

Organic matter production, a key component of the carbon cycle, is of high importance in the studies of climate change. In this short report we review the main characteristics about its physical drivers, and its responses to higher CO₂. For the marine ecosystem, depth is of critical importance since it controls light and nutrients availability, and limits primary production. In the terrestrial biomass is a good proxy for PP while in Freshwater, biomass is not a good proxy, a more important driver would be physical drivers

In the case of CO₂ driven changes on PP, the response also varies depending on the system being assessed. While terrestrial ecosystems are expected to increase PP despite the storage of carbon by non-photosynthetic tissues; inland freshwater ecosystems are for the most part already saturated in CO₂; as for marine ecosystems the acidification will impact primary producers and the production of biogenic carbonate, increase of temperature, PP and respiration rates. How these changes will occur remains unclear.

Invasive species affect availability of resources in terrestrial systems. In inland waters are vulnerable to new species in the system contrary to what happened in marine systems. The main reason for such difference may be the time it takes each system to recover from the changes generated by the invasive species. Invasive species displace the native species they encounter in the new ecosystem. They are normally characterised by high primary production, which could lead to an increase in the productivity of the system. But in fact, the incorporation of an invasive species often results in a simplification of the trophic network and a reduction in biodiversity, and a decrease in the complexity of the network of an ecosystem could result in a decrease in productivity. But there are always exceptions, for instance, there are some wetlands that PP are monopolized for just one species and are super productive.

Atmospheric sources (e.g cyclone/winds) can transport trace metals to high nutrient low chlorophyll oceanic areas and make bloom emerge. In opposition these sources will have low impact on oligotrophic areas more limited by macronutrients. Atmospheric inputs are not that crucial in the other two systems (freshwater and terrestrial).

Scales matter in every system for answering most of the questions, both in terms of temporal and spatial resolution. Satellites are the best tool that we have for global impacts but they do not accurately reproduce small scales (like the rivers or average lakes) or the spatial information below the surface. Moreover, we must remember that "all the models are wrong, but some are useful". The most important is to define every time which processes are crucial and when for the given studied scale. The inclusion of citizen sciences has proven to be an important tool to track the changes in terrestrial and inland freshwater ecosystems (with the exception of marine ecosystems), mandatory for a fast and multiscale understanding of the changing organic matter cycle.