



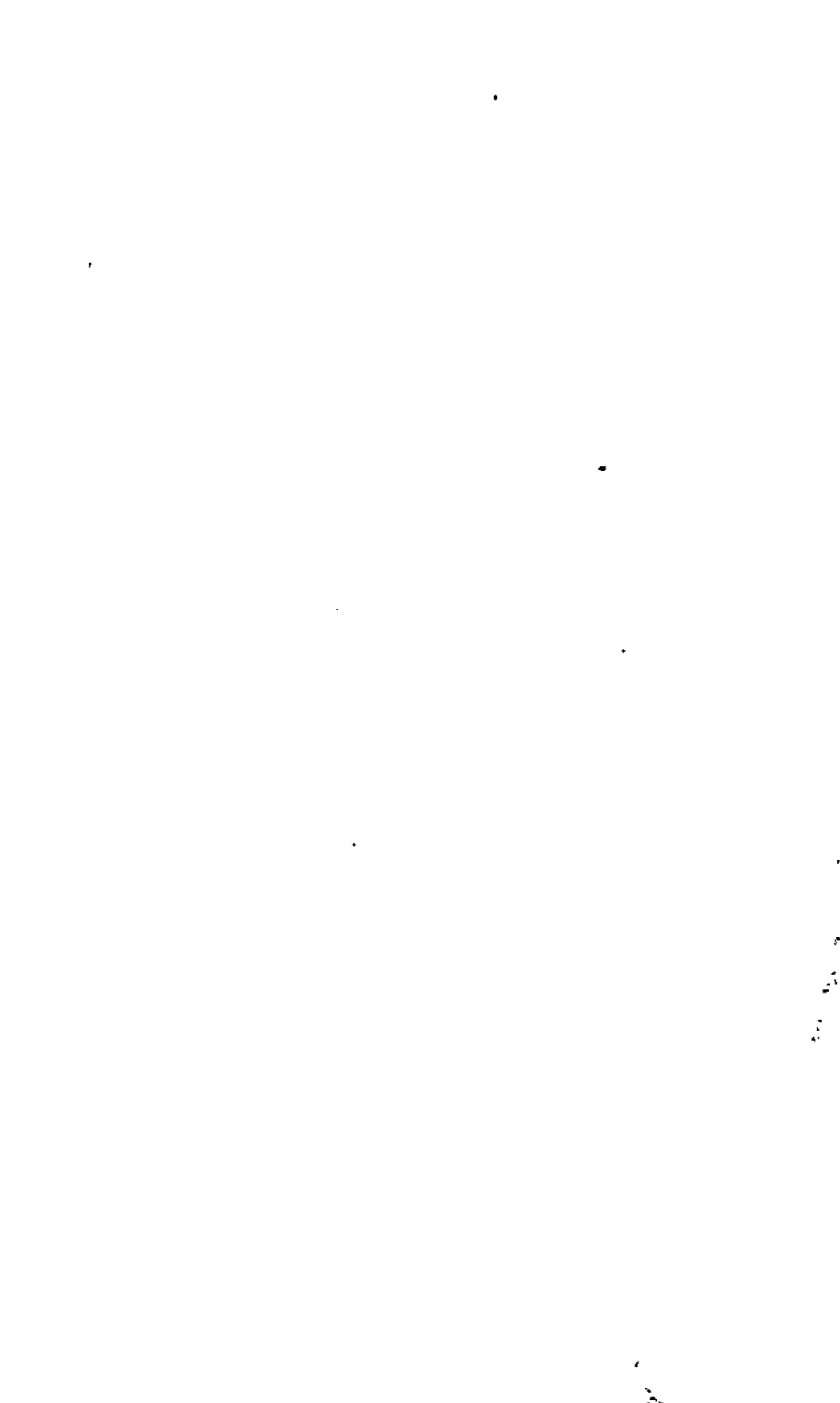
centro de educación continua  
división de estudios de posgrado  
facultad de ingeniería unam



PERCEPCION REMOTA

DR. ING. HANS PETER BAHR

MARZO, 1980



Ausschnitt der Klassenfestlegung für die Photointerpretation in Anlehnung an den Landschaftsdatenkata-  
log der Bundesanstalt für Vegetationskunde, Naturschutz und Landschaftspflege.

34 Abwasseranlagen	77 Landwirtschaft
37 stehende Gewässer	1 Brachland, Ödfläche, Abgrabung
38 fließendes Wasser	2 Grünland
48 Wald	3 Ackerland
62 Industriebetriebe	6 Obstwiesen
63 Industrieflächen	7 Weinbau
64 Wohnungs- und Siedlungsbau	8 Gewächshäuser, Gärtnerei, Baum- schulen
65 Straßenverkehr	9 Straßenbegleitgrün, andere Grün- anlagen, Buschwerk (z. B. Vogel- schutzgebiet)
67 Schienenverkehr	10 Kleingartengebiet
68 Luftverkehr	
71 Erholungsflächen	

Definición  
de clases  
de utilización

2 Ergebnisse Photointerpretation.

ejemplo →		Hartheim	Freiburg	Horben
Fläche [km <sup>2</sup> ]	area	6,2 km <sup>2</sup>	8,1	7,4
Höhenunterschied [m]		3	40	300
Bildmaßstab		1:13000	1:13000	1:21000
Digitalisierungs- grundlage		1:5800	1:6500	1:5000
Interpretation				
Anzahl der Klassen	clases	20	38	18
Arbeitszeit in Std.	duración del trabajo	11 [hours]	15	9
Digitalisieren				
Anzahl der Punkte		731	1240	2876
Anzahl der Polygone		98	152	163
Arbeitszeit in Stunden				
Markieren u. Nummerieren		4,0	6,0	10,0
Digitalisieren		1,0	1,5	3,5
Ablochen der Polygonpunkt- nummern		6,5	11	15
Transformation				
Zahl d. Paßpunkte		7	8	5
mittl. Koordinatenfehler		± 2,3 m	± 4,4 m	± 3,1 m

Resultado  
de foto-  
interpreta

3 Multispektrale Klassifizierung.

	Rechenzeit CPU	10	UNIVAC 1106 Gesamt	in min	Costas Kosten DM
Statistik	0:17	0:43	1:16		12,22 DM
Plot 2 Kanäle	0:54	3:31	4:54		47,75
Klassifizierung (hierarchisch 1 Mill. Punkte)					
3 Kanäle	7:15	0:29	7:54		77,—
25 Klassen					
2 Kanäle	5:18	0:24	5:50		57,—
8 Klassen					
Ausdrucken	4:47	6:27	13:03		128,—
Ergebnisse für Trainingsgebiete bestimmen	0:07	0:23	0:40		7,82

Clasif  
multiesp.

4 Geometrische Entzerrung

	Hartheim	Freiburg	Horben
Anzahl der Paßpunkte	26	23	35
Fenster [Pixel]	803 x 1000	675 x 800	420 x 550
mittlerer Fehler [Pixel]	± 3,4	± 2,7	± 2,4
[m]	17	27	24
Rechenzeit			
[min]	3,28 min	24,8	7,15
Kosten [DM]	35 DM	241	75
max. Winkel [gon]	25,0	56,1	60,3

Rectifi-  
cación  
geométrica

5 Arbeitszeit für die multispektrale Klassifizierung (in Stunden)

	Rechenzentrum	interactivo Prime (geschätzt)
Datei anlegen etc.	1	0,1
Trainingsgebiet bestimmen	3-5	0,5-1,5
Statistik, Eichung berechnen	1-2	0,5-1,0
Klassifizierung u. Wiedergabe	1	0,2-0,5
Kontrolle	1-3	0,1-0,5
Verbessern	1	0,2-0,5
Paßpunktbestimmung	15	2
Gesamt	<i>total</i> ~30	~8

Duración del trabajo por la clasificación multispectral [horas]

6 Kostenabschätzung für eine landesweite Auswertung von Baden-Württemberg.

Datenmengen und Beschaffungskosten				
Luftbilder, 60% Längs-, 30% Querüberdeckung				
Maßstab	<i>escala</i>	1:12.500	1:30.000	
Bilder/100 km <sup>2</sup>		43	7,5	
Bilder für BW		15.500	2.700	
Kosten für BW (DM)	<i>costas fotos</i>	1 Mill. DM	300.000	
Abtaster				
	<i>avión</i> Flugzeug	→	LANDSAT D	LANDSAT 1-3
Flughöhe	2.000 m	4.000 m	915 km	915 km
Bildelementgröße im Nadir	5 x 5 m	10 x 10 m	30 x 30 m	70 x 60 m
Bildelemente/100 km <sup>2</sup>	4 Mill.	1 Mill.	110.000	24.000
Bildelemente BW	1.400 Mill.	360 Mill.	40 Mill.	8,6 Mill.
1.600 bpi CCTs	370	150	10	10
Kosten (Minimum in DM)	500.000 DM	150.000	25.000	3.600
<i>costas</i>				
Auswertung				
		<i>Zeit tiempo</i> (Mannjahre)		Rechenkosten (DM)
Interpretation von Luftbildern	<i>interpretación</i>	<i>años/hombre</i>		
1:12.500		50		
1:30.000		40		
Klassifizierung von Abtasterdaten	<i>clasific.</i>			
Flughöhe 2.000 m		5		350.000
LANDSAT D		0,1-0,2		20.000

Costas aproxim. por el departam. total de Baden-Württemberg [35 754 km<sup>2</sup>]

7 Vergleich *Comparación*

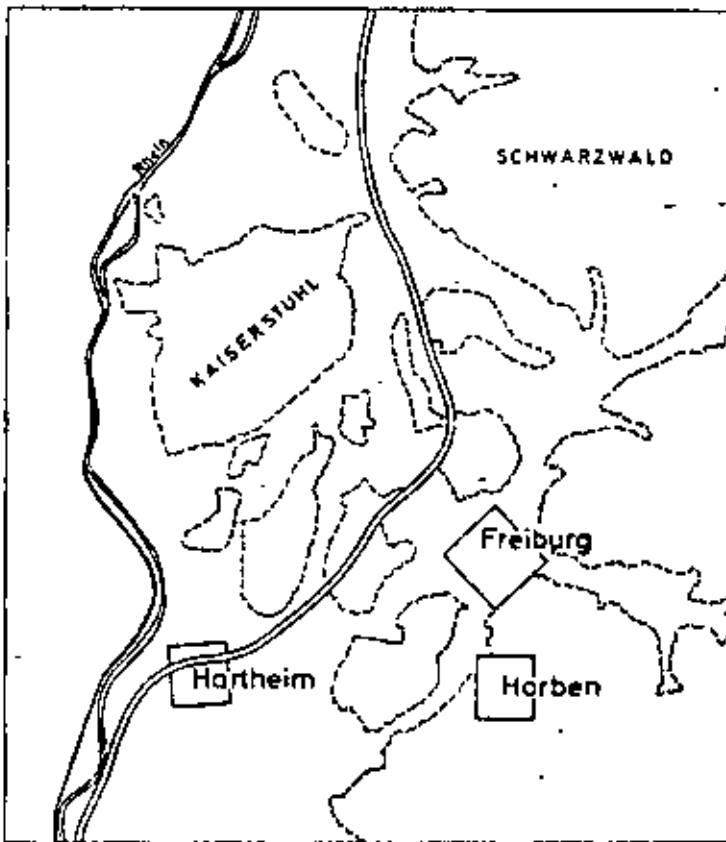
	Photointerpretation 1:12.500	Flugzeug	Klassifizierung LANDSAT D
Kosten <i>costas</i>		<i>muy altas</i>	<i>minimas</i>
Datenbeschaffung	sehr hoch	sehr hoch	gering
Arbeitszeit	sehr hoch	hoch	gering
Rechenkosten	mittel	sehr hoch	gering
Ergebnis <i>resultado</i>			
Material	gut	gut - ausreichend	gut - ausreichend
Funktion	gut	nur bedingt	nur bedingt
Geforderte Klassen	ja	z. T.	z. T.
nicht klassifizierbarer Flächenanteil	—		< 5%
Lagegenauigkeit	2-4 m	~20 m	~20 m
Vorzuziehen bei <i>ventajas</i>	Funktionalen Aussagen Kleine Gebiete	<i>terr. pequeños</i> Kleine Gebiete	Material Landesweit
nicht geeignet für <i>desventajas</i>	sehr große Gebiete rasche Wiederholung	detaillierte Untergliederung Siedlung, Industrie, Sondernutzungen	<i>países</i>

Economía de los métodos distintos

geom.

	Fall Nr.	Ausgangsdaten datos origi- nales Zeilen Spalten files column-	gewünschter Bildmaßstab (Pixel = 50µm x 50µm) escala descada	Maßstabsfaktoren M für factores de la escala Zeilen Spalten	Benutzer Affini- tätsfaktor factor afin actual	Daten nach "DEHN" datos después del tratamient del Zeilen Spalten	Pixel- Anzahl canti- dad [10 <sup>6</sup> ]	tiempo calc. Rechenzei- ten auf der CDC 73/76- Anlage [sec]
escena completa, agrandada, finidad aprox.	1	2340 3264	1:1 Mill.	1.596 1.146	1.392	3734 3740	13,9	82,8
corrección afin	2	3734 3740	1:1 Mill.	1.000 0.985	1,015	3734 3683	13,7	88,3
escena completa minorada, corrección afin	3	2340 3264	1:2 Mill.	0,798 0,564	1,413	1867 1841	3,4	26,3
parte agrandada	4	1632 2091	1:1 Mill.	1,592 1,144	1,392	2597 2391	6,2	80,5
	5	1632 2091	1:0,5 Mill.	3,185 2,288	1,392	5195 4782	24,8	279,1

Restitución de una escena LANDSAT - economía (fuente: Bähr)



Campos de test

Quiel, F. (Karlsruhe) BUL 1979  
Luftbildinterpretation und multispektrale  
klassifizierung zur Gewinnung von Land-  
nutzungsdaten

s.p.a. per le comunicazioni spaziali

## PRICE LIST EARTHNET STANDARD LANDSAT DATA

January 1st, 1979

### DIGITAL PRODUCTS

#### — MSS data

Quick look Computer Compatible Tape - CCT -  
1600 bpi, 9 track, 1 band, uncorrected US \$ 62.00

System corrected Computer Compatible Tape - CCT - 1600 bpi, 9 tracks, band  
4-5-6-7, containing an area of km 185x185 US \$ 370.00

#### — RBV data (\*)

Computer Compatible Tape containing an area of km 98x98 (corresponding to 1/4 of  
the area contained in one MSS CCT) US \$ 370.00

### PHOTOGRAPHIC PRODUCTS

#### — MSS data

Quick look print B/W, band 7, cm 12,5x18 US \$ 1.25

#### System corrected images:

70 mm film B/W 1 band US \$ 50.00

4 bands US \$ 110.00

240 mm film B/W 1 band US \$ 56.00

4 bands US \$ 125.00

240 mm print B/W 1 band US \$ 50.00

4 bands US \$ 110.00

Digitally enlarged images: prices as above.

Possible enlargement factors: 2, 3, 4, 5, 6, 8, 10.

Subscription to quick look prints: price per year: US \$ 17.00

#### — RBV data - (\*)

70 mm film B/W US \$ 62.00

240 mm film B/W US \$ 68.00

240 mm print B/W US \$ 62.00

(\*) Raw data. System corrected images not yet available.

### REMARK

Slight price variations can be applied in connection with variation in the rate of exchange.

To order please contact:

TELESPAZIO S.p.A. per le Comunicazioni Spaziali  
Remote Sensing Data User Bureau and Browse Room  
Corso d'Italia 42-43  
00198 ROME  
phone 39 6 8497306  
Telex 61065-I, 611596

## Aproximación teórica por el cálculo de métodos distintos de clasificación numérica

Fuente: Bähr

## 1. Maximum-Distance-Methode MD

$$RZ_{MD} = (n \cdot t \cdot \text{mult} + nt \cdot \text{add} + t \cdot \text{vergl}) \cdot \text{anz}$$

## 2. Maximum-Likelihood-Methode ML

$$RZ_{ML} = (2n^2 t \cdot \text{mult} + (n^2 - 1)t \cdot \text{add} + t \cdot \text{vergl}) \cdot \text{anz}$$

## 3. Quadermethode Q

$$RZ_Q = 2nt \cdot \text{vergl} \cdot \text{anz} + RZ_{ML} \cdot RZ_{MD}$$

(für eindeutige Punkte)                      (für Punkte im Oberdeckungsbereich)

Hierin bedeuten:

	<u>tiempo calculador</u>		<u>cantidad de</u>
<u>add</u>	Rechenzeit für 1 Addition	n	Kanalanzahl <u>bandas</u>
<u>mult</u>	Rechenzeit für 1 Multiplikation	t	Klassenanzahl <u>clases</u>
<u>vergl</u>	Rechenzeit für 1 Vergleichsoperation	anz	Anzahl Bildpunkte pro Szene <u>Pixels por escena</u>

Bezogen auf die Klassifizierung einer LANDSAT-Szene ( $\text{anz} = 3200 \times 2300 = 7,4 \cdot 10^6$  Bildpunkte) mit  $n = 2$  Kanälen und  $t = 7$  Klassen ergeben sich somit für die CDC-CYBER 76-Anlage des Regionalen Rechenzentrums Niedersachsen.

(add = 110 ns, mult = 137 ns, vergl = 192 ns im Mittel)

ejemplo: 2 bandas, 7 clases,  $7,4 \cdot 10^6$  pixels

$$RZ_{MD} = 35,5 \text{ s}, \quad RZ_{ML} = 83,8 \text{ s}, \quad RZ_Q = 54,4 \text{ s}.$$

↓  
30% de los puntos superponidos

Bei der Quadermethode wurden 30 % der Punkte im Oberdeckungsbereich angenommen. Die angegebenen Rechenzeiten enthalten keine Zeiten für Eingabe, Ausgabe, Speicheroperationen usw. Sie gelten nicht absolut, sondern erlauben nur einen relativen Vergleich des Rechenaufwandes der einzelnen Algorithmen untereinander.

Los resultados no contienen los tiempos por la emisión de los datos etc.



Produktion von 100 000 km<sup>2</sup> in 1 : 50 000

Producción de 100.000 km<sup>2</sup>, escala 1 : 50.000

Kartierung Producc. de mapas

m<sub>b</sub> : 1 : 56 000

~ 2 800 Modelle

~ 14 000 effektive Bildflugkilometer  
[km]

Kartierung → 8-10 Gerätejahre Zweischicht  
24 000 - 30 000 Mann-Geräte-  
stunden am topographischen 1 100 000 -  
Auswertegerät : 1 380 000 DM

Aerotriangulation → 1,4 Gerätejahre Einschicht  
2 240 Mann-Gerätstunden am  
Präzisions-Auswertegerät: 180 000 DM  
  
2 240 Mannstunden Vorbereitung: 90 000 DM  
  
Rechenkosten 2 800 Modelle : 112 000 DM

Bildflug → 14 000 km à DM 36,- : 500 000 DM  
→ 2,0 - 2,3 Mill.  
DM

Gerätebedarf: 1 Präzisions-Auswertegerät  
4-5 topographische Auswerte-  
geräte

Zeitbedarf ~ 2 Jahre

Kostenvergleich Luftbildphotogrammetrie/Satellitenphotogrammetrie (Auswertung im Maßstab 1 : 50 000)

Comparación de costas : Producción de mapas 1:50.000 (A : fotogr. clásica / B : fotogr. de satélite)

Aerea Fläche M km <sup>2</sup>	Kosten [M DM] B										
	A					Satellitenphotos			B		
	Luftbilder 1 : 56 000	Kartie- rung pred. de mapas	Kartie- rung 30% Fortf. revista	Luftbilder 1:100 000	Ortho- photo	Space Shuttle	Freiflie- gender Sa- tellit 1.Mission	Freiflie- gender Sa- tellit 2.Mission	Kartie- rung	Kartie- rung 30% Fortf.	Ortho- photo
1	5	14,8	4,45	2,9	3,85				9,7	2,9	1,35
15,75	78,8	233,4	70,0	45,7	60,6	8			152,3	45,7	21,2
31,50	157,5	466,8	140	91,3	121,3	16			304,6	91,4	42,4
47,25	236,2	700,2	210	137,0	181,9	32			456,9	137,1	63,6
63	315	933,7	280	182,7	242,6	40			609,2	182,8	84,8
78,75	393,8	1167	350,1	228,4	303,2	48			761,5	228,5	106,0
94,50	472,5	1400,4	420,1	274,0	363,8	56			913,8	274,2	127,2
110,25	551,2	1633,9	490,2	319,7	424,5	64			1066,1	319,9	148,4
126	630	1867,3	560,2	365,4	485,1	72			1218,4	365,6	169,6
141,75	708,8	2100,7	630,2	411	545,7	80			1370,7	411,3	190,8
150	750	2223	666,9	435	577,5						
157,50	787,5	2334	700,2	456,7	606,4	88	96	30	1523,0	457,0	212,0

Zum Vergleich (in Mkm<sup>2</sup>) : Europa 10,1 , Asien 44,2 , Afrika 30,3 , Nord/Mittelamerika 24,2  
Südamerika 17,8 , Australien/ozeanien 8,9 , Antarktis 14,0

Arbeitsleistung und Kosten  
**Trabajos y costas**

Producción de mapas  
 topográficos 1:100 000 y  
 1:50 000

Método fotogramétrico  
 clásico

Arbeitsleistung

Stereokartierung

Leistung:  $L [ha/h] = K \cdot m_K / 1000$

( $m_K =$  Kartenmaßstabszahl)

Efecto:

horas por

Kartier- maßstab	K		ha/h (km <sup>2</sup> /h)	Stunden pro	
	Mittelwert	Bereich		Bildpaar per de fotos	Kartenblatt 50x50cm <sup>2</sup>
1: 50 000	6	3-15	150-750 (1,5-7,5)	35-7	450- 85
1:100 000	10	5-20	500-2000 ( 5 - 20)	20-5	500-125

hoja de  
 mapa

Bildflug → Bildmaßstäbe für Stereokartierung

Vuelo → escalas

mapa Kartiermaßstab	imagenes Bildmaßstab
1 : 50 000	1 : 56 000 - 1 : 67 000
1 : 100 000	1 : 79 000 - 1 : 95 000

Orthophotoauswertung

1 Modell → 5,5 Mann-Gerätstunden + 1 Mannstunde Bearbeitung

1 Doppelmodell → 9 Mann-Gerätstunden + 1 Mannstunde Bearbeitung

Bildflug → Bildmaßstäbe für Orthophotoauswertung

Auswertemaßstab	Bildmaßstab
1 : 50 000	1 : 100 000 - 1 : 130 000
1 : 100 000	1 : 200 000 - 1 : 250 000

Aerotriangulation

Preparación

horas por hombre

Vorbereitung

- 0,2 - 1,0 (Mittel 0,8) Mannstunden

mediciones:

Messung unabhängiger Modelle  
 an Analoggeräten

0,5 - 1,0 (Mittel 0,8) Mann-Geräte-  
 stunden pro Modell

Messung von Bildkoordinaten  
 an Komparatoren bzw.  
 analytischen Auswertegeräten

0,1 - 1,0 Mann-Gerätstunden pro  
 Bild

KostenGerätekosten *Costas instrumentales*

→ Jährliche Kosten:  
C. anuales

$$K = K_0(z+1/n)$$

$K_0$ : Anschaffungspreis

$z$ : Zinssatz (12 %) *intereses*

$n$ : Abschreibungszeit (5) *Amortización*

→ Kosten pro Stunde:  $K/3000$  bei <sup>2 turnos</sup> Zweischichtbetrieb (für Mittel- und  
 $K/1600$  bei <sup>1 turno</sup> Einschichtbetrieb (Westeuropa))

Präzisions-Auswertegerät, Orthoprojektor

K: 64 000,- DM

Einschichtbetrieb 40,- DM/h

Zweischichtbetrieb 21,- DM/h

Topographisches Kartiergerät

K: 19 000,- DM

Einschichtbetrieb: 12,- DM/h

Zweischichtbetrieb: 6,- DM/h

Analytisches Auswertegerät

K: 160 000,- DM

Einschichtbetrieb: 100,- DM/h

Zweischichtbetrieb: 53,- DM/h

Mosaico de 4 fotografías foto -  
gramétricas (Original 23 cm x 23 cm,  
escala 1:20.000)



1

Camera Fotogramétrica

h= 3000 m

M= 20.000

D= 0,5 m

Camera Hasselblad

h= 3000 m

M= 150.000

D= 2,5m

Hasselblad - 35 mm (Tamaño  
origin.)



2

Scanner M<sup>2</sup>S

h= 3500 m

M= 300.000

D = 9 m

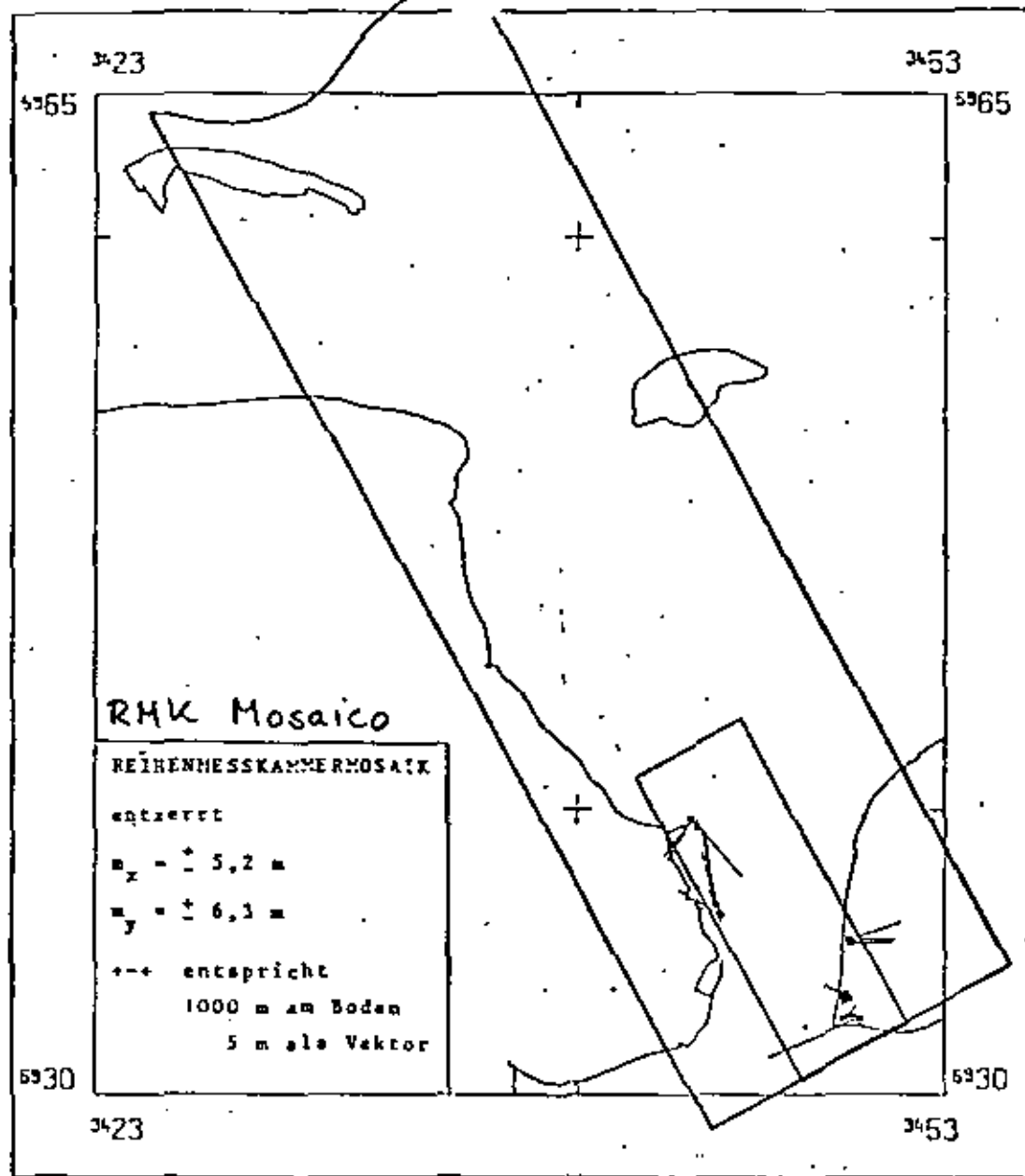
LANDSAT

h= 935 km

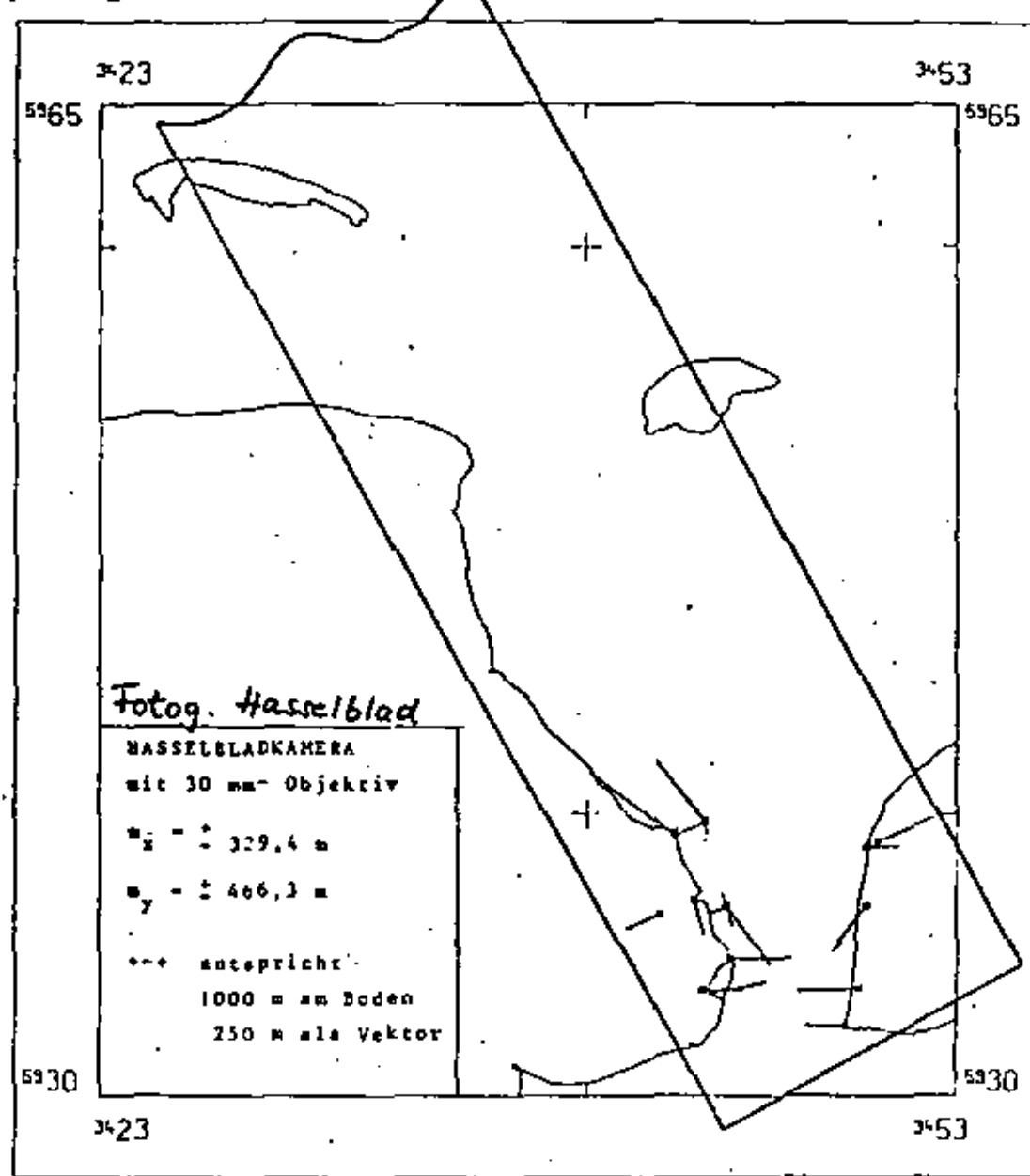
M= 1000.000

D= 79 m

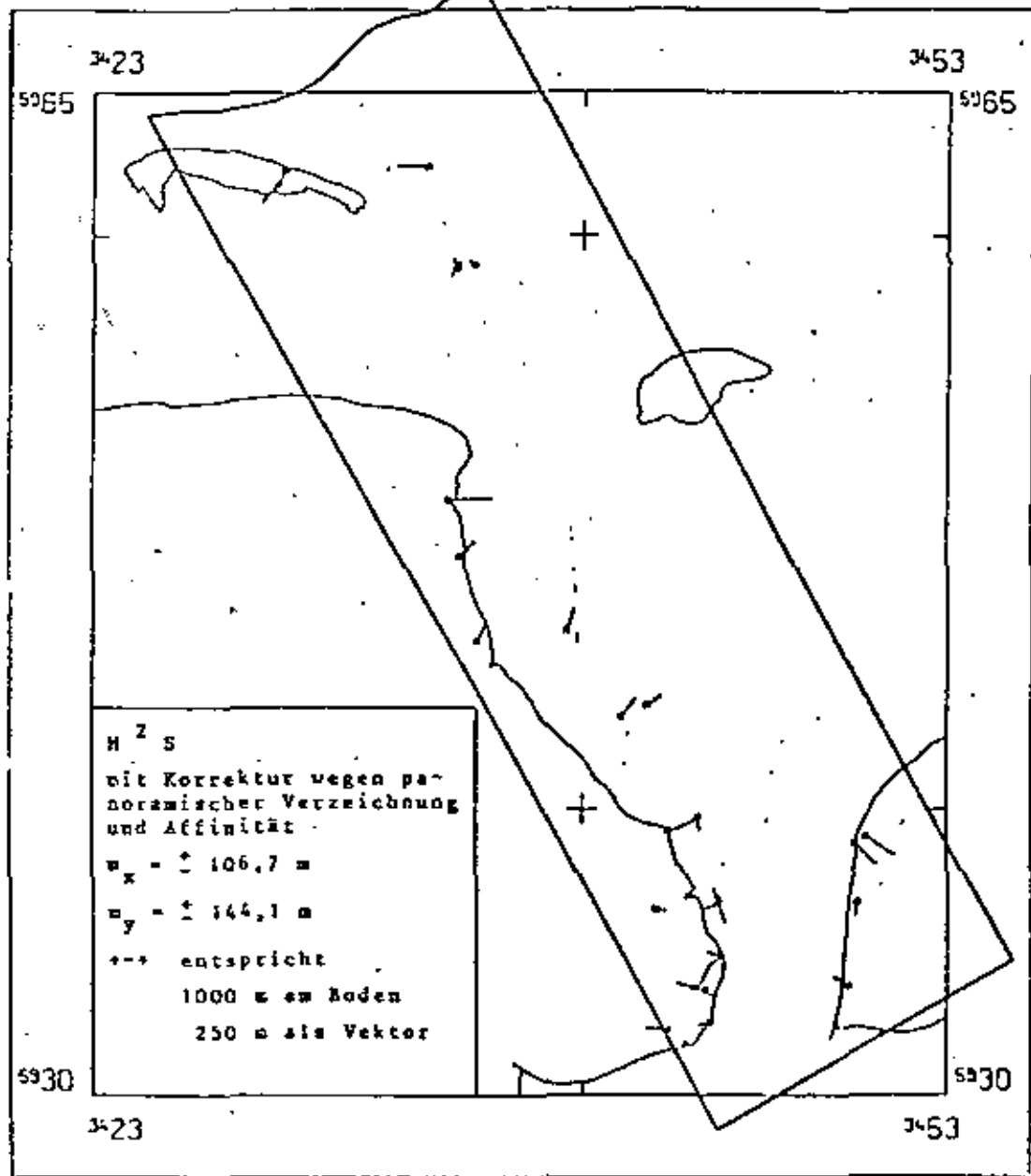




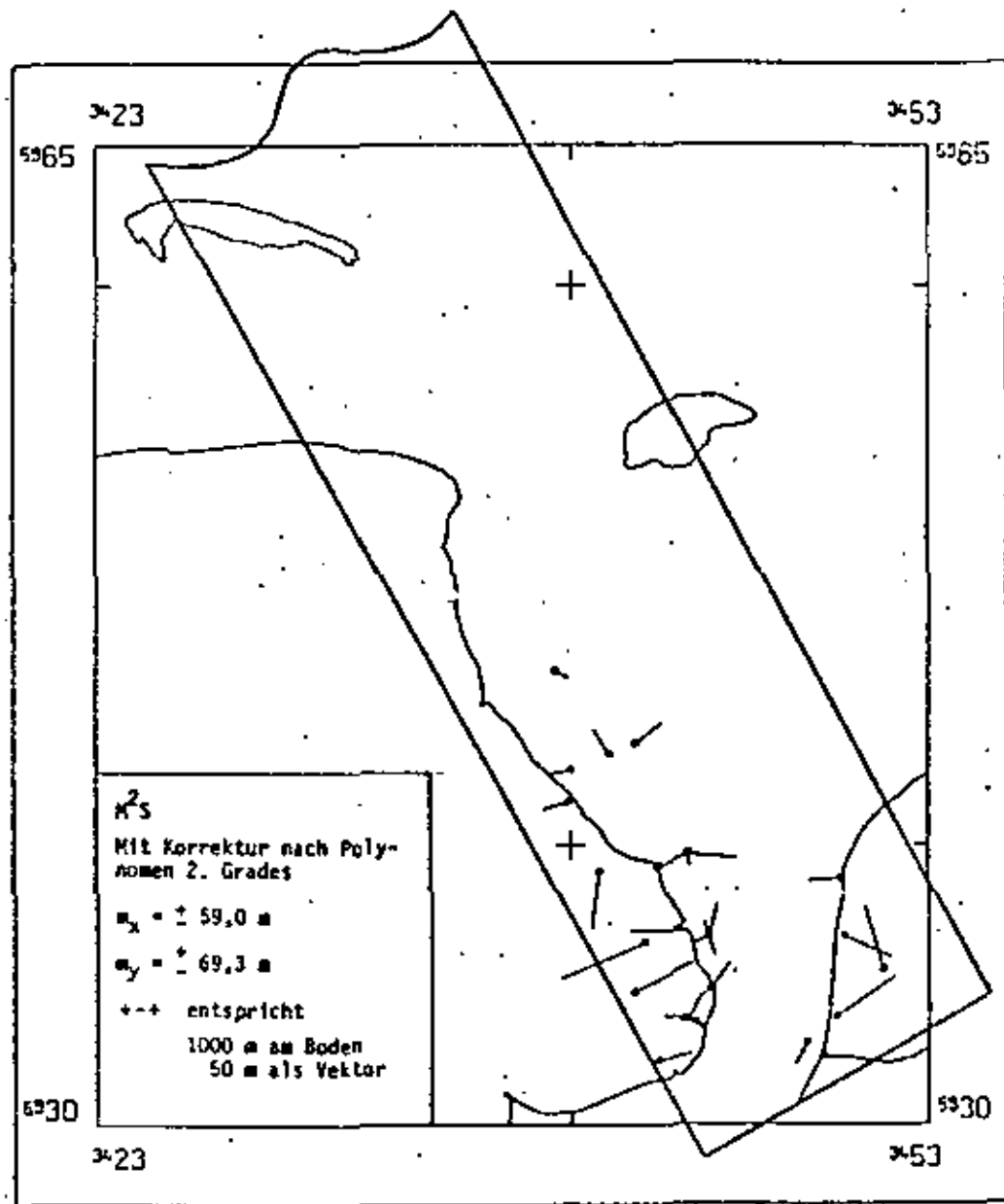
1 Restfehler nach Helmerttransformation



2 Restfehler nach Helmerttransformation



d



e



	NR	Anzahl Zeilen <i>filas</i>	Anzahl Spalten <i>columnas</i>	Faktor	Rechenzeiten [sec] <i>tiempos calcul.</i>
b (Original)	-	6400	804	-	-
c Panorämische Entzerrung	39	6400	1095	-	120
d Affine Stau- chung	3	4571	1095	1,4	100
e Entzerrung nach Polyno- men	54	2000	1095	-	180



a.  
Original



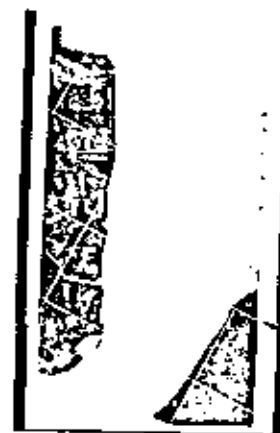
b  
Original  
(zeintas)



c  
Correcc.  
Panorämica

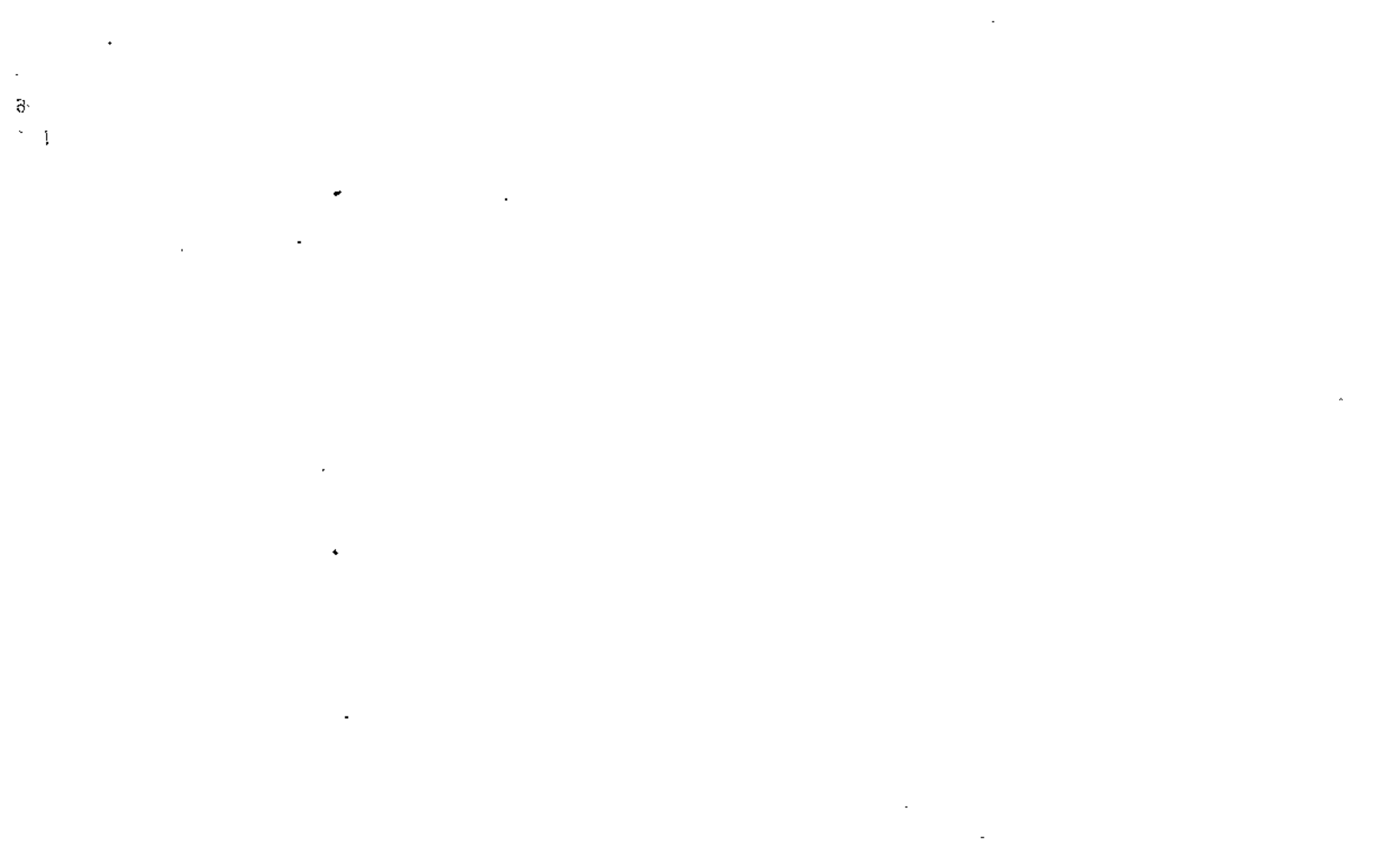


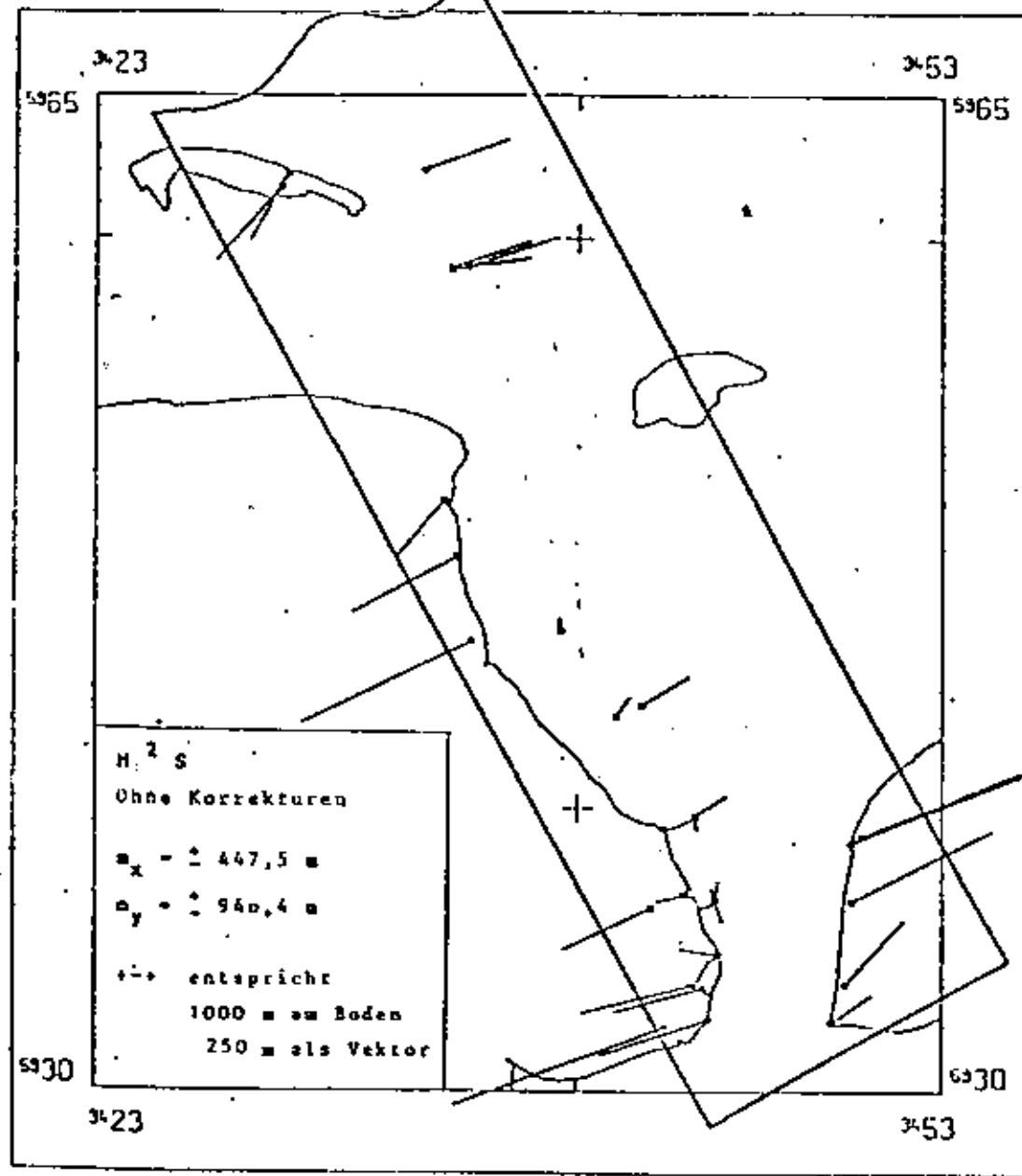
d  
Correcc.  
Afin



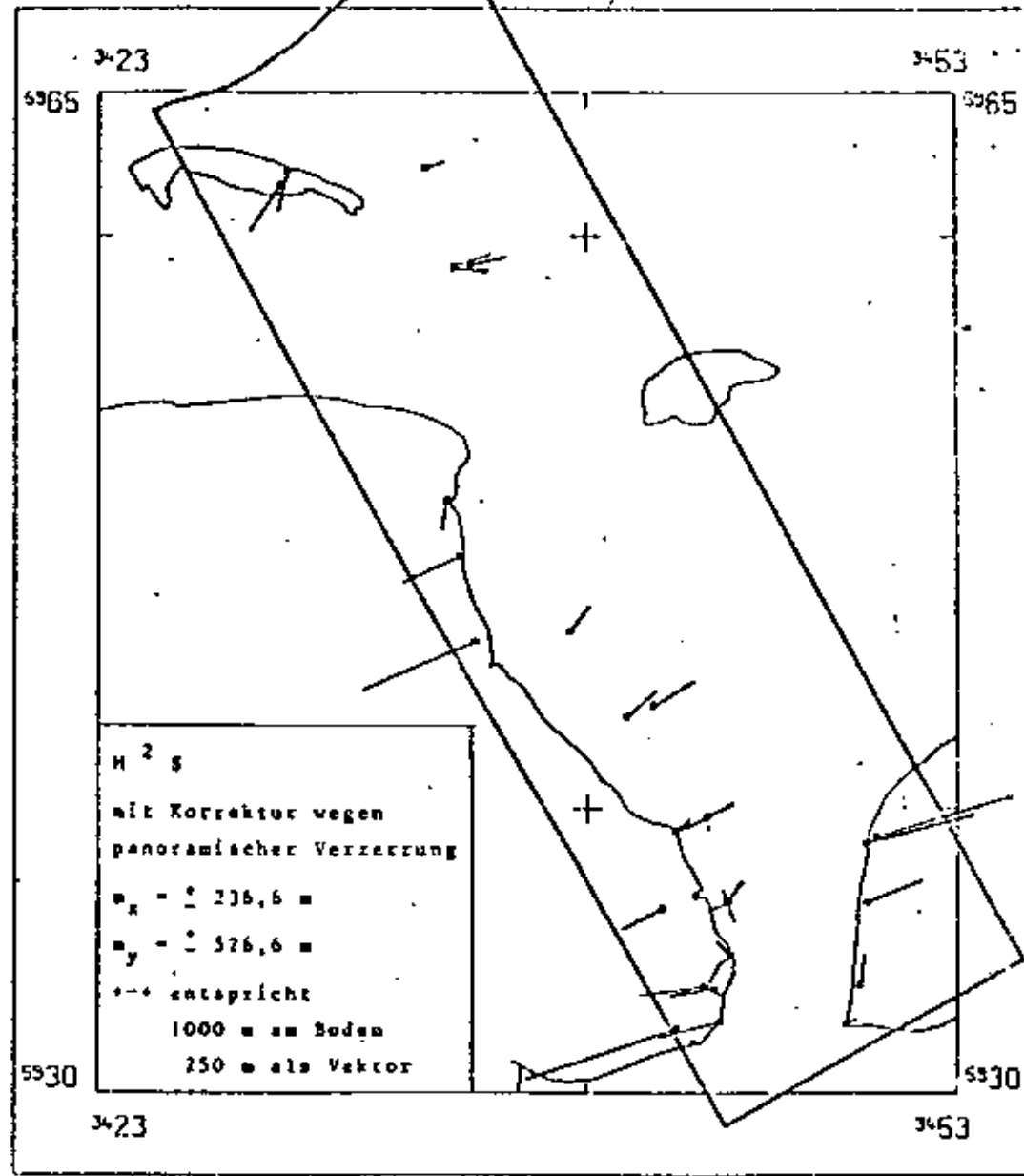
e  
Correcc.  
Polinom.

4 km





6

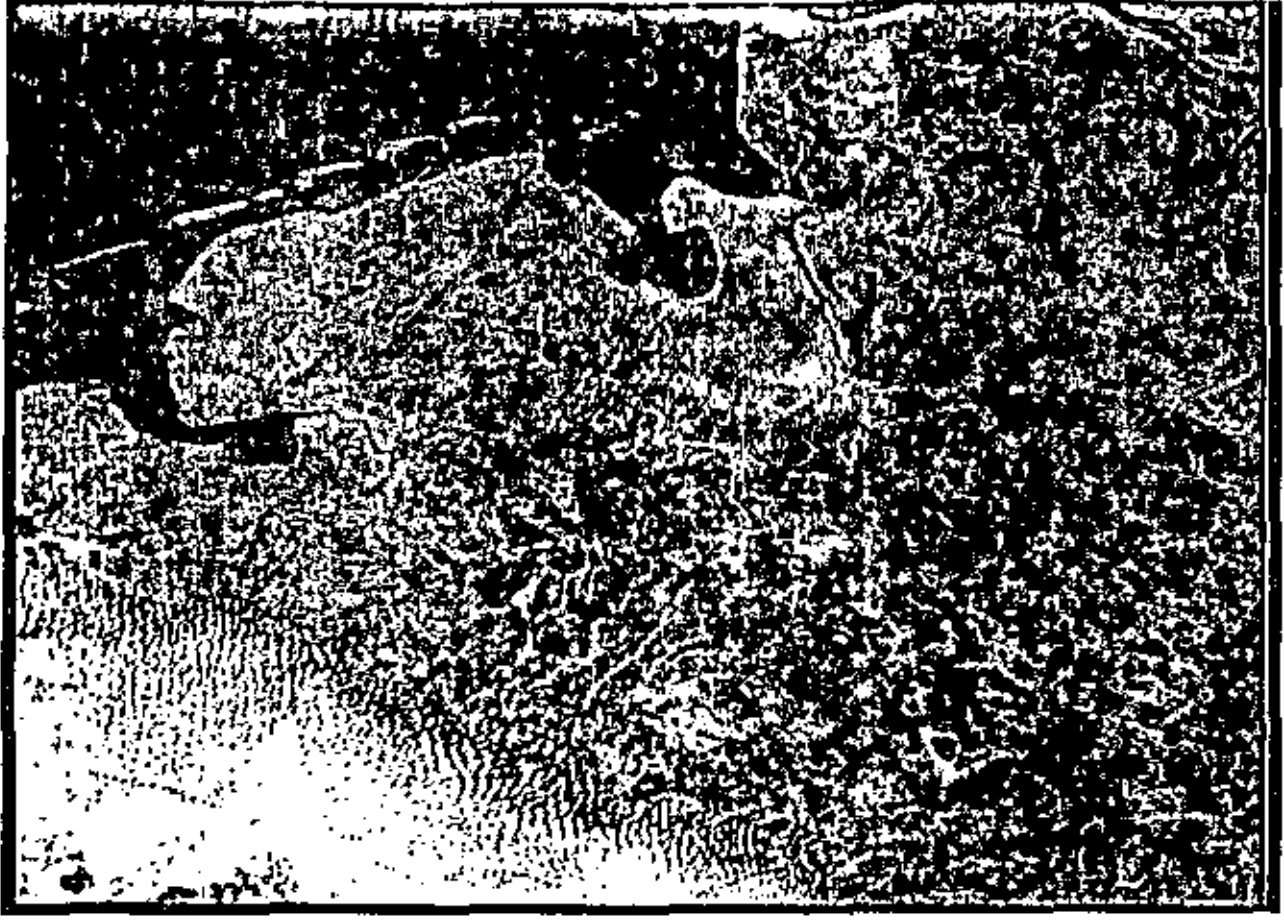


7

3

Restfehler nach Helmert-Transformation









c



d





	Original		Korrektur wegen						Anwendung Polynom		Bestes Ergebnis in Einheiten des Auflösungselements	
			Panoramischer Verzerrung		Affinität		Erddrehung					
	$m_x$ ± [m]	$m_y$ ± [m]	$m_x$ ± [m]	$m_y$ ± [m]	$m_x$ ± [m]	$m_y$ ± [m]	$m_x$ ± [m]	$m_y$ ± [m]	$m_x$ ± [m]	$m_y$ ± [m]	$m_x$ ±	$m_y$ ±
1 Reihenmeßkammer (15/23)-Mosaik	5,2	6,3									10,4	12,6
2 HASSELBLAD- 30 mm Oberweitwinkel	329,4	466,3									131,8	186,5
3 M <sup>2</sup> S	447,5	940,4	236,6	526,6	106,7	144,1			59,0	69,3	6,8	7,9
4 LANDSAT Jade					87,8	93,2	45,0	44,2			0,6	0,6
LANDSAT Nord- fries.Watt							89,7	78,8	25,7	51,3	0,5	0,8

Genauigkeitsvergleich der Bildgeometrie verschiedener Sensoren

*Comparación geométrica de sensores distintos*

minimación de errores geom.

$$m_{x,y} = \pm \sqrt{\frac{\sum_{i=1}^n \epsilon_i^2}{n}}$$

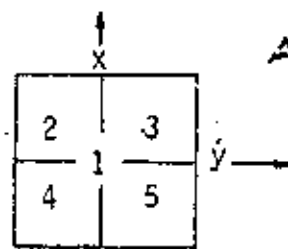
wobei  $\epsilon_i = x,y(\text{Karte})_i - x,y(\text{Bild})_i$

AT:

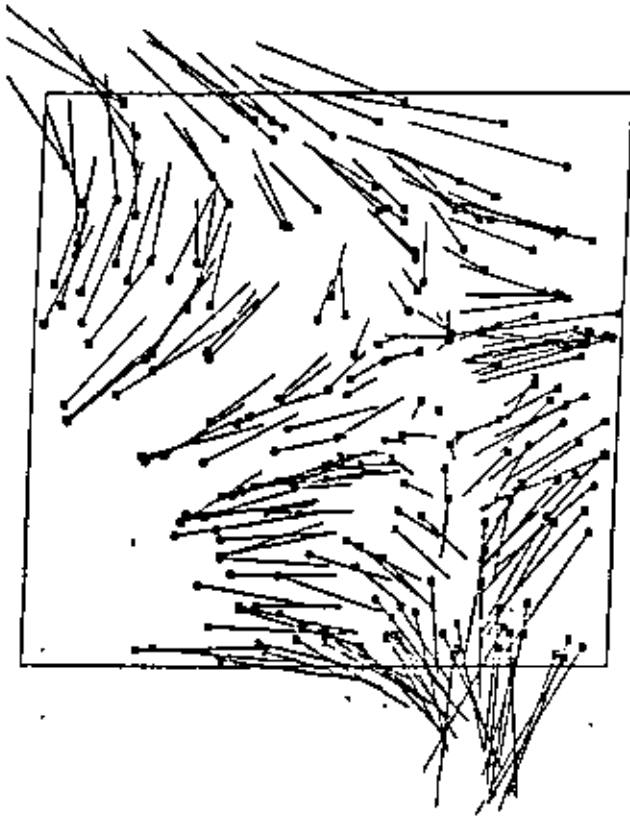
Bayern (Originalbild)					Norddeutschland						
Area N.º. Gebiet	Puntos de apoyo Gesamtzahl Paßpunkte (total)	Verwendete Paßpunkte (usadas)	$m_x \pm$	$m_y \pm$	Gesamtzahl Paßpunkte	Verwendete Paßpunkte	Originalbild		Affin korrigiertes Bild		
							$m_x \pm$	$m_y \pm$	$m_x \pm$	$m_y \pm$	
1	2	3	4	5	6	7	8	9	10	11	
1	234	234	215,0	245,3	82	82	322,8	356,3	112,4	109,4	
		9	239,5	260,7			9	340,9	359,8	77,7	125,9
		4	223,2	309,7			4	293,2	479,1	130,8	168,7
2	43	43	133,3	118,2	26	26	92,4	112,1	81,3	85,6	
		9	130,4	133,9			9	97,6	118,0	78,6	90,4
		4	114,9	178,6			4	95,2	120,1	88,2	97,2
3	62	62	112,9	136,6	18	18	193,2	201,1	66,3	55,2	
		9	162,6	108,9			9	159,4	246,1	67,7	54,6
		4	141,8	138,2			4	187,6	258,3	92,4	74,0
4	49	49	75,3	98,9	17	17	160,1	103,6	57,0	50,7	
		9	76,8	97,6			9	147,7	127,0	55,3	58,7
		4	77,1	98,4			4	166,7	99,1	65,9	56,9
5	80	80	180,2	171,1	21	21	241,6	296,2	94,2	153,1	
		9	176,8	175,6			9	306,0	268,1	133,3	133,7
		4	189,1	171,6			4	285,0	325,4	117,6	160,2
2,3 4,5	234	4	145,7	148,9	82	4	208,2	218,6	93,1	106,2	

Errores standard después de transformaciones HELMERT  
Mittlere Fehler am Boden in [m] aus Restfehlern nach Helmerttransformationen

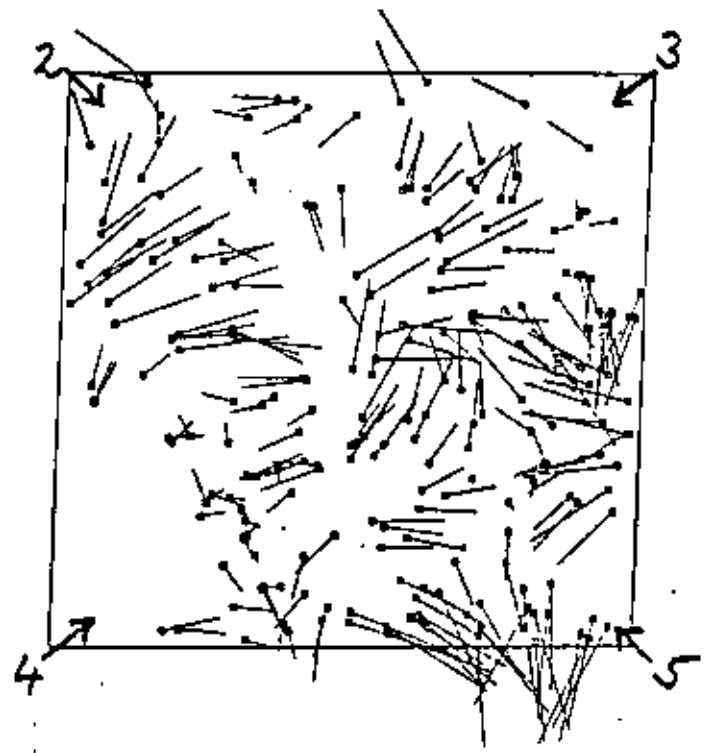
Gebietseinteilung:  
Separación de áreas distintas



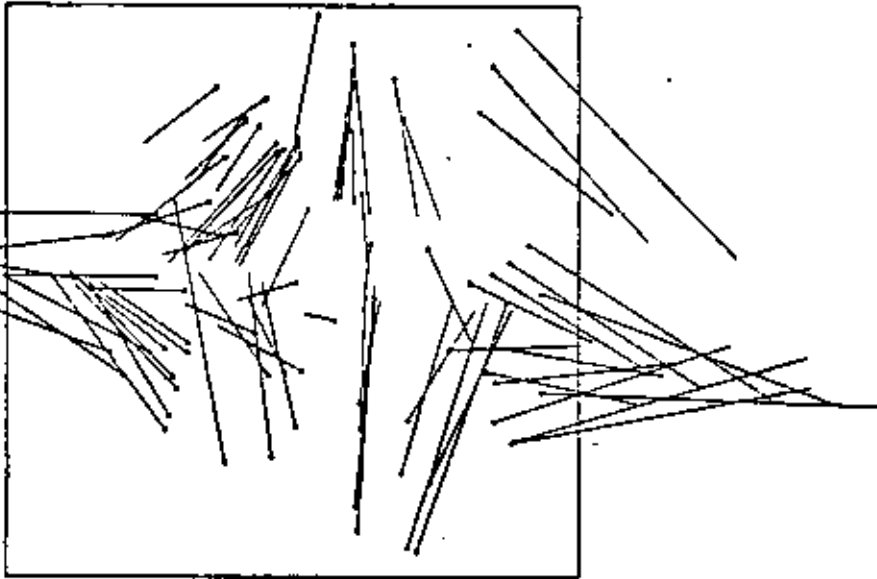
A. Métodos simplificados



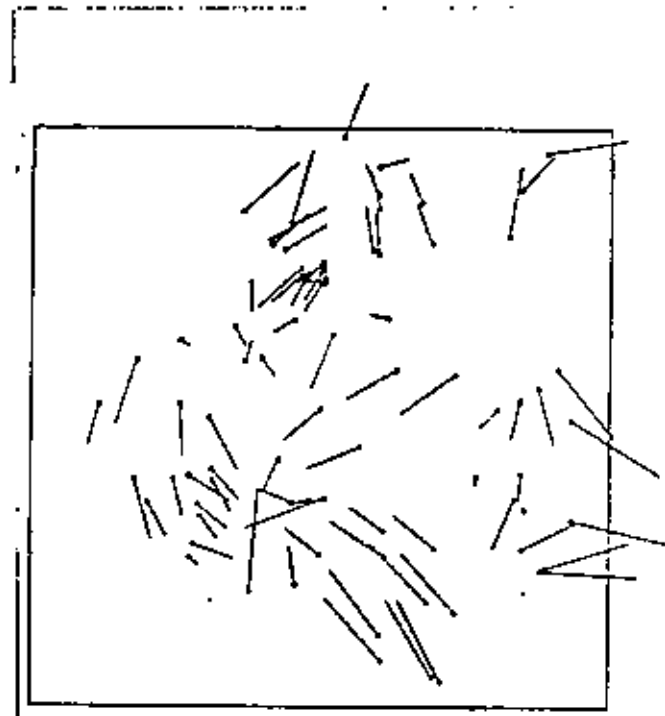
a



b



c



d

Restfehler nach Helmerttransformation

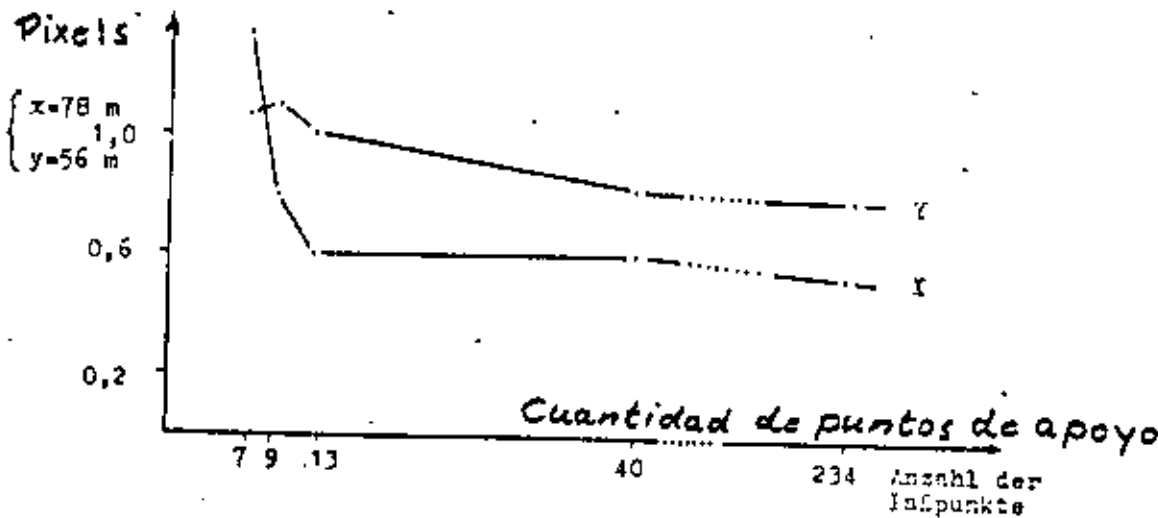
→ entspricht 25 km am Boden  
250 m als Vektor

a:	Bayern,	Originalbild	234	Paßpunkte
b:	Bayern,	4 Quadrante $\tilde{a}$	4	Paßpunkte
c:	Norddeutschland,	Originalbild	82	Paßpunkte
d:	Norddeutschland,	affin korrig.	82	Paßpunkte

Bayern					Norddeutschland			
Gebiet	Gesamtzahl Paßpunkte	Verwendete Paßpunkte	$m_x \pm$	$m_y \pm$	Gesamtzahl Paßpunkte	Verwendete Paßpunkte	$m_x \pm$	$m_y \pm$
1	234	234 9	43 53	49 54	82	82 9	65,7 77,7	80,5 104,3
2	43	43 9	41 54	32 42	26	26 9	58,5 64,4	43,6 45,9
3	62	62 9	37 39	45 55	18	18 9	27,8 33,0	24,9 34,2
4	49	49 9	39 42	47 52	17	17 9	42,0 60,4	33,1 59,4
5	80	80 9	45 56	44 48	21	21 9	37,3 45,0	47,1 57,0
2,3 4,5	234	9 für jeden Quadrant	48,8	49,8	82	9 für jeden Quadrant	53,2	49,9

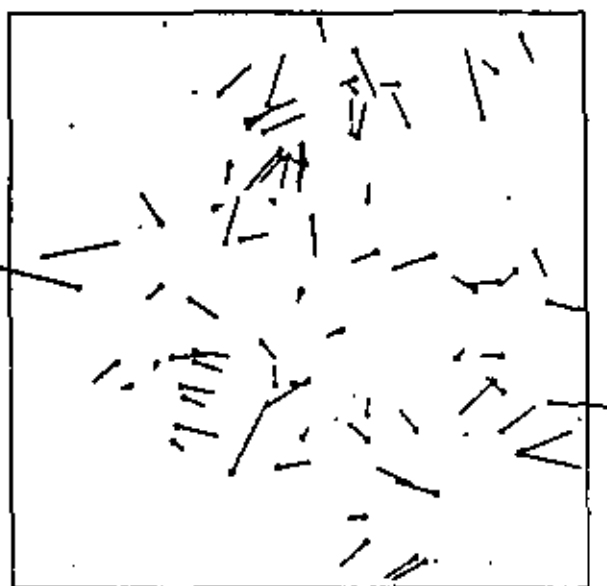
3. Polinómios

Mittlere Fehler am Boden in [m] aus Restfehlern nach Anwendung von Polynomen 2. Grades

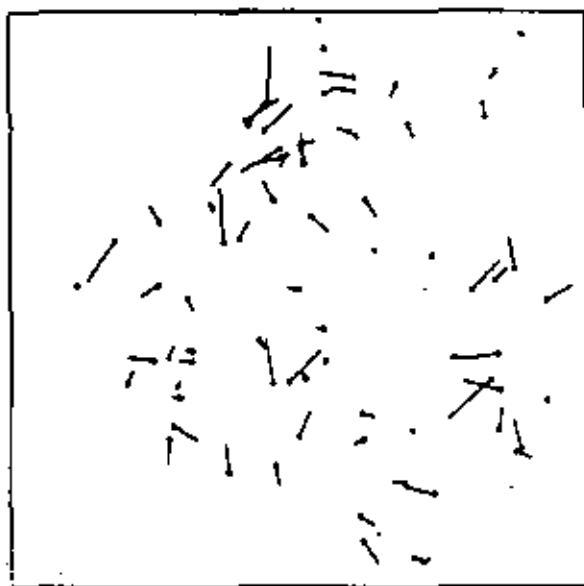


Norddeutschland					
Gebiet	Gesamtzahl Paßpunkte	Verwendete Paßpunkte	Anzahl Unbekannte	$m_x \pm$	$m_y \pm$
1	82	82	13	71	81
			4	125	96
3		29	13	50	34
			4	81	59

C. Ecuaciones de colinealidad  
(Método riguroso)



e

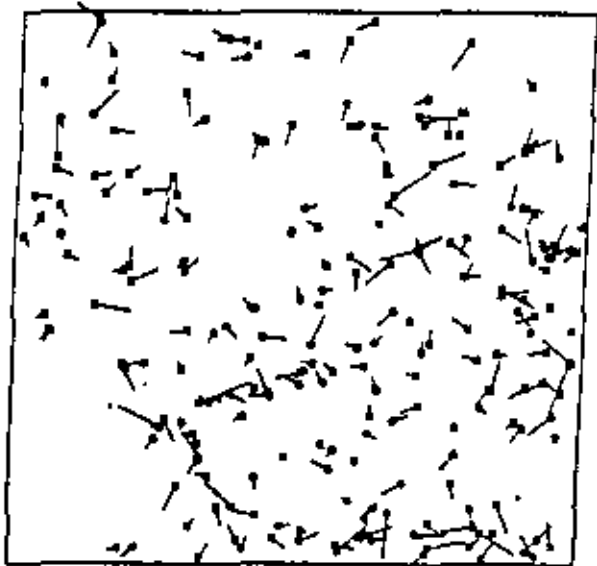


f

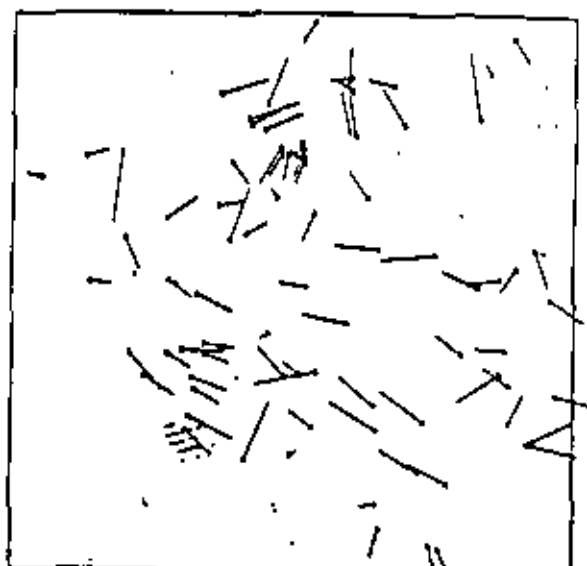
Restfehler nach Anwendung von Polynomen 2. Grades

—|— entspricht 25 km am Boden  
250 m als Vektor

g	Bayern	234 Paßpunkte	} Polinomos
e	Norddeutschland	82 Paßpunkte	
f	Norddeutschland 4 Quadrante à 9 Paßpunkte.		
h	- " -	ecuaciones de colinearidad	



g



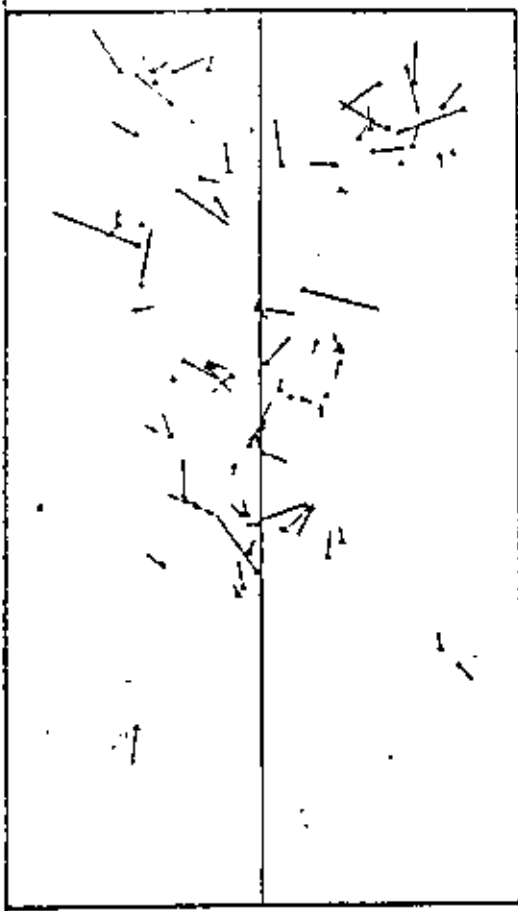
h

# ACCURACY TESTS FOR LANDSAT MSS

<u>author</u>	<u>medi- um</u>	<u>method of restoration</u>	1 pixel = 79 m			<u>coeff no.</u>
			<u>RMS</u> <u><math>\sigma_y</math></u>	<u>RMS</u> <u><math>\sigma_x</math></u>	<u>RMS</u> <u><math>\sigma_y</math></u>	
Colvocoresses 1973	bulk	nil	200-450m			
		similarity	192 m			4/12
Bähr & Schurr 1974	bulk	affine	163 m			15/18
		2 <sup>nd</sup> d. polyn.	151 m			33
Wong 1975	bulk	nil		215m	195m	131
		similarity		94m	67m	131
		affine		74m	67m	64
		20 <sup>th</sup> term polyn.		37m	44m	131
Bähr 1975	bulk	Helmert		138m	145m	41
		2 <sup>nd</sup> d. polyn.		57m	37m	10/31
		least sq. interp. filtered		57m	58m	10/31
Forrest 1975	bulk	polyn. (15 coeff.)		42m	39m	
		C.C.T.		36m	46m	
		param. (21 unkn.)		57m	54m	
Zera- Stain 1976	C.C.T.	param.	43m			13
			48m			14
Trinder 1976	bulk	param.	66m			63
		12 <sup>th</sup> term polyn.	66m			63
		affine	70m			63

Nimbus : Métodos rigurosos (unidades de medida : [pixel])

	Punkt- anzahl	MODELL 104		MODELL 204		MODELL 113		MODELL 213	
		Mittlere Fehler $m_x^{\pm}$	$m_y^{\pm}$	Mittlere Fehler $m_x^{\pm}$	$m_y^{\pm}$	Mittlere Fehler $m_x^{\pm}$	$m_y^{\pm}$	Mittlere Fehler $m_x^{\pm}$	$m_y^{\pm}$
NIMBUS-3 Bild 1	67	1,26	0,72	1,13	0,80	0,90	0,75	0,68	0,80
NIMBUS-3 Bild 2a	81	3,70	1,66	3,68	1,66	0,82	0,83	0,83	0,83
NIMBUS-3 Bild 2b	84	1,06	0,90	0,96	0,99	0,86	0,80	0,79 <sup>c</sup>	0,86
NIMBUS-4 Bild 3	40	1,31	1,08	1,16	1,30	0,91	0,81	0,81 <sup>k</sup>	0,89
Mittel	69	1,83	1,09	1,73	1,19	0,87	0,80	0,78	0,85



i

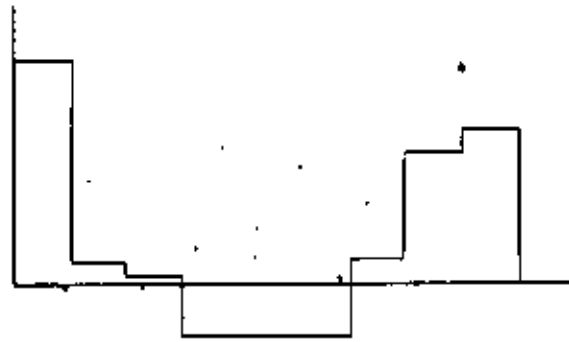
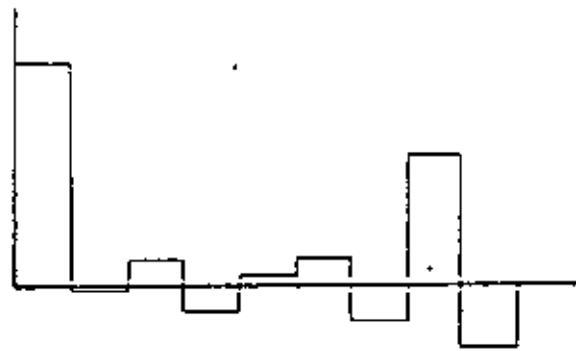
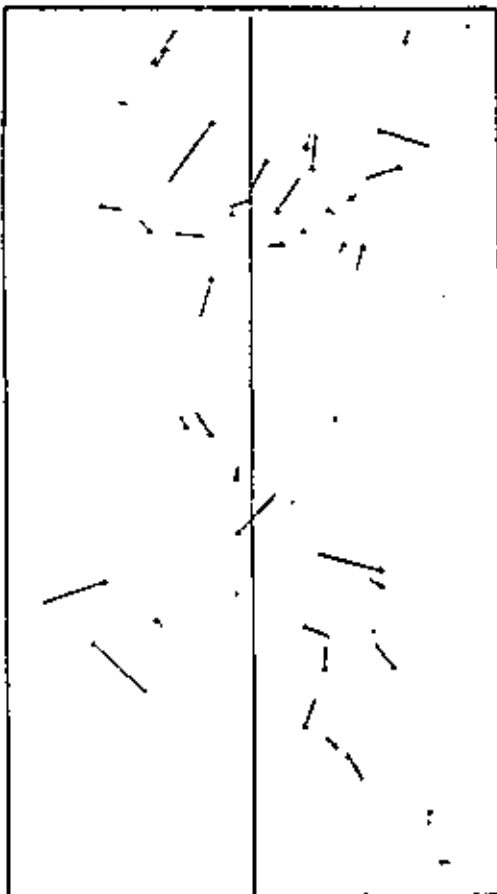


Abbildung 3.4-XVI: Bild 2b, Modell 213  
Restfehler  $\rightarrow \pm 1$  Bildelement

Kovarianzfunktionen für x (oben) und y (unten) bei 5mm  
Schrittweite im Originalmaßstab (vgl. Abb. 1.4-I)



k

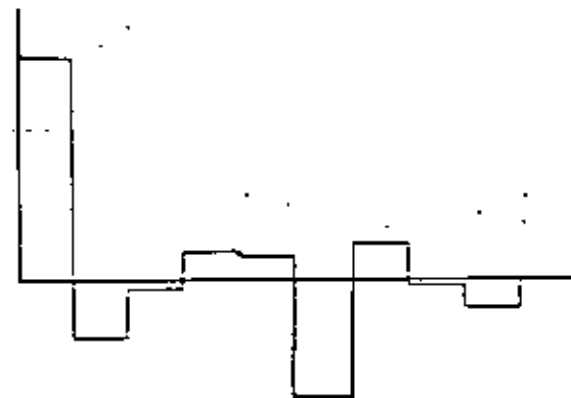


Abbildung 3.4-XVII: Bild 3, Modell 213  
Restfehler  $\rightarrow \pm 1$  Bildelement

Kovarianzfunktionen für x (oben) und y (unten) bei 5mm  
Schrittweite im Originalmaßstab (vgl. Abb. 1.4-I)



# ACCURACY TESTS FOR AIRCRAFT SCANNER IMAGERY

<u>author</u> <u>year</u>	<u>medium</u> <u>h</u>	<u>terrain</u> <u>resol.</u>	<u>method of</u> <u>restoration</u>	<u>G<sub>x</sub></u> <u>pixel</u>	<u>G<sub>y</sub></u> <u>pixel</u>	<u>G<sub>xy</sub></u> <u>pixel</u>
Konecny 1970	film 1520m	flat 2μrad	polyno- mial, stereo (DTM)	4	4	-
Liebig 1973	film 1520m	rolling 2μrad	polynomial single image stereo, polynomial	8	20	-
Derevyi 1974	film 432m	rolling 2μrad	single image affine	7	28	-
		-----	polynomial	5	12	-
		flat 2μrad	single im. affine polynomial	6	10	-
Baker & Mikhail 1975	C.C.T. 1520m	flat 5μrad	polyn. 12 terms (1sect.) (2sect.) (3sect.)			6,6 3,5 2,9
			polyn. 13 terms (1sect.) (2sect.) (3sect.)			3,2 2,6 2,0
			collinearity equ. (1s.) piecew. lin. funct. (2s.) (3s.)			6,6 3,5 2,9
			collinearity equ. (1sect.) 2 <sup>nd</sup> degr. polyn. (2s.) (3s.)			3,2 2,5 1,9
			weighted average moving average			1,9 2,3
Baker & Mikhail 1975	C.C.T. 1520m	rolling 5μrad	polyn. 12 terms (3s.) polyn. 13 terms (1s.) polyn. 13 terms (3s.)			4,5 6,0 4,5
			coll. equ. rlf. (3s.) coll. equ. polyn (1.s.) (3.s.)			4,5 5,0 6,3
			weighted ave.			5,7

## Precisión geométrica de Radar (según Konecny) (fajas solamente)

Author	radar type	terrain scale	no. of control points	no. of check points	method of restitution	$\sigma_x$ RMS m	$\sigma_y$ RMS m		
Leberl 1971	Brit. Royal Radar ESI	flat 1:250 000	150	-	linear con-	271	348		
					formal transf.				
					piecewise				
					polyn.			62	28
					parametric				
					[piecewise lin. f.]			56	68
					weighted				
arith. means	73	48							
lin. least									
sq. int.	45	43							
Booman et al 1972	Brit. Royal Radar ESI	flat 1 : 250 000				48	70		
Konecny 1972	Westinghouse	mountainous 1 : 250 000	80	-	single image	152	256		
					linear conformal transf.				
					stereo opposite				
					linear conformed transf.			68	138
					stereo saw				
side linear									
conf. transf.	130	427							
Konecny 1974	GEMS 1000 Phoenix area	mountainous 1 : 400 000	23	436	single image	60	38		
					linear conf. transf.				
Clerici Kubik 1974	GEMS 1000 Phoenix area	mountainous 1 : 400 000	17	33	single image	54	24		
					polynomial				
Deramyl 1974	GEMS 1000 Phoenix area	flat part 1 : 400 000	318	300	conformed	28	30		
					stereo affine	27	30		
					polynomial	28	30		

Table 3 : Accuracy tests for radar imagery



Kadar (ver F. Leberl)

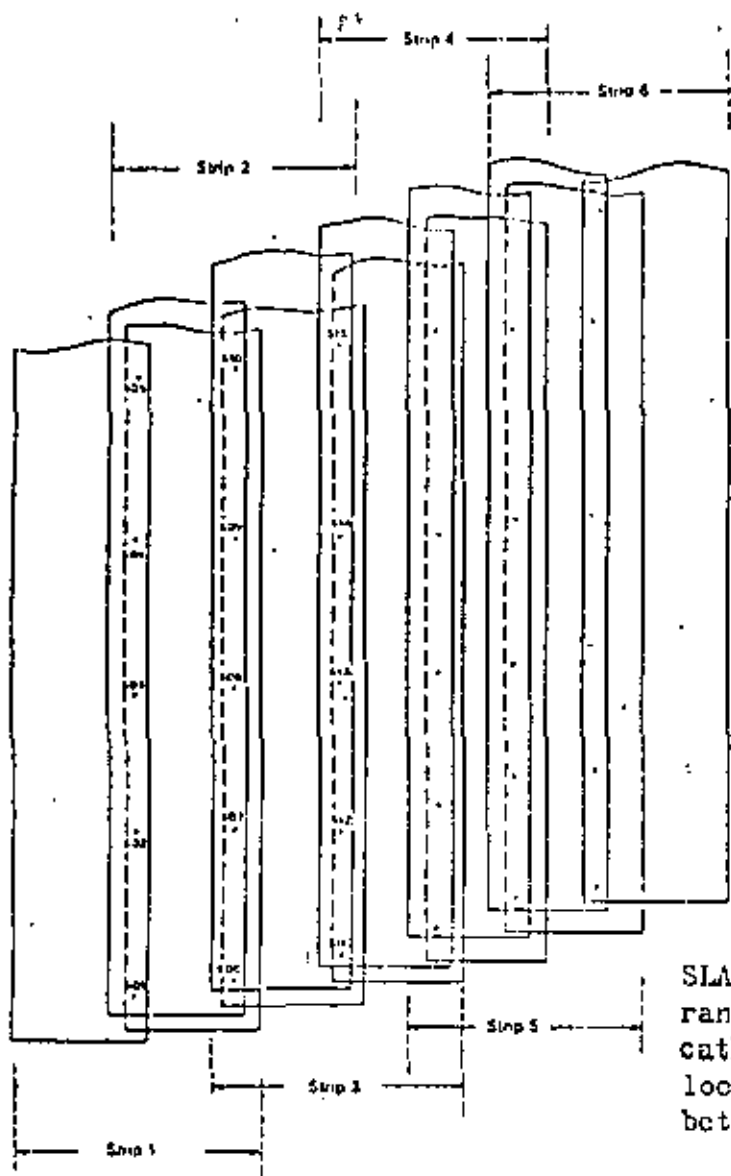
Proyecto Proradam  
en Columbia'

~ 400 000 km<sup>2</sup>

GEMS 1000 SLAR  
(Goodyear)

Escala original 1:400 000

Tratamiento : mosaicos  
1:200 000



Formación de bloques

SLAR strips with 60% overlap, but split into near range and far range views through the use of 2 cathode ray tubes (CRTs). Indicated are the locations of tiepoints in the common overlap between the two views of a strip.

