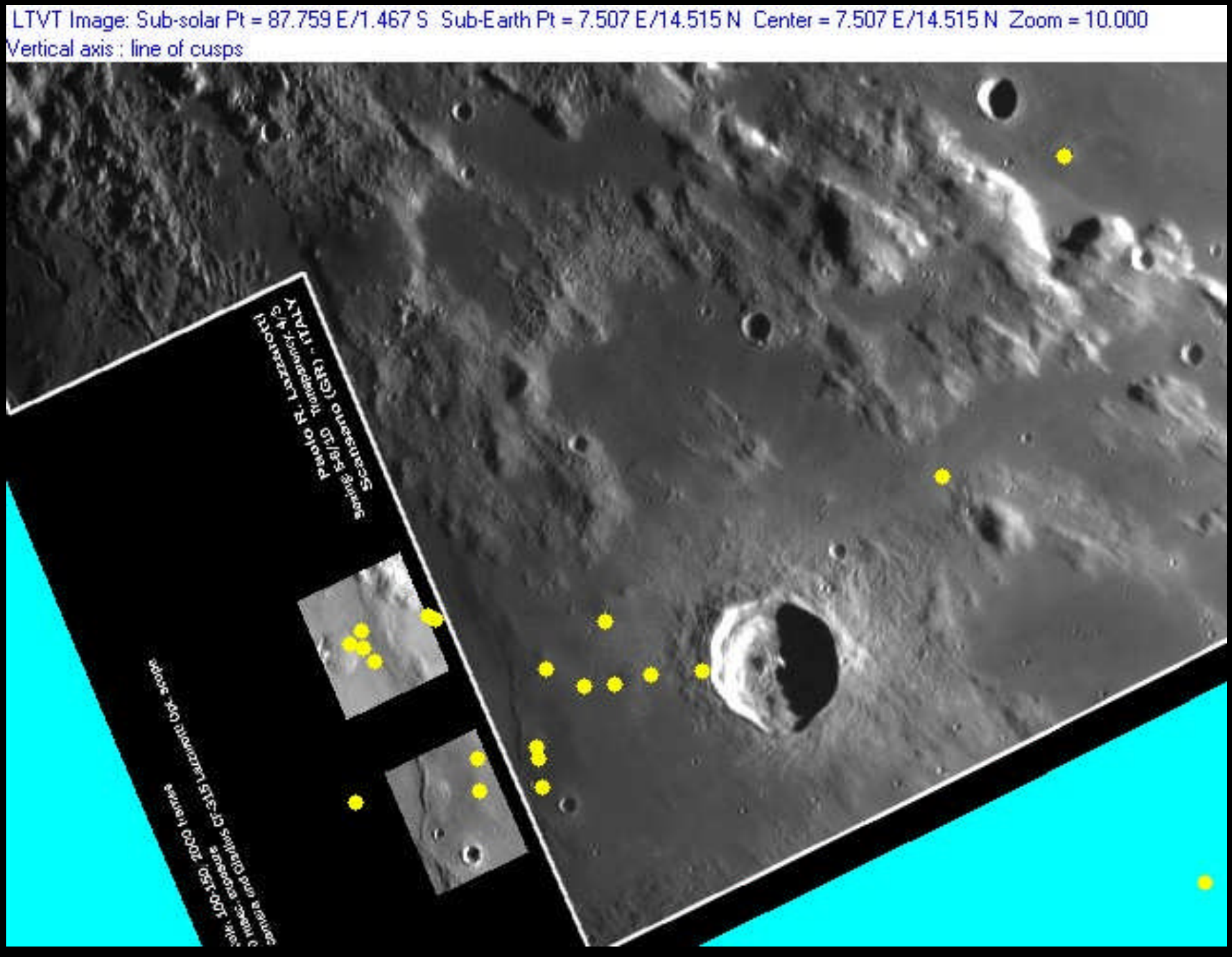
Domes Manilius 8 and Manilius 4 - DEM Construction Notes from image by Paolo Lazzarotti taken 27 Dec 2007 18:17-18:22 UTC

by K. Fisher fisherka@csolutions.net 3/19/2007 Rev. B

Paolo Lazzarotti's image that is the source for this DEM can be found at:

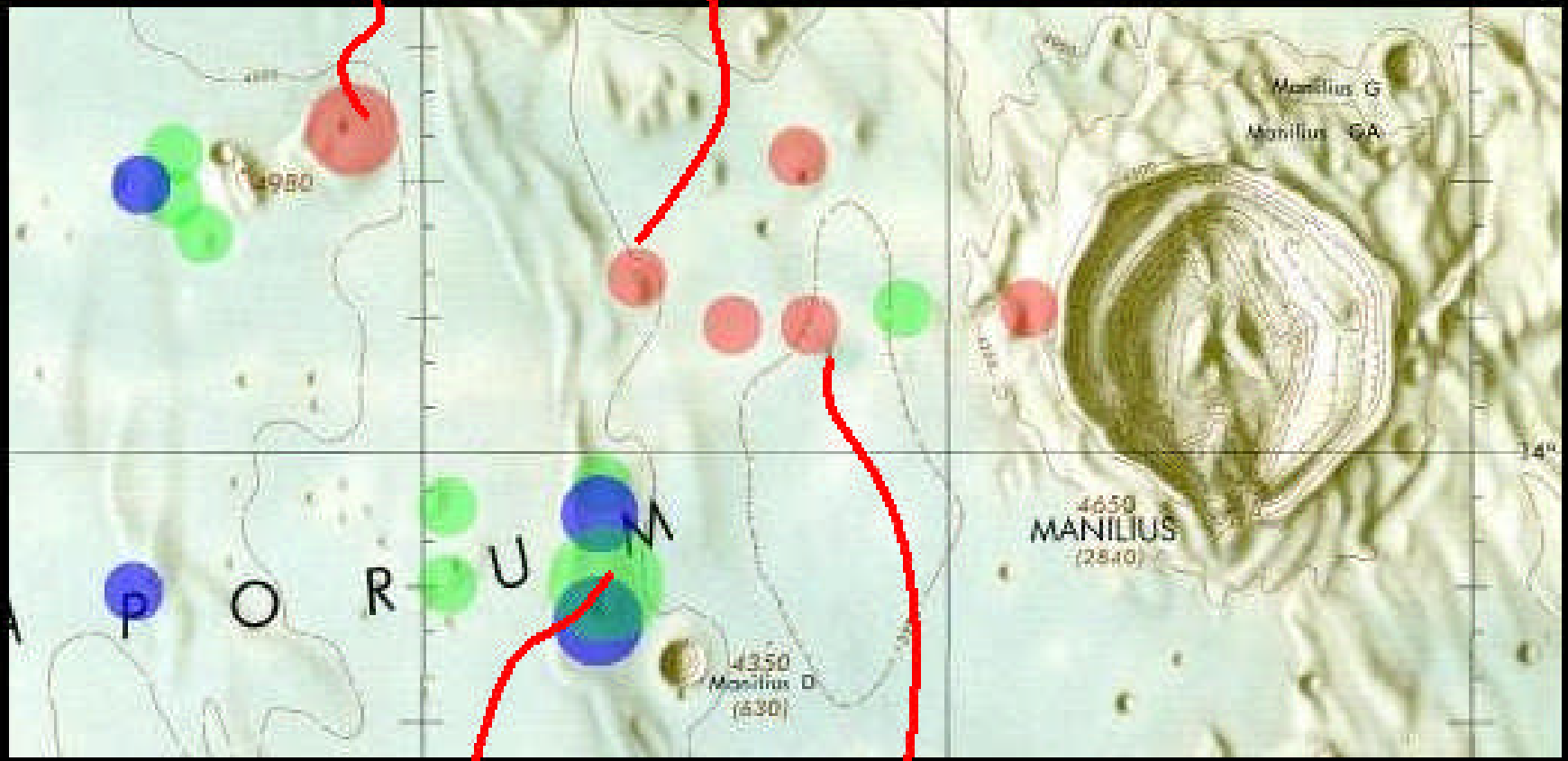
http://www.lazzarotti-hires.com/images/moon/lacusregion20061227_lazz.jpg

Lazzarotti image rectified in LTVT and annotated with GLRG Kapral-Garfinkle 2005 Dome Catalogue



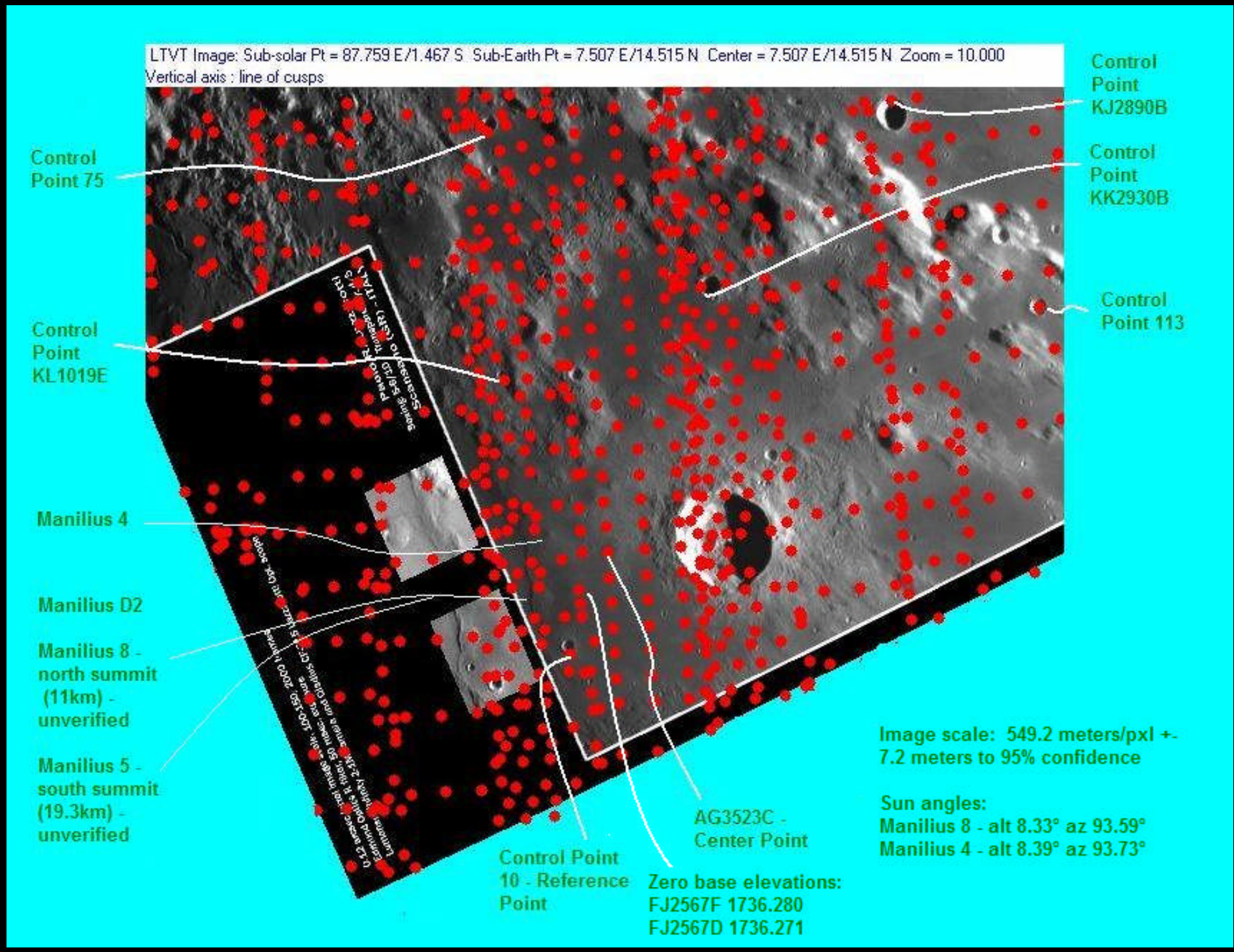
Brendan Shaw plots of GLRG domes on LAC 59

