Global Annual Precipitation Cycles and Variability

Erica Bower Western Connecticut State University

Dr. Elinor Martin The University of Oklahoma

This material is based upon work supported by the National Science Foundation under Grant No. AGS-1560419.

Climate Change and Annual Cycles

- Wet season timing
- Distribution of annual rainfall
- Global Climate Models



Onset Date

Cessation Date



Not Just Africa...

- Isolated regions have been studied
 - Global: monthly data

Figure from Dunning et al., "The Onset and Cessation of Seasonal Rainfall over Africa," 2016, *The Journal Geophysical Research*

Data

Observations

- GPCP
 - 1° resolution
 - 1997-2014
- PERSIANN-CDR
 - 0.25° resolution
 - 1983-2017

CMIP5 daily data

- Historical simulations
 - Varying resolution
 - Regridded to 1° resolution
 - 10 models chosen
 - 1900-2005
- Future projections
 - RCP 8.5
 - 8 models chosen
 - 2006-2100

How?

- Average annual cycle
 - Daily mean rainfall anomaly
- Cumulative daily mean rainfall anomaly
 - Minimum and Maximum



How?

- Average annual cycle
 - Daily mean rainfall anomaly
- Cumulative daily mean rainfall anomaly
 - Minimum and Maximum



How?

- Average annual cycle
 - Daily mean rainfall anomaly
- Cumulative daily mean rainfall anomaly
 - Minimum and Maximum









Earlier

Later

1900-2005



Hatching: significant to 95% confidence level

1900-2005



Hatching: significant to 95% confidence level

1900-2005



Hatching: significant to 95% confidence level

1900-2005



Hatching: significant to 95% confidence level

1900-2005



Hatching: significant to 95% confidence level

1900-2005



Hatching: significant to 95% confidence level





















CMIP5 Historical Model Average Trend of Yearly Precipitation in Wet Season



Historical CMIP5 Model Average of Yearly Precipitation in the Wet Season



CMIP5 Model Average Projection Trend of Yearly Precipitation in Wet Season

CMIP5 Model Average Projection of Yearly Precipitation in the Wet Season



Conclusions

- Trends have changed from the early 20th century to the present
 - Observed earlier onsets and cessations near Antarctica
 - Observed later cessation dates in most of the Arctic
 - Later onsets in the Arctic in the future
- Later onsets and earlier cessations for the CONUS, the Caribbean, northern and eastern Europe, Southern Africa in the future

Future Work

- Use more observational datasets
- Analyze more CMIP5 models, historical and future
- Examine the variability of the timing of the wet season
 - Reconcile bimodal cycles

Notes:

- Fraction of rain in the wet season (distribution)
- Standard deviation of quantities (onset, cessation, duration, amount)

Contact: ebower08@gmail.com





















































Conclusions

- Trends have changed from the early 20th century to the 21st century
 - Longer wet seasons in the Arctic
- Southern Africa seeing progressively shorter wet season
 - Deterioration of the Amazon



What's next?

- CMIP5 future model runs
- Representative concentration pathway: 8.5
- Onset dates
- Cessation dates
- Duration of wet season
- 8 models used



