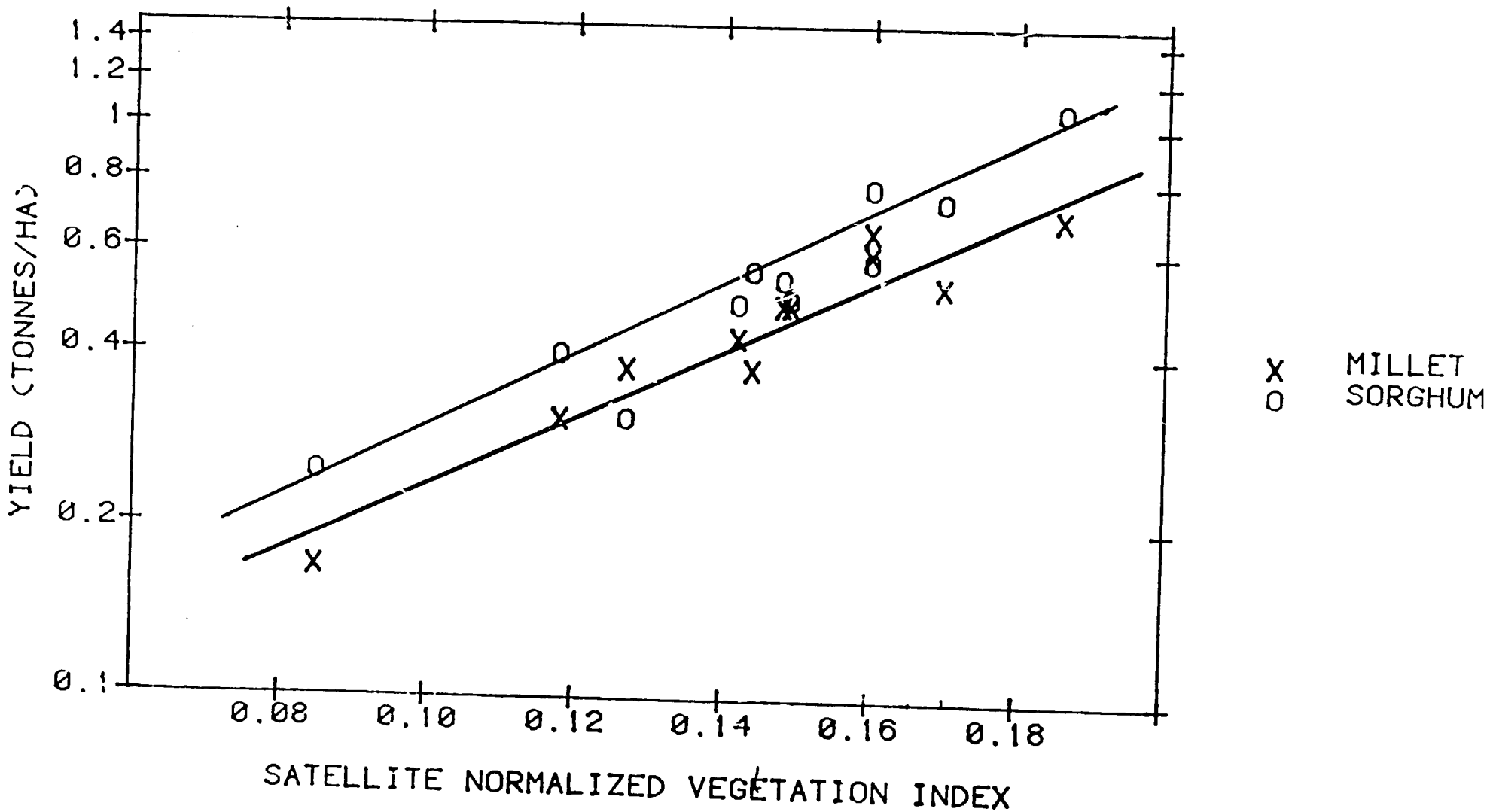
   A. Why use satellite data to estimate yield
   B. Yield estimation based on satellite data
   C. Relationship between Yield and the Environmental Conditions
   D. Relationship between Yield and NVI

III. Yield Estimates in the Sahelian countries of Africa

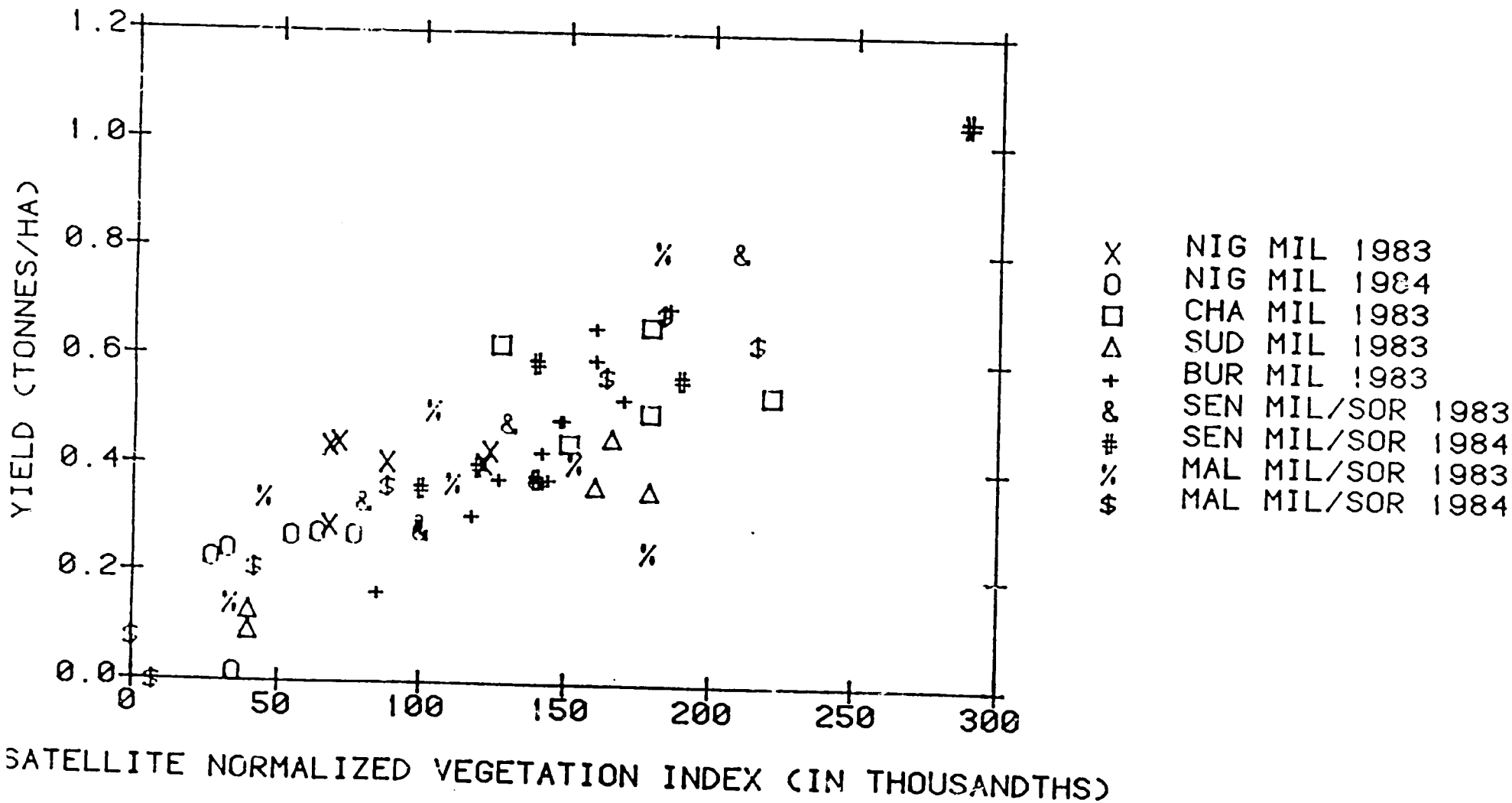
PLOT OF NVI VERSUS YIELD OF
GROUNDNUTS AND MILLET/SORGHUM
SENEGAL, 1983 AND 1984



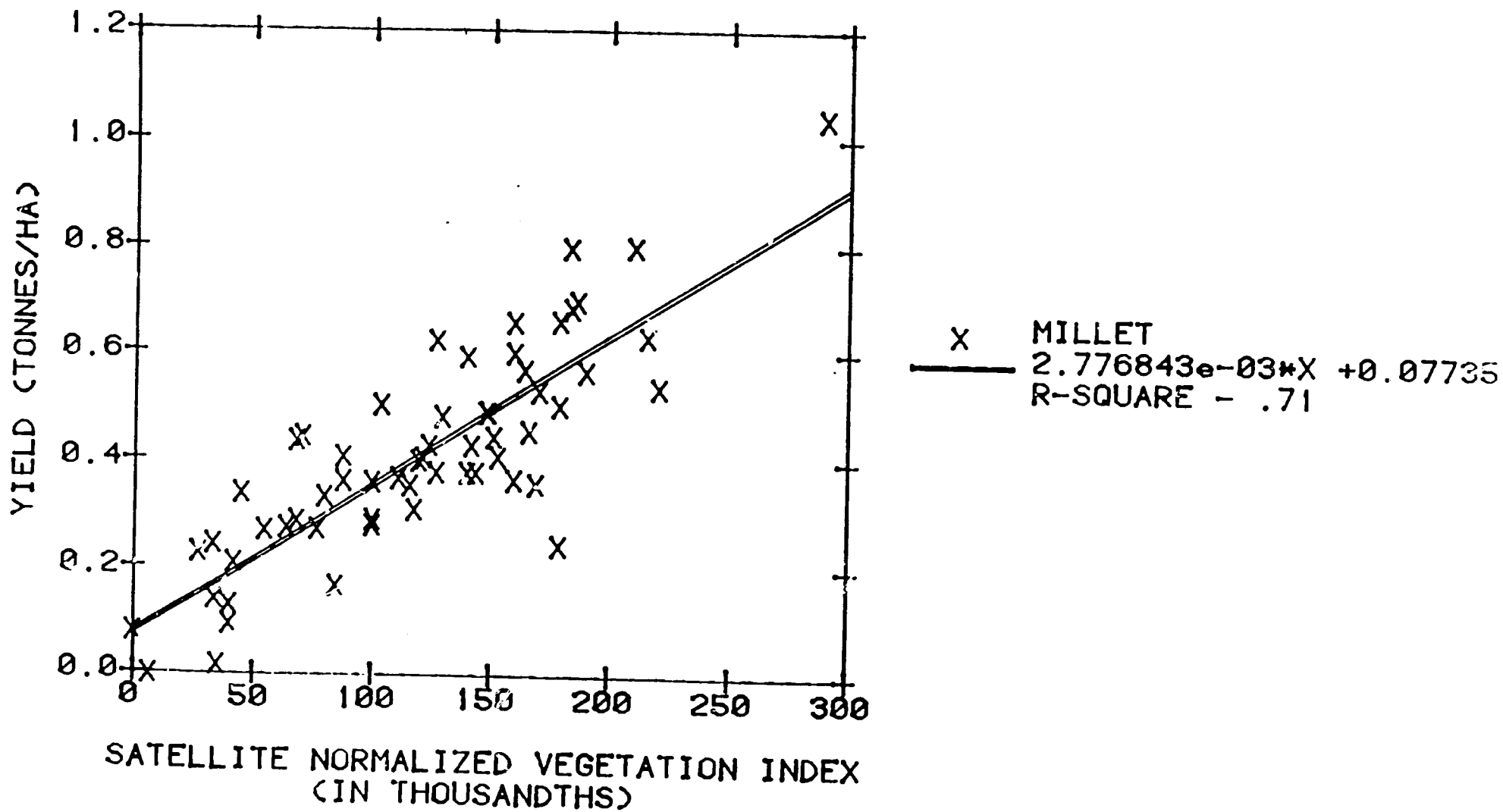
PLOT OF NVI VERSUS YIELD OF
MILLET AND SORGHUM
BURKINA FASO, 1983



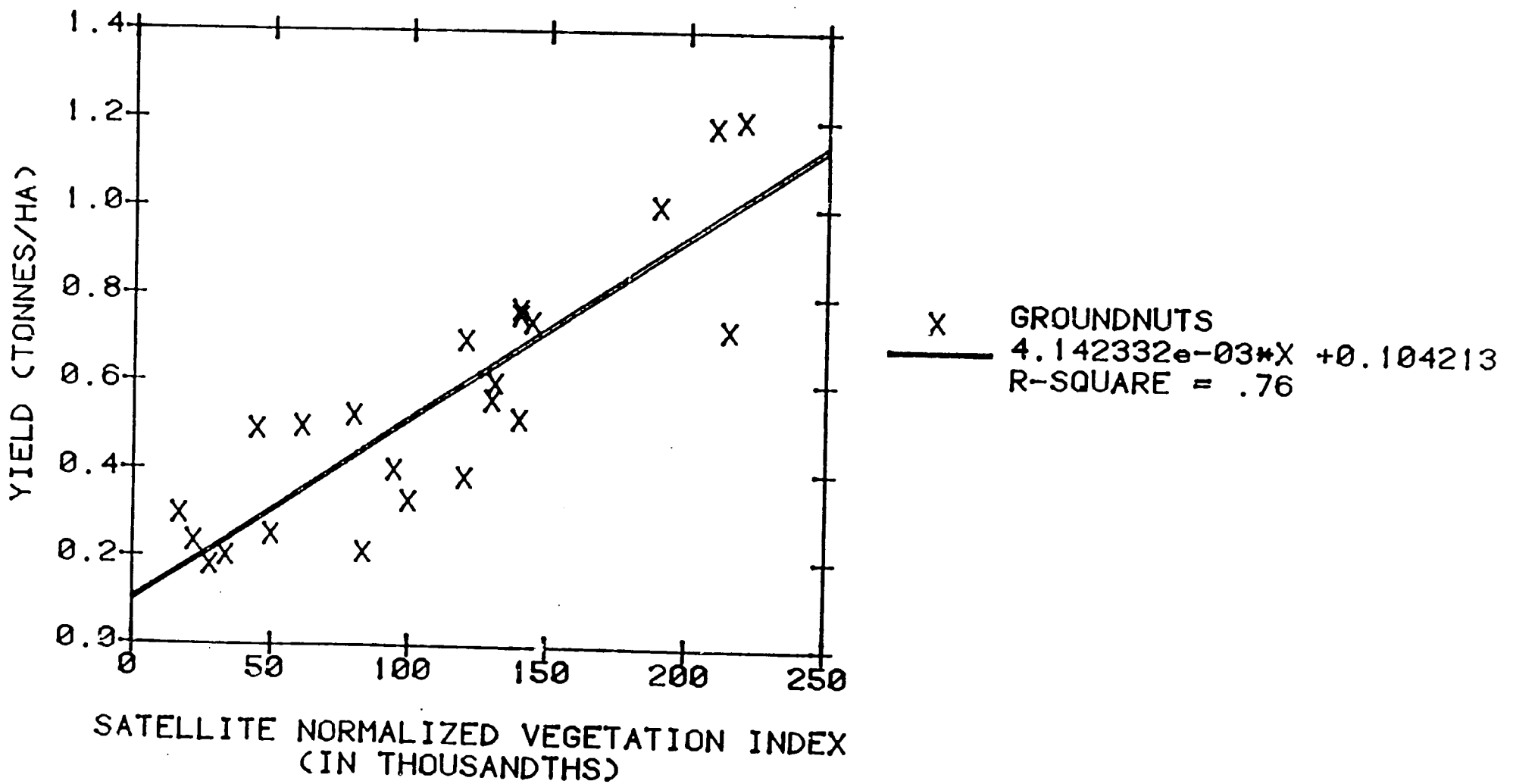
NVI VERSUS YIELD
MILLET AND MILLET/SORGHUM
NIGER, CHAD, SUDAN, BURKINA FASO, SENEGAL AND MALI
1983 AND 1984



REGRESION ANALYSIS OF
YIELD VERSUS VEGETATION INDEX
FOR MILLET IN THE SAHEL, 1983 AND 1984



REGRESSION ANALYSIS OF
YIELD VERSUS VEGETATION INDEX
FOR GROUNDNUTS IN THE SAHEL
1983 AND 1984



SATELLITE OVERVIEW: DEVELOPMENT OF NVI FOR RANGELAND ASSESSMENT

Albert van Dyk

Friday, March 28 - 10:30 A.M.

Objectives

1. To discuss relationship between NVI and Biomass.
2. To relate Biomass to Carrying Capacity.
3. To relate NVI to Carrying Capacity.

Abstract

Investigators have found a significant relationship between reflectance measurements and photosynthetically active phytomass in the form of leaf area index, biomass and straw. Radiometry has advantages over conventional biomass estimates, for example information can be collected nondestructivily over large areas. The NOAA/AVHRR NVI data have been related to a few groundtruth biomass estimates for Senegal and Mali. This relationship can be used for areas for which only the NVI is available.

I. Introduction

   A. Perspective
   B. Objectives of Presentation

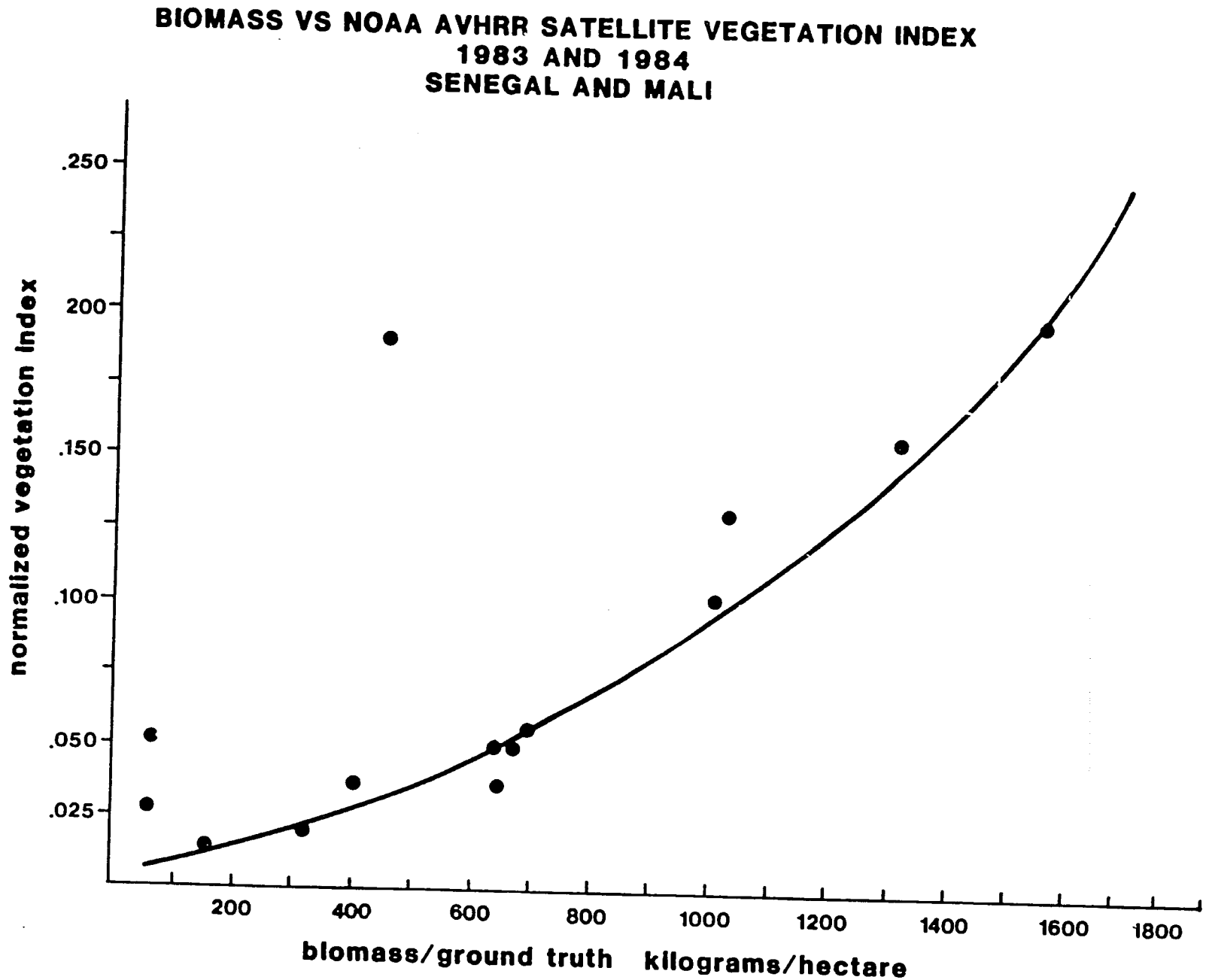
II. Review

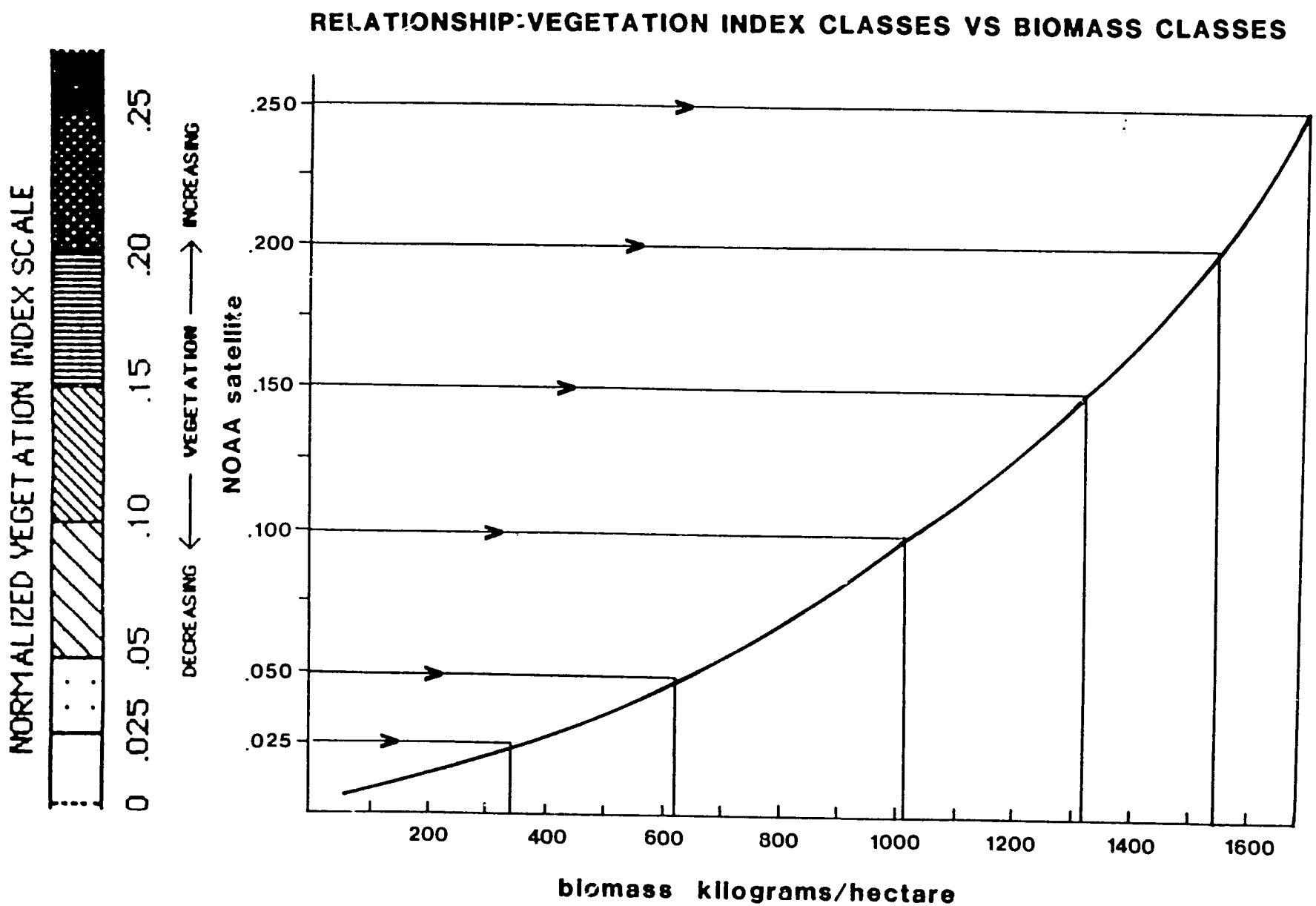
   A. Why use Remote Sensing Data to estimate biomass, LAI.
   B. Principles of Photosynthetic Active Biomass based on Vegetation Index.

