

THE CLIMATIC EFFECTS OF DEFORESTATION IN SOUTH AND SOUTHEAST ASIA

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Deforestation can have strong effects on climate by altering the surface albedo, evapotranspiration and exchange of latent and sensible heat between the surface and the atmosphere. These changes would in turn lead to modifications of surface energy and moisture budgets, thus altering the spatial and temporal patterns of temperature and precipitation. These modifications would then be further modulated or enhanced by the regional circulation. In order to understand the impacts of tropical deforestation on the climate Weather Research and Forecasting model (WRF) was used along with forcing from NCEP/NCAR Reanalysis data (NNRP). The study focused on South and Southeast Asia, all regions where the Asian monsoon plays an important role in determining the regional climate and deforestation is currently or potentially a major issue. Simulations were done for South Asia and Southeast Asia (with a 12 km resolution) as well as for Sri Lanka (4 km resolution). The WRF simulations were done for three years: 1988, 1991 and 1993, representing a strong, weak and normal monsoon year respectively. A control run as well as two idealized runs were carried out and analyzed for each of these years. The two idealized runs consisted of a completely deforested run where all the land-use categories other than inland water were replaced with grassland and a completely forested run where evergreen broadleaf forest was used. These changes, while extreme, represent the maximum possible range of changes due to deforestation. Simulations show that the climatic conditions over land regions become warmer and drier in response to deforestation with precipitation, evapotranspiration and cloud cover all showing a decrease. Analysis of the moisture budget shows that amounts of precipitation over South Asia and Sri Lanka are much greater than local evapotranspiration. This demonstrates the importance of the contribution from an external moisture source (e.g., the Indian Ocean) to the regional precipitation. Further, over Sri Lanka, the reduction in precipitation exceeds that of local evapotranspiration indicating a weakening of atmospheric moisture convergence. A stronger moisture convergence is seen over the other two domains. These changes indicate regionally specific changes in the local atmospheric circulation in response to deforestation. All the changes seen in the simulations are present in both the annual and the seasonal (monsoon season) values, suggesting that the impacts due to deforestation have the ability to override even the strongest monsoon signal.