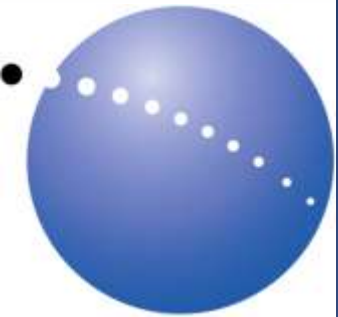


Stereo Satellite Elevation Mapping Majnoon Oil Field Development, Iraq



Gerry Mitchell
PhotoSat President

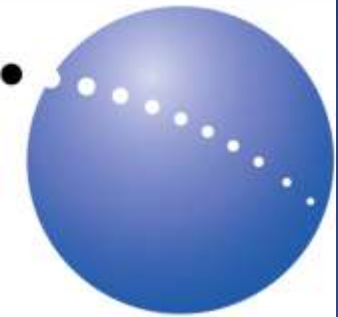
Mark Nightengale
Remote Sensing Analyst Shell

Majnoon Oil Field

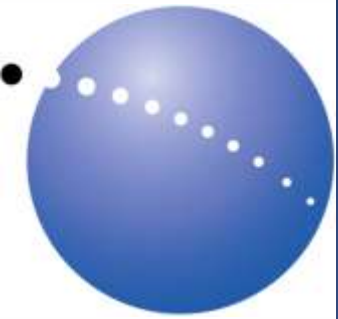
Shell Press Release
January 17, 2010

“Shell, as lead operator, will hold a 45% share, with partner Petronas holding 30%. The Iraqi state holds 25% of the participating interests in all licences.

The consortium targets a production plateau of 1.8 million barrels of oil per day, up from a current level of approximately 45,000 barrels of oil per day. Majnoon, located in southern Iraq, is one of the world’s largest oil fields.”



Stereo Satellite Elevation Mapping Area



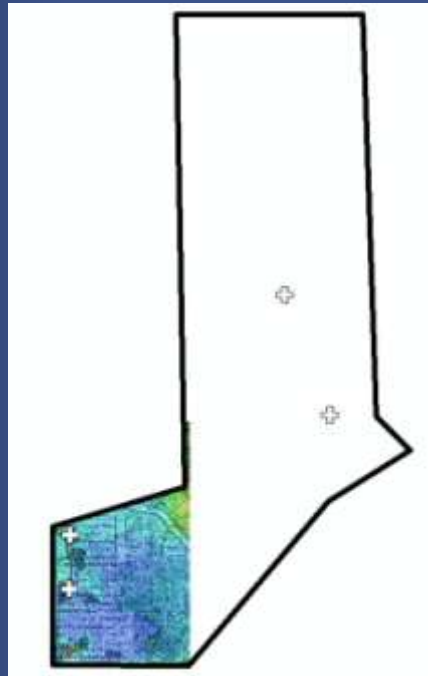
1,700 km² Majnoon mapping area

WorldView-2 Stereo Pairs

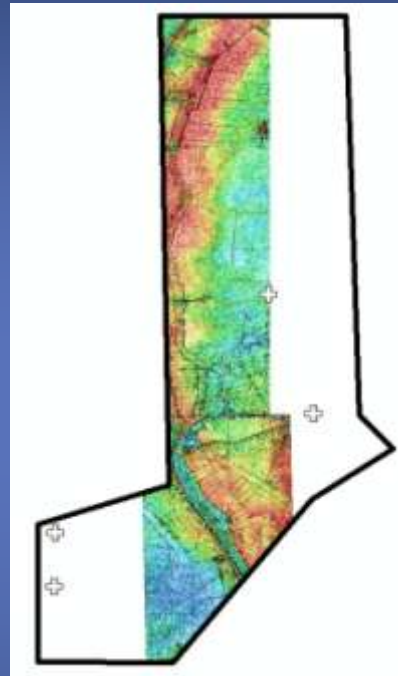


WorldView-2 stereo photos April 20, May 9 and June 11, 2010. Four survey points, GCP 1-4 were provided for ground reference.

