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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Role of surface hydrology in determining the seasonal cycle of Indian summer monsoon in a general circulation model" *by* Shubhi Agrawal and Arindam Chakraborty

Anonymous Referee #1

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This study conducted 10-years simulation of AGCM equipped with CLM to represent precipitation distribution by Indian monsoon system, and try to reveal a role of soil moisture variability in the GCM to modify the summer monsoon onset. According to the comparison of precipitation amount and distribution between CNTL run and TRMM observation, overestimation over the GP was evident on June with positive soil moisture bias in India. According to sensitive studies by changing the soil moisture in different spatial scales, remote dry soil moisture biases over Western Central Asia induced the early monsoon onset in the GP. Combined effects with remote and local configuration of soil moisture could also improve the seasonal progress of Indian monsoon. Authors

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concluded that such GCM experiments could contribute for diagnose the function of soil moisture on the monsoon onset and improve the land surface models.

First of all, I would like to mention that reduction of the model bias by changing the boundary condition (such as soil moisture distribution) does not mean that such boundary condition play an important role for actual monsoon variability. This paper confuses those two issues that lead readers for misunderstanding that soil moisture in Western Central Asia play and important role for the monsoon onset in GP. Object of the paper may be limited to improve monsoon simulation in the GCM.

By means of weather and climate system, monsoon precipitation variability in GP area is induced by maritime onset vortex and monsoon lows with continental monsoon trough combined with orographic induced thermal/dynamic flows over Indian subcontinent. If those systems were not represented in the model, precipitation and associated soil moisture distribution are failed. However, the paper did not explain about the representation of precipitation disturbances in the model. For instance, I could not understand that how the anomaly pattern of low-level flow in Fig. 12 could change the precipitation systems. Does the simulation represent diurnal precipitation variability?

I agree that Indian monsoon sector is composed by large land-surface spatial inhomogeneity, such as vegetation, complex terrain and associated soil moisture heterogeneity (P3 upper), that could link to occurrence of individual precipitation systems. Also, diurnal forcing is obviously affecting the precipitation system in the coastal and mountain range areas. To reveal the function of land-atmosphere interaction, non-hydrostatic models with dynamic downscaling simulation, that could explicitly tread the sub-grid scales functions, should be conducted. I understand that computation facility sometimes limits long-term downscaling simulations. However, this paper obviously indicated that GCM is hard to represent a reality associated with sub-grid scale hydrologic heterogeneity, because the CNTL had large biases. I doubt a scientific importance on diagnosing the role of soil moisture impacts by using GCM.

Another problem is the setting of boundary condition in the sensitivity studies. GLDRY and GLWET runs are conducted with 1% and 100 % soil water saturation, respectively. I am not sure how much they could correspond to volumetric water contents by means of in-situ soil structure, but they are definitely unrealistic. The paper set such extreme (idealized) conditions to explain the cause of biases between the CNTL products and actual statuses (observations). By means of idealized simulation, changing of SST in certain areas may cause much impact on GP precipitation, because maritime disturbances have large impacts of northwestern Indian sub-continent climate.

Accordingly, I suggest fundamental revisions before rendering the decision to be published in HESS.

Minor comments P3L7&L16 Is AGCM and CESM the same? Better to unify the term. P3L28 I could not understand the meaning of “nesting LCS4”. You calculated the land-surface part within the 0.43*0.63 degree in GCM? Or you nested a certain region in GCM to drive LCS4 ? Section 2.1 How much of the time step for calculation and time resolution of the output? Section 2.2 Better to explain in details about the soil moisture products with reliability. Also, which years of the soil moistures to be used/compared? Fig.1 Why you showed global scale distribution? In the global scale, there are many areas to be explained that CNTL and observations are different except in the Asian monsoon sector. Better to limit the discussion in a monsoon region, such as in Fig. 2. P6L15-25 June is a transitional month from pre-monsoon to monsoon. If the model output could produce daily base, why don’t you assess the difference of seasonal progress between the CNTL and observation to identify the key monsoon flow anomaly affected by the differences in soil moisture distribution if any? P8L15-16 A sentence “onset phase and its seasonal cycle” is unclear. What is the “monsoon onset” to be observed in GCM? Fig.6a,b Why the similar precipitation anomaly patterns, such as negative in northeast and positive in the central Indian subcontinent to BOB, even the GPDRY and GPWET setting are opposite soil moisture condition? P8L33 Unclear explanation that “Higher moisture advection” from where to where?

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