**Aim**

Our aim was to quantify the relationship between the light attenuation coefficient \( K_d \) and Secchi depth (SD) and analyse the variability in time and space.

**Background**

Light attenuation is a key parameter in coastal ecosystems. It responds to changes in nutrient loadings and governs the growth and distribution of underwater vegetation. Moreover, it is essential for modelling of primary production. Thus, a correct representation of light attenuation is essential in coastal ecosystem models. Current monitoring programs often use direct light measurements, allowing a calculation of the light attenuation coefficient \( K_d \) but older data is often found as Secchi depth (SD) observations. A correct validation of models back in time therefore requires quantification of the factor \( K_d \cdot SD \), which also represents the percentage of surface light remaining at the Secchi depth.

**Results**

\( K_d \cdot SD \) varies from 1.87 to 2.15, corresponding to a variation in the percentage light at Secchi depth from 11.7% to 15.4%. The lowest values were observed in the summer and the highest from September to December (Fig. 1). The most important factor in explaining the variation is \( K_d \cdot SD \) is the total light at Secchi depth from 11.7% to 15.4%. The lowest values were observed in the summer and the highest values in late autumn and early winter.

The negative relationship with TSS corresponds with a study of Alaskan lakes: Effect of yellow color and turbidity. The shallower stations are subject to a greater resuspension of settled particulate matter and therefore TSS decreases with increasing depth.

**Empirical model**

\[
K_d = \frac{SD}{a + b \cdot Depth} + c \cdot Salinity + d \cdot (Month)
\]

The most important factor in explaining the variation is \( K_d \cdot SD \) which also represents the percentage of surface light remaining at the Secchi depth. The negative relationship with TSS is most likely due to higher concentrations of phytoplankton and detritus during the growth season. The mean value of 2.00 is indicated, together with the corresponding percent of surface light at the Secchi depth.

**Conclusions**

- The mean value for \( K_d \cdot SD \) at 174 stations (37049 observations) is 2.00.
- There is a significant annual variability with the lowest values during summer and the highest values in late autumn and early winter.
- The direct negative effect of phytoplankton is statistically significant but too small to be quantitatively important.
- The most important effect is a decrease in \( K_d \cdot SD \) with increasing particle concentrations, causing a maximum in \( K_d \cdot SD \) in late summer due to accumulation of detritus during the growth season.
- An empirical model is given for \( K_d \cdot SD \) as a function of depth, salinity and month.

**Methods**

- Observations used from the Danish national monitoring program. Data was recorded in the period 1985-2011 at 174 stations.
- \( K_d \) was obtained by regression of light intensity profiles. \( K_d \cdot SD \) was calculated for matching observations of SD and light intensity profile.
- Annual variation in \( K_d \cdot SD \) and \( K_d \cdot SD \) was analysed. Variation in \( K_d \cdot SD \) was analysed by regression on parameters, including salinity and concentrations of chlorophyll-a and total suspended solids (TSS).
- Average of \( K_d \cdot SD \) at each station was compared with depth for all stations.

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