

# Minimosaic Offset Investigation

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## Introduction

The release of the MAMM 25m product, a mosaic of Antarctic Radarsat backscatter, was preceded by a beta release of “Minimosaics” over fast moving glaciers along the Antarctic coast (figure 1). The Minimosaics were compiled from Radarsat fine beam data (FN1). The mosaics are single look and have 10m pixel sites. The same fine beams were re-sampled to 25m and incorporated into the MAMM 25m mosaic. The Minimosaics were georectified using local ground control points (GCPs) and tie points at the block level. The MAMM mosaic underwent the same georectification with an additional continent wide transformation, “grand adjustment,” in order to match discrepancies between blocks.

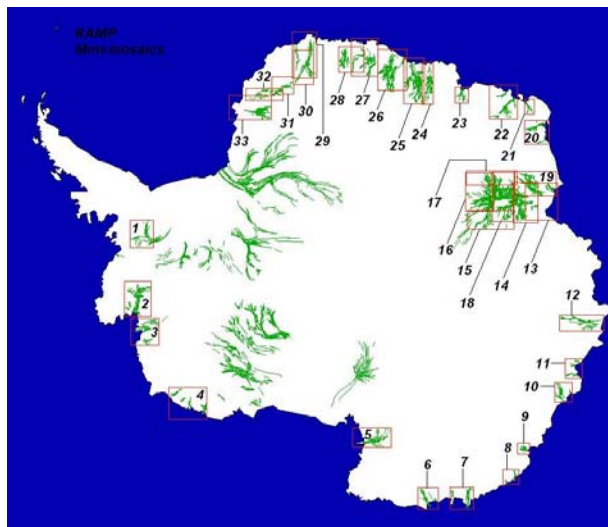


Figure 1. MimiMosaic locations

This project identified the offset between the Minimosaic 10 meter data and the Tile-overview 25 meter data. The procedure was to find validation points (VP) in both tile-overview and Minimosaic so as to derive the offset in both distances and angle. The report documents the offset between the 33 Minimosaics and their corresponding Tile-overviews. The report concludes with recommendations on corrections to the Minimosaic

## **Procedures**

A minimum of five VPs were selected for each of the Minimosaics.

### **Criteria for point selection:**

The general rules used to determine the appropriateness of a VP are:

1. Good contrast between VP and its surrounding area. Ideally the object's outline should be crisply defined with low amounts of speckling.
2. VPs should be associated with objects that have well defined shape. Examples can include:
  - a. Intersections of natural linear features that form acute angles. Ideally angles should be less than or equal to 90 degrees. The lines do not include areas where, due to DEM errors, a smearing effect occurs; or where boundaries between frames and imaging effects can be found. A natural line must be an object that exist in nature (an earth bound object) represented by a group of pixels in a row
  - b. Small protrusions from larger objects.

### **Examples:**

The following are excellent examples of the point selection criteria. Icebergs were used and are included in the following example but icebergs maybe unreliable in cases where Minimosaic and Tile-overviews utilize different frame sequences. These sequences may contain a time displacement that could show the natural drift of the iceberg.

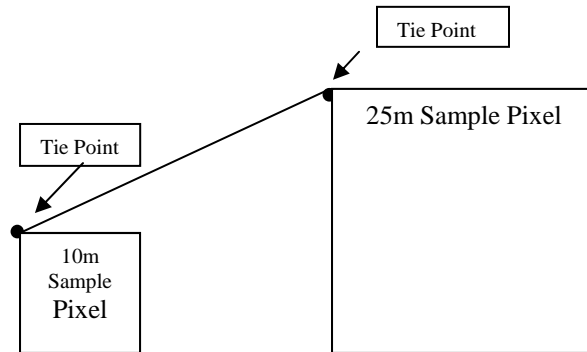
- I. Minimosaic 02 Points 01 and 02.
- II. Minimosaic 05 Point 18
- III. Minimosaic 06 Point 25

Some examples of points selected along non ideal objects follow.

- I. Minimosaic 14 Point 65
- II. Minimosaic 15 Point 69

### **Point Placement in relation to pixel:**

All points were placed in the corresponding pixel corner in both the Minimosaic and its corresponding Tile-overview to insure consistency (Figure 2).



**Figure 2. Tie point orientation**

## Discussion

Minimosaiacs 01 – 21 each have VP offsets that vary similarly across the mosaic. The range of distances between a set of points within a given Minimosaic does not exceed 100 meters and in most cases the range of angles between that set of points does not exceed 90 degrees.

Minimosaiacs 22 - 33 shows variation in angle and distance with their corresponding Tile-overview. The Minimosaiacs that show the greatest variation are 23, 26, 27, 28, and 29. Block analysis was conducted for the Minimosaiacs and the corresponding Tile-overviews for each area.

The VPs of Minimosaic 23 range in distance between 18 meters and 150 meters. VPs 112 and 113 on the far right side of the image and VP 110 on the far left side of the image range from 105 meters to 150 meters offset. VPs 106, 107, 108, 109, and 111 all of which are grouped within the middle 1/3 portion of the image range from 18 meters and 75 meters in offset. The odd consistency of the right and left most portions of the image and how they differ from the mid-portion called for investigation of the blocks that created Minimosaic 23 and Tile-overview sr\_37\_38. Results of the block investigation and the frames associated with overlapping areas are found in Appendix 1 of this text under Minimosaic 23. The above issue does not appear to be caused by block overlap. A visual investigation of the grand adjustment of the Tile-overview showed no significant difference in adjustments made to the blocks. It seems reasonable to conclude that the variations in offsets between VPs are caused by the re-sampling of the 25 meter data.

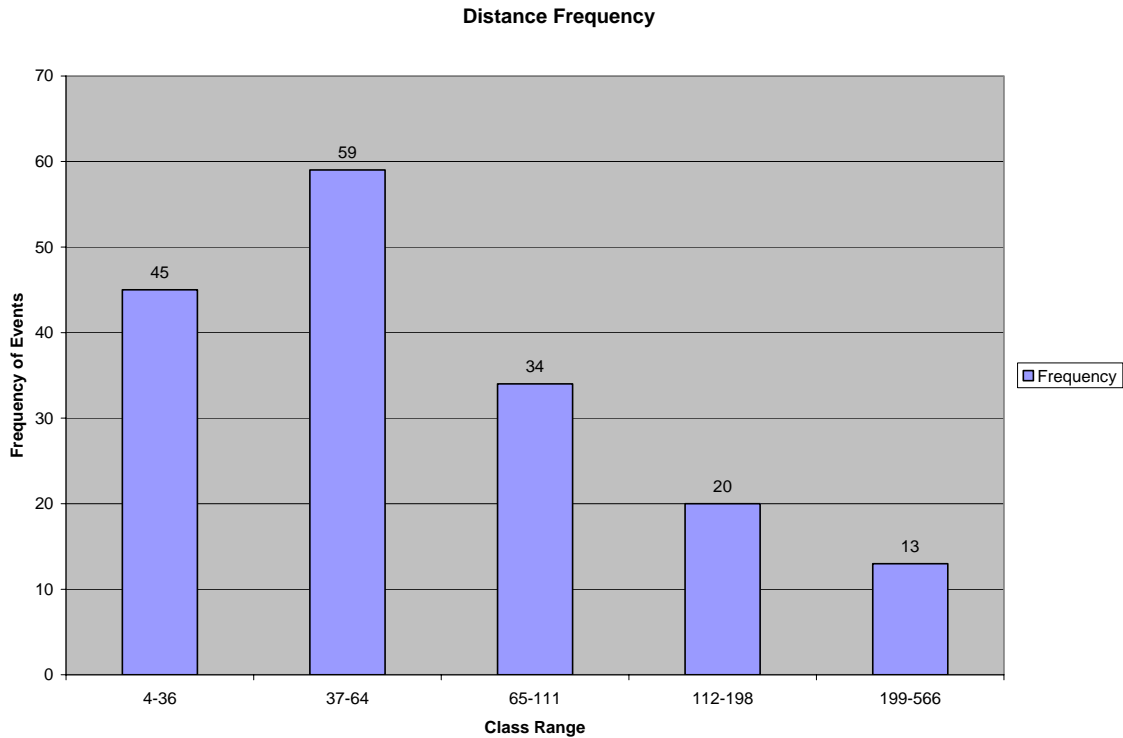
The VPs of Minimosaic 26 range in distance between 12 meters and 566 meters. VPs 124, 127, 128, 129, and 130 ranges in distance from 12 meters and 55 meters. VPs 125 and 126 range between 356 meters and 566 meters. The results of the block overlap investigation revealed discrepancies between beam types in the areas where VPs 125 and 126 are found (see appendix for results). The difference between fine beam 1 used for block 13 and the standard beam 6 frames that are found in block 75 are the likely cause of offset between the Minimosaic and the Tile-overview.

