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Supporting Research

Technical Report

NOTES FOR BRAZIL SAMPLING FRAME EVALUATION TRIP

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PREFACE

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

The work reported herein was sponsored by the Supporting Research (SR) Project under the auspices of the National Aeronautics and Space Administration, NASA. Robert B. MacDonald, NASA Johnson Space Center, was the NASA Manager of the SR Project and Dr. Glen Houston was the Technical Coordinator for the reported effort.

The Environmental Research Institute of Michigan and the Space Sciences Laboratory of the University of California at Berkeley comprise a consortium having responsibility for development of corn/soybeans area estimation procedures applicable to South America within both the Supporting Research and Foreign Commodity Production Forecasting Projects of AgRISTARS.

This reported research, directed at assisting in the evaluation of a Brazil sample frame developed by the USDA/ESS using multi-date Landsat data, was performed within the Environmental Research Institute of Michigan's Infrared and Optics Division, headed by Richard R. Legault, a Vice-President of ERIM, under the technical direction of Robert Horvath, Program Manager.

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INTRODUCTION

The following is a collection of field notes on agriculture taken by Dr. David R. Hicks of the Environmental Research Institute of Michigan during a field trip to southern Brazil from 1 February 1981 to 19 February 1981. Mr. Wayne Gardner and Mr. Van Johnson of the United States Department of Agriculture, Economic and Statistics Service (USDA/ESS) (Fairfax, Virginia) conducted the trip to southern Brazil, in order to evaluate a Brazil sample frame developed by the USDA using Landsat and collateral data for the Foreign Commodity Production Forecasting Project of the AgRISTARS program. Dr. Hicks, at Mr. Gardner's invitation, accompanied them since he had extensive agronomic field research experience in southern Brazil. Dr. Hicks assisted the USDA team in the sampling frame evaluation, provided orientation on the local agricultural scene, served as a translator, and helped to arrange field transportation.

This information is presented as edited field notes with maps which should be of interest to AgRISTARS personnel charged with Brazil corn/soybean area estimation tasks. It is offered as a technical supplement to the formal trip report prepared by USDA/ESS scientists [1] and would be best used in conjunction with that report.

Figure 1 illustrates the itinerary conducted through three southern states of Brazil: Paraná, Santa Catarina and Rio Grande do Sul. Six cities in those states were base locations for two day forays into adjoining agricultural districts. Each study area was examined on the basis of cultivated land area, land in corn and soybeans, field size and soil type. Table 1 illustrates the land use classification code employed. These ground observations were then compared to those derived by analysis of Landsat and collateral data used in the development of the sample frame. The objectives and findings of each expedition are described chronologically in this report under the title of the base city.

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[1] Wayne Gardner and Van Johnson, Brazil AgRISTARS Area Frame Evaluation, Trip Report for February 2-20, 1981, USDA/ESS, April 1981.

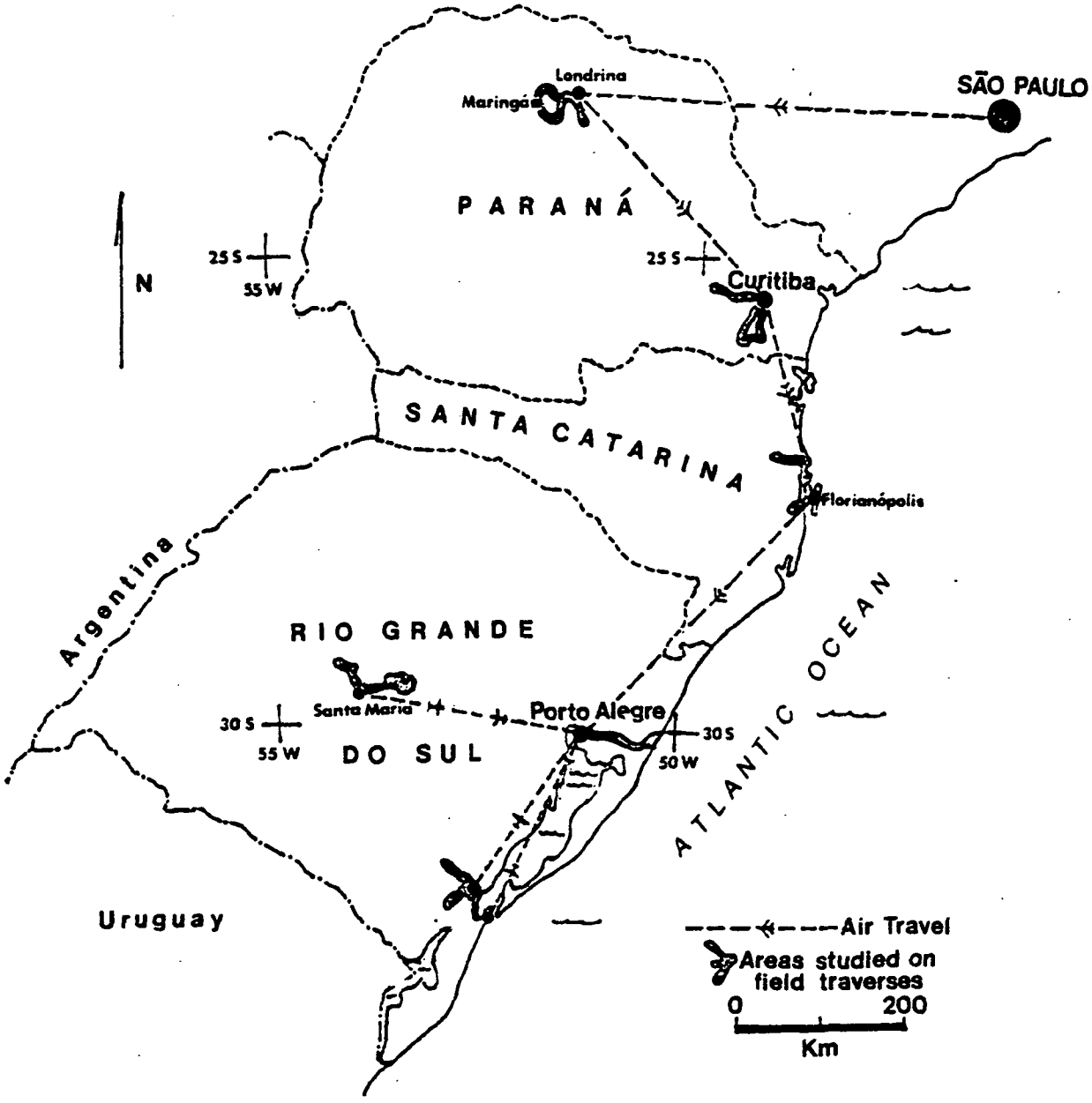

FIGURE 1. USDA SAMPLING FRAME EVALUATION TRIP TO SOUTHERN BRAZIL, FEBRUARY 1981

TABLE 1. AGRICULTURAL LAND USE CLASSIFICATION CODES USED IN BRAZIL

(Example)

