Pasang
M.Sc. LENC student
s-papasa@uni-greifswald.de

Silviya Joshi
M.Sc. LENC student
silviya.joshi@stud.uni-greifswald.de

INDIAN MONSOON CHAOTIC MULTISTABILITY

UNIVERSITÄT GREIFSWALD
Wissen lockt. Seit 1456

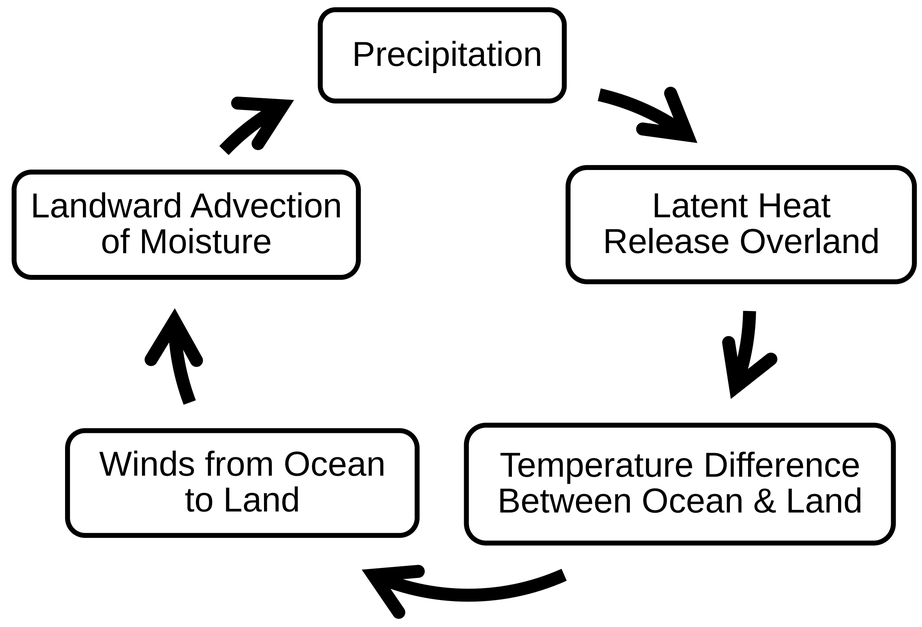
Background

Indian Monsoon typically called as Indian Summer Monsoon lasts from June to September. The Indian subcontinent receives more than 80% of their total annual precipitation during this period.[4] Indian Summer Monsoon (ISM) has two stable states:[1]

- High precipitation monsoon and
- Low precipitation monsoon

Paleoclimate records shows a number of abrupt changes in ISM.[3] Moisture advection feedback allows the existence of two stable states.[2]

Moisture Advection Feedback [2]



Driving Factors [1]

Planetary Albedo (PA)

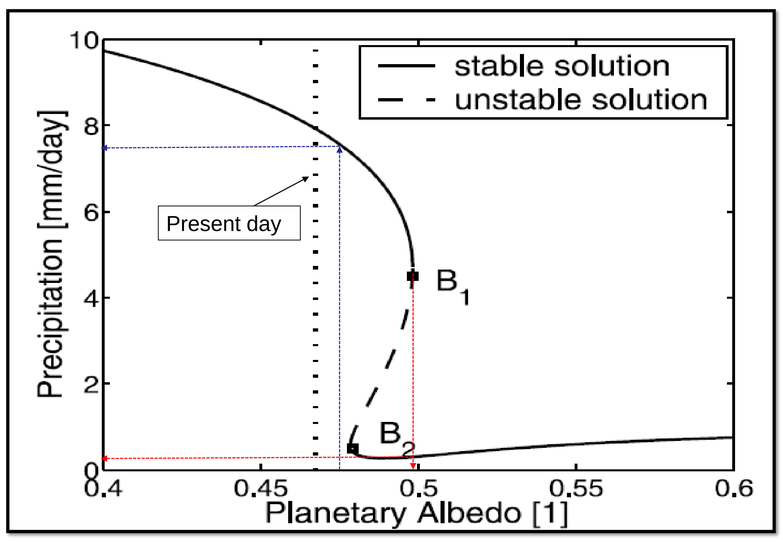
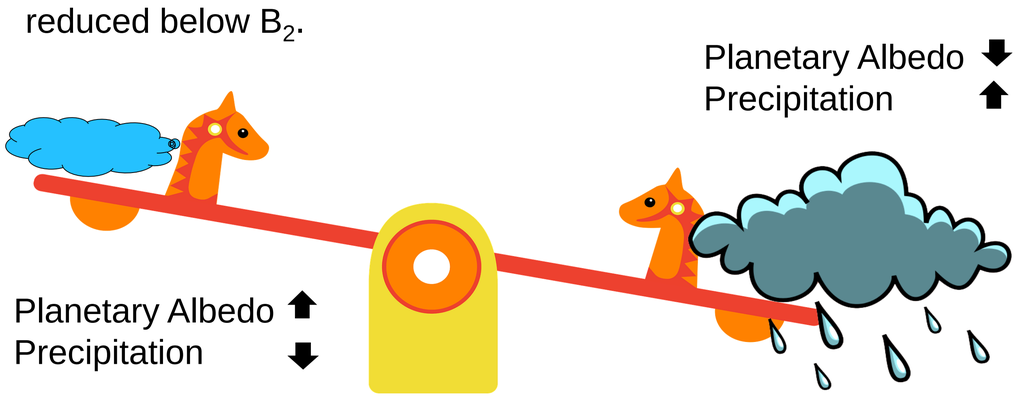