III. Relationships

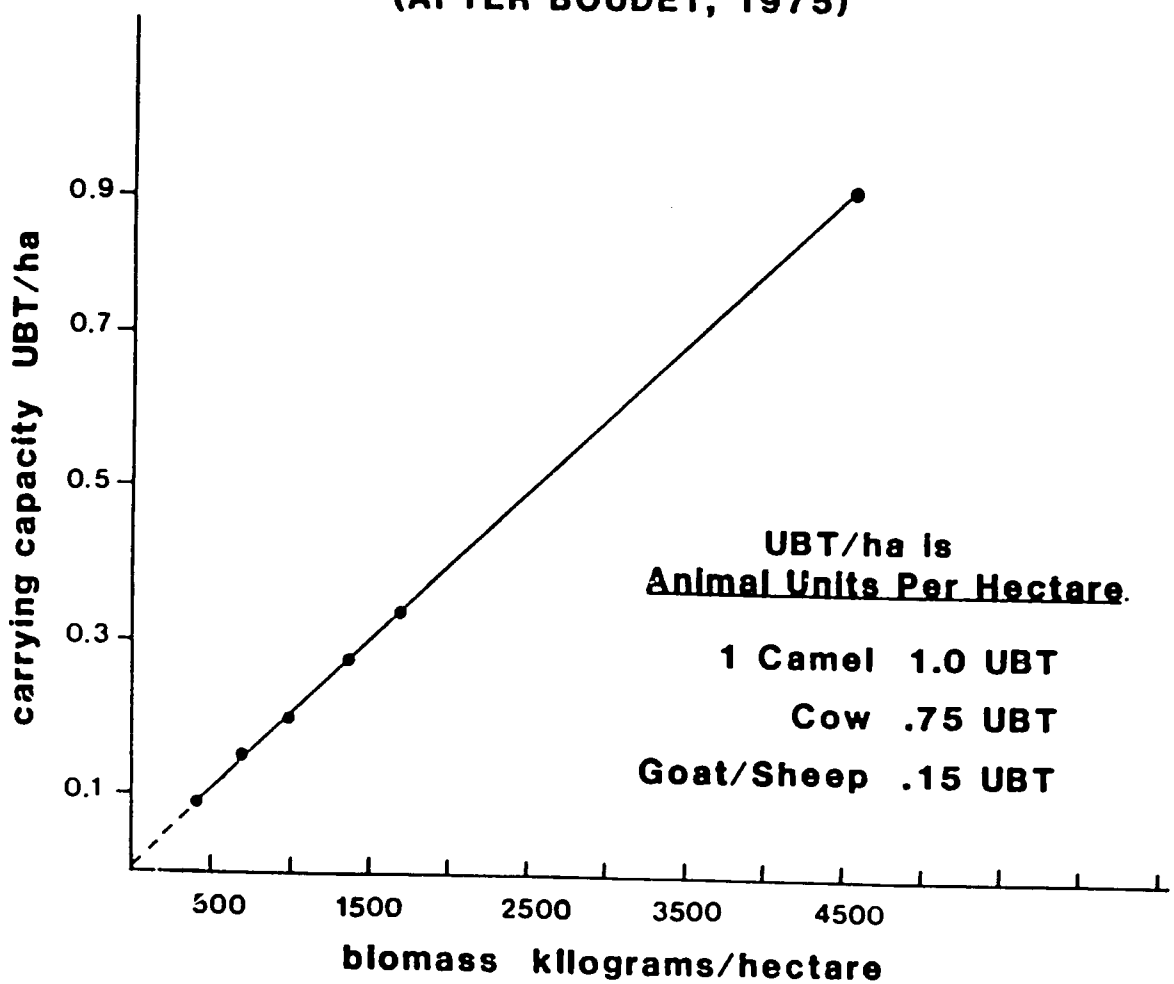
   A. Biomass vs. NVI
   B. Biomass vs. Carrying Capacity
   C. NVI vs. Carrying Capacity

IV. Possible Application

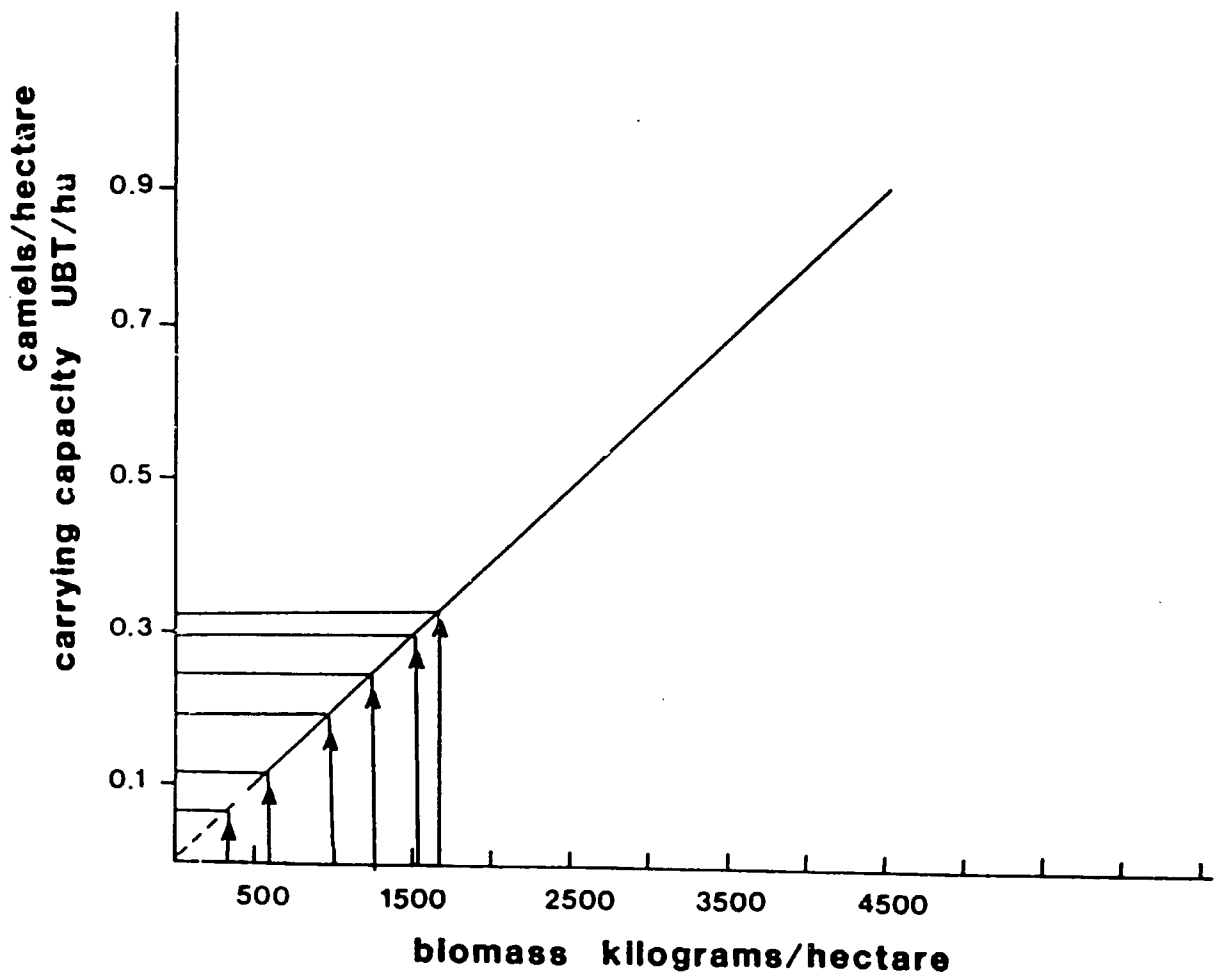

BIOMASS VS NOAA AVHRR SATELLITE VEGETATION INDEX
1983 AND 1984
SENEGAL AND MALI
normalized vegetation index
.250
200
.150
.100
.050
.025
200
400
600
800
1000
1200
1400
1600
1800
biomass/ground truth kilograms/hectare

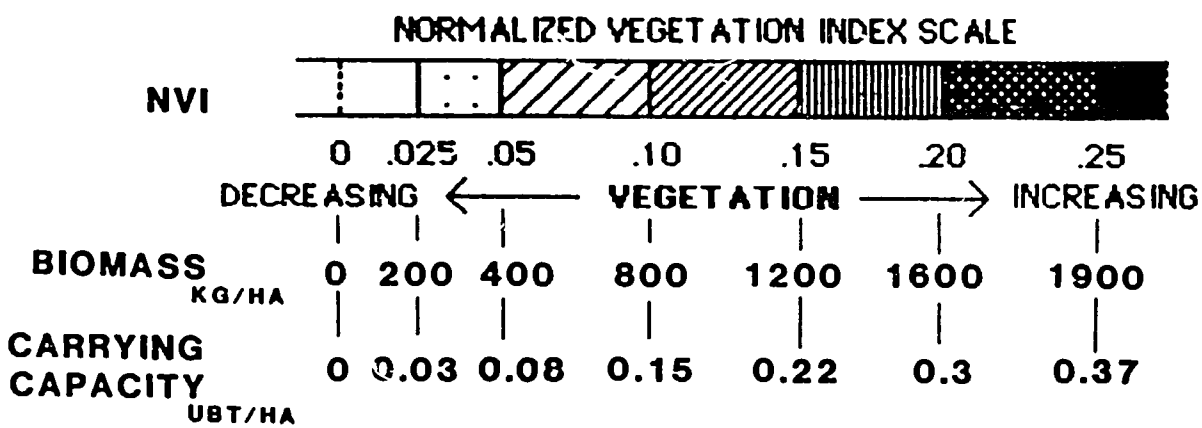

RELATIONSHIP:VEGETATION INDEX CLASSES VS BIOMASS CLASSES
NORMALIZED VEGETATION INDEX SCALE
0
.025
.05
.10
.15
.20
.25
DECREASING ← VEGETATION → INCREASING
NOAA satellite
.250
.200
.150
.100
.050
.025
200
400
600
800
1000
1200
1400
1600
biomass kilograms/hectare

RELATIONSHIP BIOMASS VS CARRYING CAPACITY
(AFTER BOUDET, 1975)



RELATIONSHIP:BIOMASS VS CARRYING CAPACITY

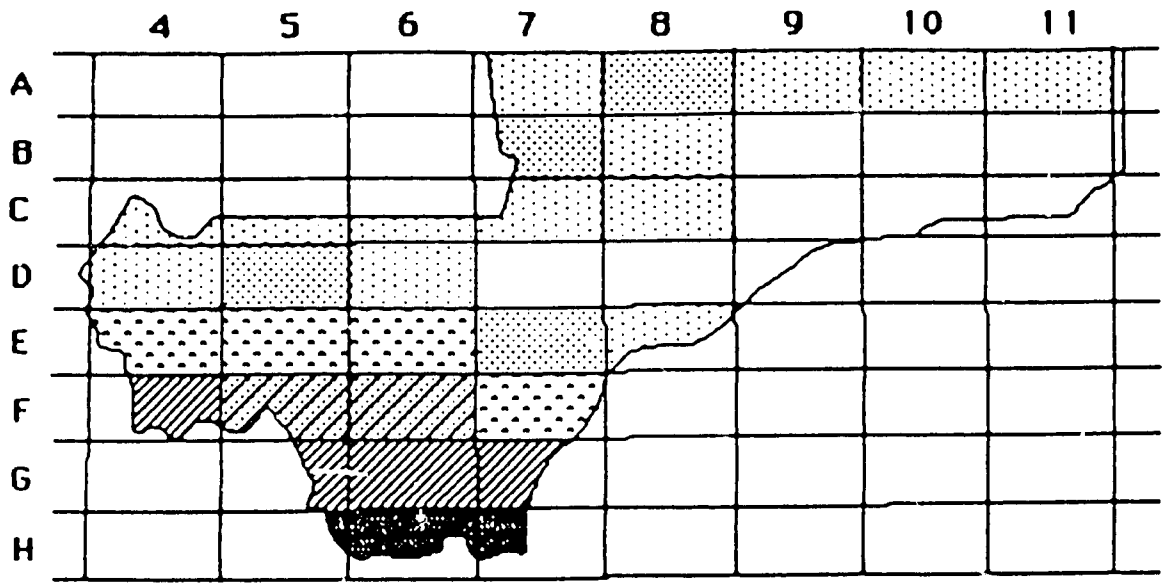


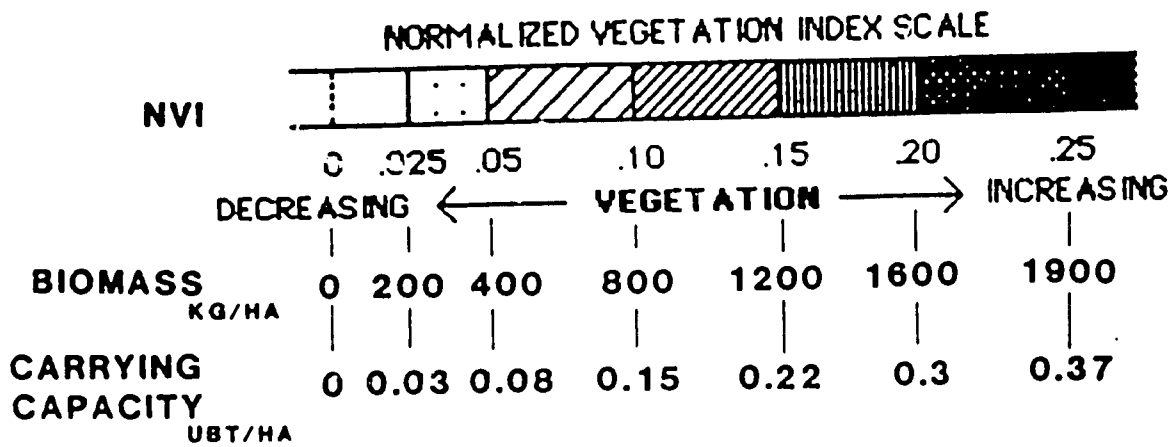

NORMALIZED VEGETATION INDEX SCALE
NVI
0 .025 .05 .10 .15 .20 .25
DECREASING ← VEGETATION → INCREASING
BIOMASS KG/HA
0 200 400 800 1200 1600 1900
CARRYING CAPACITY UBT/HA
0 0.03 0.08 0.15 0.22 0.3 0.37

NORMALIZED VEGETATIVE INDEX

(LAST WEEK OF JUNE)

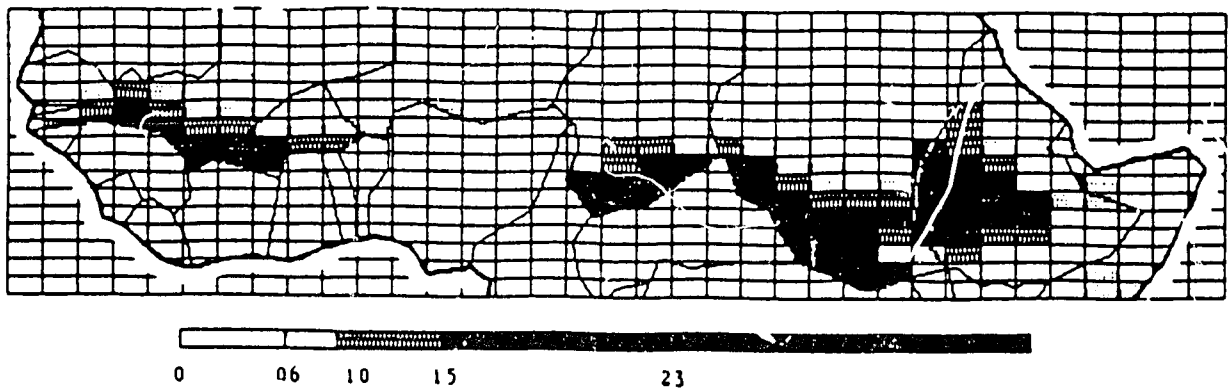
1985



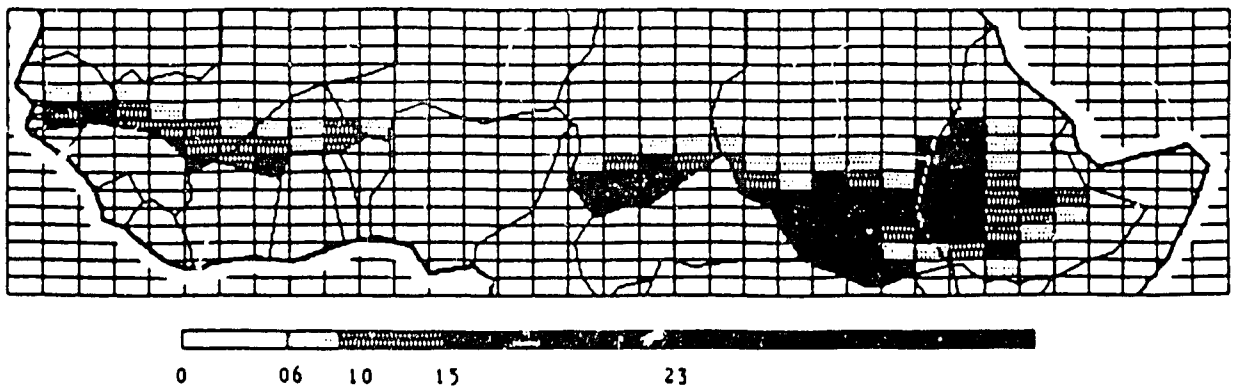


REGIONAL NORMALIZED VEGETATIVE INDEX

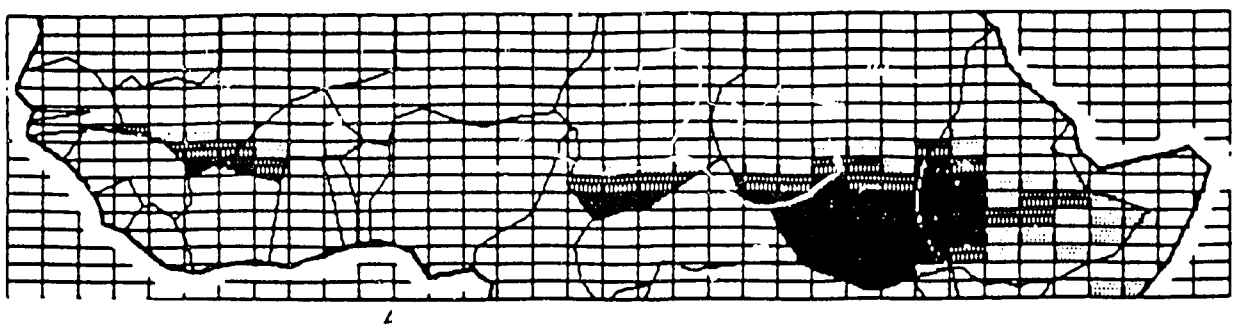
1983

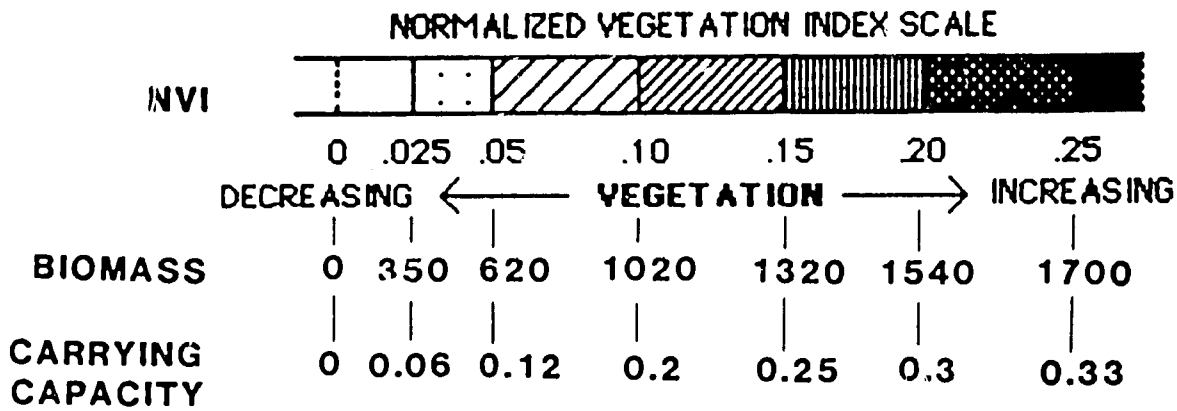


1984



1985





BUILDING A STATISTICAL CROP MODEL

Sharon LeDuc

Monday, March 31 - 8:30 A.M.
Tuesday, April 1 - 8:30 A.M.

Objective

To use multiple linear regression to determine a useful relationship for estimating the impact of weather on crop yield.

Abstract

The general approach is outlined and variations of that approach are indicated. The evaluation of a regression is recommended before actual implementation of model estimates.

I. Visual display of Yield Time-Series for Trend Detection.

II. Correlation triangle to determine best or more highly correlated Predictor Variables.

III. Scatter diagram of Yield (or detrended yield) vs. Predictor Variables.

IV. Dummy Variables

V. Covariance Structure

VI. Regression Evaluation

A. Jackknife Procedure
B. Boot Strap Procedure

V. Comparison of Regression Models

Illustration

Outputs from Benzinger VAX software.

References

Wilson, et al., Evaluation of Crop Yield Models. Payen's yield models (in French).

Exercises

Each country to work with their own data to

- Identify several possible models
- Evaluate and Compare models

Discussion of results.

AGROCLIMATIC CROP CONDITION INDEXES

Rao Achutuni

Wednesday, April 2 - 8:30 A.M.

Objective

To discuss the concept of agroclimatic crop condition indexes in early-warning assessments and present the FAO index.

Abstract

Agroclimatic crop condition indexes are used to operationally assess the impact of weather variability on agricultural crops. They have been shown to provide reliable and timely information on the impact of drought and associated production losses. The objective of this session will be to introduce the student to the concept of crop indexes with special emphasis on the FAO Water Balance Index.

I. What are Agroclimatic Crop Condition Indexes?

II. Why do we use the Indexes?

   A. Successful in real-time assessment of drought.
   B. Reliable qualitative assessments.

III. Identify all the necessary Data and Information Requirements

   A. Availability of data
   B. Index should be able to run on hand calculator or a micro-computer.

IV. The FAO Water Balance Index

   A. Output from Index should be easily understood and used with other information

Reference

"User's Guide: Development of Agroclimatic/Crop Condition Index Assessment Models" by C. M. Sakamoto, R. Achutuni and L. Steyaert. NOAA/NESDIS/AISC, 1984.

TABLE 1978 CUMULATIVE WATER BALANCE FOR DORI, BURKINA FASO (MODIFIED AFTER FRERE AND POPOV, 1979)

	MAY			JUN			JUL			AUG			SEP			OCT		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
P_N	7	9	10	14	20	25	49	50	52	63	65	61	40	32	24	10	4	1
P_A	4	11	14	23	18	58	51	48	134	9	29	28	15	32	6	0	3	
PET	75	78	80	68	63	59	59	57	59	48	47	50	47	50	52	55	59	59
KC						0.3	0.4	0.5	0.8	1.0	1.0	1.0	0.6	0.5				
WR						18	24	29	47	48	47	50	28	25		ΣWR = 318		
P_A-WR						40	27	19	87	-39	-18	-22	-13	7				
R_S						40	60	60	60	21	3	0	0	7				
S/D						0	7	19	87	0	0	-19	-13	0				
I						100	100	100	100	100	100	94	90	90				

P_N = NORMAL RAINFALL (MM)

P_A = ACTUAL RAINFALL (MM)

PET = NORMAL POTENTIAL EVAPOTRANSPIRATION (MM)

KC = CROP COEFFICIENT

WR = PET X KC = WATER REQUIREMENT (MM)

P_A - WR = DIFFERENCE BETWEEN RAINFALL AND WATER REQUIREMENTS

R_S = SOIL WATER RESERVE

S/D = SURPLUS/DEFICIT

I = WATER BALANCE INDEX

SENSE AND NONSENSE IN CROP MODELING

Clarence M. Sakamoto

Wednesday, April 2 - 10:30 A.M.

Objective

To emphasize the limits and uses of crop/weather models in a biological system.

Abstract

Crop growth and yield models attempt to quantify a biological system. When a biological system cannot be precisely described we need to recognize the size of possible errors and data limits in terms of what is achievable and reasonable. Concepts of meaningful variables, coefficients of determination, the dependent variables, trends and spatial scales are illustrated.

I. Introduction

A. Goals of Crop/Weather Modeling
B. Objective of Presentation

II. Sense and Nonsense

A. Meaningful Variables

1. Importance of appropriate structure
2. Use of quadratic terms
3. Use of highly correlated variables

B. Coefficient of Determination (R^2)

1. High R^2, but unreliable model
2. When a model with a lower R^2 can be more precise

C. The Dependent Variable

Crop statistics are estimates; the true value may never be known.

D. Trends

Technological trends and climate trends should be carefully analyzed; otherwise model mis-specification can result.

E. Spatial Scales

1. Plot model vs. large area model
2. Aggregation of data must be analyzed with respect to:

   a. type of models used
   b. climatic regime
   c. meteorological variable

Illustrations (see attached)

References (see attached article)

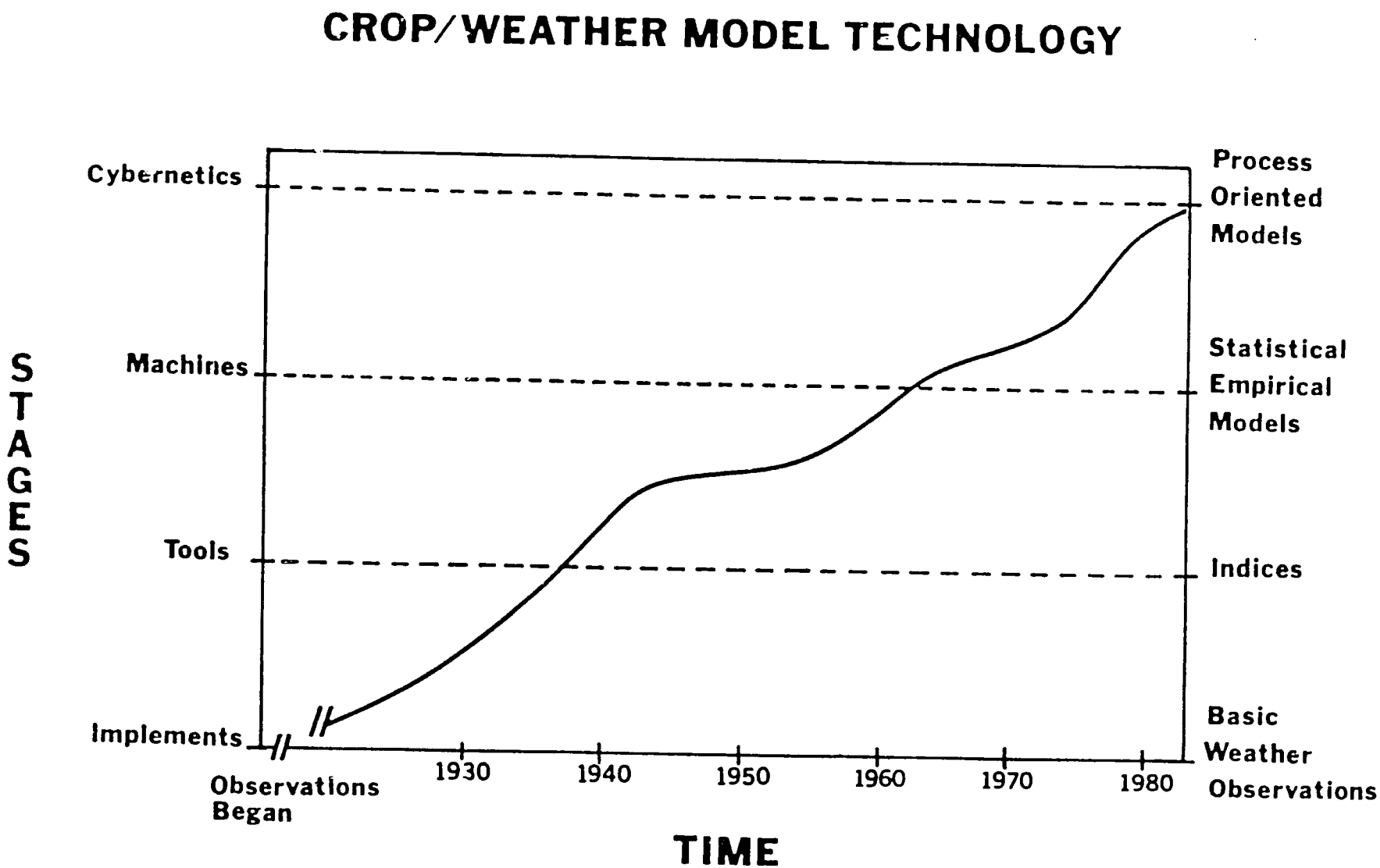


Figure 1. Evolution of crop-weather models relative to agricultural technology.