0 0 7 4 1 1 2 4 1

First three digits - work unit number
Fourth digit - percentage of total land area cultivated
Fifth digit - percentage of cultivated land in corn/soybeans
Sixth digit - maximum field size
Seventh and eighth digits - soil type
Ninth digit - check

Percentage of Total Land Area Cultivated (Agricultural Density) - Fourth Digit

1,2,3,	<	5%
4		5-20%
5		20-40%
6		40-60%
7		60-80%
8		80-95%
9	>	95%

Percentage of Cultivated Land in Corn/Soybeans (Density) - Fifth Digit

1	<	5%
2		5-15%
3		15-40%
4	>	40%

Maximum Field Size

1	<	100 hectares
2		100-300 hectares
3	>	300 hectares

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LONDRINA AREA

4 February 80 - Irere, 25 km south of Londrina

Imagery Date: 19 October 1977

Objectives: To traverse a selected work unit to check crop density and to ascertain if signatures were correct. About 20% of area in soybeans.

Remarks: Landsat imagery did not show small fields. Field size cannot be reliably determined in zones of small farms.

5 February 80 - Londrina to Maringá

Imagery Date: 19 October 1977 and 7 November 1977

Objectives: At Maringá, a major city west of Londrina, the chief objective was also to ascertain signature validity. Dark soils showed up as dark signatures, pinkish areas were pasture, and red zones were forest. Imagery interpretation results were favorable and major crop types were identified, but coffee can be a problem since dry rice interplanted with coffee bushes cannot always be detected due to lapping effect. Agricultural density was also determined for Londrina-Maringá area. Generally, agricultural density increased westward from Londrina where coffee-corn are major crops. East of Maringá about 20-40% cultivated, fairly close to estimate. Under ideal conditions lapping rows of coffee can have red signature.

East of Maringá row width of soybeans about 12-14 inches. Corn row width is 40-48 inches. Dark red, fine textured terra roxa soils. Coffee is important east of Maringá and most plants were about four years old. However, both older and younger plants were noted. Dry, rice-coffee and corn-coffee interplantings are common in northern Paraná state. In the first week of February some soybeans were observed maturing, yellowing prevalent and thinning canopy. Others are still green with thick canopy. Both observed on same day. Rice at this time has not matured, has chartreuse color. Soybeans are podding but not quite filled out. Corn looks reasonably good near Londrina.

ADDITIONAL INFORMATION

Londrina - 4 February 1981
Interview with Milton Kaster
National Soybean Research Center

Southern Brazil

Two major soybean areas - lower elevations and highland zones.

(1) Lower area includes northern margin of Paraná, and adjacent state of São Paulo. Also western portion of Paraná along Paraná River.

(2) Higher areas include Londrina, southern Paraná (Ponta Grossa too) central Santa Catarina, northern Rio Grande do Sul.

Varieties of soybeans geared to climatic and other ecological conditions

Paraná
Davis leading varieties in lower elevations of Paraná state
Bragg

Santa Rosa is popular variety in areas farther south.

Paraná, Davis, and Bragg varieties account for 75% of planting. Of this, Paraná accounts for 50%, remaining two varieties account for the balance.

Stink bugs (percevejos) are a problem.
Early varieties such as Paraná may be infected with this insect which sucks plant juices -- alternative is semi-late varieties. However, early varieties are planted in lowland areas. Wheat planted fairly early to insure enough precipitation, thus planting "early" or "precoce" soybeans helps offset this problem. However, Kaster suggests that too many "Paraná" soybeans are planted.

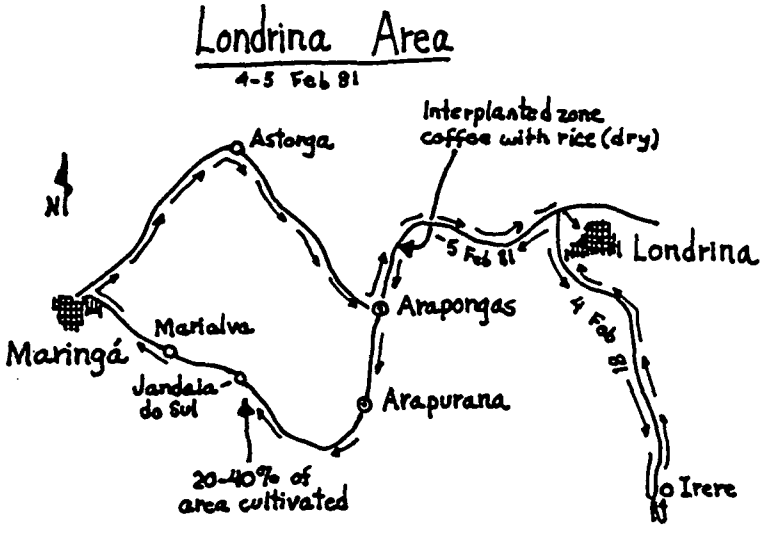
Four Groups of Soybeans Planted

Precocious or Early	- up to 125 days, Bragg, Davis, FT-1, Lancer, Paraná Pérola, (preferred); Campos Gerais and Sant'Ana (tolerated)
Medium	- 126 to 137 days, Bossier, BR-1 (preferred); Flórida (tolerated)

Semi-late - 138 to 150 days, IAC-4, Santa Rosa, São Luís, Vicoja (preferred); Andrews, Hardee, Mineira (tolerated)

Late - over 150 days, UFV-1

Varieties developed from U.S. varieties at first, now developed from Brazilian varieties.


Londrina Area
4-5 Feb 81
Interplanted zone coffee with rice (dry)
Astorga
N
Londrina
5 Feb 81
Arapongas
4 Feb 81
Marialva
Maringá
Jandaia do Sul
Arapurana
20-40% of area cultivated
Irere

CURITIBA AREA

Objectives: To determine validity of classification of small-scale agriculture signatures and density of crops. Results were generally favorable. Crop densities were also accurately obtained. However, in grassland or campo areas to the west, classification was too high. Checking on agricultural density in campos was second objective but met with poor results. Campo classified as agriculture, pink signature. Large random fields, barley, soybean, wheat, some dry rice. Campos 5% cultivated.

6 February 1980 - Curitiba and westward:

Imagery Date: 12 September 1977

Several types of soils were observed; black topsoil, light red, even gray - little pattern from place to place. Corn observed approaching Segundo Planalto, is intense cultivation and is manually harvested, considerable pasture, forests (araucarias included). On high campos farther west, soybeans and corn observed, but dry bean production also significant.

Soybean production has increased 200 percent near Palmeira west of Curitiba.

Soybeans are rather small, lower and less advanced than around Londrina. These are semi-late or late varieties. Planting dates are later, climate is cooler and soils are less fertile. Not much dry rice or livestock observed.