Lac 59 excerpt



Next Slide:

Lazzarotti image rectified in LTVT and annotated with ULCN 2005 Control Points

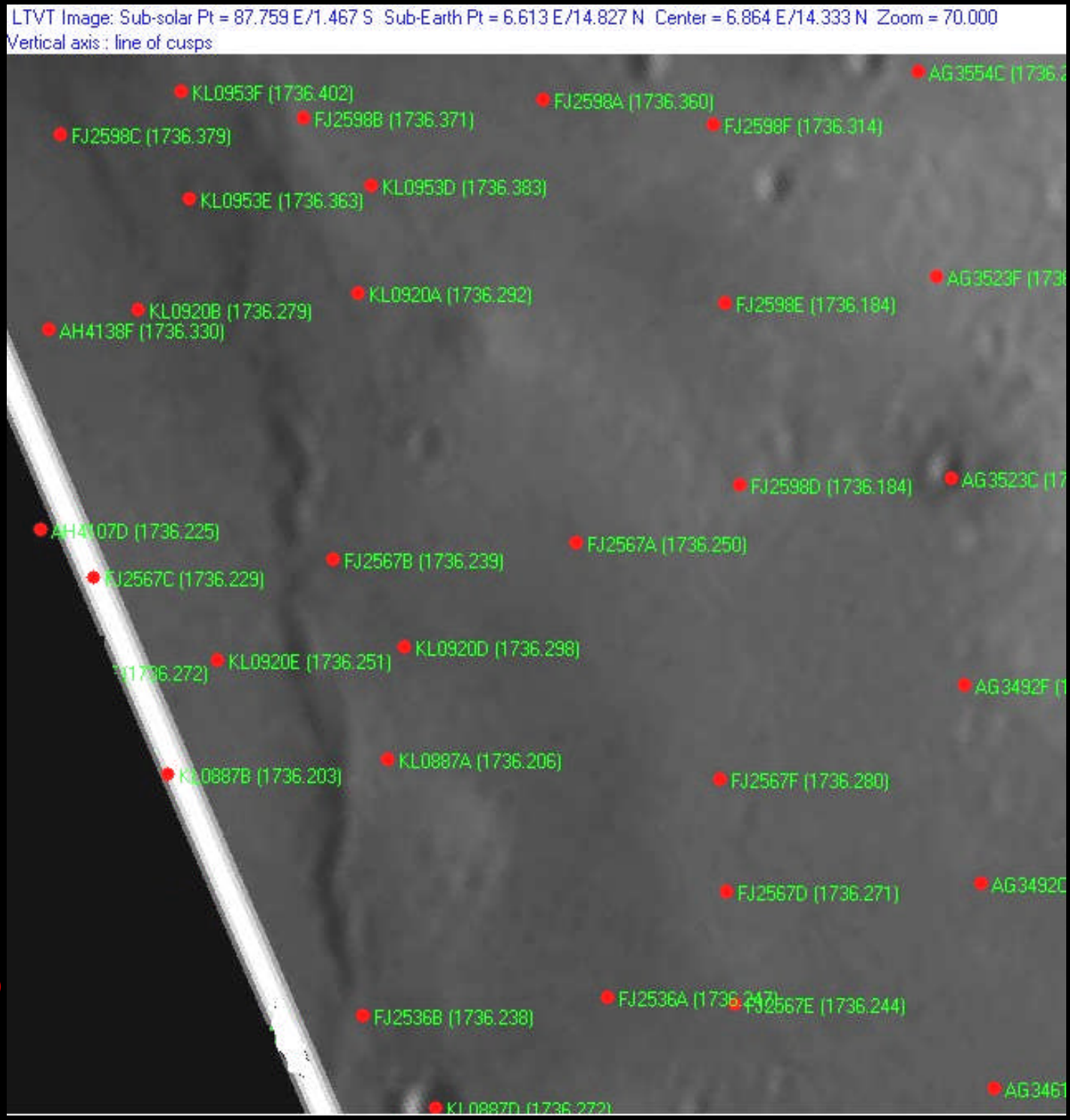

LTVT Image: Sub-solar Pt = 87.759 E/1.467 S Sub-Earth Pt = 7.507 E/14.515 N Center = 7.507 E/14.515 N Zoom = 10.000
Vertical axis : line of cusps
Control Point 75
Control Point KL1019E
Manilius 4
Manilius D2
Manilius 8 - north summit (11km) - unverified
Manilius 5 - south summit (19.3km) - unverified
Control Point 10 - Reference Point
AG3523C - Center Point
Control Point KJ2890B
Control Point KK2930B
Control Point 113
Zero base elevations:
FJ2567F 1736.280
FJ2567D 1736.271
Image scale: 549.2 meters/pxl +- 7.2 meters to 95% confidence
Sun angles:
Manilius 8 - alt 8.33° az 93.59°
Manilius 4 - alt 8.39° az 93.73°

Slide 5

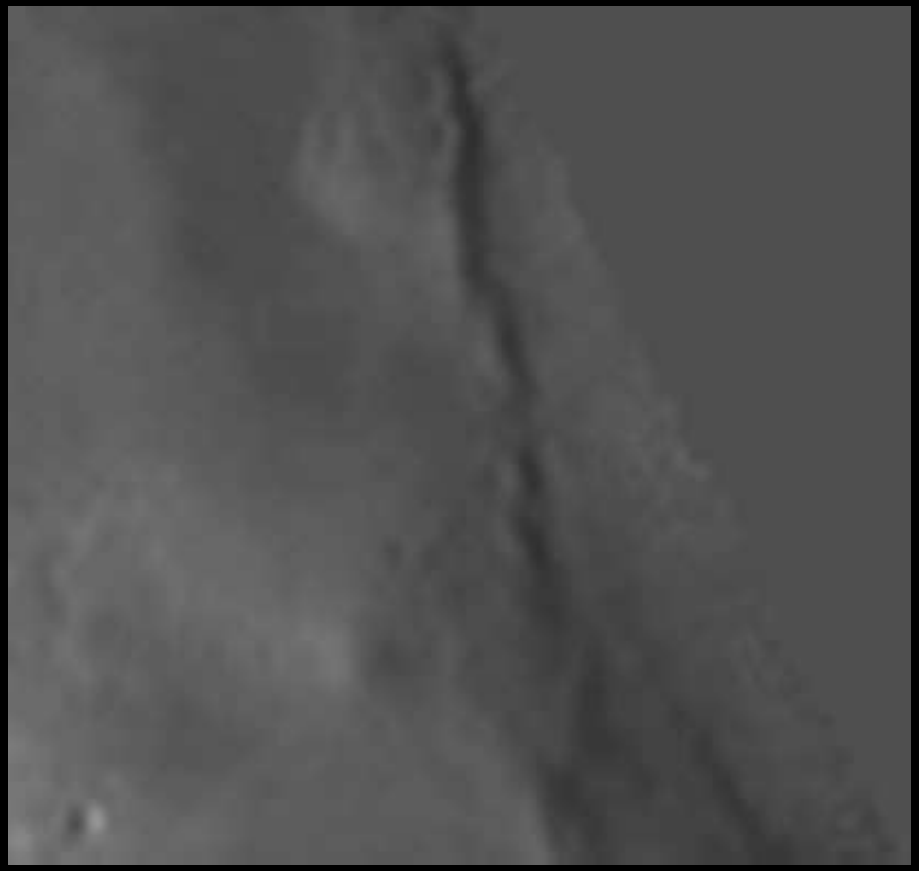
Lazzarotti image study region detail – annotated using LTVT to plot ULCN 2005 control points

LTVT shadow measurements on the wrinkle ridge next to Manilius 8 yielded a height of 111 meters. Manilius 4 measured to 204-227 meters.