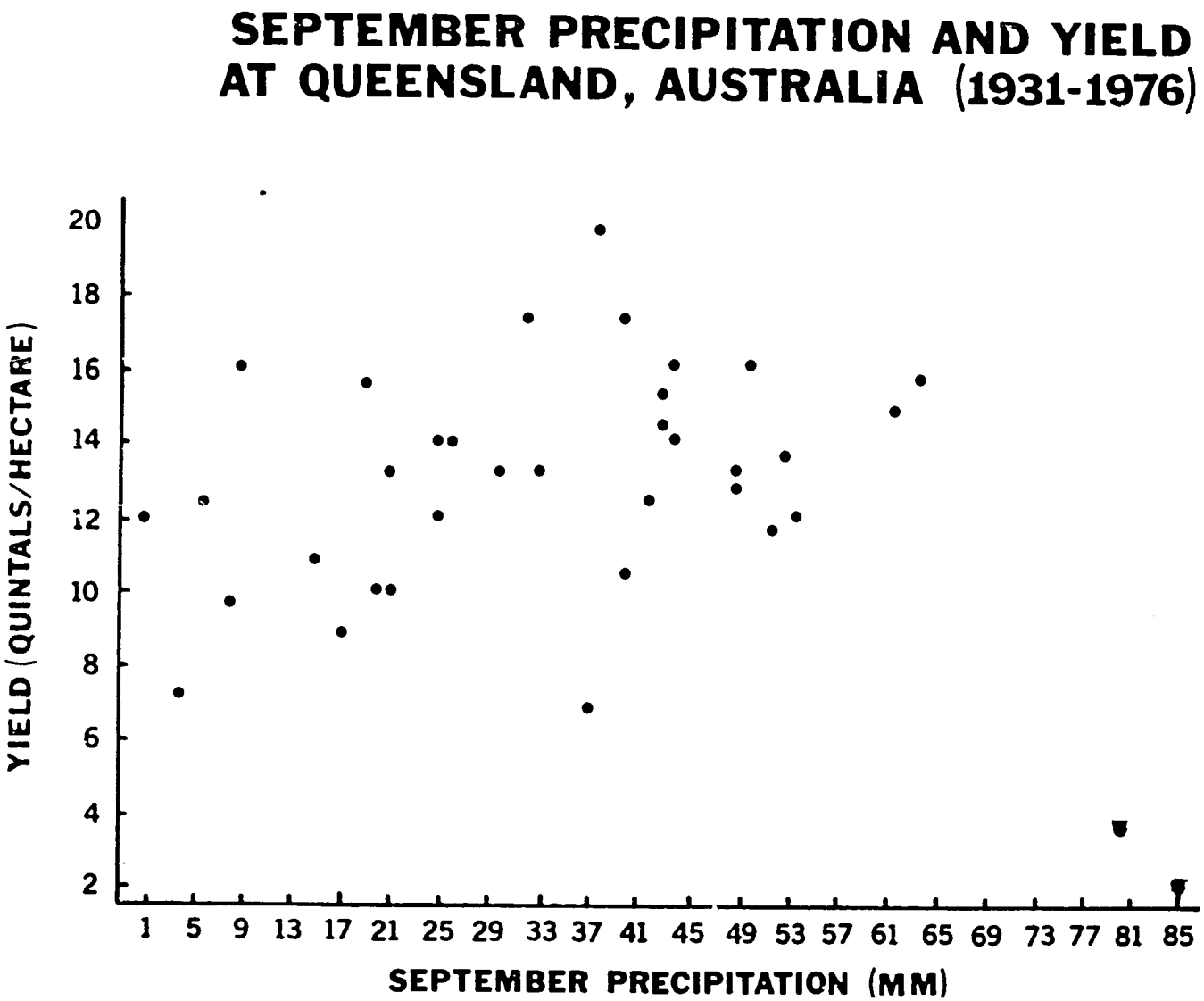
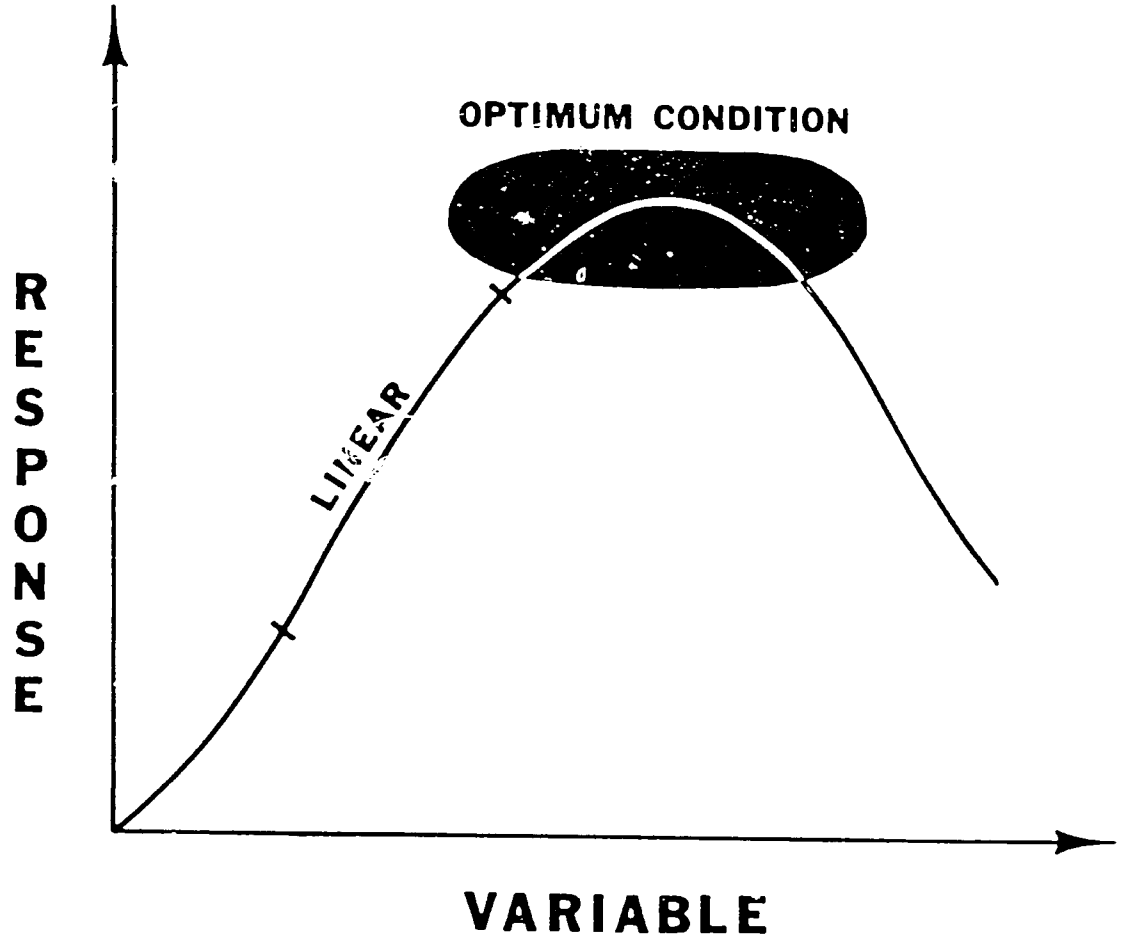

SEPTEMBER PRECIPITATION AND YIELD
AT QUEENSLAND, AUSTRALIA (1931-1976)
YIELD (QUINTALS/HECTARE)
20
18
16
14
12
10
8
6
4
2
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77 81 85
SEPTEMBER PRECIPITATION (MM)

Figure 2.



'igure 3. Hypothetical response to a variable showing a positive linear and quadratic relationship.

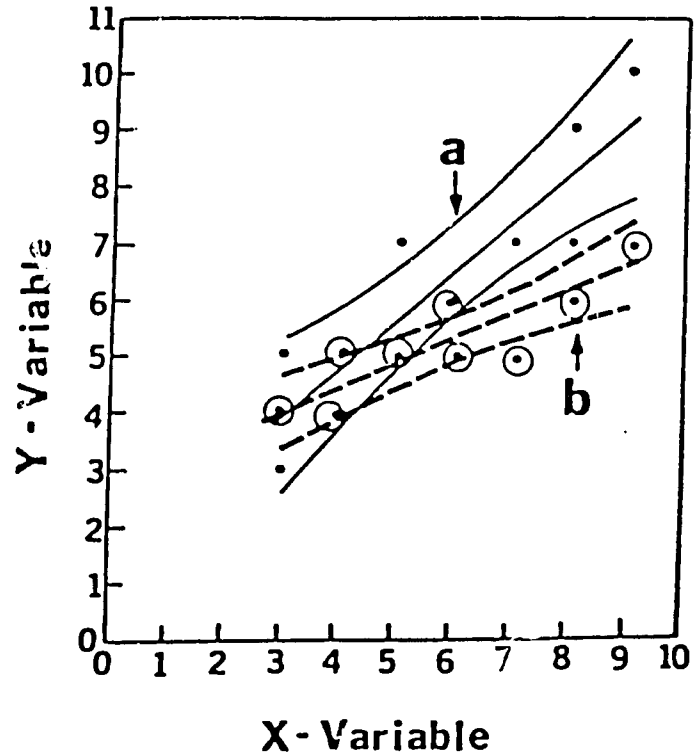


Figure 4. Two simple regression analyses with ninety-five percent confidence band.

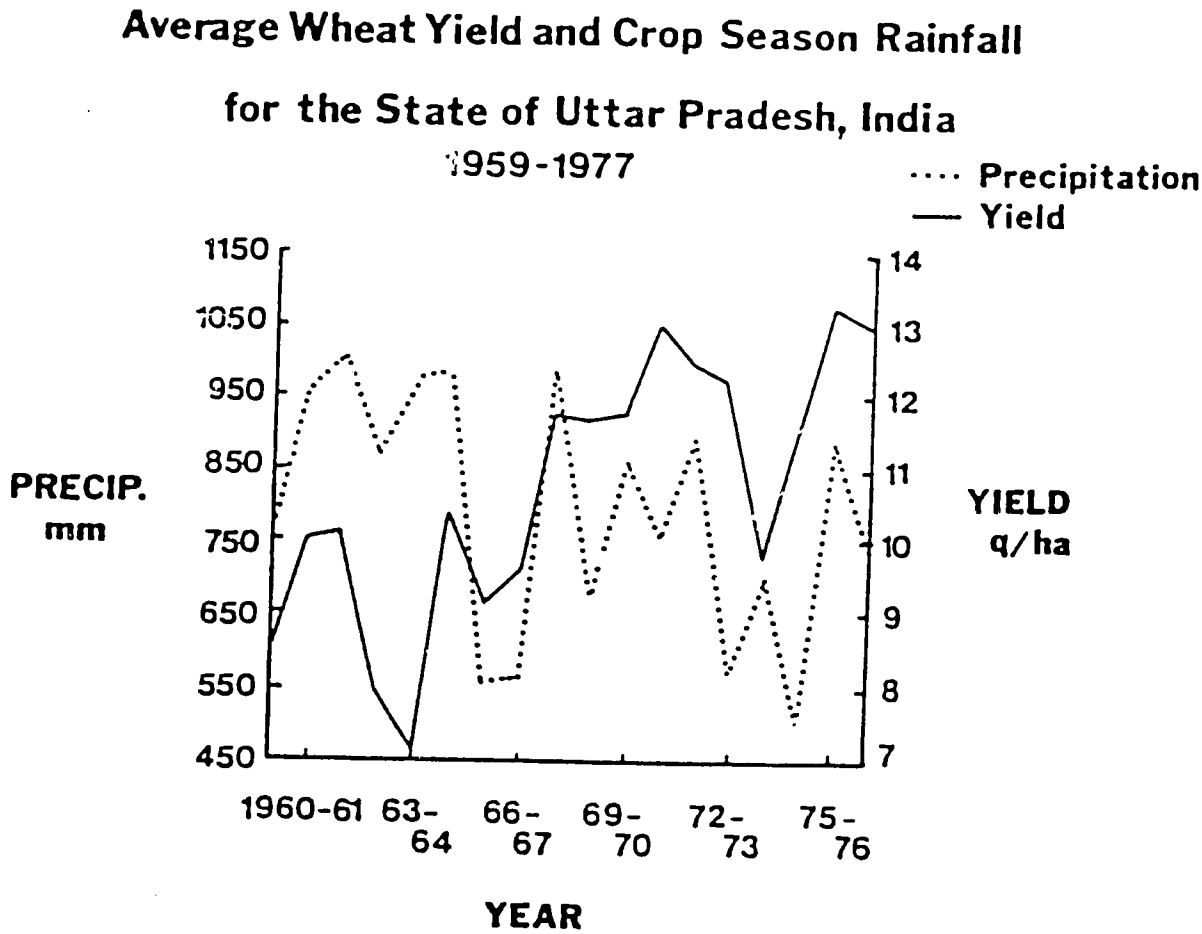

Average Wheat Yield and Crop Season Rainfall
for the State of Uttar Pradesh, India
1959-1977
Precipitation
Yield
PRECIP.
mm
1150
1050
950
850
750
650
550
450
14
13
12
11
10
9
8
7
YIELD
q/ha
1960-61
63-64
66-67
69-70
72-73
75-76
YEAR

Figure 5.

Table 1.

DIFFERENCE (DAYS) BETWEEN CROP CALENDAR MODEL ESTIMATE AND FIELD OBSERVATION SPRING WHEAT		
TEST SITE LOCATION	GROWTH STAGE	
	JOINTING	HEADING
Hand, SD	-10	-2
Hill, MT	10	6
Toole, MT	2	-1
Ft. Sask, ALTA	-1	-7
Lethbridge, ALTA	12	10
Swift Current, SASK	9	-4
Stony Mt., MAN	6	1
Altona, MAN	3	-8

Table 2.

COEFFICIENT OF DETEMINATION AS A FUNCTION OF SLOPE ANGLE (after Barrett, 1974)	
Slope Angle (degrees)	R^2
0	.00
23	.76
30	.85
45	.94
60	.98

INTEGRATING DATA AND INFORMATION FOR ASSESSMENT: GEOGRAPHIC INFORMATION SYSTEM

Lou Steyaert

Thursday, April 3 - 8:30 A.M.

Objectives

1. To outline basic concepts for a Geographic Information System (GIS).
2. To describe how NOAA/NESDIS uses GIS concepts for preparation of Special Climatic Impact Assessment Reports.
3. To illustrate the technique with a practical example.

Abstract

The NOAA/NESDIS "light-table" GIS techniques used in preparing Special Climatic Impact Assessments for Sub-Saharan Africa are described. Basic concepts are outlined for using GIS as an effective tool for spatial analysis including map overlay techniques to integrate various satellite and environmental data inputs. Inputs include AVHRR satellite images, derived rainfall estimates based on analysis of rain gauge data and satellite images, spatial and temporal display of satellite derived vegetation/biomass indexes, ten day and monthly rainfall data, various agroclimatic index models and ancillary information. Procedures for making the rainfall analysis, crop condition assessment, and satellite rangeland/biomass analysis are described. The process for integrating these analyses and preparing a special assessment are illustrated.

I. Introduction

   A. Perspective of the Problem
   B. Objectives of the Presentation

II. Basic GIS Concepts

   A. Why use GIS
   B. GIS Inputs (Fig. 1)
   C. GIS Analysis (Fig. 2, 3)
   D. GIS Outputs (Fig. 4, 5)

III. Special Climatic Impact Assessments (The Final Output)

   A. Purpose of Assessments
   B. Contents of Assessments (Fig. 6)

IV. Assessment Inputs

A. Discussion of Inputs (Fig. 7)
B. Development of Inputs (Fig. 8)

V. GIS Analysis of Inputs

A. Satellite Images (35 mm slides and hard copies)
B. Rainfall Estimates from Images (Fig. 9)
C. Vegetation/Biomass Indexes

1. Spatial (Fig. 10, 11)
2. Temporal (Fig. 12)

D. Rain Gauge Data (Fig. 13)

1. Ten day totals
2. Monthly totals

E. Agroclimatic/Crop Condition Indexes

1. FAO Index (Fig. 14)
2. Seasonal Rainfall Index (Fig. 15)

F. Resource Maps

VI. Illustrated Example - Niger 1985

A. Rainfall Analysis
B. Crop Condition Assessment
C. Rangeland/Biomass Analysis
D. Overview Statement

Illustrations

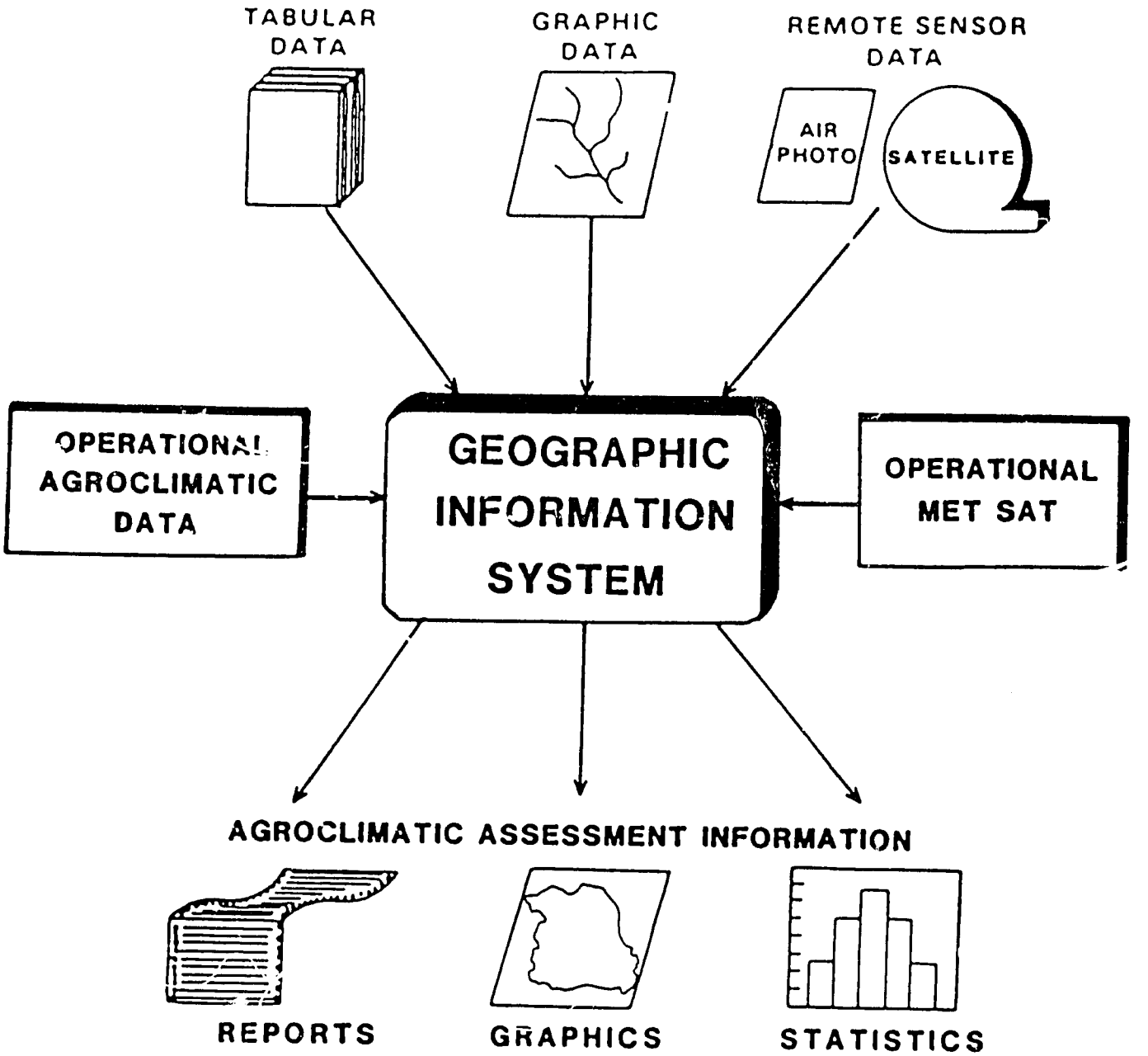
French 35 mm slides used for AID briefings and October 1985 technical assistance visits.

References:

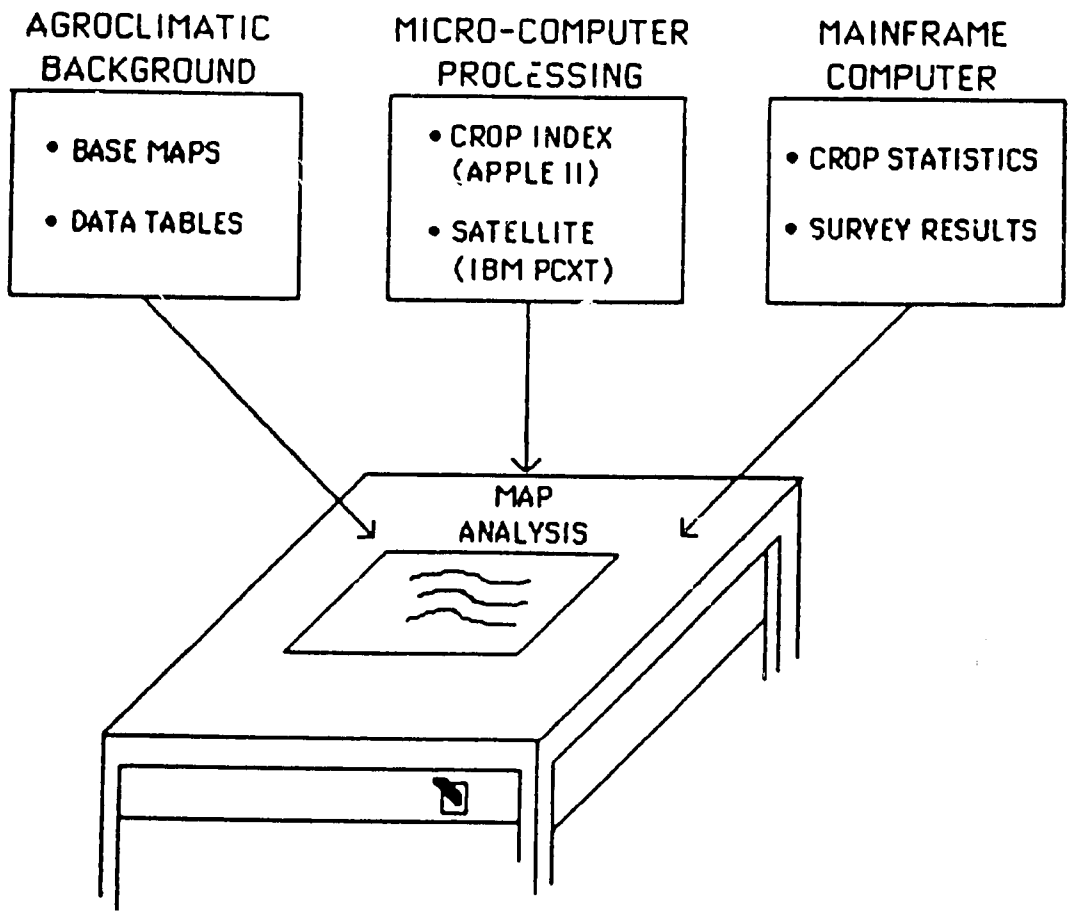
NOAA/NESDIS Special Climatic Impact Assessment Reports, July-October, 1985.

