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Objective climate classification as a framework for assessing projected climate change in High Mountain Asia

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This study builds upon foundational work by Forsythe et al (2015, doi: 10.5194/esd-6-311-2015) which used principal component analysis (PCA) and k-means clustering to derive objective present climate classifications over High Mountain Asia and adjacent regions (60E to 100E, 20N to 40N) based on global meteorological reanalyses' estimates of the drivers of water resources availability and variability (precipitation, surface shortwave radiation, daily mean near surface air temperature and its diurnal range). This study refines Forsythe et al (2015) by testing the potential for spatially disaggregating coarse global reanalyses (and climate model outputs) using iterative classification and regression processing to achieve a 5km (0.05 decimal degree) horizontal resolution in order better capture the severe topographic range and gradients of the HMA domain. This spatial refinement should allow for better intercomparability of resultant classifications derived from datasets with different native resolutions. This intercomparability is critical because the second stage of this assesses climate change projections from a range regional climate model experiments – UK Hadley Centre RQUMP 25km South Asia perturbed physics ensemble, CORDEX South Asia domain and (pending dataset availability) NextData EC-Earth 15km high resolution HMA domain – using derived objective classifications as a framework for aggregation. By establishing sub-regional units of relative homogeneity, the objective classification approach allows twofold assessment of project future climate scenarios, i.e. change can be quantified not only as perturbation of key variables (e.g. precipitation, temperature, etc) but also in terms of the spatial descriptors (areal extent, surface elevation range and mean, latitudinal and longitudinal bounds) of the identified climate zones. It is expected that this novel approach, and in particular the very high target spatial resolution, will yield important insights into the likely climate trajectories of key sub-regions within on the world's most important mountain areas.