Project: **887**

Project title: **Influence of tropical land-use transformations on local and regional climate in Sumatra/Indonesia**

Project lead: **Merja Toelle**

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South-East Asia and Indonesia undergoes major and rapid land cover changes due to cash crop land increases. Land cover modifications result in alterations to surface fluxes such as moisture, heat, and momentum fluxes, and ultimately impact the boundary layer structure, cloud cover regime, and all other aspects of local and regional weather and climate occurring not only locally, but also in regimes remote from the original landscape conversion. The extent and magnitude of the anthropogenic conversion effect is still uncertain.

In this project we examine the impact of land cover conversion on South-East Asian climate during the period 1990 to 2004 using a regional climate model COSMO-CLM. For the control run no land cover change is assumed. This simulation started in 1984 to allow the model to spin up. The potential vegetation simulation is initiated from 1990 to 2004 using the control experiment spin up as initial conditions. The CORDEX Africa configuration from Panitz et al. 2013 and Dosio et al. 2015 is adapted for the simulations over 450 x 240 grid points covering CORDEX South-East Asia at a horizontal resolution of 14 km, see Fig. 1. The integration is driven by ERA-Interim reanalysis data, as the initial and lateral boundaries for atmospheric forcing. Since lateral boundary conditions are not varied, simulated changes can be explained by land cover changes. Differential fields of potential minus actual vegetation data sets are used to represent the impacts of changing vegetation.

For comparison of modelled results of COSMO-CLM with observations, we refer to the work of Wang et al. 2013, who described and evaluated the simulations of the East Asian Monsoon region. They showed that the RCM COSMO-CLM is able to predict Monsoon features even on small scales and bears resemblance to climatological means. In addition, other RCMs were employed over similar regions and proofed the ability to model climate variability (Walsh et al. 1997). Fu 2015 have evaluated several aspects of RCMs connected with the Asian Monsoon. Dobler et al. 2008 received accurate results for Indian Summer Monsoon studies.

We compared maximum temperature patterns during four El Nino phases from 1990 to 2004 for the winter Monsoon months November to March (NDJFM) to analyse the influence land cover change on extreme warming trends in SE Asia during episodes of ENSO. In addition, the winter Monsoon period was chosen to focus on the influence of land use change and excluding the dominant mesoscale feature of the SE Asian summer Monsoon. Figs.2 (a,b) compare the differences in maximum temperatures between deforested and actual land covers (experiment with land cover change minus control without any change) using composite of four El Nino events, and the long term NDJFM average excluding El Nino years. Fig.2 (c) additionally shows the long term NDJFM difference between the El Nino and non El Nino years of the control simulation with actual land cover. Results of the long-term anomaly of maximum temperature during NDJFM in Fig.2 (a) indicate a consistent warming of up to 2°C over land areas with largest warming over the Philippines, south of Vietnam and Thailand, Malaysia and Cambodia, and over the Indonesian islands Sumatra and Borneo, regions of significant land cover change. The strongest effects are seen in the lowlands of these countries. This warming is additionally enhanced during El Nino years, see Fig.2 (b). This is in line with the study of McAlpine et al. 2007 considering mean temperatures. Without land cover changes El Nino years show alternating patterns of warming and cooling over the simulation domain with less magnitude in warming (maximum increase in Tmax of 0.4°C), see Fig.2 (c).

Fig.1: Simulation domain for the land use/cover change studies.

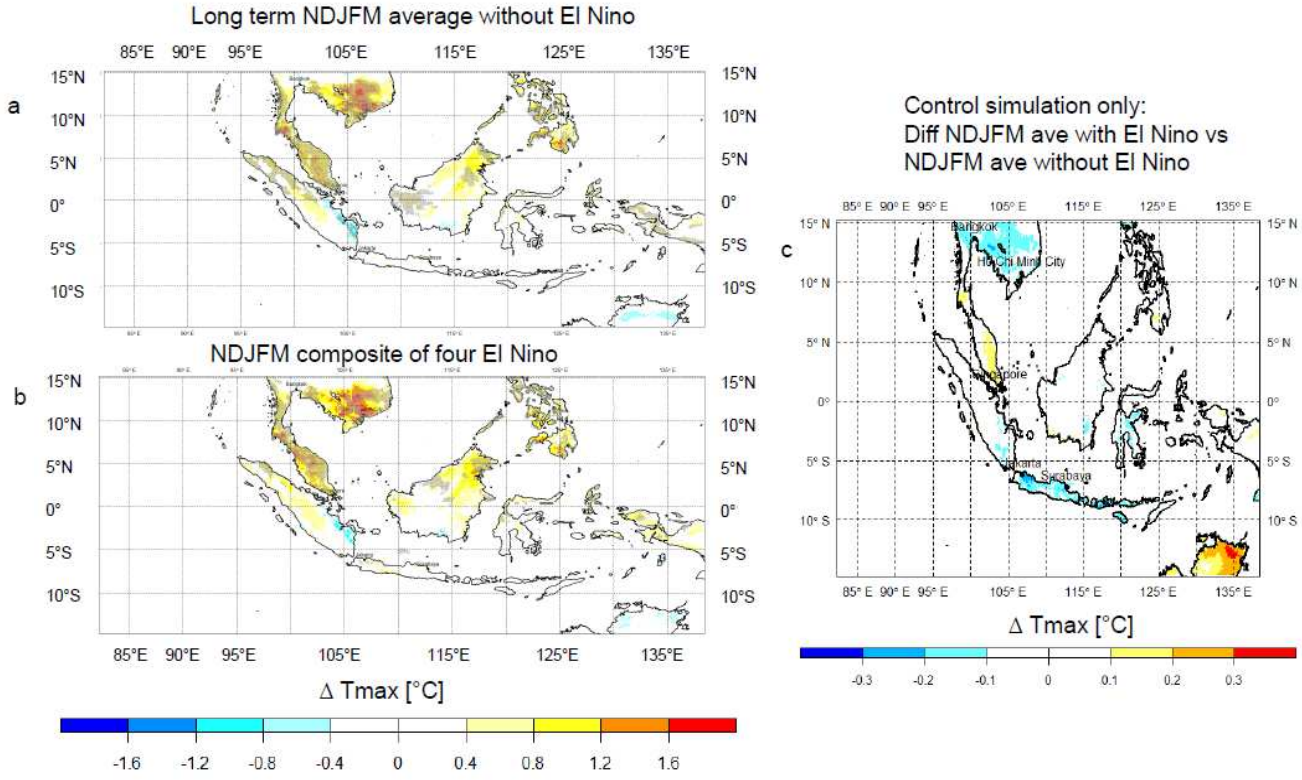

Fig. 2: Simulated maximum temperature difference (1990-2004) between potential and actual land covers for: a) Long term NDJFM average; b) NDJFM composite of four strongest El Nino (1991/92, 1994/95, 1997/98, 2002/03). Grey shaded areas are significant at 0.05 level. c) Long term NDJFM difference of maximum temperature between El Nino and non El Nino years of the actual land cover simulation.