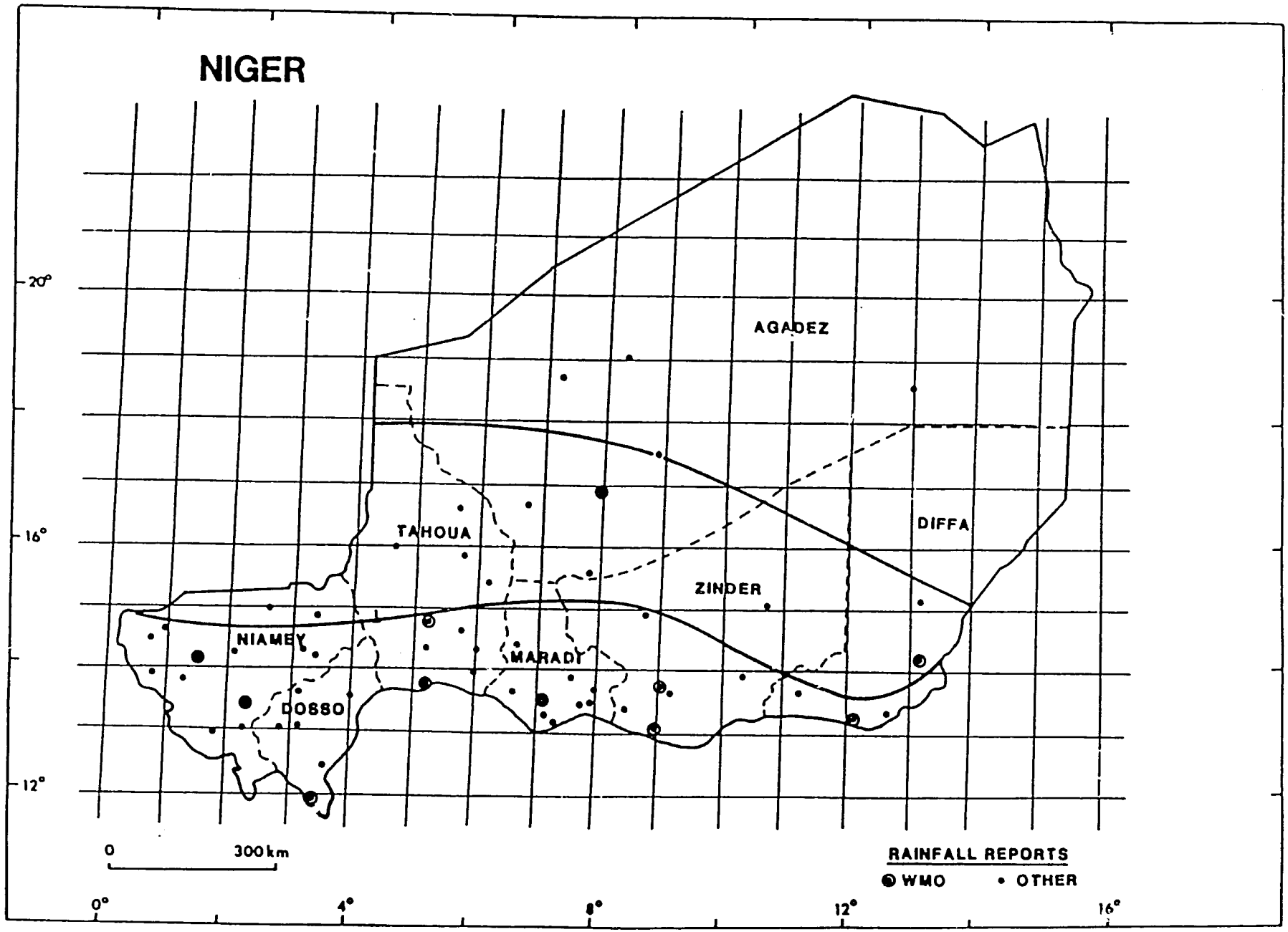
Sahel Resource Manuals.

L. Steyaert, "A Geographic Information System Analysis for Quantitative Crop Forecasting in Semi-Arid Regions of Africa: Technical Planning Document, NOAA/NESDIS AISC, Columbia, Missouri, May 15, 1985.

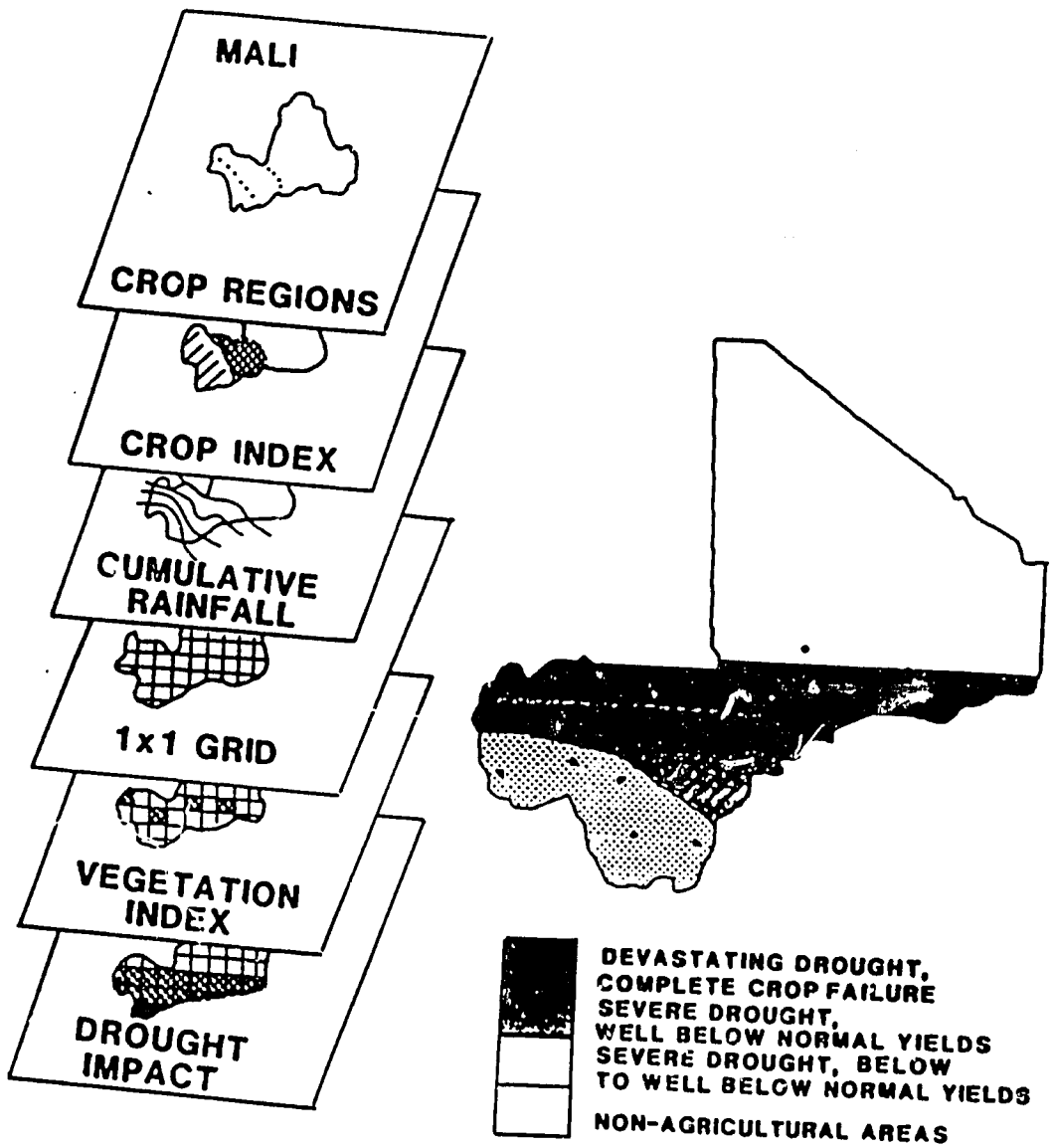

TABULAR DATA
GRAPHIC DATA
REMOTE SENSOR DATA
AIR PHOTO
SATELLITE
OPERATIONAL AGROCLIMATIC DATA
GEOGRAPHIC INFORMATION SYSTEM
OPERATIONAL MET SAT
AGROCLIMATIC ASSESSMENT INFORMATION
REPORTS
GRAPHICS
STATISTICS

GETTING STARTED WITH GIS: AVAILABLE RESOURCES/ AISC APPROACH

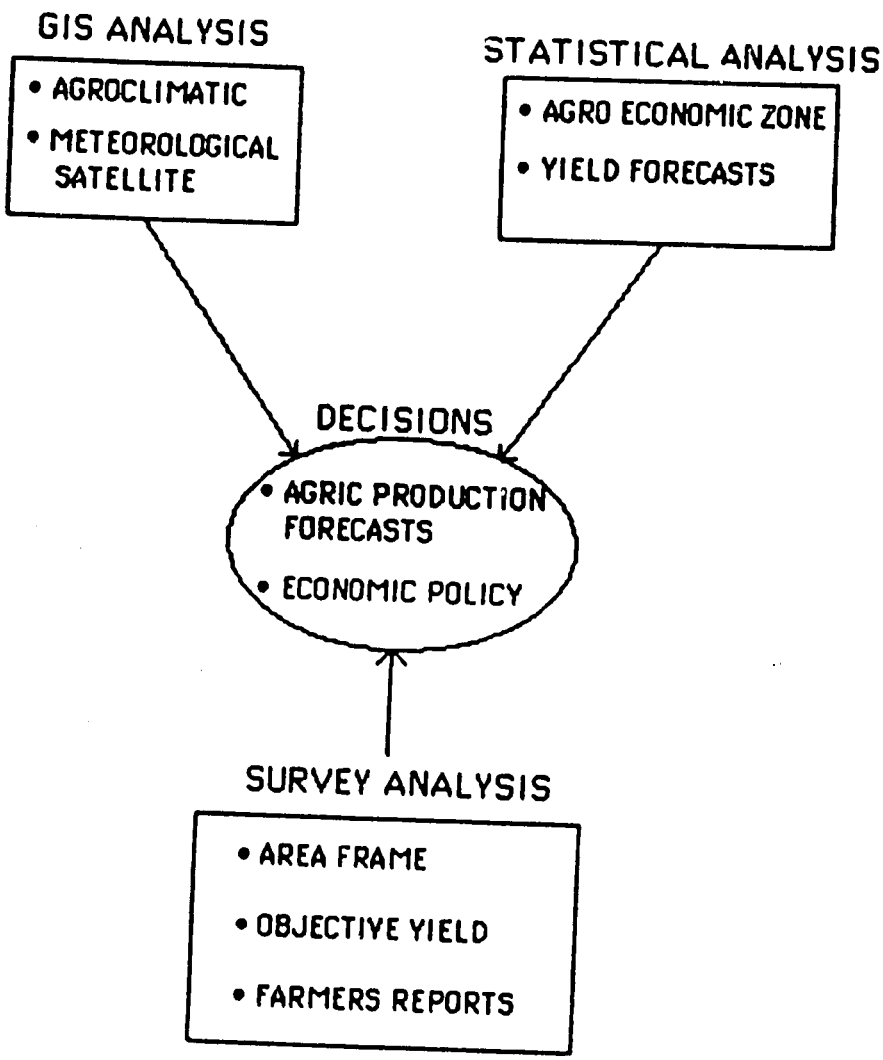



NIGER
AGADEZ
TAHOUA
DIFFA
ZINDER
NIAMEY
MARADI
DOSSO
20°
16°
12°
0
300 km
0°
4°
8°
12°
16°
RAINFALL REPORTS
WMO
OTHER

GIS: MALI (SAHEL)

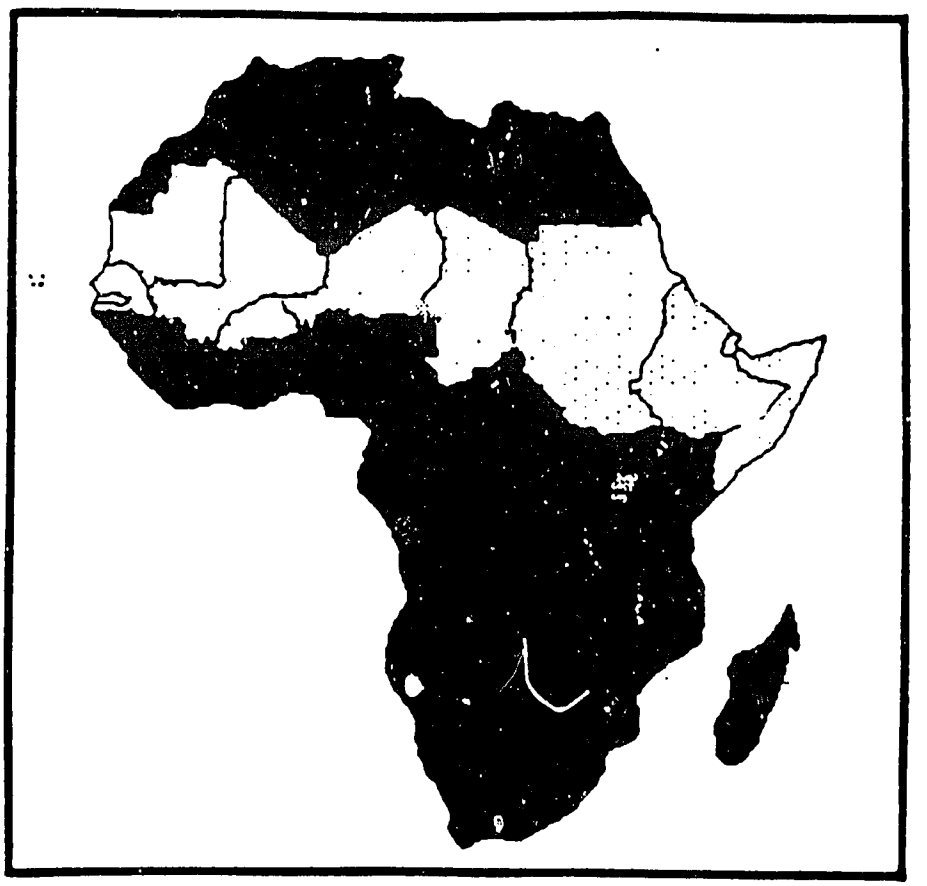


INTEGRATING AGRICULTURAL INFORMATION SYSTEMS FOR ASSESSMENT



SPECIAL CLIMATE IMPACT ASSESSMENT

SUB-SAHARAN AFRICA



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE (NESDIS)
ASSESSMENT AND INFORMATION SERVICES CENTER (AISC)

PREPARED IN SUPPORT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

MAY - AUGUST 1985

ISSUED ON AUGUST 17, 1985 VOLUME 1, NUMBER 3

NOAA/NESDIS
ASSESSMENT INPUTS

Background Information Maps

Rainfall Data Bases

Agroclimatic/Crop Condition Indexes

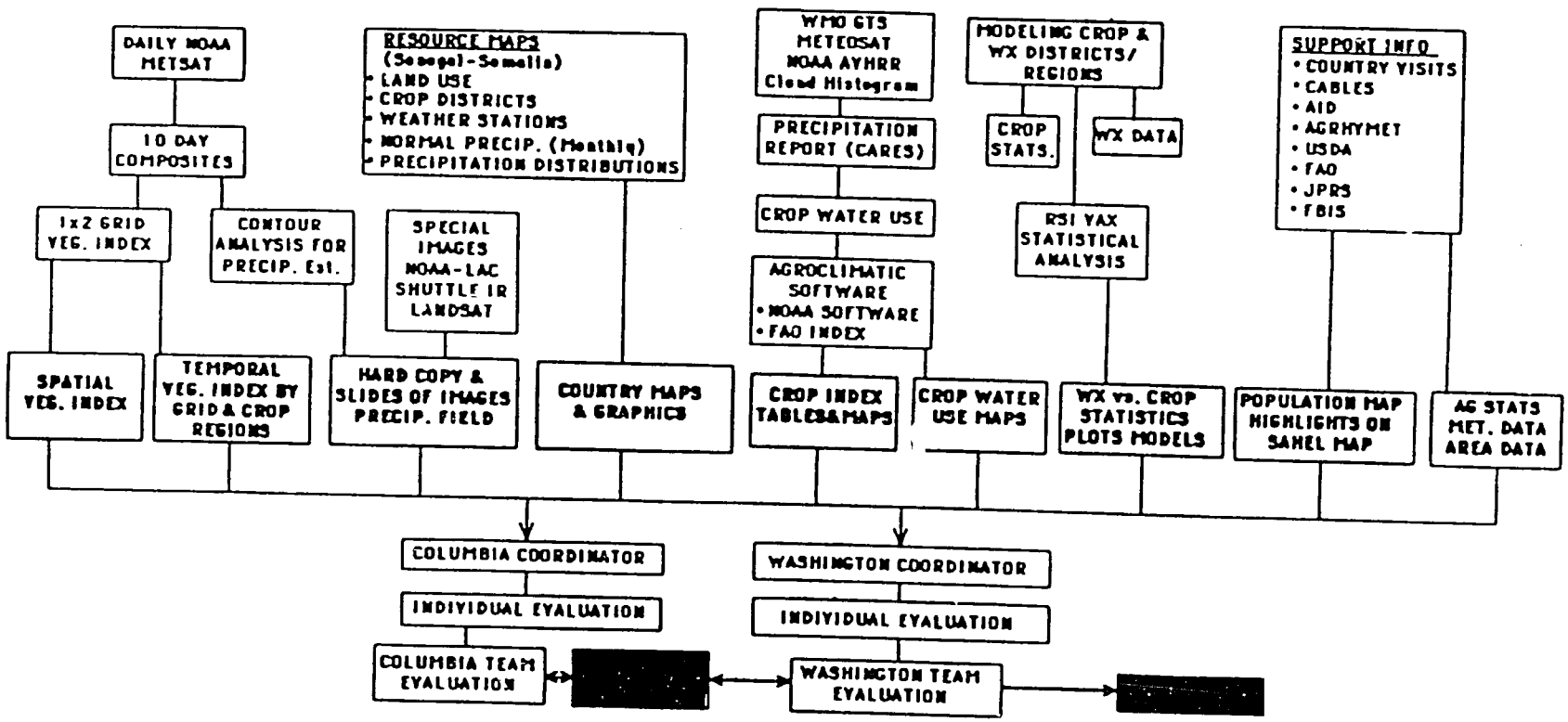
Agricultural Statistics

NOAA AVHRR Color Images

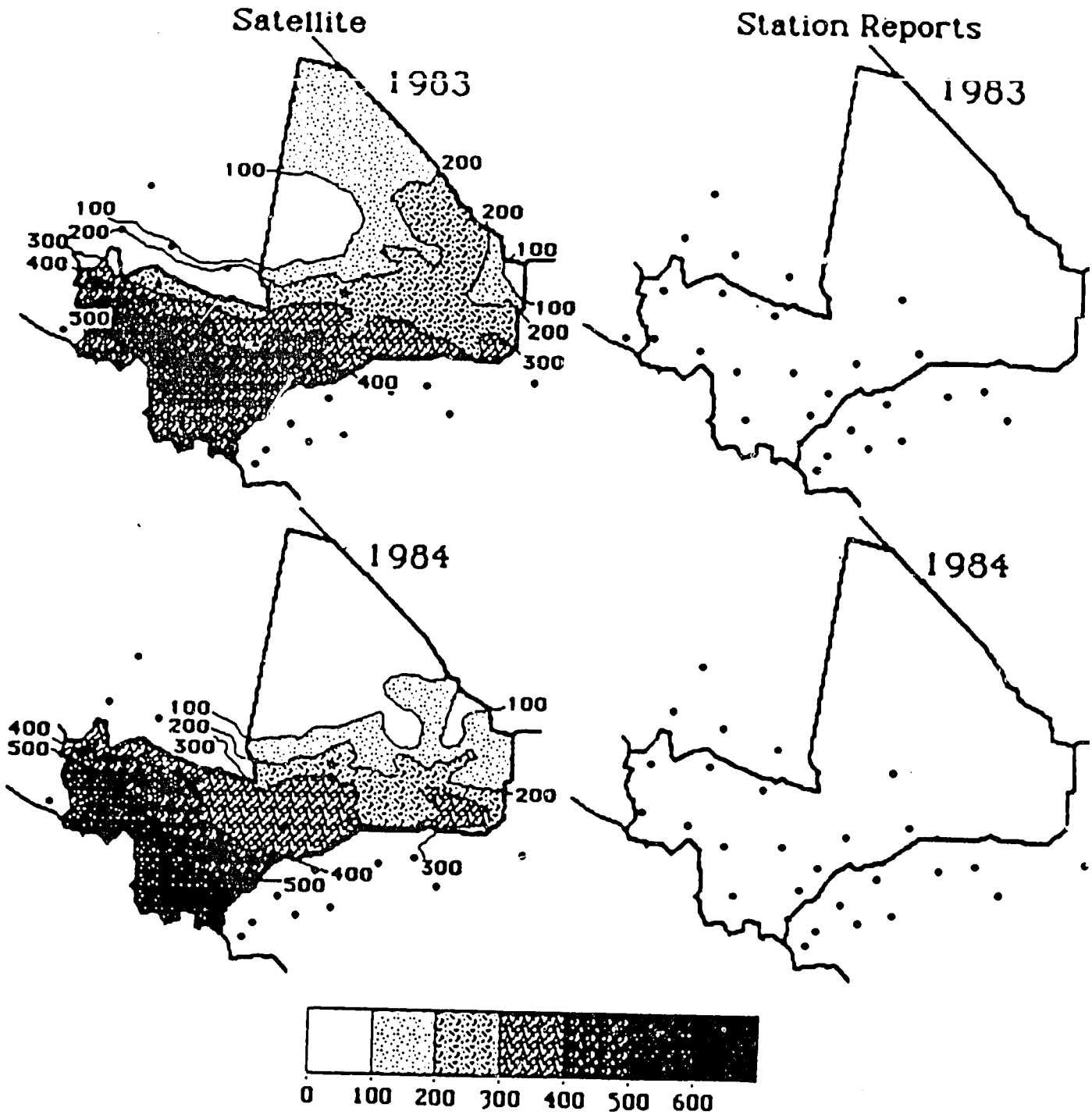
NOAA AVHRR Vegetation
- --Plots
- --Maps

Support Information

NOAA/NESDIS/AISC PLAN
1985 AFRICAN SPECIAL ASSESSMENT SYSTEM
Task Flow Chart



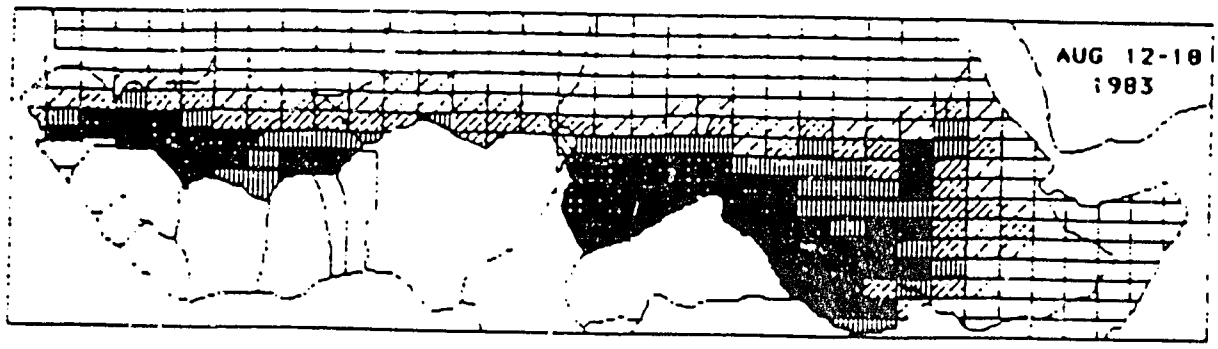
MALI: June - September Cumulative Rainfall Estimates Based on ACCS* Satellite Images

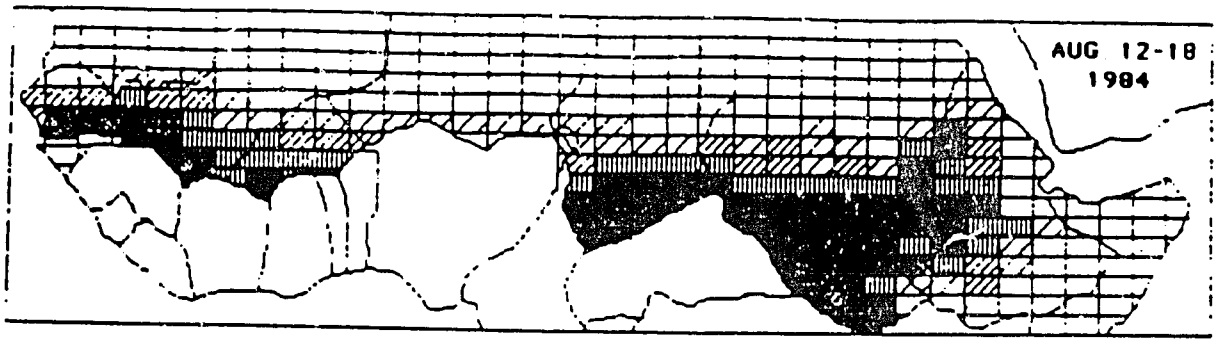


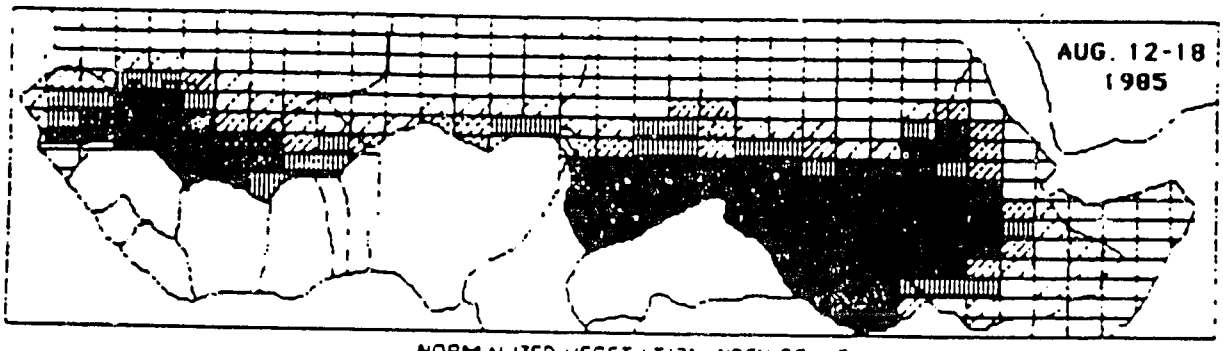
* ACCS is the Ambroziak Color Coordinate System which is designed to enhance visual perception of satellite images allowing this type of analysis to be easily done

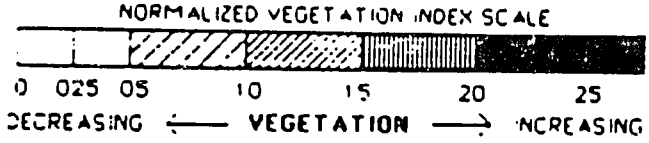
NOAA SATELLITE VEGETATION / BIOMASS INDEX

