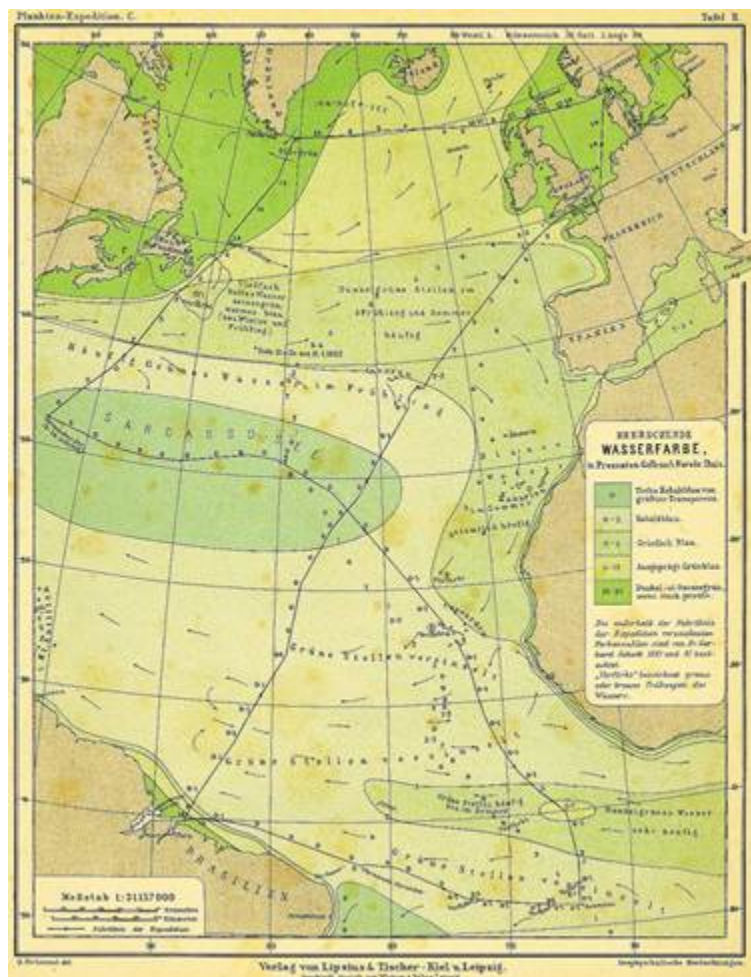


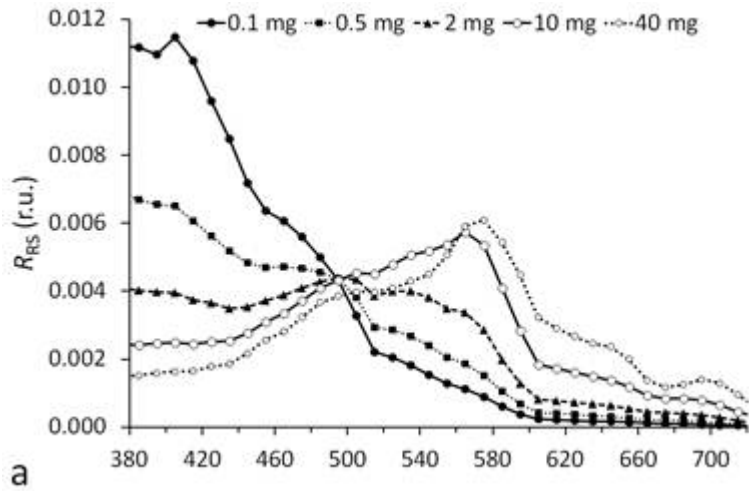
# FROM ELECTRIC BULB TO IPAD - The era of visualized trends in ocean colour and chlorophyll

Marcel R. Wernand<sup>1</sup>, Hendrik J. van der Woerd<sup>2</sup> and Winfried W.C. Gieskes<sup>3</sup> (<sup>1</sup>-NIOZ, <sup>2</sup>-VU-IVM, <sup>3</sup>-Gron.Un.)

