



## **Contrasting long-term influence of energy and water on global gross primary productivity**

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The directionality of the response of gross primary productivity (GPP) to climate has been shown to vary across space and time. This effect has been hypothesized to be the result of the interaction between multiple bioclimatic factors, including environmental energy (i.e. temperature and radiation) and water availability. This is due to the tight coupling between water and carbon cycling in plants and the fact that temperature often drives plant water demand. Using the data from observation-driven terrestrial biosphere models, we disentangled the confounding effects of multiple bioclimatic factors on GPP, and investigated temporal changes in their effects on GPP in different climate zones between 1901 and 2010. We found a significant increase in water limitation of GPP over the time period assessed across most regions, especially in arid and tropical regions. Although GPP still showed an increase with higher energy in temperate and cold regions since 1980, we also observed an increase in the limitation of water availability. In contrast, the extent of the influence of environmental energy on GPP showed a decline. Due to the drought stress, the GPP between 1980 and 2010 also showed significant decreasing trends mostly at low latitudes. Furthermore, we observed a stronger influence of elevated CO<sub>2</sub> since 1980 under ongoing climate warming possibly due to a CO<sub>2</sub>-induced alleviation of drought stress. Our study suggest that drought triggered by rising temperature as a result of global warming may have started to reduce the GPP across the globe and the observed limitation of water availability may increase with warming temperatures in the future.