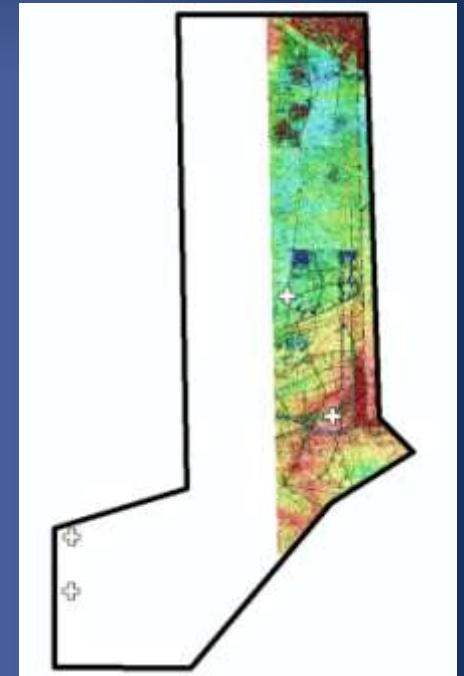
Individual stereo pair DEMs



April 20 DEM



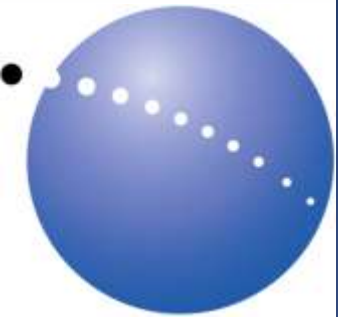
June 11 DEM



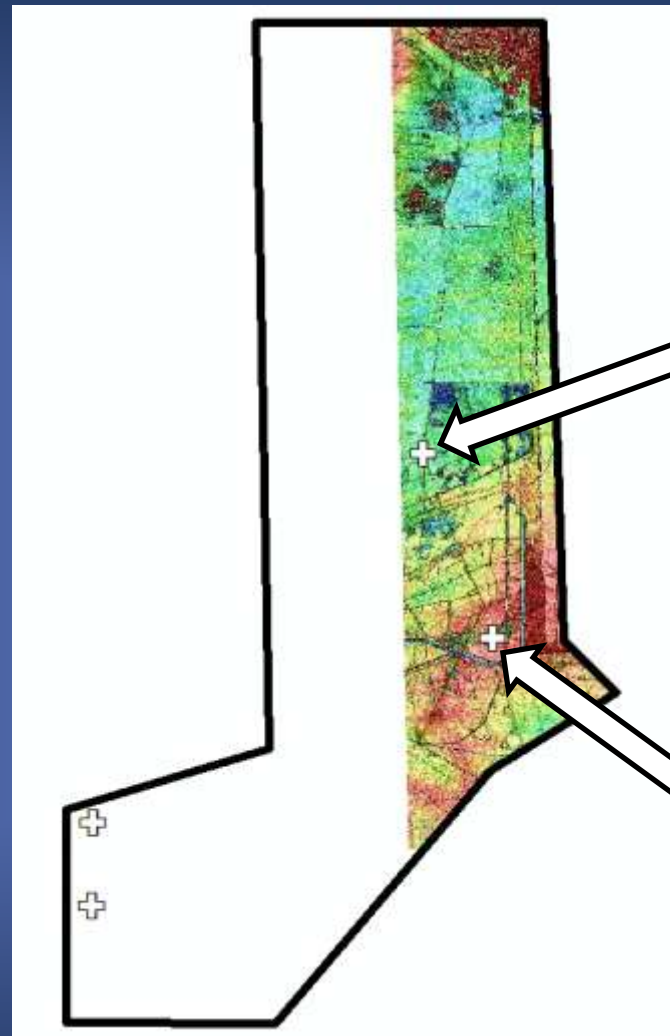
May 9 DEM

DEM were created for each of the April 20, May 9 and June 11, 2010 WorldView-2 stereo pairs without reference to the ground survey points.

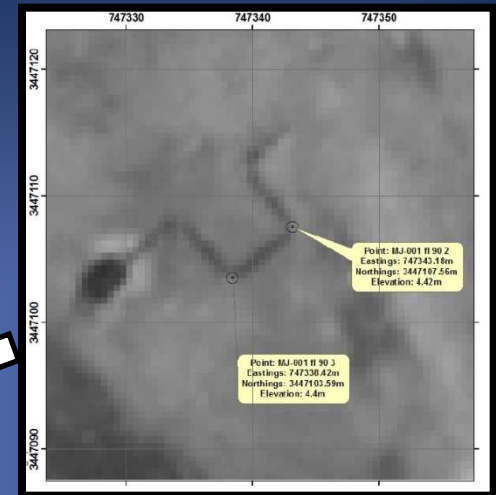
Ground Survey Reference



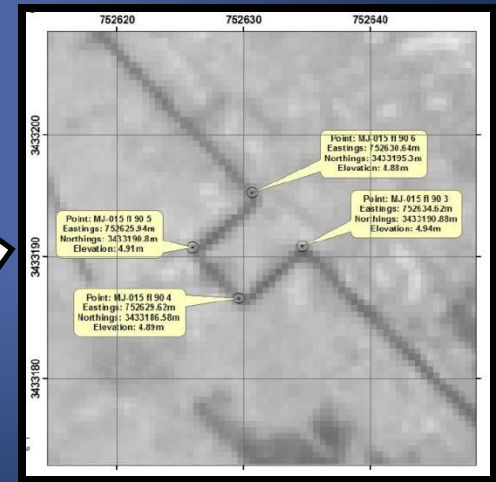
75km



May 9
DEM

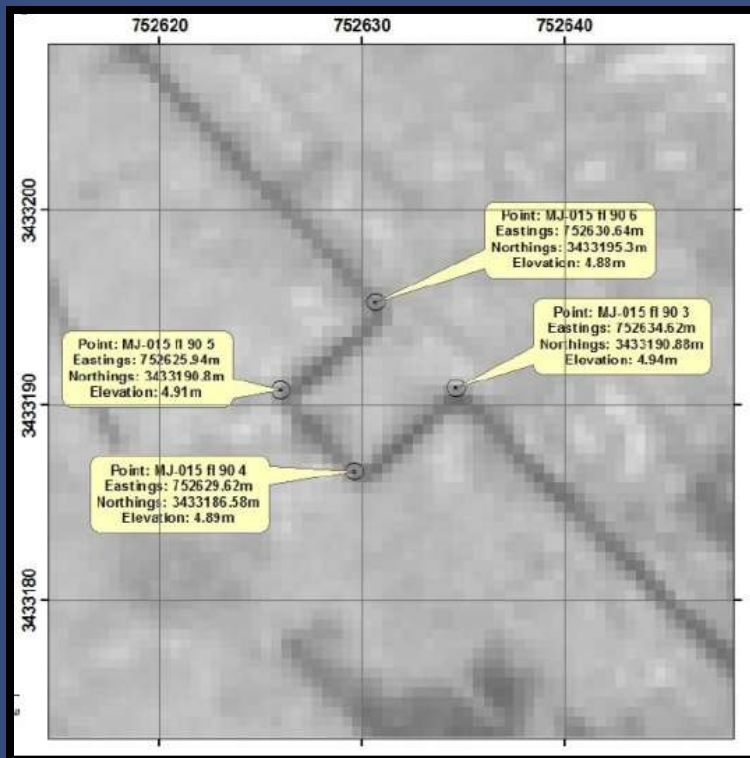


GCP 2

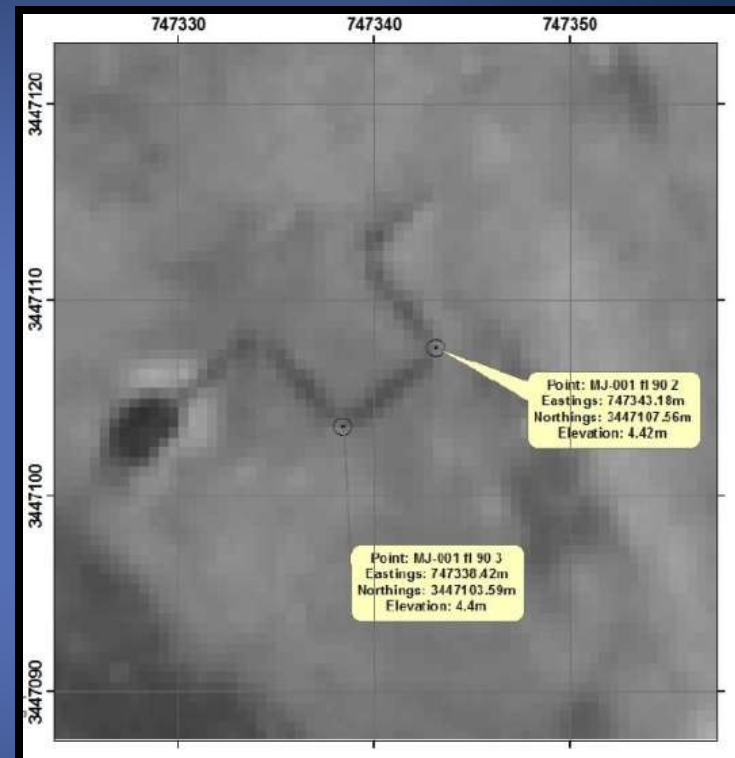


GCP 1

Good Match to GCP's 1 & 2

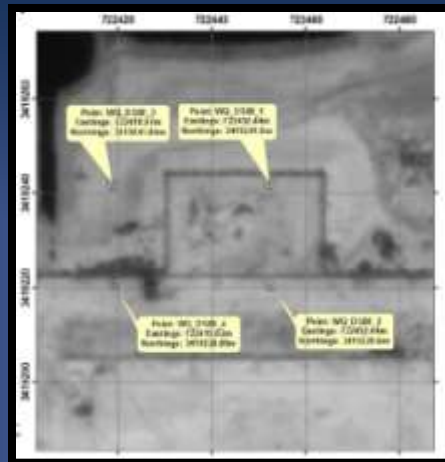
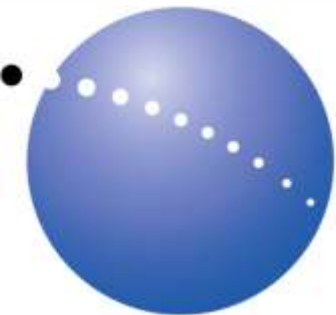


