**Highlights**

1. Obvious differences existed in the performances of CMIP6 models between EC and EW event simulations in China

2. CMIP6 models overestimated the frequencies of EW and EC events.

3. The optimal models in different regions were selected based on a multi-metric ranking.

4. The CMIP6 multi-model mean exhibited poor performance in simulating the trend of and interannual variability in extreme events.