California’s Fourth Climate Change Assessment – Technical Reports

TITLE

CUMULATIVE GLOBAL CO2 EMISSIONS AND THEIR CLIMATE IMPACT FROM LOCAL THROUGH REGIONAL SCALES

CITATION

ABSTRACT

Previous work has shown that analyzing climate change as a linear function of cumulative CO2 emissions is a useful approach when assessing climate change projections over global and large regional scales in response to different emissions scenarios. Here we demonstrate that this approach holds true for regionally confined projections over California using downscaled CMIP5 and CMIP3 GCM simulations. Measures that exhibited consistent well-behaved responses include local and regional temperature, spring snow water content over the California region, and early summer soil moisture. The response of temperature and temperature-related measures are roughly linear, with +1.4°C to +2.8°C warming for each additional 1000 GtC. Precipitation changes over the period of projected climate changes show little relationship to cumulative CO2, being dominated by the noise due to natural variations. Modeled area burned by wildfire and area of potential vegetation conversion increase substantially with cumulative CO2, illustrating how this approach may provide a way to evaluate implications of emissions on the impacts of climate change on ecosystems. Projected sea level rises are time dependent and therefore exhibit trajectories whose shapes differ between emissions scenarios.

HIGHLIGHTS

- Changes in temperature, snowpack conditions, and soil moisture at the local, regional, and California statewide level depends almost linearly upon global cumulative carbon dioxide emissions since 1870, independent of global emissions pathways. This not only applies to the current suite of global emission scenarios known as RCPs but also for the prior suite of global emission scenarios known as SRES. This correlation potentially provides a unifying way to interpret studies that have used different assumptions about global emission pathways.

- Impact of extreme temperature events, wildfires, and some measures of potential ecological impacts are also a function of global cumulative carbon dioxide emissions.
- Sea level rise in California can be explained, but require a time dependent measure in addition to global cumulative carbon dioxide emissions.
- The strong relationship of some important climate variables to cumulative CO2 emissions can be used to estimate the potential physical impacts to California of global compliance with the United Nations Framework Agreement on Climate Change Paris Agreement, which has a goal of limiting global average temperature to less than 2 °C and, if possible, to 1.5 °C.

ACCESS
For access to the full report, please email Leah.Fisher@sgc.ca.gov

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