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20th century precipitation changes in the Sahel region: sensitivity studies with ECHAM5-HAM

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The 20th century has seen an enormous growth in population and industrialization. These changes are accompanied, among others, by a substantial increase in aerosol emission. To learn more about associated consequences for the climate system we have carried out a comparatively large set of transient sensitivity studies with the global atmosphere only climate model ECHAM5-HAM, using aerosol emission data from NIES (National Institute of Environmental Studies, Japan) and prescribed, observation based sea surface temperatures (SSTs) from the Hadley Center. The sensitivity studies cover the period from 1870 to 2005 and comprise ensembles of simulations (up to 13 members per ensemble), which allow to address the role of different aerosol species, greenhouse gases, and prescribed sea surface temperatures.

We present a preliminary analysis of these global simulation data for the Sahel region (land within 20W / 35E / 10N / 20N). The annual cycle as well as the overall temporal evolution of precipitation in the Sahel according to CRU (Climate Research Unit, UK) is captured well by the model simulations: two comparatively wet phases in the 1930s and 1950s, a more or less continuous decline thereafter, and a renewed increase in precipitation since the 1980s. This decline / renewed incline since the 1950s is, however, about twice as strong in the CRU data than in the model data. The sensitivity studies reveal SSTs as a prominent factor for the time evolution of precipitation, while the atmosphere only effect of aerosols plays a minor role for the modeled precipitation. The observation based prescribed SSTs may, however, encapsulate and aerosol effect already.