A: sin corrección proyectiva

0.1 - 170

B: con " " " " "

1: sin "splines" ; 2: con "splines"

(Ver Leberl)

		A 1	A 2	B 1	B 2
5-coefficient polynomial	RMSE X	1.42 (5.99)	1.42 (5.76)	1.54 (5.51)	1.44 (5.56)
	RMSE Y	1.54 (4.15)	1.58 (3.92)	1.39 (5.92)	1.20 (5.03)
10-coefficient polynomial	RMSE X	0.83 (4.88)	0.83 (4.66)	0.71 (6.85)	0.68 (5.95)
	RMSE Y	1.00 (7.53)	1.00 (7.18)	0.70 (9.70)	0.76 (9.14)

Residuals at control points (without brackets), and corrections at radargrammetric points (in brackets), after polynomial external adjustment. Values in mm at image scale.

NR	RMSE-X	RMSE-Y	NR. OF POINTS	DATE OF ACQUISITION
1	1.06	0.51	9	Oct. 1972
2	0.80	0.69	10	Oct. 1972
3	2.77	2.85	11	Oct. 1972
4	1.32	1.26	7	Oct. 1972
5	1.08	0.71	18	Feb. 1973
6	2.29	1.35	12	Feb. 1973
7	1.15	1.35	22	Feb. 1973
Total	1.58	1.41	89	

Root mean square discrepancies between ERTS-1 MSS images and SLAR block PROGRAM. Values in mm at scale 1 : 400 000. MSS-channel 7 used.

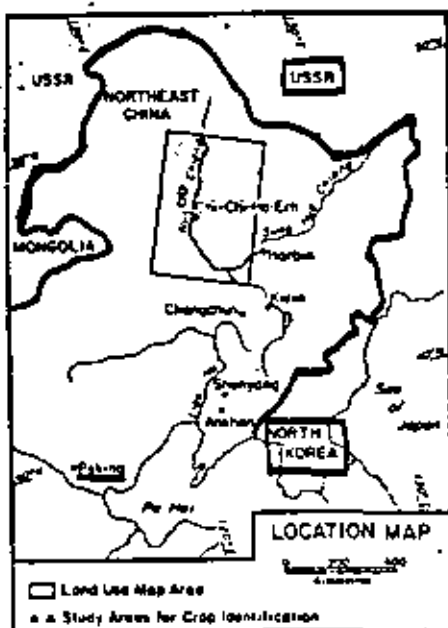
1mm corresponde a 400m

# Agronomía nueva en China (Welch et al., Phot. Eng. 1979)

Detección por LANDSAT (27 escenas)

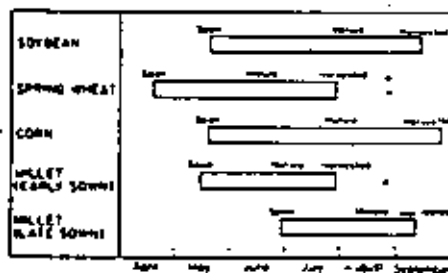
7.2.1-20

Calendario de cosecha

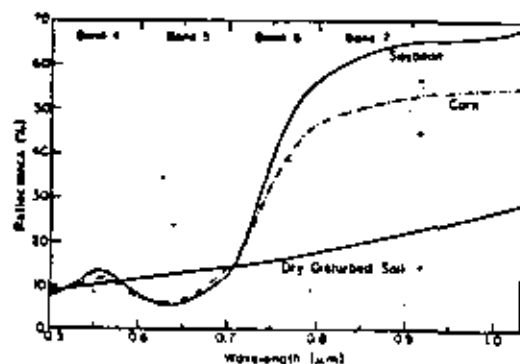


Location map of the Nun River Basin study area in Northeast China.

Soja  
trigo  
maíz

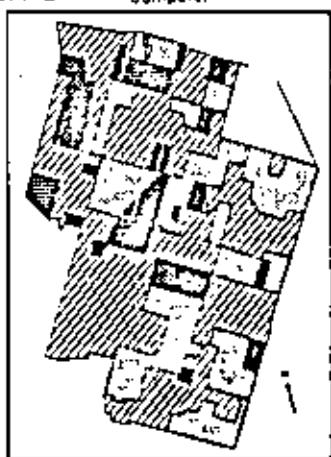
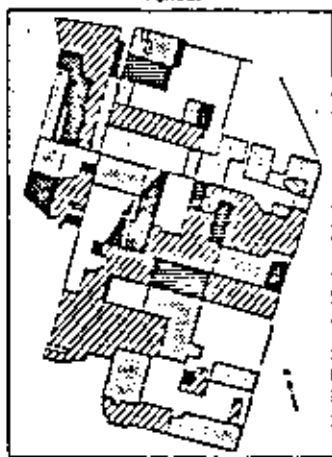


Crop calendar for soybeans, spring wheat, corn, and millet.



Generalized spectral reflectance curves for soybeans, corn/millet, and dry disturbed soil.

Manual STUDY AREA I Computer

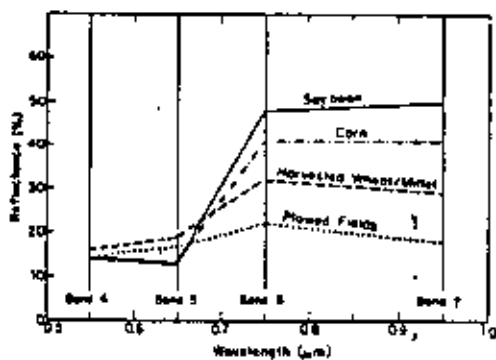


Las formas de los campos indican el grado de la mecanización

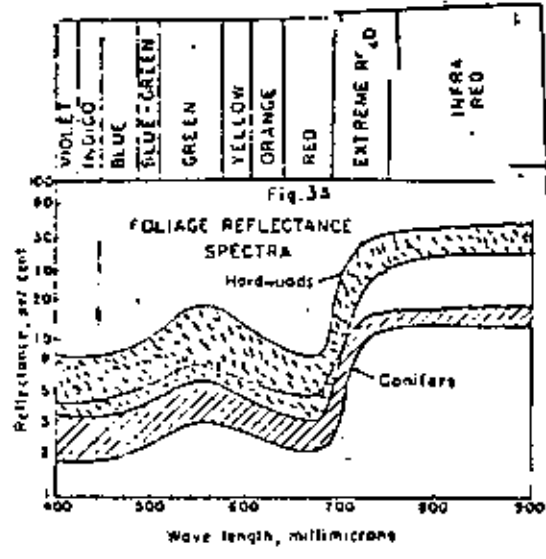
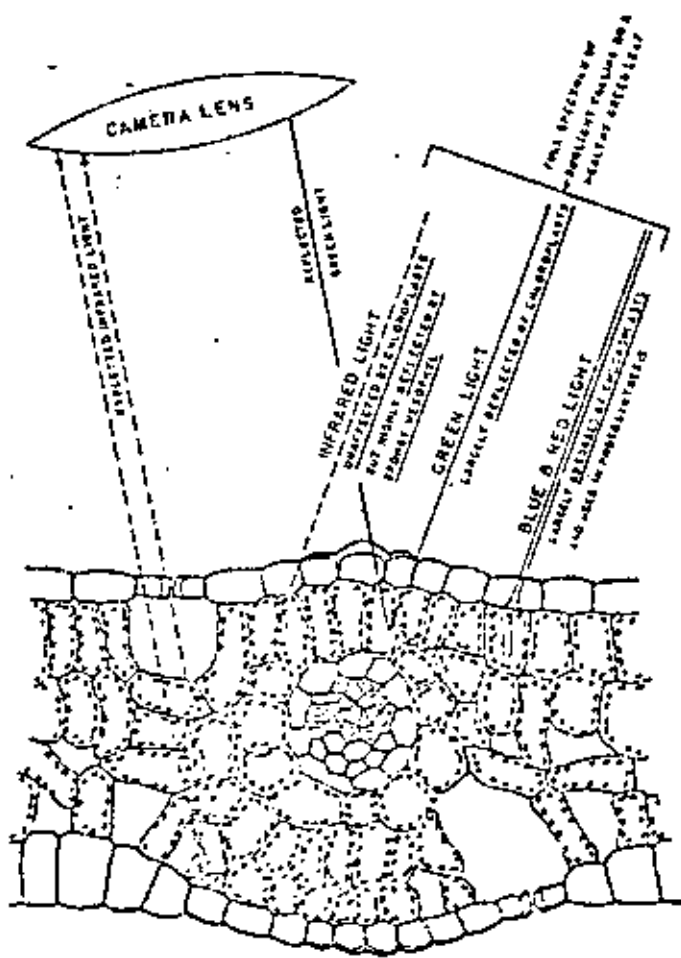
Manual STUDY AREA II Computer



Comparison of manual and unsupervised computer assisted classifications of field patterns in Study Areas I and II. Only those fields for which the crops could be identified with reasonable confidence were classified in the manual interpretation. The computer assisted approach provides a complete classification of the entire area.

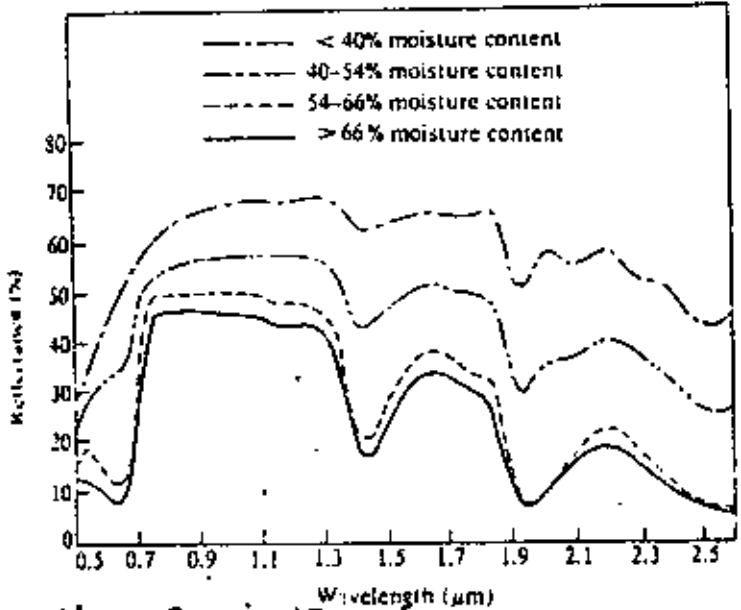
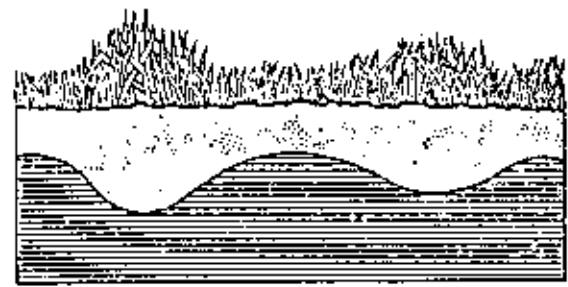
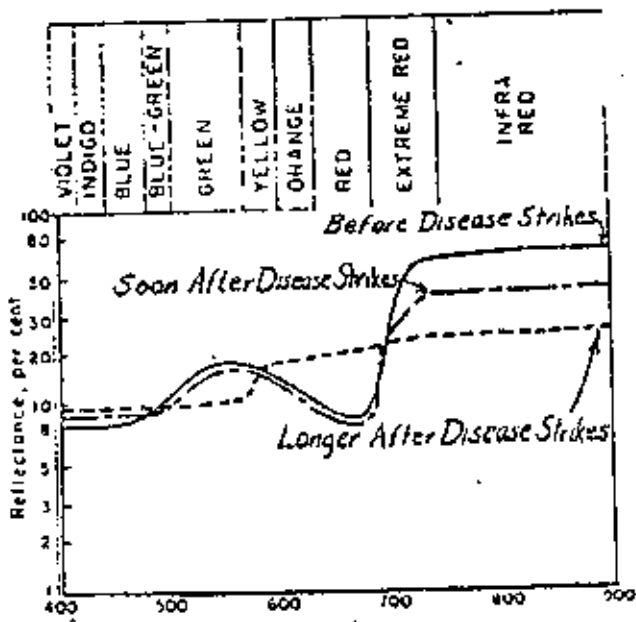


Reflectance curves for the cropland classes derived from MSS data.



Light reflectance as a function of wave-length for the foliage of representative hardwood and coniferous trees. The wide separation between these light reflectance curves in the near-infrared range (720 to 900 millimicrons) assures a consistent total separation between them on photography

(Ver Colwell)



Ver Swain / Davies  
Effect of moisture content on reflectance of green leaves. (After Miller and Zelenka, 1954)

Test programa  
en Finlandia  
(ver Kilpelä et al.  
1976)

Flight no.	Flight height (m)	Area scanned (km <sup>2</sup> )	Aerial photography	Pixel size (m <sup>2</sup> )
8	3000	18.0 x 7.1	Color	7.5 x 7.5
15	3000	25.0 x 7.1	Color IR	7.5 x 7.5
24	3000	19.0 x 7.1	B & W	7.5 x 7.5
28	3000	25.0 x 7.1	Color	7.5 x 7.5
30	3000	13.0 x 7.1	Color IR	7.5 x 7.5
31	1000	10.0 x 2.4	B & W	2.5 x 2.5

Channel	4,	wavelength	0.54-0.58	µm
"	5,	"	0.58-0.62	"
"	7,	"	0.66-0.70	"
"	9,	"	0.76-0.86	"
"	10,	"	0.97-1.06	"

1. Agronomía :  
Clasificación  
multiespectral  
(Programas LARSYS,  
Scanner avión)

Crop type	1	2	3	4	5	6	7
				(%)			
1 Pasture	75	0	4	0	2	4	15
2 Grass, regrowth	0	95	0	5	0	0	0
3 Rye	11	2	64	2	0	15	6
4 Oats	0	0	2	52	0	44	2
5 Hay, harvested	5	5	1	3	78	0	8
6 Barley	0	0	10	4	0	77	9
7 Hay, growing	10	1	13	1	1	21	53

Resultados

Channel	1,	wavelength	0.38-0.44	µm
"	4,	"	0.54-0.58	"
"	5,	"	0.58-0.62	"
"	9,	"	0.76-0.86	"
"	10,	"	0.97-1.06	"

2. Silvicultura

Timber type	1	2	3	4	5	6
				(%)		
1 Clear cut area	94	5	1	0	0	0
2 Pine, seedling stand	1	71	22	0	6	0
3 Pine, mature timber	1	8	80	3	6	2
4 Spruce, mature timber	0	0	0	99	1	0
5 Birch, seedling stand	0	4	2	0	92	2
6 Birch, mature timber	0	1	19	1	4	75

Resultados

VEGETATION DENSITY AND SOIL AND DEAD VEGETATION INDEXES DERIVED  
FROM THE UNSUPERVISED CLASSIFICATION

Método  
Sencillo

Cluster	Vegetation Density Index (Band 7 - Band 5)	Soil and Dead Vegetation Index (Band 5 - Band 4)	Group
1	39.0	-1.9	Corn/Millet
2	28.3	-0.9	Corn/Millet
3	26.4	0.9	Harvested Wheat/Millet
4	18.8	3.3	Harvested Wheat/Millet
5	15.6	3.0	Harvested Wheat/Millet
6	17.6	0.9	Harvested Wheat/Millet
7	11.8	3.4	Harvested Wheat/Millet
8	46.2	-2.7	Soybeans
9	58.9	-2.8	Soybeans
10	5.9	-0.5	Wetland/Plowed Fields

COMPARISON OF CROPLAND STATISTICS FOR STUDY AREA I AND II

	STUDY AREA I		STUDY AREA II	
	Hectares	Percent	Hectares	Percent
Soybean	2,880	14	800	13
Corn/Millet	4,860	23	1,290	20
Harvested Wheat/Millet	12,970	62	4,110	65
Plowed Field	160	1	110	2
Total Cropland	20,870	100%	6,310	100%
Non-Cropland	7,810		2,220	
Unclassified	80		260	
	28,760		8,790	

Areas of the Various Land Use Classes

Category	Area in km <sup>2</sup>	% of Nun River Basin Study Area
Wetland	26,500	14.4
Rangeland	25,200	13.7
Forest	46,400	25.1
Water	1,330	0.7
Urban	165	0.1
New Agricultural Land*	15,300	8.3
Clear-Cut and/or Burned Land	2,325	1.3
Intensive Market Garden*	785	0.4
Extensive Field Cropland*	66,500	36.0
Total Area	184,505	100.0
Total Farmland*	82,565	44.8

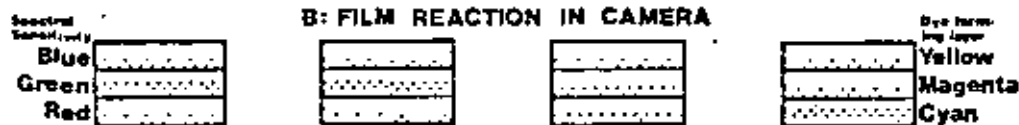
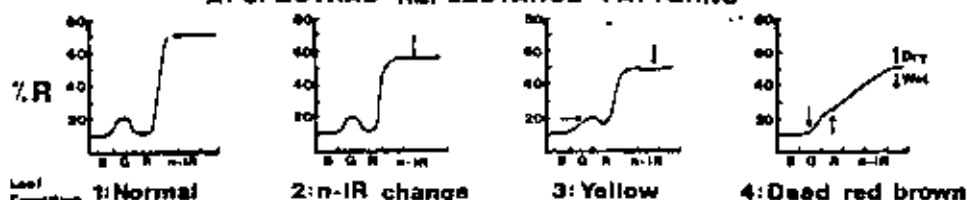
(Ver al diapositivo)



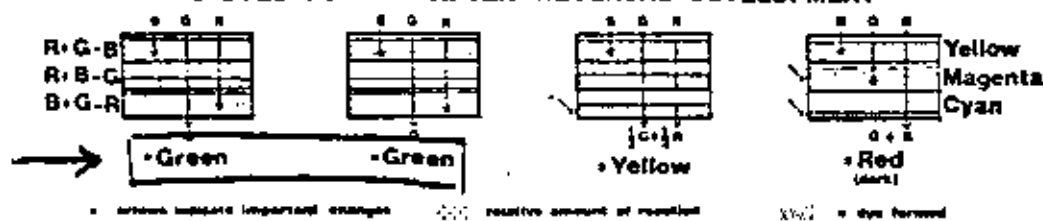
# Detección de daños en la silvicultura (P. Murtha, Phot. Eng., pág. 1147)

## Reaction of **Normal Color Film** to Reflectance Changes

### A: SPECTRAL REFLECTANCE PATTERNS



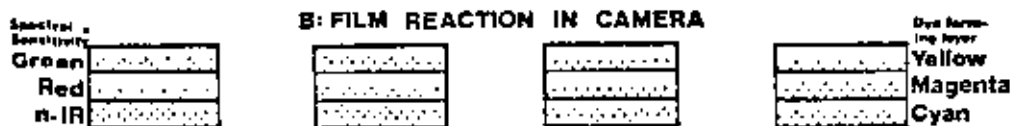
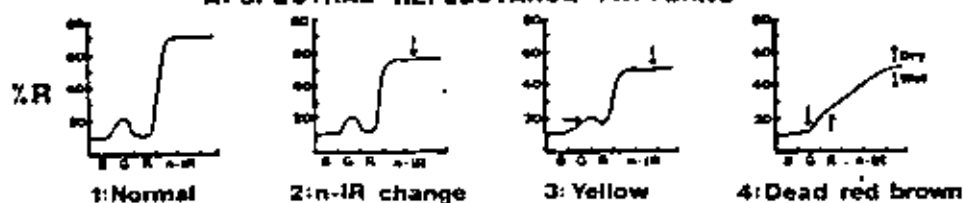
### C: DYES FORMED AFTER REVERSAL DEVELOPMENT



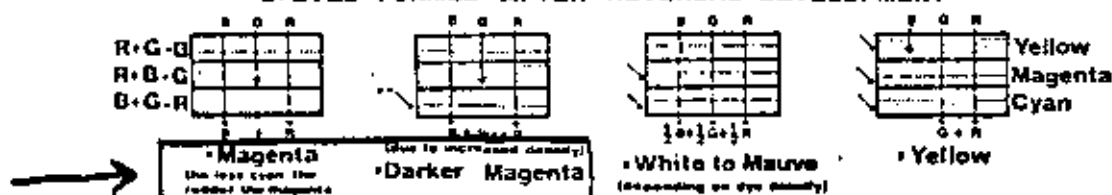
Schematic reaction of normal-color film to differences in spectral reflectance, relative amounts of dyes formed, and visual color of image.

## Reaction of **Color-infrared Film** to Reflectance Changes

### A: SPECTRAL REFLECTANCE PATTERNS



### C: DYES FORMED AFTER REVERSAL DEVELOPMENT



each of the dye forming layer is sensitive to blue light, but use of a minus blue tag, Weston 12 filter) prevents unwanted blue exposure of the dye layers.

Schematic reaction of color-infrared film to differences in spectral reflectance, relative amounts of dyes formed, and visual color of image.

Areas aproximadas por métodos de clasificación mediante LANDSAT (ver Bauer et al., Phot. Eng. 1978, pág. 1033)

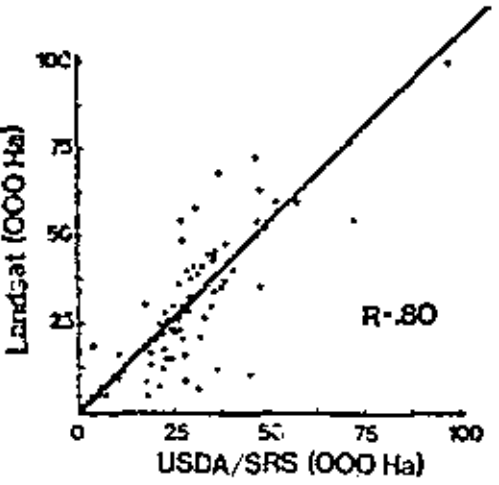
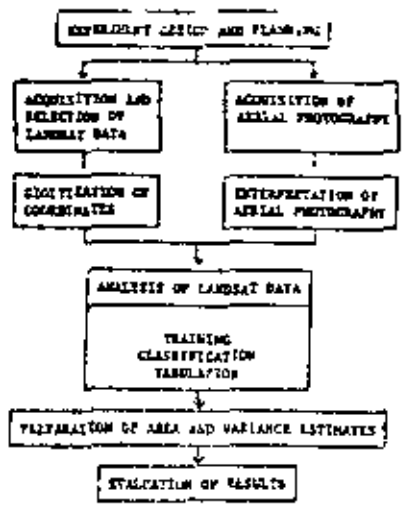


FIG. 4 Correlation of Landsat and USDA/SRS estimates of the area of winter wheat in Kansas counties.

TABLE 1. SUMMARY OF USDA/SRS AND LANDSAT ESTIMATES OF AREA AND PROPORTION OF WHEAT IN KANSAS.

Region	Area			Proportion		
	USDA/SRS	Landsat	Difference	USDA/SRS	Landsat	Difference
	(000 Hectares)			(%)		
State	4555	4613	58	26.2	26.6	0.4
District						
Northwest	470	387	-83	21.3	19.2	-4.1
North Central	578	575	-3	25.1	25.0	0.1
West Central	522	579	57	25.2	28.0	2.8
Central	770	956	187	33.1	41.2	8.1
Southwest	784	715	-68	25.6	23.3	-2.3
South Central	1164	1158	-6	40.9	40.0	-0.2
Southeast	267	242	-25	10.0	9.1	-0.9
Counties (Median)	55.0	53.4	0.6	24.85	24.25	0.4

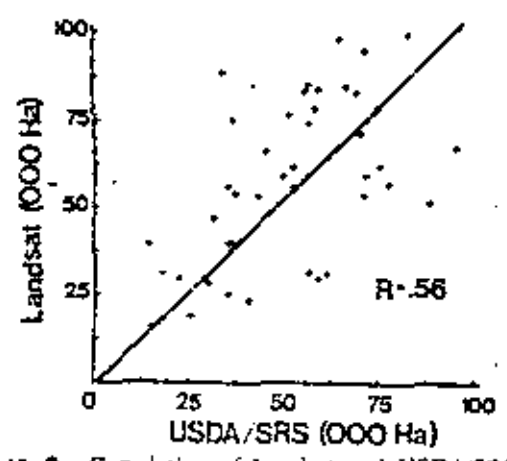


FIG. 2 Correlation of Landsat and USDA/SRS estimates of the area of soybeans in Indiana counties.

TABLE 2. COMPARISON OF USDA/SRS AND LANDSAT ESTIMATES OF AREA AND PROPORTION OF SOYBEANS IN INDIANA.

Region	Area			Proportion		
	USDA/SRS	Landsat	Difference	USDA/SRS	Landsat	Difference
	(000 Hectares)			(%)		
State	1285	1595	310	29.2	36.2	7.0
District						
Northwest	386	545	159	36	50	15
West Central	262	366	104	24	34	10
Central	474	472	-2	30	30	0
East Central	162	212	49	24	31	7
Counties (Median)	27.3	37.3	9.3	28.4	38.9	8.8

TABLE 3. COMPARISON OF USDA/SRS AND LANDSAT ESTIMATES OF AREA AND PROPORTION OF SOYBEANS IN INDIANA.

Region	Area			Proportion		
	USDA/SRS	Landsat	Difference	USDA/SRS	Landsat	Difference
	(000 Hectares)			(%)		
State	894	964	81	20.1	21.9	1.8
District						
Northwest	221	209	-12	20	19	-1
West Central	191	181	-10	18	17	-1
Central	328	405	77	21	26	5
East Central	144	170	25	22	25	4
Counties (Median)	21.1	22.1	3.1	21.5	20.9	3.0

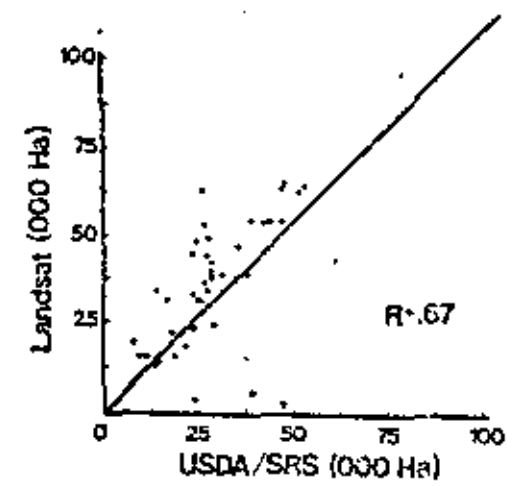
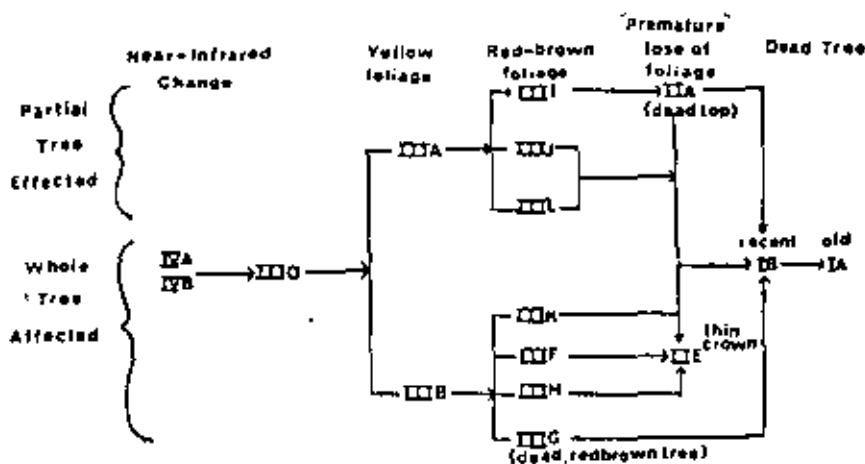


FIG. 3 Correlation of Landsat and USDA/SRS estimates of the area of soybeans in Indiana counties.

- 21a All or nearly all of crown affected ..... 22
- 22a Red-brown foliage associated with topographical pattern ..... Damage Type IIIE
- 22b Older foliage dark-green, red-brown or absent ..... 23
- 23a Older foliage dark-green or red-brown ..... 24
- 24a Dark-green old foliage ..... Damage Type IIIF
- 24b Red-brown old foliage ..... Damage Type IIIG
- 23b Older foliage absent ..... Damage Type IIH
- 21b Only a few or scattered branches with current foliage red-brown, or damage concentrated toward crown top ..... 25
- 25a Terminal leader or upper crown red-brown ..... Damage Type IIII
- 25b Lateral branches affected ..... Damage Type IIIJ
- 20b Older foliage red-brown (current foliage not red-brown) ..... 26
- 26a All or nearly all branches affected ..... Damage Type IIIK
- 26b Few branches affected ..... Damage Type IIIL
- 19b Hardwood with red-brown foliage ..... 27
- 27a Few branches with red-brown foliage ..... Damage Type IIIM
- 27b All or nearly all the crown red-brown ..... Damage Type IIIN
- 14b False-color aerial photograph ..... 28
- 28a Foliage of suspect tree a darker or lighter magenta tone than comparable unaffected tree ..... Damage Type IIIO
- 28b Suspect trees not a magenta tone ..... 29
- 29a Foliage appears mauve or yellow, if mauve see key item 15a, if yellow see key item 15b.
- 29b Trees appear blue, blue-green, silvery, which indicates defoliations. See key item 2a.
- 13b Type IV Damage: trees show no visible sign of damage, but a measurable density variation may be made ..... 30
- 30a Red-filter optical density measurements on original false-color transparency indicate higher than average optical density for the affected tree when it is compared with an unaffected tree when it is compared with an unaffected tree of the same species in the same photo frame ..... Damage Type IVA
- 30b Red-filter optical density measurements on original false-color transparencies indicate a lighter than average density ..... Damage Type IVB



Flow diagram of damage types for different stages of tree decline for trees suffering from flame damage. (Damage Types from key to Mutha (1972, 1976).)

## Llave por la interpretación

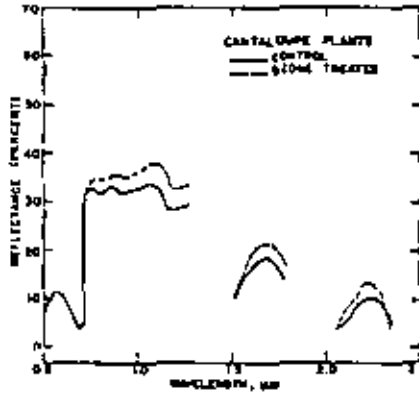
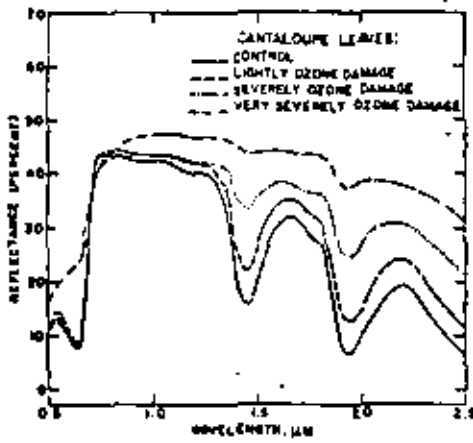
### DICHOTOMOUS KEY TO AIR PHOTO INTERPRETATION OF FOREST DAMAGE TYPES<sup>1</sup>

1a <sup>2</sup> <i>Morphological:</i> on black and white or color aerial photographs a change in form is the prominent characteristic of the damage .....	2
2a <b>Type I Damage:</b> the trees are completely defoliated, or almost completely defoliated .....	3
3a Limbs and smaller branches are gone, only the main trunk is residual .....	Damage Type IA
3b Limbs and branches are present .....	4
4a Conifer .....	5
5a Scattered individuals .....	Damage Type IB
5b Large, extensive group .....	Damage Type IC
4b Hardwood .....	6
6a Scattered individuals .....	Damage Type ID
6b Large, extensive group .....	Damage Type IE
2b <b>Type II Damage:</b> trees that show some defoliation through the presence of bare branches, or some form of malformation .....	7
7a Defoliated branches are concentrated at top or towards top of tree .....	8
8a Conifer .....	Damage Type IIA
8b Hardwood .....	Damage Type IIB
7b The defoliated branches are scattered throughout the crown, with, or without loss of limbs or branches, malformation may be present .....	9
9a Conifer .....	10
10a Malformation or obvious loss of some branches .....	Damage Type IIC
10b Most branches are present, no prominent malformation .....	11
11a Current year's foliage missing .....	Damage Type IID
11b 2nd year foliage missing, current year's foliage is present .....	Damage Type IIE
9b Hardwood .....	12
12a Loss of some branches, or malformed .....	Damage Type IIF
12b No loss of branches .....	Damage Type IIG
1b <i>Physiological:</i> on color photographs a change in the spectral reflectance pattern which is usually noted by a change in color of the foliage, or a measurable density variation in false-color photographs .....	13
13a <b>Type III Damage:</b> the foliage is another color when it is compared to normal foliage, on normal-color or false-color aerial photographs taken during summer ..	14
14a Normal-color aerial photograph .....	15
15a Current foliage yellowing or yellowish .....	16
16a Conifer .....	17
17a Few branches affected .....	Damage Type IIIA
17b All or nearly all branches affected .....	Damage Type IIIB
16b Hardwood .....	18
18a Few branches affected .....	Damage Type IIIC
18b All or nearly all branches affected .....	Damage Type IIID
15b Some or all foliage red-brown, brown or turning brown .....	19
19a Conifer with red-brown foliage .....	20
20a Current foliage red-brown .....	21

<sup>1</sup> Source of key: Murtha (1972) used by permission of the author who developed the key while employed in a research capacity with the Canadian Forestry Service, Ottawa. Copies of the publication are available from Canadian Forestry Service, Environment Canada, Ottawa, Canada.

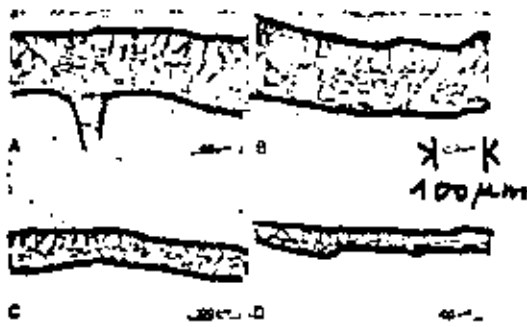
<sup>2</sup> There are two choices for each division in the key, the numbers represent the level or stage, while "a" and "b" represent the two choices involved.

Ozono causando daños de vegetación (hojas de Cantaloupe (H. W. Gausman et al., Phot. Eng. 1978, pág. 481))

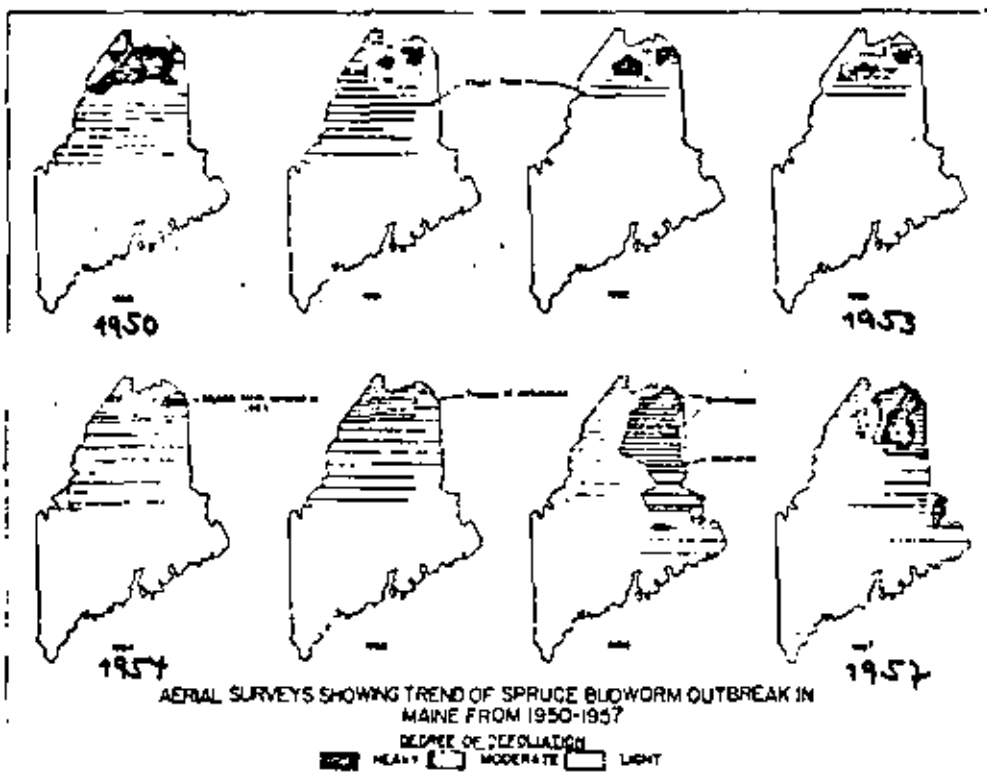


Laboratory spectrophotometric reflectance spectra over the 0.5- to 2.5-μm waveband for control and lightly, severely, and very severely ozone-damaged cantaloupe leaves.

Field spectroradiometric reflectance spectra over the 0.5- to 2.5-μm waveband for control and O<sub>3</sub>-treated cantaloupe plants.



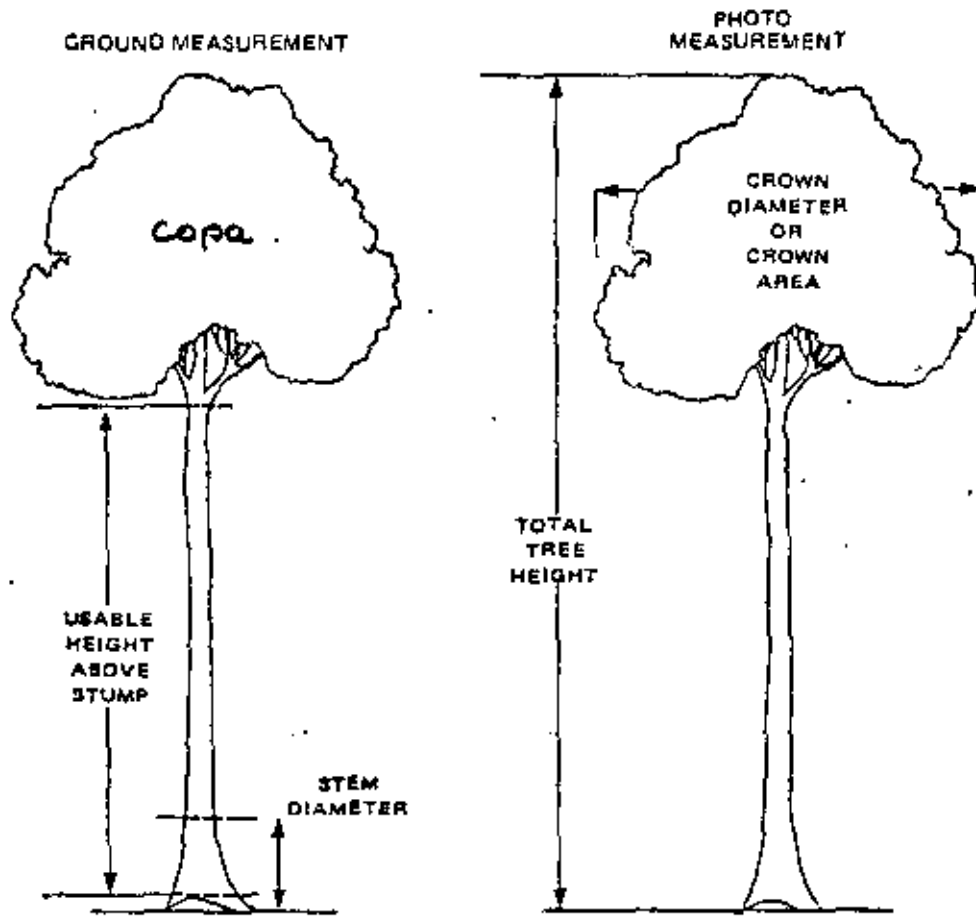
Transsections of control (A) and lightly (B), severely (C), and very severely (D) ozone-damaged leaves.



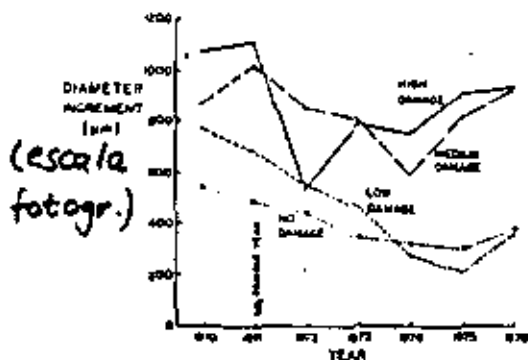
Heller, R.  
Phot. Eng. 1978

Observaciones de la pérdida de hojas por causa de "spruce budworm"

Repetitive operation recorder surveys for defoliation of balsam fir by the spruce budworm, *Choristoneura fumiferana* (Clem), in Maine from 1950 to 1957.



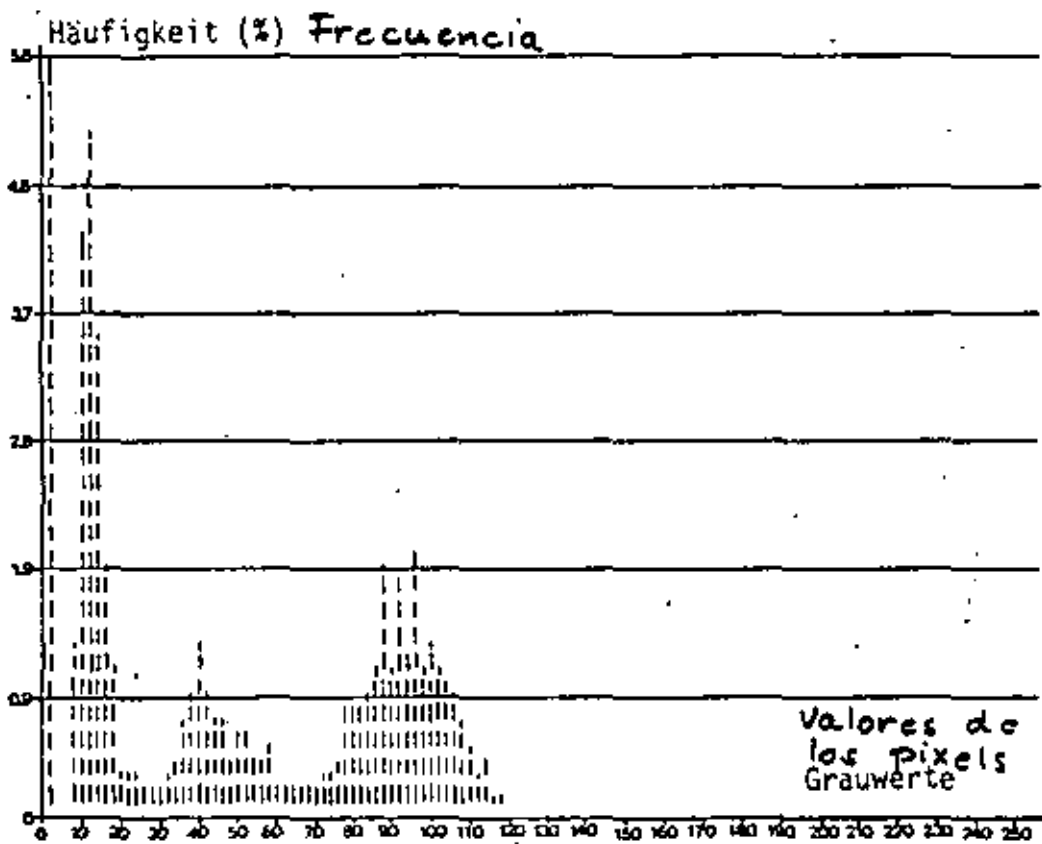
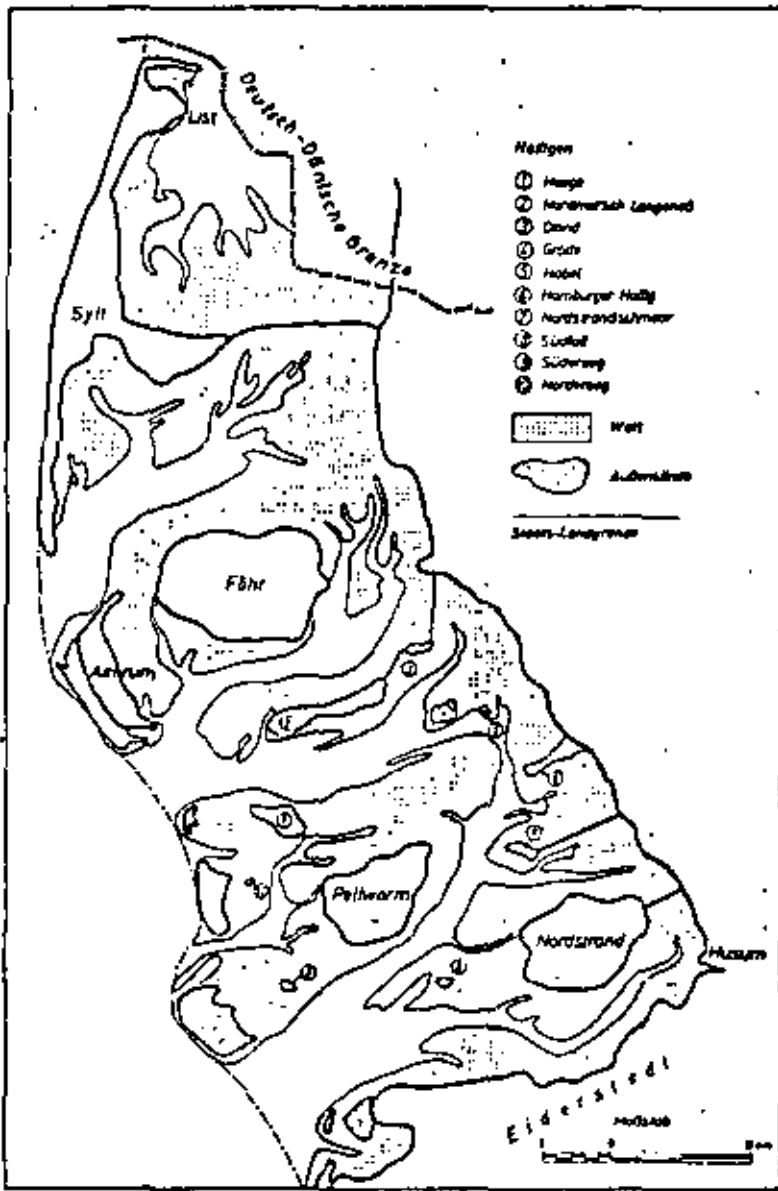
Aproximación de la cantidad de madera con métodos sencillos



Ejemplo  
acción recíproca  
entre minoración  
de copas y efecto  
de daños ( $SO_2$ )  
(Fuente: Murtha)

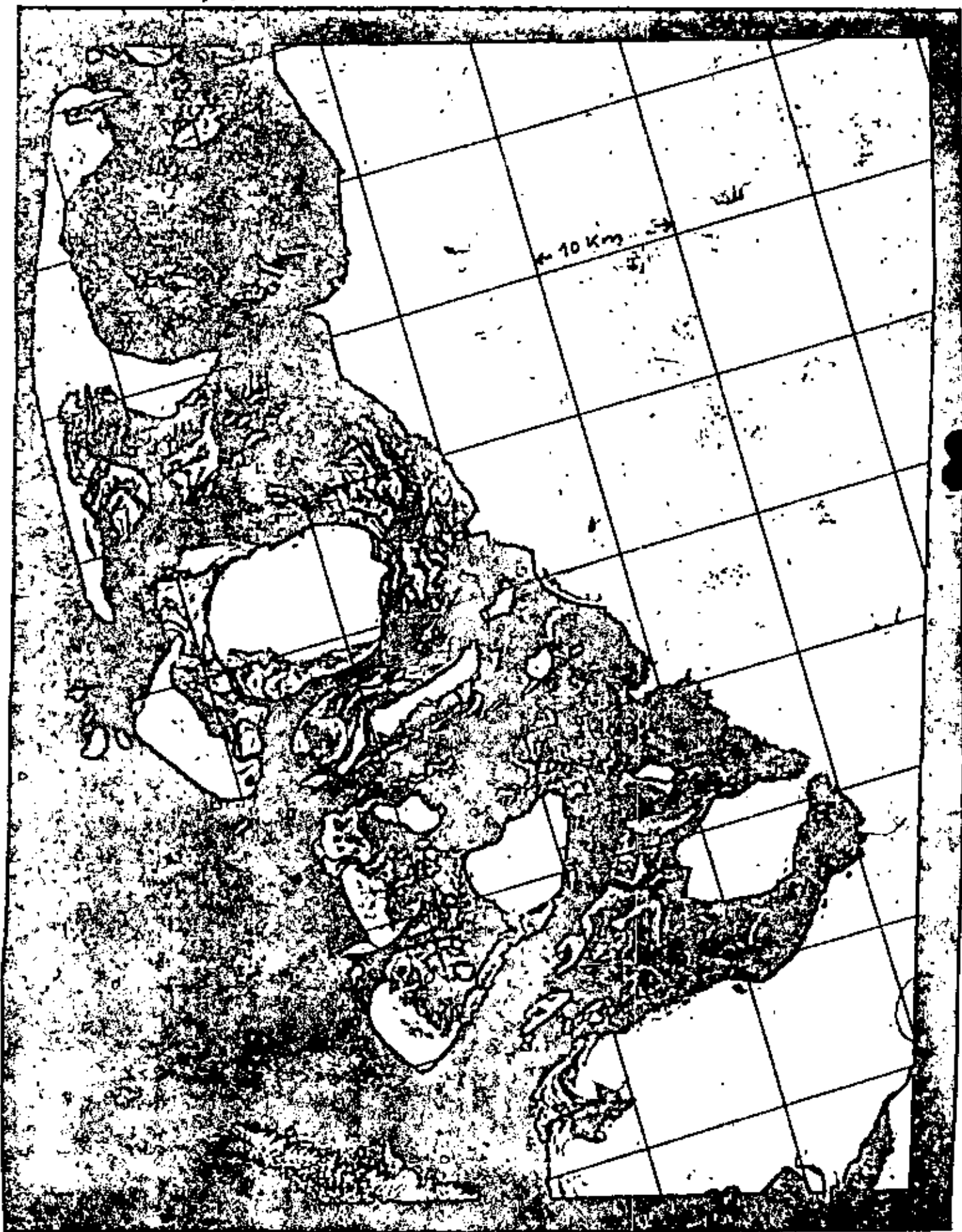
Diameter increments for three  $SO_2$  damage intensity zones and a control zone. Note the diameter increment decrease for the "High Damage" zone. These trees now display the IIE "premature loss of older foliage," or IIB "top dieback in hardwoods," damage syndromes (from Murtha and Treise, 1977).

Planos de marcas  
Costa frisona  
(Alemania)



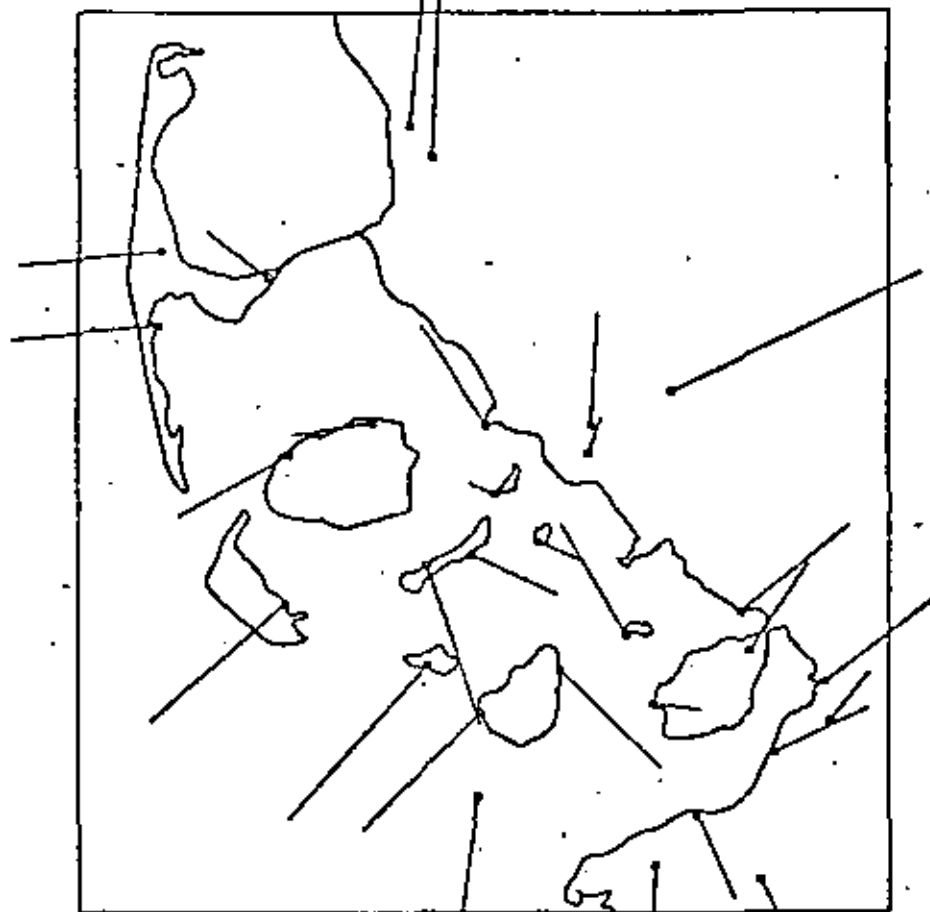
Histogramm Nordfriesisches Wattgebiet  
LANDSAT, Kanal 7

Planos de marcas (Alemania norte)

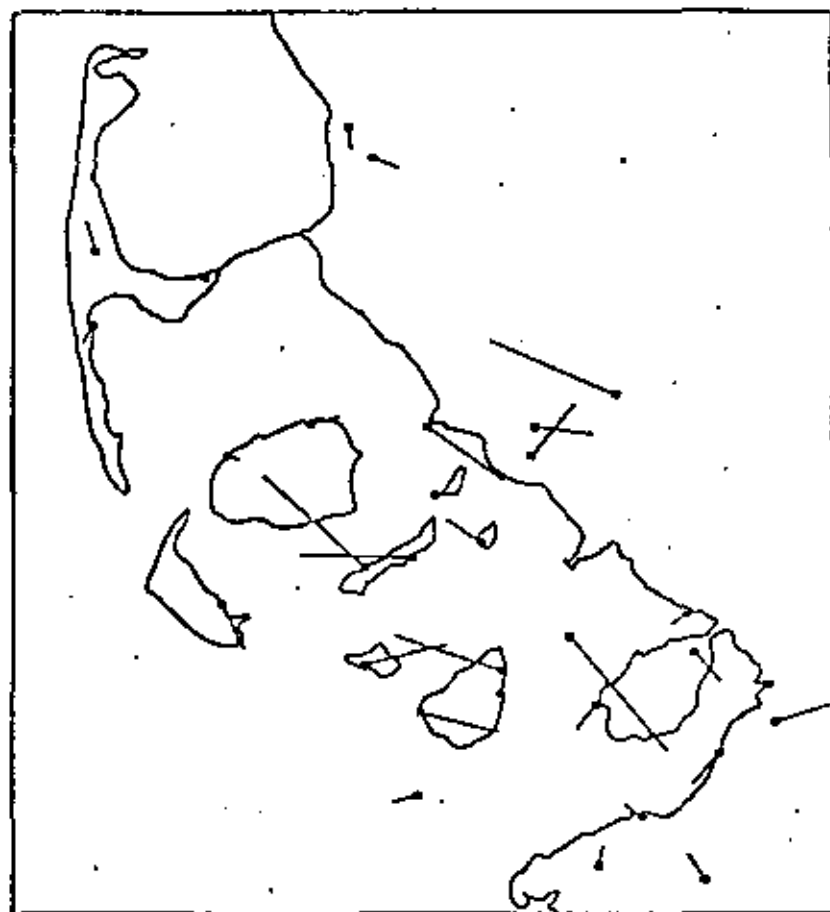


LANDSAT, banda 7





a



b

: Residuals at Control Points after Geometrical Rectification

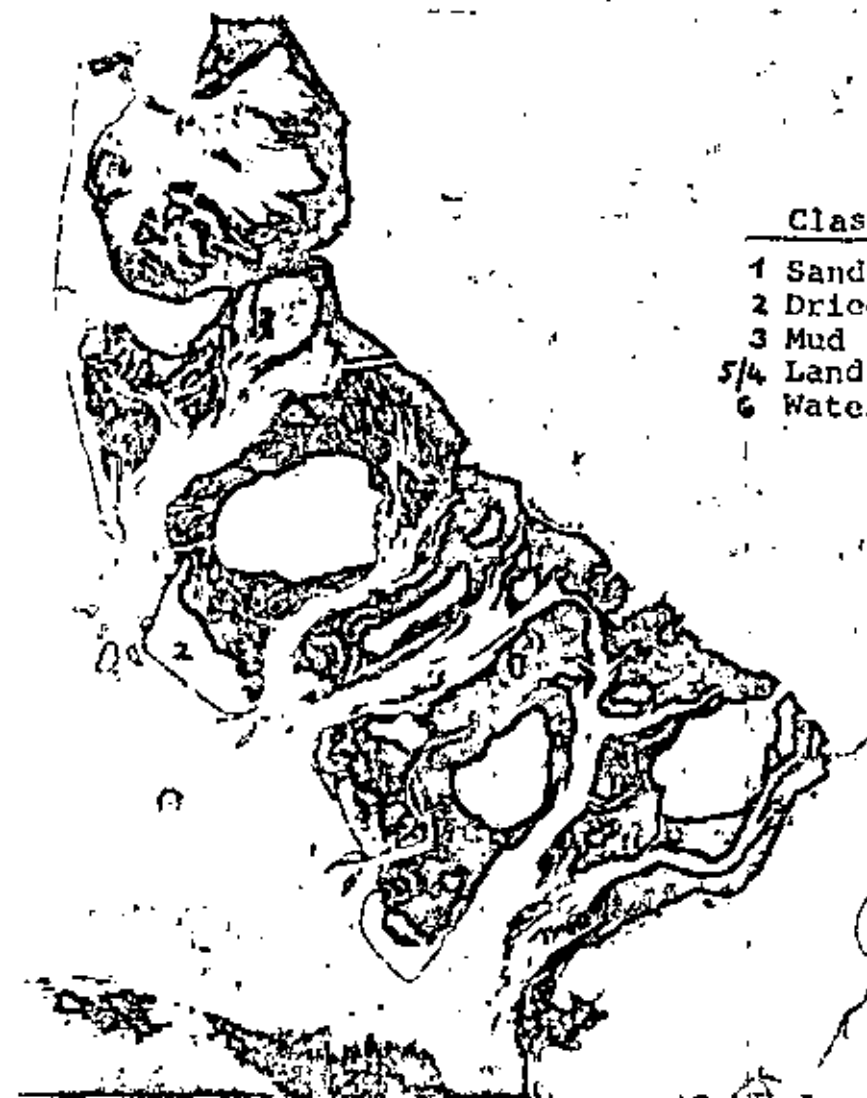
Left: Bulk Processing

Right: Precision Processing  $\pm 38m$

— Corresponds to 10 km on the Ground, to 100 m as a Vector

Manipulación  
semánticaCampos de apoyo  
("entrenamiento")

Class	area in km <sup>2</sup>
1 Sand	828
2 Dried Sand	51
3 Mud Flat	1353
5/4 Land and Foreshore	4774
6 Water	1697



3.2.3-40

Representación integral  
del resultado (HL)  
por niveles de gris



Clase: "arena"



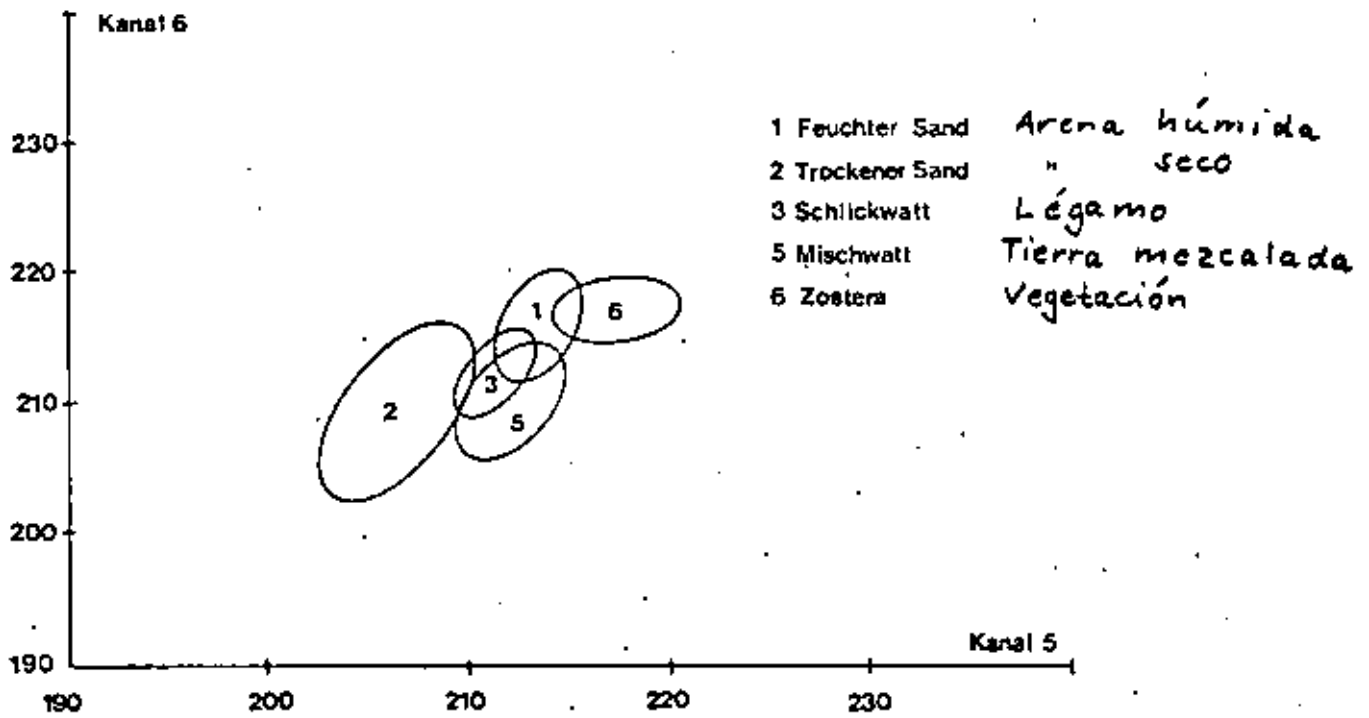
## Precisión del resultado (Bähr /Dennert -Möller)

assigned to training field	Sand	Dried Sand	Mud Flat	Fore-shore	Land	Water	unclassified
Sand	90.3	-	9.5	0.22	-	-	-
Dried Sand	-	100.0	-	-	-	-	-
Mud Flat	2.5	-	97.3	0.2	-	-	-
Fore-shore	-	-	8.1	89.6	2.3	-	-
Land	-	-	-	10.6	89.4	-	0.04
Water	-	-	-	-	-	100.0	-

Table 1: Accuracy of Classification Measured by Training Fields

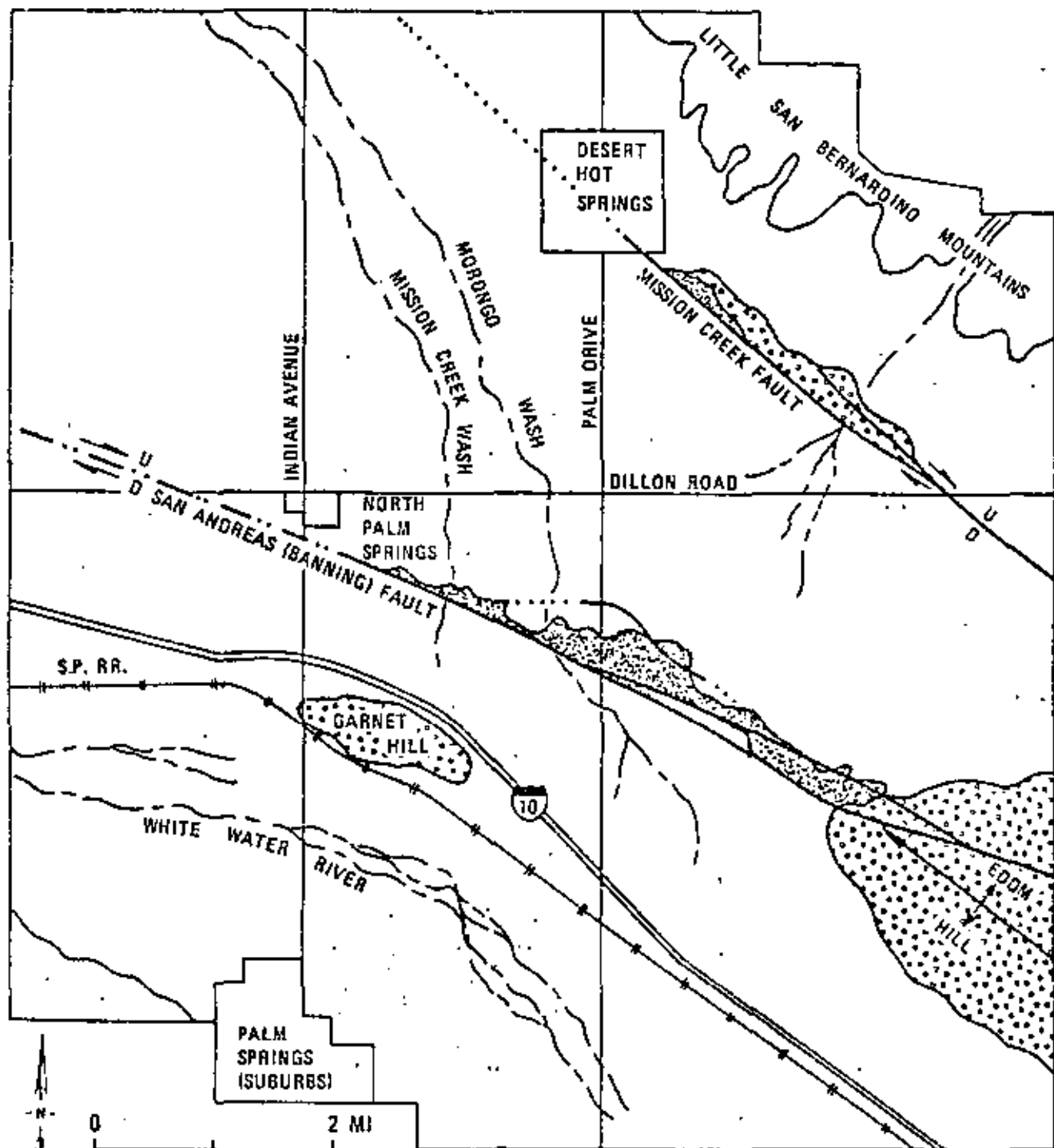
assigned to control area	Sand	Dried Sand	Mud Flat	Fore-shore	Land	Water	unclassified
Sand	93.8	-	2.7	3.1	-	-	0.4
Dried Sand	-	100.0	-	-	-	-	-
Mud Flat	-	-	99.4	0.6	-	-	-
Fore-shore	-	-	4.8	92.9	1.2	-	1.0
Land	-	-	-	13.9	85.9	-	0.2
Water	-	-	-	-	-	100.0	-

Table 2: Accuracy of Classification Measured by Control Areas



Planos de marcas cerca Wilhelmshaven (Ale.)

