

Land-atmosphere feedbacks affecting the monsoon onset over India

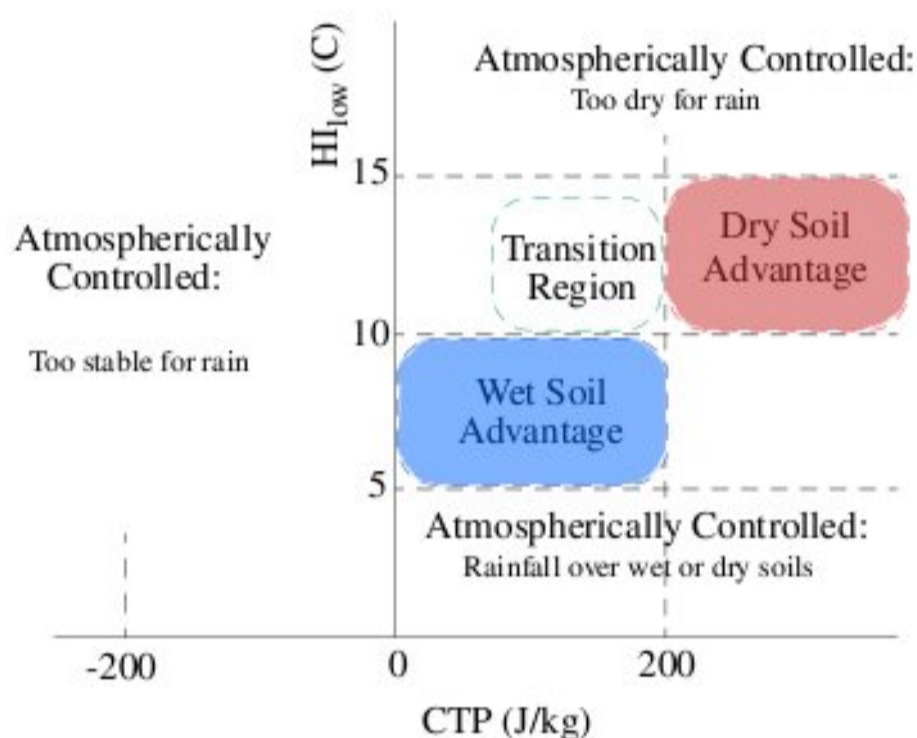
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Context

The state of the land surface can have a significant influence on the occurrence of convective precipitation. Depending on atmospheric conditions, wet soils can trigger convection while dry soils do not (positive feedback) and vice versa (negative feedback).

Using the available buoyant energy (CTP) and the water content (HI_{low}) to classify atmospheric conditions based on early morning soundings, positive and negative feedbacks are known for the USA¹:

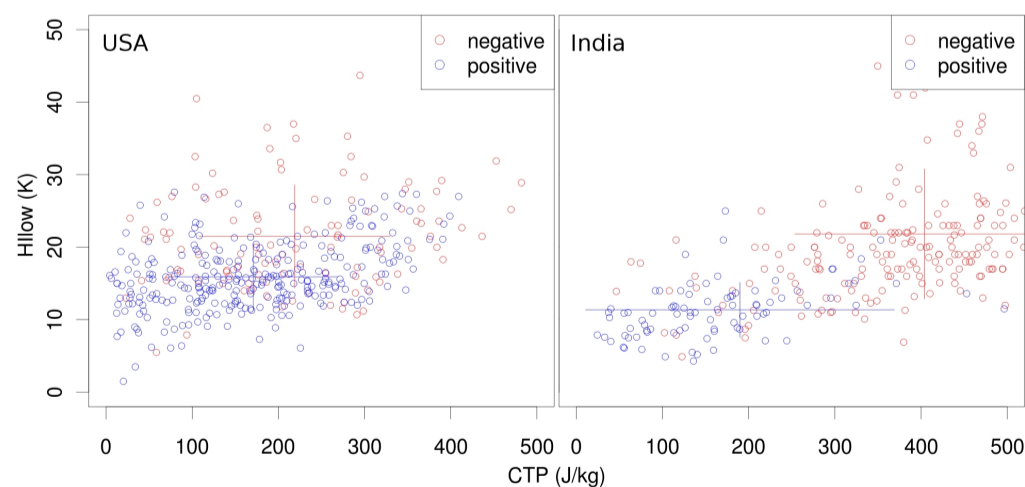


Goal

The goal of this study is to **test the CTP- HI_{low} framework approach for India** and to assess the **influence of the land surface (e.g. irrigation) on the convective precipitation** during the summer monsoon in India.