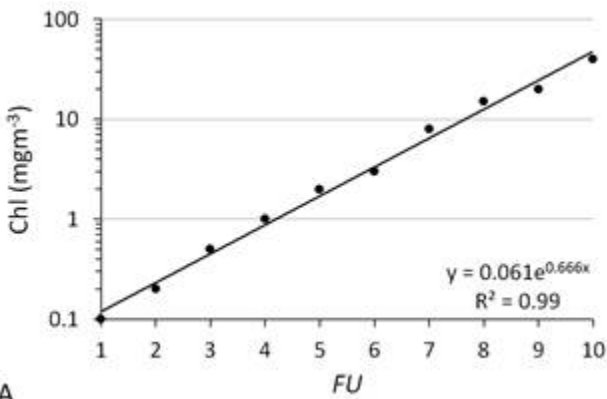
In this talk we draw attention to and provide evidence of the usefulness of the Forel-Ule (FU) scale observation record, a time series that goes back all the way to the late 19th century. We have revisited this largely unexplored database in order to provide information on changes in oceanic chlorophyll over the period that climate change became effective. The most complete FU record has been established in the North Atlantic in terms of coverage over space and in time, and this data base has been used to test the validity of colour changes, and therewith chlorophyll changes, over timescales of up to 10 decades. We show that since the early 20th century chlorophyll concentrations have decreased in the Indian Ocean and have fluctuated in the Pacific; they increased in the Atlantic Ocean. No global trend of a gradual increase or decrease in chlorophyll concentration, and therefore phytoplankton abundance, has been identified.



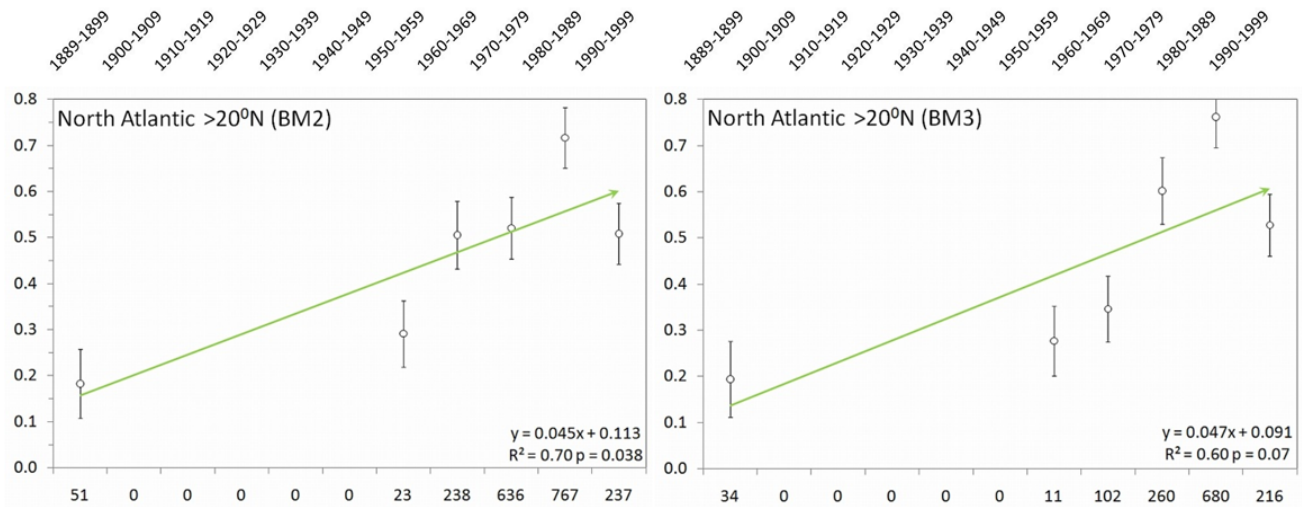
Krümmel's contoured North Atlantic FU-map (1889). The sailing track of the steamship 'National' is shown in black. The colour (Wasserfarbe) was indicated as a percentage of a yellow potassium chromate solution added to a blue copper-sulphate solution. The legend indicates the FU-scale colours 1 to 21



The modelling of the remote sensing reflectance (As input of the model changing chlorophyll concentration)



The established relation between Chlorophyll and the Forel-Ule colour index



Scatter plot showing the temporal evolution in chlorophyll ( $\text{mgm}^{-3}$ ) per decade over the period 1889-1999. The number of FU observations that were used to calculate the mean chlorophyll concentration per decade is provided below each point. Superposed lines are least-squares regression lines that indicate a greening of the Atlantic Ocean (green trend line). Regression coefficients, with the coefficient of determination  $R^2$  and  $p$  are indicated at the bottom of each graph.