Interpretación a escala grande



RECENT ALLUVIUM AND EOLIAN SAND

PLEISTOCENE AND OLDER STRATA

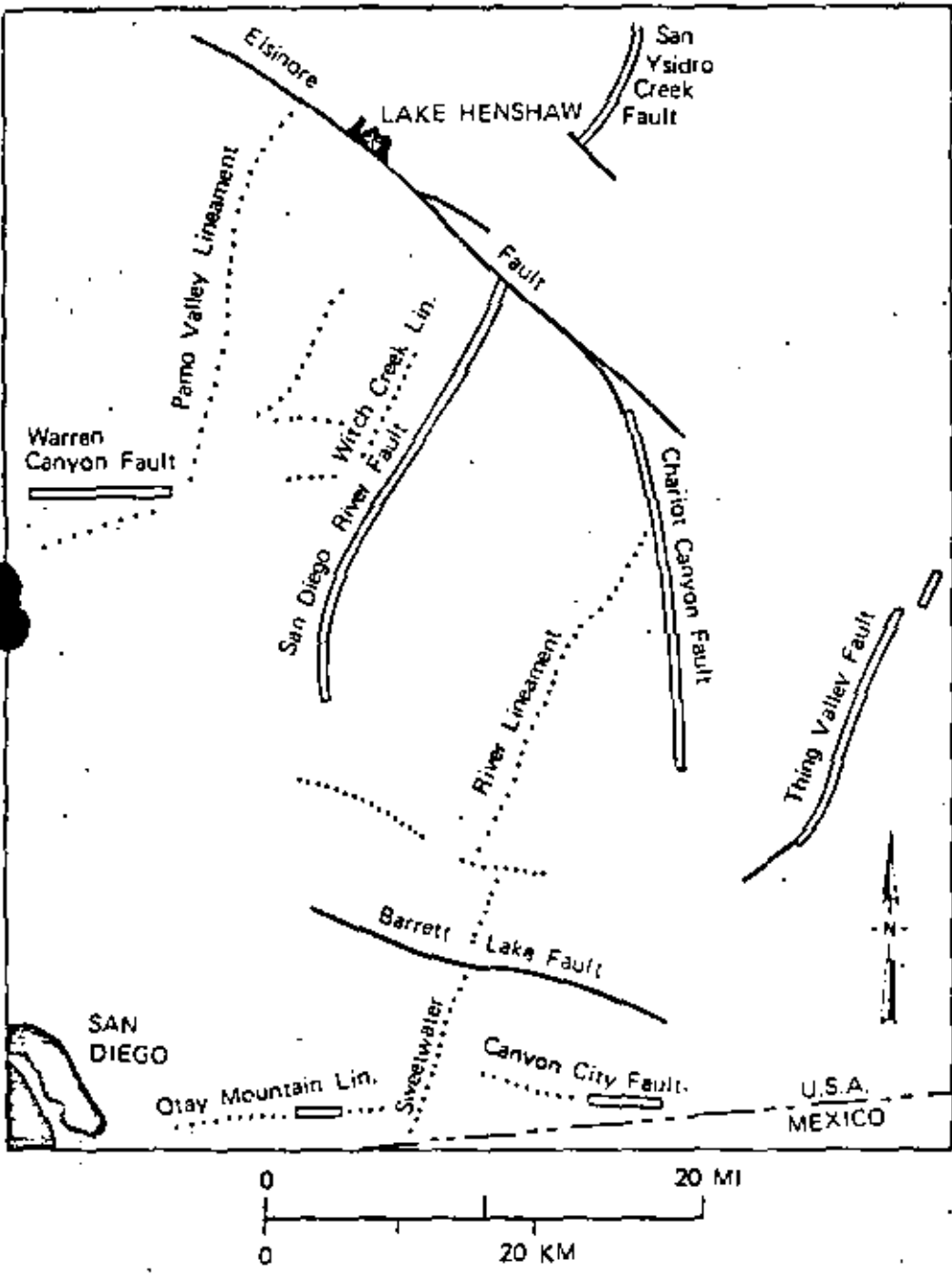
VEGETATION ANOMALY ALONG FAULTS

FAULT, DOTTED WHERE CONCEALED

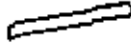

ANTICLINE

Interpretation of photomosaic of Desert Hot Springs. (Sabins)  
Geology after Proctor (1968, Plate 1).

# Detección de estructuras incógnitas por LANDSAT

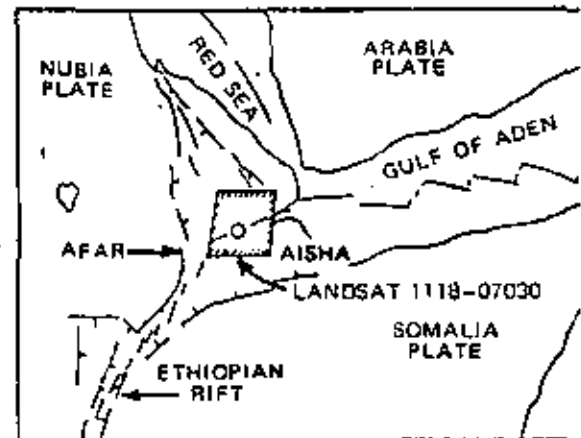
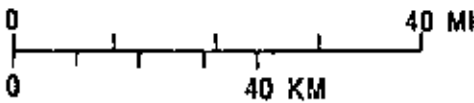
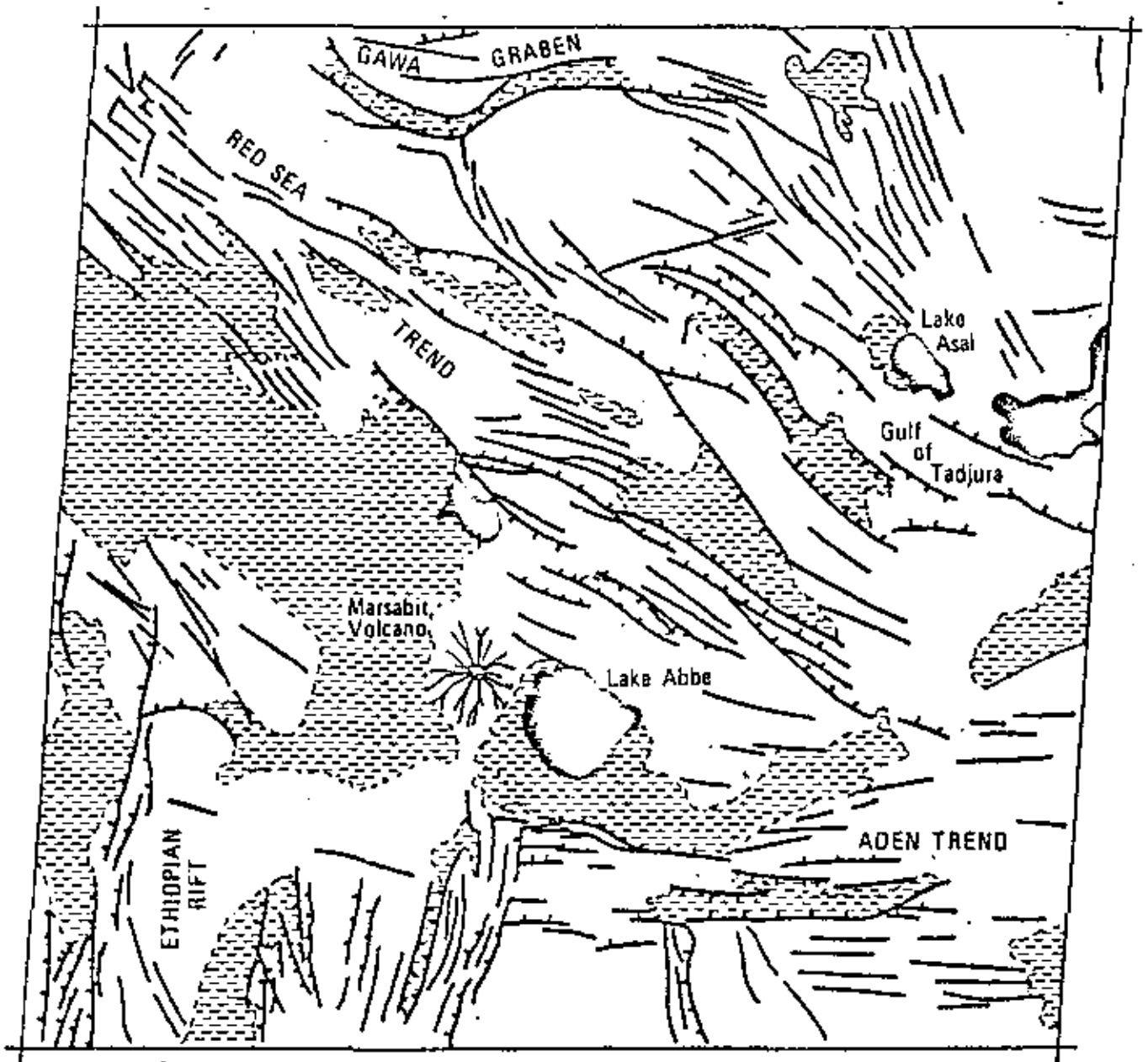


### EXPLANATION

-  PREVIOUSLY UNMAPPED FAULT INTERPRETED ON LANDSAT IMAGE
-  LINEAR FEATURES ON LANDSAT THAT CORRESPOND TO PREVIOUSLY MAPPED FAULT
-  LANDSAT LINEAMENTS NOT RELATED TO FAULTS

Field evaluation of lineaments and faults on Landsat 1105-17054 of Peninsular Ranges, California. From Lamar and Merrifield (1975, Figure 2).

(fuente: Sabins)

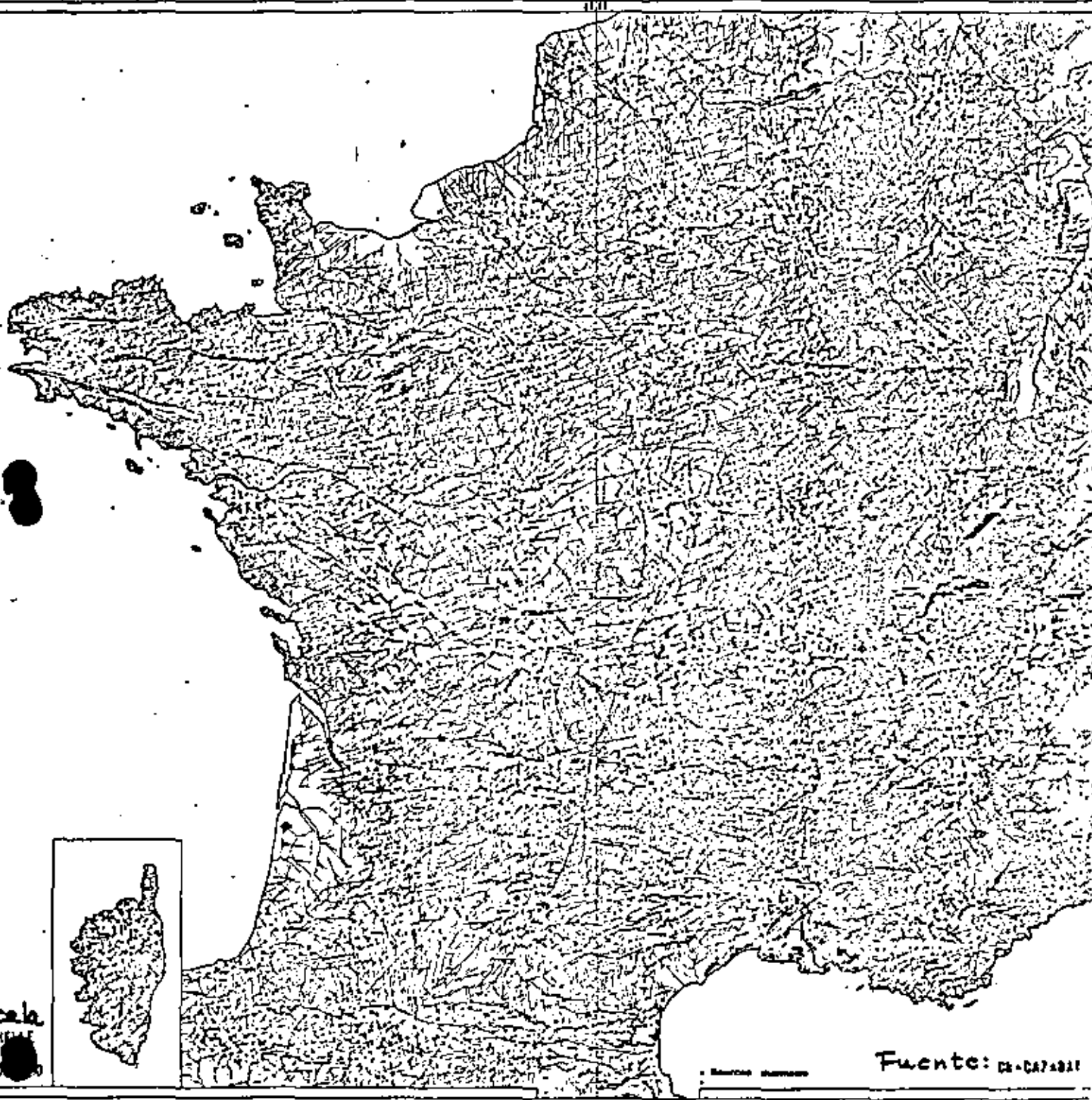


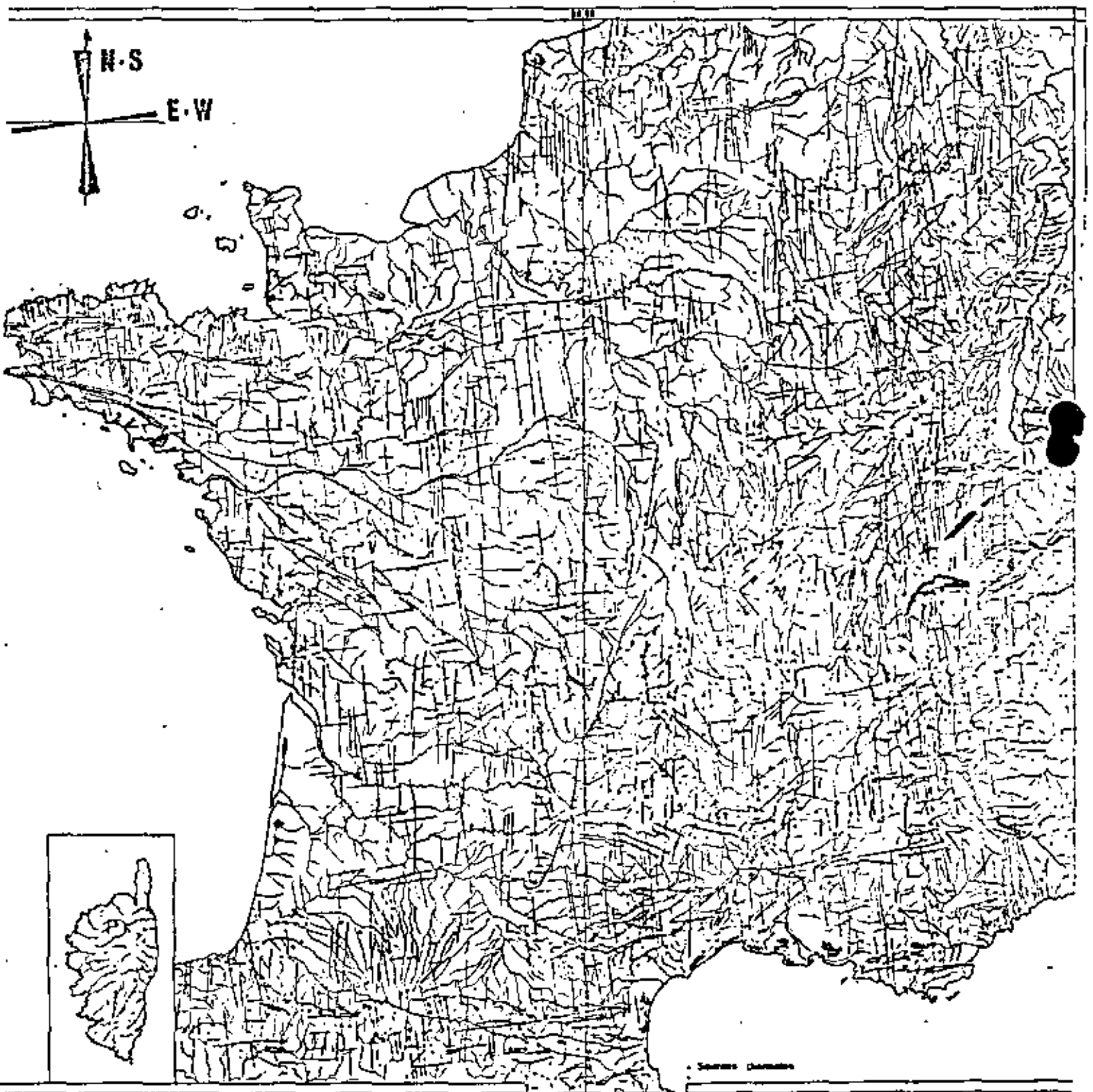
Geologic interpretation and Index map of Landsat 1118-07030, Afar triple junction, Ethiopia. (Sabins)

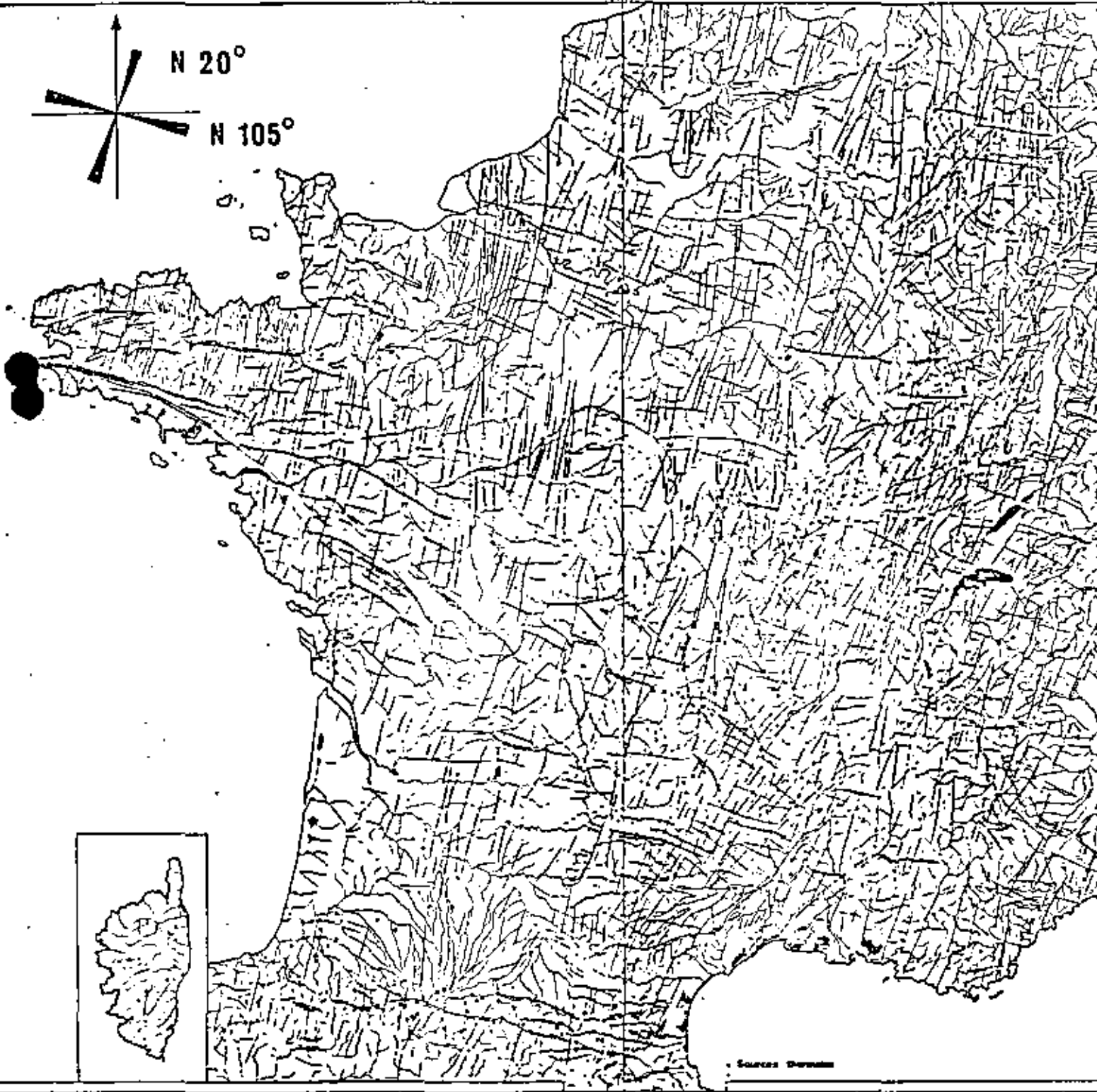


STRUCTURES LINÉAIRES DE LA FRANCE

Planche n° 3

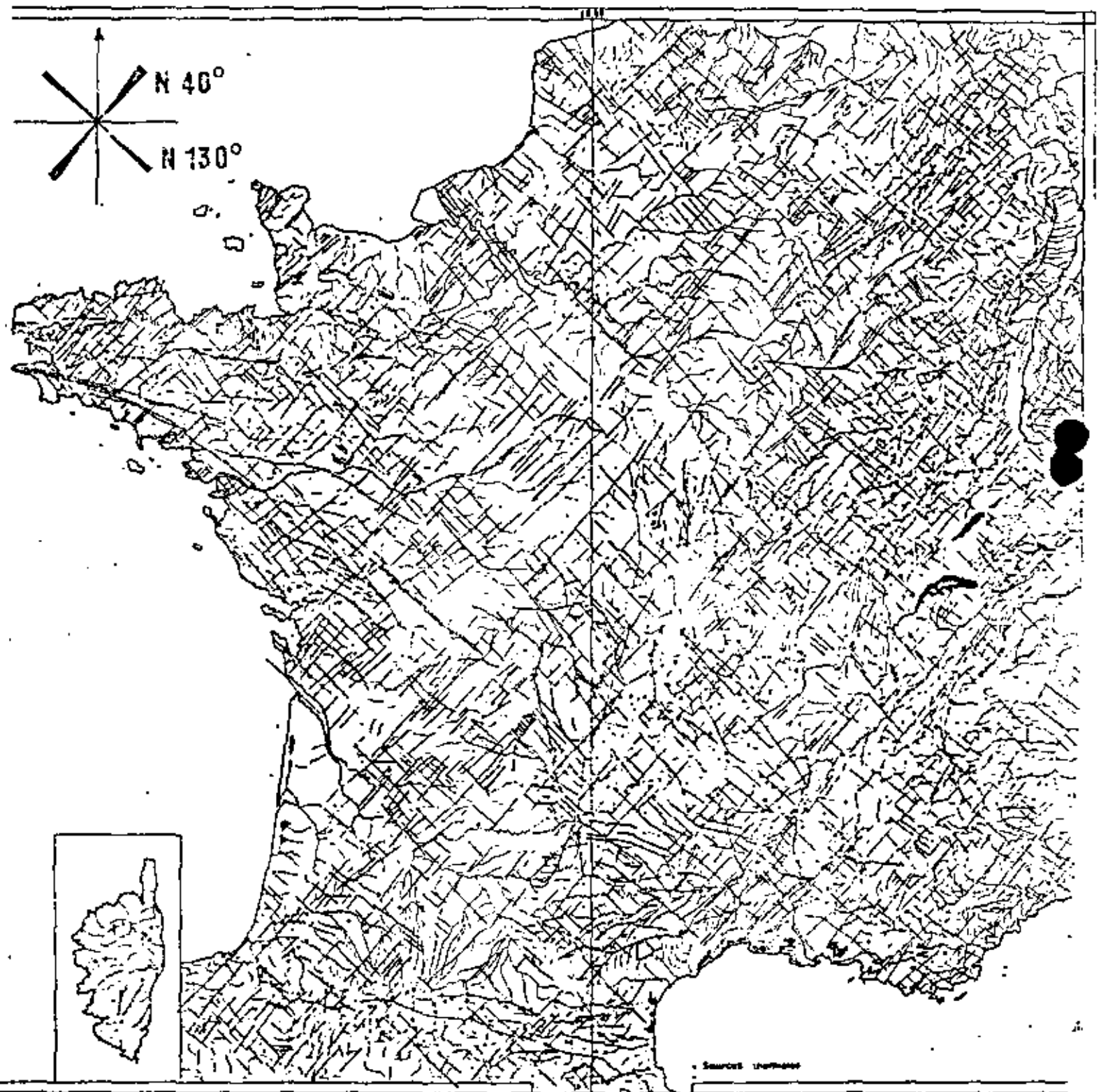






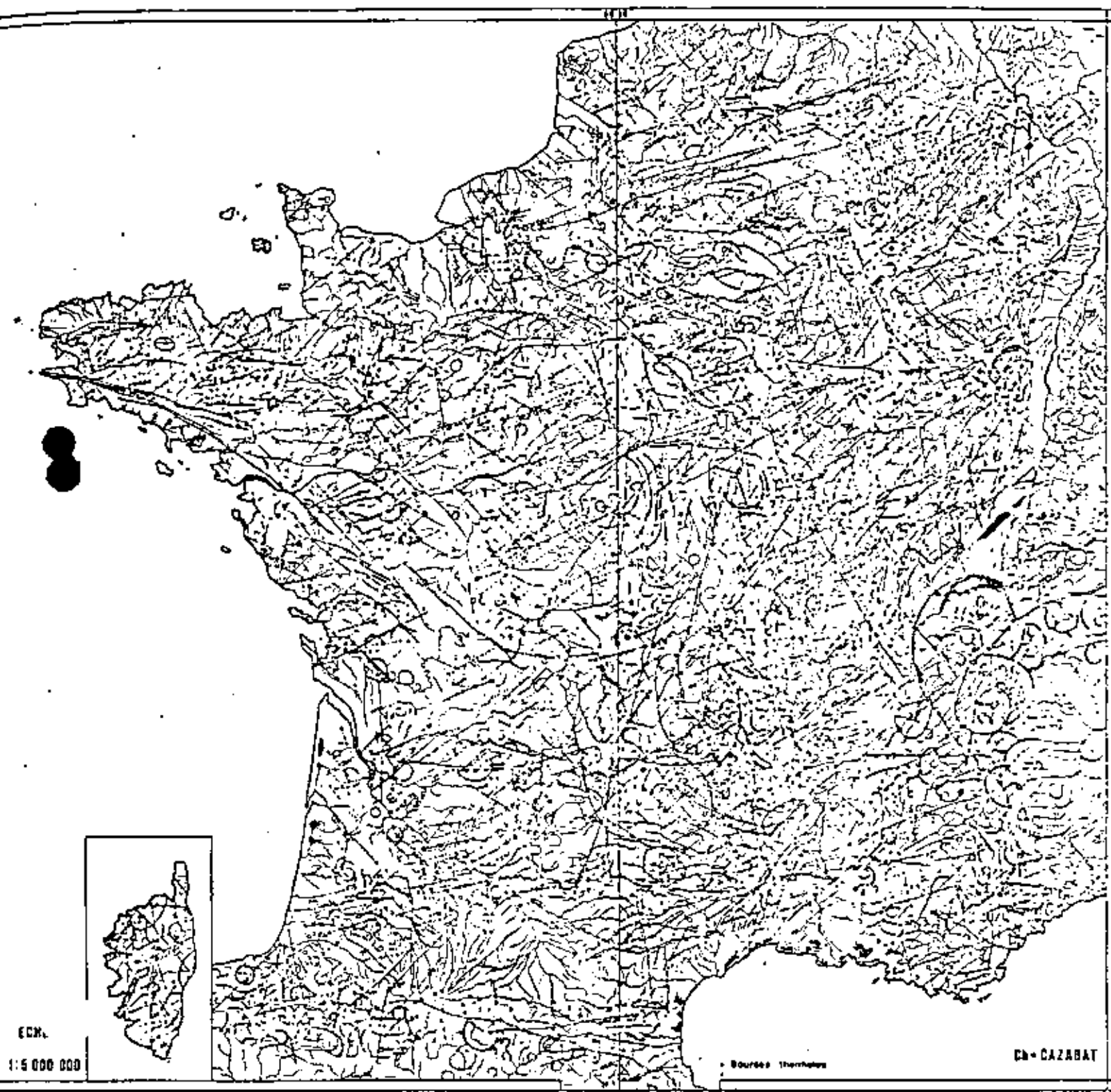
3.3 - 70

PI. 4C



# STRUCTURES CIRCULAIRES DE LA FRANCE

Plaque No 6

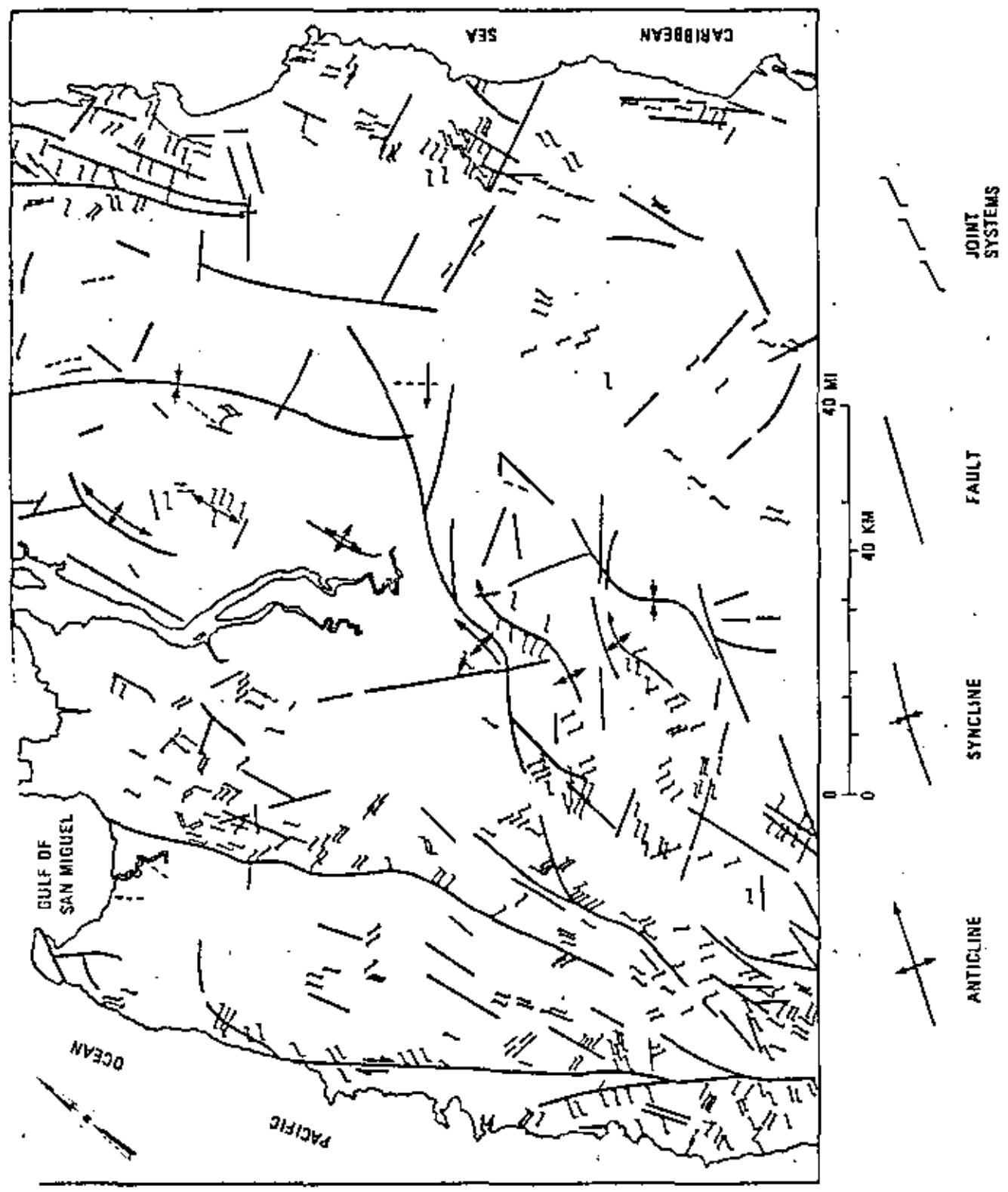


ECH.  
1:5 000 000

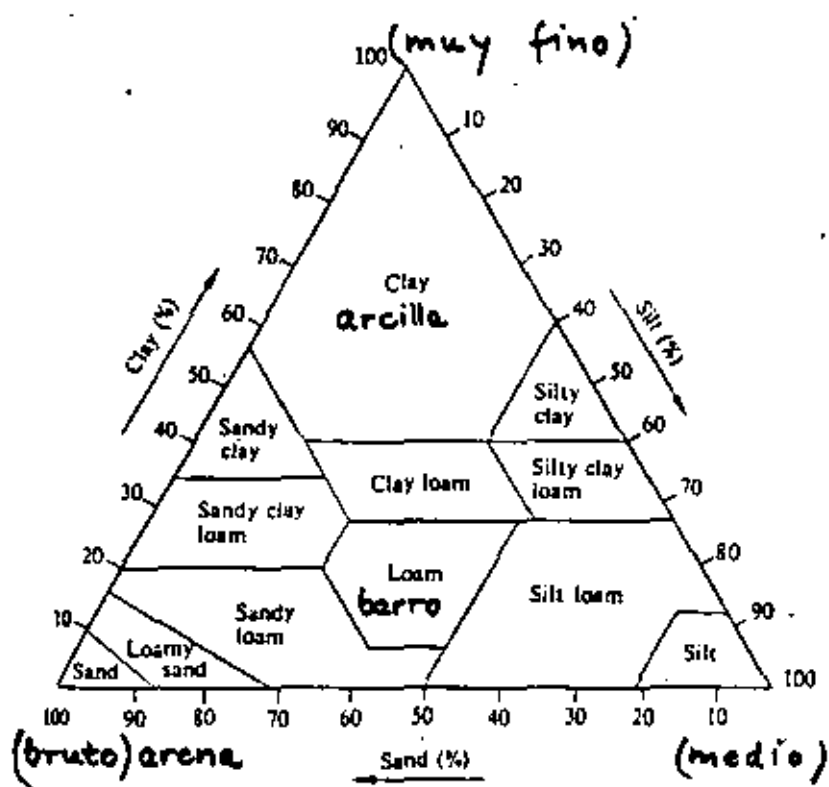
• Bourbes Thermale

Ch - CAZABAT

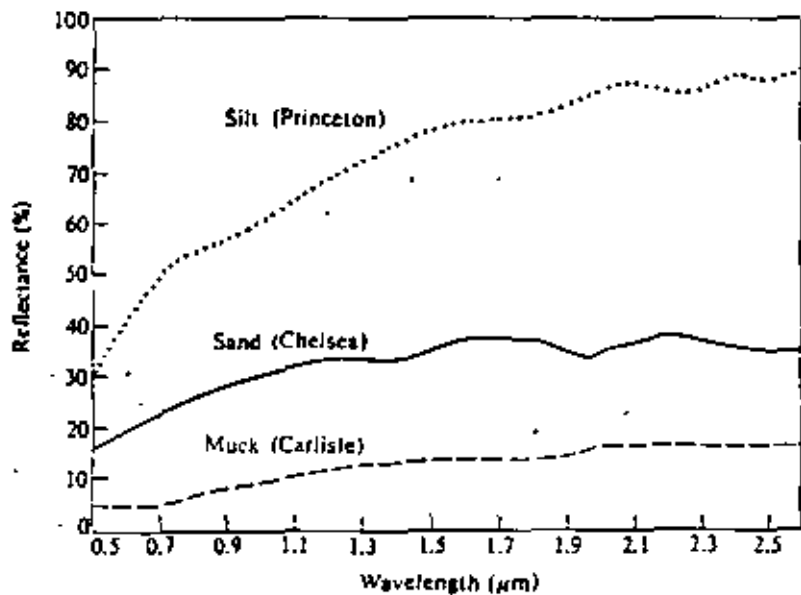
# Estructuras en un mosaico radar



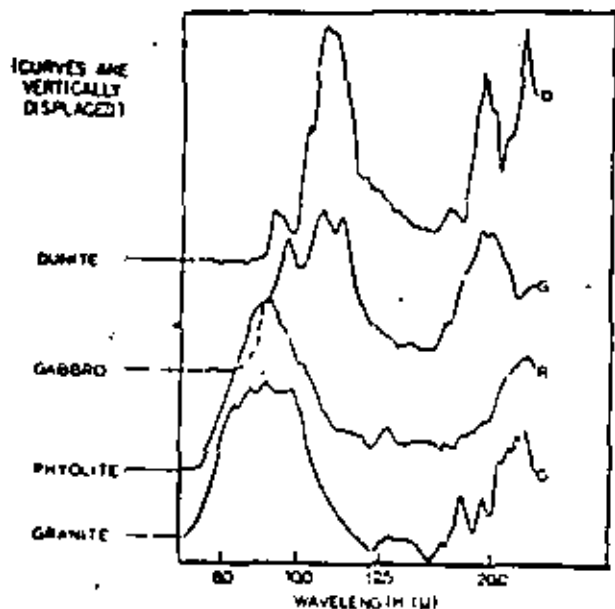
Structural interpretation of radar mosaic of Darien Province, Panama. From MacDonald (1969, Plate 1).



El tipo del terreno depende principalmente de las dimensiones de los granos



La reflectancia depende del material y del contenido de humedad



Las rocas tienen características distintas comparando con las tierras

mapa de del rio



Interpretación geológica mediante Radar y LANDSAT (M. I. Daily et al. Phot. Eng. 1979, pág. 1109 - 1116)

Ver diapositivos

Región : Death Valley

3 km

Gravas de tipo distinto, en forma de abanico

Detección de precipitaciones salinas (Fuente: K. J. Dalstedt et al., Phot. Eng. '79)

TABLE 1. SCANNER AND FILM PRODUCTS DESCRIPTION.

Sensor Mode	Data Recorded by	Film Type & Filter <sup>1</sup>	Approximate Spectral Response
Cameras 50 mm Hasselblad(s)	Film (70mm)	2402/58 (Green band)	0.47 to 0.61 $\mu\text{m}$
		2402/25 (Red band)	0.59 to 0.71 $\mu\text{m}$
		2424/89B (Black and white infrared)	0.68 to 0.90 $\mu\text{m}$
		2443/10-15M (Color infrared)	0.51 to 0.90 $\mu\text{m}$
Thermal Scanner	7 track magnetic tape	magnetic tape data transferred to film (2490) by film recorder	8.7 to 11.5 $\mu\text{m}$

Sensores

Tipo 1:  
Fase primera  
Tipo 2:  
Fase segunda  
Tipo 3:  
tierra blanca

TABLE 2. SALINE SEEP INTERPRETATIONS FROM 1973 COLOR INFRARED PHOTOGRAPHY AND COLOR INFRARED (CIR) PHOTOGRAPHY PLUS THERMAL IMAGERY.

Interpreter	Imagery Base	(A) Correct Areal Identification	(B) Type 1 Error <sup>1</sup>	(C) Type 2 Error <sup>1</sup>	(D) Areal Percentage Correct (A + A + B)	(E) Accuracy of Areal Percentage (A + A + C)	(F) Correct Identification <sup>2</sup>
One	CIR	52.0 ha	7.0	25.4 ha	88.2%	67.2%	93%
One	CIR + Thermography	52.8 ha	6.2 ha	19.2 ha	89.6%	73.4%	90%
Two	CIR	42.5 ha	16.6 ha	3.6 ha	71.0%	92.2%	86%
Two	CIR + Thermography	42.7 ha	16.3 ha	3.6 ha	72.3%	88.4%	90%

Tipo 1

Tipo 2

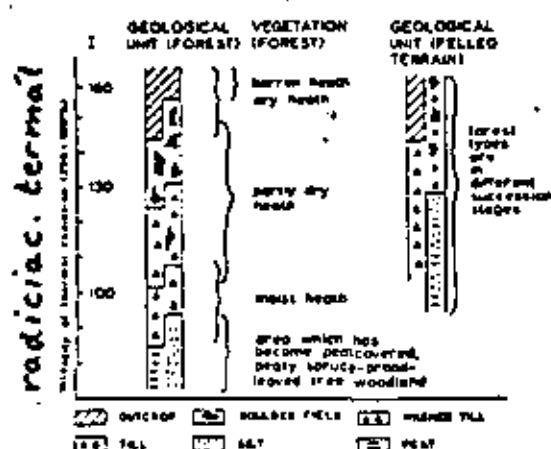
<sup>1</sup> areas that were not classified as seeps  
misclassification of areas as seeps based on numbers of seeps

TABLE 3. SALINE SEEP INTERPRETATIONS FROM 1976 COLOR INFRARED IMAGERY AND COLOR INFRARED IMAGERY PLUS THERMAL IMAGERY.

Interpreter	Imagery Base	(A) Correct Areal Identification	(B) Type 1 Error <sup>1</sup>	(C) Type 2 Error <sup>1</sup>	(D) Areal Percentage Correct (A + A + B)	(E) Accuracy of Areal Percentage (A + A + C)	(F) Correct Identification <sup>2</sup>
One	CIR	48.6 ha	13.1 ha	17.4 ha	78.8%	73.6%	77.3%
One	CIR + Thermography	50.1 ha	11.8 ha	13.4 ha	81.0%	79.0%	78.3%
Two	CIR	43.1 ha	18.7 ha	10.9 ha	69.7%	79.5%	78.3%
Two	CIR + Thermography	42.5 ha	19.5 ha	12.6 ha	68.5%	77.2%	73.9%

<sup>1</sup> areas that were not classified as seeps  
misclassification of areas as seeps based on numbers of seeps





Soil units and related vegetation in forested and clear cut area on the thermal intensity scale (8-13 μm).

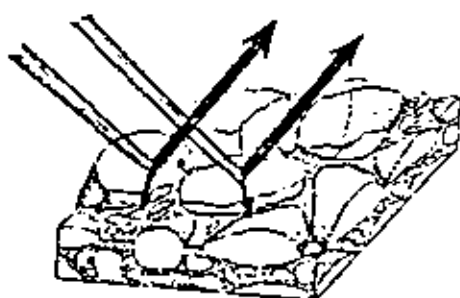
Evaluación finlandesa de la percepción remota (ver Kilpelä et al.)

Acción recíproca del terreno, vegetación y de la radiación emitida

Campos con poca errática

	0	T <sub>1</sub>	T <sub>2</sub>	G	S	B	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>
0 Outcrop	70.5	24	0.5	5					
T <sub>1</sub> Boulder Field, till 1)	T	0.2	85		3.5	4.2	7.1		
T <sub>2</sub> till 2)									
G Gravel <i>grava</i>		8	68			24			
S Silt				93	5.2		1.8		
B Barren soil					96		?		
P <sub>1</sub> Peat 1)	P	0.2	2.6		7.4		89.8		
P <sub>2</sub> Peat 2) <i>turba</i>									
P <sub>3</sub> Peat 3)									

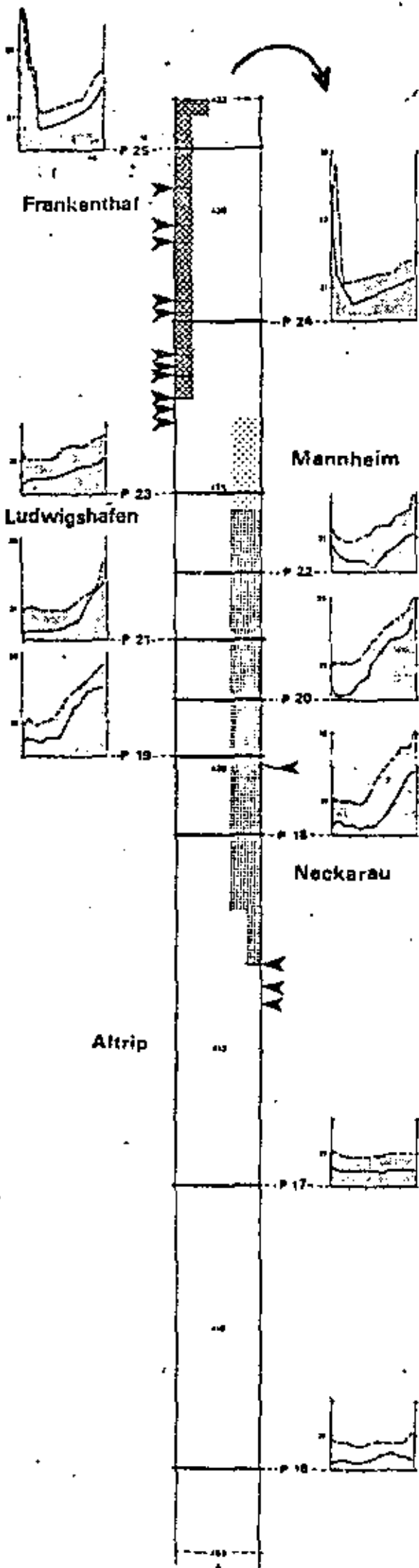
Resumen de la clasificación



Reflectividad y tipo de rocas (fuente: F. Barzegar, Phot. Eng. '79)

→ Interpretación de escenas LANDSAT en el Iran (ver diapositivos)





**Introducer**  
 ← Einleiter

Temp.-Differenz  
 zw. Fahne u. Flusswasser

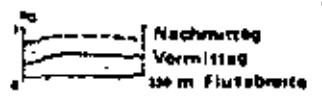
- > 3K
- 1-3K
- < 1K

Breite der Einleiterfahne

- > 75 m Breite
- < 75 m Breite

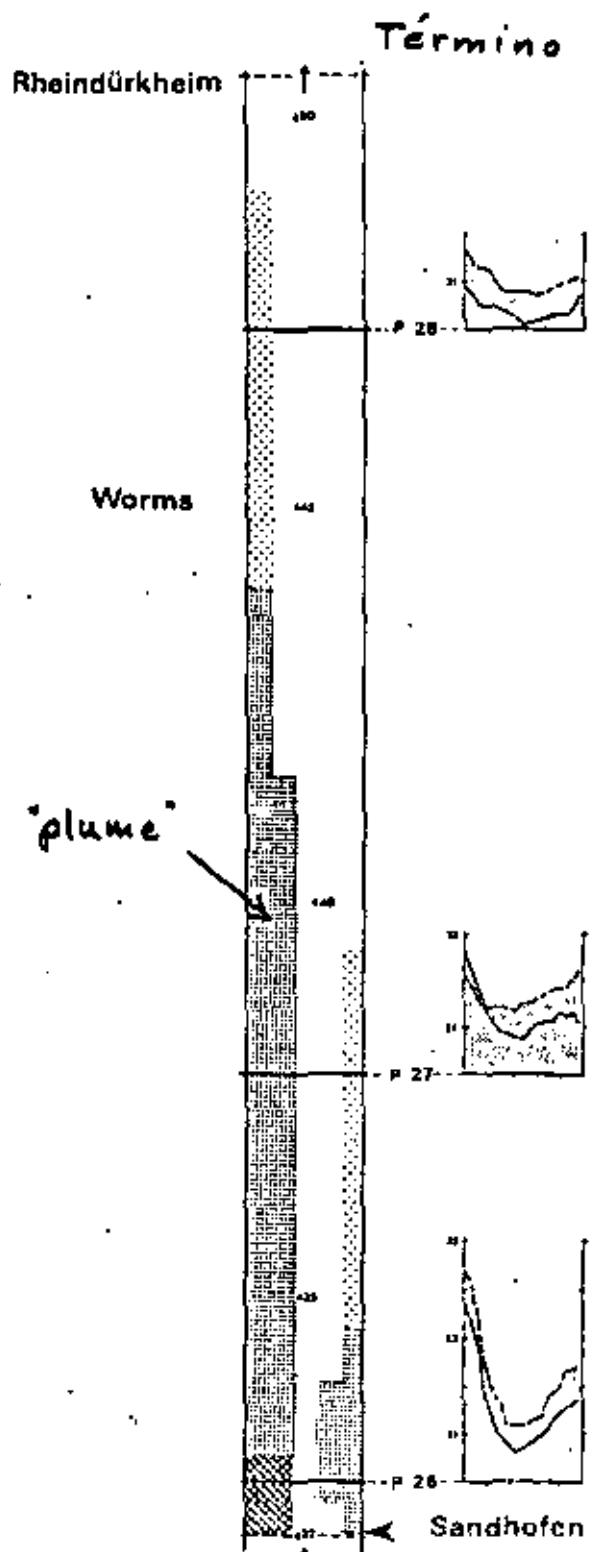
**Perfiles**

PT Laufende Profilvernummer



Profilmessung IRST, 29.1.1973

Fahnen aus IRLS-Aufnahmen  
 4.9.1973  
 31.5.1974  
 26.6.1974

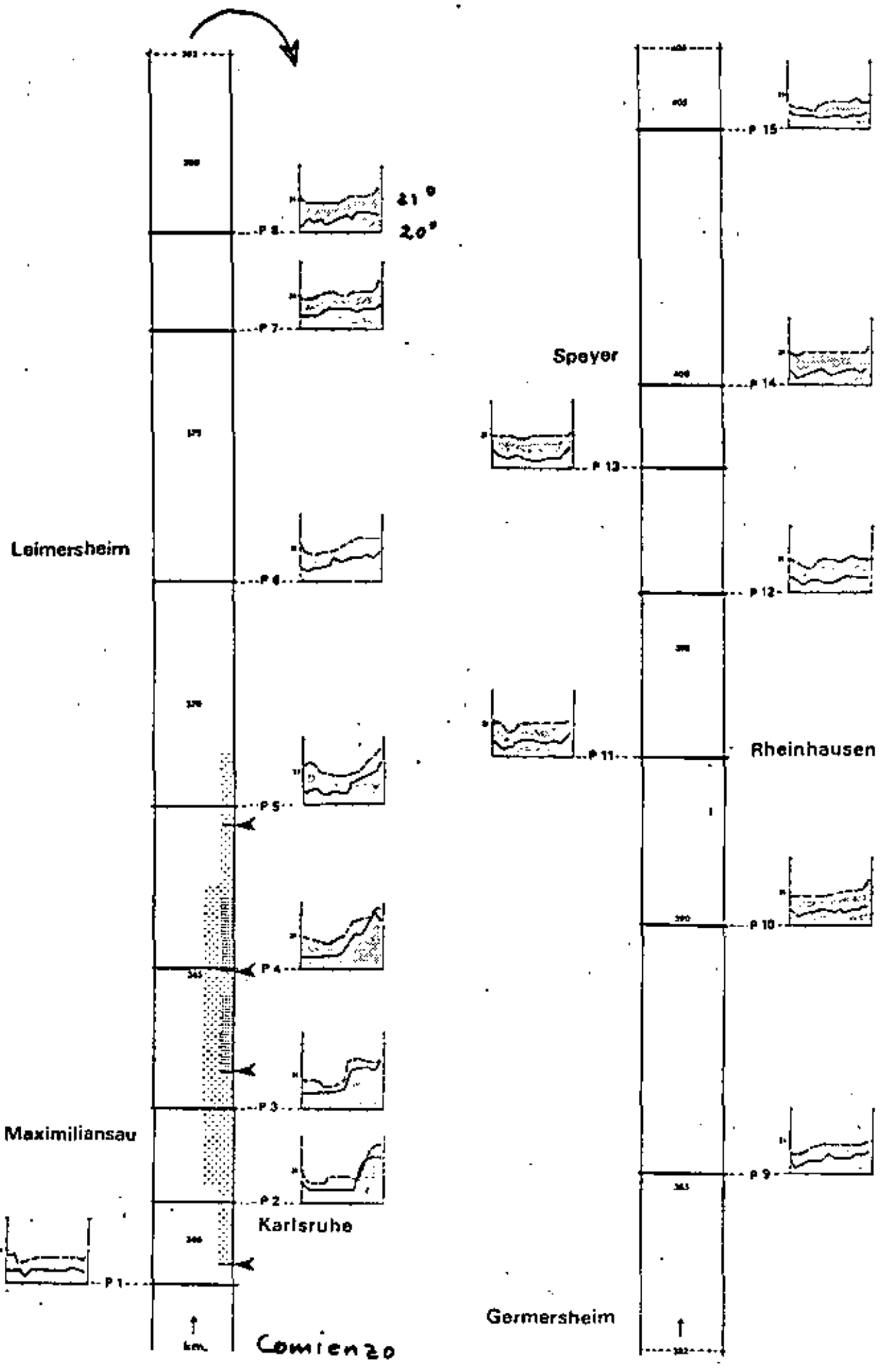


# Ensayo del río Rin de agua caliente residual

## SCHEMA DER THERMALEN EINLEITER UND EINLEITERFAHNEN (ver S.

Schneider)

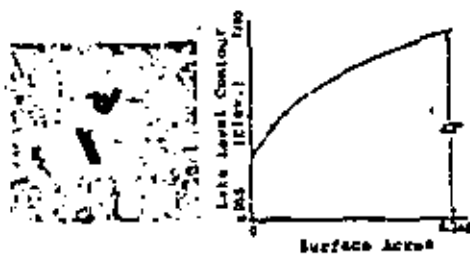
im Rhein-Abschnitt Karlsruhe-Worms  
mit ausgewählten radiometrischen Temperaturprofilen



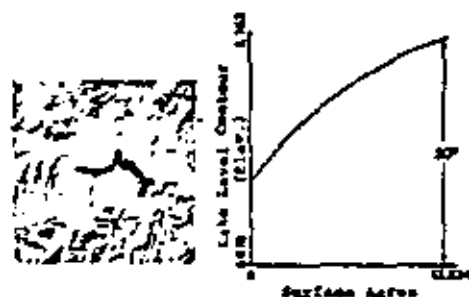
3.4.1 - 40  
 Superficies de  
 depósitos de agua  
 medidos por  
 LANDSAT  
 (H.E. White, Ph.D.  
 Eng. 1978)



NAVAJO RESERVOIR  
 complex/gentle



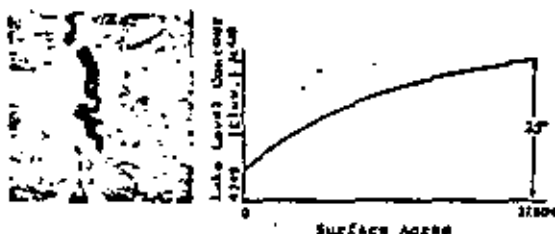
HERON RESERVOIR  
 simple/gentle



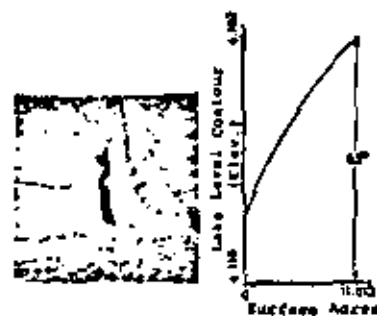
ABIQUIU RESERVOIR  
 complex/steep



CONCHAS LAKE  
 complex/steep



ELEPHANT BUTTE RESERVOIR  
 complex/gentle



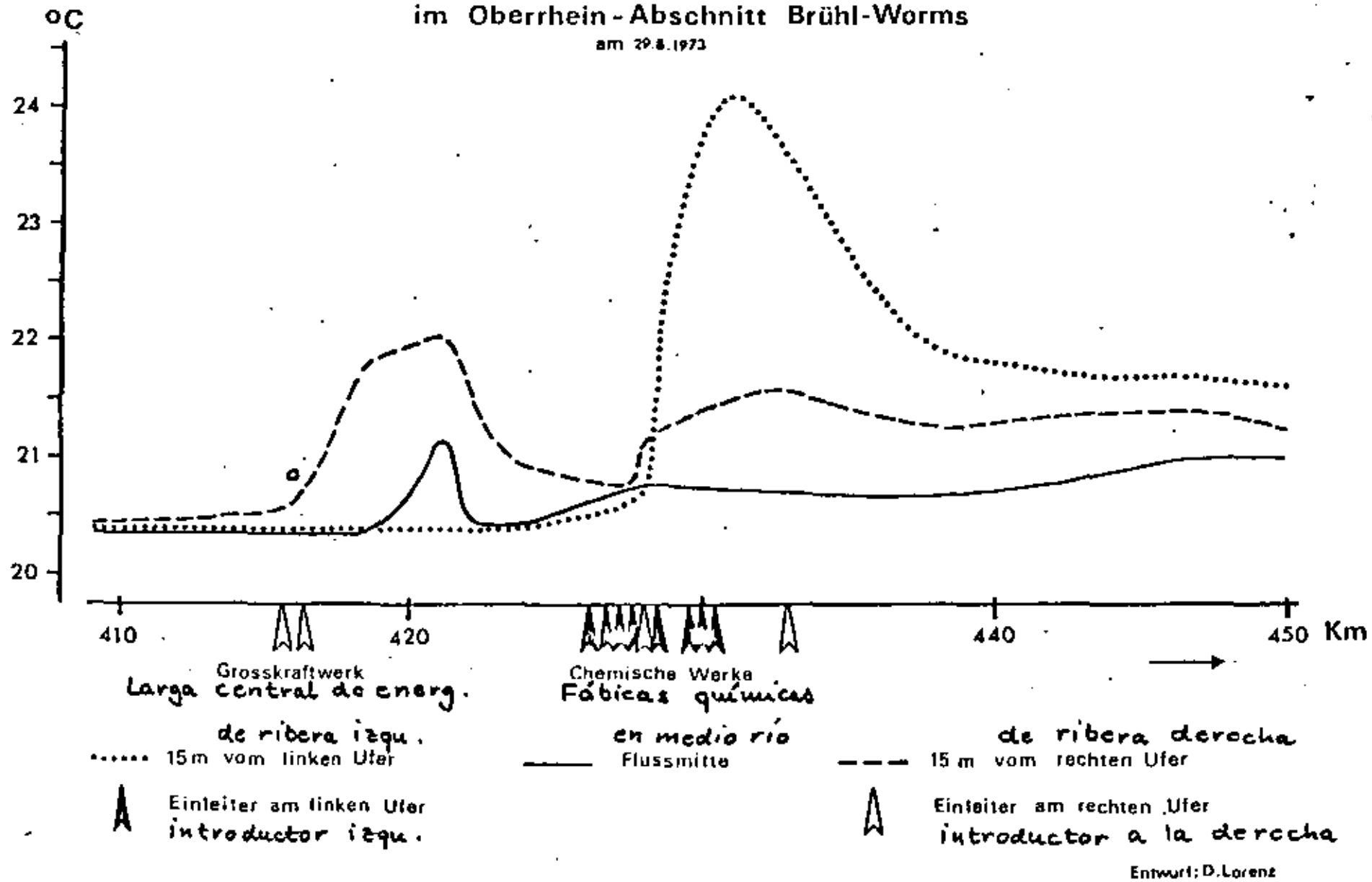
CABALLO RESERVOIR  
 simple/steep

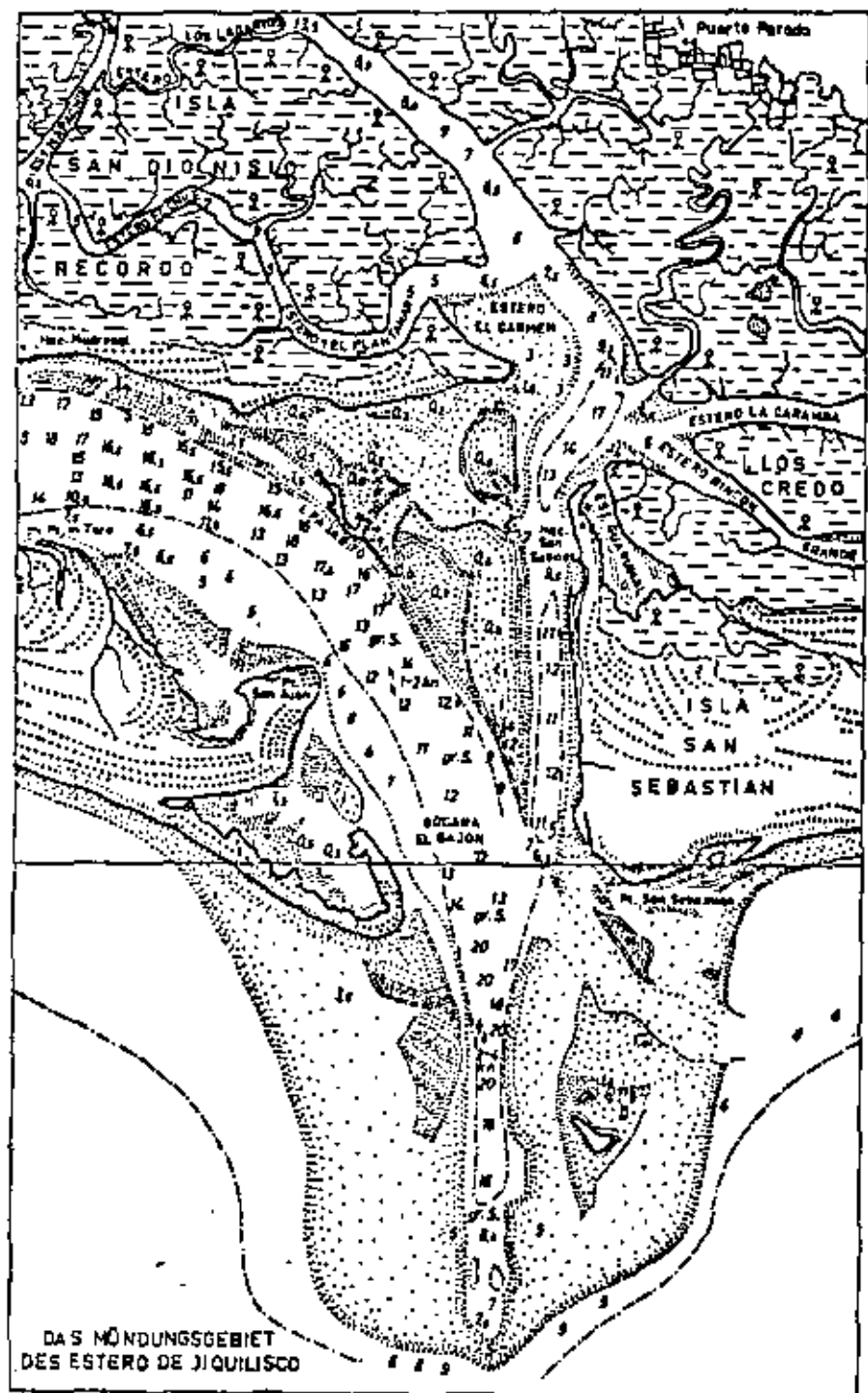
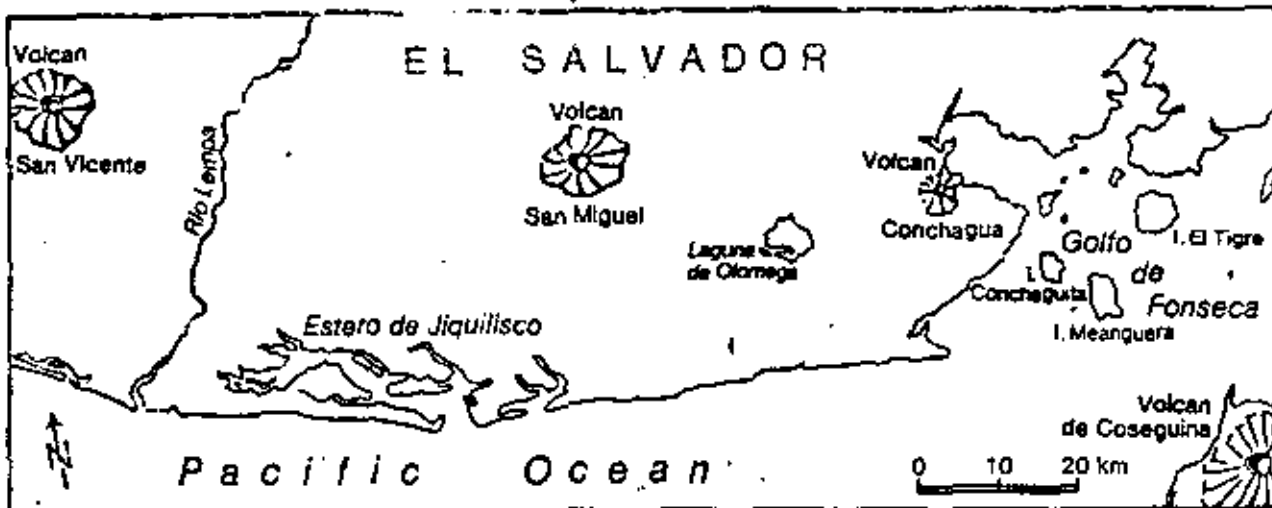
MEAN PERCENTAGE ERRORS FOR ACREAGE ESTIMATES DERIVED FROM EACH MEASURING  
 DEVICE/IMAGE SCALE/SEANIM/RESERVOIR COMBINATION INVESTIGATED.

Reservoir	Dot Grid	Planimeter	32-Level Color Density Slicer	16-Level Black- and-white Density Slicer	Scale
Navajo A.C.	107%	27%	-46%	61%	1:1,000,000
	-13%	10%	-35%	-76%	1:500,000
	36%	20%	-46%	122%	1:250,000
Heron R.C.	97%	7%	-26%	18%	1:1,000,000
	-2%	8%	-26%	-78%	1:500,000
	4%	6%	-58%	43%	1:250,000
Abiquiu A.S.	171%	27%	-35%	44%	1:1,000,000
	-19%	66%	-45%	-74%	1:500,000
	9%	15%	-66%	107%	1:250,000
Conchas A.C.	50%	17%	-39%	32%	1:1,000,000
	-11%	9%	-34%	-76%	1:500,000
	12%	8%	-60%	54%	1:250,000
Elephant Butte A.S.	14%	-1%	-40%	4%	1:1,000,000
	-13%	-4%	-36%	-80%	1:500,000
	-9%	-4%	-59%	20%	1:250,000
Caballo R.S.	54%	-4%	-16%	9%	1:1,000,000
	-11%	-1%	-31%	-79%	1:500,000
	2%	2%	-54%	26%	1:250,000

R = Rounded Shoreline      S = Steep Basin  
 A = Angular Shoreline      G = Gentle

Distribucion de la temperatura a flor de agua  
 Verteilung der Oberflächentemperatur des Flusswassers  
 im Oberrhein-Abschnitt Brühl-Worms  
 am 29.8.1973





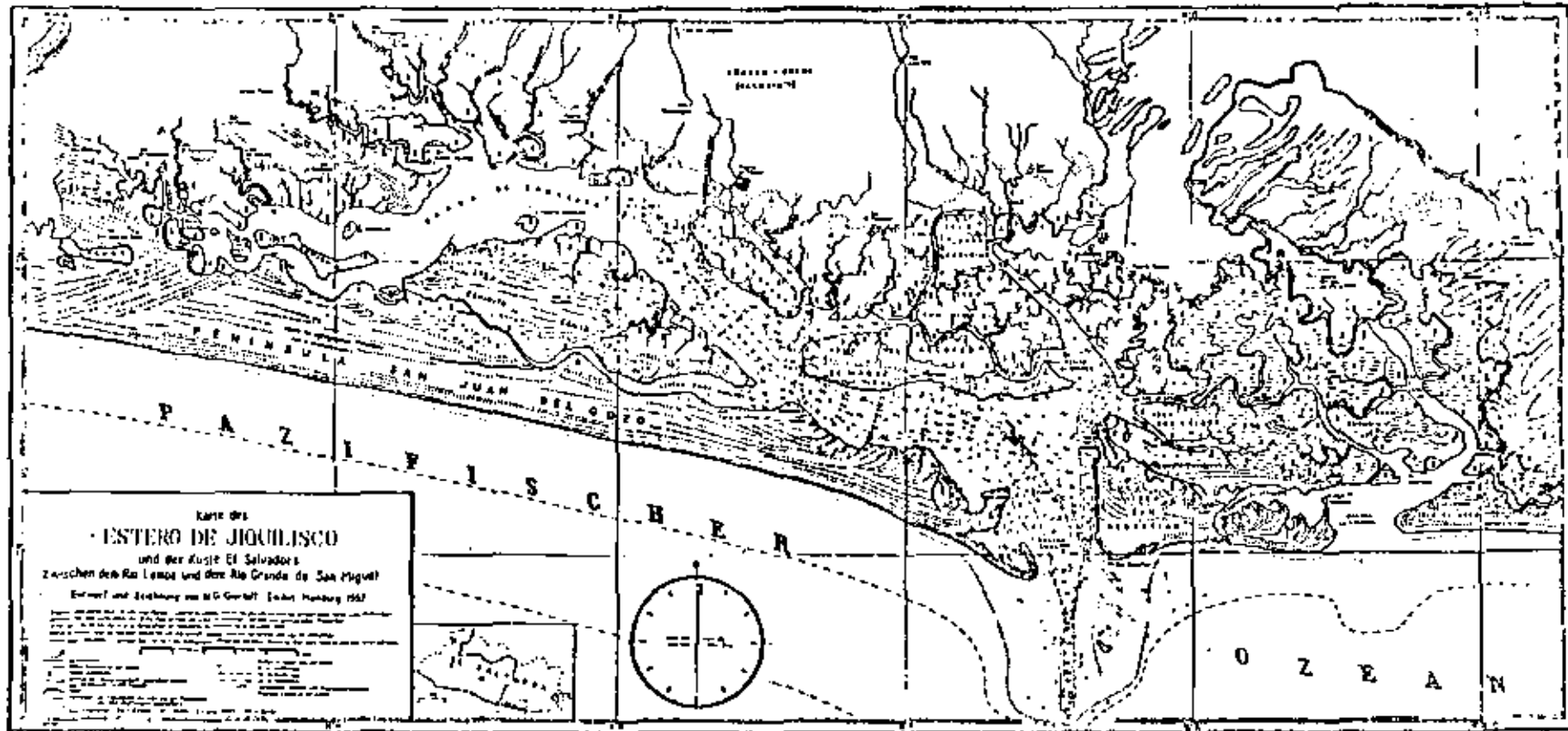
(Fuente: Gierloff-Emden)  
 Comparación de un  
 levantamiento terrestre (5  
 y una interpretación de  
 imágenes LANDSAT (173  
 feb)

Entrance and approaches of the Jiquilisco lagoon, Bocana el Bajon

scale 1 : 80 000

main channel, offshore and foreshore shoals, sandbanks, islands, beach ridges on barrier islands and mangrove vegetation

as mapped and drawn by H.G. Gierloff-Emden, 1953



Map of Estero de Jiquilisco, Coast of El Salvador

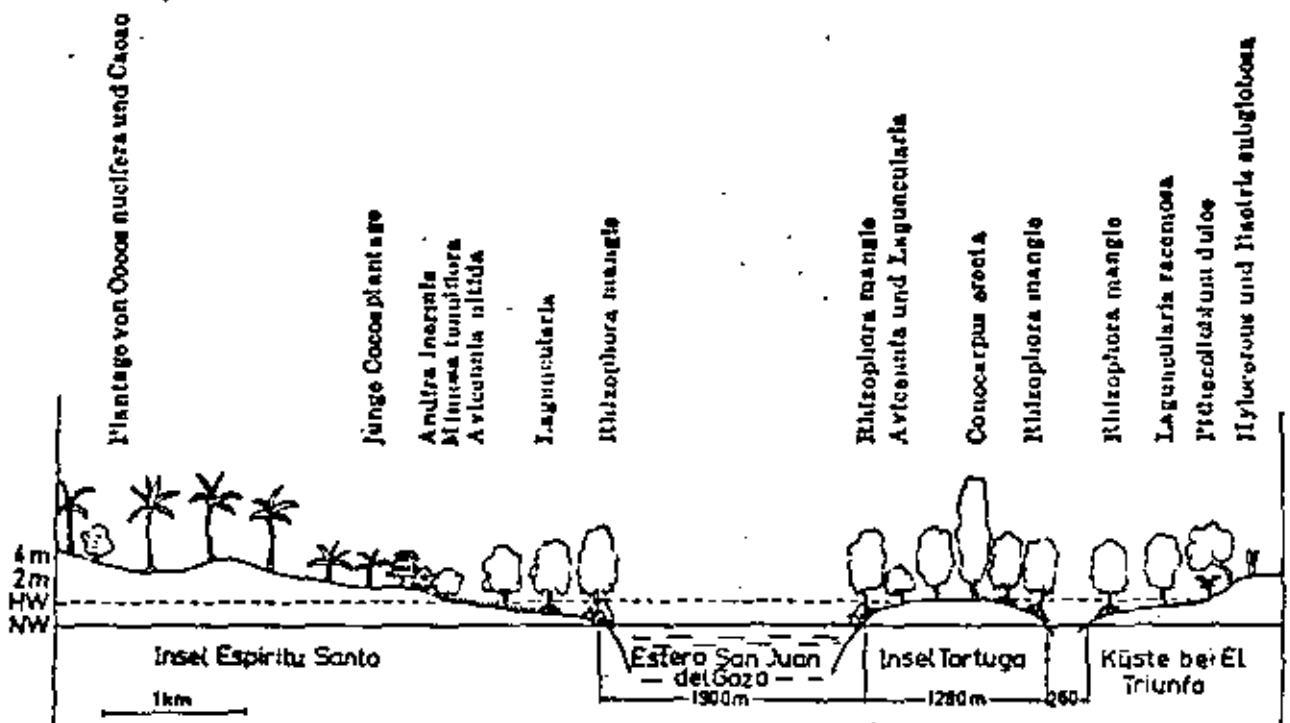
Scale 1 : 210 000

compiled and drawn by H. G. Gierloff-Emden after fieldwork and aerial photographs. This map was produced by minimizing.

presenting: barrier peninsula and barrier islands, with beach ridges (dotted lines), mangrove vegetation and lagoonal water body, water tidal channels.

Compare the details of the tidal channels and of the mangrove vegetation of this map with the small scale thematic maps made from ERTS-MSS imagery, and the ERTS imagery itself.

See following pages.