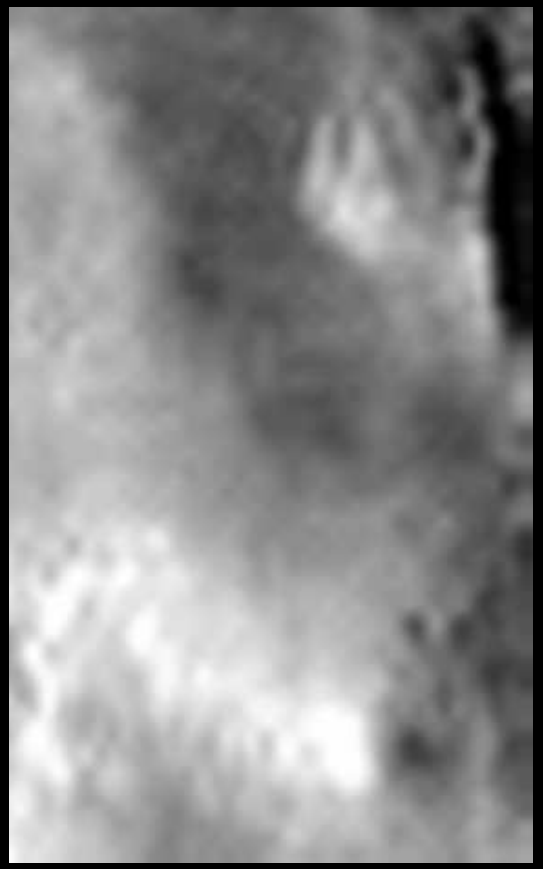
Kapral-Garfinkle's catalogue lists Manilius 8 with an elevation of 518 meters; Manilius 4 has no height entry.



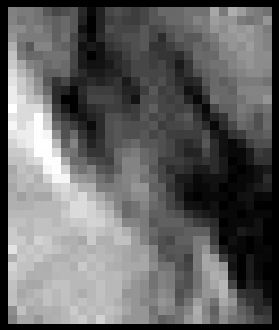
Lazzarotti image was rectified and rotated to an apparent solar angle of 270°. Then cropped greyscale images were prepared for subsequent DEM generation.



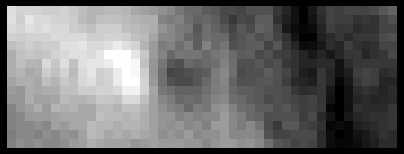
Area image of Manilius 4 and 8 with synthetic fill-in terrain



South sub-area with Manilius 4 and 8



North wrinkle ridge sub-area



Manilius 4 sub-area

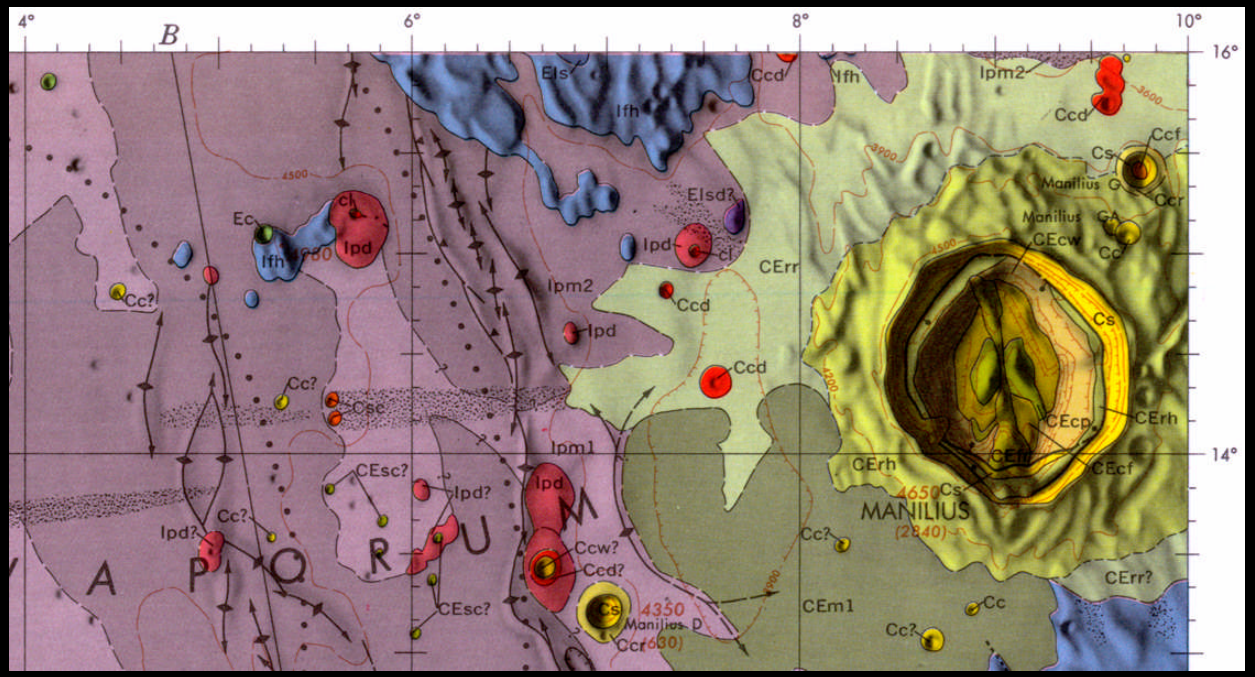
Initial modeling indicates that only the wide-area image and the south sub-area were selected for further work.

Study region – prior charts

LAC 59

Note compression plateau to the *east* of Manilius 8 shown on both maps.

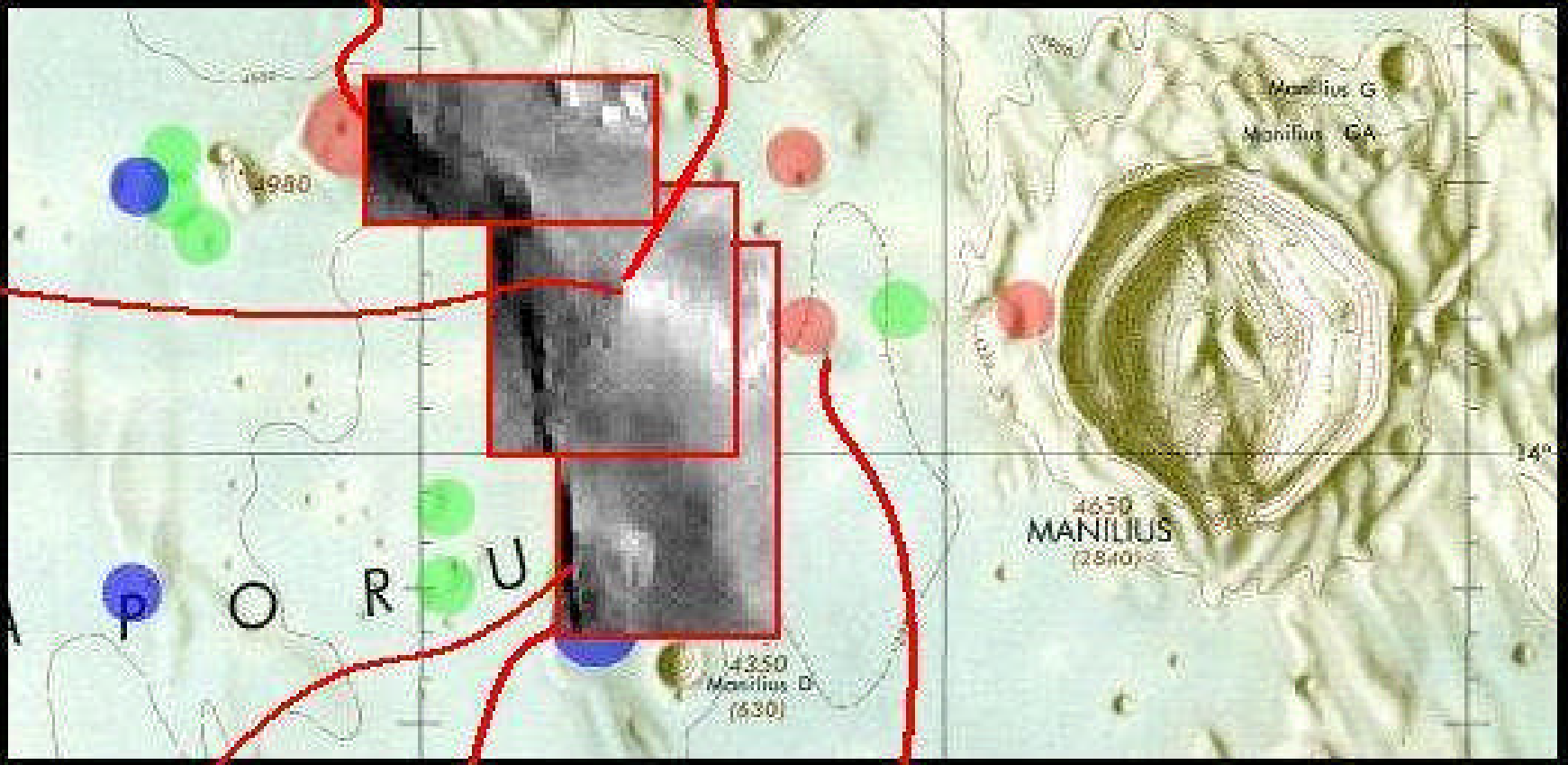
GLAC I-549



Changes in surface materials and Manilius east-west ejecta ray may adversely impact DEM modeling.

