

Simulation of impact of deforestation in African and north-east Indian region on Asian summer monsoon using CCM3 model

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The fact of rapid deforestation has been one of the major concerns since last decade. In India, the forest cover of the country has been declining since last several years. The impact of these changes on Indian monsoon is still an open question.

In this work, an attempt has been made to address this question with the National Center for Atmospheric Research (NCAR) Community Climate Model (CCM3.6). The T42 version of CCM3 with a horizontal resolution of $2.8^{\circ} \times 2.8^{\circ}$ is used for this study.

The influence of deforestation is modeled by the changes in the surface parameters such as land cover. The changes are made over the African Region and some parts of North-East Indian Region. The consequences of the changes in land cover are the changes in surface albedo, ground wetness, surface roughness etc.

The standard T42 version of NCAR Community Climate Model (CCM3) which includes LSM as a coupled model is integrated for five years, for the control run. Further the impact of deforestation have been studied for three different scenarios. The model is integrated for five years with forest cover replaced by grassland in three different classes, viz. 100%, 50%, 25%. The spatial extent of the change is $0-120^{\circ}E$, $20^{\circ}S-50^{\circ}N$. Based on the model simulations for five years in three different scenarios i.e 25%, 50% and 100% deforestation, following conclusions are drawn:-

- Wind vector fields at 850mb shows that circulation has been strengthened in Arabian Sea whereas weakened in Bay of Bengal. Due to deforestation, circulation has weakened in Indian subcontinent, Africa and north-east India. Somali Jet has also weakened.
- Wind vector fields at 200mb gives the indication that deforestation will affect the anticyclonic structure over Tibet in the upper level.
- There is considerable decrease in rain rate over Africa, north-east India, Burma and over Indian Ocean whereas over India, spatial distribution of rain rate is expected to change due to deforestation. Over northern India, rain rate has decreased whereas over southern part, it will increase. Also, over Arabian sea and Bay of Bengal, rain rate has increased up to 5mm/day.
- Over north-east India and Burma region (where forest cover was removed completely), surface temperature has increased. Over land portion of India, surface

temperature is shown to have decreased by 1°K. Over southern belt of Africa 10°S-10°N, surface temperature has increased by 7°K, whereas over northern belt 10-20°N, it has decreased by 3°K. Due to deforestation, deserts are expected to have higher surface temperature and chance of more desertification.

- Model is showing sensitivity to land surface changes. It is evident from the gradual deforestation simulation comparisons. We can see that rain rate is decreasing as we go from 25% to 100% deforestation over the selected regions.

The impact of small scale changes in land cover could not be resolved by these experiments due to 2.8°x2.8° resolution of the model. Further experiments need to be done with high resolution regional climate model to study the impact of local changes in land cover.

The following figure shows the difference in JJA rain rate due to 100% deforestation in the African and north-east Indian region.