The VPs of Minimosaic 27 range in distance between 10 meters and 223 meters. VPs 131 and 132 ranges in distance between 198 meters and 223 meters. VPs 133, 134, and 135 ranges in distance from 10 meters and 43 meters. The results of the block investigation found that the frame in block 75 that contains VP 131 is in fact standard beam 6 while the frame in block 15 that contains the same VP is fine beam 1. The large offsets found in VP 132 could not be explained in the same manner, however, visible offset is found in the grand adjustment.

The VPs of Minimosaic 28 range in distance between 50 meters and 234 meters. VPs 136, 137, 138, and 140 ranges in distance from 188 meters and 234 meters. VP 139 is offset by 50 meters. The results of the block investigation show no differences between frames. Visual investigation of the grand adjustments reveals no differences. Visual review of the VP 139 indicates a strong possibility that re-sampling of the 25 meter data could be the cause.

The VPs of Minimosaic 29 range in distance between 24 meters and 243 meters. VP 141, 142, 143, 145, 146 ranges in distance from 24 meters and 124 meters. VP 144 is offset by 243 meters. The results of the block investigation revealed no differences between frames. Visual investigation of the grand adjustments does show noticeable offsets between block 75 and block 19. Whether the grand adjustment is the reason for the differences in offsets is questionable given that VP 141 is consistent with the offsets of 142, 143, 145, and 146.

Detail project findings can be found in both the individual point images and the quad images, which show over all trends (Appendix 2). The quad images graphically illustrate both the distances of offset (grouped in five categories) and the direction of the offset. Figure 3 shows the distance statistics for each of the five categories.



Category 1 distance in meters 4-36 ...45 VPs  
 Category 2 distance in meters 37-64 ...59 VPs  
 Category 3 distance in meters 65-111 ... 34 VPs  
 Category 4 distance in meters 112-198 ...20 VPs  
 Category 5 distance in meters 199-566 ... 13 VPs

Figure 3. Offset statistics

## Adjustments to Minimosaics

Adjustments to Minimosaics may correct for the displacement from Tile-overviews by adding the Minimosaic’s average X and Y offsets to the Minimosaic’s corner coordinates. The same validation points chosen for the initial offset investigation were used in the adjustment phase to insure for consistency when comparing offset before and after corrections were made. Three test Minimosaics, 08, 24, and 33, were corrected in this manner and showed some improvements. The details of those findings can be found below.

A complete list of the offset values can be found in the following section titled “average offset per Minimosaic”.

### Results for Minimosaic 08:

Corner coordinates:

Upper Left X = 1746405 + 133 meters offset = 1746538

Upper Left Y = -1775205 + 135 meters offset = -1775070

Offset comparison for validation points (VP):

VP 31 Euclidian offset before correction: 159 meters  
Euclidian offset after correction: 39 meters  
VP 32 Euclidian offset before correction: 139 meters  
Euclidian offset after correction: 51 meters  
VP 33 Euclidian offset before correction: 219 meters  
Euclidian offset after correction: 33 meters  
VP 34 Euclidian offset before correction: 216 meters  
Euclidian offset after correction: 43 meters  
VP 35 Euclidian offset before correction: 221 meters  
Euclidian offset after correction: 40 meters  
Average Euclidian offset before correction: 191 meters  
Average Euclidian offset after correction: 41 meters  
Before offset and after offset difference: 150 meters

**Results for Minimosaic 24:**

Corner coordinates:

Upper Left X = 1006405 + (-102) meters offset = 1006303

Upper Left Y = 967995 + (-30) meters offset = 967965

Offset comparison for VP:

VP 114 Euclidian offset before correction: 221 meters  
Euclidian offset after correction: 121 meters  
VP 115 Euclidian offset before correction: 152 meters  
Euclidian offset after correction: 53 meters  
VP 116 Euclidian offset before correction: 54 meters  
Euclidian offset after correction: 65 meters  
VP 117 Euclidian offset before correction: 72 meters  
Euclidian offset after correction: 46 meters  
VP 118 Euclidian offset before correction: 149 meters  
Euclidian offset after correction: 127 meters  
Average Euclidian offset before correction: 127 meters  
Average Euclidian offset after correction: 82 meters  
Before offset and after offset difference: 45 meters

**Results for Minimosaic 33:**

Corner coordinates:

Upper Left X = -753595 + (-31) meters offset = -753626

Upper Left Y = 1663995 + 26 meters offset = 1664021

Offset comparison for VP:

VP 162 Euclidian offset before correction: 11 meters  
Euclidian offset after correction: 51 meters  
VP 163 Euclidian offset before correction: 23 meters  
Euclidian offset after correction: 25 meters  
VP 164 Euclidian offset before correction: 64 meters  
Euclidian offset after correction: 24 meters  
VP 165 Euclidian offset before correction: 75 meters

Euclidian offset after correction: 42 meters  
VP 166 Euclidian offset before correction: 76 meters  
Euclidian offset after correction: 45 meters  
Average Euclidian offset before correction: 49 meters  
Average Euclidian offset after correction: 37 meters  
Before offset and after offset difference: 12 meters

**Note for Minimosaic 33:** VP 162 offset orientation is nearly 180 degrees in the opposing direction relative to the orientation of the other four VPs. If one removes this VP the new difference in offset is 25 meters.