Study region – relating current images to prior charts

Lac 59 excerpt



Shadow ridge meas. 111 meters

Manilius 8 Kapral 2005 height - 518 meters

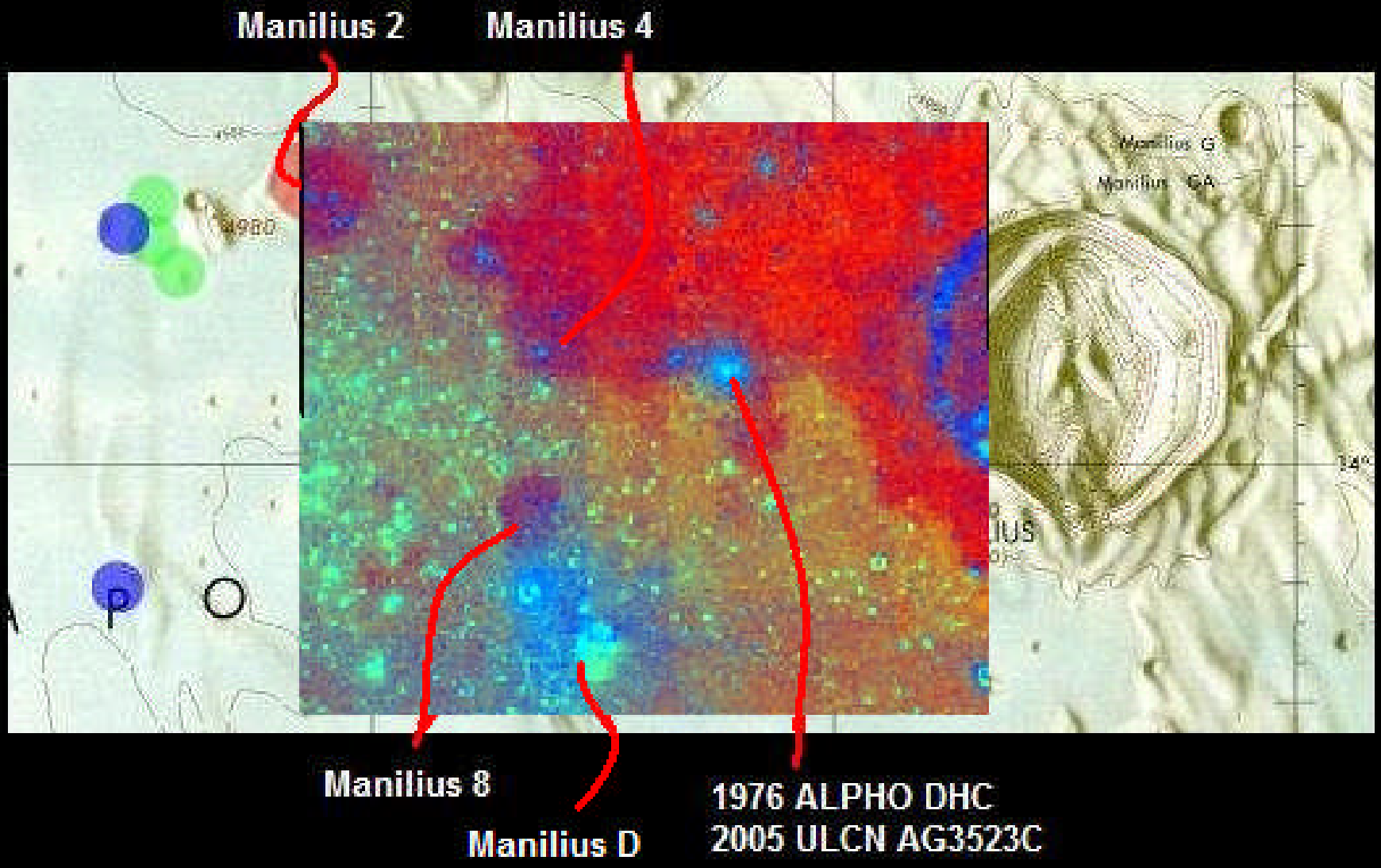
1976 ALPHO DHC 2005 ULCN AG3523C

Study region – relating current images to prior charts

Lac 59 excerpt

Study region – prior orbiter and astronaut photographs

Lac 59 excerpt



Clementine imagery re-enforces GLAC I-549: changes in surface materials may adversely impact DEM modeling.

Study region – prior orbiter and astronaut photographs

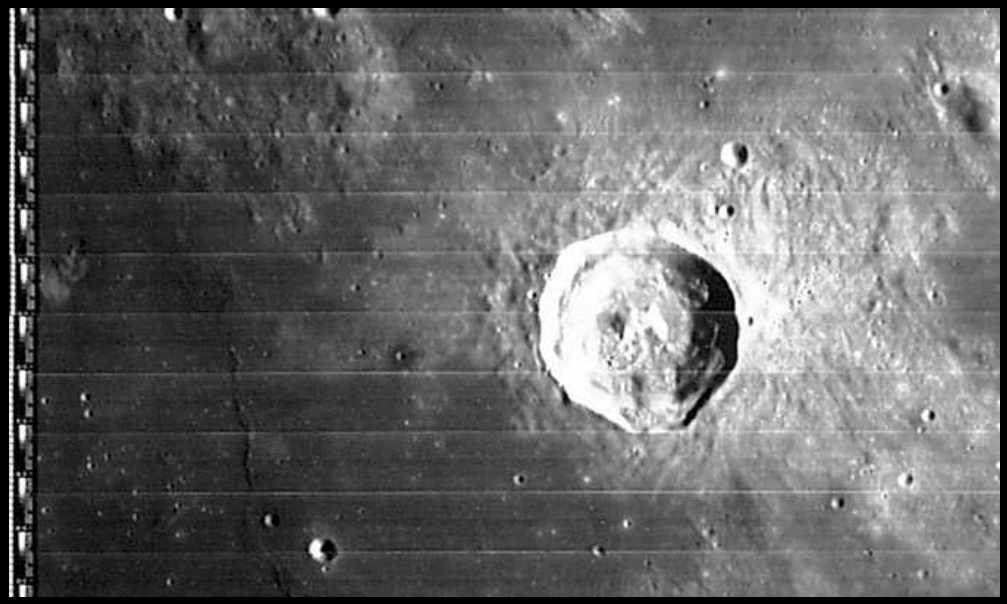


Image Lunar Orbiter IV 097-H2 reiterates that surface composition changes from Manilius ejecta blanket entering the northern end of the study zone may compromise DEM modeling.

DHC impact or pyroclastic deposits west and north-west of Manilius D exclude that region from DEM modeling.

In image Apollo AS15-93-12683 looking to the west-southwest, Manilius is in the lower left-hand corner; Manilius D is in the upper left-hand corner.

The north-south wrinkle ridge appears broken near the Manilius east-west ejecta ray.

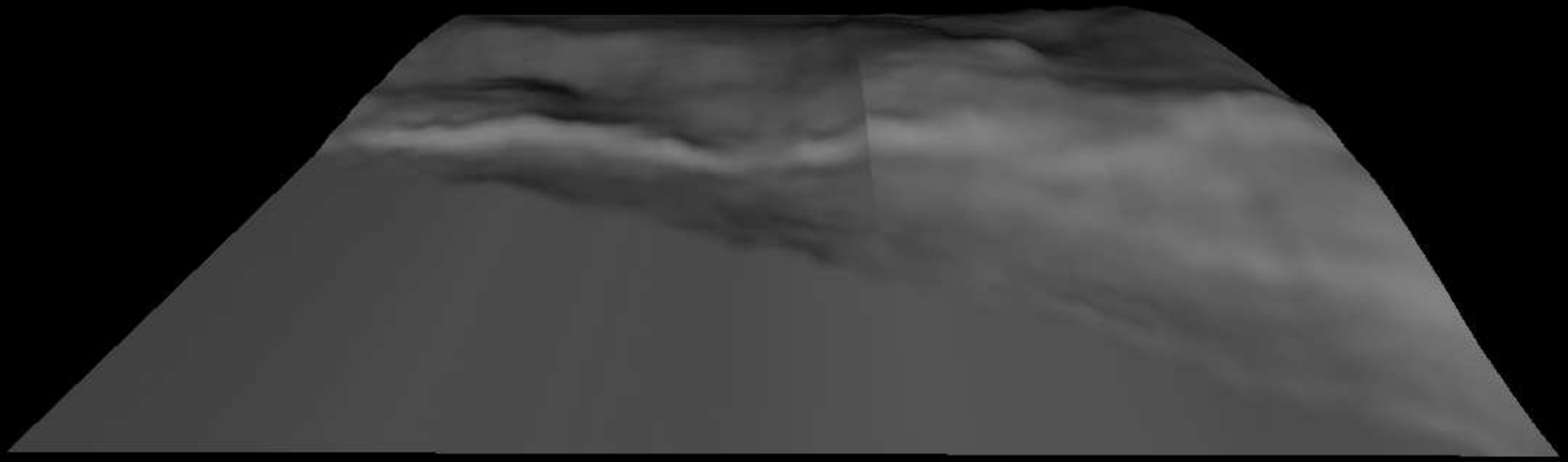
Study region – prior orbiter and astronaut photographs

In this excerpt from image Apollo AS17-M-1670, the north-south wrinkle ridge appears unbroken until north of Manilius 4. The ridge is contiguous where the east-west Manilius ejecta ray crosses.

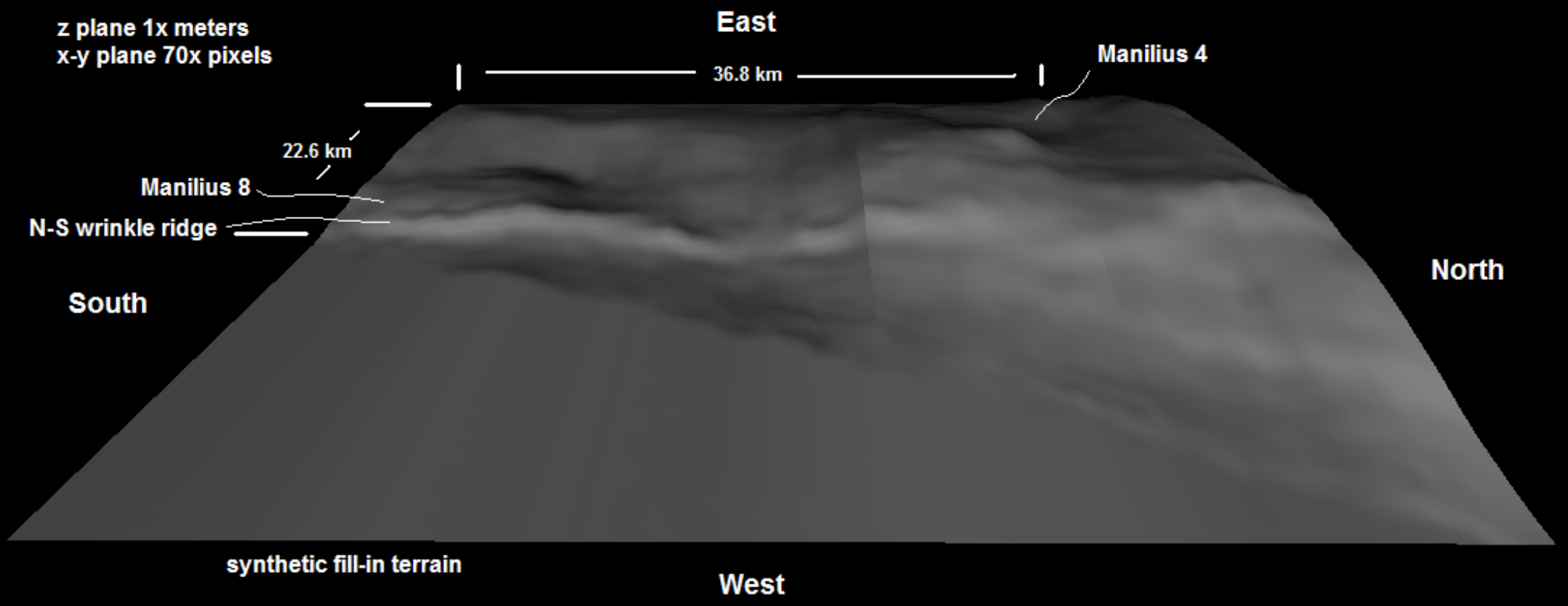
DEM generation – wide-region views

Acknowledging the problem of changes in surface composition and albedo, a study region wide-area DEM was attempted. A suitable rectangular image crop was not available in Lazzarotti's image. Synthetic terrain was added to fill in the gap. The synthetic terrain invalidated the absolute elevations in the resulting DEM, but it was felt that the relation between features in the study region might be instructional.