Profile across the main channel of the Estero de Jiquilisco, El Salvador

Zones: terrestrial, inter-tidal (between HW (High Water) and NW (Low Water) and marine mangrove vegetation in the inter-tidal zone

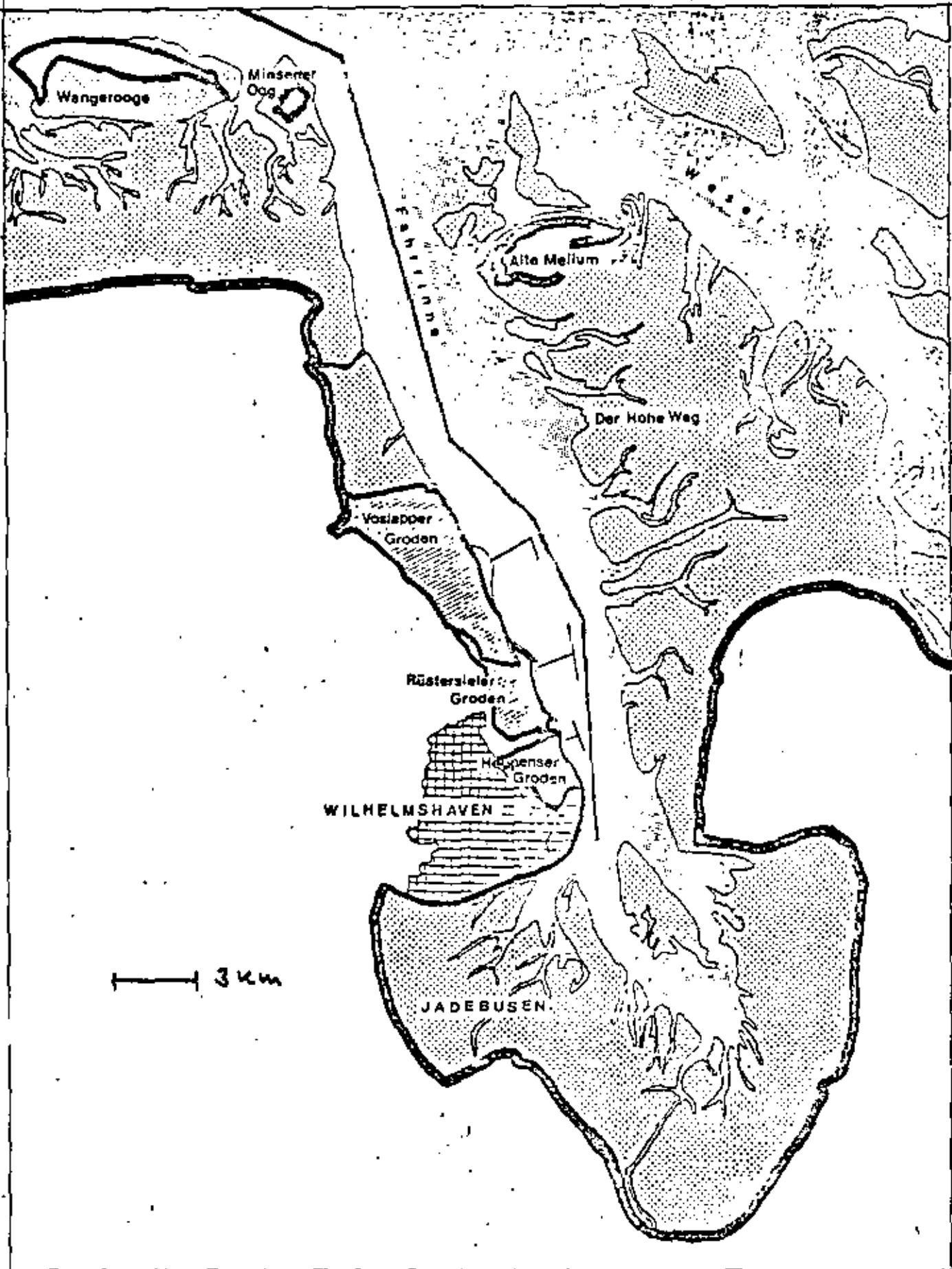
Remark: NW as the German term means "Niedrigwasser" i.e. Low Water

### Classification of vertical zones of the Lagoon of Jiquilisco, El Salvador

Depending on High Water and Low Water of prevailing tides with a mean tidal range of 2 m, the environment is separated into vertical zones:

- I above High Water level: terrestrial  
mainland, barrier islands, and peninsulas with beach ridges and spits and lagoonal islands
- II between High Water and Low Water level: inter-tidal  
tidal flats and mangrove vegetation and tidal channels; the mangrove vegetation roots in inter-tidal flats but the tops of the trees rise up into the upper level
- III below Low Water level: lagoonal and marine  
bottom of channels, i.e. submarine topography  
and water bodies of the lagoon, i.e. hydrographic features
- IV below Low Water level at the entrance and outside of the lagoon: oceanic  
offshore shoals, bottom of the sea, i.e. submarine topography and water body of the sea,  
i.e. hydrographic features





3.4.2 - 50

Wilhelms  
haven

LANDSAT

11.8.1978

Banda 7





Original  
banda 5



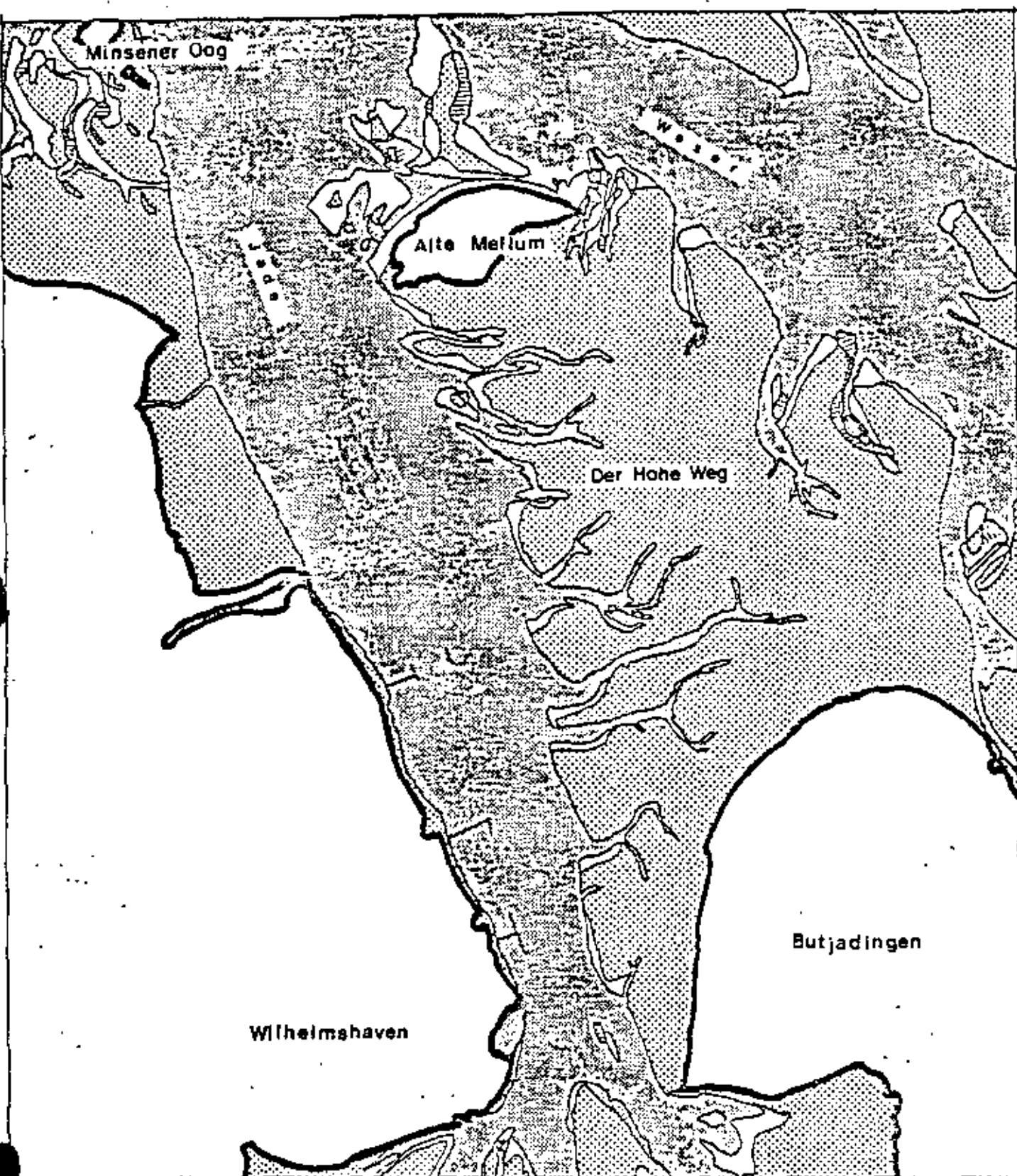
Tc9



TC 25



TC 29



Diferencias entre el mapa de mar y la imagen satélite (referencia:  
Abweichungen zwischen Seekarte und Satellitenbild in bezug auf <sup>mar</sup> nivel de  
Seekartennull)

Areas sobre nivel de mar, bajo de la línea del agua  
Flächen über Seekartennull und über Wasserlinie

Areas bajo del nivel de mar, sobre la línea del agua  
Flächen unter Seekartennull und über Wasserlinie

Areas sobre el nivel de mar, bajo de la línea del agua  
Flächen über Seekartennull und unter Wasserlinie

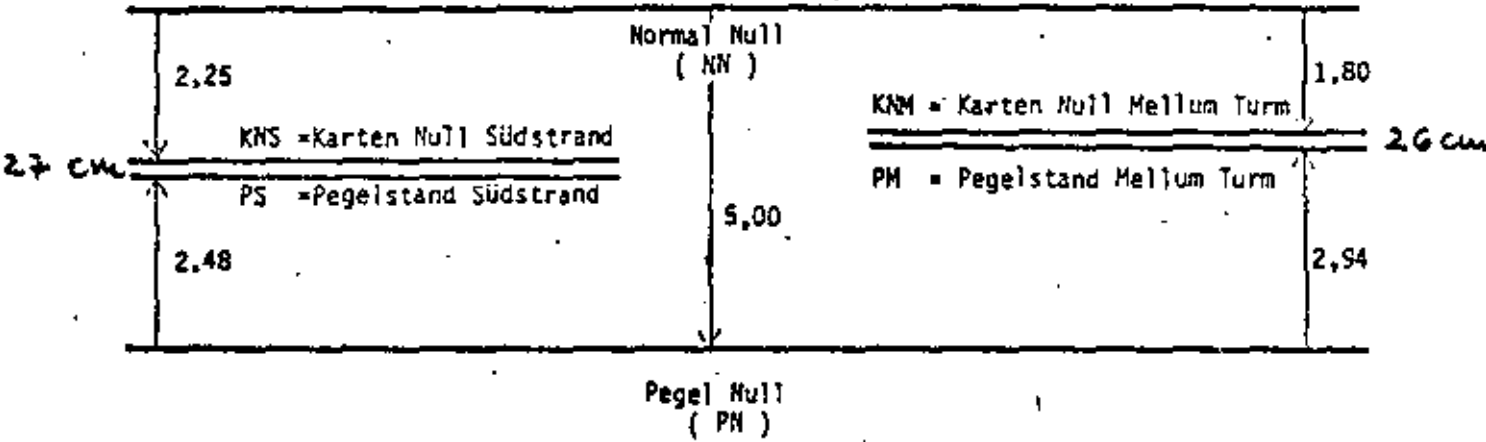
(Bähr)

Fluviómetro Sur

Fluviómetro Norte

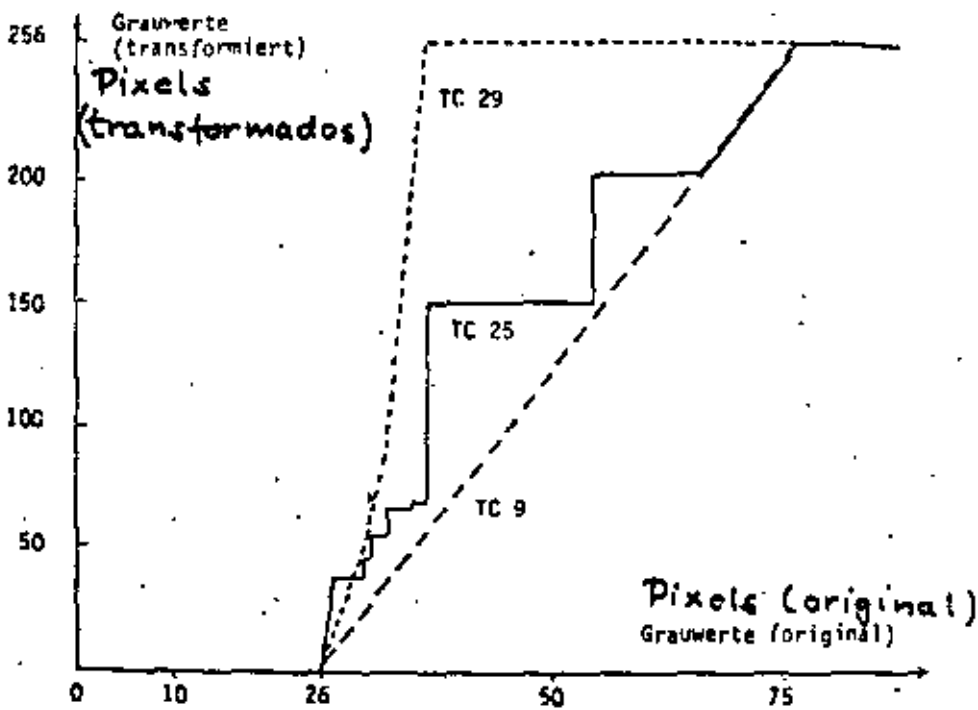
Pegel: Südstrand

Pegel Mellum Turm



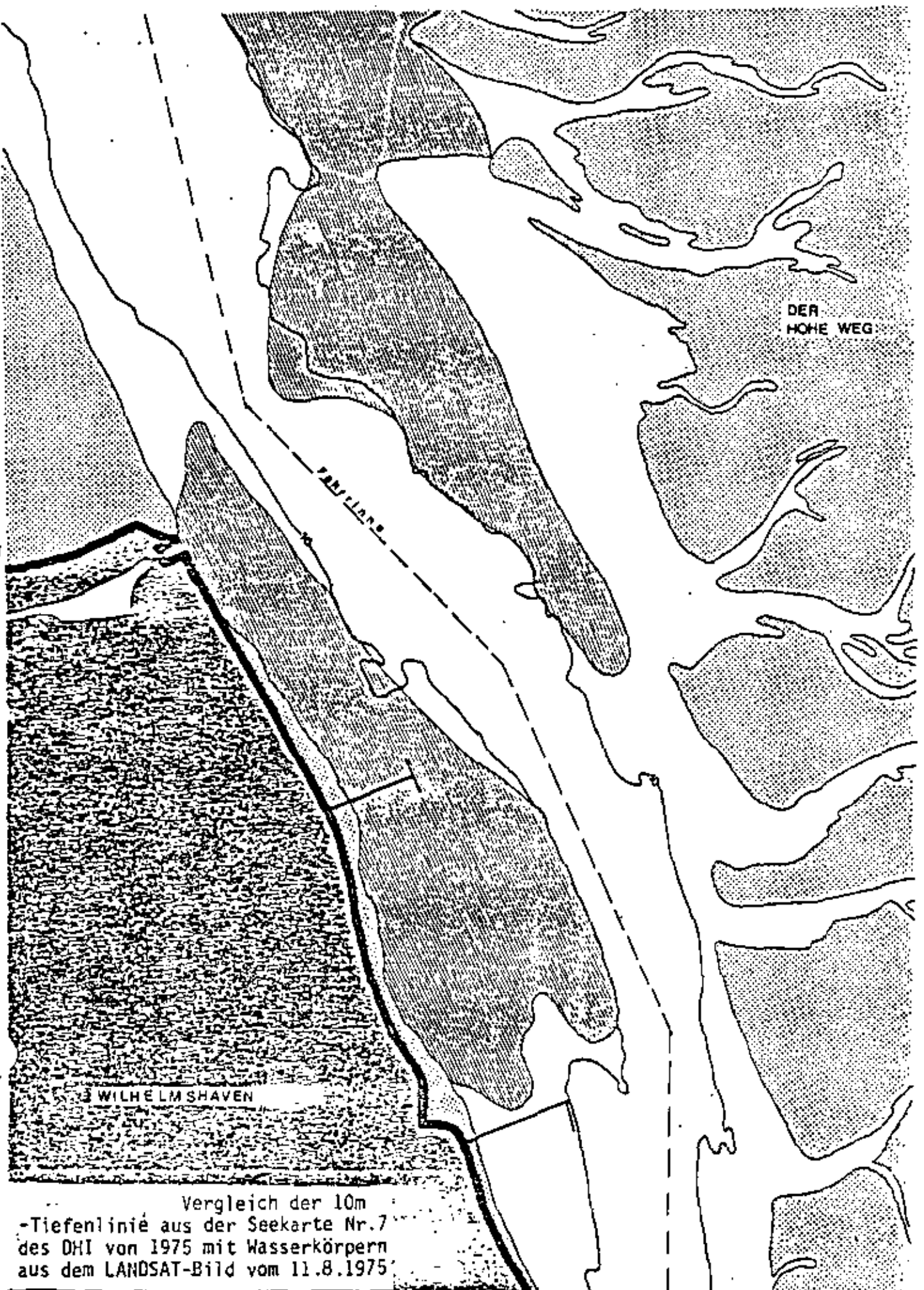
Niveles de agua

Pegelstände 11.8.1975, 9.30 Uhr im Jadebereich  
Angaben in [m]



3 Transferfunktionen für LANDSAT-Bild (Jade), Kanal 5

Banda 5 (rojo)



(Bähr)

Comparación de las líneas de profundidad del mapa de mar con los cuerpos de agua en la imagen satélite



Wilhelmshaven : imágenes scanner (avión)  
banda amarilla

A la izquierda : original

A la derecha : manipulación de  
histogramas

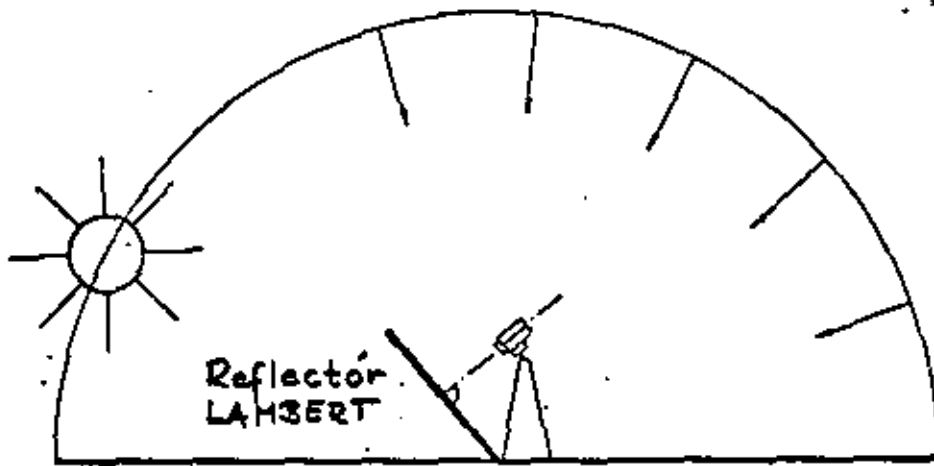


Fortsetzung:

	RMK	Hasselblad-Kamera (EL500) (Oberweitwinkel)	M <sup>2</sup> S	LANDSAT
<b>Semantica</b> III. Bildinhalt				
1. Visuelle Interpretation des Originalbildes	sehr gut, auch stereoskopisch auswertbar	nicht möglich, gilt nur für Oberweitwinkel	kaum möglich	kaum möglich, (nach Histogrammlinariisierung gut)
2. Digitale Kontrastverarbeitung Tratamiento numérico del contraste			Empfohlen zur Darstellung von Einzelphänomenen	Voraussetzung für Lesbarkeit, empfohlen zur Darstellung von Einzelphänomenen
3. Darstellung der Wasseroberfläche Superficie del agua	geringe Kontraste	sehr gute Kontraste zur Trennung von Wasserkörpern	Wasserlinie im Infrarot (1 µm) Wasserkörper optimal bei 0,55 (gelb/grün)	Wasserlinie im Infrarot (1 µm) Wasserkörper in Kanal 5 (0,6-0,7 µm)
4. Darstellung der Wattoberfläche Planos de mareas	geeignet zur Analyse von Feinstrukturen im Watt	keine Kontraste	Differenziert in den verschiedenen Kanälen des sichtbaren Spektrums	Kanal 5 (0,6-0,7 µm)
5. Multispektrale Klassifizierung Clasificación	Informationsverlust durch Filterung und Digitalisierung		notwendig für optimale Informationsverarbeitung der 11 Kanäle	sehr gut anwendbar
Vorteile des Bildinhalts für Anwendungen Ventajas de la Semántica	Auswertung ohne weitere Hilfsmittel möglich		Individuelle Kombination geeigneter Kanäle für unterschiedlichste Anwendungen	Hohe Flächendeckung u. stabile Geometrie günstig für Wasserflächen
Nachteile des Bildinhalts für Anwendungen Desventajas	Für Wasser zu geringe Flächendeckung, digitale Verarbeitung unwirtschaftlich	Oberweitwinkelaufnahmen nur digital auswertbar	Digitale Bildverarbeitung erforderlich, hohe Kosten	keine flexible Spektralkombination für verschiedene Anwendungen

Comparación de 4 sensores aplicados en zonas costeras

I. Aufnahme- parameter	MMK Camera	Hasselblad- Kamera (EL500) (Oberweit- winkel) Camera Hasselblad	M <sup>2</sup> S Scanner	LANDSAT 3.4.2 - 130
1. Plattform	Flugzeug avion	Flugzeug	Flugzeug	Satellit
2. Sensor	Kamera 23 cm x 23 cm f = 15 cm Film	Kamera 5,5 cm x 5,5 cm f = 3 cm Film	Mechanischer Abtaster Photodioden	Mechanischer Abtaster Photodioden
3. Sensibili- sierung	Farbe (3 Schichten) Color	Farbe infra- rot (3 Schich- ten Color infrarojo	11 Kanäle, von 0,3 µm (UV) bis 14 µm (thermal)	4 Kanäle, bandes von 0,5 µm bis 1,1 µm
4. Auflösungs- element A am Boden, ca. resolucion	0,5 m	2,5 m	9 m	80 m
5. Aufgenommene Fläche Superficie	21 km <sup>2</sup>	70 km <sup>2</sup>	210 km <sup>2</sup> (1 Magnet- band) cinta	32400 km <sup>2</sup> (1 Szene)
Vorteile Auf- nahmeparameter Ventajas parámetros de levantam.	Meßkamera Hohe Auflö- sung	kein Spezial- flugzeug, han- delsüblicher Film, kosten- günstig	Hohe spektra- le Informa- tion	Deckt große Flächen, kosten- günstig
Nachteile der Aufnahmepara- meter Desventajas	Spezial- flugzeug, Spezial- kamera	kleines Bild- format, inne- re Orientie- rung unbe- kannt	Verfügbarkeit eingeschränkt Befliegungs- kosten hoch	niedrige Auf- lösung, Ver- fügbarkeit sehr stark eingeschränkt (Wiederho- lungsrate, Wolken)
<u>Geometria</u> 11. Bildgeo- metrie				
1. Ent- zerrungs- verfahren Metodos de rectificación	Einzelbild- entzerrung (analog) im Nordsee- küstenbereich	Digital (nicht durchgeführt)	Digital (Polynome 2. Grades)	Digital (Affintrans- formation od. Polynome 2. Grades)
2. Erreichte Genauigkei- ten m <sub>x</sub> , m <sub>y</sub> precisión obtenida	5 m, 6 m	329 m, 466 m (unverarbei- tet)	61 m, 71 m	45 m, 44 m (Jade) 26 m, 51 m (Nordfries. Watt)
Vorteile Bild- geometrie Ventajas Geometria	Geometrische Analogverar- beitung operationell durchführbar			wenig oder kei- ne Paßpunkte erforderlich Hohe Genauigkeit in Bezug auf Auflösung
Nachteile Bildgeometrie Desventajas	Für Verar- beitung pho- togrammetri- sche Spe-	keine Analogver- arbeitung mög- lich (gilt nur für Oberweit-	Starke Ände- rung der Orientie- ungspara-	

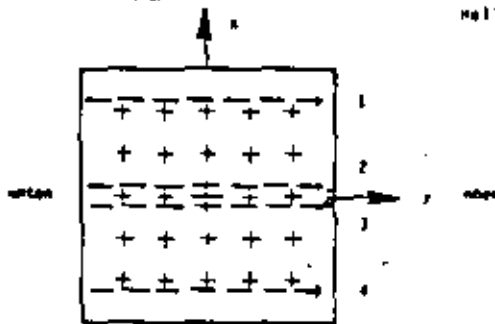
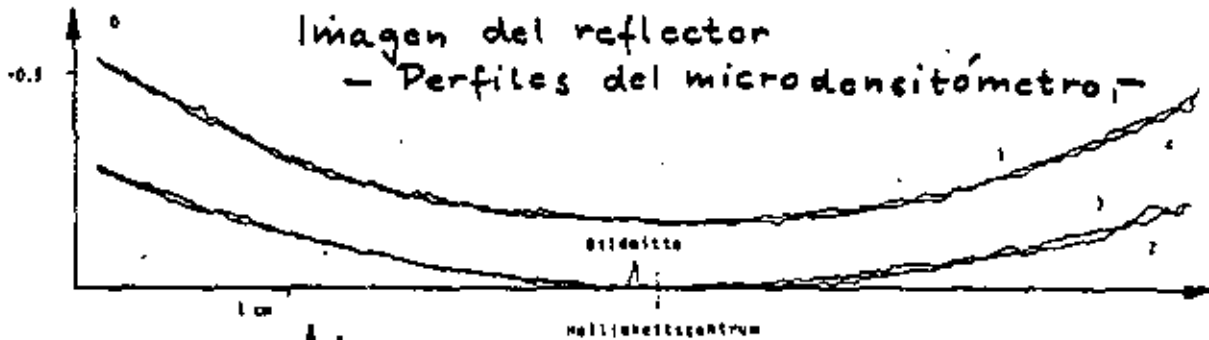


Formación de una imagen sin perturbaciones  
 : Meßanordnung bei Aufnahme des LAMBERT-Reflektors  
 (aus ALVES)

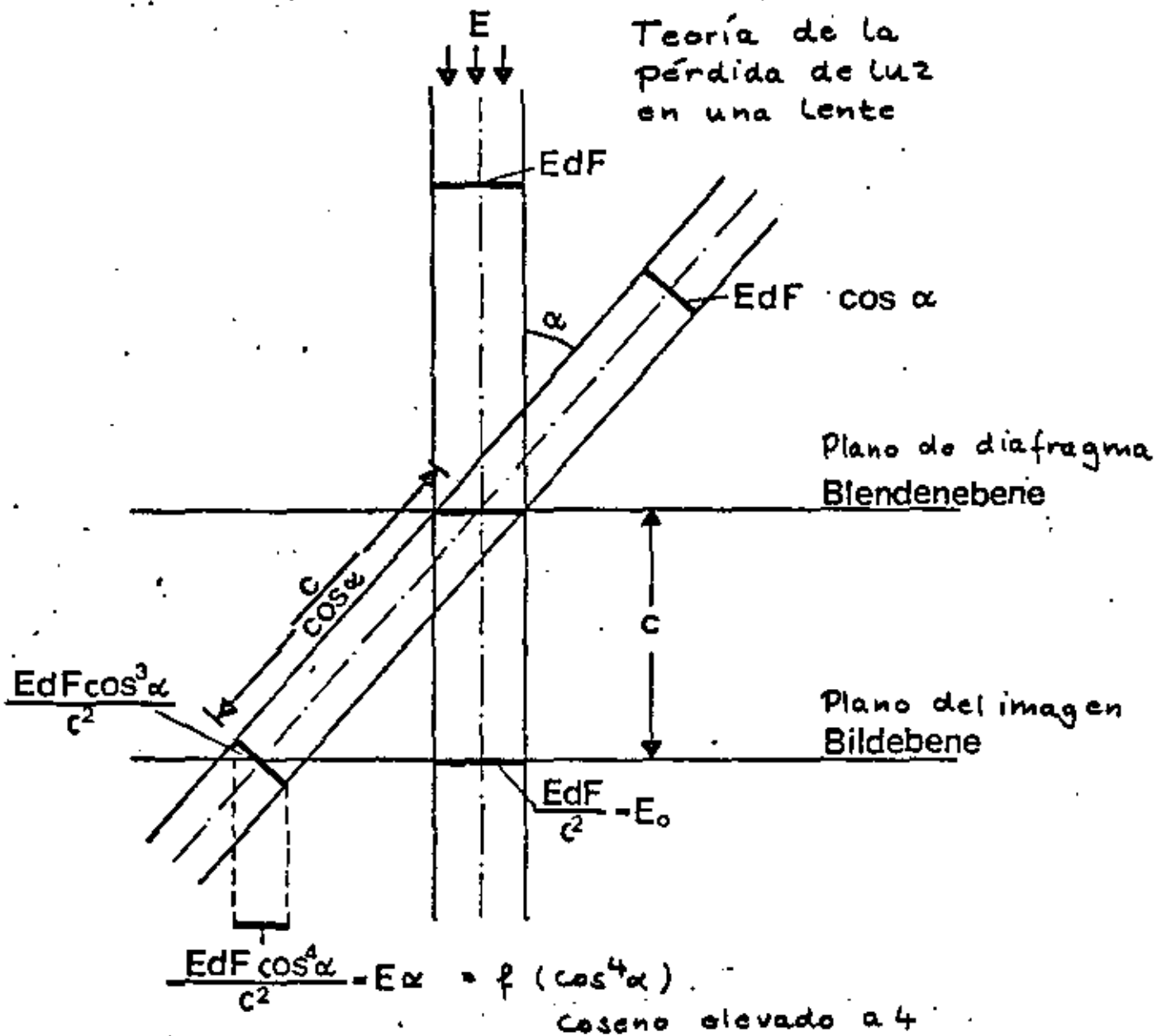
Preparación de la superficie del reflector

1. mix 20 parts Polyvinylalcohol and 100 parts aqua destillata; heat and sift the solution
2. sift Ba SO<sub>4</sub> powder and add aqua destillata to get a pulpy mass
3. take 125 ml of that mass and add 2 ml of the solution
4. now add aqua destillata until the consistency is ready for the spray gun

(Bähr)



Mikrodensitometerprofile über 4 verschiedene Bildbereiche der Aufnahme des LAMBERT-Reflektors

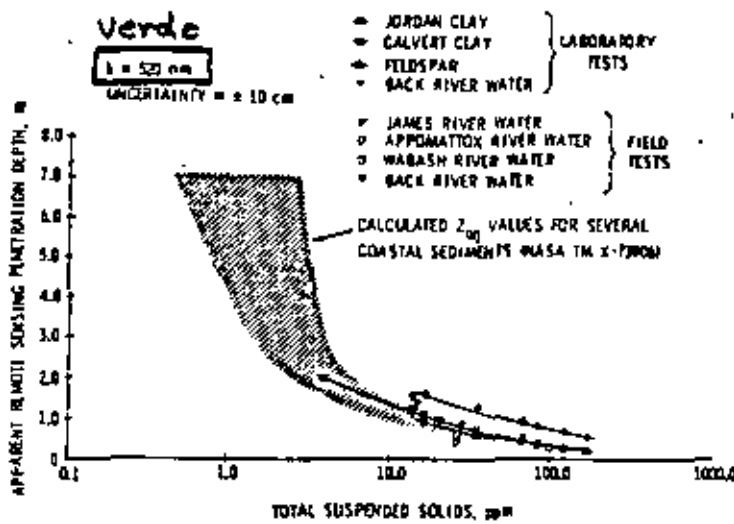
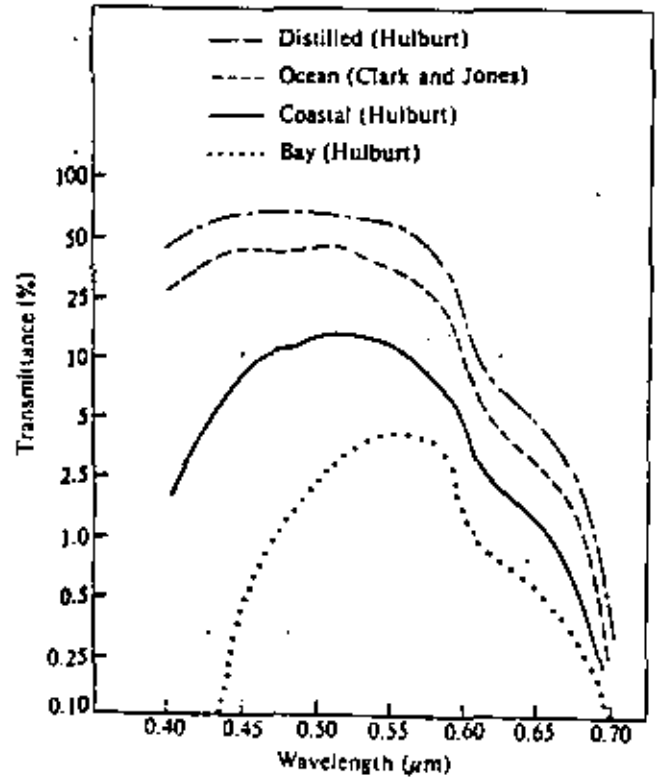
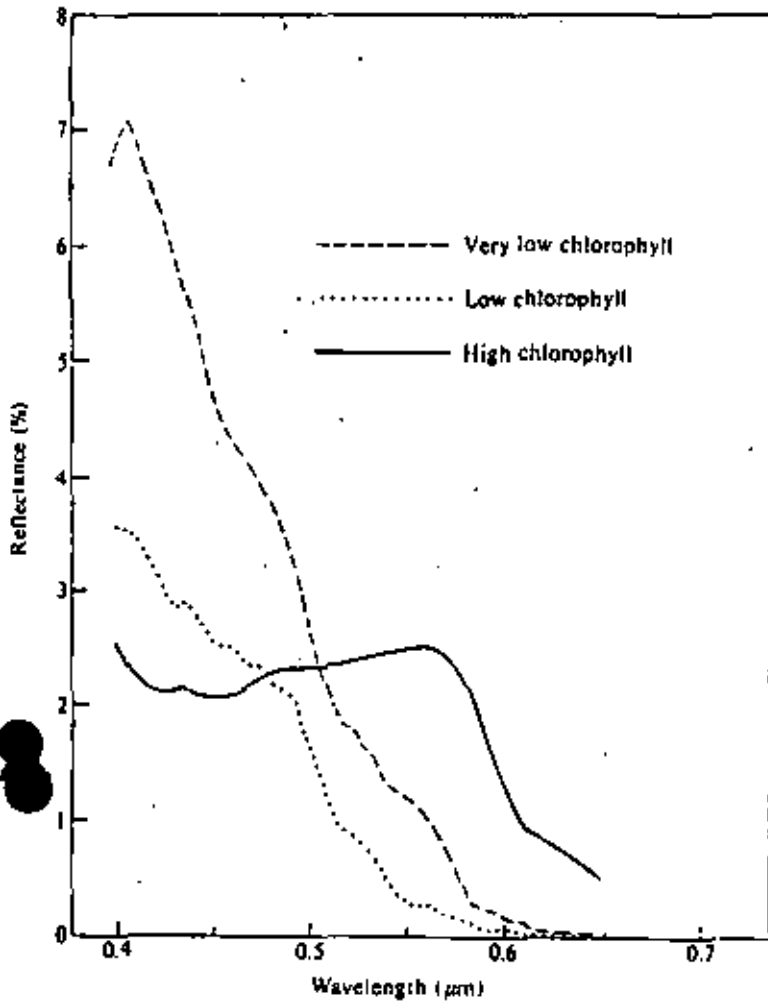
Teoría de la  
pérdida de luz  
en una lente

$$L_i = v_i + c_1 f(\cos^4 \alpha_i) + c_2 \gamma_i$$

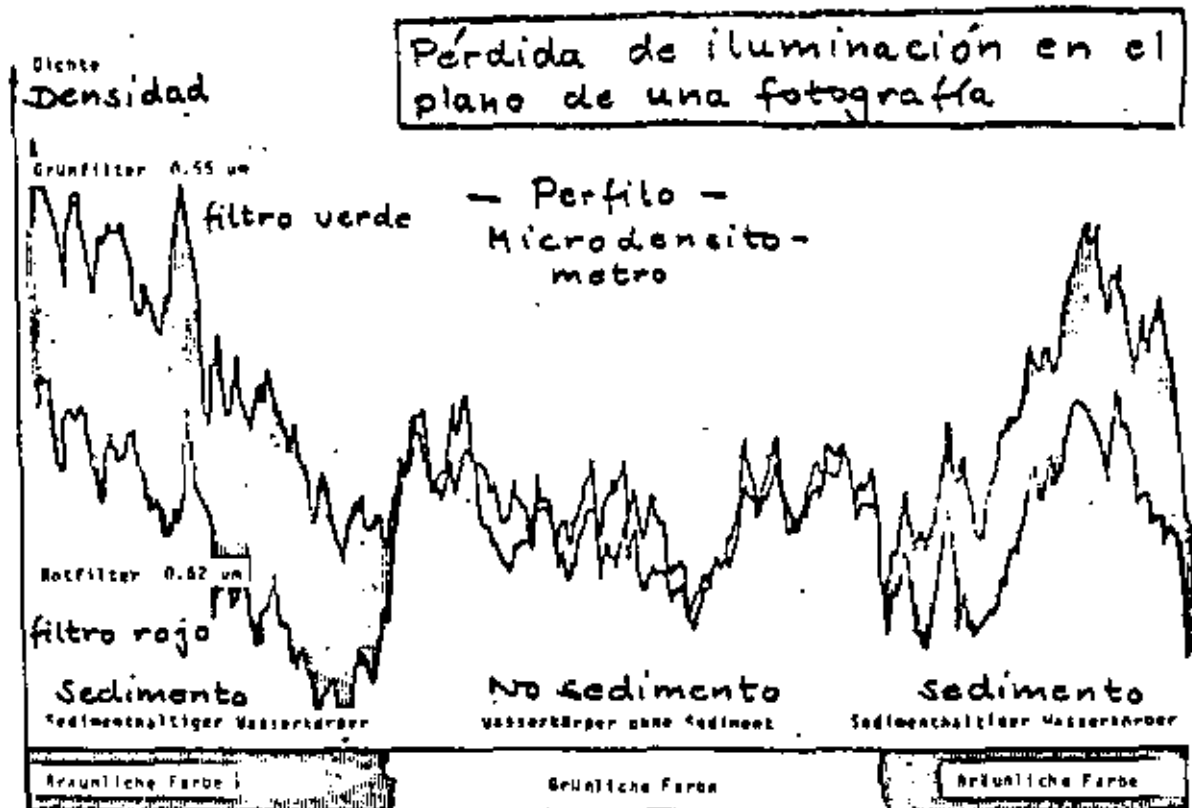
Funktion	$1 - \cos^3$	$1/\cos^3 - 1$	$1 - \cos^4$	$1/\cos^4 - 1$
$c_1$	1,0892	0,8665	0,8458	0,6229
$c_2$	0,0019	0,0019	0,0019	0,0019
$f = 1:5,6$				
$m_0 (D)$	$\pm 0,0282$	$\pm 0,0197$	$\pm 0,0297$	$\pm 0,0185$
$c_1$	0,8822	0,6963	0,6858	0,5000
$c_2$	0,0014	0,0014	0,0014	0,0014
$f = 1:8$				
$m_0 (D)$	$\pm 0,0193$	$\pm 0,0203$	$\pm 0,0195$	$\pm 0,0210$

Ergebnisse der Ausgleichung

Resultado de la compensación  
por cuadrados mínimos

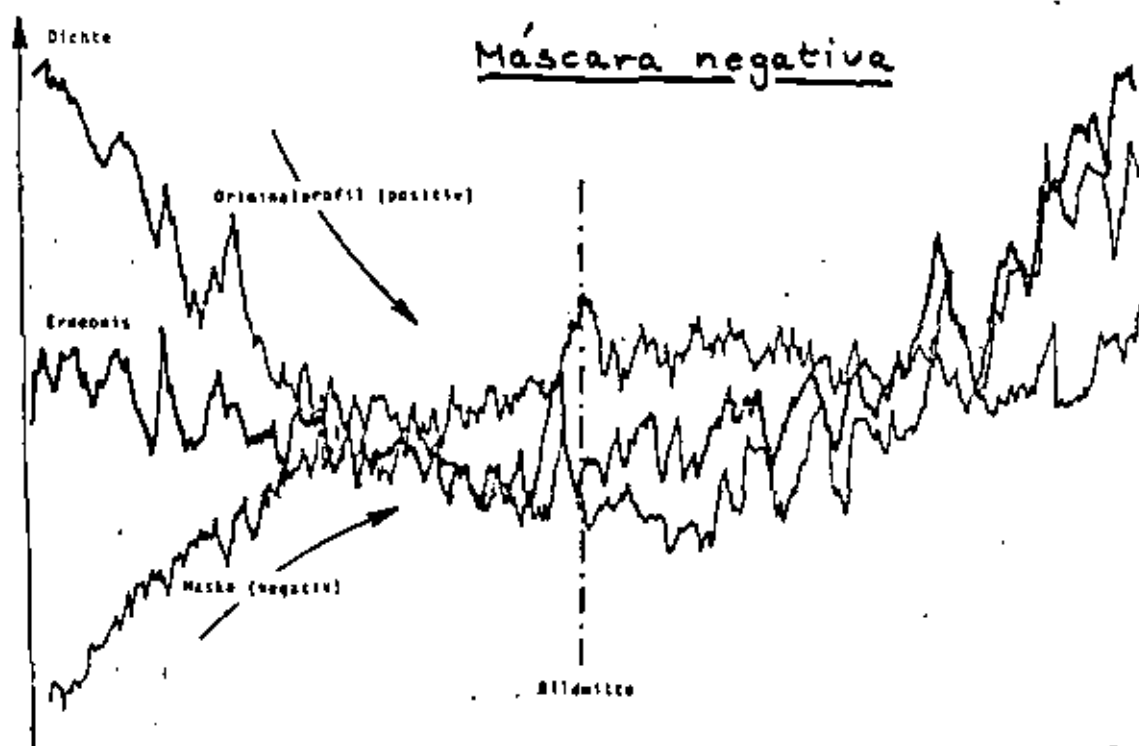


Penetración  
en agua enturbiado  
(Whitlock et al.  
Phot. Eng. '78)

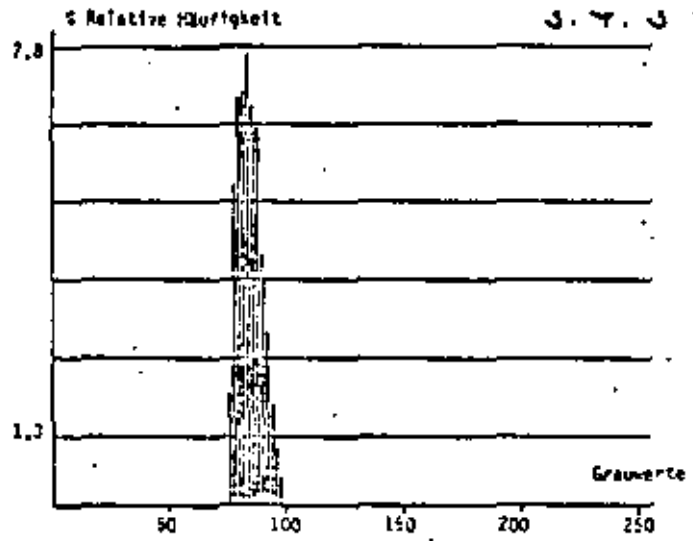
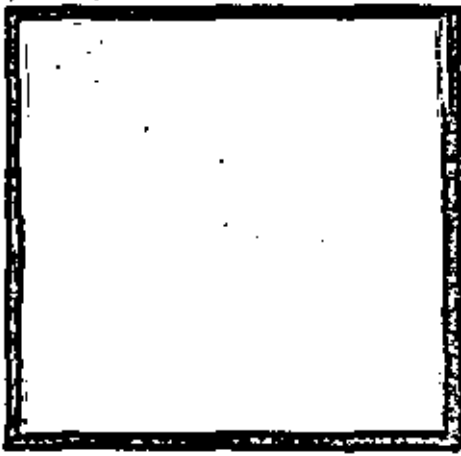


Mikrodensitometerprofile des Jadesfahrwassers in einer HASSELBLAD - MK 70 - Aufnahme (KODAK EKTACHROME)

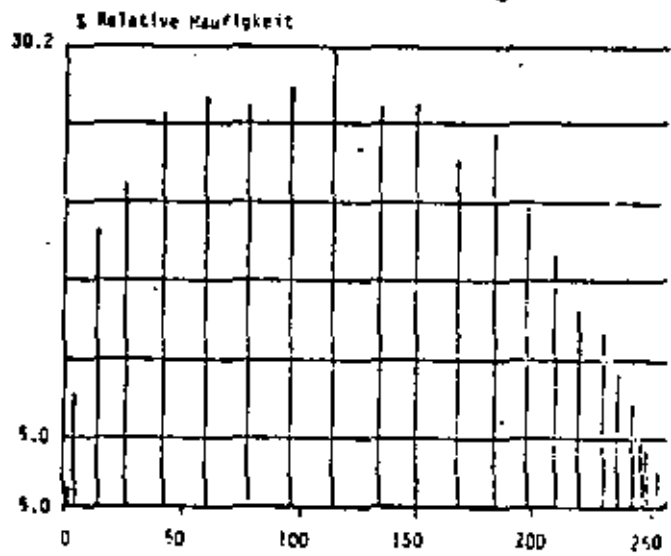
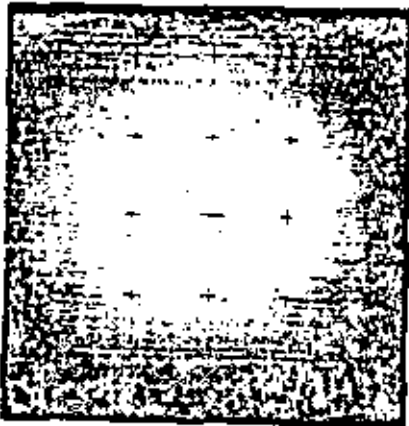
HASSELBLAD MK 70, Réseau 1138, ZEISS BIOGON f = 60 mm, Nr. 5198261



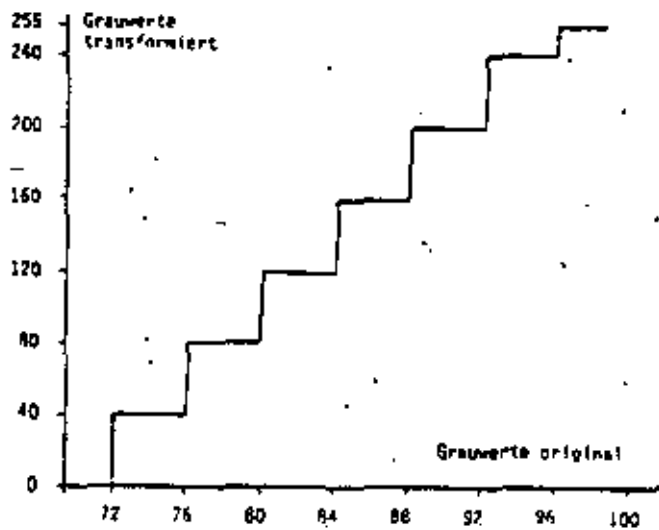
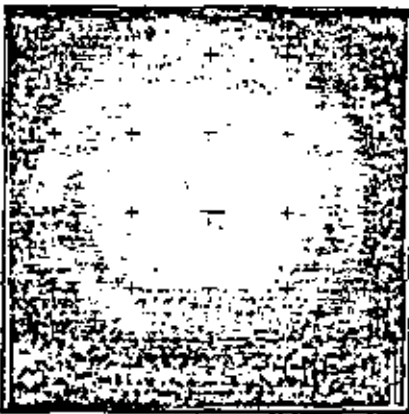
Compensación análogo (sin suceso)  
 Kompensation des Lichtabfalls durch eine negative  
 Maske aus Aufnahme des bedeckten Himmels (Mikroden-  
 sitometerprofile durch Bildmitte)



Abspfelung des digitalisierten Originalbildes mit  
zugehörigem Histogramm *Histogramma original*

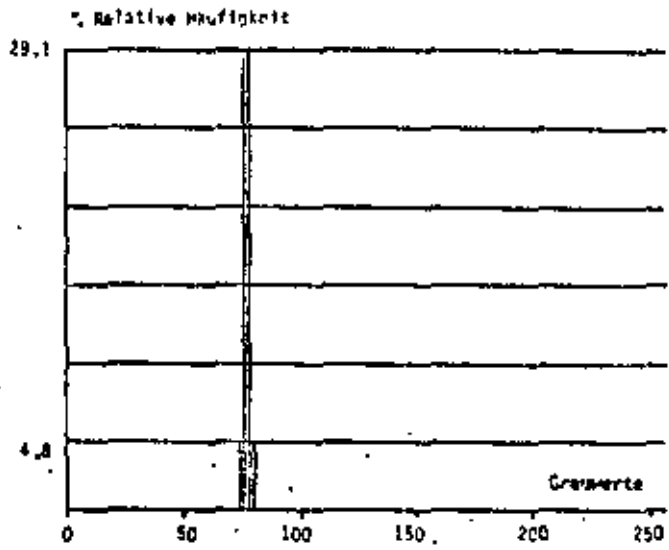
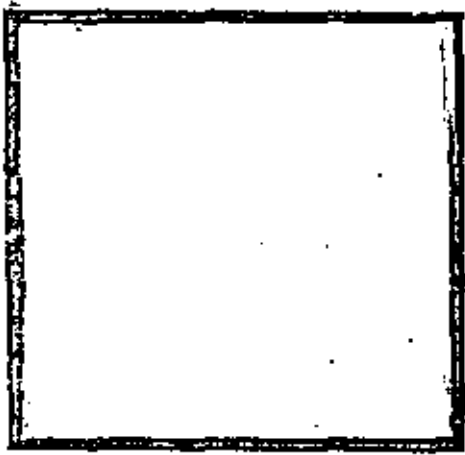


Histogrammlinearisierung des digitalisierten Original-  
bildes *Linearización de la histograma*



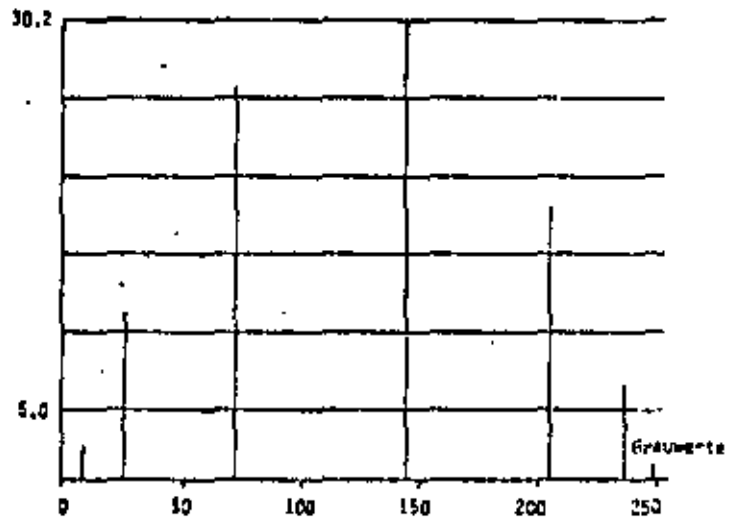
Anwendung einer 8-stufigen linearen Transformation der  
Grauwerte des digitalisierten Originalbildes zur quanti-  
fizierten Darstellung der Kontrastverhältnisse

*Transformación en 8 niveles de densidad*



Abspielung des korrigierten Bildes mit zugehörigem Histogramm  
 Histogramm *histograma de la imagen corregida*

% Relative Häufigkeit



Histogrammlinearisation des korrigierten Bildes  
 Linearización de la imagen corregida



## DEVELOPMENT OF WORLD POPULATION

year	1900 M inhab.	1975 M inhab.	annual growth rate	1985 M inhab.	2000 M inhab.
Europe <small>without U.S.S.R.</small>	308	479	0,7%	515	569
USSR	122	256	1,1%	287	334
North America <small>without Mexico</small>	81	243	1,4%	280	339
Latin America	63	327	2,9%	435	624
Africa	120	395	2,9%	530	761
Australia & Oceanica	6	22	2,2%	27	36
Asid <small>without USSR</small>	857	2307	East 1,6% S.East & A.E. 2,7%	2874	3831
World	1557	4028	2,1%	4948	6494

## WORLD URBANIZATION

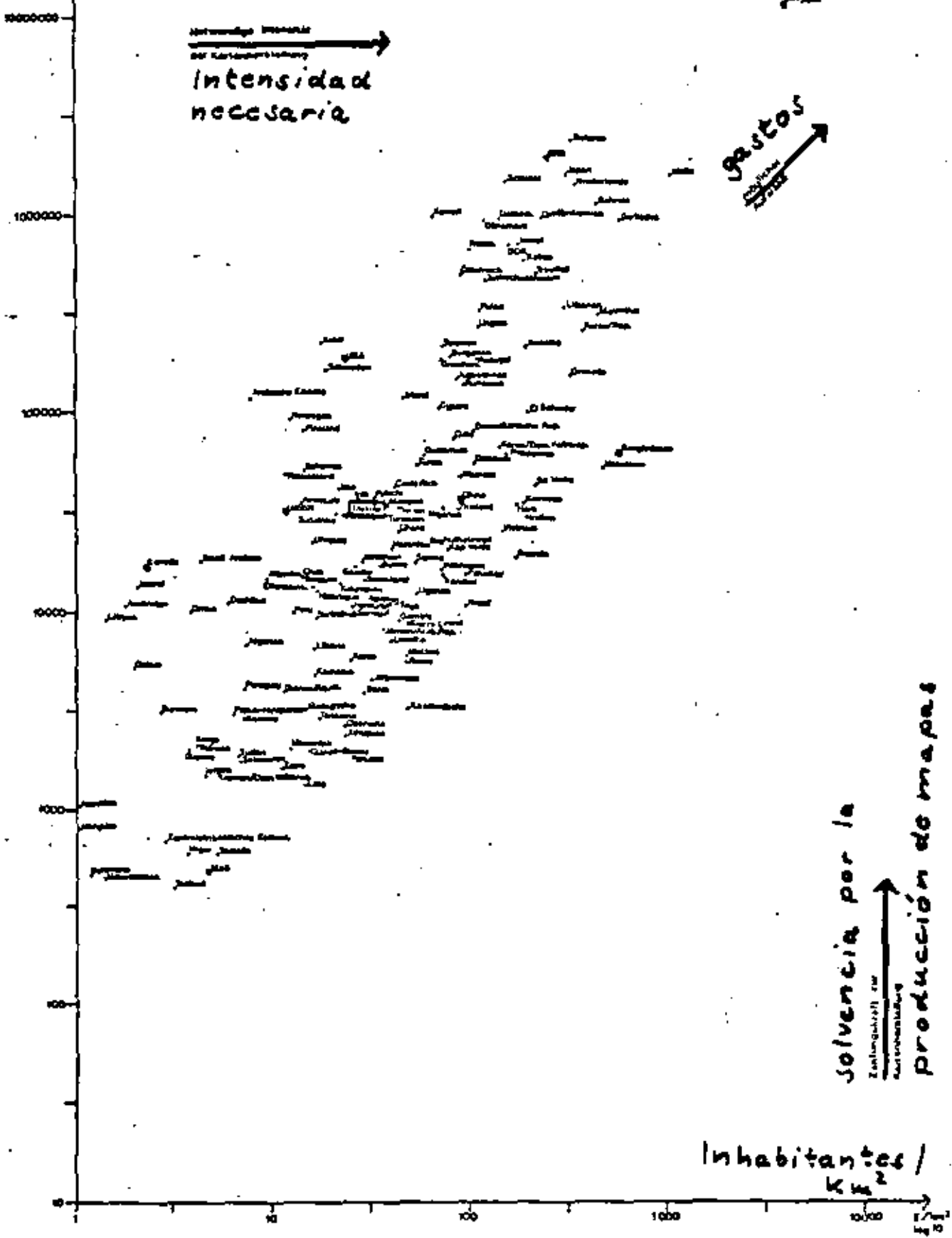
	1975 M inhab.	annual growth rate	1985 M inhab.
urban population	1596	3,3%	2198
rural population	2432	1,3%	2750

## TYPES OF ECONOMY AND NEED FOR MAPPING

TYPE OF ECONOMY	G.N.P. per inhabitant U.S.\$ /yr.	predominant production type	necessity for mapping	
			Small scale	large scale
pre-industrial	50 to 500	agriculture	transport 1:250 000 (defence 1:50 000)	(tax cadastre where desired)
industrial	500 to 3000	consumer goods	planning of natural resources 1:50 000	construc- tion (property protection where desired)
post-industrial	over 3000	services	derived from large scale maps	planning and manage- ment of natural and human resources 1:5000

1976

Producto nacional  
bruto per [km<sup>2</sup>]



solvencia por la  
Zahlungsfähigkeit zur  
Autorenentlohnung  
producción de mapas

Inhabitantes /  
km<sup>2</sup>

# Aktueller Stand der Kartographie der Welt (Stand 1978)

Situación actual de la producción de mapas topográficos en el mundo (estado en 1976)

## GEOGRAPHISCHE UNTERTEILUNG:

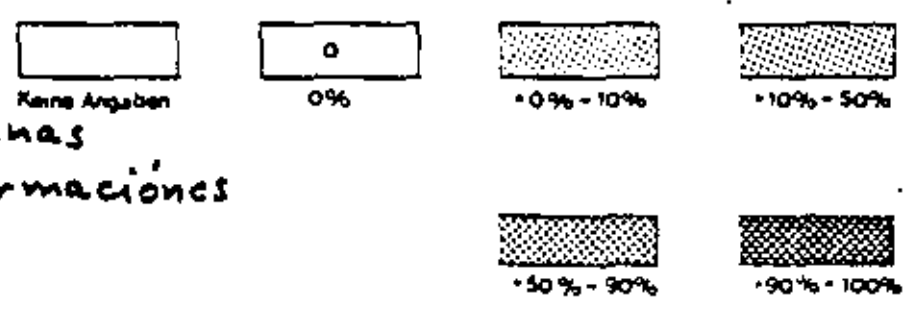
- Europa
- Nord Amerika
- Süd Amerika
- Afrika
- Asien und UdSSR
- Ozeanien

## KARTENBEDECKUNGEN DER LÄNDER IN % NACH DEN MASSTABSREIHEN:

Range Ia	1: 500	- 1: 2500
Range Ib	1: 5000	- 1: 10000
Range Ic	1: 20000	- 1: 31680
Range II	1: 40000	- 1: 75000
Range III	1: 100000	- 1: 126720
Range IV	1: 140000	- 1: 253440

según la escala internacional de las Naciones Unidas

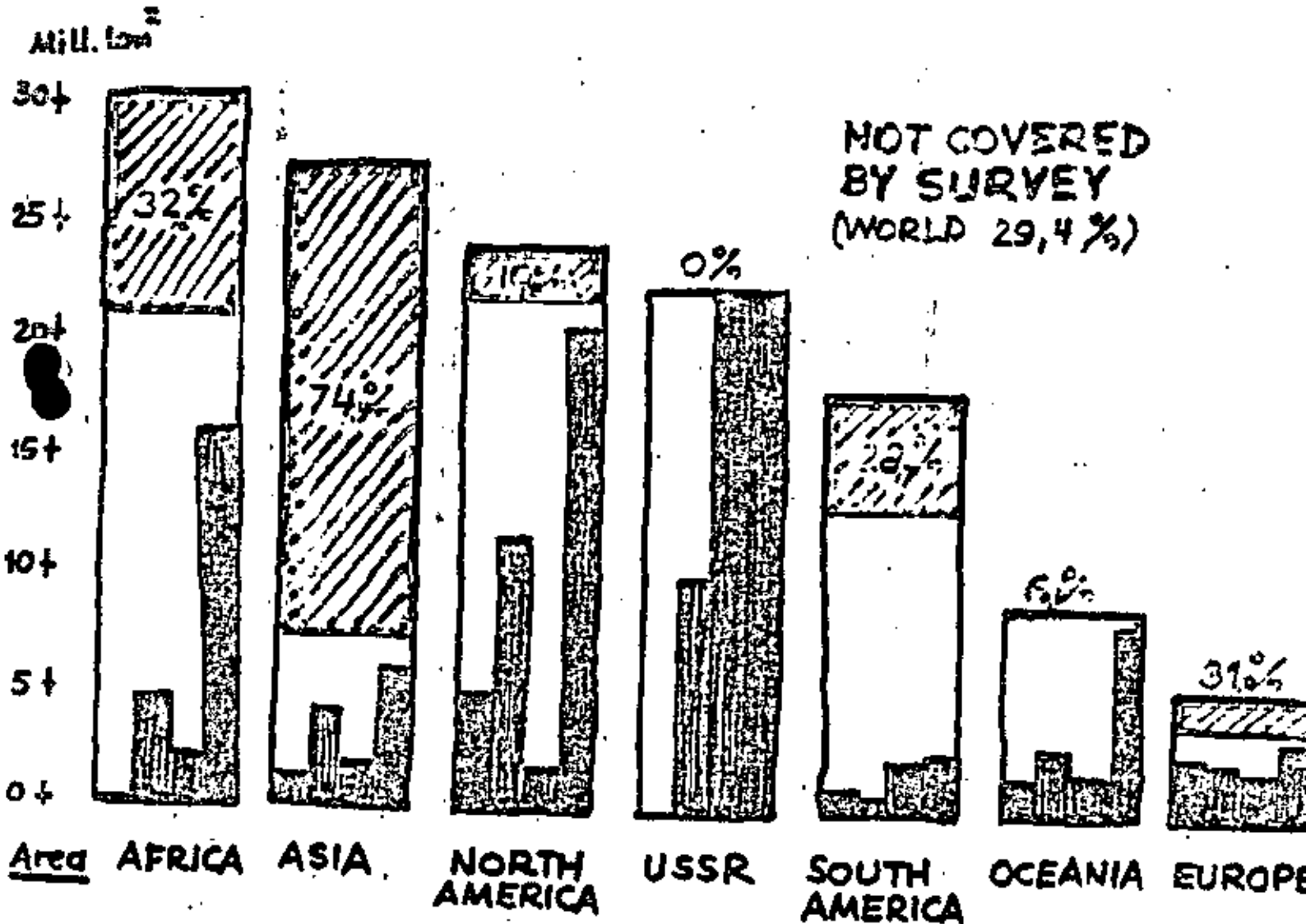
## Recubrimiento:



Ningunas Informaciones

# STATUS OF WORLD MAPPING

ACC. TO "WORLD CARTOGRAPHY" 1976, U.N.



SCALE RANGE 1: 1250 - 1: 31 680 (WORLD 11,6%)

0,3% 11,9% 23,2% - 8,9% 18,3% 75,4%

SCALE RANGE 1: 40 000 - 1: 75 000 (WORLD 35,9%)

23,6% 55,2% 50,9% 40% 6% 31,8% 70,4%

SCALE RANGE 1: 100 000 - 1: 126 720 (WORLD 34,5%)

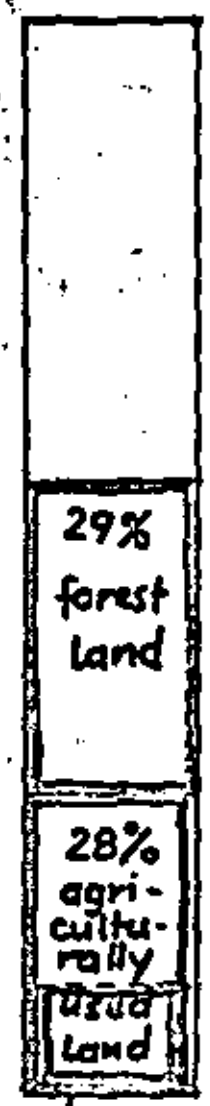
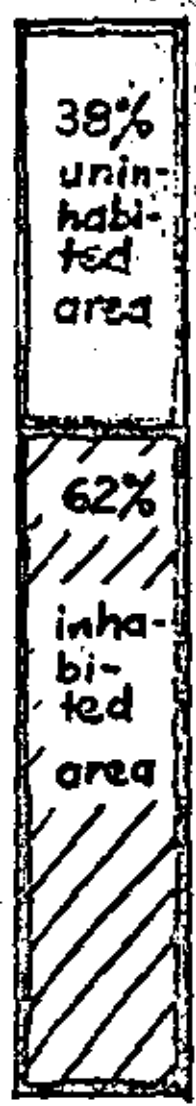
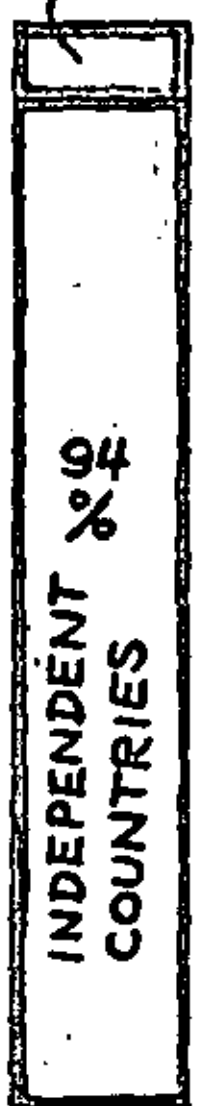
9,9% 13,1% 7,7% 100% 17,9% 19,7% 63,3%

SCALE RANGE 1: 140 000 - 1: 253 440 (WORLD 20,2%)