Ponta Grossa is soybean center with scattered surrounding production zones. Dry beans are also important and typify much larger surrounding area. Intensive small property bean cultivation in northwestern zone. Large-scale but less intensive cultivation elsewhere in the zones. Dry rice also important in northwest.

7 February 1980 - Curitiba southwestward:

Imagery Date: 16 October 1979

Southwest of Curitiba: Industrial parks, Petrobras refinery, forest areas. After crossing Rio Iguaçú, German colonial agriculture becomes important; lots or corn, dry rice. Fields are small, but well tended

and crop canopy is thick. Potatoes are a major crop near Contenda. Many fields cleared or plowed following very recent potato harvest. Can probably be identified by dark color on imagery. Floodplain areas are significant. About 5 miles northeast of Lapa - hilly, small-scale diversified agriculture gives way to larger farms and more extensive land use. Livestock ranching some corn and extensive large fields (cleared) were observed. These fields have dark signatures on imagery and can be easily identified as can marshy floodplain areas. More intensive agriculture observed between Lapa and Campo do Tenente. Corn, dry rice still prevalent. From Campo do Tenente to Curitiba-pasture, forest common-then more intense agriculture. Small fields, corn, dry rice noted south of Areia Branca do Assis. Toward Curitiba more forest and less farming.

Imagery Signature Notes

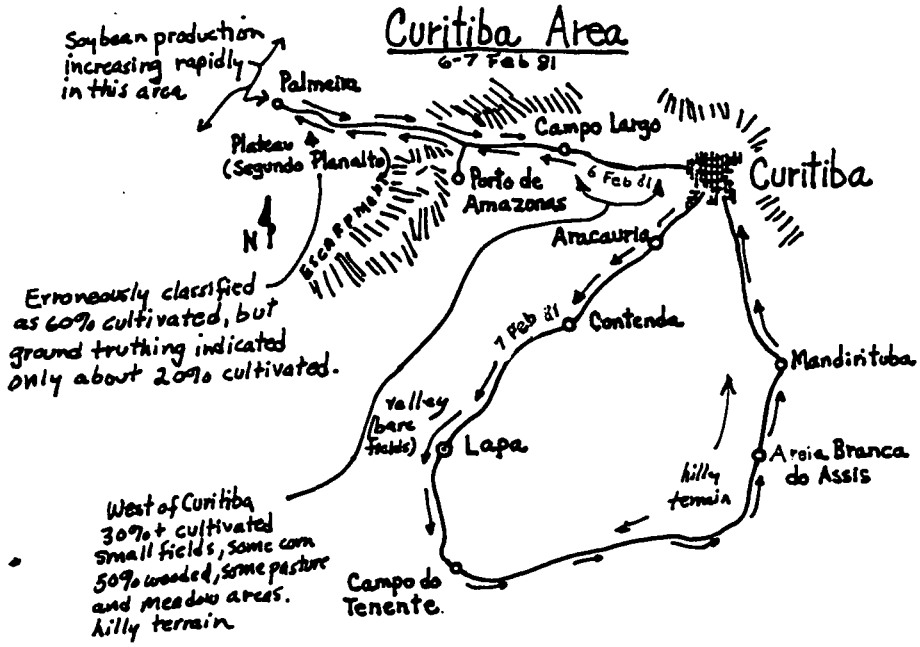
gray	-	urban areas
yellowish areas	-	growing crops in early stages of development
pasture	-	pinkish hue
reddish	-	crops in advanced stage, but unsure
red	-	forest areas - these can be positively identified
black-dark gray	-	freshly plowed fields, prior to significant emergence
black-dark gray	-	floodplain areas - also marsh can be incorrectly identified as agriculture. This was positively noted on imagery.

Small rivers can be difficult or impossible to detect but red forested margins may give clues.

Secondary roads also difficult to detect, especially if they are unpaved.

Large rivers that are muddy (terra roxa near Londrina) also difficult to detect because of color.

The high plateau grazing area (campo) west of Curitiba was classified as 40-60% cultivated. This estimate was much too high for plateau areas in southern Brazil where properties are large and where the principal rural land use is livestock raising. Actually, only 20% of the zone was cultivated. Knowledge of where major crops are grown as well as the use of topographic maps may help reduce this error in some cases. In some cases the color of signature alone, was not enough to make accurate agricultural land use determination.


Curitiba Area
6-7 Feb 81
Soybean production increasing rapidly in this area
Palmeira
Plateau (Segundo Planalto)
Campo Largo
Porto de Amazonas
6 Feb 81
Curitiba
Escarpment
N
Araucaria
Erroneously classified as 60% cultivated, but ground truthing indicated only about 20% cultivated.
7 Feb 81
Contenda
Mandirituba
valley (bare fields)
Lapa
Araucaria Branca do Assis
hilly terrain
West of Curitiba 30%+ cultivated small fields, some corn 50% wooded, some pasture and meadow areas. hilly terrain
Campo do Tenente

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FLORIANOPOLIS AREA

Objectives: Objectives were multiple:

To determine the type of agriculture that is found from Florianópolis southwest to Santo Amaro de Imperatriz. This included checking to see if low-density agriculture typified this zone. Imagery classification showed that one area en route to Santa Amaro de Imperatriz was 20-40% cultivated, while areas adjacent to the town were lower in terms of area cultivated. Field work objectives, in part, were to determine this agricultural density and compare it with analysts' estimates. Also, determination had to be made of agricultural potential in the Florianópolis area, especially along the coast.

To check pink signatures to see if these areas were in fact cultivated; and to check land use differences between light and dark signature areas. This involved a coastal trip northward (on the mainland) from Florianópolis.

Imagery Date: 9 November 1976

9 February 1981 - Traverse along west side of Santa Catarina Island north from Florianópolis. Sparsely populated zone except for resort development in some areas. Some scattered pasture and sugarcane noted. Nothing significant. Backyard gardening around isolated farmsteads.

10 February 1981 - Field trip to Santa Amaro de Imperatriz

Main Traverse route subdivided into six segments according to imagery signature.

Segment 1 - Heavily populated urban fringe of Florianópolis. Urban area is expanding - hilly topography. Agriculture non-existent, flat terrain used for residential, commercial and industrial use. Clay areas in zone, show up as white signature. Urban area is gray or white.

Segment 2 - Very little cultivation; 0-5% cultivated. Garden plots extremely small. What agriculture that exists is found in open areas. Some fields of corn, manioc, beans, and sugarcane noted. Pinkish signature.

Segment 3 - More intensively cultivated. 40% corn and sugar, 20% bananas, remainder in other crops.

Segment 3- More intensively cultivated than previous zones, 5-10% of total area. Of this 40% of area in corn and sugarcane and about 20% in bananas. Other less important crops noted but they cover much less area. Small plots.

Segment 4 - Cultivation declines to about 5% of area. Small plots on farms typify the scene.

