Operations were predominantly in the SSB. Advantage was taken of the "virgin" areas to satisfy multiple search requirements with a minimum number of operations. The large operation over China covered approximately 200,000 SNM clear.

Poppy Fields in Mexico were shot in IR/BW film in conjunction with the stellar terrain system.

There was a requirement to "status" East Europe and North Korea each mission half.

This was the #2 clear RV in HEXAGON history.

Based on RV - 1 replanned mission objectives.

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NRO

PROGRAM A

HEXAGON MISSION 1214
STELLAR TERRAIN MAPPING SYSTEM

HISTORY

MISSION	DURATION	UNIQUE REQUIREMENTS SATISFIED (MSNM)
1205	41	1.7
1206	42	2.4
1207	58	2.6
1208	61	1.3
1209	60	1.7
1210	53	1.4
1211	61	1.5
1212	62	1.3
1213	112	2.2
1214	117	4.3

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Control Systems Jointly

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Statused 85% of Eastern Europe and over 97% of North Korea.

Multiple requirements in Africa to monitor military activities in Zaire, Angola, and Ethiopia/Somalia border.

Most one time search objectives for the mission were achieved.

B Camera anomaly occured the night before RV - 2 drop.

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The pre-mission plan had as an objective 4.5 MSNM clear. We covered 4.3 MSNM clear in the proper mode. When sidelap and redundant coverage are factored out, our unique coverage was 4.1 MSNM clear.

Success factors were a 50% increase in film quantity (S01414), the bilap mode, extensive area analysis by our weather detachment, and the outstanding interface with DMA.

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1214 NORTH AMERICAN EMPHASIS

Of the 140 nominal operations over the North American continent, 63 were engineering. The remainder were for mapping and charting, Forestry Service, Department of Energy, Soil Conservation, National Ocean Survey, Environimental Protection Agency, Mexico narcotics and Cuba.

The large op represents one of the two 'pitch' shots taken. A color op covering over 2 million square nautical miles clear.

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1214 CLUSTER ACCOMPLISHMENT

These figures reflect a mono second half and reflect revised unique cloud free look objectives and film allocations.

In all cases we exceeded the objective below the predicted film cost except Korea which was at objective and on cost.

~~TOP SECRET/H~~

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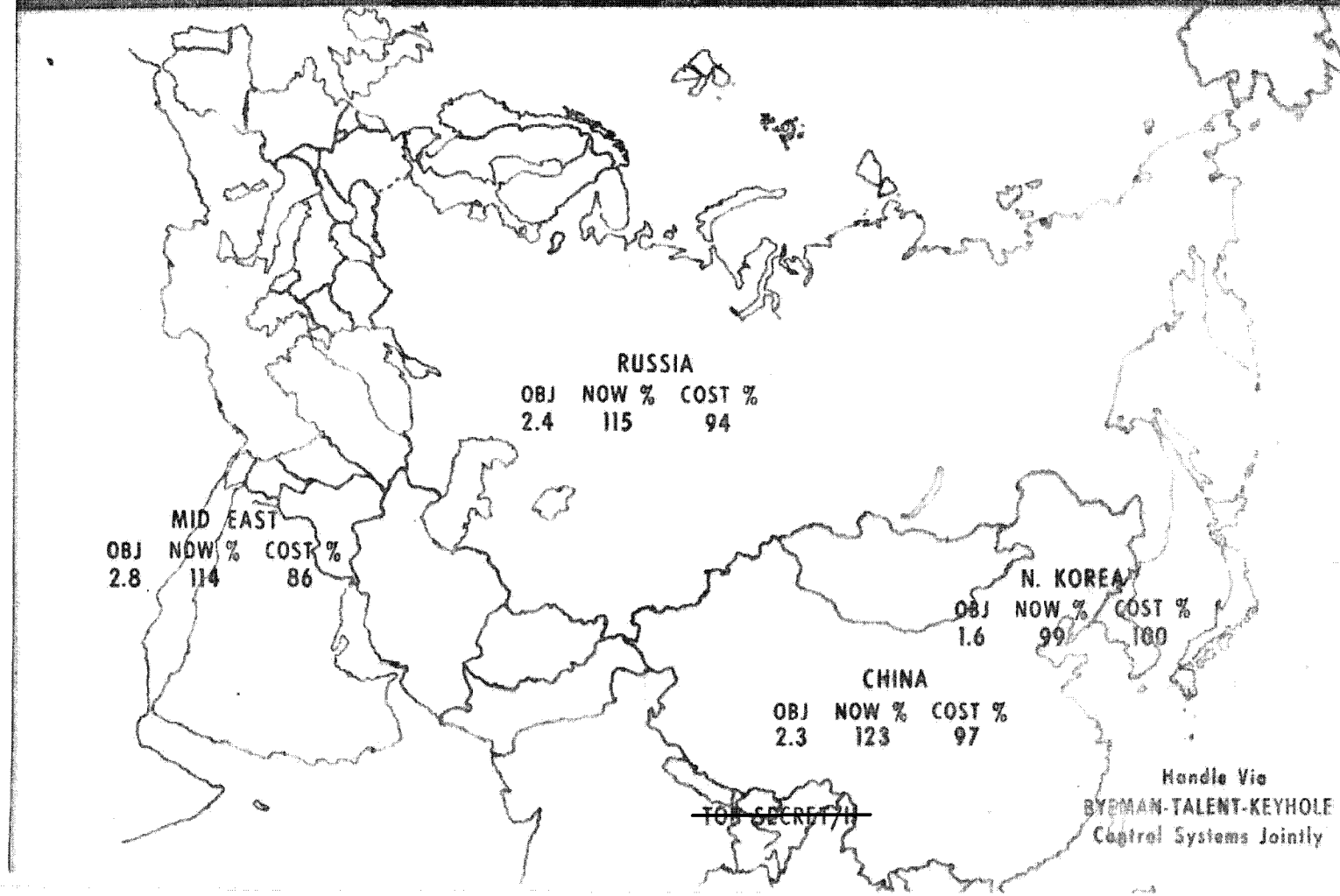
NRO

PROGRAM A

MISSION 1214

CLUSTER ACCOMPLISHMENT



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1214 SEARCH PERFORMANCE

Again, accounting for a mono second half, we exceeded all search objectives (% total area clear once).

