Highly Accurate Stereo Satellite Topographic Mapping Accuracy Study WorldView-2 Stereo Photos, Asmara, Eritrea

A one-metre square grid of elevations was produced by geophysical processing of WorldView-2 stereo satellite photos over an area of 100 square kilometres using 14 survey points for ground control and for the attenuation of satellite photo distortions.

The elevation accuracy is better than 15 cm RMSE as determined by 731 conventionally established elevation checkpoints.

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PhotoSat has made significant improvements in the accuracy of its stereo satellite topographic mapping since we produced our stereo WorldView-2 (WV2) elevation mapping accuracy study of the Eritrea test area in 2010. In the 2010 study we used two ground control points to reference the stereo WV2 mapping and achieved an elevation mapping accuracy of 28 cm RMSE. In 2014 PhotoSat is routinely achieving better than 15 cm elevation mapping accuracy on projects that have extensive existing survey data. Over the past two years we have developed methods to use existing project survey data to attenuate the systematic distortions in the stereo satellite photos, improving the elevation mapping accuracy.

Using these methods we have achieved better than 15 cm elevation mapping accuracy on many oil sands mining projects. We have also achieved better than 15 cm accuracy on a number of oil and gas projects where we have used existing seismic source point survey data to attenuate the stereo satellite photo distortions. To provide a publishable verification of this new capacity we have reprocessed 100 km2 of the 2010 stereo WV2 photos over the Eritrea test area, using 14 ground survey points to attenuate the distortions in the stereo WV2 photos.

Figure 1: WorldView-2 color image with 50 cm contours from the stereo WorldView-2 elevation mapping for the Asmara Eritrea test area.

Figure 2: WorldView-2 50 cm stereo satellite photo. 10km by 10km area Asmara, Eritrea.