NORMALIZED AVHRR DATA

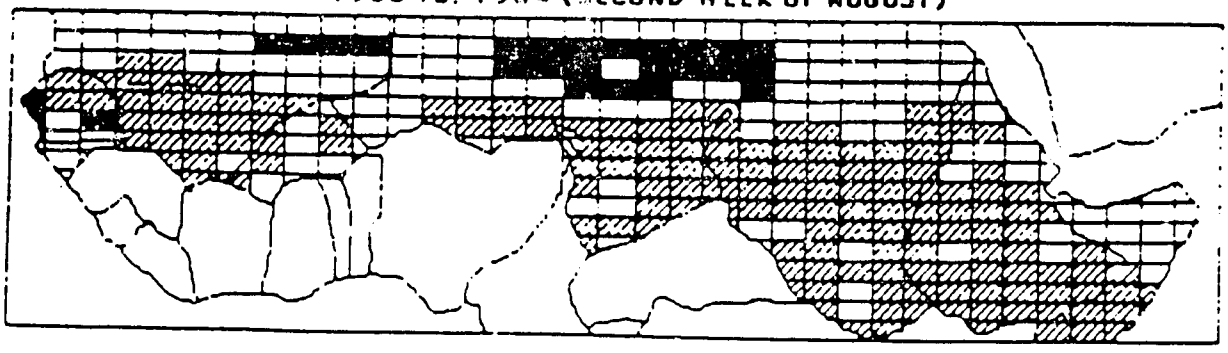






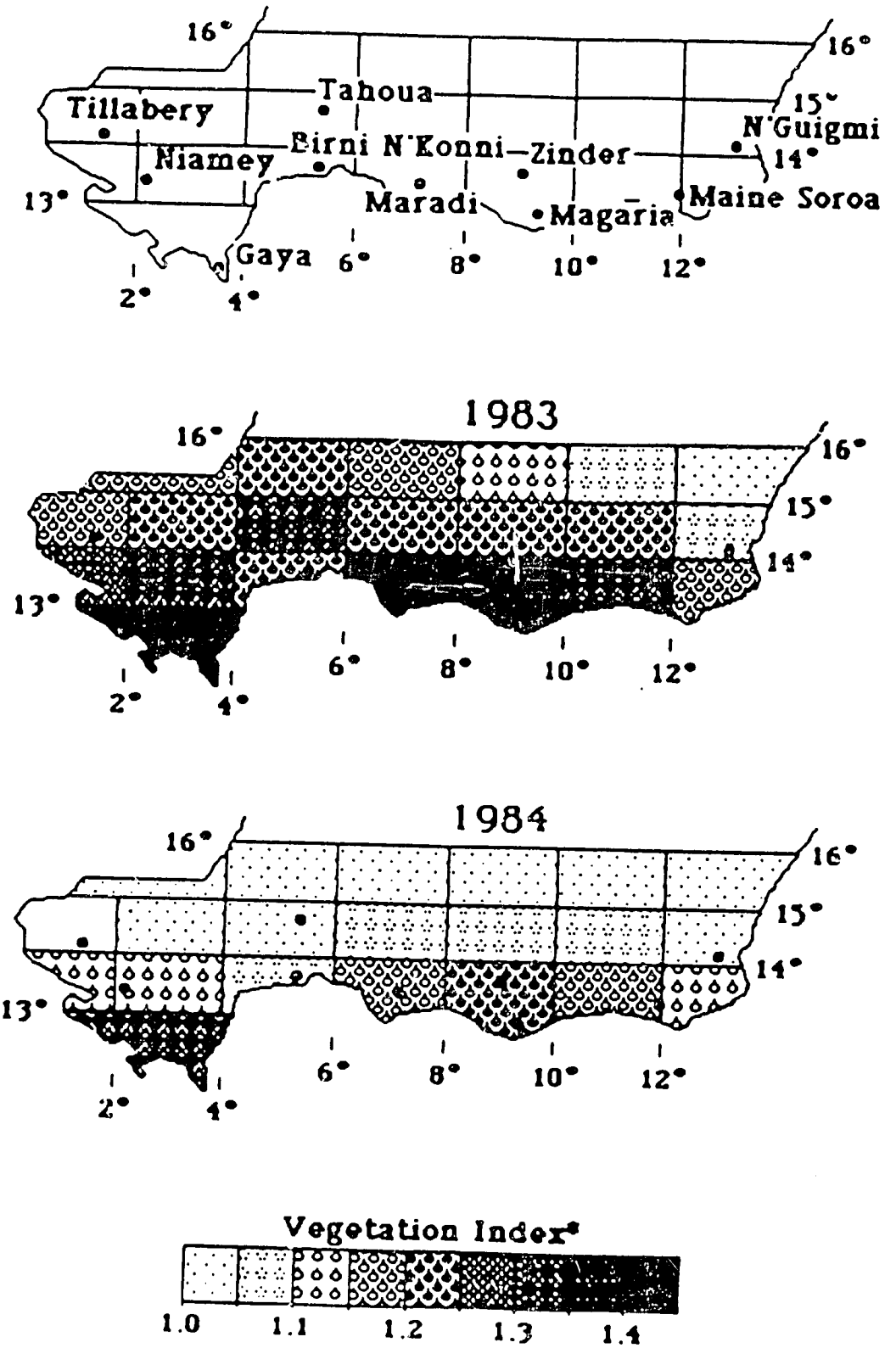


1985 VS. 1984 (SECOND WEEK OF AUGUST)



1985 GREENER NO DIFFERENCE 1984 GREENER

Niger: Satellite Index Values as of the Last Week of August

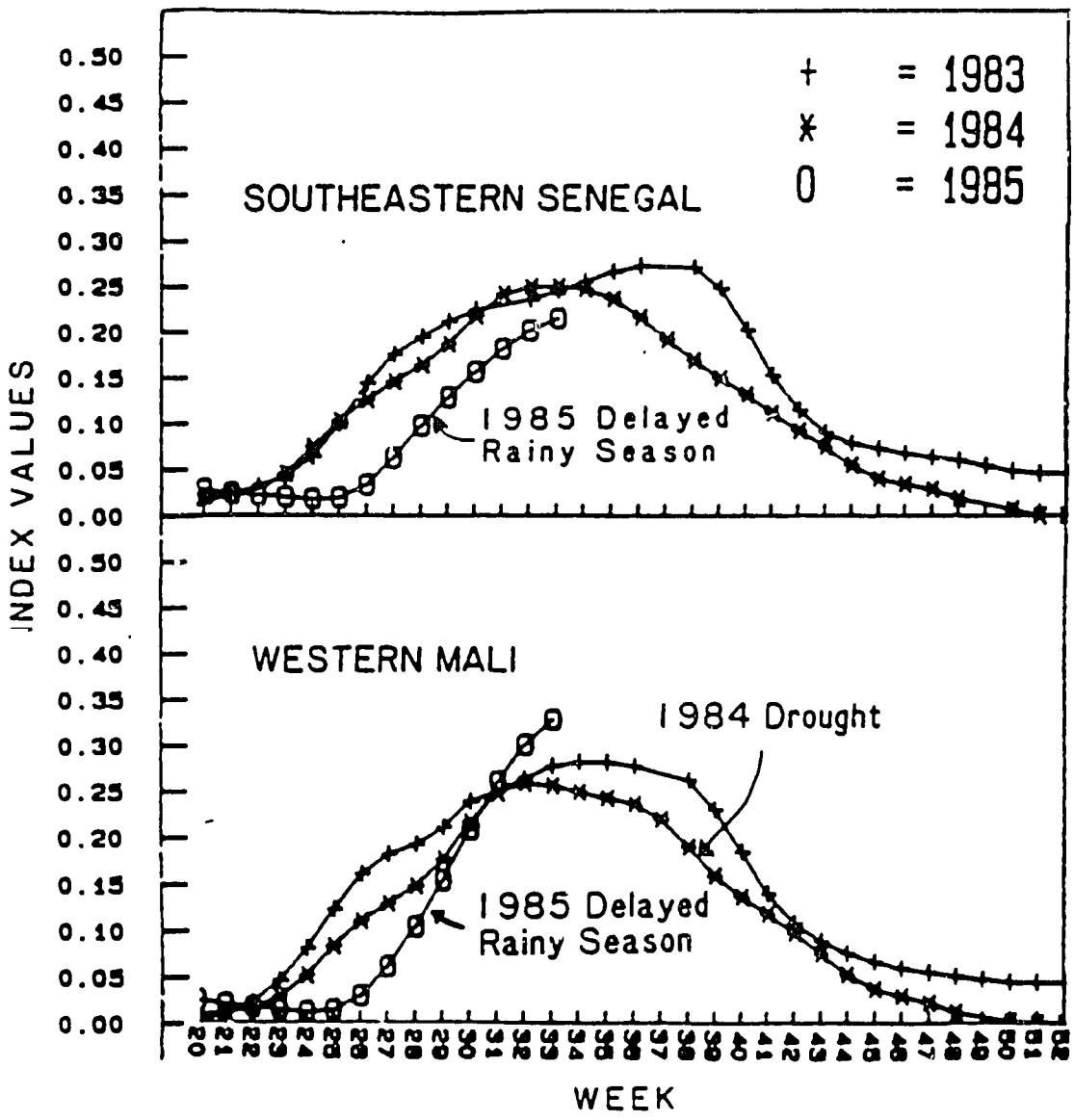


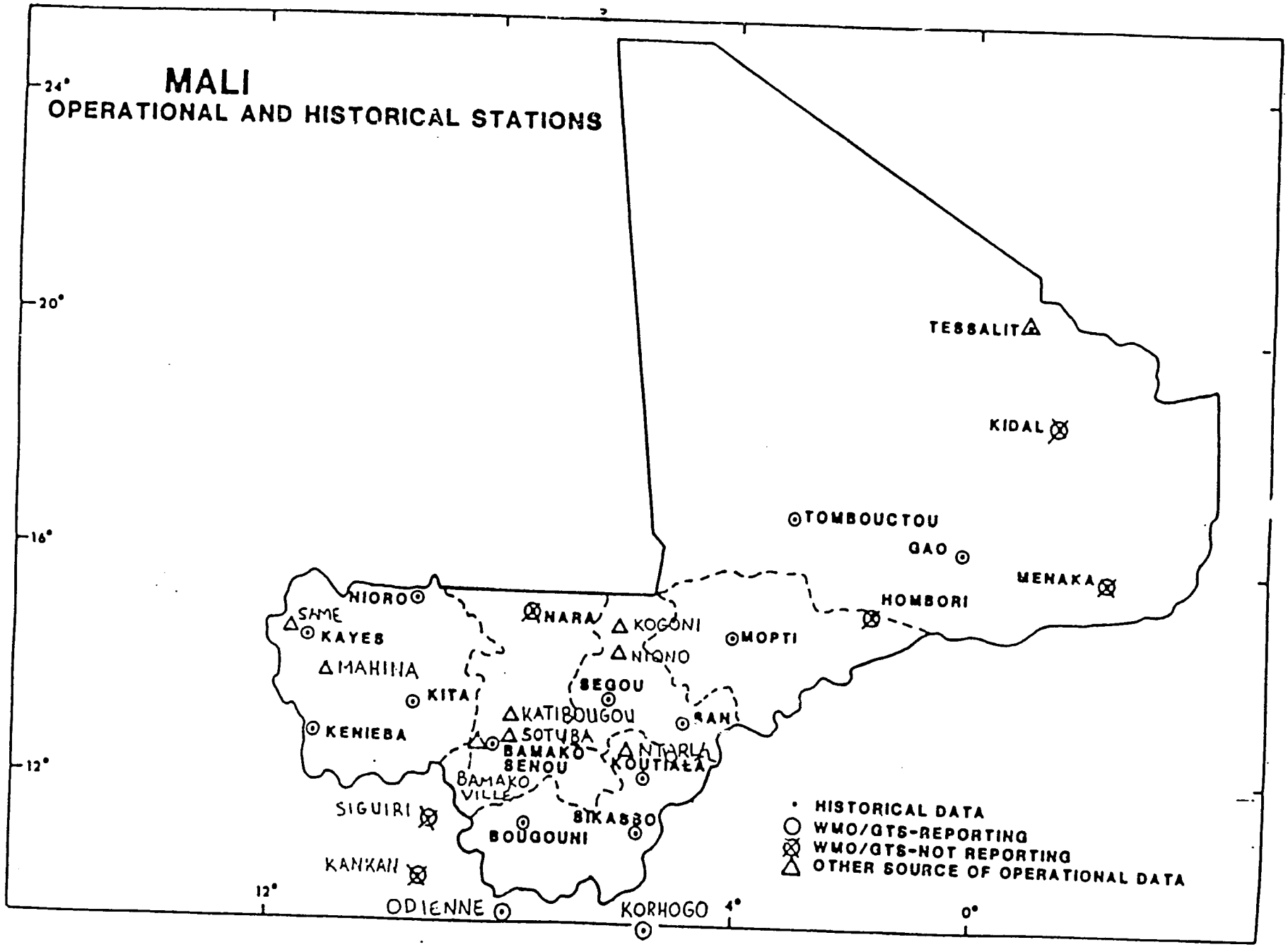
* C_2 / C_1 where C is the channel count value.

NOAA AVHRR VEGETATION INDEX

REGIONAL AVERAGE SMOOTHED NVI

(1°x2° Grid)




MALI
OPERATIONAL AND HISTORICAL STATIONS
24°
20°
16°
12°
12°
4°
0°
TESSALIT
KIDAL
TOMBOUCTOU
GAO
MENAKA
HOMBORI
MOPTI
NIORO
SAME
KAYES
MAHINA
KITA
KENIEBA
NARA
KOGONI
NIONO
SEGOU
KATIBOUGOU
SOTUBA
BAMAKO
SENOU
BAMAKO VILLE
SAN
NTARLA
KOUTIALA
SIKASSO
BOUGOUNI
SIGUIRI
KANKAN
ODIENNE
KORHOGO
HISTORICAL DATA
WMO/GTS-REPORTING
WMO/GTS-NOT REPORTING
OTHER SOURCE OF OPERATIONAL DATA

AGROCLIMATIC CROP INDEXES

Decadal (1,2,3), Monthly (Mon) and Cumulative Monthly (Cum) Statistics for Rainfall and Agroclimatic Crop Condition Index (Based on a Fixed Crop Calendar)

Country: Niger Station: Tahoua Year: 1985

		MAY (5)				JUNE (6)					JULY (7)					AUGUST (8)					SEPTEMBER (9)					OCTOBER (10)				
Cr	(T)	1	2	3	Mon	1	2	3	Mon	Cum	1	2	3	Mon	Cum	1	2	3	Mon	Cum	1	2	3	Mon	Cum	1	2	3	Mon	Cum
	Pn	3	5	9	18	13	19	25	57	75	32	38	47	116	191	47	46	44	137	328	29	20	12	61	389	6	2	0	7	396
	PET	102	102	108	312	93	87	82	263		76	72	75	223		64	62	67	193		62	65	69	196		74	78	89	240	
	Pa	0	0	0	0	16	4	13	33	33	22	17	23	62	95	3	49													
	%-N	0	0	0	0	123	21	52	58	44	69	45	49	53	50	6	107													
	%-R	3	3	3	3	69	11	22	22	17	25	14	14	17	8	3	57													

Precipitation > 1/2 (PET)

Mi	CWR																25	34			37	55	52			70	78	89		
	Dif																24													
	SWR																24	August 1985												
	S/D																0													
	Ind																100													

Optimum → Planting Date

Normal Crop Calendar

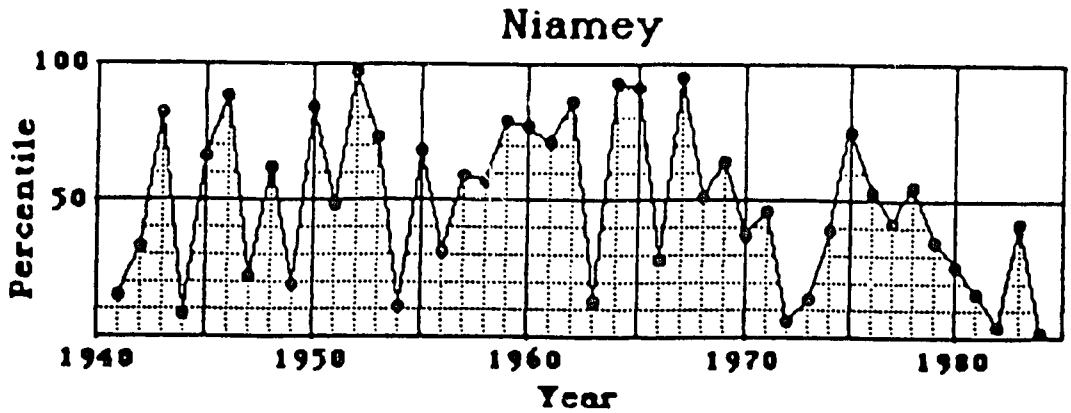
Mi	CWR					37	44	49			65	65	71			64	62	64												
	Dif					-21	-40	-36			-43	-48	-48			-61	-13													
	SWR		Water			0	0	0			0	0	0			0	0													
	S/D		Deficient			-21	-40	-36			-43	-48	-48			-61	-13													
	Ind		Crop Index			96	88	81			73	64	55			43	41													
Mi	ACI					6	8	16		17	35	50	72		73	75	124													
	%-N					120	53	53		59	61	55	53		55	41	54													
	%-R		Percentiles			64	25	22		22	25	17	8		11	3	6													

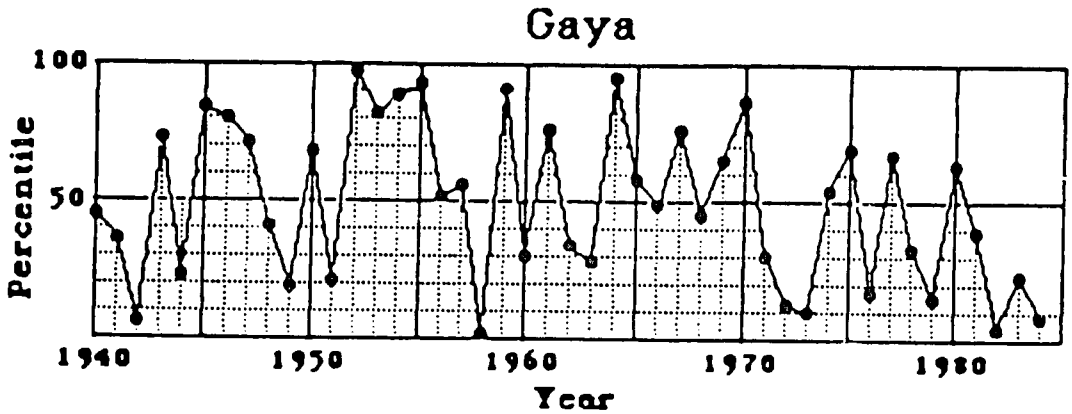
Types: Pn = Normal Precipitation Pa = Actual Precipitation PET = Potential Evapotranspiration %-N = Percent of Normal
CWR = Crop Water Requirement Dif = Difference (Pa - CWR) SWR = Soil Water Reserve %-R = Percentile Rank
S/D = Surplus or Deficit Ind = FAO Index ACI = Agroclimatic Crop Index

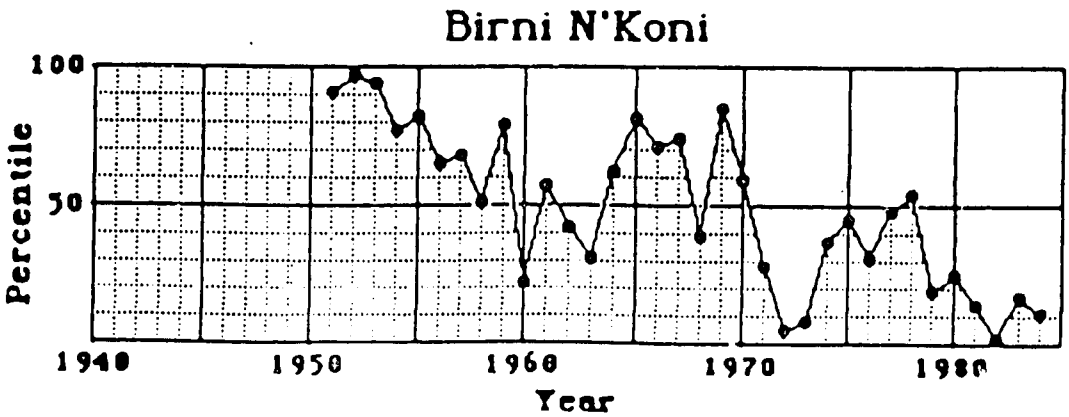
Crops: Co=Cow Peas GB=Green Bean Gn=Groundnut Mz=Maize RI=Rice Irr. RR=Rice Rfd. So=Sorghum Te=Teff Wh=Wheat/Bar

Notes: " " = No data for calculations "???" = Average rainfall zero "***" = Insufficient historical data for rank

NIGER: Percentile Ranks of the Yield Moisture Index as of the End of September







CROP CONDITION ASSESSMENT REPORTS

Rao Achutuni

Thursday, April 3 - 10:30 A.M.

Objective

To discuss Early Warning Crop Condition Assessments for policy and decision-makers.

Abstract

The purpose of Early Warning Crop Condition Assessments is to provide decision and policymakers with key information on the impact of recent weather on agricultural crops and crop production. The session is to introduce trainees to the structure of a crop condition assessment report. Emphasis will also be placed on the subsequent channels for disseminating these reports.

I. Purpose of Early Warning Assessments.

II. Format for the preparation of assessment reports

- A. Overview
- B. Rangeland Vegetation/Biomass Conditions
- C. Crop Conditions
- D. Weather Analysis

III. Frequency of issuing these assessment bulletins.

- A. Monthly Bulletins
- B. Bi-weekly Updates

IV. Identify users and establish distribution channels.

- A. Ministry of Agriculture
- B. Meteorological Department
- C. International Agencies (FAO, WMO World Food Program)

Example

1985 Assessment for Ethiopia (attached).

Reference

Personal Notes.

ETHIOPIA
1985 ASSESSMENT

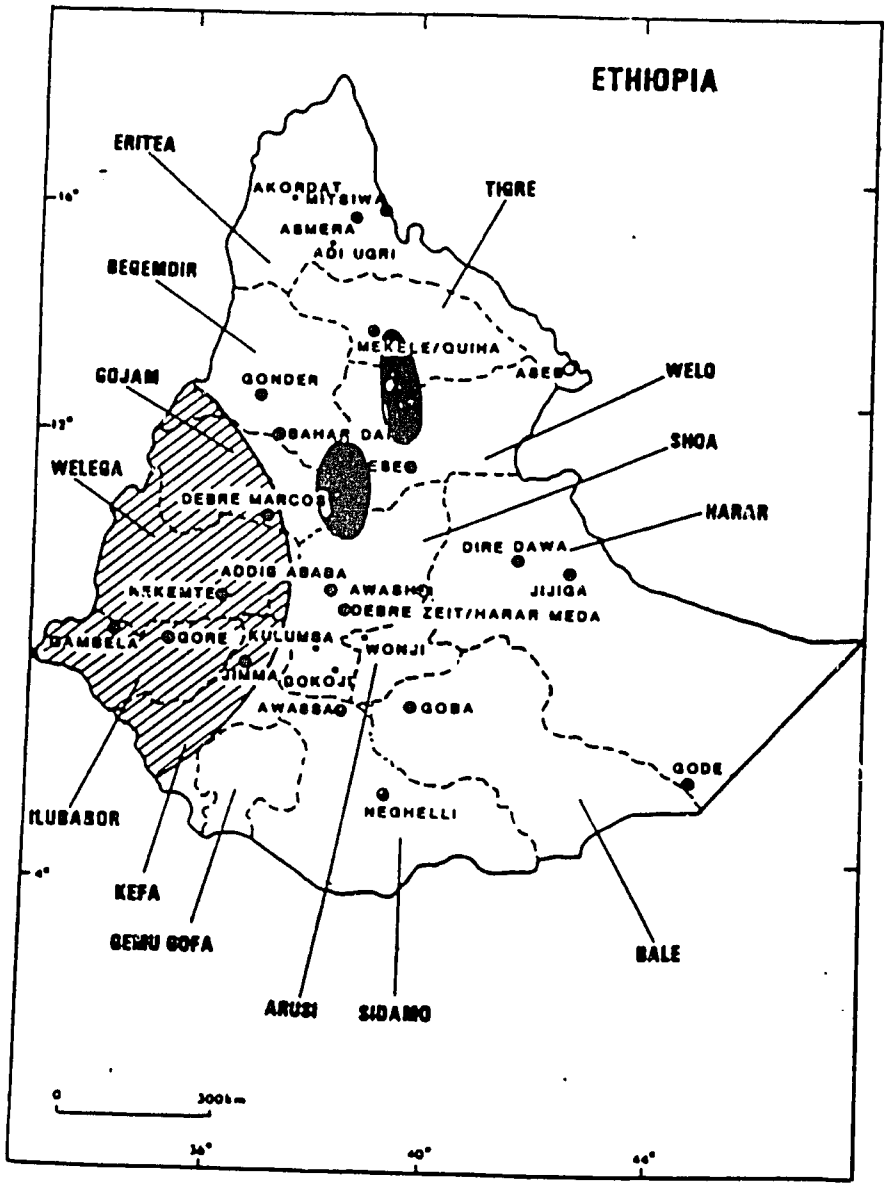


Figure 1

Overview

Due to good seasonal rains beginning in May, crop conditions for the 1985 main growing season (June-July planting) look generally good throughout Ethiopia except for some central and northern areas. Specifically, satellite imagery and rainfall index models suggest moderate drought stress for crops grown in northern Shoa (north of Addis Ababa), western Welo (e.g., Dese) and southern Tigray (e.g., Mekele, see fig. 1). Prospects for crops throughout Ethiopia, including aforementioned moderate drought stressed areas, will be dependent on timely, adequate rains during August and September. (Note: this analysis will be updated by cable within ten days). In addition, dryness in March and June caused below-average secondary crop yields, especially in parts of Welo and Shoa.