We were "over budget" on 12 - 24 month ground by approximately 5000 feet - used to build up age curves.

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PROGRAM A

MISSION 1214
SEARCH PERFORMANCE

CAT	OBJ %	NOW %	COST %
4 MO.	82	110	89
6 MO.	74	116	100
9 MO.	72	115	101
12 MO.	57	129	123
18 MO.	37	151	115
24 MO.	37	143	119

NOTE: MISSION OBJECTIVES AND SATISFACTION ACCOUNTING MODIFIED TO ACCOUNT FOR RV 3+4 MONO LIMITATION

~~TOP SECRET/U~~

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Control Systems Jointly

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1214 STATUS

On the two and four month search we came close to the USIB "ideal" currancy of 80% and exceeded in all other categories.

If we could not count mono accomplishment during RV 3 - 4 our status drops significantly. However, we will be in an excellent posture for the long term search at SV - 15 start.

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NRO

PROGRAM A

MISSION 1214

RV-4 SEARCH STATUS (AGE)

CAT	STATUS	EOM STATUS	MODE VALID	1215 START
2 MO.	74%		0	0%
4 MO.	78		14	0
6 MO.	86		54	0
9 MO.	84		52	0
12 MO.	86		86	75
18 MO.	84		84	77
24 MO.	82		82	79

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The weather during the summer portion of the mission was well above average. The bottom smooth line represents Kennedy Corrected Probability of 80 - 100% cloud-freeness over the entire SSB (no longer used in HEXAGON Operations). The middle line is the Mean cloud-freeness and the plotted line is the 5 - day Average cloud-freeness during Mission 1214.

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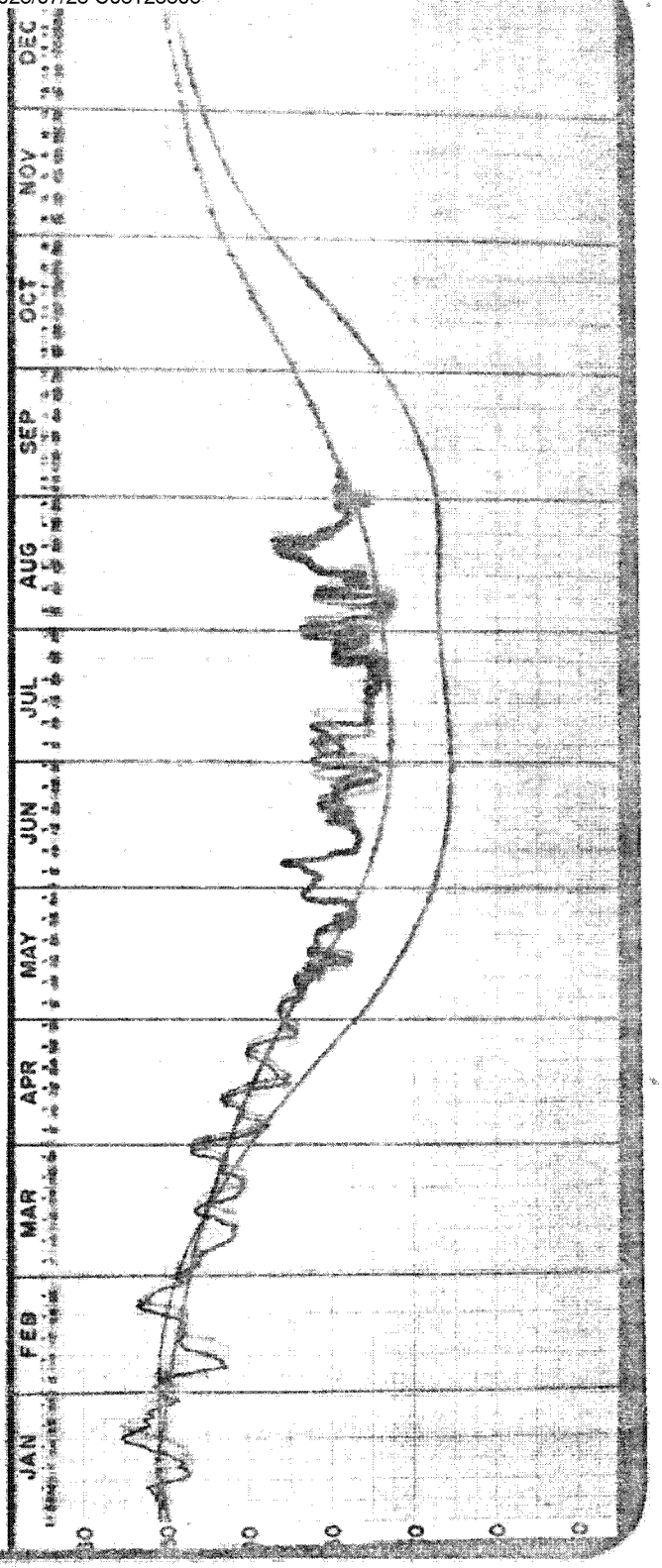
SSB CLIMO (9YR) VS DAILY WEATHER

