Project: **938**
Project title: **EXTREME (Extreme Tectonics and Rapid Erosion in Mountain Environments)**
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The EXTREME project aims to improve our understanding of the coupling between climate and tectonic interactions at plate corners and hypothesises that the cycle of processes linking rapid mountain building, climate and erosion is initiated from “the bottom up” via the 3D geometry of the subducting plate, and requires a threshold rate of “bottom up” deformation and climate induced erosion to initiate this feedback loop. As part of these efforts, the response of global and regional climate (and thus erosion) to changing boundary conditions, incl. both topographic changes and parameters specific to geological time periods, is simulated by a series of atmospheric modelling experiments with ECHAM5-wiso.

A pesent-day high resolution (T159L31, ca. 0.8°x0.8° and 31 vertical levels) ECHAM5-wiso control simulation has been validated by observational datasets incl. NCEP/NCAR and ERA40 re-analyses as well as higher resolution datasets CRU TS 3.21, UDEL, NCEP NARR and HAR for regional comparisons. Furthermore, a high resolution (T159L31) simulation was conducted for boundary conditions of pre-industrial times and the Last Glacial Maximum. Pre-industrial (PI) ocean boundary conditions were taken from the AMIP2 data and boundary sea surface temperature and sea ice concentration were derived from a coupled atmosphere-ocean model ECHO-G (Lorenz and Lohmann, 2004) as described in Dietrich et al (2013). Vegetation conditions for the LGM simulation has been constructed from PMIP (http://pmip2.lsce.ipsl.fr) data (Braconnot et al. 2007) and interpolated using vegetation model outputs (Arnold et al.2009). Green house gas concentrations and orbital parameter during LGM and pre-industrial times are based on Dietrich et al. (2013) and Otto-Bliesner et al. (2006). The pre-industrial simulation will be used as an additional control experiment for all simulations to follow. Climate simulations for Miocene boundary conditions as well as simulations for different plausible stages in the topographic evolution of the Andes and the Tibetan Plateau during that time are currently conducted (and queued) on DKRZ's Mistral.