Crop Conditions

Crops throughout Ethiopia have benefitted from seasonally good May-July rainfall except for portions of northern Shoa, western Welo and southern Tigray Provinces, where July rainfall was 60-70 percent of normal. Agroclimatic/crop condition indexes based on 1985 rainfall reports suggest moderate moisture stress for June-July planted crops at Dese and Mekele. Satellite imagery (fig. 2) and satellite derived vegetation/biomass indexes (fig. 3) tend to confirm dryness in these areas as biomass conditions for 1985 are not as good as those for 1984 (see following section). Satellite imagery also suggests extremely low biomass conditions along the eastern slope of the Eastern Escarpment within Welo and Tigray Provinces. The satellite imagery suggests isolated pockets of low biomass conditions within the Great Rift Valley; however, evidence is not sufficient to indicate drought. In particular, isolated pockets of low biomass are located just to the north and south of Awassa and just to the northwest and southeast of Wonji. Secondary (belg) crops planted in March and harvested in July were adversely affected by a late beginning of the belg rain and dry weather in June. In particular, the unfavorable weather conditions likely hurt crops in the highlands of Welo and Shoa Provinces, which are major belg-producing areas. However, even with favorable rainfall conditions, the belg crop was not expected to contribute more than a small percentage (less than 10 percent) of Ethiopia's total food production this year, due to such non-meteorological factors as lack of seed, plow ox mortality, and population displacement.

Satellite Imagery/Vegetation Index Analysis

Satellite derived vegetation/biomass indexes suggest that 1985 biomass conditions are generally better than those for 1984 except in northern Shoa, western Welo and southern Tigray. This area of low biomass is generally defined within the rectangular box determined by 10 degrees north latitude, 40 degrees east longitude, 14 degrees north latitude and 38 degrees east longitude. The satellite image tends to confirm low biomass conditions for this rectangular sized region. The image indicates that biomass conditions are good for most of Gojam and the southwest (fig. 1) and that cloud cover (after daily compositing) precludes biomass assessment for west/central Begemdir. The satellite image also suggests very low biomass/very dry conditions along the eastern slopes of the Eastern Escarpment through central Tigray and Welo Provinces. The image shows low biomass at isolated locations within the Great Rift Valley, southern Sidamo and southeastern Ethiopia. Moderately good biomass conditions are indicated to the east of the Great Rift Valley, i.e., the mountains to the northeast and the Ahmar Mountains.

Rainfall Station Report Analysis

July rainfall (Table 1) was essentially normal throughout Ethiopia except for portions of northern Shoa, western/central Welo, southern Tigray and central Begemdir Provinces. Based on available rainfall reports, July rainfall was 77 percent of normal at Addis Ababa (14th percentile), 60 percent of normal at Dese (12th percentile), and 67 percent normal at Mekele (16th percentile). July rainfall reports from weather stations located in other portions of the country were normal to above normal. In June, recently received data (not reflected in Table 1) shows below normal rainfall was reported from Dese (5 mm vs normal of 32 mm) and Mekele (11 mm vs 33). Cumulative May-July 1985 rainfall is exceptionally good for western provinces. (Note: The network of reporting weather stations is too sparse for identification of isolated drought pockets. NOAA/NESDIS could provide a much more detailed analysis if timely ten day rainfall reports were available. Above rainfall totals except where rated, are estimates based on incomplete reports supplemented by satellite cloud data).

NOAA AVHRR IMAGE 1985

Figure 3

NOAA AVHRR IMAGE 1984

Figure 2

NOAA SATELLITE VEGETATION/BIOMASS INDEX
NORMALIZED AVHRR DATA
THIRD WEEK OF JULY

ETHIOPIA

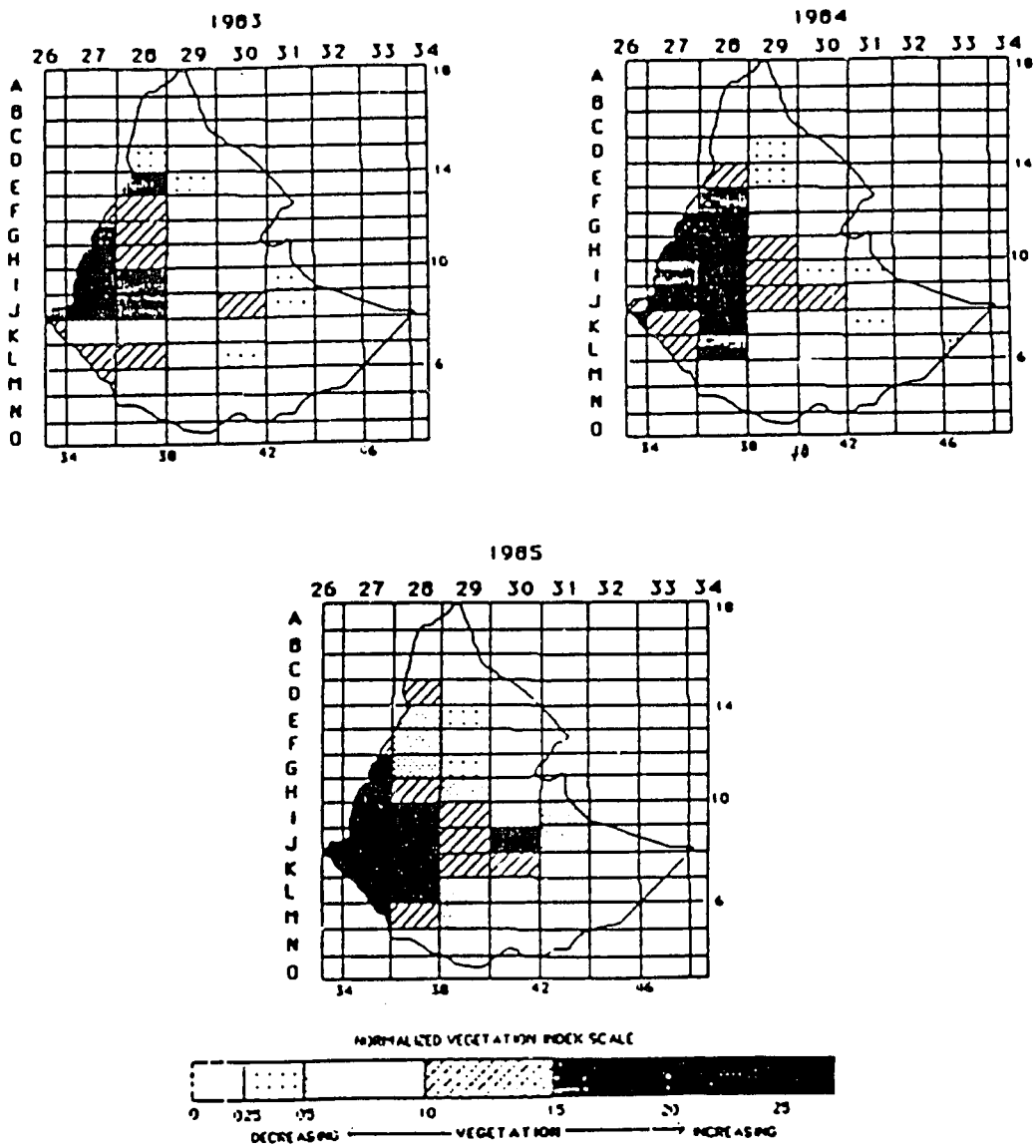


Figure 4

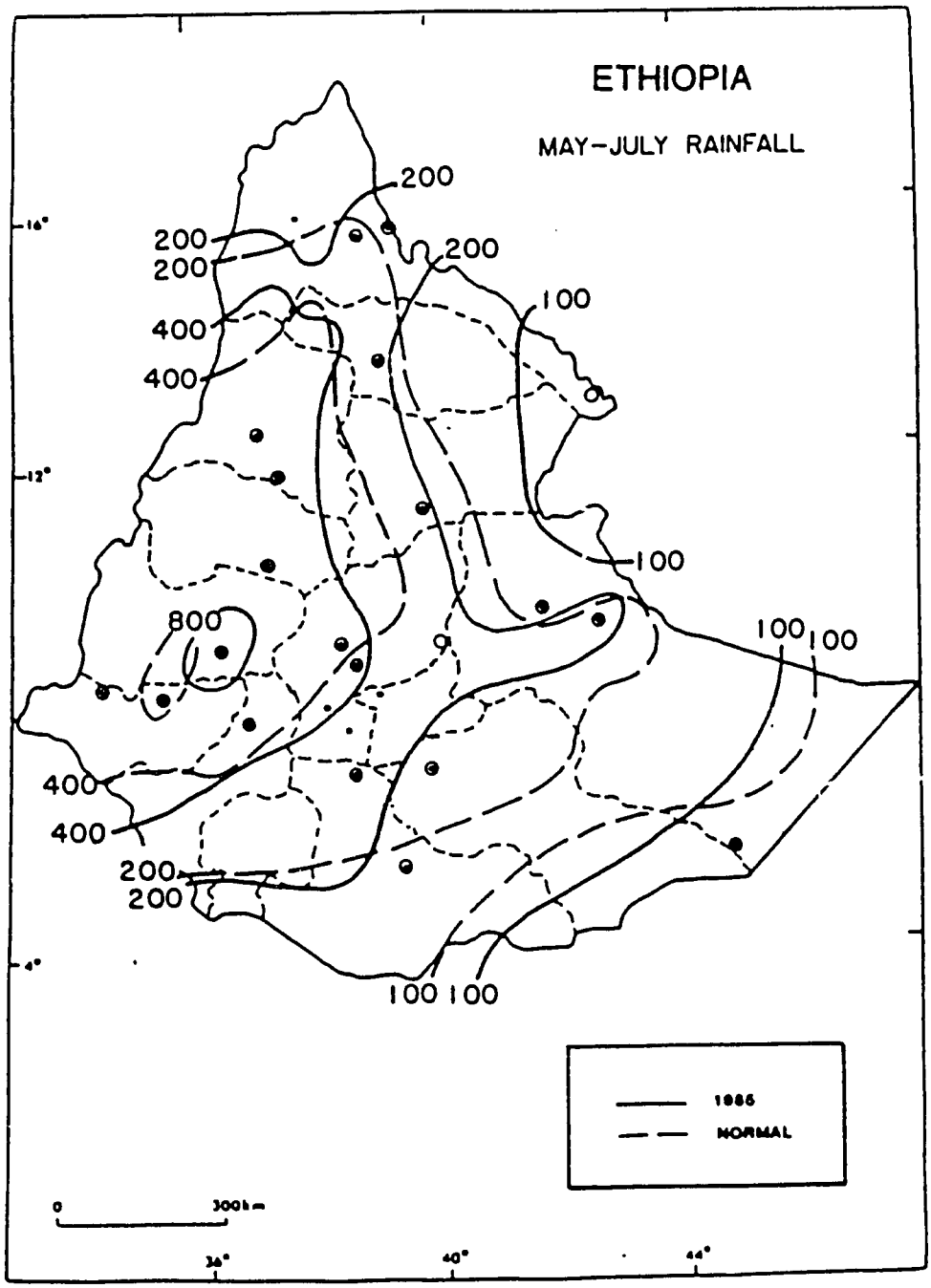

ETHIOPIA
MAY-JULY RAINFALL
200
200
200
200
400
400
100
100
800
100
100
400
400
200
200
100
100
1986
NORMAL
0
300km
36°
40°
44°
16°
12°
4°

Figure 5

MONTHLY RAINFALL TABLE

Expressed in Millimeters (mm), Percent of Normal (%) and Percentiles (Rnk, on Scale of 0 to 100)

Country: Ethiopia Year: 1985

Station	May (5) mm	May (5) %	May (5) Rnk	June (6) mm	June (6) %	June (6) Rnk	July (7) mm	July (7) %	July (7) Rnk
Akordat									
Asmara	92	236	89	94	235	86	158	82	46
Massawa (Mitsiwa)									
Gotha (Mekele)	46	184	81	33	100	55	145	67	16
Gonder	121	141	78	121	77	34	319	98	45
Bahar Dar	145	177	83	120	67	26	318	69	13
Dese (Dessie/Comaelc	56	100	59	32	100	62	161	60	12
Debre Marcos	175	192	94	200	128	81	297	100	59
Lekemti	216	89	***	320	87	***	295	74	***
Jima	193	120	66	218	100	50	203	96	47
Gore	274	120	74	322	100	53	265	82	18
Addis Ababa	117	156	80	155	138	86	191	77	14
Harar Meda (Debre Ze	114	278	89	77	96	50	214	98	61
Awasa	117	418	***	35	113	***	165	134	***
Awassa	82	67	***	125	136	***	130	98	***
Dire Dawa	45	115	62	25	104	62	120	132	79
Jijiga	58	60	32	67	103	68	105	122	65
Goba	100	95	43	38	64	22			
Gode	43	67	61	2	200	74	2	???	95
Neghelli	166	102	64	13	108	67	1	11	9

Notes:

" " = No data for calculations.

"???" = Percent of normal not calculated because average rainfall is zero.

"***" = Percentiles not calculated because less than 15 years of historical data exist on file.

Table 1

CUMULATIVE RAINFALL TABLE

Expressed in Millimeters (mm), Percent of Normal (%) and Percentiles (Rnk, on Scale of 0 to 100)

Country: Ethiopia Year: 1985

Station	May (5)			May - Jun (5-6)			May - Jul (5-7)		
	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk
Akordat									
Asmara	92	236	89	186	235	97	344	126	86
Massawa (Mitsiwa)									
Quiha (Makele)	46	184	81	79	136	61	224	82	35
Gonder	121	141	78	242	100	56	561	98	55
Bahar Dar	145	177	83	265	101	57	583	81	22
Dese (Dessie/Combolc	56	100	59	88	100	53	249	70	18
Debre Marcos	175	192	94	375	152	97	672	123	88
Lekemti	216	89	***	536	88	***	831	83	***
Jima	193	120	66	411	108	63	614	104	63
Gore	274	120	74	596	108	74	861	99	53
Addis Ababa	117	156	80	272	145	86	463	107	66
Harar Meda (Debre Ze	114	278	89	191	158	89	405	119	61
Awash	117	418	***	152	258	***	317	174	***
Awassa	82	67	***	207	96	***	337	97	***
Dire Dawa	45	115	62	70	111	59	190	123	65
Jijiga	58	60	32	125	77	47	230	93	50
Goba	100	95	43	138	84	26			
Gode	43	67	61	45	69	61	47	72	61
Neghelli	166	102	64	179	102	64	180	98	61

Notes:

" " = No data for calculations.

"???" = Percent of normal not calculated because average rainfall is zero.

"***" = Percentiles not calculated because less than 15 years of historical data exist on file.

Table 2

UTILITY OF ANCILLARY DATA IN ASSESSMENT

Rita Terry
Rao Achutuni

Friday, April 4 - 8:30 a.m.

Objective

To develop ancillary or episodic event data base for use in early warning assessment work.

Abstract

The primary purpose of ancillary or episodic event data in Early Warning Assessment work is to provide assessor with information on the occurrence of events such as drought, floods, typhoons, pests and diseases, etc. The procedure for building such a data base will be discussed.

I. Introduction

A. Definition of episodic event data

B. Purpose in assessments

II. Sources of ancillary information

A. Government agency publications

1. FBIS-Foreign Broadcast Information Service
2. JPRS-Joint Publications Research Service
3. United States Department of Agriculture

B. International agencies

1. World Meteorological Organization
2. Food and Agriculture Organization

C. Media

1. Newspapers
2. Magazines

D. On-line data bases
E. Field reports

III. Criteria for Selecting Ancillary Data

A. Weather impacts
B. Non-weather impacts

IV. Procedures for chronological documentation

V. Application in assessment process

A. Calibration of Indices

References

Sahel Ancillary Report Summary, June-October, 1985

Agrometeorological Activities in Ethiopia, Prospects for Improving Agroclimatic/Crop Condition Assessment, September 1984

Agroclimatic Conditions in Tropical West Africa, March 1985

DISCUSSION OF SATELLITE AND CROP/WEATHER MODELS FOR ESTIMATING CROP YIELD

Lou Steyaert

Friday, April 4 - 10:30 A.M.

Objectives

1. To describe NOAA/NESDIS procedures for using satellite and crop/weather models to forecast crop yield in the Sahel countries.
2. To illustrate the process with a practical example

Abstract

The NOAA/NESDIS analytic process for making quantitative crop yield forecasts is described. This process is based on two separate analysis processes: the crop condition assessment based on GIS and yield forecasts based on application of statistical models. Statistical yield forecast models incorporate both NOAA AVHRR satellite vegetation index data and monthly rainfall data. The use of each approach (GIS and Statistical Models) in conjunction with analyses of baseline agricultural statistics is described. A practical example is provided.

I. Introduction

   A. Perspective of the Problem
   B. Objectives of Presentation

II. Data Analysis

   A. Data Base Development
   B. Crop Data Analysis

      1. Time-series Plots
      2. Variability and Trend Analysis

   C. Yield/Weather Correlations

      1. Correlation Triangles
      2. Scatter Diagrams
      3. Time-series Plots

   D. Preliminary Regression Models

III. Analytic Process

A. Overview
B. GIS Crop Condition Analysis
C. Statistical Satellite Model Analysis
D. Statistical Rainfall Model Analysis
E. Use of Baseline Statistics

IV. Final Yield Forecast

A. Integrating Model Analyses
B. Verification

V. Practical Examples

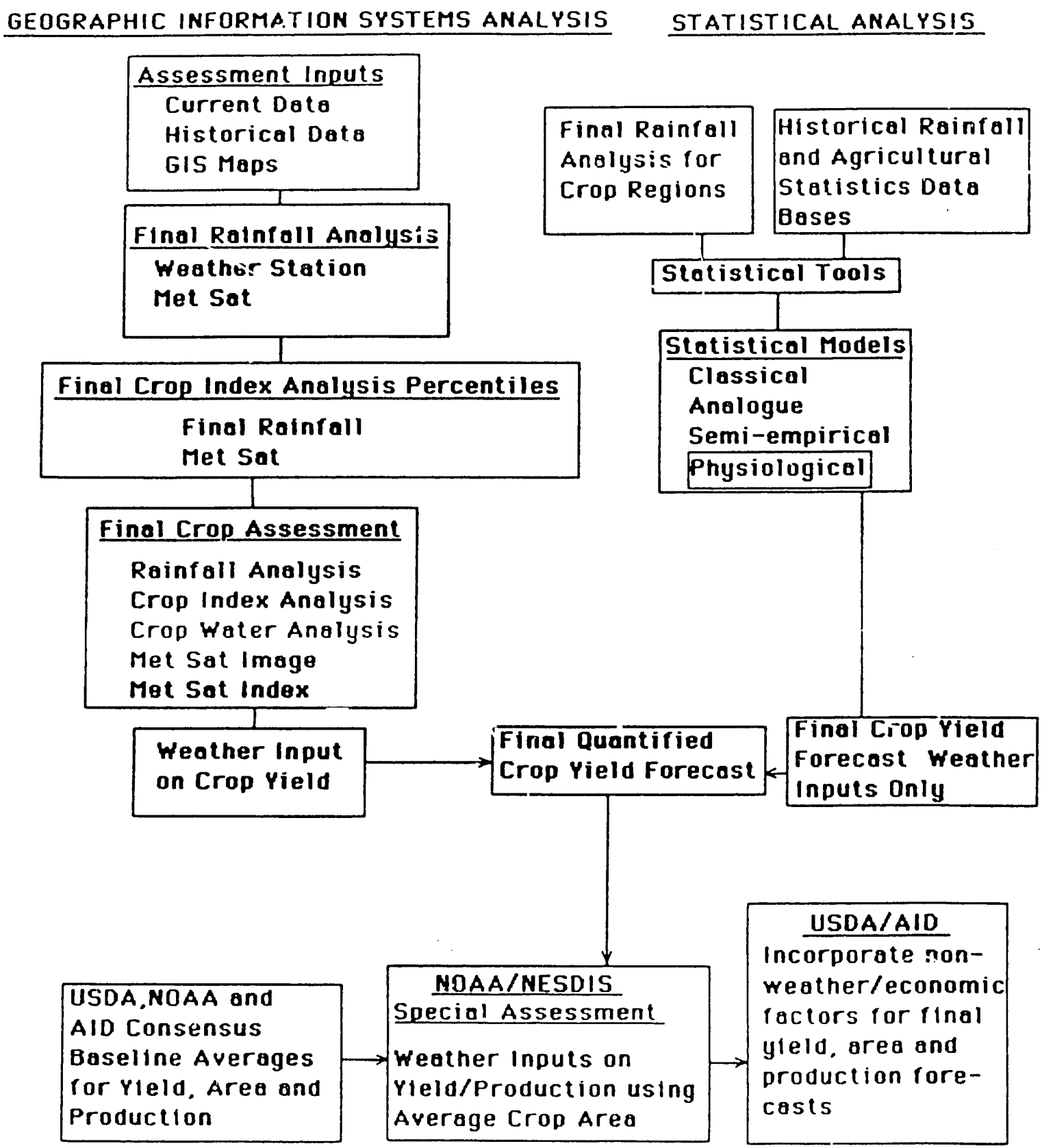
A. Niger Millet for 1985
B. Niger Sorghum for 1985

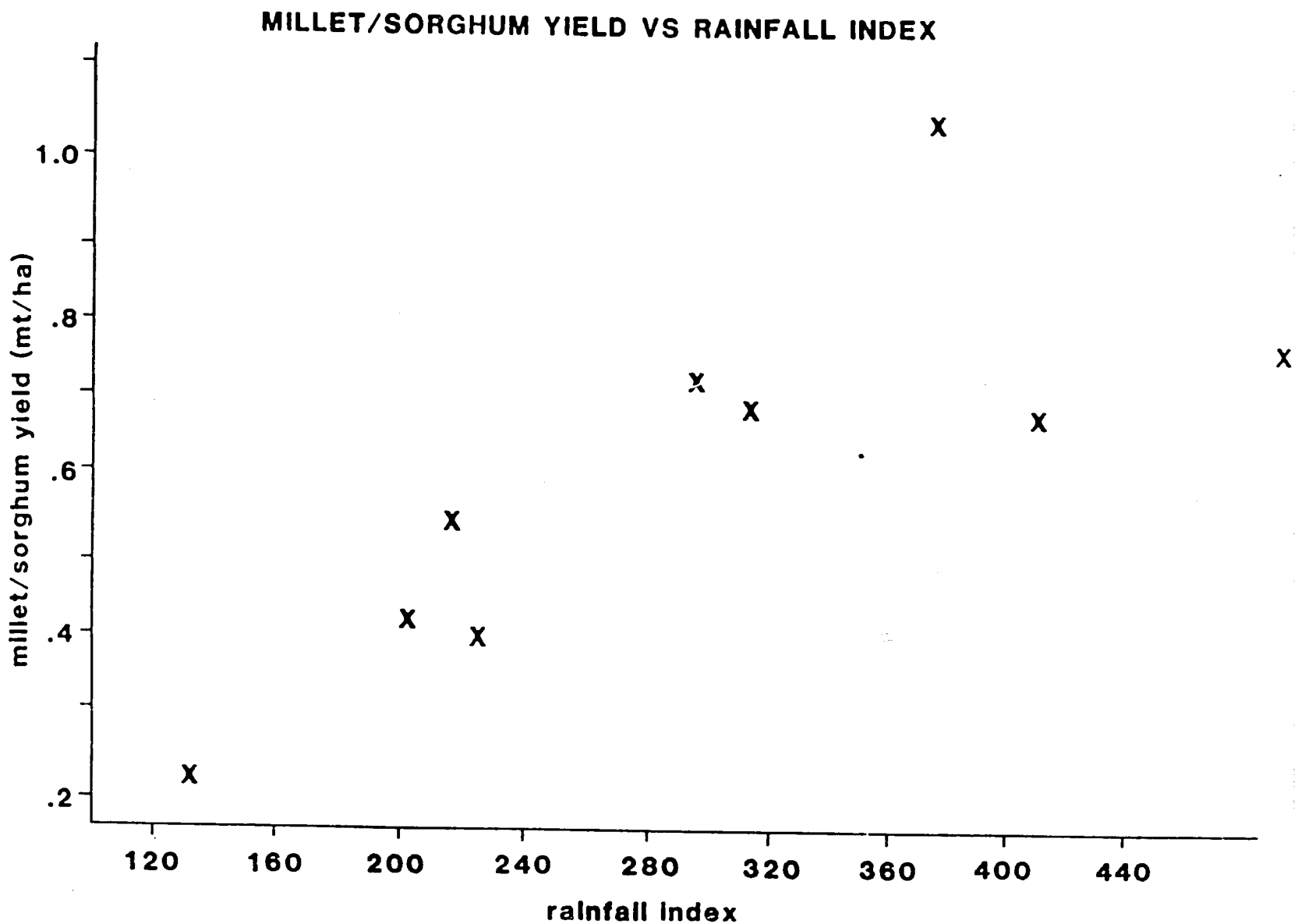
Illustrations (see attached)

Reference

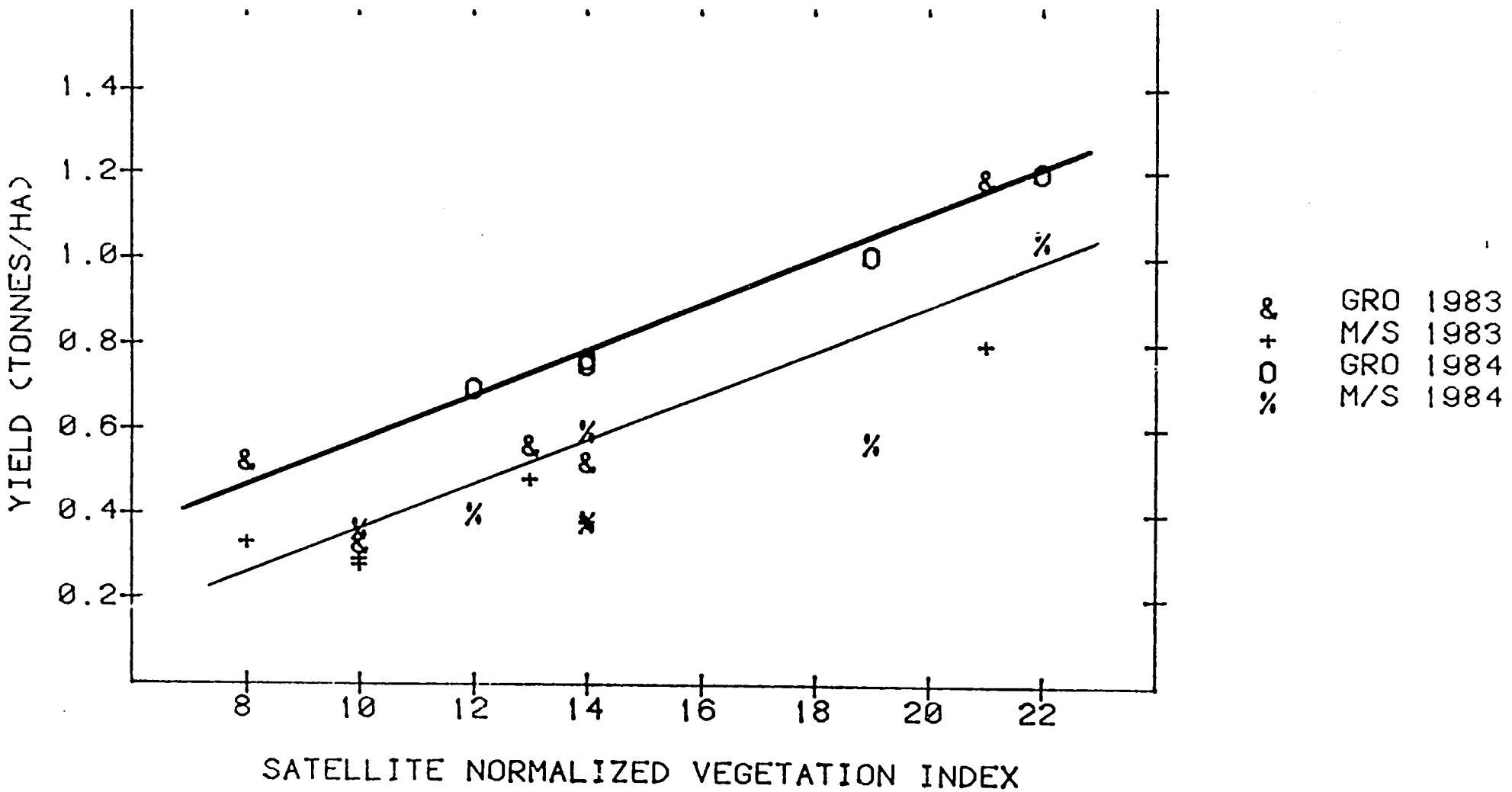
NOAA/NESDIS Special Assessment Cables to Sahel Countries.