## Average Offset per Minimosaic

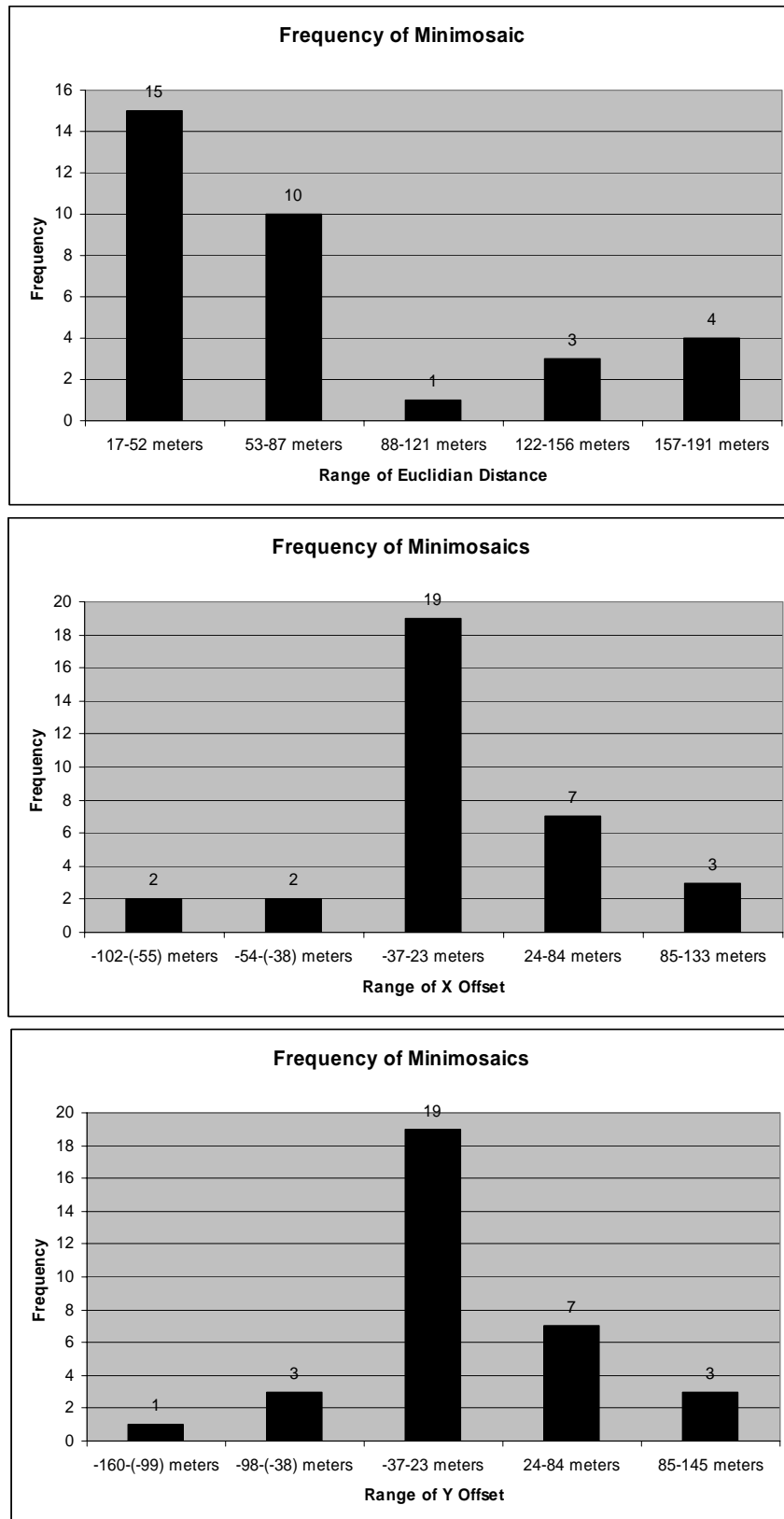


Figure 4. The average Euclidian, X, and Y offset for all Minimosaics.



Average Offset Per Minimosaic

MiniMosaic	Euclidian	X Offset	Y Offset
mm_01-10	70	68	-6
mm_02_10	122	118	18
mm_03_10	85	82	14
mm_04_10	43	-15	32
mm_05_10	53	-32	7
mm_06_10	50	23	-18
mm_07_10	50	33	31
mm_08_10	191	133	135
mm_09_10	152	75	111
mm_10_10	159	-26	145
mm_11_10	81	-68	35
mm_12_10	82	7	-80
mm_13_10	17	-6	5
mm_14_10	31	13	22
mm_15_10	39	16	-27
mm_16_10	36	22	-19
mm_17_10	30	-16	10
mm_18_10	23	-4	7
mm_19_10	38	-31	14
mm_20_10	43	-20	-8
mm_21_10	37	23	-14
mm_22_10	34	25	1
mm_23_10	81	-27	70
mm_24_10	127	-102	-30
mm_25_10	68	-51	-10
mm_26_10	162	85	-67
mm_27-10	97	6	-89
mm_28-10	181	67	-160
mm_29-10	87	-49	46
mm_30-10	67	42	42
mm_31-10	39	-5	0
mm_32-10	59	8	-32
mm_33-10	49	-31	26
Total			
Averages	75	11	6

mm\_26\_10                      42                      -7                      41

The above table shows average Euclidian, X, and Y offsets for each Minimosaic. X and Y offsets are added to the Minimosaic corner coordinates to adjust for displacement from Tile-overview. The line for Minimosaic 26 in red reflects outliers removed and recalculated averages. The outliers were likely the product of fine beam/standard beam frame comparison. This line was not figured into total averages.

## Conclusions

There are three primary issues concerning the reliability of VPs, they are: re-sampling error, grand adjustment transformations on the Tile-overview images, and block overlap issues. The combination of any of these issues limits attempts to correct for offset in any given Minimosiac. However, with the exception of the above Minimosiac that required block overlap investigation most have relatively consistent offset patterns. It is conceivable, however, that more fine beam, standard beam, overlap exist. A thorough investigation of all block overlap may be of value before any adjustment to offsets is conducted.

## Appendix 1: Anomalous Block Summary and Validation Points

### Minimosiac 23:

Block order as follows:

1. Block 73 – Top block
2. Block 27
3. Block 09 – Bottom block – Minimosiac 23 was created from this block.

Each of the VPs taken in this Minimosiac fell within Block 73; therefore, only frames within Block 73 and Block 09 are considered.

Point 106: Block 73 – Orbit 25713 Frame 3

Date of orbit – October 07 2000  
Fine Beam 1  
Block 09 – Orbit 25713 Frame 3  
Date of orbit – October 07 2000  
Fine Beam 1

Point 107: Block 73 – Orbit 25713 Frame 3

Date of orbit – October 07 2000  
Fine Beam 1  
Block 09 – Orbit 25713 Frame 3  
Date of orbit – October 07 2000  
Fine Beam 1

Point 108: Block 73 – Orbit 25613 Frame 7

Date of orbit – September 30 2000  
Fine Beam 1  
Block 09 – Orbit 25613 Frame 7  
Date of orbit – September 30 2000  
Fine Beam 1

Point 109: Block 73 – Orbit 25613 Frame 7

Date of orbit – September 30 2000  
Fine Beam 1  
Block 09 – Orbit 25613 Frame 7  
Date of orbit – September 30 2000

Fine Beam 1  
Point 110: Block 73 – Orbit 25856 Frame 2  
Date of orbit – October 17 2000  
Fine Beam 1  
Block 09 - – Orbit 25856 Frame 2  
Date of orbit – October 17 2000  
Fine Beam 1  
Point 111: Block 73 – Orbit 25713 Frame 3  
Date of orbit – October 07 2000  
Fine Beam 1  
Block 09 – Orbit 25813 Frame 8  
Date of orbit – October 14 2000  
Fine Beam 1  
Point 112: Block 73 - Orbit 25813 Frame 8  
Date of orbit – October 14 2000  
Fine Beam 1  
Block 09 – Orbit 25813 Frame 8  
Date of orbit – October 14 2000  
Fine Beam 1  
Point 113: Block 73 - Orbit 25813 Frame 8  
Date of orbit – October 14 2000  
Fine Beam 1  
Block 09 – Orbit 25813 Frame 8  
Date of orbit – October 14 2000  
Fine Beam 1

**Minimosiac 26:**

Block order as follows:

1. Block 75 – Top Block
2. Block 73
3. Block 11
4. Block 13 – Bottom Block – Minimosaic created from this block.

VPs taken fell within blocks 75, 11, and 13.