Test of Framework

A mixed layer model² initialised with atmospheric soundings shows different CTP- HI_{low} -zones for feedbacks for USA and India:

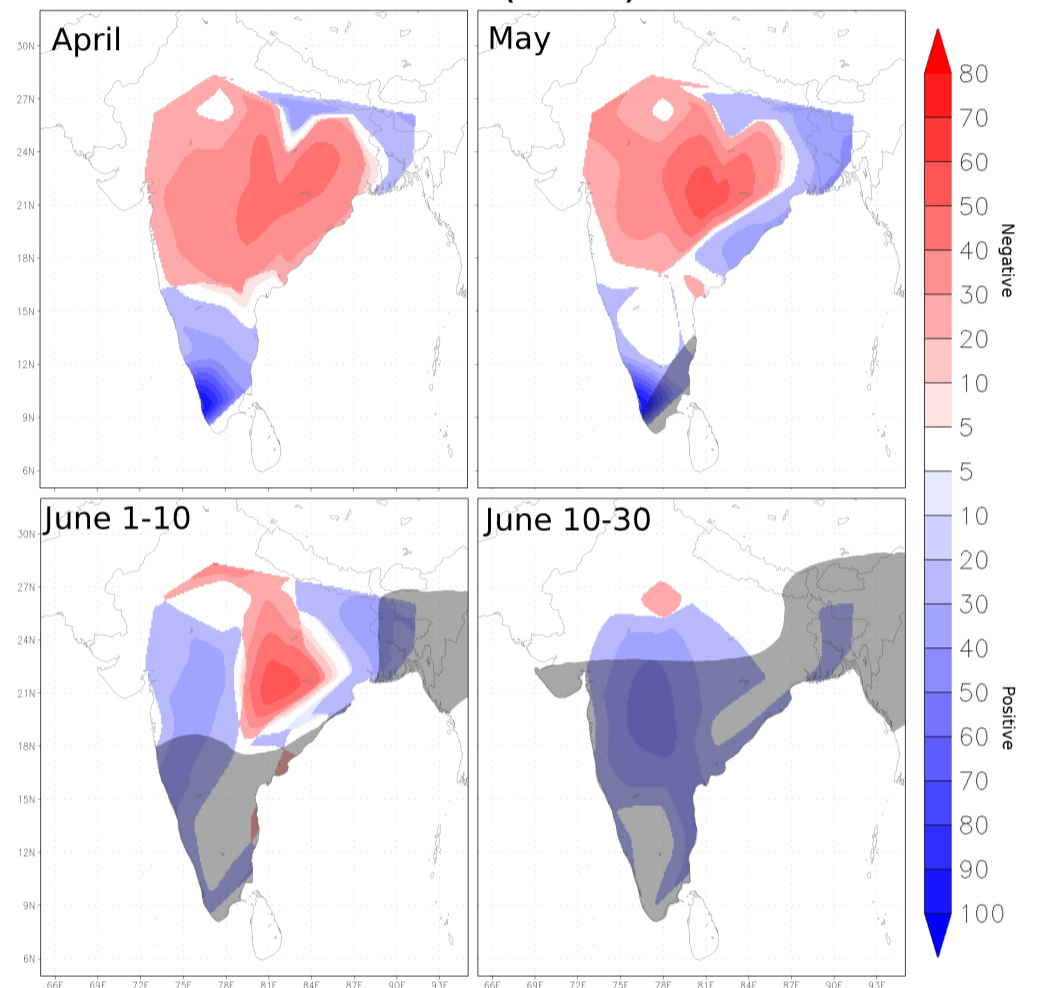


For the USA, we find feedback regions of **CTP = 0-200, HI_{low} = 5-10** (positive) and **CTP > 200, HI_{low} = 10-15** (negative), while for India we find **CTP=0-200, HI_{low} =5-15** and **CTP=200-500, HI_{low} =15-30**.

Feedbacks and Monsoon

Using the CTP- HI_{low} -zones found for India, feedbacks can be assessed from soundings. Based on all the soundings from 1980-2009 from 35 stations in India, a feedback climatology is made.

Climatological percentage of days with feedback and monsoon onset (shaded)



- The monsoon is preceded by feedbacks:
 - A weaker negative feedback zone about two months before monsoon arrival
 - A stronger positive feedback zone about one month before monsoon arrival
- During the monsoon season, the feedbacks are positive

Conclusions

1. Feedback regions in CTP- HI_{low} framework differ between USA and India
2. Both positive and negative feedbacks occur in India two months before the monsoon season
3. Large scale irrigation can affect the monsoon onset and monsoon precipitation
4. The relative importance of local processes (this study) vs. large scale processes remains to be established

References:

- ¹ K. L. Findell and E. A. B. Eltahir (2003), Atmospheric controls on soil moisture-boundary layer interactions. part I: Framework development. *Journal of Hydrometeorology*, 4, 552–569.
- ² K. L. Brubaker and D. Entekhabi (1995), An analytic approach to modeling land-atmosphere interaction 1. Construct and equilibrium behavior. *Water Resources Research*, 31, 619-632.

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