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Impacts of Climate Extremes on Gross Primary Productivity at Multiple Spatial Scales

Soyoun Kim (1), Youngryel Ryu (1,2), and Chongya Jiang (2)

(1) Department of Landscape Architecture and Rural Systems Engineering, Seoul National University, Seoul, Republic of Korea (aksghk1000wo@hanmail.net), (2) Research Institute of Agriculture and Life Science, Seoul National University, Seoul, Republic of Korea

Climate extreme events have made significant impacts on terrestrial carbon cycles. Recent studies on detection and attribution of climate extreme events and their impact on carbon cycles used coarse spatial resolution data such as 0.5 degree. The coarse resolution data might miss important climate extremes and their impacts on GPP. To fill this research gap, we use a new global GPP product derived from a process-based model, the Breathing Earth System Simulator (BESS). The BESS takes full advantages of MODIS/AVHRR land and atmosphere products, providing global GPP product in 1 km resolution from 2000 to 2015 and 1/12 degree resolution from 1982 to 1999. We first integrate the BESS GPP products to 0.5 degree (1982-2015) and apply the method of Zscheischler et al. (2013). To test the impacts of spatial resolutions on detecting extreme events, we enhance spatial resolutions of the BESS GPP from 0.5 degree to 0.25, 0.125, and 1/12 degrees and quantify the variations of areas which experienced climate extremes. We subsequently investigate hotspot regions where the extremes occur using fine resolution GPP data at 1/12 degree (1982-2015), then analyze the causes of the extreme events that substantially decreased GPP by using precipitation, air temperature, and frost. This study could improve the understanding of the relationship between climate extremes and the carbon cycle at multiple spatial scales.