DEM generation – wide-region views – view from West - unannotated

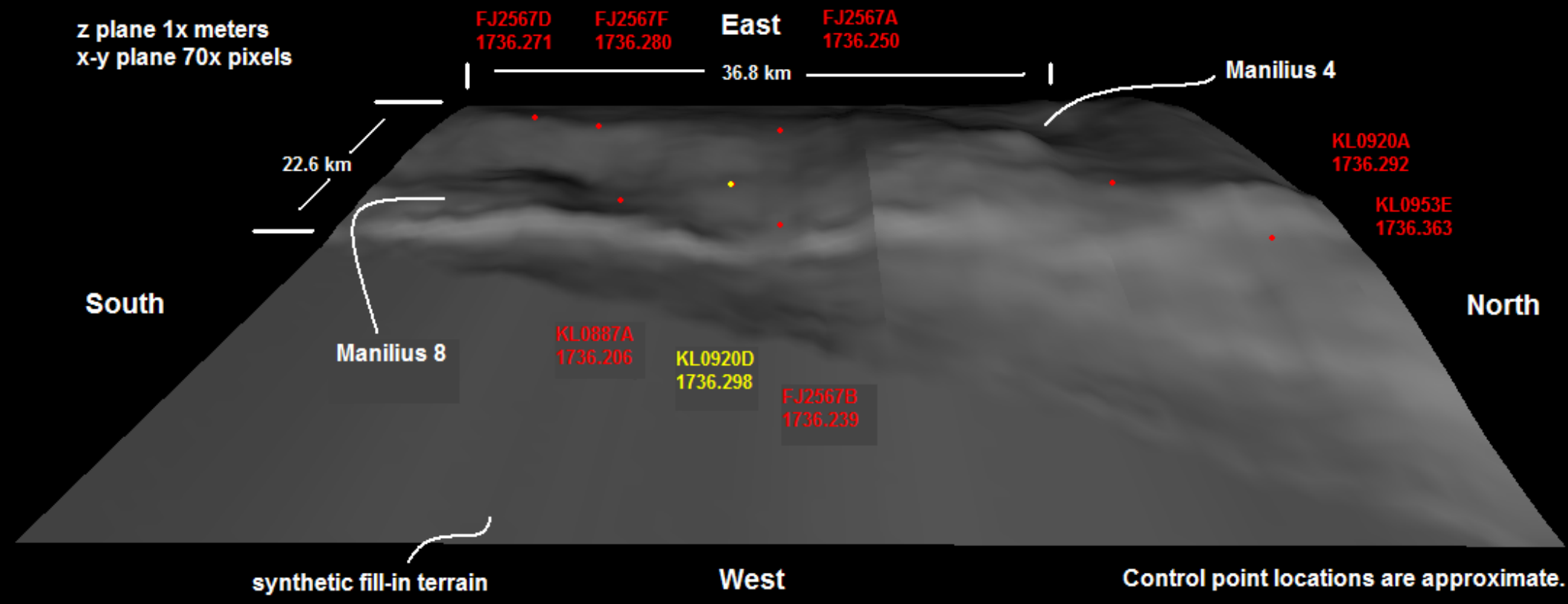


DEM generation – wide-region views – view from West – simple annotation



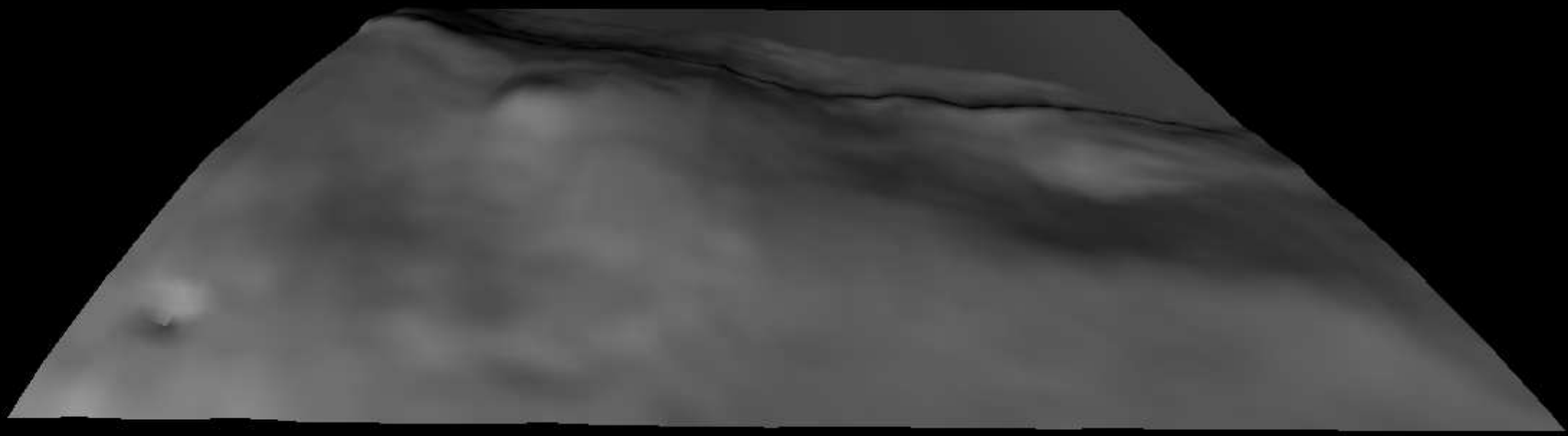
In this DEM, Manilius 8 is about as high at the wrinkle ridge measured using the shadow technique at 111 meters. Manilius 4 is a knoll at the north end of the compression ridge. The east-west ejecta ray from Manilius creates an artifact in the DEM: the north-south wrinkle ridge appears broken where the ray crosses. The ridge appears contiguous in Apollo AS17-M-1670.

DEM generation – wide-region views – view from West – detail annotation



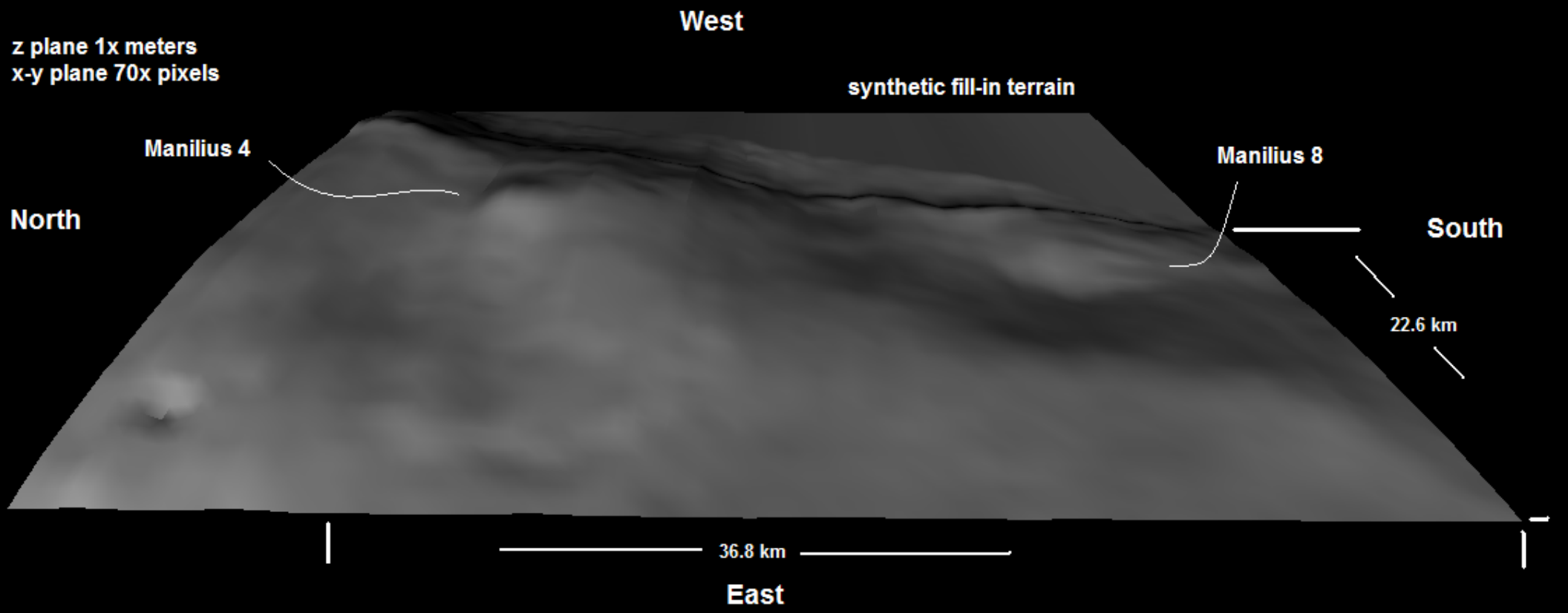
The contours of the wide study region DEM follow ULCN control points except for KL0920D. KL0920D was discounted as an outlier in the ULCN 2005 data set. Generally, the DEM rises from the south to the Apenninus foothills on the north – paralleling the trend in ULCN control points.