# WORLD AREAS

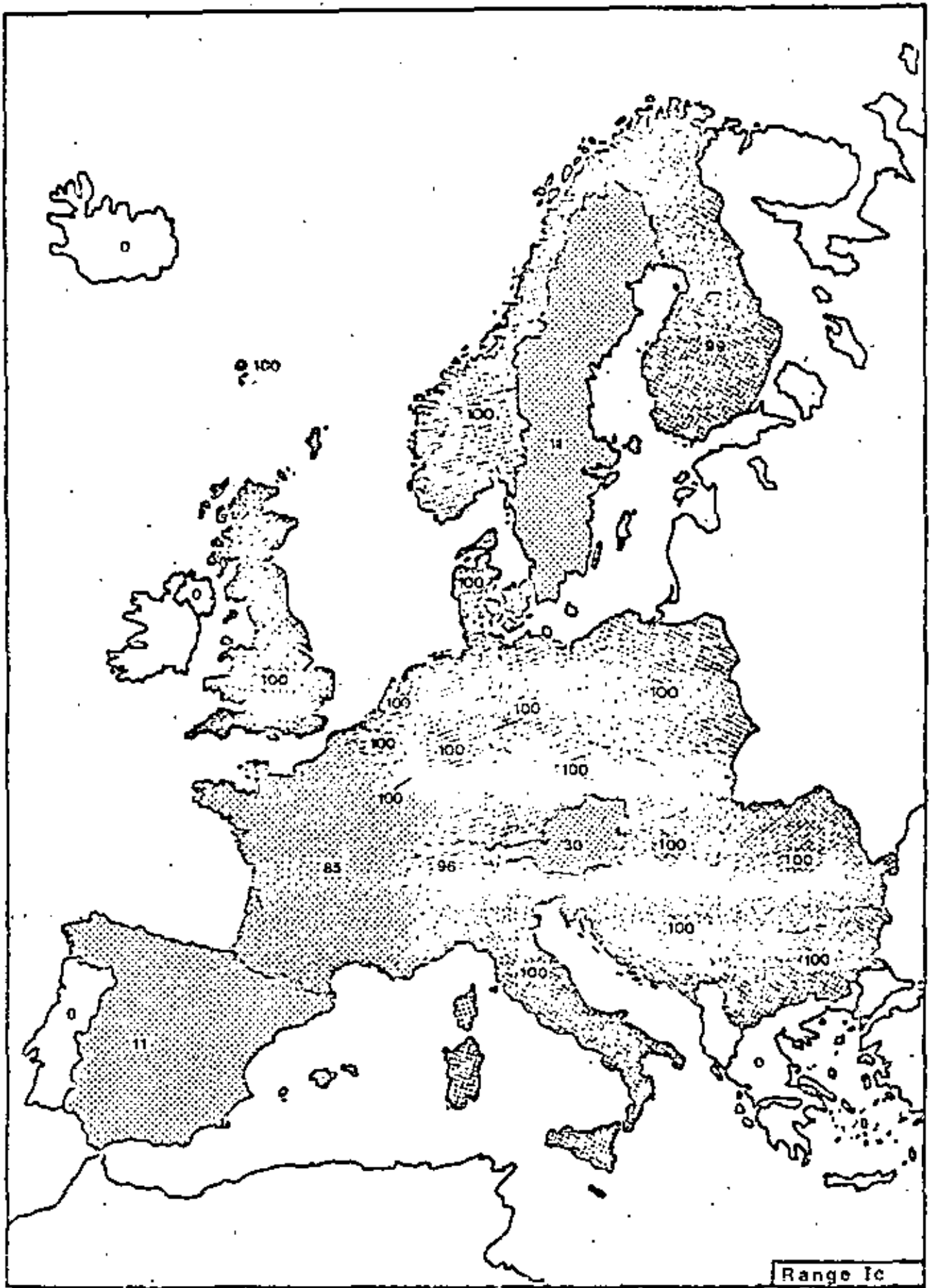
TERRITORIES  
136 M km<sup>2</sup> 6%

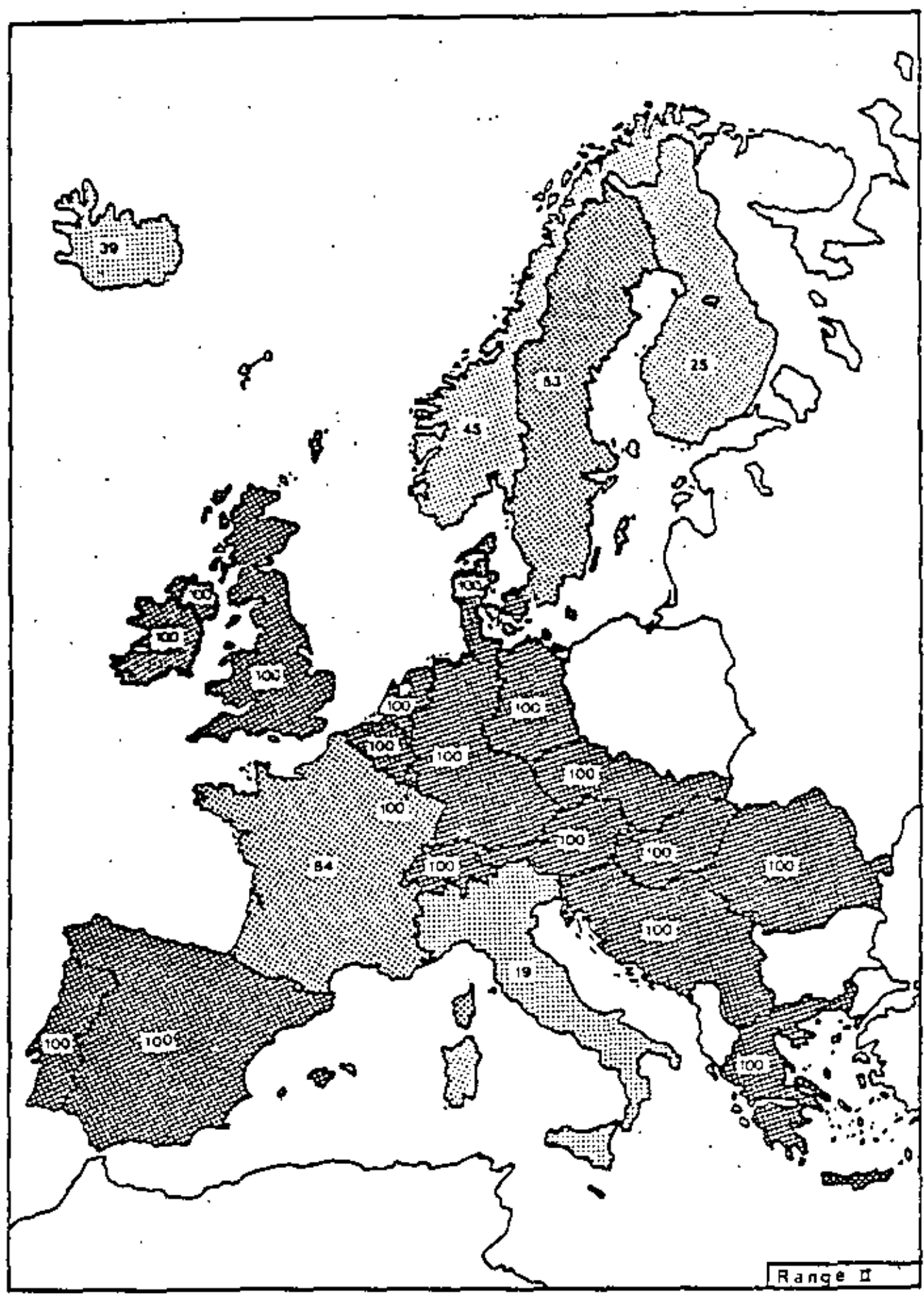
LAND  
AREA  
OF  
THE  
EARTH



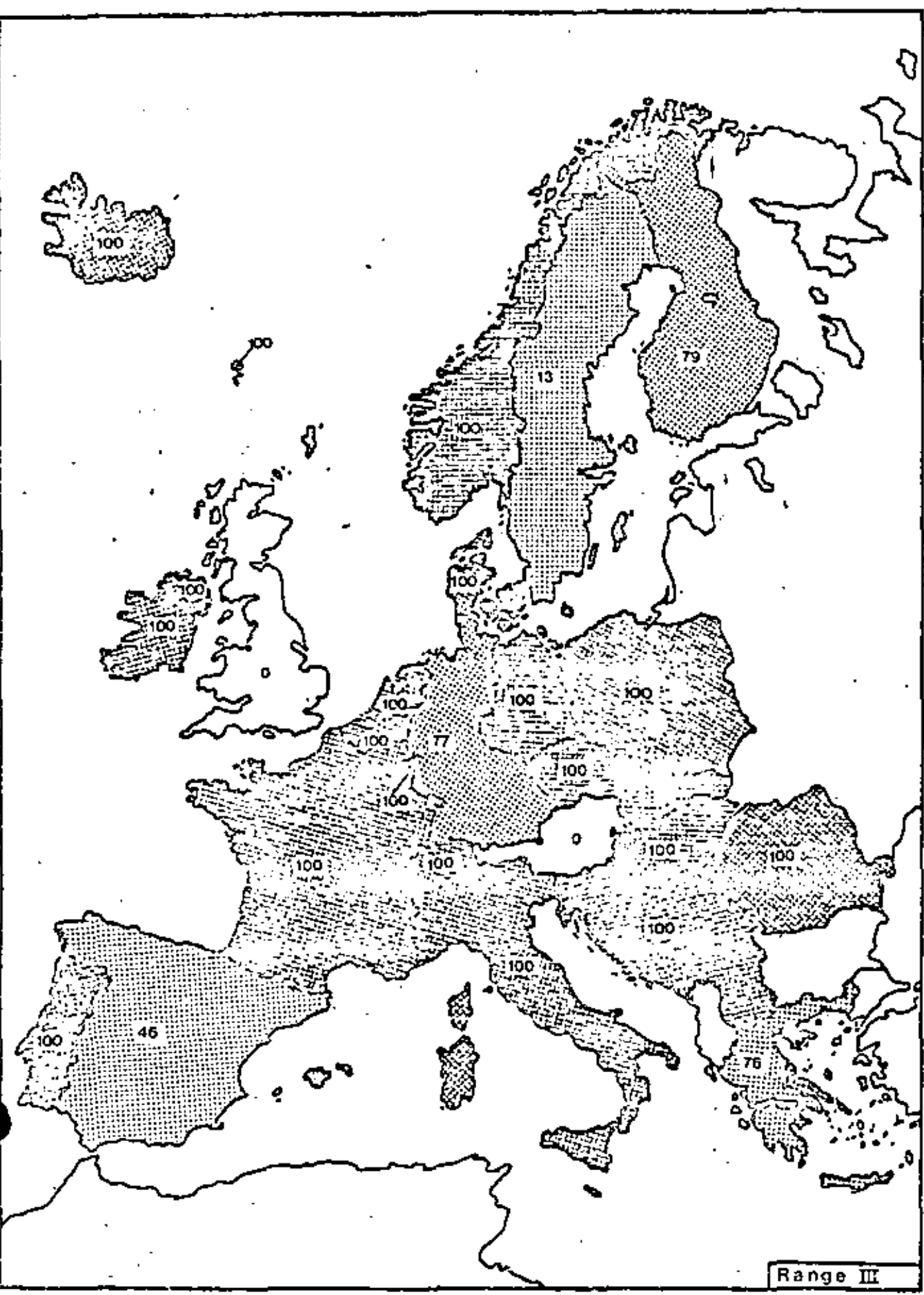
11 post-industrial countries

10% crop land

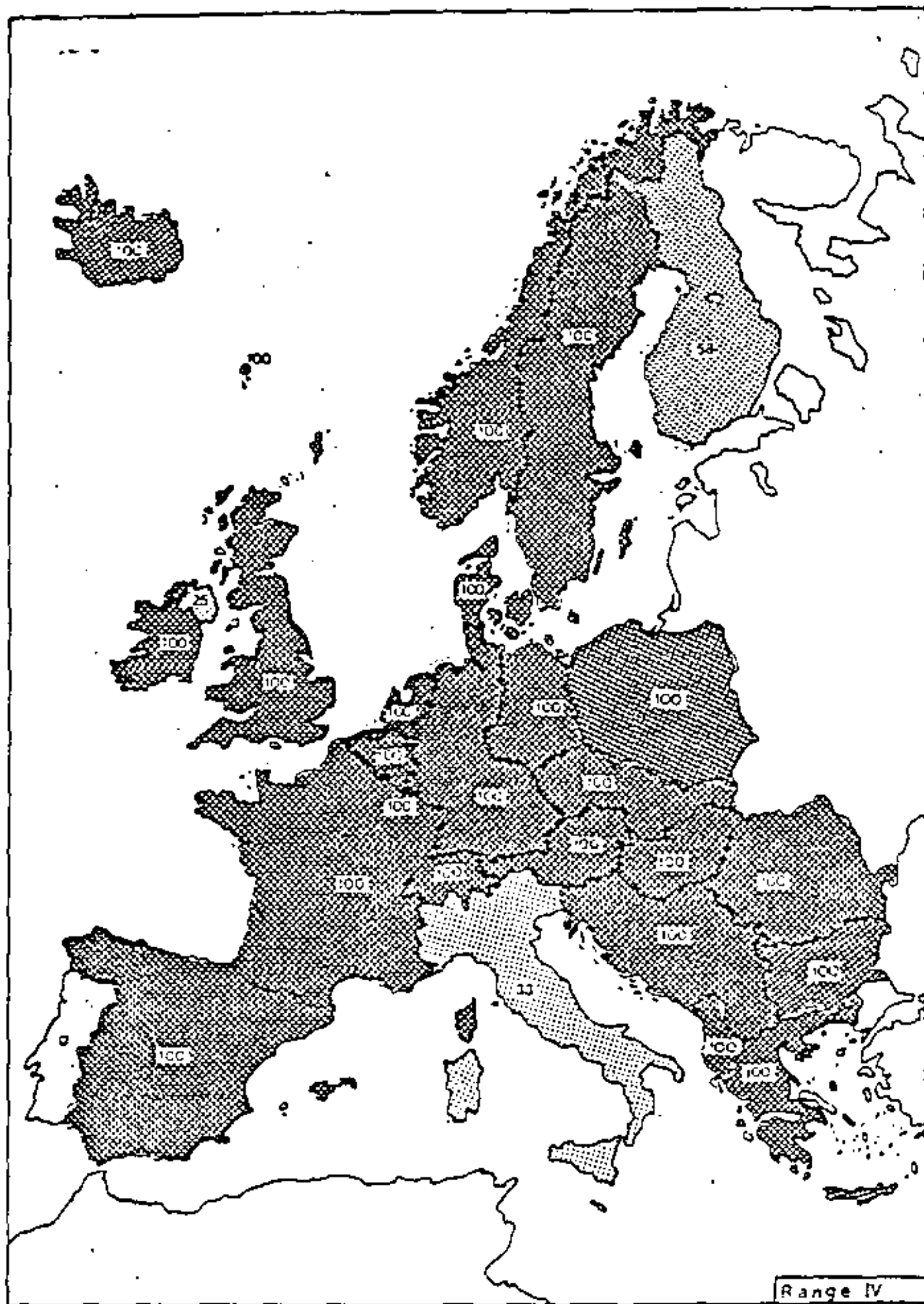


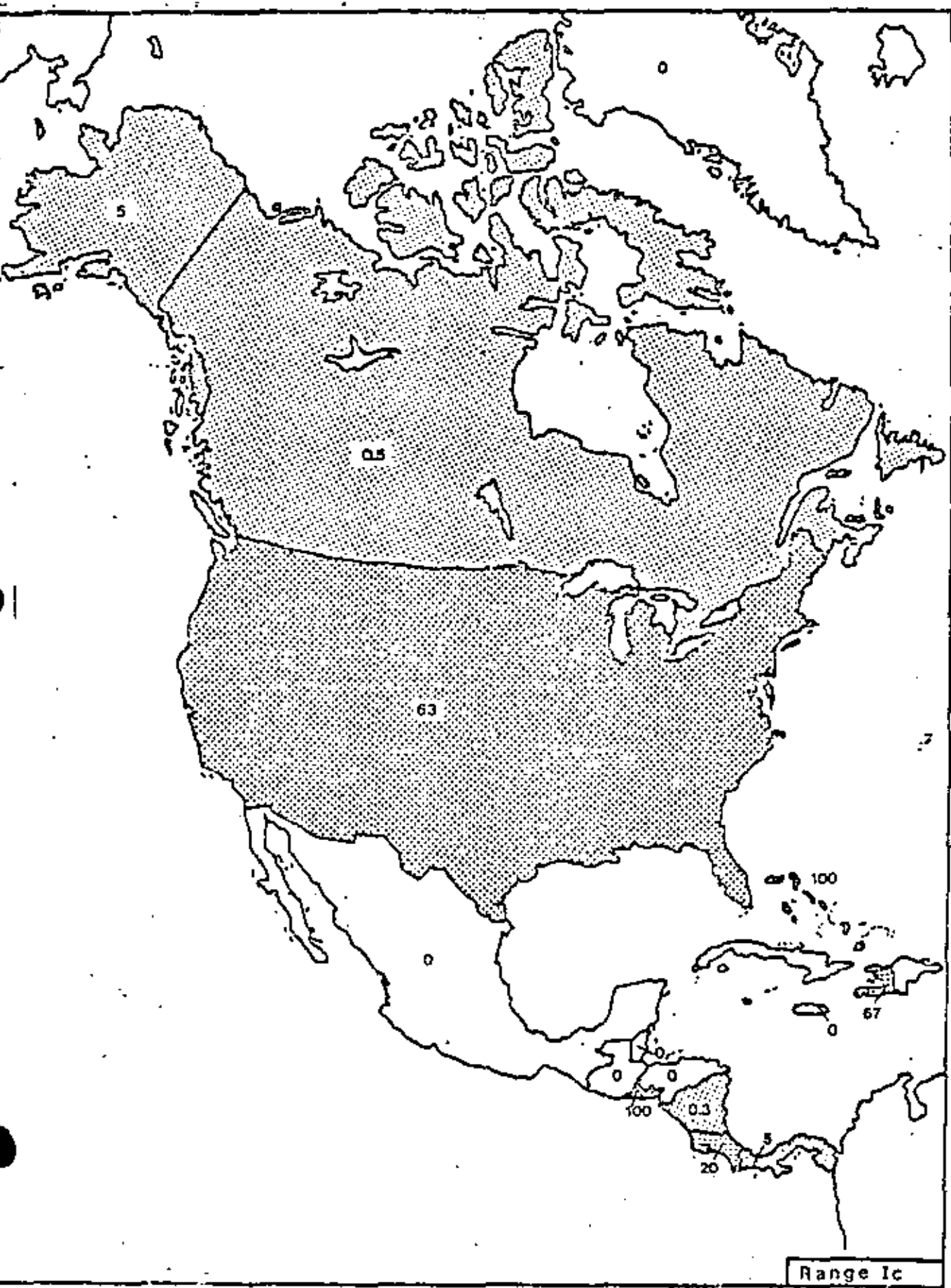


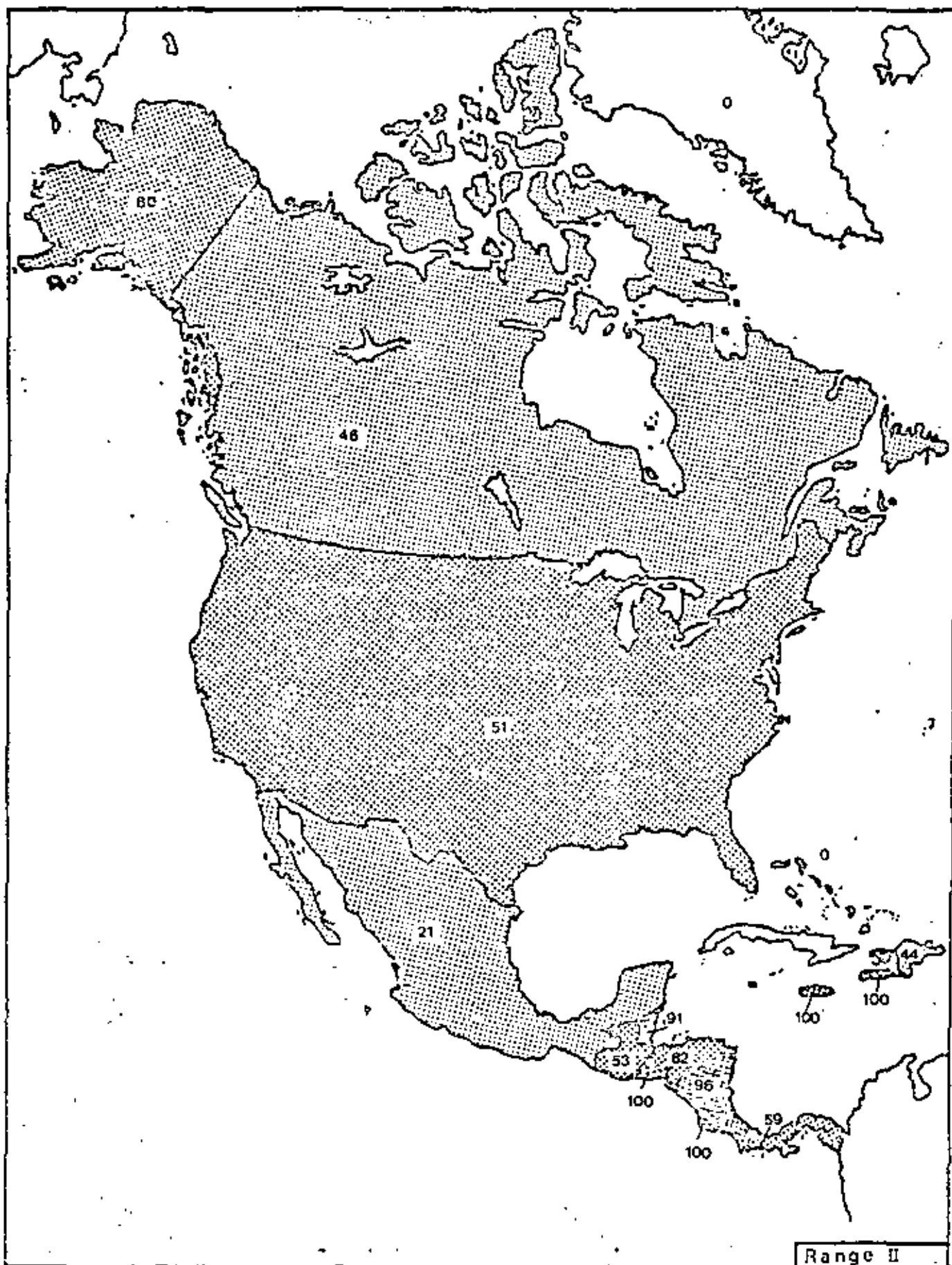


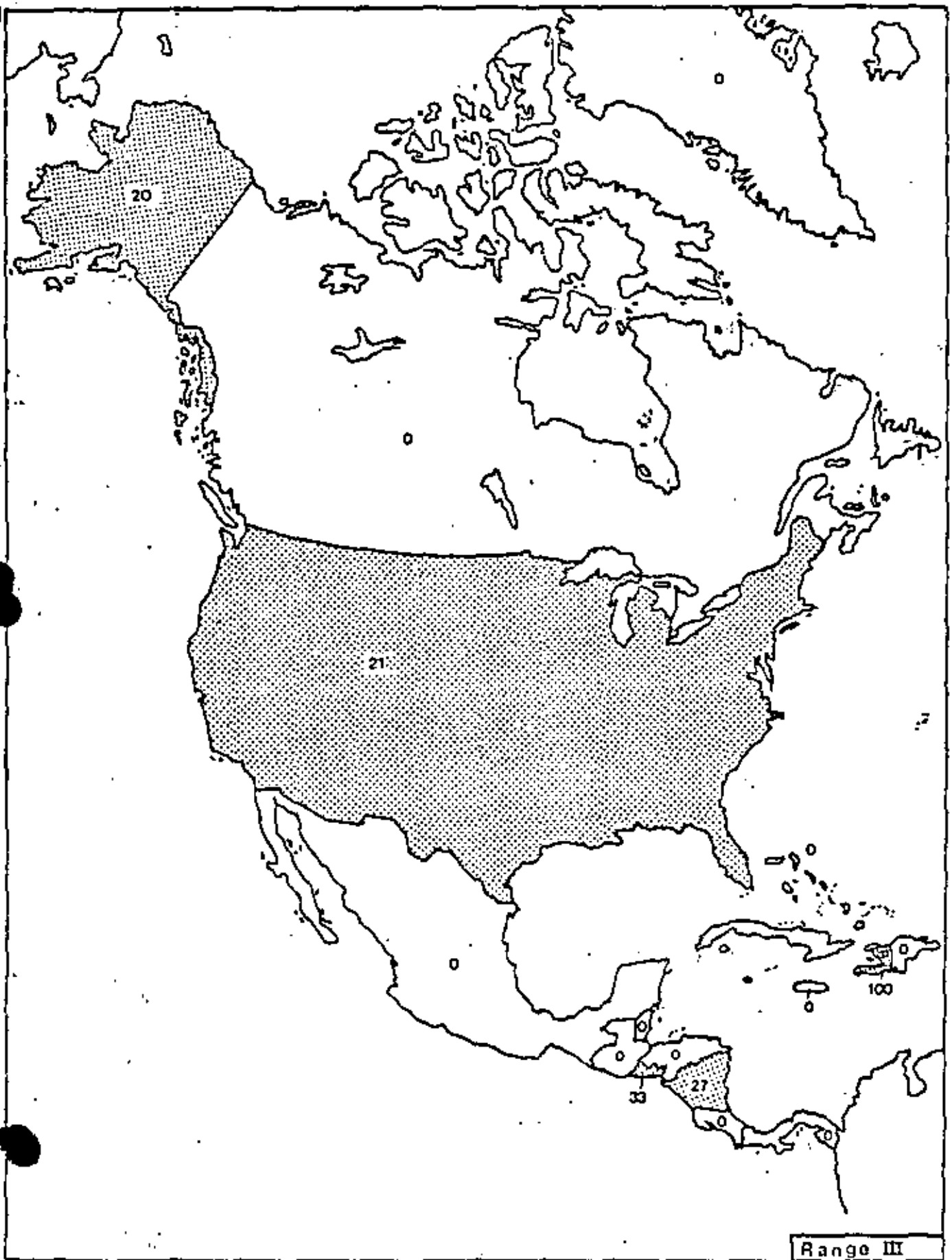


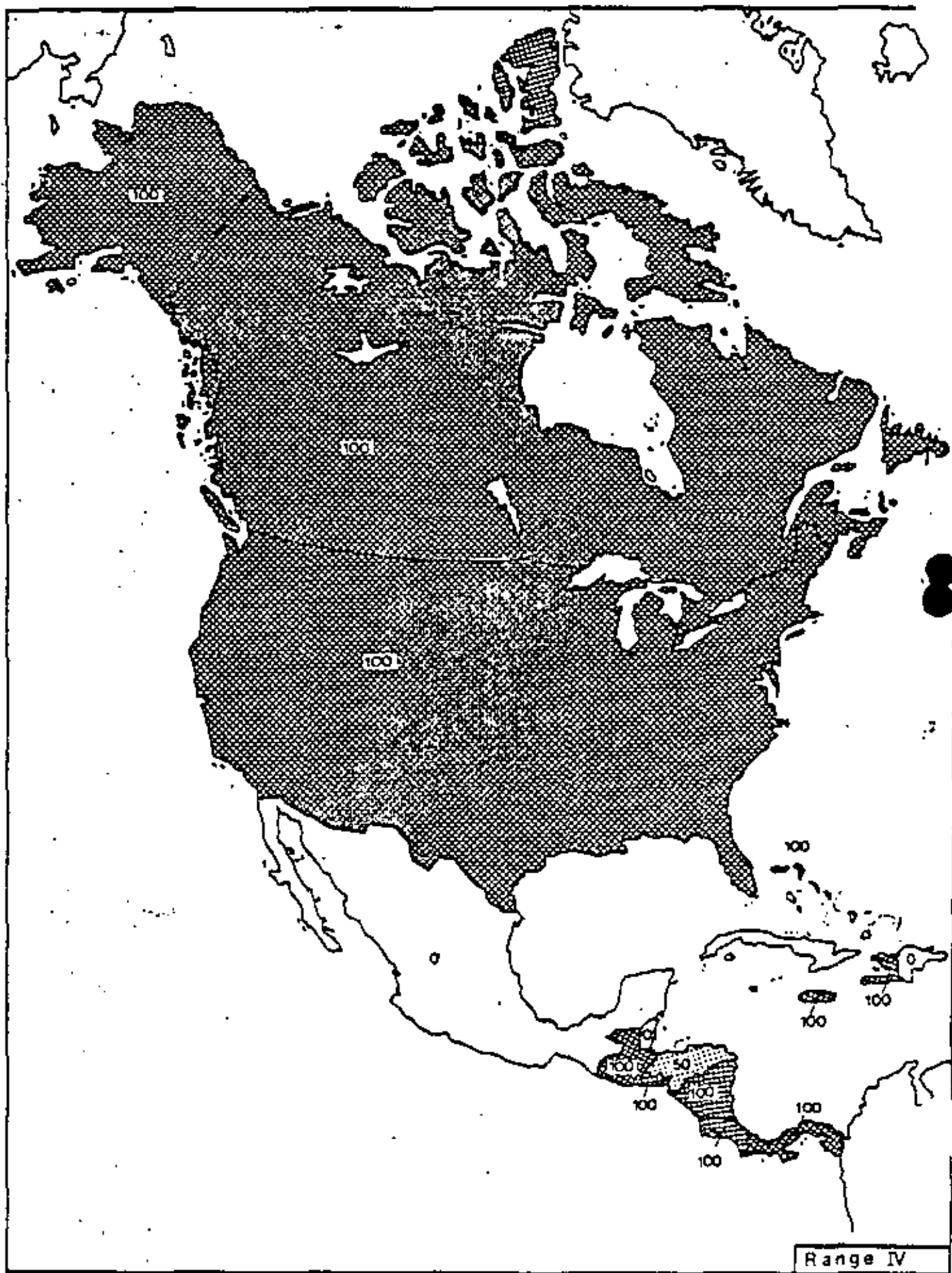
Range III

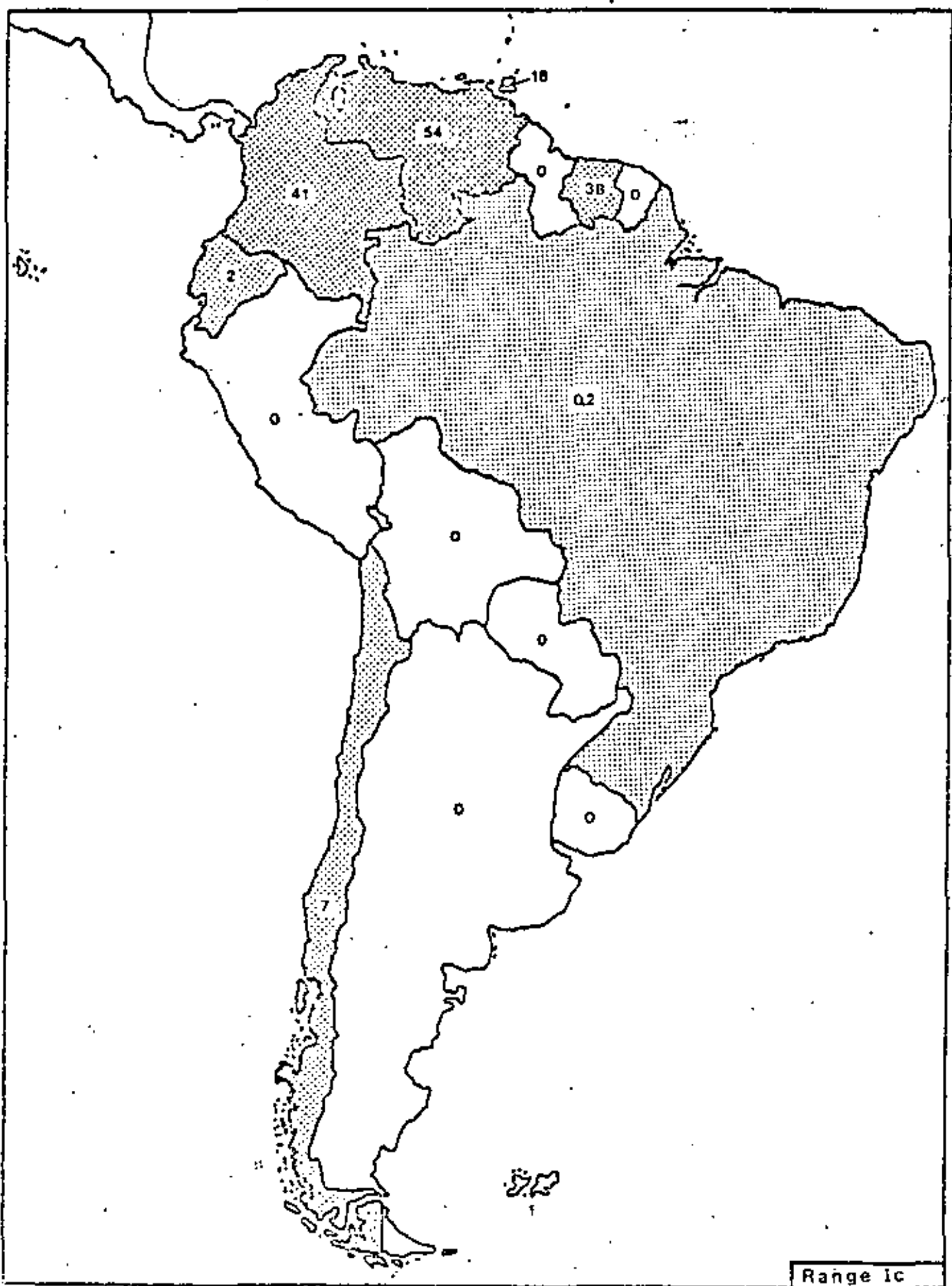


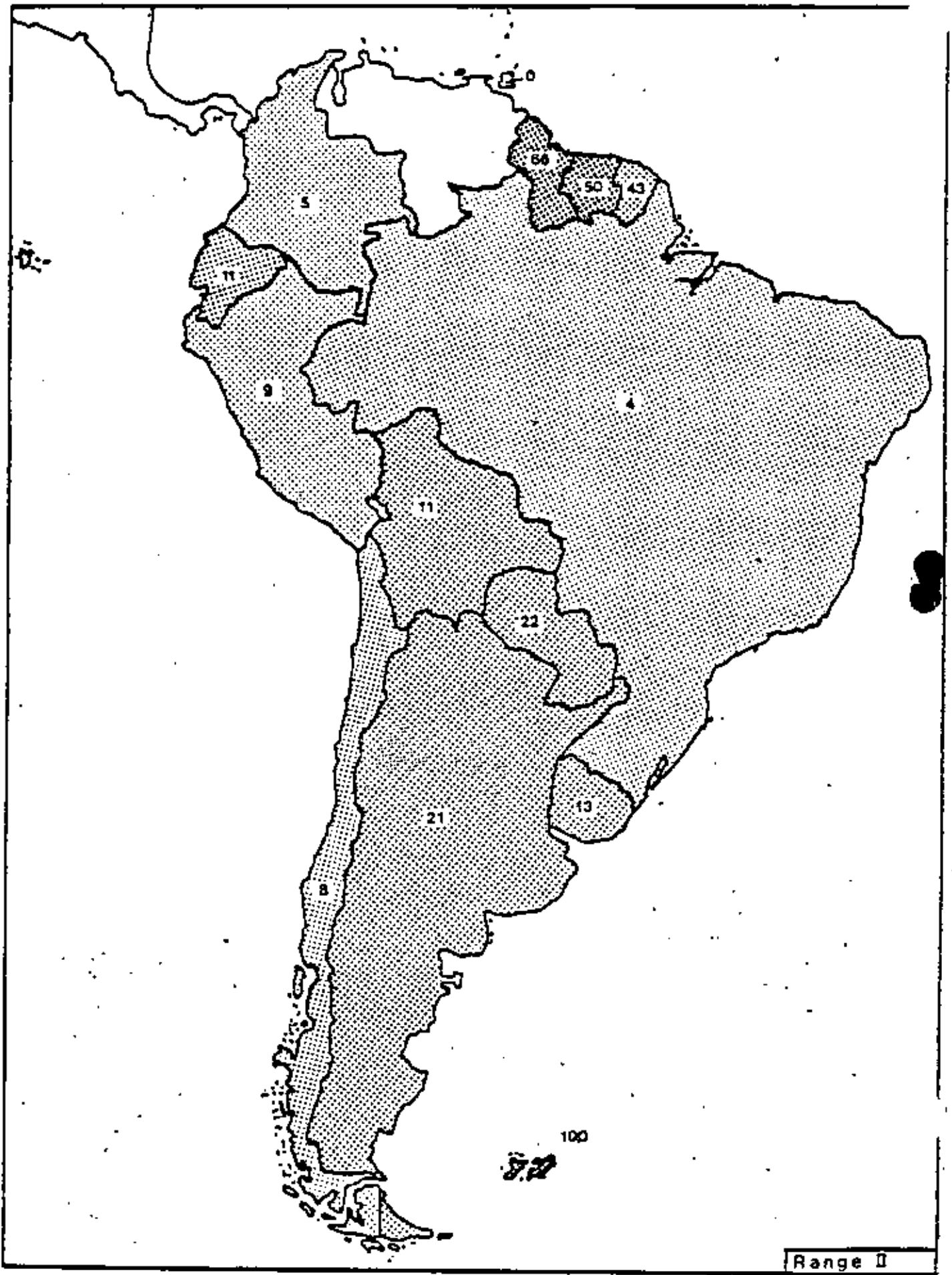




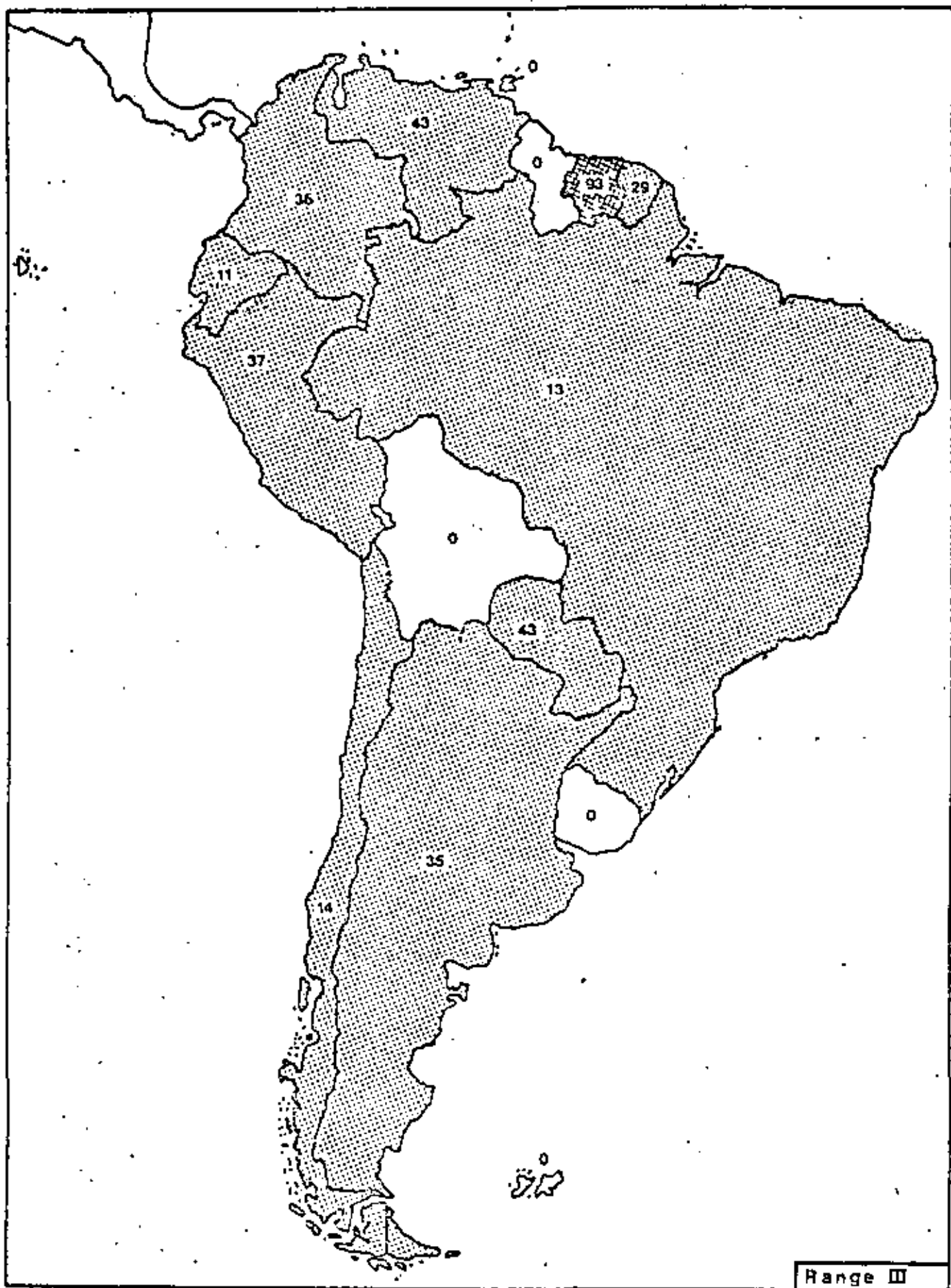




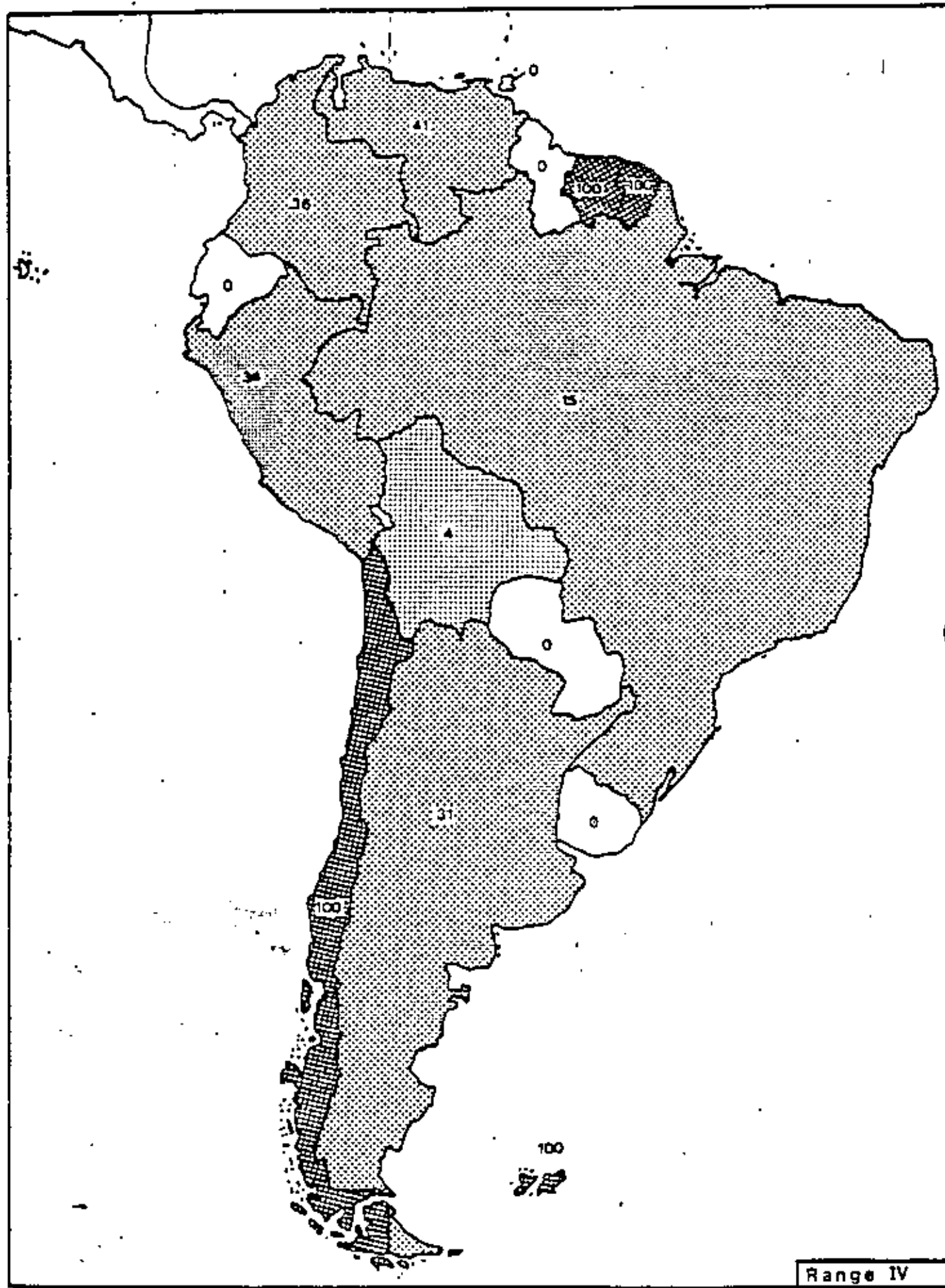




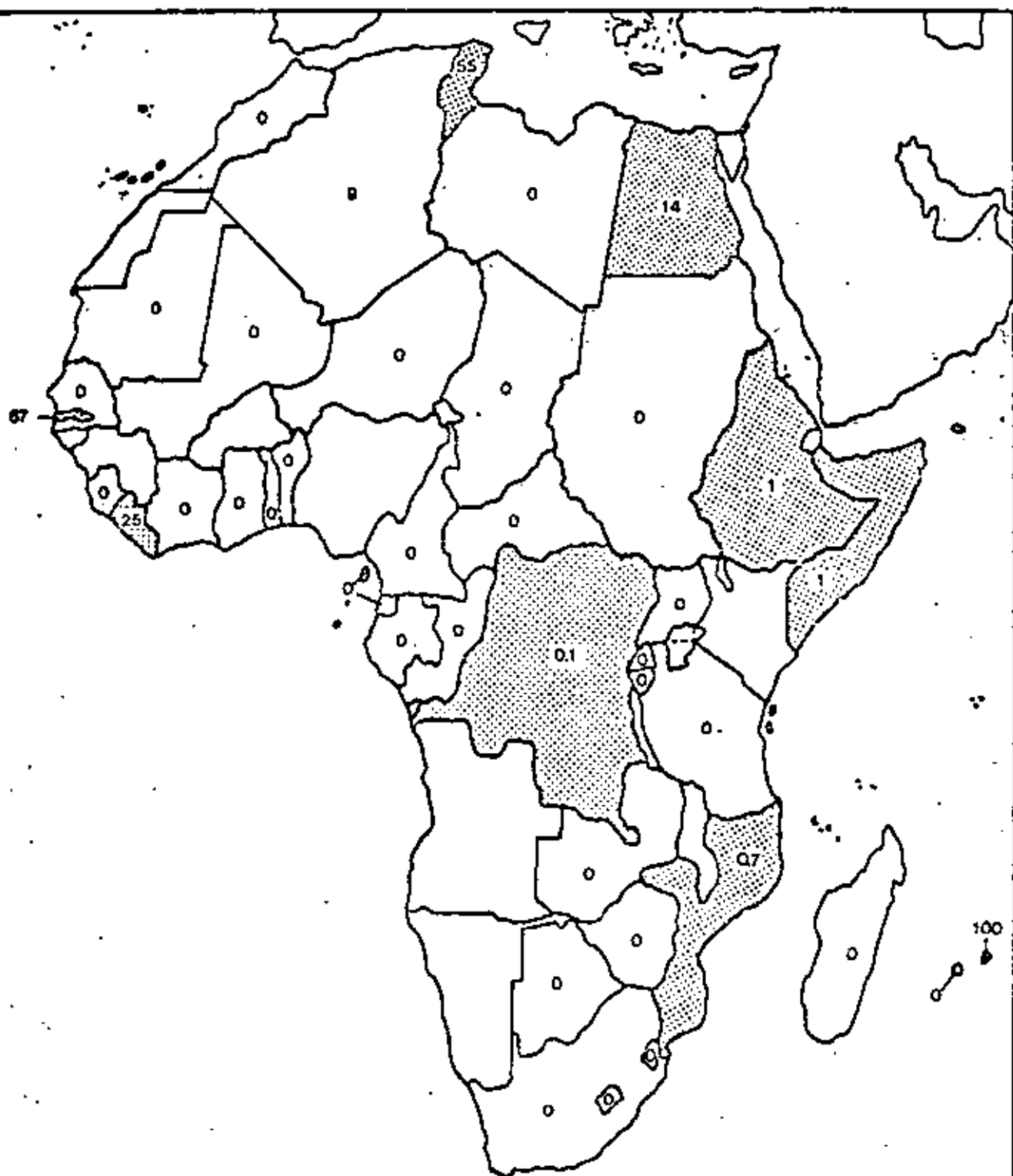




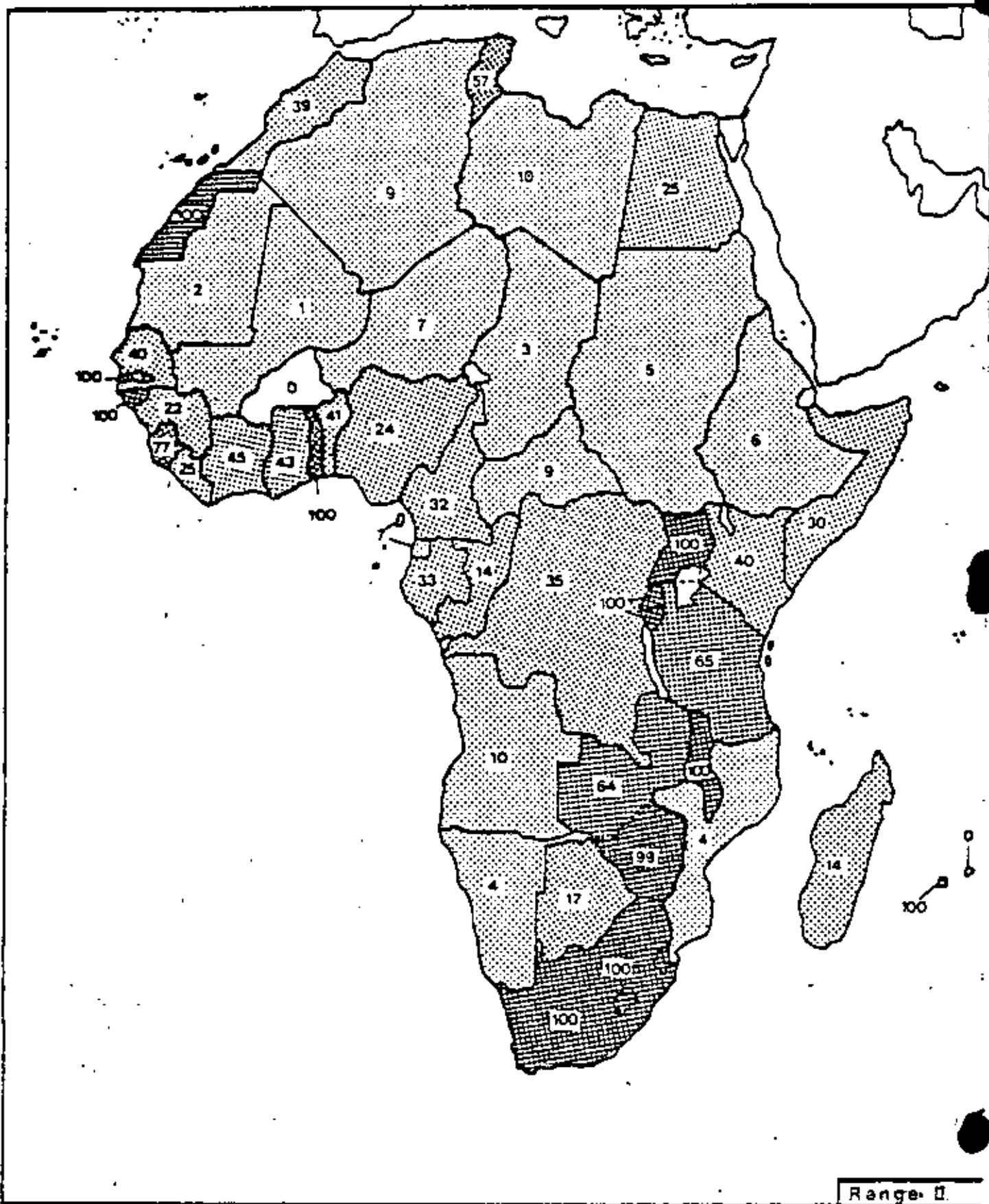
Range III

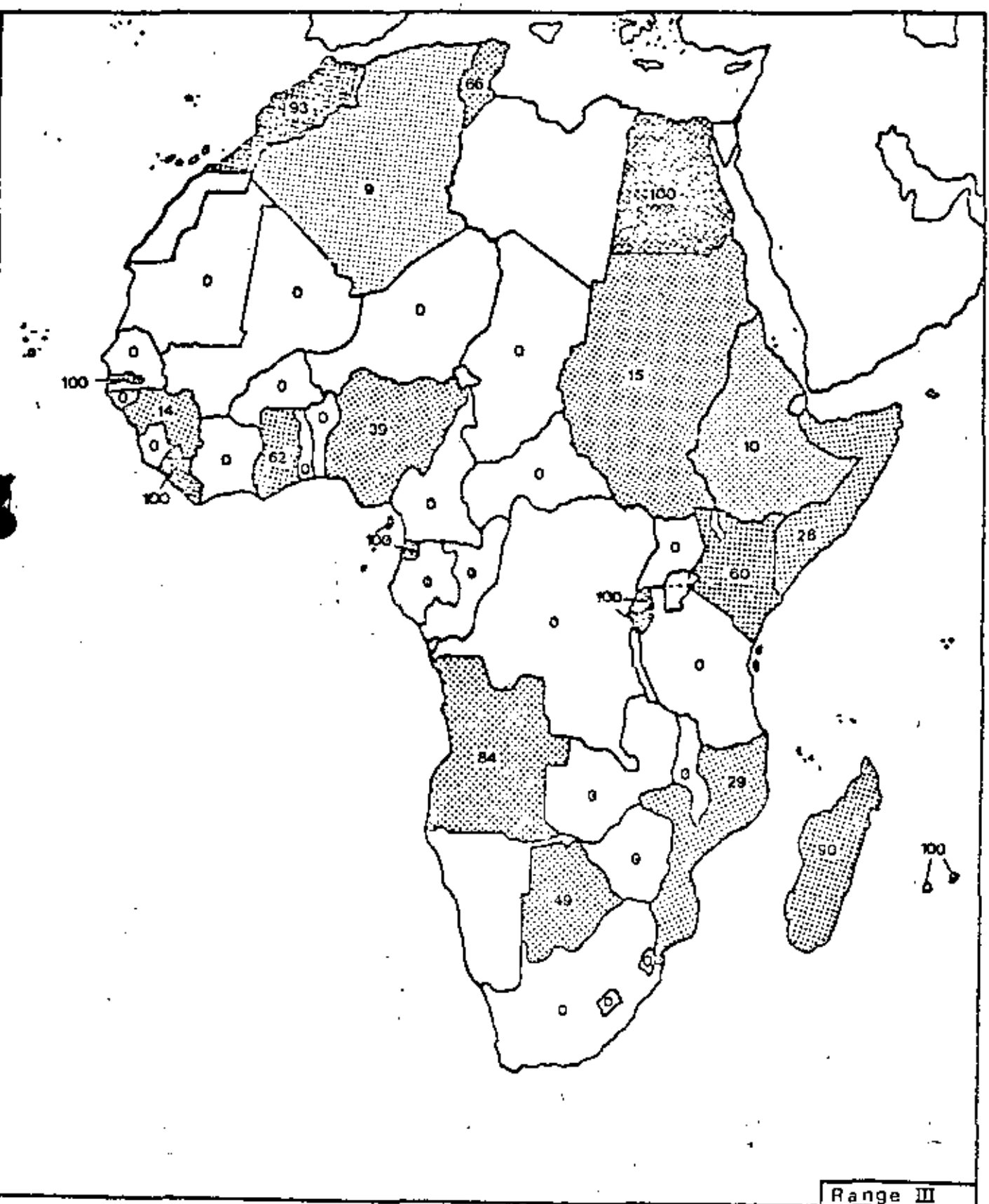


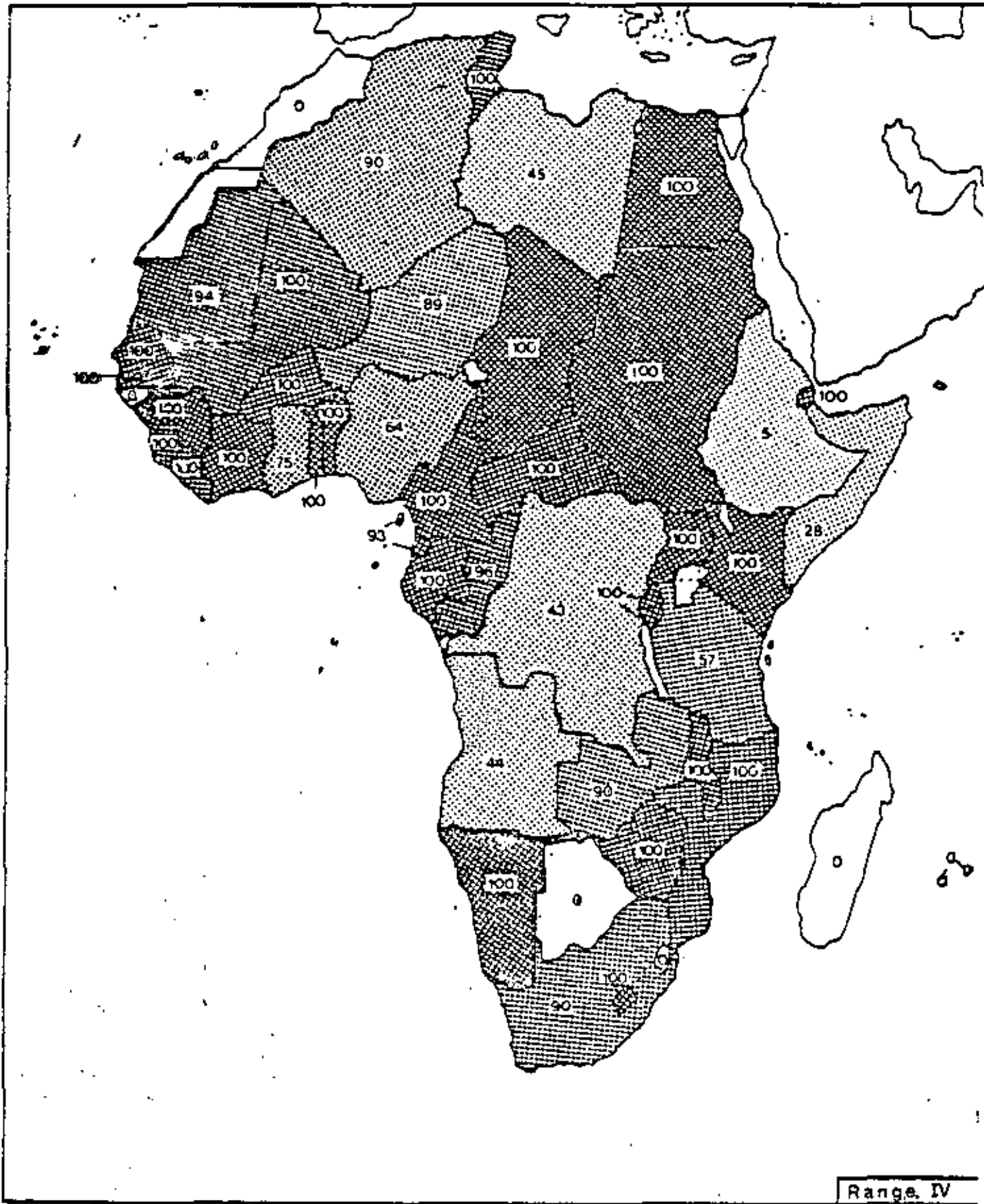
Range IV

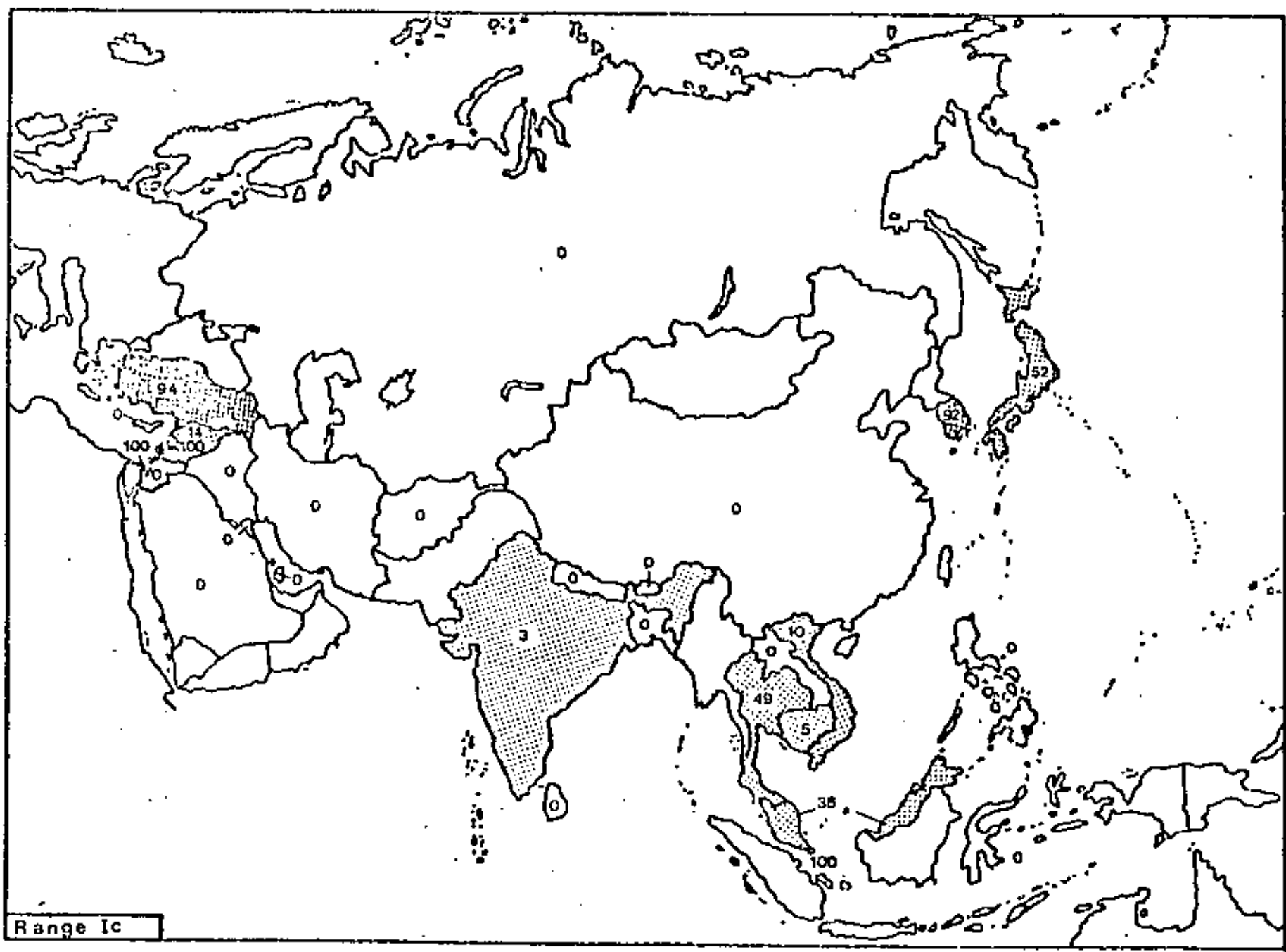


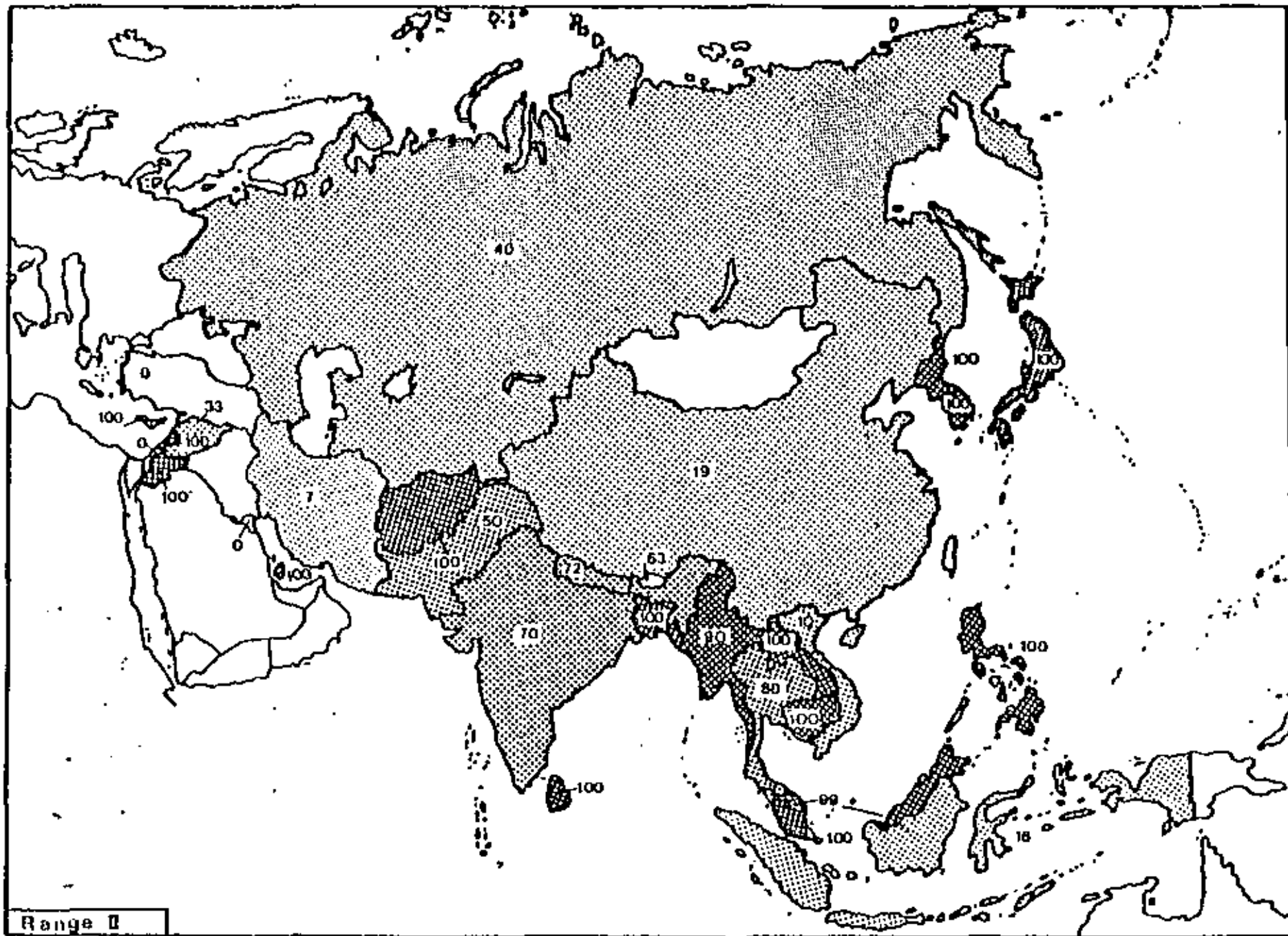
Range Ic



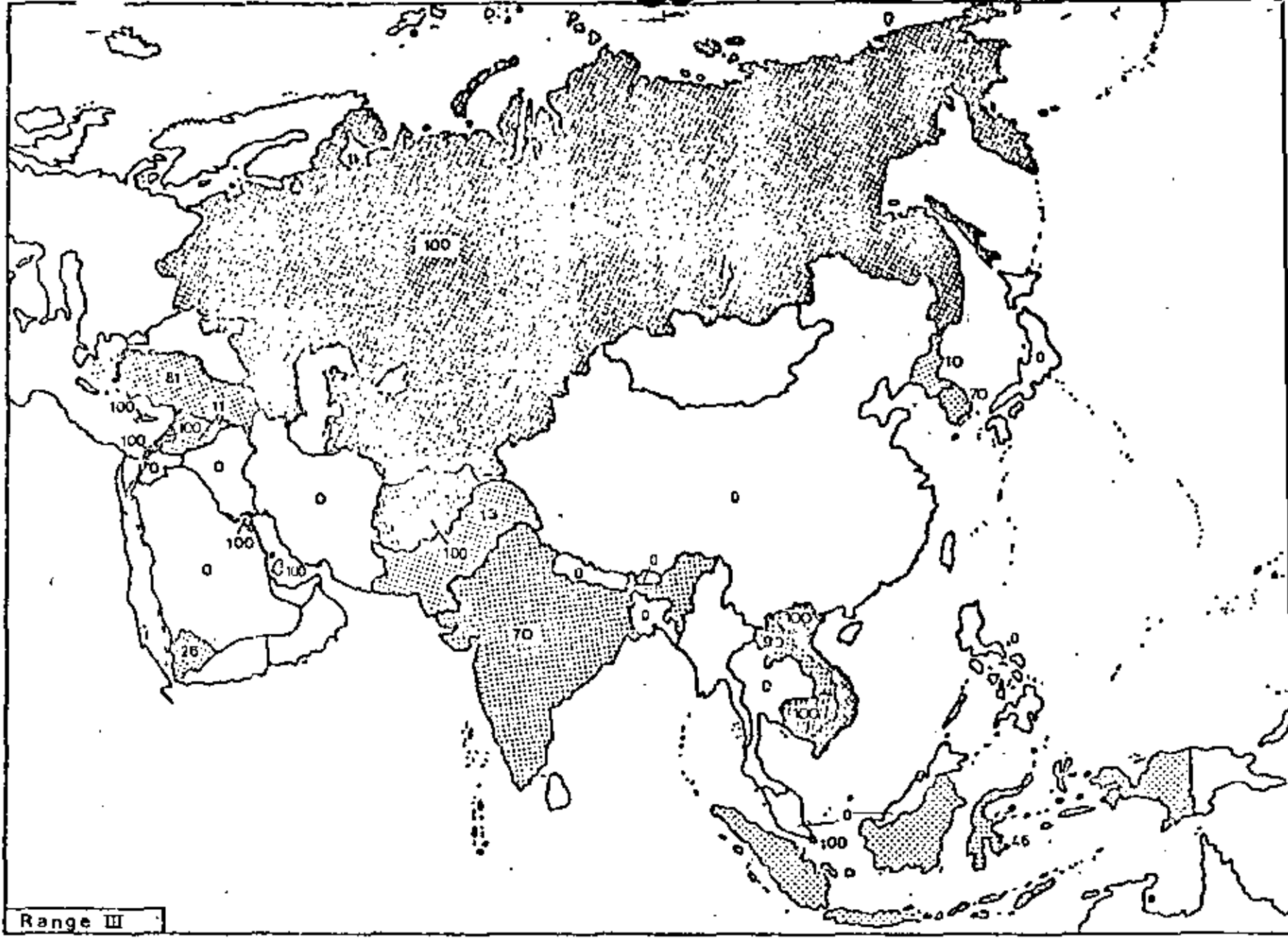




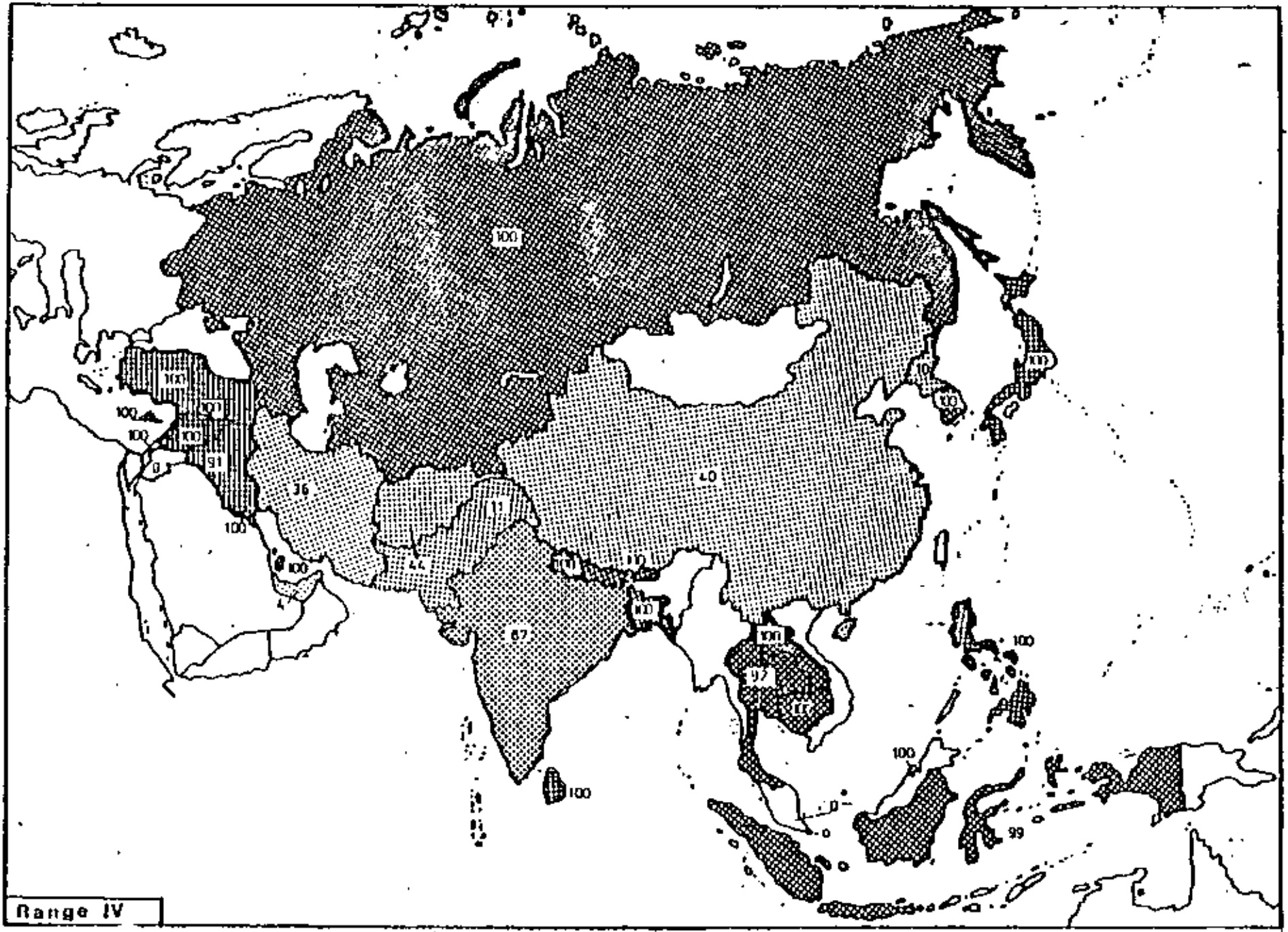




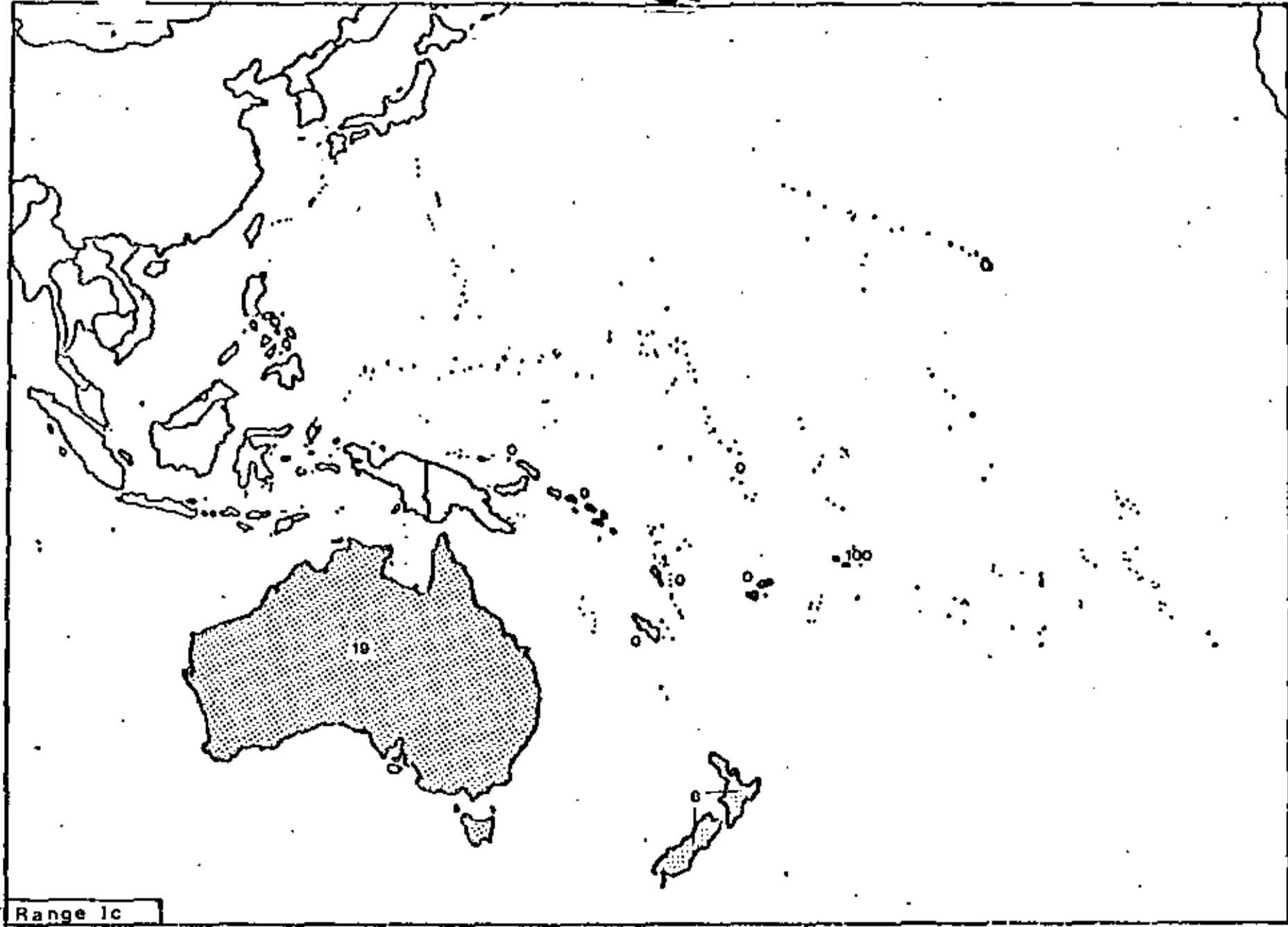




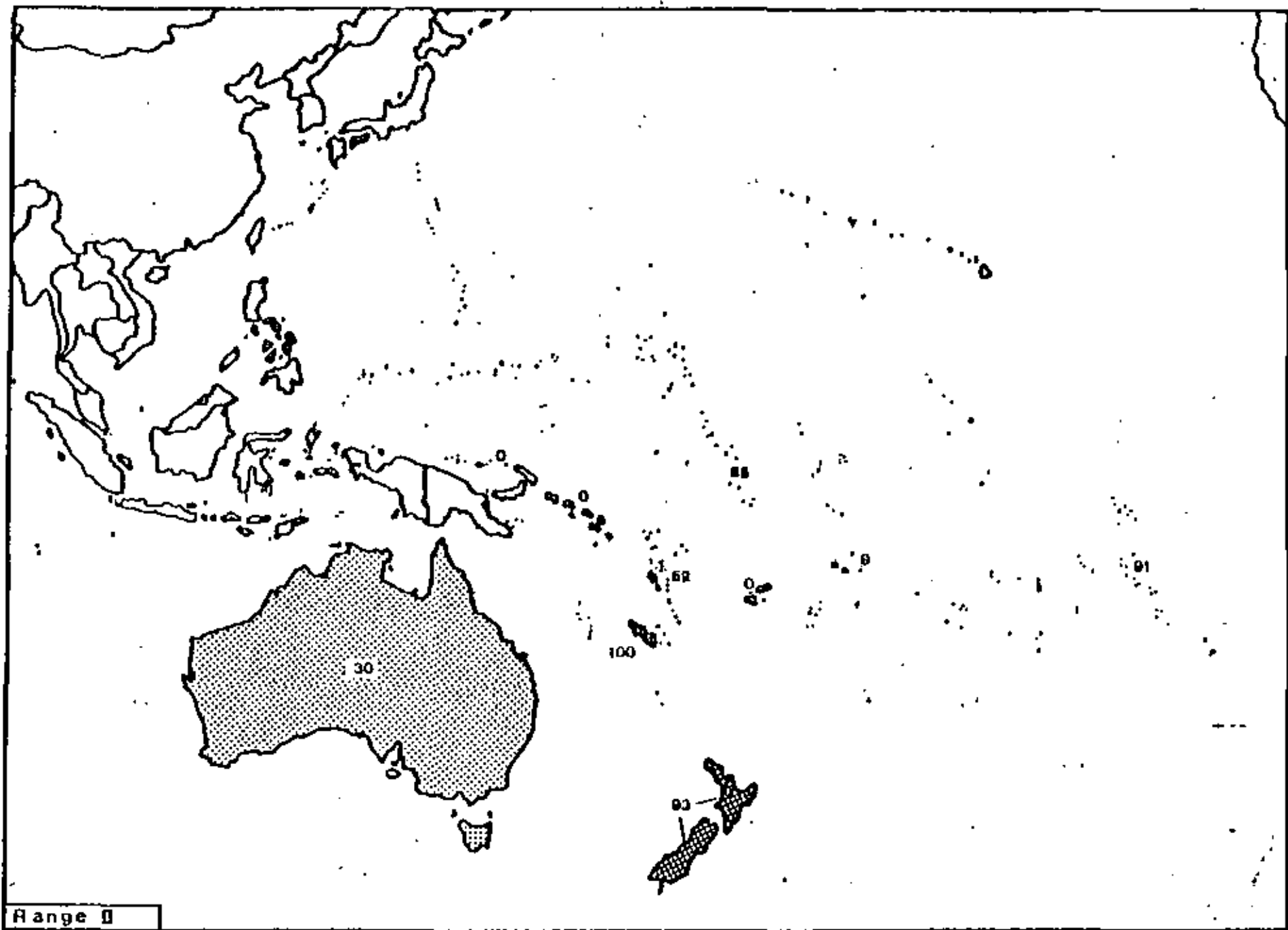
Range III

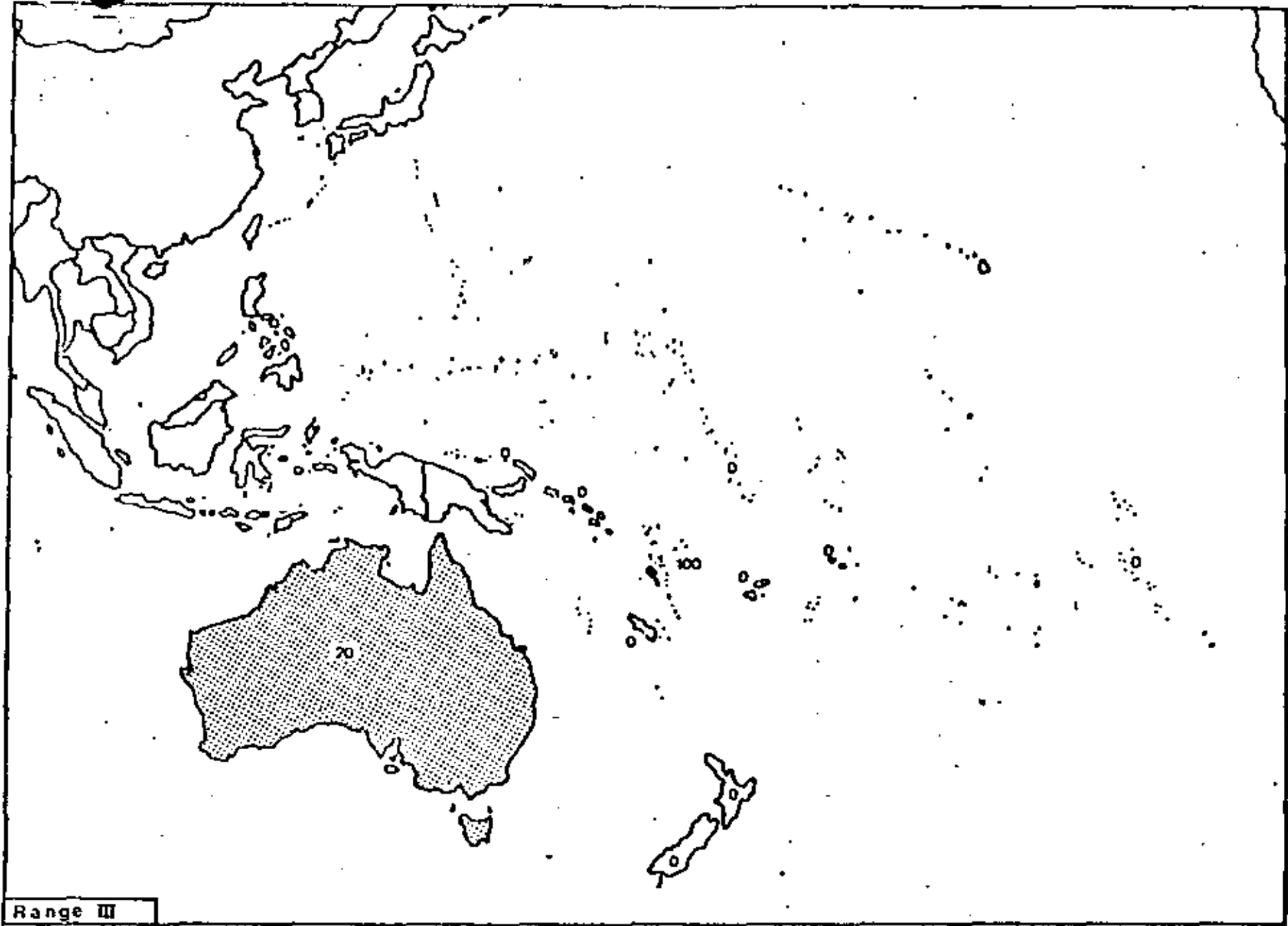


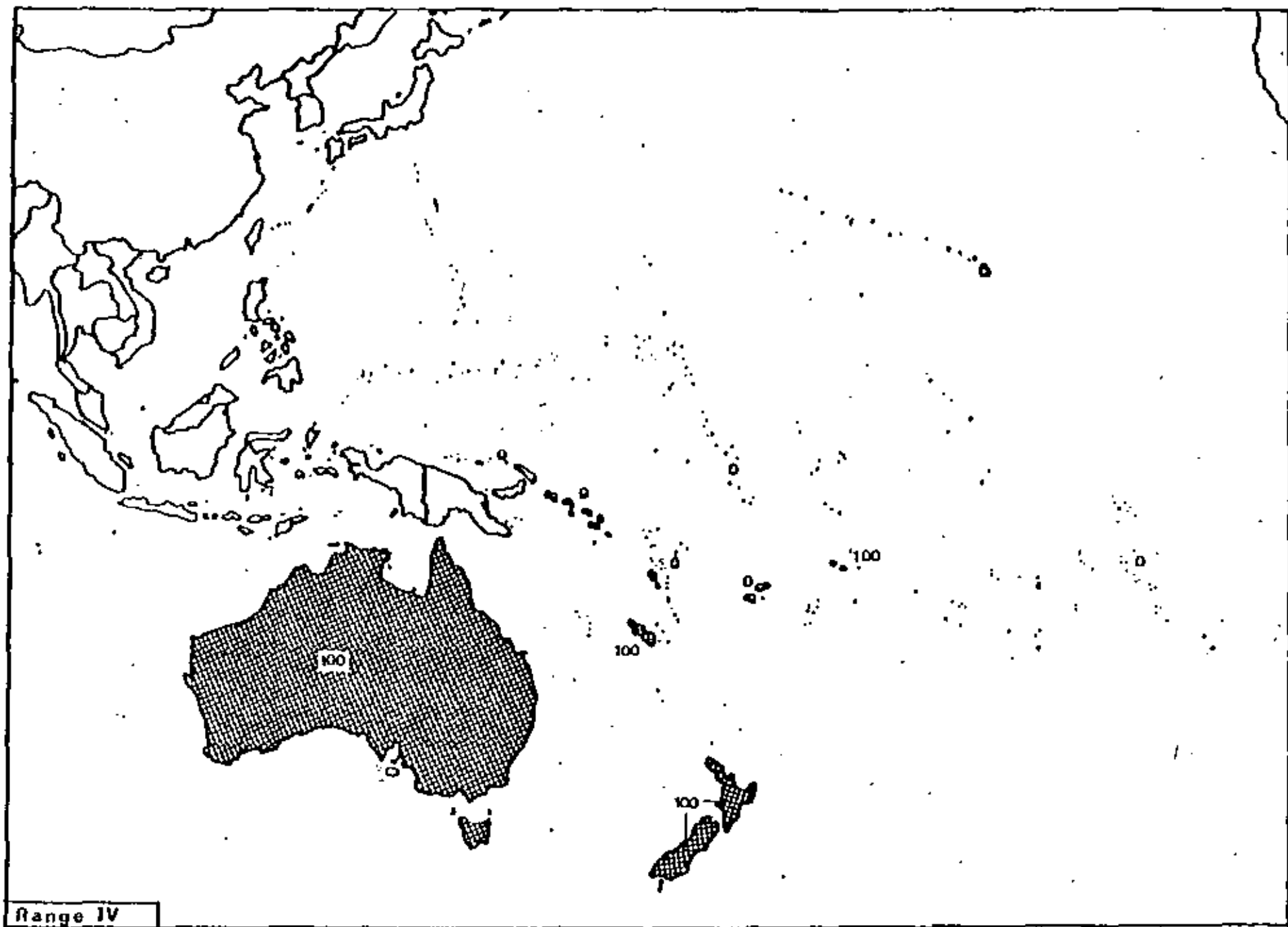
Range IV



Range 1c







STATUS DER DATENBERTRAGUNG

*Estado de la transmisión de datos*

LANDSAT 1, 2, 3

S-Band

15 Mbit/sec.

LANDSAT D

X-Band

85 Mbit/sec.

*límite actual*  
gegenwärtige Grenze

200 Mbit/sec.

*La potencia fotográfica*  
Photogr. Leistungs-  
fähigkeit würde er-  
fordern *Corresponde a*

900 Mbit/sec.

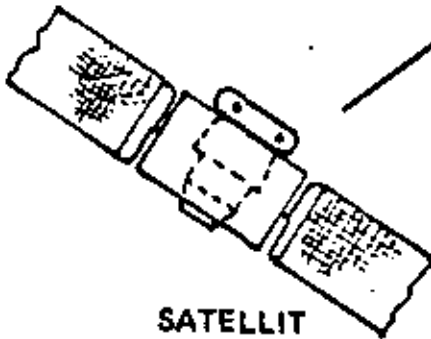
ATLAS 1



ATLAS 2/3



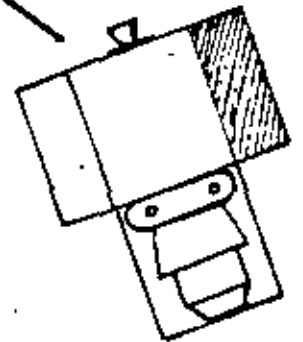
ATLAS 4



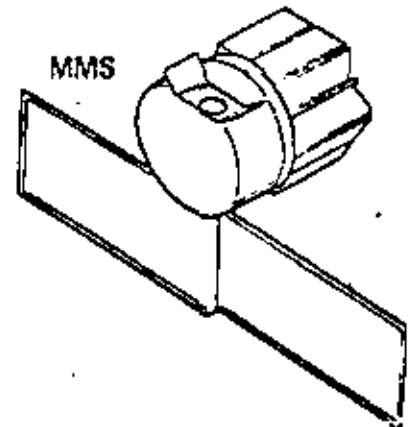
SATELLIT



SL-PALETTE



Antriebsplattform  
Plataformas separ.



