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Is green-wavelength Terrestrial Laser Scanning capable of capturing reliable underwater data in the cascade unit of a mountain channel?

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Recent global climate change has brought heavy rains which cause more severe flood and sediment related disaster in Japan. Since more than 60 percent of the national land is made up by mountains and forests in Japan, it is important to understand how the water and sediment flow in mountain channels for better risk management. Although detailed and quantitative measurement of channel and stream-bed structure would provide valuable information for fluvial disaster management, we have not had means for such measurement until recently. Terrestrial Laser Scanning (TLS) is a system that has a laser scanner mounted generally on a tripod. It has been developed and mainly used in surveying, providing highly accurate 3D information of the object on the ground. As the recent advance of the technology, the application of TLS expanded to fluvial environment. In particular, green-wavelength TLS has shown promising results in acquiring underwater data at grain-scale. Our previous research demonstrated good performance of green-wavelength TLS for measurement of submerged stream-bed in the pool unit of a steep mountain channel. This paper examines whether TLS is capable of capturing reliable underwater data in the cascade unit of a mountain channel where large boulders form steps and water flows down with foam creating complex channel structure. The results suggest that accuracy of TLS measurement was considerably lowered in this area due to water foam, complex channel bed morphology and difficulty in applying water refraction correction. Since much of channel bed is generally above water level in cascades and steps, and TLS measurement can be conducted with high accuracy for objects above water, it is effective to acquire TLS data when the water is scarce to reduce errors in the cascade unit. For the area where water foams over and where there are narrow gaps between rocks, conventional line survey would complement the error of TLS measurement to increase accuracy of derived data. At this stage, there would be no use to apply water refraction correction to the data in the cascade unit; however, error up to 5 cm should be noted for such data.