A Circulation Pattern that Affects US Heat Wave Likelihood on Subseasonal time scale

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Scientific questions

Are there internally generated large-scale midlatitude circulation anomalies that affect the likelihood of US heat waves on subseasonal time scale?

Experiment

12,000-year CAM3 forced by monthly varying present-day SST and sea ice extent at T42 resolution
subseasonal stddev

CAM3 1000yr TAS

CAM3 1000yr precipitation

NCEP/NCAR 1948-2012 TAS

GPCP 1979-2010 precipitation
Heat wave statistics

27 heat wave days from 17 events
16199 heat wave days from 5949 events
\[ \bar{F}_3 = \sigma \cos \phi \left( \frac{\bar{v}^*}{2} - \frac{1}{2\Omega \sin 2\phi} \frac{\partial}{\partial \lambda} \left( \bar{v}^* \bar{\phi}^* \right) \right) \]

\[ -\bar{u}^* \bar{v}^* + \frac{1}{2\Omega \sin 2\phi} \frac{\partial}{\partial \lambda} \left( \bar{u}^* \bar{\phi}^* \right) \]
Shading: \(-\nabla^{-2}V' \cdot \nabla \zeta'\)  

contour: psi300 composite

PSI300 tendency from synoptic eddies
Conditional probability of heat waves

on the amplitude of the wavenumber-5 pattern 15 days earlier
Are these results applicable to the real world?
Summary

• Based on a 12,000-year CAM3 integration, we show that the US heat waves tend to be preceded by amplification of a zonal wavenumber-5 planetary wave pattern by 15-20 days.

• This intrinsic circulation pattern resembles the observed leading pattern of subseasonal variability and it may affect likelihood of US heat waves on subseasonal time scale.

• Variability of the wavenumber-5 pattern can be generated solely by internal dynamics rather than being a response to Asian Monsoon rainfall. Hence accurate predictions of the tropical intraseasonal variability may not guarantee subseasonal predictions of US heat waves.