Contrast response of strong and weak winter extreme cold events in the Northern Hemisphere to global warming

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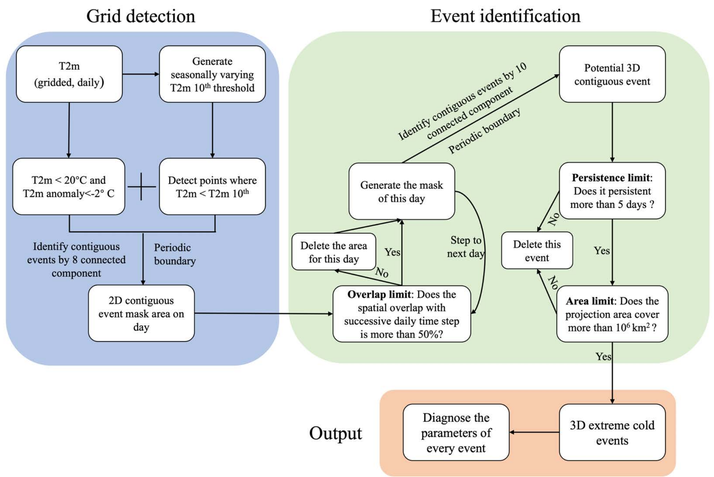
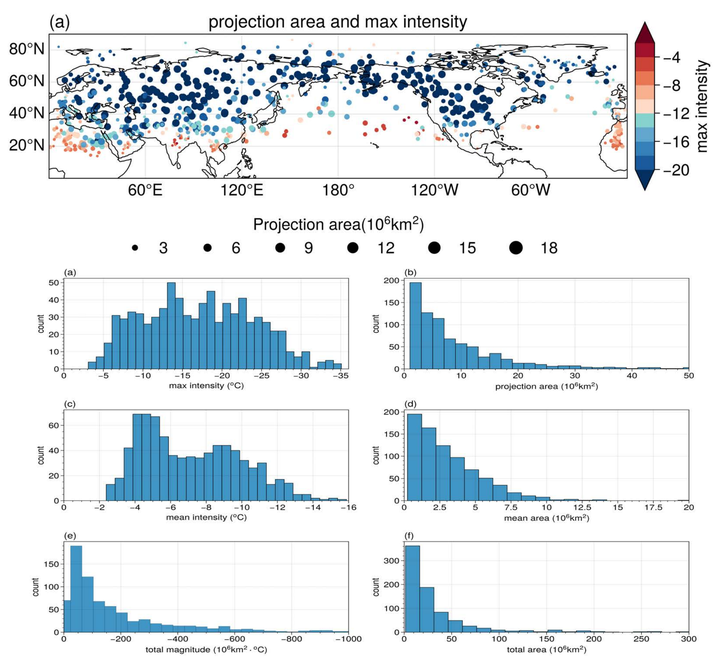
Introduction

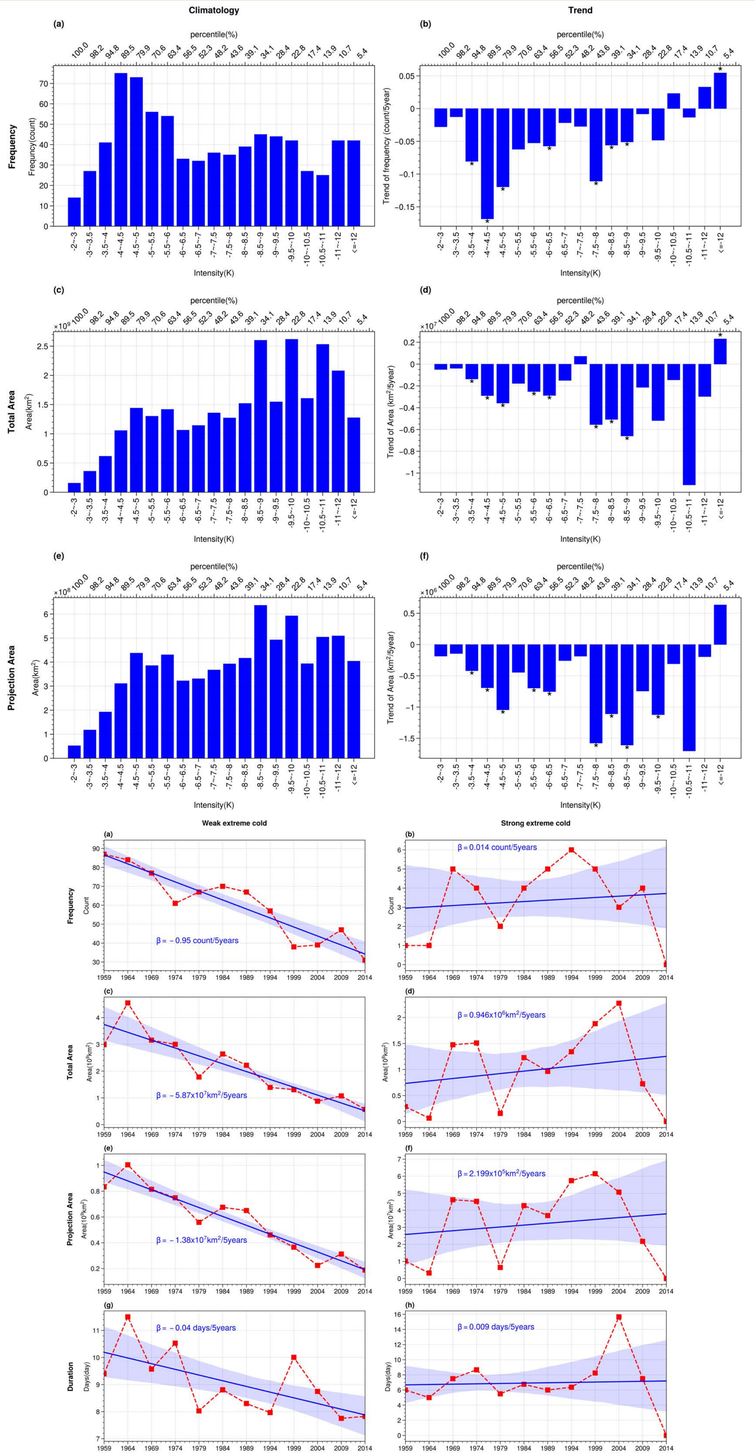
- How Extreme cold events (ECEs) are changing under global warming are not fully understanded.
- Based on traditional grid-based detection method, the frequency of ECEs have generally decreased, however, strong ECEs still occur frequently in recent decade.
- A novel 3D-connected algorithm is used to detect spatiotemporally continuous ECEs and evaluate their response to global warming.
- Whether the difference between strong and weak ECEs exist?
- Are the difference between strong and weak ECEs driven by external forcing or natural internal variability?

