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Comparison of Interglacial fire dynamics in Southern Africa

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Responses of fire activity to a change in climate are still uncertain and biases exist by integrating this non-linear process into global modeling of the Earth system. Warming and regional drying can force fire activity in two opposite directions: an increase in fire in fuel supported ecosystems or a fire reduction in fuel-limited ecosystems. Therefore, climate variables alone can not be used to estimate the fire risk because vegetation variability is an important determinant of fire dynamics and responds itself to change in climate.

Southern Africa (south of 20°S) paleofire history reconstruction obtained from the analysis of microcharcoal preserved in a deep-sea core located off Namibia reveals changes of fire activity on orbital timescales in the precession band. In particular, increase in fire is observed during glacial periods, and reduction of fire during interglacials such as the Eemian and the Holocene. The Holocene was characterized by even lower level of fire activity than Eemian. Those results suggest the alternance of grass-fueled fires during glacials driven by increase in moisture and the development of limited fueled ecosystems during interglacials characterized by dryness. Those results question the simulated increase in the fire risk probability projected for this region under a warming and drying climate obtained by Pechony and Schindell (2010).
To explore the validity of the hypotheses we conducted a data-model comparison for both interglacials from 126.000 to 115.000 BP for the Eemian and from 8.000 to 2.000 BP for the Holocene.

Data out of a transient, global modeling study with a Vegetation-Fire model of full complexity (JSBACH) is used, driven by a Climate model of intermediate complexity (CLIMBER). Climate data like precipitation and temperature as well as vegetation data like soil moisture, productivity (NPP) on plant functional type level are used to explain trends in fire activity. The comparison of trends in fire activity during the Eemian (126.000 to 120.000 BP) and the Holocene (8.000 to 200 BP) shows an increase in fire data and in simulated fire. Lower level of fire during the Holocene than Eemian can be explained by differences due to unequal trends in vegetation as a result of climate forcing due to orbital changes: while woody type vegetation plays a major role during the Eemian, the Holocene is influenced by grass land. From the modelling perspective changes in the seasonal precipitation drives the vegetation pattern.