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A Joint Program for Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing

October 1981

TECHNICAL REPORT

1981 ARGENTINA GROUND DATA COLLECTION

David Hicks, Buzz Sellman, Edwin Sheffner, Gene Thomas, Byron Wood

ERIM
ENVIRONMENTAL RESEARCH INSTITUTE OF MICHIGAN
ANN ARBOR, MICHIGAN

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SPACE SCIENCES LABORATORY
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BERKELEY, CALIFORNIA

UNITED STATES DEPARTMENT OF AGRICULTURE
NASA
DEPARTMENT OF COMMERCE UNITED STATES OF AMERICA
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16. Abstract

This report summarizes the 1981 field work conducted in Argentina for the Agronomic Understanding Task in partial fulfillment of data collection responsibilities to the Supporting Research Project of AgRISTARS. A five-member team from ERIM and UCB spent the latter half of February 1981 collecting crop identification data in 14 segments which is presented in this report. Over 600 fields in the corn, soybean and wheat growing regions of the Argentine pampa were categorized by crop or cover type and ancillary data including crop calendars, historical crop production statistics and certain cropping practices were also gathered. The report includes a summary of the field work undertaken, a country overview, a chronology of field trip planning and field work events and the field work inventory of selected sample segments. In the field inventory, Landsat images were annotated and used as the field work base and several hundred ground and aerial photographs were taken. These items along with segment descriptions are presented. Meetings were held with officials of the State Secretariat of Agriculture (SEAG) and the National Commission on Space Investigations (CNIE), and their support to the program is described.

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1981 ARGENTINA GROUND DATA COLLECTION

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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. Departments of Agriculture, Commerce, and the Interior, and the U.S. Agency for International Development. 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. Mr. Robert B. McDonald, NASA Johnson Space Center, is the NASA Manager of the SR Project and Dr. Glen Houston is the Technical Coordinator for the reported effort.

The Environmental Research Institute of Michigan and the Space Sciences Laboratory of the University of California at Berkely 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 data collection requirements in Argentina, 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, and in the Space Sciences Laboratory at the University of California at Berkeley, under the direction of Dr. Robert N. Colwell, Principal Investigator, and Claire Hay, Project Manager.

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ERRATA

1. Annotated image of Segment 604 (Juárez Celman) - The field located immediately to the east of the village of Olaeta and immediately south of the road, is unlabeled. It should be labeled CR (corn).

2. Annotated image of Segment 611 (Río Cuarto) - Photograph 13 in the western part of the segment is not included in this report. However, the label PA (pasture) is correct.

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1.0

EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report summarizes the 1981 field work conducted in Argentina by the Agronomic Understanding Task in support of responsibilities to the Supporting Research Project of Agricultural and Resources Inventory Surveys through Aerospace Remote Sensing (AgRISTARS). A consortium composed of staff from the Environmental Research Institute of Michigan (ERIM) and the Remote Sensing Research Program of the University of California at Berkeley (UCB) has been assembled to pursue crop inventory research, development, evaluation and testing of Landsat technologies for crop area estimation of several crops in the U.S., Argentina and Brazil. The activities of the Agronomic Understanding Task are essentially to gather a broad spectrum of agronomic data for indicator regions in Argentina and Brazil, and to synthesize the data into needed form for use by researchers working on other aspects of AgRISTARS technology development and testing programs. The Agronomic Understanding Task was initiated in the first quarter of 1981 and planning was immediately begun to collect an agronomic data base for Argentina. A decision was reached in early planning stages to conduct a field trip to Argentina, and that trip took place in February of 1981.

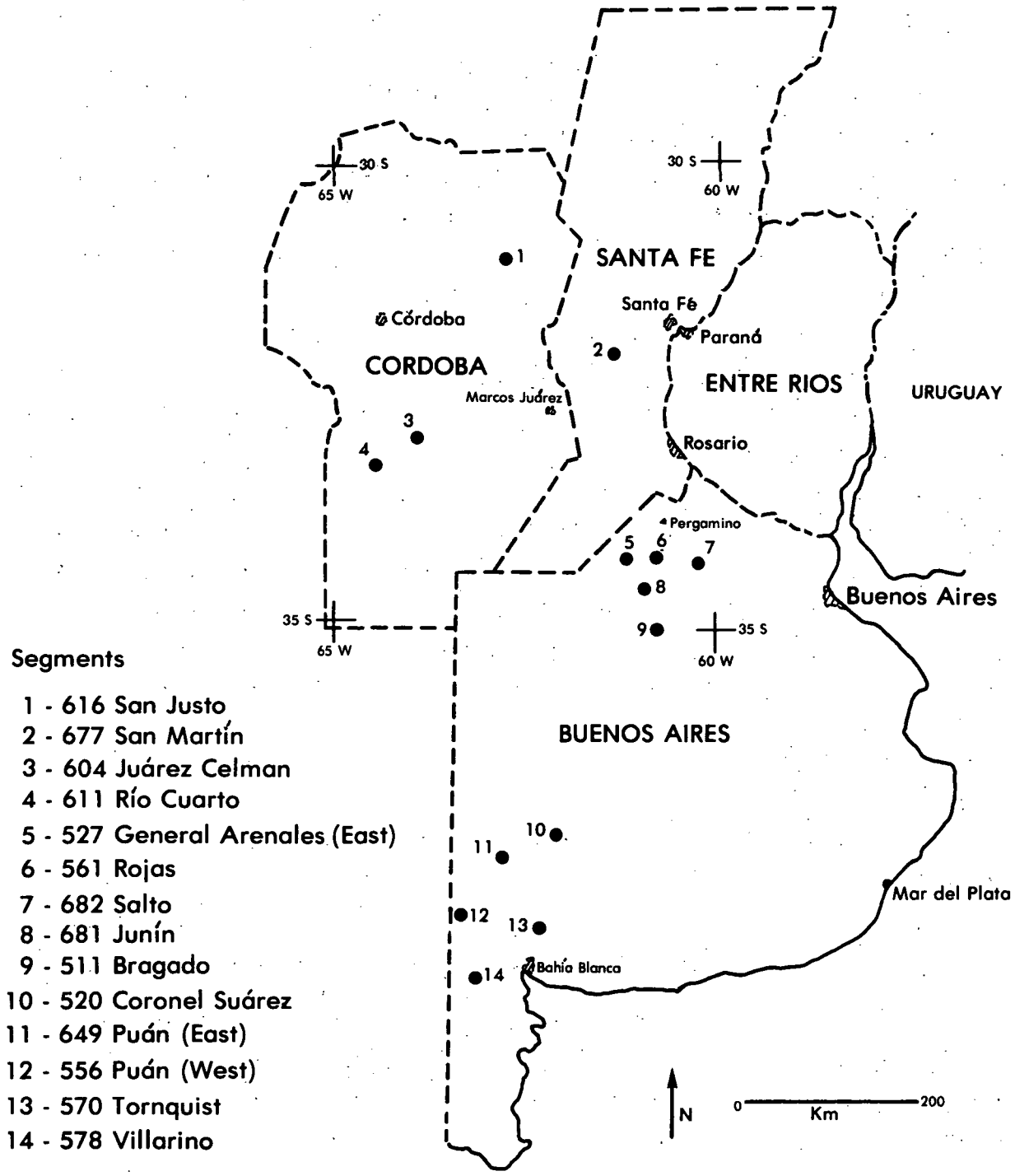
1.2 BACKGROUND

The trip to Argentina in mid-February was in pursuit of the following interrelated objectives:

(a) to become familiar with the problems as well as the opportunities of collecting ground data in support of AgRISTARS program needs.

(b) to collect crop identification data for a number of fields in fourteen 9 x 11 mile sites (see Map 1-1) located throughout the corn, soybean, and wheat growing areas of the Argentine pampa,

MAP 1-1.
LOCATION OF ARGENTINA SEGMENTS WHERE GROUND DATA WERE COLLECTED
18-26 February, 1981



Segments

1 - 616 San Justo
2 - 677 San Martín
3 - 604 Juárez Celman
4 - 611 Río Cuarto
5 - 527 General Arenales (East)
6 - 561 Rojas
7 - 682 Salto
8 - 681 Junín
9 - 511 Bragado
10 - 520 Coronel Suárez
11 - 649 Puán (East)
12 - 556 Puán (West)
13 - 570 Tornquist
14 - 578 Villarino

and to acquire collateral data such as crop calendars, and historical agronomic statistics.

(c) to meet with public officials representing the agronomic and remote sensing community of Argentina in order to familiarize them with our goals and gain their collaborative support for this ground data collection expedition.

(d) to encourage these public officials to consider future involvement in the AgRISTARS program that would be mutually beneficial.

All of the objectives, in our opinion, were achieved.

Upon approval from NASA to proceed with trip planning, two key decisions were reached by the Consortium. First, since the trip to Argentina was the first activity of its kind for the Consortium outside of the U.S. in AgRISTARS, and owing to the short period of time for planning and coordination, a rather conservative plan and limited agenda of field data collection goals was adopted. The team chose to make only roadside observations of a limited number of fields (forty fields per segment was about the average) in each of the fourteen segments selected for a visit. The segments selected represented all of those with cloud-free acquisitions available from Johnson Space Center (JSC) as of late December 1980. Thus the team knew that the segments visited would have some Landsat coverage for the 1980/1981 crop year. Fortunately, the available cloud-free data also covered the major crop group regions (corn, soybeans and wheat) and general agronomic conditions that are of interest in Argentina.

Second, the Consortium sought the assistance of the U.S. Department of Agriculture (USDA) via the Office of International Cooperation and Development (OICD) to secure entry into Argentina and to establish contact with key officials in the State Secretariat for Agriculture and Livestock Raising (SEAG). The Agricultural Attaché in Buenos Aires forwarded preliminary plans and requirements to SEAG in advance of

arrival, and arranged for appropriate meetings and introductions with key officials.

On 16 February 1981, a four member team consisting of Buzz Sellman and Gene Thomas of ERIM and Ed Sheffner and Byron Wood from UCB began the two-week ground data collection program in Argentina. A fifth team member, David Hicks of ERIM, joined the team in Buenos Aires on 20 February.

1.3 ACHIEVEMENTS

The Consortium field team spent a total of fourteen days in Argentina and concluded the following activities:

(1) A total of fifteen segments were visited by the team and field specific crop and/or cover type observations were collected for over 600 fields in fourteen of the fifteen segments. No ground enumeration was performed on the fifteenth segment because the Landsat segment imagery, which served as the image base for annotations, was a year out of date.

(2) Over 500 ground and aerial (oblique) 35mm photographs were taken of fields and ground conditions.

(3) Two soil samples and a small quantity (approximately two kilograms) of hybrid flint corn seed were gathered and transmitted to Purdue University.

(4) Historical crop calendar data for nineteen crops were obtained for the provinces of Buenos Aires, Córdoba, and Santa Fé.

(5) Historical (1975-1979) crop planting acreage statistics for eleven crops were obtained for the provinces of Buenos Aires, Córdoba, and Santa Fé.

(6) Several meetings with both management and technical level staff representing the agriculture and remote sensing agencies in

Argentina were held, resulting in their providing technical and logistical support to the team.

(7) Preliminary information covering crop mixes (confusion crops), cropping practices, technology utilization, and general agricultural land patterns and trends was collected.

(8) The team left with the impression that our Argentinian hosts were genuinely interested in the program and in participation in future year activities.

1.4 SUMMARY

The Agronomic Understanding Task team is satisfied that its first year data collection goals in Argentina were achieved. The timely planning assistance of NASA/JSC and their rapid response to our data needs was very important, as was the assistance and coordination of USDA staff in securing introductions in Argentina and providing other support as needed.

This field trip represents but one step in the overall plan to develop crop area estimation technology applicable to Argentina. The team gained practical experience and first-hand knowledge on agronomic conditions and practices in the corn, soybean, and wheat growing regions of Argentina. The data collected and observations made will provide a useful foundation for current and future year activities.

Perhaps more important, however, is the knowledge that there is considerable interest among key agency officials in Argentina to make productive use of contemporary remote sensing technologies for agricultural planning and management goals. The National Commission for Space Investigations (CNIE) operates a Landsat Ground Station and has developed a sophisticated data processing and analysis center to use Landsat data in support of national resource assessment programs. Further, CNIE and SEAG (now the Ministry of Agriculture and Livestock Raising) are collaborating on a program supported by the United Nations Food and

Agriculture Organization to investigate remote sensing contributions to a wheat production forecasting system. These activities, plus the generous and enthusiastic support received by the team from these two agencies during the field data collection program constitute a sound basis, in our opinion, for a more formal and structured arrangement under which future year program activities can proceed. The Agronomic Understanding Task team believes this is an appropriate time to build on the opportunity that currently exists, and specific observations and recommendations to capture the perceived opportunities are presented in Section 5.

The remainder of this report is divided into four sections. Section 2 presents an agronomic overview of Argentina and Section 3 offers detailed information on trip planning and a summary of daily activities conducted by the team while in Argentina. Section 4 presents the results of the field observations made in the fourteen segments visited, together with annotated Landsat imagery and ground and aerial photography collected in each segment.* Finally, Section 5 presents specific conclusions and recommendations.

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*Some copies of this report contain color images as well as 35mm slides. The remaining copies contain only black and white images and do not include 35mm slides due to cost limitations. The reader is referred to the Distribution List at the back of this report which indicates (with an asterisk) where those copies with color images and 35mm slides reside, should they need to be procured.

2.0

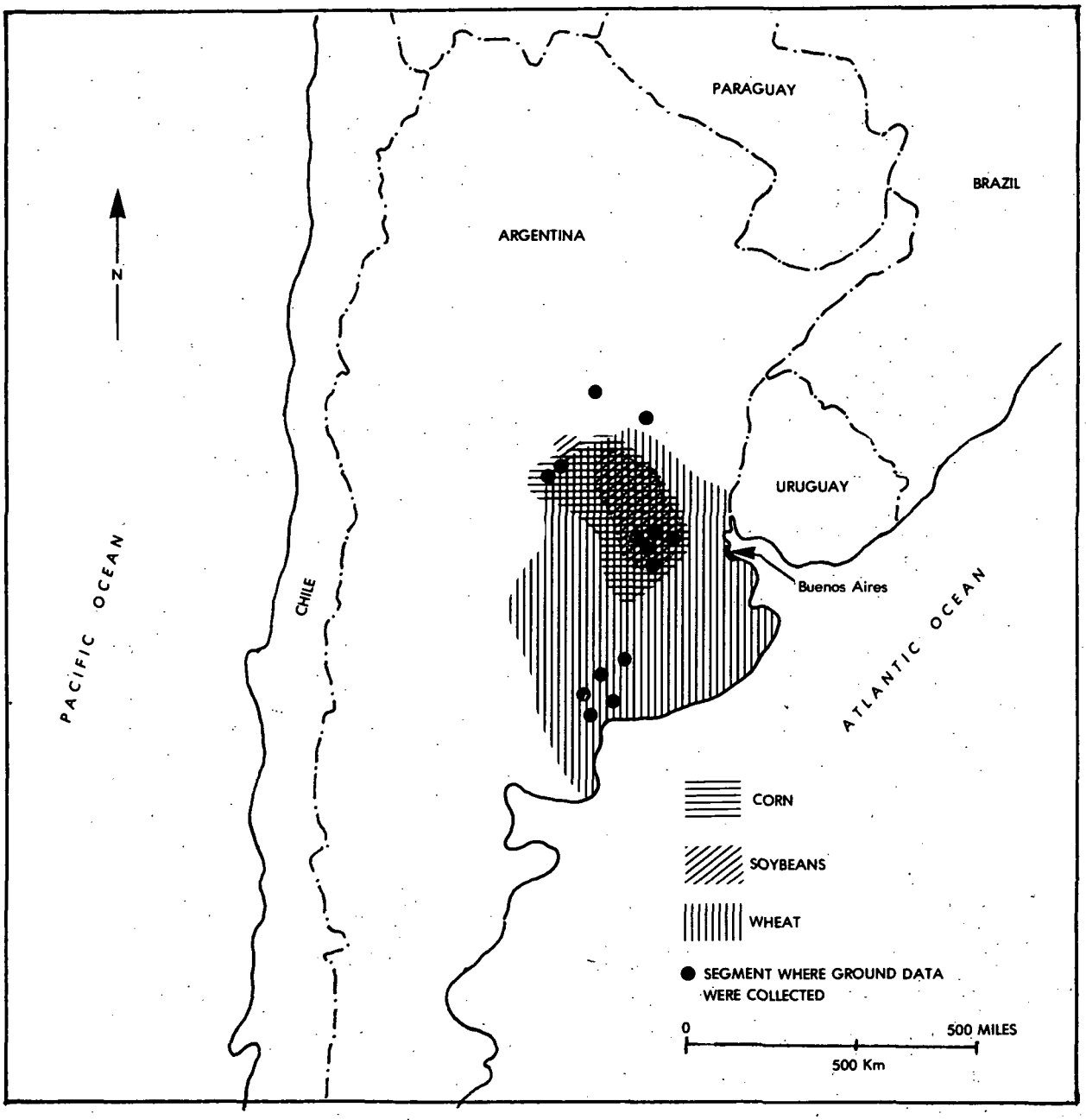
COUNTRY OVERVIEW

The area in which the fourteen segments are located is part of the pampa region of east-central Argentina (see Map 2-1), a vast plain that was formerly grassland. Today the region is one of the world's foremost crop-livestock production complexes. The pampa forms the agricultural heartland of Argentina and includes essentially all of Buenos Aires province, nearly all of Córdoba province except the far northwest, and the central and southern portion of Santa Fé and Entre Ríos. These provinces delineate the AgRISTARS Indicator Region, i.e., a selected study site in South America for the evaluation of remote sensing based crop inventory technology. In this section a description of historical and environmental factors relevant to the agronomic industry of the area are related to the fourteen sites selected for ground observation.