MMS

Resumen  
ÜBERSICHT ATLAS 1 BIS 4

	Camera / Plataforma KAMERA / TRÄGER	BAHNHÖHE/km altura AUFNAHMEFELD/km <sup>2</sup> cubierta AUFLÖSUNG/m resolución	MISSION	Campos de apli- ANWENDUNGSGEBIETE cación
ATLAS I	ZEISS RMK 30/23 im SL-MODUL camera fotogram. clásica	250 (bei 57° Incl.) 190 x 190 20 - 40	FSLP, Aug. 1981	Kartographie cartografía
• ATLAS II	ZEISS RMK 30/23, BEWEGUNGSKOMPENSATION compensac. del movemi- im SL MODUL ento	250 - 400 190 x 190 10 - 20	E - 2, 1982/83	Energie- und Mineral-Ressourcen riquezas del subsuelo
• ATLAS III	KAMERA MIT C = 60 cm, BEWEGUNGSKOMPENSATION SL (MODUL/PALETTE)	T B D 95 x 95 5 - 10	SL, 1983/84	Umweltüberwachung observación del ambiente Regionalplanung Proyectos regionales
ATLAS IV	KAMERA MIT C = 75 cm  <span style="border: 1px solid black; padding: 2px;">FREE FLYER</span>	T B D T B D T B D	1984/85	Landwirtschaft Agricultura

objetivo final →

\*ATLAS II/III wird voraussichtlich durch eine Mission mit Kamera auf der Palette ersetzt.



Literatura sobre resultados de aplicaciones carto-  
 Literatur über bisher erzielte Ergebnisse kartographischer Anwen-  
 dungen von Weltraumbildern  
gráficas de satélites

1. COLVOCORESSES, A.P.: "Overall Evaluation of Skylab (EREP) Images for Cartographic Application", Surveying and Mapping, Dec. 1976; 351-360.
2. FLEMING, E.A.: "The Use of ERTS-Imagery for Topographic Map Revision", 7th Intl.Conf.on Cartography, ICA, April-Mai 1974, Madrid, S.5
3. FLEMING, E.A.: "Canadian Mapping Use of Landsat Imagery", Proceedings, 10th Intl.Symp. on Remote Sensing of Environment, 6.-10. Oktober 1976
4. FLEMING, E.A.: "The Use of Satellite Photography in the National Topographic Mapping Program of Canada", Presented Paper, Comm. IV, 13.Kongreß der Int. Ges. f. Photogrammetrie, Helsinki, 1976
5. FLEMING, E.A.: "Positioning Off-Shore Features with the Aid of Landsat Imagery", Photogramm.Eng. and Remote Sensing, Vol. XLIII, No.1, 1977
6. KELLER, M.: "Analytic Aerotriangulation Utilizing Skylab Earth Terrain Camera Photography". Photogramm.Eng. and Remote Sensing, Vol. XLII, No.11, 1976.
7. MOTT, P.G.: Applications of Satellite Imagery to Small Scale Mapping". Proceedings of ASP-ACSM Fall Convention, Phoenix, Arizona, October 26-31, 1975
8. TRINDER, J.C., Nasca, S.V.: "Tests on Mapping Application of Landsat Imagery", Uni G, No.24, 1976
9. STEWART, R.A.: "Mapping from Satellite Photography", Commonwealth Survey Officers Conference, Paper No.K2, 1975
10. WELCH, R.: "Skylab-2 Photo Evaluation", Photogramm.Eng., Vol. XL, No.10, 1975

BEFLIEGUNGSANTRÄGE SPACE LAB - R M K

Topographische Kartenherstellung



Orthophotos



Aerotriangulation



Digitale Methoden

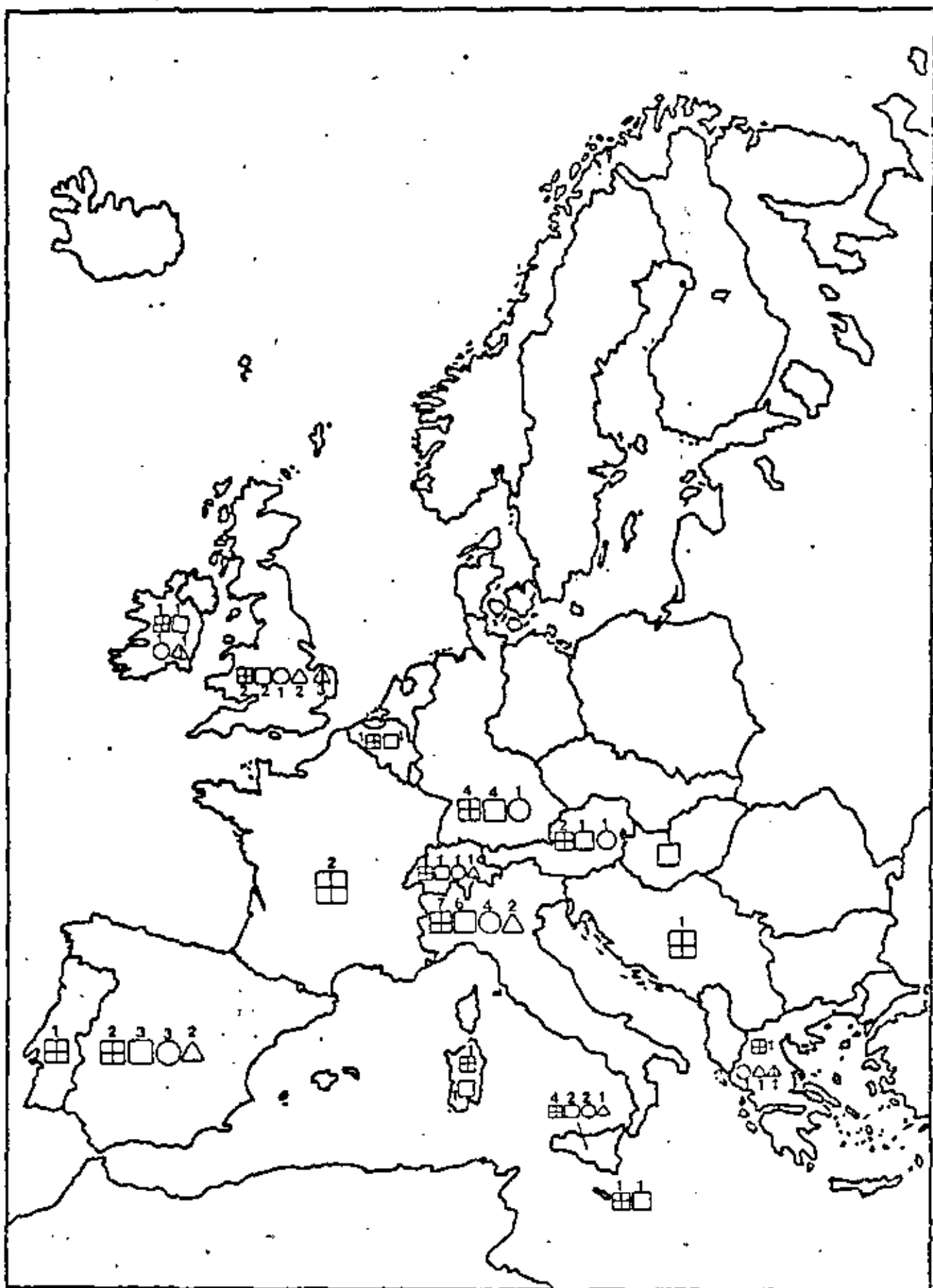


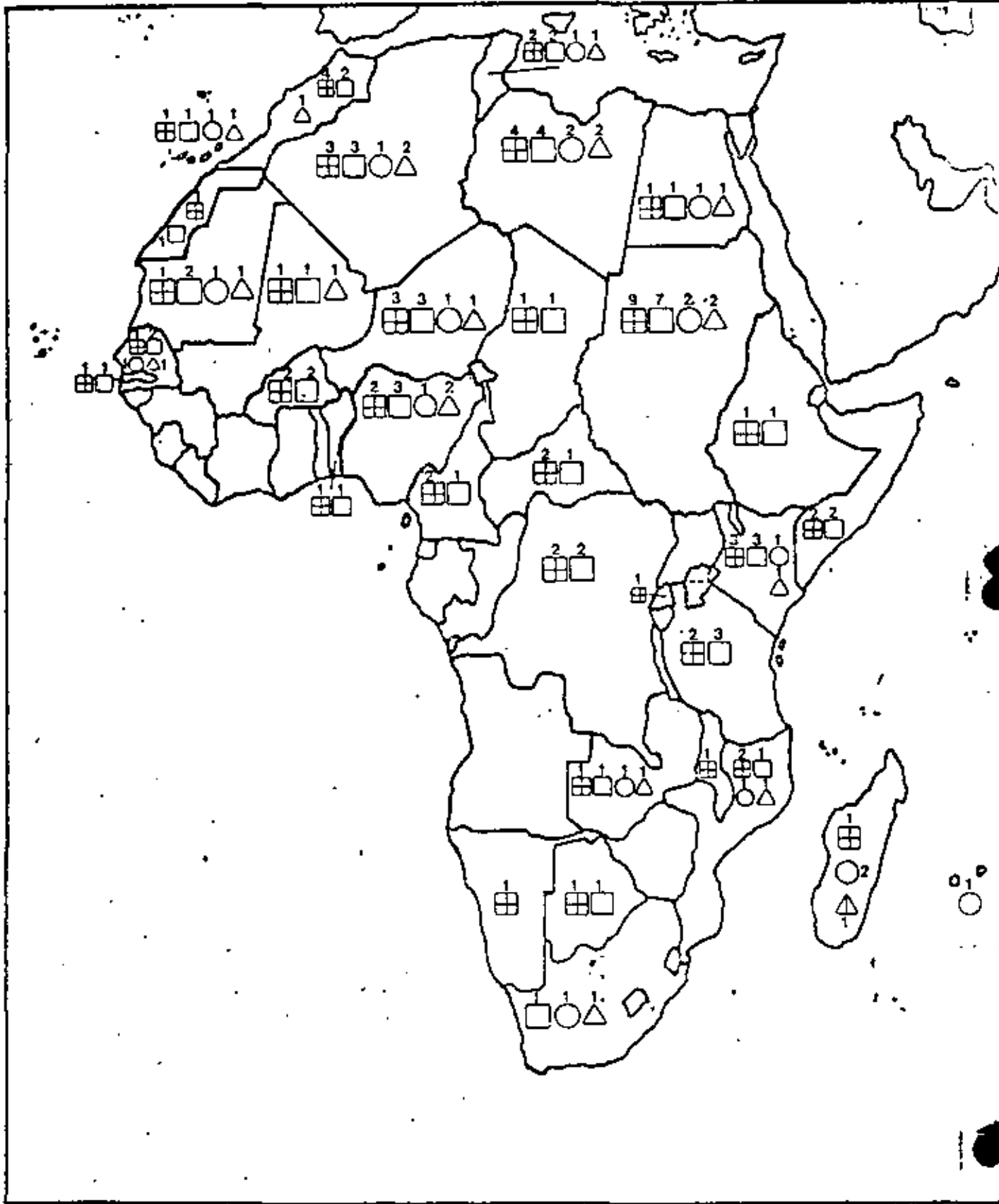
Thematische Kartenherstellung

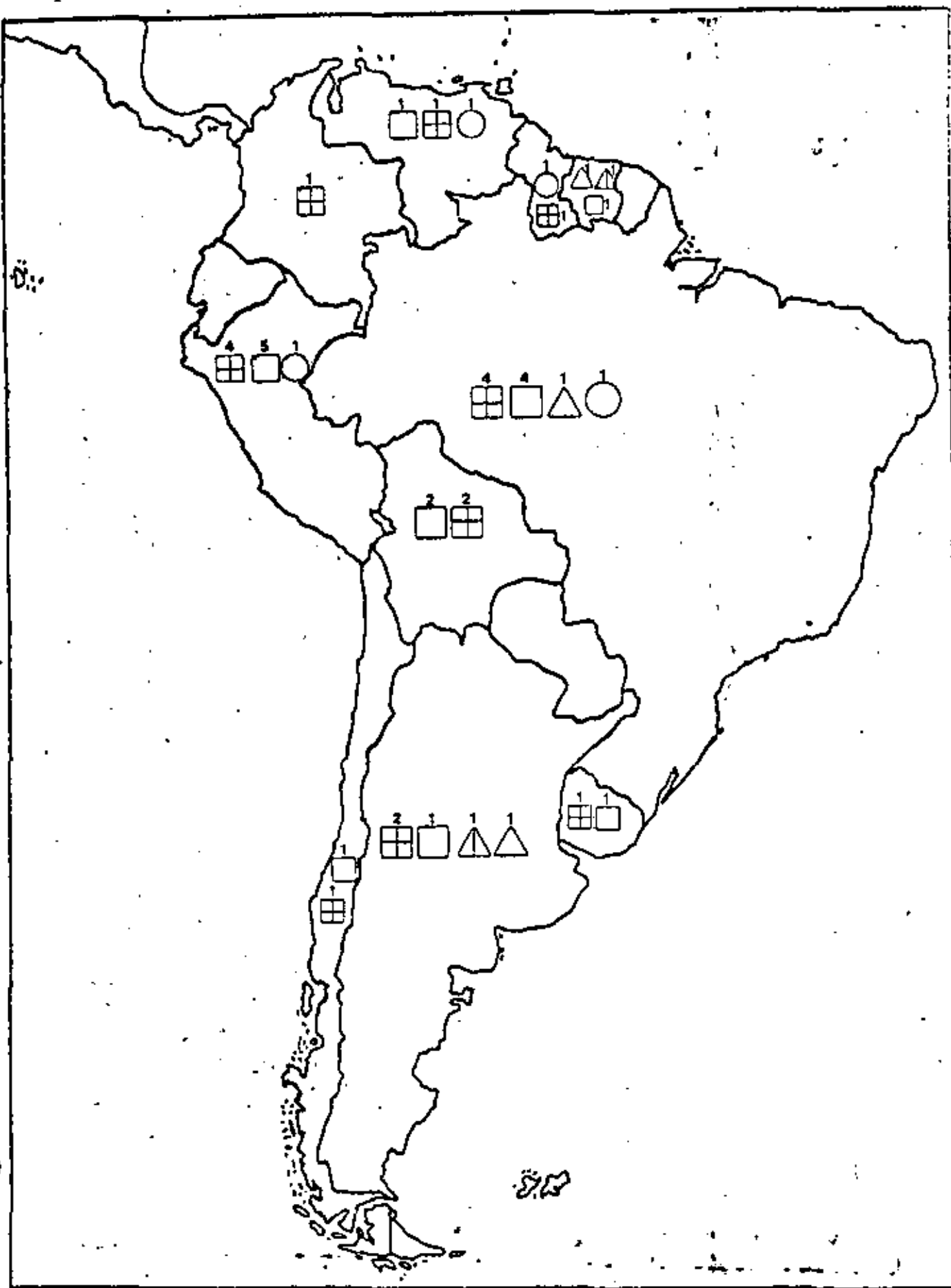


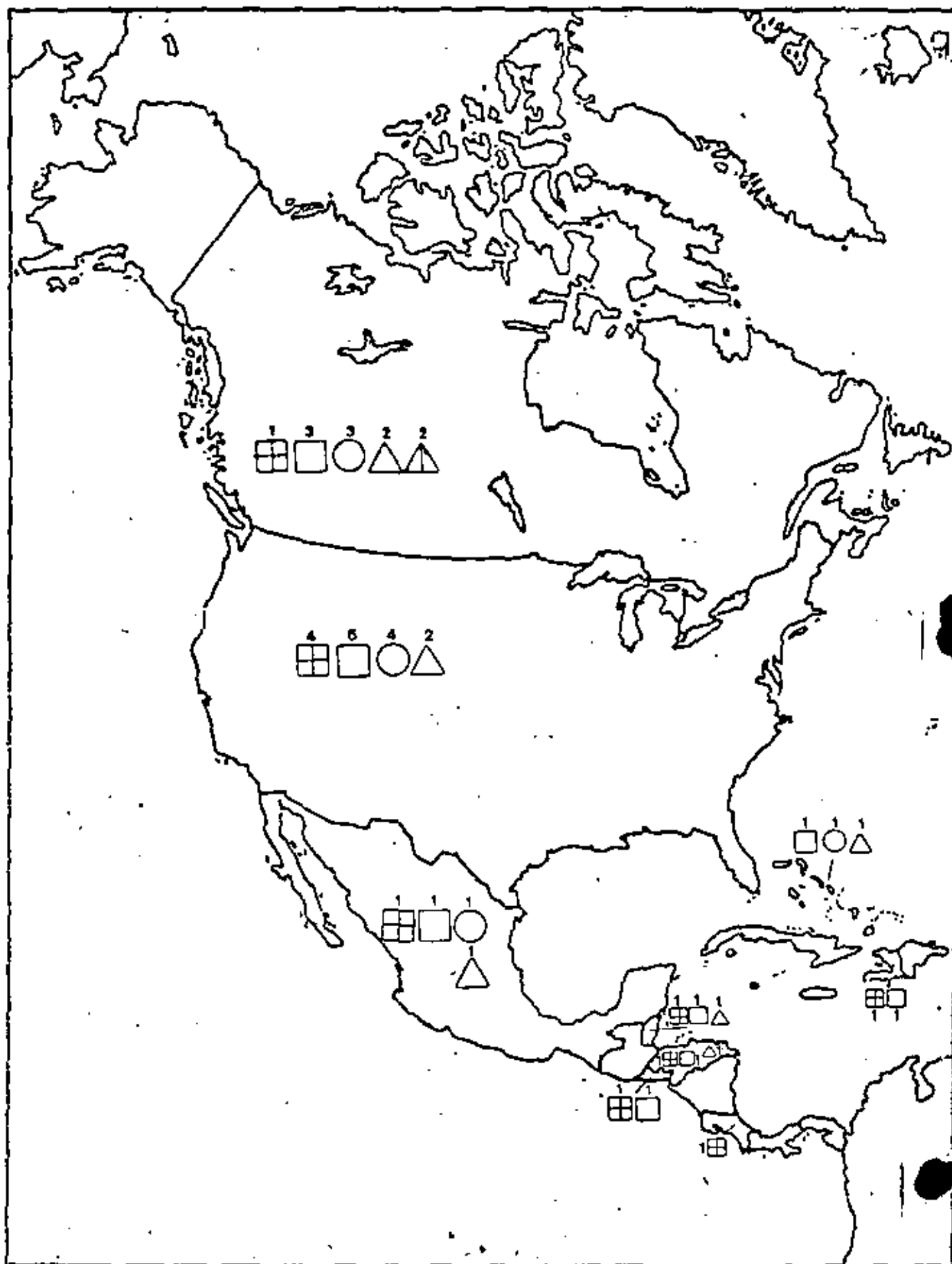
Zahlenangabe: Anzahl der gestellten Anträge

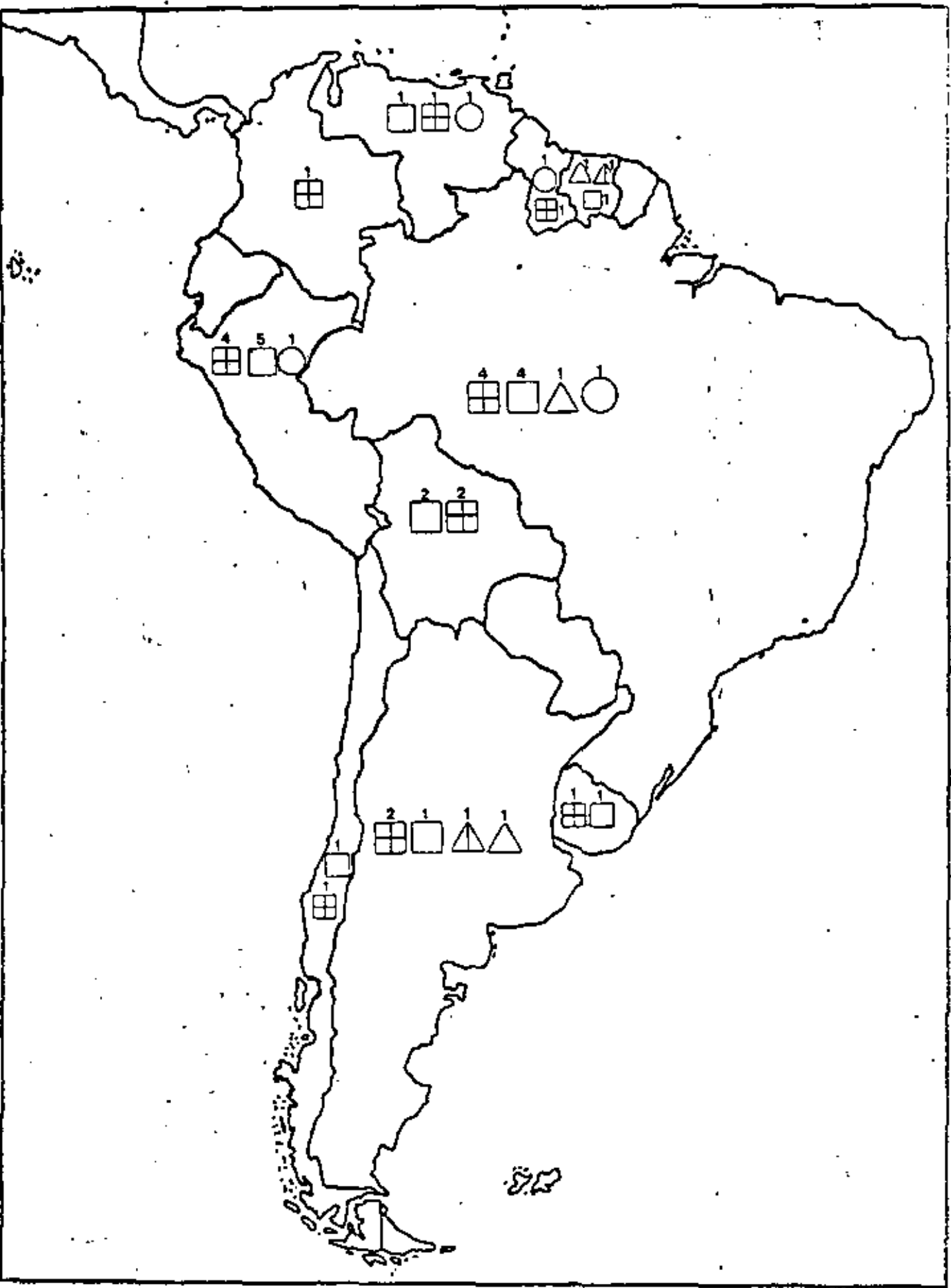
Die Anträge beziehen sich in der Regel auf verschiedene Gebietsteile des jeweiligen Staates.

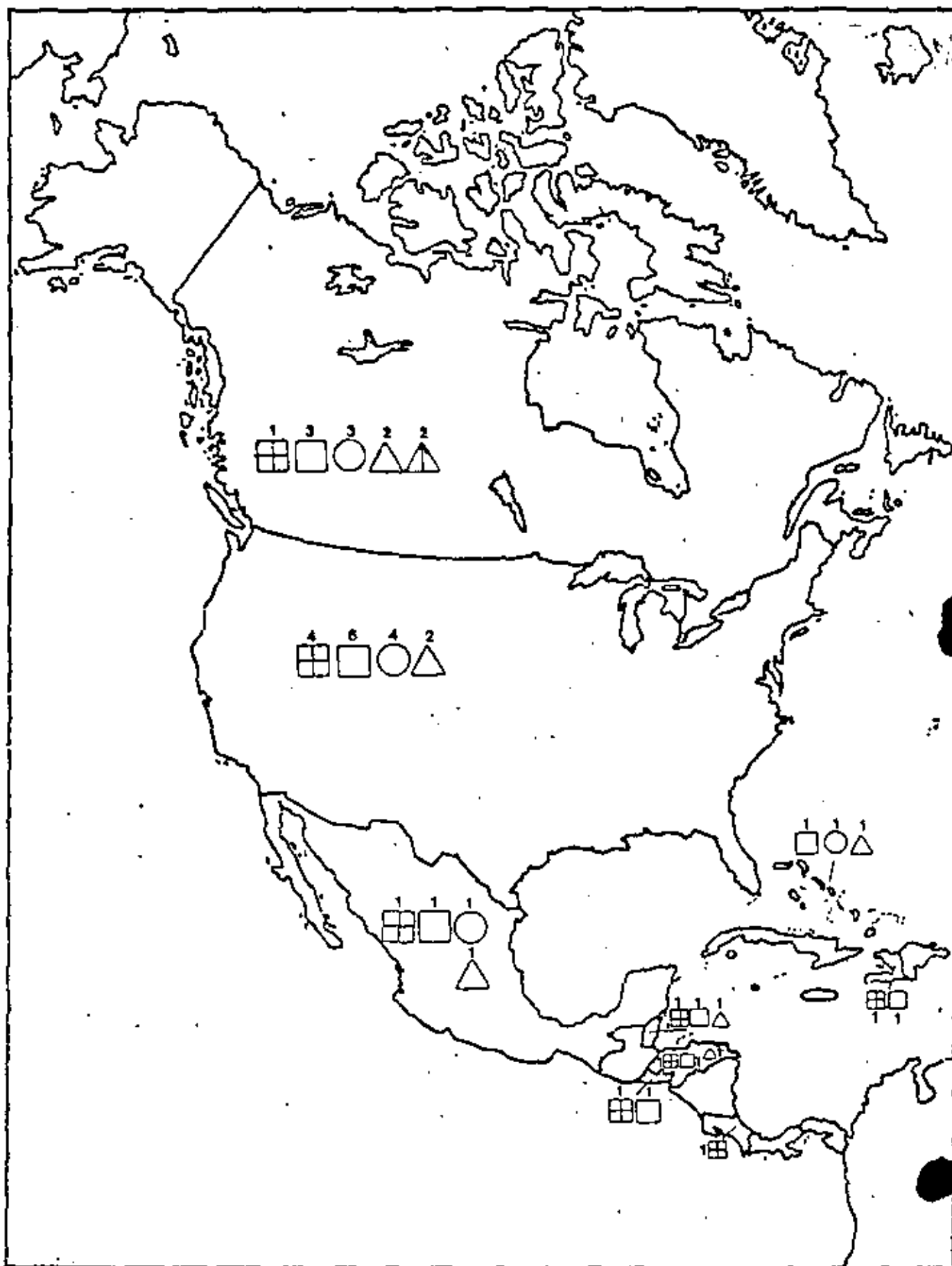
















centro de educación continua  
división de estudios de posgrado  
facultad de ingeniería unam



PERCEPCION REMOTA

DR. ING. HANS PETER BAHR

MARZO, 1980

Palacio de Minería

Colle de Tacuba 5

primer piso

México 1, D. F.

Tel: 521-40-20



SYS DEVICE 844/ E/PP FLS=100K FLL=764K MXS=60K MXL=200K MXD=300B RES

HH.MM.SS CPU SECOND ORIGIN

11.34.57.111 AC
12.17.37 00000.037 MFZ.
12.17.38 00000.015 USR.
12.17.39 00000.024 USR.
12.17.39 00000.024 USR.
12.17.39 00000.050 JOB.
12.17.39 00000.051 JOB.
12.17.39 00000.055 JOB.
12.20.48 AAA.
12.20.49 00000.056 JOB.
12.20.49 00000.061 MFZ.
12.20.49 00000.062 MFZ.
12.20.49 00000.063 JOB.
12.20.49 00000.070 LOT.
12.20.51 00000.071 MFZ.
12.20.53 00000.079 MFZ.
12.23.05 00000.082 MFZ.
12.23.05 00000.082 USR.
12.23.06 00000.093 MFZ.
12.23.06 00000.095 MFZ.
12.23.54 AAA.
12.26.55 MFZ.
12.26.55 MFZ.
12.29.45 OLT.
12.32.03 MFZ.
12.32.03 00000.113 MFZ.
12.32.03 00000.113 MFZ.
12.32.03 00000.114 MFZ.
12.32.03 00000.114 MFZ.
12.32.03 00000.114 MFZ.
12.32.03 00000.114 MFZ.
12.32.03 00000.114 MFZ.
12.32.03 00000.115 MFZ.
12.32.03 00000.115 MFZ.
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12.32.03 00000.117 MFZ.

RRZN HANN. SCOPE 3.4.3+406F0 30/03/77.

SYREI,T10,STT76,NT1.
ACCOUNT,2034V0\*\*,KG2C,REICHE.

PIIIIIIBIA.
NAME,T10,STT76,NT1.
ACCOUNT,601 GNUG,KG2A,ZACER.

\*\*\*\* RRZN-SYSTEM BULLETIN INFORMATION
\*\*\*\* LAST UPDATE 13/06/79 09.37

FILE,TAPE1,BI,RT=H,MRL=5120,MBL=5120,EO=AD.

STAGE,TAPE1,NT,PRE,HD,ST=DLT,VSN=KD9564.

VSN=KD9564=NORING=ONLINE.

GO.

PAUKE

ATTACH,BIR,MSDIB,IO=SCHAEFER,PW=\*\*\*\*\*.

PF254 - CYCLE 6 ATTACHED FROM SN=SYSTEM

PF060 - SIZE = 212050 WORDS

LIBRARY,BIR.

BILOVE.

LO333 - UNSATISFIED EXTERNALS OS.COG
LO510 - FLS REQUIRED TO LOAD - 0020661 OU.COG
LO562 - LOADER NON-FATAL ERROR FLAG SET OS.EXP
FORTRAN LIBRARY 446 04/07/77

JM260 - STAGE NT IN LFN=TAPE1 VSN=KD9564
JM270 - REQUEST NT LFN=TAPE1, VSN=KD9564

14 ASSIGNED.

IO502 - NT 14 BLOCK 4547
IO504 - REC READ PARITY ERR: RTC = 2
JM511 - WORDS READ- 76113078
SC046 - TIME LIMIT
RM770 - MAXIMUM ACTIVE FILES
RM771 - OPEN/CLOSE CALLS
RM772 - DATA TRANSFER CALLS
RM773 - CONTROL/POSITIONING CALLS
RM774 - BI DATA TRANSFER CALLS
RM775 - BI CONTROL/POSITIONING CALLS
RM776 - DIENE MANAGER CALLS
RM777 - RECALL CALLS

SC1 153.755 KWS
LC1 524.500 KWS
I/O 0.475 MW
RMS 15.254 MWS
TAPE 0.004 TS
USER 2.509 SEC
JOB 0.110 SEC
GIO 1 621,660 KW

8
22
6,986
5,397
6,381
84
482
394

Handwritten box containing '1801' and 'Lila Mandala'.

MODUL	Cintas		Sector							
	6	12	18	24	30	36	42	48	51	61
6	1	2	1	1	799	1359	0	0.000	0.000	

EINGABE VON OPTRONICSBAENDERN

EOF BEI SATZ/800

X START = 1 X END = 799

Y START = 1 Y END = 1359

PARITAETSFEHLER ENTDECKT

TAPE2 MIT 799 BILDZEILEN ZU JE 1359 PIXELN BESCHRIEBEN

5.163 SEK. CPU-RECHENZEIT

100 Zeilen filas

27	2	3	700	1200	799	1359	0	0.000	0.000
----	---	---	-----	------	-----	------	---	-------	-------

extracción de un sector de la imagen

AUSZUG EINES BILDBEREICHES

160 Spalten Columns

TAPE3 MIT 100 BILDZEILEN ZU JE 160 PIXELN BESCHRIEBEN

0.813 SEK. CPU-RECHENZEIT

9	3	0	0	0	(100)	(160)	0	0.000	0.000
---	---	---	---	---	-------	-------	---	-------	-------

5	3	4	0	0	(100)	(160)	0	0.000	0.000
---	---	---	---	---	-------	-------	---	-------	-------

HISTOGRAMMLINEARISIERUNG

TAPE4 MIT 100 BILDZEILEN ZU JE 160 PIXELN BESCHRIEBEN

0.115 SEK. CPU-RECHENZEIT

9	4	0	0	0	(100)	(160)	0	0.000	0.000
---	---	---	---	---	-------	-------	---	-------	-------

3	4	5	0	0	(100)	(160)	0	1.410	1.000
---	---	---	---	---	-------	-------	---	-------	-------

extensión de la escala (afin)

MASSSTABDEHNUNG IN X- UND Y-RICHTUNG

TAPE5 MIT 140 BILDZEILEN ZU JE 160 PIXELN BESCHRIEBEN

0.202 SEK. CPU-RECHENZEIT

43	5	6	0	0	(140)	(160)	0	53.800	53.500
----	---	---	---	---	-------	-------	---	--------	--------

compensación de la rotación terrestre

USGLEICH DER ERDREHNUNG

TAPE5 MIT 140 BILDZEILEN ZU JE 160 PIXELN BESCHRIEBEN

0.094 SEK. CPU-RECHENZEIT

3	6	7	0	0	(140)	(160)	0	1.000	1.570
---	---	---	---	---	-------	-------	---	-------	-------

MASSSTABDEHNUNG IN X- UND Y-RICHTUNG

TAPE7 MIT 140 BILDZEILEN ZU JE 276 PIXELN BESCHRIEBEN

0.313 SEK. CPU-RECHENZEIT

1	7	8	1	1	(140)	(276)	0	0.000	0.000
---	---	---	---	---	-------	-------	---	-------	-------

- 1. Steuerkarten  
EØR
- 2. Aufrufe Module  
EØR

0, 0.000 und Werte in Klammern nicht ablesen

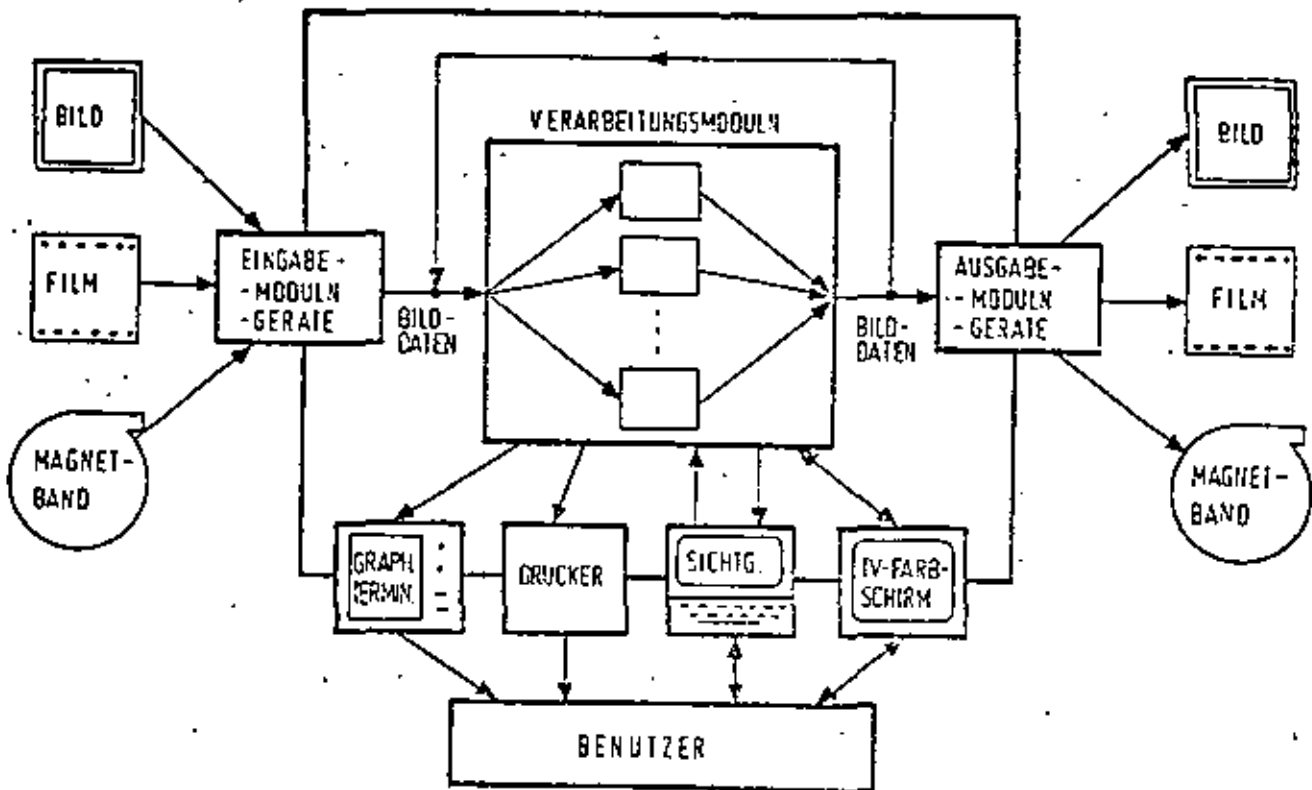
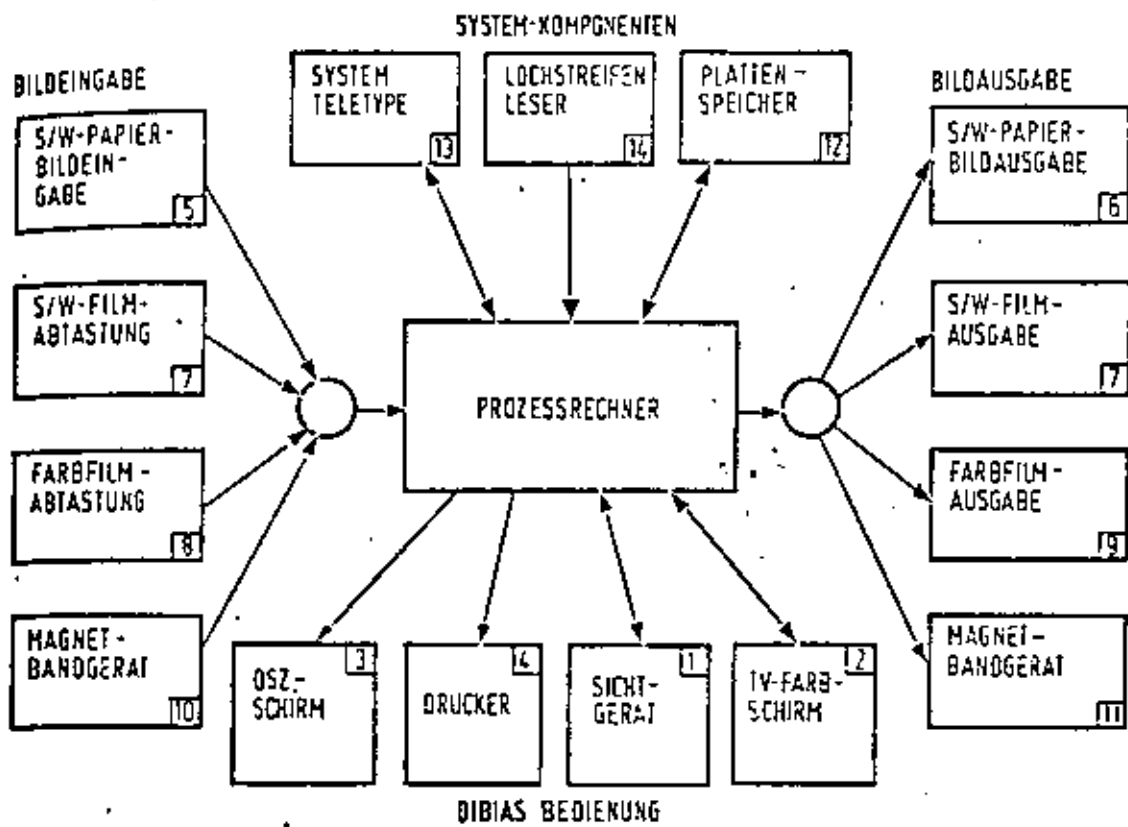
	Modul Nummer	entrada salida				numeros			
		Eingabe Band Nummer cinta	Ausgabe Band Nummer cinta			Anzahl Zeilen filas	Anzahl Spalten columns		
READ (FMP-Format)	42	1	2	0	0	2340	3264	0	0
						cálculo automático			
STRETCH X (Factor 1,392)	3	2	3	0	0	(2340)	(3264)	1,392	1.
LINEAR HISTOGRAM	5	3	6	0	0	(3264)	(3264)	0	0
REDUCTION	27	6	7	260	1	750	701	0	0
EARTH ROTATION	43	7	8	0	0	(491)	(701)	53.83	53,50
WRITE (OPTRONICS Format)	7	8	(98)	0	0	(491)	(701)	0	0

MOBI (Tratamiento Landsat)

**TABLE 7.2**  
Commercial interactive image-processing systems

Processing system	Manufacturer	Address
MDAS	Bandix Aerospace Systems Division	3621 South State Road, Ann Arbor, Mi. 48107
Series 9	Comtal Corp.	169 North Halstead, Pasadena, Ca. 91107
IDIMS	ESL Inc.	495 Java Drive, Sunnyvale, Ca. 94086
IMAGE 100	General Electric Co., Space Division	P. O. Box 2500, Daytona Beach, Fla. 32015
System 101	Stanford Technology Corp.	650 N. Mary Avenue, Sunnyvale, Ca. 94086

Program	Implemented on	Summary
ASTEP—Algorithm Simulation Test and Evaluation Program	UNIVAC 1100, EXEC 8, batch or interactive mode.	Determines the statistical properties of multispectral data. Evaluates performance of various classification techniques.
DAM—Detection and Location of Surface Water	UNIVAC 1100, EXEC 8, batch or interactive mode.	Identifies and maps surface water using Landsat CCT data.
ELLTAB—Elliptical Table Lookup Algorithm	UNIVAC 1108, EXEC 8, batch or interactive mode.	Classifies multispectral data using an advanced table lookup approach.
LACIE—Large Area Crop Inventory Experiment System	IBM 360 series, batch or interactive mode.	Performs multispectral image analysis and image registration for identifying crop types and estimating yield.
LARSYS—Laboratory for Applied Remote Sensing System, Purdue University	IBM 360 system, batch or interactive mode.	Performs supervised multispectral classification using data from training sites, and evaluates the results.
QUIKLOOK—Landsat	IBM 360/91, batch mode.	Image-enhancement program for quickly performing approximate radiometric and geometric corrections of Landsat data.
SMIPS—Small Interactive Image Processing System	IBM 360/370 series with interactive display on IBM 2250 device	Modification of VICAR with additional routines for fast access and display of image data. Designed for use by personnel who are not expert programmers.
VICAR—Video Image Communication and Retrieval	IBM 360/44, batch mode.	A very extensive system for image restoration, enhancement, and information extraction.
MOBI - Modulares Bildverarbeitung. - Paket	CDC CYBER 73/76 batch / interactivo	Geometría, mejoramiento clasificación
Sadie	CDC, batch	Filtros, mejoramiento, extracción de información



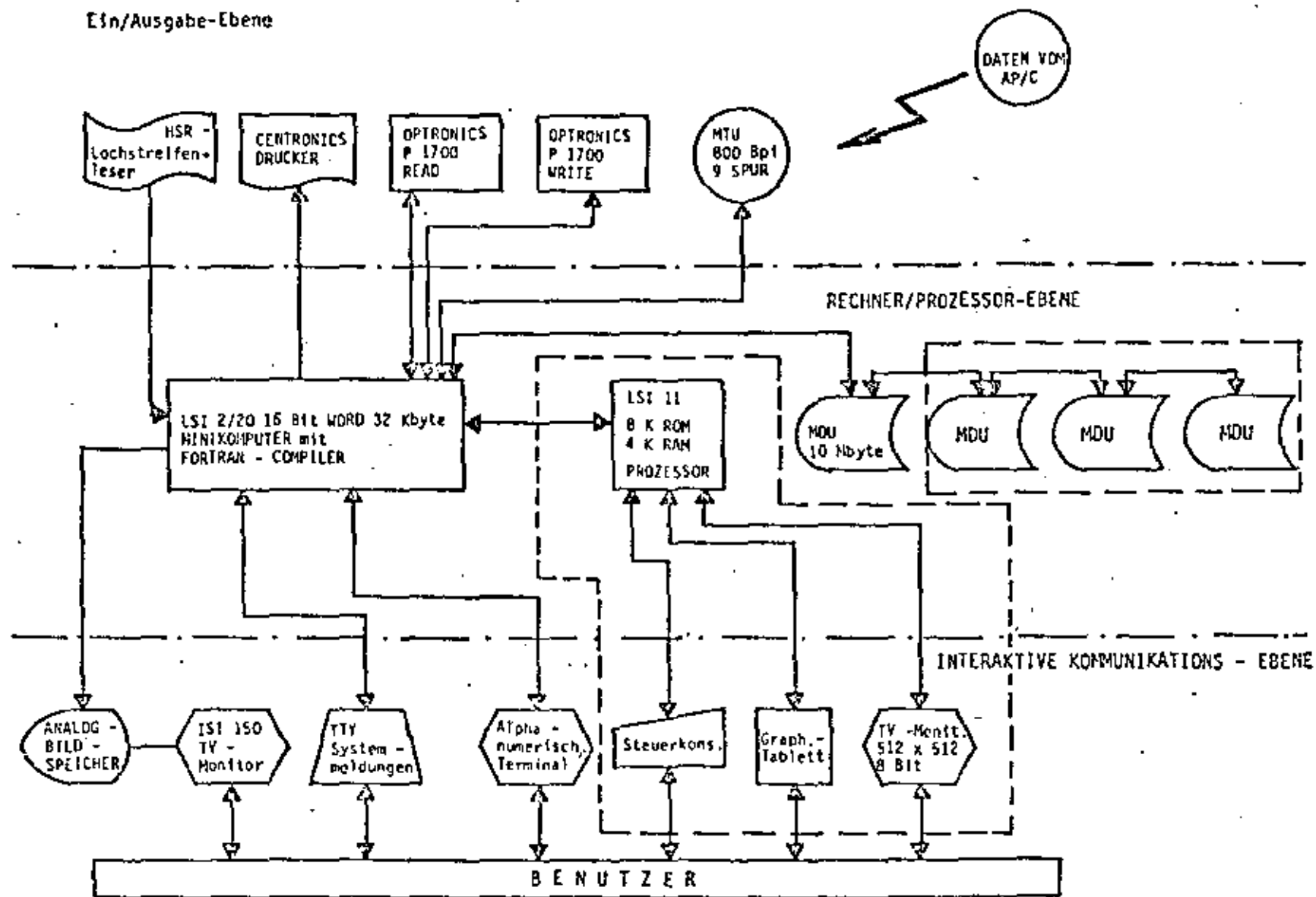
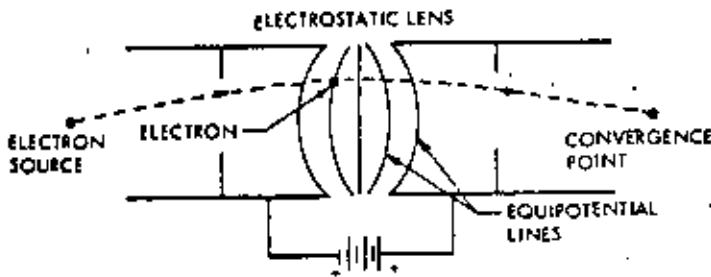
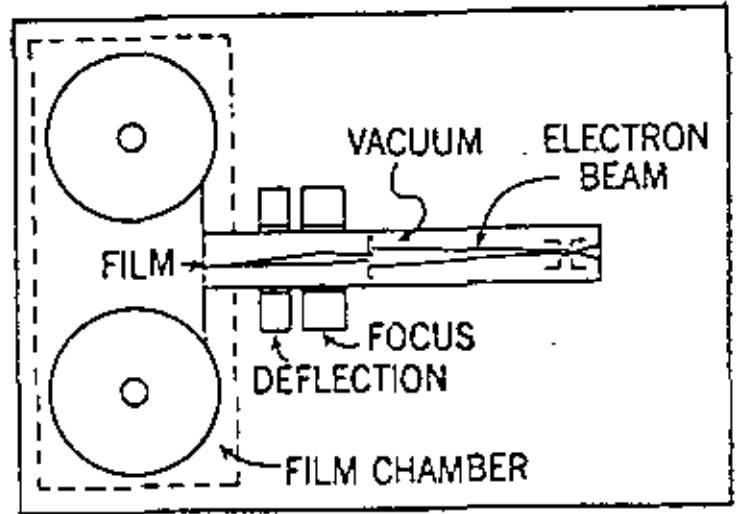
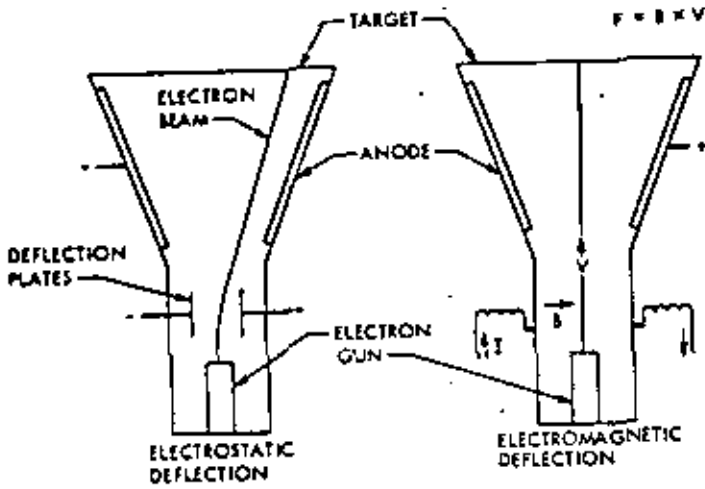
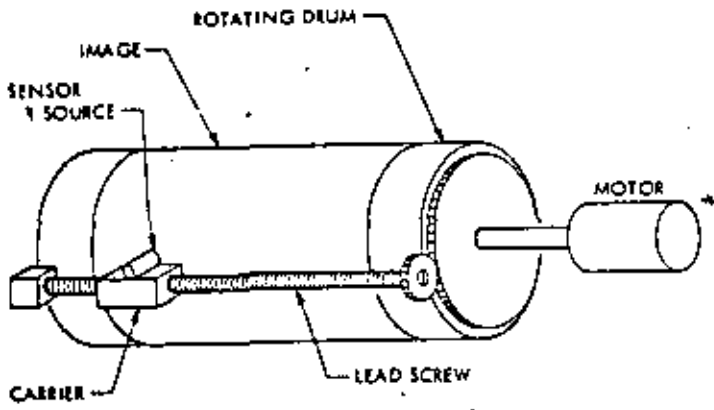


Abb. 3 Bildverarbeitungsanlage am SFB 149



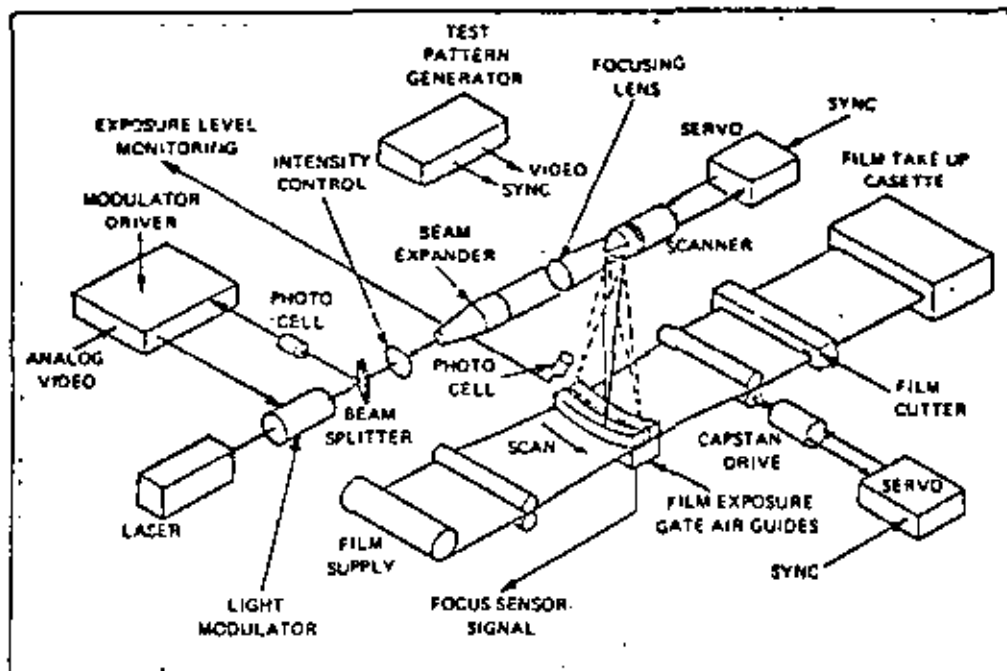
Métodos de reproducción

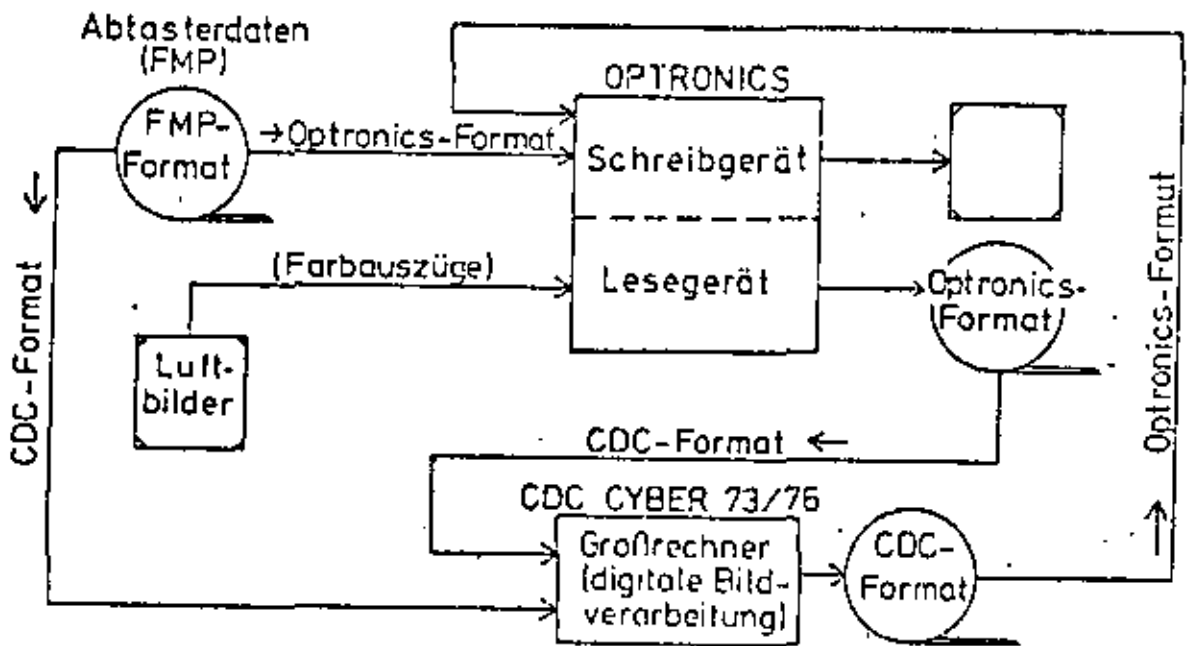
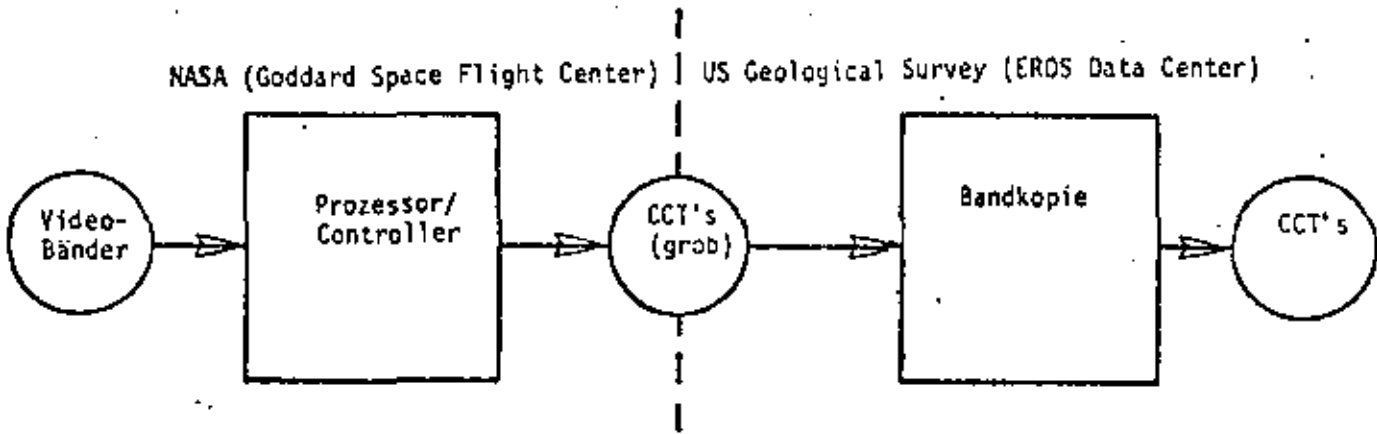
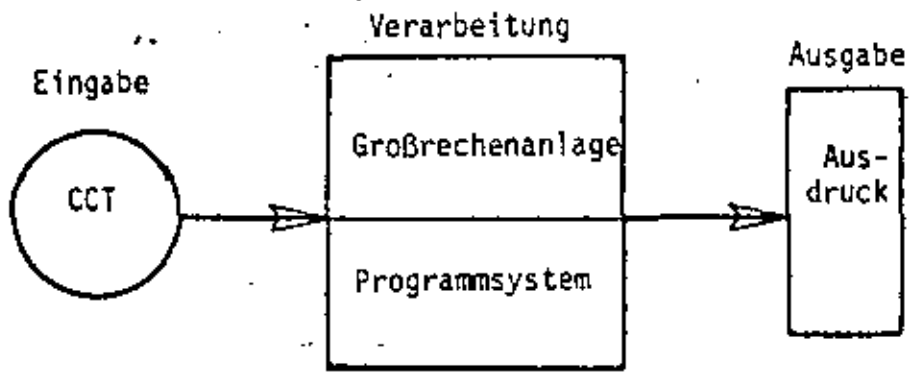
1. Solución opto-mecánica ("OPTRONICS")

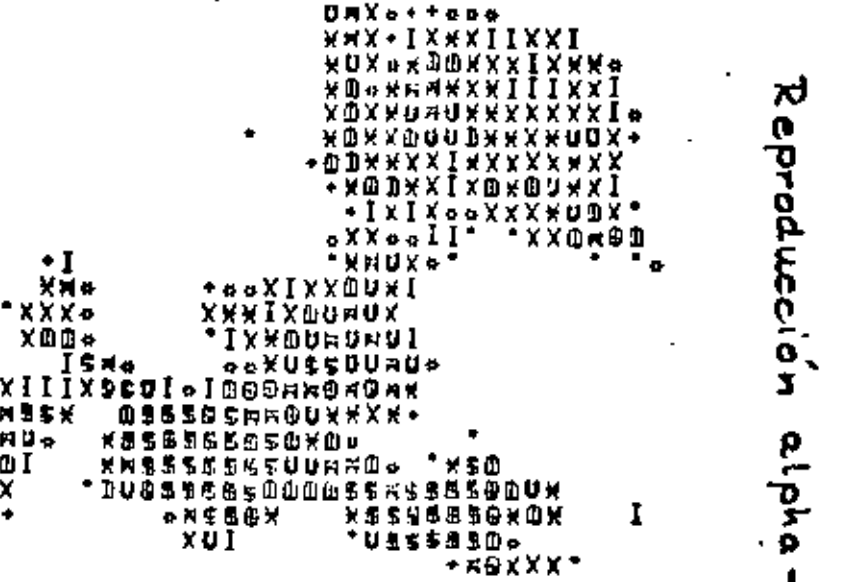


2. Electron Beam Recorder

3. Laser Beam Recorder







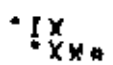
Reproduccion alpha - numerica

Nimbus-3, 9.6.1969

Alphanumerischer Ausdruck Sizilien/Malta

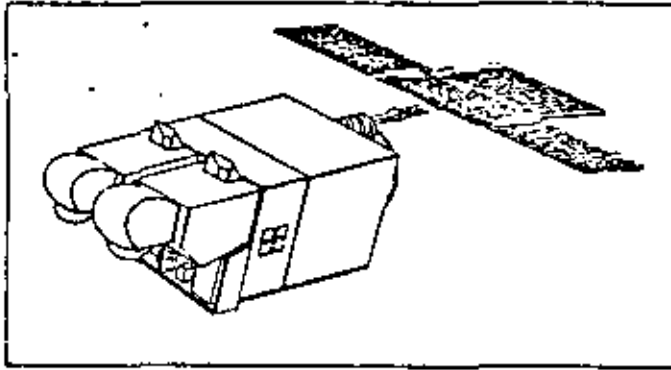
Maßstab in Bildmitte etwa 1/2.5 Mill.

2.3.4-45



+I+

\*0\*

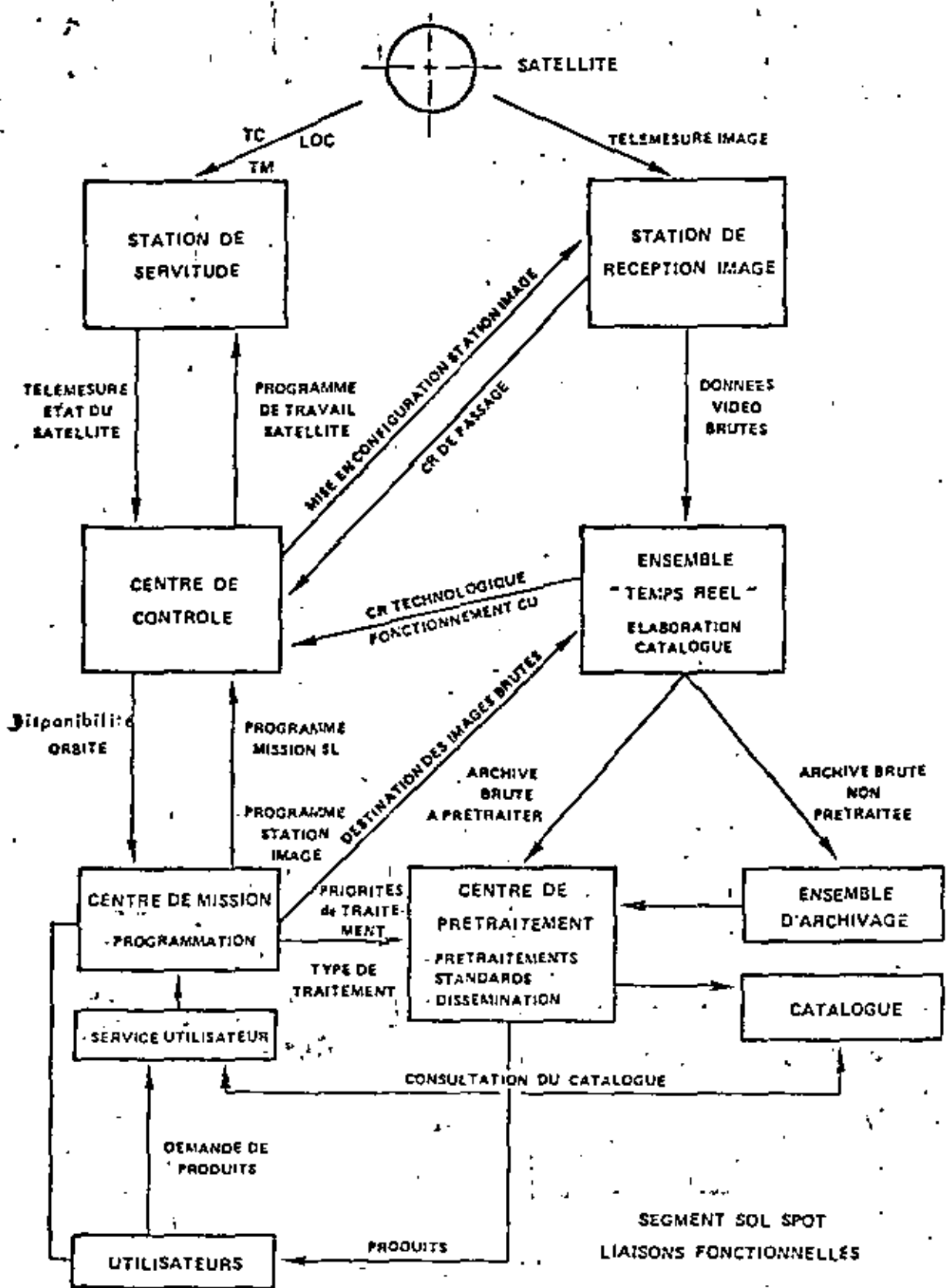


The Proposed SPOT Satellite

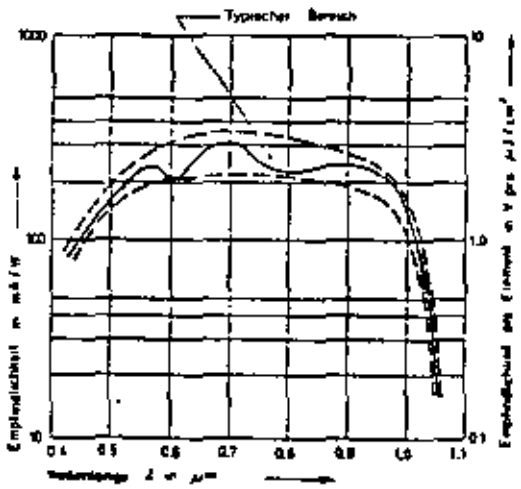
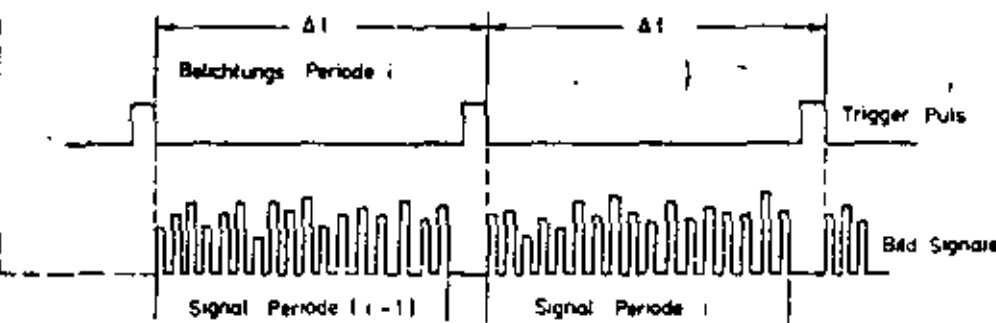
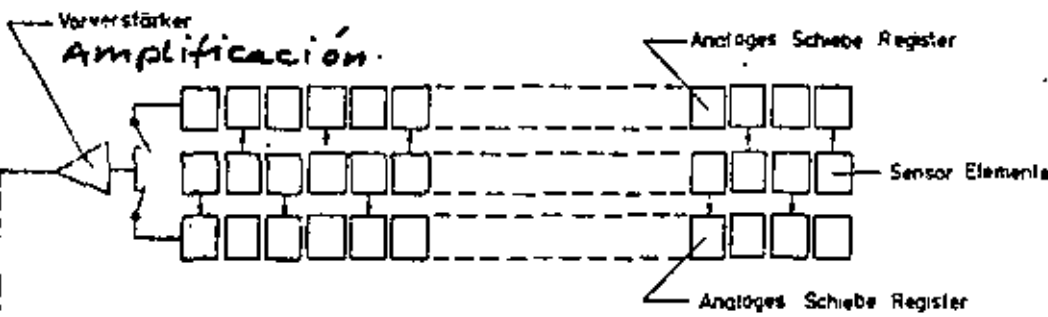
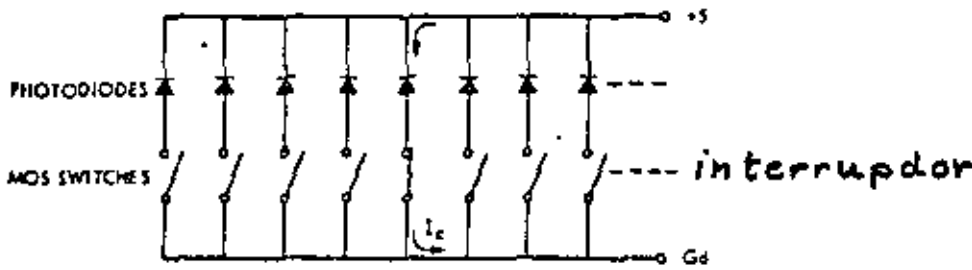
## Proyecto "SPOT" francés

A low-altitude, circular orbit has been selected which can provide coverage of the entire Earth in a repetitive 26-day cycle if needed. The pointable mirrors could make it possible to image a given area once every 2.5 days. A summary of the SPOT mission characteristics is as follows:

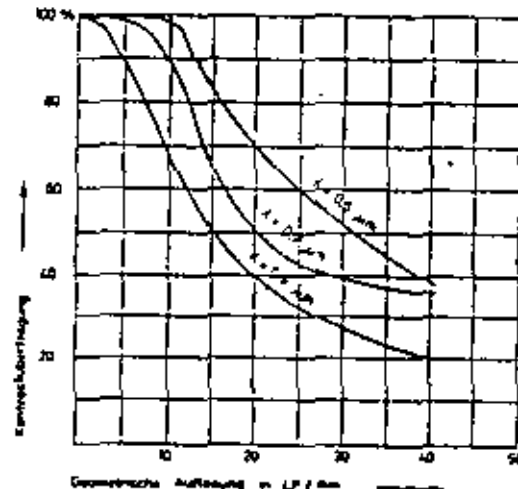
Orbit:	Near-polar, Sun-synchronous 822-km altitude 98.7° inclination Period of 101 minutes 10:30 a.m. descending node (equator)
Coverage cycle:	26 days
Swath width:	60 km
Resolution (IFOV):	10 m (panchromatic mode) 20 m (multispectral mode)
Sensors:	Two High Resolution Visible (HRV) instruments, focal length = 1082 mm, f/3.5
Bandwidths:	Panchromatic: 0.5-0.9 micrometers Multispectral: 0.50-0.59 micrometers 0.61-0.69 micrometers 0.79-0.90 micrometers
Image Products:	Landsat-compatible media



Scanning opto-electrónico



Spektrale Empfindlichkeit des CCD 131 Linear Sensors (Fairchild). **Sensibilidad**



Kontrastübertragungsfunktion des CCD 131 Linear Sensors (Fairchild). **MTF, ver paragr. 2.1.3**

Fuente:  
Hofmann, O.  
(H33)

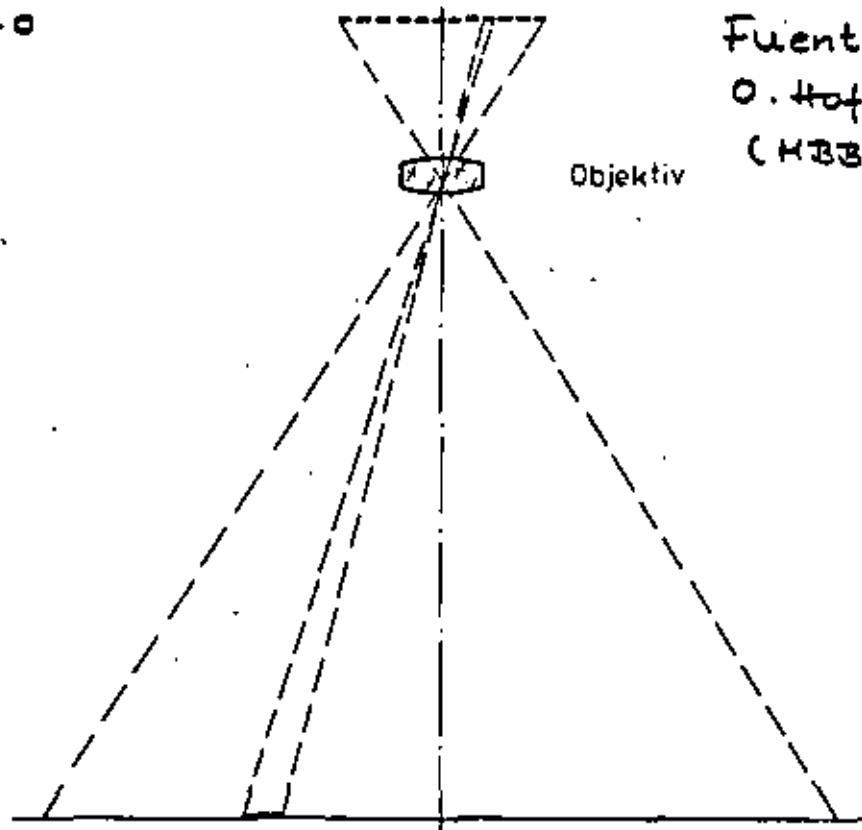
- Zahl der Bildpunkte (Pixel): 1728
- Pixel-Intervall:  $13 \mu m$
- Objektivtyp: Leitz ELMARIT-R. 1:2,8/f=24 mm
- Bildwinkel:  $50^\circ$
- Zeilenfrequenz: 80 Hz (fest eingestellt)
- v/h-Verhältnis: 1:23
- Grauton-Auflösung: 8 bit  $\approx$  256 Stufen
- Bitrate: 1,1 Mbit/s
- Spektralkanäle:  $0,45 \mu m - 1,0 \mu m$  (ohne Filter, gesamter Spektralbereich des Sensors)
  - $0,475 \mu m - 0,530 \mu m, \Delta \lambda = 0,045 \mu m$
  - $0,535 \mu m - 0,585 \mu m, \Delta \lambda = 0,050 \mu m$
  - $0,580 \mu m - 0,630 \mu m, \Delta \lambda = 0,050 \mu m$
  - $0,640 \mu m - 0,685 \mu m, \Delta \lambda = 0,045 \mu m$
  - $0,675 \mu m - 0,730 \mu m, \Delta \lambda = 0,055 \mu m$
  - $0,75 \mu m - 1,0 \mu m, \Delta \lambda = 0,25 \mu m$

instrumento  
H33

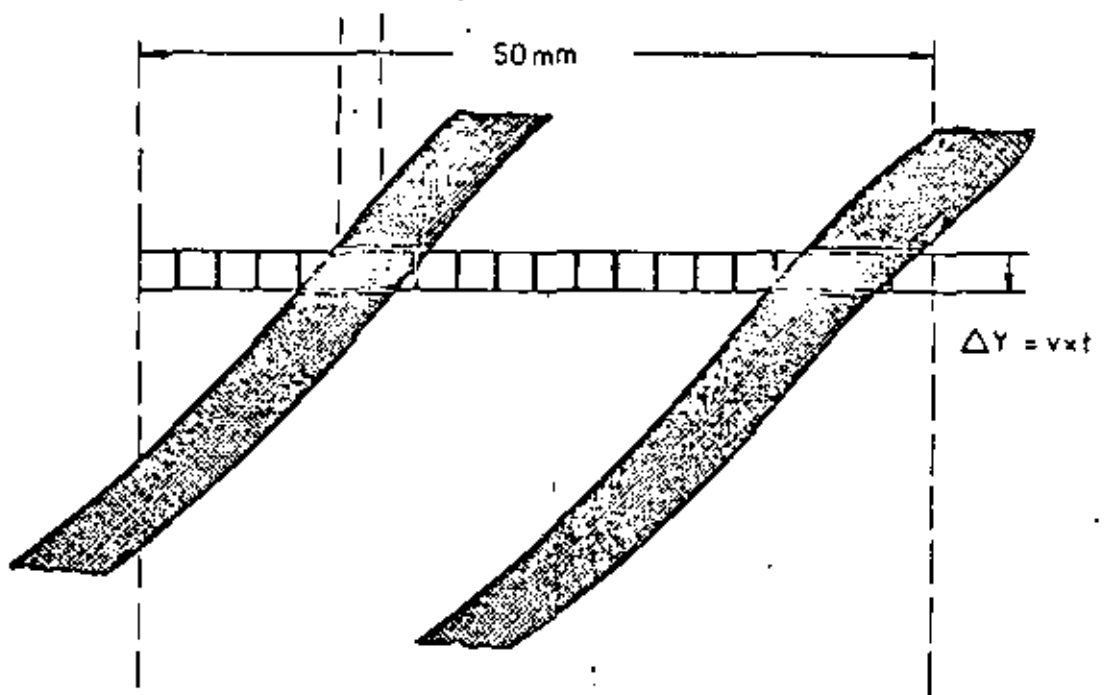
Scanning  
opto - electrónico

Fuente:  
O. Hofmann  
(HBB)

