Strategy for computation of uncertainties for the diffuse attenuation (Kd) product of PACE.

Emmanuel Boss and Robert Frouin, University of Maine and SIO, 5-16-2023

The algorithm is: *Kd* =(*a* + *bb*)/*md* where *md* is based on Twardowski and Tonizzo, 2018, which takes into account sun angle, sky light and IOPs.

Sources of uncertainty:

The algorithm we propose is an analytical equation based on radiative transfer computations for which a specific skylight model has been assumed.

The algorithm uses the total absorption (*a*) and backscattering (*bb*) and thus, any error in the IOP algorithm will transfer into *Kd*.

Finally, the algorithm does not take into account inelastic scattering (in fact we correct *Rrs* to remove Raman). Thus, there may be (small) differences between locally measured *Kd* and the product at wavelength where Raman and chlorophyll fluorescence are strong.

Evaluation of the product as a way to obtain uncertainties:

We have compared the *Kd* from our algorithm to that measured with profiling float in as many environments as we could find data for. The comparison is good and provides us a first estimate of regional uncertainty. Note that such data exists only at two wavelengths (412 and 490nm) while our algorithm is spectral (Begouen Demeaux et al., in prep).

Uncertainty computation:

Given uncertainties in total *a*, total *bb* and *md*, we will analytically compute the relative uncertainty in *Kd*. This could be done on a per-pixel basis.

Uncertainties in *a* and *bb* will be provided by the generators of these data. Uncertainties in *md* depend on the sky model assumed and are believed to be on the O(2%) or less, Twardowski and Tonizzo, 2018.

Using simple error propagation rules:

Thus:.

Given that at low values of IOPs uncertainties in optical properties are dominated by absolute (rather than relative uncertainties), the (spectral) uncertainty will be determine as follows:

.

This approach assumes no correlation between uncertainties in *a*, *bb* and *md*, which of course, given that all are derived from *Rrs* is likely a crude assumption.

If, following this approach, we find that the uncertainties are significantly different from those based on in-situ measurements, we will review and revise our approach.

References

Twardowski, M.; Tonizzo, A. Ocean Color Analytical Model Explicitly Dependent on the Volume Scattering Function. Appl. Sci. **2018**, 8, 2684. https://doi.org/10.3390/app8122684