GCP 1

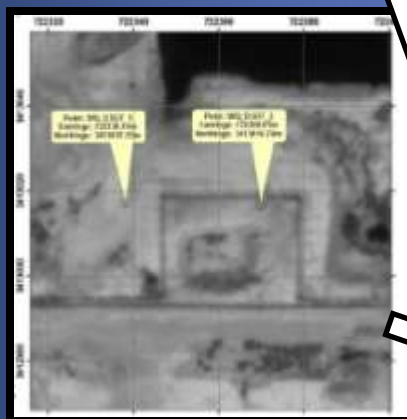


GCP 2

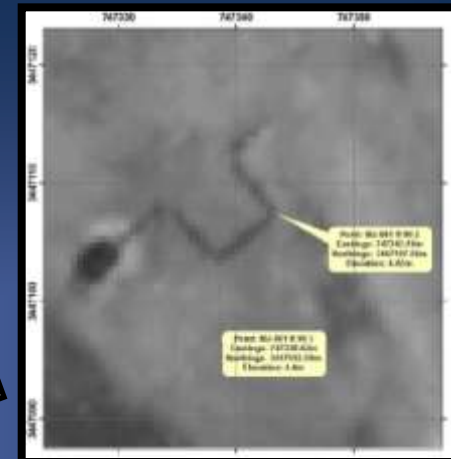
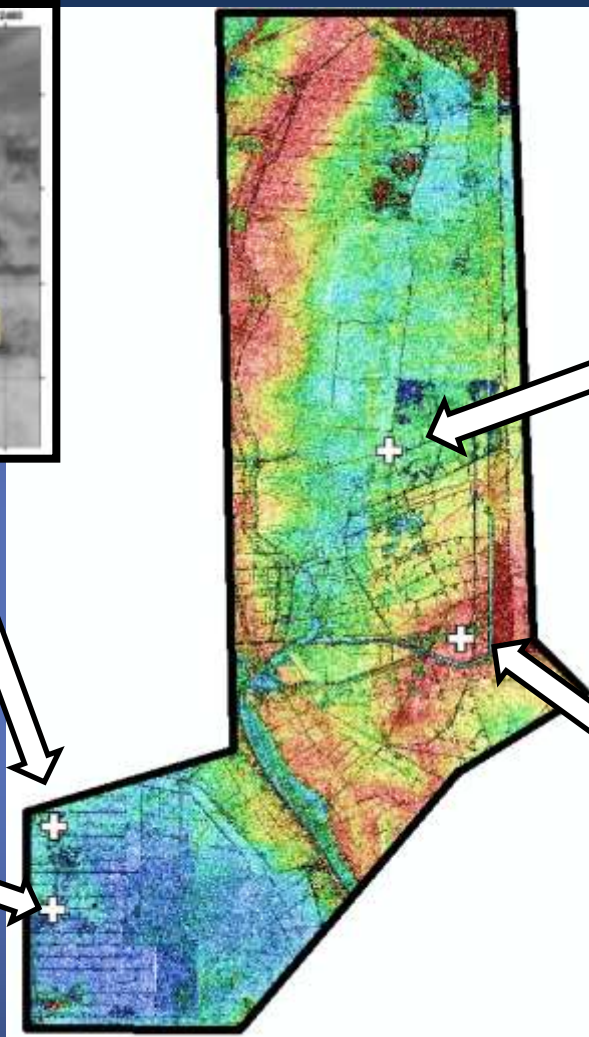
GCP1 & GCP2, separated by 15km, match the WV2 precision ortho to within 25cm with no relative horizontal adjustment.