FLIGHT / 0460

19 78



NRO

PROGRAM A

HEXAGON WX HISTORY

MSN	RV-1		RV-2		RV-3		RV-4	
	PRE	VER	PRE	VER	PRE	VER	PRE	VER
1209	82	83	81	82	69	68	54	57
1210	72	71	68	66	73	69	67	69
1212	64	52	67	60	78	72	76	70
1213	78	70	74	72	85	80	79	75
1214	85	84	83	83	82	78	78	79

THE BOTTOM LINE

	CLOUD FREE TAKE	TOTAL AREA GROSS	TOTAL AREA CLEAR
1209	72.2%	16.9 MSNM	12.2 MSNM
1210	77.4	17.7	13.7
1212	69.1	17.8	12.3
1213	78.8	20.8	16.4
1214	82.2	25.2*	20.3*

* ALL TIME RECORDS FOR HEALTHY HEX MISSIONS

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Careful shaping of operations - preference to long, narrow operations which minimized the impact of up and down ramps - kept interop wastage down and afforded us the ability to accomodate ad hoc taskings of South Africa, Ethiopia/ Somalia without jeopardizing basic search requirements.

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PROGRAM A

HEXAGON WASTAGE HISTORY

MSN	RV-1	RV-2	RV-3	RV-4	TOTAL
1209	19.7%	22.8%	24.1%	24.3%	22.7
1210	21.8	25.6	25.5	28.0	25.2
1212	27.9	28.8	28.4	31.5	29.1
1213	19.0	19.8	21.9	23.2	21.8
1214	20.1	20.3	19.5	19.5	20.0

IMPACT:

APPROXIMATELY 12,000 FT/MSN BONUS EXPOSED FILM VICE 1209 - 1213 AVERAGES

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The B side operations during RV-4 were planned so they would not conflict with the A side. The ground was not "counted down" on either East or West coast data bases. IR and color bands were used for wheat and poppy fields. Areas actually photographed is approximately 20% of the areas represented on the map. On all but two "pitch down" ops in the US there was about a 40 NM discontiguitity between frames due to the low Vx/h commanding.

"COVER THE EARTH"

1214 was the first mission where over 20 million square nautical miles were covered clear with average ver weather over 80%.

~~TOP SECRET/H~~

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Eastern Europe was sucessfully recovered, however, we weren't as successful with North Korea.

98% of South Africa was covered clear for nuclear search.

Search ground (4/6 and 6-9 month) was recovered to maintain status.

B-side photography (not shown on the chart) was executed for the duration of RV-4.

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NRO
PROGRAM A

MISSION 1214
RV-1 AND 2 ACCOMPLISHMENT

SEARCH CATEGORY	% TOTAL AREA - CLEAR ONCE PRE-MSN PLAN (ENTIRE MSN)	AT RV-2 DROP
2 mo.	95	85
4	70	68
6	53	55
9	54	52
12	32	48
18	29	33
24	37	30

CONCLUSION:

MOST OBJECTIVES FOR 1 TIME COVERAGE ESTABLISHED FOR ENTIRE MISSION MET BY RV-2 DROP AND BEFORE HARDWARE PROBLEMS BEGAN

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There were 6 successful stereo operations attempting to return to normal operations.

We capitalized on a week of unseasonably good weather in South China.

We were tasked to restatus South Africa for nuclear search, in addition to the re-status of East Europe and North Korea.

The mission was replanned and the database modified to reflect mono accomplishment.

There were two successful non-nominal B side operations - one "pitch down" and one non-contiguous over Eastern and Western US respectively.

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1214 STELLAR TERRAIN HIGHLIGHTS

117 Days Active Mission

SSB Coverage
- Continental Control Network Areas - trilap - not covered previously
  - 100 out of 115 attempted
- Directed Redundancy:
  - NTB SIOP Aim Points
  - Cruise Missle TERCOM Matrix
  - NAVPAC CCN

Island Positioning - mono/bilap
- 80% cloud cover acceptible - only need two points on island for positioning
- Overexposed to give water penetration for reef/shoal mapping

Mexico Drug Areas - trilap - in conjunction with pan system

South America - bilap

Continental Tie
- Two trilap operations to tie Eurasian and North American Land mass to WGS
  - Alaska - St. Lawrence Island
  - Siberia - St. Lawrence Island
- Did not quite satisfy - used non contiguous "B" pan shots to try to bridge

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SECTION VI

PROBLEM AREAS

6.1 MANAGEMENT

CRYSPER is a difficult program to maintain and manage. In addition to its size, it consists of three main subroutines each authored by a separate organization. Even small changes require a significant amount of care, time, and coordination. The data base for each run is enormous. The inputs are derived at various states in the assembly and test sequence of the camera system. The tests are performed at both SSC and SVIC, and the data reduced by several organizations. Many of the input values to CRYSPER are available a year or more prior to flight. The final input, which is normally the orbit case, may not be selected until the month prior to flight. The bookkeeping of the available inputs is a task in itself. Too many times, data being sent from one organization to another neither is timely nor complete. Consequently, at a time when CRYSPER could be used for mission planning, it can still be waiting proper inputs.

6.2 PERFORMANCE LEVEL

The performance predictions produced by CRYSPER should agree with the actual performance levels measured postflight, and indeed the correlation has been reasonable based on the missions flown to date. However, there are often inconsistencies related to the predictions and how they were derived. CRYSPER normally predicts two sigma low estimates based on smear. The cross-track actuals agree very well with the two sigma low predictions, indicating that the magnitude of smear being used in the program is correct. However, the in-track actuals are slightly higher than the predictions. This raises the question as to whether the smear function within the program is modeled correctly. If the median option for CRYSPER is used, vice the two sigma low smear, the predictions for both in-track and cross-track are higher than the measured performance level. The use of smear as measured in the chamber and the nature of the smear (albeit linear, non-linear, or whatever) is a continuing study.

