1st TERRABITES Symposium
Hamburg, Germany, 9-11 February 2010
TERRABITES-68

Past and future fires simulated by a fire model within CLM-CN

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Fire is an important Earth System process, which impacts climate via multiple processes, including atmospheric chemistry, aerosols, land surface properties and the carbon cycle. For recent fires, we have the capacity to observe global fire activity from space. However, historical information on fires is still very incomplete and little is known about the single driving forces of global fire activity in the past, which limits our ability to predict future fires.

Here we present results from a fire model included in CLM-CN based on the work by Arora and Boer (2005) extended by an explicit parametrization of human ignition and fire suppression as a function of population density. In addition to natural fires we also take into account deforestation fires. We evaluated the model against contemporary satellite fire records and applied it in transient simulations running from 1850 up to 2100. Several sensitivity experiments were performed to disentangle the importance of single driving forces impacting fire emissions in the past, such as land use change and wood harvest, changes in population density and changes in climate. Globally we find decreasing fire emissions caused by land use change and wood harvest over the 20th century. The increase in population density over the last century leads to an increase in fire emissions. However, when we also take into account fire suppression, only little change in fire emissions on the global scale is found. Climate change over the last three decades leads to slightly increasing fire emissions. However, larger differences are found on the regional scale. Combining all single driving forces we find decreasing carbon emissions between 1900 and 1970 followed by a pronounced increase in the last three decades on the global scale. Thereby, the importance of the single driving forces for the simulated trend over the 20th century varies considerably for different regions. For the future simulations (2000 to 2100) we employ climate forcing following the MPI Earth System Model IPCC simulations. First results of the sensitivity of future fire emissions towards projected changes in climate, population and land use activities will be presented.