Point 124: Block 13 only – Orbit 25771 Frame 2  
Date of orbit – October 11 2000  
Fine Beam 1  
Point 125: Block 75 – Orbit 25500 Frame 37  
Date of orbit – September 22 2000  
Standard Beam 6  
Block 13 – Orbit 25614 Frame 2  
Date of orbit – September 30 2000  
Fine Beam 1  
Point 126: Block 75 – Orbit 25500 Frame 38  
Date of orbit – September 22 2000  
Standard Beam 6  
Block 13 – Orbit 25857 Frame 1  
Date of orbit – October 17 2000

Fine Beam 1  
Point 127: Block 11 – Orbit 25585 Frame 2  
Date of orbit – September 28 2000  
Fine Beam 1  
Block 13 – Orbit 25828 Frame 3  
Date of orbit – October 15 2000  
Fine beam 1  
Point 128: Block 13 only – Orbit 25828 Frame 3  
Date of orbit – October 15 2000  
Fine Beam 1  
Point 129: Block 13 only – Orbit 25728 Frame 4  
Date of orbit – October 8 2000  
Fine Beam 1  
Point 130: Block 13 only – Orbit 25628 Frame 3  
Date of orbit – October 1 2000  
Fine Beam 1

**Minimosiac 27:**

Block order as follows:

1. Block 75 – Top block
2. Block 13
3. Block 15 – Bottom block – Minimosiac 27 was created from this block.

VPs fell within blocks 75 and 15.

Point 131: Block 75 – Orbit 25500 Frame 38  
Date of orbit – September 22 2000  
Standard Beam 6  
Block 15 – Orbit 25900 Frame 7  
Date of orbit – October 20 2000  
Fine Beam 1  
Point 132: Block 75 – Orbit 25800 Frame 2  
Date of orbit – October 13 2000  
Fine Beam 1  
Block 15 – Orbit 25800 Frame 2  
Date of orbit – October 13 2000  
Fine Beam 1  
Point 133: Block 15 only – Orbit 25571 Frame 3  
Date of orbit – September 27 2000  
Fine Beam 1  
Point 134: Block 15 only – Orbit 25814 Frame 8  
Date of orbit – October 14 2000  
Fine Beam 1  
Point 135: Block 15 only – Orbit 25857 Frame 3  
Date of orbit – October 17 2000  
Fine Beam 1

**Minimosaic 28:**

Block order as follows:

1. Block 75 – Top block
2. Block 15
3. Block 17 – Bottom block – Minimosiac 28 was created from this block.

VPs fell within blocks 75 and 17.

Point 136: Block 75 – Orbit 25800 Frame 2

Date of orbit – October 13 2000

Fine Beam 1

Block 17 – Orbit 25800 Frame 2

Date of orbit – October 13 2000

Point 137: Block 75 – Orbit 25700 Frame 2

Date of orbit – October 6 2000

Fine Beam 1

Block 17 – Orbit 25700 Frame 2

Date of orbit – October 6 2000

Fine Beam 1

Point 138: Block 75 – Orbit 25643 Frame 8

Date of orbit – October 2 2000

Fine Beam 1

Block 17 – Orbit 25643 Frame 8

Date of orbit – October 2 2000

Fine Beam 1

Point 139: Block 75 – Orbit 25786 Frame 1

Date of orbit – October 12 2000

Fine Beam 1

Block 17 – Orbit 25886 Frame 2

Date of orbit – October 19 2000

Fine Beam 1

Point 140: Block 75 – Orbit 25786 Frame 1

Date of orbit – October 16 2000

Fine Beam 1

Block 17 – Orbit 25843 Frame 1

Date of orbit – October 16 2000

Fine Beam 1

**Minimosiac 29:**

Block order as follows:

1. Block 77 – Top Block
2. Block 75
3. Block 19 – Bottom Block – Minimosiac 29 was created from this block.

Point 141: Block 75 – Orbit 25586 Frame 2

Date of orbit – September 28 2000

Fine Beam 1

Block 19 – Orbit 25586 Frame 2

Date of orbit – September 28 2000

Fine Beam 1

Point 142: Block 19 only – Orbit 25872 Frame 7

Date of orbit – October 18 2000

Fine Beam 1

Point 143: Block 19 only – Orbit 25672 Frame 5

Date of orbit – October 4 2000

Fine Beam 1

Point 144: Block 75 – Orbit 25672 Frame 4

Date of orbit – October 4 2000

Fine Beam 1

Block 19 - Orbit 25672 Frame 4

Date of orbit – October 4 2000

Fine Beam 1

Point 145: Block 77 – Orbit 25858 Frame 2

Date of orbit – October 17 2000

Fine Beam 1

Block 19 – Orbit 25615 Frame 12

Date of orbit – September 30 2000

Fine Beam 1

Point 146: Block 77 – Orbit 25858 Frame 2

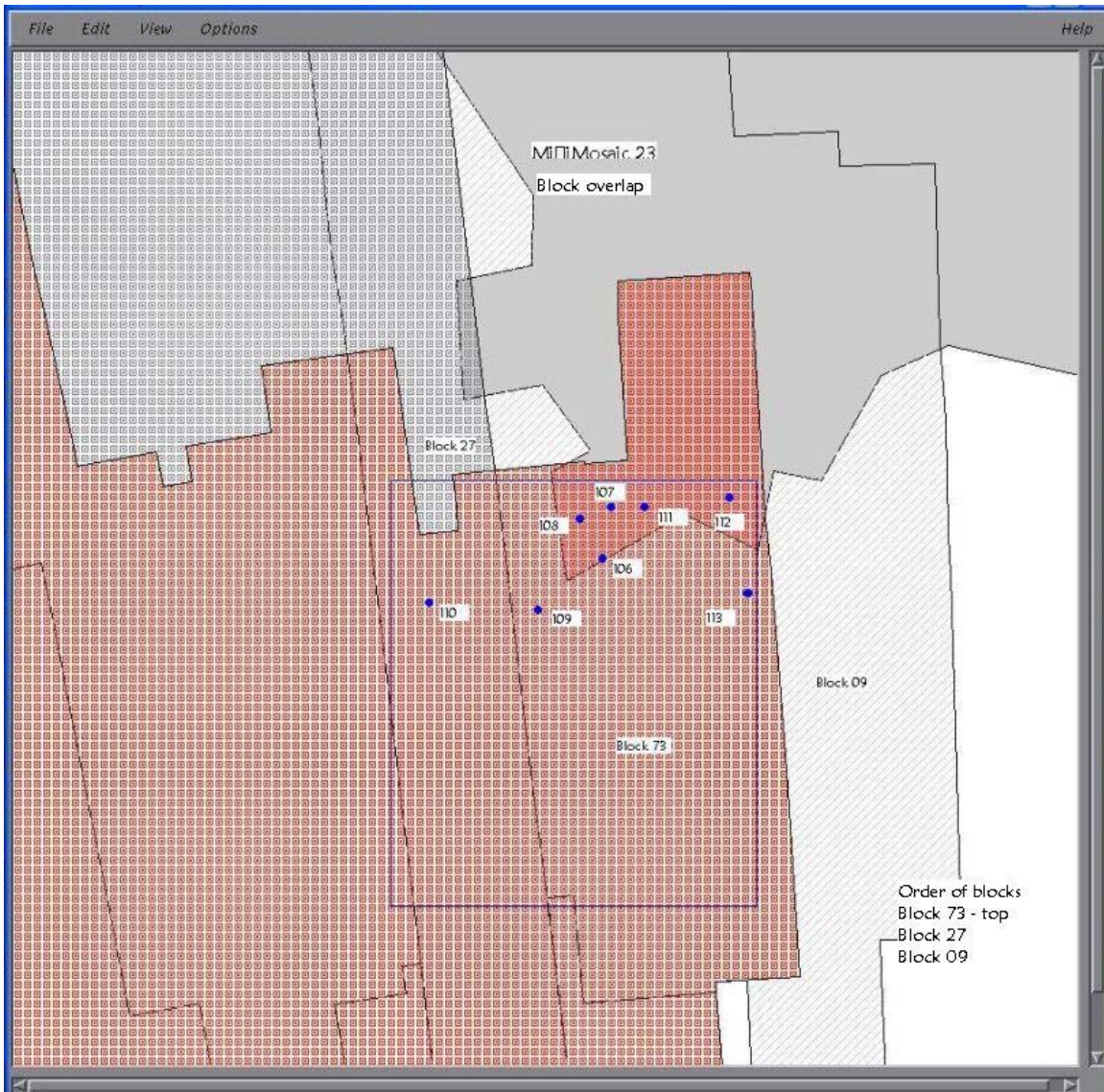
Date of orbit – October 17 2000

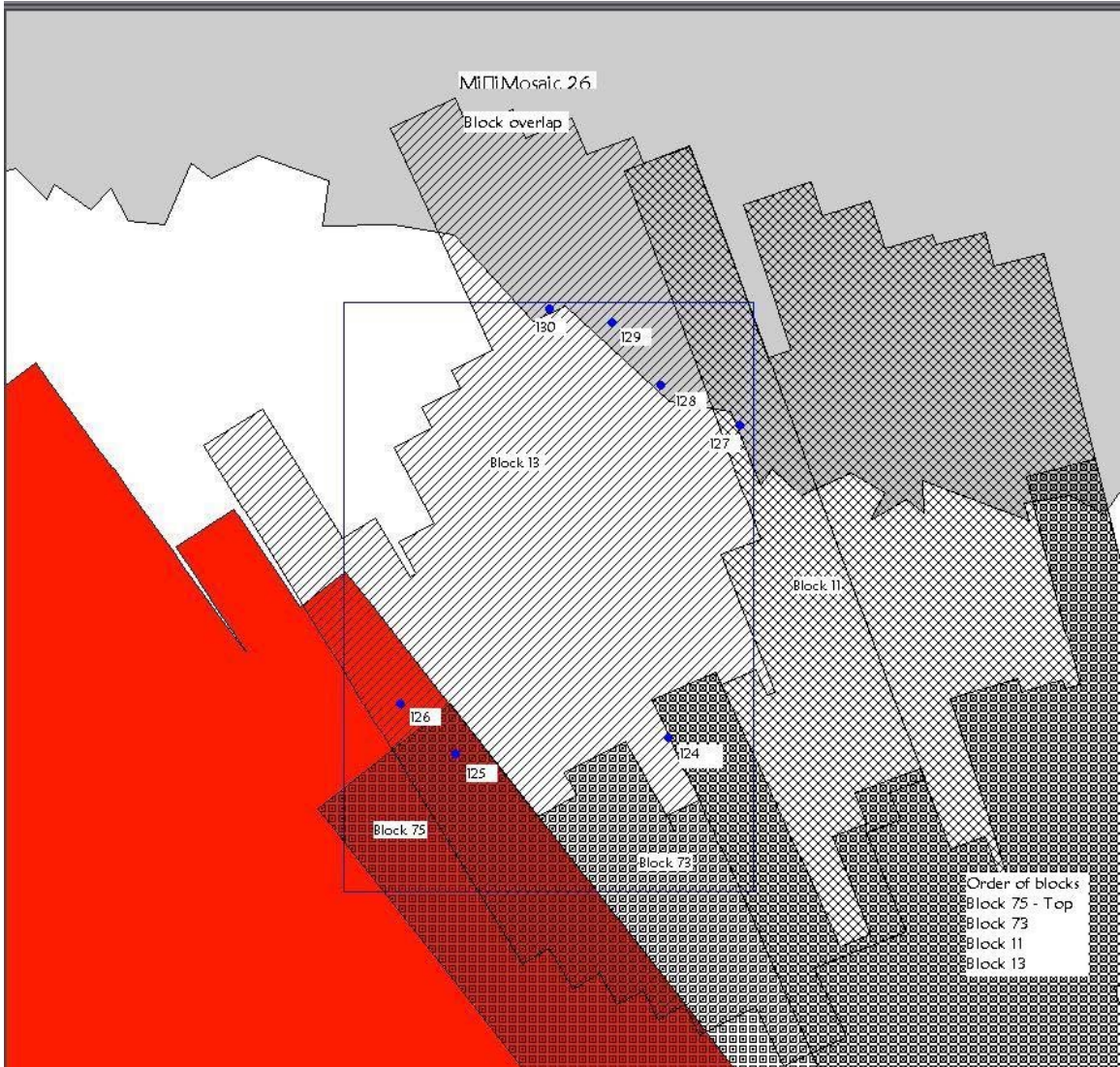
Fine Beam 1

Block 19 – Orbit 25615 Frame 12

Date of orbit – September 30 2000

Fine Beam 1

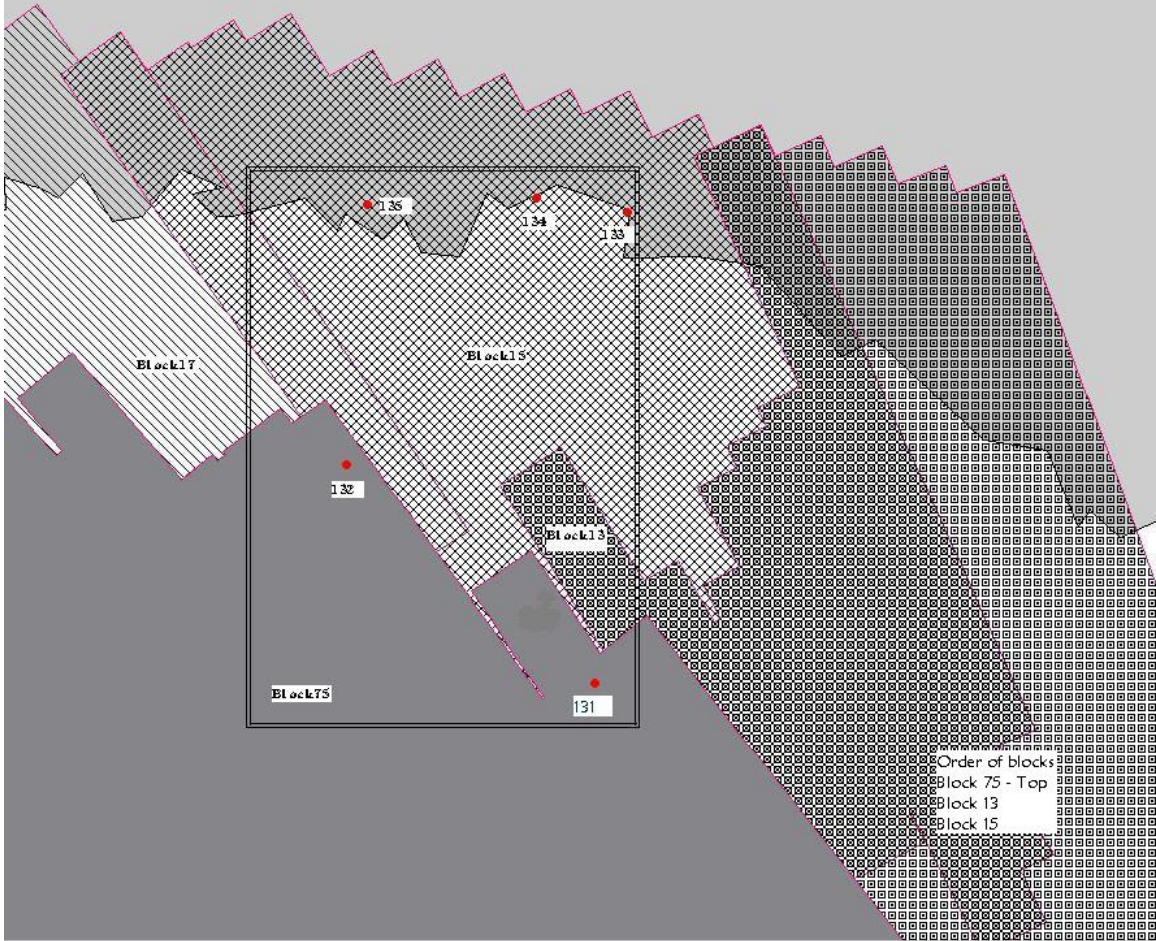