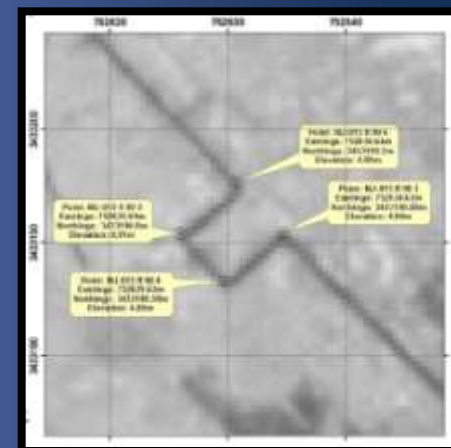
GCP 3



GCP 4



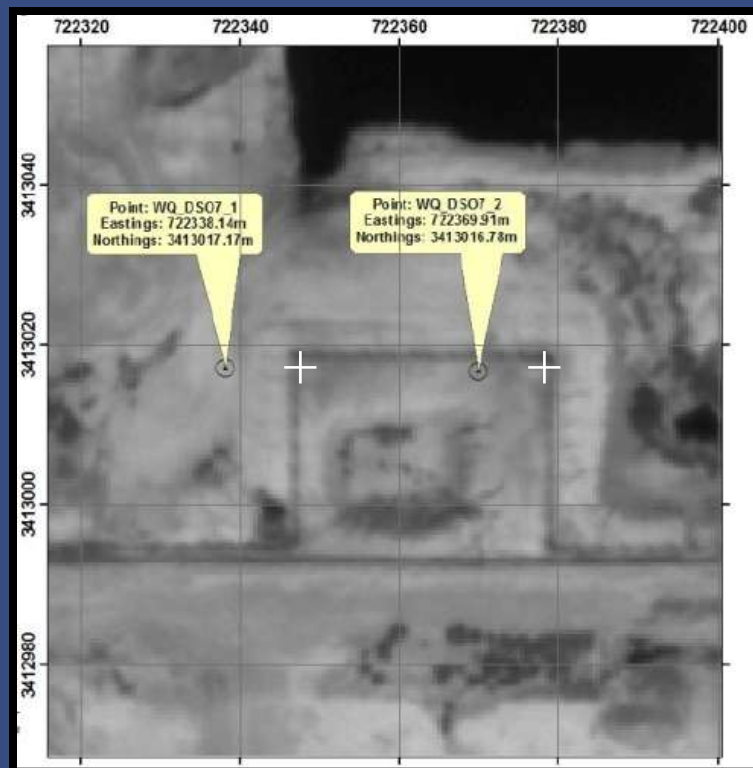
GCP 2



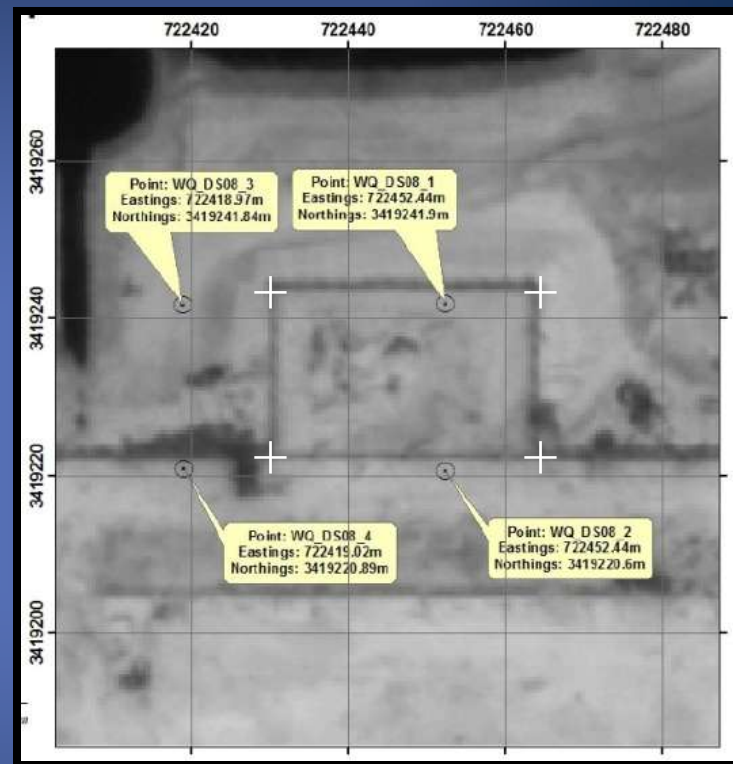
GCP 1

After matching the June 11 and April 20 DEMs and orthos to the May 9 DEM and ortho there was a mismatch of about 10m horizontally between the April 20 WV2 precision ortho and GCP 3 & 4.

Poor Match to GCP's 3 & 4



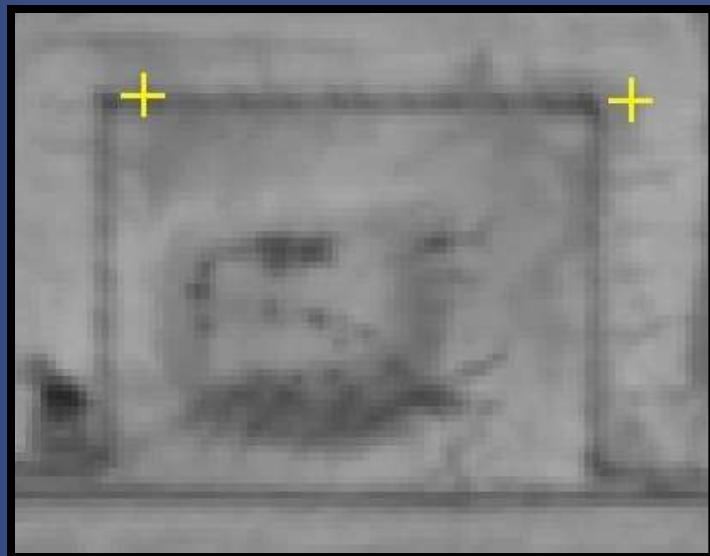
GCP 4



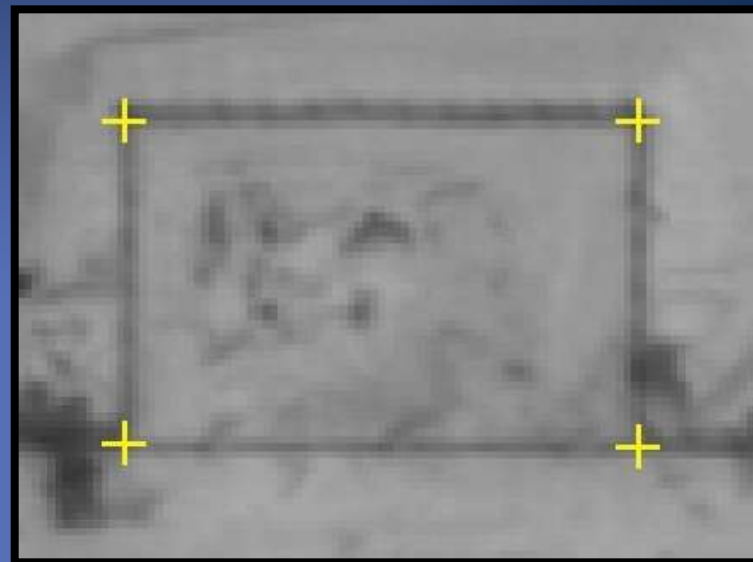
GCP 3

After matching the June 11 and April 20 DEMs and orthos to the May 9 DEM and ortho there was a mismatch of about 10m horizontal between the April 20 WV2 precision ortho and GCP 3 & 4.

Poor Match to GCP's 3 & 4



GCP 4



GCP 3

When we matched the April 20 DEMs and orthos to GCP 3, shown to the right above, GCP 4 mismatched by more than 3 meters. Survey points GCP3 & 4 appear to be in error relative to each other. We did not use the GCP 3 & 4 in the Majnoon WV2 DEM and precision ortho processing.