6.2.1 Lens MTF Mismatch

The polychromatic lens MTFs obtained from interferograms in Chamber D do not provide the same field curvature and astigmatism data obtained from a fully assembled camera tested photographically in the vacuum chambers. It is not clear at this point in time which set of data is closer to the truth. Both sets of data are acquired in a gravity environment. However, the interferogram data can be adjusted for the gravity free environment of flight, while the photographic chamber data cannot. The photographic chamber data takes into account the focus effects due to film curl, while the interferogram data does not. At this time, CRYSPER configured lens MTF data can only be obtained from the interferograms.

6.2.2 Preflight Field Angle Predictions

While the program has the capability to predict resolution for any one of five field angles, it is not possible to predict the field angle location of a target before flight. The preflight predictions generally made before flight are for the center portion of the field; the MTFs for the 0° and ±2° field position are averaged. This is, in general, the portion of the format that is of slightly better performance than the rest. On occasion, predictions have been made for a particular field position if it appears as though there is a unique problem that may cause excessively poor quality. Post flight predictions can be made for field angles closer to those positions at which targets are acquired. These types of predictions are generally for CORN tribar targets where the coordinates have been measured. Intelligence targets could be run against CRYSPER, if desired, through use of the MPR predicted coordinates or the OAK reporting. These approaches are not generally used; and at present the software to handle large volumes of this type of data does not exist.

6.2.3 Smear Data Versus Scan Angle

The program is currently configured to use as input data, smear values (mean and two sigma) for both directions of each camera as a function of Vx/h and scan angle. There are unique aspects in the camera design that change the smear characteristics as a function of scan angle length and center. This means, for example, that a 30° scan sector taken from an angle/angle table run for 120° of scan will have been run with incorrect smear values. There are 16 possible scan angle/scan center conditions available. The updated version of CRYSPER known as KAPER is being configured to use data for each of these conditions and compute 16 sets of angle/angle tables. One remaining difficulty in obtaining the smear data for all conditions is that chamber data is obtained for only three collimator locations. Interpolation and some extrapolation is used to fill in the rest of the table. If large differences between chamber or test runs occur, then it occasionally caused discontinuities in the resolution values as a function of scan.

6.2.4 Mathematical Description of Smear As a Function of Performance

CRYSPER has been programmed with two simplifying assumptions about the camera system's smear characteristics: (1) it is linear, and (2) it is normally distributed. While these are probably reasonable assumptions, there are often cases when it is clearly not appropriate. Chamber data has been obtained on some camera systems that indicate skewed frequency distribution of smear. Line target images have on occasion been significantly distorted, indicating non-linear smear. While the frequency of these effects has decreased as the systems have matured, they are still present to some degree. Electromechanical analysis from TM data indicates that there are several periodic disturbances that occur randomly or as a function of a particular mode of operation, e.g., drive capstan dither. These smear conditions are not modeled in CRYSPER per se. If the magnitude of the smear can be determined, the mean smear values can be increased by that amount and additional CRYSPER runs will show the

decrease in performance due to that smear. This is not a very efficient measure, and should only be used when a large amount of photography is affected.

6.2.5 Target Reflectance Inadequately Modeled

Data pertaining to two aspects of the target reflectance characteristics that are in need of improvement are the absolute reflectance of intelligence targets and the degree of specularity. CRYSPER presently contains a look-up table format containing estimates of reflectances by COMIREX category. The information for this table is a combination of real data from measurements of mission photography and a good deal of guesswork. On the average, the data is probably near correct but it is most assuredly not absolute for specific targets. In addition, the effective reflectance of ground targets varies as a function of factors that are not related to the target, e.g., snow surround and reflections from nearby clouds can cause significant changes in the apparent target appearance. CRYSPER contains no modeling for the degree of target specularity. This area requires the most work. Such effort is currently underway by BRIDGEHEAD under the sponsorship of the CCB (Photographic R&D).

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NORTH AMERICAN ACCOMPLISHMENT

