

Secchi 3000: New Approach to Water Quality Measurement Instruments and Systems Integration with Remote Sensing

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Remote sensing of water quality is based on multi- or hyperspectral visible and near infrared low-to-medium resolution observations of water surface reflectance. Reflectance is an apparent optical property, which in addition to the water quality is dependent on sun direction and other variable properties of the observational setup. In model-based approaches, either implicitly or explicitly, the satellite observations are first converted to inherent optical properties such as spectrally resolved absorption and scattering of the observed water. Then, either implicitly or explicitly, these optical properties are converted to estimate laboratory of in-situ measurable estimates of for example phytoplankton chlorophyll concentration by using specific inherent optical properties. These link changes in optical properties to changes in concentrations, and often they are accurately applicable merely to specific types of water with characteristic types of phytoplankton and other substances, and observed in specific seasons. However, the laboratory and other in-situ measurements have their inherent errors, which often are correlated with, for example, phytoplankton types of the measured sample. Spatial variation of water quality and differences of scale of the measured target water volumes in both horizontal and vertical direction make it difficult to integrate these measurements in order to assess the true ecological state of the observed water body. Sparse locations of observations and technical difficulties in obtaining in situ water samples or automated measurements on the other hand invite to attempt combining this source of data to the spatial coverage provided by remote sensing.

Secchi3000 arises from the need of increasing the applicability of integrated in situ measurements to be co-used with remote sensing, both in measurement data quantity and conceptual quality. Secchi3000 is based on an idea of using digital cameras viewing simultaneously different a priori known surfaces through different depths of water layers. The traditional Secchi disc depth is a measurement of depth at which a white disc disappears or re-emerges from/to sight above water surface. By using digital images these estimations can be automated, and specifically by using mobile phone cameras, information can be easily transported. We will investigate if colors and patterns visible in the image can be used for estimating absorption, scattering and, based on wavelength channel ratios, water quality, in parallel with similar data derived from remote sensing. Aside of the camera, the device could be remarkably inexpensive and easy to use, thus having potential for mass distribution and provision of extensive amounts of in situ data. Research and development activities on the Secchi3000 related techniques (innovated by Timo Pyhälähti) are on-going in SYKE and TKK.

Water Insight [1] WISP-3 hand-held spectrometer is able to derive water quality estimates from close range, but without physical contact, by measuring downwelling irradiance and radiance from two directions and applying relevant models and algorithms – which relate to those used for remote sensing and Secchi3000 data. This kind of close sensing device used with less expensive, potentially less accurate but more spatially abundant Secchi3000 observations could be an important part of the on-ground segment of EO based integrated monitoring system.

[1] <http://www.waterinsight.nl/>