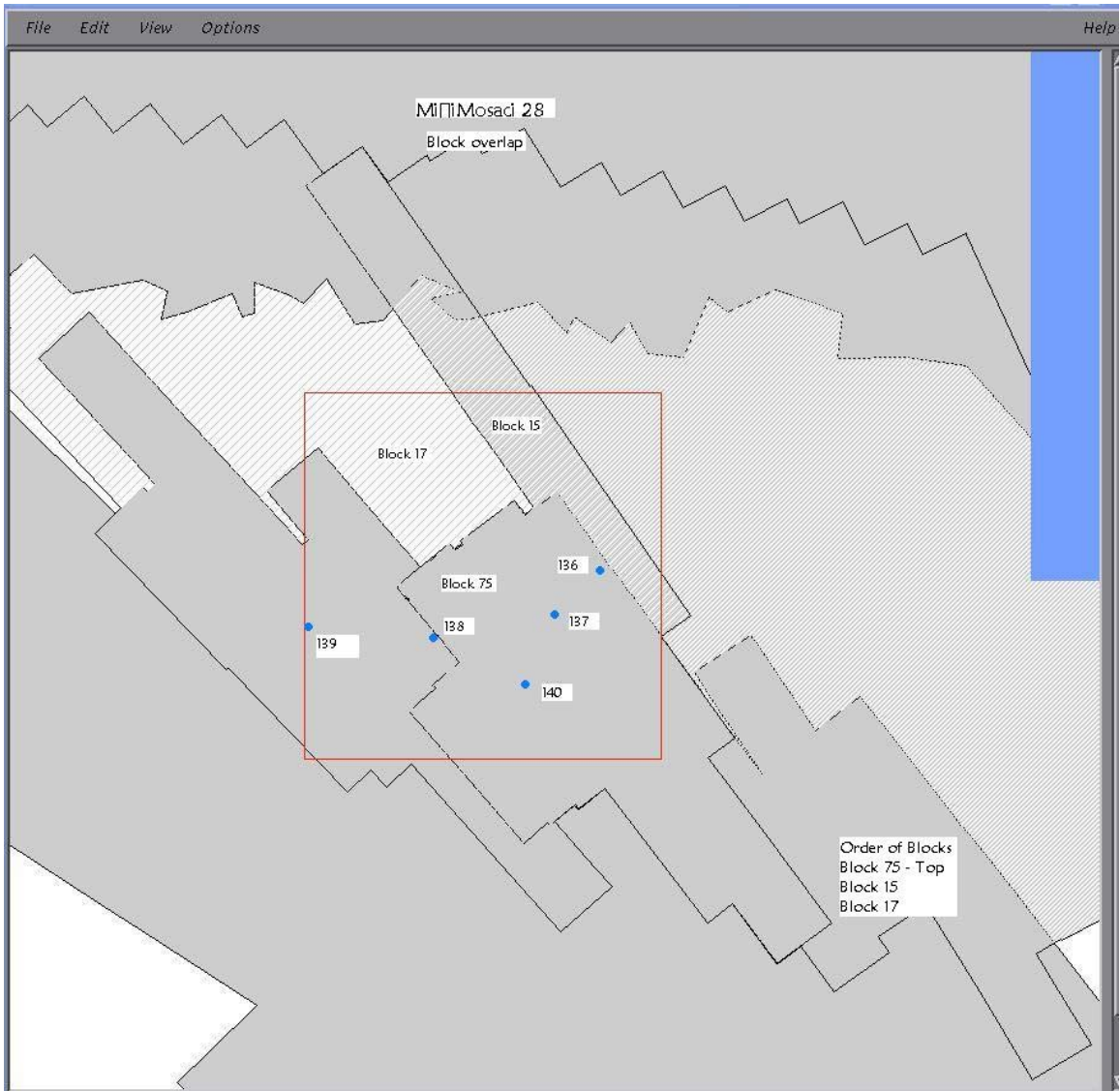


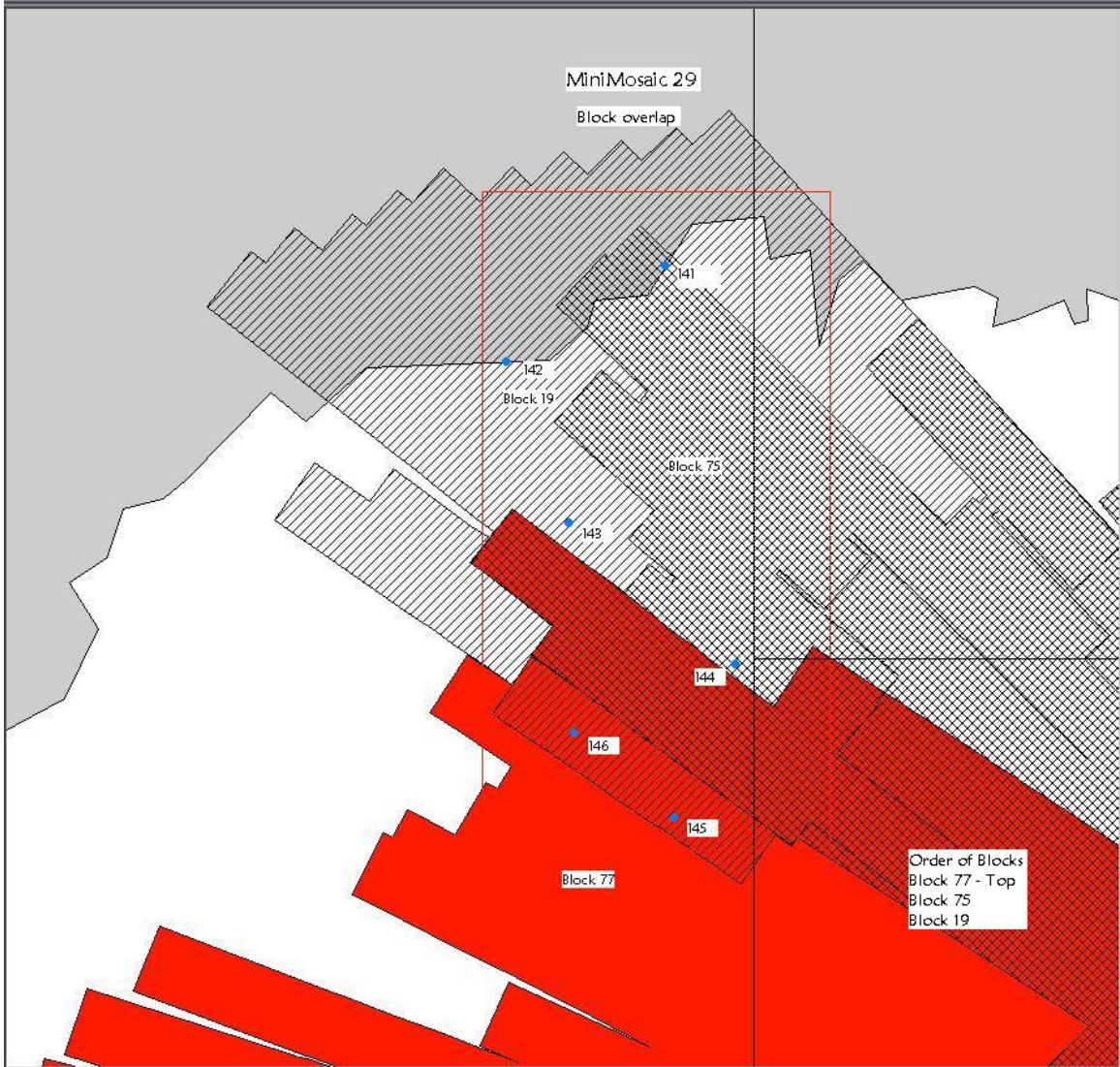


MiniMosaic 27

Block overlap



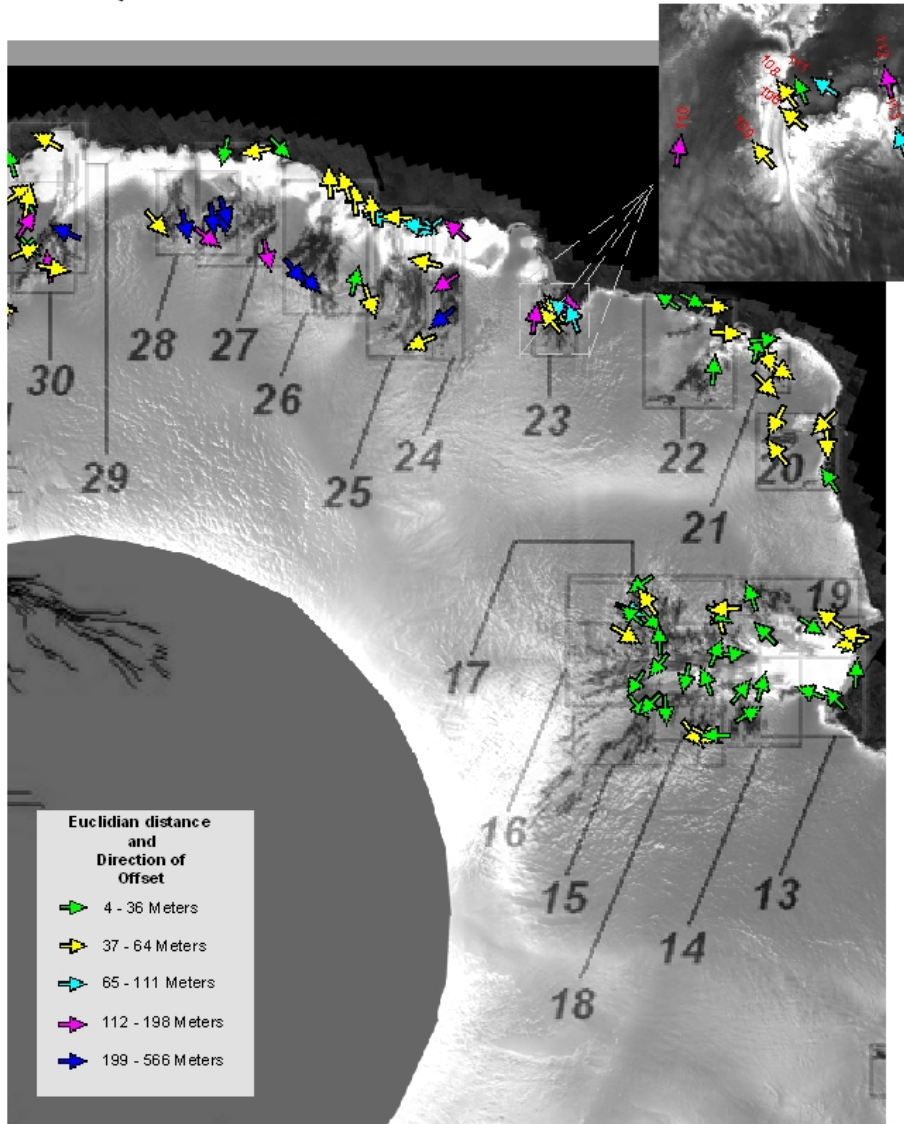




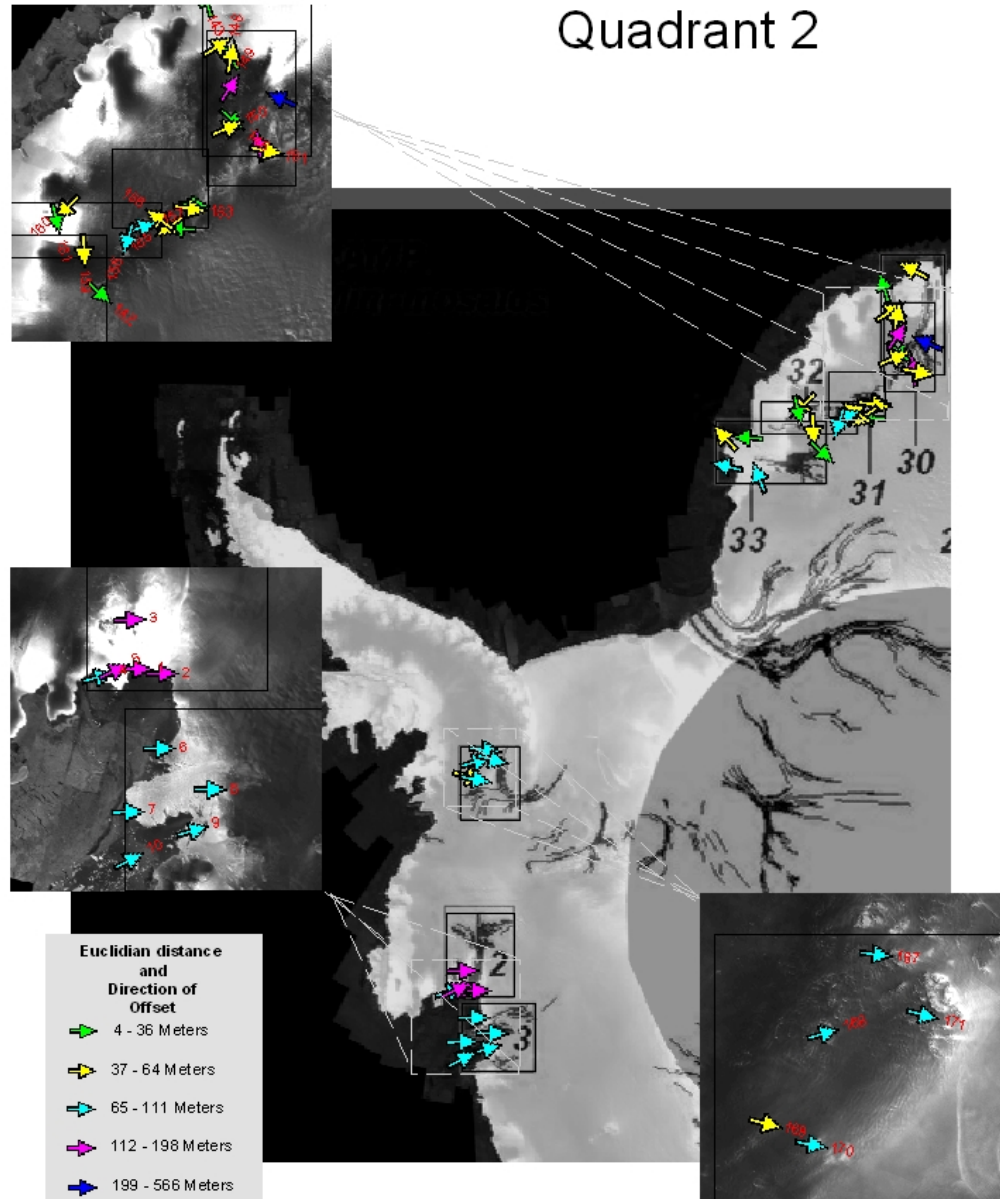
## **Appendix 2: Orientation of Offset**

Four maps were created to show the direction and distance of offset. The direction of offset may give insight into the method used for adjustments of Minimosaic. The distance is divided into five classes and visual represents the degree that VPs may vary within a Minimosaic.