Segment 5 - Valley entered which is about 2-4 miles wide. Pinkish area was sugarcane. This zone was 80% cultivated and was classified by analysts as pasture. Such a case shows that the analysts did a good classification job, but agronomic understanding with this classification effort probably would have prevented the erroneous classification.

Segment 6 - Mottled pink and white signatures indicate pasture and settled areas, respectively. Sugarcane planted along interfluves between hills. Pink and red signatures noted in these areas.

From Florianópolis to Santa Amaro de Imperatriz:

Urbanized area of Florianópolis gives way to hilly forest zone with some pasture. Agriculture increases toward Santa Amaro de Imperatriz and then declines. Great variety of crops grown, includes hillside cultivation of corn. Manioc and jaipí (also a type of manioc) are grown where terrain is more level, but topographic relief is pronounced in most areas. Small farms are the rule and polyculture rather than the production of a specific crop is the rule. However, corn production is significant. Few soybeans observed, they are grown elsewhere in Santa Catarina state.

Coastal area from Florianópolis north to Brusque turnoff:

Zone is mainly pasture and forested hills. Nice scenery. Some corn and dry rice fields noted. However, sugarcane is the most important crop. It is grown along the lower course of Rio Itajaí do Sul and in interfluve areas of the Serra do Mar (coastal mountain range). Sugarcane growing in this area was misclassified as pasture. Irrigated rice is also grown in some river floodplain areas. At the time of field work mechanized harvesting was underway.

ADDITIONAL INFORMATION

Interview at Ministerio da Agricultura with
Engineer Otto Meyer

Florianópolis, 11 February 1981

In Santa Catarina state, 1980/81 crop year:

Soybeans

510,000 hectares planted with 704,000 tons expected to be harvested. Projected yield is 1,300 kilograms per unit area. Soybean areas of Santa Catarina mainly located in central and western part of state. Campos de Lajes in the central-south is a major production zone. Soybeans exported through São Francisco, Santa Catarina or Paranaguá, Paraná. Government attempting to diversify agriculture, so as to ensure food supply and eliminate excessive dependence on soybeans. However, Santa Catarina is a modest producer compared with Rio Grande do Sul or Paraná states.

Corn

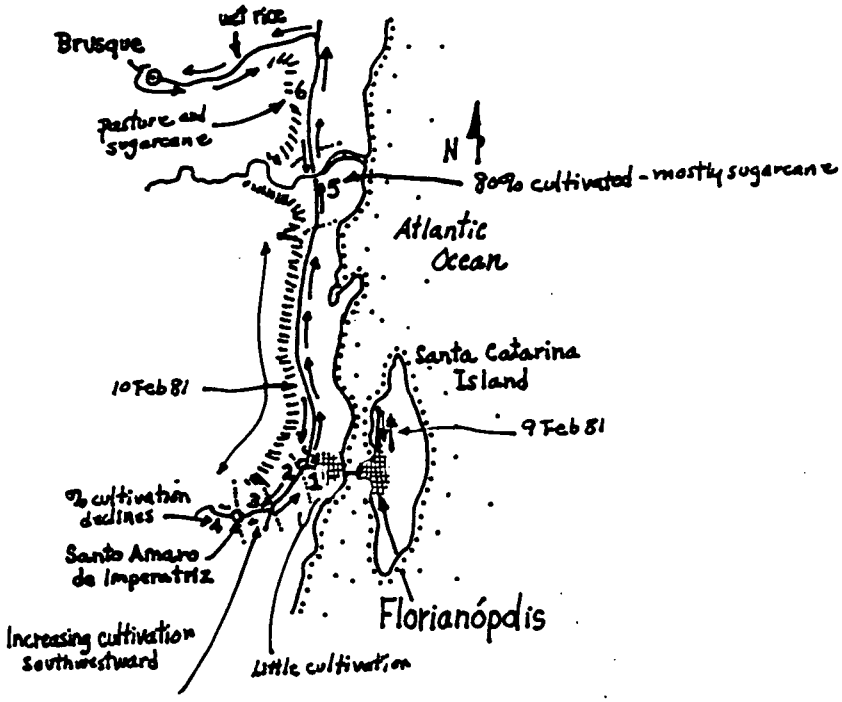
1,223,000 hectares planted-area double that of soybeans. 3,780,000 tons expected to be harvested. Yield is over 3 tons per hectare. Santa Catarina is second only to Paraná in corn production. Corn grown throughout the state, but is mainly concentrated in the west. Western part of state is expanding agricultural zone.

Wheat

Problems continue with production, e.g., disease excessive rain, hail, and even drought. 34,000 hectares planted 1979/80 crop year 1980/81 crop being marketed 19,265 hectares planted but only 12,700 hectares harvested. Less than 70% harvested due hail, wind, rain and drought.

Florianópolis Area

9-10 Feb 81



PELOTAS AREA

Objectives: To answer specific questions regarding imagery signatures in the Pelotas area and to become familiar with agriculture in the zone. Specific objectives were to:

Determine agricultural use of wetlands southeast of Pelotas to Rio Grande and to note the condition of wet rice in the zone. This was achieved to some extent by aerial observation prior to landing at Rio Grande and through travel by car to Pelotas.

Ascertain whether Rio Piratini valley area was actually cultivated or forested in one specified zone (valley was forested).

Ascertain if large fields west of Pelotas were actually forest (this was confirmed, eucalyptus forest).

Determine signature of orchard areas near Cangussu (orchards could not be detected on Landsat; this was determined through ground truthing).

Determine if pink signatures were cultivated areas, and if so, what type of cultivation.

Imagery Date: 11 December 1977

12 February 1981 - Pelotas to Pedro Osório to Cangussu and return:

Pedro Osório turnoff, (from Highway BR-116) - Lighter mottled pinkish signatures were planted fields. 75% soybeans, 25% rice. Riceland pasture was light, bluish signature, dark red was thicket area or forest along river (galeria forest). Much riceland was fallow but rice terraces were numerous. Along highway (BR-116) about 15% of land cultivated.

From Pedro Osório north, rolling grazing land and some thicket. 5-10% cultivated.

Along Highway 293 east toward Pelotas, land was heavily cultivated, around 80%, but imagery classification indicated only 5-20% cultivated. Indicates problems with Landsat in some field areas with diversified agriculture. At junction (Highway 293 and BR-116) corn and soybeans important; fairly heavily cultivated but no percentage available. Of cultivated area 75% is corn, 15% is in soybeans.

