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Diffuse radiation characterized gross primary production over the globe

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Diffuse radiation, which is modulated by cloud and aerosol conditions, can have varied impacts on gross primary production (GPP), with the specific impacts depending on vegetation density, environmental conditions, and the specific physiological characteristics of plants. To quantify the sensitivity of GPP variation to changes in diffuse radiation at the global scale, we use several reanalysis datasets and a satellite-derived products with distinct characterizations of the division between direct beam and diffuse radiation, to force the Energy Exascale Earth System Model Land Model (herein ELM). We find large variations in the range of GPP due to the change in ratio of diffuse radiation to the total downward shortwave radiation (or diffuse fraction). The research implies substantial control of diffuse radiation on atmosphere–biosphere interaction, and demonstrates the importance of thoroughly and systematically validating the simulated diffuse radiation by atmosphere modules, along with assessing the ecosystem responses to the diffuse radiation variations within global land models.