Geophysical Research Abstracts
Vol. 14, EGU2012-9040, 2012
EGU General Assembly 2012

High frequency measurements of optical lake water properties: Is there a seasonal pattern?

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Optical properties of lake waters can give insight into quantity and quality of dissolved organic carbon (DOC). DOC from in-lake and terrestrial production fuels the aquatic system with energy. This energy is used for various biotransformation processes, of which the release of carbon dioxide (CO_2) into the atmosphere plays a central role. In our study, we assessed seasonal variations in the optical properties of lake water. We tested a new absorbance spectrophotometer (spectrolyser s:can, Austria) which is capable of measuring the in-lake unfiltered absorbance spectra (250 to 735 nm) at high frequency intervals. In water quality monitoring, the absorbance spectra can be used as a surrogate for dissolved organic carbon concentrations. Between spring and fall of 2011, we retrieved continuous scans at Lake Tämnaren, an oligotrophic, humic lake in the boreal region of Sweden. Our in situ measurements were supported by a controlled sampling program consisting of bi-weekly grab samples to quantify DOC concentrations along with in laboratory spectral analysis (absorbance and fluorescence) and water quality parameters (pH, total inorganic carbon, turbidity, filtered and unfiltered absorbance, filtered fluorescence). Interpreting absorbance and fluorescence scans with common optical metrics (specific absorbance, spectral slope, fluorescence index) we found clear temporal patterns in DOC quality over the summer season which we related to a variety of variables including chamber and Eddy covariance measurements of carbon dioxide fluxes at the lake-atmosphere interface.