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Conceptual Paper

# Functions of Global Photosynthesis

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Unlike conventional photosynthesis, which deals with the photosynthesis of a particular organism, global photosynthesis considers the process in large systems for an ensemble of organisms, considering it as one organism having generalized characteristics [1]. At the same time, the essence of the process does not change. It is the process of synthesis of biomass and oxygen from carbon dioxide and water under the action of sunlight. By big systems we mean such as the biosphere or the global carbon cycle system. Conventional photosynthesis is studied well and from different sides [2], photosynthesis in large systems is not studied enough. Even the participants of global photosynthesis are not always defined properly. It is especially important to clearly define the functions of global photosynthesis.

The production function of global photosynthesis in the biosphere is associated with the synthesis of "living matter" [3]. This term was introduced by V.I. Vernadsky to define total biomass of all living organisms on the Earth. "Living matter" is considered as a product of photosynthesis, consisting of photosynthetic and heterotrophic parts. The heterotrophic biomass can also be considered as a product of photosynthesis, which was also formed in the reaction of photosynthesis with the synthesis of an equivalent amount of $O_2$, but the corresponding biomass passed to the stage of heterotrophic synthesis.

Photosynthesis in the global carbon cycle system is considered as the process of synthesis of total biomass, including "living matter", synthesized in the current period of time, as well as buried organic matter accumulated in the earth's crust by the considered time (equation 1).

$$(CO_2 + H_2O)_{\text{ocean+atmosphere}} \rightarrow \text{“living matter”} + C_{org} + O_{2\ \text{atmosphere}}$$

Since photosynthesis is dependent on environmental conditions that change in time, in this consideration the inevitable simplification and averaging depending on the adopted model, are needed. As a rule, the amount of the “living matter” much less than the amount of buried organic matter. Hence “living matter” can be neglected.

The second coupling function of global photosynthesis is related to its participation in the carbon cycle mechanism. Indeed, photosynthesis is a key element of the global carbon cycle [4]. It does not work independently and the cycle does not work without photosynthesis. According to the global cycle model, photosynthesis is embedded into the cycle operation. Photosynthesis is activated in the presence of a stream of $CO_2$, which is formed by the oxidation of sedimentary organic matter and begins in the rapid phase of lithospheric plates’ movement. In turn, photosynthesis generates a series of biotic and climatic events on Earth, ending with the beginning of a new cycle. Then everything is repeated again [5].

The third function of global photosynthesis is regulatory one coupled with evolutionary.

Biomass synthesis, as known, depends on $CO_2$ assimilation and photorespiration. The first contributes to biomass growth with $CO_2$ concentration increase, The second reduces biomass growth. The role of photorespiration increases with the growth of oxygen concentration in the atmosphere.

As in the course of photosynthesis evolution the $O_2$ concentration in the atmosphere steadily increases, whereas $CO_2$ concentration reduces, the growth of “living” matter on Earth, and, hence, organic matter in the crust decreases over time. The reduction will occur until it reaches full compensation. The state is called ecological compensation point and is achieved spontaneously. At this very moment the amount of reduced carbon formed during photosynthesis is equal to the amount of carbon returned to the oxidized inorganic form. It was achieved in the Miocene when low $CO_2$ concentrations led to a new C-4 type of photosynthetic assimilation.

These features distinguish the global photosynthesis, but all the features of ordinary photosynthesis, excepting the ability to ontogeny changes similar, to global photosynthesis [1].

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