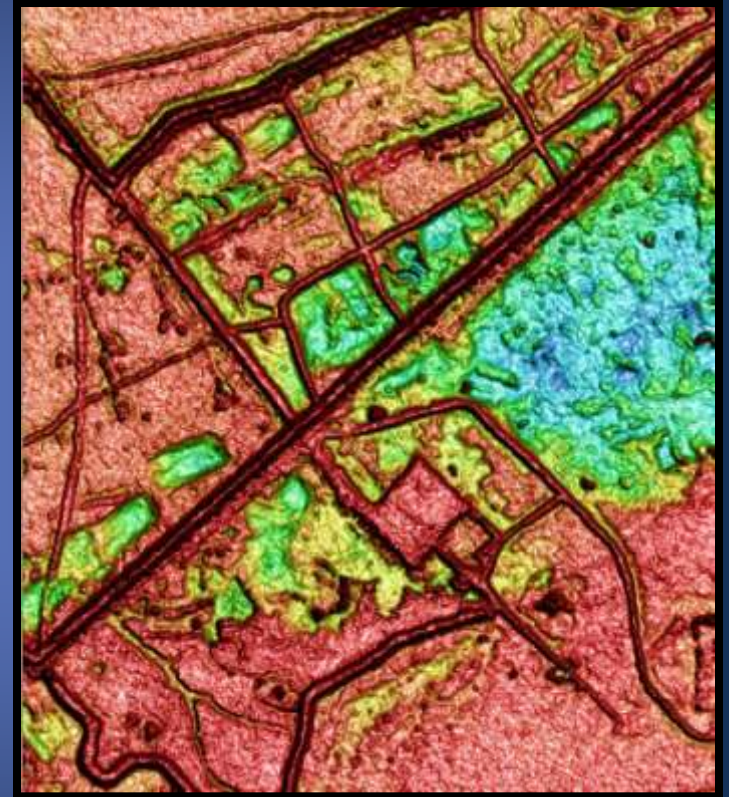
Example Ortho and DEM

← 1 km →



**WorldView-2
Precision Ortho**

← 1 km →



**WorldView-2
DEM Image**

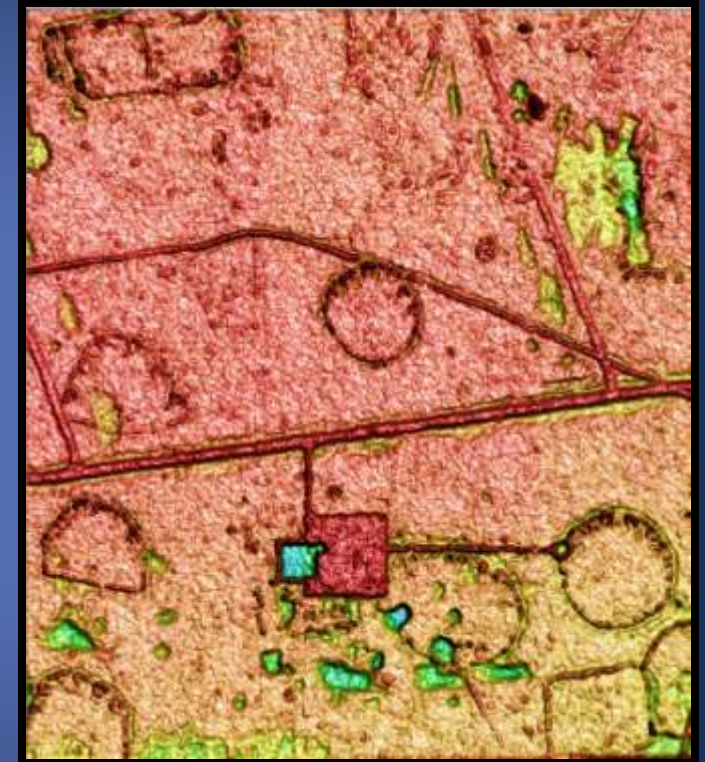
Example Ortho and DEM

← 1 km →



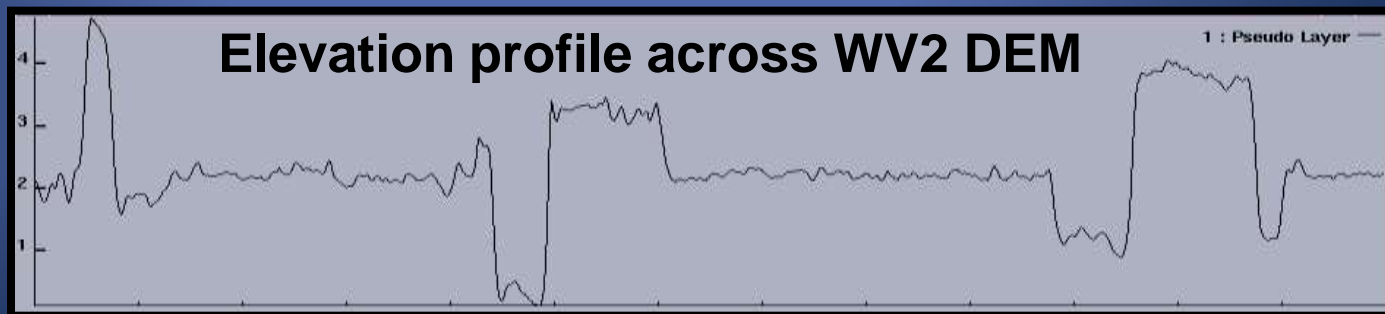
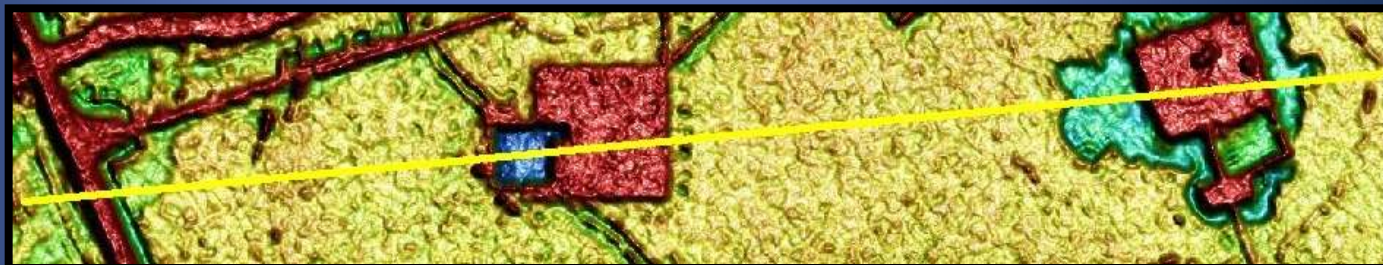
**WorldView-2
Precision Ortho**