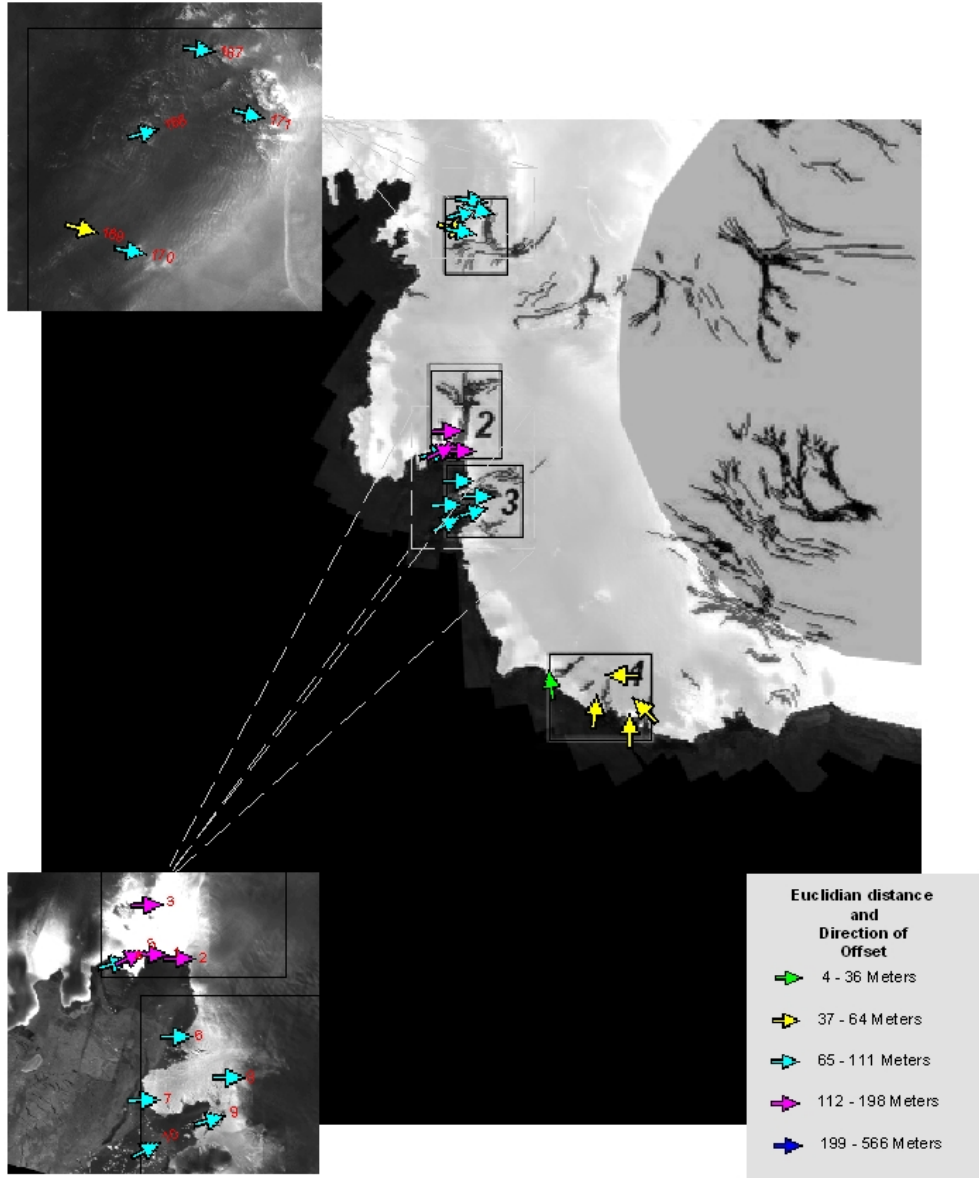
# Quadrant 1



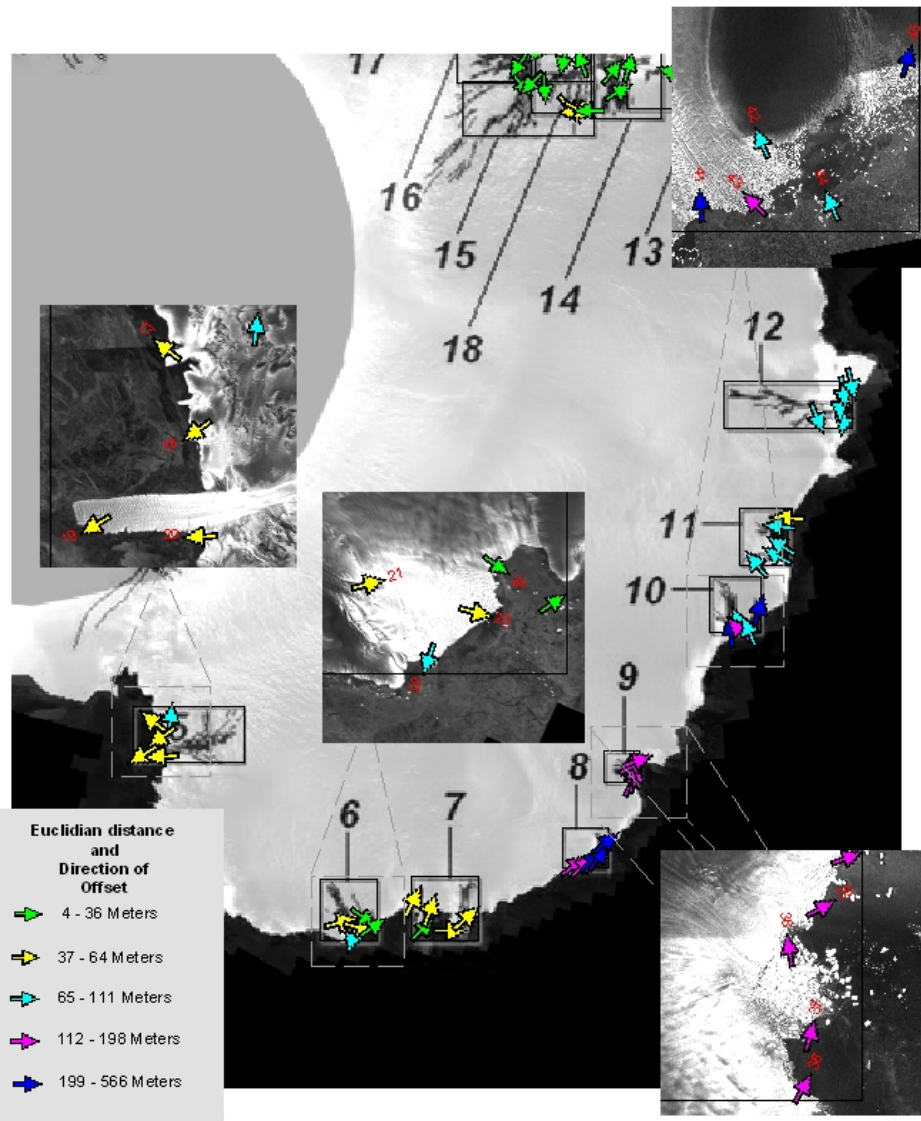
# Quadrant 2



# Quadrant 3



# Quadrant 4





## **Appendix 3: Validation Point Locations**