DEM generation – wide-region views – view from East – unannotated

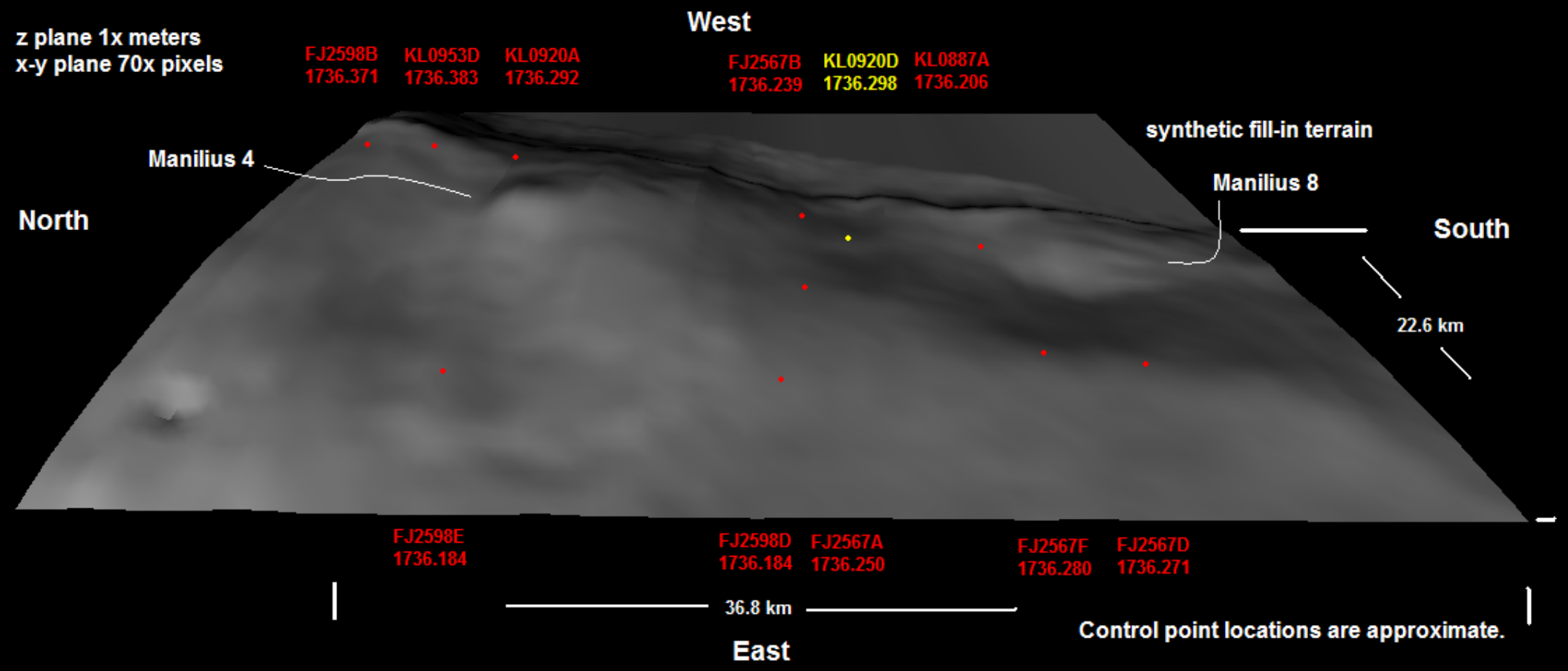


From this east view, Manilius 4 appears to be a knoll at the end of the compression ridge.

DEM generation – wide-region views – view from East – simple annotation



DEM generation – wide-region views – view from East – detail annotation



The contours of the wide study region DEM follow ULCN control points except for KL0920D. KL0920D was discounted as an outlier in the ULCN 2005 data set. Generally, the DEM rises from the south to the Apenninus foothills on the north – paralleling the trend in ULCN control points.

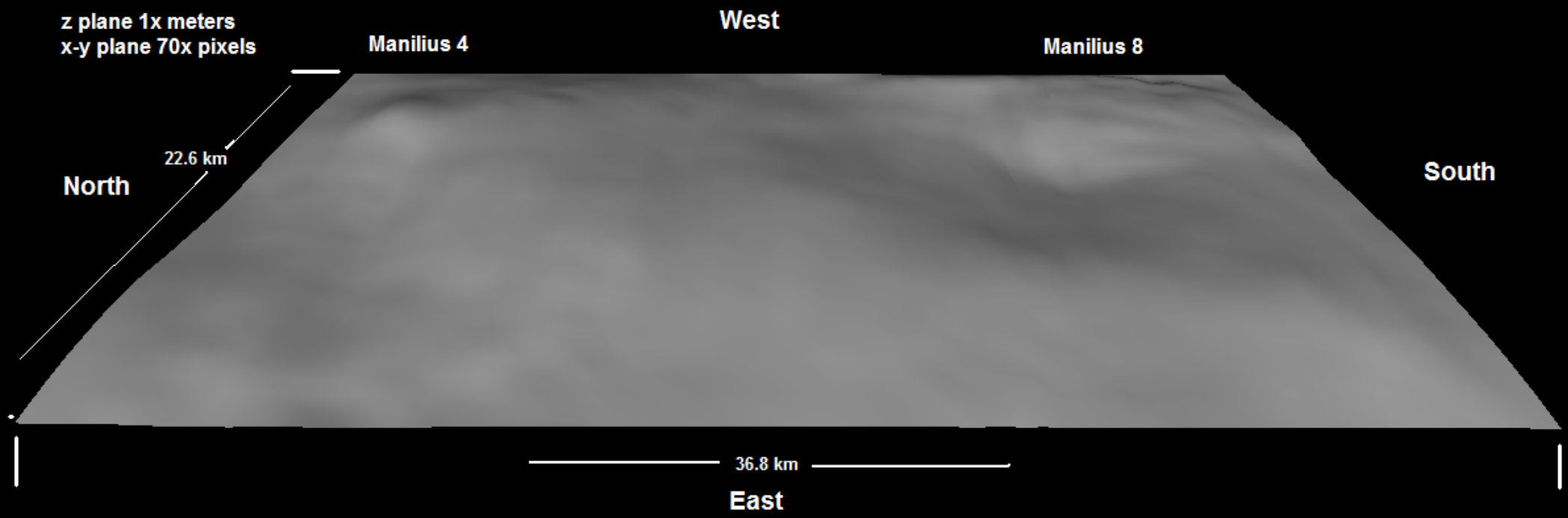
Study region – narrow study region DEM

Because the addition of synthetic terrain invalidated the absolute elevations in the wide-region DEM, a more detailed DEM covering a 36.8 km by 22.6 km sub-area was prepared that included the key features of Manilius 4, Manilius 8, the wrinkle ridge to the west of Manilius 8, and the compression ridge to the east of Manilius 8.

The selected sub-area reduces terrain in the northwest that might contain Manilius ejecta blanket surface materials and is rectangular. No synthetic terrain was added to this smaller study area.

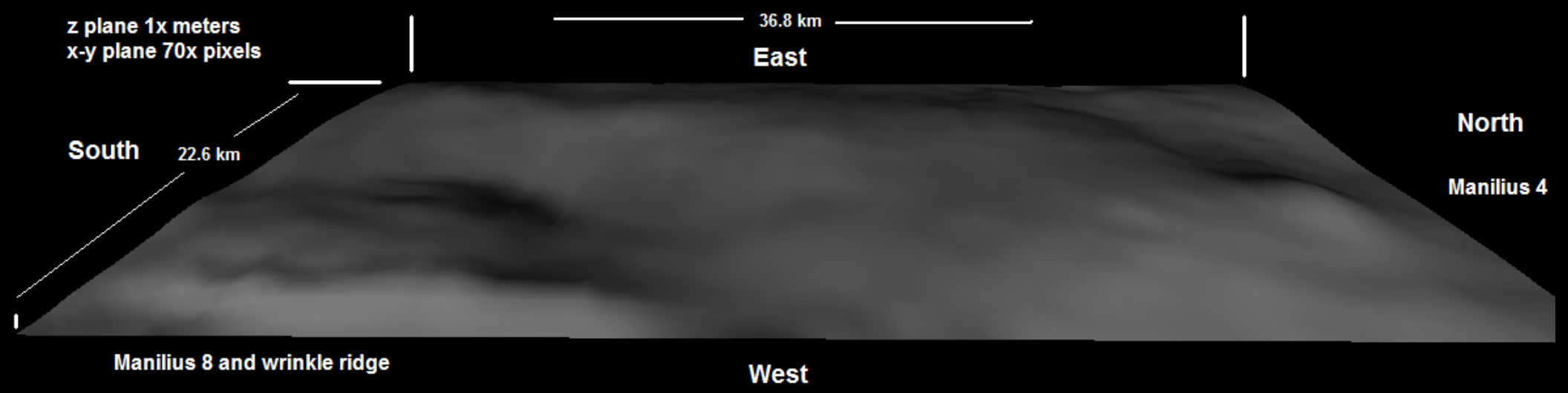
DEM generation – detail study area – view from East – unannotated