← 1 km →

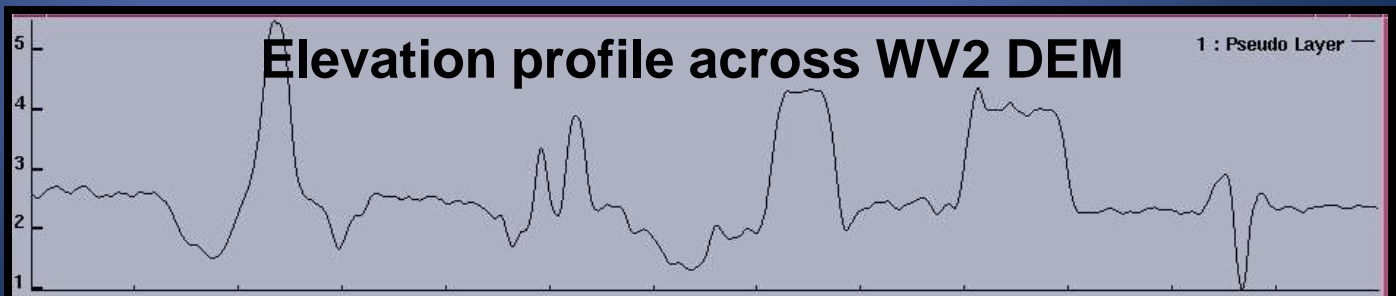
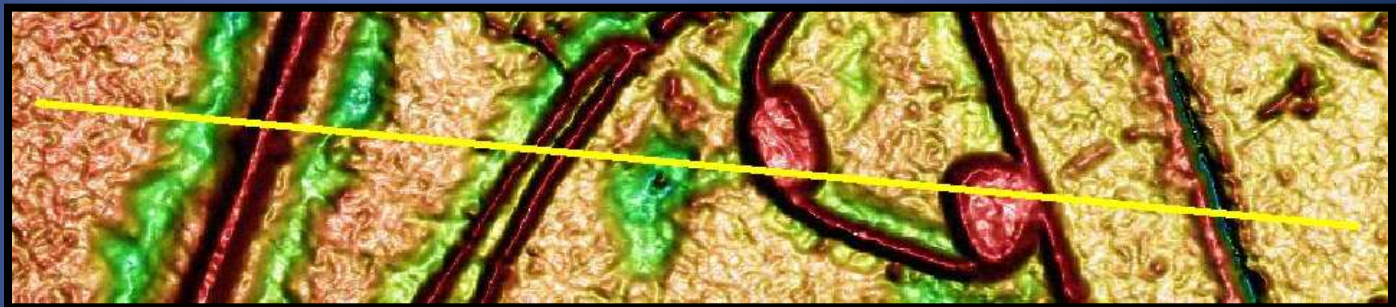
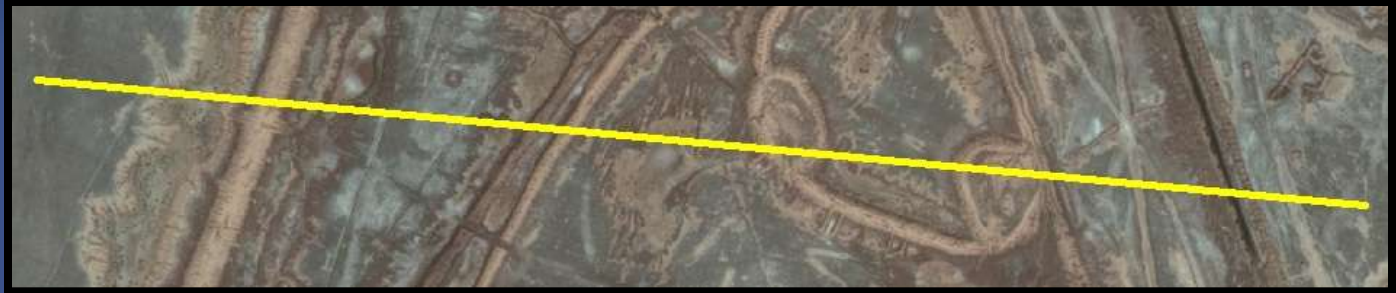


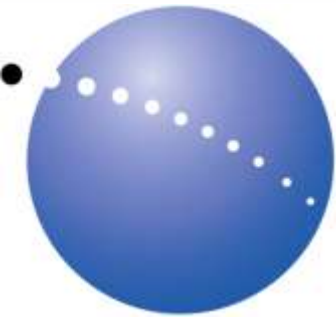
**WorldView-2
DEM Image**

Stereo Satellite Elevation Profile

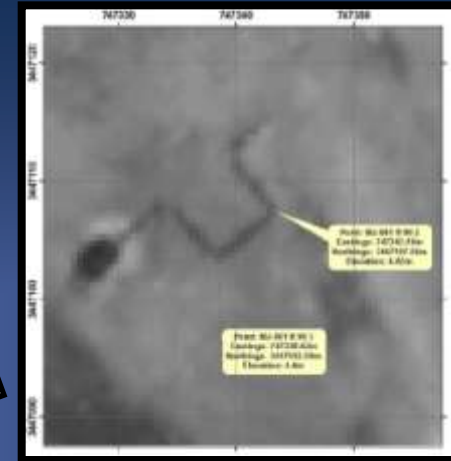
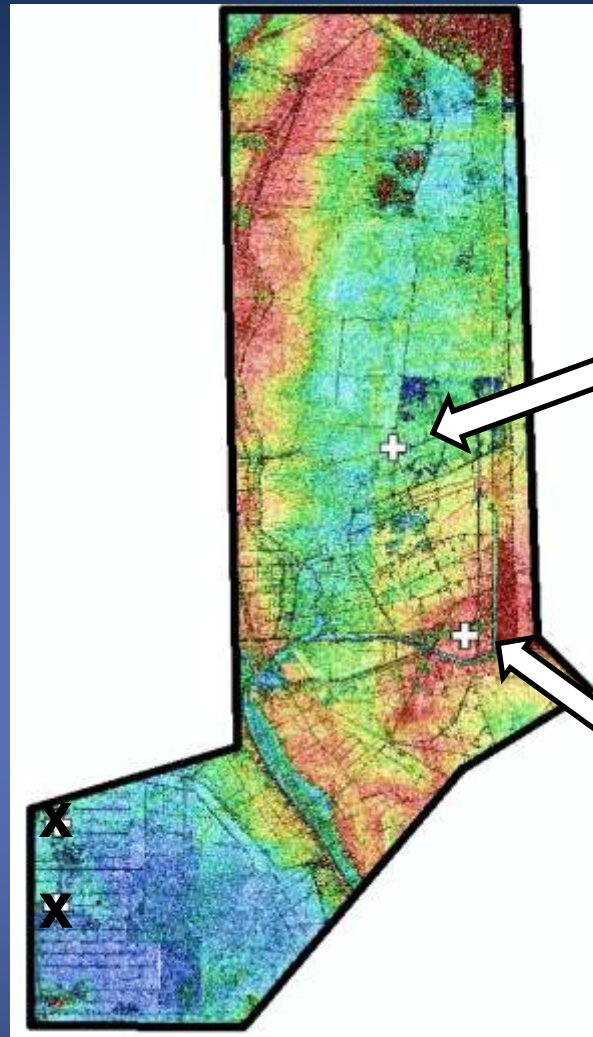


