The future of monsoon LPSs

Kieran M R Hunt University of Reading

Introduction



Methods

Tracking

- Find maxima in T63 850 hPa relative vorticity
- Link maxima with biased nearest neighbour
- Speed limit!
- Tracks must be longer than 48 hours
- Must enter South Asia domain
- Weak precipitation and intensity filters

FLIP score

- Holistic approach to determining mode skill
- Takes into account LPS (F)requency, (L)ocation, (I)ntensity, and (P)recipitation
- Based on Kolmogorov-Smirnov statistics
- Score of 1 = indistinguishable from ERA5
- Minimum score is 0

Data

- CMIP6 models
- Must have 6-hourly u/v winds and precipitation
- Scenarios:
 - Pre-industrial control
 - Historical
 - SSPs
- Global warming level computed against pre-industrial baseline

Storylines

- Compute seasonal means of 850 specific humidity, u and v winds
- k-means cluster on the 2° GWL anomaly fields
- Four clusters

Model evaluation (location)



0.02

0.60

1.40

Tracks per season passing within 250 km

2.20

3.00

3.80

- Most models capture important aspects of track density
- Poor over Arabian Sea
- Lots of diversity!

Model evaluation (FLIP)



Mean LPS responses to global warming







- CMIP6 MMM slightly underestimates LPS precip
- Scaling at centre is ~ 7% K⁻¹, as expected from C-C
- Super C-C scaling to the west
- Sub C-C scaling to the east





- CMIP6 MMM simulates LPS structure well
- LPSs weaken, but also change shape (smaller radius)
- Changes in frictional convergence very small



Storyline 1





frequency ↑ 28% intensity ↓ 13% precipitation ↑ 37%

Break-like conditions, but very moist

Weakening of trough over BoB

 Fewer BoB LPSs, but more over SL and Bangladesh

Storyline 2



Conclusions

- CMIP6 models generally simulate LPSs well, subject to resolution
- Most models agree that LPS intensity will fall in the future, but that precipitation will increase
- Due to reduced barotropic instability but increased moisture availability
- Deeper inland penetration likely, especially in some storylines
- Big impacts for west India