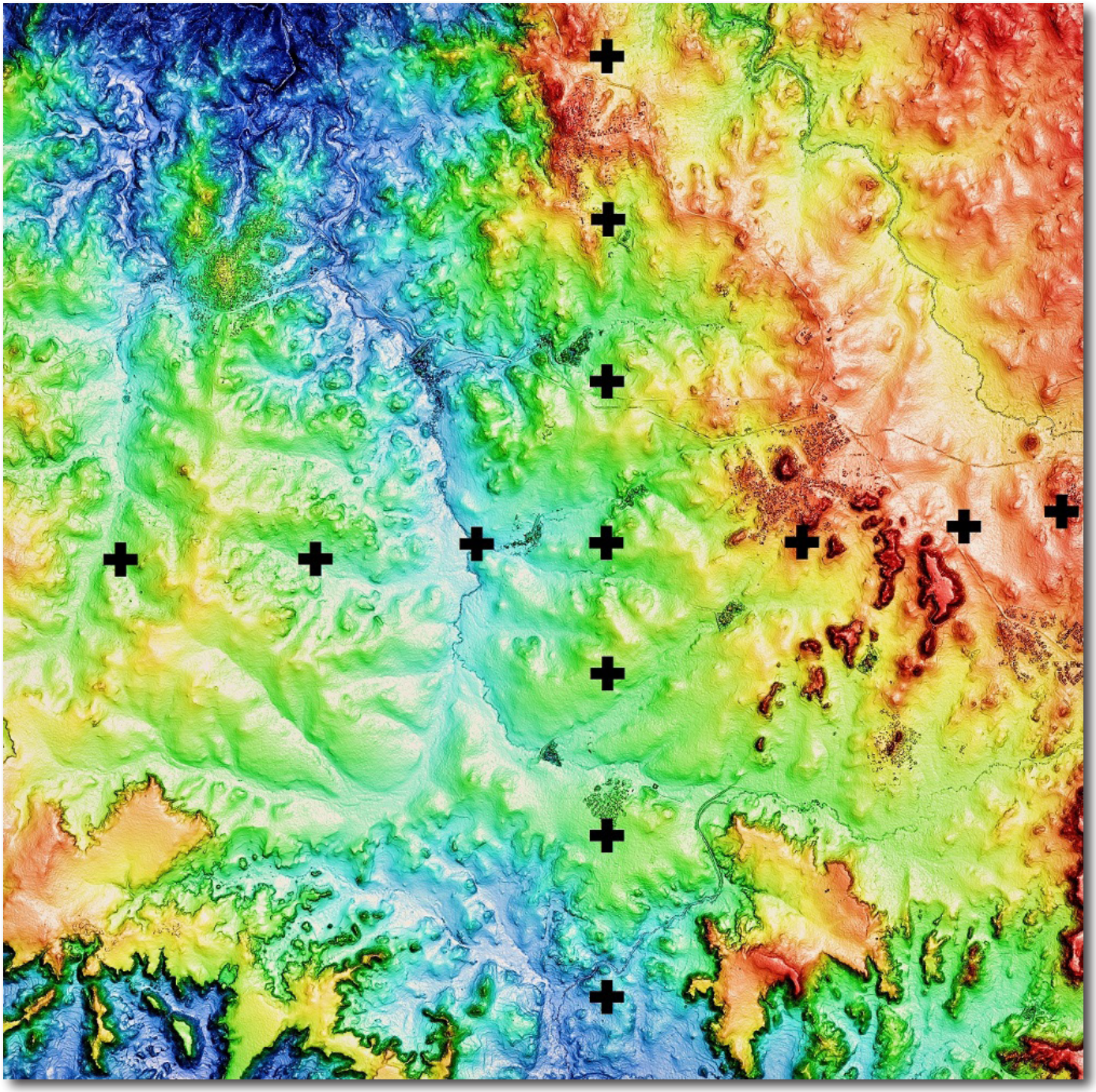

Figure 3: Area of the 10 km by 10 km Eritrea Stereo WorldView-2 1 m posted topographic grid showing the 14 ground survey points used for ground reference and to attenuate systematic distortions in the stereo WV2 photos.