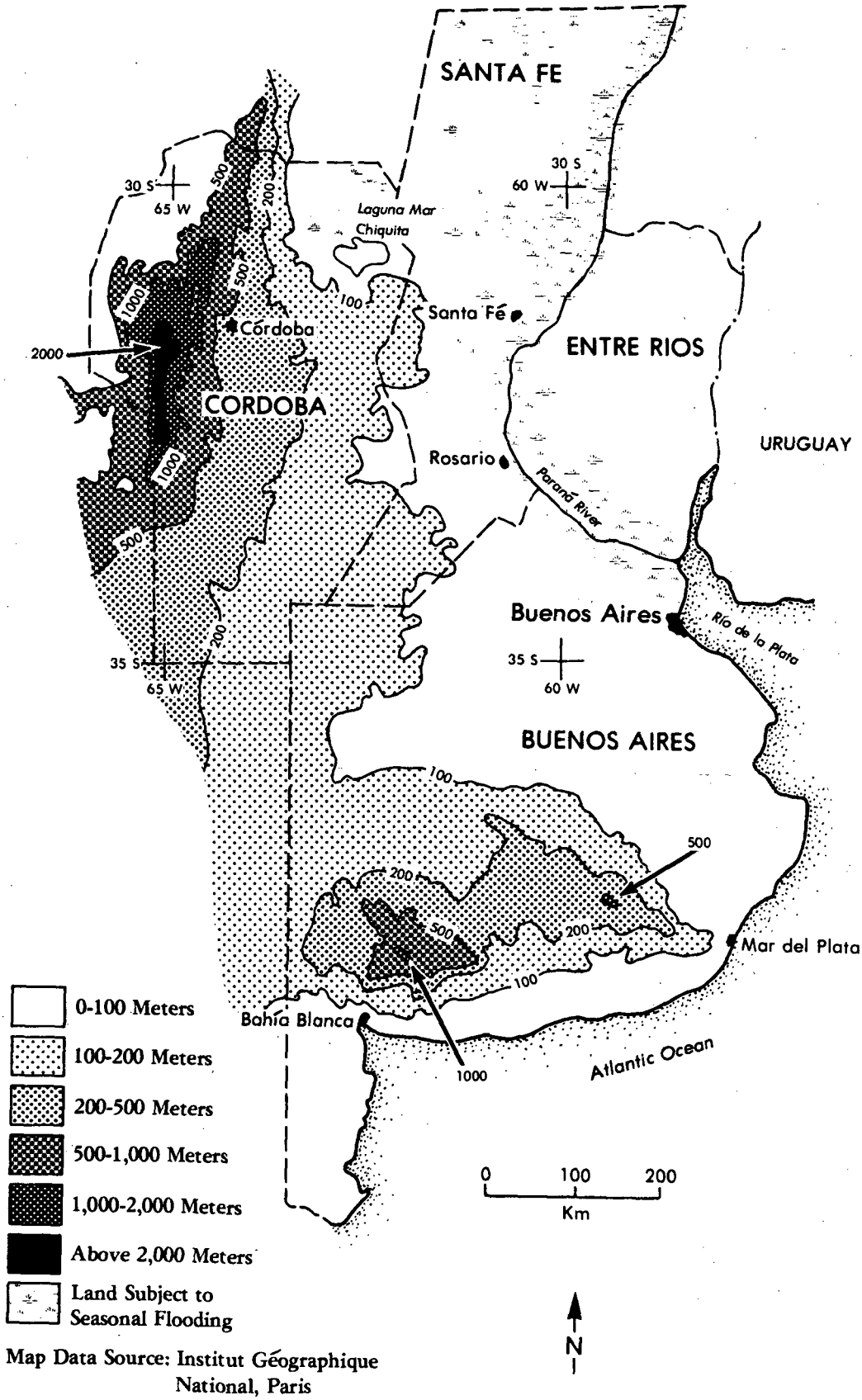
Two major agro-ecological zones are found in the pampa. The humid pampa to the west of the city of Buenos Aires, is Argentina's major corn and soybean production zone, and also important for other coarse grains, oilseeds, as well as cattle. The sub-humid pampa farther westward forms a large crescent around the humid pampa on its western margin. In the sub-humid pampa, the risk of drought restricts agriculture to the growing of wheat, oats or sorghum, while most of the land remains in pasture. Irrigated farming is not widely practiced in the sub-humid pampa since the higher costs of this practice tend to outweigh benefits.

The terrain of the pampa is flat and generally low-lying and nearly all areas are less than 300 meters above sea level (see Map 2-2). The flat relief is interrupted only by two isolated highland areas in Buenos Aires province. The region also contains some of the world's most productive soils most of which are wind-derived, having been deposited from areas farther west. Soils are deep, fertile, fine-textured and

MAP 2-1.
CORN, SOYBEAN, AND WHEAT GROWING REGIONS OF ARGENTINA



MAP 2-2.
PHYSIOGRAPHY OF AgRISTARS STUDY AREA IN ARGENTINA



Map Data Source: Institut Géographique National, Paris

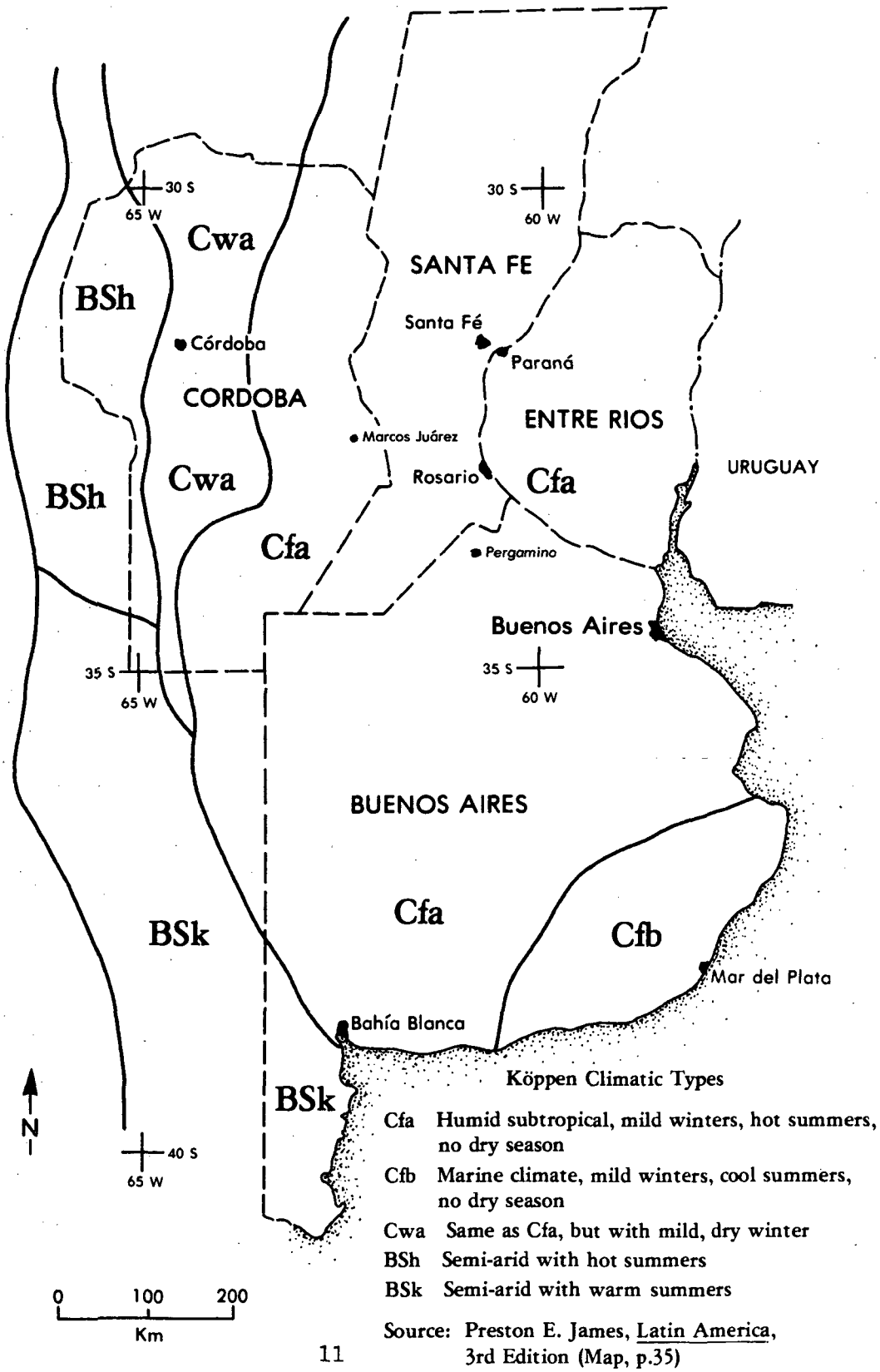
high in organic content. However, sandy and somewhat stony soils are found along the western and southwestern margins.

The climate of the pampa, particularly in the more humid areas, is very favorable for agriculture (Map 2-3). A long growing season, warm humid summer weather, mild snow-free winters and adequate precipitation that is evenly distributed throughout the year are positive factors. However, lower rainfall and drought possibilities limit the crops that can be successfully grown in the sub-humid pampa.

The transportation system of the pampa including highways and railroads focuses on the city of Buenos Aires, the chief agricultural export center, whose metropolitan area contains nearly one-third of Argentina's estimated population of 28.2 million (mid-1981). Other cities are also important administrative centers and serve as agricultural marketing and export points as well. Examples are Rosario (corn) and Bahía Blanca (wheat).

The pampa has evolved from a livestock raising area to a crop-livestock zone, specializing in beef cattle production as well as the cultivation of corn, sunflower, sorghum, flax, and more recently soybeans. From Spanish colonial times to about 1890 the economy was based primarily on the export of beef to European markets, particularly Great Britain. The introduction of improved cattle breeds from Europe, the construction of railroads into the flat grazing lands, and the advent of the refrigerator ship were key factors in the development of Argentina's beef export industry in the late Nineteenth Century. After 1890 agriculture also began to grow in importance. Large numbers of Italians arrived to cultivate alfalfa on large cattle estates whose Argentine owners disliked direct involvement in farming. The immigrants were permitted to grow wheat on portions of their rented properties by their Argentine landlords. Also, corn production began to assume importance since there was a growing demand for the product in Europe as

MAP 2-3.
CLIMATE OF AgRISTARS STUDY AREA IN ARGENTINA



Source: Preston E. James, Latin America, 3rd Edition (Map, p.35)

poultry feed. The cultivation of sorghum, sunflower and flax soon followed.

By 1900 agriculture was nearly on a par with livestock raising in terms of economic importance and both activities were carried on concurrently throughout the pampa, a practice which has continued to the present time. Heavy immigration continued until about 1930, and by the eve of World War II Argentina was firmly established as one of the world's major beef and grain exporters. Following World War II crop-livestock production fluctuated greatly due to changing governmental policies, severe inflation, and changing world markets. However, corn and wheat still remained the chief export crops. By 1975 a third major export crop, soybeans, was of growing importance and production has continued to increase to the present time given the high world demand for protein and oilseed products.

The fourteen sample segments inventoried are widely distributed throughout both the humid and sub-humid pampa. Crops grown reflect the availability of moisture to a great extent, while temperature is less of a constraint.

The two northernmost segments, one located in northeastern Córdoba province and a second in central Santa Fé province, are sorghum/pasture zones. Both grain sorghum and forage sorghum are grown in the two segments as the crops are drought-resistant. Corn and soybean production is minimal because of high evapotranspiration rates and poor drainage.

The two segments in southern Córdoba are also important for sorghum and pasture. However, because of lower evapotranspiration and better soils, corn is also grown.

Five of the fourteen segments are located in the humid pampa of northern Buenos Aires, southern Santa Fé and southeastern Córdoba, Argentina's major corn/soybean production zone. Natural conditions are very favorable for the cultivation of these two crops in this area. Soybeans are usually double-cropped with wheat, but single-crop soybeans

are also grown. Sunflower and sorghum are likewise cultivated while alfalfa is commonly planted for beef livestock pasture.

The remaining five segments inventoried are located in southwestern Buenos Aires, a much drier area that is subject to drought. Wheat is the area's major crop which is often followed by the planting of oats on the same land as winter forage. Some sorghum is grown in this region but soybeans and corn are absent because of moisture limitations. Thus, much of the land not sown to wheat is in natural pasture.

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3.0

ARGENTINA FIELD TRIP

3.1 INTRODUCTION

This section contains a description of field trip planning and a chronology of important events and considerations preceding and during the February 1981 Argentina field trip. Field trip planning consisted of several steps and they are listed below. The chronology of trip planning and trip events follows as Sections 3.1 and 3.2.

A. Obtain NASA and USDA sanction of the field trip.

B. Obtain Argentine government sanction of the field trip.

C. Choose segments for which a reasonable acquisition history existed for the portion of the crop year before the field trip. This precaution guaranteed there would be digital data corresponding to the ground data collected. The segments for which imagery was available covered the major corn, soybean, and wheat producing regions.

D. Obtain the most current Landsat imagery relative to the time of the field trip. Ordinarily, current aerial photography would be used rather than Landsat images, but it was unavailable for this mission. The imagery was enlarged to a scale of 1:85,000 (approximately) and was annotated in the field.

E. Obtain maps of the country at a variety of scales that would facilitate in-country travel and allow accurate location of the data segments.

F. Establish contact with Argentina agricultural agency (SEAG). That organization could provide information on local cropping practices, crop calendars, major meteorological events and local introductions.

G. Develop a modest field data collection plan, limited to a road-side-only observation of a small number of fields in each segment.

3.2 TRIP PLANNING

December 1980

- The ERIM/UCB Consortium identified the need for Argentina field data to support remote sensing technology development.
- The data were to be collected before April 1981.

December 1980 - January 1981

- The field work was planned.
- Requests were made by the Consortium to NASA for cloud-free, Landsat imagery of Argentina segments.
- The Consortium met with USDA officials Charles Caudill (of SRS) and James Olmes (of OICD).
- James Parker, Agricultural Attaché in Buenos Aires, Argentina, was asked to cooperate with the Consortium.
- The Consortium's formal request to proceed with trip planning was approved by NASA.
- Table 3-1. Available Landsat Coverage (cloud-free) of Argentina Segments for Crop Year 1980-81 (as of February 1981) was obtained.

February 1981

- The final planning meeting for field trip was held at Johnson Space Center, Houston, Texas.
- Consortium field team ("the team") members Byron Wood, Edwin Sheffner, Buzz Sellman and Gene Thomas met in Buenos Aires, Argentina on the 15th.

3.3 TRIP EVENTS

Monday, 16 February 1981

- The team met with James Parker at the United States Embassy.
- The team met with members of Argentina's International Agriculture Service (see Table 3-2) at their offices.

TABLE 3-1. AVAILABLE LANDSAT COVERAGE (CLOUD-FREE) OF ARGENTINA SEGMENTS FOR CROP YEAR 1980-81 (AS OF FEBRUARY 1981)

SEGMENT NUMBER AND NAME	LANDSAT ACQUISITION DATE
677 - San Martín	12 September 1980
616 - San Justo	10 December 1980
604 - Juárez Celman	12 December 1989
611 - Río Cuarto	12 December 1980
682 - Salto	23 August 1980
561 - Rojas	24 August 1980
527 - General Arenales	24 August 1980
681 - Junín	29 September 1980
511 - Bragado	24 August 1980
520 - Coronel Suárez	10 December 1980
570 - Tornquist	10 December 1980
649 - Puán (East)	10 December 1980
556 - Puán (West)	12 September 1980
578 - Villarino	10 December 1980

TABLE 3-2. ATTENDANCE AT INITIAL MEETING AT ARGENTINA MINISTRY OF ECONOMY, STATE SECRETARIAT FOR AGRICULTURE AND LIVESTOCK (SEAG) 16 FEBRUARY 1981

Julia Elena Rivarola	-	Deputy Director, International Agriculture Service
Ezequiel A. Fonseca	-	Advisor, Subsecretariat for Economic Agriculture
Eduardo Anchubidart	-	Chief, Agricultural Estimates
Carlos O. Scoppa	-	Coordinator, Soil Survey Program, National Institute for Crop-Livestock Technology (INTA), Castelar
Nestor A. Darwich	-	INTA, Balcarce
Carlos M. Liberatori	-	INTA
Carlos A. Senigagliesi	-	Crop Production, INTA, Pergamino
Jorge E. Nisi	-	INTA, Marcos Juárez
Adelqui L. Damilano	-	Coordinator, Corn Program
Norberto V. Rodríguez	-	National Statistical Service for Economy and Rural Living
Claudio A. Fonda	-	Department of Agricultural Estimates
Miguel A. Abraham	-	Subsecretary for Natural Resources and Ecology
James V.Parker	-	Agricultural Attaché, USDA(FAS), Buenos Aires
Byron L. Wood	-	University of California at Berkeley
Edwin J. Sheffner	-	University of California at Berkeley
Gene S. Thomas	-	Environmental Research Institute of Michigan
Buzz Sellman	-	Environmental Research Institute of Michigan

- The Consortium agreed to provide the Argentine government with a trip report and such technical reports as are produced on the basis of this trip.
- The team was invited to Castelar, the regional headquarters for INTA - The National Institute for Crop-Livestock Technology (Instituto Nacional de Tecnologia Agropecuaria).
- Carlos Scoppa was to be our host.