Stereo Satellite Elevation Profile

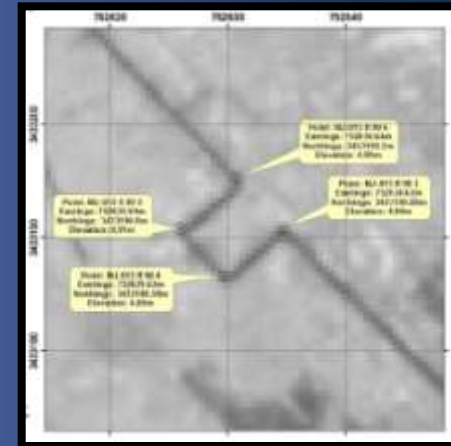




75km

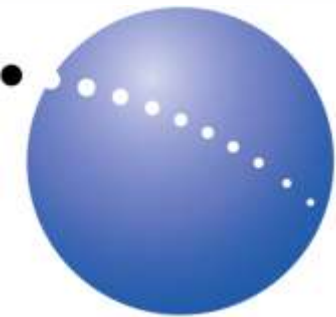


GCP 2

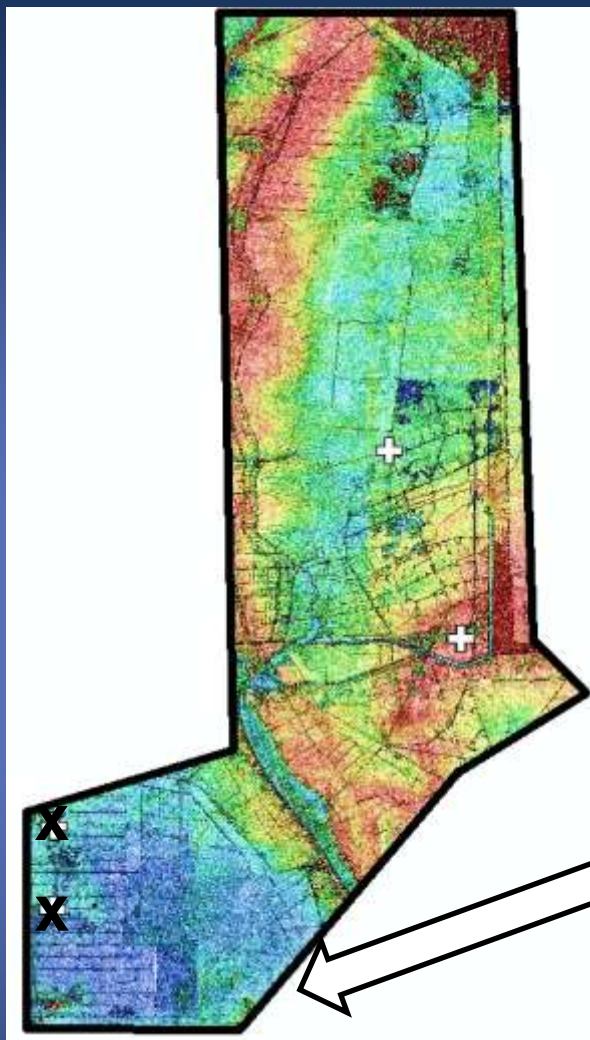


GCP 1

1700 km² , 1m stereo satellite DEM referenced to only two ground survey points. DEM completed in August 2010.

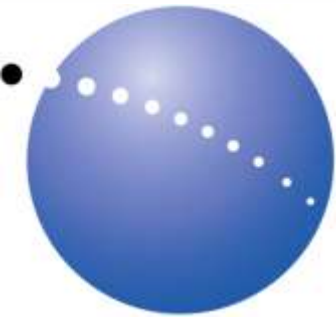


75km

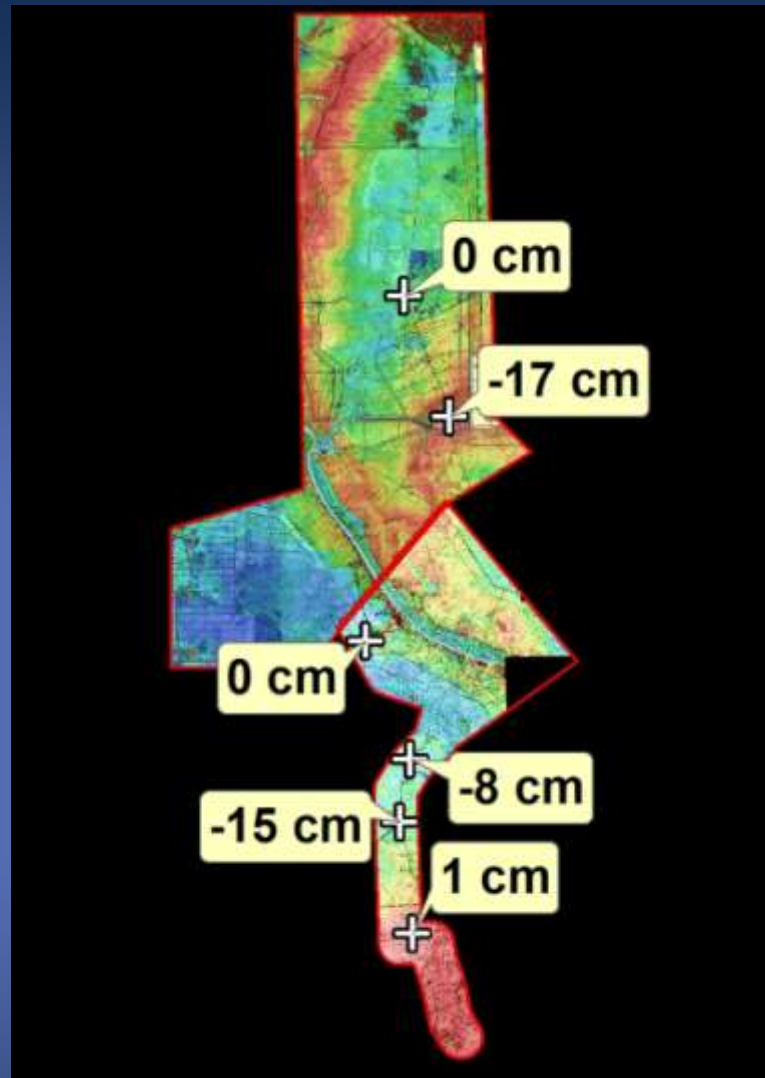


Survey confirmation,
Dec 2010; better than
20cm in elevation

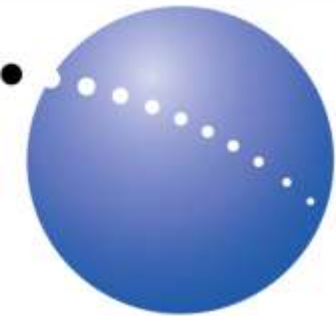
Accuracy of the southern edge of mapping area was confirmed to be better than 20cm in elevation in December 2010. This area is 27.5km from the nearest valid survey point



