THE COAST MUST BE CLEAR: DETERMINING THE LIGHT REQUIREMENTS FOR PRIMARY PRODUCTION OF THE COASTAL SYSTEM (DUTCH NORTH SEA* COAST)

Marilen M. Espinoza
Master of Science in Environment and Resource Management
Vrije Universiteit Amsterdam, The Netherlands

** This Netherlands-based environmental study has local food security and economic significance.*

ABSTRACT

Background: Coastal systems are an important component of the 'oceanic' carbon cycle because of their high rate of primary production (PP) of phytoplankton biomass. Marine net PP is the amount of carbon that is photosynthetically fixed by phytoplankton (e.g. algae) and influenced, among others, by the amount of light that can reach the deeper layers of the water column. Phytoplankton are microscopic drifting plants that live on the ocean's surface. Like their land-based relatives, they require light for their growth providing food for the fish species. For humans, fish serves as a source of proteins, provides an important source of cash income for many poor households and is a widely traded food commodity. However, depletion of the fish stock resulting from overfishing by humans triggers an imbalance in the marine ecosystem. This imbalance causes an increase in phytoplankton concentration, thus forming human-induced algal bloom, leading to decreased light penetration into the water column. This decrease in light penetration results to reduced bottom vegetation growth within the water column. The Philippines, being a signatory under the Kyoto Protocol, is committed to actively participate in addressing these local marine concerns, e.g. estimating the capacity of its coastal areas as carbon sinks, in order to develop mitigation and adaptation measures. ***Objectives:*** (1) To establish the relationship between colored dissolved organic matter (CDOM), suspended particulate matter (SPM), and chlorophyll (Chl) concentrations and their corresponding light attenuation coefficients (K_d). (2) To compare satellite-derived SPM concentrations from in-situ measurements and silt profiler data. ***Method:*** Mathematical model and remote sensing techniques were used as tools in relating satellite-based chlorophyll (Chl) estimates to PP. The Vertically Generalized Production Model (VGPM) was used to estimate the rate of PP, assuming that Chl is directly related to PP. The light attenuation coefficient (K_d) was used as the proxy indicator for turbidity, since its value depends on the concentration and composition of the suspended and dissolved matter present in the water column. Satellite-derived concentrations of CDOM, SPM and Chl and their corresponding K_d values at one transected axis (52^{o}N and 2^{o}E to 4.2^{o}E) of the North Sea were determined. Using the Statistical Package for Social Sciences (SPSS v. 12) software, the relationship of SPM, CDOM and Chl to K_d was established. ***Results:*** Among the three optically active substances, SPM has the dominant correlation to the variability of K_d. Furthermore, SPM has the dual role in both near and offshore PP. Nearshore, SPM and Chl have a direct relationship. Hence, SPM most likely has positive correlation with PP. The threshold limit for SPM nearshore or approximately less than 10 km nearshore is about 19.91

g/m^3. Offshore or between 10 and 35 km from the shore, the relatively low concentrations of SPM and CDOM do not sufficiently contribute to light attenuation, allowing enough light to penetrate the deeper layers of the water column, thereby, enhancing the rate of PP. The threshold SPM limit offshore was observed to be about 3.8 g/m^3. The satellite-derived SPM values are comparable to the measurements from the silt profiler because both of the measurements are derived from the optical properties of the seawater. ***Conclusion:*** This study established the relationship between CDOM, SPM, and Chl concentrations and their corresponding K_d. SPM has the highest correlation to the variability of K_d and strongly correlate with Chl nearshore. Satellite-derived SPM values are comparable to the data from the silt profiler. ***Recommendation:*** To better understand the processes involved specifically in nearshore PP, future studies should include other parameters, e.g. nutrients, wind speed, and magnitude of turbulence. The Philippines, having a wide range of coastal systems, should invest in similar research that utilizes satellite images to establish the baseline status of its coastal areas through estimates of its capacity of being carbon sinks. This can eventually spur projects under the clean development mechanism (CDM) of the Kyoto protocol. The baseline information can also be used as an evaluation tool in designing sustainable fisheries for the local population living along the shore.