Simulation and Projection of Global Mean Surface Temperature Using the Empirical Model of Global Climate and Comparison to CMIP6 GCMs

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The Empirical Model of Global Climate (EM-GC) (Canty et al., ACP, 2013, McBride et al., ESDD, 2020) is a multiple linear regression, energy balance model that accounts for the natural influences on global mean surface temperature due to ENSO, the 11-year solar cycle, major volcanic eruptions, as well as the anthropogenic influence of greenhouse gases and aerosols and the efficiency of ocean heat uptake. First, we will analyze the human contribution of global warming from 1975-2014 based on the climate record, also known as the attributable anthropogenic warming rate (AAWR). We will compare the values of AAWR found using the EM-GC with values of AAWR from the CMIP6 multi-model ensemble. Preliminary analysis indicates that over the past three decades, the human component of global warming inferred from the CMIP6 GCMs is larger than the human component of warming from the climate record. Second, we will compare values of equilibrium climate sensitivity inferred from the historical climate record to those determined from CMIP6 GCMs using the Gregory et al., GRL, 2004 method. Third, we will use the future abundances of greenhouse gases and aerosols provided by the Shared Socioeconomic Pathways (SSPs) to project future global mean surface temperature change. We will compare the projections of future temperature anomalies from CMIP6 GCMs to those determined by the EM-GC. We will conclude by assessing the probability of the CMIP6 and EM-GC projections of achieving the Paris Agreement target (1.5°C) and upper limit (2.0°C) for several of the SSP scenarios.