Combining radiometric and geometric information in spectral energy for improving water column estimation in shallow waters

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Passive optical remote sensing has demonstrated promising performance for mapping shallow waters owing to recent advances in spectral technology, mobile mapping, computational power, and modeling techniques. In particular, bathymetry can be derived either through radiative transfer modeling of measured radiometry or photogrammetric processing of spectral images. Each process (radiometric and geometric) has its advantages and drawbacks regarding the measurement quality and the environment to map. Although many studies have contributed to the validation and development of both techniques, the potential of combining these is not thoroughly investigated. The aim of our research it to study this potential based on statistical inference applied to physics-based radiative transfer and two-media stereo-photogrammetric retrievals for the water column depth parameter. Our first results have demonstrated that the depth uncertainty associated to radiometric analysis can be quantified properly through likelihood profiling in comparison with other first-order propagation methods. This result can be explained by the non-linearity of the radiative transfer model and implies that one should take into consideration the sample size which can be compromised by the number of parameters when evaluating uncertainty. The second part of our study deals with extending the inference framework to the geometric estimation in order to analyze its quality. In our approach, we consider statistical error modeling of geometric data such as the sensor pose for inferring the water column depth. For the interface position plays a key role as we are interested in the water column depth, the refraction is modeled analytically. We restrict our analysis to simple scenarios in which we control the constraints in order to derive qualitative statements prior to the observation. This elementary approach applied to the geometric model will enable the identification of its weak and strong points compared to the radiometric quality.