Tuesday, 17 February 1981

- Carlos Scoppa and Nestor Darwich brought the team to Castelar.
- INTA facilities serve as national agricultural and livestock research centers and provide services similar to the Extension Service in the United States.
- At the Castelar facility were maps and aerial photographs for most of the segments in Buenos Aires (B.A.) province.
- Map locations were established or verified for the ten segments in B.A. province.
- Plans were made for the team and a group of INTA personnel to visit the five segments in northern B.A. province during the rest of the week.
- The team returned to B.A.

Wednesday, 18 February 1981

- Claudio Fonda and Miguel Abraham of the Secretariat and Miguel Cuenca of INTA accompanied the team to Pergamino.
- Carlos Senigagliesi and Eduardo Lemos of the INTA office in Salto and Carlos Scoppa and Nestor Darwich joined the others there.
- The eleven-member group collected field data on Segment 682 (Salto).
- Next, the group drove to the INTA office in Rojas.
- Alberto Alesso of that office gave the team two kilograms of DeKalb and Cargill seed corn (flint type).
- The corn was to be brought to Marvin Bauer of the Laboratory for the Applications of Remote Sensing at Purdue University.

Thursday, 19 February 1981

- Alesso guided the group to Segment 561 (Rojas) and Segment 527 (General Arenales/East).
- The group also visited Segment 624 (General Arenales/West) but did not inventory fields there due to the lack of current year Landsat imagery.

Friday, 20 February 1981

- o Segment 681 (Junín) and Segment 511 (Bragado) were inventoried.
- o The team returned to Buenos Aires.
- o Dave Hicks joined the team in B.A.
- o Sellman attended a meeting at the Comisión Nacional de Investigaciones Espaciales (CNIE) (Table 3-3). Cecilia Espoz, an agronomist with CNIE, joined the "southern" team (Abraham, Sheffner and Sellman) at the request of Juan Tosso of CNIE.

Sunday, 22 February 1981

- o Claudio Fonda, Byron Wood, Dave Hicks, and Gene Thomas (the "northern" team) departed for Marcos Juárez by bus.

Monday, 23 February 1981

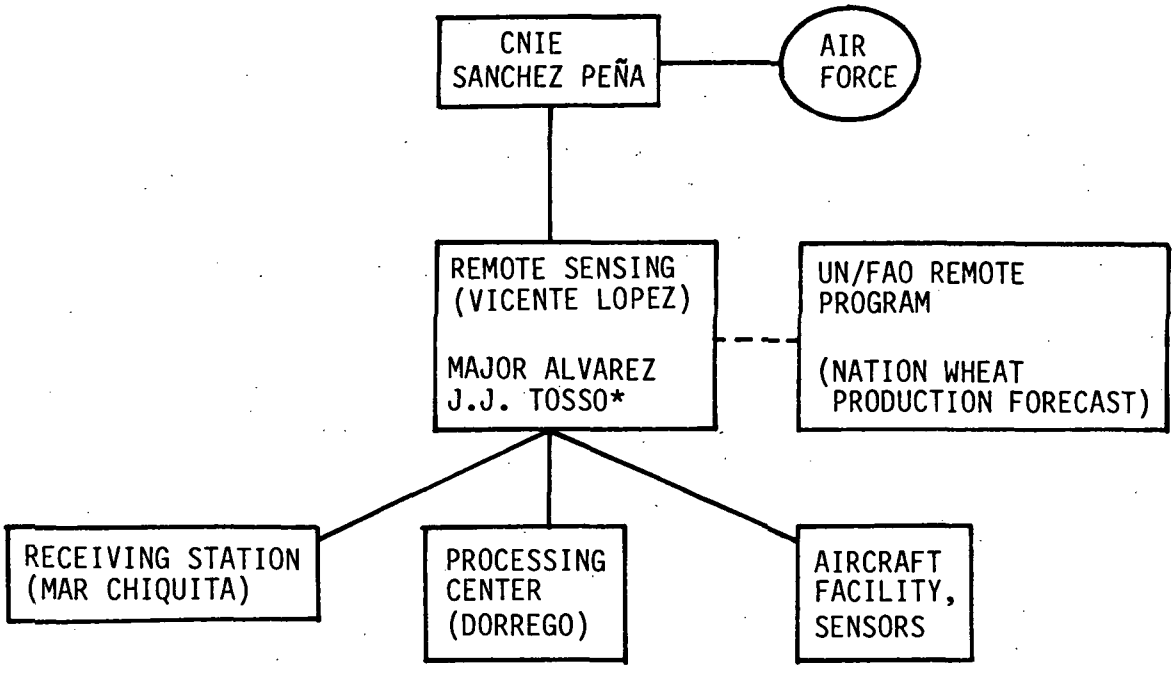
- o The northern team arrived at Marcos Juárez and made its way to INTA's experimental station there.
- o Engineer-Agronomist Cabrini, chief of the station, was briefed on the desired field work.
- o Cabrini offered the use of a six-passenger aircraft and a land vehicle for our purposes.
- o A discussion was held with Miguel Pariete, an INTA agricultural economist, who provided some information on local cropping practices.
- o The northern team flew from Marcos Juárez to Segment 604 (Juárez Celman), and Segment 611 (Río Cuarto), where aerial photographs were taken.
- o The plane landed near Río Cuarto and the northern team split into two groups. Hicks and Wood made ground observations of Segment 611 (Río Cuarto), while Fonda and Thomas inventoried Segment 604 (Juárez Celman).
- o Miguel Abraham and Edwin Sheffner flew to Bahía Blanca where they were meet by Tomas Loewy, the local INTA official.
- o Loewy, Abraham and Sheffner inventoried Segment 578 (Villarino).
- o Espoz and Sellman visited the CNIE processing facility in B.A. (Table 3-4).
- o Espoz and Sellman flew via commercial air carrier to Bahía Blanca to join the rest of the southern team.

TABLE 3-3. ATTENDANCE AT MEETING AT NATIONAL COMMISSION FOR SPACE INVESTIGATIONS (VICENTE LOPEZ), ON 20 FEBRUARY 1981

J.J. Tosso	-	National Commission for Space Investigations (CNIE)
Julia Elena Rivarola	-	International Agriculture Service, SEAG
Miguel Conde Prat	-	Coordinator, Crop-Livestock Estimates, SEAG
Eduardo Anchubidart	-	Chief, Agricultural Estimates, SEAG
Cecilia Espoz	-	Agronomist, CNIE (UN/FAO Remote Sensing Project)
Eugenio E. Portalet	-	Meteorologist, CNIE (UN/FAO Remote Sensing Project)
Buzz Sellman	-	Environmental Research Institute of Michigan

TABLE 3-4. MEETING AT PROCESSING CENTER
CNIE (AV. DORREGO) 23 FEBRUARY 1981

LUIS SOCOLOVSKY - CHIEF, PROCESSING CENTER
VICTOR D. LARIAS - DATA SERVICES
SEVERINO FERNANDEZ - SOFTWARE DEVELOPMENT
ALEJANDRO ZABALA - ELECTRONIC TECHNICIAN



*"Retired" as of December 1980.

Tuesday, 24 February 1981

- The northern team was flown to Segment 616 (San Justo), approximately 320 km northeast of Río Cuarto.
- While some government reports indicated that the area containing Segment 616 had undergone recent flooding, roads traversing the segment were dry and some pasture was being grazed by cattle.
- Aerial photographs were taken of the segment.
- The northern team flew to the vicinity of Segment 677 (San Martín).
- Neither the pilot nor the team could locate the segment from the air.
- The northern team flew to the city of Santa Fé where an INTA pickup truck was waiting.
- The northern team drove to Segment 677 (directions were obtained from various people along the way) and field inventory was performed in the afternoon.
- Difficulties occurred in matching observed fields with "fields" on the Landsat imagery.
- The southern team inventoried Segment 570 (Tornquist) and Segment 520 (Coronel Suárez).

Wednesday, 25 February 1981

- The northern team inventoried Segment 616 (San Justo).
- More difficulties in matching observed fields with Landsat "fields" lead to the "500 meter" survey. 500 meter intervals were marked out on the imagery from a readily observed and accessible ground point. Ground observations were made at 500 meter intervals (based on the truck odometer) beginning at the ground point.
- The northern team drove to Marcos Juárez.
- The southern team inventoried Segment 649 (Puán/East).
- The southern team observed a soil conservation program site.

Thursday, 26 February 1981

- The northern team returned to B.A. by bus, passing through the cities of Rosario and Pergamino.
- The southern team inventoried Segment 556 and returned to Bahía Blanca.

Friday, 27 February 1981

- The northern team reviewed activities of the preceeding week and organized trip materials.
- The southern team returned to B.A. by commercial air carrier.

Saturday, 28 February - Monday, 2 March 1981

- Three members of the team departed B.A. for home.

Monday, 2 March 1982

- Sellman and Hicks attended a final meeting with government officials (Table 3-5).

TABLE 3-5. MEETING AT ARGENTINA MINISTRY OF ECONOMY, STATE SECRETARIAT FOR AGRICULTURE AND LIVESTOCK RAISING(SEAG), 2 MARCH 1981

Antonio T. Parsons	-	Director, International Agriculture Service
Julia Elena Rivarola	-	Deputy Director, International Agriculture Service
Ezequiel A. Fonseca	-	Advisor, Subsecretariat for Economic Agriculture
Eduardo Anchubidart*	-	Chief, Agricultural Estimates, SEAG
Claudio A. Fonda**	-	Agricultural Estimates, SEAG
Miguel Abraham**	-	Subsecretary for Natural Resources and Ecology
Carlos Scoppa**	-	Coordinator, Soil Survey Program, National Institute for Crop-Livestock Technology (INTA), Castelar
Nestor Darwich**	-	INTA, Balcarce
J.J. Tosso*	-	National Commission for Space Investigations (CNIE)
Cecilia Espoz**	-	Agronomist, CNIE (UN/FAO Remote Sensing Project)
Eugenio Ernesto Portalet	-	Meteorologist, CNIE (UN/FAO Remote Sensing Project)
James V. Parker	-	Agricultural Attaché, USDA(FAS), Buenos Aires
Buzz Sellman	-	Environmental Research Institute of Michigan
David R. Hicks	-	Environmental Research Institute of Michigan

* Co-director, UN/FAO Remote Sensing Project (Wheat)

** Closest contact was with these people (Field Work).

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4.0

FIELD WORK INVENTORY OF SELECTED AgRISTARS SAMPLE SEGMENTS

4.1 INTRODUCTION

This section contains most of the ground data collected during the field program. For reporting purposes, the locations of the fourteen segments are presented on four maps to highlight basic geographic/-agronomic differences that were observed during the field work. Additional similarities or differences among the segments are also presented in subsequent discussions related to physiographic setting, crops grown, cropping practices, relative field sizes and other agronomic conditions.

An annotated Landsat image showing coded crop/cover type identification observed during the field work is included for each segment inventoried. A listing of the crop/cover code used to annotate the images is provided in Table 4-1. Other pertinent data such as segment name and number, Landsat acquisition date, field inventory date and approximate scale are shown on the margins of each image. An overall summary of observed fields is presented.

4.2 DESCRIPTION OF THE SEGMENT INVENTORIES THAT FOLLOW

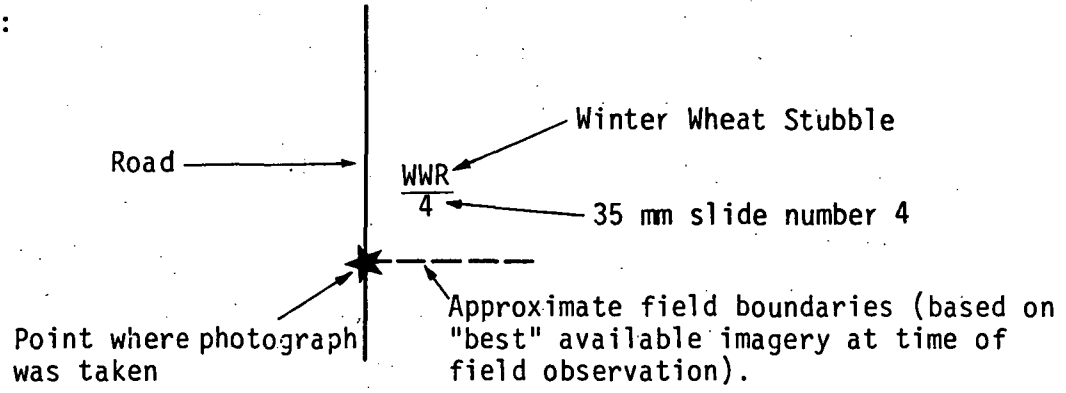
Sections 4.3 and 4.4 provide a general land use inventory for three Argentine provinces based on observations made in fourteen segments. Sections 4.5 through 4.8 divide the three provinces into four geographic areas according to where segments were located. Segments in Group 1 (616, 677) are found in the northern portion of the Argentine study area. Segments in Group 2 (604, 611) are located in the west. Segments in Group 3 (511, 527, 561, 681, 682) are located in the center of the three province study area, while segments in Group 4 (520, 556, 570, 578, 649) are located in the south.

TABLE 4-1. CROP/COVER TYPE IDENTIFICATION CODES

The following crop/cover type identification codes were used to annotate the Landsat imagery for the fourteen segments inventoried.

AH - alfalfa
BS - bare soil (if plowed, it is so indicated)
CH - chicory
CR - corn
GS - grasses (no visible signs of hay activities)
IL - idle land (idle land, fallow, no visible current year cropping activities
OA - oats
PA - pasture (all types)
PE - peanuts
SO - soybeans
SR - sorghum (grain)
SR/F - sorghum (forage)
SU - sunflower
TR - trees (usually indicated; tree "island", tree line, etc.)
WW - winter wheat
XX - non-agricultural (includes towns, cities, large water areas, marsh, swamp, etc. -- usually specifically indicated)
R - (used as 3rd letter) - previous year residue/stubble - used mainly in connection with winter wheat (WW) and coded as WWR.

Example:



4.3 AGRICULTURAL LAND USE INVENTORY - SUMMARY OF ALL SEGMENTS

Table 4-2 depicts agricultural land use in terms of the total number of observed fields devoted to each crop as well as the breakdown of crop types by segment. Several observations regarding land use can be made upon reviewing the data presented in Table 4.2. Observed fields in the northern segments in Córdoba and Santa Fé provinces were most often in pasture, sorghum, or corn production. The majority of the observed fields in Segments 616 and 677 were used for either pasture or sorghum production. Few fields in these segments were in corn or soybean production. In contrast, corn was the most often observed crop in Segments 604 and 611. Soybeans, sorghum and peanut fields were also common. Nevertheless, about one-half of the observed fields in these two segments were in pasture.

In northern Buenos Aires province, Segments 527, 561, 681 and 682 were noted as being important corn areas but soybeans constituted an important second crop, especially in Segment 681. Pasture, although frequently observed in these four segments, was much less common than in most other segments inventoried. This reflects the importance of corn and soybean cultivation in the central pampa. In contrast, an equal number of fields in pasture and corn production were observed in Segment 511 immediately to the south. The amount of pasture is partly due to poor drainage in much of this area.

In southern Buenos Aires province pasture was the most commonly observed land use category. Wheat stubble and oat plantings were observed in an equal number of fields in segment 520. Wheat fields were numerous in Segments 556, 649, and 570, while oats were less common. In Segment 578, pasture was even more common than in the other southern segments, suggesting a higher drought risk as one moves farther south.