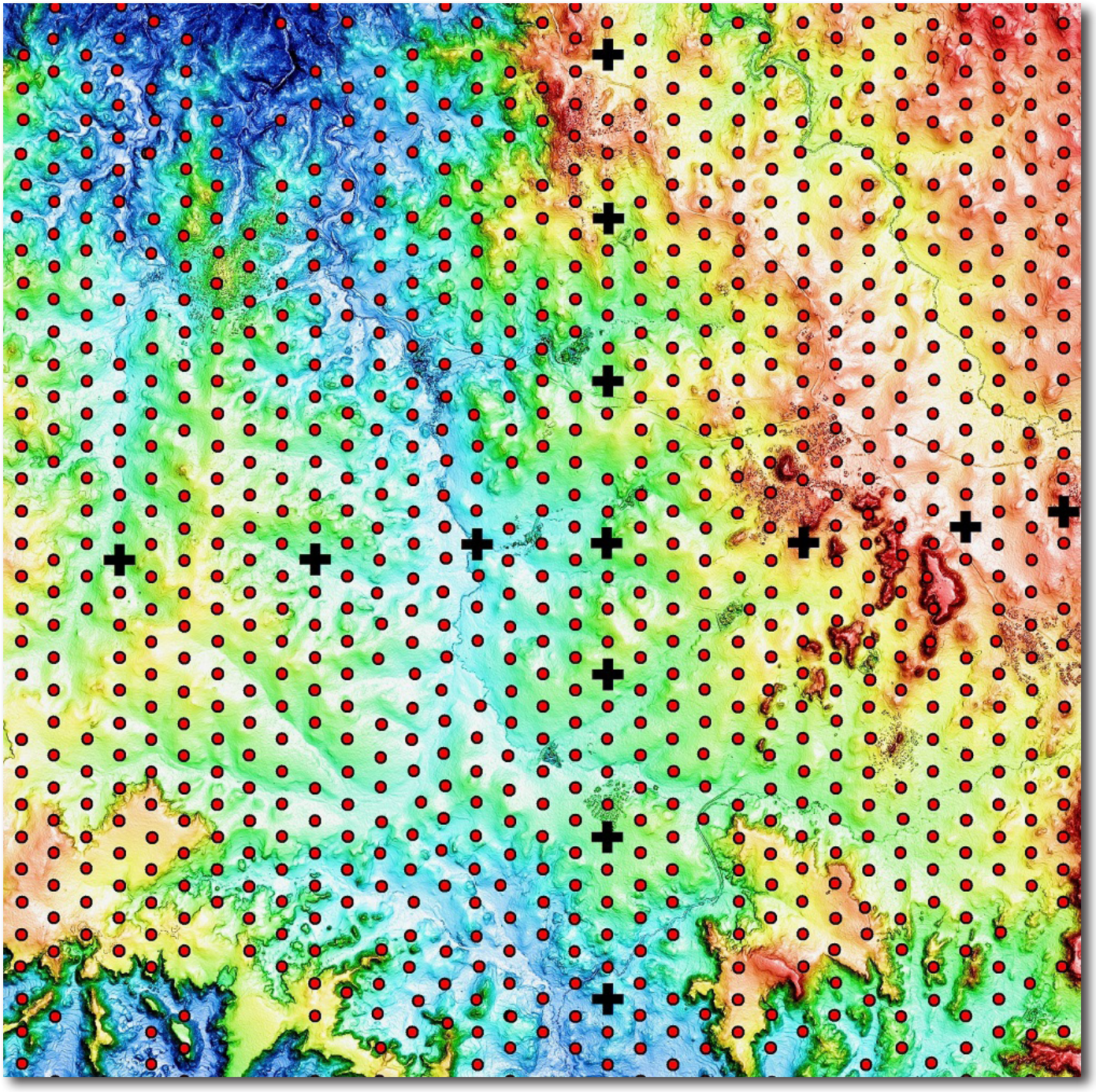

Figure 4: Area of the 10 km by 10 km Eritrea stereo WorldView-2 1 m posted topographic grid showing the 731 gravity survey stations used as elevation checkpoints to determine the accuracy of the stereo satellite elevation mapping, and the 14 ground survey points used for ground reference and to attenuate systematic distortions in the stereo WV2 photos.

Figure 5: Asmara Project, Eritrea. MWH Geo-Surveys differential GPS survey crew and equipment. Over 45,000 points were surveyed from 2004 through 2008 using differential GPS instruments from Magellan. All of the GPS positions were surveyed in Real Time Kinematic (RTK) mode with accuracies of 2 cm or better. Fourteen of these survey points were used as ground control points and 731 points were used as elevation checkpoints for the WorldView-2 stereo satellite elevation mapping accuracy assessment. The Magellan RTK base with a ProMarkTM 500 GPS rover are shown in this photo.

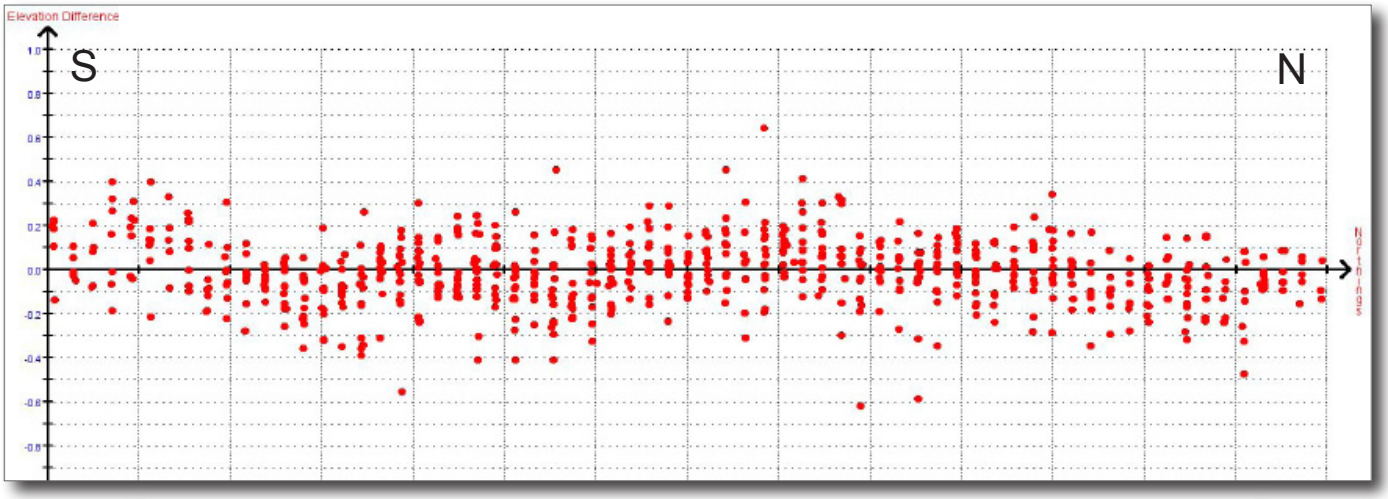

Figure 6: Scatterplot in the North-South direction of the elevation differences between the WorldView-2 stereo satellite elevations for the 10 km by 10 km area and the 731 elevation checkpoints in areas with slopes less than 20% grade. The Guidelines for Digital Elevation Data of the US National Digital Elevation Program (NDEP) recommends that elevation checkpoints should be chosen in areas with slopes less than 20% grade. RSME 15 cm.