DEM generation – detail study area – view from East – simple annotation



DEM generation – detail study area– view from West - unannotated

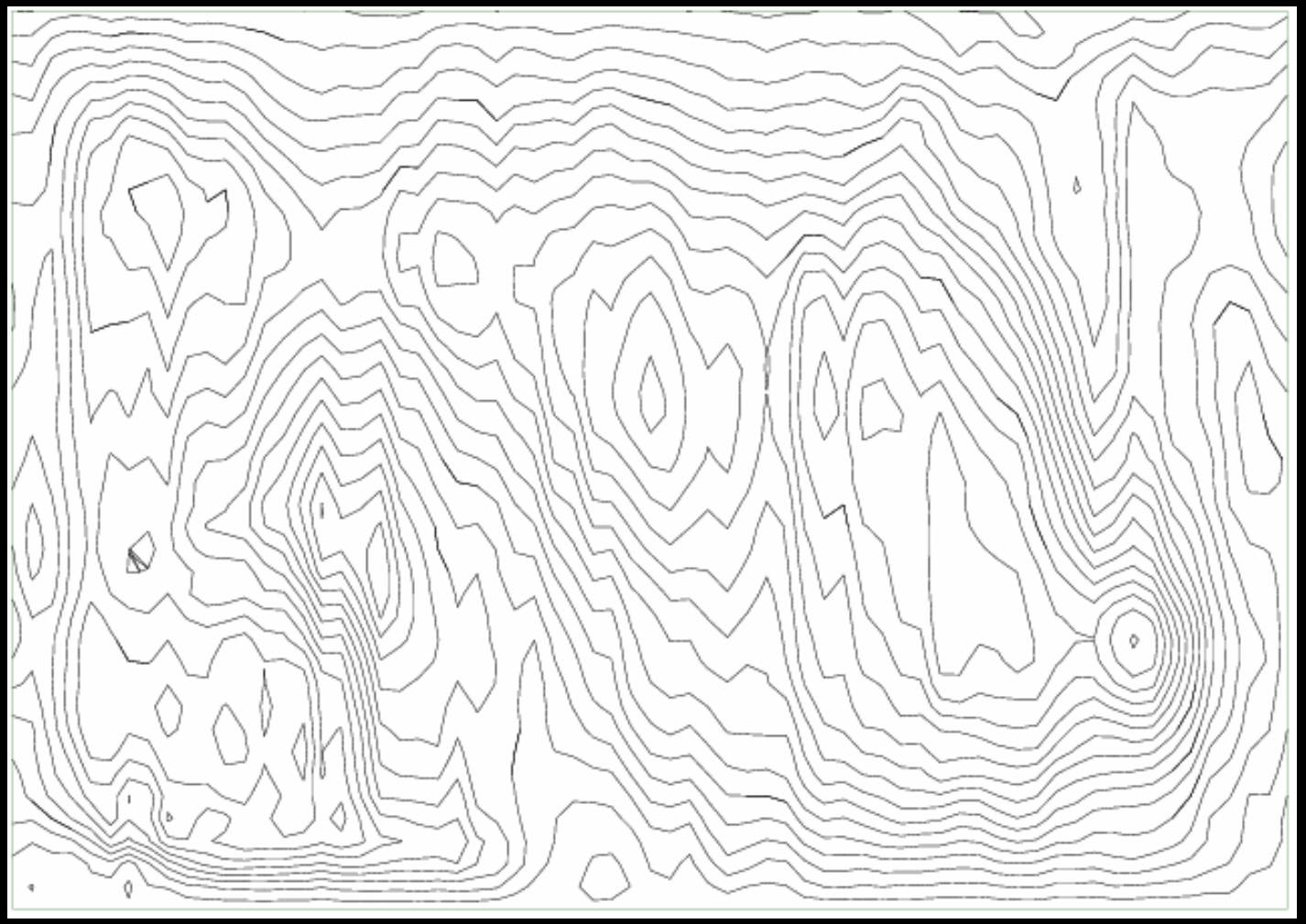
DEM generation – detail study area– view from West – simple annotation



DEM generation – detail study area – contour map

36.8 km

22.6 km



Manilius 4

Manilius 8

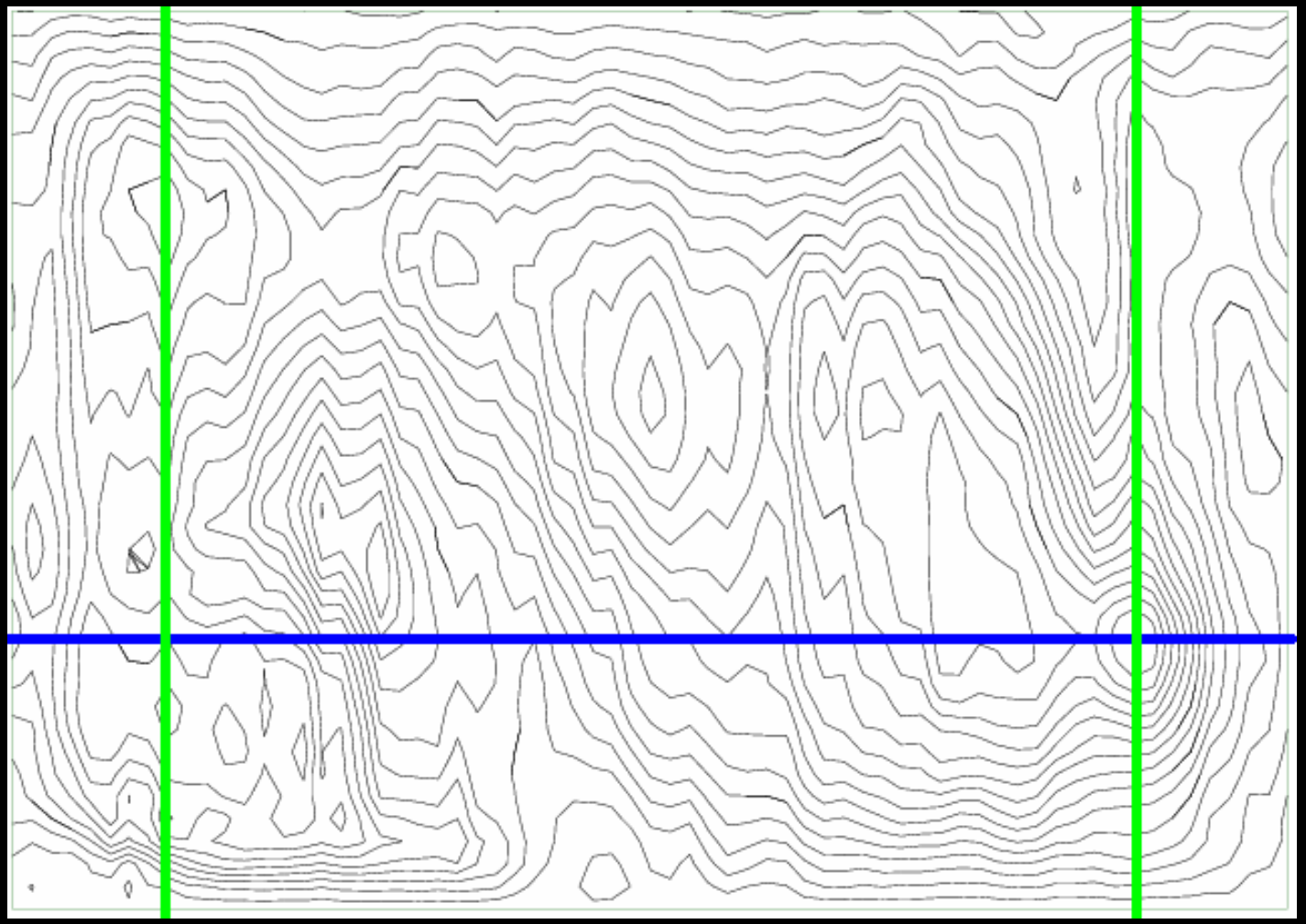
Wrinkle ridge

10 meter contour intervals

DEM generation – detail study area – location of vertical slice profiles

36.8 km

22.6 km



Manilius 4

Manilius 8

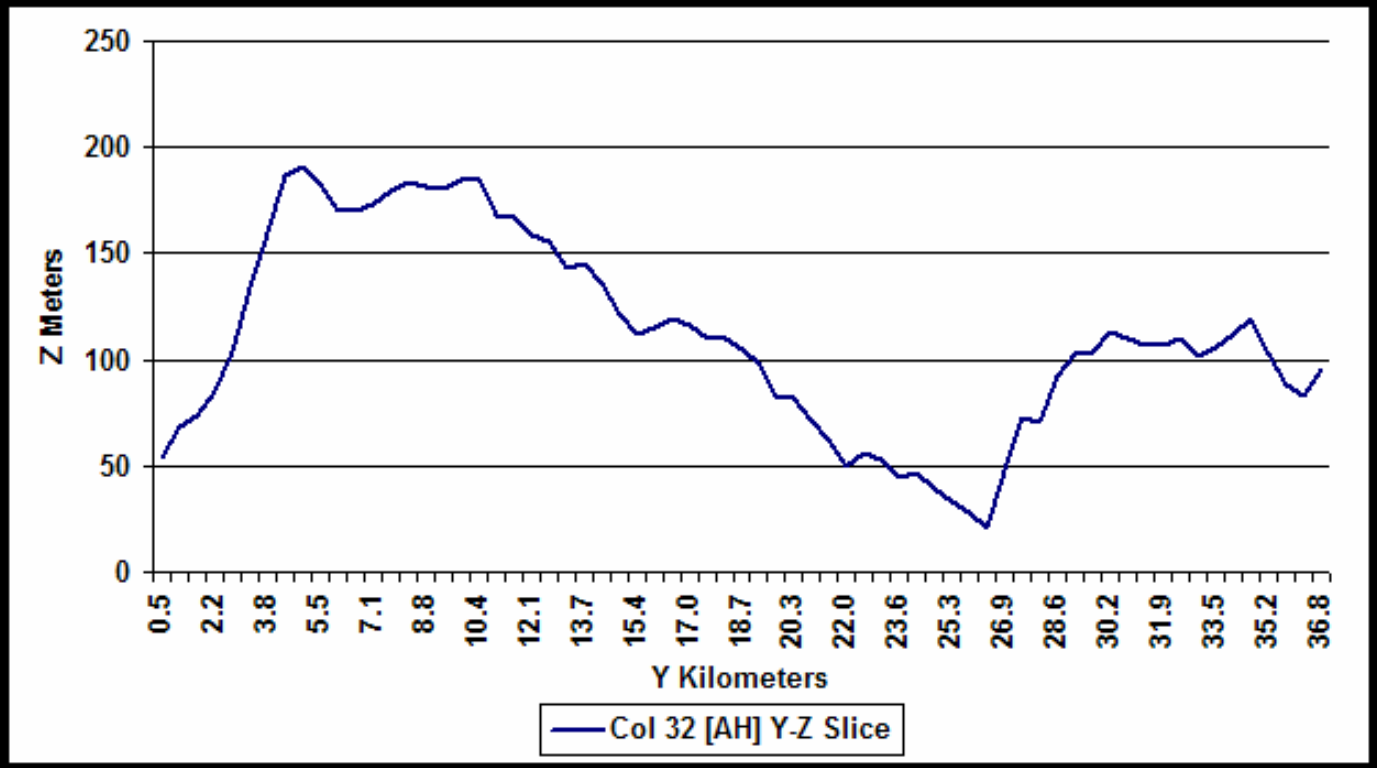
Wrinkle ridge

10 meter contour intervals. See following figures for vertical slice elevation charts.

