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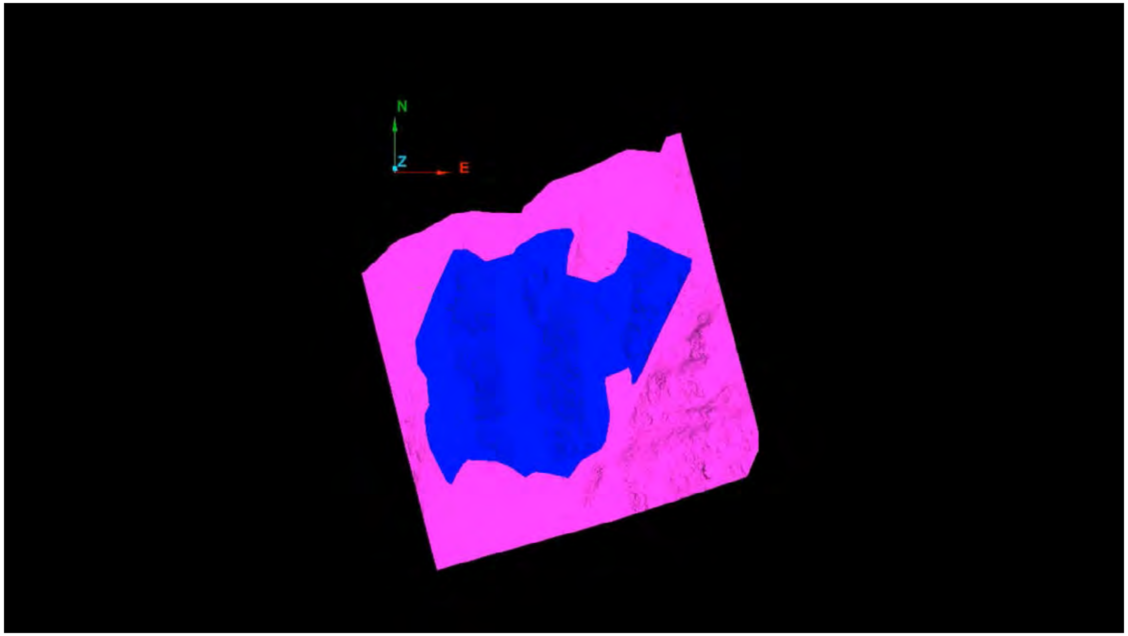


Animation 1. Visual comparison between the multiview stereo (MVS)–derived triangulated irregular network (TIN) of the Clair Camp structure constructed without ground control points (GCPs) (blue), the MVS-derived TIN of the Clair Camp structure constructed with GCPs (green), and the terrestrial laser scanner (TLS)–derived TIN (pink). The TLS-derived TIN is used as a reference. The MVS-derived TIN without GCPs lies well above the TLS-derived TIN, while the MVS-derived TIN constructed with GCPs lies slightly underneath the TLS-derived TIN. Figure 3A for scale. This video was made using I-Site Studio software. If reading the full-text version of this paper, please download article PDF to view Animation 1 in Adobe Acrobat or Adobe Reader. It is also available by visiting http://doi.org/10.1130/GES01691.a1 or the full-text article on www.gsapubs.org.

The results from Clair Camp without GCPs were pitiful, as expected because the image array geometry is very poor and Clair Camp employed the fewest camera positions of the three sites that tested this method (Table 3; Animation 1). Surprise South had a slightly better image array geometry than Clair Camp, which may explain why Surprise South outperformed Clair Camp. It is also possible that Surprise South produced slightly better results than Clair Camp due to the differences between cameras; at Surprise South we used the Nikon which has a larger sensor with better pixel resolution than the Canon used at Clair Camp. This conclusion follows with what was suggested by Mosbrucker et al. (2017). The case study presented in Mosbrucker et al., 2017 showed a strong correlation between image quality and accuracy. Sensor size, in addition to pixel resolution, plays a role in image quality. Mosbrucker et al. (2017) concluded that the camera system selection, camera configuration, and image acquisition parameters all play a role in model accuracy.

### Method Comparison

Though there is no strict control in this serendipitous field experiment to determine which GCP method performed better, general observations can be made from the results of manual analysis and CloudCompare (Table 3; Figs. 6 and 7). First is that results from sites where we used the same method seem to be grouped into distinct error ranges despite the variations between sites, where method 2 performed the best, followed closely by method 3, then method 1, and finally method 4. This outcome was generally expected based on previous work (Wolf and Dewitt, 2000). For example, it makes sense that method 4, having no GCPs in the scene, would have the worst results when compared to their counterparts that used GCPs in the scene obtained with either method 1 or method 2. That method 2 performed the best is also as expected because the GCPs came from the same TLS model that the MVS model was compared to. More important is the final observation that method 3 performed nearly as well as method 2, indicating that method 3, which uses a low-precision GNSS receiver, generates comparable results to having a high-precision GNSS for ground control. However, more data are needed to support this conclusion.

## ASSESSMENT OF INDIRECT MEASUREMENTS AND MAPPING ACCURACY

### Orientation Analyses

I-Site Studio, CloudCompare, and Move contain routines that allow estimation of planar surface orientations (strike and dip). These routines include simple three-point analysis as well as multipoint analysis. It is also possible to estimate the orientation of a plane by manually drawing the trace of its inter-