



## **Changes in hot summer extremes and internal variability under warming over Asian monsoon regions**

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Asian monsoon region, which is home to 40% of global population, is at high risk from climate change and extreme hot summers. This region accounts for an increasing share of greenhouse gas emissions, affecting not only the world but the region itself. In recent years, this region has experienced an exceptional number of high-impact extreme events, making it vulnerable to climate change. Due to external forcing factors, the summer mean temperature in CESM Large ensemble datasets is projected to increase by 1.5/2.0°C in near- to mid-term and by 5.0°C at the end of 21st century under RCP8.5 scenario. As a consequence, hot summer extremes will increase by 25%/30 years and the region could enter an entirely new climate regime, uninhabitable under exposed conditions. While the magnitude and occurrence of internal climatic variability both at mean and the extremes will either slowed down or decrease with mean temperature rise over the Asian monsoon regions. These new findings are in contrast to the popular notion that as the climate warms, temperature variability will increase and weather will get more volatile everywhere, particularly the Asian monsoon regions. The decrease is more pronounced over East Asia, where the internal variability or model uncertainty will drop down to zero, indicating an absolute consensus among the ensemble members. Moreover, we estimate the tipping point temperature at which external forcings strongly overrides the internal variability and occurrences of unprecedented hot extremes events will become a new normal over Asian monsoon region. Beyond that point internal variability no longer will obscure the anthropogenic climate change.