In summary, the tabulation of fields according to crop type suggests the following: (1) the dominance of sorghum-pasture land use in the far north, (2) the importance of corn cultivation and pasture

TABLE 4-2.- AGRICULTURAL LAND USE INVENTORY SHOWING OBSERVED FIELDS BY CROP/LAND USE TYPE

SEGMENT	CR	SO	SR	SR/F	SU	WW	OA	AH	PA	PE	CH	BS	OTHER	TOTAL
North														
677-San Martín	2	4	9	3	1				18					37
616-San Justo	5		13	19					44		1	8	3 (2 IL, 1 GS)	93
604-Juárez Celman	19	2	2	11	1				25	4		4	1 (XX)	69
611-Río Cuarto	33			14	1			1	51			11	(1 Rangeland, 1 Winter 3 Forage, 1-Trees)	114
Central														
682-Salto	17	10	1		1			2	11				1	43
561-Rojas	11	3	1		1			1	10					27
527-General Arenales	18	8	1					1	8			1		37
631-Junín	15	15		1			1		12			2	2 (trees, nat.veg.)	48
511-Bragado	8	1			2				8				1	20
South														
520-Coronel Suárez	1		3			5	5		11					25
570-Tornquist			2			8	1		9			3	2(scrub veg., ridge)	25
649-Puán (East)	1 (failed)		3			7			13			3	2	29
556-Puán (West)						15	3		17			3		38
578-Villarino			2			4	1		13				4 (1-int.drain, 3-trees)	24
	130	43	37	48	7	39	11	5	250	4	1	35	19	629

areas in western Córdoba, (3) the importance of corn, soybeans, and pasture (including alfalfa) in northern Buenos Aires, (4) corn and sunflower production in some poorly drained areas, and (5) the overwhelming emphasis on wheat production in southern Buenos Aires due to drier climatic conditions. Moreover, an underlying characteristic of the fourteen segments is that despite changes in crop mix from place to place, the importance of pasture for livestock use remains more or less constant, with the exception of Segments 527, 561, 681, and 682.

4.4 OTHER OBSERVATIONS

The fourteen segments inventoried are diverse in terms of crop type, field patterns and size and appear representative of the various crop production zones in the Argentine pampa. Most of the segments are located in partidos that are major producers of either corn, soybeans, wheat or sorghum as well as other crops.

Partido - level crop data for the fourteen segments are available for crop years 1975/76 through 1979/80 (soybeans 1975/76 through 1978/79). However, data on the national level for all producing partidos in Argentina are available only for crop years 1976/77 and 1977/78. Available data for the fourteen segments visited denote area planted, area harvested and production while that on the national level only indicate area planted. Comparisons between these data were, therefore, limited to the 1976/77 and 1977/78 crop year, i.e., the partidos visited could only be ranked nationally where data for all partidos were available. Table 4-3 shows the ranking of twelve of the thirteen partidos visited with respect to all other partidos in Argentina in terms of area planted in corn, soybeans, and wheat.*

*The thirteenth partido, San Justo, was not among the leading twenty-five partidos in Argentina in area planted in corn, soybeans or wheat and was therefore excluded from the table.

TABLE 4-3. NATIONAL RANKING OF PARTIDOS VISITED IN TERMS OF AREA PLANTED IN CORN, SOYBEANS AND WHEAT

Partido Name	Segment	National Rank 76/77	77/78
		CORN	
Río Cuarto	611	1	1
Salto	682	6	7
Rojas	561	9	10
Junín	681	13	13
General Arenales	527	18	11
Bragado	511	21	16
		SOYBEANS	
Juárez Celman	604	12	13
Río Cuarto	611	13	16
Salto	682	14	11
San Martín	677	15	12
Rojas	561	16	14
Junín	681	19	20
General Arenales	527	23	23
		WHEAT	
Puán	556, 649	3	7
Villarino	578	4	8
Tornquist	570	5	16
Coronel Suárez	520	6	11

Source: USDA data furnished by Cecil Hallum of NASA/JSC, Houston, and Claudio A. Fonda, Agricultural Estimates section, SEAG, Buenos Aires.

The implications of this information are discussed in the sections immediately following the table and should be considered in the planning of future ground truth missions and in interpreting existing information.

4.4.1 MAJOR CROPS (CORN, SOYBEANS AND WHEAT)

Some segments inventoried such as those located in partidos of northern Buenos Aires are major corn producing areas and comprise part of Argentina's most important corn production zone. In addition to northern Buenos Aires, the zone includes adjacent southern Santa Fé and eastern Córdoba provinces. One segment visited in southwestern Córdoba is located in a second important production zone. The partidos in which the segments are located rank high nationally in terms of area planted in corn. These segments are segments in nearby partidos should therefore be considered when planning future ground truthing activities.

In the case of soybeans, the segments inventoried comprise a portion of Argentina's major soybean production region in northern Buenos Aires, southern Córdoba and southern Santa Fé provinces. However, none of the most important partidos in terms of area planted to soybeans were visited. Future soybean ground truthing activity should be carried out in southern Santa Fé province which is by far the leading zone in terms of area planted to the crop.

Argentina's major wheat zone is well represented by the segments visited in southern Buenos Aires. However in 1979/80, wheat producing areas in eastern/southeastern Córdoba had surpassed some areas in southern Buenos Aires. Since wheat is important to the program, partidos in eastern/southeastern Córdoba should be inventoried along with those in southern Buenos Aires.

4.4.2 OTHER CROPS

Forage sorghum is an important crop in San Justo and San Martín in the extreme north, and in the partidos of Juárez Celman and Río Cuarto

in the northwest. It is likewise an important crop in Puán and Tornquist in the extreme south. San Justo has continued to lead the fourteen partidos visited in terms of planted area devoted to forage and grain sorghum, perhaps partly due to the crop's ability to resist drought.

The area devoted to sunflower production is also significant in some partidos where segments are located. In 1976/77 Río Cuarto was the nation's leading producer while Coronel Suárez occupied eighth place and Juárez Celman ranked twelfth. In 1977/78 Río Cuarto again led the nation followed by Coronel Suárez (fifth), Juárez Celman (eighth), and Puán (tied for tenth). More recent information on area planted to sunflower was unavailable at the time of writing.

San Justo led the remaining thirteen segments in planted rye area. Río Cuarto and Puán were also important for barley. However, little in the way of production of rye, barley and millet production was observed given the time of year the segments were visited.

Partidos having large areas devoted to the production of oats were confined to southern Buenos Aires and included Tornquist, Puán and Coronel Suárez. Numerous oat plantings, primarily for winter forage, were noted during field work in this area.

Peanut production in Córdoba province deserves comment. Two partidos, Juárez Celman and Río Cuarto, occupied third and seventh place nationally in terms of area planted for 1976/77 crop year. They ranked third and six, respectively, the following crop year. Since the 1977/78 crop year, area planted in Córdoba province has increased with Juárez Celman diminishing in importance and Río Cuarto gaining in importance in the 1979/80 crop year.

4.5 ARGENTINA SEGMENT GROUP I - (SEGMENTS 616 AND 677)

These two segments, although separated by a considerable distance, share several common characteristics (see Map 4-1). Segment 616,

MAP 4-1.
ARGENTINA SEGMENT GROUP I

677 - San Martín
(24 Feb. 1981)

616 - San Justo
(25 Feb. 1981)


677 - SAN MARTIN
XX-Colonia Belgrano (Town)
SO(Very Weedy Field)
SO 8
PA
SR
PA
SR
PA
SO
CR
SR
PA 9
SR
PA
SU
SR/F
PA
Railroad
XX Wildermuth (Hamlet)
SR
PA (Weedy) 3
PA
SR 4
PA
PA
PA 2
SR/F
SR/F
SO
PA
SR 6
CR 5
PA
PA
NOTE: Confident Placement of Field Boundaries Noted on Imagery was Difficult During Field Inventory Work.
LANDSAT ACQUISITION DATE - 12 SEP. 1980
FIELD INVENTORY DATE - 24 FEB. 1981
Approx. Scale - 1:85,000

677 - SAN MARTIN

(Comments for 35 mm slides)

1 - Harvesting old sunflowers. The field supports a very low cover of old sunflowers but is primarily weeds. Row direction was originally E-W. Considering the density and condition of the sunflowers, as well as the extent of weed cover, it would appear that this field has been left fallow for at least one growing season. Looking W.

2 - Improved pasture. Looking NE.

3 - This unimproved pasture supports a thistle-like species in addition to a number of other weedy species. Fields such as this one should probably be considered fallow since they are not being grazed, but are identified as pasture by local INTA personnel. Looking W.

4 - Mature grain sorghum about 4' high. Row direction is generally N-S, but a series of boundary rows run parallel to the road in an E-W direction. The field is unusually "clean" (free of weeds) for this area. Looking N.

5 - Dry corn 5-6' high. Row direction is N-S with E-W boundary rows. The field supports a low weed cover which is green despite the dry condition of the corn plants. Looking S.

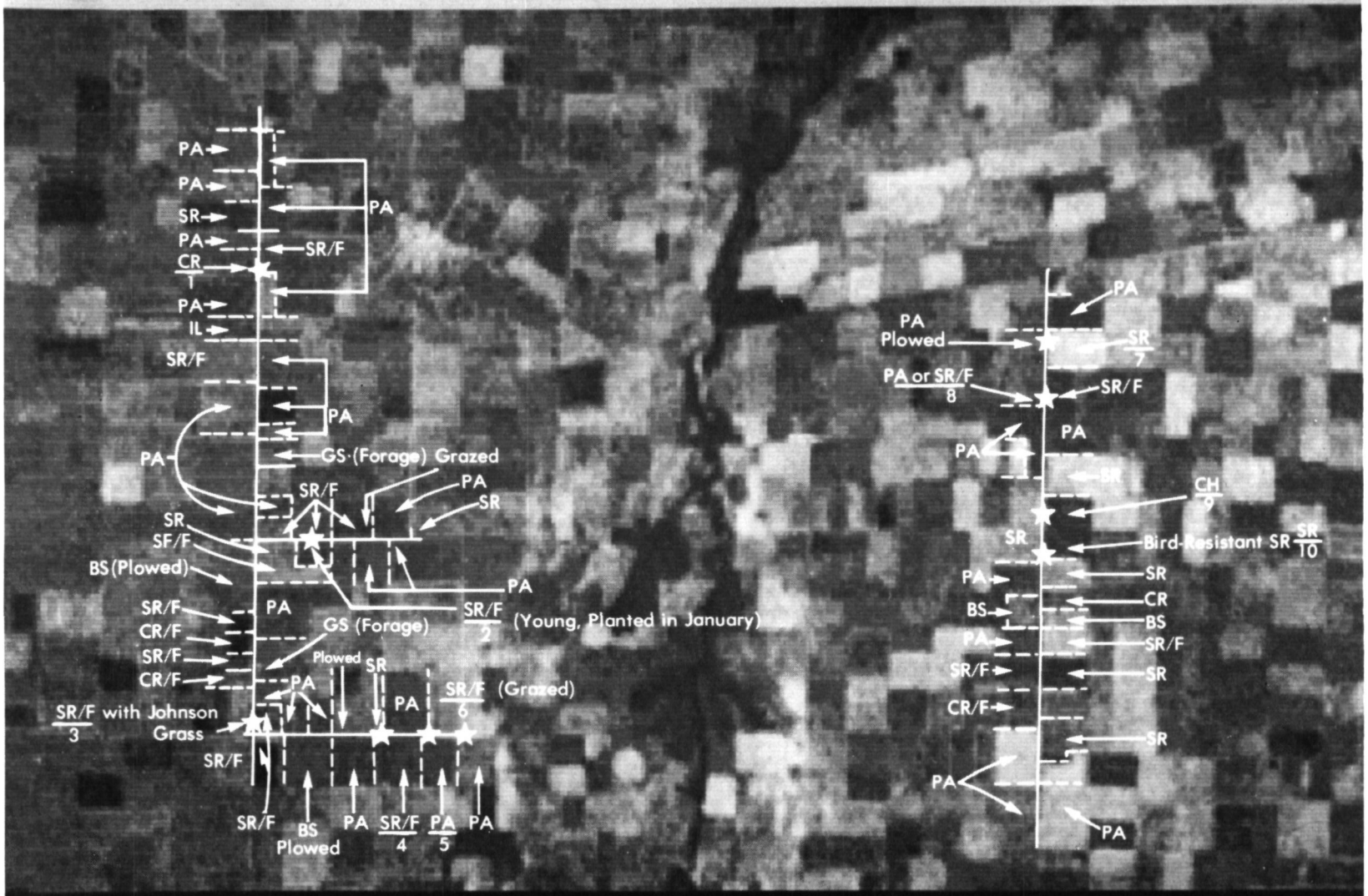
6 - A field of old, dry grain sorghum that was never harvested. The field also contains volunteer sunflowers and a variety of weeds. The grain sorghum plants are about 3' high. Judging by the amount of weeds and volunteer sunflowers, the field has been abandoned for one complete growing season. Looking SW.

7 - Pasture with a thistle-like weed cover. The cattle grazing in the background indicate that the field is not fallow. Looking NE.

8 - A field of mature soybeans about 18" high. Rows parallel the road in an E-W direction. Although some isolated patches of Johnson grass can be seen, the field is relatively "clean" for this zone. Looking N.

9 - Maintained pasture field containing only a few thistle-like weeds. The center of the field is flooded as a result of recent heavy rains. Standing water was also noted in other fields in the zone where the segment is located. Looking S.

616 - SAN JUSTO



LANDSAT ACQUISITION DATE - 12 DEC. 1980

FIELD INVENTORY DATE - 25 FEB. 1981

Approx. Scale - 1:85,000

616 - SAN JUSTO

(Comments for 35 mm slides)

1 - A field of corn. Grass in foreground with weeds in corn field. Looking W.

2 - Young forage sorghum planted in January. Note height and narrow heads. This field is relatively free of weeds compared to many others in the segment. Looking S.

3 - Forage sorghum. Note thick weed growth and Johnson grass competing with the crop. Looking W.

4 - Forage sorghum with weeds. Such conditions are quite common in the northern pampa. Looking S.

5 - Natural pasture in southern part of segment. Looking S.

6 - Forage sorghum in southern part of segment. Field is relatively free of weeds. Open areas indicate that cattle have been grazing in this field. Looking N.

7 - A field of grain sorghum relatively free of weeds. Note thick heads and high plant density. Looking E.

8 - Pasture or forage sorghum. Positive identification could not be made. Looking W.

9 - A field of chicory; the only such field noted in all of the segments inventoried. Looking E.

10 - Bird-resistant grain sorghum. Heads are smaller and stalks are thinner, thereby making it difficult for birds to perch on the plant. This variety substantially reduces crop loss. Looking E.

located in northeastern Córdoba province immediately south of Laguna Mar Chiquita, and Segment 677, located in central Santa Fé province 160 kilometers to the east-southeast, are both situated on the northern margin of the pampa region. More specifically, both segments are located in a transitional zone separating the pampa corn and soybean agricultural region to the south from the tropical scrub woodland zone, or chaco, to the north. Both areas are subject to seasonal flooding (summer) due to low, flat relief and the low permeability of sub-surface soil horizons. In addition, evapotranspiration rates in both segments are high, thereby reducing the effectiveness of available precipitation. The segments are located in subtropical climatic zones with very hot summers owing to relatively low latitude and interior location.

Although some differences do exist between the two zones, they are less important than the physiographic similarities already discussed. In general, Segment 677 receives about 800 mm (32 in) of precipitation annually while Segment 616 receives about 100 mm (4 in) less, primarily because of its more interior location. Also, the climate is less humid in Segment 616 and soils are dry for a greater proportion of the year. However, soils in both segments are less fertile than in the humid pampa to the south and overall land use is quite similar in the two segments.

In both segments unimproved pasture is the predominant form of land use. Principal field crops include forage sorghum, grain sorghum (including a bird-resistant variety) and some corn. Chicory was also noted in Segment 616 and soybeans were noted in Segment 677 where production potential is somewhat better because of increased rainfall. Cropland in both segments is often weed-infested and Johnson grass growing in association with sorghum and corn was noted in most fields. Sorghum and pasture dominate the agricultural landscape, since high evapotranspiration rates as well as flood susceptibility make corn or soybean production a much riskier venture. Consequently, the latter two crops are of little importance.

Despite the overwhelming area devoted to pasture, large herds of cattle were not observed. A point of confusion in both segments was that some Argentine agronomists include overgrown abandoned fields in the pasture category along with improved grasslands specifically planted for grazing purposes.

4.6 ARGENTINA SEGMENT GROUP II (SEGMENTS 604 AND 611)

Segments 604 and 611 are located in the flat, sub-humid pampa zone of west-central Córdoba province (see Map 4-2). Segment 604 is about forty kilometers east-northeast of the city of Río Cuarto while Segment 611 is immediately east-southeast of that city. Annual precipitation averages about 700 mm (28 in) in Segment 611 and is slightly higher in Segment 604. Although precipitation amounts received are no higher than those of segments in Group I, rainfall is more effective due to lower evapotranspiration. Subtropical climatic conditions characterize the two segments but owing to their interior location, winters are quite dry compared with segments to the southeast. Likewise, the annual temperature range is more pronounced for the same reason.

Soils in the two zones are quite fertile, but areas of somewhat coarse and sandy soils are more evident in Segment 611. Soils are mainly wind-derived, that is, transported from arid zones farther to the west.

