



Stagnant air temperature and receding glaciers - a puzzling question in the Cordillera Blanca, Peru

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The tropical Andes have been recognized as one of the most vulnerable regions to climate change. Recent research shows that climatic changes in the region are not uniform. However, in many sites, critical information on observed trends are missing and unclear, representing barriers to design and implement appropriate climate change adaptation measures. Here, we analysed air temperature trends in the Cordillera Blanca, Peru. Long temperature data series between 1964 and 2011 are available for five meteorological stations at elevations of over 3000 m asl. in the area of the Cordillera Blanca, the Cordillera Huayash and the Cordillera Central and for three additional stations near the coast, at the foothills of the Cordillera Negra. We found that - after a strong positive trend between 1965 and 1980 of about 0.5°C per decade - mean annual air temperature in the area of the Cordillera Blanca did not show any significant increase during the last about 30 years, what could be confirmed by even more stations. Additionally, also four stations situated between approx. 4000 and 4800 m asl. do not show a trend in the last decade. These findings are consistent with the ERA-Interim reanalysis data for the 500 hPa pressure level, but are not confirmed by the NCEP/NCAR Reanalysis data. The stagnant temperature in the studied area stands in contrast to the temperature trends e.g. in the Peruvian Altiplano, where no break in the increasing trend of air temperature is observed. At some stations of the Cordillera Blanca, there was even a decreasing trend observed since 1980, at least for minimum air temperature. We argue here that this might be linked with a decadal mode of the ocean-atmosphere-land climate system counteracting to the anthropogenic warming of the atmosphere during the last about 30 years.

These findings are in sharp contrast to the general pattern of the tropics characterized by an increasing freezing level height during the last few decades. Astonishingly enough, glaciers of the Cordillera Blanca were all the same receding heavily within the last 30 years. Considering that the response time of these quite small mountain glaciers are in the order of a few years, this glacier wastage seems to be contra-intuitive. One reason for this might be that equilibrium line altitudes (ELAs) are - already today - quite high in relation to a steady state ELA.

If this decadal mode turns temperature forcing from negative to positive and comes in-line with anthropogenic warming in the Cordillera Blanca region, glacier wastage may accelerate dramatically, and peak water may be delayed for the next one or two decades. Diminishing of water resources coming from glaciers may be thereafter even more abrupt than solely estimated based on CMIP5 climate model scenarios, with important consequences on climate change adaptation.