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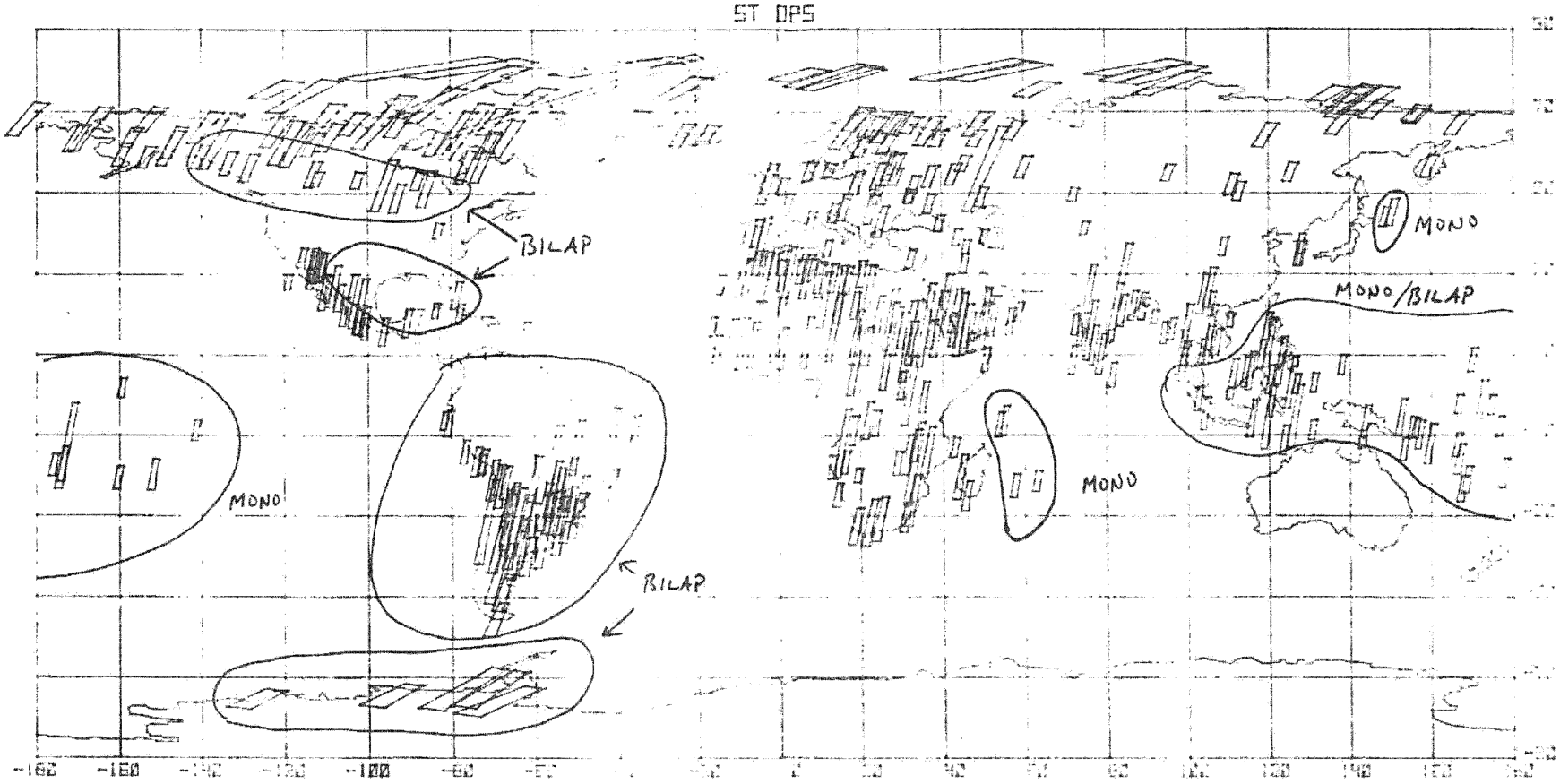
ST OPS



DATE 9 JUL 78 MISSION DAY 116 REV SPAN 19 - 1977

MSN 1214 RV-5:	PRE = 77	VER = 78	CLEAR = 4.3 MSNM
1213-5:	81	74	2.2 MSNM
1212-5:	67	59	

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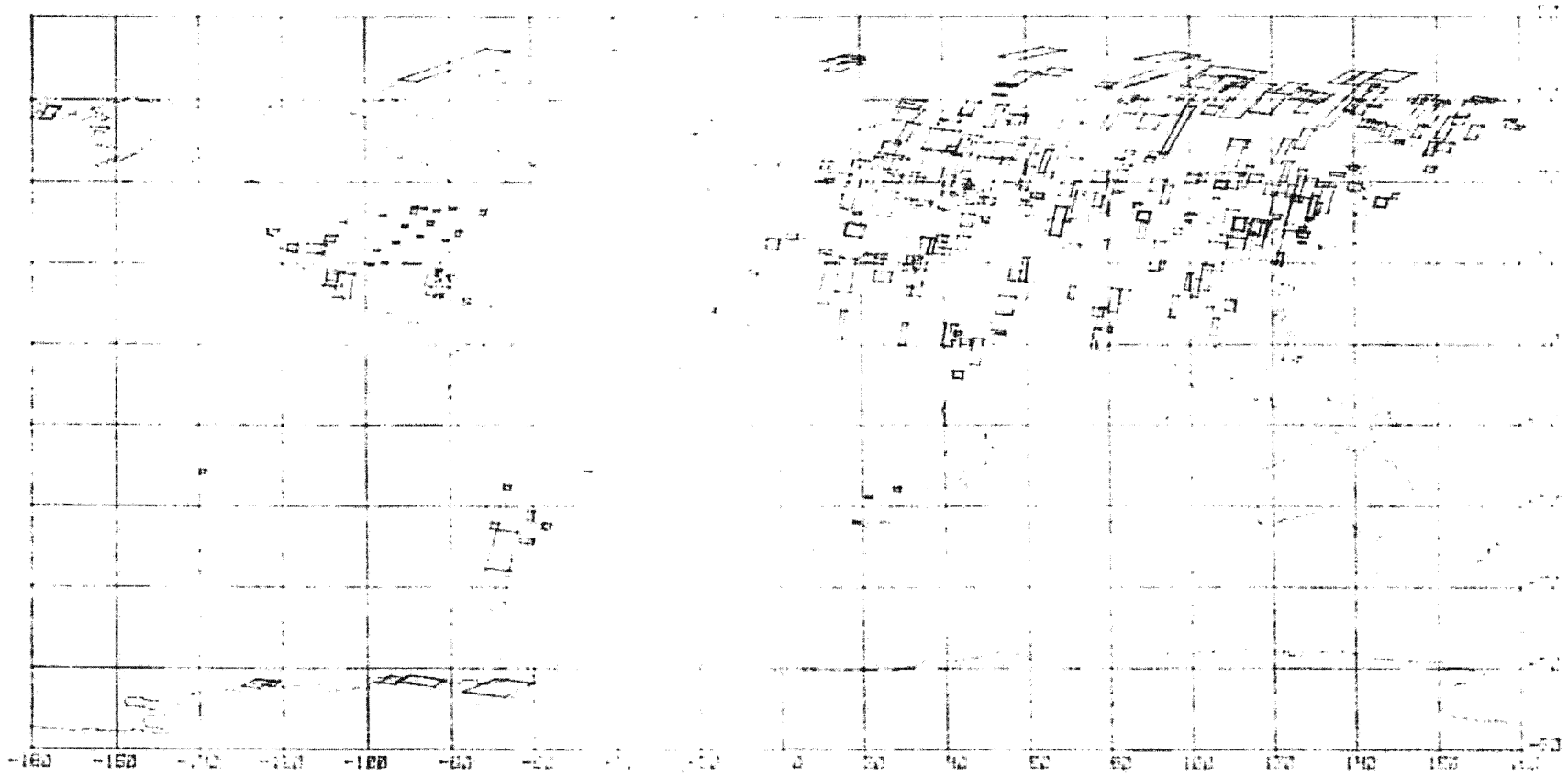
HANDLE WITH SYSTEM CONTROL SYSTEM ONLY