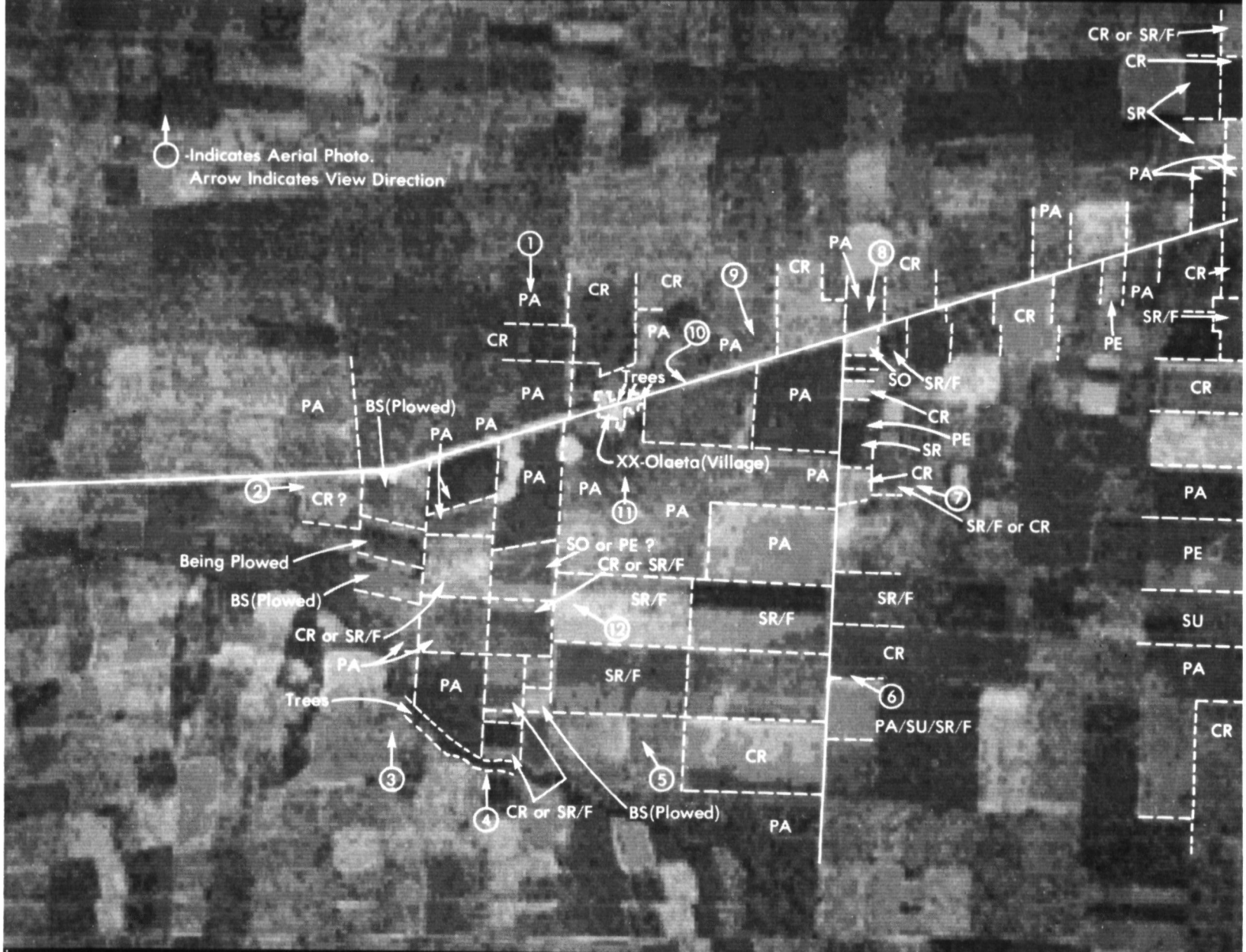
Pasture is the dominant land use in the two segments in terms of total number of observed fields, but Segment 611 is also important for corn while forage sorghum is important in both segments. Soybeans were also observed in Segment 604, and sunflowers were noted in Segment 611. Corn and forage sorghum fields were less weedy compared to those located in Segment 616 (San Justo), about 250 kilometers to the north-northeast. Large numbers of cattle were noted during overflights of the Group II segments as well as on the ground, despite the fact that some pasture areas in Segment 611 were sparsely vegetated with sandy soils exposed.

MAP 4-2.
ARGENTINA SEGMENT GROUP II

604 - Juárez Celman
(23 Feb. 1981)

611 - Río Cuarto
(23 Feb. 1981)

604 - JUAREZ CELMAN



LANDSAT ACQUISITION DATE - 12 DEC. 1980

FIELD INVENTORY DATE - 23 FEB. 1981

Approx. Scale - 1:85,000

604 - JUAREZ CELMAN

(Comments for 35 mm slides)

1 - Aerial view of pasture backed by what appears to be corn and pasture. Other pasture fields can be seen in background. The small community of Olaeta is visible in left background. Looking S.

2 - Aerial view of major E-W road traversing the segment. To the right of the road is what appears to be a corn field, backed by a recently plowed field, a line of trees and beyond that, pasture. To the left, continuous pasture borders the road. Looking E.

3 - Aerial view of two plowed fields and tree-lined creek. Between the features is a small area of pasture. Two more pasture fields and a field of corn or sorghum can be noted on the opposite side of the creek. In the extreme background more pasture areas and plowed fields can be seen. Looking N.

4 - Aerial view of tree-lined creek backed by large dark and light green fields which are pasture. Beyond these is a corn or sorghum field and two more pasture fields. Along the extreme right margin are a series of corn or sorghum fields. Looking N.

5 - Aerial view of a large pasture backed by what appears to be forage sorghum. More pasture can be seen in distance. Looking NW.

6 - Aerial view of field that is presumed to be corn. Beyond the road on the left side is pasture. The large field on the right is forage sorghum. In the background are fields of forage sorghum, corn and pasture. Looking WNW.

7 - Aerial view of relatively small fields. In the foreground is an uncultivated or fallow area backed by a small pasture and either a forage sorghum or corn field. A large corn field can be seen bordering the N-S road. Beyond are several more large pasture fields and the village of Olaeta. Looking WNW.

8 - Aerial view across the main E-W road. The small fields shown in Slide 7 can be seen in background. In addition, a soybean field can be seen in the lower right corner. Looking S.

9 - Aerial view of large pasture area. On the extreme left the corner of an adjacent corn field can be seen. Across the E-W road is pasture. Looking SSE.

10 - Aerial view of a large corn field in the tasseling stage. In the background are other fields seen in Slides 8 and 9. Looking ESE.

11 - Aerial view of pasture backed by the village of Olaeta. Part of a large corn field can be seen to the right of the settlement. Looking N.

12 - Aerial view of a large forage sorghum field being grazed by cattle. The bright green field in background is planted either in soybeans or peanuts. Most of the distant fields are pasture but the plowed field shown in Slides 2 and 3 can also be seen. Looking WNW.

611 - RIO CUARTO

LANDSAT ACQUISITION DATE - 12 DEC. 1980

FIELD INVENTORY DATE - 23 FEB. 1981

Approx. Scale - 1:85,000

611 - RIO CUARTO

(Comments for 35 mm slides)

1 - Sunflowers in bloom. Looking SW.

2 - Corn in tasseling stage. Looking SE.

3 - Bare soil exposed in some areas during disking in preparation for winter pasture. Intent of disking unknown. Looking SE.

4 - Extensive weedy pasture. Looking NW.

5 - Natural weed-infested or "dirty" pasture typical of much of Córdoba and Santa Fé provinces. Note exposed soil interspersed with grass. Looking S.

6 - A relatively weed-free or "clean" field of forage sorghum. Note windrow typical of pampa in background. Looking NW.

7 - Aerial view of idle rangeland consisting of vegetated sand hills. Plowed fields and pasture to left; plowed fields and corn to right. Looking SSW.

8 - Aerial view of forage sorghum or corn field. Positive identification could not be made. This field is backed by an alfalfa planting. The field in extreme left background is probably corn. Extensive plowed field can also be noted. Looking SW.

9 - Aerial view crossing major road within the segment. Field in left middleground is probably forage sorghum or corn. Pasture in foreground. Looking SE.

10 - Aerial view of winter pasture fields in preparation. Looking NE.

11 - Aerial view of idle field; may possibly be plowed for winter pasture. Looking NW.

12 - Aerial view of pasture (in extreme foreground) backed by a field of forage sorghum or corn. Looking NW.

4.7 ARGENTINA SEGMENT GROUP III (SEGMENTS 527, 561, 681, 682 AND 511)

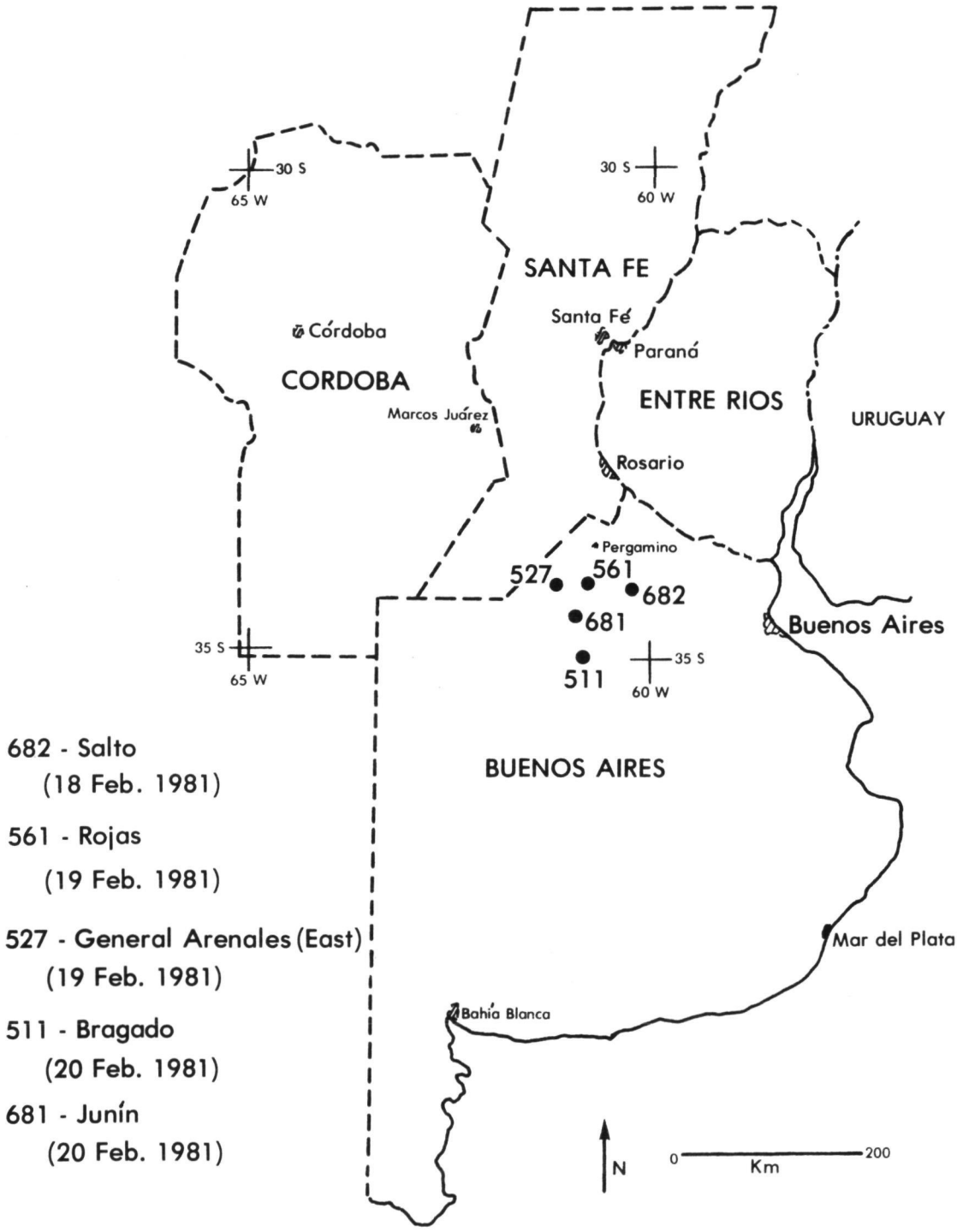
These five segments are located in the humid pampa of northern Buenos Aires province at a mean distance of 225 kilometers west of the city of Buenos Aires (see Map 4-3). Four of the five segments have common characteristics in terms of crop mix, and agricultural practices. However, Segment 511 (Bragado) the southernmost segment immediately to the south, is sufficiently different to warrant special discussion.

These five segments are located in areas of flat terrain in the western portion of the humid pampa. With the exception of Segment 511, which is lower, the average elevation is about seventy-five meters above sea level. Normally rainfall is evenly distributed throughout the year with maximum amounts being received in summer. Annual precipitation averages about 900 mm (36 in) which is sufficient to permit corn and soybean cultivation without undue risk. Rainfall reliability is greater than in areas farther westward thereby reducing the possibility of drought. Water loss by evaporation is also less of a problem than in segments to the north where drought-resistant sorghum is the major crop. Likewise, rainfall is higher than in southern Buenos Aires where agriculture is basically limited to wheat cultivation because of increased aridity.

The natural vegetation originally consisted of pampa grass, however, the widespread planting of eucalyptus and other introduced trees has dramatically altered the original landscape. Soils are well drained and fertile throughout the region but are often deficient in nitrogen and phosphorous. Nevertheless, the overall physiographic environment is very favorable for coarse grain and oilseed cultivation, particularly corn, sorghum, soybeans, and sunflowers.

Ripening corn, as well as soybeans in the reproductive stages, were observed in all segments during field work, but much of the land remains in pasture. Although corn and soybeans are important crops in these

MAP 4-3.
ARGENTINA SEGMENT GROUP III



682 - Salto
(18 Feb. 1981)

561 - Rojas
(19 Feb. 1981)

527 - General Arenales (East)
(19 Feb. 1981)

511 - Bragado
(20 Feb. 1981)

681 - Junín
(20 Feb. 1981)


682 - SALTO
SO 8
SO
PA
CR
CR
PA(Alfalfa?) 6
CR
PA
CR 4
SO 4
SU 5
CR
SO
SO 7
PA
SO
CR
CR
SO
CR(Seed Corn)
AH
PA
AH 3
PA
CR
SO
PA
CR
PA
PA
PA 2
CR
SO 1
XX-Gahan(Village)
CR
SR
Natural Vegetation
LANDSAT ACQUISITION DATE - 23 Aug. 1980
FIELD INVENTORY DATE - 18 FEB. 1981
Approx. Scale - 1:85,000

682 - SALTO

(Comments for 35 mm slides)

1 - Mature soybeans. Boundary row direction is east-west, but interior row direction is north-south. Plant height is approximately 2' and some short weeds (grasses) can be seen between the rows. A mature corn field can be seen betweeen the soybean field and Gahan (grain elevators). Corn plants are approximately 6' tall and row direction is E-W. Looking E.

2 - A weed-free or "clean" pasture which was not being grazed. Mature corn (about 6' tall) can be seen in background. Looking WNW.

3 - View of alfalfa field that had not recently been cut or grazed. Mature soybeans seen in Slide 1 are visible on the right. Looking ESE toward Gahan.

4 - Mature corn and soybeans. Row direction is parallel to the road at field ends, and perpendicular (SW-NE) in the interior of the fields. Corn height is approximately 6' while soybeans are about 18" high. The corn field contains tall weeds (probably Johnson grass) between rows. Looking NE.

5 - A field of old sunflowers that consists of about 50% weeds. The field appears to have been abandoned for at least one complete growing season. Looking SW.

6 - A view of a pasture area which may be alfalfa. Part of the field has been cut and left to dry, but it has not been grazed. Looking N.

7 - Grass and weeds backed by flooded pasture and a weed-filled soybean field comprise this scene. Johnson grass or a related species of plant appears to be growing in the soybean field. Looking SE.

8 - A field of weedy mature soybeans; dominant row direction is roughly N-S perpendicular to the road. Boundary rows at the end of the field parallel the road. The field is overrun by Johnson grass or a related species of plant. Looking NW.


561 - ROJAS
PA
PA
CR
PA
CR
CR
PA
CR
13
SU
1,2
PA
3
SR
SO
4
CR
5
CR
SO
7,8
6,9
CR
PA
SO
CR
PA
12
PA
10
AH
11
CR
PA
LANDSAT ACQUISITION DATE - 24 AUG. 1980
FIELD INVENTORY DATE - 19 FEB. 1981
Approx. Scale - 1:85,000

561 - ROJAS

(Comments for 35 mm slides)

1 - Sunflower field headed out but not mature, 4-5' high. Looking N.

2 - Close-up of sunflower.

3 - Well grazed pasture. Looking E.

4 - Soybeans, about 18" high. Looking E.

5 - Mature corn.

6 - corn on left, soybeans on right. Looking SW.

7-8 Close-up of soybean field shown in previous slide. Soybean plants are about 24" high.

9 - Soybeans (24") grown along roadside for weed control. Looking SE along road.

10 - Natural pasture with cattle grazing. Looking S.