A second traverse was made from Pelotas northwest to Cangussu, an important peach-growing area, as well as a zone of small-scale diversified agriculture. Geologically, the zone is a granitic shield, weathered and worn down. Vegetation sparse in some areas. The zone is radically different than the geologically recent rice-growing areas closer to the Atlantic Coast (Pelotas, Rio Grande areas). The region is quite hilly and is 5-20% cultivated in some areas. Other adjacent areas increase to 20-40% cultivated with manioc, potatoes, fruits, beans, and corn being grown. However, corn is the dominant crop (80% area cultivated). *Imagery signatures in the Cangussu area were:*

grayish-white - exposed rock (granite, heavily weathered sandstone)

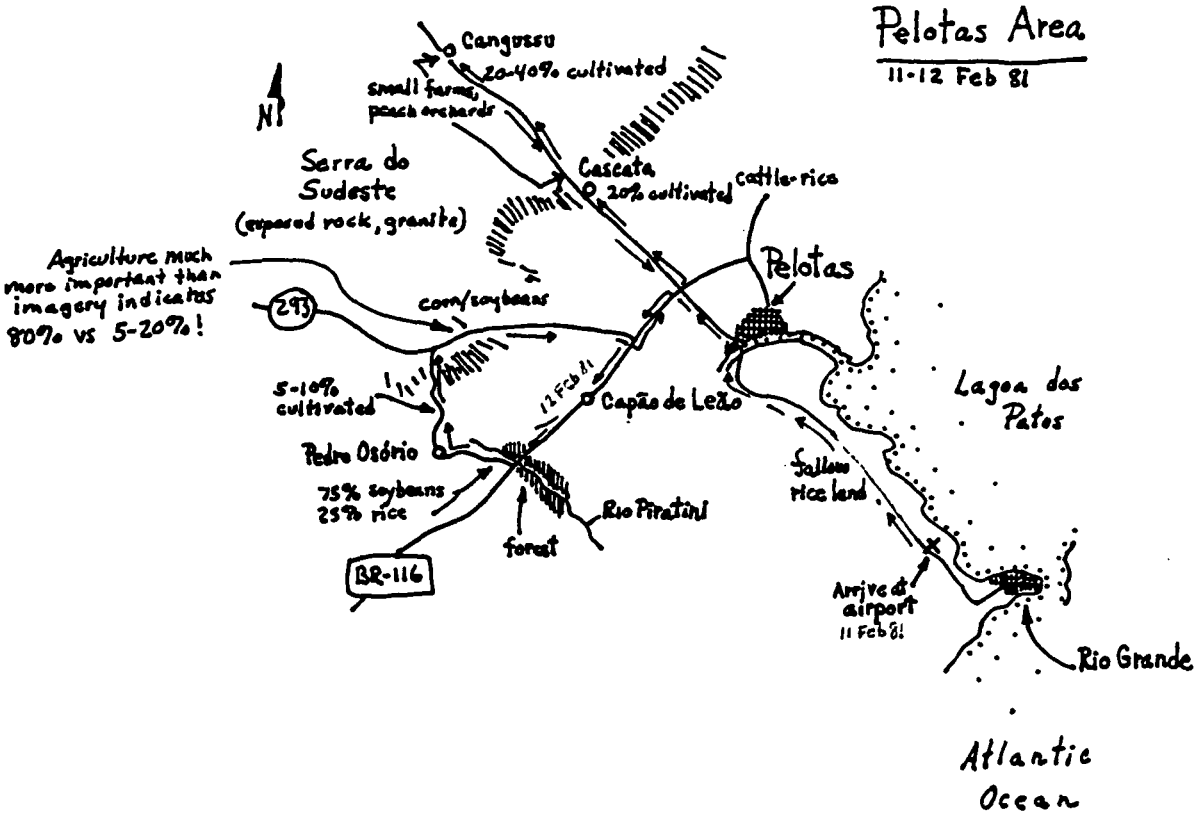
dark pink - orchards (but only detectable through ground truthing)

red - forest

blue-green - natural grass

dark green - soil tones

The Pelotas agricultural zone is topographically and agronomically diverse. Large rice-livestock properties are found in the coastal lowlands while small properties (diversified agriculture) characterize the hilly, rocky interior zone (Cangussu). Peach orchards noted between Cascata and Cangussu. Dry leaves were noted on trees in peach orchards. Orchards not well maintained by U.S. standards. Many rice fields in lowlands were fallow as previously noted. Also, soybean cultivation is expanding rapidly around Pedro Osório.


Pelotas Area
11-12 Feb 81
N
Cangussu
20-40% cultivated
small farms, peach orchards
Serra do Sudeste
(exposed rock, granite)
Cascata
20% cultivated
cattle-rice
Pelotas
Agriculture much more important than imagery indicates 80% vs 5-20%!
293
corn/soybeans
5-10% cultivated
12 Feb 81
Capão do Leão
Lagoa dos Patos
Pedro Osório
75% soybeans
25% rice
fallow rice land
Rio Piratini
forest
BR-116
Arrive at airport
11 Feb 81
Rio Grande
Atlantic Ocean

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PORTO ALEGRE AREA

Objectives: To determine analyst accuracy with respect to signatures in different terrain and landholding size zones. Specifically, differences were to be investigated in a traverse from Porto Alegre eastward for about 80 kilometers. Rolling terrain (very hilly in some parts) with small-farm diversified agriculture were noted, as were large rice-cattle properties on Atlantic coastal plain.

Porto Alegre and eastward - 15 February 1981

Imagery Date: 11 December 1977

Four zones were traversed:

Porto Alegre Urban Fringe to Viamão:

Zone is heavily populated with low-income residences. Some gardening, scattered stands of eucalyptus, and considerable areas of erosion and deforestation resulted in a white mottled signature indicative of bare soil. In addition, numerous unimproved roads and streets in the zone reinforce this signature. The point is made that bare field agricultural areas may be confused with urban fringe areas, thus analysis of the local scene is important.

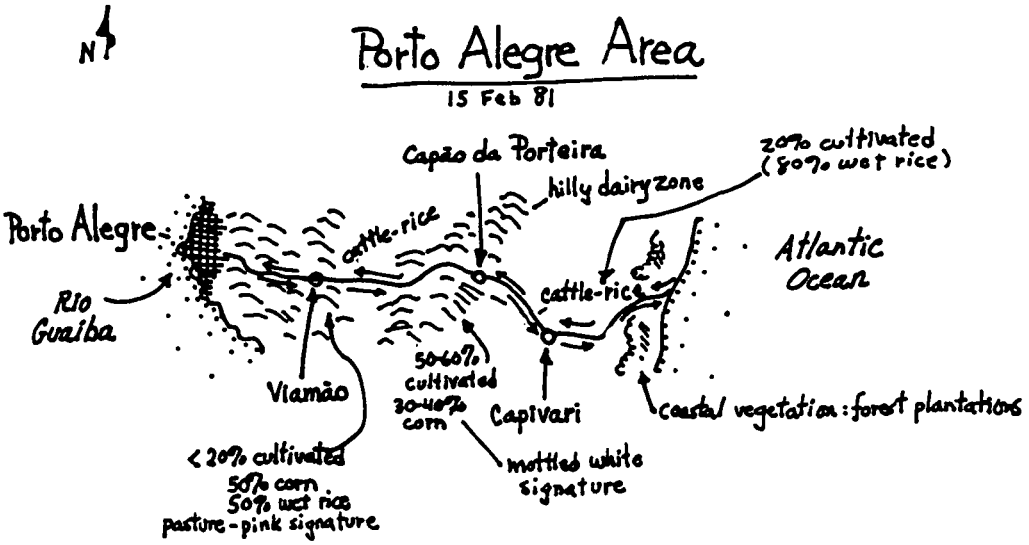
Viamao eastward toward Capão da Porteira:

From Viamão eastward: rolling plains with some trees and lowlands to north and south comprise the scene. Pasture and dairying were noted but less than 20% of the total area was cultivated. Corn and garden crops present, but few soybeans were noted as major soybean zone of Rio Grande do Sul begins about 200 km northwest of Porto Alegre. Of 20% cultivated 50% is in corn and 50% is in wet rice (the latter is confined to lowland areas). Pastures have pink signature. Zone is overwhelmingly dairy cattle pasture in terms of land use. Small fields. Hilly, upland zone was traversed near Capão da Porteira and was more intensively cultivated. About 50-60% of zone was cultivated. Major crops included corn, manioc and sugarcane. About 30-40% of planted area was in corn. Resulting imagery signature was a mottled whitish one. Very pronounced signature. Small fields.

Capivari eastward to Atlantic coastal plain:

Wet rice and pasture dominate rural land use and large fields are the case. However, much of the riceland zone was fallow, thus production was not intense. Slightly more than 20% of total area was

cultivated of which wet rice accounts for 80% of total. Corn comprises the remaining 20% of zone's agriculture. Pink signature again denoted pasture which was the dominant land use. To the east, forest plantations also noted which resulted in usual red signatures. East of forest areas coastal lagoons, sand dunes and beach dominate. This zone was visited but not formally inventoried since there was no agriculture.


N
Porto Alegre Area
15 Feb 81
Capão da Porteira
hilly dairy zone
20% cultivated
(80% wet rice)
Porto Alegre
cattle-rice
Atlantic
Ocean
Rio
Guaíba
cattle-rice
50-60%
cultivated
30-40%
corn
Viamão
Capivari
Coastal vegetation: forest plantations
< 20% cultivated
50% corn
50% wet rice
pasture - pink signature
mottled white
signature

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SANTA MARIA AREA

Multiple objectives were identified for the Santa Maria area. Traverses made to east and northwest of the city.

Site 1 At Faxinal do Soturno the objective was to ascertain or verify the existence of wet rice cultivation. This zone had a whitish/light beige signature.

Site 2 Agudo - The objective was to ascertain the light pink signature around the town of Agudo, located to the east of Faxinal do Soturno.

Site 3 Objective was to identify the type of agriculture near Camargo, a locale to the southeast of Agudo.

Site 4 Vale de Serra area - Objective was to identify pasture/soybean signature in this zone, located northwest of Santa Maria. Site 4 visited on separate trip.

17 February 1981 - Santa Maria eastward to visit Sites 1, 2, and 3

Imagery Date: late November 1979

From Santa Maria east to road north (to Faxinal do Soturno) pasture, soybeans and wet rice were noted. Zone was about 20-40% cultivated. Fields fairly large and soybeans were dominant crop. Wet rice also noted, but condition of crop was not good, indicating bad weather or neglect. The zone is interesting geographically. To the north is east-west aligned escarpment (Serra Geral) which marks southern boundary of the Central Plateau of Rio Grande do Sul (in reality plateau is situated in north-central part of state). To the south is the Central Depression (wet rice); to the west, cattle country in the rolling plains of the campanha. Except for Site 4 (on the plateau) the area ground truthed was a transitional piedmont zone between Serra Geral escarpment and Central Depression. Outliers (heavily vegetated sandstone hills) were noted. Also, the Jacuí River flows through the zone giving the Faxinal do Soturno area a varied physiographic setting. Same is true of nearby Agudo and Camargo.

As Faxinal do Soturno and the Serra Geral escarpment was approached, the percent of land cultivated increased to 70% - very high. Rice (wet) in lowland areas, as well as corn and soybeans, were the chief crops observed. Percentage breakdown was about 50% wet rice and 50% corn/soybeans. Soybeans continued to increase as Faxinal do Soturno was approached to extent that 75% of cultivated area was in corn/soybeans. Corn grown on hillsides in many cases, while soybeans planted in more level areas. Also, an area that was classified as rice on the imagery was in fact soybeans. Signature had whitish color. Upon questioning the driver about the possibility that wet rice had been planted in the zone in 1979 rather than soybeans, he stated that soybeans had probably been planted in the fields in question since 1975. In immediate vicinity of Faxinal do Soturno about 80% cultivated, nearly all in corn/soybeans. Fields were generally small in the zone although occasional large fields were noted. Area is an old colonization zone populated by persons of German descent. In general, farming methods and productivity were very advanced and high, respectively, by Brazilian standards. The presence of so many soybean fields in a former wet rice zone indicates the spread of soybean cultivation from areas to the north in recent years.

Eastward to Dona Francisca (on the Rio Jacuí) the percentage of cultivated area declines, then increases abruptly on the river floodplain. along the floodplain 95% of area cultivated. Well over half of the area was in wet rice (60%) and the remainder in corn/soybeans.

Continuing eastward (crossing the Rio Jacuí) to Agudo 60-70% of land was cultivated. Of area cultivated about 1/3 of land was in wet rice, 1/3 in corn, and 1/3 in soybeans. Remaining land included forest, pasture and small vegetable plots near houses (dooryard gardens). Rural population density is high and the area is quite progressive. The team continued southeast (upon arriving in Agudo) toward Camargo. Similar conditions prevailed with about 60% of total area being cultivated.

Camargo west to Santa Maria:

The return leg of the trip began with a recrossing of the Rio Jacuí (about 10 km south of first crossing). At the point of recrossing the river, it was noted that 80% of the land was cultivated (floodplain and margins) of which 75% was in wet rice. However, immediately west of the river virtually all of the land cultivated was in corn/soybeans (75%). In earlier trip to Brazil (1977) I noted this same floodplain agriculture pattern farther downstream.

Imagery Signature Notes

White indicates soybeans (plowed fields - newly planted).

White/beige indicates sandy soils of areas, possibly sandstone outcrops (hills) when large enough to be detected.

Pinkish indicates pasture.

Red indicates forest areas along margins of Serra Geral escarpment.