3D connected algorithm for detecting ECEs

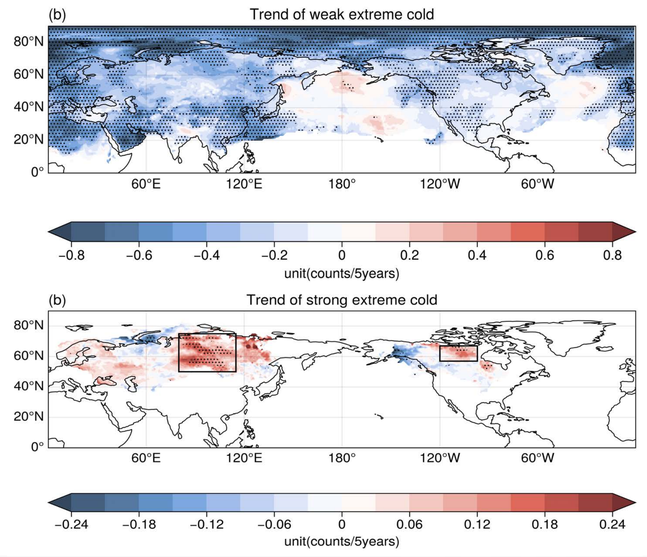




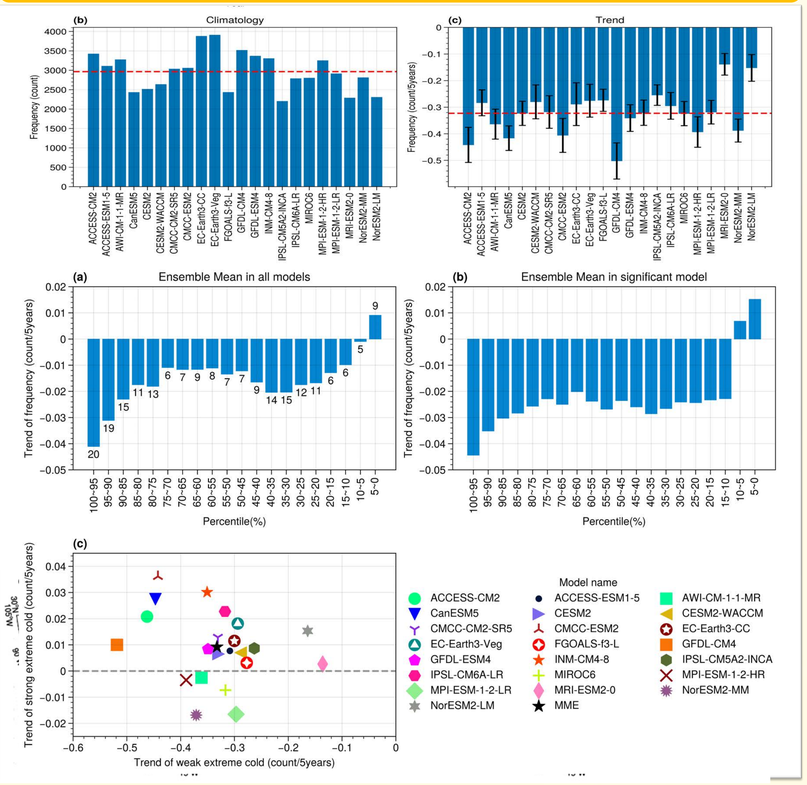
The trend of ECEs with different intensity



The contrast response of strong and weak ECEs



The driven factor of contrast response



Conclusion and Discussion

- Weak ECEs decrease, strong ECEs increase: global warming leads to fewer weak ECEs but can increase the frequency of strong ECEs.
- Locations of Strong ECEs: mostly in North America and Eurasia, with significant trends in Siberia and Canada, highlighting areas most sensitive to global warming.
- Indirect effect of global warming: Changes in atmospheric circulation due to warming indirectly heighten strong ECEs occurrences.
- Adaptation strategies needed: Despite an overall decline in ECEs, the threat of severe ECEs persist, requiring effective adaptation.