Common Questions

- Why focus on pre-instrumental eruptions? - Tambora and other historical eruptions were much larger than anything observed during the period of instrumental record. - Higher forcing yields a larger and more easily identified climatic signal.

- Why focus on the East Asian Monsoon? - The EAM is the most expansive regional monsoon system and its variability affects over 1 billion people. - Uniquely detailed historical records of paleoclimate are available from China.

The Regional-Scale Climatic Response: East Asian Monsoon Indices

- EAM Index
- LSTD
- SMI
- WNPSM1
- EAJSI
- WPShz
- OKHI

Model Validation

- Climates of the Global-Scale Climatic Response: AO & Hadley Cell

Zonal Structure of the Global-Scale Climatic Response: AO & Hadley Cell

- Annual cycle of precipitation over land (zonal averages from all longitudes)
- Annual cycle of zonal mean vertical shear of meridional wind velocity (zonal averages from all longitudes)

Conclusions

1) The global zonal structure of radiative forcing caused by large tropical eruptions leads to positive AO anomalies in winter and year-round reductions in tropical precipitation. These results are confirmed by observations, although the tropical signal is less certain due to the occurrence of ENSO events contemporaneously with recent eruptions.

2) The model correctly simulates the basic structure and seasonality of climatic boundary conditions over East Asia, as defined by regional monsoon indices. However, the observed interrelationships between these indices are not well captured by the model.

3) 20th century volcanic eruptions were not of a great enough magnitude to have caused detectable dynamical changes to the EA monsoon system.

4) Results from paleoclimate model simulations suggest that larger pre-instrumental eruptions may have caused minor perturbations to regional monsoon indices.

5) Analysis of the paleoclimate record indicates that large tropical volcanic eruptions during the past 1,000 years have typically caused wetter conditions in eastern China and drier conditions in the west. Lack of strong evidence for a dynamical climatic response, short-wave forcing from increased stratospheric optical depth becomes a likely mechanism for the observed volcanic signal.