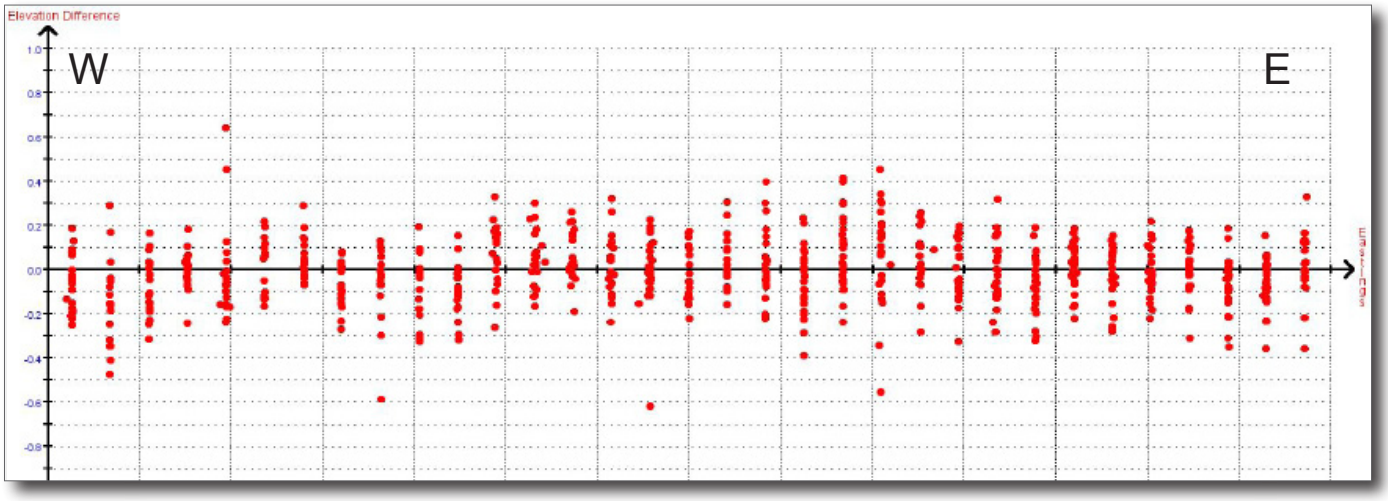

Figure 7: Scatterplot in the East-West direction of the elevation differences between the WorldView-2 stereo satellite elevations for the 10 km by 10 km area and the 731 elevation checkpoints with slopes less than 20% grade. The Guidelines for Digital Elevation Data of the US National Digital Elevation Program (NDEP) recommends that elevation checkpoints should be chosen in areas with slopes less than 20% grade. RSME 15 cm.