NOAA/NESDIS ANALYTIC PROCESS for QUANTITATIVE CROP YIELD FORECASTING

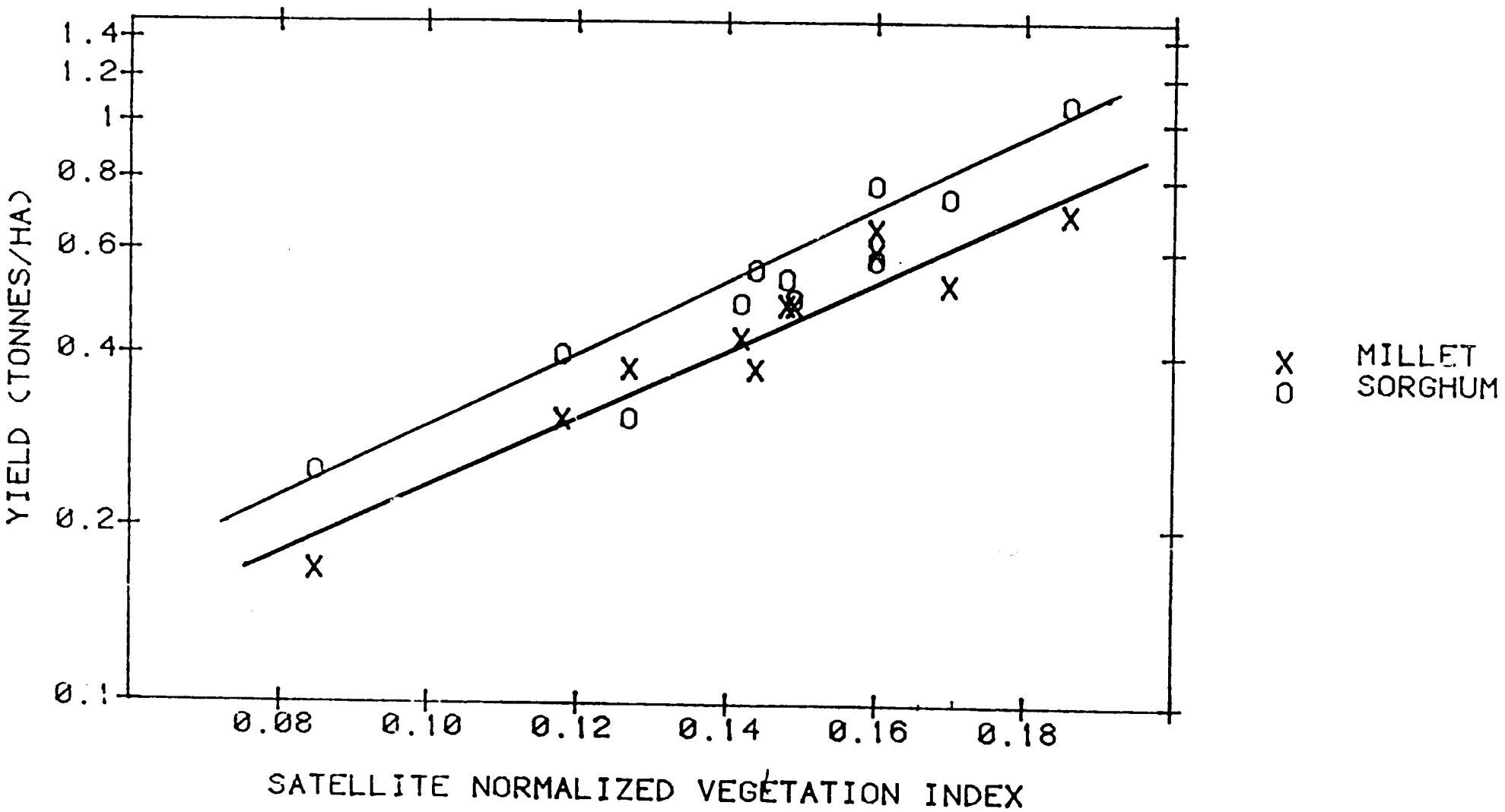



MILLET/SORGHUM YIELD VS RAINFALL INDEX
millet/sorghum yield (mt/ha)
1.0
.8
.6
.4
.2
120
160
200
240
280
320
360
400
440
rainfall index

PLOT OF NVI VERSUS YIELD OF
GROUNDNUTS AND MILLET/SORGHUM
SENEGAL, 1983 AND 1984



PLOT OF NVI VERSUS YIELD OF
MILLET AND SORGHUM
BURKINA FASO, 1983



SENEGAL CLIMATE/CROP IMPACT ASSESSMENT NO. 1/85

1. FOR USAID PASS TO MDRO, FFP, AG. DEVEL. OFFICER OR AGATT AT POST; FOR ROME PASS TO FODAG AND FAO;FOR GENEVA PASS TO UNDRO, WHO AND WMO; FOR NAIROBI AND ABIDJAN PASS TO REDSO; FOR BRUSSELS PASS TO USEC PASSEC; FOR OTTAWA PASS TO CITA. THIS ASSESSMENT MAY BE SHARED WITH HOST-COUNTRY OFFICIALS.

2. THIS REPORT FOR EVALUATION BY U.S. FIELD MISSIONS PROVIDES THE NOAA/NESDIS PRELIMINARY QUANTITATIVE ASSESSMENT OF RAINFALL IMPACTS ON COMBINED SORGHUM/MILLET YIELD AS OF AUGUST 20, 1985. COLUMNS ARE AS FOLLOWS: II, III AND IV ARE FIVE-YEAR BASELINE AVERAGES (1980-1984) FOR REGIONAL LEVEL YIELD, AREA AND PRODUCTION, RESPECTIVELY; V IS NOAA/NESDIS 1985 WEATHER ADJUSTED YIELD (WXADJ YLD); VI IS NOAA/NESDIS YIELD ASSESSMENT AS A PERCENT OF BASE (YLD PRCNT, COLUMN V DIVIDED BY COLUMN II); VII IS NOAA/NESDIS ESTIMATED SEASONAL RAINFALL FOR REGION (RAIN PRCNT, PERCENT OF AVERAGE 1951-1983 RAINFALL) AND VIII IS GOS 1984 REPORTED YIELD. CROP DATA UNITS ARE IN METRIC TONS (THOUSANDS) AND HECTARES (THOUSANDS). CROP YIELD (PRODUCTION DIVIDED BY CROP AREA) IS IN UNITS OF METRIC TONS PER HECTARE.

3. SENEGAL MILLET/SORGHUM YIELD/CLIMATE IMPACT ASSESSMENT

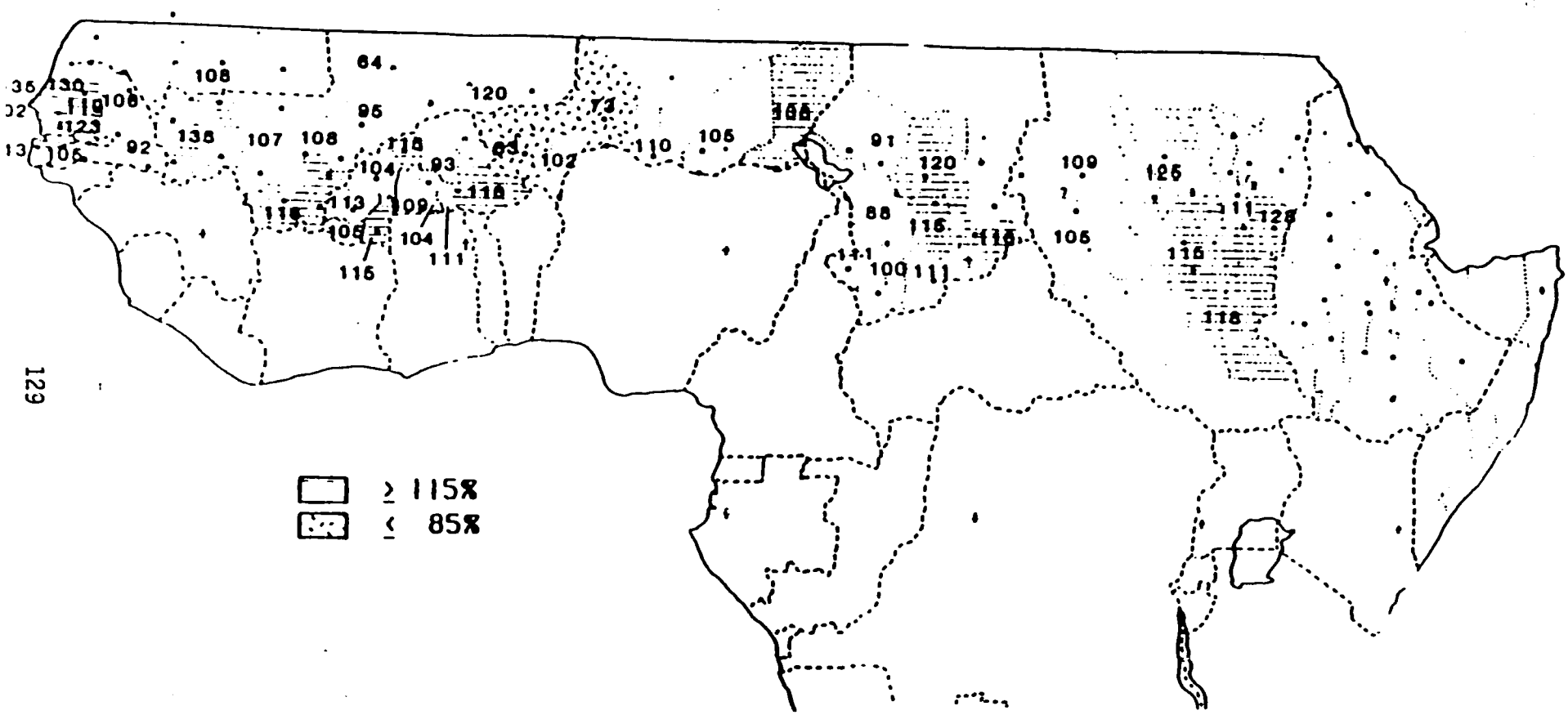
COL I ASSMT REGION	II AVG YLD	III AVG AREA	IV AVG PROD	V WXADJ YLD	VI YLD PRCNT	VII RAIN PRCNT	VIII 1984 YLD
CAP-VERT	0.54	0.6	0.3	0.55	102	125	0.00
CASAMANCE	0.81	87.8	71.0	0.85	105	90	1.04
DIOURBEL	0.42	142.7	59.7	0.50	119	90	0.38
FLEUVE	0.33	40.0	13.3	0.35	106	90	0.36
LOUGA	0.27	136.7	36.5	0.35	130	110	0.03
SENEGAL ORIENTAL	0.65	64.1	41.9	0.60	92	85	0.57
SINE SALOUM	0.61	388.5	235.7	0.75	123	100	0.59
THIES	0.52	158.8	79.5	0.70	135	100	0.40

4. YIELD FORECASTS ARE NEAR OR ABOVE THE FIVE YEAR BASELINE AVERAGE THROUGHOUT SENEGAL; HOWEVER, DUE TO THE DELAYED BEGINNING OF THE 1985 RAINY SEASON, 1985 CROPS WILL REQUIRE TIMELY, ADEQUATE RAINFALL DURING SEPTEMBER.

5. THIS PRELIMINARY ASSESSMENT WILL BE UPDATED DURING THE FOURTH WEEK OF SEPTEMBER. BY SEPTEL (IN ENGLISH AND FRENCH), NOAA/NESDIS WILL PROVIDE BACKGROUND INFORMATION ON ASSESSMENT METHODS AND OTHER CONSIDERATIONS FOR INTERPRETATION AND USE OF THIS ASSESSMENT. MISSION COMMENTS ON CORRECTNESS OF ADMINISTRATIVE REGIONS, REPRESENTATIVENESS OF BASELINE DATA, FORMAT OF CABLE AND ASSESSMENT INFORMATION PROVIDED WILL BE APPRECIATED. 00

MID - AFRICA

1985 Millet Yields, as a %
of 1980-1984 Average



INTEGRATING DATA AND INFORMATION FOR ASSESSMENT: 1985 CASE STUDY OF SUDAN

Rao Achutuni

Friday, April 4 - 1:30 P.M.

Objective

To prepare a case study assessment for Sudan during the 1985 growing season.

Abstract

The preparation of an Early-Warning Crop Condition Assessment involves a detailed analysis of all available information in the form of crop indexes, satellite imagery, crop yield models, crop calendar information, etc. The procedure for writing assessments will be demonstrated with a case study for Sudan with 1985 as a test year.

I. Discussion and Analysis of Model Results (a.m. Session)

The trainees will be provided with the relevant tables, plots, computer printouts etc., on the following:

- Crop Calendar Information
- Rainfall Analysis
- FAO Index
- Crop Model Results
- Satellite Imagery
- NVI Analysis

The trainees will be asked to analyze above material on a systematic basis. The results and conclusions are to be used in the afternoon session during the assessment write-up.

II. Preparation of Assessment (p.m. Session)

The trainees will be asked to prepare a sample assessment for Sudan during 1985. Due to time constraints, the assessment will be prepared only for the month of September, 1985.

Format for Assessment write-up:

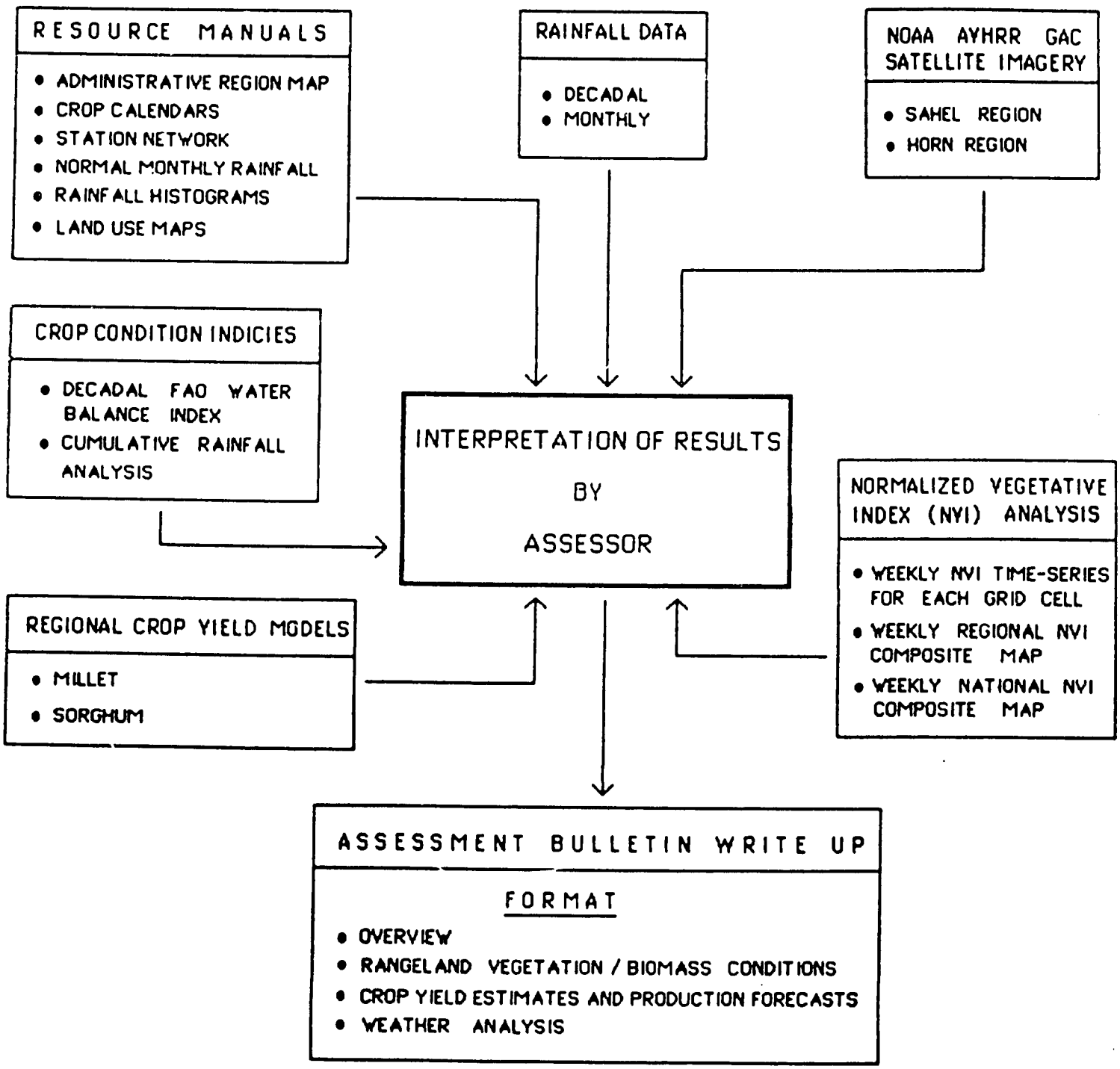
- Overview of the 1985 Growing Season
- Rangeland Vegetation/Biomass Conditions
- Crop Conditions
- Weather Analysis
- Crop Yield Estimates and Production Forecasts
- Supporting Tables, Figures, Satellite Photos

Illustrations (see attached)

References

Personal notes in extended lesson plan.

FLOW CHART FOR PREPARATION OF ASSESSMENT BULLETIN



SAMPLE ASSESSMENT FOR SUDAN DURING 1985

SUDAN
1985 ASSESSMENT

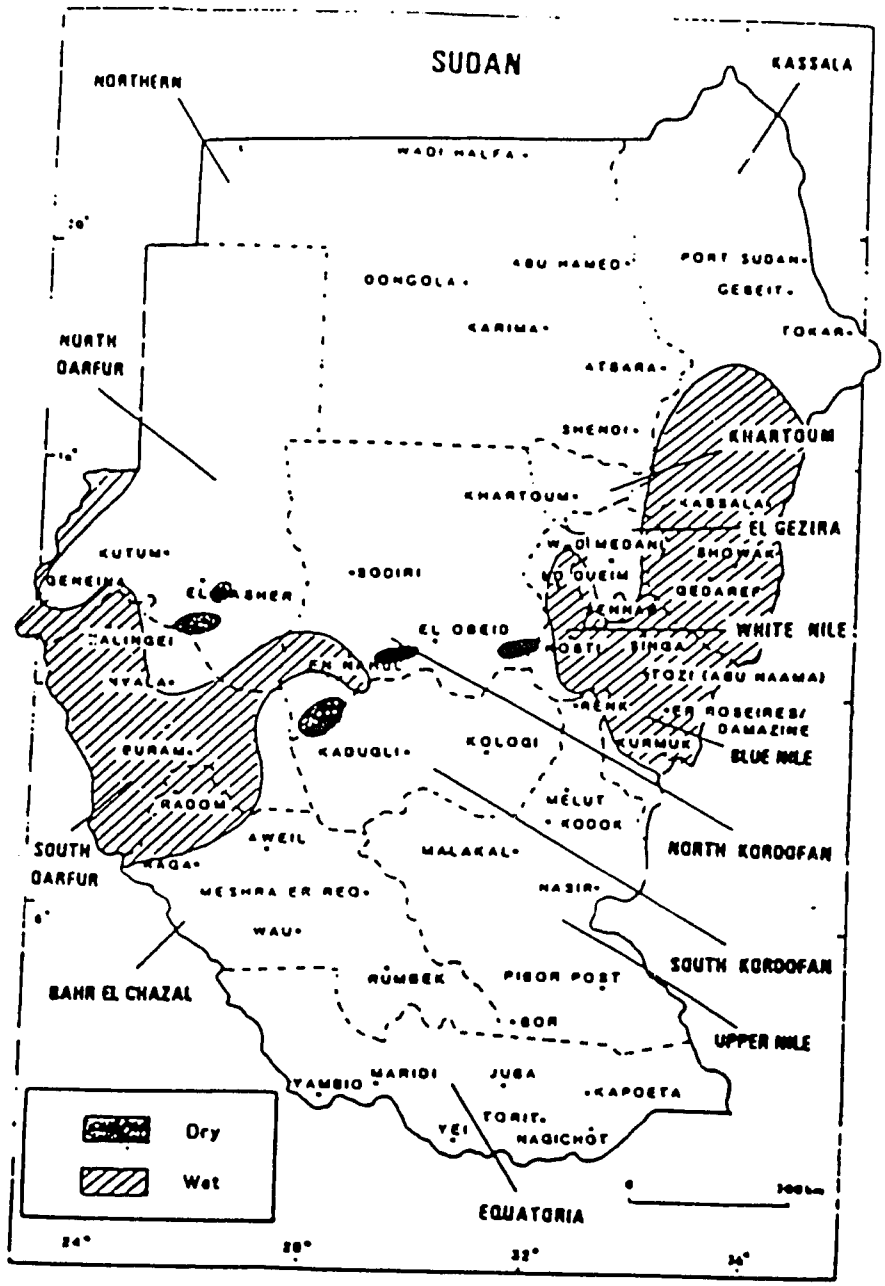


Figure 1

Overview

Crop prospects and rangeland conditions continue to be favorable and are much better than in 1983 and 1984.

Rangeland Vegetation/Biomass Conditions

Analysis of time series and maps of vegetation indices (Figures 2, 3, and 4) shows that the biomass far exceeds 1984 levels and, in most cases, 1983 levels as well. Satellite imagery suggests there are several pockets of dryness and potential grazing problems in Northern Darfur and Northern Kordofan (Figure 1). On the other hand, heavy rains favored grasslands over most of Sudan, particularly in Southern Darfur and eastern areas.

Crop Conditions

Crop conditions in 1985 are significantly improved over 1983 and 1984 throughout the country. Prospects for millet and sorghum in the Darfur and Kordofan regions are very favorable and are projected to be above average to near average. In the major sorghum areas of Kassala and Blue Nile, the 1985 vegetation index indicates production potential up to 30 percent above the 1979-83 average and about 30 to 60 percent above 1983. Other areas are also showing conditions that are favorable and much better than in 1984.

Most areas are now showing decreasing soil moisture reserves. Satellite imagery shows signs of crop maturation. Seed shortages at planting will limit overall production. Additionally, vegetation imagery suggests several "pockets" of dryness (Figure 1) where cereal yields may be below average.

Weather Analysis

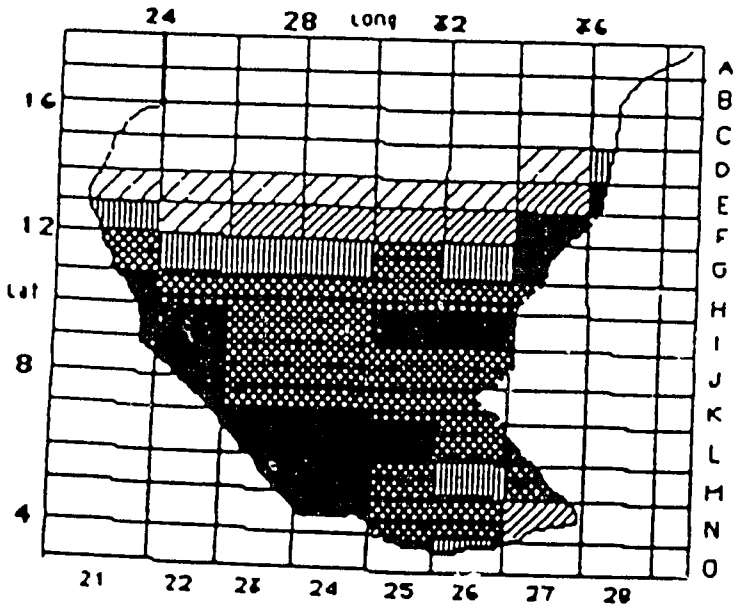
September rains show high variability, but were sufficient for most growing areas. Heaviest rainfalls (above normal) were reported in the Nile Basin and Kassala regions. Further west in Kordofan and Darfur, rainfall was near to above normal in September. May-September rainfall was generally the highest since 1981, when record sorghum yields were established. Estimated totals in the Kassala and Nile regions (Figure 1, Regional Overview) exceeded 120 percent of normal.