11 - Alfalfa, about 8" high. Looking SE.

12 - Pasture with cattle grazing.

13 - Pasture in foreground and mature corn in background.


527 - GENERAL ARENALES
SO 6
SO
CR 7
CR
CR
SO
CR
PA
SR
SO
PA
CR
CR
CR
SO
SO
CR
CR
CR
PA
PA
CR
PA
AH
SO
CR
CR
PA
CR
CR
BS
CR 1-3
SO 4-5
CR
LANDSAT ACQUISITION DATE - 24 AUG. 80
FIELD INVENTORY DATE - 19 FEB. 1981
Approx. Scale - 1:85,000

527 - GENERAL ARENALES

(Comments for 35 mm slides)

1 - Mature corn, weedy along margins. Looking SE.

2 - Weeds along edge of corn field shown in Slide 1.

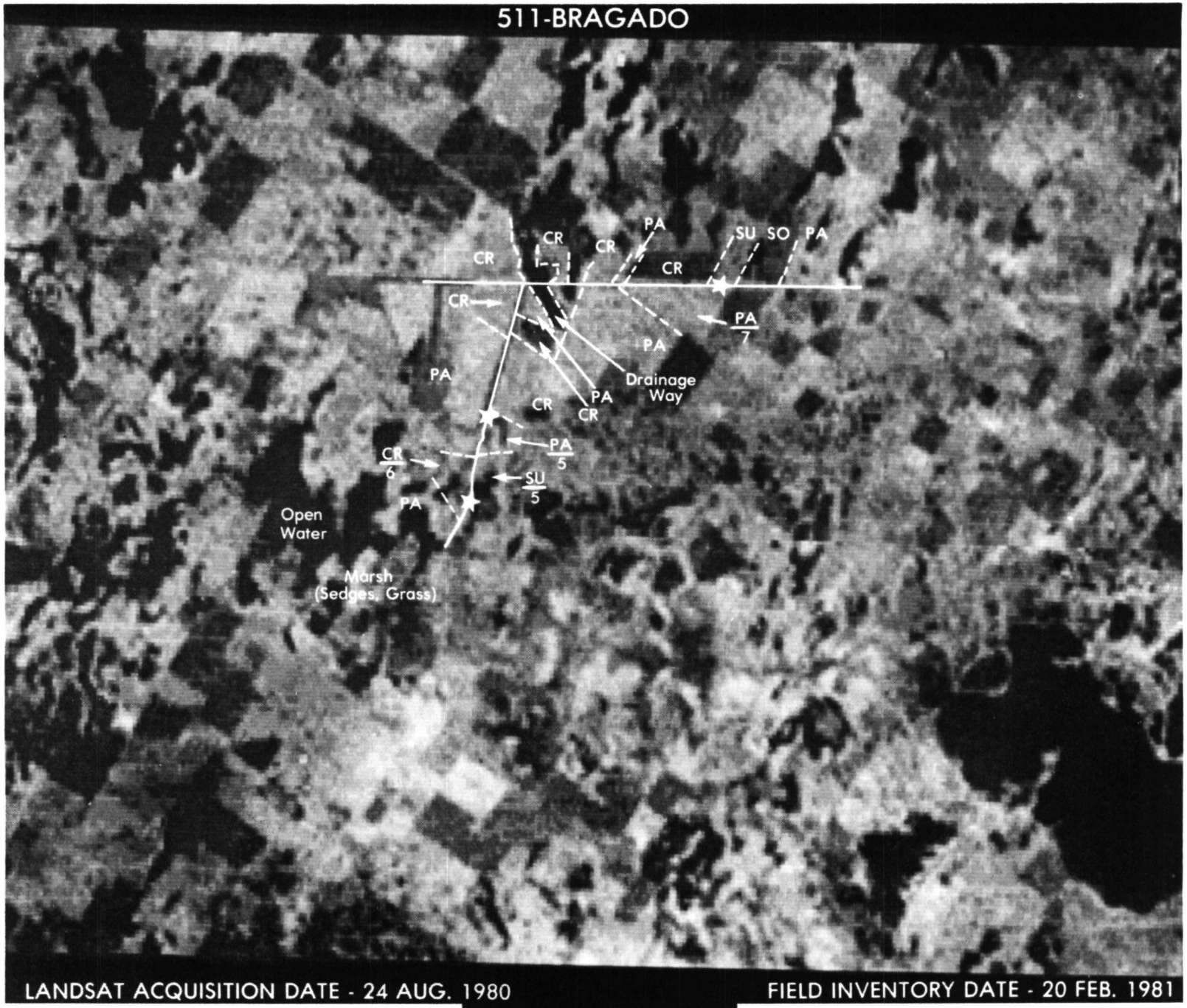
3 - Mature corn (Miguel Cuenca of INTA, Castelar, Buenos Aires province.)

4 - Unusually clean (weed-free) soybean field. Looking NW.

5 - Close-up of soybean field shown in Slide 4. About 24" high, reproductive stage.

6 - Soybean field. Looking N.

7 - Corn field (right) adjacent to railroad track. Looking W.


511-BRAGADO
CR
CR
CR
PA
CR
SU
SO
PA
CR
CR
PA
7
PA
PA
Drainage
Way
PA
CR
CR
CR
6
PA
5
SU
5
PA
Open
Water
Marsh
(Sedges, Grass)
LANDSAT ACQUISITION DATE - 24 AUG. 1980
FIELD INVENTORY DATE - 20 FEB. 1981
Approx. Scale - 1:85,000

511 - BRAGADO

(Comments for 35 mm slides)

1 - Standing water typical of much of the segment.

2 - Marshland (grasses and sedges) cover typically seen in the segment.

3 - Dense tree stand on abandoned farm.

4 - Tree-lined road near field shown in Slide 5.

5 - Pasture in foreground with sunflower, headed and drying out, in the background. Looking SSE.

6 - Mature corn, about 5' high. Looking NW.

7 - Pasture in foreground, sunflower in background. Looking SW.

8 - Sunflower field seen just outside boundary of Segment 511.


681 - JUNIN
BS (Plowed)
CR (Cloud?)
CR
PA
SR 4,5
CR
SO
CR
OA
SO
PA
CR
CR
SO
PA 2
TR
CR
O'Higgins
SO 8
TR
SO
PA 6
SO 3
PA
TR
PA
SO
CR
SO
PA
CR
Difficult to Determine Exact Placement of Boundaries
BS (Plowed)
PA
7
WA
Lago de Los Patos
CR
SO
CR
SO
CR
SO
CR
SO
Río Salado
CR 9
SO(Boundaries Difficult to Determine During Field Work)
PA 10
LANDSAT ACQUISITION DATE - 29 SEPT. 1980
FIELD INVENTORY DATE - 20 FEB. 1981
Approx. Scale - 1:85,000

681 - JUNIN

(Comments for 35 mm slides)

1 - Eucalyptus grove along the road to Junín. Looking W.

2 - Pasture which supports a low density thistle-like weed. The field appears to have been heavily grazed. Looking W.

3 - Mature soybeans. Plants are about 18" high. Row direction is generally E-W. The field contains considerable weeds, primarily Johnson grass or a related species. Looking E.

4 - Mature forage sorghum. Plants are about 7' high. Row direction is NW-SE with boundary rows running NE-SW parallel to the road. The field has already been grazed as can be seen by the many paths found throughout the field (Slide 5). Looking NW.

5 - Close-up of forage sorghum field.

6 - Pasture which has been overrun by a variety of weedy species. The same thistle-like species found in Slide 2 is common throughout this field. There is little incidence of recent grazing in this field. The cattle seen in the distance are in a separate field. Looking SE.

7 - The Lago de los Patos and Río Salado viewed from the bridge. The area is a mixture of what seems to be natural pasture and marsh vegetation. The dry parts are being grazed as incidenced by the horses in the background. Looking SE.

8 - Mature soybeans about 18-24" high. Row direction is NE-SW with a series of NW-SE boundary rows. The field supports some weeds, probably Johnson grass or a similar species. Looking S.

9 - Mature tasseled corn about 6' high. Row direction is perpendicular to the road generally NW-SE. As with most fields, a series of boundary rows run perpendicular to the general field row direction (i.e., parallel to the roads). Looking W.

10 - Poorly maintained pasture with a flooded area in the background. This is probably part of the Río Salado. The thistle-like plant common in this area is seen throughout the field. The field does not appear to have been recently grazed. Looking S.

segments, many fields were weed-infested, especially with Johnson grass. Cattle were also noted grazing on forage sorghum in some segments.

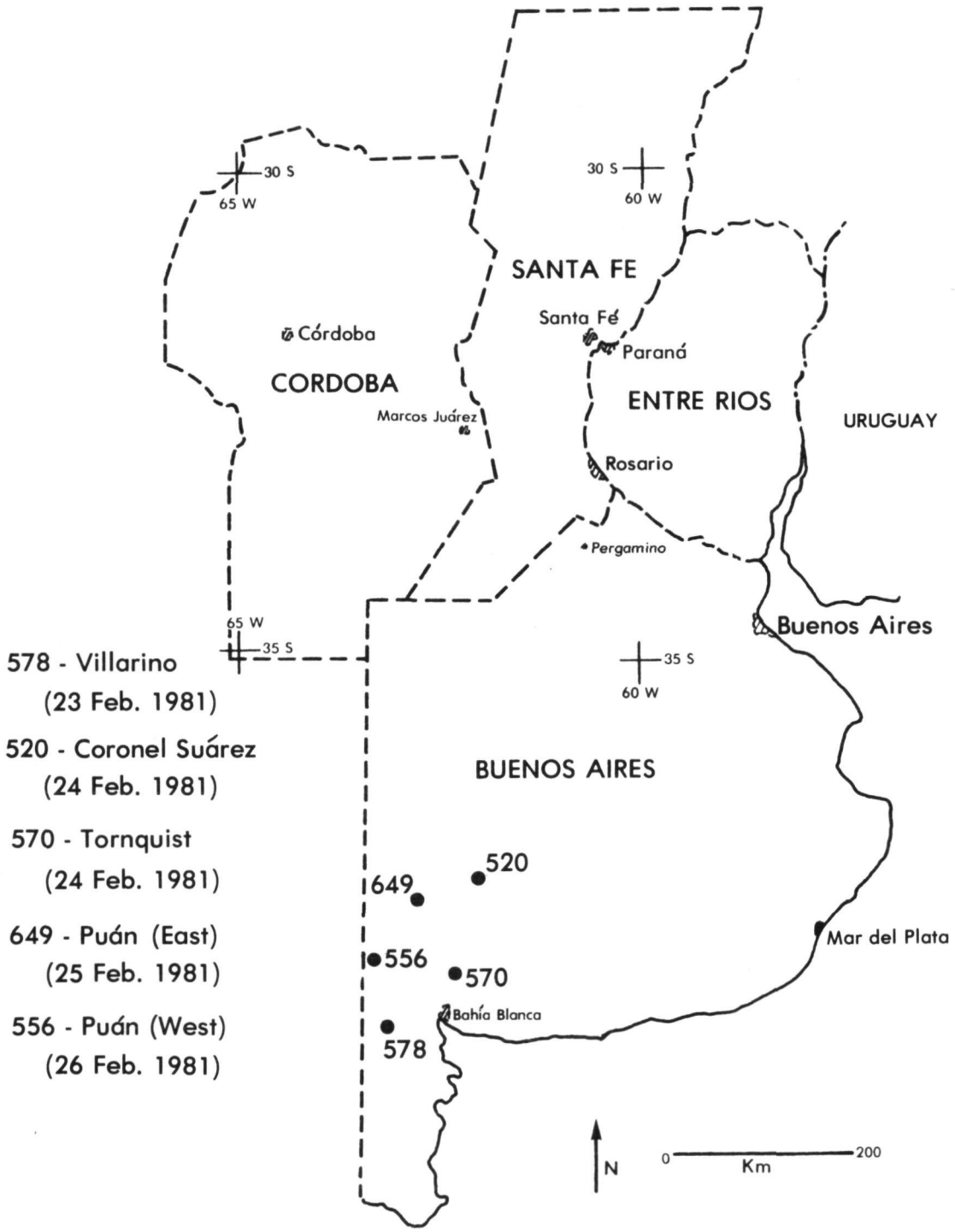
Some variation and differences between segments were also observed at the time of field inventory. Soybean production was noted as being very important in Segment 527. Sunflower plantings were quite numerous in Segment 561, as compared to other segments, while sorghum was important in Segment 681. Also, alfalfa fields were significant in Segments 561 and 682. With the exception of Segment 511, these differences do not greatly detract from the overall uniformity of the segments as major corn, soybean, and livestock production areras.

Segment 511 is located immediately to the south of the remaining segments comprising Group III. Unlike those segments, Segment 511 is part of the depressed pampa. The terrain is flat and low-lying and marshy areas are common. Soils in the zone are seasonally wet and have gray subsurface horizons over flowing permeable horizons which facilitate the formation of standing water areas during the wetter parts of the year. Corn, sunflower and soybeans in that order of importance are grown in the better drained areas. Low-lying areas were mostly natural pasture or marshland. Sunflower and soybean production occupied only a small portion of the cultivated area. Corn was seen in a mature stage, sunflowers were noted as headed or drying and soybeans were in the reproductive stage at the time of field work. Fields inventoried in Segment 511 were comparatively free of weeds, unlike Segments 527, 561, 681 and 682 located immediately to the north.

4.8 ARGENTINA SEGMENT GROUP IV (SEGMENTS 520, 556, 649, 570, AND 578)

The five segments are located in flat to rolling terrain in the sub-humid pampa of southwestern Buenos Aires province (see Map 4-4). Annual precipitation is less than in Segment Groups I, II, and III, and decreases from northeast to southwest. Pasture is the dominant rural land use, but wheat and to a lesser extent sorghum, are also grown. In

MAP 4-4.
ARGENTINA SEGMENT GROUP IV



578 - Villarino
(23 Feb. 1981)

520 - Coronel Suárez
(24 Feb. 1981)

570 - Tornquist
(24 Feb. 1981)

649 - Puán (East)
(25 Feb. 1981)

556 - Puán (West)
(26 Feb. 1981)

578 - VILLARINO

LANDSAT ACQUISITION DATE - 10 DEC. 1980

FIELD INVENTORY DATE - 23 FEB. 1981

Approx. Scale - 1:85,000

578 - VILLARINO

(Comments for 35 mm slides)

1 - Wheat stubble, about 9" high. Looking SW.

2 - Wheat stubble with weeds. Stubble infected with fungus giving it a darker appearance than normally observed in the field. Looking NE.

3 - Oats used for pasture. Looking SE.

4 - Natural brush typical of segment. Looking NE.

5 - View of natural vegetation along left side of road. Looking ESE.

6 - View of natural vegetation along and to the right of the road. Looking SE.

7 - Natural pasture with natural vegetation (see Slides 5 and 6) on upland areas in background. Looking W.

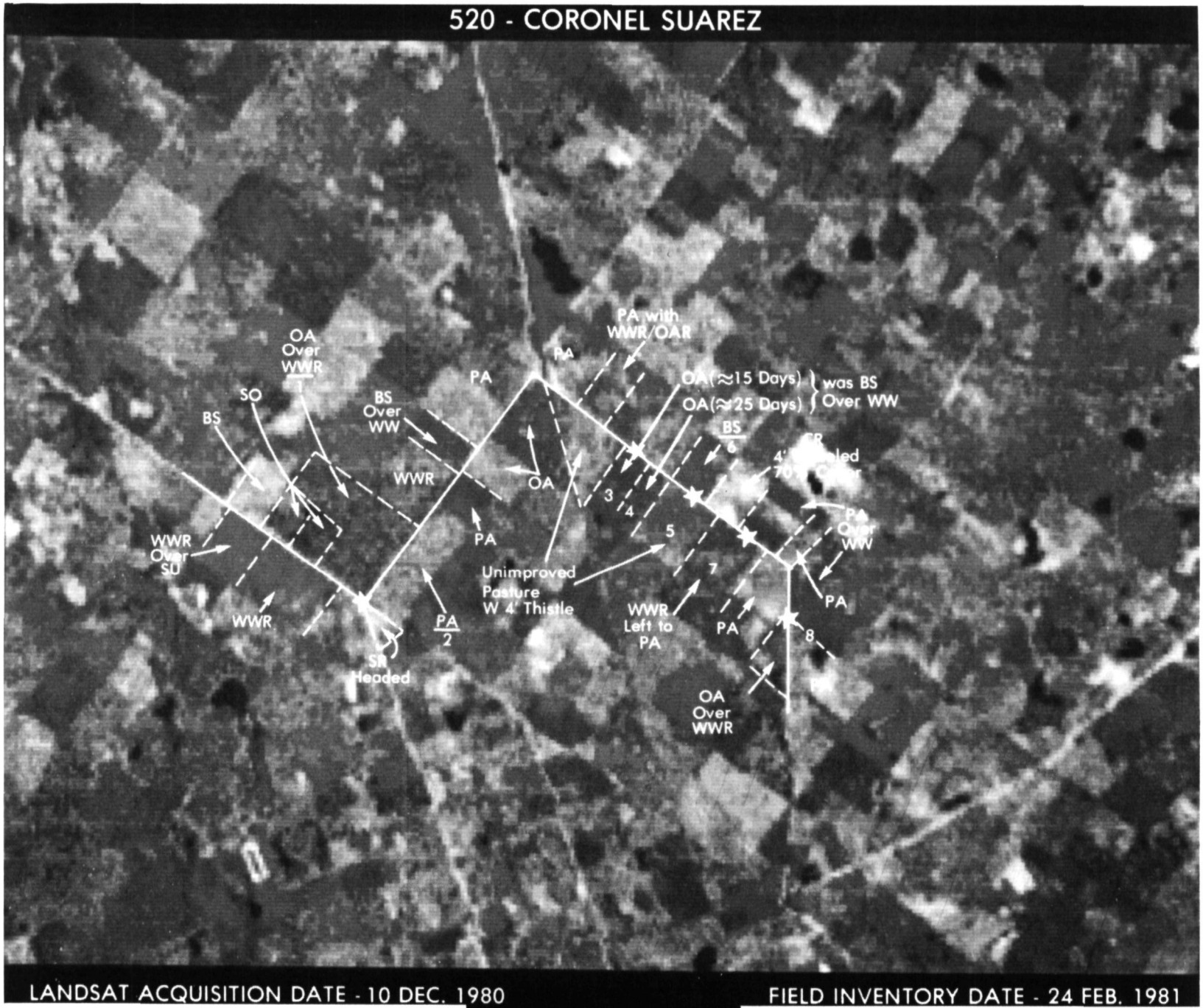
8 - Natural pasture with "Stipa" as dominant grass genera. Looking SW.