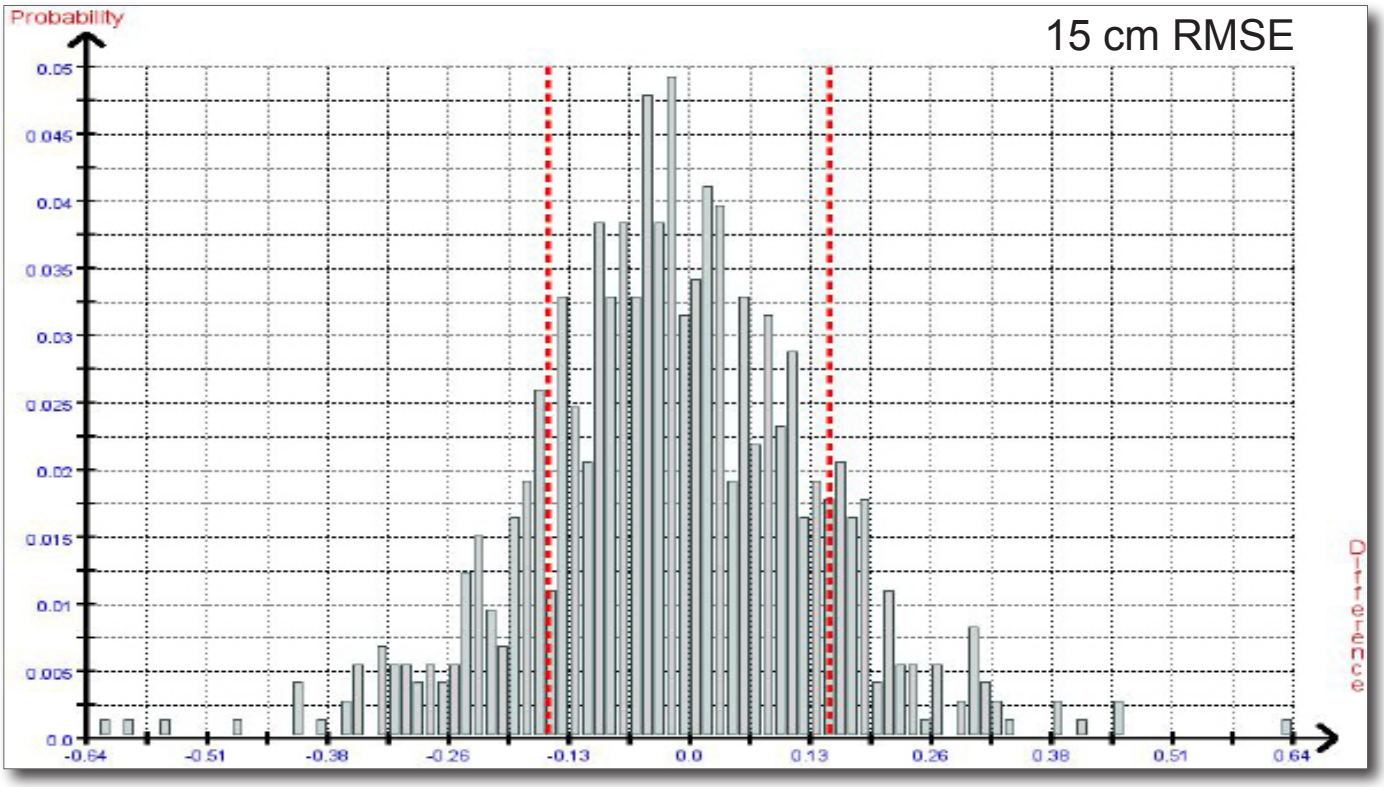

Figure 8: Histogram of the elevation differences between the WorldView-2 stereo satellite elevations for the 10 km by 10 km area and the 731 elevation checkpoints with slopes less than 20% grade. The Guidelines for Digital Elevation Data of the US National Digital Elevation Program (NDEP) recommends that elevation checkpoints should chosen in areas with slopes less than 20% grade. RMSE 15 cm.