18 February 1981 - Santa Maria north to Vale de Serra and vicinity (Site 4)

Imagery Date: 19 October 1979

The team traveled north from Santa Maria to Vale de Serra atop the southern margin of the Serra Geral escarpment. Enroute about 20% of the hilly escarpment zone was noted as being cultivated. Of 20% cultivated, 75% was corn (hillside plots, nearly all small fields). The remainder was planted in soybeans (also small fields). However, much of zone is too hilly for large-scale mechanized agriculture. Most of area is forested, although isolated pastures and subsistence garden plots were noted. Change in elevation from Santa Maria to Vale de Serra is roughly 500 meters depending on exact location. During the ascent, numerous interfluves in the escarpment were noted. The plateau area is much different -- rolling plains, isolated stands of trees, and large fields. Extensive livestock pasture areas dominate and stretch to horizon, but scattered among pasture are sizeable soybean fields. Sites 1, 2, and 3 which were previously discussed, are small-scale farming zones. A great variety of crops are grown, much of it for subsistence. Site 4, in contrast, is a zone of large properties -- cattle production and soybean cultivation with mechanized harvesting. Site 4 northwest of Vale de Serra was less than 20% cultivated (compared to 60-70% cultivated in the adjacent lowlands). However, 80% of that area was denoted to soybeans -- random large soybean fields in pasture zone. Hereford and Charolais cattle dominate.

Signature Notes

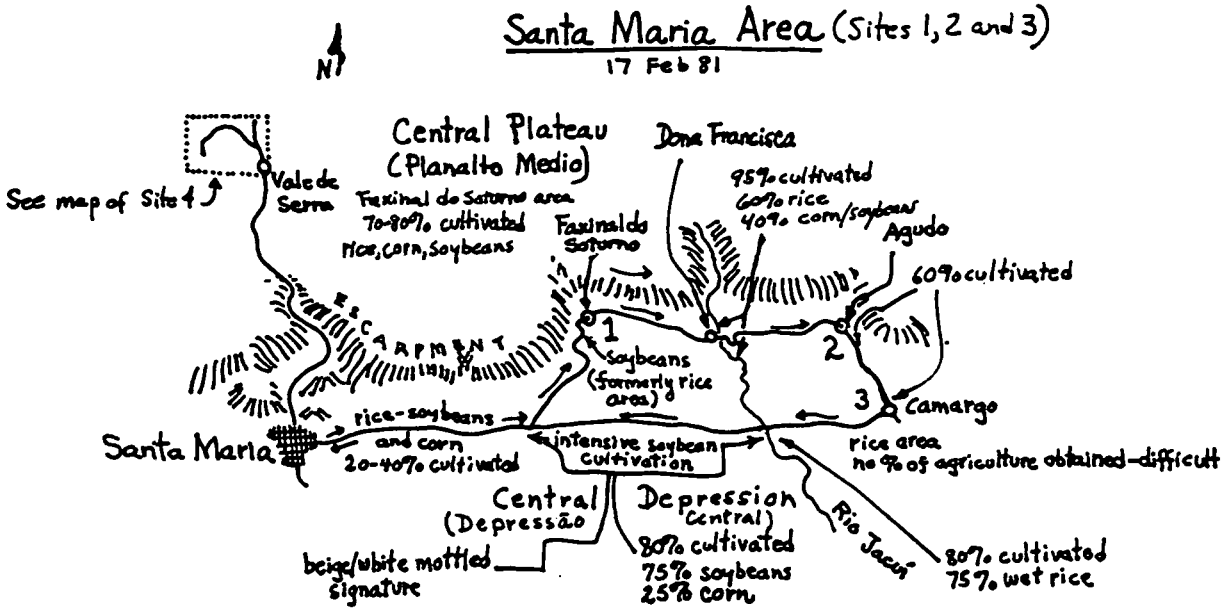
red - forest areas (noted while ascending escarpment)

pink - natural pastures on the plateau

yellowish/light amber - very recently plowed soybean fields, fields just planted (prior to emergence), or bare soil (not plowed), evidence indicates fields shifted since imagery date (1979) due to field rotation with pasture.

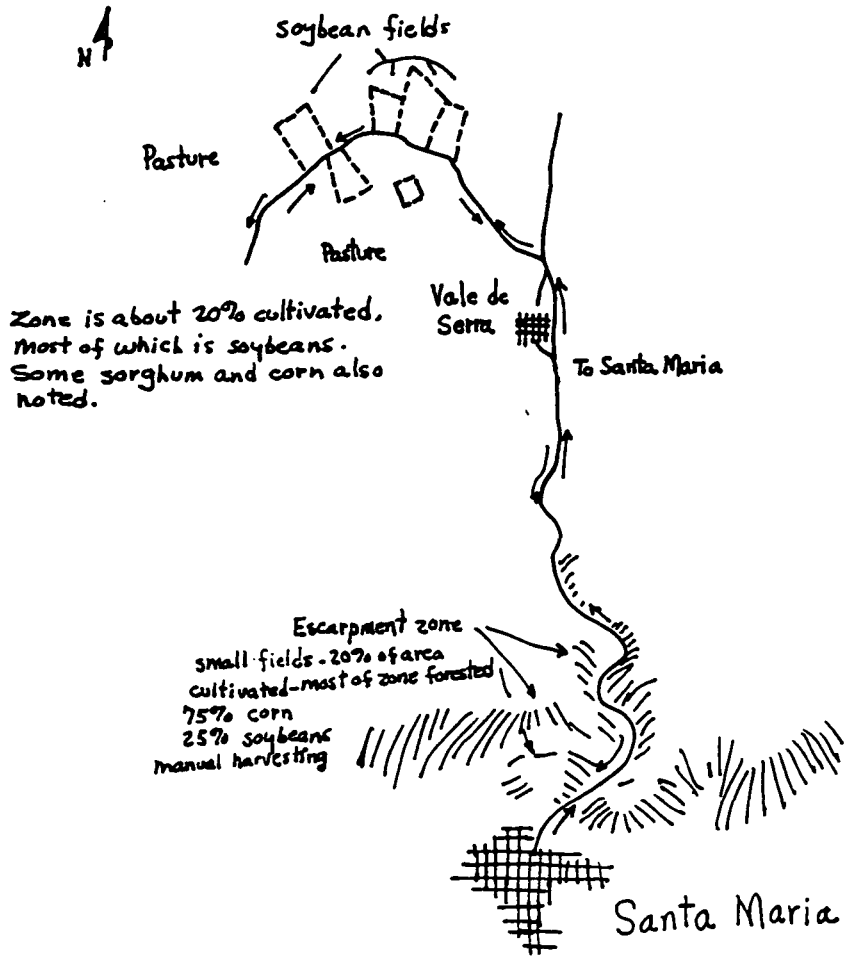
Santa Maria Area (Sites 1, 2 and 3)

17 Feb 81



Santa Maria Area (Site 4)

18 Feb 81



BRAZIL-ARGENTINA SOIL SAMPLE COLLECTION SITES
FEBRUARY 1981

BRAZIL

Parana state

Sample taken about 25 km south of Londrina at Irere
Sample taken about 65 km west of Curitiba (east of Palmeira)
Sample taken about 50 km south of Curitiba (Areia Branca do Assis)

Santa Catarina state

Sample taken about 25 km southwest of Florianópolis at Santo Amaro de Imperatriz
Sample taken about 15 km east of Brusque (90 km NNW of Florianópolis)