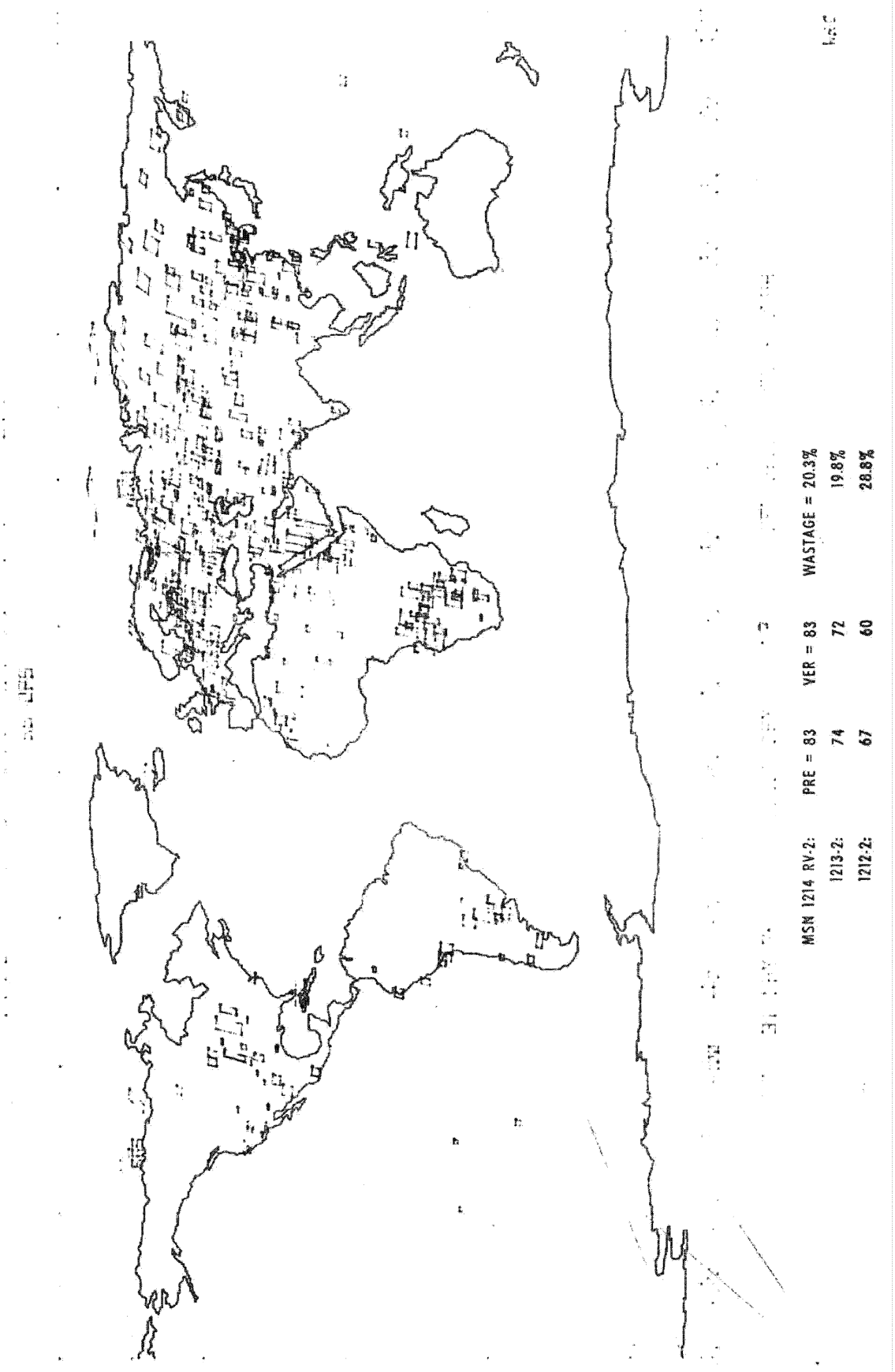
15 DPS



DATE 18 APR 78 MISSION DAY 34 REV SPAN 5 - 547

MSN 1214 RV-1:	PRE = 85	VER = 84	WASTAGE = 20.1%
1213-1:	78	70	19.0%
1212-1:	64	52	27.9%

NRC



MSN 1214 RV-2:	PRE = 83	VER = 83	WASTAGE = 20.3%
1213-2:	74	72	19.8%
1212-2:	67	60	28.8%

MSN 1214 RV-3:	PRE = 82	VER = 83	WASTAGE = 19.5%
