Where do Cold Air Outbreaks occur and how have they changed?

Key Takeaways
1. While similar, the ERAS and NNR have differences in results.
2. Cold air outbreaks (CAOs) are decreasing in frequency, duration, and magnitude in most places with increases across Eastern Europe, central Eurasia, and Southern Ocean.
3. Largest changes in CAOs have been over the ocean, with smaller and less significant changes over land.
4. CAOs have decreased most during early and late winter.
5. CAOs favor certain regions and are influenced by topography.

Research Goal
Create a global climatology of CAOs to better understand how CAOs have changed across the globe and to help delineate the cause-effect relationships between atmospheric patterns and CAOs.

Data and Methods
Period of Study: 1979 – 2018
• Winter season: Northern Hemisphere, July – June (39 seasons), Southern Hemisphere, January – December (40 seasons)

CAO Criteria
1. Magnitude
   • Daily mean T2m \(\leq -1.96\) \(\sigma\) for each grid point
   • \(\Delta T2m\) \(\geq 2^\circ\) C
   • T2m \(\leq 20^\circ\) C
2. Spatial Extent
   • Contiguous grid points that meet magnitude criterion and have an extent \(\geq 1,000,000\) km²
3. Duration
   • Spatial extent criterion met for at least 5 consecutive days

Trends
• Calculated using Theil-Sen slope estimator
• Significance of trends determined by bootstrapping
• Field significance was applied to trends of gridded data

Next Steps
1. Examine precursors to CAOs
   • Atmospheric and oceanic patterns
2. Forecast model skill
   • How well do forecast models predict location, duration and magnitude of CAOs?

Additional Information
For additional information scan QR code
Email
Erik Smith: esmit149@kent.edu
Scott Sheridan: ssherid1@kent.edu

ERAS: Mean CAO days per winter season
NNR: Mean CAO days per winter season

ERAS: change in mean CAO days per winter season (1979 – 2018). Field significance at the \(\alpha = 0.10\) level is denoted with green dots.

ERAS: change in mean annual CAO duration
ERAS: change in max. annual CAO duration
ERAS: change in minimum annual CAO magnitude
ERAS: total hemispheric seasonal CAO spatial extent
ERAS: CAOs occur more often if skewness is negative