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Changes in the atmospheric evaporative demand in Mexico

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An important driver of the hydrological cycle is the atmospheric evaporative demand (AED). Previous studies using measurements of evaporation in pans have found evidence that AED has been declining over the second half of the 20th century. Such trends have been mostly attributed to a global decline in near surface wind speed (mainly driven by changes in land cover such as the terrestrial surface roughness) whereas other variables controlling AED such as the vapor pressure deficit, solar radiation and air temperature having a more limited role (such changes are driven by long-term climatic variations). The objective of this work is to assess the temporal and spatial observed changes in pan evaporation in 151 meteorological stations located across Mexico for the period 1961-2010. The stations were located on a climatic gradient, with aridity indexes ranging between 0.3 and 10. The radiative and aerodynamic controls attributed to the observed trends are analyzed with outputs by the Noah model from the Global Land Data Assimilation System (GLDAS).

The results show a consistent decline in annual pan evaporation between 1961 and 1992 whereas the trend was reverted from 1992 until 2010. Statistically significant negative changes using the non-parametric Mann-Kendall test were found in 43% of the stations for the 1961-1992 and 20% for 1992-2010, respectively. Among the climatological variables extracted from GLDAS, it was the annual wind speed that gave the highest statistical correlation. This work agrees with previous studies in other regions of the world suggesting that pan evaporation has been on average declining until 1990 followed by a slightly positive trend during the last twenty years. Finally, we show that the magnitude of change in those regions dominated by wind and those dominated by radiative processes are strongly different.