Aufriß



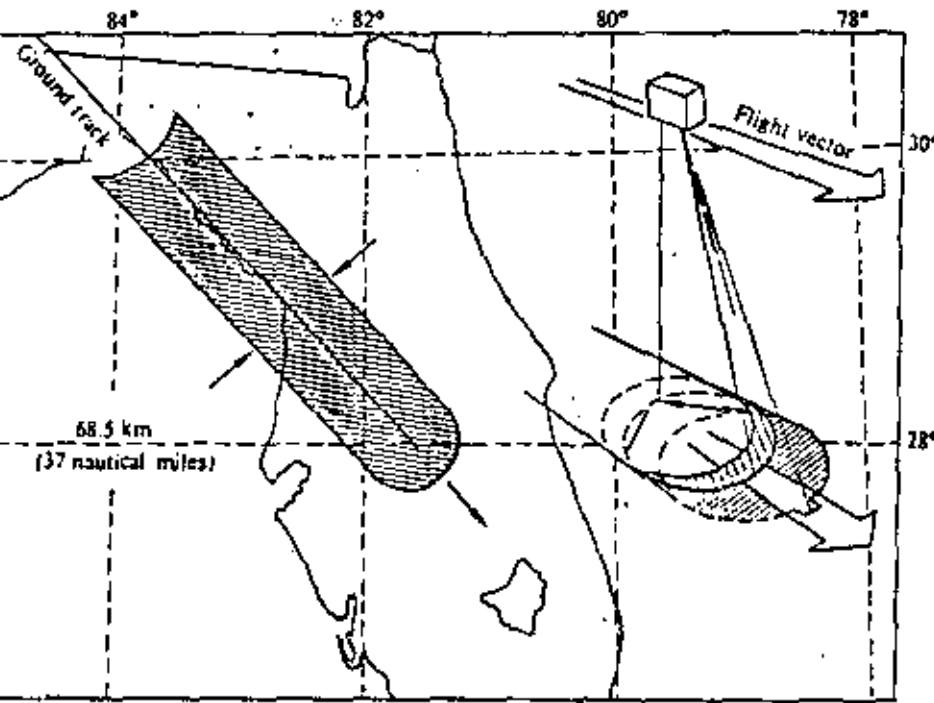
Grundriß



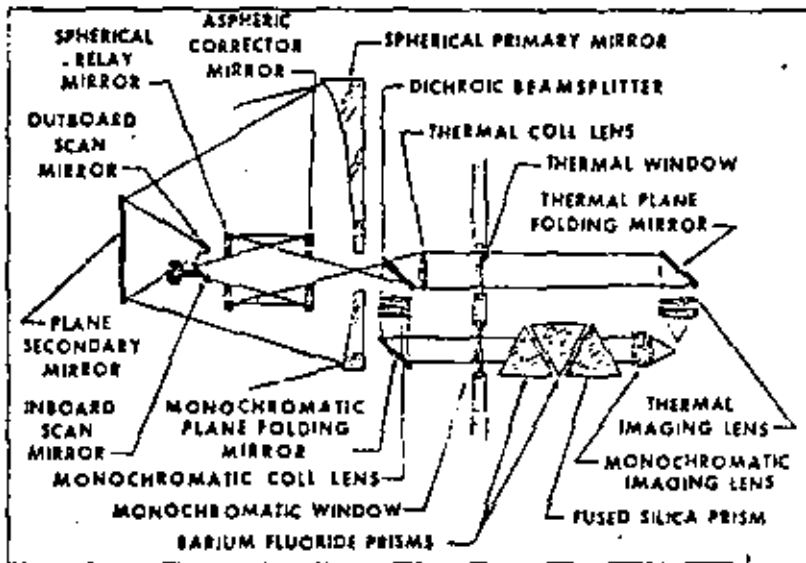
mechanische Abtastbewegung  
in Streifen - Richtung Y

Movimiento en la  
dirección Y, mecánica-  
mente

Abtast - Prinzip



Skylab S-192  
Scanner conico



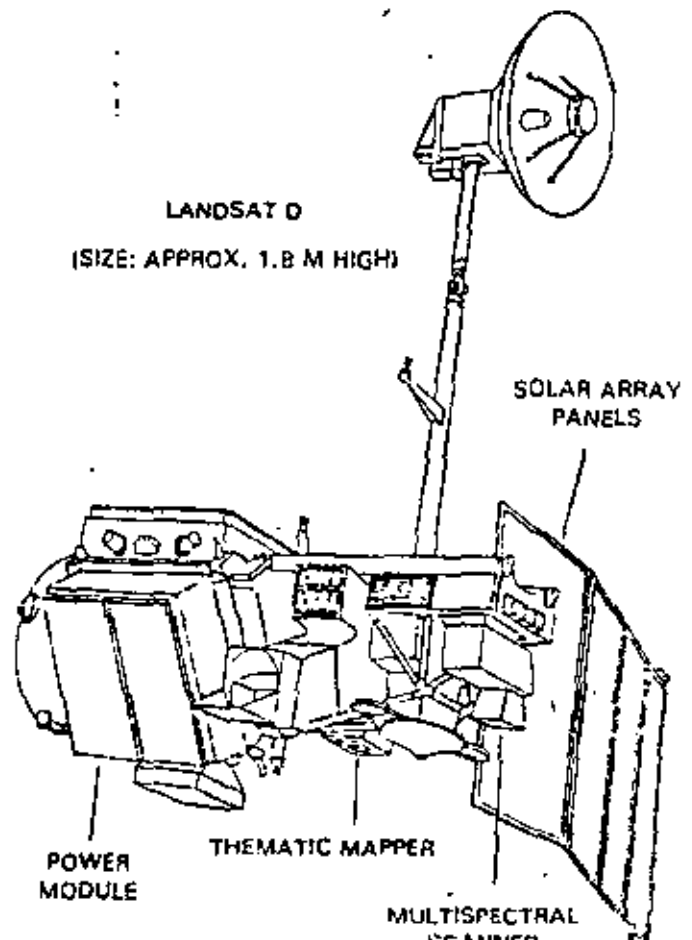
Band number	Coverage, $\mu\text{m}$
1	0.41-0.46
2	0.46-0.51
3	0.52-0.56
4	0.56-0.61
5	0.62-0.67
6	0.68-0.76
7	0.78-0.88
8	0.98-1.08
9	1.09-1.19
10	1.20-1.30
11	1.55-1.75
12	2.10-2.35
13	10.20-12.50

### LANDSAT - D

#### SPECTRAL COVERAGE OF THEMATIC MAPPER

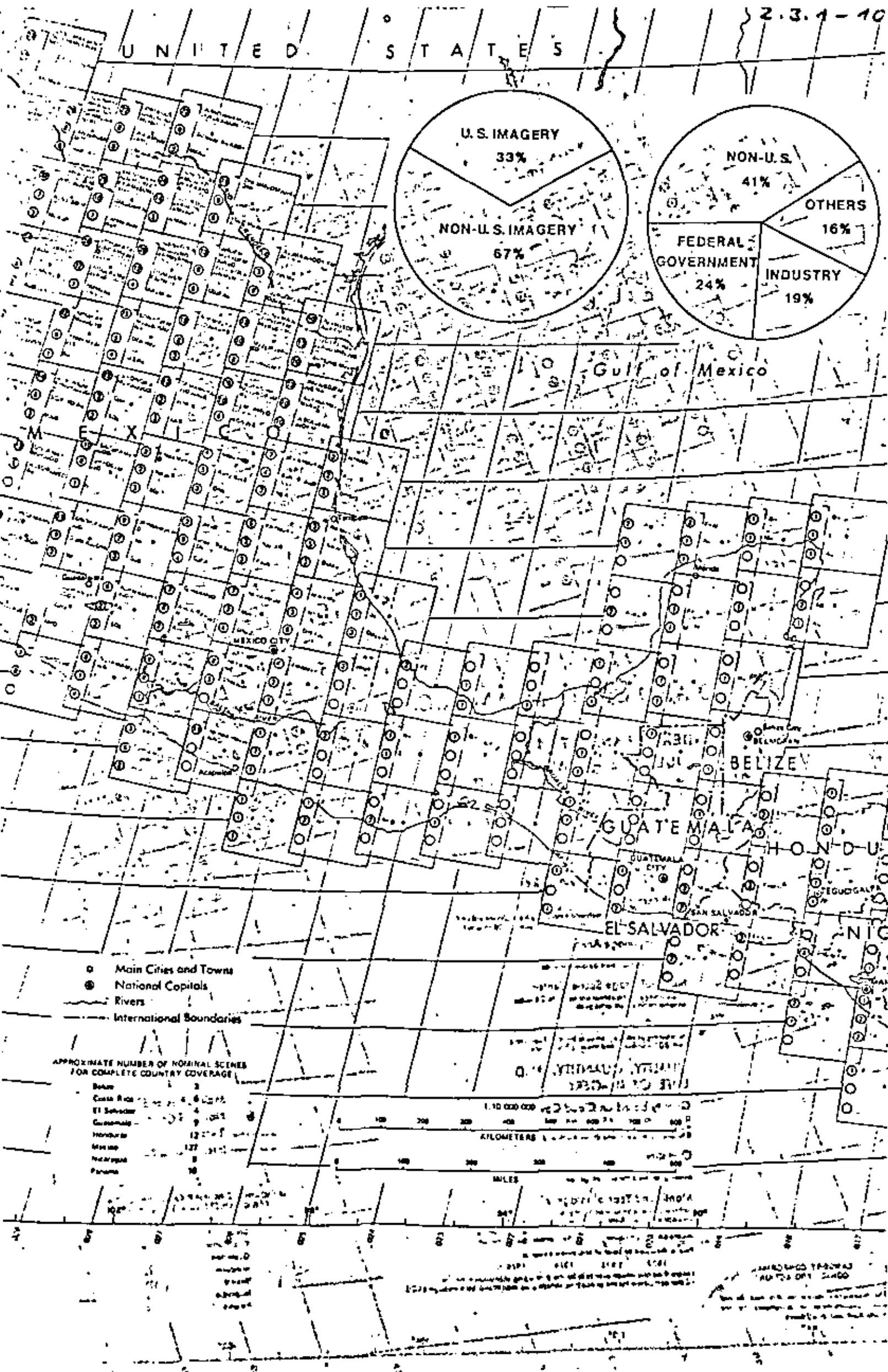
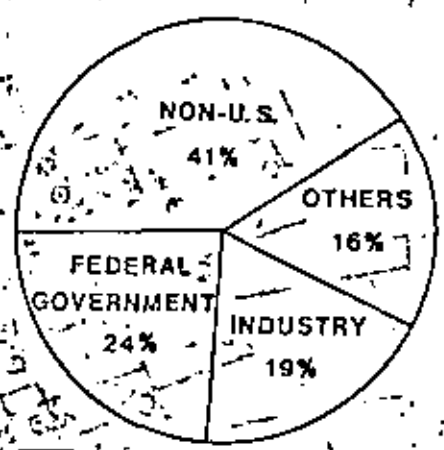
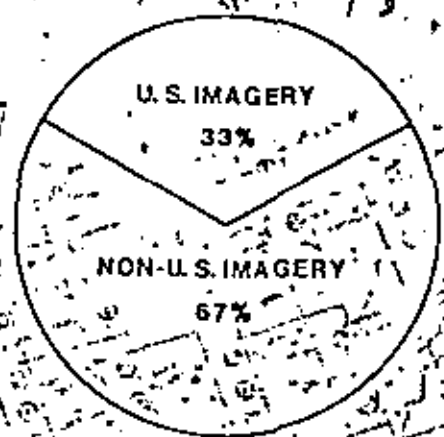
BAND	MICROMETERS
1	0.46 - 0.52
2	0.52 - 0.60
3	0.63 - 0.69
4	0.76 - 0.90
5	1.55 - 1.75
6	10.4 - 12.5
7	2.08 - 2.35

LANDSAT D  
(SIZE: APPROX. 1.8 M HIGH)





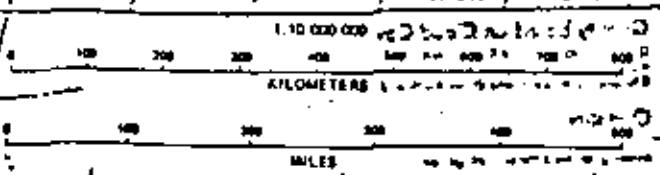
# UNITED STATES



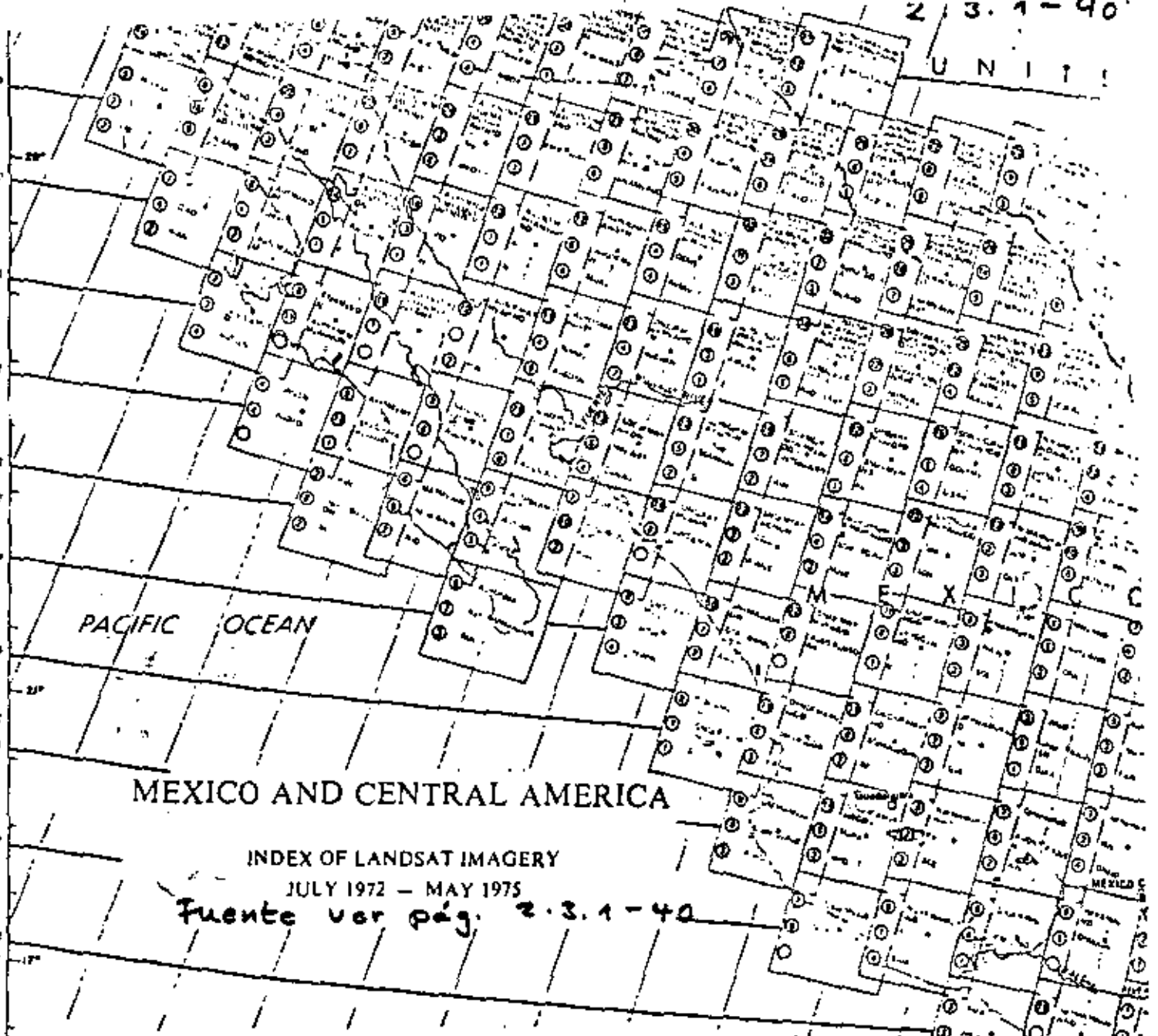
- Main Cities and Towns
- National Capitals
- Rivers
- - - International Boundaries

**APPROXIMATE NUMBER OF NOMINAL SCENES FOR COMPLETE COUNTRY COVERAGE**

Belize	3
Costa Rica	6
El Salvador	4
Guatemala	9
Honduras	12
Nicaragua	17
Panama	8



1:10,000,000 scale. This map is a reproduction of a map of the United States and is not to be used for navigation. It is intended for general reference only. The map is not to be used for navigation. It is intended for general reference only.



# MEXICO AND CENTRAL AMERICA

INDEX OF LANDSAT IMAGERY  
JULY 1972 - MAY 1975

*Fuente ver pag. 2.3.1-40*

## LOCATION OF IMAGERY

**Path (orbit)**  
Numbering of Path is westward beginning from Greenland and the Atlantic Ocean (this index covers only paths 008 - 041)

**Nominal Image Area**  
Actual areas of coverage can vary along with path dependent upon scene center. Image indices indicated by dashed lines

**Nominal Image Scene Center**  
Actual image scene center varies up to 25 miles depending on different orbit path

**Image Row**  
Numbering of image rows is by year, beginning from 80°N latitude and moving southward

## QUALITY, QUANTITY, AND DATE OF IMAGERY

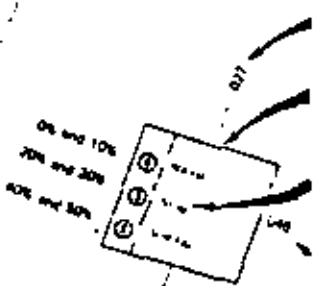
**Quality based on Cloud Cover**  
Only imagery of 0% to 50% cloud cover is indexed and classified in these categories:  
0% and 10% 20% and 30% 40% and 50%

**Quantity**  
The figures in circles (1) indicate number of images existing for the different categories

**Month and Year of Imagery**  
Abbreviations refer to months of year:  
1 - January 4 - April 7 - July 10 - October  
2 - February 5 - May 8 - August 11 - November  
3 - March 6 - June 9 - September 12 - December

Year is indicated by color of abbreviated month:  
1972 1973 1974 1975

\* More than one image available for the first and last abbreviated months  
\* Color Composite for the first and last abbreviated months available through (EOS)



- Main Cities and Towns
- ⊙ National Capitals
- Rivers
- International Boundaries

## APPROXIMATE NUMBER OF NOMINAL SCENES FOR COMPLETE COUNTRY COVERAGE

Belize	3
Costa Rica	6
El Salvador	4
Guatemala	8
Honduras	12
Nicaragua	127
Panama	6
Puerto Rico	10

LANBERT CONFORMAL CONIC PROJECTION

The information shown on this map does not constitute an endorsement or approval by the U.S. Government and its agencies.

118° 110° 102° 94° 86° 78° 70° 62° 54° 46° 38° 30° 22° 14° 6°

# LANDSAT

## Descripción de información suplementaria

a		b		c		d		e		f		g		h		i	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
12345678	9012345678901234	567890123456789012	345678901234	56789012345678	90123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789
07JUN72	C 013-05/1115-18	H 013-06/1115-20	RBV 1	RAA1	SUN EL30 AZ015	194-1234-A	1-N-P-	NASA ERTS	E-1042-16032-10								

← ①  
← ②  
← EXAMPLE

NOTES: ① THE LETTERS "a" THROUGH "i" REFER TO PARAGRAPHS IN THIS DOCUMENT THAT EXPLAIN THE ANNOTATION BLOCK.  
② CHARACTER "POSITION" IN THE ANNOTATION BLOCK.

a		b		c		d		e		f		g		h		i	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
12345678	9012345678901234	567890123456789012	345678901234	56789012345678	90123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789	0123456789
07JUN72	C 013-05/1115-18	H 013-06/1115-20	MSS 4	MSS 5	MSS 6	MSS 7	MSS 8	SUN EL30 AZ015	194-1234-A	1-N-P-18	NASA ERTS	E-1042-16032-10					

← ②  
← EXAMPLE

for Positions 01-08, 07JUN72 month and year of picture is.

Character Positions 09-23, 05/W/15-18  
Center - Latitude and longitude at the center of the RBV and map format is indicated in 1 and minutes. The MSS format is identical to the RBV 1 Center. Format Center is 1 in the geographic extension of spacecraft yaw axis to the surface.

Character Positions 26-42, 05/W/5-20  
1 and longitude of the map projection with the earth's of a perpendicular line from spacecraft to the earth 0 is indicated in degrees and . The NASA Ellipsoid is the spheroid.

Character Positions 43-54, RBV 1  
Characters in this group are and spectral band specific: RBV images:

Sensor and NODF spectral band identification code. Note that the spectral identification code numbers are determined by the spectral region used to make a color composite transmission.

90 "D" indicates direct transmission (real time); "R" indicates stored data played back from the telemetry edge-band video loss recorder.

61-62 RBV Shutter Duration Code  
The "XA" means the shutter for Camera 1 was set for 4.0 milliseconds, Camera 2 for 4.8 ms, and Camera 3 for 6.4 ms.  
"XB" would indicate the shutter setting for Camera 1 is 4.8 ms, Camera 2 is 6.4 ms, and Camera 3 is 7.2 ms.

Alpha-numeric Code	Duration of Exposure Time		
	Camera 1	Camera 2	Camera 3
A	4.0	4.8	6.4
B	5.6	6.4	7.2
C	6.0	6.8	8.8
D	17.0	13.0	12.0
E	18.0	18.0	18.0

53-54 Aperture Correction Indicator  
1b - Aperture correction "in"  
0b - Aperture correction "out"  
b - blank

For MSS images  
43-51 The sensor and NODF spectral band identification code.

53 Type of transmission, direct or recorded.

Character Position 55-68, SUN EL30 AZ015  
Sun Angle - the sun elevation angle and sun azimuth angle measured clockwise from true North at the time of RBV exposure or midpoint of MSS frame is specified to the nearest degree.

Character Positions 69-78, 194-1234-A  
Spacecraft heading, orbit revolution number, and ground recording station.

The "194" is spacecraft heading to the nearest degree, measured clockwise from true North. It is the orbital path plus spacecraft yaw. Heading relative to an ellipse is always toward the ellipse revolution block.

The "1234" is a four digit orbit revolution. Rev "0001" starts with the first ascending node (south to north equator crossing) after launch.

The "A" indicates the ground recording station, C-Goldstone, A-Alaska, N-NITF.

Character positions 80-89 1-N-P-18  
The "1" means the image is full size.

The "N" means the image was processed using normal processing procedures. Abnormal processing will be indicated with "A".

The "P" means "predicted" orbit ephemeris data was used to compute image center; a "D" indicates "definitive" or best fit ephemeris was used. Normally the latter is used since it is more accurate.

The "1" indicates a linear mode; a "2" indicates a compressed mode of MSS signal processing prior to transmission from satellite to ground station.

(This applies to Bands 4, 5, and 6 only. See Appendix A.)

NOTE: Compressed mode will be decompressed during processing.

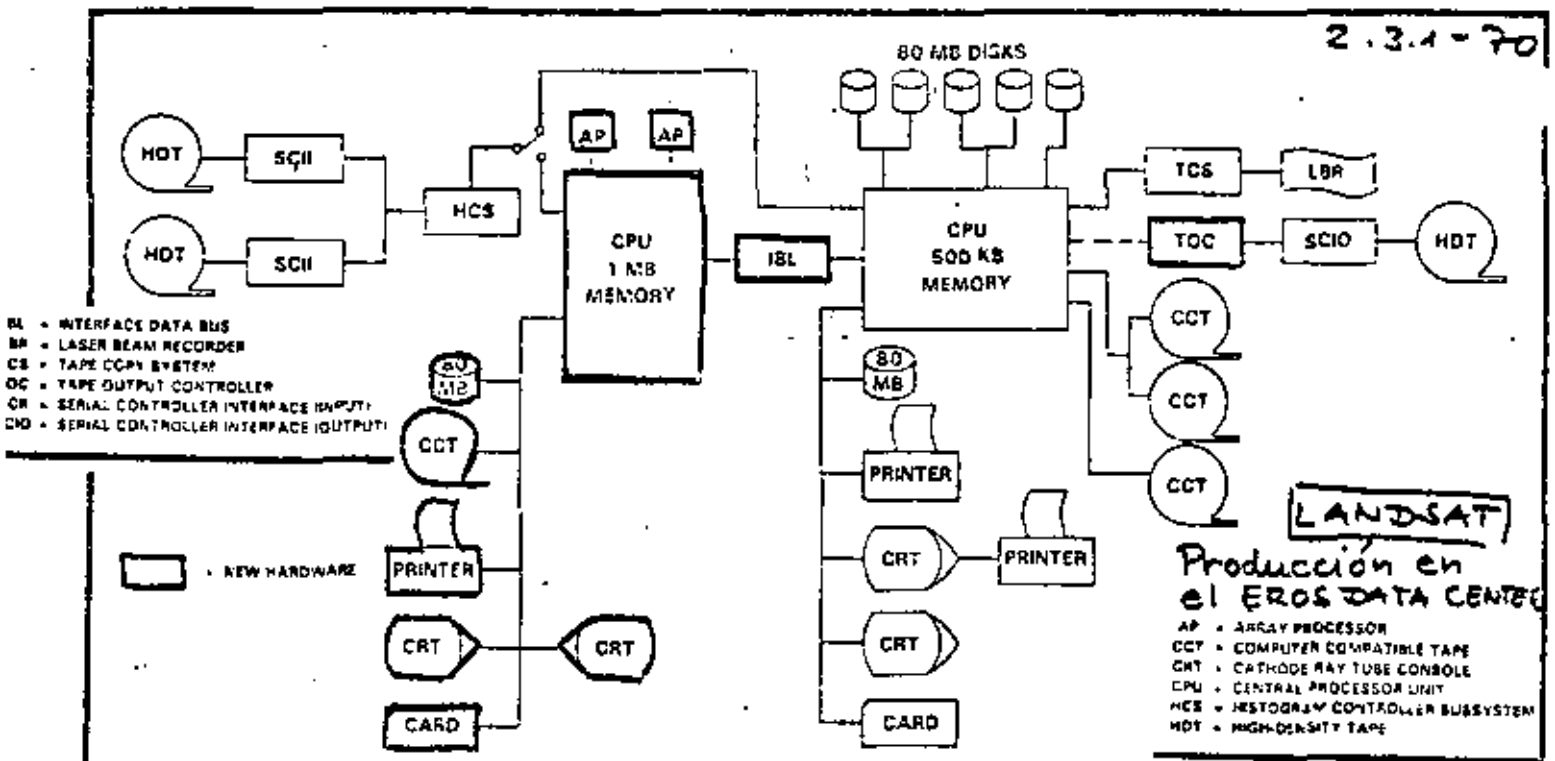
"H" is high gain, "L" is low gain for Bands 4 and 5 only, which have a commandable gain option.

Character positions 90-98 NASA ERTS  
Identifies the Agency and the Project.

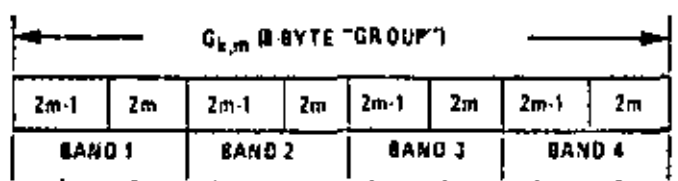
Character positions 99-114 E-1042-16032-10

Frame identification number - each image or frame will have a unique identifier which will contain encoded information consisting primarily of time of exposure relative to launch. Its format is E ADDD MMMS-BCRR and is interpreted as follows:

- E - Encoded Project Identifier
- A - ERTS Mission: 1-ERTS A, 2-ERTS B
- DDD - Day Number relative to launch at time of observation
- MM - Hour at time of observation
- MM - Minute at time of observation
- S - Tenths of seconds at time of observation
- B - NODF Identification Code (RBV: 1, 2, 3, MSS: 4, 5, 6, 7, 8)
- C - Blank for earth images either 0, 1, or 2 for RBV radiometric calibration images, indicating lowest to highest exposure level respectively.
- RR - Registration number. This is used to indicate the number of a video tape in the event of a malfunction in the original.

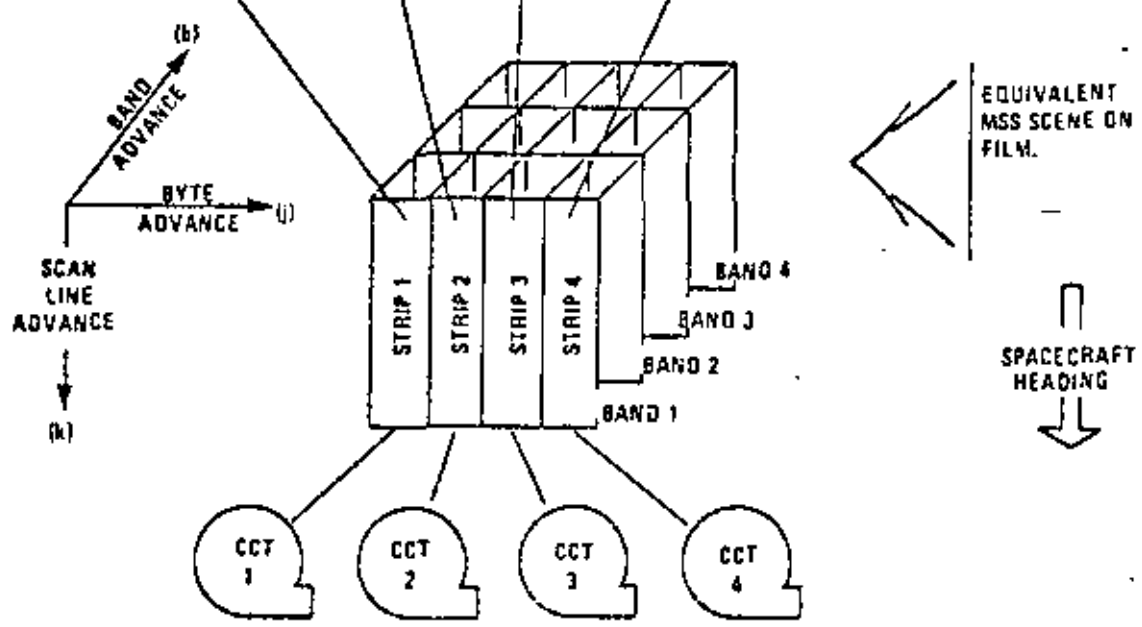
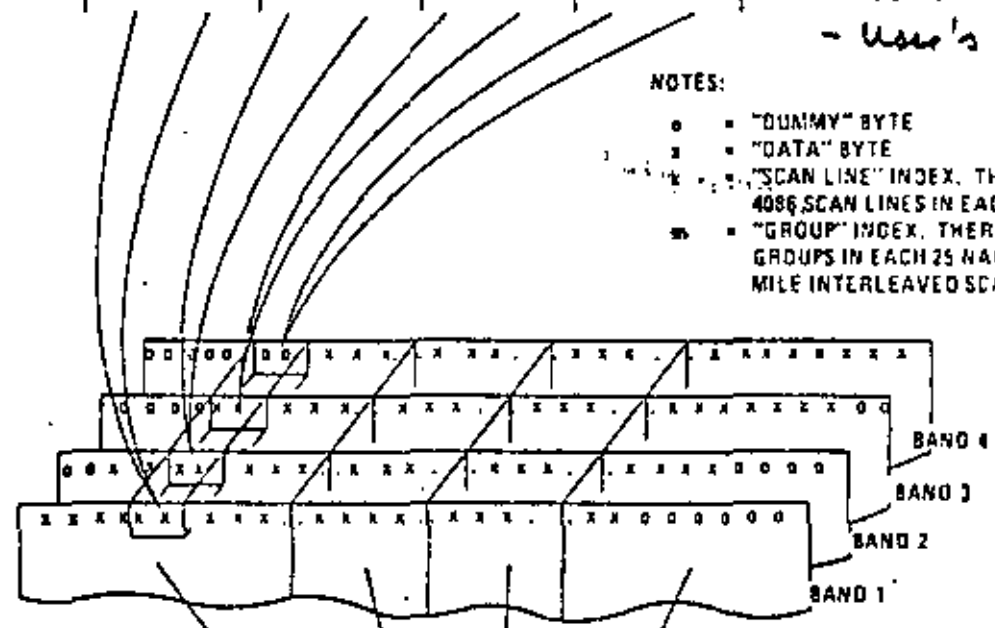


**LANDSAT**  
 Producción en el EROS DATA CENTER  
 AP - ARRAY PROCESSOR  
 CCT - COMPUTER COMPATIBLE TAPE  
 CRT - CATHODE RAY TUBE CONSOLE  
 CPU - CENTRAL PROCESSOR UNIT  
 HCS - HISTOGRAM CONTROLLER SUBSYSTEM  
 HDT - HIGH-DENSITY TAPE

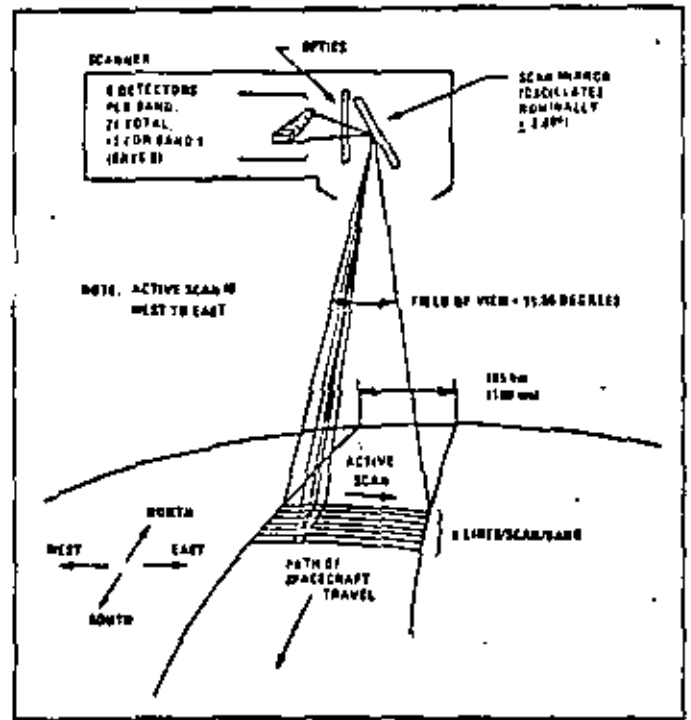
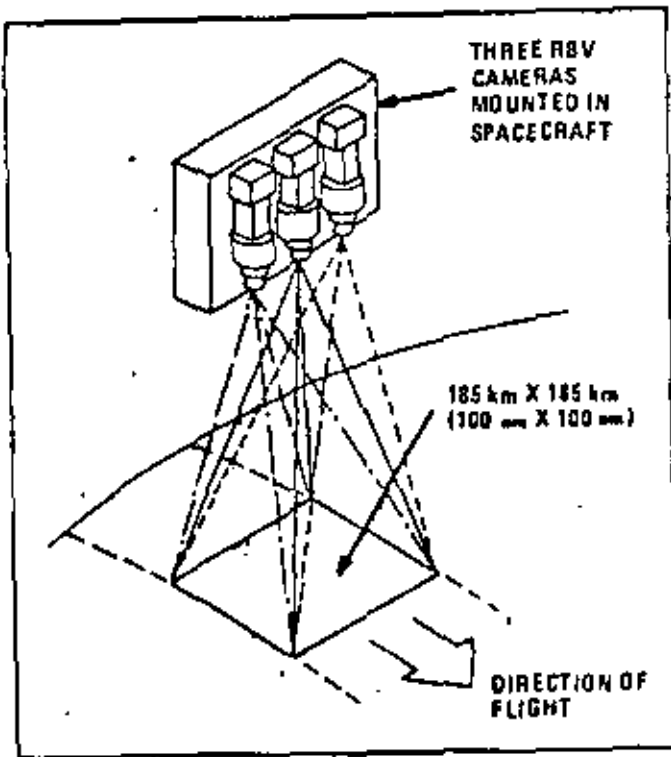


Configuración de los datos en las cintas magnéticas - User's Guide -

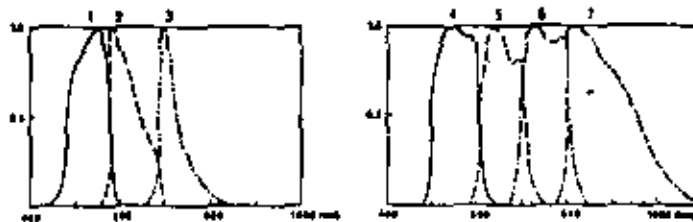
- NOTES:
- o = "DUMMY" BYTE
  - x = "DATA" BYTE
  - = "SCAN LINE" INDEX. THERE ARE 4096 SCAN LINES IN EACH STRIP
  - m = "GROUP" INDEX. THERE ARE 435 GROUPS IN EACH 25 NAUTICAL MILE INTERLEAVED SCAN LINE.



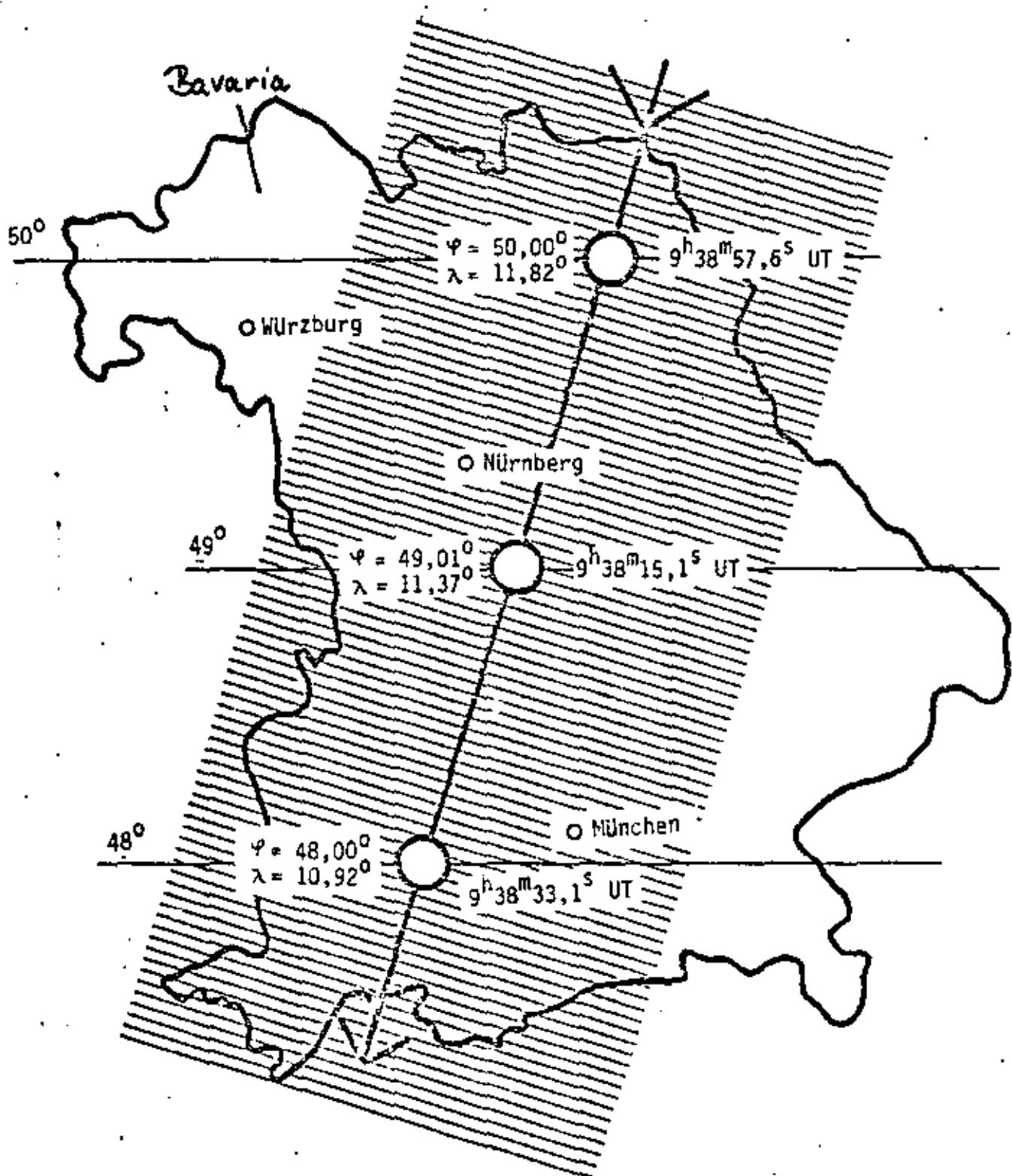
## Sistemas Landsat



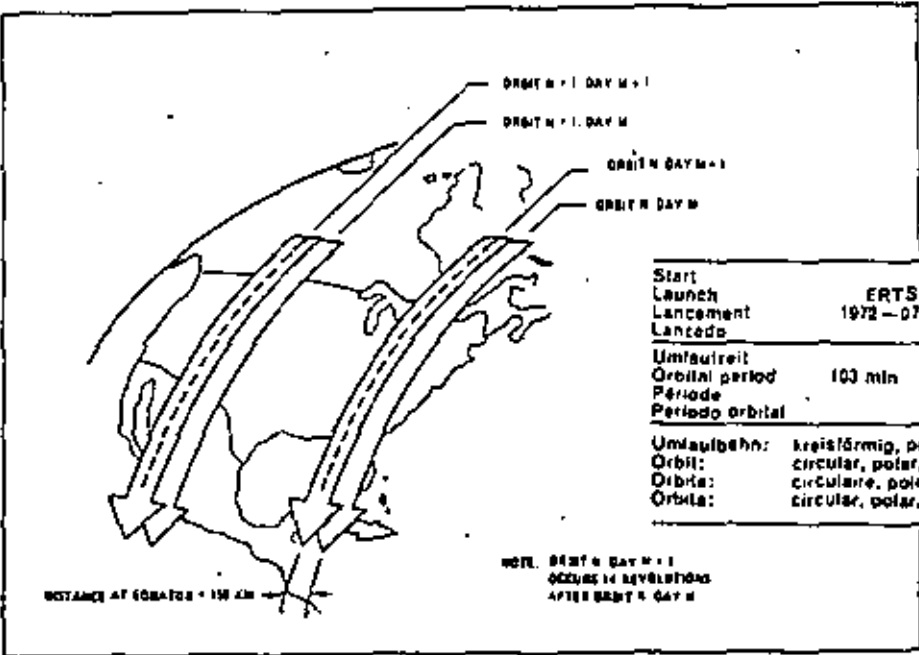
Relative spektrale Empfindlichkeit der Sensoren  
Relative spectral response of the sensors  
Sensibilité spectrale relative des capteurs-détecteurs  
Sensibilidad espectral relativa de los sensores



Return Beam Vidicon (RBV)	Multispectral Scanner (MSS)
Bildformat Image size Format d'image Tamaño de la imagen	Gesamtöffnungswinkel Field of view Angle de champ global Angulo total de abertura
Brennweite Focal length Distance focale Distancia focal	Geometrische Auflösung Geometric resolution Définition géométrique Resolución geométrica
Geländedeckung Ground coverage Aire couverte Terreno cubierto	Geländedeckung Ground coverage Aire couverte Terreno cubierto
2.54 x 2.54 cm	11.3°
126 mm	6.1 mrad
185 x 185 km 113 x 113 miles	185 x 185 km 113 x 113 miles



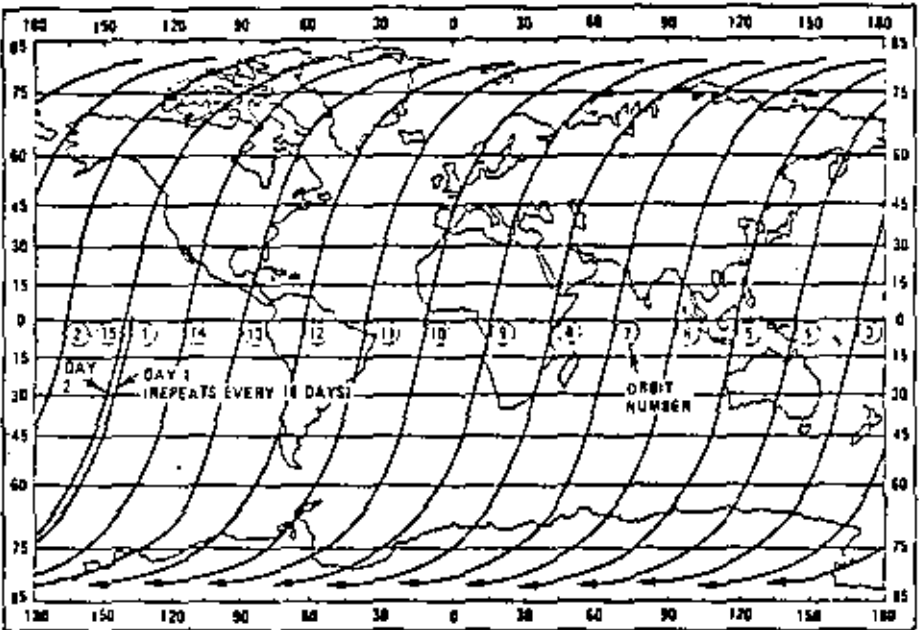
Cálculo de precisión  
de la órbita (ver 2.1.4)



Start Launch Lancement Lancédo	ERTS-1 1972-07-23	Flughöhe Altitude Altura	920 km 570 miles
Umlaufzeit Orbital period Período orbital	103 min	Wiederholungszklus Repetition cycle Cycle de répétition Ciclo de repetición	18 days jours días
Umlaufbahn: Orbit: Órbita: Órbita:	kreisförmig, polar, sonnensynchron circular, polar, sunsynchronous circulaire, polaire, synchrone du soleil circular, polar, sincrona con el sol		

Source: NASA

Typical Landsat Ground Trace for One Day (Only Southbound Passes Shown)



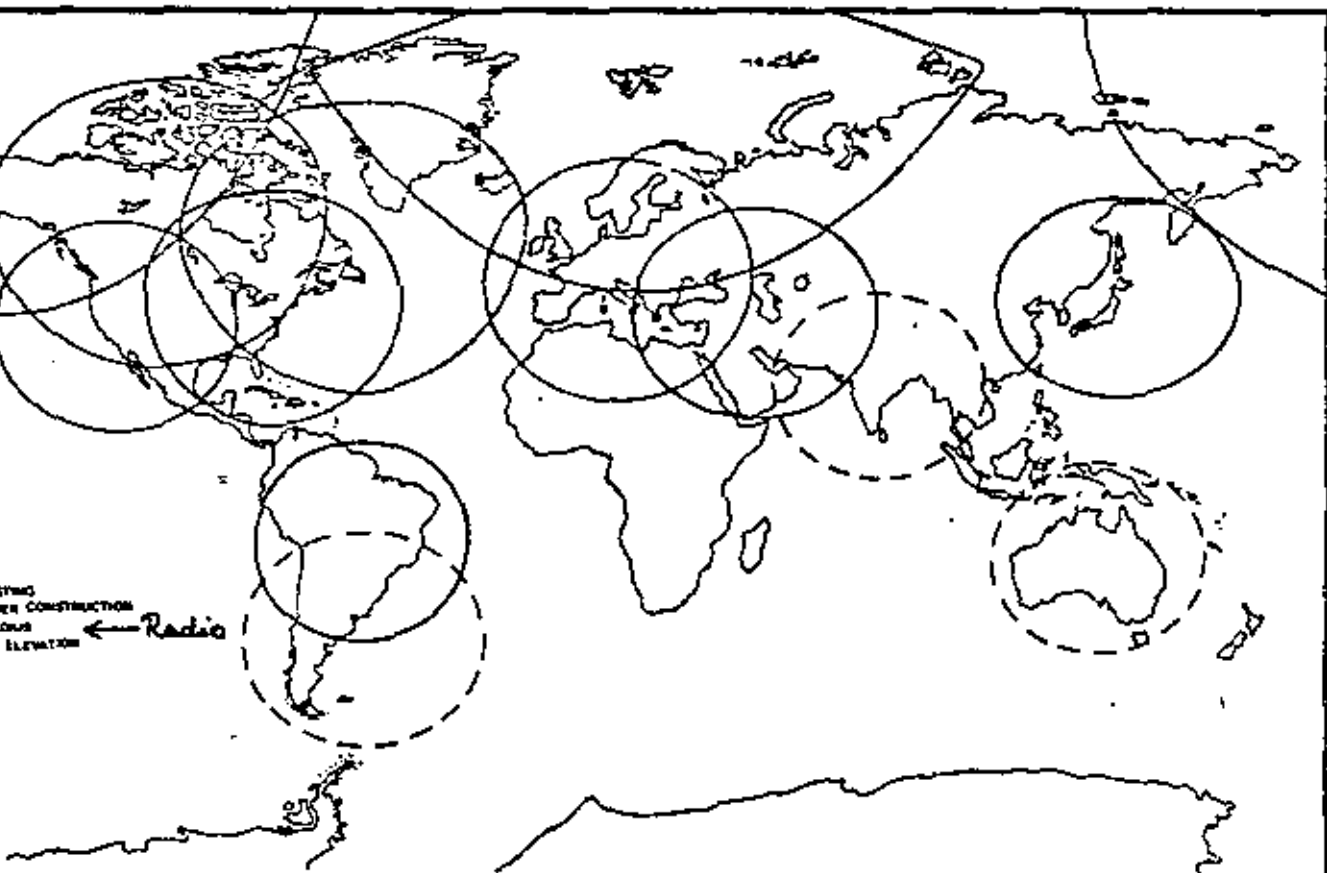
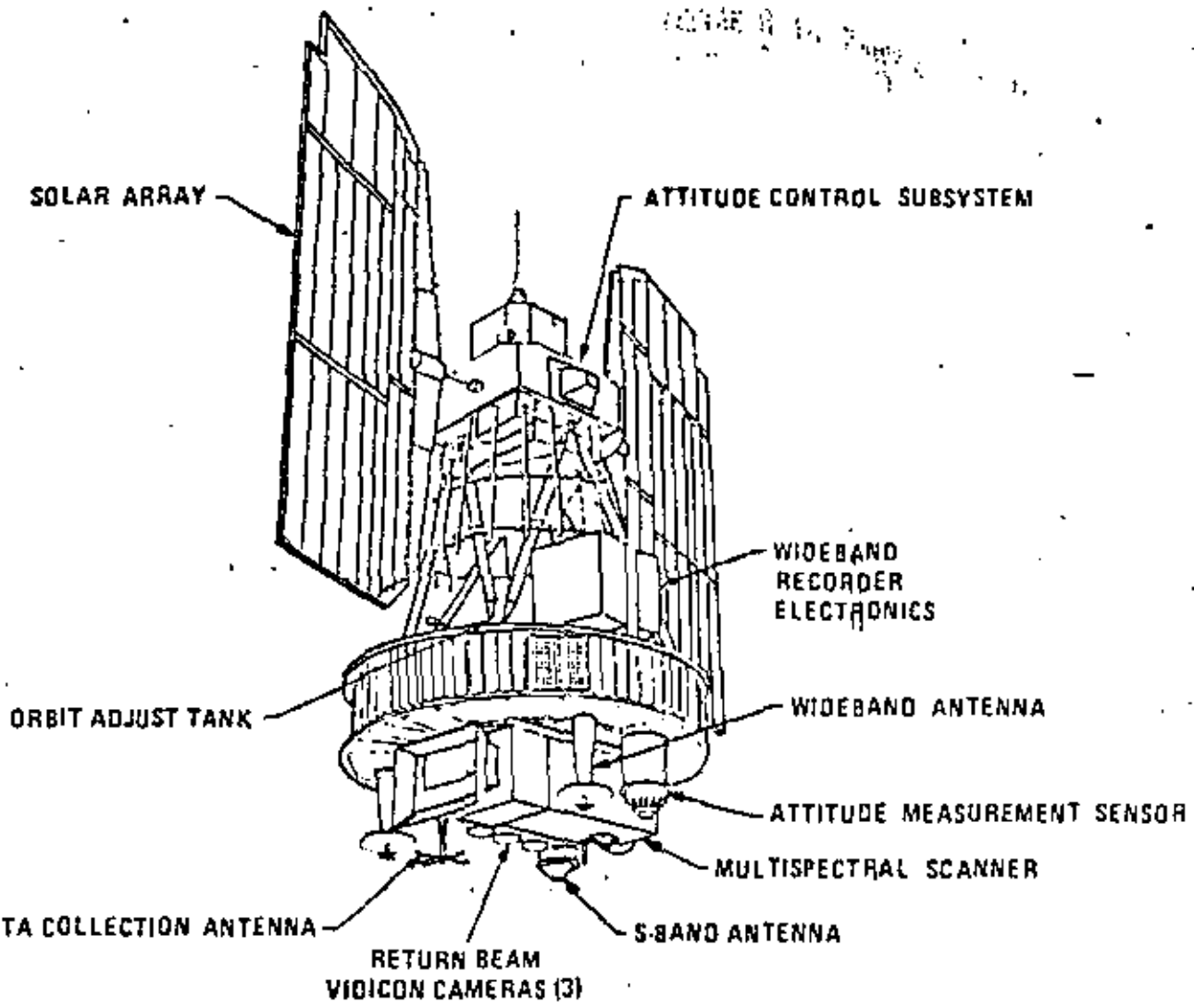
Source: NASA

Sidelap of Adjacent Landsat Coverage Swaths

Latitude (degrees)	Image sidelap (percent)
0	14.0
10	15.4
20	19.1
30	25.6
40	34.1
50	44.3
60	57.0
70	70.6
80	85.0

fuentes: Landsat Atlas of Developing countries, World Bank, Wash. DC.

# Sistema Landsat



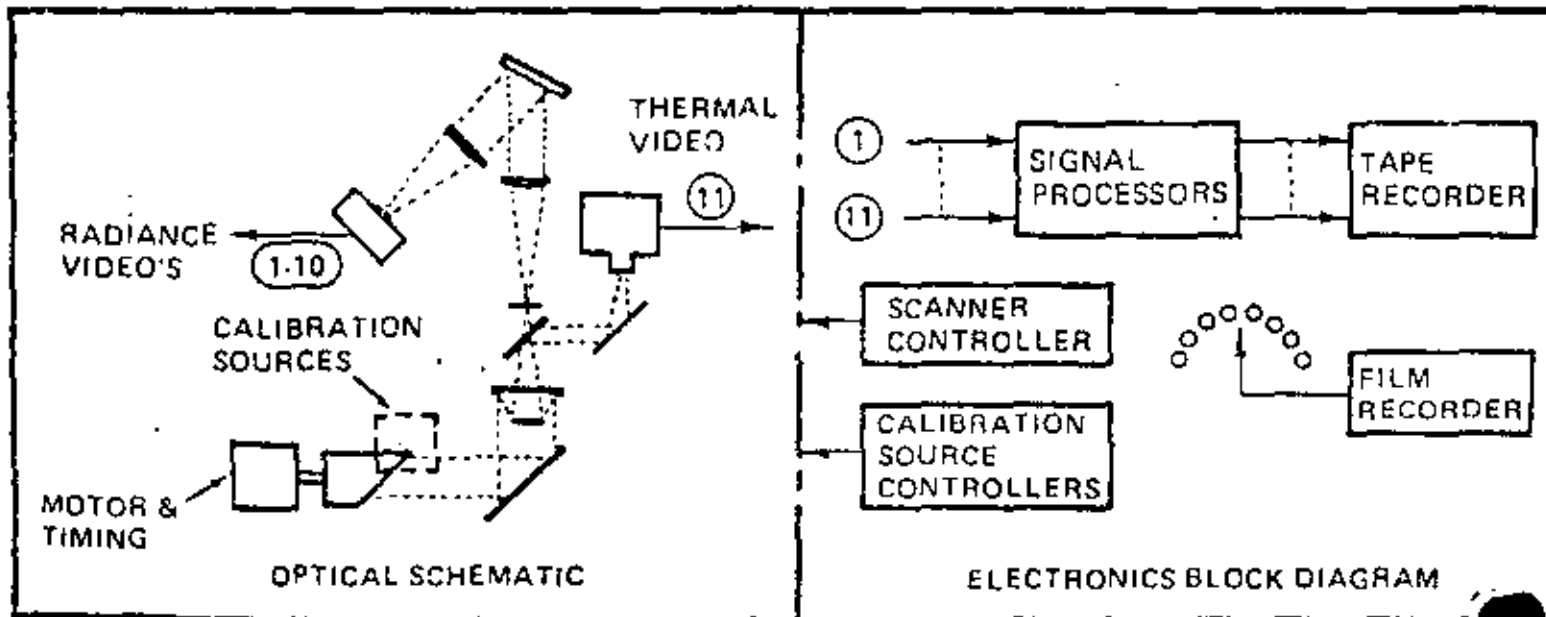




Sistemas scanner (avión)

Hersteller/Typ Manufactur./model Fabricant./modelo Fabricante/modelo	Bendix M <sup>2</sup> S	Dacalux DS - 1220	Dacalux DS - 1200	Singer Reconales XVI	Tesac Inst. RS - 310
Gesamtöffn.-Winkel/Rollstabilität Field of view-roll stabilization Angle de champ global/ stabilisation transversale Angulo total de abertura/ estabilización transversal	100°	77°20'	77°20'	120°	90°
Öffn.-Winkel d. Abtastoptik Instant. field of view Angle de champ de l'optique de balayage Angulo de abertura de la óptica de exploración	±10°	±10°	±10°	±10°	±10°
Abtastfrequenz Scan rate Fréquence de balayage Frecuencia de exploración	10-100 [scans/sec]	80	80	100	200
$\frac{y}{h_0} \rightarrow$ Seite 2.4.2 Page Página - 200	±0.25 -0.25 [mrad/sec]	0.2	0.2	0.3	0.03 -0.2
Kanäle Channels	11	11	2	1	7
Detektoren Detectors DéTECTEURS Detectores	10-Channel Spectrometer 0.4-1.1 $\mu$ m +1   +1 auswählbar Interchangeable Interchangeable				
Auflösung für IR-Detektoren Resolution of IR-detectors Définition pour détecteurs IR Resolución de detectores IR		0.2	0.2	0.1	0.2
Referenzstrahler Reference sources Sources de référence Fuentes de referencia	Sky 1 Vis. 2 IR	1 Vis. 2 IR	2 IR	2 IR	-
Datenaufzeichnung Recording Enregistrement des signaux Registro de datos	Magnetband Magnetic tape digit.	Bande magn. Cinta magn. anal.	Bande magn. Cinta magn. anal.	Bande magn. Cinta magn. anal.	Film 70 mm

↙ Bendix M<sup>2</sup>S

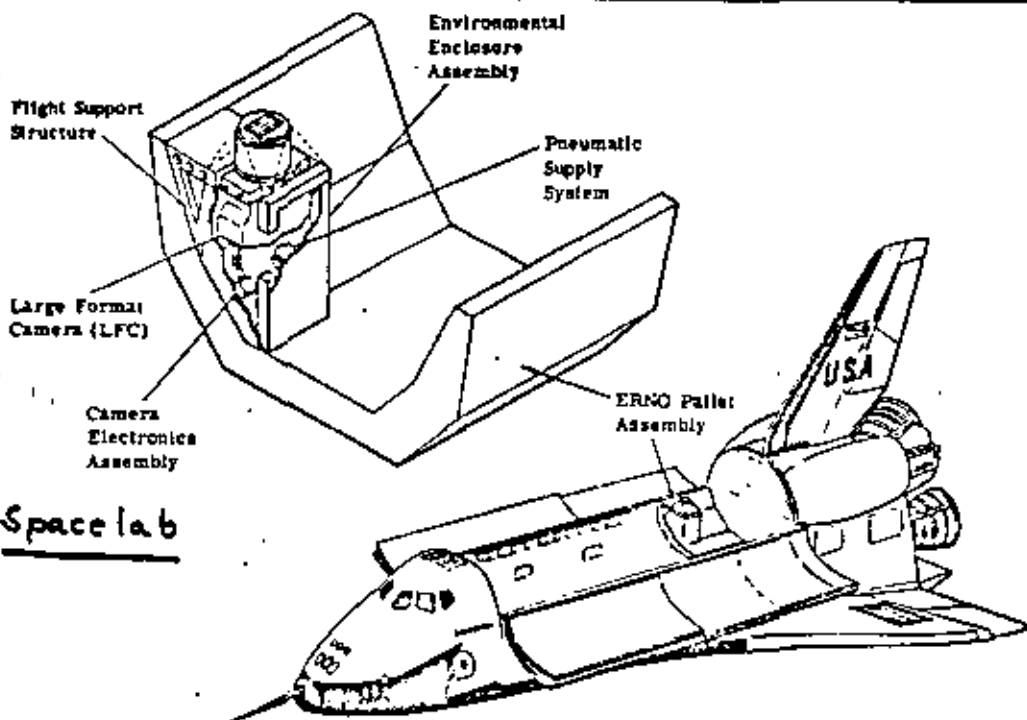


3100 MODULE BAND DESCRIPTION

Band No.	$\lambda_c (\mu m)$	$\Delta\lambda (\mu m)$	$NE\Delta\rho (\%)$	Band	$\lambda_c (\mu m)$	$\Delta\lambda (\mu m)$	$NE\Delta\rho$
1	0.410	0.06	3.0	6	0.640	0.04	0.3
2	0.465	0.05	1.0	7	0.680	0.04	0.3
3	0.515	0.04	0.5	8	0.720	0.04	0.3
4	0.560	0.04	0.5	9	0.810	0.10	0.5
5	0.600	0.04	0.3	10	1.015	0.09	1.0
11	NE $\Delta T$ for the thermal band depends on detector-filter (bandpass)-telescope options selected varies from 0.3°C — 0.5°C.						

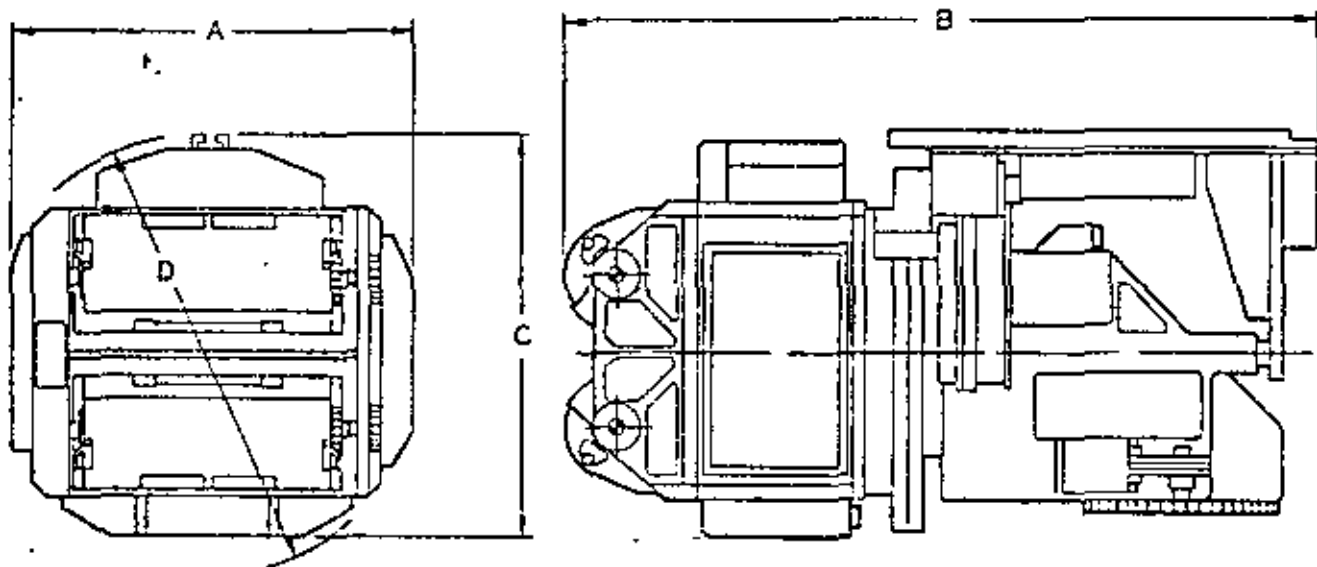
DATEN DER **LFC** - KAMERA (NASA)  
Large frame camera

Objektiv	Brennweite 305 mm Öffnung f / 6 Spektralbereich 400 bis 900 nm max. Verzeichnung $10 \mu\text{m}$ Auflösung 80 l/mm bei 2:1
Bildformat Tamaño	228 x 457 mm <sup>2</sup>
Gesichtsfeld ángulos	73,7° x 41,1°
Überlapp-Moden <sup>*</sup>	80% ; 70% ; 60% ; 10%
B / H - Werte <sup>*</sup>	
	278 km
Verschlußöffnungszeiten	3 ms bis 24 ms
compensación del movem. Bewegungskompensation	0,01 bis 0,045 rad/s
secuencia de los fotos minimale Bildfolgezeit	7 s
Film película	Länge 1200 m Breite 24 / mm Aufnahmen 2400
Leistungsaufnahme energía	260 W im Mittel 500 W maximal
Gewicht mit Stützstruktur peso	452 kg
Abmessungen dimensiones	1270 x 660,4 x 863,6 mm <sup>3</sup>



Fuente:  
Doyle, F.  
Phot. Eng. '79

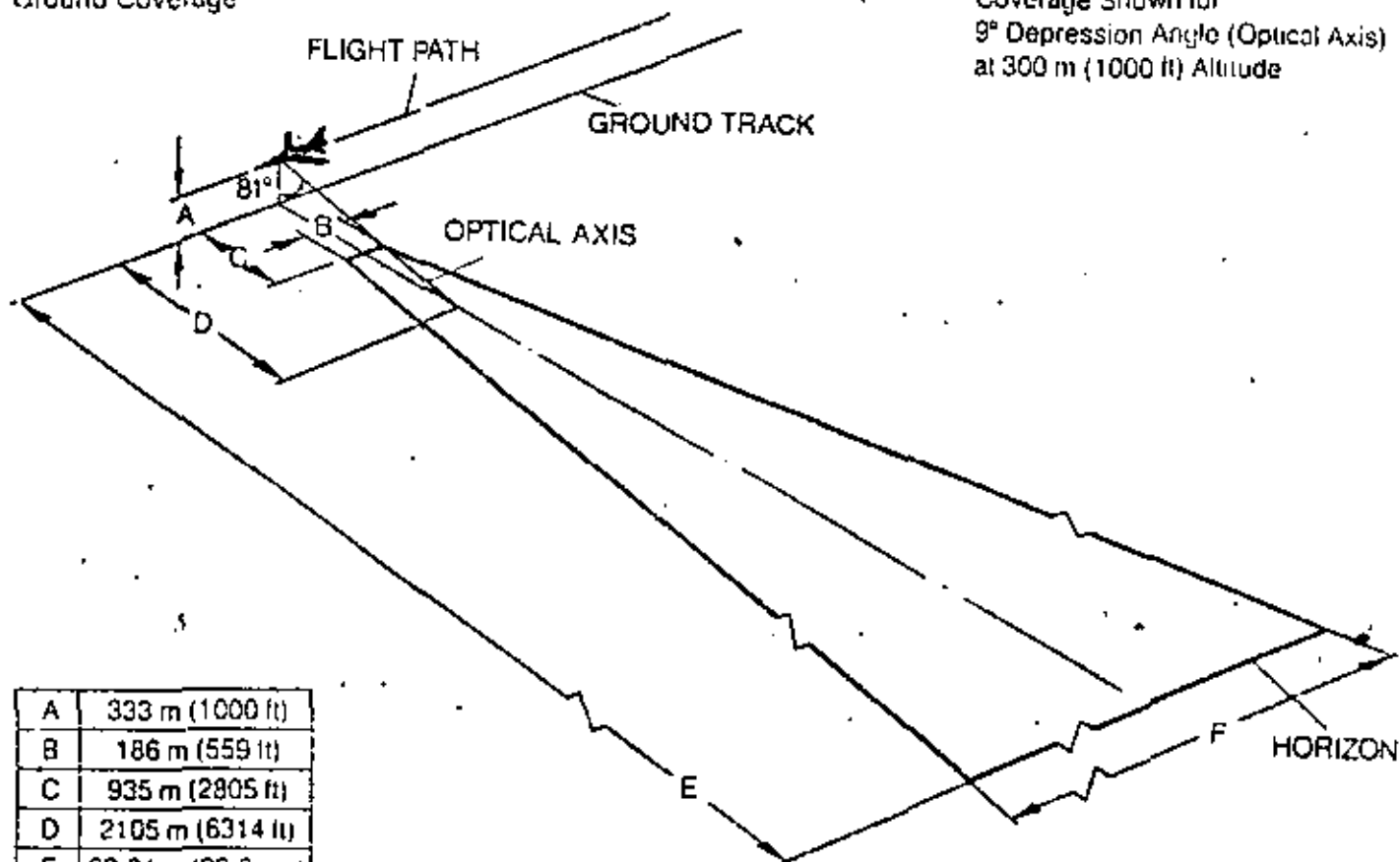
Space lab



		A	B	C	D
	Millimeters	450	836	451	490
	Inches	17.71	32.9	17.75	19.29
Small Cassettes	Millimeters	450	788	451	490
	Inches	17.71	31	17.75	19.29

Ground Coverage

Coverage Shown for  
9° Depression Angle (Optical Axis)  
at 300 m (1000 ft) Altitude



A	333 m (1000 ft)
B	186 m (559 ft)
C	935 m (2905 ft)
D	2105 m (6314 ft)
E	62.6 km (33.8 nm)
F	11.7 km (6.34 nm)

# TRb 60/24

(US-Designation KA-108A)

2.3.1-



## Specifications

<b>Mission Capability:</b>	Low altitude oblique; medium to high altitude vertical reconnaissance	
<b>Camera Type:</b>	Pulse operated framing	
<b>Angular Coverage:</b>	21.4° across track, 10.7° along track per frame	
<b>Lens Type:</b>	Zeiss TELIKON A1 4/610	
<b>Focal Length:</b>	610 mm (24.0 inches)	
<b>Aperture Range:</b>	f/4 to f/16, continuously variable	
<b>Resolution:</b>	75 lp/mm, EK 3412 film	
<b>Range Focus:</b>	In-flight variable 300 m (1000 ft) to infinity	
<b>Focus Compensation:</b>	Automatic pressure (sea level to 16,700 m (50,000 ft)) and temperature (25° C to 45° C)	
<b>Film Type:</b>	240 mm (9.5 inch) roll film any aerial type	
<b>Aerial Film Speed:</b>	AFS 8-640 variable in steps of (1) one	
<b>Film Capacity:</b>	<u>Large Cassette</u>	<u>Small Cassette</u>
2.5-mil Film	184 m (604 ft)	74 m (242 ft)
4.0-mil Film	127 m (417 ft)	51 m (167 ft)
<b>Image Dimensions:</b>	230 mm (9.0 inches) across track, 115 mm (4.5 inches) along track	
<b>Forward Motion Compensation (C):</b>	Moving film, 1300 mm per second max., true-angle corrected across entire format at any depression angle	
<b>Cycling Rate:</b>	Pulse controlled up to 4 frames per second	
<b>Shutter Speeds:</b>	1/150 to 1/2000 second	
<b>Exposure Control:</b>	Shutter priority automatic aperture and shutter setting; accuracy ± 1/2 f-stop	
<b>Standard Filters:</b>	Yellow (Zeiss B) and orange (Zeiss D); other filters available	
<b>Data Annotation:</b>	Accommodates data annotation head; provides synchronized data demand signal	
<b>Weight without film:</b>	185 lb (84 kg) without rotating mechanism	
<b>Power:</b>	115 VAC, 400 Hz, 3 Ø, 1000 VA	
<b>Design Criteria:</b>	MIL-E-5400 Class 1	
<b>Qualification:</b>	MIL-STD-810 and MIL-STD-461/462	

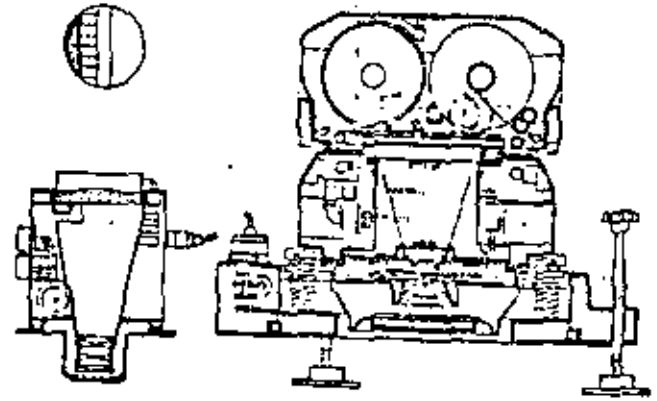
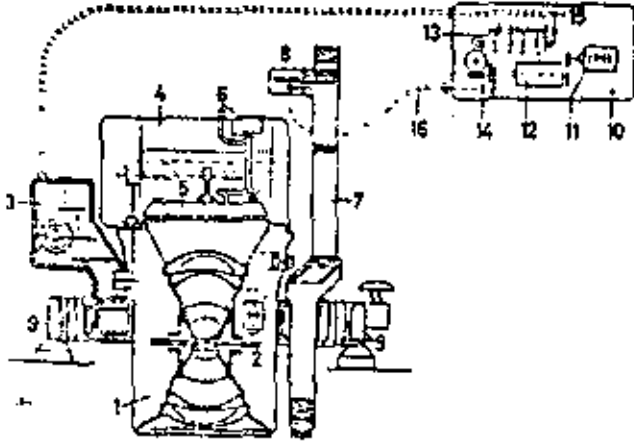
Requests for more detailed information should be directed to either of the Zeiss offices below:

Carl Zeiss  
Geschäftsbereich Instrumente II  
Prüfung Spezialexemplare  
für Grammetrie  
Postfach 1369/1380  
D-7082 Oberkochen  
Telephon: (07364) 203312  
Telex: 071375155

USA and Canada:  
Zeiss Avionics Systems, Inc.  
2223 Avenida de la Playa  
La Jolla, CA 92037/USA  
Telephone: (714) 454-8868  
TWX: (910) 337-1289

## Cameras fotogramétricas

Wild RC8 automatic film camera — Automatische Filmkammer Wild RC8 (Reihenmesskammer) — La chambre automatique à film Wild RC8.  
Wild, Heerbrugg



Cross-section through the MRB 21/1818 air survey camera — Querschnitt durch die MRB 21/1818 Luftbildmesskammer — La section à travers de la chambre aérienne MRB 21/1818.  
C. Zeiss VEB, Jena

(Fuente: Cimernan/Tomagosovich: Atlas of Photogrammetric Instrum.)