1213-3:	85	80	21.9%
1212-3:	78	72	28.4%

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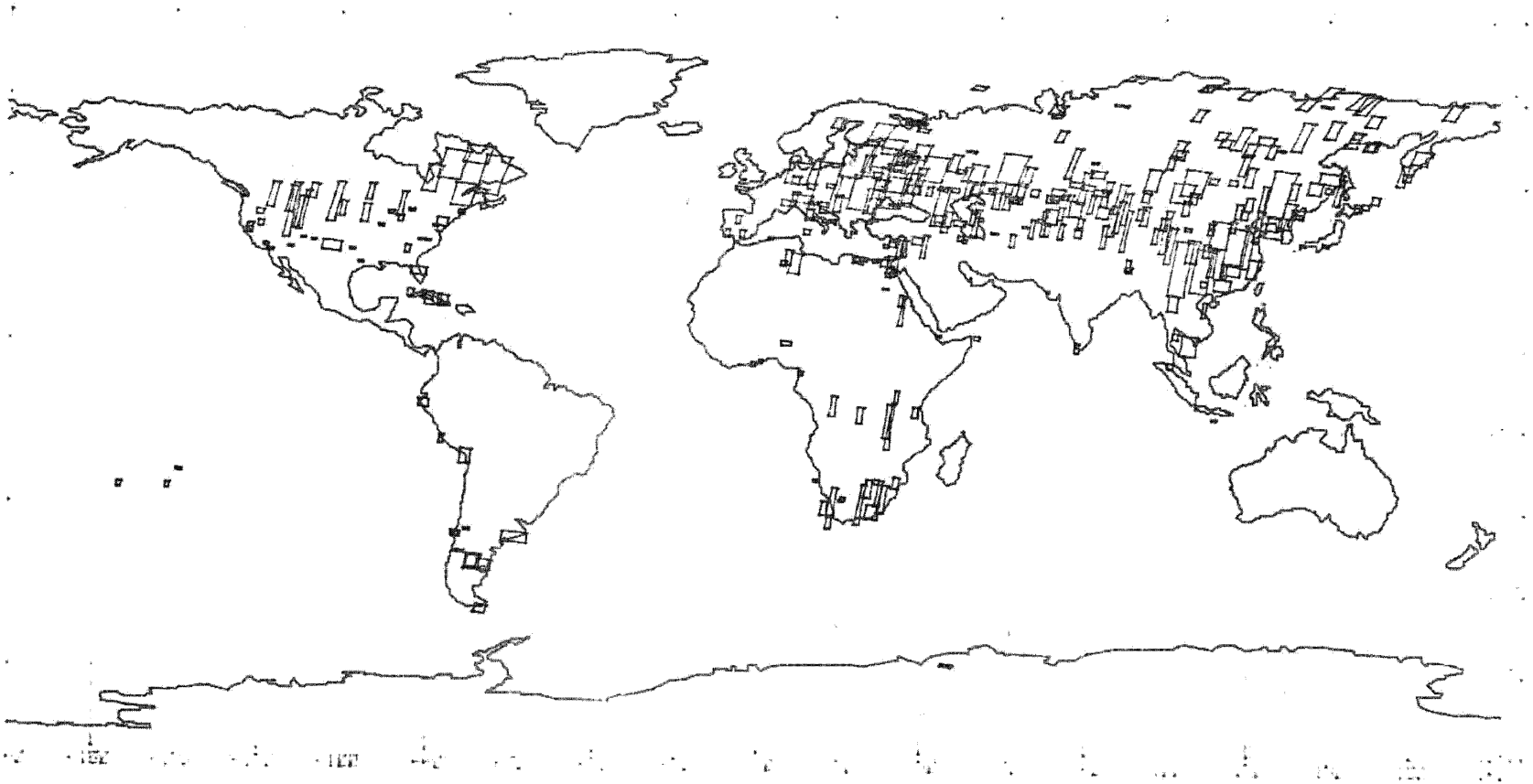
55 OPS



MSN 1214 RV-4:	PRE = 78	VER = 79	WASTAGE = 19.5%
1213-4:	79	75	23.2%
1212-4:	76	70	31.5%

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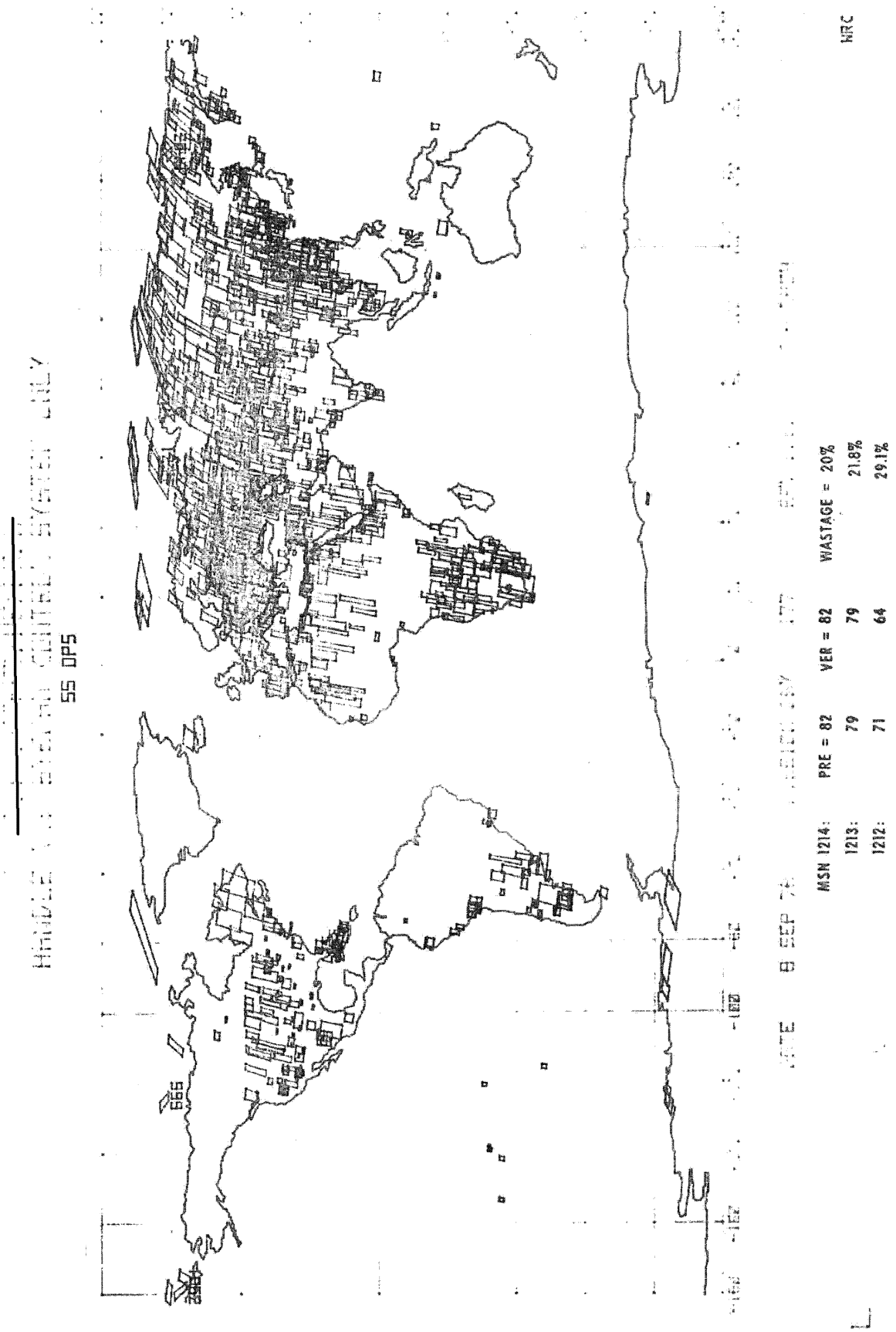