Rio Grande do Sul state

Sample taken about 35 km southwest of Pelotas at Pedro Osório
Sample taken about 30 km northwest of Pelotas (between Cangussu and Cascata)
Sample taken about 55 km east of Porto Alegre (Capão da Porteira)
Sample taken about 40 km ENE of Santa Maria (5 km east of Faxinal do Soturno)
Sample taken about 35 km north of Santa Maria (8 km northwest of Vale de Serra)

ARGENTINA

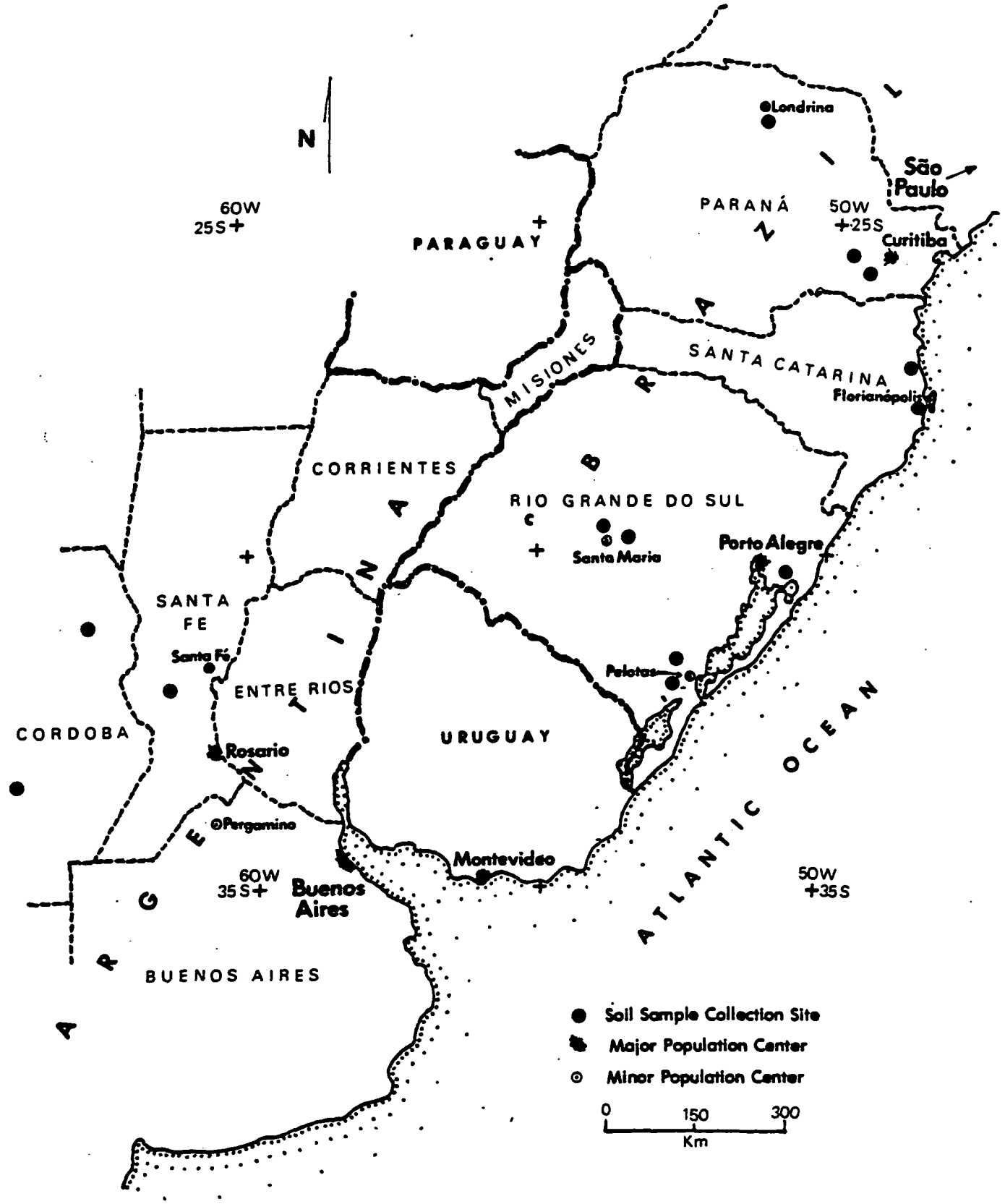
Córdoba province

Sample taken in center of Segment 611 (Río Cuarto)
Sample taken in eastern portion of Segment 616 (San Justo)

Sante Fé province

Sample taken in southern portion of Segment 677 (San Martín)

SOUTHERN BRAZIL/EASTERN ARGENTINA



GLOSSARY OF AGRONOMICALLY-RELATED TERMS FOR ARGENTINA AND BRAZIL

GENERAL TERMS

English	Spanish	Portuguese
agriculture	agricultura	agricultura
cattle	ganado	gado
county	partido	município
crop	cultivo	cultivo
crop (field of a crop)	campo	lavoura
crop-livestock (pertaining to)	agropecuaria (o)	agropecuária (o)
crop rotation	rotación de culturas	rotação de terras
harvest	cosecha, zafra	colheita, safra
livestock	pecuaria	pecuária
seed	semilla	semente

CROPS

barley	cebada	cevada
cereals	cereales	cereais
corn/maize	maíz	milho
flax	lino	linho
forage	forraje	forragem
oats	avena	aveia
oilseeds	oleaginosos	oleaginais
pasture	pasto	pastagem
peanuts	maní	amendoim
rye	centeno	centeio
sorghum (grain)	sorgo granífero	sorgo granífero
sorghum (forage)	sorgo forrajero	sorgo forrageiro
soybeans	soja	soja
wheat	trigo	trigo
winter wheat	trigo invernal	trigo de inverno

GEOGRAPHIC TERMS

drought	sequía	sêca
dry season	estación seca	estação sêca
hill	loma, cerro, cuchilla	morro, coxilha
lagoon	laguna	lagoa
lowland (floodplain)	tierra baja	terra baixa, várzea
marsh/swamp	pantano	pantanál
mountain range	sierra	serra
plain	llano, pampa	campo, campanha
river	río	rio
valley	valle	vale

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15. Supplementary Notes

Dr. Glen Houston/SH2, served as NASA Technical Coordinator of the effort, which was carried as a part of the Supporting Research Project of the AgRISTARS program.

16. Abstract

Field notes describing a trip conducted in Brazil are presented. This trip was conducted for the purpose of evaluating a sample frame developed using Landsat full frame images by the USDA Economic and Statistics Service for the eventual purpose of cropland production estimation with Landsat by the Foreign Commodity Production Forecasting Project of the AgRISTARS program. The author provided technical support to the expedition team comprised of two USDA/ESS scientists. Six areas were analyzed on the basis of land use, crop land in corn and soybean, field size and soil type. The analysis indicated generally successful use of Landsat images for purposes of remote large area land use stratification.

17. Key Words	18. Distribution Statement
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