ZEISS Reihenmeßkammern für das Standard-Bildformat 23 cm x 23 cm (9" x 9"):

Carl Zeiss  
Oberkochen

Bezeichnung Denominación	Typo Tipo	Objektiv	Öffnung Aper- tura	Max. Bild- winkel 2 <sup>a</sup> ángulo de formación	Max. rechnerische Verzerrung bis 140 mm Bildhöhe	Hauptanwendungsbereiche Aplicaciones principales
RMK A 8,5/23	125°-Über- weitwinkel- kammer	S-PLEOGON A f = 85 mm (3 1/4")	1:4 1:5,8 1:8	139° (125°)	7 μm	Großflächen-Aufnahmen für kleinmaßstäbliche Kartierungen, besonders mit Flugzeugen geringer Gipfelhöhe; spezielle Befliegungen unter der Wolkenbasis
RMK A 15/23	Weitwinkel- Standard- kammer	PLEOGON A f = 153 mm (6")	1:4 1:5,8 1:8 1:11	104° (83°)	5 μm	Universalaufgaben, das heißt für Aerotriangulation, topographische und großmaßstäbliche Auswertung
RMK AR 15/23	Weitwinkel- Reseau- kammer	PLEOGON AR f = 153 mm (6")	1:5,8 1:8 1:11	104° (83°)	5 μm	Analytische Verfahren bei der Aero-triangulation und Koordinatenermittlung; R = Reseau = Präzisionsgitter unmittelbar vor der Bildebene
RMK A 21/23	Zwischen- winkel- kammer	TOPARON A f = 210 mm (8 1/4")	1:5,8 1:8 1:11	83° (75°)	4 μm	Fortkartierungen usw.; wenn der Normalwinkeltyp nicht benutzt werden kann, weil z. B. die vorhandenen Auswertegeräte für die Brennweite f = 305 mm nicht eingerichtet sind
RMK A 30/23	Normal- winkel- Standard- kammer	TOPAR A f = 305 mm (12")	1:5,8 1:8 1:11	63° (56°)	3 μm	Luftbildpläne, Orthophotokarten, Präzisionskartierungen, Kartierungen in bebauten Lagen (Verringerung von schattigen Räumen!)
RMK AR 30/23	Normal- winkel- Reseau- kammer	TOPAR AR f = 305 mm (12")	1:5,8 1:8 1:11	63° (56°)	3 μm	Analytische Verfahren bei der Präzisions-Koordinatenermittlung; R = Reseau = Präzisionsgitter unmittelbar vor der Bildebene
RMK A 60/23	Schmal- winkel- kammer	TELIKON A f = 610 mm (24")	1:6,3 1:8 1:12,5	33° (30°)	50 μm	Sonderaufgaben: a) große Flughöhen, b) sehr eng bebauten Stadtgebiete, c) für Bildflüge im Bildmaßstab 1:250 oder 1:500 zur Erreichung zugelassener Flughöhen, d) Luftbildpläne und Orthophotokarten von Stadtgebieten mit Hochbauten

(Folleto de propaganda Zeiss)

# Dos métodos por el tratamiento de datos termal

## I. Stefan - Boltzmannsches Gesetz :

$$\text{Gesamtstrahlung } M = \sigma T^4$$

$$G = \omega \int_{\lambda_1}^{\lambda_2} \Phi_{\lambda} \epsilon_{\lambda} L_{\lambda}(T) \tau [H] d\lambda$$

Radiación termal terrestre

Wärmestrahlung der Erdoberfläche (gesuchte Größe)

$$+ \omega \int_{\lambda_1}^{\lambda_2} \Phi_{\lambda} (1 - \epsilon_{\lambda}) \frac{1}{\pi} (G_{\lambda} - \Omega_{\theta} L_{\lambda}(\theta)) \tau_{\lambda} [H] d\lambda$$

Gegenstrahlung der Atmosphäre und reflektierte Sonnenstrahlung (Störung der Meßgröße)

$$+ \omega \int_{\lambda_1}^{\lambda_2} \int_H^0 \Phi_{\lambda} L_{\lambda}(T_L [h]) \frac{\partial \tau}{\partial h} dh d\lambda$$

Emission der zwischen Objekt und Flugzeug liegenden Luftschicht (Störung der Meßgröße)

- $\Delta I$  innerer Störeinfluß des Sensors (Fehlkalibrierung der Schwarzkörper, Temp. Inkonstanz der Schwarzkörper, elektronisches Rauschen)

perturbaciones del señal medido

- mit :
- $\omega$  = Öffnungswinkel des Meßgeräts, ángulo del instrumento
  - $\Phi_{\lambda}$  = spektrale Empfindlichkeit des Meßgeräts, Sensibilidad - " -
  - $L_{\lambda}$  = Planck'sche Strahlung
  - $\tau_{\lambda} [H]$  = Transmission der Luftschicht der Dichte H
  - $\epsilon_{\lambda}$  = Emissionsvermögen
  - $G_{\lambda}$  = Gegenstrahlung der Atmosphäre Radiación atmosférica
  - $\Omega_{\theta}$  = Raumwinkel der Sonne ángulo espacial del Sol
  - $T_L [h]$  = Lufttemperatur in der Höhe h

$$\text{II. } T = f(G, Y) = a_0 + a_1 G + a_2 Y + a_3 GY + a_4 G^2 + a_5 Y^2 - \dots$$

Temperatura = f(valor del pixel, posición del pixel)

# Comparación de los métodos distintos 2.2.3 -

$\underline{ref}_k$  - Prozentsatz der Musterklasse  $k_i$  in der Originalszene;  
 $\underline{klk}_{k,XX}$  - Prozentsatz der Bildpunkte der Szene  $S$ , die dem Klassifikator  $XX$  der Musterklasse  $k_i$  zugewiesen hat;

(4.4.2.1)  $T_{XX} = 1 - \frac{1}{100} \sum_{i=1}^E (\underline{ref}_k - \underline{klk}_{k,XX})$  Medida por la precisión

sin  
repulso  
radio  
fijo  
→  
→

Klassifikator XX	Musterklassen			nicht klassifizierte Bildpunkte	$T_{XX}$
	$\underline{mk}_1$	$\underline{mk}_2$	$\underline{mk}_3$		
Verteilung in der Originalszene	3.9%	11.2%	3.6%	81.3%	-
MD,OR	40.6%	34.6%	24.8%	-	0.19
NL,OR	40.1%	50.1%	9.8%	-	0.19
MD,FR c=2.0	25.0%	24.0%	15.2%	35.9%	0.55
MD,AR c=2.0	5.1%	24.0%	6.4%	64.5%	0.83
OU,AUE/OU,NUE c=2.0	5.1%	13.7%	4.2%	77.0%	0.96
NL c=1.6	4.9%	14.0%	4.1%	77.0%	0.96

Vergleich der Klassifikatoren.

## Escena natural

### Clases

→  
→  
→

Klassifikator	Musterklassen					NO	Überdeckungs- bereiche	$T_{XX}$
	FI	WI	AG	AU	BU			
	Pinar Prado Campo - Hayas							
MD,OR	23.1%	27.3%	34.6%	10.4%	4.7%	-	-	0.75
MD,FR c=2.0	22.3%	25.3%	29.9%	8.9%	3.7%	9.9%	-	0.85
MD,AR c=2.0	18.1%	24.4%	28.0%	8.9%	2.3%	18.4%	-	0.91
NL,OR	22.7%	35.2%	31.6%	5.7%	4.8%	-	-	0.76
NL c=1.6	17.9%	25.5%	25.0%	4.7%	2.4%	24.6%	-	1.00
OU,OUe c=2.0	17.9%	22.0%	21.5%	4.4%	2.1%	27.4%	4.8%	0.92
OU,AUE c=2.0	17.9%	23.1%	25.3%	4.4%	2.1%	27.4%	-	0.97
OU,NUE c=2.0	17.9%	23.1%	25.3%	4.4%	2.1%	27.4%	-	0.97

Ergebnisse der Klassifikatoren angewendet auf eine natürliche Szene.



### QU con superposición clases

Puntos repulsados

Quader-Klassifikator in versch. Varianten	Musterklassen			nicht klassifizierte Bildpunkte
	$\underline{mk}_1$	$\underline{mk}_2$	$\underline{mk}_3$	
Verteilung im Original	3.9%	11.2%	3.6%	81.3%
QU,AUE c=4.0 ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	16.2%	35.1%	9.5%	39.2%
QU,NUE c=4.0 ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	16.4%	35.1%	9.3%	39.2%
QU,ML c=4.0 ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	16.1%	38.6%	6.0%	39.3%
QU,AUE/QU,NUE c=2.0 ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	5.1%	13.7%	4.2%	77.0%
QU,ML c=2.0 ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	4.9%	14.0%	4.1%	77.0%

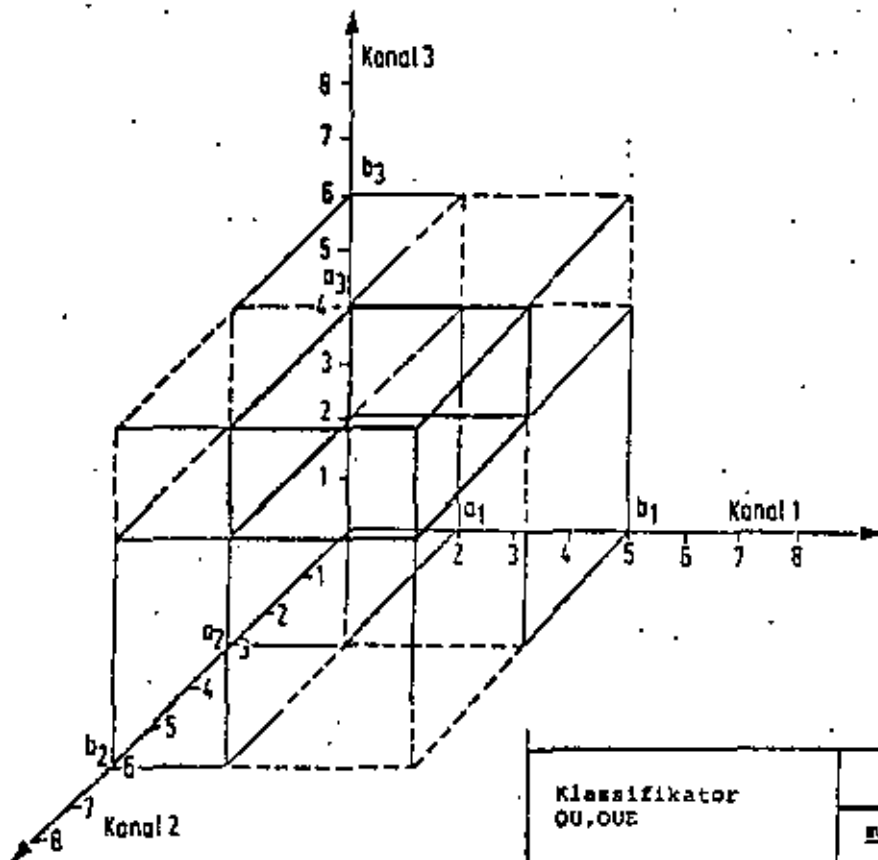
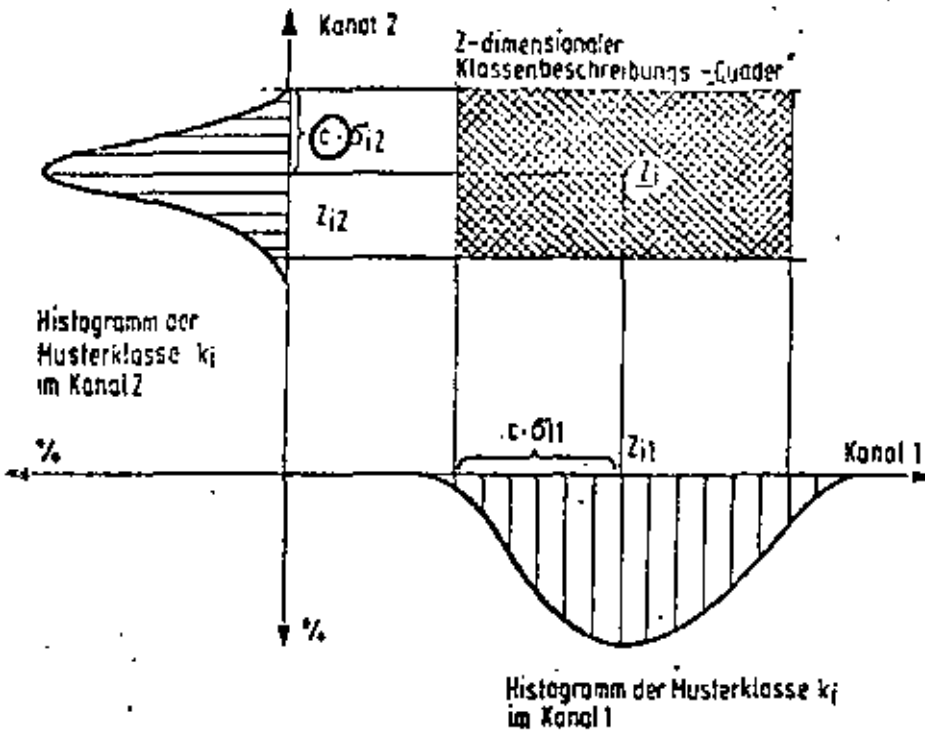
Ergebnisse der Quaderklassifikatoren mit Auflösung der Überdeckungsbereiche.

### ML

Klassifikator ML	Musterklasse			nicht klassifizierte Bildpunkte
	$\underline{mk}_1$	$\underline{mk}_2$	$\underline{mk}_3$	
Verteilung im Original	3.9%	11.2%	3.6%	81.3%
ML c=1.0 ( $\underline{mk}_1$ )	2.0%	-	-	98.0%
ML c=2.0 ( $\underline{mk}_1$ )	8.2%	-	-	91.8%
ML c=3.0 ( $\underline{mk}_1$ )	18.4%	-	-	81.6%
ML c=2.0 ( $\underline{mk}_1, \underline{mk}_2$ )	8.2%	22.4%	-	69.4%
ML c=2.0 ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	7.1%	20.6%	5.0%	67.2%
ML c=1.6 ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	4.9%	14.0%	4.1%	77.0%

Ergebnisse des ML Klassifikators.

Método sillar (QU)  
(según Haberäcker)

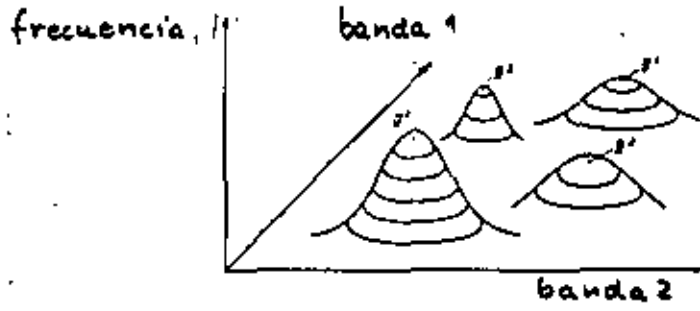


Ejemplo sintético

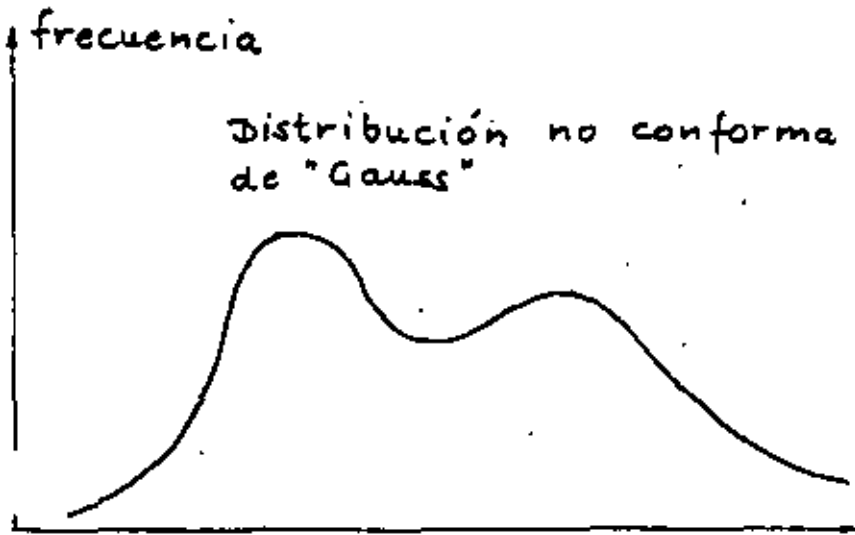
Klassifikator QU, OUE	Clase Musterklassen			Puntos nicht klassifizierten Bildpunkte no clasificados
	$\underline{mk}_1$	$\underline{mk}_2$	$\underline{mk}_3$	
Verteilung in der Originalszene distribuc. orig.	3.9%	11.2%	3.6%	81.3%
QU, OUE $c=1.0$ ( $\underline{mk}_1$ )	1.3%	-	-	98.7%
QU, OUE $c=2.0$ ( $\underline{mk}_1$ )	5.4%	-	-	94.6%
QU, OUE $c=3.0$ ( $\underline{mk}_1$ )	12.1%	-	-	87.9%
QU, OUE $c=2.0$ ( $\underline{mk}_1, \underline{mk}_2$ )	5.4%	15.0%	-	79.6%
QU, OUE $c=1.0$ ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	1.3%	3.0%	1.3%	93.6%
QU, OUE $c=2.0$ ( $\underline{mk}_1, \underline{mk}_2, \underline{mk}_3$ )	4.5%	13.4%	2.5%	77.6%

OUE: sin  
superposición

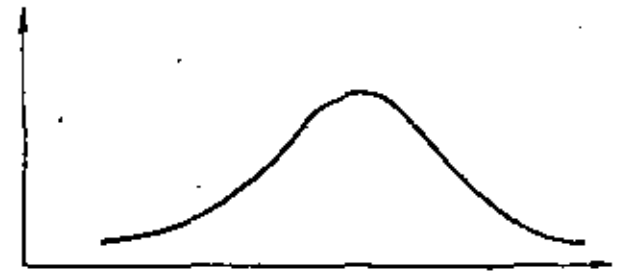
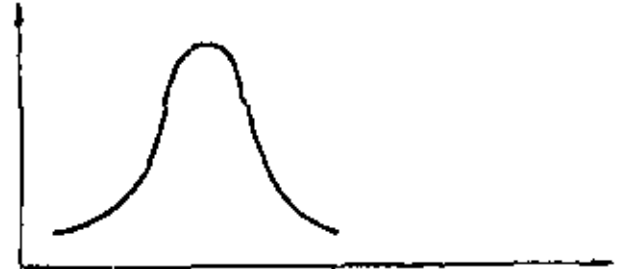
c: extensión  
del sillar



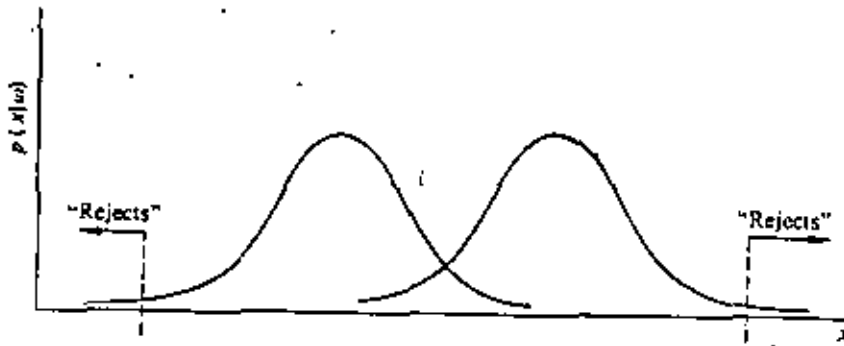
Distribución en dos dimensiones



(a) A bimodal distribution

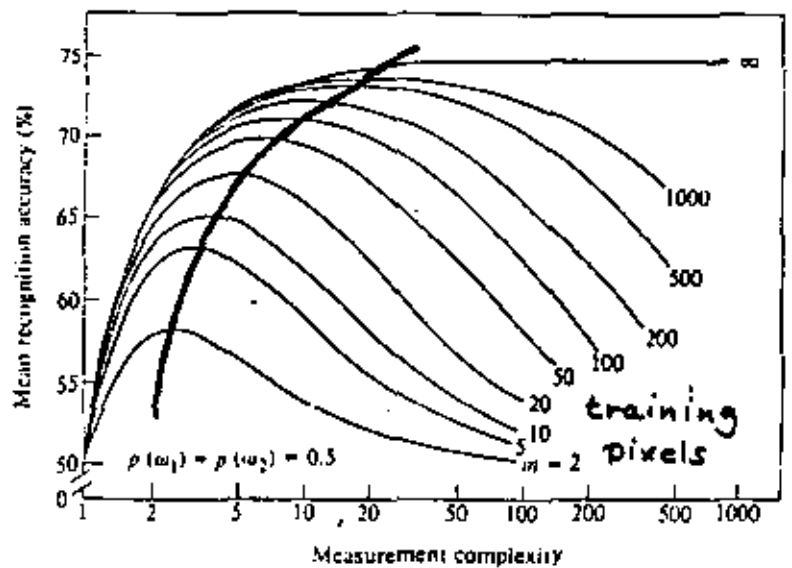


(b) Unimodal components



(Swain/Davies)

Introducción de clases repulsadas



Método Maximum Likelihood (ML)

frecuencia



Distribución Gauss  
Histograma de una clase

$$p(x|\omega_i) = \frac{1}{(2\pi)^{1/2} \sigma_i} \exp\left[-\frac{1}{2} \frac{(x - \mu_i)^2}{\sigma_i^2}\right]$$

Función de probabilidad de primer grado (una clase)

$\exp[\cdot]$  = e (the base of the natural logarithms) raised to the indicated power

$\mu_i = E[x|\omega_i]$  is the mean or average value of the measurements in class i

$\sigma_i^2 = E[(x - \mu_i)^2|\omega_i]$  is the variance of the measurements in class i

$$X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}$$

$$\mu = \begin{bmatrix} \mu_{11} \\ \mu_{12} \\ \vdots \\ \mu_{1n} \end{bmatrix}$$

$$C = \begin{bmatrix} \sigma_{111} & \sigma_{112} & \dots & \sigma_{11n} \\ \sigma_{121} & \sigma_{122} & \dots & \sigma_{12n} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{in1} & \sigma_{in2} & \dots & \sigma_{inn} \end{bmatrix}$$

Generalización

Maximum - Likelihood - Methode

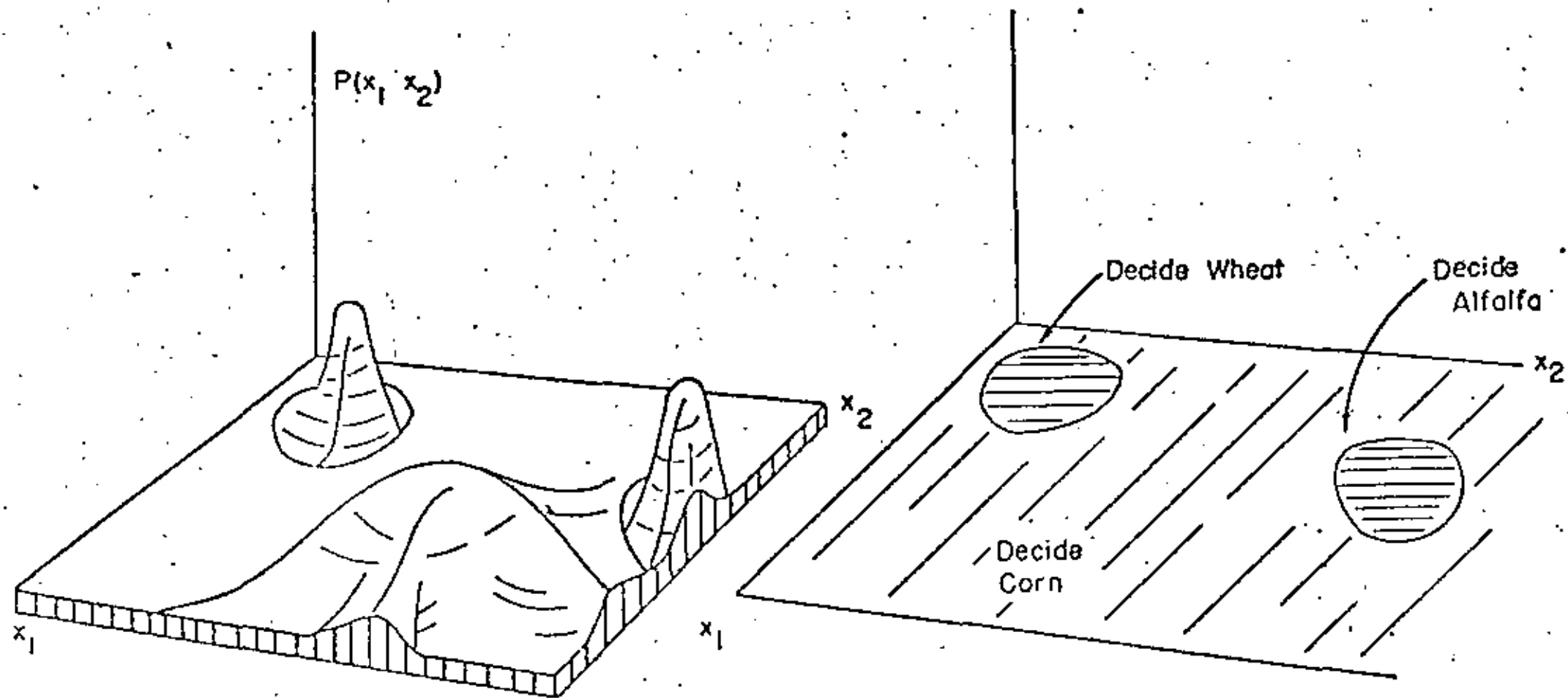


$\underline{x} \in \omega_i$  falls  $p(\underline{x}|\omega_i) \geq p(\underline{x}|\omega_j) \Rightarrow p(\omega_i) \geq p(\omega_j)$

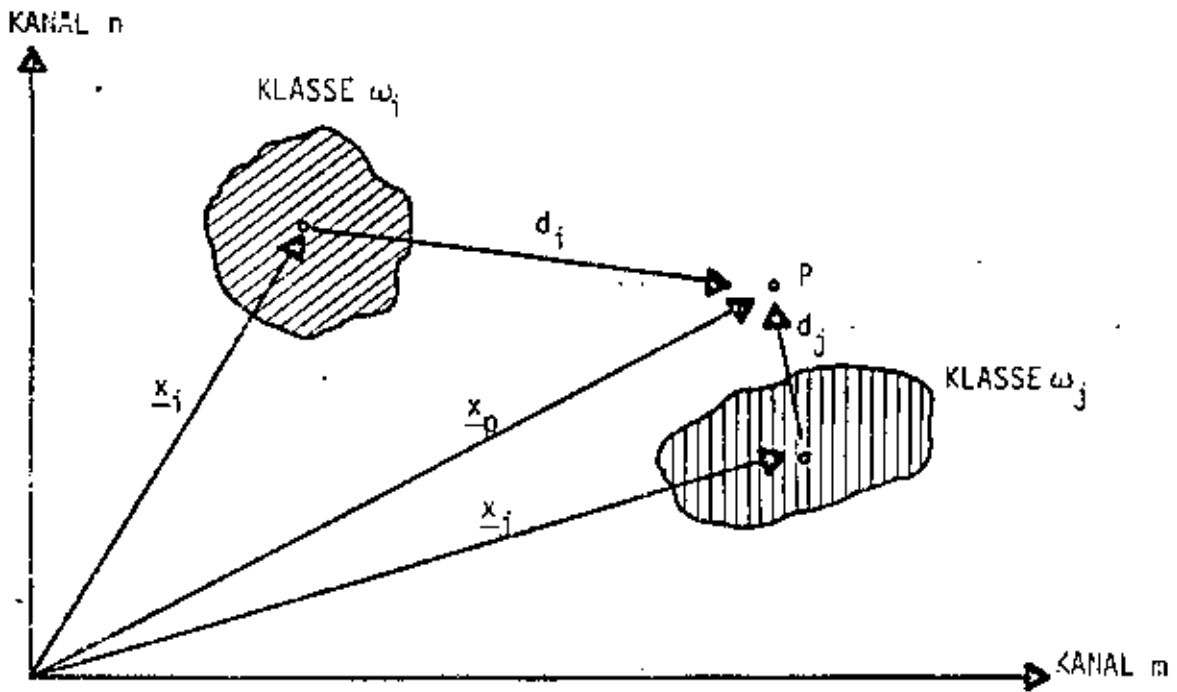
Algoritmo de parámetro de decisión

wobei

$$p(\underline{x}|\omega_i) = \frac{1}{\det(C_i) \sqrt{2\pi}} \exp\left(-\frac{1}{2} (\underline{x} - \underline{\mu}_i)^T C_i^{-1} (\underline{x} - \underline{\mu}_i)\right)$$



(a) Density Functions      (b) Decision Regions for a Statistical Approach

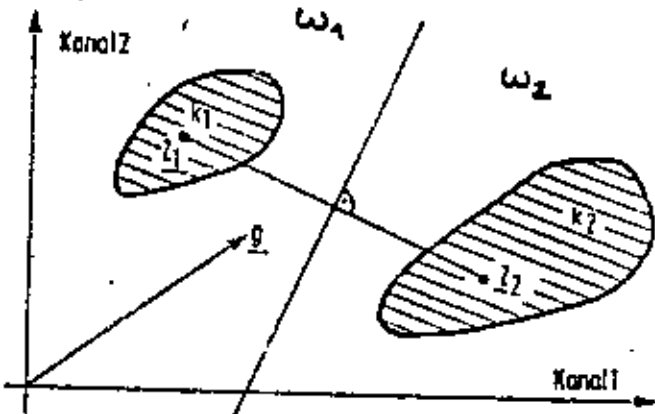


Multispektrale Klassifizierung, Prinzip

1. Minimum - Distance - Methode

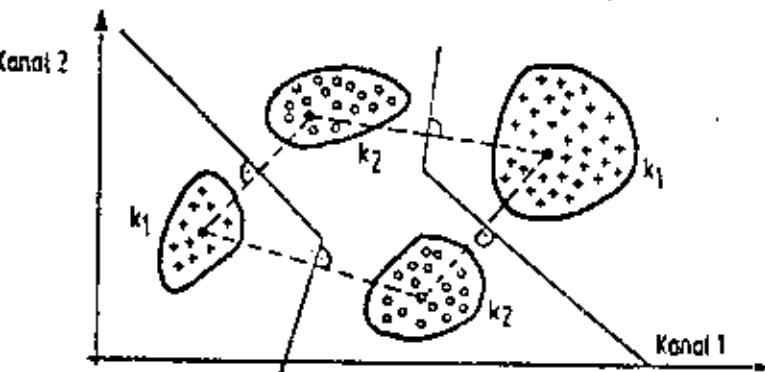
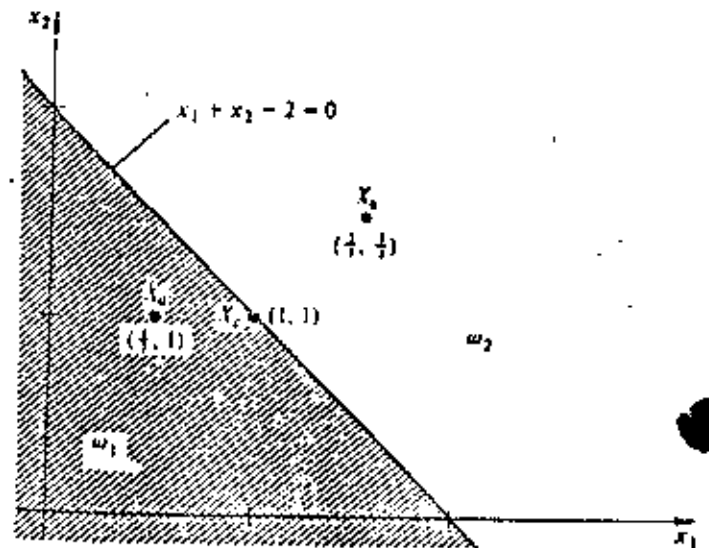
$$d_j = (x_p - x_j) < d_i = (x_p - x_i)$$

Clasificación según el principio de la distancia mínima (MD)

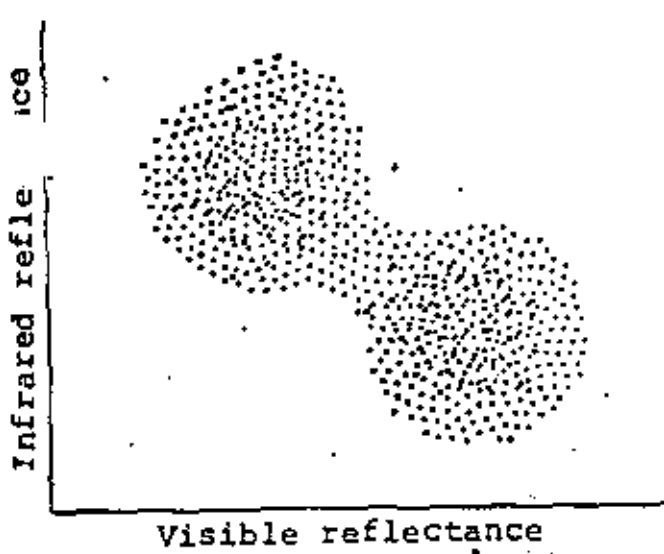
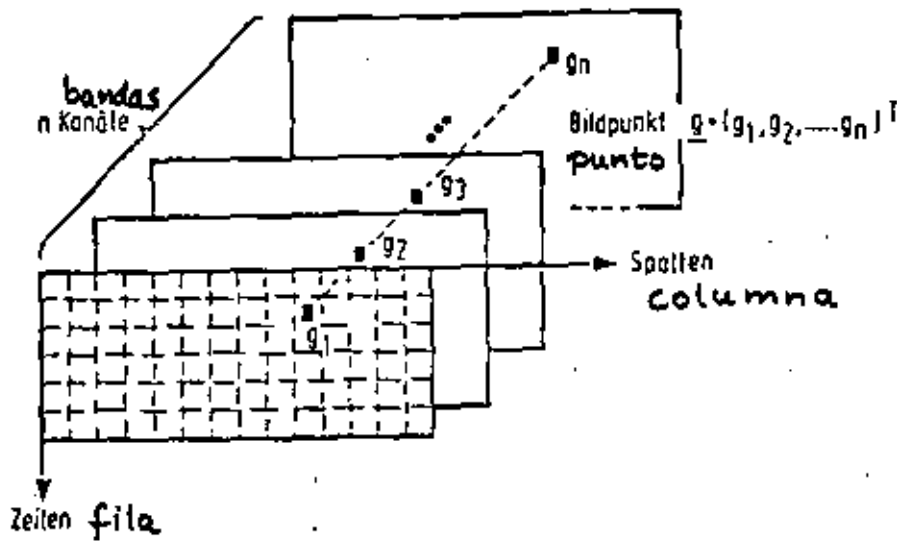


$$g_1(X) = x_1 + x_2 + 2$$

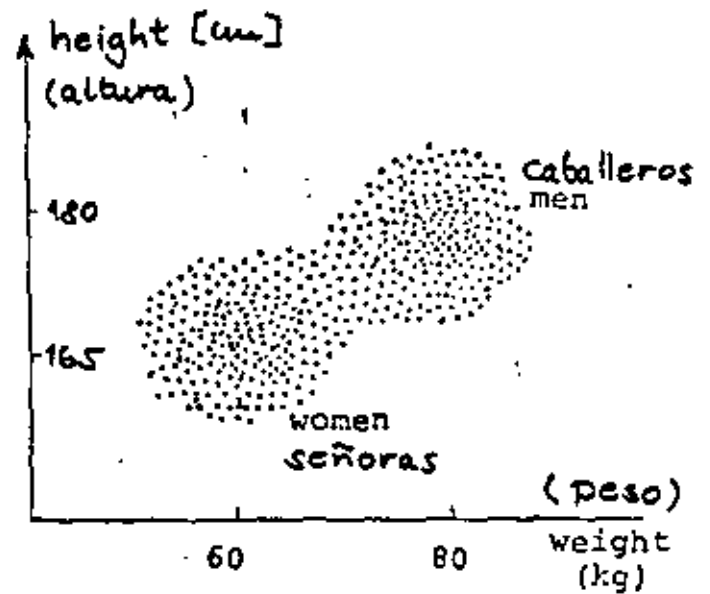
$$g_2(X) = 2x_1 + 2x_2$$



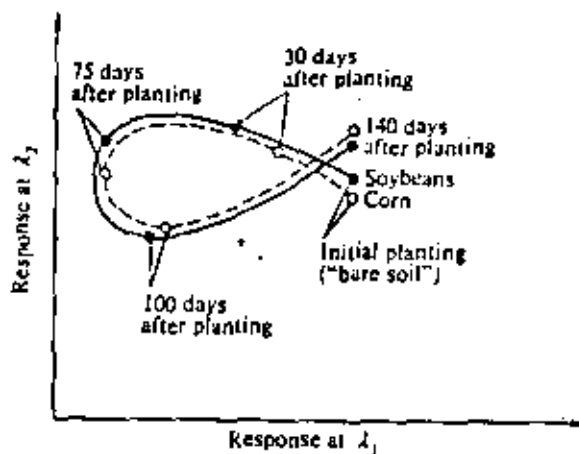
# Bandas multi espectrales



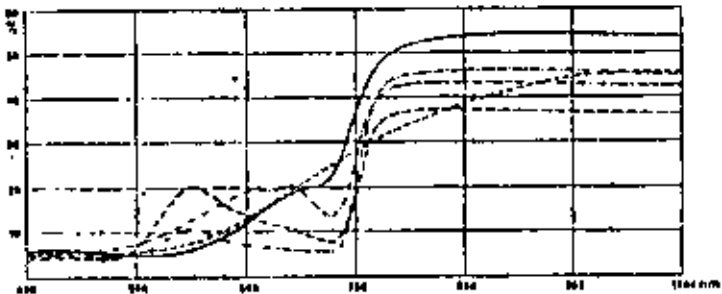
(b) Multimodal data from wheat fields (hypothetical illustration)



(a) A distribution of adult heights and weights

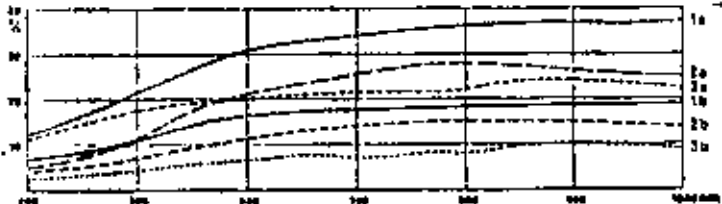


# Reflecciones características



Elchenblätter im Jahreslauf  
Oak leaves throughout the season  
Feuilles de chêne au cours des saisons  
Hojas de encina a lo largo del año

17 April  
5 May  
19 June  
28 October  
2 November



1 Sand  
Sand  
Sable  
Arena

2 Braunerde  
Brown soil  
Sol brun  
Suelo pardo

3 Asphalt  
Asphalt  
Asphalte  
Asfalto

4 trocken  
dry  
sec  
seco

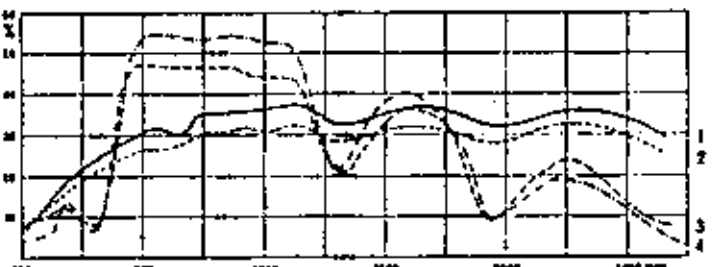
5 naß  
wet  
mouillé  
húmedo



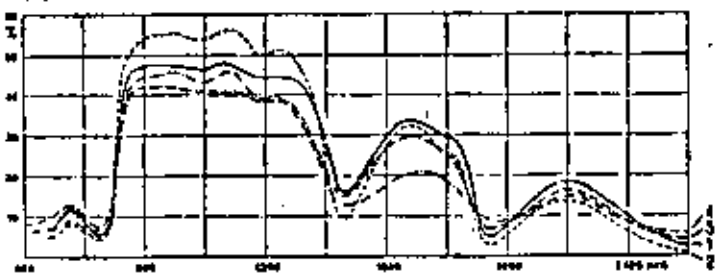
1 Esphenblätter  
Aspen leaves  
Feuilles de tremble  
Hojas de álamo

2 Espe. ganze Krone  
Aspen, whole crown  
Tremble, cime entière  
Alamo, copa completa

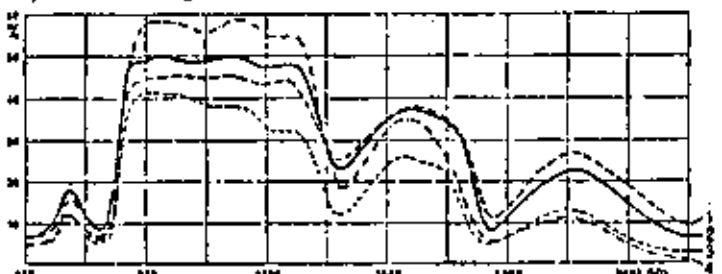
3 Espenwald  
Aspen forest  
Forêt de trembles  
Bosque de álamos



Ähren: 1 Roggen 2 Weizen Blätter: 3 Sojabohne 4 Tabak  
Ears: Rye Wheat Leaves: Soybean Tobacco  
Épis: Seigle Blé Feuilles: Soja Tabac  
Espigas: Centeno Trigo Hojas: Soja Tabaco

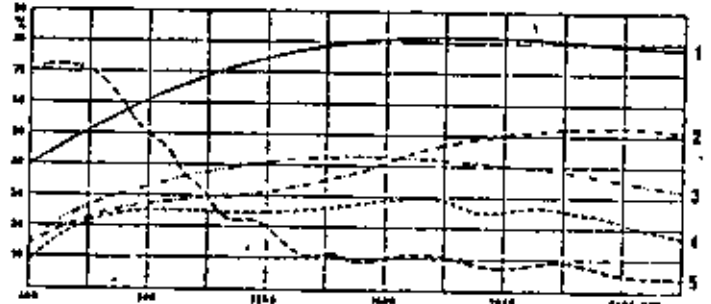


Blätter: 1 Baumwolle 2 Tomate 3 Mais 4 Kartoffel  
Leaves: Cotton Tomato Corn Potatoes  
Feuilles: Colonnier Tomate Maiz Pommes de terre  
Hojas: Algodón Tomate Maiz Patata

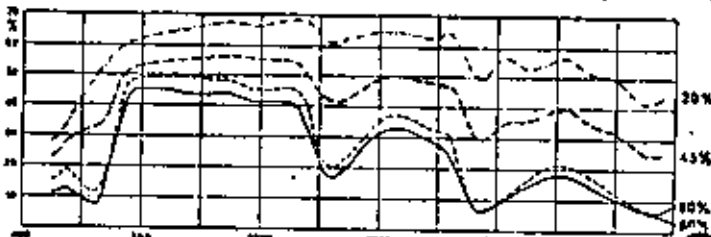


Blätter von Baumarten  
Leaves of tree species  
Feuilles des espèces d'arbres  
Hojas de ciertos árboles

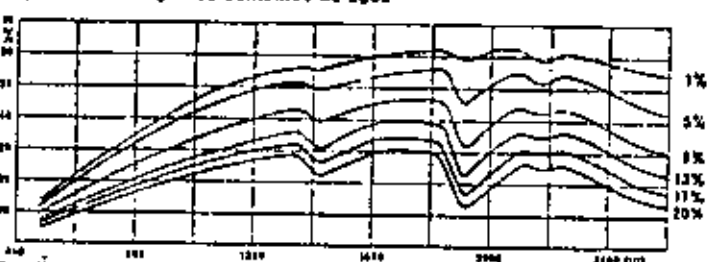
1 Ulmus americana 3 Populus deltoides  
2 Acer saccharinum 4 Nerhym alexander



1 Kalkstein 2 Gneiss 3 Sand, trocken 4 Beton 5 Altechnee  
Limestone Gneiss Sand, dry Concrete Snow, old  
Roches calc. Gneiss Sable, sec Béton Neige, ancienne  
Caliza Gneis Arena, seca Hormigón Nieve, no reciente



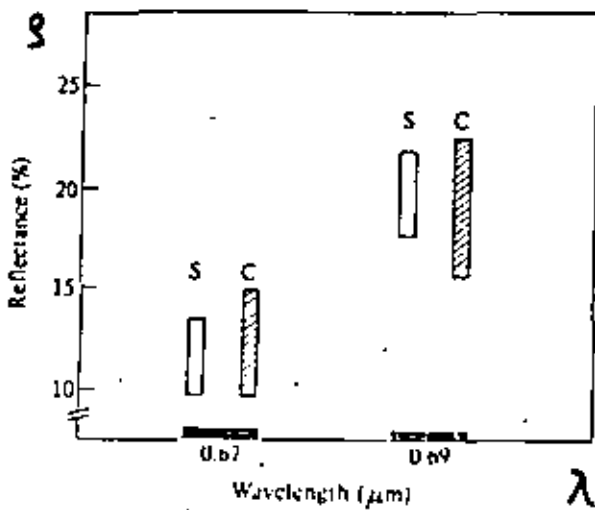
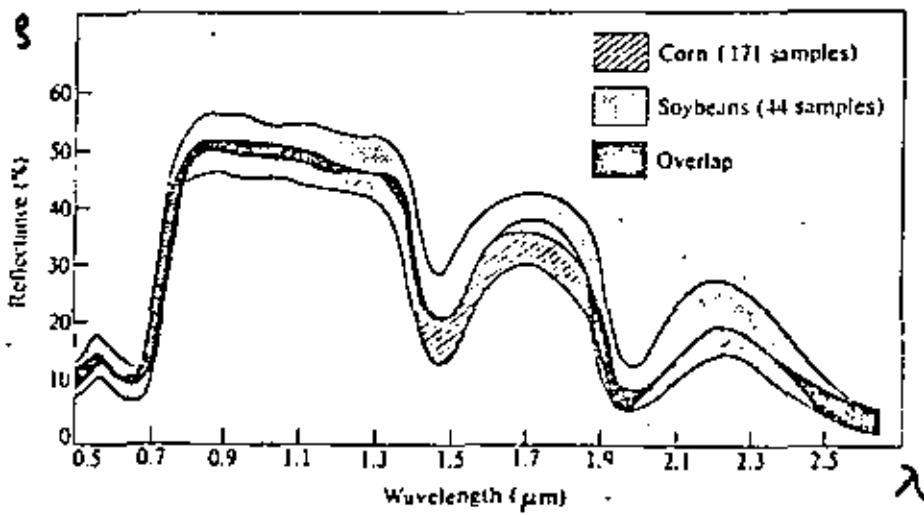
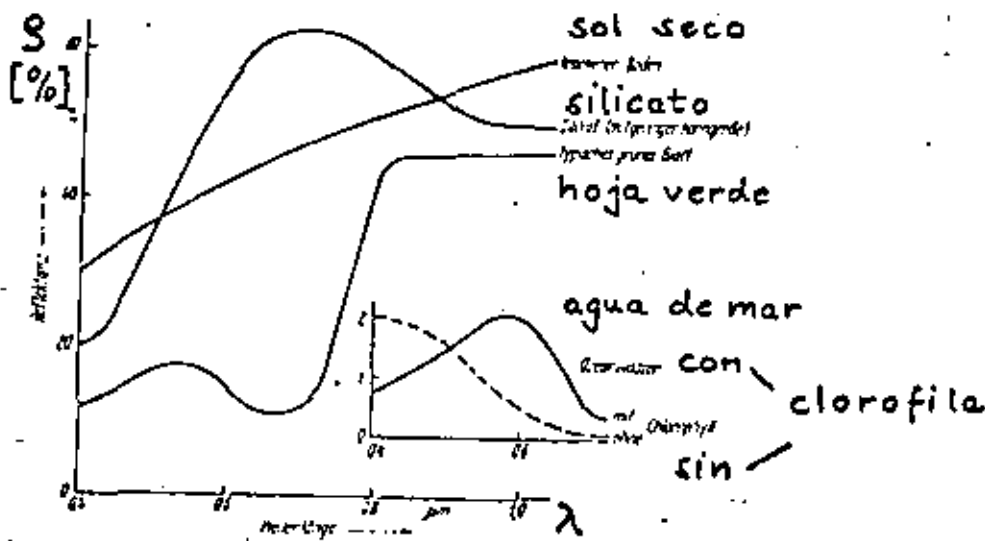
Maissblätter bei verschiedenem Wassergehalt  
Corn leaves at various moisture levels  
Feuilles de maïs à différents taux d'humidité  
Hojas de maiz según su contenido de agua



Sandiger Lehm bei verschiedenem Wassergehalt  
Silt loam at various moisture levels  
Argile sablée à différents taux d'humidité  
Barro arenoso según su contenido de agua



Reflecciones características (1)



Elevación de la reflexión rojo/infrarojo

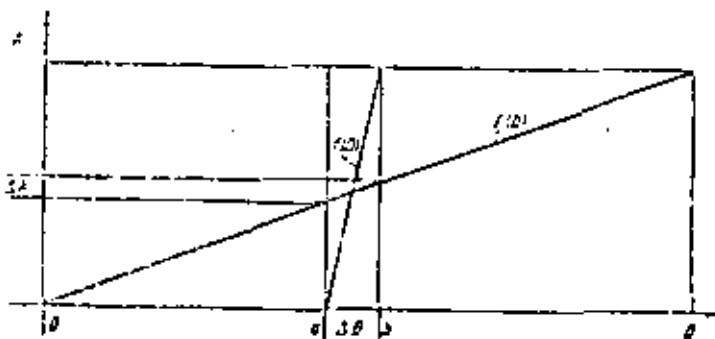
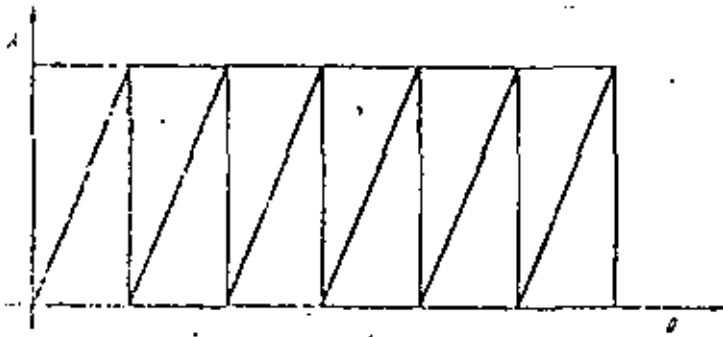
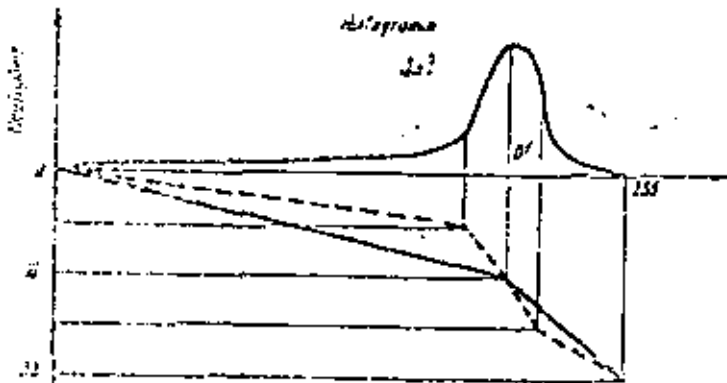
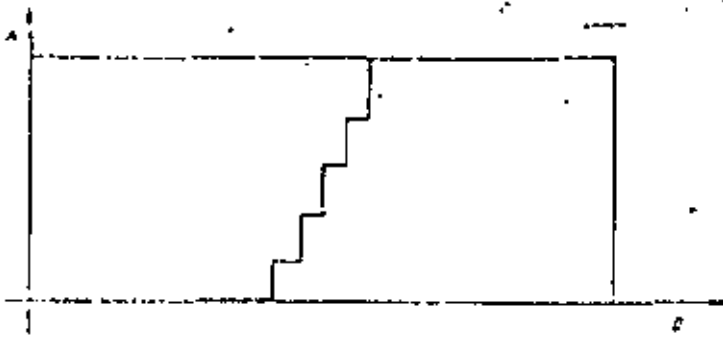
## Tratamiento de los histogramas

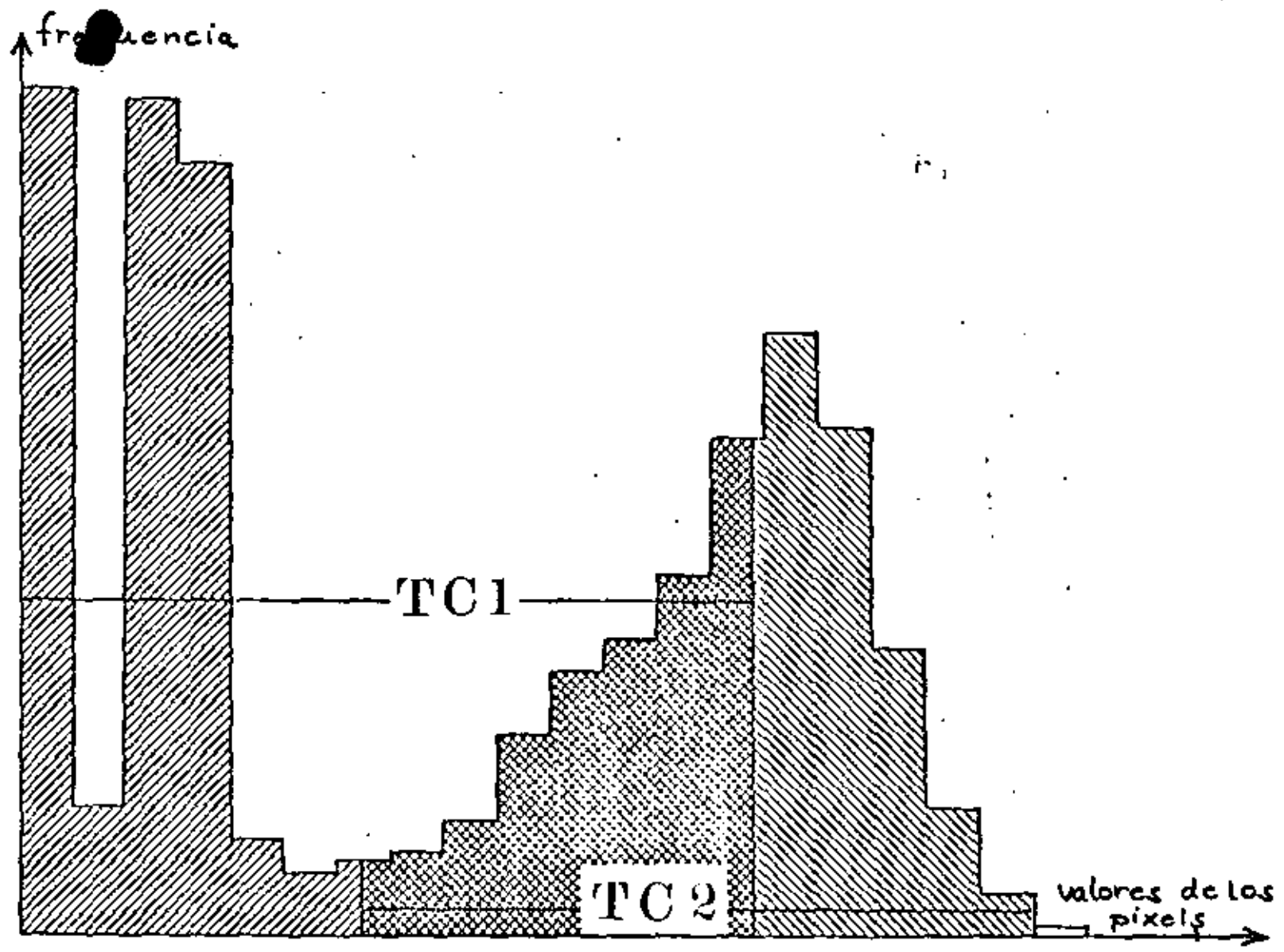
1. Pasos iguales

2. Transformación de grados diferentes

3. Manipulación del contraste de la escala completa

4. Manipulación de un parte de la escala

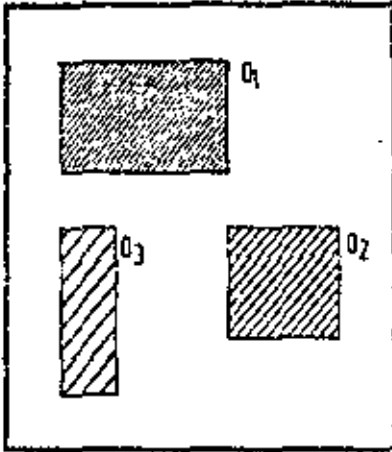




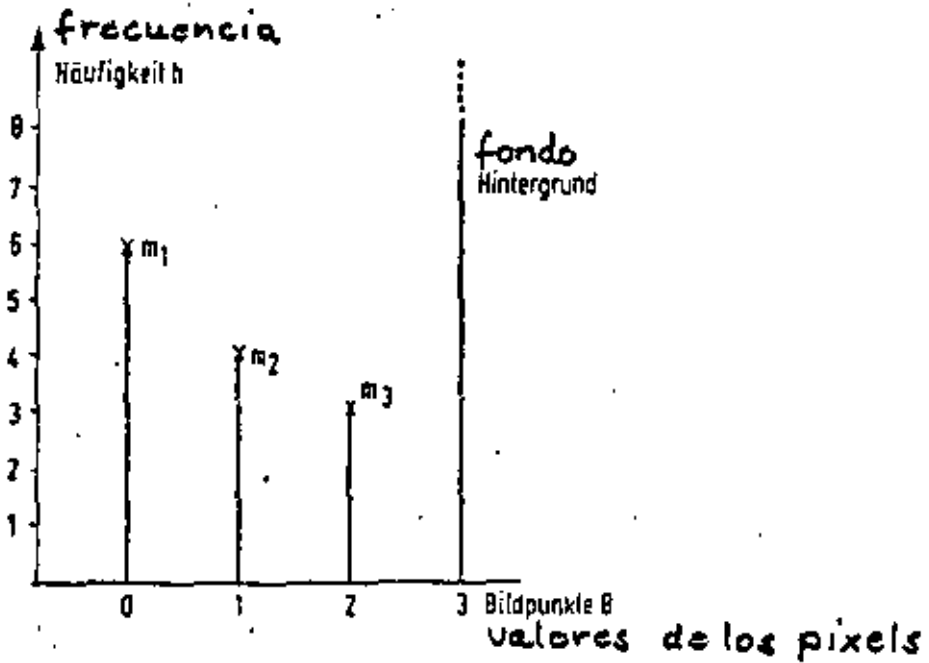
**Wasser** **Land**  
 Agua Planos de marcas Tierra sólida  
 — Histogramm des Originals —

Introducción de Histogramas

Escena sintética:



3	3	3	3	3	3	3
3	0	0	0	3	3	3
3	0	0	0	3	3	3
3	3	3	3	3	3	3
3	2	3	3	1	1	3
3	2	3	3	1	1	3
3	2	3	3	3	3	3
3	3	3	3	3	3	3



ESA  
(continuación)

1) SPACELAB-KAMERA-MISSION

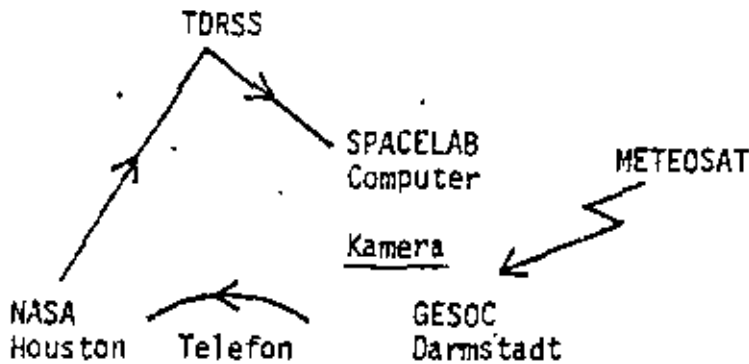
RMK 30/23

h = 250 km, Bahn 57° Inclin., 8 Tagemission

3 Filme (Filmtests DFVLR/CNES-IGN) *evaluación de películas:*

Auswertung: IGN, CNES (Frankreich) S/W  
 IFAG, DFVLR (BR Deutschland) IR Falschfarbe  
 Universität Mailand (Italien)  
 Universität Hannover (BR Deutschland)

Automat. Auslösung der Aufnahmeolge



Beschränkungen *Limitaciones:*

1. Film (3 Magazine) *película*
2. Energie 1,5 kWh *energía*
3. Andere Experimente (Ausrichtung erdorientiert) *otros experimentos*
4. Sonnenstand > 15° *altura del sol*
5. Wetter *tiempo (atmosfera)*

# ESA - continuación

2)

MICROWELLEN EXPERIMENT  
1. SPACELAB MISSION

im Bau  
en construcción

von Dornier & DFVLR

## Synthetisches Apertur Radar

X-Band	9,6 GHz
Abstrahlungswinkel	45°
Empfindlichkeit	1 db
dynam. Bereich	-30 db bis + 10 db
Auflösung resolución	100 x 100 m gewünscht 25 x 25 m

E.S.A. PLANUNG FOR ERDERKUNDUNGSSATELLITEN

c. Planung  
Proyectos

### 1. LASS

#### Land Applications Satellite System

- 30 m Pixel Zeilendiode (6 Kanäle)
- 60 m Pixel Abtaster (refl. IR) (2 Kanäle)
- 120 m Pixel Thermalabtaster (2 Kanäle)
- 100 m Pixel Synthet. Aperturradar

### 2. COMSS

#### Coastal Ocean Monitoring Satellite System

- Ozeanfarbabtaster (7 Kanäle, engbandig  
f. Chlorophyll)
- Synthet. Apertur Radar, 30 m Pixel
- Mikrowellenradiometer

Weltraum-Fernerkundungsprogramme anderer Länder
---

## Otras naciones

UdSSR - INTERCOSMOS

Soyuz

MKF-6

in Betrieb

FRANZREICH

Francia

SPOT auf ARIANE

im Bau

20 m Bildelement , 2 Bänder

10 m Bildelement

250 Bilder speicherbar

JAPAN

MOS (Marine Observation Satellite)

im Bau und geplant

50 m Bildelement, sichtbar und thermal

1983

LOS (Land Observation Satellite)

1987

30 m Bildelement

VOLKSREPUBLIK CHINAProgramm des Jen Hsi-Min Raumfahrttechno-  
logieinstituts

geplant

Weltraum-Fernerkundungsprogramme der ESA
--

## "European Space Agency"

A. Vorgegebene Entwicklungen      *desarrollos terminados*1) Bau von SPACELAB (E.R.N.O.) - *Bremen*

zur Mehrzwecknutzung im wiederverwendbaren

NASA Raumtransporter SPACE-SHUTTLE

2) Bau der europäischen Trägerrakete ARIANE*Cohete europeo*B. Systeme im Bau      *en construcción*

1) SPACELAB-1 Experiment

Photogrammetrische Kamera      *"metric camera"*

Zeiß RMK 30/23, 3 Filme = 1650 Aufnahmen

Missionsdauer 1 Woche

Start: 18.4.1982

2) SPACELAB-1 Experiment

Mikrowellenerkundung

in 3 Betriebsarten:

a) Mikrowellenscatterometer

b) Passiver Thermalsensor

c) Bildflugradar im X-Band

25 m Bildelem.

Bildbreite 9 km



Die geplanten Weltraummissionen sind im folgenden zusammengestellt, und zwar geordnet nach Aktivitäten der USA, anderer Länder sowie der ESA.

## Programas espaciales

Weltraum-Fernerkundungsprogramme der USA

### de los Estados Unidos

#### A. Vorgegebene Entwicklungen *desarrollos terminados*

- |                            |   |
|----------------------------|---|
| 1. Space-Shuttle           | Wiederverwendbarer Transporter                          |
| 2. T.D.R.S.S.              | Weltweites Empfangssystem über geostationäre Satelliten |
| 3. Multimodular-Satelliten | Genormte Satelliten                                     |

#### B. Systeme im Bau *en construcción*

- |                               |  |
|-------------------------------|--|
| 1. <u>LANDSAT - D</u><br>1982 | Thematic Mapper:<br>6 Bänder 0,42-2,35 $\mu\text{m}$<br>Bildelementgröße am Boden 30 m<br>1 Band 10-12,5 $\mu\text{m}$<br>Bildelementgröße am Boden 120 m<br>85 M bits/s Datenrate über T.D.R.S.S. |
|-------------------------------|--|

#### 2. Shuttle Experimente (O.F.T.)

- |                                      |   |
|--------------------------------------|---|
| a) Großformat-Kamera (ITEK)<br>"LFC" | c = 30 cm<br>23 x 36 cm Format<br>4000 Aufnahmen<br>Palette |
| b) SEASAT Radar                      | (X & L Band)  |

### *Sistemas proyectados*

#### C. Geplante Systeme

- |  |   |
|--|---|
| 1. <u>MAPSAT (U.S.G.S.)</u>                                | 1 Band, Bildelement am Boden 30-40 m<br>2 Bänder, Bildelement am Boden 60-90 m<br>15 Mbit/s Datenrate<br>h = 900 km |
| 2. <u>STEREOSAT (J.P.L.)</u>                               | Diodenzeilen (konvergent)<br>Bildelement am Boden 15 m  |
| 3. <u>MULTIMODULAR SATELLITEN &amp; GROSSFORMAT-KAMERA</u> | Lebensdauer 6-9 Monate<br>Parkumlaufbahn 900 km<br>Missionsumlaufbahn 250 km  |

Mission	Jahr	Kamera	H	c	Format	Auflösung	Bodenauflösung
<u>GEMINI 4-7</u>	1965	Hasselblad C.Zeiss-Optik	200 km	80 mm	5,7 x 5,7 cm	20 Lp/mm	125 m
GEMINI 10-12	1966	Maurer	200 km	80 mm	5,7 x 5,7 cm	20 Lp/mm	125 m
APOLLO 7	1968	R220 Maurer	225-420 km	80 mm	5,7 x 5,7 cm	35 Lp/mm	70 m
APOLLO 9	1969	Hasselblad C.Zeiss-Optik	192-496 km	80 mm	5,7 x 5,7 cm	35 Lp/mm	70 m
SKYLAB (S190A)	1973	ITEK	435 km	152 mm	5,7 x 5,7 cm	29 Lp/mm	99 m
<u>SKYLAB (S190B)</u>	1973	ETC Acton	435 km	360 mm	11,5 x 11,5 cm	25 Lp/mm	38 m
<u>SOJUZ 22-30</u>	seit 1976	MKF-6 Jena	250 km	125 mm	5,5 x 8,1 cm	80 Lp/mm	25 m

Bemannte Weltraumplattformen

Plataformas espaciales con tripulación

# Resumen del desarrollo de satélites terrestres por la percepción remota

1.3 - 30'

Zusammenstellung bisheriger und geplanter Erdsatelliten-Missionen

Man unterscheidet folgende Erdsatelliten-Typen:

- |                                |  | <u>Tipos</u>                       |
|--------------------------------|--|------------------------------------|
| → 1. Wettersatelliten          |  | s. <i>meteorológicos</i>           |
| 2. Nachrichtensatelliten       |  | s. <i>de telecomunicación</i>      |
| 3. Navigationssatelliten       |  | s. <i>de navegación</i>            |
| → 4. Aufklärungssatelliten     |  | s. <i>militares</i>                |
| 5. Geophysikalische Satelliten |  | s. <i>geofisicales</i>             |
| → 6. Erderkundungssatelliten   |  | s. <i>por la percepción remota</i> |

Im Zusammenhang mit einer Kartierung der Erdoberfläche interessieren nur die Typen 1, 4 und 6; hinzu kommen noch bemannte Weltraumplattformen. In den Tabellen 7a bis d sind die bisherigen Missionen mit diesen Satellitentypen zusammengestellt.

<i>nombre</i>	<i>nación</i>	<i>tiempo</i>	<i>resolución</i>
Name	Land	Zeit	Auflösung
Tiros 1-10	USA	1960-1965 h = 700 km	3,5 km Vidicon (sichtbar)
ESSA 1-9	USA	1966-1969 h = 1500 km	3,5 km Vidicon (sichtbar), APT
NOAA 1-	USA	1970 h = 1500 km	0,9 km (sichtbar & thermal APT)
KOSMOS 1-92	UdSSR	1959-1965 h = 250 km	Filmkapsel
KOSMOS -226	UdSSR	1965-1969 h = 600 km	Vidicon & IR
METEOR 1 →	UdSSR	1970 →	Vidicon, IR & APT
GEDS	USA		
<u>METEOSAT</u>	<u>ESA</u>	GARP	
JAPAN	GMS		

Wettersatelliten

s. *meteorológicos*

Name	Land	Zeit	Auflösung
NIMBUS 1-6	USA	1964 → h = 1000 km	Vidicon 1 km IR-Scanner 8 km
ATS 1-4	USA	1966-68 h = 36 000 km	Farbe
LANDSAT 1-2	USA	1972 →	Bildelement am Boden 80 m 4 Kanäle
LANDSAT 3	USA	1978 →	Bildelement am Boden 80 m 4 Kanäle oder Bildelement am Boden 40 m 1 Kanal
SEASAT 1	USA	1978	Bildelement am Boden 25 m Radar-X-Band

Erdbeobachtungssatelliten

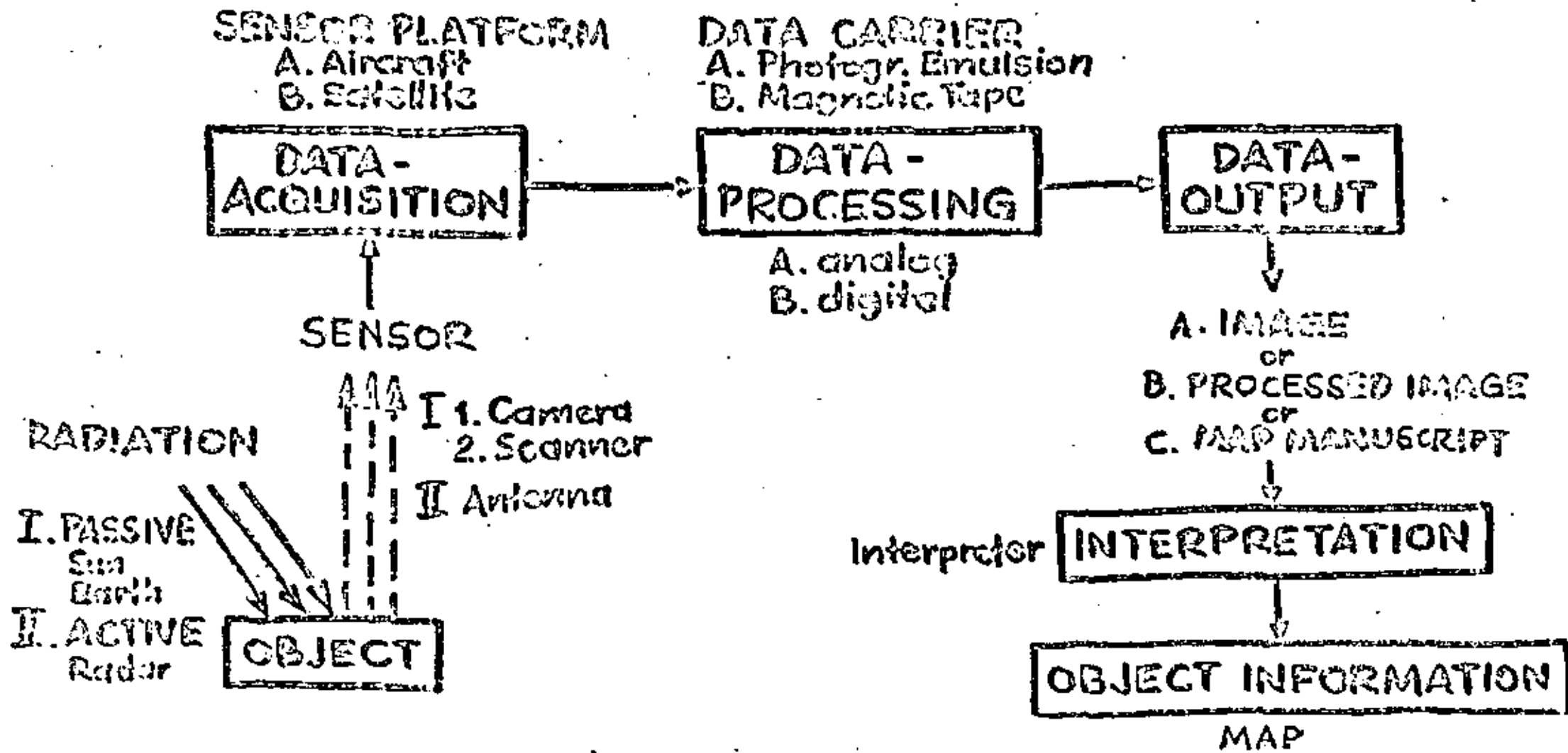
*s. per la percepció n remota*

Name	Land	Zeit	Auflösung
SAMOS 1-~80	USA	1962-1972	15 m Kameras c = 90 cm Filmrücktransport
MIDAS	USA	1967 → h = 3000 km geostationär	c = 90 cm IR,UV sichtbarer Bereich
BIG BIRD	USA	1973 → h = 150 km	1-2 m c = 1,8 m Kameras Filmrücktransport

Aufklärungssatelliten

*s. militares*

# REMOTE SENSING



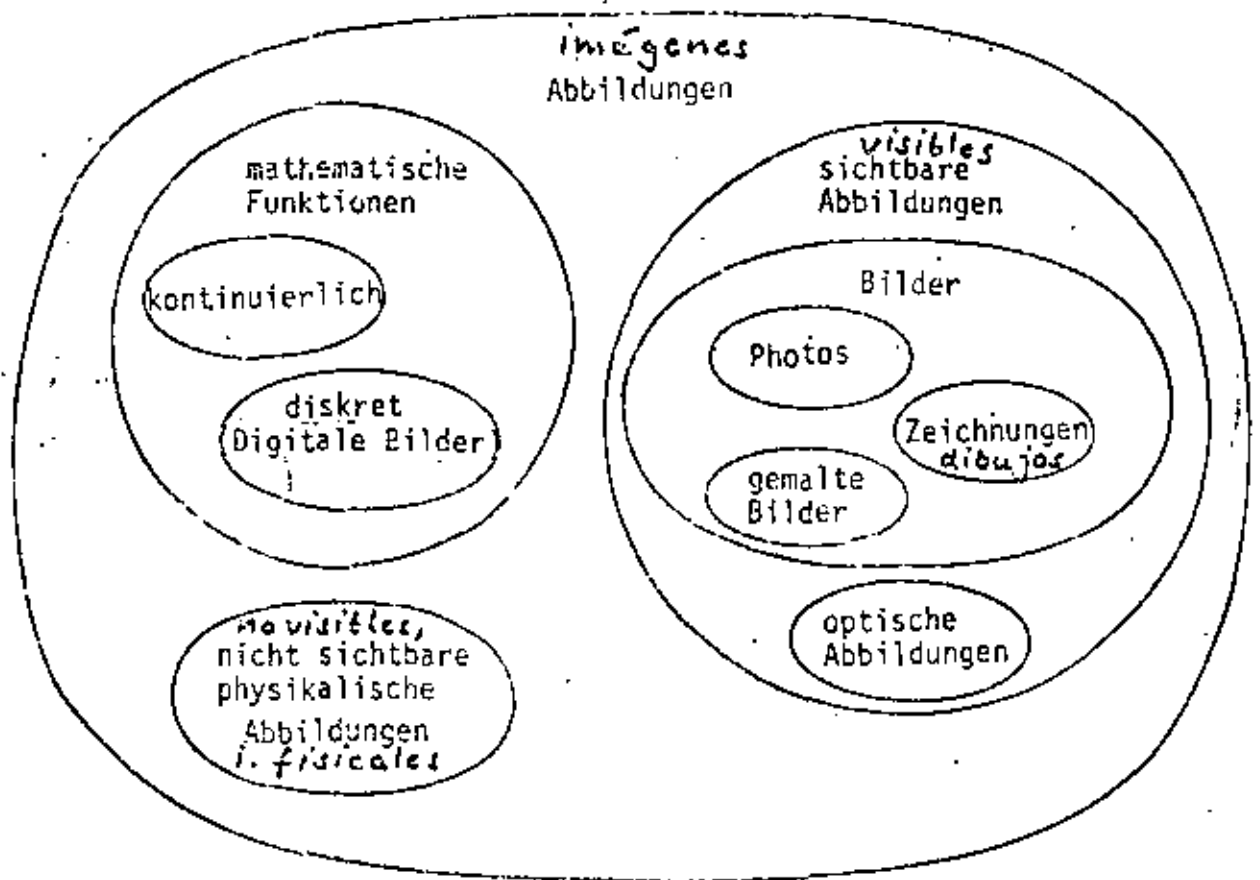
# Percepción Remota (Teledetección)

## Definición:

Recolección y tratamiento de informaciones de objetos distantes sin entrar en contacto directo con ellos

Transmisión por campos de energía

→ Limitación aquí: Sistemas imagen.



Tipos de imágenes (según Castleman)  
Arten von Abbildungen