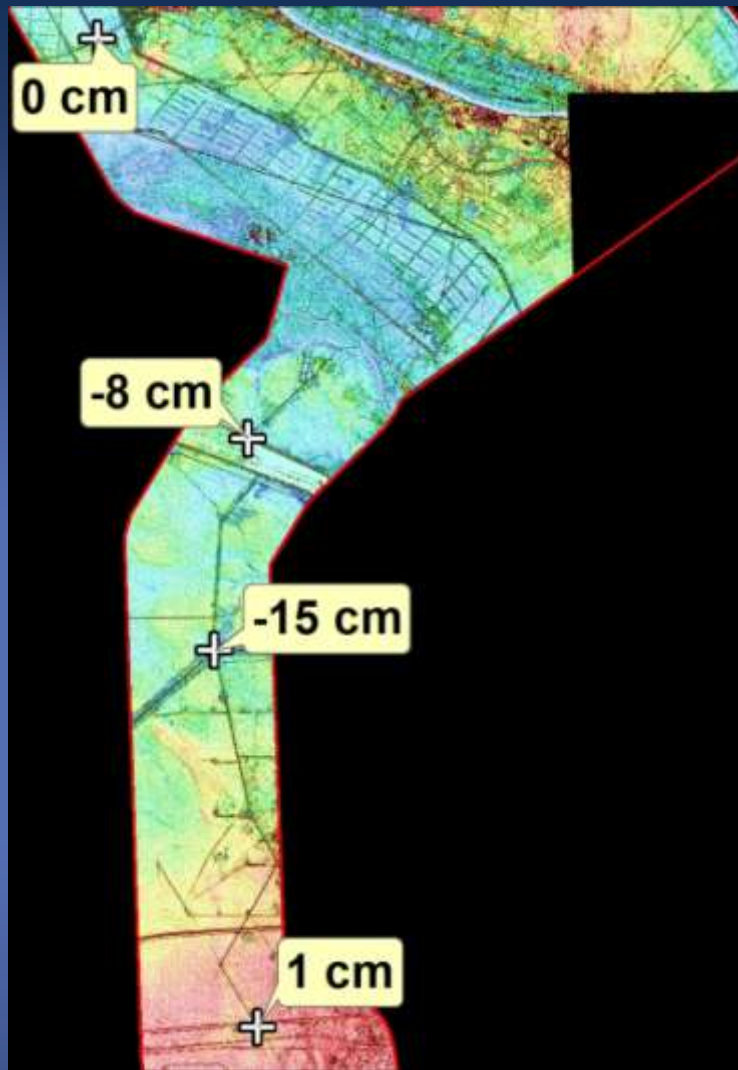
121km



Extension to the DEM completed in December 2010. Four additional ground survey points match to better than 20cm

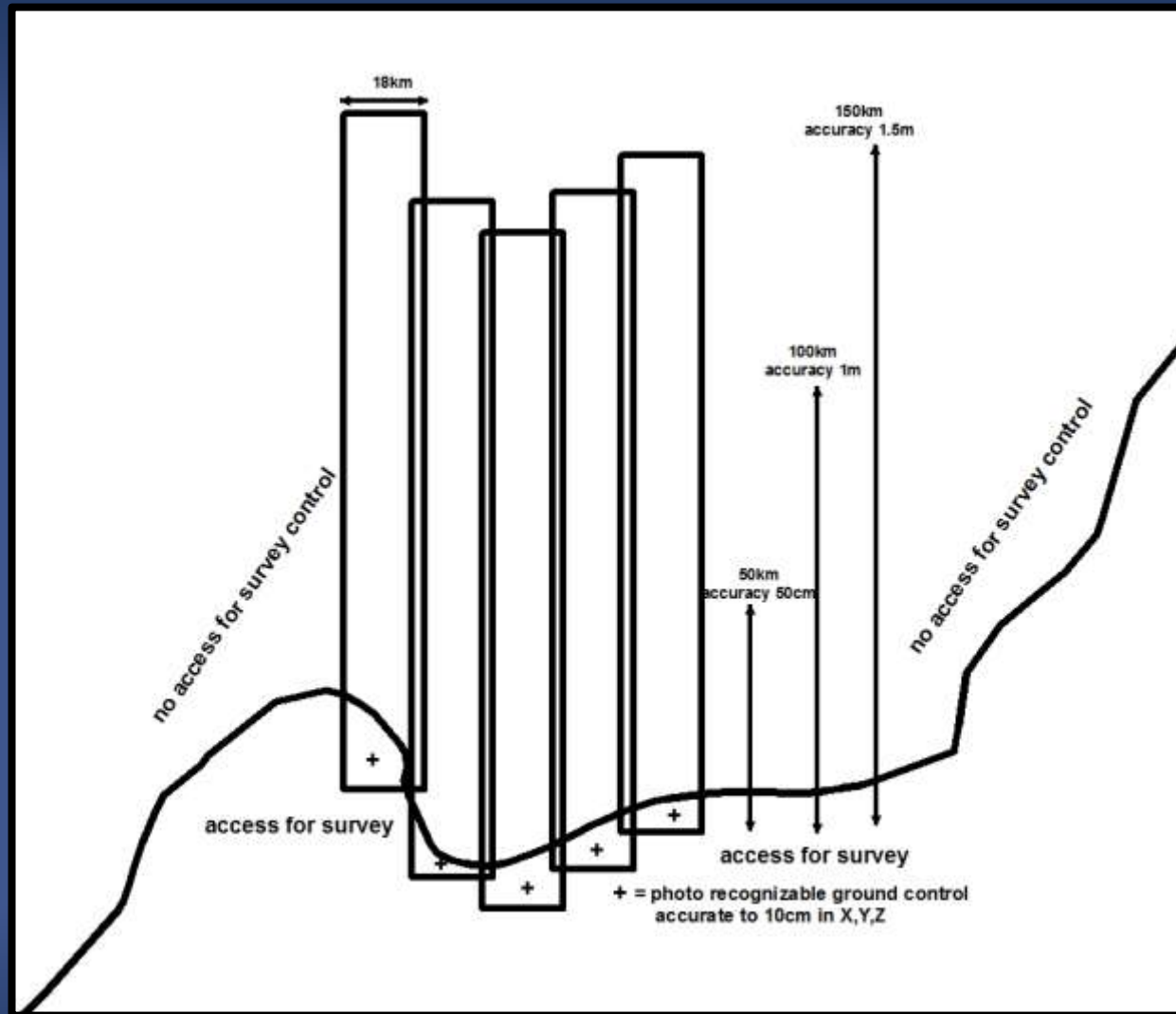
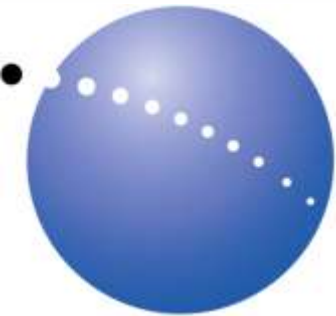


64.5 km



Extension to the DEM completed in December 2010. Four additional ground survey points match to better than 20cm

Stereo satellite elevation mapping for areas with no access for survey control



Based on PhotoSat's experience with the WV satellites, with a single ground survey point at the end of a stereo swath, the elevation error will be about 50cm for each 50 km of distance from the survey point.