9 - Natural pasture with dry pond (internal drainage) visible in center. Looking N.

10 - View of internal drainage course with pasture in background.

11 - Close-up of natural pasture.

520 - CORONEL SUAREZ



LANDSAT ACQUISITION DATE - 10 DEC. 1980

FIELD INVENTORY DATE - 24 FEB. 1981

Approx. Scale - 1:85,000

520 - CORONEL SUAREZ

(Comments for 35 mm slides)

1 - Oats (avena) over wheat. Looking N.

2 - Natural pasture. Looking E.

3 - New oat field at ± 15 days since planting. Looking SW.

4 - New oat field at ± 25 days since planting. Looking SW.

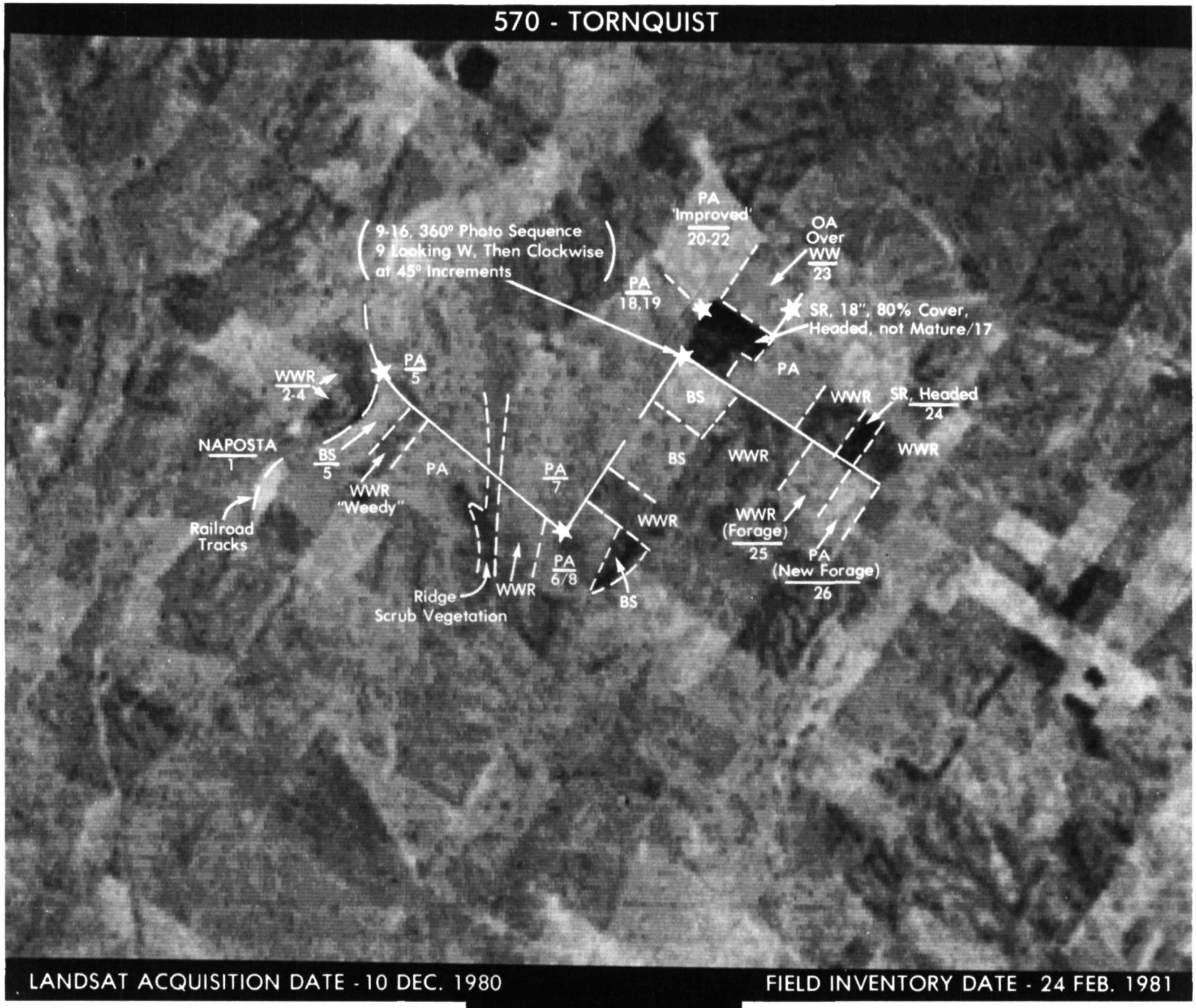
5 - Natural pasture with heavy thistle. Looking SW.

6 - Tractor disking field in preparation for planting. A disking implement - rastra de dientes - is used to break up clods prior to planting and is used after planting, but before crop emergence, to control weed growth between rows.

7 - Wheat stubble left to pasture. Most typical situation in the area. Looking SW.

8 - Pasture over wheat on the left (see Slide 7), and a "cleaner" looking pasture on right. Because this portion of the field on the right is in a narrow corner of the field the foreground area has never been plowed. Farther away, where taller weeds can be seen in the pasture, is that portion of the field which has been plowed at some time in the past.

570 - TORNQUIST



LANDSAT ACQUISITION DATE - 10 DEC. 1980

FIELD INVENTORY DATE - 24 FEB. 1981

Approx. Scale - 1:85,000

570 - TORNQUIST

(Comments for 35 mm slides)

1 - View of Naposta, which was the starting point for the day's field activities.

2 - Cecilia Espoz (CNIE, Buenos Aires), Miguel Abraham (Ministry of Agriculture, Buenos Aires), and Tomás Loewy (INTA, Bahía Blanca) in wheat stubble field. Naposta can be seen in the background. Looking SW.

3 - Another view of wheat stubble interspersed with flor amarilla (Diplotaxis teniufolia).

4 - Close-up of wheat stubble and flor amarilla. This flower was introduced into the region about forty years ago. Cattle do not eat it and it has been steadily invading pasture lands in the region. It is a perennial flower with a rhizome-type root system. Wheat can compete fairly well against it, since the wheat shoots shade the immature plants, making it difficult for them to become established.

5 - Bare soil field on right and natural pasture on left. Looking SE.

6 - Natural pasture. Looking W.

7 - Natural pasture. Looking NW.

8 - Natural pasture. Looking SE.

9-16 360° sequence of slides (running clockwise) starting with a view looking W in 9, NW in 10, and so on. The large dark field visible in the Landsat segment image is sorghum, about 18" high, and can be seen in slides 12 and 13. The last slide (16) is looking SW back towards the previous stop.

17 - Closer look at sorghum field shown in Slides 12 and 13.

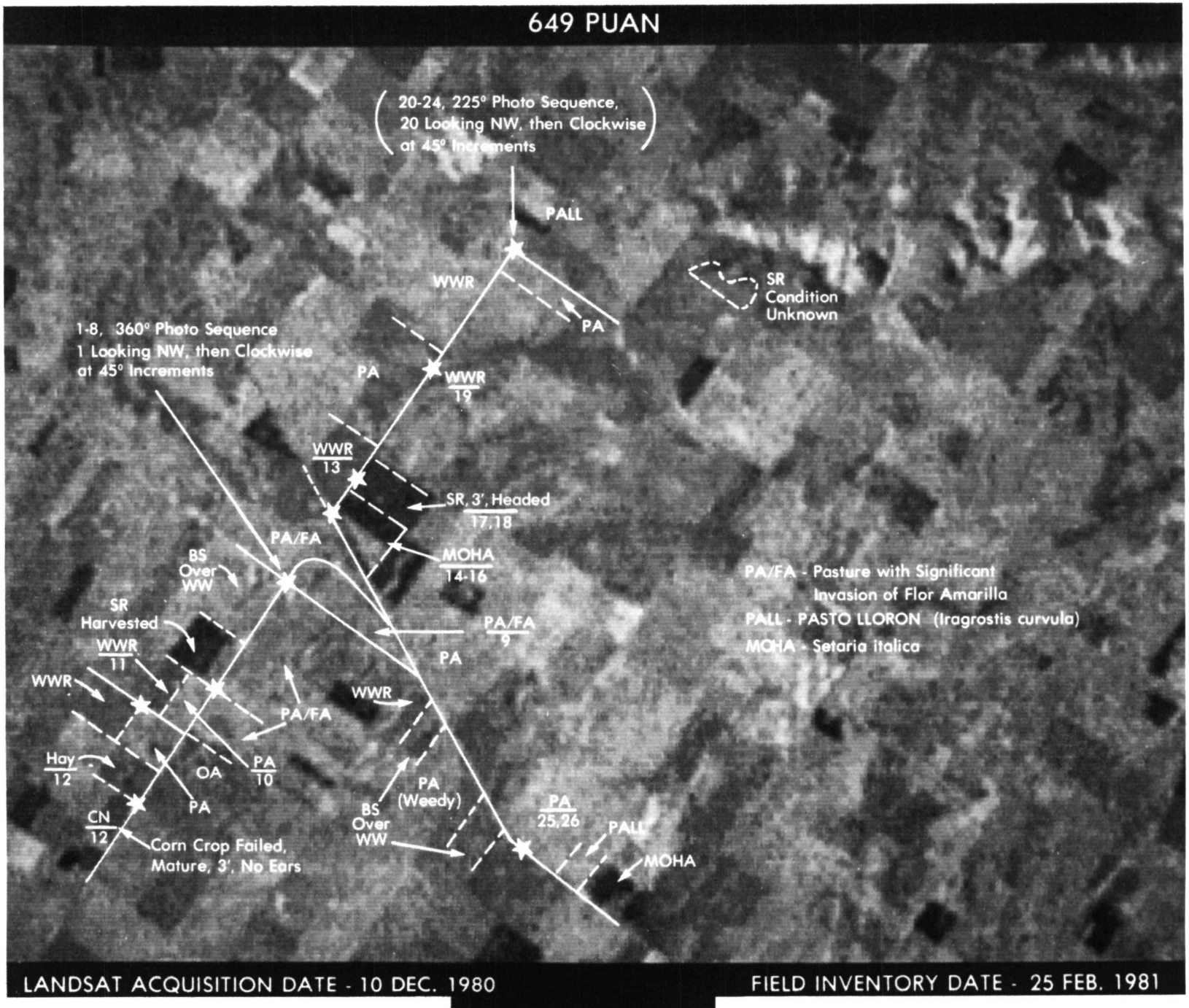
18-22 180° sequence of slides (running clockwise), with 18 looking SW over a natural pasture, 19 loooking W into same pasture (note fenceline on right hand side of frame which is boundary clearly seen on Landsat segment image). Slide 20 looks to the NW into distinctly lighter field (same fenceline as in shot 19, but now at far left of frame) which is an improved pasture. Slide 21 looks due N and in Slide 22, looking NE, one can see the sorghum field on the right side of the frame.

23 - Oats over wheat

24 - Sorghum

25 - Wheat stubble

26 - Pasture (new forage)


649 PUAN
20-24, 225° Photo Sequence,
20 Looking NW, then Clockwise
at 45° Increments
PALL
WWR
PA
SR
Condition
Unknown
1-8, 360° Photo Sequence
1 Looking NW, then Clockwise
at 45° Increments
PA
WWR
19
WWR
13
SR, 3', Headed
17,18
PA/FA
BS
Over
WW
MOHA
14-16
SR
Harvested
WWR
11
PA/FA
9
PA
WWR
WWR
PA/FA
Hay
12
OA
PA
10
PA
CN
12
Corn Crop Failed,
Mature, 3', No Ears
BS
Over
WW
PA
(Weedy)
PA
25,26
PALL
MOHA
PA/FA - Pasture with Significant
Invasion of Flor Amarilla
PALL - PASTO LLORON (Iragrostis curvula)
MOHA - Setaria italica
LANDSAT ACQUISITION DATE - 10 DEC. 1980
FIELD INVENTORY DATE - 25 FEB. 1981
Approx. Scale - 1:85,000

649 - PUAN (east)

(Comments for 35 mm slides)

1-8 360° sequences (running clockwise) in 45° increments. Slide 1 looks NW along road with bare soil on left and pasture (flor amarilla) on right. Slide 2 looks north, Slide 3 looks NE, and so forth. In Slides 3 and 4, the Sierra de Cura Malal can be seen in background. In Slide 5, looking SE, the town of Alta Vista can be seen in the background. Slide 7 looks SW along road, and Slide 8 looks N across the bare soil field seen in Slide 1.

9 - Pasture with significant invasion of flor amarilla.

10 - Natural pasture. Looking W.

11 - Wheat stubble, with Sierra de Cura Malal in background. Looking E.

12 - Failed corn crop on left (3' high, no ears). This crop was probably planted in October, and subsequently suffered from drought. Once farmer realized the crop had failed, he abandoned the field and weeds moved in. Hay field on right has moha (Setaria italica) in it.

13 - Wheat stubble field and road leading to the NE on right hand side.

14-16 Three shot sequence looking NW, E, and SE respectively into field of moha. Alta Vista can be seen in background of Slide 16. Note also presence of flor amarilla along field edges in Slides 14 and 16.

17 - Grain sorghum about 3' high, headed, still green. Looking E.

18 - Same grain sorghum as in 17. Looking NE with Sierra de Cura Malal in background.

19 - Wheat stubble in field on right. Looking NE.

20-24 Five shot sequence (running clockwise) looking first to the NW (#20), then N, NE, E, and SE (#24) of natural pasture (pasto llorón) that typifies the area. Sierra de Cura Malal can be seen in background of Slide 22.