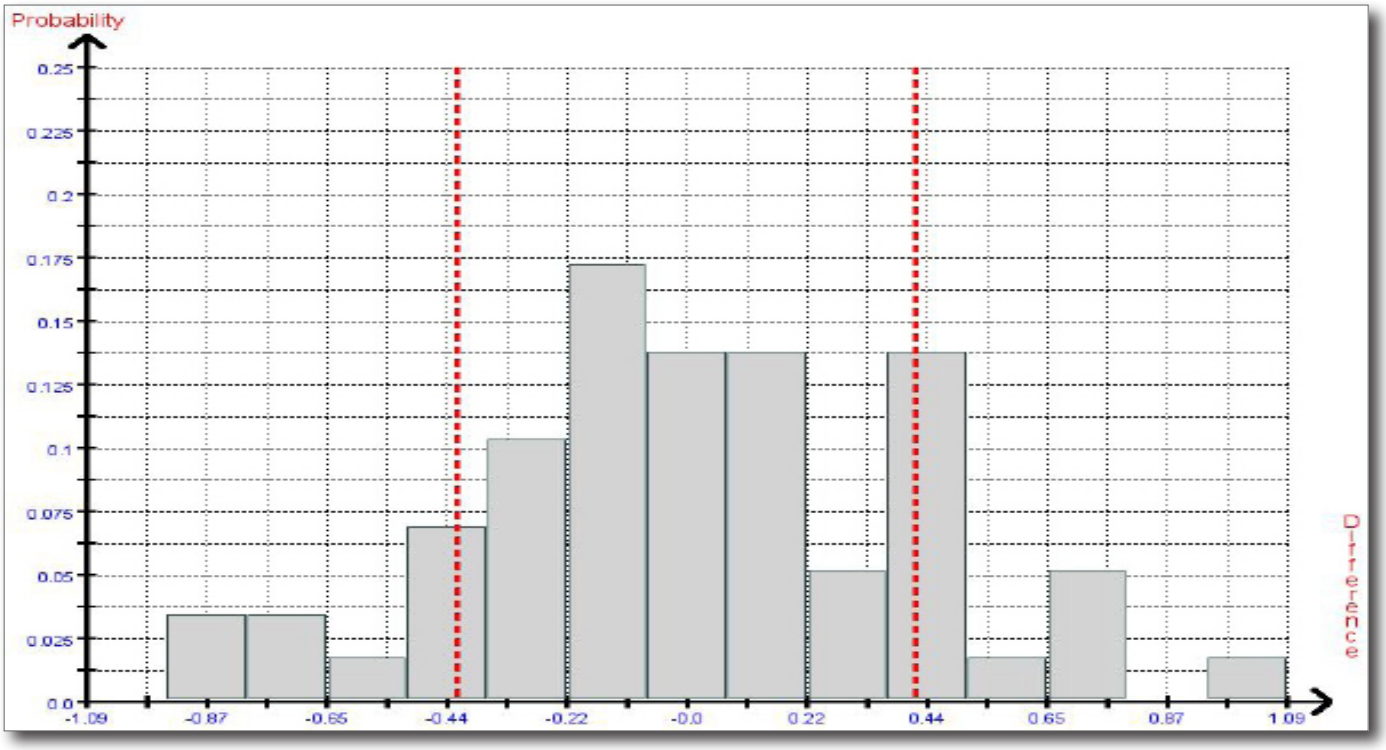

Figure 9: Histogram of the elevation differences between the WorldView-2 stereo satellite elevations for the 10 km by 10 km area and the 58 elevation checkpoints with slopes between 20% and 50% grade. RMSE 41.4 cm.

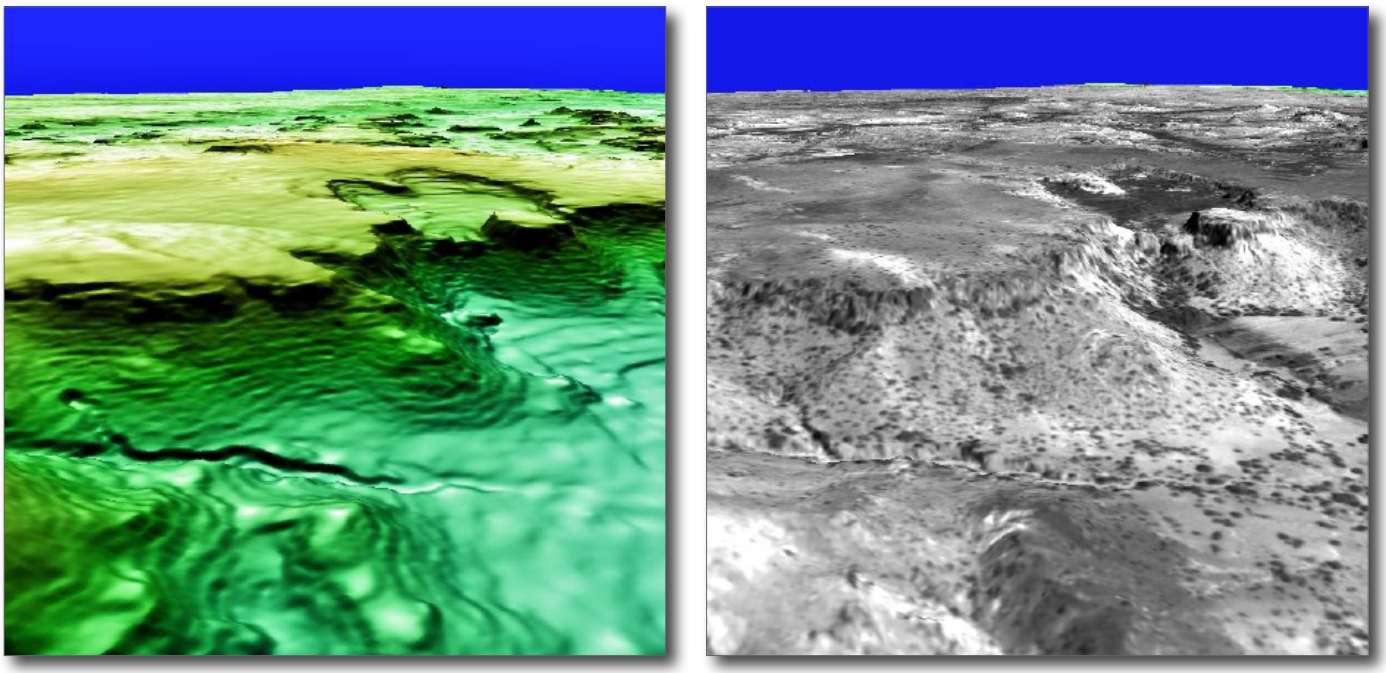

Figure 10: 3D view of the 1 m topographic grid and 50 cm WorldView-2 satellite ortho image.