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Secchi disk depth: evaluation of an algorithm based on new visibility theory

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Secchi disk depth (ZSD), a measurement of the maximum viewable depth of a white or black-and-white disk with a diameter about 30 cm when lowered into water, holds the longest (from at least 1880's) records of water transparency. This ZSD data record is found not only important for the study of climate change, but also useful for seagoers. However, there has been no standard ZSD product from all satellite ocean color missions. This may in part lie in that there was no robust algorithm to estimate ZSD of global oceans from ocean color measurements, although numerous empirical relationships were developed for various locations. In addition, the classical visibility theory suggests that ZSD is proportional to the inverse of (K+c), with K the diffuse attenuation coefficient and c the beam attenuation coefficient. Because c is significantly (2-5 or more) larger than K and that c could not be analytically retrieved from ocean color remote sensing, it has been perceived that there could be no analytical or semi-analytical algorithm for ZSD from ocean color measurements. A recent study found that this classical interpretation of ZSD is flawed, and a new theoretical relationship is developed for ZSD. With concurrent measurements of ZSD and remote-sensing reflectance (Rrs) of wide range of aquatic environments, the performance of the estimation of ZSD with Rrs as inputs by the classical and the new approaches is evaluated. The excellent results of the new relationship indicate a robust system to produce global ZSD from satellite ocean color measurements.