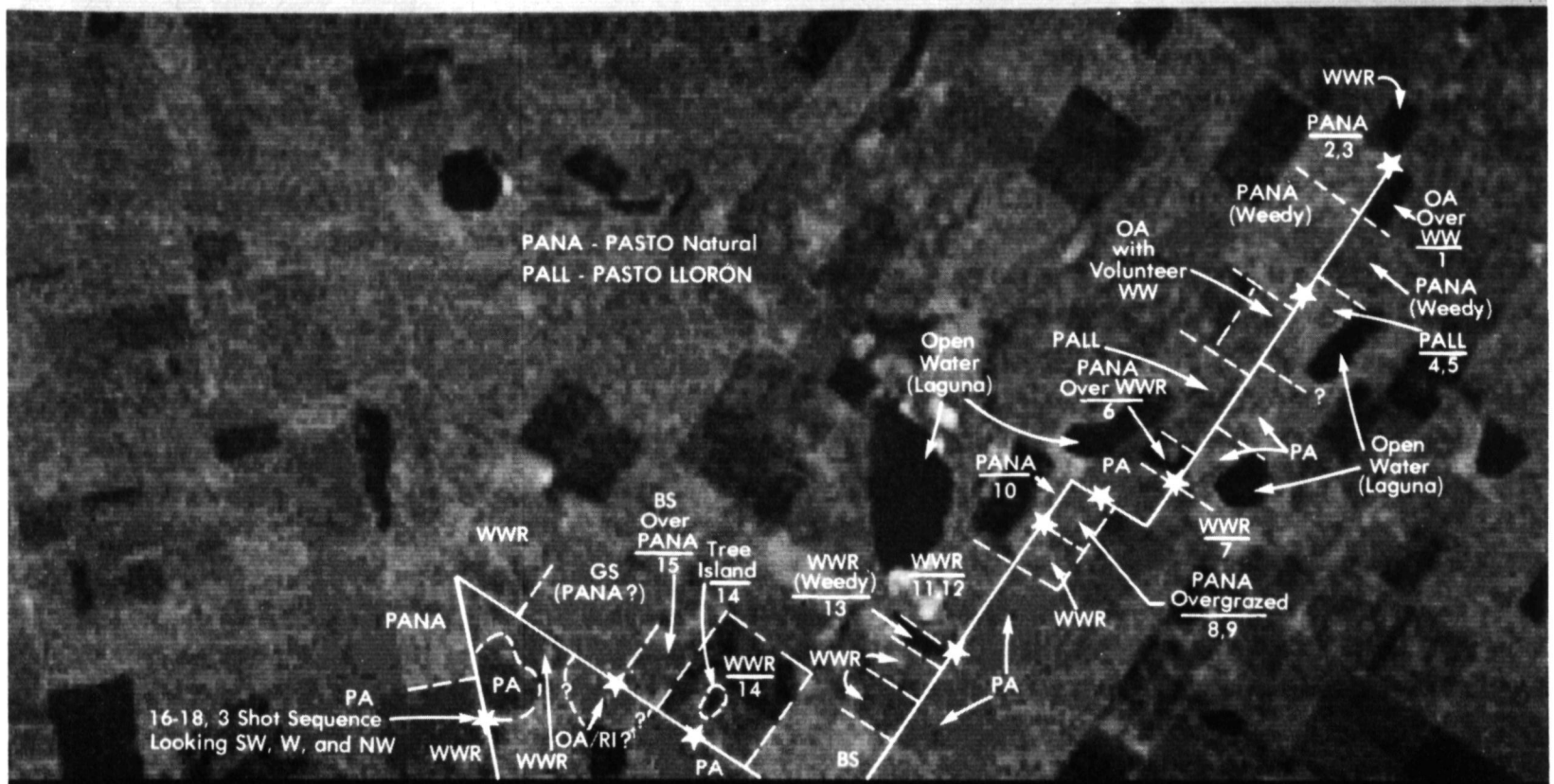
25 - Pasture. Wheat crop had failed, sheep were allowed to graze, then pulled out. Only low weeds remain. Miguel Abraham (Ministry of Agriculture, Buenos Aires) is on the far right and Tomás Loewy (INTA, Bahía Blanca) and Cecilia Espoz (CNIE, Buenos Aires) are on the left.

26 - Close-up of pasture shown in Slide 25.

27 - Terraced sunflower field observed during drive from Coronel Suárez to Puán (10 miles E of Pigüe). This type of contour planting was the first of its type seen, represents a new practice which the Ministry of Agriculture hopes can be successfully introduced to farmers and ultimately adopted as a standard practice. At level contour points across the slope one can see pasto llorón (Iragrostis curvula) planted as a soil catchment crop.

28 - Opposite side of the road from above (Slide 27) showing oats (avena) in the field on the left and cattle grazing in the background. Also, note the Sierra de Pigüe in the background, which is the northwestern arm of the Sierra de Cura Malal.

556 - PUAN



LANDSAT ACQUISITION DATE - 12 SEPT. 1980

FIELD INVENTORY DATE - 26 FEB. 1981

Approx. Scale - 1:85,000

556 - PUAN (west)

(Comments for 35 mm slides)

1 - Oats over wheat. Looking S.

2 - Natural pasture (campo natural) in which oats had been planted in the previous 2-3 weeks. Looking SW along road.

3 - Close-up of field shown in slide 2.

4 - Pasture (pasto llorón). Looking SE toward small lake (laguna).

5 - Close-up of pasto llorón.

6 - Natural pasture over wheat stubble. Note small lake (laguna) in background which is easily seen on segment image. Looking NW.

7 - Miguel Abraham (Ministry of Agriculture) and Cecilia Espoz (CNIE) in wheat stubble field. Looking S.

8 - Overgrazed pasture. Looking SW.

9 - Close-up of overgrazed pasture.

10 - Natural pasture. The large lake (laguna) on left side of slide is easily seen in the center of the Landsat segment image. Looking NW.

11 - Wheat stubble. Looking NE along road.

12 - Same wheat stubble field with large lake seen in background. Looking N.

13 - Weediest wheat stubble field seen during entire trip (not typical). Looking NW.

14 - Wheat stubble with tree "island" in background that is discernable in Landsat segment image.

15 - Natural pasture being plowed. Plowshares are lifted along field diagonals and plowed last. Looking N.

16 - Wheat stubble (best looking field in entire segment). Looking S.

17 - Same wheat stubble. Looking W.

18 - Same wheat stubble. Looking NNW.

19 - Local gentry observes AgRISTARS team.

winter, oats are commonly planted over wheat stubble. Although evapotranspiration rates are lower than in the far north, rainfall is sufficiently low to make the segments unsuitable for corn or soybean cultivation with the exception of Segment 520, which is marginally suitable for corn because of greater rainfall. Segments 556, 649 and 570 are drier and important for sorghum and wheat, both drought-resistant crops. Segment 578 is the driest of the five segments and is marginal for all crops except wheat and oats.

Segment 520, located about 155 kilometers north of Bahía Blanca, has a flat to undulating surface and an elevation of about 300 meters above sea level. To the south of the segment, elevation increases as the Sierra de Cura Malal and Sierra de la Ventana highlands are approached. The climate of the zone is subtropical, but it is considerably drier than areas to the east, particularly in winter. Precipitation averages about 700 mm (28 in) annually and the area is well drained. Soils are reasonably fertile and are a somewhat drier variant of soils found in the humid pampa region.

Large fields devoted to pasture and wheat production dominate the agricultural scene but sunflower is also of some importance in the surrounding area. Wheat is normally planted in July and harvested in December. This is customarily followed by oats planted over wheat stubble in the same fields for winter pasture. Oats were also planted in fully dressed (plowed and disked) fields. Corn and soybeans are not important crops in the segment due to moisture limitations.

Local agricultural practices are significant. Disking is practiced in winter pasture fields before and after planting (but prior to emergence) in an effort to control weed growth. Secondly, field team members observed terraced sunflower cultivation about forty kilometers west-southwest of the segment which is a new practice. Terraces are planted in pasto llorón (Iragrostis curvula), a light-colored bunch

grass, to control erosion where sunflowers are planted in rolling terrain.

These three segments form a triangle situated north-northwest of Bahía Blanca. Segment 570 (Tornquist), about thirty-five kilometers north of Bahía Blanca, is the southern apex of the triangle. Segment 649 (Puán/East), 150 kilometers north of Bahía Blanca, is the northern apex; and Segment 556 (Puán/West), 115 kilometers northwest of Bahía Blanca, is the western apex.

These segments are located in a transitional zone between the humid subtropical climate to the east and the semi-arid climate of the Argentine interior and Patagonia to the southwest. Precipitation varies from slightly less than 600 mm (24 in) in the two easternmost segments to about 520 mm (21 in) in the more westerly segment. Rainfall thus diminishes toward the southwest and the chance of drought is somewhat greater in these three segments than in Segment 520 (Coronel Suárez), which is located some fifty kilometers to the northeast. Soils, although reasonably fertile, may be dry for the periods of up to ninety days or more each year. Segment 649 (Puán/East) is situated immediately to the northwest of the Sierra de Cura Malal - Sierra de la Ventana highlands at an average elevation of 275 meters, and has both flat and rolling terrain. Segment 570 (Tornquist) located to the south of the Sierra de la Ventana, has similar terrain but is somewhat lower, around 200 meters. Segment 556 (Puán/West) is generally flat and averages about 175 meters in elevation. Despite differences in relief, similar climatic, vegetative and edaphic (soil) conditions exist between the three segments, except for the trend towards progressively drier conditions to the southwest.

Land use in the three segments is dominated by wheat production, natural pasture, winter pasture (oats) planted over wheat stubble and some limited sorghum production. Corn and soybean production is essentially absent from the three segments. Wheat, usually planted in July

and harvested in December, is the dominant crop in all three segments. Following the wheat harvest in December, oats are often planted (about February 1) for winter pasture.

The botanical composition and conditions of pasture lands varied widely in these segments. Some fields were well-tended and improved, while others showed signs of severe overgrazing. Small fields of moha (Setaria italica) were seen in Segment 649, while pasto llorón (Iragrostis curvula) was observed in larger fields in Segments 649 and 556. Severe infestations of flor amarilla (Diplotaxis tenuifolia), a small weed with yellow flowers which cattle do not eat, was common in in Segments 649 and 570.

Moisture deficits, and the possibility of drought, are more serious problems in these three segments than in Segment 520 (Coronel Suárez). Illustrative of this was a weed-infested cornfield in Segment 649, which earlier had succumbed to drought and was used for sheep grazing following abandonment. However, grain sorghum, which is more drought-resistant, was noted growing in the same segment.

Segment 578 (Villarino), about eighty kilometers west-southwest of Bahía Blanca is the southernmost of the AgRISTARS segments and is sufficiently distinct from the remaining segments to be discussed separately.

The terrain of the segment is generally rolling, and although elevation above sea level is quite low (±75 meters), change in relief within the segments averages fifteen to thirty meters. This is generally much greater than the other segments located in the pampa. Climatically this segment was the driest, since it is located on the northeastern fringe of the semi-arid Patagonian steppe. Precipitation is considerably lower than in the segments to the northeast, and averages slightly less than 500 mm (20 in) annually, most of which is received in summer. Natural vegetation mainly occurs in upland areas and consists of low trees and shrubs similar to the chaparral of California. Drainage systems tend to be internal in nature and streams

are intermittent due to low precipitation. To the west and south of the segment, where conditions are even drier, some dry salt lakes occur. Some small ponds were noted in the segment.

Agricultural activities focus on the cultivation of small grains (wheat) and pasture, and as in the other segments in the area (556,649, 520, and 570), oats were planted over wheat stubble. Fields were large and farmsteads were few. Natural pasture (campo natural) accounts for much of the unimproved grazing land. No corn or soybeans were noted during the field traverse, but one small field of sorghum was seen.

5.0

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The assistance of the USDA Office of International Cooperation and Development (OICD) and the USDA Agricultural Attaché in Buenos Aires worked extremely well in assuring the Consortium introductions and access to the appropriate administrative and scientific personnel within Argentina. This, together with the timely planning help from NASA, proved crucial to the Consortium's overall activities in preparing for the field trip.

SEAG and CNIE officials were extremely generous and flexible in their efforts to assist the Consortium in meetings its goals during the field trip. SEAG and CNIE are currently cooperating on their own remote sensing crop production forecasting program, supported in part by the United Nations Food and Agriculture Organization (UN/FAO). While the status of this program is not fully known, this program represents a potential technical and administrative base from which SEAG and CNIE could work in the future in order to join the Consortium in joint pursuit of mutual Argentine and AgRISTARS program goals.

The technical guidance and day-to-day logistical assistance provided by the field staff of the National Institute for Crop-Livestock Technology (INTA) was a key factor in the overall success of the field data collection program. The Consortium is convinced that the continued cooperation and assistance of INTA, a distinct operating unit within SEAG, could provide the essential linkage to the operational agronomic community, e.g., local extension agents, individual farmers, and various agricultural researchers in Argentina.

Finally, all fourteen segments which were selected for crop identification field work were visited during the two week field trip. The logistical success of this "feat" is owed almost entirely to SEAG and

INTA, and the nature of their contribution is summarized elsewhere in this report. Field identification data for over 600 fields were collected and several soil samples and small quantities of two distinct corn hybrid seeds (flint) were secured for transmittal back to the United States. Several hundred ground photographs were taken and supporting field and crop condition observations were noted, both for inclusion in this report and future analysis needs.

The trip, therefore, was successful in providing the Consortium with the opportunity to gather first-year data in support of presently planned analysis activities and related technology development goals. It is believed, moreover, that with the success of the first year's effort, future year field data collection activities of greater scope and intensity can and should be attempted.

5.2 RECOMMENDATIONS

Since the USDA has purview over all foreign ground data collection activities within AgRISTARS, an expansion of their involvement would greatly enhance the value of future-year program activities. The expanded USDA role could, for example, including the following: participation in future planning meetings in Argentina, collection of ground data, training in Argentinians in periodic enumeration methods, and translation of various AgRISTARS materials into Spanish. Furthermore, the existing scientific exchange agreement between the respective Agricultural departments in the United States and Argentina could simplify the planning and conduct of field data collection activities in future years.

Contact between NASA and the National Commission for Space Investigations (CNIE) in Buenos Aires should be initiated as well in order to seek mutually beneficial CNIE involvement in future field data collection and analysis support activities.

A visit by a NASA/AgRISTARS management level person to Buenos Aires and a counterpart USDA official to review the overall program with SEAG and CNIE officials would strengthen the "country-to-country" and "agency-to-agency" aspects of the program. The meeting should occur in to mid-November to mid-December timeframe to coincide with the planning trip currently proposed for the 1981/1982 crop year field trip. In addition, a specific agenda of anticipated activities, desirable levels of support and assistance for all parties (both U.S. and Argentine), as well as benefits that will be realized by all the participants, should be generated. To this end, the Consortium is currently preparing such an agenda for presentation and review by NASA and USDA. Upon approval, this plan should be sent to SEAG and CNIE for their review prior to the proposed planning meeting.

While it may appear obvious that INTA officials would participate in any future negotiations, the Consortium would recommend that a specific request for assistance of INTA in future data collection programs be pursued. Since their involvement could include the use of considerable personnel and material resources, special attention must be given to the full implications of such an investment of those resources in future planning meetings.

Planning for the 1981/1982 crop year field data collection program should proceed, with special attention given to those elements of overall program coordination and negotiations with our hosts in Argentina cited above. A more ambitious field program can be successfully conducted, but only if advanced planning with our cooperators in Argentina takes place early enough to ensure that all parties understand the program, have the necessary resources to support the program, and finally, all parties appreciate the benefits that they will receive by working in the program.

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Crop Production Data

Argentina agricultural data showing area planted for crop years 1976/77 and 1977/78 provided by Cecil Hallum (NASA/JSC). TAPE: 5132, between First EOF and Second EOF; FILE: ARGENT ARGENT and # DIRE ARGENT; FORMAT: SAS Data Set, Printout Date: January 27, 1981.

Argentina crop production data covering 1975/76 to 1979/80 crop years (to 1978/79 for soybeans) provided by Engineer Agronomist Claudio A. Fonda of the Agricultural Estimates (Estimaciones Agricolas) section of the Ministry of Agriculture and Livestock Raising (Ministerio de Agricultura y Ganadería), Buenos Aires, February 1981.

Agronomic Understanding Interviews

Numerous conversations between Dr. David R. Hicks (ERIM) and Engineer Agronomist Claudio A. Fonda during field inventory work in Argentina.

Interview between Dr. David R. Hicks and Agronomist Eduardo A. Anchubidart, Chief of the Agricultural Estimates section, Ministry of Agriculture and Livestock Raising, Buenos Aires, February 27, 1981.

APPENDIX A

GLOSSARY OF TERMS

GENERAL TERMS

English	Spanish
agriculture	agricultura
cattle	ganado
county	partido
crop	cultivo
crop (field of a crop)	campo
crop-livestock (pertaining to)	agropecuaria (o)
crop rotation	rotación de cultivos
harvest	cosecha, zafra
livestock	pecuaria
livestock raising	ganadería
seed	semilla

CROPS

barley	cebada
cereals	cereales
corn/maize	maíz
flax	lino
forage	forraje
millet	mijo
oats	avena
oilseeds	oleaginosos
pasture	pasto
peanuts	maní
potatoes	papas
rye	centeno
sorghum (grain)	sorgo granífero
sorghum (forage)	sorgo forrajero
soybeans	soja
wheat	trigo
winter wheat	trigo invernal

GEOGRAPHIC TERMS

drought	sequía
dry season	estación seca
hill	loma, cerro, cuchilla
lagoon	laguna
lowland (floodplain)	tierra baja
marsh/swamp	pantano
mountain range	sierra
plain	llano, pampa
river	río
valley	valle

ORGANIZATIONAL TERMS

AgRISTARS	- Agriculture and Resources Inventory Surveys through Aerospace Remote Sensing
CCAD	- Crop Condition Assessment Division (of the USDA/FAS)
CCT	- Computer Compatible Tape
CNIE	- Comisión Nacional de Investigaciones Espaciales (National Commission for Space Investigations)
Consortium	- The combined managerial and technical team of ERIM and UCB
ERIM	- Environmental Research Institute of Michigan
FAS	- Foreign Agricultural Service (of the USDA)
INTA	- Instituto Nacional de Tecnología Agropecuaria (National Institute of Crop-Livestock Technology)
JSC	- Johnson Space Center
LARS	- Laboratory for Applications of Remote Sensing (Purdue University)
NASA	- National Aeronautics and Space Administration
SEAG	- Secretaria de Estado de Agricultura y Ganadería (State Secretariat of Agriculture and Livestock Raising) - now the Ministry of Agriculture and Livestock Raising
SRS	- Statistical Reporting Service (of the USDA)
UCB	- University of California at Berkeley
UN	- United Nations
UN/FAO	- United Nations Food and Agriculture Organization
USDA	- United States Department of Agriculture

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