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Combined analysis of temperature and precipitation extremes over East Asia

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Climate extremes occur in various phenomena such as heat wave and heavy rains but generally extreme indices have been developed and applied for each phenomenon or variable separately. In order to monitor and analyze changes in frequency and intensity of various extremes in an integrated way, combined extreme indices have been devised. In particular, the Climate Extremes Index (CEI) which consists of five components related to temperature and precipitation extremes has been widely used to examine long-term changes in extremes over United States, Australia, and Europe. Each component of CEI is standardized by calculating fraction of areas that experience extremes (both above normal and below normal) for a specified period, and multi-variable index (defined as CEI) is obtained by taking arithmetic averages of five components. Recently, a modified CEI which includes directional information by looking at difference between upper-tail and lower-tail extremes has been suggested so as to better describe long-term trends of extremes. In this study, we analyze long-term changes in temperature and precipitation extremes over East Asia using mCEI for the past and future periods. Daily datasets of temperature and precipitation are obtained from a high-resolution gridded observation (APHRODITE) and three regional climate model (RCM) simulations participating in the CORDEX (Coordinated Regional Climate Downscaling Experiment) East Asia project. Analysis results show that there are increasing trends in mCEIs during 1979-2005 in both observations and simulations, which are mostly explained by increases of temperature extremes. Results from future simulations based on RCP4.5 scenario suggest that mCEI will be increasing rapidly around 2030s due to increases in temperature extremes. This implies that most part of East Asia will start experiencing above normal extremes every year before mid-21st century.