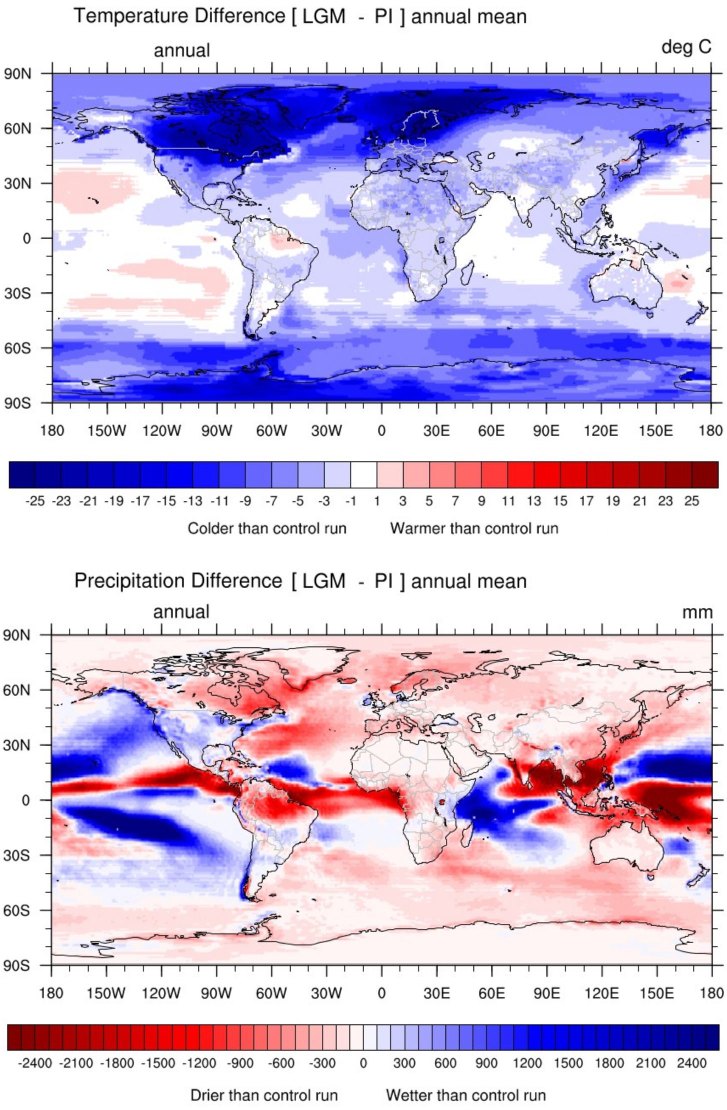

Fig.1 Difference in annual means (climatological means) of LGM and PI 2m air temperature (top) and LGM and PI total annual precipitaion (bottom) .

Results from the LGM simulation show significant differences in 2m air temperature and precipitation (Fig. 1) and other variables relevant to erosion (and therewith relevant to the broader questions addressed in the EXTREME project). Large differences in precipitation, and thus the climate's erosion potential, can be seen in several regions investigated in the project (e.g. higher LGM precipitation in Alaska and the Olympic Mountains and less LGM precipitation along the Himalayan orogen).

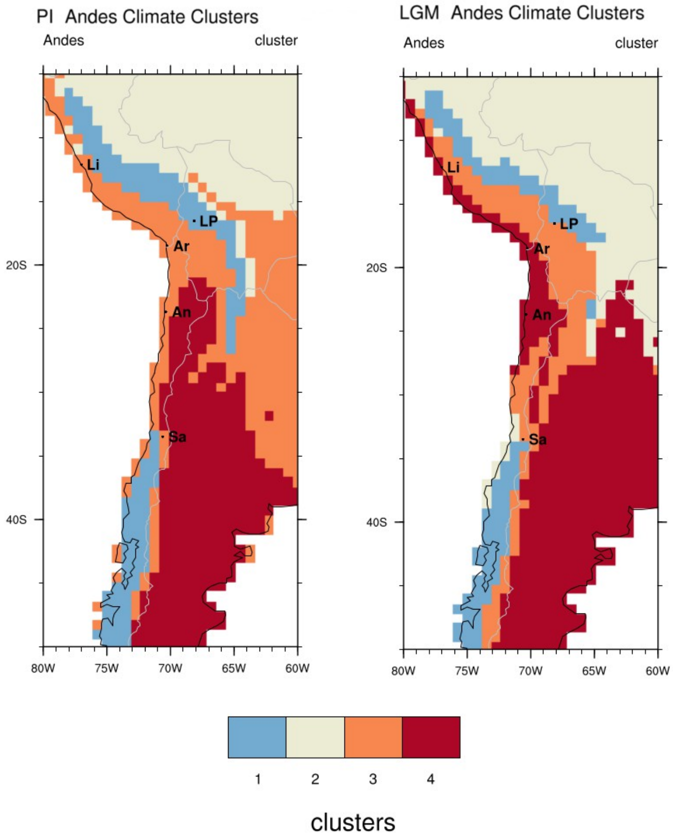

Fig. 2 Subdivision of PI (left) and LGM (right) climate in Western South America sorted from wettest (blue) to driest (red) climate.

Pre-industrial and LGM climate has been subdivided into regional climates by means of a centroid clustering method, based on the covariance of different climate variables. Fig. 2 shows an example of this for Western South America for PI (left) and LGM (right) simulations. The lower LGM precipitation rate along the South American coast segment between Antofagasta and Lima (Fig.1) is also reflected in the cluster patterns. This subdivision and quantifications for the regional climates' erosion potentials will be conducted for a series of climate model experiments set in different boundary conditions specific to other time periods (Mid-Holocene, Pleistocene, Pliocene and two Miocene time slices) as well as for different stages of the topographic evolution of the St. Elias Range, Olympic Mountains, Andes and Himalaya-Tibet.