Decadal variability of summer rainfall over mainland China: observation vs. a 1000-year simulation of HadCM3

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Global annual land mean precipitation anomalies



Observation (thick black) HadCM3 (brown) CCSM3 (dark blue) GFDL-CM2.0 (pale green) GFDL-CM2.1 (pale blue) GISS-EH (red) GISS-ER (thin black) MIROC3.2 (orange) MRI-CGCM2.3.2 (dark green) PCM (pink)

Large inter-decadal variability
A non-significant decrease since 1950s

From IPCC (2007)

Motivation



 Leading modes of long term summer rainfall variability in mainland China from 1958 to 2008

Lei et al. (2011, J. Climate)

Motivation



Total summer rainfall anomalies (mm) over three regions based on CRU data (solid line) and station observation (dashed line)

Motivation

Summer rainfall over China has shown decadal variability in the past half century. The question remains whether this is due to natural, internal variability or is part of the emerging signal of anthropogenic climate change.

Outline

A 1000-year HadCM3 simulation without additional forcing

> Climate over East Asia region

- > Internal variability of summer rainfall over China
- Comparison between observed decadal variability with internal variability in simulation

Climatology of precipitation and circulation during JJA

14.5 12.5 10.5

8.5

6.5

4.5 2.5

0.5

7

5 3

1 --1

-3 -5 -7



Maritime continent:
the largest wet bias
quadrapole circulation bias
wave-train into mid-latitude

Internal variability of precipitation



Dipole

Single

Tripole

The spatial structure and variances are similar with and without the decadal smoothing.

Regressions on larger domain





ENSOlike patterns

Observed decadal variability



Observed patterns project very strongly onto the space described by the first three model EOFs, with about 81% and 84% of the variance being described.

Correlation coefficients		Model		
		EOF1	EOF2	EOF3
Observations	EOF1	0.54	0.70	-0.16
	EOF2	-0.54	0.41	0.62

Correlations of observed decadal patterns with those in simulation of 51-yr running window



Observation-like decadal variability in the 51-year period (560-610)



Similarity in spatial pattern (0.69,0.53) and time series, as well as variance (33.7%/18.6%, 36.5%/20.1%).

Regressions of southern pattern



significant
warmth
over the
northern
Eurasian
continent

Regressions of tripole pattern



El Niño-like pattern in the East Pacific

Conclusion

The model has some useful skill in capturing the regional characteristics in decadal summer rainfall variability over mainland China.

The two leading EOFs from observations do project very strongly onto the first three EOFs of the model, with respectively, 81% and 84% of the variance being described by them.

A particular 51-year period has remarkable similarity with observations in the recent 50 years for both decadal variability of summer rainfall and other large-scale variables.