DEM generation – detail study area – vertical slices

Manilius 4

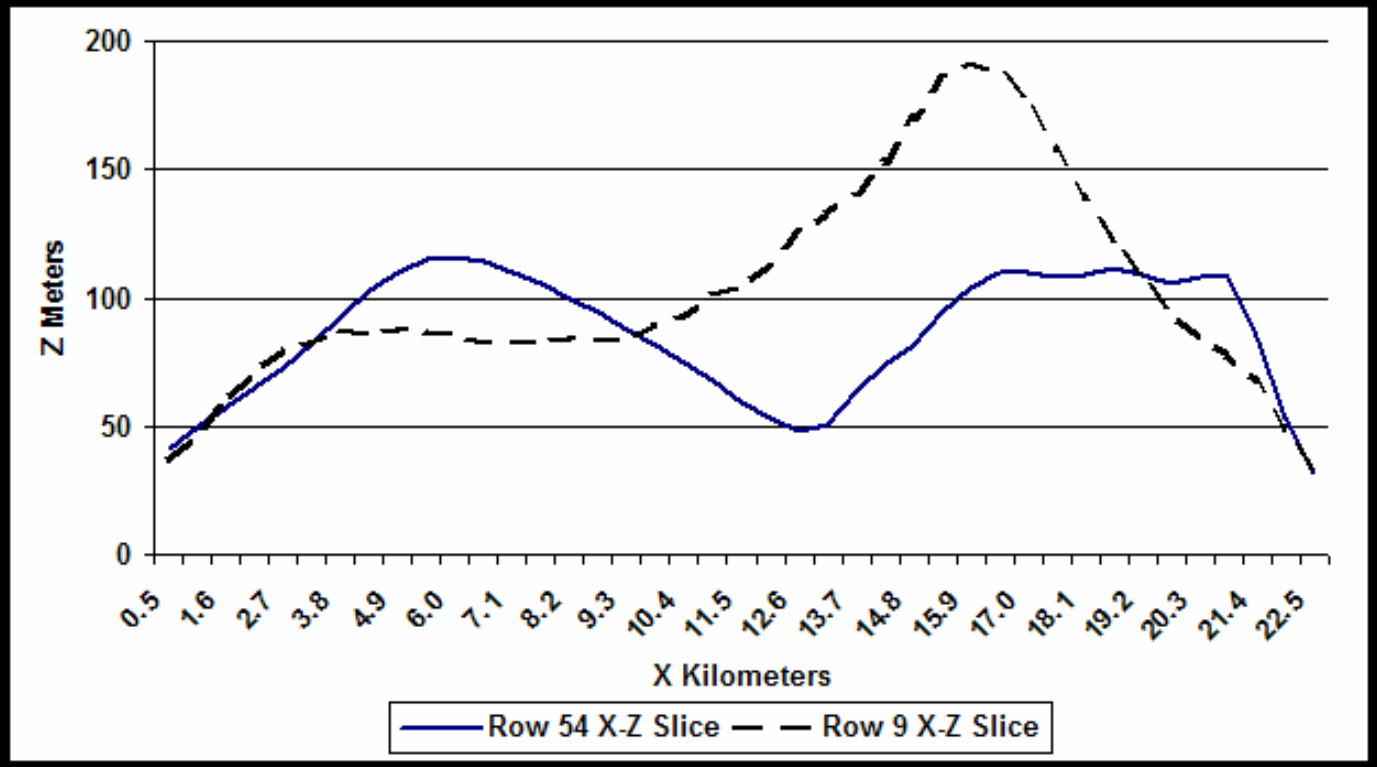
Manilius 8



The direction of plotting the elevation slice is reversed from the orientation of the contour map.

DEM generation – detail study area – vertical slices

Compression ridge



Manilius 4

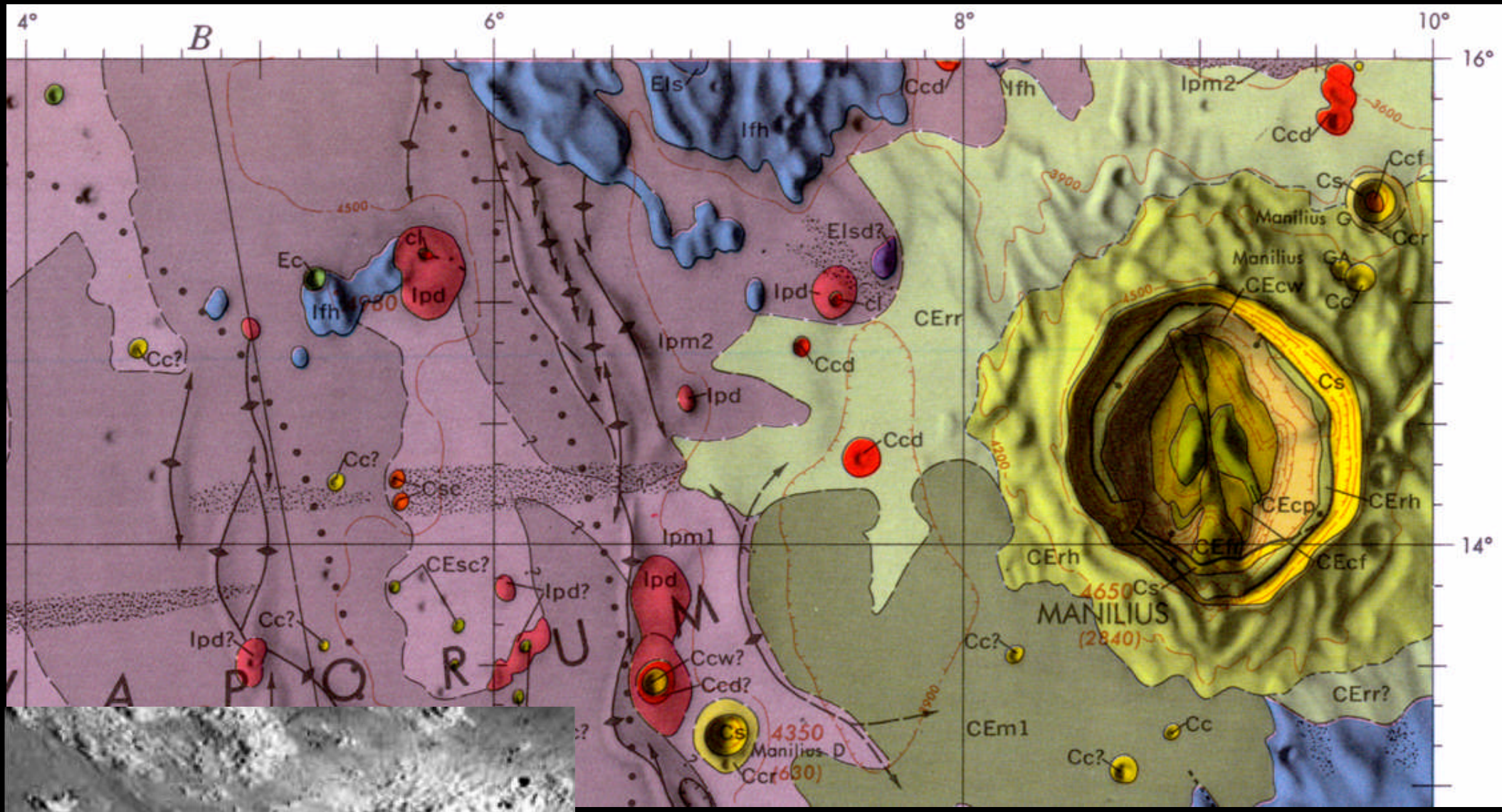
Manilius 8

The direction of plotting the elevation slices are from the top to the bottom of the contour map.

Provisional results and topographic conclusions

1. The supplemental zipped data file contains a static Excel spreadsheet of raw and zero-based DEMs for the small study area. That data could be used for further volumetric study of Manilius 8. The data file also contains VRML files for the 3-D renderings shown above.
2. The 2005 Kapral-Garfinkle catalogue lists both Manilius 8 and Manilius 4 as unverified domes.
3. Lazzarotti's image appears to show a pit at the top of Manilius 4 not shown in Lunar Orbiter IV or Apollo images.
4. The 2005 Kapral-Garfinkle catalogue lists Manilius 8 and Manilius D2 as having a height of 518 meters. The source for this value is Brungart's 1964 catalogue of dome heights based on shadow measurements.
5. Shadow measurements of the wrinkle ridge adjacent to Manilius 8 and DEM modeling presented here suggests a height of Manilius 8 of 111 meters +- 8 meters.
6. The diameter of Manilius 8 DEM modeled here is consistent with the Kapral-Garfinkle value of 7x11 km. The diameter of Manilius 4 shown here is consistent with Kapral-Garfinkle at 2x3km.
7. The terrain to the west of Manilius 4 has a slope of 0.05 (150/3000m) or about -2.8%. According to Davis (1997), a -1.5% surrounding plain slope can result in about a 39% error in measuring the height of a 1,500 meter peak.
8. The terrain surrounding Manilius 4 has multiple surface composition changes.
9. Although shadow measured at a height of 204-227 meters and DEM modeling at a height of 191 meters +- 8 meters, Manilius 4 is probably not an appropriate target for determining elevation by either method. A true measurement of the height of Manilius 4 will probably have to wait for future orbiter stereophotometry, orbiter LIDAR, or Earth-based radar studies.
10. The impression of Manilius 4 is that it is a small knoll about 50 meters high at the end of a compression ridge. The ridge drops off to the east and to the north by about 125 meters.
11. A small DHC to the south west of Manilius 4 – that is not on the ALPO DHC list – is suggested by AS15-93-12683 and Clementine false color ratio imagery. This DHC may to too small and to contrast weak to be detectible by Earth based amateur imaging.
12. The compression ridge to the east of Manilius 8 and shown on GLAC I-549 is significant to understanding the geologic history of the study area around that dome. The shape of the compression ridge as shown on I-549 suggests it formed as a result of the Manilius impact. The compression ridge travels north to Manilius 4 and then merges with the north-south wrinkle ridge to the west.

Notes on DEM construction for Manilius 8 and Manilius 4 - End



GLAC I-594

Slide 31

Apollo AS17-M-1670