Fig 1: Bifurcation diagram of Indian summer precipitation against the Planetary Albedo [1]

- Increase in PA above present-day value - precipitation decreases
- At B_1, the ISM system enters transition phase characterized by drastically reduced precipitation.
- To return to the present day precipitation level, the PA has to be reduced below B_2.



CO_2 Concentration

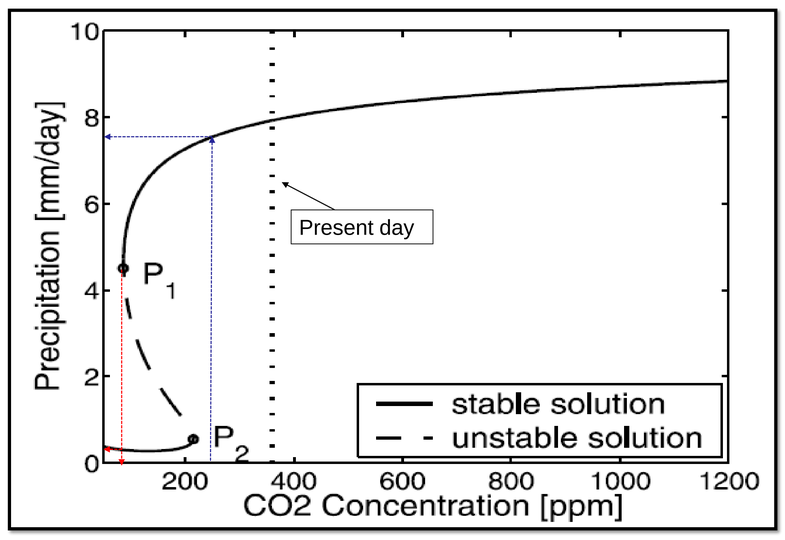
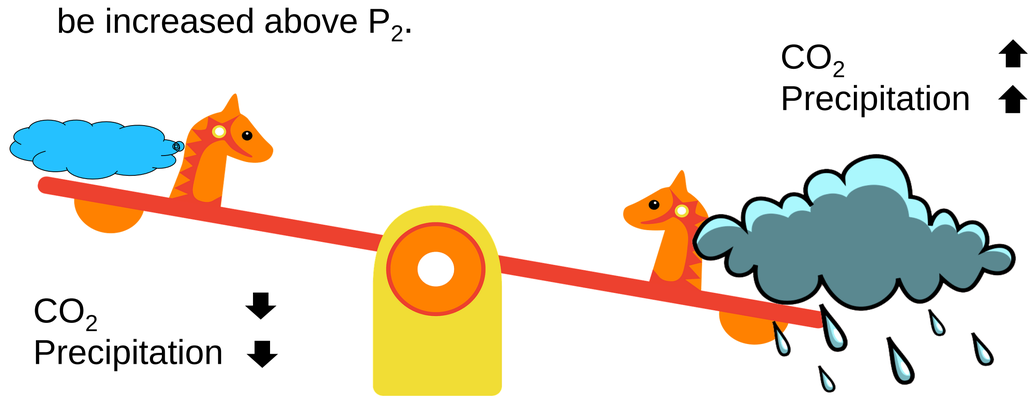


Fig 2: Bifurcation diagram of Indian summer precipitation against the CO_2 concentration [1]

- Decrease in CO_2 below present-day value - precipitation decreases
- At P_1, the ISM system enters transition phase characterized by drastically reduced precipitation.
- To return to the present day precipitation level, the CO_2 has to be increased above P_2.



Conclusion

Destabilization of the ISM could be caused by variation in PA and CO_2 concentration. The abrupt changes in monsoon rainfall is linked with the moisture advection feedback which could settle the ISM in either low precipitation state or in high precipitation state.

Future Scenarios

In future, if this multistability of monsoon continues, the livelihood and food security of Indian subcontinent which are highly sensitive and dependent to monsoon variability might be at risk.[1]

References
[1] Zickfeld, K., Knopf, B., Petoukhov, V. U., & Schellnhuber, H. J. (2005). Is the Indian summer monsoon stable against global change?. Geophysical Research Letters, 32(15). ; [2] Levermann, A., Schewe, J., Petoukhov, V., & Held, H. (2009). Basic mechanism for abrupt monsoon transitions. Proceedings of the National Academy of Sciences, 106(49), 20572-20577. ; [3] Gupta, A. K., Anderson, D. M., & Overpeck, J. T. (2003). Abrupt changes in the Asian southwest monsoon during the Holocene and their links to the North Atlantic Ocean. Nature, 421(6921), 354-357. ; [4] https://www.bbc.com/news/world-asia-india-36476535