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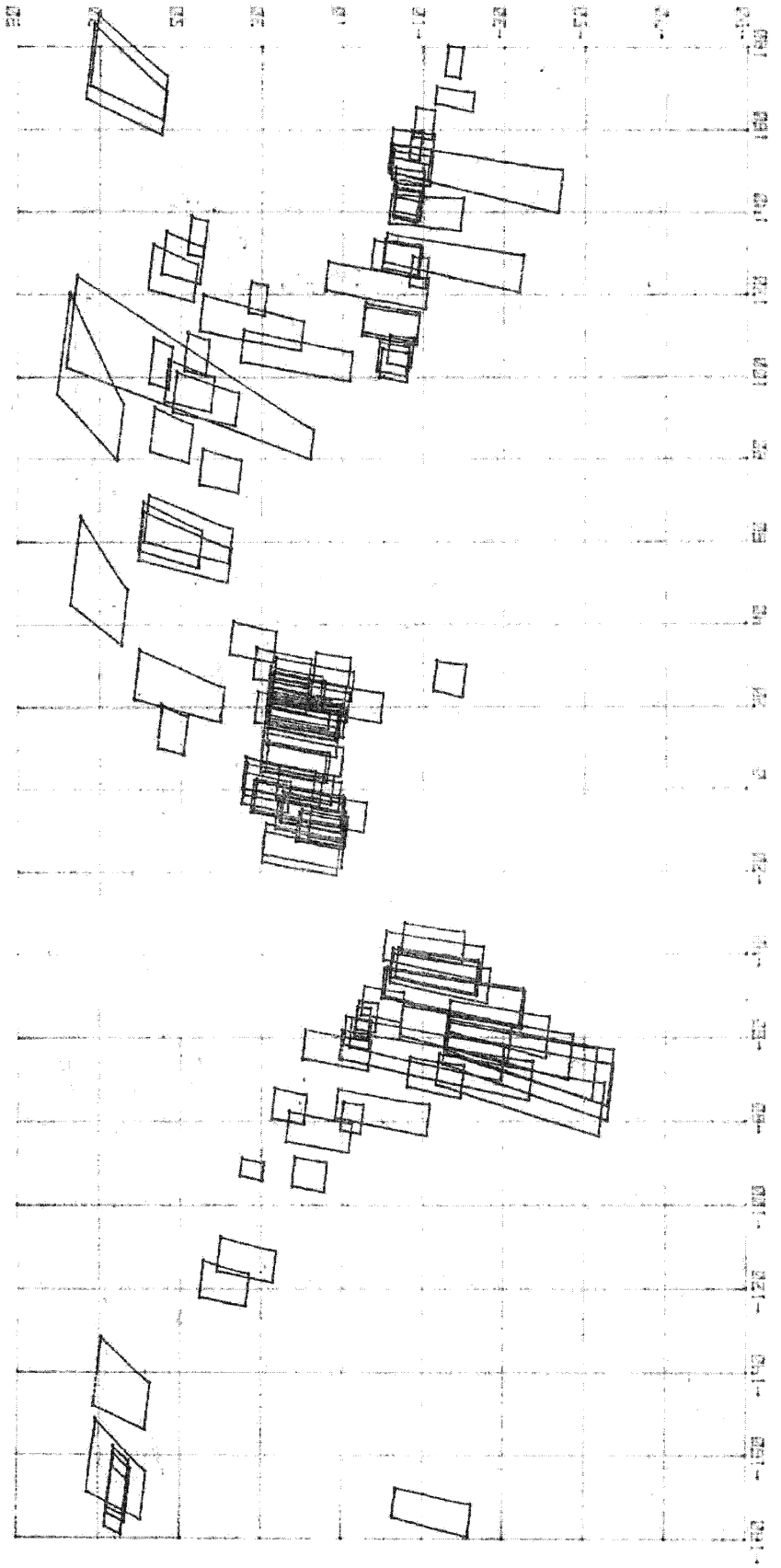
55 OPS



DATE 8 SEP 78 MISSION DAY 177 REV SPAN 2271 - 2864

WRC