EXAMPLES OF TABLES, FIGURES AND SATELLITE PHOTOS THAT WILL BE PROVIDED TO TRAINEES FOR PREPARING THE ASSESSMENT FOR SUDAN.

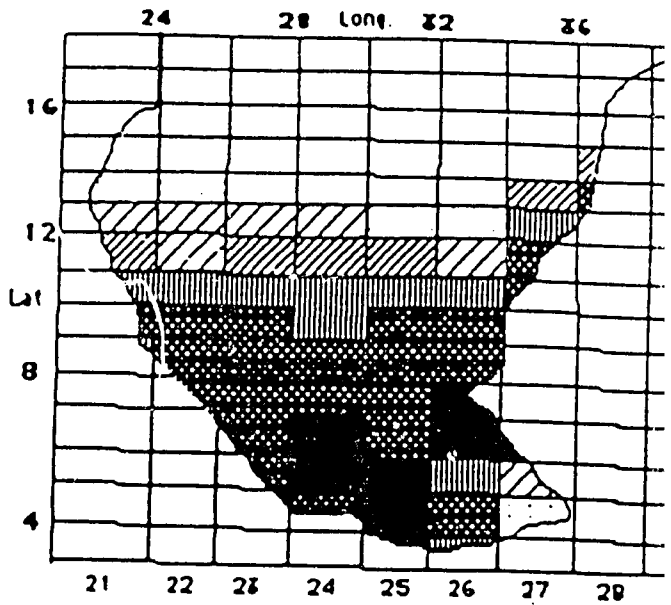
NOAA SATELLITE VEGETATION/BIOMASS INDEX
NORMALIZED AVHRR DATA

SUDAN

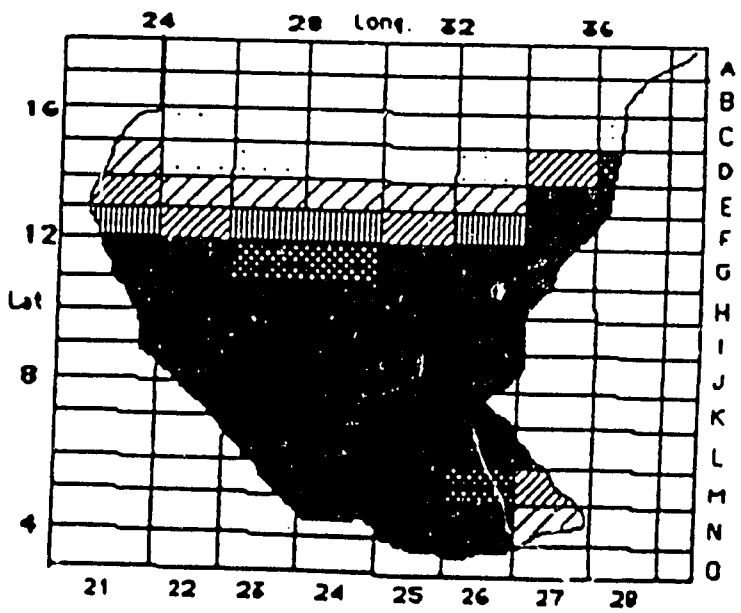
THIRD WEEK OF SEPTEMBER, 1983



THIRD WEEK OF SEPTEMBER, 1984



SECOND WEEK OF SEPTEMBER, 1985



NORMALIZED VEGETATION INDEX SCALE

0 .025 05 10 15 20 25

DECREASING ← VEGETATION → INCREASING

Figure 2

COMPARATIVE NOAA VEGETATION/BIOMASS INDEX
NORMALIZED AVHRR DATA

SECOND WEEK OF SEPTEMBER

SUDAN

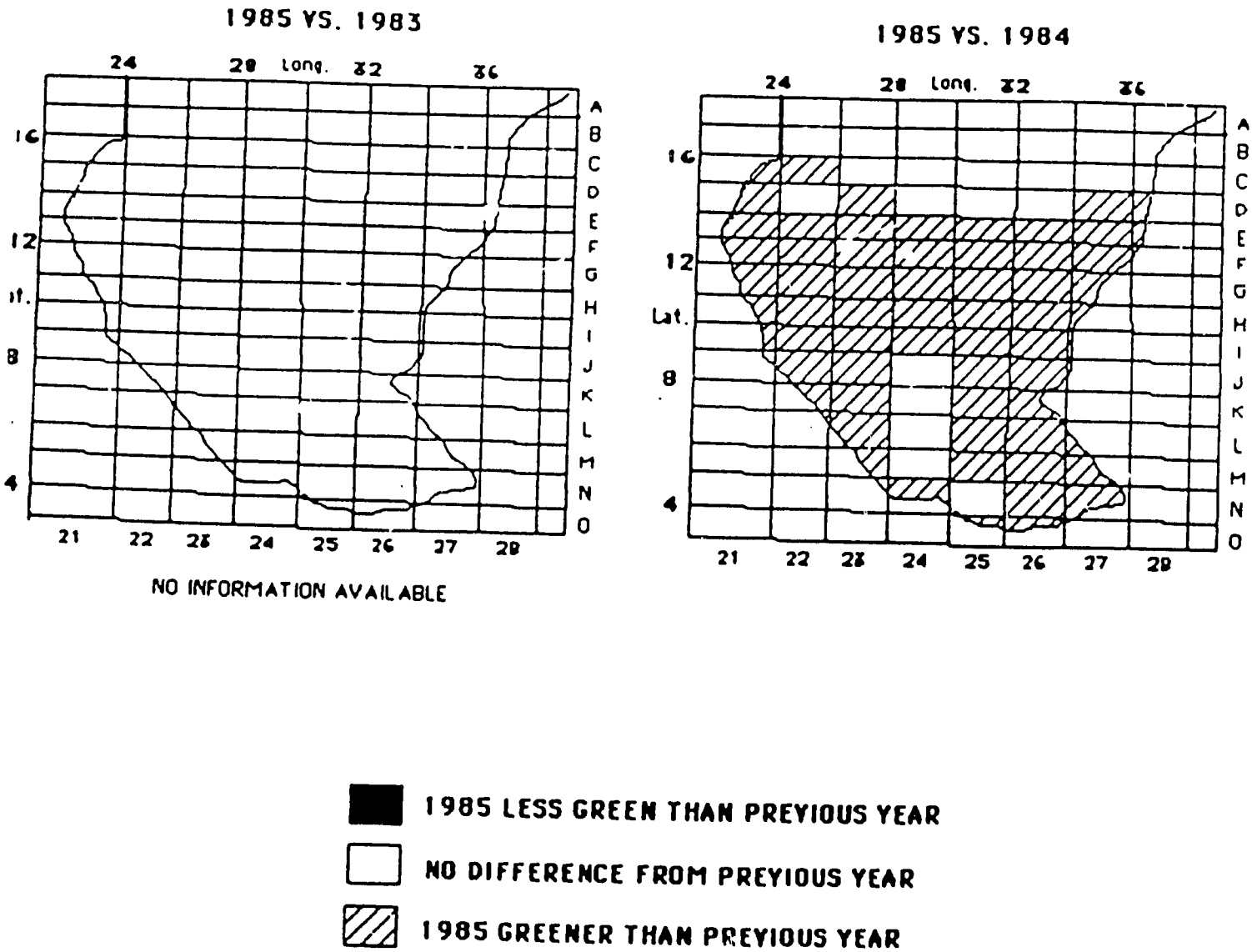


Figure 3

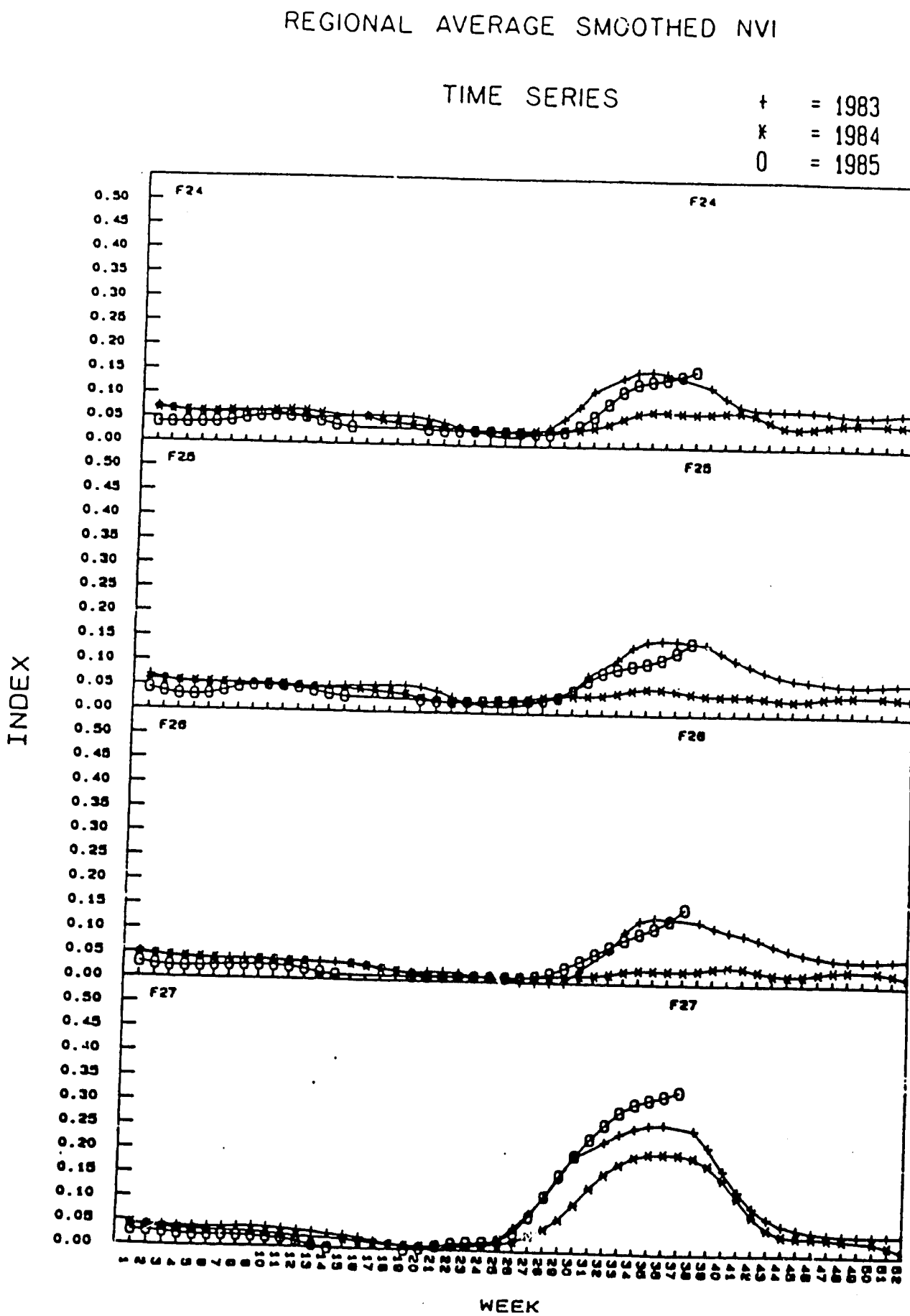

REGIONAL AVERAGE SMOOTHED NVI
TIME SERIES
+ = 1983
* = 1984
0 = 1985
F24
F25
F26
F27
INDEX
WEEK

Figure 4

Cumulative Seasonal Rainfall

Expressed in Millimeters (mm), Percent of Normal (%) and Percentiles (Rnk, on Scale of 0 to 100)

Country: Sudan Year: 1985

Station	May (5)			May - Jun (5-6)			May - Jul (5-7)			May - Aug (5-8)			May - Sep (5-9)			May - Oct (5-10)		
	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk
Abu Hamed																		
Abu Na'Ama																		
Atbara																		
Damazine	100	250	97	200	122	72	415	122	81	575	111	72						
Dongola																		
Ed Dueim	2	50	44	26	96	53	141	150	81	236	118	72						
El Fasher	2	33	53	16	80	50	85	89	47	185	87	47						
El Obeid	5	50	53	32	97	54	160	112	61	265	94	50						
En Nahud	6	50	50	50	94	50	192	109	61	377	125	78						
Gedaref	75	357	94	160	144	81	350	124	78	565	123	86						
Geneina	6	40	53	60	100	58	205	90	53	405	92	50						
Juba																		
Kadugli	37	54	42	142	82	39	333	105	64	478	99	58						
Karima																		
Kassala	60	667	97	99	275	92	202	153	89	347	153	92						
Khartoum	2	50	56	8	89	61	64	114	56	94	72	39						
Kosti	8	50	47	56	92	47	211	122	75	341	108	67						
Malakal																		
Nyala	7	37	33	68	103	58	205	105	53	355	102	50						
Port Sudan																		
Renk	14	54	39	96	98	61	272	123	75	367	100	53						

Cumulative Seasonal Rainfall

Expressed in Millimeters (mm), Percent of Normal (%) and Percentiles (Rnk, on Scale of 0 to 100)

Country: Sudan Year: 1985

Station	May (5)			May - Jun (5-6)			May - Jul (5-7)			May - Aug (5-8)			May - Sep (5-9)			May - Oct (5-10)		
	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk
Sennar	15	115	61	50	70	31	240	118	72	390	106	61						
Shendi																		
Wad Medani	16	114	64	43	96	56	197	131	83	297	106	58						
Wadi Halfa																		
Wau																		

Notes:

' ' = No data for calculations.

'???' = Percent of normal not calculated because average rainfall is zero.

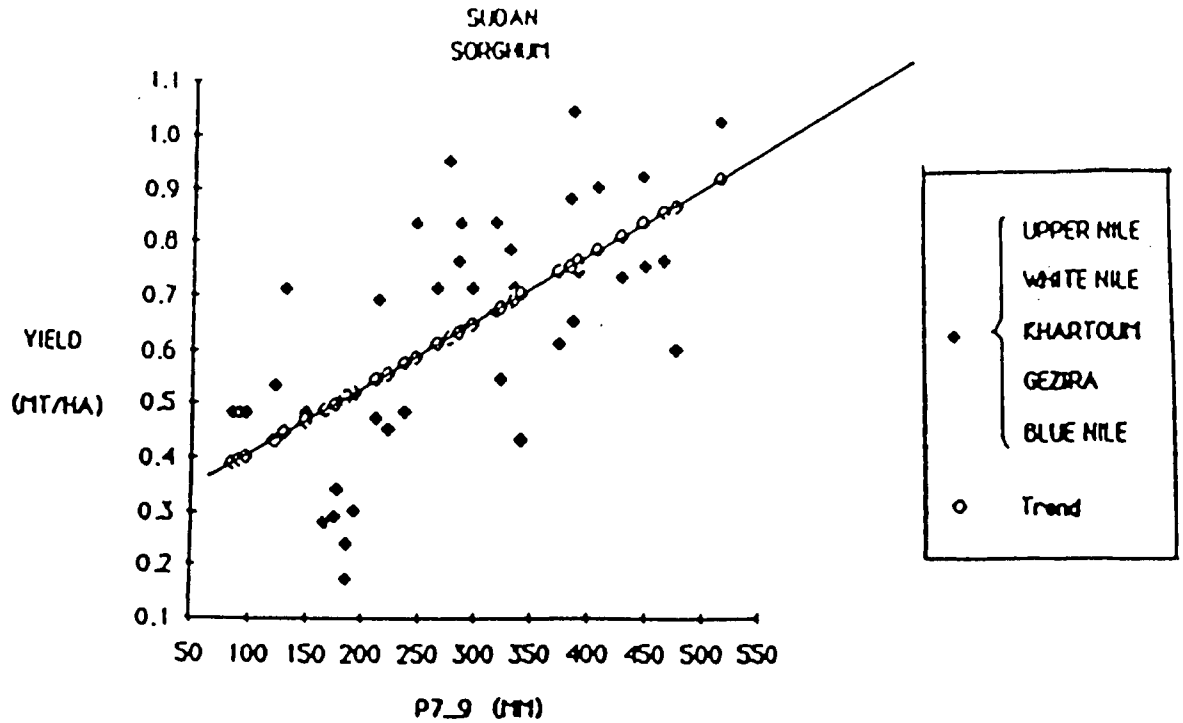
'***' = Percentiles not calculated because less than 15 years of historical data exist on file.

1985 Cumulative Water Balance (FAO Index): Precipitation > 1/2(PET)

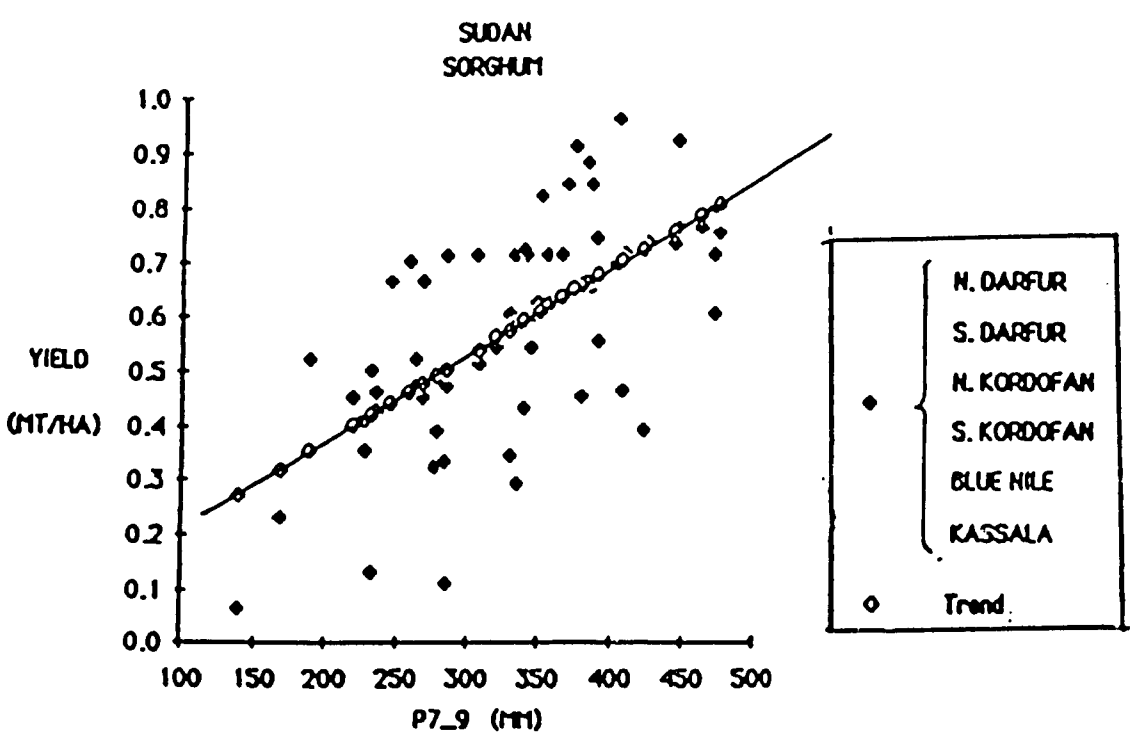
Country: Sudan Station: Kassala

Types/Crop	May (5) 1	May (5) 2	May (5) 3	June (6) 1	June (6) 2	June (6) 3	July (7) 1	July (7) 2	July (7) 3	August (8) 1	August (8) 2	August (8) 3	September (9) 1	September (9) 2	September (9) 3	October (10) 1	October (10) 2	October (10) 3
Pn	2	3	4	4	8	15	26	32	38	33	31	30	23	18	12	6	2	0
Pa							40	38	25	20	55	70						
PET	60	62	69	66	65	64	59	57	59	50	49	55	56	57	56	50	47	48
Kc Rice (Irr)							1.00	1.00	1.00	1.05	1.05	1.05	1.10	1.10	1.10			
CWR (Sum=523)							59	57	59	52	51	58	62	63	62			
Dif							-19	-19	-34	-32	4	12						
SWR							0	0	0	0	4	16						
S/D							-19	-19	-34	-32	0	0						
Ind							96	92	85	79	79	79						

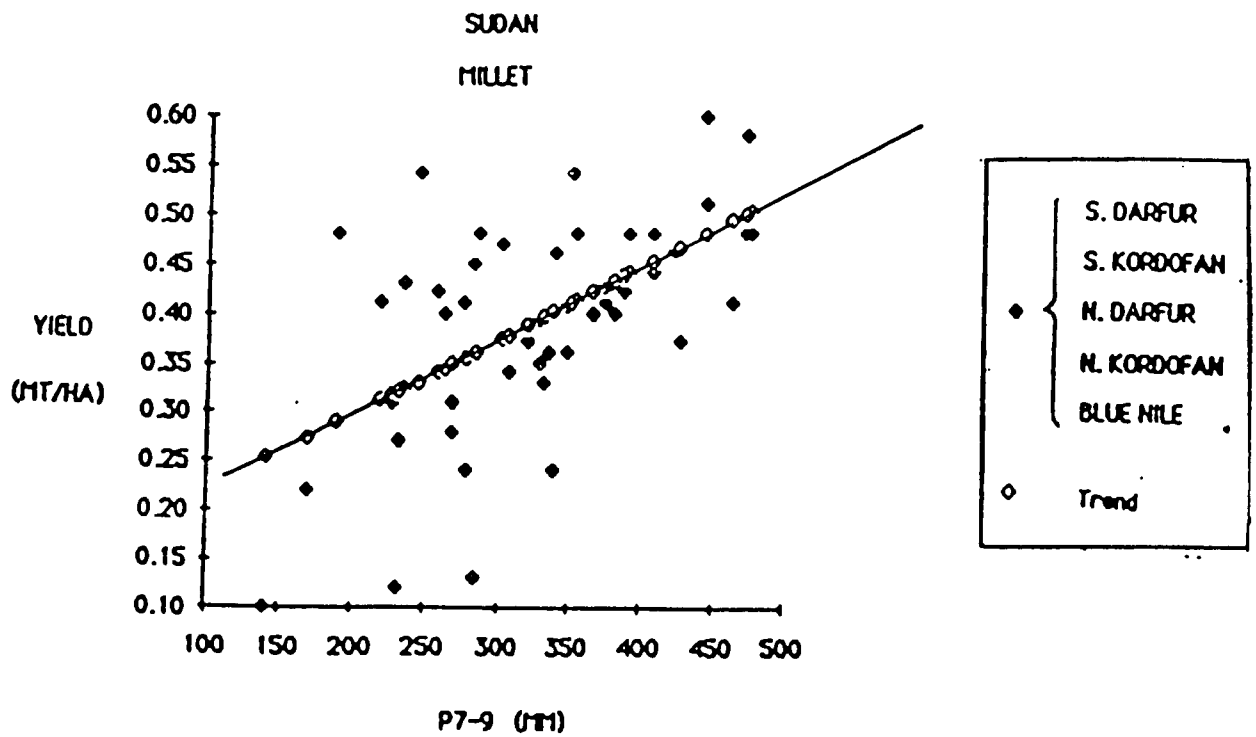
Types: Pn = Normal Precipitation Pa = Actual Precipitation PET = Potential Evapotranspiration
Kc = Crop Coefficients CWR = Crop Water Requirement Dif = Difference (Pa - CWR)
SWR = Soil Water Reserve S/D = Surplus or Deficit Ind = FAO Index



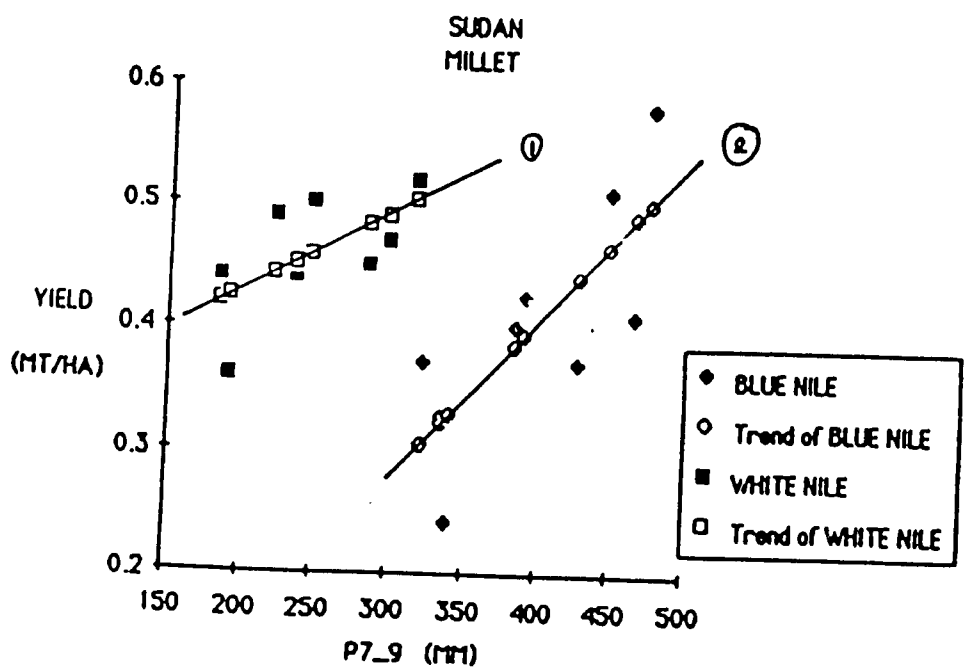
$$\hat{y} = 0.2848 + 0.0012\ P7_9$$



$$\hat{y} = 0.0533 + 0.0016\ P7_9$$



$$\hat{Y} = 0.1499 + 0.0007\,P7_9$$



① $\hat{y} = 0.3021 + 0.0006\ P7_9$

② $\hat{y} = -0.1036 + 0.0013\ P7_9$

INDIVIDUAL COUNTRY ASSESSMENT EXERCISE

Gary E. Johnson

Tuesday-Thursday, April 8-10 - A.M. & P.M.

Objective

To apply the knowledge gained in training to the production of an operational agroclimatic assessment.

Abstract

As a conclusion to the training course, all participants will prepare an actual agroclimatic assessment. Country teams will be formed, data gathered and analyzed, and the assessment prepared. Four days will be available for this concluding project.

I. Introduction

II. Assembly of Available Data

III. Preparation of the Assessment

References

Previous Assessments issued for the 1985 cropping season will be available.